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PREFACE.

WHILE treatises on Arithmetic are already so numerous that masters are perplexed in the choice, which to put before their pupils, some apology may be needful for obtruding another work on the same subject upon the public.

There was a time when such books presented the work of almost every question at *full length;* and when, of course, scarcely any thing was left for the exercise of the scholar. Then it was, that masters had the intolerable labour of writing the daily questions for their pupils in their account books, or otherwise supplying the defect by their own imperfect manuscripts.

As education became an object of more general regard, the evil was proportionably felt, and a remedy was sought for; and then, instead of School Books, in which *nothing* was left for the learner, others issued from the Press, in which he had nearly *everything* to perform; and which, with unfledged powers, he was bid to explore, while altogether unequal to the task.

Hence, in the present day, there is scarcely any Tutor's Assistant that has many of the operations given. The work of *one* question, indeed, may be seen standing at the head of the rule; but it is often such a one as is little illustrative, either of the rule itself or of the succeeding questions; scarcely any other ray of light has been shed to illuminate the path of the Tyro, though on calculations widely different from the first example.

Nor has this been all; the writers of these works seem to have often put their invention upon the rack, to introduce, in every rule, questions as useless as they are puzzling and intricate; not only beyond the learners power to work, but even to comprehend, though with the elucidations of a master. From what motive so many writers on the subject have been thus misled, it may be difficult to account, unless it were, to impress the public with an idea of the profundity of their own scientific attainments.

From whatever cause it may have originated, every experienced teacher knows that the generality of scholars are scarcely able to bring out the answer correctly to one question, in any rule, without assistance from some source; and where plagiarism is prevented, their application to him is incessant, and he finds it needful, not only to explain and illustrate, but frequently to work considerable parts of each sum for his pupils.

Hence, their progress is not only very slow, but their comprehension very inadequate to what they are made to perform; and they often finish a rule without a sufficient knowledge of its

principles. This is the present state of Arithmetic in schools, and to the present unaccommodating systems it must be, in a considerable degree, attributed.

Every master who has numerous scholars to instruct, feels its harassing effects; and sees, without hopes of effectual relief, the general incapacity of the pupils; but a removal of the cause, in any degree, is despaired of, or rather, never looked for; it seems never to have entered into a tutor's mind, that by the very simple means here adopted, much of the incomprehensibility of the scholar, and the ineffectual toil of the master may be removed.

To remedy, then, in no inconsiderable degree, these defects, is the purpose of this work; to enable the young arithmetician to understand what he is doing, and (by giving him sufficient examples, at nearly full length to illustrate the rules) to bring all within the compass of his powers.

It must also be considered, that the youths of the present day commence the study of arithmetic earlier than in former times; the child at the age of seven or eight is now put upon this important branch of knowledge, in which every succeeding idea must be altogether new; and at such a time to launch him upon the ocean of unknown difficulties, with scarcely a gleam of light to beam upon him, is to place him in a situation in which even *adult capacities* can, unaided, scarcely explore their way.

This may not be the case with every individual, but if one youth in a thousand, or rather one in a million, should, with superior powers and perseverance, attain his end, though comparatively unassisted, it cannot argue against the use of this system, as applicable to capacities generally,

Masters who have long struggled with the inconveniencies of teaching by the present existing systems, but not so long as to be wedded to their faults, and refuse relief, may be disposed to try the effects of this now offered to their notice, and dedicated to their service; and the author presumes to hope, that, after having not only critically examined, but often taught by, almost every valuable arithmetical work, and connected therewith a wide range of mathematical research, he cannot be incompetent to the task.

Since this science has been so ably and fully developed, and since, within little more than the last half-century, books on Arithmetic have been multiplied, probably beyond that of any thousand years preceding, little remains now to be done, by writers of elementary works, but to select the purest principles, better to arrange and methodize what has been already known, and to bring down to the opening capacity rules which had been previously enveloped in too much perplexity.

From the above remarks the following improvements may be anticipated:—

1st. *A complete body of Rules* drawn up with clearness, and as

free as possible from technical forms of speech, for the learner's more easy comprehension; and also a *Series of Examples*, selected with great care, accommodated to the present state of trade, ample under each rule, and exhibiting every usual variety, for their full illustration.

2nd. The omission of all such quaint and puzzling questions as are too often found in such works, though in that place totally useless, or above the learner's comprehension; and supplying their place with others more immediatly applicable to the purpose of real transactions. All the abstruse sums in each rule are removed as they ever should be, to the Appendix, as more fit for the exercise or amusement of his maturer powers.

3rd. Not only have the clearest illustrations of the rules been carefully attended to, but the fitness of every example has had its due consideration, by an arrangement that exhibits an easy gradation; by a careful association of such as are somewhat similar, and by forming them into a kind of *regular series*. And as each preceding question prepares the pupil for the succeeding one, there will be found in this compendium, no abrupt transitions from what is extremely easy to what is extremely difficult.

4th. As in each rule of Arithmetic, questions are so various that some examples can be no guide to the method of working others, the work of the first of each series is given at full length (or sufficiently so) as an example; and the pupil, by comparing that operation with the rule, will be enabled to work the succeeding ones, generally, by the exercise of his own powers; for when the technical phraseology of the rule is of itself incomprehensible, an appropriate example will illustrate it, and when difficulties occur, they will be of such a nature as a few hints from the tutor will remove.

5th. By these simple, though evident improvements, the tutor will be released from much harassing and ineffectual toil; and the young arithmetician will be able to comprehend the principle of all he does; and as his capacity opens, he will be able to proceed, through the whole course of Arithmetic, with a facility and pleasure hitherto not often experienced.

Some persons, however, may be led, by the above pretentions, to infer that the treatise must needs be *superficial;* but this is by no means the case—each rule has had its usual *full discussion*. It is easy, only because the difficulties have been so far solved, that they are no longer incomprehensible.

There was a time when, from the paucity of books and instructors, it was thought that Arithmetic conld scarcely be thoroughly gained, without absorbing all the faculties of a common mind, and all the time of the boyish age; when it left neither leisure nor capacity for language and other liberal studies. There was a time, too, when the *first* elements of arithmetic were often all that the *classical youth* had inclination for; or rather, when the science of numbers was looked down upon as almost beneath his regard.

But in the present day of mercantile greatness, the world is awake to the importance of a union of these and other branches. Arithmetic is now no longer thrown far into the background, but on the contrary, even in scholastic establishments of eminence, it is ever brought forward as an indispensable associate with classical attainments; and in such seminaries, where the variety of studies leaves less time for each one, a work of this nature, which will so materially accelerate the learner's progress, will prove, it is presumed, an important *desideratum*.

The Author is, after all, aware, that some persons, when they hear of this publication, may expect to see some novel system of magical effect, that will confer knowledge intuitively, without juvenile exertion; but this is no empyrical, treatise that will supersede the necessity of research; but it will enable the learner to think—it will bring his mind into a train for investigation, and encourage him in the exercise of his juvenile powers. He must still labour, but he will labour intelligibly, and not flounder on, as by some systems, in blind confusion, uncertainty, and disgust.

