Jn. Sapton

THE
Young Surveyor's Guide:

OR, A

New INTRODUCTION

TO THE

Whole Art of Surveying Land,

Both by the CHAIN and all Instruments now in Use.

Now first Publish'd from an Original M. S.

To which is Added,

All the useful *Geometrical Definitions*, *Axioms*, *Problems* and *Theorems*, which relate to this Art. As also the Method of Casting up the Dimensions of Artificers Work. Very useful for all Gentlemen and Others.

There is also added, by way of APPENDIX, a new way of Surveying large Tracts of Land, according to the Learned Mr *Whiston's* and Mr *Ditton's* New Method of Surveying *England* by *Explosions*.

The manner of making up and preparing Transparent Colours for Beautifying Maps, Charts, Pictures, *&c.*

The Tables of Artificial Numbers, Sines and Tangents, to every Degree and Minute of the Quadrant. All which is very much Improved and Corrected,

---

By *EDWARD LAURENCE*, Surveyor.

LONDON, *Printed for* James Knapton, *at the* Crown *in St* Paul's *Church-Yard.* 1716.

Jn. Japson

THE PREFACE.

ALTHO' there is little need of saying any thing by way of Preface to the following Treatise; yet Custom having made it almost as necessary as an Entrance to an House; I shall so far comply with Custom as to say, That the following Directions for Surveying, &c. were put into my Hands in M. S. to be Enlarged, Corrected and Improved, in such a Manner as to make them of General Use and Easy Practice, according to the Modern, Best, and most Improved Methods in that Excellent and Useful Science.

How far and how well that Design and Purpose hath been pursued in the following Pages, I must leave to the Ingenuous Reader to judge, after I have just told him that He will meet meet

A 2 with

with ſeveral very uſeful Definitions, Axioms, Problems *and* Theorems, *wholly new, or at leaſt newly apply'd. Here will be found alſo ſeveral new* Problems *added, relating to the Art of* Dividing *Land; As alſo a New Method of Surveying large Tracts of Land, by Sounds as well as Sight, by Vertue of diſtant Exploſions, firſt Invented and Publiſhed by thoſe two great Genius's and Improvers of Natural Philoſophy, the Learned Mr* Whiſton *and Mr* Ditton.

I ſhall only add, That to make this Treatiſe of as General Uſe as may be, the Reader will meet with an uſeful Collection of all tranſparent Colours proper for the Beautifying Maps, Charts, &c. *which perhaps may be thought entertaining to the Curious. But if I have made the whole Eaſy, Natural and Inſtructive, I have gained my End, and the Satisfaction I aim at.*

Edward Laurence.

CON-

CONTENTS.

APPENDIX.

The

The Explication of the Signs and Characters used in the Treatise.

$=$	Signifie	*Equality, or equal to.*
$>$		*Majority, or greater than.*
$<$		*Minority, or lesser than.*
$+$		*More, or to be added.*
$-$		*Less, or to be subtracted.*
L		*Angle used in Trigonometry.*
$\therefore$		*Therefore.*
		Proportion.
$\sphericalangle$		*Angle used in the Theorems.*

ERRATA.

PAG. 2. *line* 18, put a Period after it *p.* 4. *l.* 7, dele B. *p.* 5. *l.* 24, *r.* dividing it. *p.* 6. *l.* 23, for these, *r.* two. *p.* 7. *l.* 28, *r.* precede. *p.* 8. *l.* 21, for another, *r.* one Point. *p.* 9. *l.* 18, *r.* Octahedron. *p.* 9. *l.* 23, *r.* Icosahedron. *p.* 12. *l.* 21, *r.* a Line. *p.* 14. *l.* 9, for whose sides, *r.* each side whereof. *p.* 16. *l.* 17, for are, *r.* is. *p.* 19. *l.* 13, *r.* Angles. *p.* 20. *l.* 23, *r.* falling. *p.* 21. *l.* 1, *r.* per. 3d Def. *p.* 22. *l.* 11, *r.* 17th Def. *p.* 25. *l.* 22, *r.* 13th Def. *p.* 28. *l.* 23, *r.* 1 th Def. *p.* 29. *l.* 15, for may, *r.* was. *p.* 31. *l.* 10, instead of for, *r.* from. *p.* 36. *l.* 3, for 68. 61. *r.* 168. 61. *p.* 37. *l.* 15, for 22—30, *r.* 22° 30′ *p.* 38. *l.* 8, *r.* 407.6. *p.* 39. *l.* 2, *r.* Triangle for Angle. *p.* 39. *l.* 16, *r.* Acute Angle b. *p.* 40. *l.* 10, for b, *r.* bd. *p.* 41. *l.* 11, for ab, *r.* cb. *p.* 42. *l.* 16, for 30, 22, *r.* 39° 22′ *p.* 44. *l.* 17, for d, *r.* da. *p.* 45. *l.* 2, for 639 *r.* 63.9. *p.* 51. *l.* 29, dele and. *p.* 52. *l.* 12, for 61°, 82′, *r.* 61°, 32′. *p.* 52. *l.* 25, for 61°, 82′, *r.* 61°, 32′. *p.* 54. *l.* 10, *r.* 71°, 25′. *p.* 57. *l.* 17, *r.* Marks. *p.* 60. *l.* 26, *r.* betwixt the Quarter. *p.* 63. *l.* 24, *r.* mentioned. *p.* 71. *l.* 18, *r.* It is. *p.* 72. *l.* 19, for B *r.* 8. *p.* 88. *l.* 26, for 29, *r.* 24. *p.* 89. *l.* 9. and 11, for 6, *r.* 4. *p.* 969 *l.* 2, put the Word Deductions over the two Right-hand Columns *p.* 99. *l.* 15, *r.* 198 instead of 19. *p.* 103. *l.* 17, and 18, for Rod, *r.* Rood. *p.* 104. *l.* 19, for Roots. *r.* Roods *p.* 108. *l.* 26, for Circumference, *r.* Circumferentor. *p.* 113. *l.* 11, *r.* placing. *p.* 127. *l.* 14, *r.* *Fig.* 90. *p.* 166. *l.* 9, or Arc, *r.* Arc of a Circle. *p.* 167. *l.* 18, *r.* Circumferentor. *p.* 169. *l.* 15, for $\frac{48}{336}$ *r.* $\frac{84}{336}$. *p.* 185. *l.* 12, *r.* either of the Products is.

ADVERTISEMENT.

LOrdſhips Surveyed, and Maps drawn of the ſame. Timber Meaſured and Valued, with other Artificers Work; and Dialling in all its Parts, Performed by *Edward Laurence.*

He is to be heard of when in *London* at Mr *Senex's* at the Globe in *Salisbury-Court.*

N. B. In Winter, and at ſuch Times as he is not Surveying, Gentlemen may have their Sons or Daughters Taught Accompts after a Natural, Eaſy and Conciſe Method, with the Uſe of the Globes and Maps, and all other uſeful Parts of the Mathematicks.

Jno. Jackson

THE Young Surveyor's GUIDE.

Practical Geometry.

I Design in this part to lay down the first Principles of Geometry; and to do it methodically, to begin with Definitions, and the Explication of the most ordinary Terms: To which I shall add some Maxims, wherein Natural Reason does instruct us; and then proceed to Geometrical Problems; and such Propositions as I find convenient for this Tract, so that a Man may be able to give a demonstrable Account of what he does.

Geometrical Definitions.

1 A Point is that which is confidered as having no manner of Dimenfions: And as being indivifible in every refpect, the Ends or Extremities of Lines are Points.

2 *Fig.* 1 A Line has Length, but no Breadth, nor Thicknefs; of which there are two forts, *viz.* right or ftreight, and curve or crooked; as AB is a ftreight Line, BC a crooked Line.

3. *Fig.* 2. An Angle is the meeting of two Lines in a Point; provided the two Lines fo meeting, do not make one ftreight Line: As in the Lines AB and AC meeting together in the Point A, make an Angle BAC, which is meafur'd by an Arch of a Circle DE, defcribed from the angular Point A as a Center, and intercepted between the Lines AC, and AB, which form it an *Angle*, is faid to be *equal to*, *greater or lefs* than another, according as the Arch which meafures it, contains as *many*, *more*, or *fewer* of the equal Parts into which that Circumference is fuppofed to be divided.

Of which right-lined Angles there are three forts, *viz.* Right Angled, Acute, and Obtufe: when a Line falleth perpendicularly upon another, it maketh two right Angles, that is, neither leaneth to one fide or the other.

Example.

Example.

Fig. 3. Let CAB be a right Line, DA perpendicular to it, that is to ſay, neither leaning towards B or C, but exactly upright, then are both the Angles at A, *viz.* DAB and DAC right Angles, and contain in each juſt 90 Degrees, or the 4th part of a Circle; but if the Line DA had not been Perpendicular, but had leaned towards B, then had DAC been an Obtuſe Angle, or greater then a right Angle; and DAB, an Acute Angle; or leſs then a Right Angle.

4. A Figure is that which is comprehended under one, or more Lines.

5. All Figures contained under three Sides, are called Triangles, which *Euclid* divides, with reſpect either to their Angles or Sides.

6. *Fig.* 4. An Equilateral Triangle is that which hath its three Sides equal, as the Triangle ABC.

7. *Fig.* 5. An Iſoſceles Triangle, is that which hath two Sides equal: As if the two Sides AB and AC be equal, the Triangle ABC is Iſcoſceles.

8. *Fig.* 6. A Scelenum, is a Triangle having all the three Sides unequal, as GHI.

9. *Fig.* 7. A Rectangled Triangle, is that which hath one right Angle, as DEF.

10. *Fig.* 8. An Ambligone, or obtuſe Angled Triangle, is that which hath one Obtuſe Angle, H as IGH.

11. *Fig.* 9. An Oxygone, or Acute Angled Triangle, is that whose Angles are all Acute, as ABC.

12. *Fig* 10. A Square consists of four equal Sides, and four right Angles, as AB.

13. A Parallelogram is a Figure that hath its two opposite Sides B parallel.

14. *Fig.* 11. An Oblong Rectangle, having its opposite Sides equal, and its Angles right, as CB, is called a long Square or Parallelogram.

15. *Fig.* 12. A Rhombus, is that whose Sides are all equal, but not right Angled, as B.

16. *Fig.* 13. A Rhomboides, is that whose opposite Sides and Angles are equal among themselves; but not right Angled, as D.

17. *Fig.* 14. Parallel Lines are such as being in the same Plain will never meet, keeping still the same distance one from the other; as AB and CD.

18. *Fig.* 15. All other four sided Figures are called Trapezia: Other Figures that are contained under 5, 6, 7, or more Sides, I call Irregular, Polygones, as F is an Irregular Figure, and G is a Trapezia.

Note, Such as are made by the Circumference of a Circle divided into any Number of equal parts, are regular Figures; having all their Sides and Angles equal, and are called from the Number of Angles they contain, as a *Pentagone*, *Hexagone*, *Heptagone*, *Octagone*, &c. Which signifies a Figure of 5, 6, 7 or 8 Angles or Sides, whose

Sides

Sides and Angles are all equal one to another: For your better underſtanding of which, obſerve the Figures following.

19. *Fig.* 16. Now ſuppoſing the Sides and Angles to be all equal, (A) is a regular *Pentagone*, (B) a *Hexagone*, and C a *Heptagone*, &c.

20. *Fig.* 17. A Circle is a plain Figure, contained under one Line only, BDCGE, which is called the Perophery, in the Middle whereof there is a point A, which is called the Center; from whence all right Lines that are drawn to the Circumference are equal; as AB, AC, AD.

21. The Diameter of a Circle is a right Line drawn through the Center, and terminated by the Circumference of the Circle; thereby dividing it into two equal parts.

22. *Fig.* 17. The Semi-diameter or Radius is the half of the whole Diameter; as AC or AB are Semi-diameters.

23. A Chord is a ſtreight Line ſubtending an Arch of a Circle, dividing into two parts.

24. *Fig.* 17. A Semicircle is the half of a Circle, contained under the Diameter and half Periphery, as DBC or BEC.

25. *Fig.* 17. A Quadrant is one fourth part of a Circle; and is made by the interſection of two Diameters perpendicularly, as ADC or ABD.

26. *Fig.* 17. A Segment is a Figure comprehended under part of the Circumference of a Circle, and the Chord belonging to it, as ECG, by the Chord Line EC.

27. *Fig* 17. A Sector of a Circle is a Figure contained under two Right Lines, drawn from the Center A, and the Circumference lying between the same Lines, as ABD.

28. All Circumferences, as also like Arches, Sines, Tangents, Chords and Secants, are proportional to their Radii; That is, if the Radius of one Circle be double, treble, *&c.* the Radius of another: The Circumference as also like Arches (*i.e.* containing the same number of degrees,) and their Sines, Tangents, Chords, *&c.* of the former will be double, treble, *&c.* the Circumference like Arches, their Sines, Tangents, *&c.*

29. *Fig.* 19. A Diagonal is a streight Line drawn from one Angle of any Figure, to the opposite Angle, as CAB.

MAXIMS.

1. Those Quantities that are equal to third, are equal betwixt themselves.

2. If equal Quantities be added to those that are equal, the Sums will also be equal.

3. If equal Quantities be taken away from those that are equal, the Remainders will be equal.

If

4. If you add equal Quantities to unequal, the whole will be unequal.

5. If from equal Quantities you take unequal, the Remainder will be unequal.

6. Quantities that are double, triple, quadruble &c. to the same Quantity, are equal among themselves.

7. Those things which mutally agree to each other, are equal.

8. Right Angles are equal to one another.

9. Parallel Lines have a common Perpendicular.

ADVERTISEMENT.

There are two sorts of Propositions, *viz.* Problems and Theorems. A Problem always proposes something to be done: But a Theorem is a speculative Proposition, in which are considered the Affections and Properties of things already done.

Of Proportion.

Multiplied Magnitude, is that which contains another Magnitude, a certain Number of times precisely.

Ratio or Reason, is the Comparison of two Quantities one with another, whereby one is said to be bigger or less than another; in which Comparison, that which proceeds, is called the Antecedent, and the other the Consequent.

Thoſe Quantities only admit of Reaſon, which being multiplied may exceed each other.

10 The Homologus Terms in any Proportion are the two Antecedents, or the two Conſequents.

Reciprocal Figures, are ſuch as are when we compare the Sides of one Figure to the Sides of the other, and the Antecedents, and the Conſequents of the Reaſons are in both Figures.

Of Solids, viz. *Solid Bodies.*

A Solid Angle, is made by the meeting together of ſeveral plain Angles in one point, and of theſe there muſt be 3 at leaſt.

Like rectilineal ſolid Figures, are ſuch as are contained under an equal Number of like Plains.

A Pyramid is a ſolid Figure, contained under Plains collected from one Plain to another.

A Sphere is a ſolid Figure, bounded with a Surface, to which Superficies all the ſtreight Lines that can be drawn from the Center are equal.

The Axis of a Sphere is a right Line drawn through the Center to both parts of the Circumference, about which, if a Semi-circle be turn'd, it will beget a Sphere.

A

A Cone is a ſolid Figure, ariſing from a circular Baſe of ſtreight Lines, ending in a Point called the Vertex, or top thereof; and the Axis of this Cone, is a right Line drawn from the Vertex to the Center of the Baſe, and is called a right Cone, if the Axis be perpendicular to the Baſe, if not, a Scalene one.

A Cylinder is a ſolid Figure, riſing from a circular Baſe as the Cone does; but the right Line end all in an equal Circle.

A Cube is a Solid Figure contained under 6 equal Squares.

A Tetrahedron, is a ſolid Figure comprehended under 4 equal and equilateral Triangles; ſo that its Baſe is equal to each ſide.

An Octatredron is a ſolid Figure contained under 8 equal and Equilateral Triangles.

The Dodecahedron, is a ſolid Figure contained under 12 equal equiangular and Equilateral Pentagons.

The Icoſædron, is a ſolid Figure contained under 20 equal and equilateral Triangles.

Beſides theſe five regular Bodies, it's impoſſible to find any others, *i. e.* to form any more regular Bodies than theſe laſt, *viz.* three are made of Triangles, one of Squares, and one of Pentagons.

Practical Geometry.

PROBLEM I.

Fig. 20. TO erect a Perpendicular, from the Point B on the Line KN. Open your Compasses to any small distance; set one Foot in B, and with the other make the 2 Marks D, G. this done, open the Compasses to any convenient distance, then set one Foot in D, and with the other draw the obscure Arch GG.

Again, the Compasses still keeping the same distance, set one Foot in the Point G, and describe the Arch HH, crossing the former in the Point A, from which draw the Line AB, and it will be perpendicular to the given Line KN.

PROBLEM II.

Fig. 21. To raise a Perpendicular DB, upon the End of the Line AB. Open your Compasses to any ordinary extent, and setting one Foot upon the point B, let the other fall at pleasure, as at the Point K, and without altering the Compasses, set one Foot in the Point K, and with the other cross the Line AB, at D, also on the other Side

Side deſcribe the Arch EE, then, lay your Ruler to D, and K, draw the Line DKF: laſtly, from the point B to the Interſection at g, draw the Line B g D, which is perpendicular to the Line AB.

PROBLEM III.

Fig. 22. To let fall a Perpendicular AE, to the given Line. RQ, from the given Point A, which is out of the Line BC; having ſet the foot of the Compaſſes upon A, with any Interval, deſcribe the Arch BC, which will cut the Line RQ at the points B and C· Then divide the Line BC into two equal parts at the point E. I ſay the Line AE is perpendicular to RQ.

PROBLEM IV.

Fig. 23. From a point C given; to draw a Line CD Parallel to the Line AB given. On the Point C as on a Center, ſtrike an Arch of a Circle cutting the Line AB given in the Point A: Then ſet the Foot of the Compaſſes any where (*at a good diſtance from A*) in the given Line AB, as B, and with the ſame Interval ſtrike the Arch D: Then take in the Compaſſes the Length AB, and puting one Foot in C, draw an Arch cutting the other in the Point D, through C and D, draw the Line CD, and it will be parallel to AB. *PROB.*

PROBLEM V.

Fig. 24. To divide the given right Line AB into two equal parts, and at Right Angles. Take in your Compaſſes any diſtance above half the length of the Line AB, and ſetting one Foot in the end A, with the other draw the Arch CDE, then with the ſame interval on the Center B, deſcribe the Arch FGK, intercepting the former in F and G, from which Points draw the Line FGH, and it is done.

PROBLEM VI.

A ſecond way to draw Lines Parallel to each other.

Fig. 25. Let BD be a Line given; to make a Line Parallel unto it, ſet one Foot of the Compaſſes at G, and with the other deſcribe an Arch as a e, and do the ſame at the other end of the Line, and through the utmoſt Convexity, and of thoſe two Arches draw the Line IL.

PROBLEM VII.

A third way how to draw Lines Parallel to another Line, which alſo paſſes through a Point aſſigned.

Fig.

Fig. 26. Let BD be the given Line, E, the Point through which the Parallel muſt paſs; Place one foot of your Compaſſes in E, and open them till the other foot juſt touch the Line BC, and deſcribe the Arch *ae*; with the ſame extent in any part of the given Line, ſet one foot of your Compaſſes, and ſtrike the Arch D, then through the point E and the utmoſt Convexity of the laſt Arch draw the line CK, which is parallel to BD and through the point E.

PROBLEM VIII.

Fig. 27 To deſcribe a Triangle ACB, whoſe ſides, AC, CB, and AB, ſhall be equal to the three ſides, E, D, and F given, provided that any two of them be greater than the third. Take with your Compaſſes the Line F, to which make AB equal: Then on the Center B with the diſtance D deſcribe the Arch *z x*. Again on A with the Line E deſcribe an Arch cutting the former in C, then draw AC, and CB, and it is done.

PROBLEM IX.

Note, The very ſame way you may make a Triangle equal to another Triangle given.

PROBLEM X.

Fig. 28. To make an Angle BAC equal to the Angle EDF at A the end of the Line AB given. Describe from the Points A and D as Centers two Arches BC, and EF, with the same interval of the Compasses; then take the distance EF, and set it from B to C, then draw the Line AC, I say, the Angles BAC, and EDF, are equal.

PROBLEM XI.

Fig. 29. To make a Square BCDE, whose sides shou'd be equal to the given Line A: First, make the Line BC, equal to the Line A, and on the end thereof at C, erect the Perpendicular CD also equal to the Line A, then with the same distance, set one foot in B, strike the Arch *k l*, and on D describe the Arch *bb*, crossing each other in the point M, which will constitute the Square BCDE.

PROBLEM XII.

Fig. 30 To make a Parallelogram ABCD or long Square, having one side equal to A and the other to B. This is like the former; let two Lines be given you, AB and BC, and let it be required to make a Parallelogram of them. First lay down your longest side AB.

AB equal to A, and at the end erect a perpendicular Line equal to your shortest Line BC, and so proceed, as you were taught in the last Problem.

PROBLEM XIII.

Fig. 31. To make a Rhombus ABCD.

Make an Angle, as ABC, and make the sides AB, BC equal, then taking the length of one of them and setting your Compasses in A, describe the Arch *m m*; also put one Foot in C and strike the Arch *a a*. Lastly draw the Lines DC and DA and it's finished.

Note, A Rhombus is made by 2 equilateral or Isosceles Triangles.

PROBLEM XIV.

Fig. 32. To make a Trapeziam, A B C D, which shall have one Angle at C equal to a given Angle E, and the four sides equal to four given Lines, *viz.* the Lines f g h i.

Fig. 32. *First*, Make the Line AB equal to one of the given Lines, as f. *2dly*. Upon the point B, (*by Prob.* 10.) make the Angle ABC equal to the Angle E, making the side CB equal to the given Line g. *3dly*, Take another of your given lines, as the line h, and setting one Foot upon C, with the other describe the Arch *b b*. *Lastly*, Take the fourth line i in your Compasses, setting one foot in A

with

with the other defcribe the Arch *o o*, and draw the lines DA and DC, which will conftitute a Trapeziam, the fides whereof are equal to the four lines given, and it has an Angle equal to the Angle given, which was to be done.

PROBLEM XV.

Fig 33. To divide a Circle ABCD, into any Number of equal parts, not exceeding Ten. *Firft*, Defcribe a Circle, and crofs it with 2 Diameters, AC and BD, paffing through the point or Center E, and make A o and A Q equal to BE, and join OQ; fo is OQ the third part of the Circle: then join AB together, fo will AB be the fourth part; upon L, and the diftance LB, defcribe the Arch Bm, and join Bm, which line is the 5th part; AE or BE is the fixth part, and LO or LQ are the feventh part, and k A, will be the eighth part. Divide the Arch QAO into 3 equal parts at S, and join SQ, which will be the ninth part, EM is the tenth part.

So you may make the Figures called *Pentagon*, *Hexagon*, *Heptagon*, *Octogon*, *Nonagon*, &c.

PROBLEM XVI.

Fig 34. Any three points A. B, and C, which are not in a ftreight Line, being given; how

to

to find the Center O of the Circle BAC, which ſhall paſs through thoſe three given Points. *Firſt*, Set one foot of the Compaſſes in one of the given points, as in A, and extend the other foot to B, another of the points, and draw the Arch of a circle GFD.—— *Secondly*, The Compaſſes not altered, ſet one foot in B, and with the other croſs the former Arch with two ſmall Arches in the points D and E, and draw the right Line DE,— *Thirdly*, Set one foot of the Compaſſes in the 3*d* point C; they ſtill keeping the ſame diſtance, and with the other foot croſs the firſt drawn Arch GFD, in the points F and G, and draw the right Line FG, croſſing the former right line DE, in the point G; ſo is O the Center ſought for; upon which if you deſcribe a Circle at the diſtance GA, it ſhall paſs through all the 3 given points AB, and C, as was required.

PROBLEM XVII.

How to make an Oval ſeveral ways.

Fig 35. Make three Circles whoſe Diameters may be in a ſtreight Line, as B: Croſs the line with another Perpendicular to it at the center of the middle Circle, as cd; draw the lines ce, ch, dg, df; ſet one Foot of the Compaſſes in D, and extend the other to g, deſcribe the Arch gf, with the ſame extent, ſetting one foot in c, deſcribe the other part h e, then

then from the Center O, with the diſtance BO, deſcribe the Arch fBE. Again, with the ſame diſtance on the Center Q deſcribe the Arch gAH, and it is done.

THEOREM I.

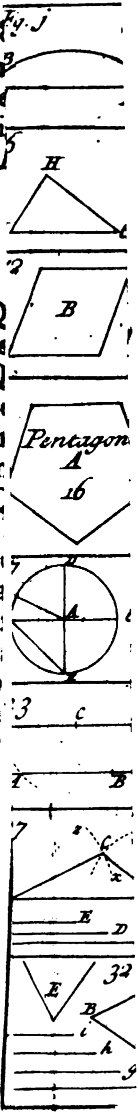
Fig 36. If any Triangle QRS hath two ſides, QR, and QS, equal to two others qr, and qs, in any other Triangle, and if alſo the < Q included by thoſe ſides = to < q, included by the other ſides; I ſay, each part in one Triangle is = to its correſponding part in the other, and therefore the whole Triangle QRS is = the Triangle qrs.

Demon. For ſuppoſe the Triangle q r s be placed upon the △ QRS, the ſide qr will fall exactly on QR (*by the ſeventh Maxim*) and the ſide qs will fall on its equal QS; becauſe < Q = < q ſo the point S will fall on s, and R on r, and therefore the whole Triangles, q r s and QRS do mutally agree, and conſequently each part in one is equal to its correſponding one in the other.

Scholium to the firſt Prop.

By the ſame Reaſoning we may Demonſtrate the following Theorem.

If the ſides R S, and r s of the two Triangles QRS, q r s were equal, and the <s adjacent


H
B
Pentagon
A
16
A
C
B
E
D
32
E
B
i
h
g

adjacent to those sides in the $\triangle$ QRS = to the <s corresponding to them in the Triangle qrs, all the rest, and also the Triangles themselves, will be equal.

For if the side q r be put upon the side QR, they will agree (*by Maxim* 7.) but because the < R = < r, and < S = < s; the side Rq will fall upon side RQ, and qs upon QS, ∴ the point q will fall upon the point Q; (*for if it fall out of Q, the Lines r q, qs do not fall upon the Lines QR, QS*) therefore they are equal (*by the seventh Maxim*) Q.E D.

THEOREM II.

*Fig.*37. In an Isoceles Triangle the Angle at the Base opposite to the equal Legs, are equal.

Let the Triangle A C B be supposed two Triangles, and the Situation of one convers to that of the other, as *b c a*: Because in the two Triangles ACB and *b c a*, the side AC is = the side b c, and the side CB is = the side ab, and the Angle C is = the Angle c, therefore the Angle at the Base A = < b by the first, which was to be Demonstrated for the Angle, B and b are the same.

THEO-

THEOREM III.

Fig. 38. If two Triangles have each side in one equal to its corresponding side in the other (*that is, ac = ef, cb=fi, and ab = ei*) they will also have = Angles opposite to those = sides (*that is c = f, a=e, and b=i*).

Let the line ab be put upon the line ei. Then the point c will either fall in f, or it will not. If it falls in f, the whole Triangles agree, and therefore all the Angles are equal by the seventh *Maxim*.

Fig. 39. If c falls out of f, draw the line fc: Because by Hypothesis the sides ef, and ac are equal, the Angle efc must be equal to the Angle ecf; by the second Proposition therefore Angle ife will be greater than Angle ecf, and Angle ifc wil be much greater than Angle icf.

Again, by supposition, because if = bc, < ifc, will be = to < icf. Therefore ifc is both much greater than, and equal to cf, which is impossible, and therefore c cannot fall out of f.

THEOREM IV.

Fig. 40. One right line CD falling on another AB, makes the Contiguous Angles = to two right Angles. Let the line CD be perpendicular to AB, then the Angles ADC and CDB will

will be right pr. 5 Def. But if the line fall obliquely as ED, raise the perpendicular CD, then, because the unequal Angles ADE and EDB occupy the same place which the two right ones ADC and CDB did, therefore they agree to two right Angles, and consequently to them (*by 7 Ax.*) Q. E.D.

THEOREM V.

Fig. 41. If two right lines (*BC, and FL*) cut one the other in any point (A) the opposite Angles at the Vertex (A) will be equal; that is, the Angle LAB is = to CAF. Because BA, stands upon the right line LF, LAB, and FAB will be equal to two right (*by the fourth Theorem.*) And because FA stands upon BC, the Angles FAC, and FAB, will be equal to two right (*by the same*) therefore the two Angles LAB, and FAB taken together will be equal to the two Angles CAF, and FAB, taken together. But the common Angle FAB being taken away, there remains the Angle LAB = CAF (*by the third Max.*) Q.E.D.

THEOREM VI.

Fig 42. If a right line GO cut the two parallel right lines (*AB CF,*) first the alternate < (*RLO, QOL, and BLO, COL.*) are equals. *Secondly*, The external Angle (*GLB*) is equal to the internal one (*LOF*,) as alſo(< *GLR*= <*LOC*.) *Thirdly*, The two internal Angles towards the ſame parts together ALO COL= to two right Angles: Alſo the <s BLO, FOL together = to two right Angles.

Demon. of the firſt part Draw LQ and RO perpendicular toCF from the points L andO and they will be alſo perpendicular to AB(*by the 12th Maxim*,) now in the △s ROL, LOQ, the ſide OL, is common to both; R O =LQ (*by the 8th Def.*)and ∴<LOR=<LOQ (*by the firſt Prop.*) alſo <R O L = < Q L O ∴ < BLO = < COL (*by the ſecond Max.*) which is the Firſt Part.

Second Part. Angle LOQ =<ROL (*by the Firſt Part*,) and < RLO= <GLB (*by the 5th Prop.*) ∴< LOQ=< GLB (*by the firſt Max.*) after the ſame manner may <LOC be proved = to < GLR which is the ſecond Part.

The 3d. Part. Angle GLB = < R LO (*by the 5th Prop.*) <COL was proved = < RLG (*in the 2d. Part.*) but< RLG + < GLB = two right <s (*by the 4th Prop.*) ∴< COL + < RLO = two right Angles, as alſo < BLO + < FOL Q. E. D.

THEOREM VII.

In any Triangle a b c, the three Angles taken together, are equal to two right ones.

Demon-

DEMONSTRATION.

*Fig.*43. Let *d* be drawn parallel to the Base ac, then the < a will = < dba (*by the 6th Prop.*) and < c, = < ebc (*by the 6th. Prop.*) but < d ba + < abc + < cbe = to two right Angles (*by the 4th Prop.*) ∴ < a + < c + < abc = two right Q. E. D.

CORROLARY. I.

Hence by having one of the acute Angles in any Rectangled △, you may find the other by taking the Angle out of 90 Degrees, and that which remains will be the Angle required; so that one Angle is the Complement of the other to 90 Degrees: If your Triangle be obtuse or acute, any two of the Angles being known, the 3*d* is known, by taking the Sum of the two Angles known, from 180 deg. and the remainder is the other Angle.

CORROLARY. II.

Fig. 44. If any side of a Triangle be produced, the external Angle o will be equal to the two Internal and opposite Angles b and e. For the Angles b and e together with d, are equal to two right ones (*by the Preced.*) and so also are the Angles O and d, (*by the 4th*) where wherefore O must be equal to b added to e, because together with d, it makes two right ones, as they do. Q. E. D.

COROLLARY. III.

Fig. 45. The internal Angles A, B, C, D, E, of any Polygon ABCDE are equal to twice as many right Angles as it has sides, except four. For every Polygon may be divided into as many Triangles, except two, as it has sides, by lines drawn from any Angle D to all the rest, except the adjoining ones A and E; but each of those Triangles contain three Angles = two right ones (*by the 7th*) therefore all the Angles of any Polygon are equal to twice as many right Angles, except four.

CORROLARY. IV.

*Fig.*46. In any Polygon A B CD E, the sides being produced will make all the external Angles a, b, c, d, e, equal to four right ones: For each internal < A with its external < a, is equal to two right Angles (*by the 4th i*) consequently all the internal and external Angles are equal to twice as many right Angles as the Figure has sides. But all its internal Angles are equal to twice as many right Angles except 4 as it has sides (*by the last Cor.*) therefore all the external Angles taken together, are equal to four right ones.

COR-

CORROLARY V.

From the third Corrolary we may deduce a Method to examine whether the Angles of a Field be taken right or not, *viz.* Multiply the number of Sides thereof by 2; substract 4 from that product, which remainder multiply'd by 90, will give the Sum of all the Angles, which Sum must be equal to the Sum of the Angles taken in the Field if rightly observ'd.

Fig. 46 For Example: Let ABCDE be a Field bounded with 5 sides, the Sum of the Angles whereof is 540° which is equal to the Number of sides (5) multiply'd by 2, and that Product lessen'd by 4, multiply'd by 90, therefore it is very probable that those Angles were rightly observ'd.

THEOREM VIII.

*Fig.*47. The opposite Sides and Angles of any Parallelogram are equal, and it is divided into two equal parts by (a Line drawn from one < to its opposite one which is called) a Diagonal Line. Because O B is parallel to DC (*by Def.* 14.) the < OBD = < BDC (*by Prop.* 6) also because DO and BC are parallel < CBD = < ODC (by the same) ∴ the whole < OBC = < ODC after the same manner < O may be

shewn

shewn to be equal to < C. But since we have shewn that these Triangles Q and R which have one side D B common, and two Angles adjacent to D B in one, equal to the two corresponding Angles in the other, therefore those Triangles and all their parts, are equal by the Scholium to the Prop. 1.

SCHOLIUM.

Fig. 48. For the Triangle AEF and GFD, having the Alternate Angles EAF and FDG, and AEF and FGD, and AF and FD equal they are equal, *(by the 1st,)* and since the Trapezium BEFD, with the Triangle AEF, that is to say, the Triangle ADB, is half the Parallelogram, *(by the last)* the same Trapezium BEFD, with the Triangle FGD, will be half the same; therefore the line EG divides it into into two equal parts.

THEOREM IX.

*Fig.*49. Parallelograms having the same Base, and being between the same Parallels, are equal. For AB = EC *&c.* *(by the 8th)* △ BAF = △ (E C G *by the 1st)* from both of which take away the common △ DEF, and there will remain the Trapezium AEDB = Trapezium DCFG, to each of which add the △ BDC and then the Parallelogram ABEC = Parallelogram FBCG *per* 2d Max. Q E D.

THEO-

THEOREM X.

Fig. 50. Triangles on the same Base AB, and being between the same Parallels CF and AB are always equal.

The Triangle ABC, is equal to the Triangle ADB. Draw the line DB parallel to AC, and the line BF parallel to AD, then there will be made two Parallelograms, A CDB; and ADFB, which being between the same parallels and on the same Base, will be equal to one another (*by the last*;) but the Triangle ACB is the half of the Parallelogram A B C D, and the Triangle DBA is the half of a Parallelogram ABDF, (*by the* 8*th*.) Therefore the Triangles A C B and A D B, must be equal, by the 6*th Max*.

CORROLARY.

Triangles having the same or equal Bases to Parallelograms, and between the same parallels, are just half those Parallelograms.

THEOREM XI.

Fig. 51. The Complements of a Parallelogram are equal. In the Parallelogram ABDC the Complements AFEH and EGDI are Equal.

DEMONSTATION.

If HG and FI be drawn through any point E of the Diagonal CB parallel to AC and CD, the Parallelogram ACDB is divided into four Parallelograms, two of which are about the Diagonal, and the other two are their Complements, which are thus shewn to be equal, △ ABC = to △ CDB and the △s H B E and EFC are = to △s IBE and ECG (*by* 8) If from the Equal △s ABC and CDB you subftract the Equal △s HBE, EFC and IBE, CEG there will remain the Parallelogram AHEF = to the Parallelogram EGID (*by* 2*d Axiom.*)

THEOREM XII.

Fig. 52. In every rectangle Triangle A B C, the Square of the fide AC, which is oppofite to the right Angle, is equal to the Squares of the other two fides (*A B*, *CB*)

Demon. Draw IC, BF, and BE, Parallel to AF. If then you add the common < BAC to the right Angles IAB, FAC, and therefore equal, the wholes IAC, FAB, will be equal, but the △s IAC, FAB have the two fides which contains thofe Angles equal (*by Def.* 15) to wit IA = BA and CA = FA ∴ △ IAC = △ F A B (*by Prop.* 1) but △ IAC = $\frac{1}{2}$ the Square ILBA and △ ABF = $\frac{1}{2}$ Parallelo-

gram

gram AFZ the (*by Prop.*10) therefore Square LIBA =the Parallelogram AFZE. It might be shewn with the same Ease that the Square BXCH =the Parallelogram CZER. Q. E. D.

THEOREM XIII.

*Fig.*53. An <(*BCA*) at the Center is double to the < (*AFB*) at the Circumference when the same Arc (*AB*) is Base to both Angles. This *Prop.* hath three Cases. The first is when the side (*CA*) coincides with the side (*AF*). For then CF = CB; because both are drawn from the Center to the Circumference of the same Circle therefore in △ CFB<CBF = < CFB (*per Prop.* 2) but <BCA =< CBF + < CFB (*per Schol.* 7 *Prop.*) ∴ < ACB is double the <CFB which may the first In the second Case CA and CB fall without AF and BF. Then <XCA is double < A FX, and < XCB is double the <XFB (*by the first Case*) Therefore the whole < ACB is double the whole < AEB. In the third Case RK cuts C A, and the < AKB is wholly without the < ACB Draw KCL then < ACL is double < AKL (*by the first Case*) and if < LCB and its double < LKB be taken away there remains <A B double < AKB. Q. E. D.

THEOREM. XIV.

All similar Triangles have their sides about their equal Angles proportional. For if they were inscribed in Circles, their Sides would be Chords of similar Arcs.

THEOREM. XV.

Fig. 54. If in any Triangle a Line be drawn parallel to the Base, that Line will cut the Legs proportionaly. In the Triangle ABC let the Line DE, be parallel to BC: I say that AD, is to AD as AB to AC and AB : BC :: AD: DE. Also DE : BC : AD: AB : or AD: AB :: AE: AC. For $\triangle$s ABC, and ADE are similar because < D = < B and < E = < C (*by the 6th*) and < A is common to both ∴ their Sides about their equal Angles are proportional (*by the last*) Q. E. D.

Of Right Lines applied to a Circle.

DEFINITIONS,

1. Every Circle is supposed to be divided into 360 Deg. and each Deg. into 60 parts, called Minutes, and each Minute into 60 parts, called Seconds, &c. Any Portion of the Circumference whereof is an Arch, and

and is Measured by the Number of Degrees it contains.

2. *Fig.* 55. A Chord is a Right Line joyning the Extremities of an Arch, as AC, is the chord of the Arches ABC, ADC.

3 A Tangent of an Arch is a Right-line drawn Perpendicular to the end of the Radius or Semi-Diameter, passing through one end of the Arch, and its length is limited by a Right-line drawn for the Center through the other End of the Arch, which is called the Secant; thus BM is the Tangent, and FM the Secant of the Arches AB and AD.

4. A Right Sine is a Right-line drawn from one End of an Arch, Perpendicular to that Diameter passing through the other End, or is half the Chord of the double Arch; AE is the Right Sine of the Arches AB, and AD. And here 'tis evident, that the Sine of 90 Deg. which is equal to the Radius, or Semi-diameter of that Circle, is the greatest of all Sines, the Sine of an Arch greater then a Quadrant, being less than the Radius.

5. A Versed Sine is the Segment of the Diameter intercepted between the Arch, and the Right Sine, EB is the Versed Sine of the Arch AB, and ED of the Arch AD.

6. The differences of an Arch from a Quadrant, whether it be greater or less,

is call'd its Complement, GA is the Complement of the Arches AB, AD; HA is the Sine of the Complement, or Cofine, GI the Tangent of that Complement, or Co-Tangent, FI the Secant of that Complement, or Co-fecant.

Plane Trigonometry,

Is the Menfuration of the Sides and Angles of plain Triangles. A plain Triangle has fix parts, *viz.* Three Sides and three Angles, whereof any three being given, except the three Angles, the other may be found by Trigonometrical Calculation.

In right Angled Triangles, there are feven Cafes, all performed by the following *Axioms.*

AXIOM I.

In any Right Angle Triangle, if either of the Legs be fuppofed to be the Radius of a Circle, the other Leg will be the Tangent of the oppofite Angle or of the Angle at the Center, and the Hypothenufe will be the Secant of that Angle: But if yon imagine the Hypothenufe to be the Radius of a Circle, then each Leg will be the Sine of its oppofite Angle, or of the Angle at the Center, as is plain from. *Fig.* 56. 57: 58:59.

In

In the firſt of which: B: (*the Baſe*) being made the Radius, P (*the Perpendicular*) is the Tangent of the Angle at a, the Center of the Circle, which is oppoſite to P, and the Hypothenuſe is the S cant of the ſame Angle.

In the ſecond of which, where P is made the Radius, B is the Targent of the oppoſite Angle at the Center: C:

In the third of which where H the Hypothenuſe is made the Radius, P is the Right Sine of the oppoſite Angle at the Center. C

In the fourth of which H being alſo made Radius, but c the Center of the Circle, B will be Sine of its oppoſite. Angle.

CASE. I.

Fig 60. Hypothenuſe and Angles given, either of the Legs required.

Example.

In △ a b c, given $\left\{ \begin{array}{l} bc = 446 \\ \angle c = 22°30 \end{array} \right\}$ req ba, and ca.

Proportion.

As the Radius : bc :: $\left\{ \begin{array}{l} s \\ cs \end{array} \right\}$ ∠ c : $\left\{ \begin{array}{l} ba \\ ca, \end{array} \right.$

S 90° : 446 :: $\left\{ \begin{array}{l} s \\ cs \end{array} \right\}$ 22°. 30′ $\left\{ \begin{array}{l} 168; 61 \\ 407. 6 \end{array} \right.$

C 5

Opera-

Operation.

To the Logar of b c 446,		2. 644044
add the Sine of Angle c 22°. 30′		9. 582840
		12. 226884.

Sum abate, Rad = Log. ba 168, 61.

By Gunters Scale.

The extent from the Sine 90°, to the Sine of the Angle c. 22. 30 on the Line of the Sines, will reach from b c 446. to b a 168. 61 on the Line of Numbers.

CASE II.

One Leg and an Angle given, the other Leg required.

Example.

In the △ abc, given $\left\{\begin{array}{l} ba = 168,61 \\ \angle c, = 22,30 \end{array}\right\}$ requir'd ca,

Proportion.

Rad : ba :: ct, ∠c : ca, i. e. T, 45, : 168, 61 :: T, 67,30 : 407, 6.

To the Logar. ba 168, 61	2, 226884
add the ct, c 22, 30	10, 382776

Sum abate, Rad = Log, c a 407,6 12.609660.

CASE III.

One Leg and an Angle given, Hypothenuse required.

Example.

Example.

In the△a b c, given $\left\{\begin{array}{l} ba = 168,6_{1} \\ \angle c = 22°,30' \end{array}\right\}$ requir'd bc

Proportion.

S, ∠c: b a : : Rad, : b c.

S, 22°, 30′ : 168 $\frac{61}{100}$: : S 90° : 446.

Operation.

To A r, co. S, < c 22°., 30′	0, 417160
Add Logar, b a 168, 61	2, 226884
Sum = Log. b c 446	2. 644044

By Gunters Scale.

The Extent, from S, ∠ c 22° 30′. To the S, 90°, on the Line of Sines. will reach from b a 168, 61. to b c 446 on the Line of Numbers.

CASE IV.

One Leg and the Hypothenuse given, the Angles required.

Example.

In the △ a b c, given, $\left\{\begin{array}{l} bc = 446 \\ ba = 168,61 \end{array}\right\}$ required ∠ $\left\{\begin{array}{l} c \\ b \end{array}\right\}$

Proportion.

As b c : Rad, : : b a : S, ∠ c

446 : S, 90° : : 168. 61 : S 22°, 30′

Opera-

Operation.

To Ar, c o, Logar. b c 446 — 7. 355956
Add Logar, b a. 68, 61. — 2. 22688.

Sum S. ∠c 22°, 30′ — 9. 582840
From. 90°, 00
Subſtract 22 30.

Remainder. 67° 30′ = < b.

By Gunters Scale.

The Extent from 446, to 16c, 61 on the Line of Numbers, reaches from S. 90°. To the Sine 22°, 30′ on the Line of Sines.

CASE V.

One Leg and the Hypothenuſe given, the other required

In the △ a b c given $\left\{ \begin{array}{l} b\,c = 446 \\ b\,a = 168{,}61 \end{array} \right\}$ requir'd c a

Proportion.

The Angles being found by the fourth Caſe.

As Rad, : c t, < c :: ba : ca.
T, 45 : T 67°. 30′ :: 168°, 61° : 407. 6.

Operation.

To the c t, < c 22°, 30′ — 10. 382776
add the Log. b a 168, 61. — 2. 226884

Sum, leſs Rad, = Log, c a 407, 6 — 12. 609660.

By

By Gunters Scale.

The extent from	T, 45°, 00′	on the Line of
To the	T, 67°, 30′	Tangents
Reaches from	168 -61	on the Line of
To	407 · 6	Numbers.

CASE VI.

The Legs given, and the Angles required.

In the $\triangle$ a b c, given, $\left\{\begin{array}{l} \text{b a, 168, 61} \\ \text{c a. 407, 6} \end{array}\right\}$ requir'd $\angle$, $\left\{\begin{array}{l} \text{c,} \\ \text{b.} \end{array}\right.$

Proporteon.

c a : b a :: Radius ; Tang, $\angle$ c,

407. 6 : 168. 61 :: T, 45° : T, 22° 30′

Operation,

To the Ar, co Logar. ca 407, 6	7. 390341
add the Logar, ba, 168, 61	2. 226884
Sum = T, $\angle$c, 22—30′	9.617225.

By Gunters Scale.

The Extent from 407, 6. to 186. 61 on the Line of Numbers, reaches from T, 45° 00′ to the T, 22°. 30′ on the Line of Tangents.

CASE VII.

The Legs given, the Hypothenuse required.

Example.

Example.

In the △ a b c, given $\left\{\begin{array}{l}\text{ac, 407. 6}\\ \text{ab, 168. 61}\end{array}\right\}$ req. b c.

Proportion.

The Angles being found by the 6th Case.

S. ∠ b : Rad, : : ac : b c.

S, 67°. 30′ : S. 90° : : 407. 6 : 446.

Operation.

To the Ar. co, S ∠ b 67°. 30′	0. 034385
add Logar. ac, 407. 6	2. 609659
Sum = Logar. b c 446.	2. 644044.

By Gunters Scale.

The Extent from S, 67° 30′		on the Line of
To the Sine	90, 00	Sines.
Reaches from	487: 6	on the Line
To	446. 0	of Numbers.

Of Oblique-Angled Plane Triangles.

Wherein there are 6 Cases, and all resolved by the three following Axioms.

AXIOM I.

In all Plane Triangles, the sides are proportional to the Sines of their opposite Angles.

AXIOM.

AXIOM III.

In all Plane Triangles,

As the Sum of the Legs of any Angle, is to their Difference;

So is the Tangent of half the Sum of their opposite Angles,

To the Tangent of half their Difference.

AXIOM IV.

As the Base, or longest Side, is to the Sum of the other Sides;

So is the Difference of those Sides,

To the Difference of the Segments of the Base.

CASE I.

Fig. 61. Two Sides, and an Angle opposite to one of them given; the Angle opposite to the other required.

Example.

In the △ b c d, given, $\left\{\begin{array}{l} cd = 139 \\ cb = 64 \\ \angle d = 22^\circ\, 30' \end{array}\right\}$ requir'd the Acute ∠

Proportion.

cb : S, ∠ d :: cd : S, ∠ b per Ax, 2.

64 : S, 22°, 30' :: 139 : S, 56° 15'

Opera-

Operation.

To the Ar. co, Logar. cb 64		8.193820
add the	Log. cd. 139	2.143142
	S, ∠ d 22°. 30'	9.582840
Sum—Radius, = S. ∠ b, 56° 15'		9.919802.

By Gunters Scale.

The extent from 64 } on the Line of Numbers.
To 139 }

Reaches from S, 22° 30' } on the Line of Sines.
To S, 56-15 }

CASE II.

Two Sides and an Angle opposite to one of them given, the third Side required.

Example.

In the △ bcd, given cd = 139, cb = 64, ∠ d 22°, 30' } requir'd b.

Preparation.

By Case the first find the Angle b, and knowing the Angle d, you will find the Angle c to be 101.° 15'.

Proportion. per Ax, 2.

S, ∠ b : cd : : S, ∠ c : b d.

S, 56. 15 : 139 : : S, 101 : 164.

Operation.

Ar. co. S, ∠ b 56° 15'		0.080554
add the	Log c d, 139	2.143142
	S. ∠ c 101. 15	9.991594.
Sum—Radius = Log. b d, 164.		12.214870.

By

By Gunters Scale.

The extent from the Sine of 56° 15′ to 101° 15′ on the Line of Sines, reaches from 139 to 164 on the Lines of Numbers.

Note, That the Sine of 101′ 15′, is the Sine of the Complement to 180. degrees = Sine of 71° 45′.

CASE III.

Two Angles and a Side given; the other Side required.

Example.

In Obl. △ bcd given, { ∠c = 101°.15′ ; ∠ d = 22. 30 ; a b, = 64 } requ. { b d ; c d }

Proportion. per Ax 2.

S, ∠ d : cb :: S ∠ c : b d.

S. 22°. 30′ : 64 :: S, 101 15 : 164.

Operation.

To Ar. co, S ∠ d 22° 30′	0. 417160
add the { S ∠ c 101°; 15′	9. 991574
add the { Log, c b 64	1. 806180
Sum — Radius = Log. bd. 164.	12. 214914

By Gunters Scale.

The extent from the S, 22° 33′ to the Sine 101° 15′ on the Line of Sines, reaches from 64 to 164 on the Line of Numbers.

Proportion.

S. ∠ d : S, ∠ b :: cb : cd

S, 22. 30 : S, 56. 15 :: 64 : 139.

CASE

CASE IV.

Two Sides and an Angle comprehended by them, given; the other Angles required.

Example.

$$\text{In obl.}\ \triangle\ bcd,\ \text{given,} \left\{\begin{array}{l} \angle c = 101^{\circ},15' \\ cb = 64 \\ cd = 139 \end{array}\right\} \text{req.} \left\{\begin{array}{l} \angle d \\ \angle b \end{array}\right.$$

Preparation by the third Axiom.

$$\begin{array}{r} cd = 139 \\ cb = 64 \\ \hline \end{array}$$

$$Sum = cb + cd = 203.$$

$$Differ.\ cd - cb = 75.$$

From 180° 0′′ = to the 3 Angles of a Triangle.
Substract 101, 15 = to the given Angle.

Remain 78, 45 = to the Sum of the opposite Angles.
½ Remain = 39 22 ½ = to half the Sum of the opposite Angles.

PROPORTION.

$$cb + cd : cd - cb :: T, \tfrac{1}{2}\ \angle\angle : T, \tfrac{1}{2}\ X\ \angle,\angle.$$

$$203 : 75 :: T,\ 30^{\circ}22'\tfrac{1}{2} : T,\ 16^{\circ}52'\tfrac{1}{2}$$

OPERATION.

To Ar. co Log. cd + cb	203		7.692504
Adding { cd − cb	75		1.875061
T, ½ Sum } ∠∠ bd		39°.22′	9.914172
Sum − Rad = T, ½ Diff.		16°.52, +	9.481737.

$$\tfrac{1}{2}\ Sum \left\{\begin{array}{c} + \\ - \end{array}\right\} \tfrac{1}{2}\ Differ\ \angle\angle = \left\{\begin{array}{l} 56\ 15 = \angle \\ \hline 22\ 30 = \angle \end{array}\right\} \angle \left\{\begin{array}{l} c \\ d \end{array}\right.$$

CASE V.

CASE V.

Two Sides, and the Angle comprehended given; the other Side required.

Example.

In the Obl. $\triangle$ dcb, given, $\left\{\begin{array}{l} cb=64 \\ cd=129 \\ \angle d=101^{\circ}\,15' \end{array}\right\}$ requ. b d.

Preparation.

Find the Angles b d, by Case the fourth.

Proportion. per. Ax 2.

S, $\angle$ b : cd : : S $\angle$c : b d.

S, 56°, 15′ : 139 : : S, 101, 15 : 164.

The Operation is the same with Case the second.

CASE VI.

Fig. 62. The three Sides given; the Angles required.

Example.

In the Obl. $\triangle$ b c d given. $\left\{\begin{array}{l} bd=105 \\ cd=70 \\ cb=50 \end{array}\right\}$ required the Angles.

Preparation by Axiom 4.

From the Vertical Angle, upon the Base bd Let fall the Perpendicular ——— ca.

Then the $\left\{\begin{array}{l}\text{whole}\triangle,\\ \text{Base}\end{array}\right\}$ is divided into 2 $\left\{\begin{array}{l}\text{L}\triangle\text{s cad, cab}\\ \text{Segments ad, ab.}\end{array}\right\}$

c d

$$cd = 70$$
$$cb = 50.$$

$$\text{Sum} = cd + cb = 120.$$

$$\text{Diff.} = cd - cb = 20.$$

Proportion per Ax. 4.

$$db : cd + cb :: cd - cb : df = da\text{-}ba.$$
$$105 : 120 :: 20 : 22,8.$$

Operation.

To Ar. co. Log.	$bd = 105$	8.978811
Add	Log. $cd + cb = 120$	1.079181
	Log. $cd - cb = 20$	0.301030
Sum — Radius = Log.	df 22, 8.	10.359022.

By Gunters Scale.

$$\left.\begin{array}{ll}\text{The extent from} & 105\\ \text{To} & 120\\ \text{Will reach from} & 20\\ \text{To} & 22.8\end{array}\right\}\text{On the Line of Numbers.}$$

$$bd = 105 = \text{Base.}$$
$$fd = 22.8 = \text{Differ. Segments,}$$

$$\left.\begin{array}{ll}\text{Sum} & 127.8\\ \text{Diff.} & 82.15\end{array}\right\}\text{its } \tfrac{1}{2}\left\{\begin{array}{l}63.9 = d = <\\ 41.7 = ba = >\end{array}\right\}\text{Segment:}$$

Then the Angles are found by Case 4*th* of Right Angled Triangles.

Proportion.

$$\text{In the } \triangle\, cab \left\{\begin{array}{l}cb : \text{Rad.} :: ab : S, \angle c\\ 50 : S, 90 :: 41.7 : S, 56.\ 30.\end{array}\right.$$

In

In the △ c a d $\begin{cases} cd : Rad. :: ad : S\angle c \\ 70 : S, 90 :: 639 : S, \angle 65°, 6'. \end{cases}$

From 90° 00'
Sub. 56 30.

Remainder = 33, 30 = ∠ b
From 90° 00'
Subftract 65 06.

Remainder = 24, 54 = ∠d.
To 56° 30'
Add 65 06.

Sum = 121. 36 = ∠ c in △ b c d.

Practical Trigonometry.

Wherein the Doctrine of Plane Triangles are applied to Practice.

IN this Section, I fhall treat only of fuch Practical parts thereof, as the Doctrine of Plane Right-lined Triangles becomes fubfervient to: As,

1. In ALTIMETRIA; By which the Height of any Object acceffible, or inacceffible, may be found; As of Trees, Steeples, Towers, *&c.*

2. In

2. In LONGIMETRIA: By which the Diſtance of one Obj ct from any place, or of many Objects one from another, whether approachable, or in-approachable may be known, their Poſitions laid down, and a Map made of them.

Of Altimetria.

Prob. 1. *Of an Altitude that is Acceſſible.*

Fig. 63. Let AB be a Tower, whoſe Height you would know. *Firſt*, At any convenient diſtance, as at C, place your Quadrant, or any other Inſtrument you make uſe of, and there obſerve the Angle ACB, which let be 58°, ſo much is your Angle of Altitude. Meaſure next the diſtance between your Inſtrument and the Foot of the Tower, *viz.* The Line CB which let be 25 Yards; then have you in a right Angled Triangle, one Angle C given, and one Leg CB to find the other AB; which you may do as you were taught in *Caſe* 1. of Trigonometry: For if you take 58 from 90, there remains 32 for the Angle at A. Then ſay,

As the Sine of the ∠ A 32	9.724210	
Is to the Log. of the Baſe CD 25	1.39740	Add the two together and from the Sum Subſtract the firſt.
So is the Sine of the ∠ C 58	9.928420	
	11.326360	

To

To the Log. Height of the Tower, AB, 40 Yards. } 1. 602150.

To this 40 Yards, you must add the heighth of your Instrument from the Ground. In this way of taking Heights, the Ground ought to be very Level, or you may make great mistakes: Also the Tower or Tree should stand Perpendicular.

Prob. 2. *Of an Altitude inaccessible.*

In the foregoing Figure, let A B be the Tower or Steeple, and suppose CB to be a Mote, or some other hindrance, that you cannot come nearer then C; plant your Instrument, and take the Angle A C B 58 deg. Then go backward any convenient distance, as to G, there also take the Angle AGB 38 deg. This done Substract 58 from 180, so have you 122 deg. the Angle ACG, then 122 and 38 being taken from 180, remains 20 for the Angle GAC, the distance GC measured is 26. Now by Trigonometry say,

As the Sine of the ∠ A 20	9. 534052
is the Log. of the distance GC26	1. 414972
So is the Sine of the Angle G 38	9. 789342
	11. 204314
to the Log. of the Line AC 47	1. 670269

Again,

Again, As Radius	10.000000
Is to the Log. of the Line AC 47	1.672098
So is the Sine of the Angle C 58	9.928420
To the Log. Height of the Tower 40 Yards.	11.600518

But as I told you before, the Ground muſt be Level. However, if it be not, I will ſhew you,

Prob. 3. *How to take the Height of a Tower, &c. when the Ground either riſes or falls.*

Fig. 64 AB is the Tower, CB the Hill whereon you are to take the Height of the Tower: Plant your Inſtrument in any place of the Hill, as at C, direct the Sights to A, and take the Angle A C d; which let be 19 d g 30 Minutes. Take alſo the Angle d C B, which is 45°, 30′; then meaſure the diſtance C B 56 Yards, take 19° 30′ there remains 70° 30′ for the Angle A, then ſay,

As Sine 70° 30′	9.974346
is to the diſtance CB 56 Yards	1.748188
So are both the Angles at C, *viz.* 60°.00′.	9.957276.
	1.7105464.
To the Height of the Tower 54 Yards.	1. 731118.

To

To take this at two Stations, without coming to the Foot of the Tower, is no more then what has been said before; for you take your Angles at C, and then measure to E, and there in the like manner as before, take your Angles again, thereby you may find all the Angles, and the Line AE, then say,

As the Sine of the Angle ABE
is to the Log. of the Liue EA,
So is the Sine of the Angle AEB
To the Log. of the Height of the Tower, AB.

Prob. 4. *How to take the Horizontal-Line of a Hill.*

Fig. 65. Suppose KLMN an Hill, whose Base you would know. Plant your Instrument at K, and cause a mark to be set up at L, so high above the top of the Hill, as the Instrument stands from the Ground at K, and take the Argle LKN 58 deg. Measure the distance KL 16 Chains, 80 Links. Then say,

As Radius	10.000000.
is to the Line KL 16 Chains 80 Lin.	3.225309
So is the Sine Complement of K. 58.	9.724210.
to part of the Base KN 8 Cha. 90 Lin.	12.949519

But if you have occaſion to meaſure the whole Hill, plant again your Inſtrument at L, *(or M,)* and take your Angle NLM, which let be 46 deg. Meaſure alſo the diſtance L M 21 Chains: Then ſay,

As Radius	10000000
Is to the Line LM 21 Chains	1322219
So is the Sine of the Angle MLN 46°.	9856934
To the part of the Baſe NM 15 Chains 12 Lin.	11.179153.

Which 15 Chains 12 Lin. added to 8 Chains 90 Lin. makes 24 Chains, 2 Lin. for the whole Baſe KM.

I mentioned this way, for to make you underſtand how to take part of a Hill; for many times your Survey may end on the Side of a Hill.

But if you find you are to take in the whole Hill, you need not take ſo much pains as the former way. But thus: Take, as before, the Angle K 58 deg. Meaſure KL. Then at L take the Angle KLM 78 deg. Subſtract thoſe 2 from 180 deg. Remains 44 for the Angle at M, Then ſay,

As the Sine of the Angle M.
is to the Log. of the Side KL;
So is the Sine of the Angle at L
to the Log. of the Baſe KM.

Prob 5.

Prob. 5. *How to take the Altitude of an Object standing upon a Hill, inaccessible.*

Fig. 66. Suppose N O to be the Object, and you standing at P were required to find the heighth thereof.

First, upon Paper draw a right Line at pleasure, as QT, and make choice of any Point at pleasure, as at P, for the place of your standing; then with a Quadrant directed to the Top of the Object, you find the Degrees cut to be 40°. 52′, and then direct the Sights to the Bottom of the Object at O, and let the Degreees cut be 22°. 25′.

Then upon P, protract an ∠ of 40° 52′ and draw the Line P w at pleasure: And an ∠ of 22°. 25′, and draw the Line P c at pleasure.

Secondly, go forwards in a right Line towards the Object as at R, 212 5 feet; and there direct your Sights to the top of the Object at N, and you will find the degrees cut to be 61°. 82′, through which draw a line at pleasure, as R S, crossing the line P w in the point M, the top of the Object: From whence a Perpendicular let fall upon the Ground-line P T, as NK; that Line shall be equal to the Altitude and of the Hill, and the Object together, (*and direct the Sights to O, and draw the Line R t, cutting the Line Pc in the point O.*)

Now by the Interſections of theſe four Lines, Pw, Rs, Pc, Rr, there is conſtituted four Triangles, *viz.* PNK, and RNK, both Right Angled at K, and PNR, and RNO Oblique angled: By the reſolving of which from the diſtance meaſured PR, and the ſeveral Angles obſerved, at R and P, you may find the required Altitude.

I. In the Oblique-angled Triangle PNR, there is given, the Angle NPR 40° 52′, and the Angle NRP 118° 28′; for it is the Complement of the Angle NRK 61° 82′ to 180°. And the Side meaſured PR, 212.5 Foot, And having the Angles at R and P, the Sum of them is 159°. 10′, which take from 180, there will remain 20° 50′, for the Angle PNR. From which Triangle given, the two other Sides PN, and NR may be found by Axiom 2. thus,

As Sine of the ∠ PNR 20° 50.
Is to the Side RP Log. 272 5
So is the Sine of NPR 40° 52
To the Side NR 380

And ſo is the Sine of the Complement of 61°.82′ = 118° 28′ (*or the* ∠ *NRP,*) To the Side PN, 515. 66.

In the Right Angled. Triangle RNK there is given, (1) The Hypothenuſe RN = 280 Foot (2) The Angle NRK 61°. 32 d. Whereby you may find NK, by Caſe 1, of Right Angle plain Triangles; thus:

A

As Radius; Sine 90 *d.*
Is to the Hypothenuse NR 380.
So is the Sine of the Angle NRK 61. 32.
To the Sine of NK 335.

Equal to the Height of the Object and the Hill together.

And so is the Cosine of NRK, *viz.* RNK 28, 28. To the Logar side RK, 179. 4 Foot.

To which, if you add the measured distance PR 212. their Sum will be 391.9, for the whole length PK. Then,

In the Triangle POK, you have given, PK 391.9 Foot, and the ∠ OPK 22 d. 25. by which you may find OK, by Case 1*st*, of Trigonometry BR, L, T. Thus,

As Radius, Tang. 45 *d.*
Is to the Side PK 391.9
So is the Tangent of the ∠ OPK 22 d. 25'.
To the Height of the Hill OK 160.19 Foot.