If the Author might be allowed to dictate to the teacher, he would recommend him uniformly to *enjoin* upon his scholars not only the *full investigation* of the *first example* that is worked at the head of *each series*, comparing it carefully with the *previous rule*, but also, in most instances, the production of that sum at full length on his slate, if not its transcription in his account book; the clear knowledge of which will lay open to him the principle of the whole series.

With respect to the *order* in which the Author has placed Vulgar and Decimal Arithmetic, he is happy in its having received the concurrence of several experienced masters.

Had this work been designed principally for adults, fractions would most certainly have taken an earlier station: but children are now uniformly put upon Arithmetic as soon as their faculties can be made to apprehend even its very first elements. Therefore, by first running through the most common rules, they will gain those essential pre-requisites, a *familiarity* with the general modes of calculation, and a *facility* in working; and they will have ample time to do this before their capacities are fully equal to fractional computations.

As a school book, therefore, the Author could not place them earlier; teachers, however, may transfer them to any place that may best suit the age, capacity, and object of the scholar.

CONTENTS.

EXPLANATION

OF THE

CHARACTERS MADE USE OF IN THIS WORK.

Although the characters may be found explained in their proper place throughout the work, yet, for convenience, they are here brought into one view.

+ *Plus*, or *more.*	The sign of Addition; as, 2+4; that is, 2 added to 4, which is equal to 6.
— *Minus*, or *less.*	The sign of Subtraction; as, 6—4; that is, from 6 take 4, or 6 minus 4, which is equal to 2.
× *Multiplied by.*	The sign of Multiplication; as, 3×8; that is 3 is to be multiplied by 8, which is equal to 24.
÷ *Divided by.*	The sign of Division; as, 8÷2; that is, 8 is to be divided by 2, which is equal to 4.
$\frac{8}{2}$ or $\frac{4}{2}$ $\frac{2}{6}$ or $\frac{1}{2}$ $\frac{3}{0}$ &c.	Numbers placed like a fraction, also denote division; the upper number being to be divided by the lower.
: *is to* : : *so is* : *to*	The sign of Proportion; thus, as 2 : 4 : : 6 : 12; that is, as 2 is to 4 so is 6 to 12.
$\surd$ or $\sqrt[2]{}$	Signs of the Square Root.
$\sqrt[3]{}$ and $\sqrt[4]{}$	Signs of the Cube and Biquadrate Root.
8^2, 8^3, 8^4.	Signs of Involution, denoting that 8 is to be squared, cubed, or raised to the 4th power.
= *equal to.*	The sign of Equality; as, 2+3=5; that is, 2 added to 3, are equal to 5.
∴ and ∵	Ergo, or therefore, and because.
i.e.	Id est, that is.
$\overline{8-2} \times 4 = 24$.	That is, 8 minus 2, multiplied by 4, are equal to 24.
$8-\overline{2 \times 4} = 2$.	That is, the sum of 2 and 4 (6) taken from 8, is equal to 2.
$\overline{6 \times 2}+8 = 20$.	Six multiplied by 2 = 12, which add to 8 = 20.
$6 \times \overline{2+8} = 60$.	Two added to 8=10, which multiplied by 6 = 60.
$\frac{\overline{4 \times 5}+7}{3} = 9$.	Four multiplied by 5 are 20, to which add 7 = 27 and 27 divided by 3 are equal to 9.

ARITHMETIC.

ARITHMETIC is the science of numbers; and teaches the art of computing by them.

The fundamental rules are, Notation (or Numeration), Addition, Subtraction, Multiplication, and Division, from which all the rest are derived:

Of NOTATION and NUMERATION.

NOTATION is the *writing* of numbers by *figures;* and NUMERATION is the art of *reading* figures correctly

The value of figures depends upon the place in which they stand: which may be seen by the following table.

&c. Hundreds of Thousands of Mill.	Tens of Thousands of Millions	Thousands of Millions	Hundreds of Millions	Tens of Millions	Millions	Hundreds of Thousands	Tens of Thousands	Thousands	Hundreds	Tens	Units
									9	9,	
									9	8,	
								9,	8	7,	
								9,	7	6,	
								8,	6	5,	
								7,	5	4,	
								6,	4	3,	
								5,	3	2,	
								4,	2	1,	
								3,	1	0,	
						9,	8	7,	6	5,	4,
						8,	7	6,	5	4,	3,
						7,	6	5,	4	3,	2,
						6,	5	4,	3	2,	1,
						5,	4	3,	2	1,	0,
					9,	8	7	6,	5	4	3,
					8,	7	6	5,	4	3	2,
					7,	6	5	4,	3	2	1,
					6,	5	4	3,	2	1	0,
				9,	8	7	6	5,	4	3	2,
				8,	7	6	5	4,	3	2	1,
				7,	6	5	4	3,	2	1	0,
			9,	8	7	6	5	4,	3	2	1,
			8,	7	6	5	4	3,	2	1	0,
			7,	6	5	4	3	2,	1	0	0,
		9,	8	7	6	5	4	3,	2	1	0,
		8,	7	6	5	4	3	2,	1	0	0,
		7,	6	5	4	3	2	1,	0	0	0,
	9,	8	7	6	5	4	3	2,	1	0	0,
	8,	7	6	5	4	3	2	1,	0	0	0,
	7,	6	5	4	3	2	1	0,	0	0	0,
9,	8	7	6	5	4	3	2	1,	0	0	0,
8,	7	6	5	4	3	2	1	0,	0	0	0,
7,	6	5	4	3	2	1	0	0,	0	0	0,

N.B. The *first nine* stands for nine units; the nine in the *second* row stands for nine tens, or *ninety;* nine in the *third* row for *nine hundred*, and nine in the *fourth* row for *nine thousand*, &c.—The same may be observed of the increased value of every other of the above figures.

A nought or cypher has no value of itself, but being placed on the right hand of other figures, it increases their value in a tenfold proportion.

In the above table there are *two whole periods* of *six figures each;* but for the more easily reading of large numbers, it is usual to subdivide them into *half-periods* of *three figures each*. The first period has Units, Tens, Hundreds, Thousands, Ten of Thousands, and Hundreds of Thousands:—the *second* period has Millions; the *third* Billions, the *fourth* Trillions, the *fifth* Quadrillions, as underneath.

Quadrillions			Trillions			Billions			Millions			Thousands			Units		
Hundreds	Tens		Hundreds	Tens		Hundreds	Tens		Hundreds	Tens		Hundreds	Tens		Hundreds	Tens	
9	8	7	6	5	4	3	2	1	9	8	7	6	5	4	3	2	1

The preceding table is thus read.—Nine hundred and eighty-seven thousand, six hundred and fifty four *quadrillions;* three hundred and twenty-one thousand, nine hundred and eighty-seven *trillions;* six hundred and fifty-four thousand, three hundred and twenty-one *billions;* nine hundred and eighty-seven thousand, six hundred and fifty-four *millions;* three hundred and twenty-one thousand, three hundred and twenty-one.

Examples.