Which subtracted from 335. the whole Height, there remains 174.81 Foot for the Altitude of the Object NO.

Of Longimetria.

Prob. 1. How (*standing upon an Object of a known Height*,) to find the distance from thence, to some other remote Object.

Fig. 66. Suppose CA to be the side of a Fort or Bulwark 22. 5 Foot high, and being upon the Platform at C, you see a

Tree, or other Object at B, whose distance you would know from the Foot of the Wall at A.

The Lines AB and AC being drawn, and the heighth of the Wall 22. 5 Foot, set from A to C, where by your Instrument directed to B, you find the Degrees cut to be 7'1°. 25', which Angle lay down; so have you the Right-angled Triangle CAB, in which there is given, (1.) CA, the heighth of the Wall 22. 5 Foot (2.) the Angle observed at C, 77°: 25' Deg. by which you may find the distance AB (*by Case 2. of Right Angled plane Triangles.*) thus,

As Radius, Tangent 45 Deg.

To C A, the heighth of the Wall 22. 5 Foot.

So is the Tangent of ACB, the Angle observed, 71.25 Deg.

To the distance AB, 66. 28 Foot.

And if you would find the Length of the Line CB, you may (*by Case 3 of Right Angle Triangle*) thus,

As the Sine of the Angle observed at C 71°.25' Deg.

Is to the distance BA, 66. 28 Foot.

So is the Radius, Sine 90 Deg.

To the Line CB, 69. 98 Foot.

Fig. 68. Is Supposed to be a piece of a River, and you measuring along one side of it, would as well know the Breadth of it, as also make a true Plot thereof, of, putting down what remarkable things are seen on the other side.

Being at ⊙ 1. the first Station, cause one of your Assistants to go to the next bend of the River, as ⊙ 2. and there set up a mark for you; then see what Angle from the Meridian ⊙ 1. ⊙ 2 makes, which let be N. W. 6 deg. also seeing several marks on the other side of the River, take their bearings, as the House A which stands upon the Bank, and is a Mark for the Breadth of the River bears N.W. 52 degrees, the Wind-mill B up in the Land, bears N W. 40 deg the Tree C by the Water-side, bears N. W 17 deg. all this note down in your Field Book, and measure the distance from ⊙ 1 to ⊙ 2, 18 Chains, 20 Links. After this coming to ⊙ 2, see how the next bend of the River bears from you, *viz.* ⊙ 3; which let be N. E. 15 deg. See also how the House A there bears from you, *viz.* S. W. 20 deg. the Wind-Mill S. W. 50 deg the Tree, N. W. 77°. Also as you are going forward if you see any thing more at this second Station, take the Bearing thereof, as a noted Castle D upon the Land, bears N W. 28°, as a Church E close by the River Brink N.W, 4°. measure the distance from ⊙ 2, to ⊙ 3. And placing your Instrument at ⊙ 3, the Church bears from you N W. 88 deg. the Castle up in the Land at D you cannot see for the Church, therefore let it alone for the next Station. But here you may see forward a little Village F, the first House thereof bears from you NW 32 deg. Measure the distance from ⊙ 3 to ⊙ 4, and Planting your Instrument in ⊙ 4, the first House of the Village F bears from you South-West 32 *d.* and the Castle D, which you could not see at the third Station, S W. 24. Having put down all this in your Field-Book, it will be as follows,

Observations 1.

⊙ 1. N. W. 6°. 18 Chains 21 Links

A Tree upon the Bank of the River bears — N. W. 17. 00

A Wind-Mill upon the Land — N. W. 40 00

A House on the River Bank — N. W. 52 00

⊙ 2 N. E, 15°. 18 Chains 20 Links.

The Tree N. W. 77° 00
The House S. W. 20 00
The Wind-Mill S. W. 50 00
These look to Observation to ⊙ 1.

A Castle far up in the Land N.W. 28 . 00
A Church upon the River Bank N.W. 4 00
Forward Observation

⊙ 3 N.W. 15° 20 Ch. 50 Lin.
The Church Bears N. W. 88°
The Castle cannot be seen
These look backward to Obs. ⊙ 2.

The end of the little Village N. W. 32.
A forward Obs.

⊙ 4. ————

The end of the little Village S W 32°,
The Castle respecting ⊙ 3 SW. 2. in the Land. S. 24.
These respect ⊙ 3, and ⊙ 2.

To

To protract this, draw the Line N.S for a Meridian, and laying your Protractor upon it, the Center thereof to ⊖ 1; against N.W. 6° make a Mark for the Line that goes to ⊖ 2. Also against N.W. 17° make a Mark for the Tree, and against 40° and 52° for the Wind-Mill and House. Then from ⊖ 1, through these marks draw the Lines ⊖ A, ⊖B, ⊖C, ⊖2. *Secondly*, Take from your Scale 18 Chains and 20 Lin. and set it off upon the Line ⊖2, which will reach to ⊖2. There lay again the Center of your Protractor; the Diameter thereof Parallel to the Line N S, and make marks as you see in the Field-Book, against N E 15°, N W 77° SW 20°, SW 50°, NW 28°, NW 4°, and through these marks draw Lines, the first Line directs to your third Station; the second Line N W 77° directs you to the Tree C upon the River Bank, for that Line cutting the Line ⊖ 1 C, shews you by the Intersection where the Tree stood, and also the Breadth of the River. Also the Line S W 20° cuts the Line from the first Station NW 52°, in the place where House A stood upon the Bank of the River. If therefore you draw a Line from A to C it will represent the farther Bank of the River. And so you may proceed on Plotting, according to the Notes in your Field-Book; and you will not only have a true Plot of the River, but also know how far the Wind-

Mill B, and the Castle D stand from the Water-side. For if you take the distance betwixt any two of the places, with your Compasses, and try it upon the same Scale that you laid down your Stationary distances, gives you the distance required:

Prob. 2. To find the distance between any two Places, both removed from the Observer.

Fig. 69. Let the two places be B and D, and let their distances be required by an Observer standing at C,

1. Let the Angle BCG be taken, between one of the Places, as B, and any visible mark; suppose G standing about the the middle of the distance, and likewise let the Angle GCD be taken.

2. Then leaving a visible mark at C, let the Observer go backwards into another Station as at H, in such manner, as that he being at H might see the mark C and G, in a right Line; and let him measure the distance between the two Stations C and H.

3. At H let him take the Angle BHG, and GHD, as he did before at C: This being done in the Triangle HBC, because the outward Angle BCG is equal to both the inward and opposite Angles BHC and HBC, therefore by Substracting BHC out of BCG, there will remain the Angle HBC. Thus all the Angles in the Triangle HBC, and the

the side HC being given either of the other two sides are found by the third Case of Plane Triangles.

Again, in the Triangle HDC, the Angle HDC, and either of the sides CD or HD may be found in the same manner.

Lastly, In the Triangle BCD, the two Sides BC and DC being found *(as is already taught)* and the Angle BCD, by Observation, the other two Angles CBD and CDB, may be found by the fourth Case of Plane Triangles, and consequently the Side BD by the third Case of Plane Triangles, which is the distance required.

Of Levelling, or Measuring the Inequallity of Places, as to their Heights.

Fig. 70. TO find out the difference of heights of one place from another, in the rising and falling, which is of constant use in conveying of Water, either above the Ground for Fountains, *&c.* or under the Ground for Adyts or Soughs, *&c.* Let your Instrument be carefully made, whether it be a Quadrant, Water-level, or any other; the best I Account to be a brass T, the sights upon the top of the T, to be Perspective Glasses, which must be tried before used, and the Glasses are to stand always one way, this will endure longer Stations than

ı ordinary, and is for many reasons the
t, it substantially made, and there must
two mark Boards placed upon quarter
es, that your Assistants may lift them
her or lower, as they shall be directed.
Then set the Level as near as you can be-
xt the 2 Marks which your Assistants
d upright in their Hands, with the slip-
g Marks; turning to one, cause him to
d or set the slit and Black stroke even
ı the Level sights, and so the other.
difference of these sights, in Inches and
ı parts gives the Ascent or Descent,
his is for one simple Station; but if it
res both Ascents and Descents, then in a
set down your Bark Stations in one
nn and you fore Stations in another,
ıp both the Columns, and take the dif-
e of them; if they be equal, the two
are Level, if your fore Station exceed, the
nce is lower, if otherwise, higher. An
ıle will clear all. I am to give the
ıce of heights of the places A and B,
ıe Line of the Level S B, chusing my
ation at C, where I plant my Instru-
betwit, the Quater Pikes A and F,
ing my Level firm, the Assistants
ıp and down the mark Boards till
ys the sights take the Black strokes
ıd E; in a little Table made, set
e heights of those stroakes from the
in two Columns, one for the left
Hand,

Hand, the other for the Right, as you see in the Table adjoining, wherein AD (*for the left hand*) is found to be four Feet three Inches $\frac{2}{10}$ of an Inch, and EF (*for the right Hand*) seven Feet, 1. 5.

Again, Let the Second Station be at G, and the left Hand height FH be ten Feet, three Inches and a half, and the Right-hand height I K three Feet, 3.7 Inches. Again, The third Station let be at M, and the Height IL 2 feet, 9,4 Inches, and ON 12 feet, 1. 5. Inches. *Lastly*, Let the fourth Station be at P, and the height OQ three Feet 10, 9 Inches, and BR 11 Feet 9, 8Inches. The Sum of the heights on the Left-hand is 212 Feet and three Inches, that of those on the Right 34 Feet and 4, 5, Inches; their difference is 13 Feet and 1, 5 Inches and so much is B lower then A.

Stations.	Heights on the Left-hand.		Heights on the Right hand.	
	Feet.	In.	Feet.	Inches.
1	4	3. 2	7	1. 5
2	10	3. 5	3	3 7
3	2	9. 4	12	1. 8
4	2	10. 9	11	9. 5
	21	3. 0	34	4. 5

Sum of the Hights on the Right-hand 34. 4 5
Snm of the Heights on the Left-hand 21. 3

Their Differ. 13, 1 5
And so much is B lower then A.

The

The Use of the Line of Proportion, or Numbers commonly called Gunter's Line.

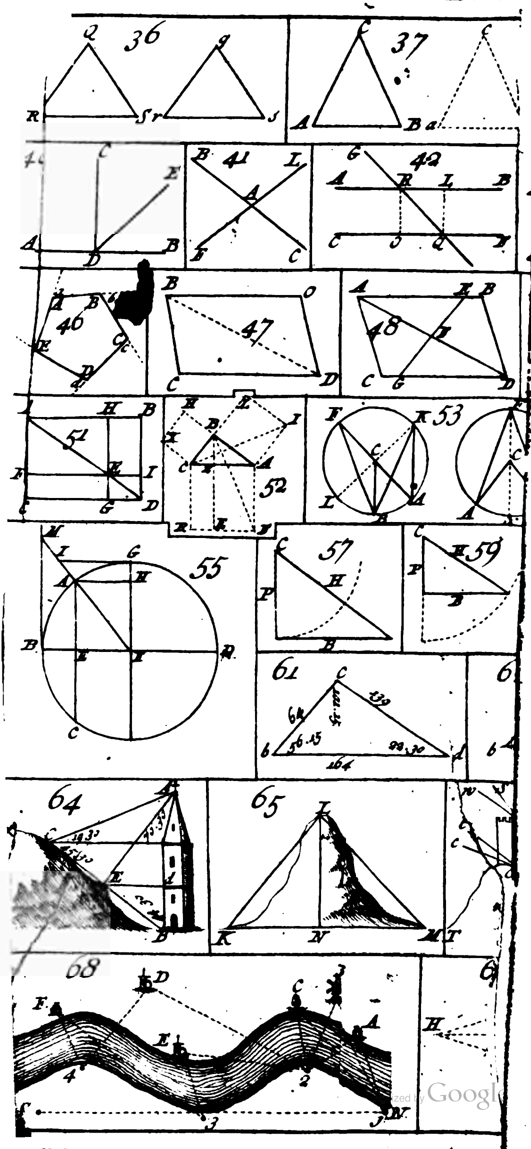
THE Ingenious Mr *Gunter* and several others have sufficiently handled this Subject, therefore I might have saved my self that trouble; but because it will be expected here, and the Book more useful, I shall say somthing to that purpose, and begin first with,

Numeration upon the Line.

Numeration by the Line may be understood from this one Thought, *viz.* That what Denomination soever the first at the beginning of the Line is, that in the middle will be ten times, and that at the end will be an hundred times so many: Which if understood, it will not be difficult to know what the intermediate Figures and parts are.

Example I.

To find the place of 25, you may call the 1 at the beginning of the Line, but 1, then will that in the middle be 10, and the two which stands upon the 2*d* Radius,


36
37
41
42
46
47
48
51
52
53
55
57
59
61
64
65
68

dius, will be 20; then count five of the grand Divisions, where stop, for that is the place which represents 25. Where note, that if you had esteem'd the 1 at the beginning of the Line but 1, that is, one tenth, the place which now represents 25, would signify but 2. 5: Also if you had esteem'd it as 10, then would the place of 25, be 250; if 100, then 2500, if but 01 then but 025, *&c.*

Example II.

To find upon the Line the the place of 3652. First, esteem the 1 at the beginning of the Line to be 100, then will that in the middle be 1000, and the three towards the middle 3000; from which count six of the Grand-divisions and a half *towards* (4000) and then you will come to the place of 3650. Now you must imagine the 2 to be a little beyond that half Division; for in this and the like examples, where we are to find 4 places, that which is Unites must be taken by estimation. So have you the place 3652.

Note, By these Examples last medtioned, you may perceive that the Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, do sometimes signify themselves alone, sometimes 10, 20, 30, *&c.* Sometimes 100, 200, 300, *&c.* As the work perform'd thereby shall require: The

first

first Figure of every Number is always that which is here ſet down, and the reſt of the Figures are to be ſupplied according as the queſtion ſhall require. And by the variation and change of the power of theſe Numbers from 1, to 10, or 100, or 1000, any Proportion, may be wrought by this,

General Rule.

Always extend the Compaſſes from the firſt Number to the ſecond, and that diſtance, or extent, applied the ſame way upon the Line, ſhall reach from the third to the fourth Number required.

Or otherwiſe, extend the Compaſſes from the firſt Number to the third, and that extent applied the ſame way, ſhall alſo reach from the ſecond to the fourth. Either of theſe ways will effect the ſame thing, as by Examples following ſhall be made appear. And it is neceſſary thus to vary the Proportion, ſo as to avoid the opening of the Compaſſes two wide.

Multiplication by the Line.

This Rule whether it be perform'd Arithmetically or Inſtrumentally, depends upon *Euclids Elem*, *Prop.* 1. *lib.* 2. where it is demonſtrated, that if two Lines be propos'd pos'd, whereof one is divided into diverſe parts, the Rectangle contained under thoſe two Lines is equal to the Rectangles contained under the Line which is divided, and the parts of the Line divided.

The proportion is, as one is the Multiplyer: So is the Multiplicand to the Product.

Example I.

Let it be required to multiply 8 by 7 the Proportion is, as 1: is to 8:: ſo is 7: to 56. Therefore extend the Compaſſes from 1 to 8; the ſame extent will reach from 7 to 56, which is the product.

Example II.

Let it be required to Multiply 37, by 5 The proportion is; As 1 : to 5:: ſo is 37 : to 185.

Set one Foot of the Compaſſes in 1, and extend the other Foot to 5; that ſame extent will reach from 37 to 185, which is the product or 37, being Multiplied by 5. Otherwiſe, ſet one Foot in 1 and extend the other to 37; the ſame extent will reach from 5 to 185

Example

Example III.

Let it be required to multiply 8. 75 by 3. 6. The Analogy or Proportion is, as 1. to 3. 6 :: So is 8. 75, to 31.5. Set one Foot in 1, and extend the other to 3. 6; the same extent applied forward upon the Line will reach from 8. 75 to 31. 5.

Division by the Line.

In Division, the Quotient contains Unity as often as the Dividend does the Divisor: It follows then from the 5th Definition to the 5th Book of *Euclids* Elements, that the Quotient is in Proportion to 1, as the Dividend is to the Divisor. From whence we may deduce the Proportion following, *viz.* As the Divisor is to Unity, so is the Dividend to the Quotient.

Example I.

Let it be required to divide 40 by 8. The proportion is, As 8 : to 1 :: 40 : 5. Set one Foot of the Compasses in 8, and extend the other Foot to 1; that same extent will reach from 40 downwards to 5, which is the Quotient.

Otherwise extend the Compasses from 8 to 40; the same extent will reach from 1, to 5.

Example

Example II.

Let it be required to divide 336 by 12. The Proportion is As 12 : 1 :: 336 : 28. Extend the Compaſſes from 12 to 336; the ſame extent will reach from 1 to 28; which is the Quotent required.

You'l know how many Figures ſhould be in the Quotient, by ſetting the Diviſor orderly under the Dividend, *&c.*

The Rule of three by the Line.

The Rule of three by the Line muſt be performed by the laſt General Rule.

Example I.

If 26 Acres of Land be worth 64 *l.* a Year; what is 36 Acres of the ſame Land worth by the Year. Proportion as 26 : 64 :: So 36 : to 88. 615.

Extend the Compaſſes from 26 to 64, the ſame extent will reach from 36 to 88, 61 which is 88 *l.* 12 *s.* 3*d.* 2 *q.* for the Anſwer of the Queſtion.

To extract the Square Root by the Line.

Divide the ſpace between Unity and the given Number into two equal parts: Where

Where that Division falls, is the Square Root sought.

Evample II.

To find the Square Root of 36. Extend the Compasses from 1 to 36, the Middle way upon the Line between these two Numbers is 6, which is the Square Root of 36. In like manner you may find the Square Root of any other Number.

Of Measureing.

A clearer Idea of which you cannot have than that given by the Ingenious Mr *Cunn*, in his excellent Treatise of Fractions compleated, which is as follows.

Every Magnitude is measur'd by some Magnitude of the same kind, a Line by a lineal Foot, Yard, *&c.* a Superficies by a square Foot Yard, *&c.* a Solid by a Cubick Foot, Yard, *&c.*

The Lineal Measure is known to all.

The superficial Measure may be conceived, by imagining a Floor pav'd with Tiles, each a Square Foot; for then the Number of Tiles is equal to the Number of square Feet in that Flooring. Now if the Flooring be just one Foot broad, the Number

ber of Tiles (*or of Square Feet*) will be equal to the Number of Lineal Feet in the Length of the Floor; but if the Flooring be 2, 3, 4, 5, *&c.* Feet broad, the Number of Tiles, or of Square Feet, will be twice thrice, four times, five times, *&c.* so many Tiles (*or Square Feet.*) So if the Floor were 11 Foot long and 7 Foot broad, 7 times 11 Tiles (*or Square Feet*) gives 77, the Number of Tiles or Square Feet in that Flooring.

The solid Measure may be conceived by imagining a Wall built with Stones, each a Cubick Foot; then the Number of Stones will be equal to th: Number of Cubick Feet in that Wall. First therefore, if the Wall be one Foot thick and one Feet high, the Number of Stones (*or Cubick Feet*) will be equal to the Number of Lineal Feet in the length of that Wall. *Secondly*, If the Wall should be of the same length and heighth one Foot as bef re, but the thickness 2, 3, 4, 5, *&c.* Feet (*instead of one Foot*); then the Number of Stones (*or Cubick Feet*) will cccrdinglyhe twice,thrice,four times five times *&c.* and as many as before. *Lastly*, If the length and thickness be the same as in the last supposition, but the height (*instead of one Foot*) be 2, 3, 4, 5 Feet; the Number of Stones (*or Cubick Feet*) will be accordingly twice, thrice, four times five times, *&c.* what it was in the foregoing. So if a Wall

Wall is seven Foot long, three Foot thick, and one Foot high: From what has been said, a Wall of seven Foot long, one Foot thick and one Foot high consists of seven Cubick Feet; but a Wall of seven Foot long, three Foot thick, and one Foot high, consists of three times seven Cubick Feet, that is, 21 Cubick Feet. *Lastly*, A Wall of seven Feet long and three Foot thick as before, but five Foot high, contains five times as many, that is five times 21 Cubick Feet, or 105 Cubick Feet.

From all which is evident, that in casting up any Mensuration, the Multiplier in any of the Multiplications is an Abstract number as well as in all other Multiplications whatsoever, which may prevent the false Consequences usually drawn from multiplying Feet by Feet, *viz.* That of multiplying by a contract number, as 3*l.* 19*s.* 0*d*: by 3l:19 s: or Half a Crown by half a Crown; which is contrary to the Nature of Multiplication, whose Operations are only compendious additions, either of the Multiplicand or some part of it, continually to its self or its part.

Of Tyling.

Suppose a Roof in length 120 Foot on both Sides, and the depth of one Side 18 Foot; these two numbers multiplied together produce 2160 Foot, which is 21 Squares, and

60 Foot, that is, 10 Foot above half a Square more, it being meaſur'd by the Square of 10 Foot every way, ſo that 100 Square Foot is one Square.

Prob. 1. *To meaſure a Geometrical, or true Square.*

Multiply the length by the Breadth, and the product is the Area thereof.

Example I.

Fig. 71. Admit KLMN, whoſe ſides is 3, which Multiplied by 3, being both the Length and Breadth, produce 9 for the Area; as may be ſeen by the Scheme

Prob. 2. *To Meaſure a long Square or Parallelogram.*

Multiply the length by the breadth, the product is the Area.

Prob. 3. *To meaſure a Rhombus.*

Is is demonſtrated (*by the 9th Theorem*) that Parallelograms having the ſame Baſe, and being between the ſame Parallels are equal, *i.e.* that the Parallelogram ABDF is equal to the Rhombus a b BF; therefore if you multi-

ply

ply BF one of the sides by DF or a k the Perpendicular, the Product will be the Area thereof.

Example I.

Let a b BF be a Rhombus, whose side BF is 40 Inches, and let the nearest distance of any two opposite sides, which is the Perpendicular, as a k = AB be 34 inches, I demand the Area.

Multiply BF = 40
by DF = 34

Answer. 1360.

Prob. 4. *To Measure a Triangle.*

The Parallelogram BACE is double to △ ADE (*by Corrol. to Theorem* 10). Therefore Multiply the Base AE by half the Perpendicular DF, and the Product is the Area of the Triangle ADE.

Example I.

Let ADE be a Triangle whose Base AE = 20, and the Perpendicular DF = B, 9 what is the Area.

Answer, 80.

Prob. 5.

Problem 5.

To measure a Triangle, the three Sides being given, without finding the Perpendicular.

RULE.

Add together all the three Sides, and from $\frac{1}{2}$ their Sum subtract every side, which call the three Differences; Multiply these three differences, and the $\frac{1}{2}$ Sum continually together, the Square Root of this last product is the Area thereof.

Prob. 6. To Measure a Trapezium.

RULE.

Having divided the Trapezium into Triangles as the Figure following, add the two Perpendiculars, *viz.* AB and CD together, and multiply that Sum by $\frac{1}{2}$ the Base LK, and the Rectangle or Product is the Area.

Example.

Fig. 74. Let ALDK be a Trapezium, let the common Base KL be 100 Inches, the Perpendicular AB 40, and CD = 14, I demand the Area.

Operation.

AB = 40
CD = 14

Sum 54.
$\frac{1}{2}$ K L = 50

2700 Answer.

Prob. 7. *To Measure any Regular Polygon.*

Fig. 75. Multiply the Sum of all the sides by $\frac{1}{2}$ the distance of any side from the Center; and the product is the Area, for they may be divided in as many Triangles as they have sides; and those all equal to one another.

Example.

Let ABCDEF be a Hexagon, any of whose sides is 10 Inches, and the nearest distance from the Center to the middle of any side is 9. 4 Inches; what's the Area.

Operation.

10
6

Multiply the Sum of the sides = 60
by Half the Perpendicular = 4. 7
4.20
2.40

282. 0. Area.

Prob. 7

Prob. 8. *To Measure a Circle several ways.*

Every Circle is equal to that Oblong, or long Square, whose Length is equal to $\frac{1}{2}$ the Circumference and Breadth equal to its Semi Diameter. For a Circle is a regular Polygon, having an infinite number of sides, and therefore the Semi Diameter is always Perpendicular to one of its sides. Wherefore multiply $\frac{1}{2}$ the Circumference by its Semi-Diameter, and the Product is the Area thereof

Prob. 9. *To find the Circumference of a Circle.*

Every Circumference is more than Triple the Diameter; but the nearest rational Number, between the Diameter and the Circumference is, as 7 to 22. Therefore if you multiply the Diameter by 22, and divide the Product by 7, the Quotient will shew you the Circumference.

Note. Every Circle is equal to a Rectangle Triangle, one of whose Legs is the Radius, and the other Right-line equal to the Circumference of the Circle.

Therefore if you multiply the Diameter by $\frac{1}{4}$ part of the Circumference, the product is the Area.

Otherwise square the Diameter, and multiply that by 11, and divide that product by 14, the Quotient is the Area.

Prob. 10. *To find the length of an Arch-Line of a Circle Geometrically.*

Fig. 76. Let ABCD be the Arch-Line given, whose Length is required. *First*, Draw the Chord-line AD, which always divide into 4 equal parts, then take one of those parts, and set it from D to C upon the Arch-Line: This done, draw a Line from the point C, to the first Division, which let be IC; this line is $\frac{1}{2}$ the Arch Line AB CD, which doubled shall be the length of the Arch-line required.

Prob. 11. *To find the Length of an Arch-line, greater than a Semi-Circle.*

Fig. 77. *First*, Divide the said Arch into two equal parts, as DK; then divide the Chord-line AD, into four equal parts; then as before draw the Line OP, which Line being taken four times, is equal to the Arch-line ADF.

Prob. 12. *To Measure the Portion of a Circle.*

Fig. 78. Every Portion of a Circle, which contained under two Semi-Diameters, and

and one Arch-line is equal to that long Square, whose Length and Breadth is equal to the Semi-Diameter, and $\frac{1}{2}$ of the Arch-Line.

To find the Center of that Circle whereof the Arch-line ABC is a part of the Perifery.

RULE.

Multiply $\frac{1}{2}$ the Chord Line, *viz.* A B by itself, then divide that product by the Versed Sine B K; then if you add the Versed Sine to the Quotient, the Sum will be the Diameter of the Circle belonging to the Segment ACK; and half thereof will be the Semi-Diameter AD.

Example.

Let ABC be a Segment of a Circle to be measured: Now it is not at the first included with two Semi-Diameters; you must therefore find the Center D, whereof the Segment ABC, is a part of the Perifery by the last Problem; then draw the two Semi Diameters AD and CD; so shall you include the Triangle ACD, more than the Segment ABC. Now first measure the whole Figure ABCD by the last Problem; then measure the Triangle ACD, and from the Content of the whole Sector ABCD, subſtract the Content of the Triangle ACD, and the Remainder is the Area of the Segment A B C.

The Operation.

Take ½ 16 the Arch Line ABC 8 the Semi-diameter.		The Perpendicu. ED	5.6
8 ½ of the Arch.		The Baſe AC	13
			168
64 Area of the Sector			56
Sub. 36.4 Area of the Triang.		Take ½	72.8
Rem. 27.6 The Area of the Segment A B C.		The Area of the Triangle A C D.	36.4

You may meaſure the Segment ABC, by multiplying BE by ⅔ of AC, and it will do well enough for common Practice.

Prob. 13. *To Meaſure an Elipſis, or Oval.*

R U L E.

Multiply the longeſt Diameter by the ſhorteſt, that product by 11, and then divide the whole product by 14, which is the Area required.

Prob. 14

Prob. 14. *To Measure the Superficial content of a Sphere or Globe.*

RULE.

Fig. 79. Multiply the Diameter by the Circumference, the product is the Superficial Content of the Globe or Sphere.

Example.

Let A be a Globe, or Sphere, whose superficial Content, or Area of the surface is required: I multiply the Circumference (*which is gained by Problem* 9.) 44 by the Diameter 14, the product is 616, the superficial Content of the Sphere required.

Prob. 15. *To Measure the Superficies of a Cone.*

RULE.

Multiply the slant heighth by $\frac{1}{2}$ the Circumference at the Base, the product is the Conical Surface; to which if you add the Area of the Circle at the Base, you shall have the whole Superficial Content.

Prob. 16. *To Measure the Superficies of the Frustrum of a Cone.*

R U L E

Add the greater and lesser Circumference of the Bases together, $\frac{1}{2}$ the Sum of which Multiplied by its heighth, produces the superficial Content of the Frustrum.

Example.

Fig. 80. Let BCDE be the Frustrum or part of a Cone, the Superficial Content thereof is required, the Circumference of the greater and lesser Base being 6 and 3, which added is 9, the $\frac{1}{2}$ is 4.5, which 4.5 multiplied by 12, the heighth BD, the product is 54 for the superficial Content of the Frustrum BCDE.

Note, The Superficial Content of a Cylender, is found by multiplying the Girt by the heighth.

Another Way,

First find the length of the whole Cone ADE, whereof the Frustrum BCDE is a part; then having the whole heighth of the Cone, measure the Superficies by the 15*th*, *Prob.* then measure the Superficies of the top part, or lesser Cone, by the same Problem, and sub-

Subſtract the Content of the leſſer Cone from the Content of the greater; and the Remainder ſhall be the Content of the Fruſtrum.

PROBLEM XVII.

The Fruſtrum BCDE given to find AD the ſide of the Cone belonging to it.

RULE.

Multiply DE by BD, and divide the product by DE — BC, the Quotient is AD ſought.

Example.

Multiply DE = 6
by BD = 12

which divide 72
by DE — BC = 3
the Quotient is AD = 24.

PROBLEM XVIII.

To find the Superficial Content of the Segment of a Sphere.

 RULE.

R U L E.

Multiply the Heighth by the Circumference of the Sphere, to which product add the Area of its Circular Base, and that Sum is the Area fought.

Prob. 19. *To Measure a Cube.*

R U L E.

Cube the Side: That is, multiply the side of the Cube by it self, and that product again by the side of the Cube, which Cube number is the Solid Content thereof.

Example.

Fig. 81. Let ABCDEFG represent a Cube; whose Side let be 30 Inches; I demand the Content.

Operation.

Multiply one Side =	30
by it self =	30
which product multiply	900
again by	30
it produces	27000, Content

By the

By the Line of Numbers.

Extend the Compasses, from 1, to 30, the same extent will reach from 30 to 900, and from thence to 27000, the Content.

Prob. 20. *To Measure a Parallelopipedon.*

RULE.

Multiply the Length by the Breadth, and the product by the Depth; which gives you the Solid Content.

Example.

Fig. 82. Let ABCDEFG, represent a Parallelopipedon; whose length AB is 40 Inches, the breadth BC = 30 Inches, and Depth CD = 15; what's the Content.

Length = 40
Breadth = 30

1200
Depth 15

6000
1200

18000 = Content.

Prob. 21.

Prob. 21. *To Measure a Globe or Sphere.*

To find the Solid Content, there are several ways. As first multiply the Cube of the Diameter by 11, and divide the product by 21, the Quotient is the Solid Content.

2. Or multiply the Diameter, by $\frac{1}{6}$ part of the Globes Superficies, the product is the Solid Content: Or one sixth part of the Diameter multiplyed by the Spheres Superficies gives the same.

3. Otherways, Multiply the Area of the Circle, whose Diameter is equal to the Globes Diameter by $\frac{2}{3}$ of the Diameter, the product is the Solid Content: Or, Multiply the Diameter by $\frac{2}{3}$ of the Circles Area, produces the same.

Prob. 22. *To find the Solid Content of a Cone.*

RULE.

By 9 *Prob.* foregoing, find out the Area of its Base, and multiply that by $\frac{1}{3}$ of its heighth, and that product is the Solid Content of the Cone required.

Example.

There is a Cone, the Circumference of whose Base is 22. 5; and its heighth is 16. I demand

I demand the Solid content of such a Cone.

As 22.

Is to 7.

So is 22. 5 the Circumference of the Base.

To 7. 16 the Diameter of the Base.

Then multiply $\frac{1}{2}$ 22. 5, which is 11. 25, by $\frac{1}{2}$ 7. 162which is 3. 58, and it produceth 40. 286, which is the Superficial Content of the Base. Again, multiply 40. 286, by 5. 333, which is $\frac{1}{3}$ of the Heighth of the Cone, and it produceth 214. 846571 the Solid Content.

But here you are to observe that the slanting side of the Cone is not to be taken for its true height, but a Perpendicular let fall from its Vertex, to its Base is its true heighth; and the same is to be observ'd in the Pyramid.

Prob. 23. *To find the Solid Content of a Pyramid.*

Between the Cone and Pyramid, this is the Difference. As the Cone hath a Circular Base, the Pyramid hath a right-lined Figure for its Base, so that its Base and Superficies are Angular, its Vertex terminating in a Point.

End.

RULE.

First, find the Superficial Content of the Base: Then multiply that by $\frac{1}{3}$ of the Heighth; and it produceth the Solid Content of the Pyramid.

Prob. 24. *To Measure the Frustrum of a Pyramid or Cone.*

Fig. 83. The Frustrum here given to be measured is ABCD, the side of the greater Base A, being 24 Inches, and the side of the lesser Base at B, 8 Inches, and the length of it I M 20 Feet = BO = CK 20 Foot.

It is evident that if I find the Solidity of the whole Pyramid AED, and also the Solidity of the lesser Pyramid BEC, and then substract the Content of BEC, from the Content of A E D, there will remain the Solidity of the Frustrum ABCD; and certainly this way of measuring the Frustrum of a Pyramid or Cone, is the most exact of any; and it may be easily measured thus: First of all find out the heighth of the whole Pyramid EM, which you may do by the following proportion, *viz.*

As the Semi-difference of the Bases,
Is to the heighth of the Frustrum,
So is $\frac{1}{2}$ the greater Base,
To the heighth of the whole Pyramid.

Which

Which proportion will hold good in Cones as well as Pyramids.

Let AD be the Diameter of the greater Base, and BC the Diameter of the lesser Base; from B, and C, let fall the Perpendiculars BO and CK, then shall OK be equal to BC, and the Sum of AO and KD are the difference of the Diameters of the Bases AD and BC; and consequently AO the Semi difference, and BO the heighth of the Frstrum, and AM is $\frac{1}{2}$ the side of the greater Base, and EM is the heighth of the whole Pyramid. Then,

As AO the Semi-difference of the Diameters,
Is to BO the heighth of the Frustrum;
So is AM ($\frac{1}{2}$ *the great Diameter*,
To EM the heighth of the whole Pyramid.

So the heighth of the whole Pyramid AED, will be found to be 30 Foot; for the greater Diameter AD is 24 Inches, the lesser 8; the difference 16, the Semi-difference 8, therefore shall ME be 30 foot; for,

8 : 20 :: 12 : 30.

Now having found the heighth of the whole Pyramid to be 30 Feet, I thereby find the content of the whole Pyramid to be 40 Foot, then in the lesser Pyramid BCE there is given the side of its Base BC = 8, and its length IE 10 Inches; for EM 30 — IM 20 = IE 10, so I find the solid Content of it to be 1.48 Foot; which being substracted from

from 40 the content of the greater Pyramid there will remain 38. 52 Feet for the true solid Content of the Frustrum ABCD.

After the same manner is found the solidity of the Frustrum of a Cone. And this is also useful in measuring of Tapering Timber, Round or Square, and for finding the Liquid Capacity of Brewers Conical, or Pyramidal Tuns.

Of Measuring Artificers Work.

Because most, if not all Workmen in casting up their Dimensions, make use of cross Multiplication, I think it will not be amiss to give you an Example, or two of it, before I enter upon their several methods of measuring their Work.

Note, Feet multiply'd by Feet produce *Feet*; Feet by Inches, produce *Feet and Inches*; and Inches by Inches, produce *Inches and twelfths of Inches.*

	Feet		Inches
Therefore to multiply	3	X	6
by	4		3
First multiply the Feet by the	12	:	0
Feet and the product is 12	2	:	12
Feet, then multiply cross-wise	0	:	9
Feet by Inches, *viz.* 4 by 6	14	:	10 $\frac{1}{4}$

which makes 29 Inches or 2 Feet and 3 by 3, which makes 9 Inches. *Lastly*, Multiply the

the Inches 6 by 3 and the product is 18 twelfths of an Inch, or 1. $\frac{1}{2}$ Inch; all which products set down and add together, as in the Operation.

More Examples.

10 X 4	12 X 7	37 X 2
5 X 5	6 X 5	6 X 4
50 : 0 :	72 : 0 :	222 : 00
4 : 2 :	5 : 0 :	1 : 0
1 : 8 :	3 : 6 :	12 : 6
0 : 1 : 8	0 : 2 : 11	0 : 0 : 8
55 : 11 : 8	80 : 8 : 11	235 : 6 : 8

First, Glasiers Work, and rub'd and gauged Brick-work are measur'd by the Foot Square.

Example

If a Window be 6 Feet 6 Inches high and 2 feet 4 Inches broad; how many Square Feet of Glazing is there. *Ans.* 21 : 8.

6 X 6	
3 X 4	
18 : 0	
2 : 0	
1 : 6	
0 : 2	
21 : 8	

Secondly,

Secondly, Painting, Paving, Plastering, and Wainscoting, are measur'd by the Square Yard.

Example.

If a Ceiling, be 13 Feet broad, and 17 Feet. 4 In long, how many Yards doth it contain? *Ans.* 25 Yards.

```
     13 X 0
     17   4
   ---------
    221 . 0
      4 . 4
   ---------
9) 225 . 4
   ---------
     25
```

Thirdly, Tyling, Raftering, and Flooring measur'd by the Square, containing 100 Square Feet.

Example.

If a piece of Tyling, be 40 Feet long and 13 Feet 5 Inches broad: How many Squares are there in it? *Ans.* 5 Sq. 36 Feet.

Square

Square Feet. 40 X 0
Ans. 5. 36. 13 X 5

520 : 0
16 : 8

536 : 8.

Fourthly, Common Brick-work is measur'd by the Square Rod, containing $272\frac{1}{4}$ Square Feet: But if the Wall be not one Brick and half thick, it must be reduced to that Standard, by this General Rule. Multiply the Superficial Content of the Wall by the thickness thereof in half Bricks; divide that product by 3, and it gives the true Quantity.

Example.

If a Brick Wall that is $1\frac{1}{2}$ Brick thick be 40 Feet long, and 9 Feet 11 Inches high from the Foundation, it will contain 1 Rod 1 Qu. 56 Feet.

40 X 0
9 X 11

360 : 0
36 : 8

$272\frac{1}{4}$ | 396 : 8 | 1
124 . 5

Exam-

Example.

If a Brick Wall 2 Bricks thick be 50 Feet 6 Inches in length, and 14 Feet 9 Inches in breadth; the true content after it is reduced to the Standard, *viz.* 1½ Brick, is 3 Rod, 2 Quarters, 40 Feet.

50 X 6
14 X 9

700 : 0
37 : 6
7 : 4

744 : 10
Numb. ½ Bricks 4 : 0
3)2979 : 4(993

Which divided by 270, 272¼, gives 3 Rods 176 Feet: Which is the true Content of the Wall.

N. B. The Bricklayers have a particular way of measuring Chimneys: Which is by multiplying the Girt of the Chimney, by the heighth thereof, from the Foundation to the Hearth of the next Chimney; and the thickness of the Jams is taken for its thickness; which method they follow, till they come to the Shafts.

And those they girt for the length of a Wall, the heighth of which is the heighth of the Shafts, and the thickness always two Bricks.

Examples

Example.

If a Chimney be 24 Feet 3 Inches about, its Heighth 9 Feet 5 Inches, and the thickness of the Jams one Brick and half, what will be its Content? *Ans.* 0 Rod 3 Qu. 24 Feet.

$$\begin{array}{rcl} 24 & \times & 3 \\ 9 & & 5 \\ \hline \end{array}$$

$$\begin{array}{rcl} 216 & : & 0 \\ 10 & : & 0 \\ 2 & : & 3 \\ 0 & : & 1 \\ \hline 228 & : & 4. \end{array}$$

Ans. in Feet.

Note, Thus they measure the Chimneys of every Floor till they come to the Shafts.

If the Girt of the Chimney Shafts be 20 Feet and the heighth 12 Feet 3 Inches, how much is their Content? *Ans.* 0 Rod 3 Qu. 41 Feet.

$$\begin{array}{rcl} 20 & \times & 0 \\ 12 & & 3 \\ \hline 240 & : & 0 \\ 5 & : & 0 \\ \hline 245 & : & 0 \end{array}$$

The

The measuring Book ought to be divided into three Columns (*as the Example shews*) in the first, the Names of the Dimensions are set down, in the second, the Dimensions themselves, and in the last the product of those Dimensions.

After you have taken, and set down the Dimensions: Your next work is to multiply them upon a waste Paper, and set down their products over against them in the second Column: As you may see in the Example.

Names

Names of the Dim.	*Dimens*	*Their Products.*
The Girt of the Foundation Wall abating 4 times its Thickness.	F. In. 115:4	$1\frac{1}{2}$ B
The Heighth.	12:0	= 1384 Feet.
Chimneys Girt	26:0	$1\frac{1}{2}$ B
Heighth twice.	12:0	= 624 Feet.
Windows deduce three times.	7:0	$1\frac{1}{2}$ B.
	3:6	= 73 F. 6 In.
Door deduct.	8:0	$1\frac{1}{2}$ B.
	3:6	= 28 Feet.
Girt upper Wall	115:4	$1\frac{1}{2}$ B.
Heighth.	13:0	=1499 F. 4 In.
Chimneys twice.	26:0	1 B.
	9:6	= 494 Feet.
Windows deduc. 7 times.	7:0	$1\frac{1}{2}$ B.
	3:6	= 171 F. 6 In.
Chimney Shafts twice.	12:0	2. B.
	4:0	= 96 Feet.

Now

Now to cast up their Dimensions: make 4 Columns, as in the Margin, in the first of which put all the product of one Brick and half Thickness that are not Deductions, if there be any of 3 Bricks thick put it down twice, &c. then put down all except deductions that are one Brick thick, if two, twice and if ½ only half, as in the Example.

Deductions.

½ Br.	1 Br.	1½ Br.	1 Br.
F. In.	F.	F. In.	
1334:0	494:0	73:6	
624:0	96:0	28:0	
1499:4	96:0	171:6	
3507:4	686:0	273:2	
273:2			
3234:2			
457:4			
	R.	Q. F.	
3693:6 =	13	2:21	

686
2

3)1372(457
17
22
1

272)3693.0)(13.
973
157.

Then add up the first Column, from the Sum of which substract the Sum of the Column of Brick and half Deductions; also from the Sum of the second Column, substract the Sum of the one Brick Deductions, (*if there be any*;) then reduce the Remainder to the thickness of a Brick and half, and add that result to the Remainder of the first Column, which gives the Content of the Brick work in Feet, and the Rods

Rods are found by dividing it by 272: As plainly appears in the Operation.

The Art of Surveying and Measuring of Land.

First of the Chain.

BEcause Mr *Gunter's* Chain is most in use among Surveyors for measuring of Lines, I shall chiefly insist on that Measure, it being the best in use for Lands.

This Chain contains in Length 4 Pole or 66 Feet, and is divided into 100 Links, each Link is therefore in Length $7\frac{92}{100}$ Inches: If you would turn any Number of Chains into Feet, you must multiply them by 66, as 100 Chains multiplied by 66, makes 6600 Feet; but if you have Links to your Chains to be turned into Feet and parts of Feet; you must set down the Chains and Links, as if they were one whole Number, and after having multiplyed that Number by 66, cut from the product the two last Figures to the Right Hand, which will be the Hundredth Parts of a Foot, and those on the Left-hand the Feet required.

Example.

Let it be required to know how many Feet there are in 15 Chains 25 Links.

I ſet down thus the Multiplicand	15,25
The Number of Feet in 1 Chain, Multiplyer.	66
	9150
	9150
Product in Feet.	1006|50

The Product is 1006 $\frac{50}{100}$: This is ſo plain, it needs no other Example.

But now on the other hand, if one thouſand and ſix Feet and an half was given you; to reduce into Chains and Links; you muſt divide 1006.50 by 66, the Quotient will be 15, 25, *viz.* 15 Chains 25 Links.

In like manner, if it had been aſked, how many Perches had been contained in 15 Chains 25 Links, you muſt divide 15, 25 by 25, the Links in one Perch and the Quotient Anſwers the Queſtion.

25.)15,25(61. Anſwer in Perches.
150

25
25

0

Admit

Admit I would know how many Chains are contained in 500 Feet.

Operation.

```
66)500(7,
   462
   ---
    38  Anſ. 7 Chains 57 Lin. 38/66.
   100
   ---
66)3800(57
   330
   ---
    500
    462
    ---
     38
```

Long Measure.

Inches.					
12	Feet.				
36	3	Yards			
19	$16\frac{1}{2}$	$5\frac{1}{2}$	Poles		
7920	660	220	40	Furl.	
63360	5280	1760	320	8	Mile.

A TABLE of Square Measure.

	Inch	Links	Feet	Yards	Pace	Perch.	Chain	Acre	Mile
Inch	1								
Links	62.72	1							
Feet	144	2,295	1						
Yards	1296	20,75	9	1					
Pace	3600	57.38	25	2,778	1				
Perch	39264	625	272,25	30,25	10,89	1			
Chain	627264	10000	4356	484	174,24	16	1		
Acre	6277540	100000	43560	4840	1742,4	160	10	1	
Mile	4014489600	64000000	27878400	3097600	1115136	102400	6400	640	1

The common Meaſure for Land is the Acre, which by Statute is appointed to contain 160 Square Perches; and it matters not in what form the Acre lyes in, ſo it contains juſt 160 Square Perches: As a Parallelogram 10 Perches one way, and 16 another contains an Acre; ſo does 8 one way, and 20 another, and 4 one way and 40 the other. If then, having one ſide given in Perchs you would know how far you muſt go on the Perpendicular to cut off an Acre, you muſt divide 160 *(the Number of Square Perches in an Acre)* by the given ſide, the Quotient is your Deſire. As for Example, the given ſide 20 Perches. Divide 160 by 20 the Quotient is 8, by this I know that 20 Perches one way, and 8 another, including a Right-Angle will be the two ſides of an Acre; the other two ſides muſt be parallel to theſe.

And here I think it convenient to inſert this neceſſary Table, ſhewing the Length and Breadth of an Acre in Perches, Feet and parts of a Foot: But if your given ſide had been in any other ſort of Meaſure; as for inſtance in Yards you muſt then have ſeen how many Square Yards had been in an Acre, and that Sum you muſt have divided by the Number of your given Yards, the Quotient would have anſwered the Queſtion.

Breadth.	Length of an Acre.		Breadth.	Length of an Acre.	
Perches.	Perches.	Feet.	Perches.	Perches.	Feet.
10	16	0	28	5	11 3/4
11	14	9	29	5	8 1/2 3/4
12	13	5 1/2	30	5	5 1/2
13	12	5 1/12	31	5	2 2/3
14	11	7 1/12	32	5	0
15	10	11	33	4	14
16	10	0	34	4	11 2/3
17	9	6 9/12	35	4	9 5/12
18	8	14 8/12	36	4	7 1/3
19	8	6 11/12	37	4	5 1/3
20	8	0	38	4	3 1/2
21	7	10 2/12	39	4	1 2/3
22	7	4 1/2	40	4	0
23	6	15 3/4	41	3	14 2/3 1/4
24	6	11	42	3	13 1/3
25	6	6 7/12	43	3	11 2/3 1/4
26	6	2 1/2 5/5	44	3	10 1/2
27	5	15 1/4	45	3	9 1/6

Example.

Example.

If 24 Yards be given for the Breadth, how many Yards ſhall there be in Length of the Acres.

Firſt, I find that an Acre contains 4840 Square Yards, which I divide by 24, the Quotient is 201 $\frac{16}{24}$ for the Length of the Acre. And thus knowing well how to take the Length and Breadth of an Acre, you may alſo by the ſame way know how to lay down any Number of Acres together.

Reducing of one ſort of Square meaſure to another, is done as before taught in Long meaſure by Multiplication and Diviſion. And becauſe Mr *Gunter's* Chain is chiefly uſed by Surveyors, I ſhall only inſtance in that, and ſhew you how to turn any Number of Chains and Links into Acres, Rods and Perches: *Note*, that a Rod is the fourth part of an Acre.

And firſt mark well that 10 Square Chains make an Acre, that is, to ſay, one Chain in Breadth and 10 in Length, or 2 in Breadth and 5 in Length, is the Acre; as you may ſee by this ſmall Table.

Length of an Acre. Ch.	Breadth of an Acre. Ch.	Links.	Parts Li.
1	10		
2	5	33	33
3	3	50	
4	2		
5	2	00	
6	1	66	66
7	1	42	23
8	1	25	
9	1	11	11

And thus well weighing that 10 Chains make one Acre, if any Number of Chains be given you to turn into Ac. you must divide them by 10, and the Quotient will be the Number of Acres contained in so many Chains.

But this Division, is abbreviated by only cutting off the last Figure, as if 1590 Chains were given to turn into Acres, by cutting off the last Figure 159,0, there is left 159 Acres, which is alone as if you had divided 1590 by 10. But if Chains and Links be given you together to turn into Acres, Roots and Perches, first from the given Sum cut off 3 Figures, which is 2 Figures for the Links, and one for the Chains, what's left shall be Acres. And to know how many Roods and Perches are contained in the Figures cut off, Multiply them by 4 from the product, cutting off the 3 last Figures, you will have the Roods: And then to know the Perches, multiply the Figurees cut off from the Roods by 40, from which product cutting off again 3 Figures, you have the Perches, and the Figures cut off are a Thousand parts of a Perch.

Example.

Example.

1599 Square Chains, and 55 Links, how many Acres, Roods and Perches.

Acres 159|955
4

Ans. 159 Ac. 3 Roods. Roods 3|820.
32 Perches. 800 40

1000 Perches 32|800.

On the contrary, if to any Number of Acres given, you add a Cypher, they will be turned into Chains, thus 99 Acres are 990 Chains, 100 Acres 1000 Chains, *&c.* the same as if you had multiplitd the Acres by 10. And if you would turn Square Chains into square Links, add four Cyphers to the end of the Chains, so will 990 Chains be 9900000 Links, 1000 Chains 10000000 Links, all one as if you had multiplyed 990 by 10000, the Number of Square Links contained in one Chain.

And now, whereas in Casting up the Content of a piece of Land measured by Mr *Gunter's* Chain, *viz.* Multiplying Chains and Links by Chains and Links, the product will be Square Links; you must therefore from that product cut off 5 Figures to find the Acres; which is the same as if you divided the product by 100000, the Number of Square Links contained in one Acre, then multiply the 5 Figures cut off by 4; and from that product cutting off 5 Figures you will have the Roods. *Lastly*, Multiply by 40. and take away as before 5 Figures, the rest are Perches.

Example.

Admit a Parallelogram, or long Square, to be one way 5 Chains 55 Links, and the other way 4 Chains 35 Links: I demand the content in Acres, Roods and Perches.

	Multiplicand. 555
	Multiplicator. 435
Ans. 52 Acres.	2775
	1665
1. Rood.	2220
26 Perches.	Acres 2|41425
	4

And $\frac{28}{100}$ parts of a Perch.

Perches 26\|28000.

Of Instruments and their Use.

THere are several sorts of Chains, as Mr. *Ratbborns* of 2 Perch long: Other, of one Perch long; some have had them 100 Feet in Length:

Length: But that which is most in use among Surveyor's, as being indeed the best, is Mr *Gunter's*, which is 4 Poles long, containing 100 Links, each Link being $7\frac{22}{100}$ Inches: The description of which Chain you have had already: In this place I shall give you some few directions for the use of it in Measuring Lines. Take care that they which carry the Chain deviate not from a streight Line, which you may do by standing at your Instrument, and looking through the sights. If you see them between you and the Mark observed, they are in a streight Line, otherwise not. But without all this trouble, they may carry the Chain true enough, if he that follows the Chain, always causes him that goes before him to be in a direct Line between himself and the place they are going to, so as that the fore Man may always cover the Mark from him that goes behind. If they swerve from the Line, they will make it longer than really it is; a streight Line being the nearest distance that can be between any 2 places.

Be sure that they which carry the Chain mistake not over or under in their Account, for if they should, the the Error would be very considerable.

But the usual way to prevent such mistakes is, to be provided with 10 small sticks sharp'd at one end to stick in the Ground, and

and let him that goes before take all into his hand at setting out, and at the end of every Chain stick down one; which let him that follows take up; when the 10 sticks are done, besure they have gone 10 Chains; then if the Line be longer, let them change the sticks, and proceed as before, keeping in Memory how often they change. They may either change at the end of 10 Chains; then the hindermost Man gives the foremost all his sticks, or which is better at the end of 11 Chains, and then the last Man must give the first but 9 sticks, keeping one to himself. At every change count the sticks, for fear you have dropt one, which sometimes happens.

Of Instruments for taking of an Angle in the Field.

THERE are but two material things to be done in the Field, the one is to Measure the Lines, and the other is to measure the Quantity of an Angle included by these Lines; and the Instruments of the greatest esteem, are the plain Table for small Inclosures, the Semi-Circle for Champaign Grounds, the Circumference or the Theodolite, &c. To describe these to you, their parts, how to put them together, take them asunder, &c. is like teaching the Art of of Fencing by Book, one Hours use of them, or but looking on them in the Instrument-makers Shop, will better describe them to you than the Reading one Hundred Sheets of Paper concerning them.

To take the Quantity of an Angle.

Fig. 84 Let AB and AC be 2 Hedges of a Field, to find the quantity of the Angle A by the plain Table.

Place the Table as nigh to the Angle A as you can, the North end of the Needle hanging directly over the Flower de Luce; then make a Mark upon the Sheet of Paper at any constant place for the Angle A, and lay the edge of the Index to the Mark, turning it about, till through the sights you espy B, then draw the Line AB by the edge of the Index. Do the same for the Line AC, keeping the Index still upon the first Mark, then will you have upon your Table an Angle equal to the Angle in the Field.

To take the quantity of the same Angle by the Semi-Circle.

Place your Semi-Circle in the Angle A, as near the very Angle as possibly you can; and Cause Marks to be set up nigh B and C, so far off the Hedges, as your Instrument

at

at A stands, then turn the Instrument about till through the fixed sights you see the Mark at B, there Screw it fast; next turn the moveable Index till through the sights thereof you see the Mark at C, and see what deg. upon the Limb are cut by the Index; which let be 45, so much is the Angle BAC.

How to take the same by the Circumferentor.

Place your Instrument as before, with the Flower de Luce towards you, then direct your Sights to the Mark at B, and see what degrees are then cut by the South end of the Needle, which let be 55; do the same to the Mark at C, and let the Needle there cut 100, Substract the lesser out of the greater, and the Remainder is 45, the Angle required. If the Remainder had been more then 180 degrees, you must then have substracted it out of 360, the last Remainder would have been the Angle desired.

How by the Semi-Circle to take the Quantity of an Angle in the Field by the Needle.

Screw fast the Instrument, the North-end of the Needle hanging directly over the Flower de Luce in the Chord, turn the Index about, till through the Sights you spy the Mark at B, and note what degrees

the

the Index cuts, which let be 40; move again the Index to the Mark at C, and note the degree cut, *viz.* 55, substract the less from the greater, Remains 15, the Quantity of the Angle.

Note, If you turn the Flower de Luce towards the Marks, you must look at the North-end of the Needle for your degrees. And the East and West points are marked contrary, *viz.* East with a W. and West with an E, because when you turn the Instrument to the Eastward, the end of the Needle will hang over the West-side, &c.

If by this way of Division of the Chord, you would take the aforesaid Angle, direct the Instrument (*so the Flower de Luce from you,*) till through the Sights you espy the Mark at B; then see what degrees are cut by the North end of the Needle, which let be N. E. 44; next direct the Instrument to C, and the North-end of the Needle will cut N. E. 89. Substract the one from the other, and there will remain 45 for the Angle.

Of the Field Book.

You must always have in readiness in the Field, a little Book, in which fairly to insert your Angles and Lines; which Book you may divide by Lines into Columns, as you shall think convenient in your Practice

Practice, having always a large Column to the Right-hand, to put down remarkable things you meet with, as Brooks, Mills, *&c.*

Example.

If you had taken the Angle A, and found it to contain 45 Degrees; and measured the Line AB, and found it to be 12 Chains 55 Links, set it down in your Field Book thus,

A	deg.	Min.	Ch.	Lin.	
	45	00	12	25	

Lastly, You may chuse whether you will have any Lines or not, if you can write streight, and put the Figures directly one under another; for this I leave to your own fancy; for I believe there are not two Surveyors in *England*, that have exactly the same Method for their Field Notes.

Of the Scale.

There are several sorts of Scales, some large, some small, according as Men have occasion to use them, for the laying down Chains and Links; also you have upon the

the ſame Scale Lines of Chords, for laying down and Meaſuring of Angles. I canno better explain the Scale to you, than by ſhewing the Figure of ſuch a Decimal Scale as I think moſt uſeful, and are commonly ſold in Shops.

Of the Protractor.

The Protractor is an Inſtrument with which, with more eaſe and exactneſs you may lay down an Angle of any Number of Degrees, than you can by the Line of Chords: And when you have Surveyed by the Needle, by pacing the Diameter of the Protractor upon a Meridian Line made upon your Paper, you readily with a Needle upon the Arch of your Protractor, prick off the true Situation of any Line from the Meridian, without ſcratching the Paper, as you muſt do in the uſe of the Line of Chords. It is made almoſt like, and graduated altogher like the Braſs Limb of a Semi-Circle, performing the ſame upon Paper, as your Inſtrument did in the Field.

How to lay down an Angle with the Protractor.

Fig. 85. If it were required by the Protractor to lay down an Angle of 30 deg. Draw

Draw the Line AB, then take the Protractor and putting the Needle through the Center-point thereof, place the Needle in A, so that the Center of the Protractor may lye just upon the Line at A, move the Protractor about till you find the Diameter thereof lye upon the Line AB; then at 30 degrees upon the Arch, with your Protracting Needle make a Mark upon the Paper, as at C, draw the Line CA, which shall make an Angle of 30 degrees, *viz.* BAC.

How to lay down the Angle by the Line of Chords.

Fig. 86. If it were required to make an Angle that should contain 45 degrees. Draw a Line at pleasure, as AB; then setting one Foot of your Compasses at the beginning of the Line of Chords, see that the other fall just upon 60 Degrees; with that extent set one Foot in A, and describe the Arch CD; then take from your Line of Chords 45 degrees, and setting one Foot in D, make a Mark upon the Arch at C, through which draw the Line AE; so shall the Angle EAB be 45 degrees. If by the Line of Chords you would erect a Perpendicular Line, it is no more but to make an Angle that shall contain 90 Degrees.

The

The reason why I bid you take 60 from the Line of Chords to make your Arch by, is because 60 is the Semi-diameter of a Circle whose Circumference is 360.

How to cast up the Content of a Figure, the Lines being given in Chains and Links.

HAving described these plain Instruments, and in some measure shewed the use of them, I intend to shew him, 1. How he ought to make his Computations; 2. The Grounds or Principles that will justify him in so doing.

For the First take these Rules.

1. Put down your Length and Breadth of Squares and Oblongs, and your Base and $\frac{1}{2}$ Perpendicular of Triangles directly under one another, expressed by Chains and Links, with a prick betwixt them.

2. If the odd Links were under 10, put a Cypher before the Figure, expressing them as Chains and Links; and if there be no odd Links, but all even Chains, put two Cyphers after the prick.

3. Multiply Length by Breadth, and Base by $\frac{1}{2}$ Perpendicular, according to the Rules for finding the Content of Figures.

4.

4. From that product cut off 5 Figures reckoned from the Right-hand backwards with a dash of your Pen, so shall those on the Left-hand be Acres.

5. If those on the Right-hand were not all 5 Cyphers, multiply them by 4, and cutting off 5 towards the Right-hand again, the rest on the Left-hand will be Roods or Quarters.

6. If amongst these 5 Figures towards the Right-hand that were cut of at the second Multiplication, there be any Figures besides Cyphers, multiply all the 5 by 40, and cutting 5 again with a dash of your Pen, those on the Left-hand are Square Perches.

Example I.

What is the Content of a Square, whose sides are every one of them 4, 50 Links.

```
Length   4. 50
Breadth  4. 50
        ------
         22500
        1800
        ------
        2|0 25 00
               4
        ------
         1|0000
             40    Ans. 2 Acres and 4
        ------          Perch, as appears.
        4|00000
```

Example II.

Let a long Square, whofe Length is 14 Chains, and Breadth 6 Chains and 5 Links what is the Content?

```
Length,   14.00
Breadth,   6.05
        -------
          7000
        84000
        -------
        8|47000
              4
        -------      Anf. 8 Ac. 1 Rood,
        1|47000      35 Perches, as the
             40      work makes evident.
        -------
       35|20000.
```

Example III.

There is a Triangle, whofe Bafe is 3 Chains, and $\frac{1}{2}$ the Perpendicular is 45 Lin. what is the Content.

The

The Baſe 3.00
Half Perpen. 0.45

1500 — A R P
1200 — *Anſ.* 0—0—21

13500
4

54000
40

21|60000

I ſhall now demonſtrate this way of caſting up a piece of Land by the following Steps.

1. It is evident, that in this way of Multiplication, the product is Square Links; for every Chain being a Hundred Links, it is all one to multiply 4.50, by 4.50 or 450 without the Pricks, for they ſignify nothing at all in Operation. The product therefore of the firſt Example was 202.500 Links.

2. Every Chain being 4 Perches long, it follows, that 5 Chains in Length and 2 Chains in Breadth, make an Acre, or 160 Square Perches.

3. From hence it plainly follows farther, that there are exactly 100000 Square Lin. in an Acre; for 5 Chains multiplied by 2,

is

is the same with 500 Links by 200, which makes 100000. Then according to the Old plain Rule in Arithmetick, when the Divisor consists of 1 and Cyphers, (*as* 10, 100, 1000, 100000, *&c.*) cut off from the Right Hand so many Figures of the Dividend as the Divisor hath Cyphers, and counting them for the remains, so shall the rest on the left side be the Quotient. It is plain then that 1.57506 square Links makes 1 Acre, and 57506 square Links over.

So I have made it clear, as far as concerns Acres, that the Rules for Computation are good. Now for Roods and Perches, it is plain from that known Rule in Decimal Arithmetick: Multiply the given Decimal by the Number of parts in the next inferiour denomination, that are equal to an Integer in the same denomination with the given Decimal; and see how many places are in the product, more than were in the given Decimal; and cut so many off from the Left-hand, and those Figures so cut off, are the value of the said Decimal. So that this way of casting up the Content of a piece of Land is true.

How

How to measure a piece of Land, and to Protract it, and to give up the Content.

ALL Closes, or Parcels of Land, are either such as need not to be plotted for finding out their Content, but the Chain alone does the work; or such as cannot be measured without plotting or Protraction; of the first sort are the Squares and long Squares, and these, I say, need no plotting, for you need only to multiply the Chains and Links of the Length, by the Chains and Links of the Breadth, so proceed as in the last Examples: But all others, whether Triangles or Triangulate, are to be protracted. I shall give Examples therefore in the 3 sorts of Figures, Triangular, Quadrangular, and Mutangular. But let me advise the Young Practitioner to remember these things.

1. To begin at some notable Angle of the Field, where there is some Gate, Style, &c. Or if there be none, to dig up a Clod, or at least to observe what Quarter of the Heavens it pointeth toward, and on your Paper mark it with some Letter.

2. To go Parallel to the side of the Field, accustoming your self to go either with your Left-hand towards the Hedges, or

Contra

contra with your Right-hand towards them; and when you go contrary to your usual Custom; note it on your Paper by some mark known to your self.

3. To take heed, lest you confound your self by taking Lines off of several Scales, or measuring Perpendiculars upon wrong ones; for every Line of the same Figure must be made by the same Scale, and the Perpendiculars measured by it.

4. To make use of a large Scale in small Closes, and of a smaller when you measure great ones.

5. To set on your Chains and Links at twice, when any Line is too long for your Scale.

These things being premised, I proceed thus:

Fig. 87. Suppose ABC to be a Close, beginning at the Eastern Angle A, and going with my Right-hand towards the Hedge, I find the sides to be 4. 07, 2. 29, 3. 45.

I first, with my Compasses, take off from my Scale 4 Chains and 7 Links, and setting it from A to B, draw that Line for the Base, because it is the longest of the three: Then I take 2. 29 off the same Scale, and put one Foot of the Compasses in B, I describe the Arch OK. Next taking with my Compasses upon the same Scale, the extent of 3. 45: I place one Foot in the point A, and with the other make the Arch PQ, intersecting the other in the point C; and drawing the Lines AC and CB, the Triangle ABC is the Plot of the Field meaſured.

Next I muſt find the Length of the Perpendicular, which is done by ſetting one Foot of the Compaſſes in C, and extending the other to the Baſe AB, ſo as it touch and paſs not over it; then the Length of the Perpendicular is between the points of the Compaſſes, and it being applied to the Scale that the Triangle was made by, it appears to be 1 Chain 42 Links; with the ½ whereof I multiply the Baſe AB, 4.07, and proceeding according to the Rule before delivered, the Content appears to be 0 Acres, 1 Rood, 6 Perches, as is evident.

The Baſe	4.07
½ Perpend.	0.71
	407
	2849
	2|8897
	4
	1|15588
	40
	6|23520

The Content of this piece of Land may be very readily found without plotting it, it, thus: First, Measure the Base Line AB, then by the help of your Cross Staff, find where the Perpendicular will fall from the Angle C, upon the Base AB, which is always the nearest distance from C to the Base AB; and then measure the Length of your Perpendicular by your Chain, and having the Perpendicular and Base, you know how to find the Content.

How to Measure a Quadrangular or Four sided Field.

Fig. 88. Let ABCD be a four corner'd Field: I begin as before at some remarkable Angle; and going round the Field, I find the sides to be 9.04, 8.75, 9.12, 8, 17, and the Diagonal AC 10, 00, I begin to protract thus:

I first, by the help of my Scale and Compasses, draw my Diagonal 10, 00, from A to C, and I make a Triangle of it and the first and second side 9. 04, and 8. 75, as in the last Field, and another after the same method of that Diagonal, and the third and foruth sides 9. 12 and 8. 17, so have I the Trapezium ABCD.

Then by the help of my Scale and Compasses, I find the Length of the Perpendicular of the Triangle ABC to be 6. 90, and of the other CDA 7. 20, which added together are 14. 10, whereof the $\frac{1}{2}$Sum is 7.5,

 by

by which multiplying the Base 10, 00, and proceeding as formerly hath been shewn, I find the Content of the Field to be 7 Acres, 0 Roods, 8 Perches, as here follows.

The Base 10. 00
$\frac{1}{2}$ Perpen. 7. 05

50.00
7000

7 | 05000
4

20000
40

8 | 00000

How to take the Plot of any Multangular Field.

Fig. 89. Let the following Figure A, B, C, D, F, E, represent a Field, of which the Plot is required.

First, Measure the Length of the Hedge AB 7 Chains, then Measure the Length of the Fence BC 6 Chains; as also from A to C the Base Line proper to that Triangle which is found 10, 00; all which write down in your Field Book.

Then

Then Measure the second Triangle in the same Order, beginning at C, and Measuring to D, which is found to be 3. 10; then Measure from D to E 5. 15, and likewise the Base Line C E 8. 00, which put down for the second Triangle.

Then observe the last Triangle, which is an outward Angle, and must accordingly be Measured on the out-side of the Field, and so noted down in your Field Book; so the Length of the Line EF 2.15, and AE 5.80, the Base Line, and AF 4.00, all which enter in your Book as follows.

First Triangle ABC inward, 2, Triangle CED inward.

	C	L		C.	L.
AB	7.	00	C D	3.	10
BC	6.	00	D E	5.	15
AC	10.	00	C E	8.	00

Third Triangle AEF outward.

	C.	L.
E F	2.	15
F A	4.	00
A E	5.	80

How to Protract the former Work upon Paper

First, Draw a Line upon your Paper at pleasure, as AC, and take from your Scale the Length of that Line, 10. 00, and set it from A to C; then take from your Scale the Length of the Line AB 7.00, and put one Foot of your Compasses in A, with the other describe the Arch aa; then take the Length of the Line BC 6.00 from your Scale; placing one Foot in C, with the other cross the former Arch in B, as bb, this done draw the 2 Lines AB and BC.

Second, Take from your Scale the Base Line CE 8.00, and placing one Foot of your Compasses in C, with the other describe the Arch ee, then take with your Compasses the Length of the Base Line EA 5.80, setting one Foot in the point A with the other cross the former in the point E, as ff, which point E is the meeting Angle to both the other 2 Angles.

Thirdly, For the protraction of the Triangle CED, take from your Scale the Line CD 3.10, placing one Foot of your Compasses in C, and with the other make the Arch cc, then take the Length of the Line DE 5.15, and setting one Foot in E, with the other cross the former at D, as dd, from which Intersection draw the 2 Lines CD and DE.

Lastly, For the Triangle AEF, take with your Compasses EF 2.15, placing one Foot of your Compasses in E, with the other strike the Arch hh, then take AF 4.00, setting one Foot in A, and with the other cross the former Arch in F, draw Lines therefrom,

as

as from A to F, and from F to E, so have you protracted your Plot upon Paper, as was required.

And you must be careful to note down the Scituation of the Angles, *viz.* inward and outward, for fear of committing of a mistake when you protract the same.

Now if you draw a Line from C to F, you divide it into 2 Trapeziums; and then the Content is found as hath been before taught.

How to take the Plot of a Field by going round the same.

Fig. 90 Let ABCD represent a Field to be measured. First beginning at the Angle A, I measure one Chain in Length towards B, as to a, and another towards E as to b; next, I take the distance from a to b 1. 50, and note it down in my Field Book, for the Quantity of the Angle A; and measure the Hedge AB 3. 00, and put it in my Field Book.

Next I come to the Angle B, and measuring one Chain to d, and another to c, I take the distance d c with my Chain, and I find it to be 1. 40, and the Hedge BC 3. 15. Next I come to the Angle C, and measuring one Chain to e, and another to f, and take the distance f e, I find it to be 1. 10, and from C to D, 2. 17, and so I proceed till I come to the Angle A; and I find to be as follows.

		C.	L.			C.	L.
Angles	A	1.	50	Sides	AB	3.	00
	B	1.	40		BC	3.	15
	C	1.	10		CD	2.	17
	D	1.	80		DE	2.	80
	E	1.	39		EA	2.	60

How to Protract the former Work.

First, I take from my Scale 1 Chain, and having drawn a Line as AB, upon A as a Center, I strike the Arch a b; then take from your Scale 1. 50, and set it from a to b, and draw the Line AE, setting thereon 2. 60 from A to E, and 3 Chains from A to B; then taking one Chain from my Scale and putting one Foot in B. I strike the Arch c d; next I take 1 Chain 40 Links, the Quantity of the Angle B, and set it from d to c, and draw the Line BC, making it to be in Length 3. 15. Next I come to the Angle C, and setting one Foot in C, with the other I describe the Arch e f, then taking 1. 10, from your Scale, I set it from e to f, and through the point f, I draw the Line CD in Length 2. 17. Next I come to the Angle D, and always taking 1 Chain from my Scale, I put one Foot in D, and with the other describe the Arch o n; then taking

taking 1 Chain and 80 Links, I set it from o to n, and the Line DE, which Line must just meet the end of the Line AE and contain in Length 2. 80. if your Work be well done.

I must acknowledge that this sort of Plotting of Parcels of Land that have many Angles, requires not only more care and pains; but better Skill and Memory than to draw Diagonals upon Paper, when the Plot is already taken by the plain Table. I shall therefore give you some ways to help your self, so as to be out of danger of Mistakes.

One way is, to divide a Multangular Field into 2 or more parts, then might each part be measured severally, as if they were several Mens Lands parted by a Boundary.

Another way, which much helps the Memory and Understanding, is to draw a rude Draught of the Figure of the Lands you intend to measure, not only as to the sides, but also the Diagonals: Then measure the Lines upon the Ground correspondent to those on the Paper, and set the Lines as you measure them, upon the Sides of your Draught, as if they were the true ones, and when you have finished your Measuring, protract it truly, and it will do your Business.

How to take the Plot of a Field from one Station taken in the middle thereof, by the Chain.

Fig. 91. Let ABCDE represent the Field to be plotted: first at K, I set down a Stick, then Measure one Chain in Length towards A, as K o, and also the Length of the whole Line K A, which note down upon your rude Draught: Next measure one Chain in Length towards B, as K p, and also the Length of the Line KB; and note it on your foul Draught: Next you must measure the distance betwixt o and p, and so place it down upon your Draught.

And so I measure one Chain in Length towards C, as K q, and also the Length of the Line KC; and note it down upon my rude Draught, as also the distance pq: And so I proceed round the whole Field, and find them to be as is noted in the Figure following.

How to Protract this Work.

First take from your Scale one Chain in Length, then upon K as a Center, describe the Circle o p q RS; next take from your Scale 2 Chains, the Length of the Line KA, and set it from K to A: Next take from your Scale 172 Lin. and set it from o till it touch the Circle in p, and through the point p, draw the Line KB, making it to be in Length 215: Then

Then take from your Scale the Length of the Line pq 135, and set it from p to q, and through the point q draw the Line KC, making it to contain in Length 216 : Next take from your Scale 112, and set it from q to R, and through the point R draw the Line KD, and take from your Scale 217, and set it from K to D ; and so proceed till you have finished your Plot. And, *Lastly*, Through the several points A B C D, *&c.* draw the Boundary Lines.

How to take the Plot of a Field by the plain Table, at one or more Stations.

There are three ways for doing this Work. The first performs the Work by measuring every Line from the Instrument to the Angles, and is a good way, when it can be done. The second does it, by Measuring only the Stations or Distances, and is very quick, but not so sure and exact as the other ; yet if it be manag'd by a skilfull Artist, it will come near enough the matter in many Cases ; as Measuring for Mowing or Reaping Fields by the Acre, or in Case of Law Suits, when you cannot come nigh the Ground to be Measured.

The 3*d* is by way of Circulation, the Instrument being oft to be planted, and the plot to be measured by going round about it, by which thick Woods or Bogs may be measured.

In

In all these Methods two things are to be performed.

1. At every Angle where there is no Mark already, as a *Tree*, or *Bush*, &c. one must be placed with a white Paper; or one must go from Angle to Angle.

2. When ever you have occasion to plant your Instrument more then once, you must be sure to let it stand just as it did the first time, that is, for Situation, which if your Needle be good, will perform the Work; but is not thought sufficient without a back-sight and fore-sight. Now for the first Method.

To take the Plot of a Field at one Station, in any part thereof, from whence you may see all its Angles or Corners.

Fig. 92. Suppose ABCDEF be a Field to be measured. First, Cause marks to be set up in every Corner of it; then make Choice of some convenient place therein, from whence you may best view all the Angles thereof; in which place at H, plant your Table (*covered with a Sheet of clean Paper,*) turn the Table about till the Needle stand over the *Flower de Luce*, and so fasten it with the Screw-pin, that the Table stir not. Then placing your Index upon the Table, lay the Fiducial Edge thereof upon the point H, representing the place

place of your Station; and draw a Line with your Compasses point, by the side of the Index upon the Paper; which done, direct your sight to B, (*still keeping the Edge of your Index to the point H*) and draw a Line as before; and so in like manner direct your Index to C, D, E and F, drawing the Lines upon the Paper by the Edge of your Index, with the point of your Compasses, and so having finished the same, measure with your Chain the distance of every of those Marks, from the place of your Station at H, and then by the help of your Scale and Compasses, set the same distances from the point H, in the Lines drawn upon the Table, making a small prick with your Compasses point at the end of every one of them; then with the point of your Black-lead Pencil, draw a small Line from one point to another, as namely from A to B, from B to C, from C to D, *&c.* so shall you have upon your Table the exact Plot of your Field.

To take the Plot of any Field at one Station, in any one Angle thereof, from whence all other Angles may be seen.

*Fig.*93 First, as before, set up Marks in every Corner of the Field, as at BCDEFG; then make Choice of the most convenient Angle therein; from whence you may best view all the rest, as A; and having fixt your Table there,

there, as before is taught, apply the Index to the point A, and direct the sights to B; then draw a Line AB upon the Paper, and with your Chain measure the Length thereof, and set it down by the help of your Scale from A to B.

Then from the said point A, turn your sights to C, your second Mark, and then draw with one point of your Compasses upon the Paper the Line AC, measuring the distance, and setting down the Length as you were before taught.

In like manner direct your sights to D, E, F and G, and drawing Lines upon your Paper, measure with your Chain the Distance of each of the same Angles, from your Station point at A, where your Table is planted; then with your Compasses take from the Scale the respective distances, and and set them down from the point upon the several Lines, and so describe the Lines AB, BC, CD, DE, EF, FG, GA; which will exactly represent the just Figure of your Field.

How to take the Plot of a Field at two Stations, when all the Angles cannot be seen at one.

It oftentimes happeneth, through Hills or the largeness of Grounds, that you cannot from any one place of the Field see all the Corners thereof; in which Case you must make

make Choice of two convenient places within the same: So that here you are to perform at two Stations, what you did before at one.

Fig. 94. Suppose therefore, that the Figure CDEFGHIKLM, be a Field to be plotted; I make Choice of two Stations, within the same, as A and B, where I can view all the Angles. And first, I plant my Table at A, from whence I can see the Angles M CDEF; then placing the Edge of my Index upon the point A, I direct my sights severally to the Angles within my View, as to MCDEF, drawing Lines, as is directed in the Figure; which done, I measure every one of them with my Chain, and note them down from my Scale, as formerly.

Then (*my Table remaining fixt*) I view the other parts of the Field, and make choice of the point B for my second Station; because from thence, I can see all the other Angles of the Field; then setting up a Mark there, I go back to my first Station at A, (*where my Table stands fixed, as I left it,*) upon which point I move my Index, till through the sights thereof, I espy the Mark at B, which done, I draw a Line by the Edge of the Index, with the point of my Compass, extending it the Length of my Table, as is represented by the Line ZX; which being thus performed, I measure my Stationary distance AB, AB, 2 Chains which I fet off from A to B, the place of my fecond Station, by the help of my Scale and Compaffes.

Secondly, I plant my Table upon the point B, and laying my Index upon the Line ZX, I turn the Table about, till through the fights I behold my firft Station at A, then I Screw the Table faft to the ftaff; afterwards moving my Index upon the point B, I direct the fights to G, drawing the obfcure Line BG, containing 1 Chain 75, then again I direct the Index to the Angle H, and find it diftant from my Station 1 Chain 72; and thus turning my Index about upon the point B, I draw obfcure Lines to the other Angles as I did before, and meafuring their refpective diftances with my Chain, I prick down the points I, K, L, upon my Paper, ever obferving to take off with my Compaffes upon the Scale the exact Quantity of Chains and Links, meafured with the Chain.

Laftly, (*The feveral points or Angles of the Field, as CDEFGHIKLM, being found out, and mark'd upon my Paper*,) I draw the Boundary Lines from point to point, which will reprefent the true Plot of the Field, to be Meafured.

To

To take the Plot of a Field removed from you, at two Stations, when you are not permitted to come within the same.

Fig. 95. It often happeneth that you are to measure a Field, and cannot, either for Water, Moorish Ground, or danger of Suit, enter into it. Suppose the Field is CDEFG, I make Choice of two convenient Stations without it, as A and B, from each of which I can see all the Angles of the Field; and having planted my Table at A, I place the Edge of my Index thereupon, and direct to all the Angles of the Field respectively, drawing Lines with the point of my Compasses, as AG, AE, AF, AD, AC, AH. Then my Table remaining fix'd, I direct the Index towards B, and having drawn out my Stationary Line, I measure the distance thereof in the Field, and place it on the Paper from A to B, then planting the Table at B, place your Index upon the Stationary Line AB, and then move the Table, till through the sights you behold your Station at A; which being effected, direct your Index to all the several Angles of the Field, as you did before at A; and the intersections of these Lines, will give the points C, D, E, F, G, H, from which draw the Lines CD, DE, EF, FG, GH, and HC, and you will have the true Plot, and Proportion of the Field. To

To Survey Wood-lands by the plain Table.

In very irregular Grounds where you can make long Stations, you cannot ſee all the Angles from each Station; but in going on your Stationary Line, all the little corners in the Hedges may be ſeen; therefore, that you may Plot all the Angles as you meaſure on your Stationary Lines, obſerve this General Rule, *viz.*

A General Rule.

In going on your Stationary Line, mark where an Angle falls in a Right-Angle to your Stationary Line, there plant the Table, laying your Index upon the Stationary Line, and turning your Table upon the Head of your Staff, till you can ſee either the Station you came from, or that you are going to, (*for You muſt always obſerve to meaſure in a ſtreight Line from Station to Station,*) there ſcrew it faſt; then obſerve how far you have meaſured on your Stationary Line, which diſtance take from your Scale, and place from your laſt Stationary Line, there make a prick with your Compaſſes point, and there take the Angle.

Example.

Example

Fig. 96. Suppofing ABCDEFGHIKLMNOP, to be a great Pool or Wood: Though there be Fifteen Angles, I plant my Table only five times, *viz.* at AEFH and M, and upon the dry Lines AE, FH, HM, and MA, I raife their Perpendiculars in due places, (*according to Meafure*) and alfo of a right heighth: By which and my five Stationary Angles, I draw the bounding Lines of the Plot, excluding all the Triangles as foreign to it, they being no refemblances of any part of the Pool, but of Land adjacent. That if by reafon of troublefome Brufh-wood, Gorfe or Bogs, *&c.* I could not have meafured clofe to the fides E-F, HI, or LM, it would be the fame thing if I went parallel to them. And this is a fhift that the Practical Suveryors will oft be put to make ufe of.

Now before I pafs to further Varieties let my Reader take notice of thefe following things.

1. That it is the quickeft way to meafure, firft from the Inftrument to the firft Angle, and then back from the fecond Angle to the Inftrument, and fo the reft in order; ftill one from the Inftrument, and the other to it.

2. In

2. In all working by the plain Table, you muſt have a care that the Inſtrument be not moved out of its due place, till you have finiſhed the work at the preſent Station, for which purpoſe caſt your Eye now and then upon your Needle, obſerving whether it hangs directly over the ſame point you ſet it at when you began your work, and to rectify your Inſtrument if you ſee cauſe. But becauſe all Inſtruments have not Needles, make uſe of the following help.

When you have planted your Inſtrument, and made a prick on your Paper, repreſenting your Station, ſet the Edge of the Index to it and turning it ſoftly about till you find ſome remarkable thing upon one ſide of the Cloſe, and another on the oppoſite ſide as you look through the ſights of your Index, and draw a remarkable Line quite over your Paper; then if you ſuſpect that by any accident the Inſtrument is removed, you may eaſily try and rectify it, by applying the Index to the ſame line, and making uſe of fore-ſights and back-ſights again, upon the ſame marks which you before obſerved upon the oppoſite ſides of the Cloſe. And this is a very good way when you plant your Inſtrument in the middle of the Field.

Concerning

Concerning the Plotting of many Closes together, whether the Ground be even or uneven.

Fig. 97. Suppose ABCDEFGHIKLM to be a Tenement or small Demesn divided into 14 Closes, to be measured and protracted according to their several shapes and Situation. I first draw the Plot of the whole by the method of Circulation; this being done, a Line from A to C gives the Triangular Close ABC, for the first. In the next place, I go round the two Closes beginning at A, then at C, and so about to A again: And then for the third Close, I plant my Table at D, and go round to C, the line CD being protracted already, and so of all the rest, still observing which are common lines belonging to several Closes, that you may avoid the measuring of lines more than once, and lay every part of every Close in its due place; that you besure to keep the Instrument throughout the whole work to its true position by Needle, fore-sight and back sight.

There are I confess divers other ways of doing this work, but none more sure.

2. If you are to make a Map of a Lordship, walk over the Lordship 2 or 3 times, till you can bear the Map of it in your Head, that you may the better conceive to carry on the whole work, and to make choice of the

the fitteſt place for your Stations. Plot your Townſhip firſt, beginning in the moſt convenient place to make your firſt Station as long as poſſible you can; and likewiſe from your main Stations, taking therefrom all Out-Houſes, and little intermediate Offices, and then return to your mean Station again.

Obſerve this General Rule.

When you cannot perform from your main Station, or ſee all the Angles, or Backſides near joining thereupon, to make inner Stations as before, and to perform the work of each main Station with inner Stations, till the Townſhip be finiſhed.

And where you conclude your Townſhip from Your laſt main Station, direct your ſights to a Station in ſome convenient place of the adjoining Fields; ſo may you take the Plot thereof from as many Stations as need requires, ſo will ſuch Grounds be joined to the Townſhip, and ſo may you proceed with next adjoining Grounds.

Your Townſhip being by the preceding Rules compleated upon your Table, with as many of the adjoining Grounds as will come thereupon, make Marks upon your Plot as you proceed with your Work, where the next Ground joins or falls upon thoſe Fences you have already plotted, that

that you may know, when you have taken the Plot of the feveral Fields joining upon your former Plot, how to join them thereto.

Proceed where you left off, and take as many of the Inclofures upon your Table as it will bear, and join them to the former work, by the directions of the Marks beforementioned; and in this order proceed till the whole Lordfhip be finifhed, obferving to defcribe upon your Plot all Roads, and whatever is remarkable that you meet with in your way. Obferve to place the Trees, in each Hedge-row, fo that the Landlord or Owner thereof may know by infpecting the Map what Fences belong to each Ground.

The true method of taking the Plot of uneven Hilly Grounds, in refpect of their true Quantity, by the plain Table.

1. In Grounds where there are multiplicity of Hills running out into another Irregularly, place Beacons upon ferveral of the Heigheft of the moft material Hills, whether you can fee the Angles in the Hedges, or the Hedges themfelves from feveral of the faid Hills, and direct your fights from Station to Station, laying down each Stationary diftance upon your Paper with your Scale, placing your Station Marks

Marks so, that your Chain in measuring these Stationary distances may pass over the most material Hills in the Ground, as we shall here demonstrate.

2. *Fig.*98. Admit the Figure noted with AB CDEF, *&c.* be a Hilly Ground to be plotted, whose just number of Acres is required; set up Beacons or Stationary Marks upon the top of most of the material Hills, as X, W ♂, ♄ y, z, *,

3. Plant your Table at X, your first Station, directing your sights therefrom, to the Angle D; then with your Chain measure the distance X D on the Ground, which take from your Scale and set from X to D, where make a prick; then direct your sights to E, which distance take from your Scale and set from X to E; then direct your sights to F, which prick off from X to F on the Paper; then again direct your sights to G and H, and measure the Ground Lines, which set off upon your Paper; so have you finished the work of your first Station.

4. Direct (*before you alter the Table; as it stands planted at the first Station*) your sights to your second Station at W, drawing your Stationary Line by the Edge of your Index, and measure the Length of the said Stationary Line on the Ground, which take from your Scale, and set from X to W, where place down your Table, laying the Edge of your Index upon the Stationary Line

XW;

XW; your Index resting in this postures, turn the Table gently upon the Head of your three Legged Staff, till through the sights you see the first Station mark at X, where screw it fast; then direct your sights to all your several Angles in view, as K, L, M, and measure their several distances from your Station at W, which several distances take from your Scale and prick off upon their Respective Lines upon your Paper.

5. Then (as before) direct your sights to ♂ your Third Station, and draw a Line by the Edge of you Index, then measure on the Ground from W to ♂ which take from your Scale and set on your Paper from W to ♂, where plant your Table, as was before directed, at your last Station.

Now, because you cannot see your Fences in any part of the Ground by reason of the Hill from this Station, therefore direct your sights to ♄, your fourth Station, which distance ♂ ♄, measure on the Ground, which take from your Scale, and set from ♂ to ♄, where plant your Table by the former directions, nd direct your sights to y, your fifth Station; then measure the the Stationary distance ♄ y, which take from your Scale, and place from ♄ to y, where plant your Table.

6. Then direct your sights from your Station at y, and therefrom observe, mea-

ure, and lay down upon your Paper, as ou were directed at your other Stations; ;hen direct your sights to your sixth Station t z, and strike a Line by the Edge of your ndex for your Stationary Line, which take om your Scale, and set from y to z; where lant our Table by the foregoing directions.

7. Your Table being planted at z, direct our sights to all the Angles in view, and rike Lines by the Edge of your Index hereto, as to O, P, Q, R, S, T, and meaure their distances on the Ground from your lace of standing; which several distances ake from your Scale, and set from Z, to), P, Q, R, S, T, where make pricks with our Compasses point; which done direct our sights to your 7th, or last Station, rawing a Line by the Edge of your Index or the last Stationary Line; then measure e distance Z *; which take from your ale, and set from Z to *, (as before taught) here plant your Table; which done, di-ct your sights to the Angle N, which di-nce measure on the Ground, and then ce from your Scale and set from * to where make a prick; so have you prickt all the Angles in the Field.

8. *Lastly*, From the several pricks, as from to B, from B to C, and so to D, *&c.* w Lines therefrom till you come again A, which shall include the Mountainous ld: which was required.

And

And here you may observe, that the Chain being drawn over all the Hills and Dales, must necessarily produce a larger Plot, viz. more Ground, then going round about the Hedges all the way upon level or even Ground to plot the same: Hence I may affirm, that this way ought to be practised by Surveyors; from which Map the true Number of Acres is found that the said Ground containeth.

Concerning Shifting of Paper.

It very ordinarily falls out in practice, with your Table, as it is covered with Paper, is too little in several Cases, especially in great Grounds; in such Cases when you have proceeded as far as you can, till the Lines run off your Table or Paper, you must shift your Paper, and put a fair sheet upon the Table.

First then, upon your last Stationary Line which runs off your Table, observe to shift that Sheet so far off or beside the Table, that your last Station marked thereupon, may be marked just upon the Table to which Sheet in this order glew a fair Sheet with Mouth Glew, and so fasten them down with the Frame of the Table.

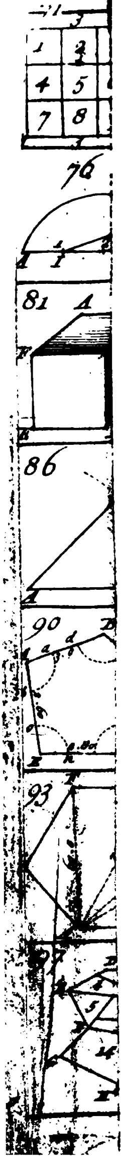
Second, Lay a Ruler upon that part of the Stationary Line, from the Station, which as I said before, is just upon the Edge of the

Table, and draw or augment that Line on the fair Paper, upon which Line prick off your Stationary distance.

Third, Upon this Stationary Line lay the Edge of your Index, then turn the Table upon the Head of your Staff, till through the sights you see the last Station you directed to; so will your Table be rectified to proceed with your work.

Example.

Fig. 99. Admit the following Figure G H I K L M N O P Q R S T U W X, represent a Field to be plotted by the plain Table, which is so large that it cannot all be plotted on the Table; and because I would have as much upon the Table as it will bear, I begin as near the Edge of my Table as I can; let us suppose the Table within the Frame to be understood by the Line Y A, therefore I make choice to begin at A, planting my Table there, and directing my sights to F; I measure the Stationary distance A F, which is almost the Length of the Table; then I come back to my first Station, and there again plant my Table in the same posture I did at first, so directing the sights to B, taking the Angles by the way, then to direct my sights to C, where I plant my Table, taking my Angles therefrom that are in view; next I direct the sights


76
81
86
90
93

to the Station at D, drawing a Line by the Edge of the Index to the farther end of the Table, as C d, where it runs off the Table; then because I can proceed no farther before I shift my Paper, and put a clean sheet upon the Table: I take this sheet off, and with Mouth Glew, I glew another sheet to it at YY; then I put them both together upon the Table in this order; *viz.* I bring the Station C, to the Station B, upon the Table, and so fasten them down with the Frame, so that the Line zz, possesseth the place of the Line AB, so that part of the Plot is yet upon the Table, *viz.* from C to e, and the rest of the Table being covered with fair Paper; then plant again your Table at the Station C, laying the Edge of the Index upon that part of the Stationary Line, which was drawn before your Paper was shifted, *viz.* C e, and extend it to D, upon your fair Paper, and then proceed to finish your Plot.

Note, There is another way to perform this work, *viz.* by the Scales of equal parts upon the Frame of the Table, which is taught in several Authors.

To take the Plot of any Champion Field containing 2000, or 3000 Acres of Ground, by the plain Table, and yet never be forced to change your Paper.

You must in this Case place your Instrument in every Angle, and so get every Angle and its Sides, not regarding the Length of the containing Sides, as you use to do, then must you measure every Hedg, and as you were wont to lay the same down by your Scale and Compasses. Here you shall only write the Length of every Hedge upon the Lines drawn upon your Paper, and corresponding thereunto, so have you finished, and you shall never be forced to shift your Paper, nor have the Lines to run off the same, for you may draw them as long, or as short as you please. Now when you come home, upon some sheet of Paper, protract all the Angles one after another, as you found them in the Field, allowing by your Scale and Compasses every Line its due Length: According as you find the same, note these Figures upon the said correspondent Lines, and you will produce a Figure like, and Proportional to the Field proposed. This is most excellent for large Champion Grounds, and therefore worthy of Note.

How

How to know whether a Plot be truly taken, by proving the work at every Station; and in case of Errors how to find and Correct them, before you are too far past them, by the plain Table.

First, In the plotting any Field by the plain Table; be sure to let your Station Marks stand up in every hole till you have finished your Plot; and likewise Marks in most of the material Angles of the Field; which by the following directions will inform you whether you have done right or not; and in Case of an Error committed, how to find where it is.

Second; When you are departed from your first Station, and have proceeded to your second, and taken all your Angles by the way, and planted your Table at your second Station, in order to proceed to your third Station, and would know whether the work of your first and second Station be right or not: Direct your fights to one or more of the most material Angles you took, as you proceeded from your first to your second Station; and if the Edge of your Index cut the Angles upon the Plot, your work is so far truly taken, otherwise not.

Third; When you have planted your Table at your third Station, and taken all the

Angles by the way; then direct your sights to your first Station; and if you find the Edge of your Index to cut your first Station upon your Plot, your work is exactly performed to your third Station, where you then are: But in case you cannot see your first Station mark from your third Station, or place of standing, then according to the last Rule of directions, direct your sights to some Angle in the Field which you have taken upon your Plot, and if the Edge of your Index, cut the same Angle upon your Plot, your work is right, otherwise not.

Fourth, Likewise when your Table is rightly placed or planted at your fourth Station, and all the Angles betwixt your third and fourth Station being taken, cast your Eye into that part of the Field you have plotted; and view which of your Station Marks you can see that you are already come from, *viz.* either first or second; as suppose you could see only your second Station mark, then direct your sights from your fourth Station, or place of standing, to your second Station; and if the Edge of the Index cut the second Station upon the Plot, your work is so far performed right, otherwise not; and if at any time you cannot see some one or more of your Beacons or Stationary marks, besides the last you came from, that you have already passed,

then

then make use of some Angle, to prove your Plot by, as I said before; and by observing this Method, 'tis easie to know whether you have committed any Error or not, and if you have, how and speedily to find it before you be gone far past it; which is so plain and easie, that it needs no farther Demonstration.

The best way of Measuring the several, and particular Quantites of Arrable Lands, Leys, and Meadows, lying in the open or common Fields; with short Directions for the taking in and inclosing a Lordship.

When the Surveyor is to proceed about the Survey of a Lordship, or Mannor, wherein the Lord and Free-holders are agreed to improve it, in laying each Mans Land together; it will be convenient to begin at one side of the Field, and there set down the name of your first Furlong; in a Book of a Quire of Paper, wherein each Page is divided into six Columns, so as the two first towards the Left-hand shall serve the Breadth of the Land at each end; the third or greater Column, shall contain the number of every Mans Lands, and also his Name; and the *4th*, *5th*, and *6th*, for the reduced Length, Breadth, and Quantity

Next after you have thus done, and are come to the Furlong where you began, express in your Book the Name of your Field, and the Furlong; then in the middlemost, or greater Column, note down the Name of the Free-holder that first begins it, with the number of his Lands; against which in the two first Columns towards the Left-hand, write the Breadth of the Lands at each end, and in the three last put the reduced Breadth, Length and Quantity; which done, set down the Name of the Free-holder that lies next, and the number of his Lands, together with the Length, Breadth and quantity, as before, and so proceed in order till you have finished the Furlong.

And so on from one Furlong to another, till you have finished the whole Field.

But that you may the more fully understand the Form thereof: I shall shew you in the following Example an absolute Method, how you may effect the same.

The

The Form of the Field B O O K.

Tourner's *Furlong beginning West, at the way leading to* Wombridge.

B	B	Persons Names.	Mean B	L	Content.		
C. L	C. L		C. L	C. L	A	R	P
5. 07	4. 15	*Samuel Hunt.* 2 Lands	5. 11	28. 00	14	1	9
6. 06	6. 00	*John Baker.* 3 Lands	6. 03	28. 00	16	3	14
8. 18	8. 14	*Samuel Hunt.* 5 Lands	8. 16	28. 04	20	3	21
1. 05	1. 13	*Tho. Smith.* 1 Land.	1. 09	28. 06	3	0	9

The Second Furlong beginning West.

B C.	B L.	P C.	P L.	Persons Names.	Mean B C.	Mean B L.	L C.	L L.	Content. A	R	P
17.	17	17.	65	*John Hills* 11 Lands.	17.	11	24.	00	4	0	10
1.	18	1.	06	*Joseph Strings* 1 Land.	1.	12	20.	05	2	0	39
1,	14	1,	08	*Han. Wheeler* 2 Lands.	1.	16	17.	03	1	3	38
2.	12	2.	10	*Tho. Frisk* 3 Lands.	2.	11	18.	05	3	2	9

After

After this manner you are to proceed from one Furlong to another, until you have finished your Field-Book; which being done, you are next to make a particular of every Mans Arrable, Leys and Meadows severally, to which purpose, upon a fair sheet of Paper, you are to make so many Columns, as there are Freeholders, every one whereof is to be subdivided into three, so will the first serve for Arrable, the second for Ley Ground, and the third and last for Meadow, if there be any: And if one sheet will not contain the whole, then may you take two or three, or so many as you see convenient.

Next you are to take the Plot, and general Survey of the whole, according to the Rules before delivered, and see if the Sum of all the Particulars agree with the Total, then you may conclude the work is right, but most commonly the Particulars will somewhat exceed the General Survey; and in this Case, that both may agree, you are to reduce the Sum of every Mans Particulars answerable to the Proportion of his Ground, which may be effected by the Golden Rule. For, if in the whole Field (which admit it be 1000 *Acres*) the Particulars exceed the General Survey 3 Acres, what shall 20 Acres? the *Answer* will be, 8 Perches, and so much I am to deduct out of the Sum Total

Total of such a Mans Particulars, according to which I am to Plot him 19 Acres 3 Roods, 32 Perches. And so of thee rest.

How to take the Plot of a Field from one Station taken in the middle thereof, by the Theodolite, or by the Degrees on the plain Table.

Fig. 100. Let ABCDE represent the Figure of a Field to be plotted by the plain Table in Rainy Weather. put on the Frame without a Paper, the graduted side upwards, and plant it in some convenient place, whence I can see all the Angles, as at O; then placing the Index upon the Table so that the fiducial Edge doth at the same time time go through the Center upon the Table, and the Lines upon the Frame of the Table cutting it Perpendicularly at 360, (*where the Degrees begin and end*) and 180 (*the exact half*) I turn about the Table upon the Staff-head, till through the sights (*the side marked with* 180 *being next mine Eye*) I see the Angle A, and then screw it fast, observing where my Needle cutteth, and by back-sight causing a Mark to be set up in the Line CD at the point E, that the Instrument may be kept firm from moving (*or be rectified if it be moved*) during the Work And now the Line AOE passing upon the Band from the Angle A, directly under

under the sights of the Instrument to the mark at F, is *(as it were)* the prime Diameter whence the Degrees of the Angles are to be numbred, and accordingly I mark the Angle A, in my Table hereafter to be exemplified with 360 Degrees. But to proceed, turning the Index with the fiducial Edge upon the Center, till I see that Thread cutting the Mark at at B, the said Edge cuts upon the Frame at 76 Degrees 15 Minutes: I note down for that Angle: The like work I do, turning the sights to C, D and E, *(but not to F, for there is no Angle but only a Mark in the Boundary)* and I find mine Index to cut for every Angle as I have Marked them within the pricked Circle of the last Figure, *viz.* 157 deg. 35 Minutes for C, 225 degrees 20 Minutes for D, and 278 Degrees and 50 Minutes for E.

Then I measure *(or cause to be strictly measured by others)* the distances betwixt the place where the Instrument stands, and every Angle, and find them to to be as I have set them upon the pricked Lines in the little Circle, *viz.* A 4 Chains 20 Links, B 4 Chains 3 Links, C 3 Chains 84 Links, D 5 Chains 35 Links, E 6 Chains 6 Links. And now my Table both for Lines and Angles is thus perfected.

Field Book.

	D	M	D	L
A	360	00	4	20
B	76	15	4	03
C	157	35	3	84
D	225	20	5	35
E	278	c	6	0

ed, and the work is ready for Protraction within Doors.

Now to protract our Observations: I draw upon Paper a Line A F at Adventure, so it be long enough, and stick a pin in it at pleasure for the Center O, upon which I place the Center of the Protractor, so that the streight side of the Protractor may lye upon the Line AF, the Limb or Arched side being upwards towards B, by the help whereof I make a prick on the Paper at 76 deg. 15 Min. for B, and at 157 deg. 35 Min. for C, according to the numbers in my Field-Book.

Then turning the Protractor about the pin, with the Limb down towards D and E, till the Diameter lye again just upon the Line AF, I number downwards from the Right-hand towards the Left, beginning 190, 200, *&c.* And ove-ragainst the place where 225 degrees 20 Minutes and 278 degrees 50 Minutes fall, I prick the Paper at the side of the Limb, and through those four points. I draw so many several Lines, upon which, and also upon the Line A O, I mark out by points the true measure of every Line by a Scale from the Center, and from those points drawing the Lines AB, BC, CD, DE, and EF, I have the true Plot of the Field.

How-

How to take the plot of an Irregular Field by the Theodolite or by the Degrees on the plain Table by going round the same, being the best Method in Practice.

Fig. 101 First cause marks to be set up at every Station, as A, B, C, D, E, F; then making Choice of a Station at A to begin at: Measure from A, to the Hedge at a, which you'll find to be 35 Links, which note down in your Eye Draught or Field Book, likewise measure from A, to the Hedge at b, and you'll find it to be 20 Links, which Note down; then measure from your Station A, towards B your second Station. and at 6 *c.* 40 *l.* you have an off-set of 30 Links to the right at the corner c, and at 6*c.*50*l.* you have measured to your second Station at B, where you are to fix your Instrument and take the Angle ABC, which is found to be 126° 30′ which note down; then measure from your Station B to your Station C: which contains 3*c.* 25 *l.* at Station C, measure to the Hedge at right Angles to d; which let be 35 Links, and from C to the Hedge at e, is 20 Links, fixing your Instrument at C take the Angle: B C D, which contains 104° 0′; then measure in a streight Line from C: towards D, and at 1 *c.* 70 *l.* you have an off-set to the Corner at f, which contains 25 Links; at 2 *c.* 50 *l.* you have an off-set to the Corner g: which is

1 *c.*

1 *c.* 20 *l.* at 3 *c.* 90 *l.* you have another, at h, of 1 *c* 40 *l.* then measuring on 6 *c.* 30 *l.* you are come to your Station D: measure from D to the Hedge at right Angles to i, which is 80 Links, and from D to k: which is 50 Links: Then fix your Instrument at D: and take the Angle CDE: which is 75° 30′: Measuring along the Line DE, you'll find that at 3 *c.* 60 *l.* you have an off-set of 1 *c.* 50 *l.* to the Angle at l: and at 8 *c.* 15 *l.* you have an off-set of 1 *c.* 50 *l.* to the Angle at m: and at 13 *c.* 20 *l.* you have measured to your Station at E: from E to the Hedge at right Angles measure to n: which is 30 Links, and from E to o, which is 30 Links also: Then fix your Instrument first at E, and take the Angle DEF, which is 99° : 0′, then measuring in a streight line from E towards F: you'll find that at 4 *c.* 10 *l.* you touch the Hedge, and at 8 *c.* 30 *l.* you have measured to your Station at F: From F to the Corner q, at right Angles contains 53 Links; because you have measured to the very Corner, you have no occasion to measure from the Station F, to the Hedge at r: Having fixt your Instrument at F: take the Angle EFA which contains 108° 30′ then measuring from F: towards A you'll find that at 2 *c.* 70 *l.* you have an off-set of 85 Links to the bend at S: and at 6 *c.* 65 *l.* you have measured to your first Station at A: where you began.

How

How to protract these Observations.

First draw an obscure line at pleasure, as AB, then with your thin Ruler, having 27 equal parts in an Inch placed upon the very Edge (*being the number that this Draught was protracted by*) apply the Edge of this Ruler to the Line AB, and with your protracting pin make a mark at 35 Links, from A to *a*; then place the Edge of your Ruler at right Angles to the line AB, and prick off 20 Links from A to b: then place the beginning of your Scale at the point A: the Edge being laid along the Line AB, by your Field Book or Eye Draught you'll find that at 6 *c.* 40 *l.* you have an off-set to the Corner *c*: which accordingly prick off, and draw the Black-line b c, then at 6 *c.* 50 *l.* prick off the length of the Line AB; at the point B, with your protractor lay down the quantity of the Angle ABC 126*d*: 30, and with your thin Ruler prick off upon the Line BC 3 *c.* 25 from B to C, at the Station C: prick off 25 Links to d, and 20 Links to *c*: both being at right Angles; at the point C: Protract the quantity of the Angle BCD 104*d* 0', then with your Scale prick off upon the line CD 1 *c.* 70 *l.* and at right Angles to this point prick off 25 Links to the Hedge at f: Then draw your boundary Line through the point f and e:

and

And likewise through c, and d, and where these Lines Intersect gives you the very corner at x: Next from the point C, prick off 2 *c*. 50 *l.* and at right Angles to the point at 2 *c*. 50 *l.* prick off 1 *c*. 20 *l.* to the Hedge at g, and draw the black Line g f: Next from the point C: prick off 3 *c*. 90 *l.* and at that distance prick off 1 *c* 40 *l* at right Angles, to the Hedge at h, and draw the Black-line h g, then from the point C prick off 6 *c*. 30 *l.* to the Station at D; at this Station D prick off 80 Links to the Hedge at c, and 50 Links to k, both at right Angles: At the Station D prick the Quantity of the Angle CDE with your protractor, which contains 75° 30′ then from the point D, with your Scale prick off 3 *c*. 60 *l.* and at right Angles to this Mark last set off, prick off 1 *c* 5° *l*, to the Angle at C, and draw the Lines l k and h i, till they intersect each other, which will give you the corner at z. At the Station D. Prick off 8 *c*. 15 *l.* from your Scale of equal parts, and at right Angles to this last Mark prick off 1 *c*. 50 *l.* to the Angle at m; and draw the Black-line m l. At the Station D, prick off upon the Line DE 13 *c*. 20 *l.* to the Station at E; from this Station prick off 30 Links at right Angles to the Hedge at n, and 30 Lin. to the Hedge at o; at the point E protract the Quantity of the Angle DEF with your protractor, which contains 99° : 0′ then

from

from the point E prick off 4 *c* 10 *l.* where it touches the Hedge at p, then prick off 8 *c.* 30 *l.* to your Station at F. prick off at the point F 50 Links at right Angles to the corner at g, then draw the Black-lines p q p o. Likewise draw the Black-lines m n; where the two Lines m n and p o Intersect gives you the very corner of the Field at y: at the point F, protract the Quantity of the Angle EFA with your protractor, which contains 108° 30, and if the Line FA falls in the point A; your work is right so far: From the point F prick off 2 *c.* 70 *l.* from which point prick off at right Angles 85 Links to the Angle at s; then from the point F prick off 6 *c.* 65 *l.* and if 6 *c.* 65 *l.* reaches just to the point A, you may be assured your Survey was taken truly. To enclose your Field draw the Black-line from q to s, and from s to a, the line c b and f a being continued, will intersect at w, the very corner which encloses your Field.

N. B. As I have recommended in this Example the thin Ruler with equal parts, upon the very Edge to protract with, being much better than Compasses on many Accounts, as every Surveyor will find. So I wou'd advise every Surveyor, that is curious, to make use of Mr *Ward's* Protractor improved: The Semi-Circle is made near as usual; upon this Semi-Circle is moveable Index of 7 Inches long, the upper part

part being 5 degrees from the Center, and the lower part next the Limb; 4 Degrees, so that each Edge will be Diagonal of one deg. upon this Edge is unequal Divisions Calculated to every Minute. This Description is according to Mr *Wards*, instead of having the Index thus made, I think it much better to have that part of the Index above the Limb to be part of an Arch of two degrees, and the other part supposed to pass thro' the Centre: Now upon this Index the Divisions will be equal, and will be considerably larger at the beginning of the Divisions than in the other. The Demonstration of this depends upon *Theo.* 13 where 'tis proved that the Angle at the Center is double to that at the Circumference. The use of this Instrument is very easy; for you have no more to do but to set the Index to the whole degrees observed, and upon the Index graduated, prick off the Minutes: This Protractor with Scales, as before mentioned, with all sorts of Mathematical Instruments, are made and sold by *Benjamin Scot* (*who served his time with Mr* Rowley,) he keeps a Shop at the Mariner and Globe over against *Exeter Change* in the *Strand*.

Having now recommended proper Instruments for protracting your Observations, I cannot avoid acquanting the Reader, that the best Instrument to take Angles, is the

Theodo-

Theodolite with Telescope sights, as every Practioner will soon find the Advantage; as for the plain Table, it is a proper Instrument for Learners of this Art to use it for a small Inclosure or two, such as Gardens, or Ground-plots of Houses, *&c.* But 'tis a shame for any Artist to use this Instrument to Survey a Gentlemans Estate. I have Surveyed after those who have used this Instrument, and I have increased upon him no less than two Acres in a Field of 20. This was occasioned by his going out in such a Morning that was Foggy, which dampt his Paper, and after he had workt about two Hours the Sun shone out and diminished his plot upon his plain Table to the above-mentioned two Acres. The like Error has been committed by the Circumferencor. I hope Gentlemen and others will take this into their Consideration, and not suffer themselves to be imposed upon by having such Instruments used in Surveying their Estates.

The Dividing (or cutting off) *both Right lined and Irregular Figures, into as many parts as you shall require, equal or unequal.*

PROBLEM. I.

To cut off from a Triangle any parts, as $\frac{1}{2}\frac{1}{3}\frac{1}{4}$, *&c.* with a Line issuing from any Angle assigned.

RULE.

RULE.

Triangles consisting of equal Bases, and and in the same Parallel are equal; therefore take $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{40}$, &c. of the Line opposite to the Angle; draw a Line, which shall include a Triangle to contain the parts required.

Example.

Fig. 102. Admit ABC, to be a Triangle, whose $\frac{1}{4}$ part is required to be cut off, with a Line issuing out of the Angle B, to cut the Line AC; and then will AB be one side of the Triangle: Then let the $\frac{1}{4}$ part of the Triangles Base be taken, which endeth in D, and let the Line BD be drawn, which includeth the Triangle ABD, which is the $\frac{1}{4}$ part of the Triangle ABC.

PROBLEM II.

To cut off from a Triangle any number of Measures, as 4, 6, 8, 32, &c. with a Line issuing out of the Angle assigned.

RULE.

First Measure the Area of the whole Triangle, then multiply the side opposite to the

the Angle aſſigned by the parts to be cut off, and divide the product by the Area of the whole Triangle; the Quotient ſhews how much you ſhall cut off, to make a Triangle to contain the required.

Example.

Fig. 102. Let ABC be a Triangle given, and let the Propoſition be to cut off 84 parts, with a Line iſſuing from the Angle B, and falling on the Line AC, and making BC one of the ſides of the new Triangle; firſt, the whole content of the Triangle ABC, is found to be 336. Having proceeded thus, let 84 be the Numerator, and 336 the Denominator, which being abbreviated thus, $\frac{84}{336}$, $\frac{42}{168}$, $\frac{21}{84}$, $\frac{1}{4}$ of the Content; then proceed in all reſpects as you did in the laſt Problem, and you ſhall find the Triangle BCD, to contain 84 parts of the Area of the Triangle ABC, which was required.

Arithmetically performed.

Firſt, The Content or Area of the whole Triangle ABC, being found to contain 336, and the Line AC 42; then ſay by the Rule of Proportion, as the whole Area 336, is to 42; ſo is the leſſer Area 84, to a fourth Number, which is found $10\frac{1}{2}$ in the ſame

Parallel, which set from C towards A, which falleth in D: Then draw the Line BD, which Triangle BCD, contains 84 parts, the thing required.

PROBLEM III.

To cut off any number of parts, as 20, 40. 60, &c. in a Triangle, Proportional to the Triangle given, with a Line parallel to any side given.

RULE.

First, Measure the whole Triangle, then Square any of the sides, in which you would have the Parallel to cut; that Square number multiply by the parts given to be cut off, and divide the product by the Area of the whole Figure; out of which Quotient extract the Square-Root, and it shews how much you shall take of the side of the Triangle, to make a new Triangle; with which Measure found, set from B to G.

Example.

Fig. 103. Let ABC be a Triangle given, from which 112 is to be cut off with a Line Parallel to the Line CA; the Triangle being measured, and found to be 336, then

then put 112 over for the Numerator, and 336 under it for the Denominator; and by abbreviating it, you ſhall find the ſame to be $\frac{1}{3}$, then having deſcribed the Semi-Circle on the Line AB, divide the Line AB into 3 equal parts, and from one of them erect the Perpendicular DE; then take the diſtance from B to E, and ſet the ſame from B, towards A, which endeth in F; by which point draw a Line Parallel to AC: So the Triangle BGF doth contain 112, as was required.

Arithmetically performed.

Firſt, Square the ſide BC 20, which makes 400; then ſay, as 336 is to 400, the Square of that ſide, ſo is 112 to 133$\frac{1}{3}$, whoſe Square Root is 11$\frac{2}{3}$ near rational; which is the diſtance from B to G; ſo a Line drawn from G Parallel to CA, you have the Triangle BGF, which contains 112, as before.

PROLEM IV.

From a Triangle given, to lay the parts cut off in a Trapezium; if there be a Proportion given between the parts cut off, and the whole Figure.

Example.

Fig. 104. Let the Triangle ABC be given, from whence $\frac{2}{5}$ is to be cut off in a Trapezium: First then on the Line CB describe a Semi-Circle; then divide CB into 5 equal parts, and of 3 of them from B, erect the Perpendicular DE, then setting one Foot of your Compasses in B, extend the other to E, which distance set off from B towards C, which endeth in F; by which point draw a Line Parallel to AC: So I include the Triangle GFB, to contain $\frac{3}{5}$ of the whole: And consequently the Trapezium ACFG doth contain $\frac{2}{5}$ of the same as was required.

Arithmetically performed.

First take $\frac{2}{5}$ from the whole, the remainder will be $\frac{3}{5}$; then by the last Problem make the Triangle GFB to contain $\frac{3}{5}$, and then it will follow, that the Trapezium ACFG must contain $\frac{2}{5}$ of the whole Triangle, which was required.

PROBLEM V.

To divide a Triangle, when the Line of Partition goes not parallel with any side, take this Example.

Fig.

Fig 105. Let ABC be a Triangle to be divided into two parts which shall bear Proportion to one another, as 3 and 2, by a Line drawn from the point D in the Base or Line AC.

From the limited point draw a Line to the Angle B; then divide the Base AC into five equal parts, and from the third point of Division draw the Line to E, Parallel to BD. *Lastly*, from E draw the Line ED, so shall the Trapezium ABED be in Content as three to two, to the new Triangle DEC.

I have now done with the Division of Triangles, when I have added these three Advertisements.

First, You must be sure to take very exactly the distance of every Point, where a dividing Line cutteth any side, to one of the ends of the same side, as in the last Figure, the distance BE and AD, which distances being applied to the Scale by which the Figure was protracted with, will shew at how many Chains and Links end, you are to make your dividing Line on the Field itself.

Second, The proportions by which you are to divide, are not always so formally given as in the former Example, but are sometime to be found out by Arithmetical working, as in this Case.

Suppose a Triangle of 6 Acres, 2 Roods, 31 Perches, must be divided, so as the one of the 2 parts shall be 4 Acres 3 Roods, and 5 Perches, and the other consequently 1 Acre, 3 Roods, and 26 Perches; reduce both measures into Perches, and the one will be 765, and the other 306. There Sum is 1071; which by their common measure being reduced into their lowest terms of Proportion in whole numbers, will be 5, 2, and 7, which shews that the Triangle being divided in 7 equal parts, the one must have 5 of those 7 parts, and the other 2. And observe that it will be sufficient to find the common measure between the Sum of the Terms, and either of the Terms; the Method whereof is shewed in every Arithmatical Book for reducing Fractions into their lowest Terms.

Third, In these and all other Divisions of Land, where a strict Proportion of Quantity is to be observed, you must have respect to the Rules hereafter delivered. But if there be any useful Pond or Well to draw the Line of Division through; but if there be an unuseful Pond, Lake or Puddle, or if there be any Boggy or barren Ground, that must be cast out in the Division; measure that first, and substract it from the Content of the whole Close, and then lay the just Quantity of the remainder on that side that is free from it, that the other may have his

his juſt part alſo, beſides that which is uſeleſs.

PROBLEM VI.

To cut off from a Square any part propounded in a Parallelogram.

RULE.

Divide the parts to be cut off, by the ſide of the Square; the Quotient ſhews how much of the ſide of the Square you ſhall take for the Breadth of the Parallelogram; at which diſtance draw a Parallel Line, which ſhall include the Parallelogram required.

Example.

Fig. 106. Admit ABCD to be a Square given, whoſe ſide is 20; from whence 160 parts is to be cut off with a Line Parallel to CD, ſo then CD makes one of the ſides of the Parallelogram; then work as is before taught, and draw the Line EF; which includeth the Parallelogram CDEF, and contains 160, the parts required.

Note, And if you would have cut off $\frac{2}{3}$, $\frac{7}{15}$, *&c.* then you muſt divide the Square Side to be cut off into theſe Proportional parts, and ſo by thoſe parts draw a Parallel Line, which would have included a Parallelogram to have contained the parts Proportionable.

PROBLEM VII.

From an Irregular Figure to cut off any parts required.

RULE.

Meaſure ſo many Triangles lying next to the part aſſigned, till you have ſomething too much, then by the firſt and ſecond Problem of this part, cut of the overpluſs from the laſt Triangle, ſo ſhall you have a Figure to contain the parts required.

Example.

Fig. 107. Admit ABCDEFG to be a Plot, from whence 480 parts are to be cut off with a Line iſſuing from C, and to be towards the ſide AB: Firſt, let the Trapezium ABCG be meaſured, whoſe Area is 370, which added to 136, the Area of the Triangle CFG maketh 506, which is too much by 26, which 26 let be cut off from the Triangle CFG, by the Line Cb; ſo doth the Figure ABCbG, contain 480, the parts required to be cut off.

Note, This Problem is very material in the Practice of Surveying, in dividing and

laying

laying out Grounds, whether into parts equal or unequal; which every Surveyor ought well to acquaint himſelf with.

For the better underſtanding this point, we will ſuppoſe a point given in the Perimeter of the Plot, from which the ſaid Plot is to be divided into as many equal parts as ſhall be required: Firſt, Meaſure the Area of the whole Plot, then divide that Content by the number of parts to be cut off, and the Quotient ſheweth how many meaſures each part ſhall contain; then cut off each part ſeverally, as you were taught in the preceeding work.

PROBLEM VIII.

To divide a Common-Field or Paſture, into as many parts as ſhall be required, according to each Man's Proportion of Rent.

Example I.

Fig. 108. Let ABCDEFGHIK, be a Common-Field or Paſture, in the Uſe and Occupation of three Men, *viz.* A, B, C, and it is agreed by them all, that each Man ſhall have his Proportion of Ground laid out, according to his Quantity of Common in the ſame place.

First, Measure the whole Field, and it will be found to contain 35 A. 3 R. 15 P. or 5735 Perches; then consider how many Beast-Gates there are in the Pasture, and divide the Quantity of the Field accordingly by the rule of Proportion, thus; saying, if the whole number of Beast-Gates of A, B, C give the whole Quantity of Perches in the Field 5735, what shall the number of them belonging to A, be, and the Answer will be his part; and so work severally for each Mans part: But we may suppose them thus, to A, 1817 Perches, to B, 1716 Perches, to C, 2202 Perches. Then to lay out every Mans Plot, I divide the Figure by the Directions aforegoing by the Lines B L, and CM, which to lay out upon the Ground, take from your Scale the distance on the Plot between H and L, then measure out the distance on the Ground from the Angle H to L, also from the Angle A, Measure out 31. 16 to B, then draw the Line BL; again take from your Scale the Quantity of LM 28. 00, which measure on the Ground from L to M, and there set a Mark: and in like manner Measure from B to C upon the Ground 25. 10, equal to BC upon the plot, drawing the Line CM: So is your plot divided according to every Mans just Quantity and Proportion.

Example.

Example II.

Fig. 109. But ſuppoſe it was required to divide this Field between three Perſons, *viz.* A, B, C, according to each Mans proportion of Rent; As ſuppoſe the whole Grounds to be 20 Pounds a Year, whereof A pays 9 *l.* B 7 *l.* C 4 *l.* the Queſtion is, how many Acres, Roods and Perches belong to each Man, according to his Proportion of Rent, which by the Rule of three argue thus, (*firſt for A*) If 20 *l.* the whole Rent, give 5735 Perches, (*being the Content of the whole Field in Perches,*) what will 9 *l.* give? *viz.* 2581 Perches, or 16 A 0 R. 21 P. being the proportion of Ground belonging to A, for his 9 *l.* Rent. In like manner, B will have 12 A. 2 R. 07 Perches, being his Quantity of Ground proportionable to his Rent of 7*l.* and C for his 4 *l.* Rent, will have 7 A. 0 R 27 Perches. Then to lay out theſe parts upon the Ground, obſerve the directions in the former Example.

PROBLEM IX.

To divide a Field into three equal parts, and each Man to have the Benefit of a Pond about the middle of the Field.

Suppoſe *Fig.* 110. containing 27 Acres is to be divided between three Men, each to have 9 Acres

Acres, and the Lines of Division to run from a Pond in the Field, so that every one may have the Benefit of the Water, without going over anothers Land.

First from the pond ⊙ draw Lines to every Angles ⊙ A, ⊙ B, ⊙ C, ⊙ D, ⊙ E, and then is the Figure divided into 5 Triangles each of which measure, and put the Contents severally; which Contents reduce all into Perches so will the Triangle,

A ⊙ B	be	674	Perches.
B ⊙ C		390	
C ⊙ D		1238	
D ⊙ E		911	
E ⊙ A		1107	
		4320	

The whole Content being 4320 Perches or 27 Acres, each Mans Proportion being 1440. From ⊙ to any Angle draw a Line for the first division Line as ⊙ A. Then consider that the first Triangle A ⊙ B, is but 674 Perches and the second B ⊙ C 390, both together but 1064 Perches, less by 376 than 1440, one Mans Portion: You must therefore cut off from the third Angle C ⊙ D 376 Perches for the first Man's Dividing Line; which thus you may do: The Base DC is 18 Chains; the Content of the Triangle

Triangle 1238 Perches: Say then, if 1238 Perches give 18 Chains, 00 Links, what shall 376 Perches give? *Answer*, 5 Chains 45 Links; which set from C to F, and drawing the Line ⊙ F, you have the first Mans part, *viz.* A ⊙ F.

Secondly, See what remains of the Triangle; C ⊙ D 376 being taken out, and you will find it to be 862 Perches, which is less by 578 than 1440. Therefore from the Triangle D ⊙ E cut off 578 Perches, and the point of Division will fall in G. Draw the Line ⊙ G, which with A ⊙ and ⊙ F divides the Figure into three equal parts.

PROBLEM X.

To make a Parallelogram having an Angle equal to any Angle given; and a side of any Length, which shall be equal to the Area of any Right-lined Figure whatsoever.

Fig. 111. Let ABCDE represent a Field of 5 unequal Sides, and it was required to lay out a Parallelogram that shall contain the same Area, draw the prickt Lines E B and DB, then have you made the Field to consist of three Triangles. Make the Triangle a b e equal to the Triangle ABE by *Prob.* 8. Divide the Base e b into two equal parts at z, and draw the Line a z, which divides the Triangle e a b into two

equal

equal parts, *viz.* the Triangle e a z = to the Triangle abz (*by Theorem* 10;) at the point z make the Angle n z b = to the Angle F, draw n m Parallel to z b, and of equal Length to z b, draw m b Parallel to n z and of equal Length to n z, then is the Parallelogram m n z b equal to the Triangle e a b. Now because it is required that a Parallelogram should have its side equal to the Line AB, continue the Line n m, and make m x eqal to AB, continue the Line z b, and make br equal to m x, and join, the Line x r, from the point x and b, draw the prickt Line at pleasure, continue the Line n z to intersect at the point o, draw o y Parallel to z r, and continue the Line m b to intersect at p, making p y equal and Parallel to b r, and join the Line r y; then is the Parallelogram b r y p, equal to the Parallelogram n m b z, by *Theorem* 11. In like manner make the Parallelogram p y q s equal to the Triangle EBD.; likewise make the parallelogram s q f h equal to the Triangle DBC, then will the Parallelogram b r f h be equal to the Right-line Figure ABCDE QEF and QED.

If it were required to lay out a Right-angled Parallelogram equal to the same Right-lined Figure, and the Side equal to the Line AB, let the Right-lined Figure ABCDE contain 12 Acres, adding 5 Cyphers to it, the same Field will contain 1200000 Square Links: Let the Line AB represent

present the Length of a Hedge given containing 60 Chains or 6000 Links; Divide 1200000 by 6000 and the Quotient will be 2000 Links or 20 Chains for the Breadth of the Right-Angled Parallelogram; for 2000 Links multiplyed by 6000 Links, produces 1200000 Square Links, or 12 Square Acres.

To reduce Statute-measure to Customary-measure, and the Contrary.

Although an Acre of Land by Statute is to contain 160 Square Perches, of 16 Feet and ½ in the Perch; yet in some places of the Nation, through long Custom, there is at this day other Perches used, as 18, 20, 24, and 28 Feet to the Perch; it is therefore necessary to shew how to reduce Statute-measure to Customary, &c.

Suppose therefore you would reduce Statute measure to Wood-land-measure of 18 Feet to the Perch, then say,

As the Square of the greater Perch of 18 Feet, is to the Square of the lesser Perch of 16 Feet and ½; so is the Content in Acres according to the lesser Perch, to the Content in Acres, according to the greater Perch.

Example.

Example.