Write in WORDS, *the following numbers.*

Ex.	(1)	4	(5)	6,789	(9)	7,532,434
	(2)	54	(6)	56,789	(10)	15,276,928
	(3)	654	(7)	456,789	(11)	927,613,458
	(4)	7,654	(8)	3,456,789	(12)	1,851,242,376

Write in FIGURES, *the following numbers.*

(13) Three hundred and sixty-five.
(14) One thousand eight hundred and twenty-three.
(15) Three hundred and twenty-four thousand, six hundred.
(16) One million, three hundred and twenty-four thousand
(17) Forty-four millions, five hundred and twenty-two thousand, six hundred and ninety-seven.
(18) Nine hundred and eighty-seven millions, six hundred.
(19) One hundred millions, one hundred thousand, and one
(20) One million, eight hundred and fifty-four.
(21) Five millions, one thousand, and twenty.
(22) Eighty-six millions, four hundred and thirty.
(23) One hundred and sixty-two millions, five hundred.
(24) One billion, one million, one thousand, and one.

The ROMAN NOTATION.

The Romans expressed numbers by the following letters, I. V. X. L. C. D. M. which singly stood for, 1, 5, 10, 50, 100, 500, and 1000; which were combined as follows :—

I	1	IX	9	XVII	17	LXX	70	DC	600
II	2	X	10	XVIII	18	LXXX	80	DCC	700
III	3	XI	11	XIX	19	XC	90	DCCC	800
IV or IIII	4	XII	12	XX	20	C	100	DCCCC	900
V	5	XIII	13	XXX	30	CC	200	M	1000
VI	6	XIV	14	XL	40	CCC	300	MDCCCL	
VII	7	XV	15	L	50	CCCC	400	One thousand eight hundred and fifty.	
VIII	8	XVI	16	LX	60	D	500		

From an inspection of the above table it is seen, that *prefixing* a letter of a lower value to one of a higher, *subtracts* its value; thus I prefixed to V is four (IV). IX nine, XL forty, XC ninety, &c., and also *annexing* a letter of lower value to one of a higher, *increases* its value, thus, VI signifies six, and XI eleven, LX sixty, &c. &c.

SIMPLE ADDITION.

SIMPLE ADDITION teaches the method of finding the *sum* of two or more numbers.

RULE 1st. Place the numbers *under each other*, so that units may stand under units, tens under tens, &c.

2nd. Add up the figures in the row of units, set down what remains *above* the *even tens*, or if nothing remains, a *cypher;* and carry as many *ones* to the next row as there were *tens.*

3rd. Add up the other rows, in the same manner, and in the *last* column set down the *whole sum* contained in it.

Proof.

1. Cut off the upper line, add up the rest as before, and set the sum under the lower line.

2. Add this second sum to the upper line, and if it be the same as that of the first addition, the work is right.

ADDITION AND SUBTRACTION TABLE.

1	2	3	4	5	6	7	8	9	10
2	4	5	6	7	8	9	10	11	12
3	5	6	7	8	9	10	11	12	13
4	6	7	8	9	10	11	12	13	14
5	7	8	9	10	11	12	13	14	15
6	8	9	10	11	12	13	14	15	16
7	9	10	11	12	13	14	15	16	17
8	10	11	12	13	14	15	16	17	18
9	11	12	13	14	15	16	17	18	19
10	12	13	14	15	16	17	18	19	20

EXAMPLES.

Ex.	(1)	(2)	(3)	(4)
	2423	4140	2430	5250
	3132	313	121	132
	5344	3241	2562	3366
	4210	1424	340	2644
	2132	312	4213	322
	1325	2430	2653	4566
	18566			
	16143			
	18566			

Ex. (5)

22471
13163
4235
21377
15426
6132
51595
134399

(6)

21347
2408
43216
3465
26459
17534
3372

(7)

62316
7705
31232
28101
5364
43429
2357

(8)

13003
3352
51240
5364
26527
1439
18268

(9)

42137
1342
34035
5260
72043
4605
13721

(10)

20104
3210
14541
5106
15243
432
36715

(11)

74203
4137
52314
43473
2425
13050
7634

(12)

14721
400
43742
4137
52173
20736
51342

(13)

71403
54270
23152
321
37046
54300
1021

(14)

12345
3456
84567
64278
75359
24678
2567

(15)

14210
22171
3413
47030
5135
13421
6342

(16)

10342
734
26213
13473
12305
300
76215

(17)

71426
35751
14935
179
49214
36348
892

(18)

47321
13714
6276
19395
4576
67398
34264

(19)

3219
7946
84297
421
98468
76529
1090

(20)

75968
68579
42786
34968
71214
12976
68798

MISCELLANEOUS QUESTIONS.

(21) If a man was born in the year 1769, when was he 70 years of age? *Ans.* 1839

(22) Add together a million, a thousand, and a hundred. *Ans.* 1001100

(23) Add the following sums 98765+3240+567+310 and 1148. *Ans.* 104030

(24) Suppose a boy born in the year 1852, when will he be of age? *Ans.* 1873

(25) Add the years before Christ (4004) to the year 1857, and tell me the age of the world. *Ans.* 5861 *years*

(26) Add together the chapters in the several books of the New Testament. *Ans.* 260 *chapters*

(27) In the year 1806 I took the lease of a house for 49 years, when did the lease expire? *Ans.* 1855

(28) How many days are there in the last 9 months of the year? *Ans.* 275 *days*

(29) Add the shillings in a florin, a crown, a half-sovereign, a sovereign, a guinea, and a six and thirty together. *Ans.* 94 *shillings*

(30) A skilful boy won one day at marbles, of A. 13, of B. 11, of C. 15, of D. 21, of E. 9, of F. 19, and of G. 12, how many did he win in all? *Ans.* 100 *marbles*

(31) How many days from Lady-day till Michaelmas-day, that is, from March 25 to September 29? *Ans.* 188 *days*

(32) What is the sum of one million and one, one thousand and one, and one hundred and one? *Ans.* 1001103

(33) Add together 35040+32654+32697 and 98765. *Ans.* 199156

(34) If I travel the first day 65 miles, the second 59, the third 67, the fourth 41, the fifth 45, and the sixth 36, how many miles do I travel in the six days? *Ans.* 313 *miles*

(35) How many chapters are there in the first five books of the Old Testament? *Ans.* 187 *chapters*

(36) An American merchant shipped, at Liverpool, goods to the following amount, which he purchased in England: namely, in Worcester to the amount of 570*l.*, in Kidderminster 340*l*, in Birmingham 1600*l.*, in Wolverhampton 590*l.*, in Sheffield 900*l.*, in Leeds 1000*l.*, in Manchester 1500*l.*: I demand the whole amount. *Ans.* 6500*l.*

(37) Suppose London to contain 2,300,000 inhabitants, Paris 1,000,000, Vienna 475,000, Petersburg 520,000, Edinburgh 162,000, Dublin 250,000, what is the population of the whole? *Ans.* 4,717,000

SIMPLE SUBTRACTION.

By Subtraction we find the *difference* between any two numbers.

Rule 1st. Place the less number under the greater, so that units may stand under units, tens under tens, &c.

2nd. Begin at the right hand, that is, at the unit's place, and take each figure in the lower line from the figure above it, and set down the remainder.

3rd. If the figure in the lower line be the greater, add ten to the upper line, and then take the lower figure from the sum; set down the remainder, and carry one to the next lower figure, with which proceed as before.