Let it therefore be required to reduce 36 Acres, 2 Roods, 10 Perches, at 16 Feet and $\frac{1}{2}$ to the Perch, into Wood-land-measure of 18 Feet to the Perch.

First, You must observe that the Square of 16 Feet and $\frac{1}{2}$ is Decimally 272, 25, and the Square of 18 Feet is 324; then I reduce the 36 Acres 2 Roods, 10 Perches, into Perches, which makes 5850, then I multiply the same by the Square of the lesser Perch, 272. 25, and the Product is 1592662. 50, being divided by the Square of the greater Perch 324, the Quotient is 4915, 625, which is 30 Acres, 2 Roods, 25 Perches for the *Answer.*

But suppose you would reduce Wood-land-measure into Statute-measure, then say,

As the Square of the lesser Perch of 16 Feet and $\frac{1}{2}$, is to the Square of the greater Perch 18 Feet; so is the Content in Acres according to the greater Perch to the Content in Acres, according to the lesser Perch.

How to cast up the Content of any Plot, in Acres, Roods, and Perches.

Fig. 112. Admit the following Figure noted with the Letters A, B, C, D, E, F, G, H, I, be the plot of a Field, whose Content

Content in Acres, Roods and Perches is required.

First, Then (*in all such Cases*) divide your Plot into Trapezia's and Triangles; accordingly this Figure is divided into one Trapezium, as K, D, P, I, and four Triangles; for finding the Area of all which, begin with any one first, and multiply the whole of the Base by one half of the Perpendicular, or (*which is alone*) the whole of the Perpendicular, by the ½ of the Base; the product either of the Content of that Triangle; and then Sum up all the Area's of the several Triangles together, gives you the Content of the whole Plot.

		A.	R.	P.
Let the Area or Content of the Trapezium and Triangles be.	Trap. KDPI	7	2	25
	Trian. ABK	0	1	00
	Trian. BCD	1	0	01
	Trian. DEF	1	3	00
	Trian. EGP	1	3	15
The Area of the whole Field.		12	2	01

But the most exact way of all, is to multiply the Length of the Base of each Triangle, by the Length of the Perpendicular; the Sum Total of all the Triangles being halved, gives the true Area of the whole Field in Square Links, (*or Chains and Links*);

Links,) which may be reduced at last (*by the former Directions*) into Acres, Roods and Perches.

Of laying out New-Lands.

A certain Quantity of Acres being given, how to lay out the same in a Square Figure.

R U L E.

Annex to the number of Acres given five Cyphers, which will turn the Acres into Links; then from the Number thus increased, extract the Square Root, which shall be the side of the proposed Square.

Example.

Suppose the Number given to be 100 Acres, which I am to lay in a Square Figure; I join to the 100, five Cyphers, and then it is 10000000 Square Links, the Root of which is 3162 nearest, or 31 Chains 62 Links the Length of one side of the Square.

Again, If I were to cut out of a Corn-Field one Square Acre, I add to one five Cyphers, and then it is 100000, the Root of which is 3 Chains 16 Links, and something more, for the side of the Acre.

How

How to lay out any given Quantity of Acres in a Parallelogram, whereof one side is given.

R U L E.

Turn first the Acres into Links, by adding as before five Cyphers; that Number thus increased, divide by the given Side, the Quotient will be the other Side.

Example.

Let it be required to lay out 100 Acres in a Parallelogram, one side of which shall be 20 Chains: First to the 100 Acres I add five Cyphers, and it is 100, 00000, which I divide by 20 Chains, the Quotient is 50 Chains, for the other side of the Parallelogram.

How to make a Triangle that shall contain any number of Acres, being confined to a certain Base.

R U L E.

Double the given number of Acres, to which annex five Cyphers, which divide by the Base; the Quotient will be the Length of the Perpendicular. This needs no Example.

How

How to find the Length of the Diameter of a Circle, which shall contain any Number of Acres.

RULE.

Say, as 11 is to 14, so will the Number of Acres given, be to the Square of the Diameter of the Circle required.

Example.

What's the Length of the Diameter of a Circle, whose superficial Content shall be 100 Acres? Add five Cyphers to the 100, and it makes 100 00000 Links, which multiply by 14 it makes 140000000; which divide by 11, gives for the Quotient 12727272; the Root of which is 35 Chains, 67 and somewhat more. And so much shall be the Diameter of the required Circle.

Of Reduction.

How to reduce a large Plot of Land or Map into a lesser Compass, according to any given Proportion; & *contr*, how to enlarge it.

Fig. 113. The best way to do this, is, if your plot be not too large, to Plot it over again by a smaller Scale; but if it be large,

as

as the Map of a County, or the like, the only way is to compass in the Plot first within one Square, and afterwards to divide that into as many little Squares, as you shall see convenient. Also make the same number of little Squares upon a fair piece of Paper, by a lesser Scale, according to the Proportion given. This done, see in what Square, and part of the same Square, any remarkable Accident happens to fall, and accordingly put it down in the lesser Squares; and that you may not mistake, it is a good way to number your Squares. I cannot make it plainer then by giving you the following Example, where the Plot ABCD, made by a Scale of 10 Chains in an Inch, is reduced into the Plot EFGH, of 30 Chains in an Inch.

What has been hitherto said concerning reducing of a Plot from a greater to a lesser Volumn, the same is to be understood *vice versa*, of enlarging a Plot from a lesser to a greater. But this seldom comes in Practice.

Knowing the Content of a piece of Land, to find out what Scale it was plotted by.

First, By any Scale measure the Content of the plot; which done, the Proportion is as the Content found, is to the Square of the Scale it was tried by; so is the Content, to the Square of the true Scale it was plotted by.

Example;

Example.

Admit, there is a plot of a piece of Land containing 10 Acres, and I measure it by a Scale of 11 in an Inch, find it contain 12 Acres.

Then I say; if 12 gives for its Scale 121, What shall 10 give?

Answer, 10. Therefore I conclude it was plotted by a Scale of 10 in an Inch.

FINIS.

APPENDIX.

APPENDIX.

How to take the Ground-plot of any City or Corporation by the Theodolite or Degrees on the plane Table.

FOR the performance of which, it will be necessary for the young Surveyor to provide himself of a Chain that is 50 Foot long, containing 50 Links, and each Link a Foot; for all Cities are best laid down by a Scale of Feet: It will be convenient that he have a Rod that is 5 or 10 Foot in Length, and to be subdivided into Feet: This Rod is to take the Off-sets of the Houses on both sides your Chain, as you measure along the Streets or Lanes.

Example.

Example.

Let *Fig.* 1. be a part of some City, and you are required to take a Ground-plot thereof.

First, Cause two Men to stand, one at B, and the other at F; then placing your Instrument at A, laying the Index upon the Diameter, turn it about until through the Sights you espie the Man at F; then screw your Instrument fast, and direct your Sights to the Man at B, and note the degrees cut by the Index, which let be 95 deg. and 30 min. Note this 95 deg. and 30 min. down in your Field-Book, as you did when you measured the Lane; then with your Rod measure your Off sets both the Right and Left, as you did in measuring the Lane also; which you will find to be to the Right 5 Feet; then with your Chain measure towards B, and at 6 Foot distance from A, you will have your Off-set to the Left to be 7 Feet; note both these down in your Feld-Book or Eye-draught, which is best to represent the thing; then measuring on toward B, you will find that at 47 Feet distance from A, you will have a Street both to the Right and Left, and the Off-set to the Right will be 10 Foot, and to the Left 6; note these down in your Field Book or Eye-draught; then still measuring toward B, you

you will find that at 90 Foot diſtance from A, you will have an Off-ſet to the Left that is 5 Foot; note this down in your Feld-Book, and at the ſame time your Off-ſet to the Right will be 11 Foot; note this down alſo; then come to B, where one of your Men ſtood, and by meaſuring with your Chain, you will find the diſtance between A and B to be 100 Foot; then placing your Inſtrument at B (cauſing the Man that ſtood at F, to ſtand at A, ſo ſoon as you took your Inſtrument up from A) laying your Index upon the Diameter, turn your Inſtrument about until you through the Sights eſpy the Man at A; there make your Inſtrument faſt, and cauſe the Man that ſtood at B, to go and ſtand at C; then direct your Sights to C, and note the deg. cut by the Index, which let be 140 deg. then with your Rod meaſure the Off-ſet both to the Right and Left, and you will find that to the Right is 11 Foot, and to the Left 8 Foot; then cauſe your Men to meaſure towards C, in as direct a Line as they can, and at 61 Foot diſtance from B, you have a Street both to the Right and Left; then meaſure the Off ſets, and you will find it will be 9 Foot on both ſides the way, *viz.* to the Right and Left, at 120 Foot diſtance from B, the Off ſet to the Left will be found to be 8 Foot, and at 127 Foot diſtance from B, the Off ſet to the right is 8 Foot alſo;

then you will find you are come to C; then cause a Man to go and stand at B, and another to stand at D; place your Instrument at C, and lay the Index thereof upon the Diameter, turning it about till through the Sights you espie the Man at B; there screw your Instrument fast; then direct your Sights to the Man at D, and the Index will be found to cut 100 deg. and if you measure with your Rod, the Off-set to the right at the same time, it will be found to be 8 Foot; then measure with your Chain towards D, and at 8 Foot distance from C, the Off-set to the left will be found to be 9 Foot; then measure on with your Chain, and you will find that at 64 Foot distance from C, the Off set to the left is 4 Foot, at 75 Foot the distance of CD, the Off-set to the right is 12 Foot; then place your Instrument at D, and cause a Man to stand at C, and another at E; and laying the Index of the Instrument upon the Diameter, turn it about till through the Sights you espie the Man at C; there make your Instrument fast; then direct your Sights unto the Man at E, and you will find that the Index will cut 100 deg. then with your Rod measure the Off-set to the right, and it will be found to be 9 Foot, and the Off-set to the left 11 Foot; then with your Chain measure towards E, and at 41 Foot distance from D you will have a Street to the right and left; then measuring on towards E, you will find that at

92 Foot distance from D you will have an Off set to the Right of 5 Foot, and the whole distance between D and E will be found to be 100 Foot; then placing your Instru- at E, cause a Man to stand at D, and another at F, and lay the Index upon the Diameter, and turn your Instrument about till you espie the Man at D; there make fast your Instrument, and direct your Sights to F, and note the degrees cut by the Index, which will be found to be 216 deg. then with your Rod measure the Off-set to the Right, and it will be found to be 7 Foot; then with your Chain measure towards F, and at 9 Foot distance from E, you will have a Street both to the Right and Left; the Off set at the same time will be found to be to the Right 7 Foot, and to the Left 12 Foot; still measuring towards F, you will find that at 70 Foot distance from E, your last Station, you will find the Off set to the Left to be 7 Foot, and the Off set to the Right to be 7 Foot, the whole distance between E and F is 81 Foot, then placing your Instrument at F, cause a Man to stand at A, and another to stand at E, the place where you last had a Station, then laying your Index upon the Diameter of your Instrument, turn the same about until through the Sights you espie the Man at E; there make your Instrument fast, and direct your Sights to the Man

that ſtands at A, and you will find the Index will cut 74 deg. and 30 min, then with your Chain meaſure towards A, and at 8 Foot diſtance from F the Off-ſet to the Right will be found to be 5 Foot, and to the Left 7 Foot; then meaſuring on towards A, at 67 Foot diſtance from F, you will have a Street both to the Right and Left; and ſtill meaſuring on towards A, at 123 Foot diſtance from F, the Off-ſet to the Right is 4 Foot, and to the Left 5 Foot, and the whole diſtance between F and A is 129 Foot, then have you done with the Obſervations in the High Streets.

Note, You are to ſet down all your Obſervations as you go along in your Field-Book or Eye-draught, which is beſt. You may make an Eye-draught thus; Firſt go along the place that you intend to take a Plot of, and draw Lines to imitate the ſame, with croſs Streets if there be any, noting your Stations therein by this Mark ⊙; ſetting at every Station the Angles obſerved, and the Off-ſet on either ſide the Line, as you find it to be when you take them, and the Length of the Lines between Station and Station, and by this means when you come to protract your Work, you will have a repreſentation of all the Work that you have taken; but if you ſet down all your Obſervations in your Field Book, it will be neceſſary to ſet them down in manner and form following.

The

The Table of Observations taken when you went about the High Streets.

Station.	Angles.		Dist.		Off-sets.	
					R.	L.
	d.	m.	Feet.		Feet	Feet
1 ⊙ A	95	30			5	00
at—			6	from A	00	7
at—			47	from A		
—			—	a Street R.&L.	10	6
at—			92	from A	0	5
at—			100	from A	12	00
2 ⊙ B	140	00	100	from A	11	8
at—			61	from B a Street		
—			—	to the R. & L.	9	9
at—			120	from B	0	8
at—			127	from B	8	00
3 ⊙ C	100	00	127½	from B	8	00
at—			8	from C	00	9
at—	00	00	64	from C	00	4
at—			75	from C	12	00
4 ⊙ D	100	00	75	from C	9	11
at—			41	from D a Street		
—				to the R. & L	5	00
at—			93	from D	00	7
5 ⊙ E	210	00	100	from D		
at—			9	a Street R. & L.	7	12
at—			70	from E	7	7
6 ⊙ F	74	30	83	from E	5	
at—			8	from F		7
at—			67	a Street R. & L.		
at—	00	00	123	from F	4	5

Having thus taken your High Streets, you may in the like manner proceed with the other small Streets and Lanes, with several Boughs and Breaches, noting down in your Eye-draught or Field-Book against every one of them, the Off-sets to the Right or Left, according as you find them on either side of your Chain.

Note, That when you take your main Streets, it will be convenient as often as you come against any cross Street to take a Sight down it, and note the place or mark that you take to, and the place of standing when you take your Sight to any Mark that is in the cross Streets in your Eye-draught with this Mark ⊖, and so by that means you will know where to place your Instrument when you begin to take the cross Streets; your high Streets and your cross Streets being thus taken, in the next place you are to take the measure of the Houses to the Front, and likewise the depths of every one of them, and with your Rod or Bevil take the Plots of your Courts and Alleys, first by drawing an Eye-draught of them, setting upon every Break or Return thereof the measure you took with your Rod; and in so doing, you will find it no hard matter to protract the same after you have protracted both sides of every Street; for you will have the Representation of every Court and Alley in its proper place.

CHAP.

CHAP. II.

How to protract or lay down any Observation taken according to the Directions of the last Chapter.

FIrst, having provided your self of good Paper or Velam to protract it upon, draw a Line at length to represent the Line AF first; then laying the Center of your Protractor upon the Point, turn your Protractor about until the Line AB thereof lye directly on the Line AF; then finding by your Field-Book or Eye-draught that the Angle observed at A, was 95 deg. and 30 min. against 95 deg. 30 min. of your Protractor make a Mark, and draw the Line AB at length; then finding also that the length of AB was 100 feet, take 100 from off your Scale of equal Parts, and place it from A to B; then placing the Center of your Protractor on the point B, turn your Protractor about until the Line AB thereof lie directly upon the Line AB last drawn; then finding that the Angle observed at B was 140 deg. against 140 of your Protractor make a Mark with your protracting pin, and draw the Line B C at length ; then finding also that the length of B C was 127 foot, take 127 from off your Scale of equal parts, and place it from B to C ; then laying the Center of your Protractor upon the point C, turn it about until the Line A B thereof lie directly on the Line B C last drawn ; then finding by your Field-Book or Eye-draught that the Angle observed at C was 100 deg. against 100 deg. with your protracting-pin make a Mark, and draw the Line C D at length ; then finding that the length of the Line was 75 foot, take 75 foot from off your Scale of equal parts, and place it from C to D ; then lay the Center of your Protractor upon D, and turn it about until the Line A B thereof lie directly on the Line D C last drawn ; then finding by your Field-Book or Eye-draught that at D you did observe an Angle of 100 deg. therefore against 100 deg. of your Protractor, with your protracting-pin make a Mark, and draw the Line D E, at length ; then finding also that the length of your Line D E was 100 foot, take 100 from off your Scale of equal parts, and place it from D to E ; then remove your Protractor, and lay the Center thereof upon the point E, and finding by your Field-Book the Angle observed at E was 210 deg. against 210 deg. of your Protractor make a Mark with your protracting-pin, and draw the Line EF at length ; then finding that the length of EF was

83 foot, take 83 from off your Scale of equal parts, and place it from E to F; then placing the Center of your Protractor upon the point F, turn it about until the Line AB thereof lie directly on the Line EF last drawn; then finding by your Field-Book that the Angle observed at F was 74 deg. and 30 min. against the same deg. and min. of your Protractor make a Mark with your protracting-pin, and draw the Line F A; which if you have protracted right, will fall to be exactly 129 foot; then have you protracted your principal Lines. Now begin to protract your Off-sets thus.

First, finding by your Field Book or Eye-draught that at your first station A, the Off-set to the Right was 5 foot, take 5 foot from off your Scale of equal parts, and place it from A to *a*; then finding also that at 6 foot distance from A, the Off-set to the Left was 7 foot, take 7 foot from off the same Scale of equal parts, that you protracted your principal Lines from, and place it from A to *o*; then finding that at 47 foot distance from A, the Off-set to the Right was 10 foot, take 10 from off your Scale of equal parts, and place it from *e* on the Line AB, to 2, and draw the Line *a* 2 at length; then finding also at the same time the Off-set to the Left was 6 foot, take 6 from off your Scale, and setting one point of your Compasses in *e*, on the Line AB, with the other make a Mark on the Left hand of the Line AB, and draw a Line from *o* to this last Mark made; then because you find by your Field-Book that at the last Off-sets there was a Street both to the Right and Left, you must make a Mark to signify the same; then finding by your Field-Book that at 92 foot distance from A, the Off-set to the Left was 5 foot, these 5 foot take off from off your Scale of equal parts, and setting one foot of your Compasses in the point *f*, with the other make a small Mark on the Left hand of the Line AB, and draw a Line from the Street to this Mark, the Off-set to the Right at the same time was 12 foot; take this 12 foot from off your Scale, and setting one foot of your Compasses in the point, with the other make a Mark on the Right side of the Line AB, and draw a Line from the Street to this Mark last made; then finding that at your Station B, you had the Off-set to the Right 11 foot, take 11 from off your Scale of equal parts, setting one foot of your Compasses in the point B, with the other make a Mark on the Right-hand side of the Line BC, the Off-set at the same time to the Left was 8 foot, take 8 foot from off your Scale of equal parts, and setting one foot of your Compasses in the point B, with the other make a Mark on the Left side of the Line BC; then finding by your Field-Book or Eye-draught that at 61 foot, the Off-

set

et to the Right and Left was 9 foot, take 9 from off your Scale of equal parts, and setting one foot of your Compasses in the point p, with the other make a Mark on both sides the Line; then draw Lines on both sides of the Line BC, from the Marks made on both sides of the Line at B, to the Marks last made; and because there is a Street at the Off-set last taken, make a Mark to signify the same at 120 foot distance from B, the Off set to the Left was 8 foot; take 8 from off your Scale of equal parts, and setting one foot of your Compasses in the point V, with the other make a Mark on the Left side of the Line B C; and draw a Line from the Street on the left side of the Line BC to the last Mark made; then at your station C, you had an Off set to the Right of 8 foot also; take 8 from off your Scale of equal parts, and setting one foot of your Compasses in the point C, with the other make a Mark on the Right side of the Line BC, and draw a Line from the Mark that you made for the Street on the Right side of the Line BC, through the last Mark made at length; then finding by your Field-Book or Eye-draught, that when you had observed the Angle at C, you had an Off-set to the Right of 8 foot, take 8 foot from off your Scale of equal parts, and setting one foot of your Compasses in the point C, with the other make a Mark on the Right

side

side of the Line CD; you likewise find at 8 foot distance from C, you had an Off-set to the Left of 9 foot; therefore take 9 from your Scale of equal parts, and placing one foot of your Compasses in the point X, with the other make a Mark on the Left side of the Line C D; you will likewise find by your Field-Book or Eye-draught that at 64 foot distance from C, you had an Off-set to the Left 4 foot; take 4 from off your Scale of equal parts, and setting one foot of your Compasses in the point Z, with the other make a Mark on the Left side of the Line CD, and draw a Line from the Mark that was made on the Left side of the Line CD, at X, to the mark last made; then by your Field-Book you will find that at your station D, the Off-set to the Right was 12 foot; take 12 foot from off your Scale, and setting one foot of your Compasses in the point D, with the other make a Mark on the Right side of the Line CD, and draw a Line from the Mark that was made on the right side of the Line CD, *viz.* at C to the Mark last made; then finding that when you observed your Angle at D, you had the Off-set to the Right 9 foot, and to the Left 11 foot, take 9 foot from off your Scale of equal parts, and placing one foot of your Compasses in the point D, with the other make a Mark on the right side of the Line DE, and take 11 from off the same Scale, set-

ting

ting one foot as before in D, make a Mark on the left side of the Line DE with the other; by your Field-Book you will find that at 41 foot distance from D you had a Street both to the Right and Left; make a Mark to signify the same: Likewise you will by your Field-Book find that at 92 foot distance from D, you had an Off-set to the Right of 5 foot; take 5 from off your Scale of equal parts, and setting one foot of your Compasses in the point Y, with the other make a Mark on the right side of the Line DE, and draw a Line from the Mark made at D, on the right side of the Line DE, to the Mark last made at length, until it doth intersect the Line that was drawn on the right side of the Line CD: You will find by your Field-Book that at your Station E, the Off set to the Left was 7 foot; this 7 foot take from off your Scale of equal parts, and setting one foot of your Compasses in the point E, with the other make a Mark on the left side of the Line DE, and draw a Line from the Mark made on the left side of the Line DE, at D; to this Mark last drawn at length; you will find by your Field-Book that at 9 foot distance from E towards F, you had an Off-set to the Right 7 foot, and to the Left 12 foot; therefore take 7 foot from your Scale of equal parts, and placing one foot of your Compasses in the point H, with the other make a Mark

on

on the right side of the Line FE; and likewise take 12 from the same Scale, and placing one foot of your Compasses as before, in the point H, with the other make a Mark on the left side of the Line FF, and draw a Line from the Mark that was made on the left side of the Line DE, at Y, to this Mark last made; then because these two last Off-sets were the Corners of two Streets, make a Mark to signify the same; at 70 foot distance from E towards F, the Off-set to the Right was 7 foot, and to the Left 7 foot also, take 7 foot from off your Scale of equal parts, and placing one foot of your Compasses in the point K, with the other make a Mark on each side of the Line EF, and draw a Line from the Mark that was made on the right side of the Line EF, at H, to the Mark that was last made on the right side of the Line EF at K; and draw a Line likewise from the Mark that was made on the left side of the Line EF, at H, to the Mark that was last made on the left side of the Line EF, at K; then by your Field-Book you will find that at your Station F, your Off-set to the Right was 5 foot; take 5 from your Scale of equal parts, and placing one foot of your Compasses in the point F, with the other make a Mark on the right side of the Line FA, and at 8 foot distance from F, you had also the Off-set to the Left 7 foot; take 7 from off your Scale

of

of equal parts, and placing one foot of your Compasses in the point N, with the other make a Mark on the Left side of the Line F A. At 67 Foot distance from F, you had a Street to the Right and Left; therefore make a Mark to signifie the same; at 123 foot distance from F, towards A (by your Field-Book you will find) you had an Off-set to the Right 4 foot; take 4 from off your Scale of equal parts, and placing one foot of your Compasses in the point R, with the other make a Mark on the right side of the Line FA, and draw a Line from the Mark that was made on the right side of the Line FA, at the point N, to the point that was last made, so that the Line which you draw may intersect the Line which is drawn on the right side of the Line EF, and the Line that is drawn on the right side of the Line AB; then at the same time you had an Off-set to the Left, of 5 foot; take 5 likewise from your Scale of equal parts, and placing one foot of your Compasses in the point R, with the other make a Mark on the left side of the Line FA, and draw a Line from the Mark that was made on the left side of the Line FA, at N, to the Mark that was last made on the left side of the same Line at R; then have you made an end of protracting your High Streets: In the same manner you must protract your by-Lanes and Streets. You must likewise deal so with all Alleys that are Thorough fares.

Your

Your Streets and Lanes being thus protracted, you may proceed to the protracting and laying down the Ground-plot of the several Houses thereon; for the doing of which, it will be convenient that you have a small Scale that is actually divided into 50 equal parts in an Inch; then laying your Scale a long by the side of the Line *o e*, and against the measured breadth of each House, with your protracting pin make a Mark or Marks; then lay the Edge of your small Scale along the side of the Line *e* S, and against the measure of each several House that is thereon, with your protracting-pin make a Mark; then lay your small Scale along the side of the Line SQ, and finding by your Eye-draught that there is a Court or Yard, first make a Mark against the measure of the several Houses until you come to the Court or Yard, and then mark out the breadth of the Entrance thereof as you did the breadth of the Houses; and likewise make Marks against the breadth of each House on the other side of the Court also; then laying your small Ruler or Scale along the side of the Line Q O, against the measure of the breadth of each several House, with your protracting-pin make a Mark. Having thus laid down the breadth of each several House, the next thing you do lay down the depth of each House, and draw Lines in the same manner as you see those in the *Fig.* and shadow

ſhadow them alſo as you ſee, that they may repreſent the Ground-plot of a Houſe.

When you come to protract the Court, lay your Eye-draught before you, and draw the bending and turning according to diſcretion, laying down the meaſure of each ſeveral Houſe that is therein, as you did in the Streets; you muſt alſo protract the Yards or Gardens that are behind the Houſes; with the turnings and windings thereof accordingly as you take them.

Note, That when you take the Ground-plot of any Church, you muſt be very exact in taking the Buttreſſes, and the Steeple, and every one of the Pillars, and protract or lay them down in the ſame form and meaſure as you found them ſtanding, and ſhadow them very deep, that they may be known to be Churches.

You muſt likewiſe uſe the like exactneſs in meaſuring and protracting Halls, Inns of Court, Colledges, and all eminent Houſes, and ſhadow them accordingly.

A new Method of Surveying Countries, or large Tracts of Land.

THE common Method of performing this Problem, is by taking and protracting inaccessible *Distances*, which has been treated of (*in general*) already; and therefore, supposing that the Ingenious Surveyor cannot be incapable of applying it to this *particular*, I shall wholly omit this, and give you a new Method, invented by those Learned Mathematicians Mr *Whiston* and Mr *Ditton*, in order to which, let us premise the following Lemmata.

I. All sounds are propagated almost evenly, and are observed to move 8 measured Miles in 37 Seconds.

This is well known from the last and most accurate Observations about the Velocity of Sounds, which are those of Mr * *Derham*.

* *Philo. Tran.* N° 247.

II. An ordinary Mortar is easily able to cast a Projectile about a Mile in Perpendicular Heigth; and the Sound thereof may be heard near 20 Miles.

The truth of both these Propositions have been sufficiently proved by divers Experiments made by Mr *Whiston* for that purpose.

III.

III. A Projectile may be fill'd with Combustible Matters; to take Fire as soon as discharg'd; and continue burning till it comes to the Ground.

This all that deal in Rockets, Bombs, and Mortars, do very well know, and is found to be true upon Tryal.

IV. Fire, or Light about a Mile high will be visible in the Night time, when the Air is tolerably clear about, 70 Miles.

This also hath been made manifest by many Experiments made on purpose.

The Solution of the Problem.

Let a Shell that will take Fire as soon as discharg'd, and continue Burning till it comes to the Ground, be shot perpendicularly about a Mile high out of a Mortar at any convenient place in a clear Night; and this Discharge will by the Bearing, and Interval of the Flash and Sound, give the Distance and Bearing of an Observer within the Hearing and Sight thereof, according to the foregoing Lemmata.

Example.

Fig. 2. Let the Bearing of a Shell discharg'd out of a Mortar at C, and also the Interval of the Flash and Sound thereof be observ'd by Persons sent to A. B. E. F. G. H. I. D.

H.I.D. places within 20 Miles round C, who muſt be furniſhed with an Inſtrument to meaſure Angles; for taking the Bearing of the ſhell; and a Thread 39.2 Inches long, with a Plummet faſten'd to one end, which being ſuſpended by the other end to a Pin, or Nail, and made to ſwing, will vibrate ſeconds by which the Interval between the Flaſh and Sound may be nicely meaſured, and let their Obſervations be as follows.

Places of Obſervations.	*Interval between the Sound and Flaſh in Seconds of Times.*	*Bearings of theShells.*	*Seconds turn'd into Miles according to the Proportion of 37 to 8 Miles.*
			Miles.
D.	63 $\frac{3}{4}$	S.E. 33	14
A.	74	30	16
G.	55 $\frac{1}{2}$	87	12
E.	83 $\frac{3}{4}$	S.W. 40	18
F.	51	90	11
I.	55 $\frac{1}{2}$	N.E. 6	12
H	78 $\frac{1}{5}$	50	17
B.	69 $\frac{1}{2}$	NW. 60	15

To protract which, through the point C, draw the Meridian N. S. and lay off

off the Angles NCD. 3°, NCA 30°, NCG. 87° from the North towards the West. The Angles NCE. 40°, NCF 90°, from the North towards the East. The Angles SCI. 6°, SCH 50°, from the South towards the West. *Lastly*, Lay off the Angle SCB 60° from the South towards the East. Then set off their distances from the Mortar at C. *viz.* DC = 14 *m.* AC = 16 *m.* &c. according to the Observations. So will you have an exact Map of the place A.B.C.D.E.F.G.H.I., and the Scituation of the Villages about each Station may be easily taken by the Observer thereof after the common method of taking inaccessible Distances.

CORROLARYs.

I. If each Observer were to let off a Rocket at his own Station, and take the mutual Bearing, of each others it wou'd be a great Check to any Error that could possibly happen.

II. If a great Gun were discharg'd near the Mortar, and the Sound thereof used instead of that of the Mortar; it would be heard much further, and consequently a much larger Tract of Land might be surveyed at once.

A ready way to find a true Meridian-line by the Pole-Star.

The right Afcenfion of the Pole Star for this Year (1716) is 37 Minutes of Time; and it increafes one Minute 16 Seconds every ten Years: Therefore having at any time this Star's Right Afcenfion, and the Right Afcenfion of the Sun both in Time, if you fubftract the latter from the former, adding 24 Hours to the Right Afcenfion of the Pole-Star, when it is lefs than the Sun's the Remainder will be the time of the Star's, coming to the Meridian, at which time hang up two Pendulums between your Eye and the Pole-Star, and a Right-line drawn through them, will be a true Meridian-line.

In the Survey juft now treated of, you may ufe the fights of a good Circumferentor, or any other Surveying Inftrument, having one of the fights long enough to take in the Pole-Star.

If you wou'd know, what Angle the Pole-Star makes with the true Meridian at other times, the following Table will fhew.

Sideral

Siderial Hours.		Distance from North above the Pole.			Siderial Hours.		Distance from N. below the Pole.		
12	12	0°	00		6	6	3°	41	1/3
1/2	1/2	0	30	1/2	1/2	1/2	3	38	
11	1	1	00	1/2	5	7	3	31	
1/2	1/2	1	29	1/15	1/2	1/2	3	20	3/5
10	2	1	56		4	8	3	6	5/6
1/2	1/2	2	20	3/4	1/2	1/2	2	50	1/3
9	3	2	42	1/2	3	9	2	31	
1/2	1/2	3	00		1/2	1/2	2	9	3/5
8	4	3	16	5/6	2	10	1	46	
1/2	1/2	3	28	1/3	1/2	1/2	1	21	
7	5	3	36	2/3	1	11	0	54	2/3
1/2	1/2	3	45	1/4	1/2	1/2	0	27	1/2
6					12	12	0	00	

The

The Names of such Colours as are necessary for the Washing of Maps, Charts, or Plots, with the manner how to temper and use the same upon Velom, Paper or Parchment.

IT is not convenient for a Surveyor when he hath drawn the draught of a Mannor, and reduced it to his intended bigness, to repair to a Painter to finish his work, the thing itself being very commendable, and easie to be attained: And besides a Painter is not to be found in every Country, nor is every Painter furnished with Colours fitting for such a purpose, they for the most part using more gross and ordinary Colours. Now for the benefit of such who desire to exercise themselves in this kind of practice, I have added these necessary directions following.

How to make Gum-Water.

Take Gum Arabick what quantity you please, of the whitest and clearest you can get, which bruise into small pieces, and tie them up loosely in a fine linnen Rag, then take of the clearest Water you can get, and put it into a clean vessel, as a poringer, (or such like) then hang your Cloath in which you

you put your Gum into this Water, letting it hang till all the Gum be dissolved; then when you put your Fingers into this Water, if you find them to stick together, as if they were glewed, your Water is too stiff of the Gum, which you may remedy by putting thereto more fair Water, and if you find it too weak, you may add more Gum; with this Water most Colours are to be tempered.

How to make Allum-Water.

Take a Pound of Allum, and beat it to Powder, then take a Gallon of clean Water, and set it on a Fire, letting it boil till all the Allum be melted, then take it off the Fire, and when it is cold you may put it into a Vessel and keep it for your use: With this Water, if you wet your Paper before you lay on your Colours, it will keep them from sinking into the Paper, and will also add a Lustre and Beauty to the Colours laid thereon.

The Names of such Colours as are necessary for the Washing of Maps, Plots, or Charts.

REDS.	YELLOWS.	BLEWS.
Vermillion.	*Gumbooge.*	*Bice.*
Lake.	*Yellow Berries.*	*Indigo.*
Read Lead.	*Orpiment*, i.e.	*Verditer.*
Rosset.	*Arsnick*	*Litmose.*
		Logwood
		Brazile.

REDS	YELLOWS	BLEWS	GREENS.
Brazile.	*Masticot.*	*Ultramerine*	*Bice,*
Turnſoile.	*Saffron.*	*the beſt Blue.*	*Sap Green.*
Indian Cakes.			*Vertdegreaſe.*
Carmine the			*Verditure.*
beſt Red.			
Scarlet Flocks			

BLACKS.	WHITES.	BROWNS.
Lamp-Black.	*White*	*Spaniſh-Brown.*
Printers-Black.	*Lead in*	*Umber.*
Ivory }	*Shaving flakes.*	*Wood-Soote.*
Harts-Horn } *burnt.*		*Rindes of Green*
Indian-Ink.		*Wall nuts.*

N. B. Colours made from Vegitables fades the ſooneſt.

Being thus provided of theſe ſeveral Colours here named, which you may have in divers places in *London*, as alſo of a Grinding-Stone and Muller, which any Maſon in *London* will furniſh you with, alſo divers Pencils of ſeveral ſizes, and Gally-pots, Gar-Glaſſes, or Horſe-Muſcle-ſhells, to put your Colours in when they are ground and tempered, you are then ready at any time to make uſe of them, and now will I ſhew you how all the forementioned Colours are to be ground and tempered.

Of

Of the ordering of Colours.

Of these Colours before mentioned, some are to be *Ground* some *Washed*, some only *Steeped* or *Dissolved*, others to be *Boyled*, and some to be *Burnt*, and then *Ground*.

1. *How any Colour is to be Ground.*

Take what Quantity of any Colour you please, that is to be *Ground*, and lay it upon your *Grinding-stone*, being clean, as also your *Muller*, then with your *Muller* bruise the Colour, if it be lumpish, and when it is reasonable small or fine, put some fair *Water* to it, and with your *Muller* grind the *Colour* and *Water* together till it be very fine; then with a *Knife* or piece of thin *Lanthorn-horn*, being clean, take it off from the Stone, and put it into a Shell, and when it is dry you may take it out of the Shell, and keep it for your use.

The Colours to be Ground are,

Vermillion, *Lake*, *Indigo*, *Masticot*, *White-Lead*:

In *Grinding* of your Colours put not too much Water to them upon the Stone, for they ought to be ground Stiff, like weak Paste, or Pap.

2. *How Colours are to be Washed.*

Take a good Quantity of the Colour which you intend to *Wash*, and put it into a *Bason*, pouring to it a good Quantity of *fair Water*, and stir the Colour and the *Water* often together, and then you will see a great deal of filth swim at the top of the *Water*; when the *Colour* is settled to the bottom of the Bason, pour away that Water gently into another Vessel or Bason, and pour more fair Water to the Colour, then stir the Colour and that fresh Water together, and when the Colour is settled, pour away that second Water to the former, and so put a third and fourth Water, stirring it often till the Water come from the Colour without filth, then is your Colour Washed: But before you take the Colour out of the Vessel, lay it with your Hand very thin about the sides of the Vessel, and when it is dry, some of it will fall to the bottom, which put upon a sheet of Paper, which will be good Colour; but the Remainder, which sticks to the sides of the Bason, is best of all, which with a Feather strike off the sides of the Vessel, for it will be finer than any Flour.

The Colours to be Washed are,

Rosset.	*Bice*	*Orpiment*
Red-Lead	*Verditer*	*Spanish-Brown.*

These

These or other Colours thus washed, you may reserve in white Paper free from Dust, and make use of them as you have occasion.

3. *How Colours are to be Steeped.*

This is only to put the *Colour* into some kind of *Liquor*, and there to dissolve; some in cold Liquors, others upon the Fire.

The Colours to be steeped in cold Liquors are,

Yellow-Berries.	*Sap-Green.*
Gum Buge.	*Litmose.*
Saffron.	*Indian-Cakes.*

The Colours to be steeped or boiled are,

French-Verdigrease.	*Turnsoil.*
Brazil.	*Wood Soot.*
Logwood.	

Rindes of Wall-nuts.

These Colours when *steeped* or *boiled* are to be kept close in *Glasses*, till you have occasion to use them.

4. *How Colours are to be burned.*

Some use only to put a Lump of Colour into a Red-hot place of the Fire, and there let it lye till it be thoroughly burnt; but this is both wasteful and slovenly. *The best way is this.*

Take a Quantity of your *Colour*, and put it into a clean *Crucible*, putting thereto some *Fair water*, then cover the *Crucible* with *Clay*, and set it into a *hot* place of the *Fire*, letting it there continue till the *Crucible* be Red-hot, then take it out, and when it is cold you may take out the Colour, and grind it as is before taught.

The Colours to be burnt are,

Spanish-Brown.	*Printers-black.*	*Ivory.*
Umber.	*Lamp-black.*	*Harts-horn*

Or any other gross and foul Colour.

Having shewed you the way how to *Grind*, *Wash*, *Steep*, *Boil*, and *Burn* your *Colours*, I will shew you now

5. *How to temper your Colours.*

First, Such Colours as are *ground* with Fair-water, take a small Quantity thereof, and put it into a *Mussle-shell*, putting thereto some *Gum water*, and the *Colour* in a short time will be molified; then with your Finger (being very clean) bruise the *Colour* against the *Shell*, till you find no *knots* undissolved, then with a clean *Pencil* stroak down the *Colour* towards the bottom of the *Shell*, and it it is fit for use; but if it be too thick, add more Gum-water to it.

Such Colours as are *Washed*, you must temper in a *Shell* with *Gum water*, in the same manner as you did those that were *Ground*.

Such Colours as are *Steeped*, the Liquor only of them is to be used, without any Addition.

Of the several Simple Colours, how to order them, without any mixtures.

1. *Of REDS.*

Carmine, being tempered with weak Gum-water makes the best of *Reds*.

Vermillion, being Ground and tempered with Gum-water, makes a deep *Red* or *Scarlet* Colour.

Lake, Ground and Tempered with Gum-water, makes a deep *Pink* or *Bloom* Colour.

Red Lead, *Washed*, is a brave Orient, Colour, between a Red and an Orange Colour.

Rosset, Washed, and tempered with Gum-water, differs not much in Colour from *Lake*, but it will soon fade and grow lighter, but being tempered with *Brazil-water* it will be more deep.

Brazil. The *Shavings* or *Grindings* thereof being boiled in *Vinegar* and *small Beer* (or fair-water) in an Earthen Vessel, with some powder of *Allum* put therein to heighten the *Colour*, makes an *excellent Pink* or *light Violet Colour*. When you strain the Liquor from the dregs of the *Brazil*, add thereto ſome Gum-Arabick to bind it.

Turnſoil. It is made of *Linen Rags dyed*, which being put into a *Saucer* or the like, with ſome Vinegar, and ſet upon a Chafing-diſh of *Coals*, the Rags ſqueezed into the Vinegar, with ſome Gum to bind it, makes a good Colour to ſhadow all *Yellows* with.

Indian Cakes. Uſe them as you do *Turnſoil*, and they make a good *Red-tranſparent* Colour: Into the Liquor put ſome Gum to bind it.

Scarlet-Flocks, (which is bought at the Cloath-Workers,) boiled gently in Fair-water for about 5 Hours, putting a ſpoonful of *Soap-Lees* to bring out the Colour; makes an excellent *Tranſparent-Red*, or *Scarlet Colour.*

2. *Of YELLOWS.*

Gumbooge, Steeped in Fair water only, makes the moſt excellent, and moſt tranſparent *Yellow Colour*: It is of that Nature, that it will admit of no mixture.

Yellow-Berries, Steeped in Fair-water and a little powder of *Allum* added thereto (or ſteeped in Allum-water) makes a very good and *Tranſparent Yellow.*

Orpiment, Waſhed and tempered with Gum-water, makes an *Orient* or *Gold-Colour*, there

there are ſeveral degrees of it, ſome more *Red*, and others more *Yellow*.

Maſticot, Ground and tempered with Gum-water, makes a good, but no *Tranſparent Yellows*.

Saffron, Steeped in Fair-water all night, makes an excellent Tranſparent *Gold Colour*.

3. *Of* BLUES.

Ultramerine, Being tempered with a weak Gum-water makes the beſt Blue.

Bice, Waſhed and tempered with Gum-water, is an excellent Blue, but not tranſparent, and there are ſeveral ſorts of it, ſome lighter ſome ſadder.

Indigo, Ground and tempered with Gum-water, makes a deep *Blue*, and it fit to ſhadow all other *Blues*.

Verditer, Waſhed and tempered with Gum-water, is a good *Blue*, but not tranſparent.

Litmoſe, Cut it in ſmall ſlices, and ſteep it in a weak Water, made of *Gum-Black*, for the ſpace of a day or more, and you will have a *tranſparent Blue*.

Logwood, Boiled in all reſpects as *Brazil*, makes an excellent *Violet* or *Purple-Colour*.

4.

4. *Of* GREENS.

Bice, Washed and tempered with Gum-water, makes a good, but no transparent *Green*.

Sap-Green, Steep'd in Fair-water, and a little Powder of Allum added thereto, makes a good *Green* to shadow or damask withal.

Verditure, Washed and tempered with Gum-water, makes a Green, not transparent.

Half a pound of *French-Verdigrease*, boiled with a Quart of Fair-water, putting in an Ounce of *Argol* to bring out the Colour, makes an excellent Transparent *Green* inclining to *Blue*.

N. B. This Colour must be boiled very gently for about five Hours, then take it off the Fire and let it settle all Night, and the next Morning pour off the clear part.

5. *Of* BLACKS.

Indian-Ink, Ground and tempered with a weak Gum-water, is the best Black for shadowing deeper *Blacks*.

Lamp-black, *Printers-black*, *Ivory*, *Harts-Horn* Shavings, being Burnt, Ground, and Tempered with Gum-water, are all good Blacks.

6.

6. Of WHITES.

White-Lead, Ground and tempered with Gum-water, is the beſt *White.*

7. Of BROWNS.

Spaniſh-Brown, Burnt, ground and tempered with Gum-water, makes a *Reddiſh-Brown*, or *Liver-Colour.*

Umber, Burnt, ground, and tempered with Gum-water, makes a good *Hair-Colour*, and is good to *ſhadow* upon *Gold.*

Wood-Soot, or *Rindes of Wall-nuts*, Boiled in Fair-water, and ſtrained, and ſome Gum-Arabick put into the Liquor, to bind it, either of them makes a moſt excellent Colour for to expreſs High-ways, Lanes, *&c.*

Of Mixture of Colours.

All the fore-mentioned Colours that we have hitherto treated of, are ſuch as are ſimply of themſelves, without any mixture, of which infinite may be compounded; nay, almoſt what you will. But for our purpoſe the moſt tranſparent Colours are the Principal, for this our purpoſe of Colouring of Plots. Of which *Brazil* and *Logwood Water*, *Carmine*, *Indian-Cakes*, *Turnſoil*,

Soil, Ultramerine, Gumbooge, Yellow-berries, Saffron, Litmose, Sap-Green, French-Verdigrease, Wood-Soot and *Walnut-husks*, are the principal, and of these several others may be compounded.

For GREEN.

Verdigrease-water, and *Yellow-berry-water*, makes an excellent transparent *Green*, either sadder, or lighter, according to the Quantity that you take of either.

For BLUE.

Litmose-Water, To which add *Yellow-berry-water*, and you have a sad *Green*.

For ORANGE *Colour*.

Brazil-water and *Yellow-berry-water*.

Infinite Colours, I say, may be made of these, which may better be found out by practice than by many words: And therefore now I will show you what Colours do shadow one another.

Concerning Shadowing.

All light Colours are shadowed with Colours of their same Nature but more sad,

sad, for which take these Brief Directions.

Vermillion,	Is Shadowed with	*Lake, or Spanish-brown*
Verditer and Bice.		*Indigo.*
Gumbooge and Yellow-berries,		*Umber, with Read-lead or Vermillion.*
Red-Lead,		*Lake, or Spanish-brown,*
Masticote,		*Red Orpiment,*
Spanish-brown.		*Burnt Umber i:b Brazil-water,*
Umber,		*Umber Burnt,*
Rosset and Brazil, &c.		*Spanish-brown, mixed with Brazil-water.*
Verdigrease,		*Indigo and Yellow-berry water mixed.*
Wood-Soot and Wal-nuts,		*Umber*

Concerning the laying on of your Colours.

For the laying on of your Colours, you must provide your self of Pencils of several sizes, bigger and lesser, and if you will be curious, you ought to have a great and a small to each respective Colour, if not, you must always have by you a dish of Fair-water, in which you must swill or cleanse your Pencil, wiping it with with a Clean Linen

Linen Cloath, before you put it into another Colour.

For your Pencils, you may chuſe, in your buying, thoſe that are good in this manner: See that they be fulleſt next to the Quill, deſcending or leſſening into a ſmall room and ſharp point, which you may produce by putting of the Hair into your Mouth, and drawing it through your Lips once or twice, then may you ſee what it is, and if you find any extravagant Hairs, ſinge them off by a Candle's Flame.

Being thus provided with Colours and Pencils, if you would lay any Colour about the Edges of any part or piece of Ground in a Plot; as ſuppoſe you would incloſe a Field in a Plot with Yellow; with your Pencil take of Gumbooge or Yellow-berries, a very ſmall Quantity, and on the inſide of the Black-Lead-line, draw the Colour along of an equal breadth (*as near as you can*) from the Line, broader or narrower, according as your Field is in bigneſs (*not daubing your Field all over with your Colour, as I have ſeen ſome, otherwiſe good things,*) by this plaſtering way (*as I may call it*) moſt notoriouſly abuſed. Then having gone round your Field in this manner with your Colour, wet your Pencil in your Mouth, or have a ſmall Quantity

tity of Water by you to dip it in, and ſtrike along the inſide of the Coloured Line, bringing it more down towards the Center of the Field; and this will ſweeten your Colour, and make it ſhow as if it loſt itſelf by degrees, to the very Colour of your Paper or Parchment: And this courſe is to be taken not only for *Yellows* but for all other *Colours*. Then laſtly with a *Pen* (if you cannot handle a ſmall *Pencil* handſomely and evenly) take ſome of that Colour which ſhadoweth that Colour you coloured your Field with, and go over your Black-Lead Line only, ſo ſhall your Field be finiſhed.

And in this manner may you do a Hundred Fields in one Plot, of divers Colours: only obſerve this, that as near as you can, you colour not two Fields adjoyning one to the other both of the ſame Colour, but of different: and therefore it will be convenient to underſtand what Colours do ſet one another off beſt, and as near as you can to lay Cloſes, adjoyning one to another, of two ſuch Colours, that one Shadow may ſerve both.

FINIS

A Table of Logarithms, from Unity to 10000.

N	Log.	N	Log.	N	Log.
1	000000	34	531479	67	826075
2	301030	35	544068	68	832599
3	477121	36	556302	69	838849
4	602060	37	568202	70	845098
5	698970	38	579784	71	851258
6	778151	39	591065	72	857332
7	845098	40	602060	73	863323
8	903090	41	612784	74	869232
9	954242	42	623249	75	875061
10	000000	43	633468	76	880814
11	041393	44	643453	77	886491
12	079181	45	653212	78	892095
13	113943	46	662758	79	897627
14	146128	47	672098	80	903090
15	176091	48	681241	81	908485
16	204120	49	690196	82	913814
17	230449	50	698970	83	919078
18	255272	51	707570	84	924279
19	278754	52	716003	85	929449
20	301030	53	724276	86	934498
21	322219	54	732394	87	939519
22	342423	55	740463	88	944483
23	361728	56	748188	89	949390
24	380211	57	755875	90	9[illegible]4242
25	397940	58	763428	91	959041
26	414973	59	770852	92	963788
27	431364	60	778151	93	968483
28	447158	61	785330	94	973128
29	262398	62	792392	95	977724
30	477121	63	799341	96	982271
31	491362	64	806180	97	986772
32	505150	65	812913	98	991226
33	518514	66	819944	99	995635

N	0	1	2	3	4
100	000000	000434	000868	001301	001734
101	004321	004751	005181	005609	006038
102	008600	009026	009451	009876	010300
103	012837	013259	013679	014100	014520
104	017033	017451	017868	018284	018700
105	021189	021603	022016	022428	022841
106	025306	025715	026124	026533	026942
107	029384	029789	030195	030600	031004
108	033424	033826	034227	034628	035029
109	037426	037825	038223	038620	039017
110	041393	041787	042182	042575	042969
111	045323	045714	046105	046495	046885
112	049218	049605	049993	050380	050766
113	053078	053463	053846	054230	054613
114	056905	057286	057666	058046	058426
115	060698	061075	061452	061829	062206
116	064458	064832	065206	065580	065953
117	068186	068557	068928	069298	069668
118	071882	072250	072617	072985	073352
119	075547	075912	076276	076640	077004
120	079181	079543	079904	080266	080626
121	082785	083144	083503	083861	084219
122	086360	086716	087071	087426	087781
123	089905	090258	090611	090963	091315
124	093422	093772	094122	094471	094820
125	096910	097257	097604	097951	098297
126	100371	100715	101059	101400	101747
127	103804	104145	104487	104828	105169
128	107210	107549	107888	108227	108565
129	110590	110926	111262	111598	111924
130	113943	114277	114611	114944	115278
131	117271	117603	117934	118265	118595
132	120574	120903	121231	121560	121888
133	123852	124178	124504	124830	125156
134	127105	127429	127752	128071	128399

5	6	7	8	9	D
002166	002598	003029	003460	003891	432
006466	006894	007321	007748	008174	428
010724	011147	011570	011993	012415	424
014940	015360	015779	016197	016615	420
019116	019532	019947	020361	020775	416
023252	023664	024075	024486	024896	411
027350	027757	028164	028571	028978	408
031408	031812	032216	032619	033021	404
035430	035830	036229	036629	037028	401
039414	039810	040207	040602	040998	397
043362	043755	044148	044540	044931	393
047275	047664	048053	048442	048830	390
051152	051538	051924	052309	052694	386
054906	055378	055760	056142	056524	383
058805	059185	059562	059942	060320	379
062582	062958	063333	063708	064083	376
066326	066698	067071	067443	067814	373
070038	070407	070776	071145	071514	370
073718	074085	074451	074816	075102	366
077368	077731	078094	078457	078819	364
080987	081347	081707	082067	082426	361
084576	084934	085291	085647	086004	357
088136	088490	088845	089198	089552	355
091657	092018	092369	092721	093071	352
095169	095518	095866	096215	096562	349
098644	098989	099335	099681	100026	347
102091	102434	102777	103119	103462	344
105510	105851	106191	106531	106870	341
108903	109241	109578	109916	110253	338
112270	112605	112940	113275	112609	336
115610	115943	116276	116608	116940	332
118926	119256	119586	119915	120245	330
122216	122543	122871	123198	123525	328
125481	125806	126131	126456	126781	325
128722	129045	129368	129690	130012	323

N	0	1	2	3	4
135	130334	130655	130977	131298	131619
136	133539	133858	134177	134496	134814
137	136721	137037	137354	137671	137987
138	139879	140194	140508	140822	141136
139	133015	143327	143639	143951	144263
140	146128	146438	146748	147058	147367
141	149219	149527	149835	150142	150449
142	152288	152594	152900	153205	153510
143	155336	155640	155943	156245	156549
144	158362	158664	158965	159266	159567
145	161368	161667	161967	162266	162564
146	164353	164650	164947	165244	165541
147	167317	167613	167908	168203	168497
148	170262	170555	170848	171141	171434
149	173186	173478	173769	174060	174351
150	176091	176381	176669	176959	177248
151	178977	179264	179552	179839	180126
152	181844	182129	182415	182699	182985
153	184691	184975	185259	185542	185825
154	187521	187803	188084	188366	188647
155	190332	190612	190892	191171	191451
156	193125	193403	193681	193959	194237
157	195900	196176	196453	196729	197005
158	198657	198932	199206	199481	199755
159	201397	201670	201943	202216	202488
160	204120	204391	204663	204934	205204
161	206826	207096	207365	207634	207904
162	209515	209783	210051	210319	210585
163	212188	212454	212720	212986	213252
164	214844	213109	215373	215683	215902
165	217484	217747	218010	218273	218536
166	220108	220370	220631	220892	221153
167	222716	222976	223236	223496	223755
168	225309	225568	225826	226084	226342
169	227887	228144	228400	228657	228913

5	6	7	8	9	D
131939	132260	132580	132900	133219	321
135133	135451	135768	136086	136403	319
138303	138618	138934	139249	139564	316
141450	141763	142076	142389	142702	314
144574	144885	145196	145507	145818	311
147676	147985	148294	148603	148911	309
150746	151063	151370	151676	151982	307
154815	154119	154424	154728	155032	305
156852	157154	157457	157759	158061	303
159868	160[illegible]68	160469	150769	161068	301
162863	163161	163459	163758	164055	298
165838	166134	166430	166726	167022	297
168792	169086	169380	169674	169968	295
171726	172019	172311	172603	162895	292
174641	174932	175222	175512	165802	290
177535	177825	178113	[illegible]78[illegible]01	178689	289
180413	180699	180986	181272	181558	287
183270	183555	183839	184123	184407	285
186108	186391	186674	186956	187239	283
188928	189210	189490	189771	190051	281
191730	192009	192289	192567	192846	279
194514	194792	195069	195346	195623	278
197281	197556	197832	198107	198382	276
200029	2003[illegible]3	200577	200850	201124	274
202761	203033	203305	203577	203848	272
205475	205746	206016	206286	206556	271
208173	208440	208710	208978	209247	269
219853	211121	211388	211654	211921	267
213518	213783	214049	214314	214579	266
216166	216430	216694	216957	217221	264
218798	219060	219323	219585	219846	262
221414	221675	221936	222196	222456	261
224015	224274	224533	224791	225051	260
226600	226858	227115	227372	227630	258
229170	229426	229682	229938	230194	257

N	0	1	2	3	4
170	230449	230704	230960	231215	231470
171	232996	233250	233504	233757	234011
172	235528	235781	236033	236285	236537
173	238046	238297	238548	238799	239049
174	240549	240799	241048	241297	241546
175	243038	243286	243534	243782	244030
176	245513	245759	246005	246252	246499
177	247973	248219	248464	248709	248954
178	250420	250664	250908	251151	251395
179	252853	253096	253338	253580	253822
180	255272	255514	255755	255996	256236
181	257679	257918	2 8158	258398	258637
182	260071	260310	260548	260787	261025
183	262451	262688	262925	263162	263399
184	265818	265054	2652 0	265525	265761
185	267172	267406	267641	297875	268110
186	269513	269746	269980	270213	270446
187	271842	272074	272306	272538	272770
188	274158	274389	274620	274850	275081
189	276462	276691	276921	277151	277380
190	278754	278982	279210	279439	279667
191	281033	281261	281488	281715	281942
192	283301	283527	283753	283979	284205
193	285557	285782	286007	286232	286456
19	287802	288025	88249	288473	288696
195	290035	290257	290480	290702	290925
196	292256	292178	292599	292920	293141
197	294466	294687	294907	295127	295347
198	296665	296884	297104	297323	297542
199	298853	299071	299289	299 07	299725
200	301030	301247	301464	301681	301898
201	303196	303 12	303628	303844	304059
202	305351	305566	305781	305996	306210
203	307469	307710	307927	308137	308351
204	309630	309843	310056	310260	310481

5	6	7	8	9	D
231724	231979	232233	232488	232742	254
234264	234517	23477	235023	235276	253
236789	237041	237292	237544	237795	252
239299	239550	239800	240050	240300	250
241795	242044	242293	242541	242790	249
244277	244524	244772	245019	245266	247
246745	246991	247236	247482	247728	246
249198	249443	249687	249932	250176	244
251638	251881	252125	252367	252610	243
254064	254306	254548	254790	255031	242
256477	256718	256958	257198	257439	241
258877	259116	259355	259594	259833	240
261263	261501	261738	261976	262214	238
263636	263873	264109	264345	264582	237
265996	266232	266467	266702	266937	235
268344	268578	268812	269045	269279	234
270679	270912	271144	271377	271609	233
273001	273233	273364	273696	270927	231
275311	275542	275772	276002	276237	230
277609	277838	278067	278296	278525	229
279895	280123	280351	280578	280806	228
282169	282395	282622	282849	283075	227
284431	284656	284882	285107	285332	226
286681	286905	287130	287354	287578	225
288920	289143	289366	289589	289812	224
291147	291369	291591	291813	292034	222
293363	293583	293804	294025	294246	222
295567	295787	296007	296226	296446	220
297760	297979	298198	298416	298635	218
299943	300160	300378	300595	300813	218
302114	302331	302547	302764	302980	216
304275	304490	304706	304921	305136	217
306425	306639	306854	307068	307282	215
308564	308778	308991	309204	309417	213
310693	310960	311118	311330	311542	212

N.	0	1	2	3	4
205	311754	311966	312177	312389	312600
206	313867	314078	314289	314499	314710
207	315970	316180	316390	316599	316809
208	318063	318272	318481	318689	318898
209	320146	320354	320562	320769	320977
210	322219	322426	322633	322839	323046
211	324282	324488	324694	324899	325105
212	326336	326541	326715	326950	327155
213	328380	328583	328787	328991	329194
214	330414	320617	350819	331022	331224
215	332430	332640	332842	333044	333046
216	333454	334655	334856	335057	335257
217	336460	336660	336860	337060	337260
218	338456	338656	33 855	339054	339253
219	330444	340642	340841	341039	341237
220	342423	342620	342817	343014	343212
221	344392	344589	344785	344981	345178
222	346353	346549	3.6744	346939	347135
223	348305	348500	348694	348889	349083
224	350248	340442	350636	350829	351023
225	352183	352375	352568	352761	352954
226	354108	354301	354493	354685	354876
227	356026	356217	356408	356599	356790
228	357935	358125	358316	358506	358696
229	359835	340025	360215	360404	360593
230	361728	361917	362105	362294	362482
231	363612	363800	363988	364176	364363
232	365488	363675	365862	366049	366236
233	367356	367542	367729	367915	368101
234	369216	369101	369587	369772	369958
235	361068	371253	371437	371622	371806
236	372912	373096	373280	373464	373647
237	374748	374932	375115	375298	375481
238	376577	376759	376942	377124	377306
239	378398	378588	378761	378943	379124

5	6	7	8	9	D
312812	313023	313234	313445	313656	211
314920	315130	315340	315551	315760	210
317018	317227	317436	317646	317854	209
319106	319314	319522	319730	319938	208
321184	321391	321598	321805	322012	207
323252	323458	323665	323871	324077	206
325310	325516	325721	325926	326131	205
327359	327563	327767	327972	328176	204
329398	329601	329805	330008	330211	203
331427	331630	331832	332034	332236	202
333447	333649	333859	335051	334253	202
335458	335658	335859	336059	336260	201
337459	337659	337858	338058	348257	200
339451	339650	339849	340047	340246	199
341435	331632	341830	342028	342225	198
343409	343606	343802	343999	344196	197
345374	345570	345766	345962	346157	196
347330	347525	347720	340915	348110	195
349278	349572	349666	349864	340054	194
351216	351410	351603	351796	351989	193
353147	353339	353532	353724	353916	193
355068	355260	355452	355643	355834	192
356981	357172	357363	357554	357744	191
358889	359079	359266	359456	369646	190
360783	360972	361161	361350	361539	189
362671	362859	363048	363236	363424	188
364551	364739	364926	365113	365301	188
366413	366510	365796	36698[illegible]	367169	187
368287	368473	368659	368845	369030	186
360143	370328	370513	370699	370883	185
371991	372175	372360	372544	372728	184
373831	374015	374198	374382	374565	184
375664	375846	376029	376212	376394	183
377488	377670	377852	378034	378216	182
379306	379487	379668	379849	380030	181

N	0	1	2	3	4
240	380211	380392	380573	380754	380934
241	382017	382197	382377	382557	382737
242	383815	383995	384174	384353	384533
243	385606	385785	383964	385142	386321
244	387390	387568	387746	387923	388101
245	389166	389343	389520	389697	389875
246	390935	391112	391288	391464	391641
247	392697	302873	393048	393224	393400
248	394452	394627	394802	394077	395152
249	396199	396374	396548	396722	369875
250	397940	398114	398287	398461	398634
251	399674	399847	400020	400192	400365
252	401400	401573	401745	401917	402089
253	403120	403292	403464	403635	403807
254	404834	405005	405176	405346	405517
255	406540	406710	406881	407051	407221
256	408240	408410	408579	408749	408918
257	409933	410102	410271	410440	410608
258	411620	411708	411956	412124	412291
259	413300	413467	413635	413802	413970
260	414973	415140	415307	415474	415641
261	416640	416807	416973	417139	417306
262	418301	418467	418633	418798	418954
263	419956	420121	420286	420451	420616
264	421604	421768	421933	422097	422261
265	423246	423410	423573	423737	423901
266	424882	425045	425208	425371	415534
267	426511	426674	426836	426999	427161
268	428135	428297	428459	428621	428782
269	429752	429914	430075	430236	430398
270	431364	431525	411685	431845	432007
271	432969	433129	433290	433450	433610
272	434569	434728	434888	435048	435207
273	436163	436322	436481	436640	436798
274	437751	437909	438067	438226	438384

5	6	7	8	9	D
381115	381296	381476	381656	381837	181
332915	383097	383477	383456	183636	180
384712	384 91	385070	385249	385427	179
386499	386577	3868,6	387034	387212	178
388279	388156	388634	388811	388989	178
390051	390228	390415	390582	390758	177
391817	391993	392.69	393345	392,21	176
393575	393751	393926	394101	394176	175
395326	395501	395676	395850	396025	174
397070	397245	397418	397592	397766	174
398808	3989:1	399154	399327	499501	174
400538	400711	400883	401056	401228	173
402251	402433	402605	402777	402949	172
403978	404149	404320	404492	404663	171
405688	405858	406029	406199	406370	171
407391	407561	407731	407900	408070	170
409087	409257	409426	409595	409764	169
410777	410946	411114	411293	411451	169
412460	412628	412795	412964	4131,2	168
4141,7	414305	414472	414639	414806	167
415808	415974	416141	416308	416474	167
417472	417638	417804	417970	418185	166
419129	419295	419460	419625	419791	165
420781	420945	421110	421275	421539	165
422426	422599	422754	422918	423082	165
424064	424228	424392	424555	424718	164
425697	425860	426023	426186	426349	163
427324	427486	427648	427811	427973	163
428944	429106	429268	429429	429591	162
430559	430720	430881	431042	431203	161
432107	432328	432488	432649	432809	160
433720	433930	434090	434249	434409	160
435366	435526	435685	435844	436003	159
436957	437116	437275	437433	437592	159
438542	4 8700	438859	439017	439175	158

N	0	1	2	3	4
275	439333	439491	439648	439806	439964
276	440909	441066	441224	441381	441538
277	442480	442637	442793	442950	443106
278	444045	444201	444357	444515	444669
279	445604	445760	445915	446071	446229
280	447158	447313	447468	447623	447778
281	448706	448861	449015	449176	449324
282	450249	450403	450557	450711	450865
283	451789	451940	452093	452247	452400
284	453318	453471	453624	453777	453930
285	454845	454997	455149	455302	455454
286	456366	456518	456670	456821	456973
287	457882	458033	458184	458336	458487
288	459392	459543	459694	459845	459995
289	460898	461048	461198	461348	461499
290	462398	462548	462697	462847	462997
291	463893	464042	464191	464340	464489
292	465383	465532	465680	465829	465977
293	466868	467016	467164	467312	467460
294	468347	468495	468643	468790	468938
295	469822	569969	470116	4702 3	470410
296	471292	471438	471585	471732	471878
297	472756	472903	473049	473195	473341
298	474216	474362	474508	474653	474799
299	475671	476816	475962	476107	476252
300	477121	477266	477411	477555	477700
301	478566	478711	478855	478999	479143
302	480007	480151	480294	480438	480582
303	481443	488586	481729	481872	482016
304	482874	483016	483159	483302	483445
305	484300	484442	484585	484727	484869
306	485721	485863	486005	486147	486286
307	487138	487280	487421	487563	487704
308	488551	488692	488833	488974	489114
309	489958	490099	490239	490380	490520

5	6	7	8	9	D
440122	440279	440437	440594	440752	158
441695	441852	442009	442166	442323	157
443263	443419	443576	443732	443889	157
444825	444981	445137	445293	445449	156
446382	446537	446692	446848	447003	155
447933	448088	448242	448397	448 52	155
449478	449633	449787	449941	450095	154
451018	451172	451326	451479	451633	154
452553	452706	452859	453012	453165	153
454082	454235	454387	454540	454692	153
455606	455758	455910	456062	4562 4	152
457125	457276	457428	457579	457731	152
458638	458789	458940	459091	459242	151
460146	460296	460447	460597	460748	151
461649	461799	461948	462098	462248	150
463146	463296	463445	463594	463744	150
464639	464787	464936	465085	465234	149
466125	466274	466423	466571	466719	149
467608	467756	467504	468052	468200	148
469085	469233	469380	469527	469675	147
470557	470704	470851	470998	47114[illegible]	147
472025	47217	472318	472464	472610	146
473487	473633	473779	473925	47407	146
474944	475090	475235	475381	475526	146
476397	476542	476687	276832	476976	145
477844	477939	478133	478278	478422	145
479287	479431	479575	479719	479863	144
480725	480869	481012	481156	481299	144
482159	482302	4824[illegible]5	482588	482731	143
483587	4[illegible]2730	483872	484015	484157	143
485011	4581[illegible]3	4852[illegible]5	485437	485579	142
486430	486572	486714	4868[illegible]5	486997	142
487845	487986	438127	488269	4884[illegible]0	141
489255	4893[illegible]6	4[illegible]9537	489677	489818	141
490661	490801	490941	491081	491222	140

N	0	1	2	3	4
10	491362	491502	491642	491782	491922
11	492760	492900	493040	493179	493319
12	494155	494294	494433	494572	494711
13	495544	495683	495822	495960	496099
14	496930	497068	497206	497344	497482
15	498311	498448	498586	498724	498862
16	499687	499824	499962	500099	500236
17	501059	501196	501333	501470	501607
18	502427	502564	502700	502837	502973
19	503791	503927	504063	504199	504335
20	505150	505286	505421	505557	505692
21	506505	506640	506775	506911	507046
22	507856	507991	508125	508260	508395
23	509202	509337	509471	509606	509740
24	510545	510679	510813	500947	511081
25	511883	512017	512150	512284	512417
26	513218	513351	513484	513617	513750
27	514548	514681	514813	514946	515079
28	515874	516006	516139	516271	516403
29	517196	517328	517460	517592	517724
30	518514	518645	518777	518909	519040
31	519828	519959	520090	520221	520352
32	521138	521 69	521400	521530	521661
33	522444	522575	522705	522835	522966
34	523746	523876	524006	524136	524266
35	525045	525174	525304	525433	525563
36	526339	526468	526598	526727	526856
37	527630	527759	527888	528016	528145
38	528917	529045	529174	529302	529430
39	530200	530328	530456	530584	530712
40	531479	531607	531734	531862	531989
41	532754	532882	533009	533136	533263
42	534026	534153	534280	534407	534534
43	535294	535421	535547	535674	535800
44	536558	536685	536811	536937	537063

5	6	7	8	9	D
492062	492201	492341	492481	492621	140
493458	493593	493737	493876	494015	139
494850	494989	495128	495267	495406	139
496237	496376	496514	496653	496791	139
497621	497759	497897	498035	498173	138
498999	499137	499275	499412	499550	138
500374	500511	400648	500785	500922	137
501744	501880	402017	502154	502290	137
503109	503246	503382	503518	503654	136
504471	504607	504743	504878	505014	136
505828	505963	506099	506234	506370	136
507181	507316	507451	507586	507721	135
508530	508664	508799	508633	509068	135
509874	510008	510143	510277	510411	134
511215	511348	511482	511616	511750	134
512551	512684	512818	512951	513084	134
513883	514016	514149	514282	514415	133
515211	515344	515476	515609	515741	132
516535	516668	516800	516932	517064	132
517855	517987	518119	518251	518382	131
519171	519303	519434	519566	519697	131
520483	520614	520745	520876	521007	131
521792	521922	521053	522183	522314	131
523096	523226	523356	523486	523616	130
524396	524526	524656	524785	52491[illegible]	130
525692	525822	525951	526081	526210	129
526985	527114	527243	527372	527501	129
528274	528402	528531	528660	528788	129
529559	529687	529815	529943	530072	128
530840	530968	531095	531223	531351	128
532117	532245	532372	532500	532627	128
533391	533518	533645	533772	533899	128
531661	534787	534914	535041	535167	127
535927	536053	536179	536306	536432	127
537189	537315	537441	537567	537693	12[illegible]

N	0	1	2	3	4
345	537819	537945	538071	538197	538322
346	539076	539202	539327	539452	539578
347	40329	540455	540580	540705	5 0830
348	541579	541704	541829	541953	542078
349	542825	542950	543074	543199	543323
350	544068	514192	544316	544440	544564
351	545307	545431	545555	545678	545 02
352	546543	546665	546789	546913	547036
353	543775	547898	548021	548144	548267
354	549003	519126	5 9249	549371	549494
355	550228	550351	550473	550595	550717
356	551450	551572	551694	551816	551938
357	552668	552790	552911	553033	553155
358	553885	554004	554126	5542 7	554368
359	555094	555215	555336	555457	555578
360	556303	556423	556541	556664	55678
361	557507	557627	557748	557868	557988
362	558709	558829	558948	559068	559188
363	559907	560026	560146	560265	560385
364	561101	561221	5613 0	61459	561578
365	562293	562412	562531	562650	562769
366	563481	563600	563718	563837	563955
367	564666	564784	564903	565021	565139
368	565848	585966	566084	566202	566320
369	567026	56 144	567262	567379	067497
370	568202	568319	568436	568554	568671
371	569374	569491	569608	569725	569842
372	570543	570660	570776	570891	571010
373	571709	57182	571942	572058	572174
374	72872	572988	573104	573220	573336
375	574031	572147	574263	574379	574494
376	575188	575303	575419	575534	575650
377	576341	576457	576572	576687	576802
378	377492	577607	577722	577836	577951
379	578639	578754	578868	578983	579097

5	6	7	8	9	D
538448	538574	538699	538825	538951	126
539703	539829	539954	5 0079	540204	125
540955	541080	541205	541330	541454	125
542203	542327	542452	542575	542701	12
543 47	543571	543696	543820	543944	124
544688	544812	514936	545060	545183	124
545925	546049	546172	546296	546419	124
547159	547282	547 05	547529	547652	123
548389	548512	548635	548758	548881	123
349616	549739	549861	549984	550 06	122
5 0840	550962	551084	551206	551328	122
552059	552181	552303	552425	552547	122
553276	553398	553519	553640	553762	121
554489	554610	554731	554852	554973	121
555699	555820	555940	555061	556182	121
556905	557026	557146	557267	557387	120
558108	558228	558349	558469	558589	120
559303	559428	559548	559667	559787	120
560504	560624	56074	560863	560982	119
561698	061817	561936	562055	562174	119
562887	563006	563125	563244	563362	119
564074	564192	564311	564429	564548	119
65257	565375	565494	565612	565730	118
566437	56655	566673	565791	566909	118
567614	567732	567849	567967	568084	118
568788	568905	56 .032	569140	560257	117
569959	570076	570193	570309	570426	117
571126	571243	571359	571476	571592	117
572291	572407	572523	572639	571755	116
573452	573568	573684	573800	573915	116
574610	574726	574841	574957	575072	116
575765	575880	575996	576111	576226	115
576917	577032	577147	577262	577377	115
578066	578181	578295	578 10	578525	115
579212	579326	579441	579555	579669	114

N	0	1	2	3	4
380	579784	579898	580012	580126	580240
381	580925	581039	581153	581267	581381
382	582063	582177	582291	582404	582518
383	583199	583312	583425	583539	583652
384	584331	584444	58455[illegible]	584570	584783
385	585461	585573	585686	585799	585912
386	586587	586700	586812	586925	587037
387	587711	587823	587935	588047	588160
388	588832	588944	589055	589167	589279
389	589950	590061	590173	590284	590390
390	591065	591176	591287	591398	591510
391	592177	592288	592399	592510	592621
392	593286	593397	593508	5 3618	593729
393	594392	594503	544613	594724	594834
394	595496	565606	595717	595827	595917
395	596597	596707	596817	596927	597037
396	597695	597805	597914	598024	598134
397	598790	598900	599009	599119	599228
398	599383	599992	600101	600210	600319
399	600973	601082	601190	601299	601402
400	602060	602168	602277	602 86	602 94
401	603144	603253	603361	603469	603577
402	604226	604334	604442	604550	604658
403	605305	605413	605550	605628	605736
404	606381	606489	606596	606704	606811
405	607455	607562	607669	607777	607884
406	608526	608633	608 40	608847	608954
407	609594	609701	609808	609914	610021
408	610660	610767	610873	610979	611086
409	611723	611829	611936	612042	612148
410	612784	612890	612996	613101	613207
411	613842	613947	614053	614159	614264
412	614897	615003	615108	615213	6 5319
413	615950	616055	616160	615265	616370
414	617000	617105	617210	617315	617420

5	6	7	8	9	D
580355	580469	580583	580697	580811	114
581494	581608	581722	581836	581950	114
582631	582745	582859	582972	583085	113
583765	583879	583992	584105	584218	113
584895	585007	585122	585235	585348	113
586024	586137	586250	586362	586475	112
587149	587262	587374	587486	587599	112
588272	588384	588495	588608	588720	112
589391	589503	589615	589726	589838	112
590507	590619	590730	590842	590953	111
591621	591732	591843	591955	592066	111
592732	592843	592954	593064	593175	111
593840	593950	594061	594171	594282	111
594945	595055	595165	595276	595386	111
596047	595157	596267	596377	596487	110
597146	597256	597366	597476	597586	109
598243	598353	598462	598572	598681	109
599337	599446	599556	599665	599774	109
600428	600537	600646	600755	600864	109
601517	601625	601734	601843	601951	109
602603	602711	602819	602928	603035	109
603685	603794	603902	604010	604118	108
604766	604874	604982	605089	605197	108
605843	605951	606059	606166	606274	107
606918	607026	607133	607240	607348	107
607991	608098	608205	608312	608419	107
609060	609167	609274	609381	609488	107
610128	610234	610341	610447	610554	107
611192	611298	611405	611511	611617	106
612254	612360	612466	612572	612678	106
613313	613419	613525	613630	613736	106
614370	614475	614581	614686	614792	105
615424	615529	615634	615740	615845	105
616475	616580	616685	616790	616895	105
617524	617629	617734	617839	617943	105

N	0	1	2	3	4
415	618048	618153	618257	618362	618466
416	619093	619198	619302	619406	619511
417	620136	620240	620344	620448	620552
418	621176	621280	621384	621488	621592
419	622214	622318	622421	622525	622628
420	623249	623353	623456	623559	623663
421	624282	624385	624488	624591	624695
422	625312	625415	625518	625621	625724
423	626340	626443	626546	626648	626751
424	627365	627468	627571	627673	627775
425	628389	628491	628593	628695	628797
426	629410	629511	629513	629715	629817
427	630428	630530	630631	630733	639835
428	631444	631545	631647	63174	631849
429	632457	632559	632660	632761	632862
430	633468	633569	633670	637713	633872
431	634477	634578	634679	634779	634880
432	635484	635584	635685	635785	635886
433	636488	636588	636688	636785	636889
434	637490	637599	637690	637790	637890
435	638489	638589	638689	638789	638888
436	639486	639586	639686	639985	639885
437	6 0 81	640581	640680	640779	640879
438	641475	641573	641672	641771	641871
439	642465	642563	642662	642761	642860
440	643453	643551	643650	643749	643847
441	644 39	644537	644636	644734	644832
442	645422	645521	645619	647717	645815
443	646404	646502	646600	646698	646796
444	647383	647481	147579	647676	647774
445	648360	648458	648555	648653	648750
446	649335	649432	649530	649627	649724
447	650398	650405	650502	650599	650696
448	651278	651375	651472	651569	651666
449	652246	652343	652440	652356	652633

5	6	7	8	9	D
618571	618676	618780	618884	618989	105
619615	619719	619824	619928	620032	104
620656	620760	620864	620968	621072	104
621695	621799	621992	622007	622110	104
622732	622835	622939	623042	623145	104
623766	623869	623973	624076	624179	103
624798	624901	624004	625107	625209	103
625827	625929	626032	626135	626238	103
626853	626959	627058	627161	627263	103
627878	627980	628072	628185	628287	102
628900	629002	629104	629205	629308	102
629919	630021	630123	630224	630326	102
630936	631038	631139	631241	631342	102
631951	632052	632153	632255	632356	101
632963	633064	633165	633266	633367	101
633973	634071	634175	634276	634375	100
634981	635081	635182	635283	635383	100
635986	636087	636187	636288	636388	100
636989	637089	637189	637289	637390	100
637990	638090	638190	638289	638389	99
638988	639088	639188	639287	639387	99
639984	940084	630183	640283	640382	99
640978	641077	631177	641276	641375	99
641970	642059	632168	842267	642366	99
642959	643058	633156	643255	643354	99
643945	644044	644143	644242	644340	98
644931	645029	645127	645226	645324	98
645913	646011	646109	646208	645306	98
646894	646992	647089	647187	947285	98
647872	647969	648067	648165	648262	98
648848	648945	949043	649140	649237	97
649821	649918	650015	650113	650210	97
650794	650890	650987	651084	651181	97
650762	651859	651956	652053	652150	97
652730	652826	652923	653019	653116	97

N	0	1	2	3	4
450	653212	653309	653405	653502	653598
451	654175	654273	654369	654465	654562
452	655138	655234	655331	655427	655523
453	656098	656194	656290	656386	656481
454	657054	657151	657247	657343	657438
455	658011	658107	658202	658298	658393
456	658965	659060	659155	659250	659346
457	659916	660011	660106	660201	660296
458	660865	660960	661055	661150	661245
459	661813	661907	662002	662096	662191
460	662758	662852	662947	663041	663135
461	663701	663795	663889	663983	664078
462	664642	664736	664830	664924	665016
463	665581	665 75	665768	665862	665956
464	666518	666612	666705	666799	666892
465	667453	667546	667640	667733	667 26
466	668386	668479	668572	668605	668758
467	669317	669410	669503	669595	669589
468	670246	970339	670431	670524	670617
469	671173	671265	671358	671451	671543
470	672098	672190	672283	672375	672467
471	673021	673113	673205	673297	673390
472	673942	674034	674126	674218	674310
473	674861	674953	675045	675136	975228
474	675778	675870	675961	676053	676145
475	676694	675 85	675876	676968	677059
476	677607	677698	677789	677881	677972
477	678518	678609	678700	678791	678882
478	6794 8	679519	679610	679700	679791
479	680335	680426	680517	680607	680698
480	681241	681332	681422	681513	681603
481	682145	682235	682326	682416	682506
482	683047	683137	688227	683317	683407
483	683947	684037	684127	684217	684307
484	684845	684935	685025	685114	685204

5	6	7	8	9	D
653695	653791	653888	653984	654080	97
654658	654754	654850	654946	655042	96
655619	655714	655710	655906	656002	96
656577	656673	650769	656864	656960	96
657534	657629	657725	657820	957916	96
6584 8	658584	658679	658774	658870	95
659441	659535	659631	659726	659821	95
660391	660486	660581	660676	660771	95
661339	661434	661529	661623	661718	94
662285	662380	662474	662569	662663	94
663230	663324	663418	663512	663507	94
664172	664266	664360	664454	664548	94
665112	665205	665299	665393	665487	94
666050	666143	660237	666331	666424	94
666986	667079	667173	667266	667359	94
667920	668013	668106	668199	668293	94
668852	6 8945	669038	669131	669224	94
669782	669874	669967	670060	670153	93
670710	670802	670895	670988	671080	93
671636	671728	671821	671913	672005	93
072560	672652	072744	672836	672929	93
673482	673574	673666	673758	673850	92
674402	674494	674585	674677	074769	92
675320	675412	675503	675595	675687	92
676236	6763 8	676419	676511	676602	91
677150	677242	677333	677424	677516	91
678063	678154	678245	678336	674127	91
678973	679064	679155	679246	679337	9
679882	679973	680063	680154	680245	91
680789	68 879	680970	681060	681151	91
681693	681784	681874	681964	682055	90
682596	682686	682777	682867	682957	90
683497	683587	683677	683767	683857	90
684396	684486	684575	684666	684756	90
685294	685383	685473	685563	685652	90

N	0	1	2	3	4
485	685742	685831	685921	686010	686100
486	686636	686726	686815	686904	686994
487	687529	687618	687707	687796	687885
488	688420	688599	688598	688687	688776
489	689309	689398	689486	689575	689664
490	690196	690285	690373	699462	690550
491	691081	691170	691258	691347	691435
492	691965	692053	692142	692230	692318
493	692847	692935	693023	693111	693199
494	693727	693815	693903	693991	694078
495	694605	694693	694781	694868	69 956
496	695482	695570	695657	695744	695832
497	696356	696445	696531	696618	696706
498	697229	697317	697404	697491	697578
499	698101	698188	698275	698362	698449
500	698970	699057	699144	699231	699317
501	699838	699924	700011	700098	700184
502	700704	700790	700877	700963	701049
503	701568	701654	701741	701827	701913
504	702430	702517	702603	702689	702775
505	703291	703317	703463	709231	703635
506	704151	704236	704322	700400	704494
507	705008	705094	705179	705165	705350
508	705864	705949	706035	706120	705206
509	706718	706803	706888	706974	707059
510	707570	707655	707740	707826	707911
511	708421	708506	708591	708676	708761
512	709270	709455	709440	709524	709609
513	710117	710202	710287	710371	710456
514	710963	711048	711132	711217	711591
515	711807	711892	711976	712060	712144
516	712650	712734	712818	712902	712986
517	713491	713575	713659	713742	713826
518	714330	714414	71449	714581	714665
519	715167	715251	715335	715415	715501

5	6	7	8	9	D
686189	686279	686368	686458	686547	89
687083	687172	687[illegible]61	68735[illegible]	687440	89
687975	688064	688153	6[illegible]8242	688331	89
688865	688953	689042	689131	689220	89
689753	689841	689930	690019	680107	89
690639	690727	690816	690905	690993	89
691524	691612	691706	691789	691877	88
692406	692[illegible]94	692583	692671	692759	88
693287	693[illegible]75	693463	693551	693639	88
684166	694254	694342	694430	694517	88
695044	695131	695219	695307	695404	88
695919	696007	696094	696182	696270	87
696795	696880	696968	697055	697142	87
697665	697752	697839	697926	698014	87
698537	698622	698[illegible]09	698706	698883	87
69040[illegible]	69[illegible]491	699578	699664	699751	87
700271	700358	700443	700531	700617	87
701136	701222	701309	701395	701482	86
701999	702086	702172	702258	702314	86
702861	702947	703033	703119	703205	86
703721	703807	703893	703979	704065	86
704579	704995	704751	704837	704922	86
705436	705522	705607	705693	705778	86
706291	706376	706462	706[illegible]47	706632	85
707144	707229	707[illegible]	707400	707485	85
707996	708081	70[illegible]166	708251	708336	85
708846	708931	709015	709100	70918[illegible]	85
709964	709779	709863	709948	210033	85
710540	710625	710710	710794	71087[illegible]	85
711385	711469	[illegible]11554	911639	711722	84
712229	712313	712397	712481	712566	84
713070	713154	713238	713323	713407	84
713910	713994	714078	714162	714246	84
714749	714833	214916	715000	715084	84
715589	715669	715753	715836	715920	84

N	0	1	2	3	4
520	716003	716087	716170	716258	716337
521	716838	716921	717004	717088	717171
522	717671	717754	717837	717920	718003
523	718502	718585	718668	718751	718834
524	919331	719414	719497	719580	719663
525	720159	720242	720325	720407	720490
526	720986	721068	721151	721233	721316
527	721811	720893	721975	722058	722140
528	722633	722714	722798	722881	722963
529	723406	723538	723620	723702	723784
530	724276	724358	724440	724522	724603
531	725092	725176	725258	725340	725422
532	725912	725993	726075	726156	726238
533	726727	726809	726890	726972	727053
534	727541	722623	727704	727785	727856
535	728354	728435	728516	728597	728678
536	729165	729246	729327	729408	729481
537	729974	730055	730136	730217	730298
538	730782	73 863	730944	731024	731105
539	731589	731569	731750	731830	731911
540	732394	732474	732555	732635	732715
541	733197	733278	733358	733438	733518
542	633999	734079	734159	734240	734320
543	734800	734880	734960	735040	735120
544	735599	735679	735759	735838	735918
545	736397	736476	736556	736635	736715
546	737193	737272	737352	737431	737511
547	737987	738067	738146	738225	738305
548	738781	738860	738939	739018	735197
549	739572	739651	739731	739810	739889
550	740363	740442	740521	740599	740678
551	741152	741230	741309	741388	741467
552	741939	742018	742096	742175	742254
553	742725	742804	742882	742961	743039
554	743510	743588	743667	743745	743823

5	6	7	8	9	D
716421	716504	716588	716671	716754	83
717254	717338	717421	717504	717587	83
718086	718169	718253	718336	718419	83
718917	719000	719083	719165	719248	83
719745	719828	719911	719994	720077	83
720573	720655	720738	720821	720903	83
721398	721481	721563	721646	721728	82
722222	722305	722387	722459	722552	82
723045	723127	723209	723291	723374	82
723865	623948	724030	724112	724194	82
724685	724767	724849	724931	725013	82
725503	725585	725667	725748	725830	82
726320	726401	726483	726564	726646	82
727134	727216	727297	727379	727460	81
727948	728029	728110	728191	728273	81
728759	728841	728922	729003	729084	81
729570	729651	729732	729813	789893	81
730378	730459	730540	730621	730702	81
731186	731266	731347	731428	731508	81
731991	732072	732152	732233	732313	81
732796	732876	732956	733037	733117	80
733598	733679	733759	733139	733919	80
734400	734480	734560	734640	734720	80
735199	735279	735359	735439	735519	80
735998	736078	736157	736237	736317	80
736795	736874	736954	737074	737113	80
737590	737670	737749	737829	737908	79
738384	738463	738543	738622	738701	79
739177	739256	739335	739414	739493	79
739968	740047	740126	740205	740284	79
740757	740836	740915	740994	741073	79
741546	741624	741703	741782	741860	79
742332	742411	742489	742568	742641	79
743118	743196	743275	743353	743431	78
743902	743980	744058	744136	744215	78

N	0	1	2	3	4
555	744293	744371	744449	744528	744606
556	945075	745153	745231	745309	745387
557	745855	745933	746011	746089	746167
558	746634	746712	746790	746868	746945
559	747412	747487	747567	747645	747722
560	748188	748266	748343	748421	748498
561	748963	749040	749118	749195	749272
562	749736	749814	749891	749968	750045
563	750508	750586	750663	750740	750817
564	751279	751356	751433	751510	751587
565	752048	752125	752202	752279	752356
566	752816	752893	752970	753047	753123
567	753583	753660	753736	753813	753889
568	754348	754425	754501	754578	754654
569	755112	755189	755265	755341	755417
570	755875	755951	756027	756103	756179
571	756636	756712	756788	756864	756940
572	757396	757472	757548	757624	757700
573	758155	758230	758306	758382	758458
574	758912	758988	759063	759139	759214
575	759668	759743	759819	759864	759970
576	760422	760498	760573	750549	760724
577	761176	751251	751326	751402	761477
578	751928	762003	762078	762153	762228
579	762679	752754	762829	762904	762978
580	763428	663503	763578	763653	763727
581	764176	754251	764326	764400	764475
582	764923	754998	765072	765147	765221
583	765669	765743	765818	765892	765966
584	766416	765487	765561	756636	766710
585	767156	767230	767304	767379	767453
586	767898	767972	768046	758120	768194
587	768638	763712	768786	758860	768934
588	769377	769451	769525	769599	769673
589	770115	770189	760263	760336	770410

5	6	7	8	9	D
744684	744752	744840	744919	744997	78
745 16	745543	745621	745699	745777	78
746245	746323	746401	746479	746556	7
747023	747101	747179	747256	747334	78
747800	747877	747955	748033	748110	78
748576	748653	74873	748808	748885	77
749350	749427	749504	749582	7496 9	77
750123	750200	750277	750354	750431	77
750894	750971	751048	751125	751 02	77
751664	751741	751818	751895	751972	77
752433	752509	752586	752653	752740	77
753200	753277	7533 3	753430	753506	77
753966	754042	754119	754195	754272	77
754730	754807	754883	754960	75 036	76
755494	755570	755646	755722	755799	76
756256	756332	756 08	756484	756560	76
757016	757092	757927	757244	757320	76
757775	757851	7 7927	758003	758079	76
758533	758709	758685	758761	758836	76
759290	759366	759441	7 9517	759592	76
760045	760121	760196	760272	760347	75
760799	760875	760950	761026	761101	75
761552	761627	761702	761778	761853	75
762303	761378	762453	762529	762604	75
765053	763128	763203	763278	763351	7 5
763802	763877	763952	764027	764101	75
764550	764624	764699	764774	764848	75
765295	765370	765445	765519	76 594	75
766041	766115	766190	766264	766338	74
767 85	766859	766933	767007	767082	74
767527	767601	767675	767749	767823	74
768268	769342	768416	768490	768564	74
769008	769082	769156	769230	769303	74
769746	769820	76 894	769968	770042	74
770404	720557	770531	760705	770778	74

N	0	1	2	3	4
590	770852	770926	770999	771073	771146
591	771587	771661	77 734	77180	771881
592	772322	772395	772468	772544	772615
593	773055	773128	773201	773276	773348
594	773789	773860	773933	774006	775079
595	774517	774500	774663	774736	774809
596	775245	775319	775392	775465	775538
597	775974	776047	776120	776193	776265
598	776701	776774	776846	77 919	776 92
599	777427	777499	777572	777644	777717
600	778151	77 224	778296	778368	778441
601	778874	778947	779019	779091	779163
602	779596	779669	779741	779813	779885
603	780317	780389	780461	780533	730605
604	781037	781109	781181	781253	781324
605	7817 6	781827	781899	781971	782042
606	782473	782 44	782616	782688	782759
607	783189	783260	783332	783403	783475
608	783904	783975	784046	784118	784189
609	784617	784689	784760	784831	784902
610	785330	785401	785472	785543	785615
611	786041	7 6112	786183	786254	786325
612	786751	786822	786893	786964	787035
613	787460	787531	787602	787673	787744
614	788 68	788239	788310	788381	788451
615	788875	788946	789016	789087	789157
616	789581	789651	789722	789792	789863
617	790285	790356	790426	790496	790567
618	790988	791059	791129	791199	791269
619	791691	7 1761	791831	791901	791971
620	792392	792462	792532	792602	792672
621	793092	793162	793231	793301	793371
622	793790	793868	793930	794000	794070
623	794488	794550	794627	794697	794767
624	795185	795254	795324	795393	795463

5	6	7	8	9	D
771220	771293	771367	771440	771514	74
771955	77 028	772102	772175	772248	73
772688	772762	772835	772908	772981	73
773421	773494	773567	773640	773713	73
774152	774225	774298	774371	774444	73
774882	774955	775028	775100	775173	73
775610	775683	775756	775829	775902	73
776338	775411	776483	776556	776629	73
777064	777137	777209	777282	777354	73
777789	777862	777934	778006	778079	72
778513	778585	778658	778720	778802	72
779236	779308	779380	779452	779524	72
779957	770029	780101	780173	780245	72
780677	780749	780821	780893	780965	72
781395	781468	781540	981612	781684	72
782114	782186	782258	782329	782401	72
782831	782902	782974	783046	783117	72
783546	783618	783 89	783761	783832	71
784261	784332	784403	784475	784546	71
784974	785045	785116	785187	785259	71
785685	785757	785828	785899	785970	71
786396	786467	786538	786609	786680	71
787106	787177	787248	787319	787399	71
787815	787885	787956	788027	788098	71
788522	788593	788663	788734	788804	71
789228	789299	789359	789440	789510	71
789933	790004	790074	790144	790215	70
790637	790707	790778	790848	790918	70
791340	791410	791480	791560	791620	70
792041	792111	792181	792252	792322	70
792742	792812	792882	792952	793022	70
793441	793511	793581	793651	793721	70
794139	794209	794279	794349	794418	70
794836	794906	794976	795045	795119	70
795532	795602	795672	795741	795810	70

N	0	1	2	3	4
625	795880	795949	796019	796088	796158
626	796574	795644	796713	795782	796852
627	797268	797337	797406	797475	797545
628	797960	7980 9	798098	758167	798236
629	798651	798720	798789	798858	798927
630	799341	799409	799478	799547	799616
631	800029	800098	800167	800236	800305
632	8 0717	800786	800854	800923	800992
633	801404	801472	801541	801609	801678
634	802089	802258	802226	802295	802363
635	802774	802842	802910	802979	803047
636	803457	803525	80 594	803662	803730
637	804139	804208	804276	804344	804412
638	804821	804889	804957	805025	805093
639	805501	805569	805637	805705	805773
640	806180	806248	805316	806384	805451
641	806858	806926	806993	807061	807129
642	807535	807623	807670	807738	807805
643	808211	808279	808346	808414	808481
644	808886	808953	809021	809088	809156
645	809560	809627	809694	809762	809829
646	810233	810301	810367	810434	810501
647	810904	810971	811039	811106	811173
648	811575	811642	811709	81 776	811843
649	812245	812312	812379	812445	812512
650	812913	812980	8 3047	813114	813181
51	813581	813648	813714	813781	813848
652	814248	814314	814381	814447	814514
653	814913	814980	8 5046	815113	815179
654	815578	815641	815711	815777	815843
655	816241	816241	8 6374	816440	816506
656	816904	816904	817036	817102	817169
657	817565	817 65	817698	817764	817830
658	818226	818226	8183·8	818424	818490
659	818835	818885	819017	819083	8 9149

5	6	7	8	9	D
796227	796297	796366	795436	796505	69
795921	795990	797060	792129	797198	69
797614	797683	797752	797821	797890	69
798305	798374	798443	798513	798582	69
798996	799065	799121	799203	799272	69
799685	799754	799823	799892	799961	69
800373	800442	800511	800580	800648	69
801061	801129	801198	801265	801335	69
801747	801815	801884	801952	802021	69
802432	802500	802568	802637	802705	68
803116	803184	803252	803321	803389	68
803798	803867	803935	804003	804071	68
804480	804548	804616	804685	804753	68
805151	805229	805297	805365	805433	68
805840	805908	805976	806014	806112	68
806519	806587	805655	806722	806790	68
807197	807264	807332	807400	807467	68
807873	807941	808008	808076	808143	68
808548	808616	808584	808751	808818	67
809223	809290	809358	809425	809492	67
809896	809964	810031	810098	810165	67
810569	810636	810703	810770	810837	67
811240	811307	811374	811441	811508	67
811910	811977	812044	812111	812178	67
812579	812646	812713	812780	812847	67
813247	813314	813381	813418	813514	66
813914	813981	814048	814114	814181	66
814581	814647	814714	814780	814847	66
815246	815312	815379	815445	815511	66
815910	815975	816042	816109	816175	66
816573	816639	816705	816771	816838	66
817235	817301	817367	817433	817499	66
817896	817962	818028	818094	818160	66
818556	818622	818688	818754	818819	66
819215	819281	819347	819412	819478	66

N	0	1	2	3	4
660	819541	819610	819676	819741	819807
661	820102	820267	820333	820399	820464
662	820858	820924	820989	821055	821120
663	821514	821579	821645	821710	821776
664	822168	822233	822299	822354	824130
665	822822	822887	822952	823018	823083
666	823474	823539	823605	823670	823735
667	824126	824101	824256	824321	824386
668	824777	824842	824907	824972	825036
669	825426	825491	825555	825621	825686
670	826075	826140	626204	826269	826334
671	826723	826787	826852	826917	826981
672	827369	827434	827499	827563	827608
673	828015	828080	828144	828209	828273
674	828660	828724	828789	828853	828918
675	829334	829368	829432	829497	829561
676	829947	830011	830075	830139	830204
677	830589	830653	830717	830781	830845
678	831230	831294	831358	831422	831486
679	831870	831934	831998	832062	832126
680	832509	832573	832636	832700	832764
681	833147	833211	833275	833338	833402
682	833784	833848	833912	833975	834039
683	834401	834484	834548	834611	834675
684	835056	835120	835183	835247	835310
685	835691	835754	835817	835881	835944
686	836324	836387	835451	836514	836577
687	836957	837020	837083	837146	837209
688	837588	837652	837715	837778	837841
689	838219	838282	838345	838408	838471
690	838849	838912	838975	839038	839101
691	839478	839541	839604	839667	839729
692	840106	840169	840232	840294	840357
693	840733	840795	840859	840921	840984
694	841359	841422	841485	841547	841610

5	6	7	8	9	D
819870	819939	8 0004	819070	820136	66
820530	820596	820 61	820727	820792	66
821185	821251	821317	821382	8214 8	66
821841	821906	821972	822037	822102	65
822495	822560	822626	822691	822756	65
823148	823213	833279	828344	823409	65
823802	823865	823930	823996	824 51	65
824451	824516	824581	824646	824711	65
825101	825166	825231	82529	825361	65
825751	825815	825880	825945	826009	65
826399	826464	826528	826593	826658	65
827046	827111	827175	827240	827305	65
827692	827707	827421	827886	827951	65
8 8338	828402	828867	828531	828596	64
828982	829046	829111	829175	829240	64
829625	829 90	829754	829818	829882	64
830268	830332	83 3 6	830460	830525	64
833909	830973	831037	831102	831166	64
831 50	831614	831678	831742	831806	64
832189	842253	832317	832381	832445	64
832828	832892	832956	833019	833 83	64
833465	833530	833593	833 7	833721	64
834103	834166	83 230	834294	834357	64
834739	834702	834866	834929	834993	64
835373	835 37	835 00	835564	835627	63
836007	836071	836134	836197	836261	63
836541	836704	836767	836830	836894	63
83 273	837336	837399	837461	837525	63
837904	83 967	838030	8380 3	838156	63
838534	838597	838660	838723	838786	63
839 64	839237	839289	839352	839415	63
839792	8398 5	839918	839981	840043	63
840400	840482	840545	840508	840671	63
841046	841109	841172	841234	8412 7	63
841672	841735	841797	841860	841922	63

N	0	1	2	3	4
695	841985	842047	842110	842172	842235
696	842609	842672	842734	842796	842859
697	843233	843295	843357	843420	843482
698	843855	843918	843980	844042	844104
699	844477	844539	844601	844664	844726
700	845068	845160	845222	845284	845345
701	845718	845780	845842	845904	845966
702	846337	846399	846461	846523	846585
703	846955	847017	847079	859141	847202
704	847573	847634	847696	847758	847819
705	848189	848251	848312	848374	848435
706	848805	848899	848928	848989	849051
707	849419	849481	849542	849604	849665
708	850033	850095	850156	850217	840279
709	850646	850707	850769	850830	850891
710	851258	851319	851381	851442	851503
711	851869	851931	851992	852053	852114
712	852480	852541	852602	852663	852724
713	853089	853150	853211	853272	853333
714	853698	853759	853820	853881	853941
715	854306	854367	854428	854483	854549
716	854913	854974	855034	855095	855856
717	855519	855580	855640	855701	855761
718	856124	856185	856245	856306	856366
719	856729	856789	856850	856910	656970
720	857333	857393	857453	857513	857574
721	857935	857995	858056	858116	858176
722	858537	858597	858657	858718	858778
723	859138	859198	859258	859318	859378
724	859739	859799	859859	859918	859978
725	860338	860398	860458	860518	860578
726	860937	860996	861056	861116	861176
727	861534	861594	861654	861714	861773
728	862131	862191	862251	862310	862370
729	862727	862787	862842	862906	862966

5	6	7	8	9	D
842297	842360	842422	842484	842547	62
842921	842983	843046	843108	843170	62
843544	843606	843669	843731	843793	62
844166	844229	844291	844353	844415	62
844788	844850	844912	844974	845036	62
845408	845470	845532	845594	845656	62
846028	846090	846151	846213	846275	62
846646	846708	846770	846832	846894	62
847263	847 25	847388	847449	847511	62
847881	847943	848004	848066	848127	62
848497	848559	848620	848682	848743	61
849112	849174	849235	849297	849358	61
849726	849788	849849	849911	849972	61
850340	850401	850462	8 0524	850585	61
850952	851014	85 075	851136	851197	61
851564	851625	851686	851747	851809	61
852175	852236	852297	852358	852419	61
852785	852846	852907	852968	853029	61
853374	853455	853516	853576	853637	61
854002	854063	854124	854184	854245	61
854610	854670	854731	854792	354852	61
855216	855277	855337	855398	855459	61
875821	855882	8 5943	856003	856064	61
856427	856487	856548	856608	1 66 8	60
857031	857091	857151	857212	857272	60
857 34	857694	857754	857815	857875	60
858236	858296	858 57	858417	858477	60
858 38	858898	858958	859018	859078	60
859439	859499	859559	859619	859679	60
860038	860098	850158	860218	850278	60
860637	850697	860757	860817	8 0877	60
861236	861295	861355	861415	860475	60
861833	861893	861952	862012	862072	60
862430	862489	862549	862608	862668	60
863025	863085	863144	863204	863263	60

N	0	1	2	3	4
7 0	863323	863382	863442	86350	863561
731	863917	863977	864036	864069	86 155
732	864511	864570	864630	864689	86 748
733	86 104	865163	865222	8 5282	865341
734	8 5696	865755	865815	865 73	865933
735	866287	866346	866 05	866465	66524
736	86 878	866937	766996	867055	867114
737	8674 7	867526	867585	86 644	67703
738	868058	868115	868174	868 33	8682 2
739	868644	868703	8687 2	868821	868876
740	869232	86 290	69 49	869408	869466
741	869818	869877	8699 5	869994	870053
7 2	870404	8 0462	70521	870579	870638
743	870589	87 047	871106	871164	871223
744	871573	871631	87169	871708	871805
745	872156	87221	872273	872332	87 389
745	872739	872797	872855	872913	872972
747	873321	873379	873437	873495	8 3553
748	8739 2	87396	8740 8	874076	874134
749	874 82	8743 4	874398	874656	874714
750	8750 1	875119	875177	175235	875293
751	875640	875698	875756	875813	875871
7 2	87021	876276	876 3	876391	876449
753	876 95	87685	87691	876968	877026
754	87737	877429	8774 8	877544	877602
755	877947	8 8004	878062	878119	678177
756	87852	878579	878637	878694	878751
757	879096	879153	879211	879268	879 5
758	879 69	879 36	879784	87984	8798 8
759	80 41	880299	870356	880413	880471
760	880814	880871	8809 8	880985	81042
761	881 85	881442	881499	8815 6	88161 3
762	881955	882012	882069	8 2126	882 83
763	88 524	88 58	88 638	882695	882 52
764	83 93	883050	883207	88 26	883321

5	6	7	8	9	D
863620	863680	863739	863798	863858	59
864214	864274	864333	864392	864452	59
864808	864867	864926	864985	865045	59
865400	865459	865518	865578	865637	59
865992	866051	866110	866169	866228	59
866585	866642	866701	866760	866819	59
867173	867232	867291	867350	867409	59
867762	867821	867880	867939	867997	59
868350	868409	868468	868527	868586	59
868908	868997	869056	869114	869173	59
869525	869584	869642	869701	869760	59
870111	870170	870228	870287	870345	59
870696	870755	870813	870872	870930	58
871281	871339	871398	871456	871515	58
871865	871923	871981	872040	872098	58
872448	872506	872564	872622	872681	58
873030	873088	873146	873204	873262	58
873611	873669	873727	873785	873843	58
874192	874250	874308	874366	874424	58
874772	874830	874887	874945	875003	58
875351	875409	875466	875524	875582	58
875929	875987	876044	876102	876160	58
876506	876564	876622	876680	876737	58
877083	877141	877198	877256	877314	58
877659	177717	877774	877832	877889	58
878234	878292	878349	878407	878464	57
878809	878866	878924	878981	879038	57
879383	879439	879497	879555	879612	57
889956	880013	880070	880127	880185	57
880528	880585	880642	886699	880756	57
881099	881156	881213	881270	881328	57
881670	881727	881784	881841	881898	57
882240	882297	882354	882411	882468	57
882809	882866	882923	882980	883035	57
883377	883434	883491	883548	883665	57

N	0	1	2	3	4
765	883661	883718	883775	883832	883888
766	884229	884285	884342	884399	884455
767	884795	884852	884909	884965	885022
768	885361	885418	885474	885531	885587
769	885926	885983	886029	886097	886155
770	886491	886547	886604	886 ·60	886716
771	887054	887111	887167	887223	887280
772	887617	887673	887730	887786	887842
773	888179	888236	888292	888348	888404
774	888741	898797	888853	888909	888964
775	889302	889358	889414	889470	889526
7 6	889862	889918	889974	8500 0	890030
777	890421	890477	8905;3	890589	890644
718	890980	891c35	891091	891147	8912?3
7'9	891537	891593	891549	891705	891760
780	892095	892150	892206	892262	892317
781	892651	892707	892752	892818	8,2873
7?2	893207	893:52	893318	893373	8,3429
783	893 62	893817	893873	893928	893984
734	894316	894371	894427	894482	894538
785	8?4870	894925	894980	895036	895091
7?6	895422	895178	895533	895588	895643
787	895975	895030	896085	896140	896195
788	896526	896581	89?636	89?691	896747
789	897077	897132	897187	897243	897297
790	897672	897682	897737	897792	897847
791	898176	8,8231	898286	898341	898396
792	8,8725	898780	89883;	898890	898944
793	89;273	89)328	899383	899437	899492
794	899820	899375	899930	899985	890039
795	900367	900422	900416	900531	900586
796	900913	900968	901022	901077	9011.3
797	901458	9015 3	901567	901622	901676
79?	902003	902057	90:112	902166	902220
799	902547	902601	902655	902710	902764

5	6	7	8	9	D.
883945	884002	885049	884115	884172	57
884512	884509	884625	884682	884739	57
885078	885135	885191	885248	885305	57
885644	885700	885757	885813	885870	57
886207	886265	886321	886378	886434	56
886773	886829	886885	886941	886998	56
887336	887392	887449	887505	887561	56
887898	887955	888011	888067	888123	56
888460	888516	888573	888629	888685	56
889021	889077	889133	889190	889246	56
889582	889538	889694	889750	889806	56
890141	890197	890253	890309	890365	56
890700	890756	890812	890868	890924	56
891259	891314	891370	891426	891482	56
891816	891872	891928	891983	892039	56
892373	891428	892484	892540	892595	56
892929	892985	893040	893096	893151	56
893484	893540	893595	893651	893706	56
894039	894094	894150	894205	894261	55
894593	894648	894704	894759	894814	55
895145	895201	895257	895312	895367	55
895699	895754	895809	895864	895919	55
896251	896306	896361	896416	896471	55
896802	896857	896912	896967	897022	55
897352	897407	897462	897517	897572	55
897902	897957	898011	898067	898122	55
898451	898506	898561	898615	898670	55
898999	899054	899109	899164	899218	55
899547	899602	899656	899711	899766	55
900094	900149	900103	900258	900312	55
900640	900695	900749	900804	900858	55
901186	901240	901295	901349	901404	55
901731	901785	901840	901894	901948	54
902275	902329	902384	902438	902492	54
902818	902873	902927	902981	903036	54

N	0	1	2	3	4
800	903090	903144	903198	903253	903307
801	903632	903687	903741	903795	903849
802	904194	904228	904283	904337	904391
803	904715	904770	904824	904878	904932
804	905256	905310	905364	905418	905472
805	905706	905850	905904	905958	906012
806	906335	906389	906443	906497	906550
807	906873	906927	907981	907035	907089
808	907411	907465	907519	907573	907626
809	907648	908002	908056	908109	908163
810	908485	908539	908592	908646	908699
811	909021	909074	909128	909181	909235
812	909556	909609	909663	909716	909770
813	910090	910144	910197	910251	910304
814	910624	910678	910731	910784	910838
815	911158	911211	911264	911317	911371
816	911690	911743	911797	911850	911903
817	912222	912275	912323	912381	912435
818	912753	912806	912859	912912	912966
819	913284	913337	913390	913443	913490
820	913814	913867	913920	913973	914026
821	914343	914396	914449	914502	914555
822	914872	914920	914977	915030	915583
823	915400	915453	915505	915558	915611
824	915927	915980	916033	916085	916138
825	916454	916507	916559	916612	916664
826	916980	917033	917085	917138	917190
827	917565	917558	917611	917663	917715
828	918030	918083	918135	918188	912240
829	918554	918607	918659	918712	918764
830	919078	919130	919183	919235	919287
831	919601	919653	919700	919758	919810
832	920123	920175	920228	920280	920332
833	920645	920697	920742	920801	920853
834	921666	921218	921270	921322	921374

5	6	7	8	9	D
903361	9035·6	603470	903524	903578	54
903.03	903958	904012	904066	904·20	54
·04445	904499	904553	904607	904651	54
904986	905040	905·94	905148	905202	54
9055·6	9055·0	905624	905688	905742	54
906065	906119	906172	906227	906281	54
906601	90665·	906712	906766	905820	54
907142	907196	907250	90730·	907358	54
907680	9·7·34	90·7·7	907841	907895	54
908217	90827·	908324	908·7·	908·31	54
9087·3	908807	908800	90·91·	9089·7	54
909288	909342	909395	909449	90·502	54
909823	909877	9099·0	9·9984	910037	53
910357	910411	910464	910518	·10571	53
910891	910944	910998	911051	911104	53
911424	911477	911530	611584	911637	53
911956	912009	912062	912116	912169	53
912488	912541	912594	912647	912700	53
913019	913072	913125	913178	913231	53
913549	913602	913655	913708	913761	53
914·79	914132	914184	91158·	914290	53
914608	914660	914713	912116	914819	53
91513·	9·5189	915241	912647	915347	53
8·5654	915716	915769	913178	915874	53
916191	916243	916296	913708	91·401	53
916717	916770	916822	916875	916927	53
917243	917295	917348	917400	917·53	53
917768	917820	927873	917925	917978	52
918292	918345	918397	918459	918502	52
918806	918869	918921	918973	919026	52
919340	919392	919444	919496	919549	52
919862	919914	919967	920029	920071	52
920384	920436	920489	920541	920593	52
920900	920958	921010	9210·2	921114	52
921426	921478	921530	921582	9·1634	52

N	0	1	2	3	4
835	9·1686	921738	921790	9218 2	92 894
836	922206	9222,8	922310	922352	922414
837	922725	922777	9228·9	922881	922933
838	923244	923295	9233·8	923399	923451
839	923752	923814	923865	923917	923969
840	924279	924331	924383	924434	924485
841	924796	924848	924899	924951	925002
842	925312	925364	925415	925467	925518
843	925828	9·5879	925931	925982	926034
844	926342	926394	92644·	926497	926548
845	926857	926908	926959	927011	927062
846	927370	927422	927473	927514	927576
847	927883	927935	927986	928037	928088
848	928396	928447	928498	928549	92·691
849	928908	928959	929010	929061	929112
850	929419	929470	929521	929572	929623
851	929930	929981	930032	930083	930134
852	930440	930491	930541	930592	930643
853	930949	931000	931051	931102	931153
854	9324·8	931509	931560	631610	931661
855	931966	932017	932068	932118	932169
856	932474	932524	932575	932624	932677
857	932981	933031	933082	933131	933283
858	933487	933538	933588	933639	933690
859	933993	934014	934094	934145	934195
860	934498	934549	934599	934650	934700
861	935003	935054	935104	935154	935205
862	936507	935558	935608	935658	935·09
863	93·011	936061	93·111	936162	936212
864	936511	936564	936514	93·665	936715
865	937016	93·066	937116	937167	937217
866	937518	937568	937618	937668	937718
867	938019	93·069	938119	938169	938219
868	938520	938570	938620	93·670	9·8720
869	939020	939070	9391·0	939170	939220

5	6	7	8	9	D
921946	921998	922050	922102	922154	52
922466	922518	922570	922621	922674	52
922,85	923037	923088	923140	923192	52
923503	923555	923607	923658	923710	52
924022	924072	924124	924176	924228	52
924538	924589	924641	924693	924744	52
923054	925105	925157	925209	925261	52
925570	925621	925673	925725	925776	52
926085	926137	926188	926239	926291	51
926600	926651	926702	926754	926805	51
927114	927165	927216	927268	927319	51
927627	927678	927730	927781	927832	51
928140	928191	928242	928293	928345	51
928552	928703	928754	928805	928856	51
929163	929214	929265	9 9317	929368	51
929674	929725	929776	929827	929878	51
930185	930236	930287	930338	930389	51
930694	930745	930796	930847	930898	51
931203	931254	931305	931356	931407	51
931712	931763	931814	931854	931915	51
932220	932271	932322	932372	932423	51
932727	932778	932829	932879	932930	51
933234	933285	933335	933386	933437	51
933740	933791	933841	933892	933943	51
934256	934296	934347	934397	934448	51
934751	934801	934852	934902	934953	50
935255	935306	935356	935406	935457	50
935759	935809	935860	935910	935960	50
936262	936313	9363[illegible]	936413	936463	50
936765	936815	936865	936916	936966	50
937267	937317	937357	937418	937468	50
937769	937819	937869	937919	937969	50
938269	638319	938370	938420	938469	50
938770	938820	938870	938920	938970	50
939270	939320	939370	939420	939470	50

N	0	1	2	3	4
870	939519	939569	939519	949668	939719
871	940018	940068	940188	940168	940218
872	940516	940565	940616	940666	940716
873	941014	941064	941114	941663	041213
874	941511	941561	94161	941660	941710
875	942008	942058	942107	942157	942206
876	942504	942554	942603	942653	942702
877	943000	943049	943079	943148	943198
878	943494	943544	943593	943643	9 3592
879	943989	944038	944088	944137	944186
880	944483	944532	944581	944631	944680
881	944976	945025	945074	945124	945173
882	945469	945518	945567	945616	945665
883	945951	946010	946059	946108	946157
884	946452	946501	946551	946600	9466 9
885	946943	946992	947041	947090	947139
886	947434	947483	947532	947581	947630
887	947924	947973	948022	948070	948119
888	948413	948462	948511	948560	948609
889	948902	948951	948999	940048	949097
890	949390	949439	949488	949535	9 9585
891	949878	949926	949975	950024	950073
892	950365	950414	950462	950511	950566
893	950851	950900	950949	950997	951046
894	951337	951386	951435	951483	951532
895	951823	951872	951920	951969	952017
896	952303	952356	952405	952453	952501
897	952792	9528 1	95 889	952938	95 986
898	9 3276	953325	953373	953421	953470
899	953760	953 03	953856	953905	953953
900	954242	954291	95 339	954387	954435
01	954725	9 4773	954821	954869	954918
902	955207	955255	955303	955351	955399
903	955 88	955736	955784	955832	955890
904	956168	956216	956264	956313	956361

5	6	7	8	9	D
939769	939818	939868	939918	939968	50
940267	940317	940367	940417	940467	50
940765	940815	940865	940915	94 964	50
941263	941313	941362	941412	941462	50
941760	941809	941859	941909	941958	50
942256	942306	942355	942405	942454	50
942752	942801	942851	942900	942950	50
943247	243297	943346	943396	943445	49
943742	943721	943841	953890	943639	49
944236	944285	944335	944384	944433	49
944729	944779	944828	944877	94 927	49
945222	945272	945321	945370	945419	49
945715	945764	945813	94 862	945911	49
94 207	946256	946305	94635	946403	49
946698	946747	946796	946845	946894	49
947189	94 238	947287	947336	947385	49
947679	947728	947777	647826	947875	49
948168	948217	948266	948315	948 64	49
948657	948705	948755	948804	94885[illegible]	49
949146	949195	949 45	949292	949341	49
949634	949683	949731	949780	949829	49
9501[illegible]1	950170	950219	95 267	950316	49
950608	950657	950703	950754	950803	49
951095	951143	951192	951240	951289	49
9518[illegible]	951629	951677	9517[illegible]9	951775	49
952066	952114	952163	952211	952259	49
952550	952599	952647	952696	95 744	48
953034	953083	953131	95318	9 3228	48
953518	953566	953615	953663	953711	48
954001	954049	954098	954146	954194	48
954484	954532	954 80	95 628	95 977	48
954966	955214	955 62	955110	955158	48
95 447	9 549	255543	955591	955640	48
955928	955976	956024	956072	956120	48
956409	956457	956505	9 6 53	956601	48

N	0	1	2	3	4
9 5	956649	956697	956745	956793	95 840
905	957128	957176	957224	957272	957320
907	957607	957655	957703	957751	957799
908	958086	958144	958181	958229	958277
909	958564	958612	958659	958707	958755
910	959041	959089	959137	959184	959232
911	959518	959566	959 14	959651	959709
912	959995	960042	960090	960138	9 0185
913	960471	960518	960566	960613	960661
914	960946	960904	961041	961089	961136
915	961421	961468	961516	961563	961611
916	961895	96 943	961990	692038	962085
917	962369	962417	962454	962511	962559
918	962843	962890	962937	962985	963032
919	963315	963363	963410	963457	963504
920	963788	963835	963882	963929	963977
921	964260	964307	664354	964101	964448
922	964731	964778	664825	964872	954919
923	955202	965246	965295	965343	99 390
924	965672	965719	965756	965813	965860
925	966142	966189	966236	966283	966329
926	966611	965658	966705	966752	966798
927	967080	957127	957173	967220	967267
928	967548	967595	967642	967688	967735
929	968016	968062	968109	968156	9 8202
930	9 8481	968520	968576	968623	968670
931	968950	968995	969043	969090	9 9136
932	9 9416	9 9463	969509	969555	969602
933	969882	9699 8	96 975	97002	970068
934	970347	970393	970440	970485	9705 3
935	970812	970858	97090	970951	970997
936	671276	971322	971369	7 415	971401
937	971249	971786	971832	972879	971925
938	972203	972249	972295	72342	972388
939	972666	972712	97 578	728 4	972851

5	6	7	8	9	D
956888	956936	956984	957032	957080	48
957368	957416	957464	957512	957559	48
957847	957894	957942	957990	958038	48
958325	958373	958421	958468	958516	48
958803	958850	958898	658946	958994	48
959280	959328	959375	959423	959971	48
959757	959804	959852	959900	959947	48
960233	960280	960328	960376	960423	48
960709	960756	960804	960851	960899	48
961184	961231	961279	961326	961374	47
961658	961706	961753	961801	961848	47
662132	962180	962227	962275	962322	47
962606	962653	962701	962748	962795	47
963079	963126	963174	963221	963268	47
963552	963599	963646	963693	963741	47
964024	964071	964118	964165	964212	47
964495	964542	964590	964637	964684	47
964966	965013	965061	965108	965155	47
965437	965484	965531	965578	965624	47
965907	965954	966001	966048	966095	47
966376	966423	966470	966517	966564	47
966845	966892	966939	966986	967033	47
967314	967361	967408	967454	967501	47
967782	967829	967875	967922	967969	47
968249	968296	968343	968389	968436	47
968716	968763	968810	668856	968903	47
969183	969229	669276	969323	969369	47
969649	969695	969742	969789	969835	47
970114	970161	970207	970254	970300	47
970579	970626	970672	970719	970765	46
971044	971090	971137	971183	971229	46
971508	971554	971601	671647	971693	46
971971	972018	972064	972110	972157	46
972434	972481	972527	972573	972619	46
972897	972943	972989	973035	973082	46

N	0	1	2	3	4
940	973128	973174	973220	973266	973313
941	973590	973636	973682	973728	973774
942	974051	974 97	974143	974189	974235
943	974512	974558	974604	974650	974696
944	974972	975018	975064	975110	975156
945	975432	975478	975524	975570	975616
946	975891	975937	975483	976029	976075
947	976350	976396	976442	976488	976533
948	976828	976854	976899	976946	976992
949	977265	977312	977358	977403	977449
950	977724	977769	977815	977861	977906
951	978181	978226	978272	978317	978363
952	978637	978683	978728	978774	978819
953	979093	979138	979184	979230	979275
954	979548	979594	979639	979685	979730
955	980003	980049	980094	980140	980185
956	980458	980503	980539	980594	980640
957	980912	980957	981003	981048	981093
958	9 1366	981411	981456	981501	981547
959	9818 9	981864	981909	981954	982000
960	982271	982316	982362	982407	982452
961	982723	982769	982814	982859	982904
962	983175	983220	983265	983310	983356
963	983626	983671	983716	983762	983807
964	9840 7	984122	983167	984212	984257
965	984527	984572	984617	984662	984707
966	984977	985022	985067	985112	985157
967	985426	985471	985516	985561	985606
968	985875	985920	985965	986010	986055
969	9 6324	986369	986413	986458	986503
970	986772	986816	986861	986906	986951
971	987219	987264	987309	987353	987398
972	987666	987711	987756	989800	987846
973	988113	988157	988 02	988247	988295
974	988569	988604	988648	988693	988730

5	6	7	8	9	D
973359	973405	973451	973497	973513	46
973820	973866	973913	973959	974005	45
974281	974327	974374	974420	974466	46
974742	974788	974834	974880	974926	46
975202	975248	975294	975340	975386	46
975662	975707	975753	975799	975845	46
976121	976167	975212	976258	976304	4
976579	976625	976671	975717	976763	46
977037	977083	977129	977175	977220	46
977495	977541	977586	977632	977678	46
977952	977998	978043	978089	978135	46
978409	978454	978500	978546	978591	46
978865	978911	978956	979002	979047	45
979321	979366	979412	979457	979502	46
979776	979821	979867	979912	979658	46
980231	980276	980322	980367	980412	45
980685	980730	980776	980821	980867	45
981139	981184	981229	981275	981320	45
981592	981637	981683	981728	981773	45
982045	982090	982135	982181	982226	45
982467	982543	982588	982633	982678	45
982949	982994	983040	983085	983130	45
983401	983446	983491	983536	983581	45
983852	983897	983942	983987	984032	45
984302	894347	984392	984437	984482	45
984752	984797	984842	984887	984932	45
985202	985247	985292	985327	985382	45
985651	985695	985741	985786	985830	45
986100	986144	986189	986324	986279	45
986548	986593	986637	986682	986707	45
986996	987040	987085	987130	987175	45
987443	987488	987522	987577	987612	45
987890	987934	987979	988024	988068	45
988336	988381	988425	988470	988514	45
988782	988826	988871	988916	988960	45

N	0	1	2	3	4
975	989005	989049	989094	989138	989183
976	989450	989494	989539	989583	989628
977	989895	989939	989983	990028	990072
978	990339	990383	990428	990472	990516
979	990783	990827	990871	990946	990960
980	991226	991270	991315	991359	991403
981	991669	991713	991757	991802	991845
982	992111	992155	992200	992244	992288
983	992554	992598	992642	992686	992730
984	992995	993039	993083	993127	993172
985	993436	993480	993524	993568	993613
986	993877	993921	993965	994009	994053
987	994317	994361	994405	994449	994493
988	994757	994801	994845	994889	994933
989	995196	995240	995284	995328	995372
990	995635	995679	995723	995767	995811
991	996074	996117	996161	996205	996249
992	996512	996555	996599	996643	996687
993	996949	996993	997037	997080	997124
994	997386	997430	997474	997517	99756
995	997823	997867	997910	997954	997998
996	998259	998303	998346	998390	998434
997	998695	998739	998782	998826	998869
998	999130	999174	999218	999261	999305
999	999565	999609	999652	999696	999730

End of the Table

5	6	7	8	9	D
9[illegible]922	9[illegible]937	989316	989301	989405	45
[illegible]8[illegible]672	989717	989761	989805	989[illegible]50	44
990117	99016[illegible]	960[illegible]05	99025[illegible]	990294	44
990561	990605	990650	990694	990738	44
991004	991509	991094	991137	99[illegible]182	44
[illegible]91448	991492	991536	991580	991625	44
991890	99[illegible]934	991979	992023	992067	44
992333	992377	992[illegible]21	992465	992509	44
992774	992819	992863	992907	99295[illegible]	44
993216	993260	993304	993348	993392	44
993557	993701	993745	993789	993833	44
993[illegible]97	994141	994185	994229	994273	44
994537	994581	994625	994669	994713	44
994977	995021	995065	995108	995152	44
995416	995460	995504	995547	995591	44
995854	995898	995942	995986	996030	44
996293	99633[illegible]	996380	996424	996468	44
996731	996774	996818	996862	995905	44
997168	997212	997255	997299	997043	44
9[illegible]7695	997648	997692	997736	997779	44
998041	998085	998129	998172	998216	44
99[illegible]477	998521	998564	998608	998652	44
998913	998956	999000	999043	9990[illegible]7	44
9994[illegible]8	999392	999435	99[illegible]479	999522	44
999783	999826	999870	999913	999956	43

Of Logarithms.

A
TABLE
OF
Artificial SINES
AND
TANGENTS,
For every
Degree and Minute
OF THE
QUADRANT,
Eittted to the Size
OF THE
LOGARITHMS.

LONDON,
Printed for *James Knapton*, at the *Crown*
in St. *Paul's Church-Yard*, 1716.