Proof. Add the remainder to the last line; and if the sum be equal to the first, the work is right.

Examples.

	(1)	(2)	(3)
From	7463274	4673985	7900764
Take	2152143	1371702	4172413
Remains	5311131	3302283	3728351
Proof	7463274	4673985	7900764

(4)	(5)	(6)	(7)
7574967	4768395	3472196	9372628
4261724	1426153	2461072	5130324

(8)	(9)	(10)	(11)
3746947	5728416	7052673	3710470
1729742	1348306	4872167	3402143

(12)	(13)	(14)	(15)
7421643	5301743	3000765	1213007
6917269	2700755	2999387	782714

(16) 7502374 − 1924737 = 5577637

(17) 1426432 − 987654 =

(18) 7421376 − 4371498 =

(19) 4712600 − 841974 =

(20) 7421362 − 760493 =

(21) 7142600 − 847599 =

(22) 1000000 − 999999 =

(23) 7111111 − 6000000 =

(24) 7214000 − 767284 =

(25) 9142174 − 407300 =

(26) 4721610 − 3091371 =

(27) 1245674 − 245675 =

(28) 9104002 − 9030001 = 74001

(29) 4030300 − 1761073 =

(30) 7654321 − 765432 =

(31) 7090900 − 3241090 =

(32) 6321736 − 239216 =

(33) 9006654 − 999999 =

(34) 7140091 − 26730 =

(35) 1173000 − 981911 =

(36) 8410824 − 231486 =

(37) 4065410 − 456789 =

(38) 1840842 − 236494 =

(39) 9876023 − 987134 =

(40) 4012348 − 124865 =

(41) 9054102 − 392047 =

(42) 5024102 − 1456789 =

(43) 6408230 − 2675864 =

(44) 3700046 − 143128 =

(45) 8999994 − 1045605 =

(46) 7210841 − 1486328 =

(47) 8006678 − 4118789 =

MISCELLANEOUS QUESTIONS.

(48) If a child was born in the year 1794, how old was he in 1855? *Ans.* 61 *years old.*

(49) From one hundred millions, take one hundred thousand. *Ans.* 99900000

(50) How much is 9876 less than ten thousand? *Ans* 124

(51) If London contains 2,300,000, and Paris 1,000,000 what is the difference of the population? *Ans.* 1,300,000

(52) If from London to York be 196 miles, and from London to Edinburgh, through York, 399 miles. what is the distance from York to Edinburgh? *Ans.* 203 *miles*

(53) If from London to the Land's End in Cornwall, through Exeter, be 302 miles, and to Exeter be 176, what is the distance from Exeter to the Land's End? *Ans.* 126 *miles*

(54) Sir Isaac Newton was born in the year 1642, and he died in 1727, how old was he? *Ans.* 85 *years*

(55) The North American States were first peopled about the year 1496, how many years had elapsed till their Independence was acknowledged in 1783? *Ans.* 287 *years*

(56) A tradesman began business with 569*l.*, and in three years found himself worth 965*l.*, what had he gained in trade? *Ans.* 396*l.*

(57) How much does 987654 exceed 123456? *Ans.* 864198

(58) A gentleman dying left 11,698*l.* between his son and daughter, the son's portion was 6349*l.*, what was the daughter's? *Ans.* 5349*l.*

(59) How long did Homer live before Virgil, if the era of the former be fixed at 907 years before Christ, and the latter only 70 years before that period? *Ans.* 837 *years*

(60) A merchant had three debtors, A. B. and C. who owed him 1760*l.*, A. and B. owed him 1111*l.*, what was C.'s debt? *Ans.* 649*l.*

(61) Noah's flood is said to have happened about the year of the world 1656, and the birth of Christ in 4004, what is the difference of time? *Ans.* 2348 *years*

(62) What number must I add to 12345 to make it 98765. *Ans.* 86420

(63) How much is X. whose age is 95, older than Z. who is 59 years old? *Ans.* 36 *years*

(64) Subtract the sum of 1236 and 7890 from 9876 added to 6789? *Ans.* 7539

(65) Take 50 millions from 50 billions.

Ans. 49999950000000

SIMPLE MULTIPLICATION.

MULTIPLICATION is a short method of performing Addition, and it teaches us to find what a number will amount to, when repeated a certain number of times. It consists of the following parts:—

1st. The *Multiplicand*, or number to be multiplied;
2nd. The *Multiplier*, or number by which you multiply;
3rd. The *Product*, or number produced by multiplying.

CASE I.—*When the Multiplier does not exceed* 12.

RULE. Begin at the *right hand*, and multiply *every* figure in the multiplicand; consider how many *tens* there are in each product, the remaining *units* set down under the figure multiplied, and carry the *tens* as so many ones to the next product. The last product is to be wholly set down.

THE MULTIPLICATION TABLE.

Twice	3 times	4 times	5 times	6 times	7 times
2 .. 4	2 .. 6	2 .. 8	2 .. 10	2 .. 12	2 .. 14
3 .. 6	3 .. 9	3 .. 12	3 .. 15	3 .. 18	3 .. 21
4 .. 8	4 .. 12	4 .. 16	4 .. 20	4 .. 24	4 .. 28
5 .. 10	5 .. 15	5 .. 20	5 .. 25	5 .. 30	5 .. 35
6 .. 12	6 .. 18	6 .. 24	6 .. 30	6 .. 36	6 .. 42
7 .. 14	7 .. 21	7 .. 28	7 .. 35	7 .. 42	7 .. 49
8 .. 16	8 .. 24	8 .. 32	8 .. 40	8 .. 48	8 .. 56
9 .. 18	9 .. 27	9 .. 36	9 .. 45	9 .. 54	9 .. 63
10 .. 20	10 .. 30	10 .. 40	10 .. 50	10 .. 60	10 .. 70
11 .. 22	11 .. 33	11 .. 44	11 .. 55	11 .. 66	11 .. 77
12 .. 24	12 .. 36	12 .. 48	12 .. 60	12 .. 72	12 .. 84

8 times	9 times	10 times	11 times	12 times	
2 .. 16	2 .. 18	2 .. 20	2 .. 22	2 .. 24	£ denotes libræ, or pounds.
3 .. 24	3 .. 27	3 .. 30	3 .. 33	3 .. 36	
4 .. 32	4 .. 36	4 .. 40	4 .. 44	4 .. 48	s, solidi, or shillings.
5 .. 40	5 .. 45	5 .. 50	5 .. 55	5 .. 60	
6 .. 48	6 .. 54	6 .. 60	6 .. 66	6 .. 72	d, denarii, or pence.
7 .. 56	7 .. 63	7 .. 70	7 .. 77	7 .. 84	qrs. quadrantes, or fa things.
8 .. 64	8 .. 72	8 .. 80	8 .. 88	8 .. 96	
9 .. 72	9 .. 81	9 .. 90	9 .. 99	9 .. 108	¼ one farthing.
10 .. 80	10 .. 90	10 .. 100	10 .. 110	10 .. 120	½ a halfpenny.
11 .. 88	11 .. 99	11 .. 110	11 .. 121	11 .. 132	¾ three farthings.
12 .. 96	12 .. 108	12 .. 120	12 .. 132	12 .. 144	

EXAMPLES.