Degree 0

M	Sine	Co-sine	Tangent	Co Tang.	
0	0 0000000	0 0000000	0,000000	Infinita	60
1	6,463726	9,99999[illegible]	6,463726	13,536274	59
2	6 764756	[illegible],999999	6 764756	13,235241	58
3	6,940847	9 999999	6,940847	13,059153	57
4	7,065786	9 999999	7,065786	12 934[illegible]14	56
5	7 162696	9,999999	7 [illegible]63696	12 837304	55
6	7 241877	9,999999	7,241878	22,758122	54
7	7,308824	9,999999	7,308825	12,691175	53
8	7 366816	9,999999	7,366817	12,633183	52
9	7,417968	9,999999	7,417970	12 582030	51
10	7,463726	9,999998	7,463727	12,536273	50
11	7,505118	9,999998	7,565120	12,494880	49
12	7 542906	9,999997	7,542909	12,457[illegible]91	48
13	7,[illegible]77668	9,96999[illegible]	7,577[illegible]72	12,422328	47
14	7,609853	9,999996	7,609857	12,390143	46
15	7 [illegible]39816	9 999996	7,639826	1[illegible],360180	45
16	7,667844	9 9[illegible]9995	7,667849	12,3[illegible]2151	44
17	7,694173	9,999995	7,694179	1[illegible],305821	43
18	7,718977	9,999994	7,719003	12,281997	42
19	7,742477	9 999993	7,742484	12,257516	41
20	7,764754	9 999993	7,764761	12,235239	40
21	7,785943	9,999992	7,785951	12,21[illegible]049	39
22	7,806140	9 999991	7,806145	12 193845	38
23	7,825451	9,9[illegible]9990	7,825460	12,174540	37
24	7 843934	9 999989	7,8[illegible]3944	12,156056	36
25	7,861662	9,99[illegible]68[illegible]	[illegible]861674	12,138326	35
26	7,878695	9 999988	7 878708	12,121292	34
27	7,895085	9 999987	7,865099	12,104901	33
28	7 910879	9 999986	7,910894	12,089106	32
29	7,925219	9 999[illegible]85	7,926134	12,073866	31
30	7,9[illegible]0842	9,9[illegible]96[illegible]	7,9408[illegible]8	12 059142	30
	Co sine	Sine	Co-Tang.	Tangent	

Degree 89

Degree 0

M	Sine	Co-sine.	Tangent.	Co-Tang.	
30	7,940842	9,999983	7,940858	12,059142	30
31	7,955082	9,999982	7,955100	12,044900	29
32	7,968870	9,999981	7,968889	12,031111	28
33	7,982233	9,999980	7,982253	12,017747	27
34	7,995198	9,999978	7,995215	12,004781	26
35	8,007787	9,999978	7,007810	11,992191	25
36	8,020021	9,999976	8,020044	11,979956	24
37	8,031919	9,999975	8,031945	11,968055	23
38	8,0435[illegible]	9,999973	8,043527	11,956473	22
39	8,054781	9,999972	8,054809	11,945181	21
40	8,065776	9,999971	8,065806	11,934194	20
41	8,076500	9,9999[illegible]6	8,076531	11,923469	19
42	8,086965	9,999968	8,086997	11,913003	18
43	8,097183	9,999966	8,097217	11,902783	17
44	8,107167	9,999964	8,107203	11,892797	16
45	8,116926	9,999963	8,116963	11,883037	15
46	8,126471	9,999961	8,126510	11,873490	14
47	8,135819	9,999959	8,135851	11,864149	13
48	8,144953	9,999958	8,144996	11,855004	12
49	8,153907	9,999955	9,153952	11,846048	11
50	8,162681	9,999954	8,162727	11,837273	10
51	8,171280	9,999952	8,171328	11,828672	9
52	8,179713	9,999950	8,179763	11,820237	8
53	8,187985	9,999948	8,188036	11,811964	7
54	8,196102	9,999946	8,196156	11,803844	6
55	8,204070	9,999944	8,204126	11,795874	5
56	8,211895	9,999942	8,241953	11,788047	4
57	8,219581	9,999940	8,219641	11,780359	3
58	8,227134	9,999938	8,227195	11,772804	2
59	8,234557	9,999936	8,234621	11,765379	1
60	8,241855	9,999934	8,241921	11,758079	0
	Co-sine.	Sine	Co Tang.	Tangent.	M

Degree 89

Degree 1.

M	Sine	Co fine.	Tangent	Co-Tang.	
0	8,241855	9,999934	8,241921	11,758079	60
1	8,249033	9,999932	8,249102	11,750898	59
2	8,256094	9,999929	8,255165	11,743835	58
3	8,263042	9,999927	8,263115	11,736885	57
4	8,269881	9,999925	8,269956	11,730044	56
5	8,276614	9,999922	8,276691	11,723309	55
6	8,283243	9,999920	8,283323	11,716677	54
7	8,289773	9,999918	8,289856	11,716144	53
8	8,296207	9,999915	8,296292	11,703708	52
9	8,302546	9,999913	8,302634	11,697366	51
10	8,308794	9,999910	8,308884	11,691116	50
11	8,314954	9,999997	8,315046	11,684954	49
12	8,321027	9,999905	8,321122	11,678878	48
13	8,327016	9,999902	8,327114	11,672886	47
14	8,332924	9,999899	8,333025	11,666975	46
15	8,338753	9,999897	8,338856	11,661144	45
16	8,344504	9,999894	8,344610	11,655390	44
17	8,350180	9,999891	8,350289	11,649711	43
18	8,355783	9,999888	8,355895	11,641105	42
19	8,361315	9,999885	8,361430	11,638570	41
20	8,366777	9,999882	8,356895	11,633105	40
21	8,372171	9,999879	8,372292	11,627708	39
22	8,377499	9,999875	8,377522	11,622378	38
23	8,382 62	9,999873	8,382889	11,617111	37
24	8,387962	9,999870	8,388092	11,611908	36
25	8,393101	9,999857	8,393234	11,606766	35
26	8,398 79	9,999864	8,398315	11,601685	34
27	8,403199	9,999861	8,403338	11,596662	33
28	8,408161	9,999858	8,40 304	11,591696	32
29	8,413068	9,999854	8,413213	11,586787	31
30	8,417919	9,999851	8,418068	11,585932	30
	Co-fine.	Sine	Co Tang.	Tangent.	M

Degree 88.

Degree 1.

M	Sine	Co-sine.	Tangent	Co-Tang.	
30	8,417919	9,999851	8,418068	11,581932	30
31	8,421717	9,999848	8,422869	11,577131	29
32	8,427462	9,999844	8,427618	11,572382	28
33	8,432156	9,999841	8,432315	11,567685	27
34	8,436800	9,999838	8,436962	11,563038	26
35	8,441394	9,999834	8,441560	11,558440	25
36	8,445941	9,999831	8,446110	11,553990	24
37	8,450440	9,999827	8,450613	11,549387	23
38	8,454891	9,999824	8,455070	11,544930	22
39	8,459301	9,999820	8,459481	11,540519	21
40	8,463665	9,999816	8,463849	11,536151	20
41	8,467985	9,999812	8,468172	11,531828	19
42	8,472263	9,999809	8,472454	11,527546	18
43	8,476498	9,999805	8,476693	11,523307	17
44	8,480693	9,999801	8,480892	11,519108	16
45	8,484848	9,999797	8,485050	11,514950	15
46	8,488963	9,999794	8,489170	11,510830	14
47	8,493040	9,999790	8,490250	11,506750	13
48	8,497078	9,999786	8,497293	11,502707	12
49	8,501080	9,999782	8,501298	11,498702	11
50	8,505045	9,999778	8,505267	11,494733	10
51	8,508974	9,999774	8,509200	11,490800	9
52	8,512867	9,999769	8,513098	11,486902	8
53	8,516726	9,999765	8,516961	11,483039	7
54	8,520551	9,999761	8,520790	11,479210	6
55	8,524343	9,999756	8,524586	11,475414	5
56	8,528102	9,999753	8,528349	11,471651	4
57	8,531828	9,999748	8,532080	11,467920	3
58	8,535523	9,999744	8,535779	11,464221	2
59	8,539186	9,999940	8,539447	11,460553	1
60	8,542819	9,999735	8,543084	11,455910	0
	Co sine.	Sine	Co-Tang.	Tangent.	M

Degree 88.

Degree 2.

M	Sine	Co-sine.	Tangent.	Co-Tang.	
0	8,542819	9,999735	8,543084	11,456916	0
1	8,546422	9,999731	8,546691	11,453309	59
2	8,549995	9,999726	8,550268	11,449732	58
3	8,553558	9,99972[illegible]	8,55[illegible]817	11,446183	57
4	8,557054	9,999717	8,557[illegible]36	11,4[illegible]2664	56
5	8,560540	9,999713	8,560827	11,439172	55
6	8,563999	9,999708	8,564291	11,435709	54
7	8,567431	9,999703	8,567727	11,432[illegible]72	53
8	8,570836	9,999699	7,571137	11,428863	52
9	8,574211	9,999694	8,574520	11,425480	51
10	8,577565	9,999639	8,577877	11,422123	50
11	8,580892	9,999685	8,581208	11,418792	49
12	8,584193	9,999680	8,584514	11,415486	48
13	8,587469	9,999675	8,587795	11,412205	47
14	8,590721	9,999670	8,591051	11,408949	46
15	8,593948	9,999665	8,594283	11,405717	45
16	8,597152	9,999660	8,597492	11,402508	44
17	8,600332	9,999655	8,600677	11,399323	43
18	8,603[illegible]88	9,999650	8,603838	11,396161	42
19	8,606622	9,999645	8,606978	11,[illegible]93022	41
20	8,609734	9,99[illegible]640	8,610094	11,[illegible]89966	40
21	8,612823	9,999635	8,613189	11,386811	39
22	8,615891	9,999629	8,616262	11,383738	38
23	8,6[illegible]8937	9,999624	8,619313	11,380687	37
24	8,62[illegible]967	9,999619	8,622343	11,377657	36
25	8,624965	9,999614	8,625352	11,374648	35
26	8,617948	9,999608	8,628340	11,371660	34
27	8,6309[illegible]1	9,999603	8,631308	11,3[illegible]8692	33
28	8,633854	9,999597	8,634456	11,365744	32
29	8,636776	9,99959[illegible]	8,637[illegible]84	11,362816	31
30	8,639619	9,9995[illegible]6	8,640093	11,35990[illegible]	30
	Co-sine.	Sine	Co-Tang.	Tangent	M

Degree 87.

Degree 2.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	8,639679	9,999586	8,640093	11,359907	30
31	8,642563	9,999581	8,642982	11,357017	29
32	8,645428	9,999575	8,645853	11,354147	28
33	8,648274	9,999570	8,648704	11,351296	27
34	8,651102	9,999564	8,651538	11,348463	26
35	8,653911	9,999558	8,654352	11,345648	25
36	8,656702	9,999553	8,657149	11,342851	24
37	8,659475	9,999547	8,659928	11,340072	23
38	8,662230	9,999541	8,662689	11,337311	22
39	8,664968	9,999535	8,665433	11,334567	21
40	8,667689	9,999529	8,668160	11,331840	20
41	8,670393	9,999523	8,670869	11,329130	19
42	8,673080	9,999518	8,673563	11,326437	18
43	8,675751	9,999512	8,676239	11,323761	17
44	8,678405	9,999506	8,678866	11,321100	16
45	8,681043	9,999499	8,681544	11,318456	15
46	8,683665	9,999493	8,684172	11,315828	14
47	8,686272	9,999487	8,686784	11,313216	13
48	8,688892	9,999481	8,689381	11,310619	12
49	8,691438	9,999475	8,691963	11,308037	11
50	8,693998	9,999469	8,694529	11,305471	10
51	8,696543	9,999462	8,697081	11,302919	9
52	8,699073	9,999456	8,699617	11,300383	8
53	8,701589	9,999450	8,702139	11,297861	7
54	8,704090	9,999443	8,704646	11,295354	6
55	8,706576	9,999437	8,707139	11,292860	5
56	8,709049	9,999431	8,709518	11,290381	4
57	8,711507	9,999424	8,712083	11,287917	3
58	8,713952	9,999418	8,714543	11,285466	2
59	8,716383	9,999411	8,716972	11,283028	1
60	8,718800	9,999404	8,719396	11,280604	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 87.

Degree 3.

M	Sine	Co sine	Tangent	Co-Tang.	
0	8,718800	9,999404	8,719396	11,280604	60
1	8,721204	9,999398	8,721806	11,278194	59
2	8,723595	9,999391	8,724254	11,275746	58
3	8,725972	9,999384	8,726588	11,273412	57
4	8,728336	9,999378	8,728959	11,271041	56
5	8,730688	9,999371	8,731317	11,268683	55
6	8,733027	9,999364	8,733663	11,266337	54
7	8,735354	9,999357	8,735996	11,264004	53
8	8,737667	9,999350	8,738317	11,261683	52
9	8,739969	9,999343	8,740626	11,259374	51
10	8,742259	9,999336	8,742922	11,257078	50
11	8,744536	9,999329	8,745207	11,254793	49
12	8,746801	9,999322	8,747479	11,252521	48
13	8,749055	9,999315	8,749740	11,250240	47
14	8,751297	9,999308	8,751989	11,248011	46
15	8,753528	9,999301	8,754227	11,245773	45
16	8,755747	9,999294	8,756453	11,243547	44
17	8,757955	9,999286	8,758668	11,241332	43
18	8,760151	9,999279	8,760872	11,239128	42
19	8,762337	9,999272	8,763065	11,236935	4
20	8,764511	9,999265	8,765246	11,234754	40
21	8,766675	9,999257	8,767417	11,232583	39
22	8,768828	9,999250	8,769578	11,230422	38
23	8,770970	9,999242	8,771727	11,228273	37
24	8,773101	9,999235	8,773866	11,229134	36
25	8,775213	9,999227	8,775995	11,224005	35
26	8,777333	9,999220	8,778114	11,221886	34
27	8,779434	9,999212	8,780222	11,219778	33
28	8,781524	9,999204	8,782320	11,217680	32
29	8,783605	9,999197	8,784404	11,215592	31
30	8,785675	9,999189	8,786486	11,213514	30
	Co-sine	Sine	Co-Tang.	Tangent.	M

Degree 86.

Degree 3.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	8.785675	9.999187	8.786486	11.213514	30
31	8.787736	9.999181	8.788554	11.211446	29
32	8.789787	9.999174	8.790613	11.20928	28
33	8.781828	9.999166	8.792662	11.207338	27
34	8.793859	9.999158	8.794701	11.205299	26
35	8.795881	9.999150	8.795731	11.203269	25
36	8.797894	9.999142	8.798752	11.201248	24
37	8.799897	9.999134	8.800763	11.199237	23
38	8.801891	9.999126	8.802765	11.197235	22
39	8.803876	9.999118	8.8[illegible]758	11.19[illegible]242	21
40	8.805852	9.999110	8.806742	11.193258	20
41	8.807819	9.999102	8.808717	11.191285	19
42	8.809777	9.999094	8.812683	11.[illegible]8[illegible]317	18
43	8.811726	9.999086	8.812641	11.187359	17
44	8.813667	9.999077	8.814589	11.185411	16
45	8.815598	9.999069	8.816529	11.183471	15
46	8.817522	9.999061	8.818461	11.181539	14
47	8.819436	9.999052	8.820384	11.179516	13
48	8.821342	9.999044	8.822298	11.177702	12
49	8.823240	9.99[illegible]0[illegible]6	8.824205	11.17[illegible]795	11
50	8.825130	9.999027	8.826103	11.173897	10
51	8.8270[illegible]1	9.999019	8.827992	11.172008	9
52	8.828884	9.999010	8.829874	11.1701[illegible]6	8
53	8.830719	9.999002	8.831748	11.168252	7
54	8.832106	9.998993	8.833613	11.166387	6
55	8.834456	9.998984	8.835471	11.164529	5
56	8.836297	9.998976	8.837321	11.162679	4
57	8.838130	9.998967	8.839163	11.160837	3
58	8.839956	9.99[illegible]958	8.840958	11.159002	2
59	8.841774	9.998940	8.842825	11.157175	1
60	8.843585	9.99[illegible]941	8.844644	11.155456	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 86.

Degree 4.

M	Sine	Co-sine	Tangent	Co-Tang	
0	8.843584	9.998941	8.844649	11.155 56	60
1	8.845387	9.998931	8.846455	11.153545	59
2	8.847183	9.998923	8.848240	11.151740	58
3	8.848971	9.998914	8.850057	11.1499[illegible]	57
4	8.850751	9.998905	8.85 846	11.1481[illegible]	56
5	8.852525	9.9[illegible]8896	8.853628	11.146372	55
6	8.854291	9.9[illegible]8887	8.855403	11.144597	54
7	8.856049	9.998878	8.857171	11.142829	53
8	8.857801	9.998869	8.858922	11.141068	52
9	8.859546	9.998860	8.860686	11.139314	51
10	8.861283	9.998851	8.862433	11.137507	50
11	8.863014	9.998841	8.864173	11.[illegible]358[illegible]7	49
12	8.864738	9.998832	8.865906	14.13[illegible]094	48
13	8.866454	9.998823	8.867632	11.132368	47
14	8.868[illegible]65	9.998813	8.869351	11.130649	46
15	8.869868	9.998804	8.871064	11.128936	45
16	8.871565	9.998795	8.872750	11.127230	44
17	8.873255	9.998785	8.874469	11.12553[illegible]	43
18	8.874938	9.998776	8.876162	11.123[illegible]38	42
19	8.876615	9.998766	8.877849	11.122151	41
20	8.878285	9.998757	8.8[illegible]9529	11.120471	40
21	8.879949	9.998747	8.881202	11.118798	39
22	8.881607	9.998738	8.882869	11.117131	38
23	8.883258	9.998728	8.884530	11.115470	37
24	8.884903	9.998718	8.886185	11.[illegible]815	36
25	8.886542	9.998708	8.887833	11.112167	35
26	8.8[illegible]8174	9.998699	8.889475	11.110524	34
27	8.889801	9.998689	8.891112	11.108888	33
28	8.891421	9.998579	8.892742	11.107258	32
29	8.893035	[illegible].998669	8.[illegible]94366	11.105634	31
30	8.894643	9.[illegible]98659	8.895984	11.104016	30
	Co-sine	Sine	Co.Tang	Tangent	M

Degree 85.

Degree 4.

M	Sine	Co-sine	Tangent	Co-Tang	
30	8.894643	9.998659	8.895940	11.1040 6	30
31	8.896246	9.998649	8.897596	11.102404	29
32	8.897842	9.998639	8.899103	11.100797	28
33	8.899432	9.998629	8.900803	11.099197	27
34	8.901017	9.998619	8.902398	11.097602	26
35	8.902596	9.99[illegible]60[illegible]	8.903987	11.096013	25
36	8.904169	9.998599	8.905570	11.094430	24
37	8.905736	9.998589	8.907147	11.093853	23
38	8.907297	9.998577	8.908719	11.091281	22
39	8.908853	9.998568	8.910285	11.089715	21
40	8.910404	9.998558	8.911846	11.088154	20
41	8.911949	9.998548	8.913401	11.086599	19
42	8.913488	9.998537	8.914951	11.085049	18
43	8.915022	9.998527	8.916495	11.083505	17
44	8.916550	9.998516	8.918034	11.081960	16
45	8.918073	9.998506	8.919568	11.080432	15
46	8.919591	9.998495	8.921095	11.078924	14
47	8.921103	9.998485	8.922619	11.077381	13
48	8.922610	9.998474	8.924136	11.075864	12
49	8.924112	9.998464	8.925649	11.074351	11
50	8.925609	9.998453	8.927156	11.072844	10
51	8.927100	9.998442	8.928658	11.071344	9
52	8.928587	9.998431	8.930155	11.069845	8
53	8.930068	9.998421	8.931647	11.068353	7
54	8.931544	9.998410	8.939134	11.066866	6
55	8.933015	9.998309	8.934616	11.065384	5
56	8.934481	9.998388	8.936093	11.063907	4
57	8.935942	9.998377	8.937565	11.062435	3
58	8.937398	9.998366	8.939031	11.060968	2
59	8.938850	9.998355	8.940494	11.059506	1
60	8.940296	9.998344	8.941952	11.058048	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 85.

Degree 0

M	Sine	Co-sine	Tangent	Co Tang.	
0	0 0000000	0 0000000	0,000000	Infinita	60
1	6,463726	9,999999	6,463726	13,536274	59
2	6 764756	9,999999	6 764756	13,235244	58
3	6,940847	9 999999	6,940847	13,059153	57
4	7,065786	9 999999	7,065786	12 934214	56
5	7 162696	9,999999	7 163696	12 837304	55
6	7 241877	9,999999	7,241878	12,758122	54
7	7,308824	9,999999	7,308825	12,691175	53
8	7 366816	9,999999	7,366817	12,633183	52
9	7,417968	9,999999	7,417970	12 582030	51
10	7,463726	9,999998	7,463727	12,536273	50
11	7,505118	9,999998	7,505120	12,494880	49
12	7 542906	9,999997	7,542909	12,457091	48
13	7,577668	9,969997	7,577672	12,422328	47
14	7,609853	9,999996	7,609857	12,390143	46
15	7,639816	9 999996	7,639826	12,360180	45
16	7,667844	9 999995	7,667849	12,332151	44
17	7,694173	9,999995	7,694179	12,305821	43
18	7,718977	9,999994	7,719003	12,281997	42
19	7,742477	9 999993	7,742484	12,257516	41
20	7,764754	9 999993	7,764761	12,235239	40
21	7,785943	9,999992	7,785951	12,214049	39
22	7,806140	9 999991	7,806145	12 193845	38
23	7,825451	9 999990	7,825460	12,174540	37
24	7 843934	9 999989	7,843944	12,156056	36
25	7,861662	9,999688	7,861674	12,138326	35
26	7,878695	9 999988	7 878708	12,121292	34
27	7,895085	9 999987	7,865099	12,104901	33
28	7,910879	9 999986	7,910894	12,089106	32
29	7,925219	9 999 85	7,926134	12,073866	31
30	7,940842	9 999984	7,940858	12 059142	30
	Co sine	Sine	Co-Tang.	Tangent	

Degree 89

Degree 0

M	Sine	Co-sine.	Tangent.	Co-Tang.	
30	7,940842	9,999983	7,940858	12,059142	30
31	7,955082	9,999982	7,955100	12,044900	29
32	7,968870	9,999981	7,968889	12,031111	28
33	7,982233	9,999980	7,982253	12,017747	27
34	7,995198	9,999978	7,995215	12,004785	26
35	8,007787	9,999978	7,007810	11,992191	25
36	8,020021	9,999976	8,020044	11,979956	24
37	8,031919	9,999975	8,031945	11,968055	23
38	8,043500	9,999973	8,043527	11,956473	22
39	8,054781	9,999972	8,054809	11,945191	21
40	8,065776	9,999971	8,065806	11,934194	20
41	8,076500	9,999969	8,076531	11,923469	19
42	8,086965	9,999968	8,086997	11,913003	18
43	8,097183	9,999966	8,097217	11,902783	17
44	8,107167	9,999964	8,107203	11,892797	16
45	8,116926	9,999963	8,116963	11,883037	15
46	8,126471	9,999961	8,126510	11,873490	14
47	8,135810	9,999959	8,135851	11,864149	13
48	8,144953	9,999958	8,144996	11,855004	12
49	8,153907	9,999955	9,153952	11,846048	11
50	8,162681	9,999954	8,162737	11,837273	10
51	8,171280	9,999952	8,171328	11,828672	9
52	8,179713	9,999950	8,179763	11,820237	8
53	8,187985	9,999948	8,188036	11,811964	7
54	8,196102	9,999946	8,196156	11,803844	6
55	8,204070	9,999944	8,204126	11,795874	5
56	8,211895	9,999942	8,241953	11,788047	4
57	8,219581	9,999940	8,219641	11,780359	3
58	8,227134	9,999938	8,227195	11,772805	2
59	8,234557	9,999936	8,234621	11,765379	1
60	8,241855	9,999934	8,241921	11,758079	0
	Co-sine.	Sine	Co Tang.	Tangent.	M

Degree 89

Degree 1.

M	Sine	Co sine.	Tangent	Co-Tang.	
0	8,241855	9,999934	8,241921	11,758079	60
1	8,249033	9 999932	8,249102	11,750898	59
2	8,256094	9,999929	8,255165	11,743835	58
3	8,263042	9,999927	8,263115	11,736885	57
4	8,269881	9,999925	8,269956	11,730044	56
5	8,276614	9,999922	8,276691	11,723309	55
6	8,283243	9,999920	8,283323	11,716677	54
7	8,289773	9,999918	8,289856	11,716144	53
8	8,296207	9,999915	8,296292	11,703708	52
9	8,302546	9,999913	8,302634	11,697366	51
10	8,308794	9 999910	8,308884	11,691116	50
11	8,314954	9,999997	8,315046	11,684954	49
12	8,321027	9,999905	8,321122	11,678878	48
13	8,327016	9,999902	8 327114	11,672886	47
14	8,332924	9 999899	8,333025	11,666975	46
15	8,338753	9,999897	8,338856	11,661144	45
16	8,344504	9 999894	8,344610	11,655390	44
17	8,350180	9,999891	8 350289	11,649711	43
18	8,355783	9,999888	8,355895	11,641105	42
19	8 361315	9,999885	8 361430	11 638570	41
20	8,366777	9,999882	8,356895	11,633105	40
21	8 372171	9,999879	8 372292	11,627708	39
22	8 377499	9 999875	8,377522	11,622378	38
23	8,382762	9,999873	8 382889	11,617111	37
24	8,387962	9 999870	8 388092	11,611908	36
25	8,393101	9,999857	8,393234	11,606766	35
26	8,398179	9,999864	8 398315	11,601685	34
27	8,403199	9,999861	8,403338	11,596662	33
28	8,408161	9,999858	8 408304	11,591696	32
29	8,413068	9,999854	8 413213	11,586787	31
30	8,417919	9,999851	8,418068	11,585932	30
	Co-sine.	Sine	Co Tang.	Tangent.	M

Degree 88.

Degree 1.

M	Sine	Co-sine.	Tangent	Co-Tang.	
30	8,417919	9,999851	8,418068	11,581932	30
31	8,422717	9,999848	8,422869	11,577131	29
32	8,427462	9,999844	8,427618	11,572382	28
33	8,432156	9,999841	8,432315	11,567685	27
34	8,436800	9,999833	8,436962	11,563038	26
35	8,441394	9,999834	8,441560	11,558440	25
36	8,445941	9,999831	8,446110	11,553990	24
37	8,450440	9,999827	8,450613	11,549387	23
38	8,454891	9,999824	8,455070	11,544930	22
39	8,459301	9,999820	8,459481	11,540519	21
40	8,463665	9,999816	8,463849	11,556151	20
41	8,467985	9,999812	8,468172	11,531828	19
42	8,472263	9,999809	8,472454	11,527546	18
43	8,476498	9,999805	8,476693	11,523307	17
44	8,480693	9,999801	8,480892	11,519108	16
45	8,484848	9,999797	8,485050	11,514950	15
46	8,488963	9,999794	8,489170	11,510830	14
47	8,493040	9,999790	8,490250	11,506750	13
48	8,497078	9,999786	8,497293	11,502707	12
49	8,501080	9,999782	8,501298	11,498702	11
50	8,505045	9,999778	8,505267	11,494733	10
51	8,508974	9,999774	8,509200	11,490800	9
52	8,512867	9,999769	8,513098	11,486902	8
53	8,516726	9,999765	8,516961	11,483039	7
54	8,520551	9,999761	8,520790	11,479210	6
55	8,524343	9,999756	8,524586	11,475414	5
56	8,528102	9,999753	8,528349	11,471651	4
57	8,531828	9,999748	8,532080	11,467920	3
58	8,535523	9,999744	8,535779	11,464221	2
59	8,539186	9,999940	8,539447	11,460553	1
60	8,542819	9,999735	8,543084	11,455910	0
	Co-sine.	Sine	Co-Tang.	Tangent.	M

Degree 88.

Degree 2.

M	Sine	Co-sine.	Tangent.	Co-tang.	
0	8,542819	9,999735	8,543084	11,456916	0
1	8,546422	9,999731	8,546691	11,453309	59
2	8,549995	9,999726	8,550268	11,449732	58
3	8,553558	9,9997[illegible]	8,55[illegible]817	11,446183	57
4	8,557054	9,999717	8,557326	11,4[illegible]2664	56
5	8,560540	9,999713	8,560827	11,439172	55
6	8,563999	9,999708	8,564291	11,435709	54
7	8,567431	9,999703	8,567727	11,432[illegible]72	53
8	8,570836	9,999699	7,571137	11,428863	52
9	8,5742[illegible]	9,99[illegible]694	8,574520	11,425480	51
10	8,577565	9,999689	8,577877	11,421123	50
11	8,58[illegible]392	9,999685	8,581208	11,418792	49
12	8,584193	9,999680	8,584514	11,415486	48
13	8,587469	9,999675	8,587795	11,412205	47
14	8,590721	9,999670	8,591051	11,408949	46
15	8,593948	9,999665	8,594283	11,405717	45
16	8,597152	9,999660	8,597492	11,40[illegible]508	44
17	8,600332	9,999655	8,600677	11,399323	43
18	8,603[illegible]88	9,999650	8,603838	11,396161	42
19	8,606622	9,999645	8,606978	11,393022	41
20	8,609734	9,99[illegible]640	8,610094	11,[illegible]89966	40
21	8,612823	9,999635	8,613189	11,386811	39
22	8,615891	9,999629	8,616262	11,383738	38
23	8,6[illegible]8937	9,999624	8,619313	11,380687	37
24	8,62[illegible]967	9,999619	8,622343	11,377657	36
25	8,624965	9,999614	8,625352	11,374648	35
26	8,617948	9,999608	8,628340	11,371660	34
27	8,6309[illegible]1	9,999603	8,631308	11,3[illegible]8692	33
28	8,633854	9,999597	8,634456	11,365744	32
29	8,636770	9,99959[illegible]	8,637[illegible]84	11,362816	31
30	8,639619	9,9995[illegible]6	8,640093	11,35990	30
	Co-sine.	Sine	Co-Tang.	Tangent	M

Degree 87.

Degree 2.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	8,639679	9,999586	8,640093	11,359907	30
31	8,642563	9,999581	8,642982	11,357017	29
32	8,645428	9,999575	8,645853	11,354147	28
33	8,648274	9,999570	8,648704	11,351296	27
34	8,651102	9,999564	8,651538	11,348463	26
35	8,653911	9,999558	8,654352	11,315648	25
36	8,656702	9,999553	8,657149	11,342851	24
37	8,659475	9,999547	8,659928	11,340072	23
38	8,662240	9,999541	8,662689	11,337311	22
39	8,664968	9,999535	8,665433	11,334567	21
40	8,667689	9,999529	8,668160	11,331840	20
41	8,670393	9,999523	8,670869	11,329130	19
42	8,673080	9,999518	8,673563	11,326437	18
43	8,675751	9,999512	8,676239	11,323761	17
44	8,678405	9,999506	8,678866	11,321100	16
45	8,681043	9,999499	8,681544	11,318456	15
46	8,683665	9,999493	8,684172	11,315828	14
47	8,686272	9,999487	8,686784	11,313216	13
48	8,688892	9,999481	8,689381	11,310619	12
49	8,691438	9,999475	8,691963	11,308037	11
50	8,693998	9,999469	8,694529	11,305471	10
51	8,695543	9,999462	8,697081	11,302919	9
52	8,699073	9,999456	8,699617	11,300383	8
53	8,701589	9,999450	8,702139	11,297861	7
54	8,704090	9,999443	8,704646	11,295354	6
55	8,706576	9,999437	8,707139	11,292860	5
56	8,709049	9,999431	8,709518	11,290381	4
57	8,711507	9,999424	8,712083	11,287917	3
58	8,713952	9,999418	8,714543	11,285466	2
59	8,716383	9,999411	8,716972	11,283028	1
60	8,718800	9,999404	8,719396	11,280604	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 87.

Degree 3.

M	Sine	Co sine	Tangent	Co-Tang.	
0	8,718800	9,999404	8,7[illegible]9396	11,280604	60
1	8,721204	9,999398	8,721806	11,278194	59
2	8,723595	9,999391	8,724254	11,275756	58
3	8,725972	9,999384	8,726588	11,273412	57
4	8,728336	9,999378	8,728959	11,271041	56
5	8,730688	9,999371	8,731317	11,268683	55
6	8,733027	9,999364	8,733663	11,266337	54
7	8,735354	9,999357	8,735996	11,264004	53
8	8,737667	9,999350	8,738317	11,261683	52
9	8,739969	9,999343	8,740626	11,259374	51
10	8,742259	9,999336	8,742922	11,257078	50
11	8,744536	9,999329	8,745207	11,254793	49
12	8,746801	9,999322	8,747479	11,252521	48
13	8,749055	9,999315	8,749740	11,250240	47
14	8,751297	9,999308	8,751989	11,248011	46
15	8,753528	9,999301	8,754227	11,245772	45
16	8,755747	9,999294	8,756453	11,243547	44
17	8,757955	9,999286	8,758668	11,241332	43
18	8,760151	9,999279	8,760872	11,239128	42
19	8,762337	9,999272	8,763065	11,236935	41
20	8,764511	9,999265	8,765246	11,234754	40
21	8,766675	9,999257	8,767417	11,232583	39
22	8,768828	9,999250	8,769578	11,230422	38
23	8,770970	9,999242	8,771727	11,228273	37
24	8,773101	9,999235	8,773866	11,229134	36
25	8,775213	9,999227	8,775995	11,224005	35
26	8,777333	9,999220	8,778114	11,221886	34
27	8,779434	9,999212	8,783222	11,219778	33
28	8,781524	9,999204	8,782320	11,217680	32
29	8,783605	9,999197	8,784404	11,215592	31
30	8,785675	9,999189	8,786486	11,213514	30
	Co-sine	Sine	Co-Tang.	Tangent,	M

Degree 86.

Degree 3.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	8.785675	9.999187	8,786486	11.213514	30
31	8.787736	9.999181	8.788554	11.211446	29
32	8.789787	9.999174	8.790613	1[illegible]20928[illegible]	28
33	8.781828	9,999166	8.792662	11.207338	27
34	8.793859	9.999158	8.794701	11.205[illegible]99	26
35	8.795881	9.999150	8.796731	11.203269	25
36	8.797894	9.999142	8.798752	11.201248	24
37	8.799897	9.999134	8.800763	11.199237	23
38	8.801891	9.999126	8.802765	11,197235	22
39	8.803876	9.999118	8.8[illegible]758	11.19[illegible]242	21
40	8.805852	9.999110	8.806742	11.193258	20
41	8.807819	9.999102	8.808717	11.191285	19
42	8.809777	9.999094	8.812683	11.[illegible]89317	18
43	8.811726	9.999086	8.812671	11.187359	17
44	8.813667	9.999077	8.814589	11,185411	16
45	8.815598	9.999069	8.816529	11.183471	15
46	8.817522	9.999061	8.818461	11.181539	14
47	8.819436	9.999052	8.820384	11.179616	13
48	8.821342	9.999044	8.822298	11.177702	12
49	8.823240	9.99[illegible]0[illegible]6	8.824205	11.17[illegible]795	11
50	8.825130	9.999027	8.826103	11.173897	10
51	8.8270[illegible]1	9.999019	8.827992	11.172008	9
52	8.828884	9.999010	8.829874	11.170126	8
53	8.830719	9.999002	8.831748	11.168252	7
54	8,832106	9.998993	8,833613	11.166387	6
55	8.834456	9.998984	8.835471	11.164529	5
56	8.836297	9.998976	8.837321	11.162679	4
57	8.838130	9.998967	8.839163	11.160837	3
58	8 839956	9.99[illegible]958	8.840998	11.159002	2
59	8 841774	9.998940	8.842825	11.157175	1
60	8.843585	9.99[illegible]941	8.844644	11.155356	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 86.

Degree 4.

M	Sine	Co-sine	Tangent	Co-Tang	
0	8.843584	9.998941	8.844649	11.155 56	60
1	8.845387	9.998931	8.846455	11.153545	59
2	8.847183	9.998923	8.848240	11.151740	58
3	8.848971	9.998914	8.850057	11.1499[illegible]	57
4	8.850751	9.998905	8.85 846	11.14815[illegible]	56
5	8.852525	9.998896	8.853628	11.146372	55
6	8.854291	9.998887	8.855403	11.144597	54
7	8.856049	9.998878	8.857171	11.142829	53
8	8.857801	9.998869	8.858922	11.14 068	52
9	8.859546	9.998860	8.86 686	11.139314	51
10	8.861283	9.998851	8.86 433	11.137507	50
11	8.863014	9.998841	8.864173	11. 3[illegible]8 7	49
12	8.864738	9.998832	8.865906	14.13 094	48
13	8.866454	9.998823	8.867632	11.132368	47
14	8.868 65	9.998813	8.869351	11.130649	46
15	8.869868	9.998804	8.871064	11.128936	45
16	8.871565	9.998795	8.872750	11.127230	44
17	8.873255	9.998785	8.874469	11.12553[illegible]	43
18	8.874938	9.998 76	8.876162	11.123838	42
19	8.876615	9.998766	8.877849	11.122151	41
20	8.878285	9.998757	8.8 9529	11.120471	40
21	8.879949	9.998747	8.881202	11.118798	39
22	8.881607	9.998738	8.882869	11.117131	38
23	8.883258	9.998728	8.884530	11.115470	37
24	8.884903	9.998718	8.886185	11.113815	36
25	8.886542	9.998708	8.887833	11.112167	35
26	8.888174	9.998699	8.889475	11.110524	34
27	8.889801	9.998689	8.891112	11.108888	33
28	8.891421	9.998579	8.892742	11.107258	32
29	8.893035	9.998669	8.894366	11.105634	31
30	8.894643	9.998659	8.895984	11.104016	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 85.

Degree 4.

M	Sine	Co-sine	Tangent	Co-Tang	
30	8.894643	9.998659	8.895940	11.1040 6	30
31	8.896246	9.998649	8.897596	11.102404	29
32	8.897842	9.998639	8.899103	11.100797	28
33	8,899432	9.998629	8.900803	11.099197	27
34	8.901017	9.998619	8.902398	11.097602	26
35	8,902596	9.99[illegible]60[illegible]	8.9[illegible]3987	11.096013	25
36	8.904[illegible]69	9.998599	8.905570	11.[illegible]94430	24
37	8.905736	9.998589	8.907147	11.093853	23
38	8.907297	9.998577	8.908719	11.091281	22
39	8.908853	9.998568	8.910285	11.089715	21
40	8.910404	9.998558	8.911846	11.088154	20
41	8.911949	9.998548	8.913401	11.086599	19
42	8.913488	9.998537	8.914951	11.085049	18
43	8.915022	9.998527	8.916495	11.083505	17
44	8.916550	9.998516	8.918034	11.081960	16
45	8.918073	9.998506	8.919568	11.080432	15
46	8.919591	9.998495	8.921095	11.078924	14
47	8.921103	9.998485	8.922619	11.077381	13
48	8.922610	9.998474	8.924136	11.075864	12
49	8.924112	9.998464	8.925649	11.074351	11
50	8.925609	9.998453	8.927156	11.072844	10
51	8.927100	9.998442	8.928658	11.071344	9
52	8.928587	9.998431	8.930155	11.069845	8
53	8.930068	9.998421	8.931647	11.068353	7
54	8.931544	9.998410	8.933134	11.066866	6
55	8.933015	9.998309	8.934616	11.065384	5
56	8.934481	9.998388	8.936093	11.063907	4
57	8.935942	9,998377	8.937565	11.062435	3
58	8,937398	9.998366	8.939031	11.060968	2
59	8,938850	9.998355	8.940494	11.059506	1
60	8.940296	9.998344	8.941952	11.058048	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 85.

Degree 5.

M	Sine	Co-sine	Tangent	Co-Tang	
0	8,940296	9,998344	8,941952	11,058048	60
1	8,941738	9,998333	8,943404	11,05[illegible]596	59
2	8,943174	9,998322	8,944852	1[illegible],055148	58
3	8,944606	9,998311	8,9[illegible]6205	11,0537[illegible]5	57
4	8,946024	9,998300	8,94[illegible]7[illegible]4	11,05[illegible]2[illegible]6	56
5	8,957456	9,998289	8,9491[illegible]8	11,[illegible]5[illegible]832	55
6	8,958814	9,998277	8,950597	[illegible],049[illegible]0[illegible]	54
7	8,950287	9,998266	[illegible],95[illegible]62	11,047979	53
8	8,951696	9,998255	8,9[illegible]3441	1[illegible],[illegible]46559	52
9	8,953099	9,[illegible]9824[illegible]	8,95[illegible]8[illegible]6	11,0451[illegible]4	51
10	8,954499	9,99823[illegible]	8,95626[illegible]	[illegible]1,043703	50
11	8,9558[illegible]4	9,998220	8,957674	11,0[illegible]2326	49
12	8,957284	9,998209	8,959075	11,0409[illegible]5	48
13	8,9[illegible]58[illegible]70	9,998197	8,9604[illegible]3	11,039527	47
14	8,96[illegible]052	9,998[illegible]86	8,961866	1[illegible],038134	46
15	8,9[illegible]1429	9,998174	8,963254	[illegible]1,036746	45
16	8,96[illegible]801	9,998163	[illegible],964639	11,[illegible]35361	44
17	8,964[illegible]70	9,998151	8,966019	11,033981	43
18	[illegible],9655[illegible]3	9,9981[illegible]9	8,96[illegible]394	11,032606	42
19	8,966893	9,99812[illegible]	8,968766	11,031234	41
20	8,958349	[illegible],998105	8,970133	[illegible]1,029867	40
21	8,969600	9,998104	8,97149[illegible]	11,0285[illegible]5	39
22	8,970947	9,99809[illegible]	8,972855	11,0271[illegible]5	38
23	8,972289	9,998080	8,974209	11,025791	37
24	8,9736[illegible]6	9,998068	8,975560	11,024440	36
25	8,974962	9,998[illegible]56	[illegible],976906	11,023094	35
26	8,976293	9,[illegible]93044	8,978248	[illegible]1,021752	34
27	8,977619	9,998032	8,9795[illegible]6	11,020414	33
28	8,978941	9,998020	8,980921	1[illegible],019079	3[illegible]
29	8,980259	9,998008	8,982251	11,017749	31
30	8,981573	9,997996	8,983577	11,016423	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 85.

Degree 5

M	Sine	Co-sine	Tangent	Co-Tang	
30	8,981573	9,99[illegible]996	8,98357[illegible]	11,01[illegible]423	30
31	8,98[illegible]883	9,997984	8,984899	11,015101	29
32	,984189	9,99[illegible]971	8,9862[illegible]	11,0[illegible]3782	28
33	,98[illegible]491	9,99[illegible]959	8,987532	11,012468	27
34	8,9[illegible]8[illegible]	9,9979[illegible]7	8,988842	11,011158	26
35	8,988[illegible]83	9,997935	8,990149	11,009851	25
36	[illegible],989374	9,9979[illegible]2	8,991451	14,0[illegible]8549	24
37	8,990660	9,997910	8,992750	11,007250	23
38	8,991943	9,99[illegible]897	8,994045	11,00[illegible]955	22
39	8,993228	9,99788[illegible]	8,995337	11,0[illegible]4663	21
40	8,994497	9,9978[illegible]3	8,996624	11,003376	20
41	8,995768	9,997860	8,997908	11,002092	19
42	8,997036	9,997847	8,999 88	11,000812	18
43	8,998299	9,99783[illegible]	9,000465	10 999535	17
44	8,999560	9,997822	9,001738	10 998262	16
45	8,900816	9,997809	9,003007	10 99[illegible]993	15
46	9,002069	9,99[illegible]797	9,[illegible]04272	10,995728	14
47	9,003318	9,997784	9,005534	10,994465	13
48	9,0045[illegible]3	9,99777[illegible]	9,006792	10,993208	12
49	9,005805	9,997758	9,008047	10,991953	11
50	9,007 44	9,997742	9,009298	10 990702	10
51	9,[illegible]8278	9,997732	9,010546	10,989454	9
52	9,009510	[illegible],997719	9,011790	10.988210	8
53	9,010737	9,997706	9,013031	10,986969	7
54	9,011962	9,99769[illegible]	9,014208	10,9[illegible]5732	6
55	9,013182	9,997680	9,0155[illegible]2	10,984498	5
56	9,014399	9,997667	9,016732	10 983268	4
57	9,015[illegible]13	9,997654	9,017959	10,982041	3
58	9,016824	9,997641	9,019183	10 980817	2
59	9,[illegible] 8031	9,997628	9,020403	10,979[illegible]97	1
60	9,019235	9,99[illegible]614	9,021620	10 978380	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 8

Degree 6

M	Sine	Co-sine	Tangent	Co-Tang	
0	9.015235	9 997614	9,021620	10,978380	60
1	9,020435	9 997601	9 0 2834	10,977166	59
2	9 021632	6,997588	9,02404	10,975956	58
3	9 022825	9 997574	9,025251	10,974749	57
4	9,024016	9,997562	9 026455	10,973545	56
5	9 025203	9,997548	9,027655	10,972345	55
6	9 026306	9.997534	9,028852	0,971148	54
7	9,027567	9 997520	9,030046	10,969954	53
8	9,028744	9 997507	9,031237	10,968763	52
9	9 029918	9 997493	9,032425	10,967575	51
10	9,031089	9 997480	9 033609	10 966391	50
11	9,032257	9 997466	9,034791	10 965209	49
12	9.033421	9,997452	9,035969	10 964031	48
13	9.034582	9.997439	9,037144	10,962856	47
14	9 035741	9 997425	9,038316	10,961634	46
15	9 036896	9,997411	9,039485	10,960515	45
16	9,038048	9.997397	9,040651	10,959349	44
17	9,039197	9 997383	9,041813	10.958187	43
18	9.040342	9,997369	9,042973	10,957027	42
19	9 041485	9.997355	9 044130	10,955870	41
20	9 042625	9,997341	9 045284	10,954716	40
21	9,043762	9 997327	9,046434	10,953566	39
22	9,044895	9.997313	9.047582	10,952418	38
23	9,046026	9.947299	9,047827	10,951273	37
24	9,047154	9 997285	9,049869	10,950131	36
25	9,048279	9 997271	9,051008	10,958992	35
26	9, 49400	9 997256	9,052144	10,947856	34
27	9,050519	9 997242	9,053277	10,946723	33
28	9.051635	9.997228	9 054408	10,945592	32
29	9.052749	9,997214	9,055535	10,944465	31
30	9 053859	9 997299	9 056640	10,943340	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 83

Degree 6.

M	Sine	Co sine	Tangent	Co-Tang	
30	9,053859	9,997199	9,056630	10,943340	30
31	9,054966	9,997185	9,057781	10,942219	29
32	9,056071	9,997170	9,058900	10,941100	28
33	9,057172	9,997156	9,060016	10,939984	27
34	9,058271	9,997141	9,061130	10,938870	26
35	9,059367	9,997127	9,062240	10,937760	25
36	9,060460	9,997112	9,063348	10,936652	24
37	9,061551	9,997098	9,064453	10,935547	23
38	9,062538	9,997083	9,065556	10,934444	22
39	9,063723	9,997068	9,066655	10,933345	21
40	9,064806	9,997053	9,067752	10,932248	20
41	9,065885	9,997039	9,068847	10,931153	19
42	9,066962	9,997024	9,059938	10,930062	18
43	9,068036	9,997009	9,071027	10,928973	17
44	9,069107	9,996954	9,072113	10,927887	16
45	9,070176	9,996979	9,073197	10,926803	15
46	9,071242	9,996964	9,074278	10,925722	14
47	9,072306	9,996949	9,075356	10,924644	13
48	9,073366	9,996934	9,076432	10,923568	12
49	9,074424	9,996919	9,077505	10,922495	11
50	9,075480	9,996904	9,078576	10,921424	10
51	9,076533	9,996889	9,079644	10,920356	9
52	9,077583	9,996874	9,080710	10,919290	8
53	9,078631	9,996858	9,081773	10,918227	7
54	9,079676	9,996843	9,08283	10,917167	6
55	9,080719	9,996828	9,083891	10,916109	5
56	9,081759	9,996812	9,084947	10,915053	4
57	9,082797	9,996797	9,085999	10,914000	3
58	9,083832	9,996782	9,08705	10,912950	2
59	9,084864	9,996766	9,088098	10,911902	1
60	9,085894	9,99675	9,08914	10,910856	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 83.

Degree 7.

M	Sine	Co-sine	Tangent	Co-Tang	
0	9,085894	9,996751	9,089144	10,910856	60
1	9,086922	9,996735	9,090187	10,909813	59
2	9,087947	9,996720	9,091228	10,908772	58
3	9,088970	9,996704	9,092266	10,907734	57
4	9,089990	9,996688	9,093302	10,906698	56
5	9,091088	9,996673	9,094336	10,905664	55
6	9,092024	9,996657	9,095367	10,904633	54
7	9,093037	9,996641	9,096395	10,903604	53
8	9,094047	9,996525	9,097422	10,962578	52
9	9,095056	9,996610	9,098446	10,901554	51
10	9,096062	9,996594	9,099468	10,900532	50
11	9,097065	9,996578	9,100487	10,899513	49
12	9,098066	9,996562	9,101504	10,898496	48
13	9,099065	9,996546	9,102519	10,897481	47
14	9,100062	9,996530	9,103532	10,896468	46
15	9,101056	9,996514	9,104542	10,895458	45
16	9,102048	9,996498	9,105550	10,894450	44
17	9,103037	9,996482	9,106556	10,893444	43
18	9,104025	9,996465	9,107559	10,892441	42
19	9,105010	9,996449	9,108560	10,891440	41
20	9,105992	9,996433	9,109559	10,890441	40
21	9,106973	9,996417	9,110556	10,889444	39
22	9,107951	9,996400	9,111551	10,888449	38
23	9,108927	9,996384	9,112543	10,887457	37
24	9,109901	9,996368	9,113533	10,886467	36
25	9,110872	9,996351	9,114521	10,885478	35
26	9,111842	9,996335	9,115507	10,884493	34
27	9,112809	9,996318	9,116491	10,883509	33
28	9,113774	9,996302	9,117472	10,882528	32
29	9,114737	9,996285	9,118452	10,881548	31
30	9,115698	9,996269	9,119429	10,880571	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 82.

Degree 7.

M	Sine	Co-sine	Tangent	Co-Tang	
30	9,115698	9,996259	9,119427	10,880571	30
31	9,116655	9,996252	9,120404	10,879595	29
32	9,117612	9,996235	9,121317	10,878623	28
33	9,118567	9,996218	9,122348	10,877652	27
34	9,119519	9,996202	9,123317	10,876683	26
35	9,120469	9,996185	9,124284	10,875716	25
36	9,121417	9,996168	9,125248	10,874751	24
37	9,122362	9,99[illegible]2	9,126211	10,873789	23
38	9,123306	9,996134	9,127172	10,872828	22
39	9,124248	9,99[illegible]7	9,12813[illegible]	10,871870	21
40	9,125187	9,996100	9,129087	10,870913	20
41	9,126124	9,996083	9,130041	10,869959	19
42	9,127060	9,996066	9,130994	10,869006	18
43	9,127993	9,996049	9,131944	10,868056	17
44	9,128925	9,996032	9,132893	10,867107	16
45	9,129854	9,995015	9,133839	10,866161	15
46	9,130781	9,995998	9,134784	10,865216	14
47	9,131706	9,995980	9,135726	10,864274	13
48	9,132630	9,995963	9,136665	10,863334	12
49	9,133551	9,995945	9,137605	10,862395	11
50	9,134476	9,995928	9,138542	10,861458	10
51	9,135387	9,995911	9,139476	10,860524	9
52	9,136303	9,995894	9,140409	10,859591	8
53	9,137216	9,995876	9,141340	10,858660	7
54	9,138127	9,995859	9,142269	10,857731	6
55	9,139037	9,995841	9,[illegible]4319	10,856804	5
56	9,139944	9,995825	9,144121	10,855879	4
57	9,140850	9,995806	9,145044	10,854956	3
58	9,141754	9,995788	9,1[illegible]5965	10,854035	2
59	9,142555	9,995770	9,149885	10,853115	1
60	9,143555	9,995753	9,147803	10,852197	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 82

Degree 8.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,143555	9,995753	9,147803	10,852197	60
1	9,144453	9,995735	9,148718	10,851282	59
2	9,145349	9,995717	9,149632	10,850368	58
3	9,146243	9,995699	9,150544	10,849456	57
4	9,147136	9,995681	9,151454	10,848546	56
5	9,148026	9,995664	9,152362	10,847637	55
6	9,148915	9,995646	9,153269	10,846731	54
7	9,149801	9,995528	9,154174	10,845825	53
8	9,150686	9,995610	9,155077	10,844923	52
9	9,151569	9,995591	9,155978	10,844022	51
10	9,152451	9,995573	9,156877	10,843123	50
11	9,153330	9,995555	9,157775	10,842225	49
12	9,154208	9,995537	9,158671	10,841329	48
13	9,155082	9,995519	9,159565	10,840435	47
14	9,155957	9,995501	9,160457	10,839543	46
15	9,156830	9,965482	9,161347	10,838653	45
16	9,157700	9,995464	9,162236	10,837764	44
17	9,158569	9,995446	9,163123	10,836877	43
18	9,159436	9,995427	9,164008	10,835992	42
19	9,160301	9,995409	9,164892	10,835108	41
20	9,161164	9,995390	9,165773	20,834225	40
21	9,162025	9,995372	9,166654	10,833346	39
22	9,162885	9,995353	9,167532	10,832468	38
23	9,163741	9,995334	6,168409	10,831591	37
24	9,164600	9,995316	9,169284	10,830716	36
25	9,165454	9,995297	9,170157	10,829843	35
26	9,166307	9,995278	9,171029	10,828971	34
27	9,167158	9,995260	9,171899	10,828101	33
28	9,168008	9,995241	9,172767	10,827233	32
29	9,168856	9,995222	9,173634	10,826356	31
30	9,169702	9,995203	9,174499	10,825501	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 81.

Degree 8.

M	Sine	Co-sine	Tangent	Co-Tang	
30	9,179702	9,995203	9,174499	10,825501	30
31	9,170516	9,995184	9,175362	10,824638	29
32	9,171,89	9,995165	9,176234	10,823776	28
33	9,172230	9,995145	9,177084	10,822916	27
34	9,173070	9,995127	9,177942	10,822057	26
35	9,173908	9,995108	9,178799	10,821201	25
36	9,174744	9,995089	9,179655	10,820345	24
37	9,175578	9,995070	9,180508	10,819492	23
38	9,176411	9,995061	9,181360	10,818940	22
39	9,177242	9,995032	9,182211	10,817789	21
40	9,178072	9,995012	9,183060	10,816940	20
41	9,178900	9,994993	9,183907	10,816093	19
42	9,179726	9,994974	9,184752	10,815248	18
43	9,180551	9,994955	9,185597	10,814403	17
44	9,181374	9,994935	9,186439	10,813561	16
45	9,182196	9,994916	9,187280	10,812720	15
46	9,183016	9,994896	9,188120	10,811880	14
47	9,183834	9,994876	9,188957	10,811642	13
48	9,184651	9,994857	9,189794	10,810206	12
49	0 185456	9,994838	9,190629	10,809371	11
50	9,186280	9,994818	9,191462	10,808538	10
51	9,187092	9,994798	9,192294	10,807706	9
52	9,187903	9,994779	9,193124	10,806876	8
53	9,188712	9,994759	9,193953	10,806047	7
54	9,189519	9,994739	9,194780	10,895220	6
55	9,190325	9,994719	9,195606	10,804394	5
56	9,191130	9,994599	9,196440	10,803569	4
57	9 191933	9,994680	9,197253	10,802747	3
58	9 162734	9,994660	9,198674	10,801926	2
59	9,193534	9,994640	9,198894	10,801106	1
60	9,194332	9,994620	9,199712	10,800287	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 81.

Degree 9.

M	Sine	Co sine	Tangent	Co-Tang.	
0	9,194332	9,994620	9,199712	10,800887	60
1	9,195129	9,994600	9,200529	10,799470	59
2	9,195925	9,994580	9,201345	10,798655	58
3	9,196718	9,994560	9,202159	10,797841	57
4	9,197511	9,994540	9,202971	10,797029	56
5	9,198302	9,994519	9,203782	10,796218	55
6	9,199091	9,994499	9,204592	10,795408	54
7	9,199879	9,994479	9,205400	10,794600	53
8	9,200666	9,994459	9,206027	10,793793	52
9	9,201451	9,994438	9,207013	10,792987	51
10	9,202234	9,994418	9,207817	10,792183	50
11	9,203017	9,994368	9,208619	10,791381	49
12	9,203797	9,993377	9,209420	10,790580	48
13	9,204577	9,994357	9,210220	10,789780	47
14	9,205354	9,994336	9,211018	10,788912	46
15	9,206131	9,994316	9,211815	10,788185	45
16	9,206906	9,994295	9,212611	10,787389	44
17	9,207679	9,994274	9,213405	10,786595	43
18	9,208452	9,994254	9,214198	10,785802	42
19	9,209222	9,994233	9,214989	10,785011	41
20	9,209992	9,994212	9,215780	10,784220	40
21	9,210760	9,994191	9,216568	10,783432	39
22	9,211526	9,994171	9,217356	10,782644	38
23	9,212291	9,994150	9,218142	10,781858	37
24	9,213055	9,994129	9,218926	10,781074	36
25	9,213818	9,994108	9,219710	10,780290	35
26	9,214579	9,994087	9,220491	10,779508	34
27	9,215338	9,994066	9,221272	10,778728	33
28	9,216097	9,994044	9,222052	10,777948	32
29	9,216854	9,994022	9,222830	10,777170	31
30	9,217609	9,994003	9,223607	10,776393	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 86.

Degree 9.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.217609	9.994003	9.223607	10.776393	30
31	9.218363	9.993982	9.224382	10.775618	29
32	9.219116	9.993960	9.225156	10.774844	28
33	9.219868	9.993939	9.225929	10.774071	27
34	9.220618	9.993918	9.226704	10.773300	26
35	9.221367	9.993897	9.227471	10.772529	25
36	9.222115	9.993875	9.228240	10.771760	24
37	9.222861	9.993854	9.229007	10.770993	23
38	9.223605	9.993832	9.229774	10.770226	22
39	9.224349	9.993811	9.230539	10.769461	21
40	9.225092	9.993789	9.231302	10.768698	20
41	9.225833	9.993758	9.232065	10.767935	19
42	9.226573	9.993746	9.232826	10.767174	18
43	9.227311	9.993725	9.233586	10.766414	17
44	9.228048	9.993703	9.234345	10.765655	16
45	9.228784	9.993681	9.235103	10.764897	15
46	9.229518	9.993660	9.235859	10.764141	14
47	9.230252	9.993638	9.236614	10.763386	13
48	9.230984	9.993616	9.237368	10.763632	12
49	9.231715	9.993594	9.238120	10.761880	11
50	9.232444	9.993572	9.238872	10.761128	10
51	9.233172	9.993550	9.239622	10.760378	9
52	9.233899	9.993528	9.240371	10.759629	8
53	9.234624	9.993506	9.241118	10.758882	7
54	9.235349	9.993484	9.241865	10.758135	6
55	9.236073	9.993462	9.242610	10.757390	5
56	9.236795	9.993440	9.243354	10.756646	4
57	9.237515	9.993418	9.244097	10.755902	3
58	9.238835	9.993396	9.244839	10.755161	2
59	9.238952	9.993374	9.245579	10.754421	1
60	9.239670	9.993351	9.246319	10.753681	0
M	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 80.

Degree 10.

M	Sine	Co-sine	Tangent	C.-Tang.	
0	9,239670	9,993351	9,246310	10,753681	60
1	9,240386	9,993329	9,247057	10,752943	59
2	9,241101	9,993307	9,247794	10,752206	58
3	9,241814	9,993284	9,248530	10,751470	57
4	9,242526	9,993262	9,249264	10,750736	56
5	9,243217	9,993240	9,249998	10,750002	55
6	9,243947	9,993217	9,250730	10,749270	54
7	9,244656	9,993195	9,251461	10,748539	53
8	9,245353	9,993172	9,252191	10,747809	52
9	9,246070	9,993149	9,252920	10,747080	51
10	9,246775	9,993127	9,253648	10,746352	50
11	9,247478	9,993104	9,254374	10,745626	49
12	9,248181	9,993011	9,255200	10,744900	48
13	9,248883	9,993059	9,255824	10,744176	47
14	9,249583	9,993036	9,256547	10,743453	46
15	9,240282	9,993013	9,257269	10,742731	45
16	9,250980	9,992990	9,257990	10,742010	44
17	9,251677	9,992967	9,258710	10,741290	43
18	9,252373	9,992944	9,259429	10,740571	42
19	9,253067	9,992921	9,260146	10,749854	41
20	9,253761	9,992898	9,260863	10,749137	40
21	9,254453	9,992875	9,261578	10,738422	39
22	9,255144	9,992852	9,262292	10,737708	38
23	9,255834	9,992829	9,263005	10,736995	37
24	9,256523	9,992806	9,263717	10,736283	36
25	9,257211	9,992783	9,264428	10,735572	35
26	9,257898	9,992759	9,265138	10,734862	34
27	9,258583	9,992736	9,265847	10,734153	33
28	9,259268	9,992613	9,266555	10,733445	32
29	9,259951	9,992690	9,267261	10,732739	31
30	9,250643	9,992656	9,267957	10,732033	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 79.

Degree 10.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.260533	9.9926[illegible]6	9.267967	10.732033	30
31	9.261314	9.99[illegible]643	9.2686[illegible]1	10.7[illegible]1329	29
32	9.26[illegible]9[illegible]4	9.992619	9.269375	10.730625	28
33	9.262673	9.992596	[illegible]270778	10.7[illegible]9922	27
34	9.263[illegible]	9.992572	9.271479	10.72922[illegible]	26
35	9.264[illegible]27	9.992[illegible]49	9.271[illegible]70	10.72852[illegible]	25
36	9.26470[illegible]	9.9[illegible]2525	9.27217[illegible]	10.727822	24
37	9.265378	9.992501	9.2728[illegible]6	10.727[illegible]24	23
38	9.266051	9.992478	9.273573	10.726427	22
39	9.26[illegible]723	9.992454	9.274269	10.725731	21
40	9.267395	9.992430	9.2[illegible]1964	10.72[illegible]036	20
41	9.268065	9.992406	9.275658	10.724342	19
42	9.268734	9.992382	9.276351	10.723649	18
43	9.269402	9.992361	9.277043	10.722957	17
44	9.270[illegible]69	9.992335	9.277734	10.72[illegible]226	16
45	9.270735	9.992311	9.278424	10.721576	15
46	9.271400	9.992287	9.279113	10.720887	14
47	9.272063	9.992263	9.279801	10.72[illegible]19[illegible]	13
48	9.272726	9.99[illegible]239	9.280488	10.7[illegible]9512	12
49	9.273388	9.992214	9.281174	10.7[illegible]8826	11
50	9.274049	9.992190	9.2[illegible]1858	10.718[illegible]14[illegible]	10
51	9.274708	9.992166	9.282542	10.717458	9
52	9.275367	9.992142	9.283225	10.716775	8
53	9.276025	9.992118	9.283907	10.716[illegible]93	7
54	9.276681	9.992093	9.284588	10.7154[illegible]2	6
55	9.277337	9.992069	9.285268	10.71[illegible]732	5
56	9.277991	9.992045	9.285946	10.714053	4
57	9.27[illegible]685	9.992020	9.286624	10.71337[illegible]	3
58	9.279297	9.991996	9.287301	10.712[illegible]	2
59	9.279948	9.991971	9.287977	10.7120[illegible]3	1
60	9.280599	9.991947	9.288652	10.7[illegible]1348	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 79.

Degree 11.