Multiplicand	(1) 7421635	(2) 3764158	(3) 8742693
Multiplier	2	6	12
Product	14843270	22584948	104912316

Ex. (4) 7421635 × 2

(5) 3764158 × 3

(6) 8742693 × 4

(7) 9126543 × 5

(8) 2345674 × 6

(9) 6342157 × 7

(10) 716482539 × 8

(11) 987654321 × 9

(12) 864213579 × 10

(13) 471526389 × 11

(14) 234579876 × 12

(15) 371529684 × 12

(16) 4286925 × 2

(17) 7424394 × 3

(18) 3742845 × 4

(19) 9429545 × 5

(20) 8345974 × 6

(21) 9342487 × 7

(22) 718482599 × 8

(23) 987958824 × 9

(24) 884275579 × 10

(25) 474528389 × 11

(26) 254579878 × 12

(27) 377529884 × 12

II. *When the multiplier is any number between* 12 *and* 20.

RULE. Multiply by the unit figure, and to each product add the remainder to be carried, and also the figure last multiplied.

Ex. (28) 4321835 × 14 = 60505690

(29) 1371429 × 15 =

(30) 7310286 × 16 =

(31) 372473673 × 17 =

(32) 571839264 × 18 =

(33) 987654321 × 19 =

III. *When the multiplier consists of several figures.*

RULE. Multiply the multiplicand by each figure of the multiplier separately, beginning with the right-hand figure; and let the first figure of every product stand exactly under the figure multiplied by. Add these products together, and their sum will be the answer, or whole product required.

PROOF. The common method is by casting out the nines, but this is by no means infallible; the best method is to make the multiplier the multiplicand, and the multiplicand the multiplier; and if the product found from this operation, be the same as before, the work is right.

EXAMPLES.

(34) 6375246 × 32 =

12750492
19125738

204007872

(35) 4563742 × 54 =

18254968
22818710

246442068

(36) 4313247 × 98 =

34505976
38819223

422698206

(37) 56347 × 681 =

56347
450776
338082

38372307

(38) 25681 × 347 =

179767
102724
77043

*8911307

* The method of *proving* multiplication sums, by *casting out the nines*, the pupil will better understand by one minute's oral explanation, than by a page of description.

Ex. (39) 46572374 × 43 (40) 34583472 × 54
(41) 92416436 × 65 (42) 39321835 × 76
(43) 35732813 × 87 (44) 83742186 × 98
(45) 84213958 × 432 (46) 58236437 × 543
(47) 63857426 × 654 (48) 27948314 × 765

IV. *When ciphers are intermixed with the figures in the multiplier.*

Rule. Omit the ciphers, and let the first figure of each product be placed under its multiplier.

Examples.

Ex. (49) 5869374 × 3005 = 17637468870

29346870	
17608122	
17637468870	

(50) 50862470 × 6009 = 305632582230

457762230	
305174820	
305632582230	

(51) 7483952 × 4008 (52) 4372849 × 6004

V. *When there are ciphers at the end of the multiplier or multiplicand.*

Rule. Multiply the significant figures in the multiplicand by those of the multiplier, and place as many ciphers to the right hand of the product as there are in both factors.

Examples.

(53) 8536274 × 40 = 341450960

(54) 842593700 × 8000 = 6740749600000

(55) 87654321 × 30 (56) 4276958 × 900
(57) 24736849 × 6400 (58) 3869275 × 87000

VI. *When the multiplier is the product of two or more numbers or factors.*

Rule. Multiply by one of the numbers, and that product by the other, and so on; the result will be the answer.

Examples.

(59) 5826347 × 25 = 5 × 5 = 145658675

29131735	
5	
145658675	

(60) 4627538 × 84 = 12 × 7 = 388713192

55530456	
7	
388713192	

(61) 9582374 × 30 (62) 5742983 × 45

MISCELLANEOUS QUESTIONS.

(63) What is the product of 123456 multiplied by 4321 ?
Ans. 533453376

(64) A privateer of 284 men took a prize which amounted to 95*l.* each man ; what was the value of the prize ?
Ans. 26980*l.*

(65) If a merchant began business with 5000*l.* and retired after 21 years' trading, in which he cleared on an average 1,836*l.* per year, what sum did he retire with ? *Ans.* 43556*l.*

(66) Suppose a gentleman to lay by each year 365*l.*—what will it amount to in 33 years ? *Ans.* 12045*l.*

(67) How many trees are there in a plantation of 26 rows of 1960 trees in each ? *Ans.* 50960

(68) The railroads of England are estimated at 8000 miles in length, each mile costing 37,500*l.* ; what was the cost of the whole. *Ans.* 300,000,000*l.*

(69) When the multiplicand is 98765 and the multiplier 43210, what is the product ? *Ans.* 4267635650

(70) I planted 20 rows of potatoes, of 30 in each row ; how many potatoes will they produce, supposing 7 to each root ?
Ans. 4200

(71) If a boy can point 16 thousand pins in an hour, how many can he do in 6 days, supposing him to work at them 9 hours each day ? *Ans.* 864,000

(72) How many miles will a person walk in a year, at the rate of 15 miles per day ? *Ans.* 5475

(73) How much will a person spend in 7 years, at the rate of 10*s.* per day ? *Ans.* 25550*s.* = £1277 10*s.*

(74) What is the product of 49 times 12, multiplied by 25 times 11 ? *Ans.* 161700

(75) Multiply 12 dozen-dozen by half a dozen-dozen.
Ans. 124416

(76) In an army consisting of 189 battalions, each 450 men, how many effective soldiers ? *Ans.* 85050

(77) What is the product of one hundred millions, multiplied by one hundred thousand ? *Ans.* 10000000000000

(78) If 52 walnuts will fill a quart, how many will fill a bushel containing 32 quarts ? *Ans.* 1664 walnuts

(79) A gentleman at his decease had 19 sons and daughters, and left his whole property equally among them ; when divided, the portion of each was 9999*l.* ; what was the sum left ? *Ans.* 189981*l.*

(80) A gentleman gave to his daughter, as her marriage portion, a scrutoire in which were 9 drawers, in each drawer were 4 divisions, and in each division 100 sovereigns ; what was her fortune ? *Ans.* 3600*l.*

SIMPLE DIVISION.

BY Division, we find how often one number is contained in another of the same denomination: this is a short method of performing subtraction. It consists of three parts:—

The *Dividend*, or number to be divided;

The *Divisor*, or number by which you divide; and

The *Quotient*, or number arising from the divisor.

I. *When the divisor does not exceed* 12.

RULE. Draw a curve, and write the divisor on the left-hand of the dividend; then consider *how many times* the *divisor* is contained in the *first* figure or figures of the *dividend*, and set the quotient under it; and for every *unit* remaining after subtraction carry *ten* to the next figure of the dividend.

PROOF. Multiply the quotient by the divisor, and to the product add the remainder, if any; the product will be equal to the dividend, if the work is right.

EXAMPLES.