M	Sine	Co-sine	Tangent	Co-Tang	
0	9,280599	9,991947	9,288652	10,711348	60
1	9,281229	9,991922	9,289326	10 710674	59
2	9,281897	6,9918 7	9,289999	10,710001	58
3	9 282544	9,991873	9,290671	10,709329	57
4	9,283190	9,991848	9,29 342	10,708658	56
5	9,283836	9 991823	9,292013	10,707987	55
6	9 284480	9,991799	9,292682	10,707318	54
7	9,285124	9,991774	9,293350	10,706650	53
8	9 285766	9 991749	9,295017	10,705983	52
9	9,286408	9 991724	9, 94684	10,705316	51
10	9,287048	9 991699	9,295349	10 704651	50
11	9,287688	9,991674	9,29 013	10,703987	49
12	9,288326	9,991649	9,296677	10 703323	48
13	9,288964	9,991624	9,297339	10,702661	47
14	9,289600	9,991599	9,298001	10 701999	46
15	9,290236	9,991574	9,298662	10,701338	45
16	9,290870	9 991549	9, 99322	10 700678	44
17	9,291504	9,991524	9,299980	10,700020	43
18	9,292137	9 991493	9,300638	10,699362	42
19	9 292768	9,991473	9,301295	10,698105	41
20	9,293399	9,991448	9,301951	10,698049	40
21	9,294029	9,991422	9,302607	10,697393	39
22	9,294658	9,991397	9,303261	10,656739	38
23	9 295286	9,991372	9,303914	10,696086	37
24	9,2 5913	9,991346	9,304567	10,695433	36
25	9,296539	9,991321	9,305218	10,694782	35
26	9,297164	9 991295	9,305867	10,694131	34
27	9,297788	9 991270	9,306519	10,693481	33
28	9 298412	9 991241	9 307168	10,692832	32
29	9,299034	9,991218	9,307816	10,692184	31
30	9 299655	9 991193	9 308463	10,691537	30
	Co sine	Sine	Co-Tang.	Tangent	M

Degree 78.

Degree 11.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,299655	9,991193	9,308463	10,690537	30
31	9,300275	9,991167	9,309109	10,690891	29
32	9,300895	9,991141	9,309754	10,690246	28
33	9,301514	9,991115	9,310399	10,689601	27
34	9,302132	9,991090	9,311042	10,688958	26
35	9,302749	9,991064	9,311685	10,688315	25
36	9,303364	9,991038	9,312327	10.687673	24
37	9,303979	9,991012	9,312968	10,687032	23
38	9,304593	9,990986	9,313608	10,686392	22
39	9,305207	9,990960	9,314247	10,685753	21
40	9,305819	9,990934	9,314885	10,685115	20
41	9,306430	9,990908	9,315523	10,684477	19
42	9,307041	9,990382	9,316159	10,683841	18
43	9,307650	9,990855	9,316795	10,683205	17
44	9,308257	9,990829	9,317430	10,682570	16
45	9,308867	9,990803	9,318064	10,681936	15
46	9,309474	9,990777	9,318697	10,681303	14
47	9,310080	9,990750	9.319330	10,680670	13
48	9,310685	9,990724	9,319961	10,680039	12
49	9,311289	9,990697	9,320592	10,679408	11
50	9,311899	9,990671	9,321222	10,678778	10
51	9,312495	9,990645	9,321851	10,678149	9
52	9,313997	9,990618	9,321479	10,677521	8
53	9,313698	9,990591	9,323106	10,676894	7
54	9,314297	9,990565	9,323733	10,676267	6
55	9,314897	9,990538	9,324358	10,675642	5
56	9,315495	9.999512	9,324983	10,675017	4
57	9,316092	9,990485	9,325607	10,674393	3
58	9,316689	9,990458	9,326231	10,673769	2
59	9,317284	9,990431	9,326853	10,673147	1
60	9,317879	9,990404	9,327475	10,672525	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 78.

Degree 12.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,317879	9,990404	9,327475	10,67252[illegible]	60
1	9,31847[illegible]	9,990377	9,328095	10,671905	59
2	9,319065	9,990351	9,328715	10,671285	58
3	9,319658	9,990324	9,329334	10,670566	57
4	9,322250	9,990297	[illegible],329953	[illegible]0,67[illegible]047	56
5	9,320840	9,99027[illegible]	9,[illegible]20570	10,67[illegible]430	55
6	9,32[illegible]430	9,990[illegible]42	9,331[illegible]87	1[illegible],688[illegible]3	54
7	9,322019	9,990215	9,331[illegible]03	10,668197	53
8	9,3226[illegible]7	9,99018[illegible]	9,3[illegible]4[illegible]8	10,[illegible]7582	52
9	9,323194	9,950[illegible]6[illegible]	[illegible],33[illegible]033	10,6669[illegible]7	51
10	9,323780	9,990134	9,33[illegible]364[illegible]	1[illegible],666354	50
11	9,324360	9,990107	9,334259	1[illegible],6[illegible]5741	49
12	9,324950	9,990075	9,3348[illegible]	10,[illegible]65[illegible]29	48
13	9,325534	9,99005[illegible]	9,33548[illegible]	10,664518	47
14	9,526117	9,990025	9,336093	10,6[illegible]3907	46
15	9,326699	9,989997	9,336702	10,663298	45
16	9,327281	9,989970	9,337311	10,662689	44
17	9,327852	9,989942	9,337919	10,662081	43
18	9,328441	9,989915	9,338527	10,661473	42
19	9,329020	9,989887	9,339133	10,660867	41
20	9,329599	9,98986[illegible]	9,339739	10,660261	40
21	9,330176	9,989832	9,340344	10,659656	39
22	9,330753	9,989804	9,340948	10,659052	38
23	9,311328	9,989777	6,341552	10,658448	37
24	9,331903	9,989749	9,342155	10,657845	36
25	9,332478	9,989721	9,342757	10,657243	35
26	9,333051	9,989693	9,343358	10,656642	34
27	9,333624	9,989665	9,343958	10,656042	33
28	9,334195	9,989557	9,344558	10,655442	32
29	9,334766	9,989609	9,345157	10,654843	31
30	9,335337	9,989581	9,345755	10,654245	30
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 77.

Degree 1 .

M	Sine	Co-sine	Tangent	Co Tang.	
30	9,335337	9,989581	9,345755	10,654245	30
31	9,335905	9,989553	9,346353	10,653647	29
32	9,336475	9,989525	9,34694[illegible]	10,653051	28
33	9,337043	9,989597	9,347545	10,652[illegible]55	27
34	9,337610	9,98[illegible]463	9,348141	10,651859	26
35	9,338176	9,989441	9,343735	10,651205	25
36	9,338[illegible]42	9,989413	9,349329	10,650671	24
37	9,339305	9,9[illegible]384	9,349922	10,6[illegible]078	23
38	9,339870	9,989356	9,350514	10,64[illegible]486	22
39	9,340431	9,989328	9,351[illegible]6	10,640894	21
40	9,340996	9,989299	9,351697	10,648303	20
41	9,341558	9,9[illegible]9271	9,352[illegible]7	10,6477[illegible]3	19
42	9,342119	9,989243	9,35[illegible]87[illegible]	10,647124	18
43	9,342679	9,989214	9,353465	10,646535	17
44	9,343[illegible]9	9,989186	9,354053	10,645947	16
45	9,343797	9,989157	9,354640	10,645360	15
46	9,344355	9,989128	9,355227	10,944773	14
47	9,344912	9,989100	9,352812	10,644187	13
48	9,345469	9,989071	9,356398	10,643602	12
49	9,34[illegible]024	9,989042	9,356982	10,643018	11
50	9,346579	9,989014	9,357566	10,642434	10
51	9,347134	9,988985	9,358149	10,641851	9
52	9,347687	9,988956	9,358731	10,641269	8
53	9,348240	9,988927	9,359313	10,640687	7
54	9,348792	9,988898	9,359893	10,640107	6
55	9,349343	9,988869	9,360474	10,639526	5
56	,349893	9,988840	9,361053	10,638947	4
57	9,350443	[illegible],988811	9,361632	10,638369	3
58	9,350992	9,988782	9,362210	10,637790	2
59	9,351540	9,988754	9,362787	10,637213	1
60	9,352088	9,988724	9,363364	10,636636	0
	Co-sine	Sine	Co Tang.	Tangent	M

Degree 77.

Degree 13.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.352 88	9.98 721	9.363364	10.636639	60
	9 35263	9.988695	9.363940	10.636060	59
2	9.353181	9. 88666	9.364515	10.635485	58
3	9.353706	9.988636	9 365090	10.634910	57
4	9 354271	9.988607	9.365664	10.634336	56
5	9 354185	9.988578	9.366237	10.633763	55
6	9.355358	9.988548	9.366810	10.633190	54
7	9 3559 1	9.988519	9.367382	10.632618	53
8	9. 56441	9.988489	9 367953	10.632047	52
9	9.356984	9.988460	9.368524	10.631476	51
10	9.357524	9 988430	9.369 94	10.630906	50
11	9.358054	9.988401	9.369663	10.630337	49
12	9.358603	9.988371	9.370232	10.629768	48
13	9.3 9141	9.988311	9 370799	10.629201	47
14	9.3 9679	9 988312	9.371367	10.628633	46
15	9.350215	9.988282	9.37 933	10.628067	45
16	9.360752	9.988252	9.372499	10.627501	44
17	9.361287	9.988223	9.373064	10.626936	43
18	9.361822	9.988193	9.373629	10.626371	42
19	9.362356	9.988163	9.3 4193	10.625807	41
20	9.362889	9.988133	9.374756	10.625244	40
21	9.363421	9.988103	9 375319	10.624681	39
22	9.363954	9.988073	9.375881	10.624119	38
23	9.364485	9.988043	9.376442	10 623558	37
24	9 365016	9.988013	9.377003	10.622997	36
25	9.365545	9.987983	9 377562	10.622437	35
26	9.366075	9.98 953	9.378122	10 621878	34
27	9 366604	9.987922	9.378581	10 621319	33
28	9.367132	9.987892	9.379239	10.620761	32
29	9.367659	9.987862	9.379797	10.620201	31
30	9 368185	9.987832	9.3803 4	10 6196 6	30
	Co-fine	Sine	Co.Tang	Tangent	M

Degree 76.

Degree 13.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,368185	9,987832	9,380354	10,619646	30
31	9,368711	9,987801	9,380910	10 619090	29
32	9,369236	9,987771	9,381466	10,618534	28
33	9,369761	9,987740	9,382021	10,617980	27
34	9,370285	9,987710	9,382575	10,617425	26
35	9,370808	9,987679	9,383129	10,616871	25
36	9,371330	9,987649	9,383682	10,616318	24
37	9,371852	9,987618	9,384234	10 615766	23
38	9,372373	9,987588	9,384786	10,615214	22
39	9,372894	9,987557	9,385337	10,614663	21
40	9,373414	9,987526	9,385888	10 614112	20
41	9,373933	9,987496	9,386438	11,613562	19
42	9,374452	9,987465	9,386987	11,613013	18
43	9,374970	9,987434	9,387536	10,612464	17
44	9,375487	9,987403	9,388084	10,611916	16
45	9,376003	9,987372	9,388631	10 611369	15
46	9,376519	9,987341	9,389178	10.610822	14
47	9,377035	9,987310	9,389724	10,610276	13
48	9,377549	9,987279	9,390270	10.609730	12
49	9,378063	9,987248	9,390815	10,609185	11
50	9,378577	9,987217	9,391360	10 608540	10
51	9,379089	9,987186	9,391907	10,608097	9
52	9,379601	9,987155	9,392467	10,607553	8
53	9,380113	9,987124	9,392989	10,607011	7
54	9,380624	9,987092	9,393531	10,606469	6
55	9,381134	9,987061	9,394074	10.605927	5
56	9,381643	9,987030	9,394614	10,605386	4
57	9,382152	9,986998	9,395154	10 604846	3
58	9,382661	9,986967	9,395694	10 604306	2
59	9,383168	9,986936	9,396233	10,603767	1
60	9,383675	9,986904	9,396771	10 603229	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 76.

Degree 5.

M	Sine	Co-sine	Tangent	Co-Tang	
0	9,383675	9,986904	9,396771	10,603229	60
1	9,384181	9,986873	9,397309	10,602694	59
2	9,384687	9,986841	9,397846	10,602154	58
3	9,385192	9,986809	9,398383	10,601617	57
4	9,385697	9,986778	9,398919	10,501081	56
5	9,386201	9,986746	9,399455	10,600545	55
6	9,386704	9,986714	9,399990	10,600010	54
7	9,387207	9,986683	9,400524	10,599476	53
8	9,387709	9,986651	9,401058	10,598942	52
9	9,388210	9,986619	9,401591	10,598409	51
10	9,388711	9,986587	9,402124	10,597876	50
11	9,389211	9,986555	9,402656	10,597344	49
12	9,389711	9,986523	9,403187	10,596813	48
13	9,390210	9,986491	9,403718	10,596282	47
14	9,390708	9,986459	9,404249	10,595751	46
15	9,391206	9,986427	9,404778	10,595222	45
16	9,391703	9,985395	9,405306	10,594693	44
17	9,392199	9,986363	9,405836	10,594164	43
18	9,392695	9,986338	9,406364	10,593636	42
19	9,393190	9,986299	9,406892	10,593608	41
20	9,393685	9,986266	9,407419	10,592581	40
21	9,394179	9,986234	9,407945	10,592055	39
22	9,394673	9,986201	9,408471	10,591529	38
23	9,395166	9,986169	9,408996	10,591001	37
24	9,395654	9,986137	9,409521	10,590479	36
25	9,396150	9,986124	9,410045	10,589954	35
26	9,396641	9,986072	9,410569	10,582431	34
27	9,397131	9,986039	9,411092	10,588908	33
28	9,397621	9,986007	9,411615	10,588385	3
29	9,398111	9,985974	9,412137	10,587863	31
30	9,398600	9,985942	9,412658	10,587342	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 75.

Degree 14.

M	Sine	Co-fine	Tangent	Co-Tang.	
30	9,398600	9,985942	9,412658	10,587342	30
31	9,399087	9,985909	9,413179	10,586821	29
32	9,399575	9,985876	9,413699	10,586301	28
33	9,400062	9,985843	9,414219	10,585781	27
34	9,400549	9,985811	9,414738	10,585262	26
35	9,401035	9,985778	9,415257	10,583742	25
36	9,401520	9,985745	9,415775	10,584225	24
37	9,402005	9,985712	9,416293	10,583707	23
38	9,402489	9,985679	9,416810	10,583190	22
39	9,402972	9,985646	9,417326	10,582674	21
40	9,403455	9,985613	9,417842	10,582157	20
41	9,403938	9,985580	9,418357	10,581642	19
42	9,404420	9,985547	9,418873	10,581127	18
43	9,404901	9,985513	9,419387	10,580613	17
44	9,405382	9,985480	9,419901	10,580099	16
45	9,405862	9,985447	9,420415	10,589585	15
46	9,406341	9,985414	9,420927	10,579072	14
47	9,406820	9,985380	9,421440	10,578560	13
48	9,407299	9,985347	9,421951	10,578048	12
49	9,407776	9,985314	9,422463	10,577537	11
50	9,408254	9,985280	9,422973	10,577026	10
51	9,408731	9,985247	9,423484	10,576516	9
52	9,409207	9,985213	9,423993	10,576007	8
53	9,409682	9,985180	9,424503	10,575497	7
54	9,410157	9,985146	9,425011	10,574989	6
55	9,410632	9,985112	9,425518	10,574480	5
56	9,411106	9,985079	9,426027	10,573973	4
57	9,411579	9,985045	9,426534	10,573466	3
58	9,412052	9,985011	9,427041	10,572959	2
59	9,412524	9,984977	9,427547	10,572453	1
60	9,412996	9,984943	9,428052	10,571947	0
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 75.

Degree 15.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,412996	9,984944	9,428052	10,571947	60
1	9,413467	9,984910	9,428557	10,571442	59
2	9,413938	9,984876	9,429067	10,570938	58
3	9,414408	9,984842	9,429565	10,570434	57
4	9,414878	9,984808	9,430070	10,569930	56
5	9,415347	9,984774	9,430573	10,569427	55
6	9,415815	9,984740	9,431075	10,568925	54
7	9,416283	9,984705	9,431577	10,568423	53
8	9,416850	9,984672	9,432079	10,567921	52
9	9,417217	9,984637	9,432580	10,567420	51
10	9,417684	9,984603	9,433080	10,566920	50
11	9,418149	9,984569	9,433580	10,566419	49
12	9,418615	9,984535	9,434080	10,565920	48
13	9,419079	9,984500	9,434579	10,565421	47
14	9,419544	9,984465	9,435078	10,564922	46
15	9,420007	9,984431	9,435576	10,564424	45
16	9,420470	9,984397	9,436073	10,563927	44
17	9,420933	9,984363	9,436570	10,563430	43
18	9,421395	9,984328	9,437067	10,562933	42
19	9,421857	9,984293	9,437563	10,562437	41
20	9,422317	9,984259	9,438059	10,561941	40
21	9,422778	9,984224	9,438554	10,561446	39
22	9,423238	9,984189	9,439048	10,560952	38
23	9,423697	9,984155	9,439543	10,560457	37
24	9,424156	9,984120	9,446036	10,559964	36
25	9,424615	9,984085	9,440529	10,559471	35
26	9,425072	9,984050	9,441022	10,558978	34
27	9,425530	9,984015	9,441514	10,558486	33
28	9,425987	9,983980	9,442006	10,557994	32
29	9,426443	9,983945	9,442497	10,557503	31
30	9,426899	9,983910	9,442988	10,557911	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 74.

Degree 15.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,416899	9,983910	9,442988	10,557011	30
31	9,427354	9,983875	9,443479	10,556521	29
32	9,427809	9,983840	9,443968	10,556031	28
33	9,428264	9,983805	9,444458	10,555542	27
34	9,428717	9,983770	9,444947	10,555053	26
35	9,429170	9,983735	9,445435	10,554565	25
36	9,439623	9,983699	9,445923	10,554077	24
37	9,430075	9,983664	9,446411	10,553589	23
38	9,430507	9,983629	9,446898	10,553102	22
39	9,430978	9,983593	9,447384	10,552616	21
40	9,431429	9,983558	9,447870	10 552129	20
41	9,431879	9,983523	9,448356	11,551644	19
42	9,432328	9,983487	9,448841	11,551159	18
43	9,432778	9,983451	9,449325	10,55 674	17
44	9,433206	9,983415	9,449870	10,550131	16
45	9,433574	9,983380	9,440294	10,549706	15
46	9,434122	9,983345	9,4 0777	10,549223	14
47	9,434569	9,983309	9,451260	10,548740	13
48	9,435016	9,983273	9,451743	10,543257	12
49	9,435462	9,983238	9,452225	10,547775	11
50	9,4359 8	9,983202	9,452706	10 547295	10
51	9,436353	9,983166	9,453187	10,546813	9
52	9,436798	9,983130	9,453668	10,545332	8
53	9,437242	9,983094	9,454148	10,5558 2	7
54	9,437686	9,983058	9,454629	10,545372	6
55	9,438129	9,983022	9,455107	10,544893	5
56	9,438572	9,982986	9,455586	10,544414	4
57	9,439014	9,982950	9,456064	10,543936	3
58	9,439456	9,982914	9,456542	10,553458	2
59	9,439897	9,982878	9,457019	10,542980	1
60	9,430338	9,982842	9,457497	10,542503	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 74.

Degree 16.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,440338	9,932842	9,457496	10,542503	60
1	9,440778	9,982805	9,457973	10,542027	59
2	9,441218	9,982769	9,458449	10,541551	58
3	9,441658	9,582733	9,458925	10,541075	57
4	9,442096	9,982696	9,459400	10,540600	56
5	9,442535	9,982660	9,459875	10,540125	55
6	9,442973	9,982623	9,460349	10,539651	54
7	9,443416	9,582587	9,460829	10,539177	53
8	9,443848	9,982550	9,461297	10,538703	52
9	9,444284	9,982514	9,461770	10,538230	51
10	9,444720	9,982477	9,462242	10,537750	50
11	9.445155	9,982441	9,462714	10,537285	49
12	9,445550	9,982404	9,463186	10,536814	48
13	9,446025	9,982367	9,463658	10, 36342	47
14	9,446459	9,982330	9,464129	10,535871	46
15	9.446593	9,982294	9,464599	10,535401	45
16	9 447326	9,982257	9,465069	10,534931	44
17	9,447759	9,982220	9,465539	10,534461	43
18	9,448191	9,982183	9,46600[illegible]	10,533992	42
19	9,448623	9,982146	9,466476	10,533523	41
20	9,449054	9,982109	9,466945	10,533055	40
21	9,449485	9,982072	9,467413	10,532587	39
22	9,449915	9,982035	9,467880	10,532120	38
23	9,450345	9,981998	9,468347	10,531653	37
24	9,450775	9,981964	9,468814	10,531186	36
25	9,451203	9,981923	9,469280	10,530720	35
26	9,451632	9.981886	9,469746	10,530254	34
27	9,452060	9.981849	9,470211	10,529789	33
28	9,452488	9,981812	9,470676	0,529324	32
29	9.452915	9,981774	9.471141	10,528859	31
30	9.453312	9,98 737	9,471605	10,528395	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 73.

Degree 16.

M	Sine	Co sine	Tangent	Co-Tang.	
30	9.453342	9,981737	9,471605	10,528395	30
31	9,453768	9 981699	9,472068	10,527932	29
32	9,454194	9,981662	9,472532	10.527468	28
33	9,454619	9,981624	9,472995	10.527005	27
34	9 455044	9,981587	9,473457	10,526543	26
35	9 455469	9,981549	9,473919	10 526081	25
36	9,455892	9,981512	9,474381	10,525619	24
37	9 456316	9,981474	9,474842	10 525158	23
38	9,456739	9,981436	9,475303	10,524697	22
39	9,457162	9,981398	9,475763	10,524237	21
40	9,457584	9,981361	9 476223	10,523777	20
41	9,458005	9,9 1323	9,476683	10,523317	19
42	9,448427	9,981285	9,477142	10,522858	18
43	9,458848	9,981247	9 477601	10,522399	17
44	9,459268	9,981209	9 478059	10,521941	16
45	9,459684	9,981171	9 478517	10,521483	15
46	9,460108	9,981133	9,478975	10,521025	14
47	9,460527	9,981095	9,479432	10,520568	13
48	9,460946	9,981057	9,475889	10,520111	12
49	9,461364	9,981019	9 480345	10 519655	11
50	9,461782	9,980980	9 480801	10 519199	10
51	9,462199	6,980942	9 481257	10.518743	9
52	9,462616	9,980904	9,481712	10 518288	8
53	9,463032	9,980866	9,482167	10,517833	7
54	9,463448	9,980827	9,482621	10,517379	6
55	9.463864	9 980789	9 483075	10,516925	5
56	9 464279	9,980750	9 483528	10,516471	4
57	9.464691	9,980712	9,483982	10,516018	3
58	9,465108	9,980672	9,484434	10,515566	2
59	9,465522	9,980635	9,484887	10,515113	1
60	9,465953	9,980596	9 485339	10 514661	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 73.

Degree 17.

M	Sine	Co-sine	Tangent	Co-Tang.	'
0	9,465935	9,980596	9,485339	10,514661	60
1	9,466348	9,980558	9,485791	10,514209	59
2	9,466761	9,980519	9,486242	10,513758	58
3	9,467173	9,980480	9,486693	10,513307	57
4	9,467585	9,980441	9,487143	10,512857	56
5	9,467996	9,980403	9,487593	10,512407	55
6	9,468407	9,980364	9,488043	10,511957	54
7	9,468817	9,980325	9,488493	10,511507	53
8	9,469227	9,980286	9,488949	10,511059	52
9	9,469637	9,980247	9,489390	10,510610	51
10	9,460446	9,980208	9,489838	10,510162	50
11	9,470455	9,980169	9,490286	10,509714	49
12	9,471863	9,980130	9,490733	10,509267	48
13	9,471071	9,980091	9,491180	10,508820	47
14	9,471678	9,980052	9,491627	10,508373	46
15	9,472086	9,980012	9,492073	10,507928	45
16	9,472492	9,979973	9,492519	10,507481	44
17	9,472898	9,979934	9,492964	10,507036	43
18	9,473304	9,979894	9,493410	10,506590	42
19	9,473710	9,979855	9,493854	10,506145	41
20	9,474115	9,979816	9,494299	10,505701	40
21	9,474519	9,979776	9,494743	10,505257	39
22	9,474923	9,979737	9,495186	10,504813	38
23	9,475327	9,979697	9,495630	10,504370	37
24	9,475730	9,979658	9,496073	10,503928	36
25	9,476132	9,979618	9,496515	10,503485	35
26	9,476536	9,979578	9,496957	10,503043	34
27	9,476938	9,979539	9,497399	10,502601	33
28	9,477340	9,979499	9,497840	10,502160	32
29	9,477741	9,979459	9,498282	10,501718	31
30	9,478142	9,979419	9,498722	10,501278	30
	Co-sine	Sine	Co-Tang.	Tangent	M.

Degree 72.

Degree 17.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.478142	9.979419	9.498722	10.501278	30
31	9.478542	9.979380	9.499163	10.500837	29
32	9.478942	9.979340	9.499602	10.500398	28
33	9.479342	9.979300	9.500042	10.499958	27
34	9.479741	9.979260	9.500481	10.499519	26
35	9.480140	9.979220	9.500920	10.499080	25
36	9.480538	9.979180	9.501359	10.498641	24
37	9.480935	9.979140	9.501797	10.498203	23
38	9.481334	9.979099	9.502234	10.497764	22
39	9.481731	9.979059	9.502672	10.497328	21
40	9.482128	9.979019	9.503107	10.496891	20
41	9.482525	9.978980	9.503546	10.496454	19
42	9.482921	9.978939	9.503982	10.496018	18
43	9.483316	9.978898	9.504418	10.495582	17
44	9.483711	9.978858	9.504854	10.495146	16
45	9.484106	9.978817	9.505289	10.494711	15
46	9.484501	9.978777	9.505724	10.494216	14
47	9.484895	9.978736	9.506158	10.493841	13
48	9.485289	9.978696	9.506593	10.493407	12
49	9.485682	9.978655	9.507026	10.492973	11
50	9.486075	9.978615	9.507459	10.492540	10
51	9.486467	9.978574	9.507892	10.491107	9
52	9.486859	9.978533	9.508326	10.491674	8
53	9.487251	9.978493	9.508759	10.491241	7
54	9.487642	9.978452	9.509181	10.490809	6
55	9.488033	9.978411	9.509622	10.490377	5
56	9.488424	9.978370	9.510054	10.499946	4
57	9.488814	9.978329	9.510485	10.489515	3
58	9.489204	9.978288	9.510916	10.489084	2
59	9.489593	9.978247	9.511346	10.488654	1
60	9.489982	9.978206	9.511776	10.488225	0
M	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 72.

Degree 18.

M.	Sine.	Co-sine	Tangent	Co-Tang.	
	9.489982	9.978206	9.511776	10,488224	60
1	9.490371	9,978165	9.512206	10.487794	59
2	9,490759	9.978124	9,512635	10,487365	58
3	9,491147	9,978083	9,513064	10,486936	57
4	9.491534	9.978042	9,513493	10,486507	56
5	9.491922	9,978000	9,513921	10,486079	55
6	9.492308	6,977956	9,514349	10.485651	54
7	9.492695	9,977918	9,514777	10,485223	53
8	9.493080	9,977877	9.515204	10.484796	52
9	9.493465	9,977835	9.515631	10,484369	51
10	9,493851	9,977794	9,516057	10,483942	50
11	9.494236	9.977752	9,516484	10.483516	49
12	9.494620	9.977711	9,516910	10.483090	48
13	9.495005	9.977669	9.517335	10.482665	47
14	9.495388	9.977628	9.517761	10.482239	46
15	9.495771	9.977586	9.518185	10.481814	45
16	9.496154	9.977544	9.518610	10.481390	44
17	9.496537	9.977503	9.519034	10.480966	43
18	9.496916	9.977461	9.519458	10.480542	42
19	9.497301	9.977419	9.519882	10.480118	41
20	9.497682	9.977377	9.520305	10.479695	40
21	9.498063	9.977335	9.520728	10.479272	39
22	9.498444	9.977293	9.521151	10.478849	38
23	9.498824	9.977251	9.521573	10.478427	37
24	9.499204	9.977209	9.521995	10.478005	36
25	9.499584	9.977167	9.522417	10.477583	35
26	9.499963	9.977125	9.522838	10.477162	34
27	9.500342	9.977083	9.523259	10.476741	33
28	9.500720	9.977041	9.523679	10.476320	32
29	9.501099	9.976999	9.524100	10.475900	31
30	9.501476	9,976956	9.524520	10.475480	30
	Co-sine.	Sine	Co.Tang.	Tangent	M

Degree 71.

Degree 18.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.501476	9.977956	9.524520	10.475030	30
31	9.501854	9.976914	9.524939	10.475060	29
32	9.502231	9.976827	9.525359	10.474641	28
33	9.502607	9.976830	9.525778	10.474222	27
34	9.502984	9.976787	9.526197	10.473803	26
35	9.503360	9.976745	9.526615	10.473385	25
36	9.503735	9.975702	9.527033	10.4729 7	24
37	9.5041 0	9.976650	9.527451	10.472549	23
38	9.504485	9.976617	9.527868	10.472132	22
39	9.504840	9.976574	9.528285	10.471115	21
40	9.505234	9.976532	9.528702	10.471298	20
41	9. 05608	9.975489	9.529118	10.470881	19
42	9.505981	9.976445	9.529535	10.470465	18
43	9.506354	9.976404	9.529950	10.4700 9	17
44	9.506727	9.976361	9.530366	10.469634	16
45	9.507099	9.976318	9.530781	10.469219	15
46	9.507471	9.976275	9.531169	10.468 04	14
47	9.507843	9.976232	9.531611	10.468389	13
48	9.508214	9.976183	9.532025	10.467975	12
49	9.508585	9.976146	9.532438	10.467561	11
50	9.508955	9.976103	9.532852	10.467147	10
51	9.509326	9.976060	9.533266	10.466784	9
52	9.509696	9.976017	9.533679	10.466321	8
53	9.510055	9.975973	9.534092	10.465908	7
54	9.510431	9.975930	9.534504	10.465496	6
55	9.510803	9.975887	9.534916	10.465084	5
56	9.511171	9.975844	9.535328	10.464672	4
57	9.511540	9.975800	9.535739	10.464261	3
58	9.511907	9.975757	9.536150	10.463849	2
59	9.512275	9.975713	9.536561	10.463439	1
60	9.512641	9.975670	9.536972	10.4630.8	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 71.

Degree 19.

M	Sine	*Co-fine*	Tangent	*Co-Tang.*	
0	9,512642	9,975670	9,536972	10,463028	60
1	9,513009	9,975626	9,537382	10,462618	59
2	9,513375	9,975583	9,537792	10,462208	58
3	9,513741	9,975539	9,538202	10,461798	57
4	9,514107	9,975496	9,538610	10,461389	56
5	9,514472	9,975452	9,539020	10,460980	55
6	9,514837	9,975408	9,539429	10,460571	54
7	9,515202	9,975364	9,539837	10,460163	53
8	9,515566	9,975321	9,540245	10,459755	52
9	9,515930	9,975277	9,540653	10,459347	51
10	9,516294	9,975233	9,541061	10,458939	50
11	9,516657	9,975186	9,541468	10,458532	49
12	9,517020	9,975145	9,541875	10,458125	48
13	9,517382	9,975101	9,542281	10,457719	47
14	9,517745	9,975057	9,542688	10,457312	46
15	9,518107	9,975013	9,543094	10,456906	45
16	9,518468	9,974969	9,543499	10,456501	44
17	9,518829	9,974925	9,543905	10,456095	43
18	9,519190	9,974880	9,544310	10,455690	42
19	9,519551	9,974836	9,544715	10,455285	41
20	9,519911	9,974792	9,545119	20,454881	40
21	9,520271	9,974747	9,545524	10,454476	39
22	9,520631	9,974703	9,545927	10,454072	38
23	9,520990	9,974659	6 546331	10,453669	37
24	9,521349	9,974614	9,546735	10,453265	36
25	9,521707	9,974570	9,547138	10,452862	35
26	9,522065	9,974525	9,547540	10,452459	34
27	9,522423	9,974480	9,547943	10,452057	33
28	9,522781	9,974435	9,548345	10,451655	32
29	9,523138	9,974391	9,548747	10,451253	31
30	9,523495	9,97434[illegible]	9,5491[illegible]9	10,450851	30
	Co-fine	Sine	*Co-Tang.*	Tangent	M

Degree 70.

Degree 19.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,523495	9,974346	9,549149	10,450851	30
31	9,523851	9,974302	9,549550	10,450450	29
32	9,524208	9,974257	9,549951	10,450049	28
33	9,524564	9,974212	9,550352	10,449648	27
34	9,524920	9,974167	9,550752	10,449048	26
35	9,525275	9,974122	9,551152	10,448848	25
36	9,525630	9,974077	9,551552	10,448448	24
37	9,525984	9,974032	9,551952	10,448048	23
38	9,526339	9,973987	9,552351	10,447649	22
39	9,526693	9,973942	9,552750	10,447250	21
40	9,527046	9,973987	9,553149	10,446851	20
41	9,527400	9,973852	9,553548	10,446452	19
42	9,527753	9,973807	9,553946	10,446054	18
43	9,528105	9,973761	9,554344	10,445656	17
44	9,528458	9,973716	9,554741	10,445259	16
45	9,528810	9,973671	9,555139	10,444861	15
46	9,529161	9,973625	9,555536	10,444464	14
47	9,529513	9,973580	9,555932	10,444068	13
48	9,529864	9,973535	9,556329	10,443671	12
49	9,530214	9,973489	9,556725	10,443257	11
50	9,530565	9,972443	9,557121	10 442876	10
51	9,530915	9,973398	9,557517	10,442483	9
52	9,531265	9,973352	9,557912	10,442088	8
53	9,531614	9,973307	9,558308	10,441692	7
54	9,531963	9,972261	9,558702	10,441298	6
55	9,532312	9,972215	9,559097	10,440903	5
56	9,532651	9.973169	9,559491	10,440509	4
57	9,533099	9,973123	9,559885	10,440115	3
58	9,533357	9,973078	9,560279	10,439721	2
59	9,533704	9,973032	9,560673	10,439327	1
60	9,534052	9,973986	9,561066	10,438934	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 70.

Degree 20.

M	Sine	Co sine	Tangent	Co-Tang.	
0	9,534052	9,972 86	9,561066	10,438934	60
1	9,534399	9,972940	9,56 459	10,438541	59
2	9,534745	6,972894	9,561851	10,438148	58
3	9,535091	9,972848	9,562244	10,437756	57
4	9,535437	9,972801	9,562636	10,437364	56
5	9,535782	9,972755	9,563028	10,436972	55
6	9,536129	9,972709	9,563419	10,436580	54
7	9,536474	9,972663	9,563811	10,436189	53
8	9,536818	9,972617	9,564202	10,435798	52
9	9,537163	9,972570	9,564592	10,435407	51
10	9,537507	9,972521	9,554983	10,435017	50
11	9,537851	9,972477	9,555373	10,434627	49
12	9,538194	9,972431	9,565763	10,434237	48
13	9,538537	9,972384	9,556153	10,433847	47
14	9,538880	9,972338	9,566542	10,433457	46
15	9,539222	9,972291	9,566932	10,433 68	45
16	9,539566	9,972245	9,5 7320	10,432679	44
17	9,539907	9,972198	9,567709	10,432291	43
18	9,540249	9,972151	9,568097	10,431902	42
19	9,540590	9,972105	[illegible]68486	10,431514	41
20	9,540931	9,972058	9,569873	10,431126	40
21	9,541272	9,972011	9,569261	10,430739	39
22	9,541612	9,971964	9,569648	10,430351	38
23	9,541953	9,971917	9,560035	10,429964	37
24	9,542292	9,971870	9,560402	0,429578	36
25	9,542632	9,071822	9,560809	10,429191	35
26	9,542971	9,971776	9,571195	10,428805	34
27	9,543310	9,971729	9,571581	10,428419	33
28	9,543649	9,971632	9,571967	10,428033	32
29	9,543987	9,971685	9,572352	10,427643	31
30	9,544325	9,971588	9,572738	10,427262	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 69.

Degree 20.

M	Sine	Co fine	Tangent	Co-Tang.	
30	9,544325	9,971588	9,572738	10,427262	30
31	9,544663	9,971540	9,573123	10,426877	29
32	9,545000	9,971492	9,573507	10,426492	28
33	9,545338	9,971446	9,573892	10,425108	27
34	9,545674	9,971398	9,574276	10,425724	26
35	9,546011	9,971351	9,574660	10,425340	25
36	9,546347	9,971303	9,575044	10,424956	24
37	9,546683	9,971256	9,575427	10,424573	23
38	9,547019	9,971208	9,575810	10,424189	22
39	9,547354	9,971161	9,576193	10,423807	21
40	9,547689	9,971112	9,576576	10,423424	20
41	9,548024	9,971065	9,576958	10,423041	19
42	9,548358	9,971018	9,577341	10,422659	18
43	9,548693	9,970970	9,577723	10,422277	17
44	9,549025	9,970923	9,578104	10,421896	16
45	9,549360	9,970874	9,578486	10,421514	15
46	9,549693	9,970826	9,578867	10,421133	14
47	9,550026	9,970779	9,579248	10,420752	13
48	9,550359	9,970731	9,579628	10,420371	12
49	0 550692	9,970683	9,580009	10,419991	11
50	9,551024	9,970634	9,580389	10,419611	10
51	9,551355	9,970586	9,580769	10,419231	9
52	9,551687	9,970538	9,581149	10,418851	8
53	9,552018	9,970490	9,581528	10,418472	7
54	9,552349	9,970442	9,381907	10,418092	6
55	9,552680	9,970394	9,582286	10,417713	5
56	9,553010	9,970345	9,582665	10,417335	4
57	9,553340	9,970297	9,583043	10,416956	3
58	9,553670	9,970247	9,583422	10,416578	2
59	9,554000	9,970200	9,583800	10,416200	1
60	9,554329	9,970152	9,584177	10,415823	0
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 69.

Degree 21.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,554329	9,970155	9,584177	10,415822	60
1	9,554658	9,970105	9,584555	10,415445	59
2	9,554987	9,970055	9,584932	10,415068	58
3	9,555315	9,970006	9,585308	10,414691	57
4	9,555643	9,969957	9,585686	10,414314	56
5	9,555971	9,969909	9,586062	10,413938	55
6	9,556299	9,969860	9,586439	10,413561	54
7	9,556626	9,969811	9,586815	10,413185	53
8	9,556953	9,969762	9,587190	10,412800	52
9	9,557279	9,969715	9,587566	10,412434	51
10	9,557606	9,969665	9,587941	10,412059	50
11	9,557932	9,969616	9,588316	10,411684	49
12	9,558258	9,969567	9,588691	10,411309	48
13	9,558583	9,969518	9,589066	10,410934	47
14	9,558909	9,969569	9,589440	10,410560	46
15	9,559234	9,969419	9,589814	10,410185	45
16	9,559558	9,969370	9,590188	10,409812	44
17	9,559883	9,969321	9,590561	10,409438	43
18	9,560207	9,969272	9,590935	10,409065	42
19	9,560531	9,969223	9,591308	10,408692	41
20	9,560855	9,969173	9,591681	10,408319	40
21	9,561178	9,969124	9,592054	10,407946	39
22	9,561501	9,969075	9,592426	10,407574	38
23	9,561824	9,969025	9,592798	10,407201	37
24	9,562146	9,968976	9,593170	10,406829	36
25	9,562468	9,968926	9,593542	10,406457	35
26	9,562790	9,968877	9,593914	10,406086	34
27	9,563112	9,968827	9,594285	10,405715	33
28	9,563433	9,968777	9,594656	10,405344	32
29	9,563754	9,968728	9,595027	10,405073	31
30	9,564075	9,968678	9,595397	10,404602	30
	Co sine	Sine	Co-Tang.	Tangent	M

Degree 68.

Degree 21.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,564075	9,968678	9,595397	10,404602	30
31	9,564396	9,968628	9,595768	10,404232	29
32	9,564716	9,9[illegible]8578	9,596138	10,403802	28
33	9,565036	9,968528	9,596508	10,403492	27
34	9,565356	9,968478	9,596878	10,403122	26
35	9,565675	9,968428	9,597247	10,402753	25
36	9,565993	9,968378	9,59[illegible]616	10,402384	24
37	9,566314	9,968328	9,597985	10,402015	23
38	9,566632	9,968278	9,598354	10,401646	22
39	9,566951	9,968228	9,598722	10,401277	21
40	9,567269	9,968178	9,599091	10,400909	20
41	9,567587	9,968128	9,599459	10,400541	19
42	9,567904	9,968078	9,599827	10,400173	18
43	9,568222	9,968027	9,600194	10,399806	17
44	9,568539	9,967977	9,600562	10,399438	16
45	9,568855	9,967927	9,600929	10,399071	15
46	9,569172	9,967876	9,601296	10,398704	14
47	9,569488	9,967826	9,601662	10,398337	13
48	9,569804	9,967775	9,602029	10,397971	12
49	9,570120	9,967725	9,602395	10,397605	11
50	9,570435	9,967674	9,602761	10,397239	10
51	9,570751	9,967623	9,603127	10,396873	9
52	9,571065	9,967573	9,603493	10,396507	8
53	9,571380	9,9[illegible]7522	9,603858	10,396142	7
54	9,571695	9,967471	9,604223	10,395777	6
55	9,572009	9,967420	9,604588	10,395412	5
56	9,572322	9,967370	9,604953	10,395047	4
57	9,572636	9,967319	9,605317	10,394683	3
58	9,572949	9,967268	9,605681	10,394318	2
59	9,573263	9,967217	9,606046	10,393954	1
60	9,573575	9,967166	9,606409	10,393592	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 68.

Degree 22.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,573575	9,967166	9,606409	10 393590	60
1	9,573888	9,967115	9,606773	10,393227	59
2	9,574200	9,967064	9,607136	10,392863	58
3	9,574512	9,967012	9,607500	10,392500	57
4	9,574824	9,966961	9,607862	10,392137	56
5	9,575135	9,966910	9,608225	10 391774	55
6	9,575447	9,966859	9,608588	10,391412	54
7	9,575758	9,966807	9,608950	10 391050	53
8	9,576058	9,966756	9,609312	10,390688	52
9	9,576379	9,966705	9,609674	10,390326	51
10	9,576689	9,966653	9,600036	10,389964	50
11	9,576999	9,966602	9,610397	10,389603	49
12	9,577309	9,966550	9,610758	10,389241	48
13	9,577618	9 966499	9,611119	10 388880	47
14	9,577927	9,966447	9,611480	10 388520	46
15	9,578236	9,966395	9,611841	10,388159	45
16	9,578545	9,966344	9 612201	10,387799	44
17	9 578853	9,966292	9,612561	10,387438	43
18	9.579161	9 966240	9,612521	10,387078	42
19	9,579469	9,966188	9,613281	10,386719	41
20	9,579777	9 966136	9 613641	20,386359	40
21	9,580084	9,966084	9 614000	10,386000	39
22	9,580392	9,966032	9,614359	10,385641	38
23	9,580698	9.965980	6 614718	10,385282	37
24	9 58 005	9 965928	9,615077	10 384923	36
25	9,581311	9 965876	9,61 435	10,384565	35
26	9,581618	9,965824	9,615793	10,384207	34
27	9,581923	9 965772	9,616151	10,383418	33
28	9,582229	9 965720	9,616509	10,383491	32
29	9,582534	9,965668	9,616867	10,383133	31
30	9,582840	9 965615	9,617224	10,382776	30
	Co-sine	Sine	Co Tang.	Tangent	M

Degree 67.

Degree 22.

M	Sine	Co-sine	Tangent	Co-Tan.	
30	9,582840	9,965615	9,617224	10,3827 6	30
31	9,583144	9,965563	9,617581	10,382418	29
32	9,583449	9,965511	9,617938	10,382061	28
33	9,583753	9,965458	9,618295	10,381705	27
34	9,584058	9,965405	9,618652	10,381348	26
35	9,584361	9,965353	9,619008	10,380992	25
36	9,584665	9,965301	9,619364	10,380635	24
37	9,584968	9,965248	9,619720	10,380279	23
38	9,585271	9,965195	9,620076	10,379924	22
39	9,585574	9,965143	9,620432	10,379568	21
40	9,585877	9,965090	9,620787	10,379213	20
41	9,586179	9,965037	9,621142	10,378858	19
42	9,586481	9,964984	9,621497	10,378503	18
43	9,586783	9,964931	9,622852	10,378148	17
44	9,587085	9,964878	9,622206	10,377793	16
45	9,587386	9,964825	9,622561	10,377489	15
46	9,587687	9,964772	9,622915	10,377085	14
47	9,587988	9,964719	9,623269	10,376731	13
48	9,588289	9,964665	9,623623	10,376377	12
49	9,588589	9,964613	9,623976	10,376004	11
50	9,588890	9,964560	9,624330	10,375670	10
51	9,589190	9,964507	9,624683	10,375317	9
52	9,589489	9,964454	9,625036	10,374964	8
53	9,589789	9,964401	9,625388	10,374612	7
54	9,590088	9,964347	9,625741	10,374259	6
55	9,590387	9,964294	9,626093	10,373907	5
56	9,590686	9,964240	9,626445	10,373555	4
57	9,590984	9,964187	9,626797	10,373203	3
58	9,591282	9,964133	9,627149	10,372850	2
59	9,591580	9,964080	9,627501	10,372499	1
60	9,591878	9,964026	9,627852	10,372148	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 67.

Degree 23.

M	Sine	Co-sine	Tangent	Co Tang.	
0	9,591878	9,964026	9,627[illegible]52	10,3[illegible]21[illegible]8	60
1	9,592175	9,963972	9,628203	10,371797	59
2	9,592473	6,963919	9,628554	10,371244	58
3	9,592770	9,963865	9,628905	10,371095	57
4	9,593057	9,963811	9,629255	10,370744	56
5	9,593363	9,963757	9,629906	10,370394	55
6	9,593659	9,963703	9,629956	10,370044	54
7	9,593955	9,963650	9,630306	10,369694	53
8	9,594251	9,963596	9,630655	10,369344	52
9	9,594547	9,963542	9,631005	10,368995	51
10	9,594842	9,963488	9,631354	10,368645	50
11	9,595137	9,963433	9,631704	10,368926	49
12	9,595432	9,963379	9,631053	10,367947	48
13	9,595727	9,963325	9,632401	10,367598	47
14	9,595021	9,963271	9,632750	10,367250	46
15	9,596315	9,963217	9,633098	10,366901	45
16	9,596610	9,963102	9,633447	10,366553	44
17	9,596903	9,963108	9,633795	10,366205	43
18	9,597196	9,962654	9,634043	10,365857	42
19	9,597490	9,962999	9,634490	10,365510	41
20	9,597783	9,962945	9,634838	10,365162	40
21	9,598075	9,962892	9,635185	10,364815	39
22	9,598368	9,96[illegible]836	9,635530	10,364468	38
23	9,598660	9,962781	9,635879	10,364121	37
24	9,598952	9,962726	9,636226	10,363774	36
25	9,599244	9,962672	9,636572	10,363428	35
26	9,599536	9,962617	9,636918	10,363081	34
27	9,599827	9,962562	9,637205	10,362735	33
28	9,600118	9,962507	9,637611	10,362389	32
29	9,600409	9,962453	9,637956	10,362044	31
30	9,600700	9,962398	9,638302	10,361698	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 66.

Degree 23.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.600700	9.962398	9.638302	10.361698	30
31	9.600990	9.962345	9.638647	10.361353	29
32	9.601280	9.962288	9.638992	10.361007	28
33	9.601570	9.962233	9.639337	10.350662	27
34	9.601860	9.962178	9.639685	10.360318	26
35	9.602149	9.962122	9.640927	10.369923	25
36	9.602439	9.962067	9.640371	10.359629	24
37	9.602728	9.962012	9.640716	10.359284	23
38	9.603017	9.961957	9.641060	10.358940	22
39	9.603305	9.961902	9.641404	10.358596	21
40	9.603594	9.961816	9.641747	10.358258	20
41	9.603882	9.961791	9.642091	10.357909	19
42	9.604170	9.961735	9.642434	10.357566	18
43	9.604457	9.961680	9.642777	10.357223	17
44	9.604745	9.961624	9.643120	10.356980	16
45	9.605032	9.961569	9.643463	10.356537	15
46	9.605319	9.961513	9.643806	10.356194	14
47	9.605606	9.961458	9.644148	10.355582	13
48	9.605892	9.961402	9.644490	10.355510	12
49	9.606179	9.961346	9.644832	10.355 68	11
50	9.606465	9.961290	9.645174	10.354826	10
51	9.606750	9.961235	9.645516	10.354484	9
52	9.607039	9.961179	9.645857	10.354142	8
53	9.607322	9.961123	9.646199	10.353801	7
54	9.607607	9.961067	9.646540	10.353460	6
55	9.607892	9.961011	9.646881	10.353119	5
56	9.608176	9.960955	9.647222	10.352778	4
57	9.608461	9.960899	9.647562	10.352438	3
58	9.608745	9.960842	9.647903	10.352097	2
59	9.609029	9.960786	9.648243	10.351752	1
60	9.609313	9.960730	9.648583	10.351417	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 66.

Degree 24.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9,609313	9,960730	9,648583	10,351417	60
1	9,609597	9,960674	9,648923	10,351077	59
2	9.609880	9,960617	9,649263	10,350737	58
3	9,610163	9,960561	9,649602	10,350308	57
4	9,610445	9,960505	9,649942	10,350058	56
5	9,610729	9,960448	9,650281	10,349719	55
6	9,611012	9,960392	9,650620	10,349380	54
7	9,611294	9,960335	9,650959	10,349041	53
8	9,611575	9,960279	9,651297	10,348703	2
9	9,611858	9,960222	9,651636	10,348364	51
10	9,612140	9.960165	9,651974	10,348026	50
11	9,612421	9,960109	9,652312	10,347688	49
12	9,612702	9,960052	9,652550	10,347350	48
13	9,612983	9,959995	9,652988	10,347012	47
14	9,613264	9,959938	9,653326	10,346674	46
15	9,613545	9,959881	9,653663	10,346337	45
16	9 614825	9,959824	9,654000	10,345999	44
17	9,614105	9,959768	9,654337	10,345662	43
18	9,614385	9,959710	9,654674	10,345325	42
19	9,614665	9,959653	9,655011	10,344989	41
20	9,614944	9,959595	9,655348	10,344652	40
21	9,615223	9,959539	9,655684	10,344316	39
22	9,615502	9,959482	9,656020	10,343980	38
23	9,615781	9,959425	9,656355	10,343643	37
24	9,616050	9,959367	9,656692	10,343308	36
25	9,616338	9,959110	9,657028	10,342972	35
26	9,616616	9.959253	9,657363	10,342636	34
27	9,616894	9.959195	9,657699	10,342301	33
28	9,617172	9,959138	9,658034	10,341966	32
29	9,617450	9,959080	9,658369	10,341631	31
30	9,617727	9,959023	9,658704	10,341296	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 65.

Degree 24.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9,617727	9,959023	9,658704	10,341296	30
31	9,618004	9,958965	9,659039	10,340961	29
32	9,618281	9,958908	9,659373	10,340627	28
33	9,618558	9,958850	9,659708	10,340292	27
34	9,618834	9,958792	9,660042	10,339958	26
35	9,619110	9,958734	9,660276	10,339624	25
36	9,619386	9,958677	9,660710	10,339290	24
37	9,619662	9,958619	9,661043	10,338957	23
38	9,619938	9,958561	9,661377	10,338623	22
39	9,620213	9,958503	9,661710	10,338290	21
40	9,620488	9,958445	9,662043	10,337956	20
41	9,620763	9,958387	9,662376	10,337624	19
42	9,621038	9,958329	9,662709	10,337291	18
43	9,621313	9,958271	9,663042	10,336958	17
44	9,621587	9,958212	9,663374	10,336625	16
45	9,621861	9,958154	9,663707	10,336293	15
46	9,622135	9,958096	9,664039	10,335961	14
47	9,622409	9,958038	9,664371	10,335629	13
48	9,622682	9,957979	9,664763	10,335297	12
49	9,622956	9,957921	9,665035	10,334965	11
50	9,623229	9,957862	9,665366	10,334634	10
51	9,623502	6,957804	9,665697	10,334302	9
52	9,623776	9,957745	9,666019	10,333971	8
53	9,624047	9,957687	9,666360	10,333640	7
54	9,624319	9,957628	9,666691	10,333309	6
55	9,624591	9,957570	9,667021	10,332979	5
56	9,624863	9,957511	9,667352	10,332648	4
57	9,625134	9,957452	9,667682	10,332318	3
58	9,625406	9,957393	9,668012	10,331987	2
59	9,625677	9,957334	9,668343	10,331657	1
60	9,625948	9,957276	9,668672	10,331327	0
	Co-sine	Sine	Co-Tang	Tangent	M

Degree 65.

Degree 25.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.625948	9.957276	9,668[illegible]72	10,3[illegible]1327	60
1	9.62[illegible]219	9,957217	9.[illegible]69002	10.330998	59
2	9,626490	9.[illegible]5[illegible]158	9,669332	[illegible]0,330663	58
3	9,6206[illegible]9	9,957099	9 669661	10,330339	57
4	96[illegible]7[illegible]30	9.95704[illegible]	9,669990	10,330009	56
5	9.627[illegible]00	9.95[illegible]9[illegible]1	9,670320	[illegible]0,329680	55
6	9.62757[illegible]	6,956922	9,[illegible]70649	10.329351	54
7	9.6[illegible]840	9,956862	9,670917	10,329022	53
8	9.628109	9,95[illegible]803	9.671[illegible]05	10.328694	52
9	9.628378	9,956744	9.671634	10,328365	51
10	9,628647	9,956684	9,671963	10,328035	50
11	9.628916	9.95[illegible]625	9,672291	10.327609	49
12	9.629184	9.9565[illegible]5	9,672619	10.327351	48
13	9.6294[illegible]3	9.9[illegible]6506	9,[illegible]72947	10.327053	47
1[illegible]	9.629721	9.956446	9.673274	10.326725	46
15	9.629[illegible]89	9.956387	9.673603	10.326[illegible]	45
16	9.6[illegible]0257	9.956327	9.673[illegible]29	10.326070	44
17	9.630524	9.956267	9.674258	10.325743	43
18	9.630792	9.956208	6.674584	10.325416	42
19	9.631059	9.956148	9.674910	10.325089	41
20	9.631326	9.956088	9 675237	10.324763	40
21	9.631592	9.9560[illegible]9	9 675564	10.324436	39
22	9.631859	9.955969	9.675890	10.32[illegible]11[illegible]	38
23	9.632125	9.955909	9.676216	10 323783	37
24	9.632392	9.955849	9.676543	10.323457	36
25	9.632957	9.955789	9.676869	10.323131	35
26	9.632923	9.955739	9.677194	10 322805	34
27	9.633189	9.955669	9.677520	10.322480	33
28	9.633454	9.955609	9.677845	10.322154	32
29	9.633719	9.955[illegible]8	9.678171	10.[illegible]21829	31
30	9 633984	9.955[illegible]88	9.678496	10 3[illegible]1504	30
	Co-sine	Sine	Co.Tang.	Tangent	M

Degree 64

Degree 25.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.633984	9.955488	9.678496	10.321504	30
31	9.634249	9.955428	9.678821	10.321179	29
32	9.634514	9.955867	9.679146	10.320854	28
33	9.634778	9.955307	9.679471	10.320529	27
34	9.635042	9.955246	9.679795	10.320205	26
35	9.635306	9.955286	9.680120	10.319880	25
36	9.635570	9.955125	9.680444	10.319556	24
37	9.635833	9.955065	9.680768	10.319232	23
38	9.636097	9.955004	9.681092	10.318908	22
39	9.636360	9.954944	9.681416	10.318584	21
40	9.636623	9.954883	9.681740	10.318266	20
41	9.636886	9.954823	9.682063	10.317937	19
42	9.637148	9.954762	9.682386	10.317613	18
43	9.637411	9.954701	9.682710	10.317290	17
44	9.637673	9.954640	9.683033	10.316967	16
45	9.637935	9.954579	9.683356	10.316644	15
46	9.638197	9.954518	9.683678	10.316321	14
47	9.638458	9.954457	9.684001	10.315999	13
48	9.638720	9.954396	9.684321	10.315676	12
49	9.638981	9.954335	9.684646	10.315334	11
50	9.639242	9.954274	9.684968	10.315032	10
51	9.639503	9.954213	9.685290	10.314710	9
52	9.639764	9.954152	9.685612	10.314388	8
53	9.640024	9.954090	9.685934	10.314066	7
54	9.640284	9.954029	9.686255	10.313745	6
55	9.640544	9.953968	9.686577	10.313423	5
56	9.640804	9.953906	9.686898	10.313102	4
57	9.641064	9.953845	9.687219	10.312781	3
58	9.641323	9.953783	9.687540	10.312460	2
59	9.641583	9.953722	9.687861	10.312138	1
60	9.641842	9.953660	9.688182	10.311818	0
M	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 64.

Degree 26.

M	Sine	Co-sine	Tangent	Co Tang.	
0	9,641842	9,953660	9,688182	10,311818	60
1	9,642101	9,953593	9,688502	10,311493	59
2	9,642360	9,953537	9,688823	10,311177	58
3	9,642618	9,953475	9,689143	10,310857	57
4	9,642876	9,953413	9,689463	10,310537	56
5	9,643135	9,953351	9,689783	10,310217	55
6	9,643393	9,953290	9,690103	10,309897	54
7	9,643650	9,953228	9,690423	10,309577	53
8	9,643,908	9,953166	9,6[illegible]0742	10,309258	52
9	9,644165	9,953104	9,691062	10,308938	51
10	9,644423	9,953042	9,69138	10,308619	50
11	9,644680	9,952980	9,691700	10,308300	49
12	9,644936	9,952917	9,692019	10,307981	48
13	9,645193	9,952855	9,692338	10,307662	47
14	9,645449	9,952793	9,692656	10,307343	46
15	9,645706	9,952731	9,692975	10,307025	45
16	9,645962	9,952668	9,693293	10,306706	44
17	9,646218	9,952606	9,693612	10,306388	43
18	9,646473	9,952544	9,693930	10,306070	42
19	9,646729	9,952481	9,694248	10,305752	41
20	9,646984	9,952419	9,694566	10,305434	40
21	9,647239	9,952356	9,694883	10,305117	39
22	9,647494	9,952294	9,695201	10,304799	38
23	9,647749	9,952231	9,695518	10,304482	37
24	9,64800	9,952168	9,695835	10,304164	36
25	9,648258	9,952105	9,696153	10,303847	35
26	9,648512	9,952043	9,696470	10,303530	34
27	9,648765	9,951980	9,696786	10,303213	33
28	9,648020	9,95[illegible]17	9,697103	10,203297	32
29	9,649[illegible]74	9,951854	9,697420	10,302580	31
30	9,649527	9,95179	9,697738	10,302264	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 36.

Degree 26.

M	Sine	Co-fine.	Tangent	Co-Tang.	
30	9.649527	9.951791	9.697738	10.302264	30
31	9.649781	9.951728	9.698052	10.301947	29
32	9.650034	9.951665	9.698369	10.301631	28
33	9.650287	9.951602	9.698685	10.301315	27
34	9.650519	9.951539	9.699001	10.300999	26
35	9.650798	9.951476	9.699316	10.300684	25
36	9.651044	9.951412	9.699632	10.300368	24
37	9.651796	9.951349	9.699947	10.300052	23
38	9.651648	9.951286	9.700263	10.299737	22
39	9.651800	9.951222	9.700578	10.299422	21
40	9.652052	9.951159	9.700893	10.299107	20
41	9.652303	9.951095	9.701208	10 208792	19
42	9.652555	9.951032	9.701522	10.298477	18
43	9.652806	9.950968	9.701837	10.298163	17
44	9.653057	9.950905	9.702152	10.297848	16
45	9.653307	9.950841	9.702466	10.297534	15
46	9.653558	9.950777	9.702780	10.297219	14
47	9.653808	9.950714	9.703095	10.296905	13
48	9.654059	9.950650	9.703409	10.296591	12
49	9.654309	9.950536	9.703722	10.296277	11
50	9.654558	9.950522	9.704036	10.295964	10
51	9.654808	9.950453	9.704350	10.295650	9
52	9.655057	9.950304	9.704663	10.295337	8
53	9.655307	9.950330	9.704976	10.295023	7
54	9.655556	9.950266	9.705290	10.294710	6
55	9.655805	9.950202	9.705603	10.294397	5
56	9.656053	9.950138	9.705915	10.294084	4
57	9.656302	9.950074	9.706228	10.293771	3
58	9.656550	9.950009	9.706541	10.293459	2
59	9.656799	9.949945	9.706853	10.293146	1
60	9.656447	9.949881	9.707166	10.292834	0
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 63.

Degree 27.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.657047	9.949880	9.707166	10.292834	60
1	9.657295	9.949816	9.707478	10.292523	59
2	9.657542	9.949752	9.707790	10.292210	58
3	9.657790	9.949687	9.708102	10.291897	57
4	9.658037	9.949623	9.708414	10.291586	56
5	9.658284	9.949598	9.708726	10.291274	55
6	9.658531	9.949494	9.709037	10.290962	54
7	9.658777	9.949429	9.709349	10.290651	53
8	9.659024	9.949364	9.709660	10.290340	52
9	9.659271	9.949300	9.709971	10.290029	51
10	9.659517	9.949238	9.710282	10.289718	50
11	9.659763	9.949174	9.710593	10.289407	49
12	9.660009	9.949105	9.710904	10.289096	48
13	9.660255	9.949040	9.711214	10.288785	47
14	9.660500	9.948976	9.711525	10.288475	46
15	9.660746	9.948910	9.711836	10.288164	45
16	9.660991	9.948845	9.712146	10.287854	44
17	9.661236	9.948760	9.712456	10.287544	43
18	9.661481	9.948715	9.712766	10.287234	42
19	9.661726	9.948650	9.713076	10.286924	41
20	9.661970	9.948584	9.713285	10.286614	40
21	9.662214	9.948519	9.713695	10.286305	39
22	9.662459	9.948453	9.714005	10.285995	38
23	9.662702	9.948388	9.714314	10.285686	37
24	9.662947	9.948323	9.714624	10.285376	36
25	9.663190	9.948257	9.714933	10.285067	35
26	9.663433	9.948191	9.715241	10.284758	34
27	9.663677	9.948126	9.715550	10.284449	33
28	9.663920	9.948060	9.715859	10.284140	32
29	9.664164	9.947995	9.716168	10.283832	31
30	9.664406	9.947929	9.716477	10.283523	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 62.