(1) Divis. 2)4682462	Divid. (2)6)7296731	(3) 12)4684707
Quotient 2341231	$1216121\frac{5}{6}$	$390392\frac{3}{12}$
2	6	12
Proof 4682462	7296731	4684707

(4) 2)62486284	(5) 3)42942369	(6) 4)72852696
(7) 5)15255105	(8) 6)86251734	(9) 7)38142171
(10) 8)16280168	(11) 9)18273783	(12) 10)71632987
(13) 11)10874216	(14) 12)14326871	(15) 12)17210543

II. *When the divisor consists of several figures.*

RULE 1. Draw a curve line on the right and left of the dividend, and write the divisor on the left.

2. Find how many times the divisor is contained in as many figures of the dividend as are just necessary, and place the number on the right for a quotient.

3. Multiply the divisor by this quotient figure, and having subtracted the product from the above mentioned figures of the dividend, bring down the next figure of the dividend, or more if necessary, to the right of the remainder.

4. Divide the remainder, so increased, by the divisor, as before, for the second figure of the quotient; observing if it goes 0 times, to put a cipher, and bring down another figure to the remainder.

5. Proceed with this result as with the former, and so on till all the figures of the dividend are brought down.

PROOF. As before.

EXAMPLES.

(16) 65)123456(1899 (17) 543)7653927(14095

	65		65	543	543
	584		9495	2223	42285
	520		11394	2172	56380
	645		21	5192	70475
	585		123456 *Proof.*	4887	342
	606			3057	7653927
	585			2715	
	21			342	

(18) 8731047 ÷ 37 (19) 3917253 ÷ 64
(20) 2526074 ÷ 139 (21) 12768423 ÷ 543
(22) 48408825 ÷ 425 (23) 68304137 ÷ 876
(24) 12345678 ÷ 7304 (25) 56932073 ÷ 9531

III. *When ciphers are annexed to the divisor.*

RULE. Cut off the ciphers from the divisor, and the same number of figures from the right hand of the dividend; then divide the remaining figures of the dividend by the remaining part of the divisor, and the result will be the answer. To the remainder, if any, join those figures of the dividend which were first cut off, and set the whole over the divisor, for the fractional part.

EXAMPLES.

(26) 2,0)472163,9
236081 $\frac{1}{2}\frac{9}{0}$

(27) 12,00)27136,72
2261 $\frac{4}{1}\frac{7}{2}\frac{2}{0}\frac{}{0}$

(28) 321,00)45686,46(142
321
1358
1284
746
642
10446 remainder

(29) 543,00)270657,84(497
2172
5305
4887
4187
3801
38684 rem.

(30) 4712639 ÷ 40
(31) 7294732 ÷ 600
(32) 1398521 ÷ 8000
(33) 3712659 ÷ 1100

IV. *When the divisor is the product of two or more numbers.*

RULE. Divide the given number by one of those parts, and the quotient thus arising by another, and so on; and the last result will be the answer required.

(34) 24 { 6)7142168 ÷ 24
4)1190361—2 } 8 rem.162
297590—1 }

(35) { 9)25716953 ÷ 162
6) 2857439—2 }
3) 476239—5 } 101
158746—1 }

The rem. $= \overline{1 \times 6} + 2 = 8$. The rem. $101 = \overline{1 \times 6} + 53 \times 9 + 2$

The Tutor will now teach his pupil *how to value the remainders*, viz. by × the *last remainder* by the *preceding divisor*, and to that product, *add* the *first remainder*, &c.

(36) 47321952 ÷ 16
(37) 17304275 ÷ 28
(38) 12347164 ÷ 36
(39) 36924634 ÷ 42
(40) 57132063 ÷ 63
(41) 71285951 ÷ 84

V. *What is often called the* ITALIAN METHOD *should sometimes be taught*, which is, to *omit* putting down the figures resulting from *multiplying* the quotient with the divisor.

With this mode of operation, the first two long division sums, page 15, will stand thus—

(42) 65)123456 (1899
584
645
606
21

(43) 543)7653927 (14095
2223
5192
3057
342

As every Tutor knows this method, when the scholars have gained more proficiency in arithmetic they may return and work the *preceding* sums by it, under his instruction.

MISCELLANEOUS QUESTIONS.

(44) If 1664 walnuts will fill a bushel which contains 32 quarts, how many will there be to a quart? *Ans.* 52

(45) If I planted 2520 potatoes in 84 equal rows, how many were set in each row? *Ans.* 30

(46) If the quotient be 49 times 12, and the dividend be 161700, what is the divisor? *Ans.* 275

(47) Divide 12 dozen-dozen by half a dozen-dozen? *Ans.* 24

(48) Divide 10,000,000,000,000 by one hundred millions? *Ans.* 100,000

(49) If a person walks 5475 miles in a year, how many miles is that per day? *Ans.* 15

(50) When the dividend is 4267635650, and the quotient is 98765, what is the divisor? *Ans.* 43210

(51) If the earth's distance from the sun be 95,000,000 miles, and a ray of light pass from the sun to us in 8 minutes, at what rate does it fly per minute? *Ans.* 11,875,000 *miles*

(52) If there are 4768 nuts in a bushel, how many are there in a quart of 32 to the bushel? *Ans.* 149

(53) A merchant cleared 38556*l.* in 21 years; in what proportion is that per year? *Ans.* 1836*l.*

(54) What is the quotient of 533453376 divided by 123456? *Ans.* 4321

(55) A privateer of 284 men took a prize worth 26980*l.* what was each man's share? *Ans.* 95*l.*

(56) Suppose a gentleman in 33 years to lay by 12045*l.*; how much is that on an average per year? *Ans.* 365*l.*

(57) The railroads of England are estimated at 8000 miles in length, the whole costing 300,000,000*l.*; how much did each mile cost. *Ans.* 37,500*l.*

(58) The number of young trees in even rows amounts to 50960, there were 26 rows; I demand how many trees in each row? *Ans.* 1960

(59) Suppose a gentleman to leave 189,981*l.* equally among his 19 sons and daughters; I require the portion of each? *Ans.* 9999*l.*

(60) Divide 10 times 48 by 10 times eight and forty? *Ans.* 4

(61) If those who live upon the equator, are carried by the earth's diurnal motion 25,000 miles in 24 hours, what is the movement per hour? *Ans.* 1041$\frac{1}{2}\frac{4}{4}$

(62) Suppose the earth to move in its orbit at the rate of 72,000 miles in an hour (which is something greater than the truth), what would be its rate every moment? *Ans.* 20 *miles*

COMPOUND ADDITION.

COMPOUND Addition is a method of collecting *several numbers* of different denominations into *one sum*.

Rule 1. Place the numbers, so that those of the same denomination may stand directly *under each other*, and draw a line below them.

2. Add the numbers in the *lowest* denomination together, and find how many *units* of the next *higher* denomination are contained in their sum.

3. Set down the *remainder*, and carry the *units* to the next *higher* denomination, which add up as before, and so on to the end.

Proof. The method of proof is the same as in simple addition.

OF MONEY

		marked.
¼ Farthing.	4 Farthings make 1 Penny,	*d.*
½ Halfpenny.	12 Pence . . . 1 Shilling,	*s.*
¾ Three Farthings.	20 Shillings. . . 1 Pound,	£

Farthings.