Degree 27.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.664406	9.947929	9.716477	10.283523	30
31	9.664648	9.947863	9.716785	10.283215	29
32	9.664891	9.947797	9.717093	10.282907	28
33	9.665133	9.947731	9.717401	10.282598	27
34	9.665375	9.947665	9.717709	10.282290	26
35	9.665617	9.947599	9.718017	10.281983	25
36	9.665858	9. 47533	9.718325	10.281675	24
37	9.666100	9.947467	9.718633	10.281367	23
38	9.666341	9.947401	9.718940	10.281060	22
39	9.666583	9.947335	9.719248	10.280752	21
40	9.666824	9.947269	9.719555	10.280445	20
41	9.667065	9.947203	9.719862	10.280138	19
42	9.667305	9.947136	9.720169	10.279831	18
43	9.667546	9.947070	9.720476	10.289524	17
44	9.667786	9.947004	9.720783	10.279217	16
45	9.668026	9.946937	9.721089	10.278911	15
46	9.668266	9.946871	9.721395	10.278604	14
47	9.668506	9.946804	9.721702	10.278298	13
48	9.668746	9.946738	9.722008	10.277991	12
49	9.668986	9.946671	9.722315	10.277685	11
50	9 669225	9.946604	9.722621	10.277379	10
51	9.669464	9.946537	9.722927	10.277073	9
52	9.669703	9.946471	9.723232	10.276768	8
53	9.669942	9.946404	9.723538	10.276462	7
54	9.670181	9.946337	9.723843	10.276156	6
55	9.670419	9.946270	9.724149	10.275851	5
56	9.670657	9.946203	9.724454	10.275546	4
57	9.670896	9.946136	9.724759	10.275240	3
58	9.671134	9.946069	9.725065	10.274935	2
59	9.671372	9.946002	9.725369	10.274630	1
60	9.671609	9.946935	9.725674	10.274326	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 26.

Degree 28.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.671609	9.945935	9.725674	10.274326	60
1	9.671847	9.945868	9.725979	10.274021	59
2	9.672084	9.945800	9.726284	10.273816	58
3	9.672321	9. 45733	9.726588	10.273412	57
4	9.672558	9.945666	9.726892	10.273107	56
5	9.672795	9.945598	9.727197	10.272803	55
6	9.073032	9.945531	9.727501	10.272499	54
7	9.673268	9.945463	9.727805	10.272195	53
8	9.673505	9.945396	9.728109	10.271891	52
9	9.673741	9.945328	9.728412	10.271587	51
10	9 673977	9.945261	9.728716	10.271284	50
11	9.674213	9.945193	9.729020	10.270980	49
12	9.674448	9.945125	9.729323	10.270677	48
13	9.674684	9.945058	9.729626	10.270374	47
14	9.674919	9.944990	9.729929	10.270070	46
15	9.675154	9.944922	9.730222	10.279767	45
16	9.075389	9.944854	9.730535	10.269464	44
17	9.675623	9.944786	9.730838	10.269162	43
18	9.675859	9.944718	9.731141	10.268859	42
19	9.676094	2.944650	9.731443	10.268556	41
20	9.676328	9.944582	9.731746	10.268354	40
21	9.075502	9.944514	9.732048	10.267952	39
22	9.676796	9.944446	9.732351	10.267649	38
23	9.677030	9.944377	9.732653	10.267347	37
24	9.677264	9.944309	9.732955	10.267045	36
25	9.677497	9.944241	9.733257	10.266743	35
26	9.077731	9.944172	9.733558	10.266441	34
27	9.677964	9.944104	9.733860	10.266140	33
28	9.678197	9.944015	9.734162	10.265838	32
29	9.678430	9.943967	9.734463	10.265537	31
30	9.678663	9.943898	9.734764	10.265236	30
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 61.

Degree 28.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.978663	9.943898	9.734764	10.265236	30
31	9.678895	9.943830	9.735066	10.264934	29
32	9.679128	9.943761	9.735362	10.264633	28
33	9.679360	9.943692	9.735668	10.264332	27
34	9.679592	9.943624	9.735968	10.264031	26
35	9.679824	9.943555	9.736269	10.263731	25
36	9.680056	9.943486	9.736570	10.263430	24
37	9.680288	9.943417	9.736870	10.263130	23
38	9.680519	9.943348	9.737171	10.262829	22
39	9.680750	9.943279	9.737471	10.262529	21
40	9.680982	9.943210	9.737771	10.262229	20
41	9.681213	9.943141	9.738071	10.261929	19
42	9.681443	9.943071	9.738371	10.261629	18
43	9.681674	9.943003	9.738671	10.261329	17
44	9.681904	9.942933	9.738971	10.261029	16
45	9.682135	9.942864	9.739271	10.260729	15
46	9.682365	9.942795	9.739570	10.260430	14
47	9.682595	9.942725	9.739870	10.260130	13
48	9.682825	9.942656	9.740169	10.259831	12
49	9.683055	9.942587	9.740468	10.259532	11
50	9.683284	9.942517	9.740767	10.259233	10
51	9.683514	9.942448	9.741066	10.258934	9
52	9.683743	9.942378	9.741365	10.258635	8
53	9.683972	9.942008	9.741664	10.258336	7
54	9.684201	9.942239	9.741962	10.258038	6
55	9.684430	9.942169	9.732261	10.257739	5
56	9.684058	9.942099	9.742559	10.257441	4
57	9.684887	9.942029	9.742858	10.257142	3
58	9.685115	9.941059	9.743156	10.256844	2
59	9.685343	9.941889	9.743454	10.256546	1
60	9.685571	9.941819	9.743751	10.256248	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 61.

Degree 29.

	Sine	Co-sine	Tangent	Co-Tang.	
0	9.685571	9.941819	9.743752	10.256248	60
1	9.685799	9.941749	9.744050	10.255950	59
2	9.686027	9.941679	9.744348	10.255652	58
3	9.686254	9.941609	9.744645	10.255355	57
4	9.686482	9.941539	9.744943	10.255057	56
5	9.686709	9.941468	9.745240	10.254760	55
6	9.686936	9.941398	9.745538	10.254462	54
7	9.687163	9.941328	9.745835	10.254165	53
8	9.687389	9.941257	9.746132	10.253868	52
9	9.687616	9.941187	9.746429	10.253571	51
10	9.687842	9.941116	9.746726	10.253274	50
11	9.688069	9.941046	9.747023	10.252977	49
12	9.688295	9.940975	9.747319	10.252680	48
13	9.688523	9.940905	9.747616	10.252384	47
14	9.688747	9.940834	9.747912	10.252087	46
15	9.688972	9.940763	9.748209	10.251791	45
16	9.689198	9.940693	9.748505	10.251495	44
17	9.689421	9.940622	9.748801	10.251199	43
18	9.689648	9.940551	9.749097	10.250902	42
19	9. 89873	9.940480	9.749393	10.250607	41
20	9.690098	9.940409	9.749689	10.250311	40
21	9.690323	9.940338	9.749985	10.250015	39
22	9.690548	9.940267	9.750281	10.249719	38
23	9.690772	9.940196	9.750576	10.249424	37
24	9.690996	9.940125	9.750872	10.249128	36
25	9.691220	9.940053	9.751167	10.248833	35
26	9.691444	9.939982	9.751462	10.248538	34
27	9.691668	9.939911	9.751757	10.248243	33
28	9.691892	9.939840	9.752052	10.247948	32
29	9.692115	9.939768	9.752347	10.247653	31
30	9.692339	9.939697	9.752642	10.247358	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 60.

Degree 29.

M	Sine	Co-fine	Tangent	Co-Tang.	
30	9.692339	9.939697	9.752642	10.247358	3
31	9.692562	9.939625	9.752937	10.247063	2
32	9.692785	9.939554	9.753231	10.246769	2
33	9.693008	9.939482	9.753526	10.246474	2
34	9.693231	9.939410	9.753820	10.246180	2
35	9.693453	9.939339	9.754115	10.245885	2
36	9.693676	9.939267	9.754409	10.245591	2
37	9.693898	9.939195	9.754703	10.245297	2
38	9.694120	9.939125	9.754997	10.245003	2
39	9.694342	9.939051	9.755291	10.244709	21
40	9.694564	9.938980	9.755584	10.244415	2
41	9.694786	9.938908	9.755878	10.244122	1
42	9.695007	9.938835	9.756172	10.243828	1
43	9.695229	9.938763	9.756465	10.243535	1
44	9.695450	9.938691	9.756759	10.243241	1
45	9.695671	9.938619	9.757052	10.242948	1
46	9.695892	9.938547	9.757345	10.242655	1
47	9.696113	9.938475	9.757638	10.242362	1
48	9.696334	9.938402	9.755931	10.242069	1
49	9.696554	9.938330	9.758224	10.241776	11
50	9.696774	9.938257	9.758517	10.241483	1
51	9.696995	9.938185	9.758810	10.241190	
52	9.697215	9.938112	9.759102	10.240898	
53	9.697435	9.938040	9.759395	10.240605	
54	9.697654	9.937967	9.759687	10.240313	
55	9.697874	9.937895	9.759979	10.240021	
56	9.698093	9.937822	9.760271	10.239728	
57	9.698313	9.937740	9.760564	10.239436	
58	9.698532	9.937676	9.760856	10.239144	
59	9.698751	9.937593	9.761147	10.238862	
60	9.698970	9.937531	9.761439	10.238561	
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 60.

Degree 30.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.699970	9.937531	9.761439	10.238561	60
1	9.699189	9.937458	9.761731	10.238269	59
2	9.699407	9.937385	9.762023	10.237977	58
3	9.699626	9.937312	9.762314	10.237686	57
4	9.699844	9.937238	9.762606	10.237394	56
5	9.700062	9.937165	9.762897	10.237103	55
6	9.700280	9.937092	9.763188	10.236812	54
7	9.700498	9.937019	9.763479	10.236521	53
8	9.700716	9.936945	9.763770	10.236230	52
9	9.700933	9.936872	9.764061	10.235939	51
10	9.701151	9.936799	9.764352	10.235648	50
11	9.701568	9.936725	9.764643	10.235357	49
12	9.701585	9.936652	9.764933	10.235067	48
13	9.701802	9.936578	9.765224	10.234776	47
14	9.702019	9.936505	9.765514	10.234486	46
15	9.702236	9.936431	9.765805	10.234195	45
16	9.702452	9.936357	9.766095	10.233905	44
17	9.702669	9.936284	9.766385	10.233615	43
18	9.703885	9.936210	9.766675	10.233325	42
19	9.703101	9.936136	9.766965	10.233035	41
20	9.703317	9.936062	9.767255	10.232745	40
21	9.703533	9.935980	9.767545	10.232455	39
22	9.703748	9.935914	9.767834	10.232166	38
23	9.703964	9.935840	9.768124	10.231876	37
24	9.704179	9.935766	9.768413	10.231587	36
25	9.704395	9.935692	9.768703	10.231297	35
26	9.704610	9.935618	9.768992	10.231008	34
27	9.704825	9.935543	9.769281	10.230719	33
28	9.705040	9.935469	9.769570	10.230430	32
29	9.705254	9.935395	9.769859	10.230141	31
30	9.705469	9.935320	9.760148	10.229852	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 59.

Degree 30.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.705469	9.935320	9.770148	10.229852	30
31	9.705683	9.935246	9.770437	10.229563	29
32	9.705897	9.935171	9.770726	10.229274	28
33	9.706112	9.935097	9.771015	10.228985	27
34	9.706326	9.935022	9.771303	10.228697	26
35	9.706539	9.934948	9.771592	10.228408	25
36	9.706753	9.934873	9.771880	10.228120	24
37	9.706967	9.934798	9.772168	10.227832	23
38	9.707180	9.934723	9.772456	10.227543	22
39	9.707393	9.934649	9.772745	10.227255	21
40	9.707606	9.934574	9.773033	10.226967	20
41	9.707819	9.934499	9.773321	10.226679	19
42	9.708032	9.934424	9.773008	10.226391	18
43	9.708245	9.934349	9.773896	10.226104	17
44	9.708457	9.934274	9.774184	10.225816	16
45	9.708670	9.934199	9.774471	10.225529	15
46	9.708882	9.934123	9.774759	10.225241	14
47	9.709094	9.934048	9.775046	10.224954	13
48	9.709306	9.933973	9.775333	10.224666	12
49	9.709518	9.933897	9.775621	10.224379	11
50	9.709730	9.933322	9.775908	10.224092	10
51	9.709941	9.933747	9.776195	10.223805	9
52	9.710153	9.933671	9.776482	10.223518	8
53	9.710364	9.933596	9.776768	10.223232	7
54	9.710575	9.933520	9.777005	10.222945	5
55	9.710786	9.933444	9.777342	10.222658	5
56	9.710997	9.933369	9.777628	10.222372	4
57	9.711208	9.933293	9.777915	10.222085	3
58	9.711418	9.933217	9.778201	10.221799	2
59	9.711629	9.933141	9.778487	10.221513	1
60	9.711839	9.923066	9.778774	10.221226	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 59.

Degree 31.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.711839	9.933066	9.778774	10.221226	60
1	9.712049	9.932990	9.779060	10.220940	59
2	9.712259	9.932914	9.779346	10.220654	58
3	9.712469	9.932838	9.779632	10.220368	57
4	9.712679	9.932761	9.779918	10 220082	56
5	9.712889	9.932685	9.780203	10.219796	55
6	9.713098	9.932609	9.780489	10.219511	54
7	9.713308	9.932533	9.780775	10.219225	53
8	9.713517	9.932457	9.781660	10.218940	52
9	9.713726	9.932380	9.781346	10.218654	51
10	9.713935	9.932304	9.781631	10.218369	50
11	9.714144	9.932447	9 781916	10.218084	49
12	9.714352	9.932151	9.782202	10.217799	48
13	9.714561	9.932074	9.782486	10.217514	47
14	9.714769	9.931990	9.782771	10.217229	46
15	9.714977	9.931921	9.783056	10.216944	45
16	9.715186	9.931845	9 783341	10.216659	44
17	9.715394	9.931768	9.783626	10.216374	43
18	9.715601	9.931691	9.783910	10.216090	42
19	9.715809	9.931914	9.784195	10.215805	41
20	9.716017	9.931537	9.784479	10.215520	40
21	9.716224	9.931460	9.784764	10.215236	39
22	9.716431	9.931383	9.785048	10.214952	38
23	9.716639	9.931306	9.785332	10.214668	37
24	9.716846	9.931229	9.785616	10.214384	36
25	9.717053	9.931152	9.785900	10.214099	35
26	9.717259	9.931079	9 786184	10.213816	34
27	9.717456	9.930998	9.786468	10.213532	33
28	9.717672	9.930920	9.786752	10.213248	32
29	9.717869	9.930843	9.787036	10.212964	31
30	9.718085	9.930766	9.787319	10.212681	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 58.

Degree 31.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.716 05	9.930766	9.787319	10.212681	30
31	9.718291	9.930688	9.787603	10.212397	29
32	9.718497	9.930611	9.787886	10.212114	28
33	9.718703	9.930533	9.788170	10.211830	27
34	9.718909	9.930456	9.788453	10.211547	26
35	9.719114	9.930378	9.788736	10.211264	25
36	9.719320	9.930300	9.789019	10.210981	24
37	9.719525	9.930223	9.789302	10.210698	23
38	9.719730	9.930145	9.789585	10.210415	22
39	9.719935	9.930067	9.789868	10.210132	21
40	9.720140	9.929989	9.770151	10.209849	20
41	9.720345	9.929911	9.790433	10.209566	19
42	9.720549	9.929833	9.790716	10.209284	18
43	9.720754	9.929755	9.790999	10.209001	17
44	9.720958	9.929677	9.790281	10.208719	16
45	9.721162	9.929599	9.791563	10.208436	15
46	9.721366	9.929521	9.791840	10.208154	14
47	9.721570	9.929442	9.792128	10.207872	13
48	9.721774	9.929364	9.792410	10.207590	12
49	9.721978	9.929283	9.792692	10.207308	11
50	9.722181	9.929207	9.792974	10.207024	10
51	9.722385	9.929129	9.793256	10.206744	9
52	9.722588	9.929050	9.793538	10.205462	8
53	9.722791	9.928972	9.793819	10.206180	7
54	9.722994	9.928893	9.794101	10.205899	6
55	9.723197	9.928814	9.794388	10.205627	5
56	9.723400	9.928736	9.794664	10.205236	4
57	9.723603	9.928657	9.794945	10.205054	3
58	9.723805	9.928578	9.795227	10.204773	2
59	9.724007	9.928499	9.795508	10.204492	1
60	9.724219	9.928420	9.795789	10.204211	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 58.

Degree 32.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.724210	9.928420	9.795789	10.204211	60
1	9.724412	9.928341	9.796070	10.203930	59
2	9.724614	9.928262	9.796351	10.203649	58
3	9.724816	9.928183	9.796632	10.203368	57
4	9.725017	9.928104	9.796913	10.203087	56
5	9.725219	9.928025	9.797194	10.202896	55
6	9.725620	9.927946	9.797474	10.202522	54
7	9.725622	9.927867	9.797755	10.202245	53
8	9.725823	9.927787	9.798036	10.201964	52
9	9.726024	9.927708	9.798316	10.201684	51
10	9.726225	9.927628	9.798596	10.201404	50
11	9.726426	9.927549	9.798877	10.201123	49
12	9.726626	9.927469	9.799156	10.200843	48
13	9.726827	9.927390	9.799437	10.200563	47
14	9.727027	9.927310	9.799717	10.200283	46
15	9.727228	9.927231	9.799997	10.200003	45
16	9.727428	9.927151	9.800277	10.199723	44
17	9.727628	9.927071	9.800557	10.199443	43
18	9.727828	9.926991	9.800836	10.199163	42
19	9.728027	9.926911	9.801116	10.198884	41
20	9.728227	9.926831	9.801396	10.198604	40
21	9.728427	9.926751	9.801675	10.198325	39
22	9.728626	9.926671	9.801955	10.198045	38
23	9.728825	9.926591	9.802234	10.197766	37
24	9.729024	9.926511	9.802513	10.197487	36
25	9.729223	9.926431	9.802792	10.197207	35
26	9.729422	9.926351	9.803072	10.196928	34
27	9.729621	9.926270	9.803351	10.196649	33
28	9.729820	9.926190	9.803630	10.196370	32
29	9.730018	9.926110	9.803908	10.196091	31
30	9.730216	9.926029	9.804187	10.195813	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 57.

Degree 32.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.730216	9.926079	9.804187	10.195813	30
31	9.730415	9.925949	9.804466	10.195534	29
32	9.730613	9.925868	9.804745	10.195255	28
33	9.730811	9.925787	9.805023	10.194977	27
34	9.731009	9.925707	9.805302	10.194698	26
35	9.731206	9.925626	9.805580	10.194420	25
36	9.731404	9.925545	9.805859	10.194141	24
37	9.731601	9.925464	9.806137	10.193863	23
38	9.731799	9.925384	9.806415	10.193585	22
39	9.731996	9.925303	9.806693	10.193309	21
40	9.732193	9.925222	9.806971	10.192828	20
41	9.732390	9.925141	9.807249	10.192751	19
42	9.732587	9.925060	9.807527	10.192433	18
43	9.732784	9.924978	9.807805	10.192195	17
44	9.732980	9.924897	9.808083	10.191917	16
45	9.733177	9.924816	9.808361	10.191639	15
46	9.733373	9.924735	9.808638	10.191362	14
47	9.733569	9.924653	9.808916	10.191084	13
48	9.733765	9.924572	9.809193	10.190807	12
49	9.733961	9.924491	9.809471	10.190529	11
50	9.734157	9.924409	9.809748	10.190252	10
51	9.734353	9.924328	9.810025	10.189975	9
52	9.734548	9.924246	9.810302	10.189697	8
53	9.734744	9.924164	9.810580	10.189420	7
54	9.734939	9.924083	9.810857	10.189143	6
55	9.735134	9.924001	9.811134	10.188866	5
56	9.735330	9.923919	9.811410	10.188589	4
57	9.735525	9.923837	9.811687	10.188313	3
58	9.735719	9.923755	9.811964	10.188036	2
59	9.735914	9.923673	9.812241	10.187759	1
60	9.736109	9.923591	9.812517	10.187483	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 57.

Degree 33.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.736109	9.923591	9.812517	10.187483	60
1	9.736309	9.923509	9.812794	10.187206	59
2	9.737497	9.923427	9.813070	10.186930	58
3	9.736692	9.923340	9.813347	10.186653	57
4	9.736886	9.923023	9.813623	10.186377	56
5	9.737080	9.923180	9.813899	10.186101	55
6	9.737274	9.923098	9.814175	10.185824	54
7	9.737467	9.923016	9.814452	10.185548	53
8	9.737661	9.922930	9.814728	10.185272	52
9	9.737854	9.922851	9.815004	10.184996	51
10	9.738048	9.922768	9.815279	10.184720	50
11	9.738241	9.922680	9.815555	10.184445	49
12	9.738434	9.922605	9.815831	10.184169	48
13	9.738627	9.922520	9.816107	10.183893	47
14	9.738820	9.922438	9.816382	10.183617	46
15	9.739013	9.922355	9.816658	10.183342	45
16	9.739205	9.922272	9.816933	10.183066	44
17	9.739398	9.922189	9.817209	10.182791	43
18	9.739590	9.922106	9.817484	10.182516	42
19	9.739783	9.922023	9.817759	10.182040	41
20	9.739975	9.921940	9.818035	10.181965	40
21	9.740197	9.921857	9.818310	10.181690	39
22	9.740359	9.921770	9.818585	10.181415	38
23	9.740550	9.921690	9.818860	10.181140	37
24	9[illegible]0742	9.921607	9.819135	10.180855	36
25	9.740934	9.921524	9.819410	10.180590	35
26	9.741125	9.921441	9.819684	10.180315	34
27	9.741316	9.921357	9.819959	10.180041	33
28	9.741507	9.921274	9.820234	10.179766	32
29	9.741698	9.921190	9.820568	10.179492	31
30	9.741889	9.921100	9.820783	10.179217	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 56.

Degree 33.

M	Sine	Co-fine	Tangent	Co-Tang.	
30	9.741889	9.922107	9.820783	10.179217	30
31	9.742086	9.921023	9.821057	10.178943	29
33	9.742271	9.920939	9.821332	10.178668	28
33	9.742461	9.920855	9.821606	10.178394	27
34	9.742652	9.920772	9.821880	10.178120	26
35	9.742842	9.920688	9.822154	10.177846	25
36	9.743032	9.920604	9.822429	10.177571	24
37	9.743223	9.920520	9.822703	10.177297	23
38	9.743412	9.920436	9.822977	10.177023	22
39	9.743602	9.920352	9.823250	10.176739	21
40	9.743792	9.920268	9.823524	10.176476	20
41	9.743982	9.920184	9.823798	10.176202	19
42	9.744171	9.920093	9.824072	10.175928	18
43	9.744361	9.920015	9.824345	10.175655	17
44	9.744550	9.919931	9.824619	10.175381	16
45	9.744739	9.919846	9.824892	10.175108	15
46	9.744928	9.919762	9.825166	10.174834	14
47	9.745117	9.919677	9.825439	10.174560	13
48	9.745306	9.919593	9.825713	10.174287	12
49	9.745494	9.919508	9.825986	10.174014	11
50	9.745683	9.919424	9.826259	10.173741	10
51	9.745871	9.919339	9.826532	10.173468	9
52	9.746059	9.919254	9.826805	10.173195	8
53	9.746248	9.919169	9.827078	10.172922	7
54	9.746436	9.919084	9.827351	10.1726[illegible]	6
55	9.746624	9.918999	9.827624	10.172[illegible]	5
56	9.746811	9.918915	9.827897	10.172103	4
57	9.746999	9.918830	9.828170	10.171830	3
58	9.747187	9.918744	9.828442	10.171558	2
59	9.747374	9.918656	9.828715	10.171285	1
60	9.747562	9.918574	9.828987	10.171012	0
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 56.

Degree 33.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.747562	9.918574	9.828987	10.171012	60
1	9.747749	9.918489	9.829260	10.170740	59
2	9.747936	9.918404	9.829532	10.170468	58
3	9.748123	9.918318	9.829805	10.170195	57
4	9.748310	9.918233	9.830077	10.169923	56
5	9.748497	9.918147	9.830349	10.169651	55
6	9.748683	9.918062	9.830621	10.169379	54
7	9.748870	9.917976	9.830893	10.169106	53
8	9.749056	9.917891	9.831165	10.168834	52
9	9.749242	9.917805	9.831437	10.168503	51
10	9.749429	9.917719	9.831705	10.168291	50
11	9.749615	9.917634	9.831981	10.168019	49
12	9.749801	9.917548	9.832253	10.167747	48
13	9.749986	9.917462	9.832525	10.167475	47
14	9.750172	9.917376	9.832796	10.167204	46
15	9.750358	9.917290	9.833068	10.166932	45
16	9.750543	9.917204	9.833339	10.166660	44
17	9.750729	9.917118	9.833611	10.166389	43
18	9.750914	9.917032	9.833882	10.166118	42
19	9.751099	9.916945	9.834154	10.165846	41
20	9.751284	9.916859	9.834425	10.165575	40
21	9.751469	9.916773	9.834696	10.165304	39
22	9.751954	9.916686	9.834967	10.165033	38
23	9.751838	9.916600	9.835238	10.164762	37
24	9.752023	9.916514	9.835509	10.164491	36
25	9.752207	9.916427	9.835780	10.164220	35
26	9.752392	9.916240	9.836051	10.163949	34
27	9.752576	9.916254	9.836322	10.163678	33
28	9.752760	9.916167	9.836593	10.163407	32
29	9.752944	9.916080	9.836864	10.163136	31
30	9.753128	9.915994	9.837124	10.162866	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 55.

Degree 34.

M	Sine	Co-sine	Tangent	Co Tang.	
30	9.752128	9.915994	9.827134	10.126866	30
31	9.753312	9.915907	9.837405	10.162595	29
32	9.753495	9.915820	9.837675	10.162325	28
33	9.753679	9.915733	9.837946	10.162054	27
34	9.753862	9.915646	9.838216	10.161784	26
35	9.754046	9.915559	9.838487	10.161513	25
36	9.754229	9.915472	9.838757	10.161243	24
37	9.754412	9.915385	9.839027	10.160973	23
38	9.754595	9.915297	9.839297	10.160702	22
39	9.754778	9.915210	9.839568	10.160432	21
40	9.754960	9.915123	9.839838	10.160162	20
41	9.755143	9.915035	9.840108	10.159892	19
42	9.755325	9.914948	9.840378	10.159622	18
43	9.755508	9.914860	9.840647	10.159352	17
44	9.755690	9.914773	9.840917	10.159083	16
45	9.755872	9.914685	9.841187	10.158813	15
46	9.756054	9.914597	9.841457	10.158543	14
47	9.756236	9.914510	9.841726	10.158273	13
48	9.756418	9.914422	9.841996	10.158004	12
49	9.756600	9.914334	9.842266	10.157734	11
50	9.756781	9.914246	9.842535	10.157465	10
51	9.756963	9.914158	9.842804	10.157195	9
52	9.757144	9.914070	9.843074	10.156926	8
53	9.757306	9.913982	9.843343	10.156657	7
54	9.757507	9.913894	9.843602	10.156387	6
55	9.757688	9.913806	0.843882	10.156118	5
56	9.757869	9.913718	9.844151	10.155849	4
57	9.758049	9.913630	9.844420	10.155580	3
58	9.758230	9.913542	9.844689	10.155311	2
59	9.758411	9.913453	9.844958	10.155042	1
60	9.758591	9.913304	9.845227	10.154774	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 55.

Degree 35.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.758591	9.913364	9.845227	10.154774	60
1	9.758772	9.913270	9.845496	10.154504	59
2	9.758952	9.913187	9.845764	10.154235	58
3	9.759132	9.913091	9.846533	10.153967	57
4	9.759312	9.913010	9.846302	10.153698	56
5	9.759492	9.912972	9.846570	10.153429	55
6	9.759672	9.912833	9.846839	10.153161	54
7	9.759851	9.912744	9.847107	10.152892	53
8	9.760031	9.912655	9.847376	10.152624	52
9	9.760210	9.912566	9.847644	10.152356	51
10	9.760390	9.912477	9.847913	10.152087	50
11	9.760569	9.912388	9.848181	10.151819	49
12	9.760748	9.912299	9.848449	10.151551	48
13	9.760927	9.912210	9.848717	10.151283	47
14	9.761106	9.912121	9.848985	10.151015	46
15	9.761285	9.912031	9.849254	10.150746	45
16	9.761464	9.911942	9.849522	10.150478	44
17	9.761642	9.911853	9.849789	10.150215	43
18	9.761821	9.911763	9.850057	10.149943	42
19	9.761999	9.911674	9,850325	10.149675	41
20	9.762177	9.911584	9.850593	10.149407	40
21	9.762456	9.911495	[illegible].850861	10.149139	39
22	9.762534	9.911405	9.851128	10.148872	38
23	9.762712	9.911315	9.851396	10.148604	37
24	9.762889	9.911226	9.851664	10.148336	30
25	9.763067	9.911136	9.851931	10.148069	35
26	9.[illegible]63245	9.911046	9.852199	10.147801	34
27	9.763422	9.910956	9.852466	10.147534	33
28	9.763599	9.910866	9.852701	10.147267	32
29	9.763777	9.910776	9.853001	10.146999	31
30	9.763954	9.910686	9.853268	10.146732	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 54.

Degree 35.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.763954	9.910686	9.853268	10.146732	30
31	9.764131	9.910596	6.853532	10.146465	29
32	9.764306	9.910506	9.853802	10.146198	28
33	9.764485	9.910415	9.854069	10.145930	27
34	9.764662	9.910325	9.854336	10.145664	26
35	9.764838	9.910235	9.854603	10.145397	25
36	9.765015	9.910144	9.854870	10.145130	24
37	9.765191	9.910054	9.855137	10.144863	23
38	9.765367	9.909963	9.855404	10.144596	22
39	9.765544	9.909873	9.855671	10.144329	21
40	9.765720	9.909782	9.855937	10.144063	20
41	9.765896	9.909691	9.856204	10.143796	19
42	9.766071	9.909601	9.856471	10.143529	18
43	9.766247	9.909510	9.856737	10.143263	17
44	9.766423	9.909419	9.857004	10.142996	16
45	9.766598	9.909328	9.857270	10.142730	15
46	9.766774	9.909237	9.857537	10.142463	14
47	9.766949	9.909146	9.857803	10.142197	13
48	9.767124	9.909055	9.858069	10.141931	12
49	9.767299	9.908964	9.858336	10.141664	11
50	6.767474	9.908873	9.858602	10.141398	10
51	9.767649	9.908781	9.858868	10.141132	9
52	9.767824	9.908690	9.859134	10.140166	8
53	9.767997	9.908599	9.859400	10.140600	7
54	9.768173	9.908509	9.859666	10.140334	6
55	9.768348	9.908416	9.859932	10.140068	5
56	9.768522	9.908324	9.860198	10.139802	4
57	9.768696	9.908233	9.860464	10.139536	3
58	9.768871	9.908141	9.860730	10.139270	2
59	9.769045	9.908049	9.860995	10.139005	1
60	9.769219	9.907958	9.861261	10.138739	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 54.

Degree 36.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.769219	9.907958	9.861261	10.138739	60
1	9.769392	9.907866	9.861527	10.138473	59
2	9.769566	9.907774	9.861792	10.138208	58
3	9.769740	9.907682	9.862053	10.137942	57
4	9.769913	9.907590	9.862323	10.137677	56
5	9.770087	9.907498	9.862589	10.137411	55
6	9.770260	9.907406	9.862854	10.137146	54
7	9.770433	9.907314	9.863119	10.136880	53
8	9.770606	9.907221	9.863385	10.136615	52
9	9.770779	9.907129	9.863650	10.136350	51
10	9.770952	9.907037	9.863915	10.136085	50
11	9.771125	9.906945	9.864180	10.135820	49
12	9.771298	9.906852	9.864445	10.135554	48
13	9.771270	9.906760	9.864710	10.135289	47
14	9.771643	9.906667	9.864975	10.135024	46
15	9.771815	9.906574	9.865240	10.134759	45
16	9.771987	9.906482	9.865505	10.134495	44
17	9.772159	9.906389	9.865770	10.134230	43
18	9.772331	9.906296	9.866035	10.133965	42
19	9.772503	9.906203	9.866300	10.133700	41
20	9.772675	9.906111	9.866564	10.133436	40
21	9.772847	9.906018	9.866829	10.133171	39
22	9.773018	9.905925	9.867094	10.132906	38
23	9.773190	9.905832	9.867358	10.132642	37
24	9.773361	9.905738	9.867623	10.132377	36
25	9.773533	9.905645	9.867887	10.132113	35
26	9.773704	9.905552	9.868152	10.131848	34
27	9.773875	9.905459	9.868416	10.131584	33
28	9.774046	9.905365	9.868680	10.131320	32
29	9.774217	9.905272	9.868945	10.131055	31
30	9.774388	9.905179	9.869209	10.130791	30
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 53.

Degree 36.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.774388	9.905179	9.869209	10.130791	30
31	9.774558	9.905085	9.864773	10.130527	29
32	9.774729	9.904992	9.867337	10.130263	28
33	9.774899	9.904898	9.870001	10.129999	27
34	9.775070	9.904804	9.870265	10.129735	26
35	9.775240	9 904711	9.870529	10.129471	25
36	9.775410	9.904617	9.870793	10.129207	24
37	9.775580	9.904523	9.871057	10.128943	23
38	9.775750	9.904429	9 871321	10 128679	22
39	9.775920	9 904335	9.871585	10.128415	21
40	9.776090	9.904241	9.871849	10.128151	20
41	9.776259	9.904147	9.872112	10.127888	19
42	9.776429	9.904053	9.872376	10.127624	18
43	9.776598	9.903959	9.872640	10.127360	17
44	9.776768	9.903864	9.872903	10.127097	16
45	9.776937	9.903770	9.873167	10.126833	15
46	9.777106	9.903676	9.873450	10.126570	14
47	9.777275	9.903581	9.873694	10.126306	13
48	9.777444	2.903486	9.873957	10.126043	12
49	9.777613	9.903392	9.874220	10.125780	11
50	9.777781	9.903298	9.874480	10.125516	10
51	9.777950	9.903203	9.874747	10.125253	9
52	9.778119	9.903108	9.875010	10.124990	8
53	9.778287	9.903013	9.875273	10.124727	7
54	9.778455	9.902919	9.875536	10.124464	6
55	9.778623	9.902824	9.875799	10.124201	5
56	9.778792	9.902729	9 876063	10.123937	4
57	9.778960	9.902634	9.876326	10.123674	3
58	9.779129	9.902539	9.876589	10.123411	2
59	9.779295	9 902444	9.876851	10.123149	1
60	9.779463	9.902349	9.877114	10.122885	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 53.

Degree 37.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.779463	9.902349	9.877114	10.122885	60
1	9.779631	9.902254	9.877377	10.122623	59
2	9.779798	9.902158	9.877640	10.122360	58
3	9.779965	9.902063	9.877903	10.122097	57
4	9.780133	9.901967	9.878165	10.121834	56
5	9.780300	9.901872	9.878428	10.121572	55
6	9.780467	9.901776	9.878691	10.121309	54
7	9.780634	9.901681	9.878953	10.121047	53
8	9.780801	9.901585	9.879216	10.120784	52
9	9.780968	9.901488	9.879478	10.120522	51
10	9.781134	9.901391	9.879741	10.120259	50
11	9.781301	9.901298	9.880003	10.119997	49
12	9.781467	9.901202	9.880265	10.119734	48
13	9.781694	9.901106	9.880528	10.119472	47
14	9.781800	9.901010	9.880790	10.119210	46
15	9.781966	9.900914	9.881052	10.118948	45
16	9.782132	9.900828	9.881314	10.118686	44
17	9.782298	9.900722	9.881576	10.118424	43
18	9.782464	9.900626	9.881839	10.118161	42
19	9.782690	9.900529	9.882101	10.117899	41
20	9.782796	9.900433	3.882363	10.117637	40
21	9.782961	9.900337	9.882625	10.117375	39
22	9.783127	9.900240	9.882886	10.117114	38
23	9.783292	9.900144	9.883148	10.116852	37
24	9.783457	9.900047	9.883410	10.116590	36
25	9.783623	9.899951	9.883672	10.116328	35
26	9.783788	9.899854	9.883934	10.116066	34
27	9.783953	9.899757	9.884195	10.115805	33
28	9.784118	9.899660	9.884457	10.115543	32
29	9.784282	9.899563	9.884719	10.115281	31
30	9.784447	9.899467	9.884980	10.115020	30
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 52.

Degree 37.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.784447	9.899467	9.884980	10.115020	30
31	9.784616	9.899370	9.885242	10.114758	29
32	9.784776	9.899273	9.885503	10.114497	28
33	9.784941	9.899175	9.885765	10.114235	27
34	9.785105	9.899078	9.886026	10.113974	26
35	9.785269	9.898981	9.886288	10.113712	25
36	9.785433	9.898884	9.886549	10.113451	24
37	9.785591	9.898787	9.886810	10.113190	23
38	9.785761	9.898689	9.887072	10.112928	22
39	9.785925	9.898592	9.887333	10.112667	21
40	9.786088	9.898494	9.887594	10.112406	20
41	9.786252	9.898397	9.887855	10.112145	19
42	9.786416	9.898299	9.888116	10.111884	18
43	9.786579	9.898201	9.888377	10.111623	17
44	9.786742	9.898104	9.888638	10.111362	16
45	9.786909	9.898006	9.888899	10.111101	15
46	9.787069	9.897908	9.889160	10.110840	14
47	9.787232	9.897810	9.889421	10.110579	13
48	9.787395	9.897712	9.889682	10.110318	12
49	9.787557	9.897614	9.889943	10.110057	11
50	9.787720	9.897516	9.890204	10.109796	10
51	9.787883	9.897418	9.890465	10.109535	9
52	9.788045	9.897320	9.890725	10.109275	8
53	9.788208	9.897222	9.890986	10.109014	7
54	9.788370	9.897123	9.891247	10.108753	6
55	9.788532	9.897025	9.891507	10.108493	5
56	9.788694	9.896926	9.891768	10.108232	4
57	9.788856	9.896828	9.892028	10.107972	3
58	9.789018	9.896729	9.892289	10.107711	2
59	9.789180	9.896631	9.892549	10.107451	1
60	9.789342	9.896532	9.892810	10.107190	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 52.

Degree 38.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.789342	9.896532	9.892810	10.107190	60
1	9.789504	9.896433	9.893070	10.106930	59
2	9.789665	9.896335	9.893330	10.106669	58
3	9.789827	9.896236	9.893591	10.106409	57
4	9.789988	9.896137	9.893851	10.106149	56
5	9.790149	9.896038	9.894111	10.105889	55
6	9.790310	9.895939	9.894371	10.105628	54
7	9.790471	9.895840	9.894632	10.105368	53
8	9.790632	9.895741	9.894892	10.105108	52
9	9.790793	9.895641	9.895152	10.104848	51
10	9.793954	9.895542	9.895412	10.104588	50
11	9.791115	9.895443	9.895672	10.104328	49
12	9.791275	9.895343	9.895932	10.104068	48
13	9.791436	9.895244	9.896192	10.103808	47
14	9.791596	9.895144	9.896452	10.103548	46
15	9.791756	9.895045	9.896712	10.103288	45
16	9.791917	9.894945	9.896971	10.103028	44
17	9.792077	9.894846	9.897231	10.102769	43
18	9.792237	9.894746	9.897491	10.102509	42
19	9.792397	9.894646	9.897751	10.102249	41
20	9.792557	9.894546	9.898010	10.101990	40
21	9.792716	9.894446	9.898270	10.101730	39
22	9.792876	9.894346	9.898530	10.101470	38
23	9.793035	9.894246	9.898789	10.101211	37
24	9.793195	9.894146	9.899049	10.100951	36
25	9.793354	9.894046	9.899308	10.100692	35
26	9.793513	9.893946	9.899568	10.100432	34
27	9.793673	9.893845	9.899827	10.100173	33
28	9.793832	9.893745	9.900086	10.099913	32
29	9.793991	9.893645	9.900346	10.099654	31
30	9.794149	9.893544	9.900605	10.099395	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 51.

Degree 38.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.794149	9.893544	9.900605	10 099395	30
31	9 794308	9.893444	9.900864	10.099135	29
32	9.794467	9.893343	9.901124	10.098876	28
33	9.794626	9.893243	9.901383	10.098617	27
34	9.794784	9.893142	9.901642	10.098358	26
35	9.794942	9.893041	9.901901	10.098099	25
36	9.795101	9.892940	9.902160	10.097839	24
37	9.795259	9.892839	9.902419	10.097580	23
38	9.795417	9.892738	9.902678	10 097321	22
39	9.795575	9.892637	9.902937	10.097062	21
40	9.795733	9.892536	9.903196	10.096803	20
41	9.795891	9.892435	9.903455	10.006544	19
42	9.796049	9.892334	9.903714	10.096285	18
43	9.796206	9.892233	9.903973	10.096027	17
44	9.796364	9.892132	9.904232	10 095768	16
45	9.796521	9.892030	9.904491	10.095509	15
46	9.796678	9.891929	9.904750	10.095250	14
47	9.796836	9.891827	9.905008	10.094991	13
48	9.796993	9.891726	9.905267	10.094733	12
49	9.797150	9.891624	9.905526	10.094474	11
50	9.797307	9.891522	9.905784	10.094215	10
51	9.797464	9.891421	9.906043	10.093957	9
52	9.797621	9.891310	9.906302	10.093698	8
53	9.797777	9.891217	9.906560	10.093440	7
54	9.797934	9.891115	9.906819	10.093181	6
55	9.798091	9.891013	9.907077	10.092923	5
56	9.798247	9.890911	9.907336	10.092664	4
57	9.798403	9.890809	9.907594	10.092406	3
58	9.798560	9.890707	9.907852	10.092147	2
59	9.798716	9.890605	9.908111	10.091889	1
60	9.798872	9.890503	9.908369	10.091631	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 51.

Degree 39.

M	Sine	*Co-sine*	Tangent	*Co-Tang.*	
0	9.798872	9.890503	9.908369	10.091631	60
1	9.799028	9.890400	9.908627	10.091373	59
2	9.799184	9.890298	9.908886	10.091114	58
3	9.799339	9.890195	9.909144	10.090856	57
4	9.799495	9.890093	9.909402	10.090598	56
5	9.799651	9.889990	9.909660	10.090340	55
6	9.799806	9.889888	9.909918	10.090081	54
7	9.799961	9.889785	9.910176	10.089823	53
8	9.800117	9.889682	9.910435	10.089565	52
9	9.800272	9.889579	9.910693	10.089307	51
10	9.800427	9.889476	9.910951	10.089049	50
11	9.800582	9.889374	9.911209	10.088791	49
12	9.800737	9.889271	9.911467	10.088533	48
13	9.800892	9.889167	9.911724	10.088275	47
14	9.801047	9.889064	9.911982	10.088017	46
15	9.801201	9.888961	9.912240	10.087760	45
16	9.801356	9.888858	9.912498	10.087502	44
17	9.801510	9.888755	9.912756	10.087244	43
18	9.801665	9.888651	9.913014	10.086986	42
19	9.801819	9.888548	9.913271	10.086729	41
20	9.801973	9.888444	9.913529	10.086471	40
21	9.802127	9.888341	9.913787	10.086213	39
22	9.802282	9.888237	9.914044	10.08[illegible]956	38
23	9.802435	9.888133	9.914302	10.085698	37
24	9.802589	9.888030	9.914560	10.085440	36
25	9.802743	9.887926	9.914817	10.085183	35
26	9.802897	9.887822	9.915075	10.084925	34
27	9.803050	9.887718	9.915332	10.084568	33
28	9.803204	9.887614	9.915590	10.084410	32
29	9.803457	9.887510	9.915847	10.084153	31
30	9.803510	9.887406	9.916104	10.083895	30
	Co-sine	Sine	*Co-Tang.*	Tangent.	M

Degree 50.

Degree 39.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.803510	9.887406	9.916104	10.083895	30
31	9.803664	9.887302	9.916362	10.083638	29
32	9.803817	9.887198	9.916619	10.083381	28
33	9.803970	9.887093	9.916876	10.083123	27
34	9.804123	9.886989	9.917134	10.082866	26
35	9.804276	9.886884	9.917391	10.082609	25
36	9.804428	9.886780	9.917648	10.082352	24
37	9.804581	9.886675	9.917905	10.082094	23
38	9.804734	9.886571	9.918162	10.081837	22
39	9.804886	9.886466	9.918420	10.081580	21
40	9.805038	9.886361	9.918677	10.081323	20
41	9.805191	9.886257	9.918934	10.080066	19
42	9.805343	9.886152	9.919191	10.080809	18
43	9.805495	9.886047	9.919448	10.080552	17
44	9.805647	9.885942	9.919705	10.080295	16
45	9.805799	9.885837	9.919962	10.080038	15
46	9.805951	9.885732	9.920219	10.079781	14
47	9.806103	9.885627	9.920476	10.079524	13
48	9.806254	9.885521	9.920733	10.079267	12
49	9.806406	9.885416	9.920990	10.079010	11
50	9.806557	9.885311	9.921247	10.078753	10
51	9.806709	9.885205	9.921503	10.078496	9
52	9.806860	9.885100	9.921760	10.078240	8
53	9.807011	9.884994	9.922017	10.077983	7
54	9.807162	9.884889	9.922274	10.077726	6
55	9.807313	9.884783	9.922530	10.077469	5
56	9.807464	9.884677	9.922787	10.077213	4
57	9.807615	9.884572	9.923044	10.076956	3
58	9.807766	9.884466	9.923300	10.076699	2
59	9.807917	9.884360	9.923557	10.076443	1
60	9.808067	9.884254	9.923813	10.076186	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 50.

Degree 40.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.808067	9.884254	9.923813	10.076186	60
1	9.808218	9.884148	9.924070	10.075930	59
2	9.808368	9.884042	9.924327	10.075673	58
3	9.808519	9.883936	9.924583	10.075417	57
4	9.808669	9.883829	9.924839	10.075160	56
5	9.808819	9.883723	9.925096	10.074904	55
6	9.808909	9.883617	9.925352	10.074647	54
7	9.809119	9.883510	9.925609	10.074391	53
8	9.809269	9.883404	9.925865	10.074135	52
9	9.809419	9.883297	9.926121	10.073878	51
10	9.809569	9.883191	9.926378	10.073622	50
11	9.809718	9.883084	9.926634	10.073366	49
12	9.809868	9.882977	9.926890	10.073110	48
13	9.810017	9.882871	9.927147	10.072853	47
14	9.810166	9.882764	9.927403	10.072597	46
15	9.810316	9.882657	9.927659	10.072341	45
16	9.810465	9.882550	9.927915	10.072085	44
17	9.810614	9.882443	9.928171	10.071829	43
18	9.810763	9.882336	9.928427	10.071573	42
19	9.810912	9.882228	9.928683	10.071316	41
20	9.811061	9.882121	9.928940	10.071060	40
21	9.811210	9.882014	9.929196	10.070804	39
22	9.811358	9.881907	9.929452	10.070548	38
23	9.811506	9.881799	9.929708	10.070292	37
24	9.811655	9.881692	9.929964	10.070036	36
25	9.811804	9.881584	9.930219	10.069781	35
26	9.811952	9.881477	9.930475	10.069525	34
27	9.812100	9.881369	9.930731	10.069269	33
28	9.812248	9.881261	9.930987	10.069013	32
29	9.812396	9.881153	9.931243	10.068757	31
30	9.812544	9.881045	9.931499	10.068501	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 49.

Degree 40.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.812544	9.881045	9.931499	10.068501	30
31	9.812692	9.880939	9.931755	10.068245	29
32	9.812840	9.880829	9.932010	10.067989	28
33	9.812938	9.880722	9.932266	10.067734	27
34	9.813135	9.880613	9.932522	10.067478	26
35	9.813283	9.880505	9.932778	10.067222	25
36	9.813430	9.880397	9.933033	10.066967	24
37	9.813578	9.880289	9.933289	10.066711	23
38	9.813725	9.880180	9.933545	10.066455	22
39	9.813872	9.880072	9.933800	10.066200	21
40	9.814019	9.879963	9.934056	10.065944	20
41	9.814166	9.879855	9.934311	10.065683	19
42	9.814313	9.879746	9.934567	10.065433	18
43	9.814460	9.879637	9.934822	10.065177	17
44	9.814607	9.879529	9.935078	10.064922	16
45	9.814753	9.879420	9.935333	10.064666	15
46	9.814900	9.879310	9.935589	10.064411	14
47	9.815046	9.879202	9.935844	10.064156	13
48	9.815193	9.879093	9.936100	10.063900	12
49	9.815339	9.878984	9.936355	10.063645	11
50	9.815485	9.878875	9.936610	10.063389	10
51	9.815631	9.878766	9.936866	10.063134	9
52	9.815777	9.878656	9.937121	10.062879	8
53	9.815923	9.878547	9.937376	10.062673	7
54	9.816069	9.878438	9.937632	10.062368	6
55	9.816215	9.878228	9.937887	10.062113	5
56	9.816361	9.878219	9.938142	10.061858	4
57	9.816506	9.878129	9.938397	10.061602	3
58	9.816652	9.877990	9.938653	10.061347	2
59	9.816797	9.877890	9.938908	10.060092	1
60	9.816943	9.877780	9.939163	10.060837	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 49.

Degree 41.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.816943	9.877780	9.939163	10.060837	60
1	9.817088	9.877670	9.939418	10.060582	59
2	9.817233	9.877560	9.939673	10.060327	58
3	9.817378	9.877450	9.939928	10.060072	57
4	9.817523	9.877340	9.940183	10.059816	56
5	9.817668	9.877230	9.940438	10.059562	55
6	9.817813	9.877120	9.940693	10.059307	54
7	9.817958	9.877009	9.940948	10.059052	53
8	9.818103	9.876899	9.941203	10.058797	52
9	9.818247	9.876789	9.941458	10.058542	51
0	9.818492	9.876678	9.941713	10.058287	50
1	9.818536	9.876568	9.941968	10.058032	49
2	9.818681	9.876457	9.942223	10.057777	48
3	9.818825	9.876347	9.942478	10.057522	47
4	9.818969	9.876235	9.942733	10.057267	46
5	9.819113	9.876125	9.942988	10.057012	45
6	9.819257	9.876014	9.943243	10.056757	44
7	9.819451	9.875904	9.943498	10.056502	43
8	9.819545	9.875793	9.943752	10.056248	42
9	9.819689	9.875682	9.944007	10.055993	41
0	9.819832	9.875571	9.944262	10.055738	40
1	9.819976	9.875459	9.944517	10.055483	39
2	9.820119	9.875348	9.944771	10.055229	38
3	9.820263	9.875237	9.945026	10.054974	37
4	9.820406	9.875125	9.945281	10.054719	36
5	9.820549	9.875004	9.945535	10.054464	35
6	9.820693	9.874903	9.945790	10.054210	34
7	9.820836	9.874791	9.946045	10.053955	33
8	9.820979	9.874679	9.946299	10.053701	32
9	9.821122	9.874568	9.946554	10.053446	31
0	9.821264	9.874450	9.946808	10.053192	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 48.

Degree 41.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.821264	9.874456	9.946808	10.053192	30
31	9.821407	9.874367	6.947063	10.052937	29
32	9.821550	9.874210	9.947317	10.052682	28
33	9.821692	9.874172	9.947572	10.052428	27
34	9.821835	9.874008	9.947826	10.052173	26
35	9.821977	0.873896	9.948081	10.051919	25
36	9.822120	9.873784	9.948335	10.051664	24
37	9.822262	9.873672	2.948590	10.051410	23
38	9.822404	9.873560	9.948844	10.051156	22
39	9.822546	9.873447	9.949099	10.050901	21
40	9.822688	9.873335	9.949353	10.050647	20
41	9.822830	9.573223	9.949607	10.050393	19
42	9.822972	9.873110	9.949862	10.050138	18
43	9.823114	9.872998	9.950116	10.049884	17
44	9.823255	9.872885	9.950370	10.049630	16
45	9.823397	9.872772	9.950625	10.049375	15
46	9.823538	9.872659	9.950879	10.049121	14
47	9.823680	9.872546	9.951233	10.048867	13
48	9.823821	9.872434	9.951388	10.048612	12
49	9.823962	9.872321	9.951642	10.048358	11
50	9.824104	9.872208	9.951896	10.048104	10
51	9.824245	9.872094	9.952150	10.047850	9
52	9.824386	9.871981	9.952404	10.047575	8
53	9.824527	9.871868	9.952659	10.047341	7
54	9.824667	9.871755	9.952915	10.047387	6
55	9.824808	9.871641	9.953167	10.046833	5
56	9.824949	9.871538	9.953421	10.046579	4
57	9.825090	9.871414	9.953675	10.046325	3
58	9.825230	9.871301	9.953929	10.046071	2
59	9.825370	9.871187	9.954183	10.045817	1
60	9.825511	9.871070	9.954437	10.045562	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 48.

Degree 42.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.825511	9.871073	9.954437	10.045562	60
1	9.825651	9.870960	9.954691	10.045308	59
2	9.825791	9.870846	9.954945	10.045054	58
3	9.825931	9.870732	9.955199	10.044800	57
4	9.826071	9.870618	9.955453	10.044546	56
5	9.826211	9.870504	9.955707	10.044292	55
6	9.826351	9.870390	9.955961	10.044038	54
7	9.826491	9.870275	9.956215	10.043784	53
8	9.826631	9.870161	9.956469	10.043531	52
9	9.826770	9.870047	9.956723	10.043276	51
10	9.826930	9.869933	9.956977	10.043023	50
11	9.827049	9.869818	9.957231	10.042769	49
12	9.827189	9.869704	9.957485	10.042515	48
13	9.827328	9.869589	9.957739	10.042261	47
14	9.827467	9.869474	9.957993	10.042067	46
15	9.827606	9.869360	9.958246	10.041753	45
16	9.827745	9.869245	9.958500	10.041500	44
17	9.827884	9.869130	9.958754	10.041246	43
18	9.828023	9.869015	9.959008	10.040992	42
19	9.828162	9.868900	9.959262	10.040738	41
20	9.828301	9.868785	9.959515	10.040485	40
21	9.828439	9.868670	9.959769	10.040231	39
22	9.828578	9.868555	9.960023	10.039977	38
23	9.828716	9.868429	9.960277	10.039723	37
24	9.828855	9.868324	9.960530	10.039469	36
25	9.828993	9.868209	9.960784	10.039216	35
26	9.829131	9.868092	9.961038	10.038962	34
27	9.82926[illegible]	9.867978	9.961291	10.038708	33
28	9.829407	9.867862	9.961545	10.038455	32
29	9.829545	9.867747	9.961797	10.038201	31
30	9.829683	9.867631	9.962052	10.037947	30
	Co-fine	Sine	Co-Tang.	Tangent	M

Degree 47.

Degree 42.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.829683	9.867631	9 962052	10.037947	30
31	9.829821	9.867515	9.962306	10.037694	29
32	9.829959	9.867399	9.962560	10.037140	28
33	9.830096	9.867283	9.962813	10.037187	27
34	9.830234	9.867167	9.963067	10.036933	26
35	9.830372	9.867051	9.963320	10.036680	25
36	9.830509	9.866935	9.963574	10.036426	24
37	9.830646	9.866819	9.963827	10.036173	23
38	9,830784	9.866703	9.964081	10 035910	22
39	9.830921	9.866586	9.964335	10.035665	21
40	9.831058	9.866470	9.964588	10.035412	20
41	9.831195	9.866353	9.964842	10.035158	19
42	9.831332	9.866237	9.965095	10.034905	18
43	9.831469	9.866120	9.965348	10.034652	17
44	9.831606	9.866004	9.965602	10.034398	16
45	9.831742	9.865887	9.965855	10.034144	15
46	9.831879	9.865770	9.966109	10.033891	14
47	9.832015	9.865653	9.966362	10.033638	13
48	9,832152	9.865536	9.966616	10.033384	12
49	9.832288	9.865419	9.966869	10.033131	11
50	9.832425	9.865302	9.967122	10.032878	10
51	9.832561	9.865185	9.967376	10.032624	9
52	9.832697	9.865068	9.967629	10.032371	8
53	9.832833	9.864950	9.967883	10.032117	7
54	9.832969	9.864833	9.968136	10.031864	6
55	9.833105	9.864716	9.968389	10.031611	5
56	9.833241	9.864598	9.968643	10.031357	4
57	9.833376	9.864480	9.968896	10.031104	3
58	9.833512	9.864363	9.969149	10.030851	2
59	9.833648	9.864240	9.969403	10.030597	1
60	9.833783	9.864127	9.969656	10.030344	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 47.

Degree 43.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	9.833783	9.864127	9.969656	10.030344	60
1	9.833919	9.864010	9.969909	10.030091	59
2	9.834054	9.863892	9.970162	10.029838	58
3	9.834189	9.863774	9.970416	10.029584	57
4	9.834324	9.863656	9.970669	10.029331	56
5	9.834460	9.863537	9.970922	10.029078	55
6	9.834595	9.863419	9.971175	10.028825	54
7	9.834730	9.863301	9.971428	10.028572	53
8	9.834865	9.863183	9.971682	10.028318	52
9	9.834999	9.863064	9.971935	10.028065	51
10	9.835134	9.862946	[illegible]	10.027812	50
11	9.835269	9.862827	9.972441	10.027559	49
12	9.835403	9.862709	9.972694	10.027306	48
13	9.835538	9.862590	9.972948	10.027052	47
14	9.835672	9.862471	9.973201	10.026799	46
15	9.835806	9.862353	9.973454	10.026546	45
16	9.835941	9.862234	9.973707	10.026293	44
17	9.836075	9.862115	9.973960	10.026040	43
18	9.836209	9.861996	9.974213	10.025787	42
19	9.836343	9.861877	9.974466	10.025533	41
20	9.836477	9.861757	9.974719	10.025280	40
21	9.836611	9.861638	9.974973	10.025027	39
22	9.836745	9.861519	9.975226	10.024774	38
23	9.836878	9.861399	9.975479	10.024521	37
24	9.837012	9.861280	9.975732	10.024268	36
25	9.837146	9.861161	9.975985	10.024015	35
26	9.837279	9.861041	9.976238	10.023762	34
27	9.837412	9.860921	9.976491	10.023509	33
28	9.837546	9.860802	9.976744	10.023256	32
29	9.837679	9.860682	9.976997	10.023003	31
30	9.837812	9.860562	9.977250	10.022750	30
	Co-fine	Sine	Co-Tang	Tangent	M

Degree 46.

Degree 43.

M	Sine	Co-sine	Tangent	Co-Tang	
30	9.837812	9.860562	9.977250	10.022750	30
31	9.837945	9.860422	9.977503	10.022497	29
32	9.838078	9.860322	9.977756	10.022244	28
33	9.838211	9.860202	9.978009	10.021991	27
34	9.838344	9.860082	9.978262	10.021738	26
35	9.838477	9.859962	9.978515	10.021485	25
36	9.838609	9.859842	9.978768	10.021232	24
37	9.838742	9.859721	9.979021	10.020979	23
38	9.838875	9.859601	9.979274	10.020726	22
39	9.839007	9.859480	9.979527	10.020473	21
40	9.839140	9.859360	9.979780	10.020220	20
41	9.839272	9.859239	9.980033	10.019967	19
42	9.839404	9.859118	9.980235	10.019714	18
43	9.839536	9.858998	9.980538	10.019461	17
44	9.839668	9.858877	9.980791	10.019209	16
45	9.839800	9.858756	9.981044	10.018956	15
46	9.839932	9.858635	9.981297	10.018703	14
47	9.840064	9.858514	9.981550	10.018450	13
48	9.840196	9.858193	9.981803	10.018197	12
49	9.840328	9.858272	9.982056	10.017944	11
50	9.840459	9.858150	9.982309	10.017691	10
51	9.840591	9.858029	9.982562	10.017438	9
52	9.840722	9.857908	9.982814	10.017185	8
53	9.840854	9.857786	9.983067	10.016933	7
54	9.840985	9.857665	9.983320	10.016680	6
55	9.841116	9.857543	9.983573	10.016427	5
56	9.841247	9.857421	9.983820	10.016174	4
57	9.841378	9.857300	9.984079	10.016921	3
58	9.841509	9.857178	9.984331	10.015668	2
59	9.841640	9.857056	9.984584	10.015416	1
60	9.841771	9.856954	9.984837	10.015163	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 46.

Degree 44.

M	Sine	Co-sine	Tangent	Co-Tang.	
0	9.841771	9.856934	9.984837	10.015162	60
1	9.841902	9.856812	9.985090	10.014910	59
2	9.842033	9.856690	9.985343	10.014657	58
3	9.842163	9.856568	9.985596	10.014404	57
4	9.842294	9.856445	9.985848	10.014151	56
5	9.842424	9.856323	9.986101	10.013899	55
6	9.842555	9.856201	9.986354	10.013646	54
7	9.842685	9.856078	9.986607	10.013393	53
8	9.842815	9.855956	9.986859	10.013140	52
9	9.842945	9.855833	9.987112	10.012888	51
10	9.843076	9.855710	9.987365	10.012635	50
11	9.843206	9.855588	9.987618	10.012382	49
12	9.843336	9.855465	9.987871	10.012129	48
13	9.843465	9.855342	9.988123	10.011877	47
14	9.843595	9.855219	9.988376	10.011624	46
15	9.843725	9.855096	9.988629	10.011371	45
16	9.843855	9.854973	9.988882	10.011118	44
17	9.843984	9.854850	9.989134	10.010866	43
18	9.844114	9.854727	9.989387	10.010613	42
19	9.844243	9.854603	9.989640	10.010360	41
20	9.844372	9.854480	3.989893	10.010107	40
21	9.844502	9.854356	9.990145	10.009855	39
22	9.844631	9.854233	9.990398	10.009602	38
23	9.844760	9.854109	9.990651	10.009349	37
24	9.844889	9.853986	9.990903	10.009096	36
25	9.845018	9.853862	9.991156	10.008844	35
26	9.845147	9.853738	9.991409	10.008591	34
27	9.845276	9.853614	9.991662	10.008338	33
28	9.845404	9.853490	9.991914	10.008086	32
29	9.845533	9.853366	9.992167	10.007833	31
30	9.845662	9.853242	9.992420	10.007580	30
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 45.

Degree 44.

	Sine	Co sine	Tangent	Co-Tang.	
30	9,845662	9,853242	9,992420	10,007580	30
31	9,845790	9,853118	9,992671	10,007328	29
32	9,845919	9,852994	9,992925	10,007075	28
33	9,846047	9 852869	9,993178	10,006822	27
34	9,846175	9,852745	9,993430	10,006569	26
35	9,846304	9,852620	9,993683	10,006317	25
36	9,846432	9,852496	9,993936	10,005964	24
37	9,846560	9.852371	9,994189	10,005811	23
38	9,846688	9,852246	9,994442	10,005559	22
39	9,846816	9,852122	9,994694	10,005306	21
40	9,846944	9,851997	9,994947	10,005053	20
41	9,847071	9,851872	9,995199	10,004801	19
42	9 847199	9,851747	9,995452	10,004548	18
43	9.847327	9,851622	9,995705	10,004295	17
44	9,847454	9,851497	9,995957	10,004043	16
45	9,847582	9,851372	9,996210	10,003790	15
46	9 847709	9,851245	9,996463	10.003537	14
47	9,847836	9,851121	9,996715	10,003285	13
48	9,847964	9,850996	9,996968	10,003032	12
49	0,848091	9.850870	9,997220	10,002779	11
50	9.848218	9,850745	9,997473	10,002527	10
51	9,848345	9,850619	9,997726	10,002274	9
52	9,848472	9,850493	9,997979	10,002021	8
53	9,848599	9,850367	9,998231	10,001769	7
54	9,848726	9,850242	9,998484	10,001516	6
55	9 848852	9.850116	9,998737	10,001263	5
56	9,848979	9.849990	9,998989	10,001011	4
57	9,849106	9.849864	9,999242	10,000758	3
58	9,849132	9.849737	9,999495	10,000505	2
59	9,849359	9.849611	9,999747	10,000253	1
60	9,849485	9.849485	9,100000	10,000000	0
	Co-sine	Sine	Co-Tang.	Tangent	M

Degree 45.

Jno. Tapson