4 = 1 Penny.
48 = 12 = 1 Shilling.
960 = 240 = 20 = 1 Pound.

N.B.—A Moidore, 27*s.*—A Sovereign, 20*s.*—A Guinea, 21*s.*—A Mark, 13*s.* 4*d.*—An Angel, 10*s.*—A Noble, 6*s.* 8*d.*—A Crown, 5*s.*—Half Crown, 2*s.* 6*d.*

Farthing Table.		*The Pence Table.*						*The Shilling Table.*					
qrs.	*d.*	*d.*	*s.*	*d.*	*d.*	*s.*	*d.*	*s.*	£	*s.*	*s.*	£	*s.*
4 ..	1	20 ..	1	8	90..	7	6	20..	1	0	140..	7	0
8 ..	2	24 ..	2	0	96..	8	0	30..	1	10	150..	7	10
12 ..	3	30 ..	2	6	100..	8	4	40..	2	0	160..	8	0
16 ..	4	36 ..	3	0	108..	9	0	50..	2	10	170..	8	10
20 ..	5	40 ..	3	4	110..	9	2	60..	3	0	180..	9	0
24 ..	6	48 ..	4	0	120..	10	0	70..	3	10	190..	9	10
28 ..	7	50 ..	4	2	130..	10	10	80..	4	0	200..	10	0
32 ..	8	60 ..	5	0	132..	11	0	90..	4	10	210..	10	10
36 ..	9	70 ..	5	10	140..	11	8	100..	5	0	220..	11	0
40 ..	10	72 ..	6	0	144..	12	0	110..	5	10	230..	11	10
44 ..	11	80 ..	6	8	150..	12	6	120..	6	0	240..	12	0
48 ..	12	84 ..	7	0	156..	13	0	130..	6	10	250..	12	10

TROY WEIGHT.

24 Grains (*gr.*) . . .	make 1 Pennyweight	***dwts.***
20 Pennyweights	1 Ounce . .	*oz.*
12 Ounces	1 Pound . .	*lb.*

Grains.
24 = 1 Pennyweight.
480 = 20 = 1 Ounce.
5760 = 240 = 12 = 1 Pound.

By this weight, gold, silver, jewels, and precious stones, are weighed It is also used in ascertaining the strength of liquors; and most other things of a fine or costly nature.

AVOIRDUPOIS WEIGHT.

16 Drams (*dr.*) . . .	make 1 Ounce . . .	*oz.*
16 Ounces	1 Pound . . .	*lb.*
28 Pounds	1 Quarter . . .	*qr.*
4 Quarters, or 112 lbs.	1 Hund. Weight	*cwt.*
20 Hundred Weight . . .	1 Ton . . .	*ton.*

Drams.
16 = 1 Ounce.
256 = 16 = 1 Pound
7168 = 448 = 28 = 1 Quarter.
28672 = 1792 = 112 = 4 = 1 Hund. wt.
573440 = 35840 = 2240 = 80 = 20 = 1 Ton.

Other Denominations in this Weight.

A Firkin of Butter .	*lb.* 56	A Stone of Iron Shot,	*lb.*
——— Soap. . .	64	or Horseman's Wt.	. 14
A Barrel of Anchovies .	30	A Truss of Straw . .	. 36
——— Soap. . .	256	——— New Hay .	. 60
——— Raisins .	. 112	——— Old Hay .	. 56
A Fother of Lead	*cwt.* 19½	36 Trusses	a Load

WOOL WEIGHT.

7 Pounds (*lb.*)	1 Clove . . .	*cl.*
2 Cloves, or 14 lb.	1 Stone . . .	*st.*
2 Stone, or 28 lbs.	1 Tod . . .	*td.*
6 Tods and a half	1 Wey . . .	*wy.*
2 Weys	1 Sack . . .	*sa.*
12 Sacks.	1 Last . . .	*la.*

And a *Pack* of Wool is 12 score, or 240 pounds.

APOTHECARIES' WEIGHT.

20 Grains (*gr.*) . . .	make 1	Scruple .	*sc.* or ℈
3 Scruples	1	Dram . .	*dr.* or ʒ
8 Drams	1	Ounce . .	*oz.* or ℥
12 Ounces	1	Pound . .	*lb.* or lb

Grains				
20	= 1	Scruple		
60	= 3	= 1	Dram	
480	= 24	= 8	= 1	Ounce
5760	= 288	= 96	= 12	= 1 Pound

The Apothecaries mix their medicines by this weight; but they buy and sell their commodities by Avoirdupois Weight.

The *pound* and *ounce* in this weight are the same as those in Troy Weight, but the *smaller divisions* are different.

CLOTH MEASURE.

2¼ Inches	make 1	Nail	*nl.*
4 Nails	1	Quarter of a Yard	*qr.*
3 Quarters.	1	Flemish Ell . .	F. E.
4 Quarters.	1	Yard	*yd.*
5 Quarters.	1	English Ell . .	E. E.
6 Quarters.	1	French Ell. . .	Fr. E.

Inches				
2¼	= 1	Nail		
9	= 4	= 1	Quarter	
36	= 16	= 4	= 1	Yard
27	= 12	= 3	= 1	Flemish Ell
45	= 20	= 5	= 1	English Ell

LONG MEASURE.

3 Barley-corns (*b. c.*) . .	1	Inch	*in.*
12 Inches.	1	Foot	*ft.*
3 Feet	1	Yard.	*yd.*
6 Feet or 2 yards	1	Fathom	*fath*
5½ Yards	1	Rod, Pole, or Perch	*r. p.*
40 Poles	1	Furlong . . .	*fur.*
8 Furlongs	1	Mile	*mi.*
3 Miles	1	League	*lea.*
60 Geographical Miles, or 69½ English Miles . .	1	Degree .	*deg.* or °

Barley C.							
3 =	1 Inch						
36 =	12 =	1 Foot					
108 =	36 =	3 =	1 Yard				
594 =	198 =	16½ =	5½ =	1 Pole			
23760 =	7920 =	660 =	220 =	40 =	1 Furlong		
190080 =	63360 =	5280 =	1760 =	320 =	8 =	1 Mile	

Note. 4 inches make a *hand;* used only in measuring the height of horses.—The origin of Long Measure is taken from a grain of Barley, three of which, full-sized, make an inch.

SQUARE OR LAND MEASURE.

144 Square Inches	1 Square Foot
9 Square Feet	1 Square Yard
100 Square Feet	1 Sq. of flooring, roofing, &c.
30¼ Sq. Yds. or 272¼ Sq. Feet	1 Square Rod or Perch
40 Square Rods	1 Square Rood
4 Sq. Roods, or 160 Sq. Rods, or 4840 Sq. Yds.	1 Square Acre of Land
640 Square Acres	1 Square Mile
30 Acres	1 Yard of Land
100 Acres	1 Hide of Land.

Inches						
144 =	1 Foot					
1296 =	9 =	1 Yard				
39204 =	272¼ =	30¼ =	1 Pole			
1568160 =	10890 =	1210 =	40 =	1 Rood		
6272640 =	43560 =	4840 =	160 =	4 =	1 Acre	

By this measure, all things that have length and breadth are measured; as land, paving, plastering, roofing, tiling, flooring, plumbing, glazing, &c. *Land* is measured by a chain, called Gunter's Chain, which is 4 poles, or 22 yards, or 66 feet long; and consists of 100 links. Also 10 of these chains in length, and one in breadth, make an acre.

CUBIC OR SOLID MEASURE.

1728 Cubic Inches	1 Cubic Foot
27 Cubic Feet	1 Cubic Yard
40 Feet of rough timber, or 50 Feet of hewn ditto . .	1 Load or Ton
42 Cubic Feet	1 Ton of Shipping.

By this measure, stone, timber, and all works that have length, breadth, and thickness, are measured

WINE MEASURE.

4	Gills (*gl.*)	1	Pint	. . . .	*pt.*
2	Pints	1	Quart	. . . .	*qt.*
4	Quarts	1	Gallon	. . . .	*gal.*
10	Gallons	1	Anker of Brandy		*ank.*
18	Gallons	1	Rundlet	. . . .	*run.*
42	Gallons	1	Tierce	. . . .	*tier.*
2	Tierces, or 84 Gallons	1	Puncheon	. . . .	*pun.*
63	Gallons or 52½ Imp. Gals.	1	Hogshead	. . . .	*hhd.*
2	Hhds. 126 Gals. or 105 Imp.	1	Pipe or Butt		*p.*
2	Pipes, or 252 Gals. or 210 do.	1	Tun	. . . .	*t.*

Pints						
2	=	1	Quart			
8	=	4	=	1	Gallon	
336	=	168	=	42	=	1 Tierce
504	=	252	=	63	= 1½ =	1 Hogshead
672	=	336	=	84	= 2 = 1⅓ =	1 Puncheon
1008	=	504	=	126	= 3 = 2 = 1½ =	1 Pipe
2016	=	1008	=	252	= 6 = 4 = 3 = 2 =	1 Tun.

A tun of Wine used to be reckoned about 18 cwt. Avoirdupois, the wine gallon containing 231 cubic inches. By this measure all kinds of spirits, as well as cider, mead, vinegar, oil, honey, &c., were measured previously to the 1st of Jan. 1826.

N.B. The Pipe varies in different wines—thus Claret has 126 gallons old measure; Madeira, 110; Vidonia, 120; Sherry, 130; Port, 138 Lisbon, 140 gallons, &c.

ALE AND BEER MEASURE.

2	Pints (*pt.*)	1	Quart	*qt.*
4	Quarts	1	Gallon	*gal.*
9	Gallons	1	Firkin*	*fir.*
2	Firkins	1	Kilderkin	*kil.*
2	Kilderkins or 4 Firkins	1	Barrel	*bar.*
1½	Barrel or 54 Gallons	1	Hogshead	*hhd.*
2	Barrels	1	Puncheon	*pun.*
2	Hogsheads	1	Butt	*but.*
2	Butts	1	Tun	*t.*

Pints							
2	=	1	Quart				
8	=	4	=	1	Gallon		
72	=	36	=	9	=	1	Firkin
144	=	72	=	18	=	2 =	1 Kilderkin
288	=	144	=	36	=	4 = 2 =	1 Barrel
432	=	216	=	54	=	6 = 3 = 1½ =	1 Hogshead
576	=	288	=	72	=	8 = 4 = 2 = 1½ =	1 Puncheon
864	=	432	=	108	=	12 = 6 = 3 = 2 = 1½ =	1 Butt.

* Formerly, while the wine gallon contained 231 cubic inches, the ale and beer gallon contained 282 cubic inches, and the gallon dry measure 268¾ cubic measure. But by Act 5 Geo. IV, c. 74, these distinctions are abolished. [See Tables at the end of this volume.]

DRY MEASURE.

2 Pints (*pt.*)	1 Quart	*qt.*
2 Quarts	1 Pottle	*pot.*
2 Pottles	1 Gallon	*gal.*
2 Gallons	1 Peck	*pk.*
4 Pecks	1 Bushel	*bu.*
4 Bushels	1 Coomb	*co.*
2 Coombs, or 8 bushels	1 Quarter	*qr.*
4 Quarters	1 Chaldron	*ch.*
5 Quarters	1 Wey or Load	*wey.*
2 Weys	1 Last	*la.*

Pints							
8 =	1 Gallon						
16 =	2 =	1 Peck					
64 =	8 =	4 =	1 Bushel				
256 =	32 =	16 =	4 =	1 Coomb			
512 =	64 =	32 =	8 =	2 =	1 Quarter		
2560 =	320 =	160 =	40 =	10 =	5 =	1 Wey	
5120 =	640 =	320 =	80 =	20 =	10 =	2 =	1 Last.

This measure is applied to all dry goods; as Corn, Seeds, Roots, Salt, Coals, &c.

N.B. In the purchase of Coals, 3 bushels are 1 sack, and 12 sacks, or 36 bushels, 1 chaldron.

TIME.

60 Seconds	1 Minute	*mi.*
60 Minutes	1 Hour	*ho.*
24 Hours	1 Day	*da.*
7 Days	1 Week	*wk.*
4 Weeks	1 Month	*mo.*
13 Months, 1 day, 6 ho. or 12 Calendar Months,—or 52 Weeks	1 Year	*yr.*

Seconds							
60 =	1 Minute						
3600 =	60 =	1 Hour					
86400 =	1440 =	24 =	1 Day				
604800 =	10080 =	168 =	7 =	1 Week			
2419200 =	40320 =	672 =	28 =	4 =	1 Month		
31557600 =	525960 =	8766 =	365¼ =	1 Year.			

To know the days in each month, observe:
Thirty days hath September, April, June, and November,
February hath twenty-eight alone; all the rest have thirty-one,
Except in Leap Year, at which time, February's days are twenty-nine.

EXAMPLES IN ADDITION OF MONEY.

	£	s.	d.
(1)	24	4	7
	15	7	3
	42	5	6
	37	2	5
	15	9	8
	73	6	4
Sum	207	15	9
	183	11	2
Proof	207	15	9

	£	s.	d.
(2)	37	7	4
	29	4	8½
	51	12	11
	14	7	5½
	60	15	6½
	92	3	10
	285	11	9¼
	248	4	5¼
	285	11	9¼

	£	s.	d.
(3)	174	19	11½
	26	15	4¼
	43	3	7¾
	59	13	5¼
	36	7	10¾
	28	9	3½
	369	9	7
	194	9	7½
	369	9	7

	£	s.	d.
(4)	157	15	4¾
	375	10	8
	39	12	11¼
	4	16	10¾
	700	0	0
	73	19	10¾
	1351	15	9½
	1194	0	4¾
	1351	15	9¼

	£	s.	d.
(5)	72	3	7
	44	4	3
	73	7	8
	26	2	2
	94	6	9
	57	5	2
	67	4	3

	£	s.	d.
(6)	27	3	7
	98	7	4
	35	5	5
	73	9	8
	85	8	6
	42	6	3
	87	8	9

	£	s.	d.
(7)	76	7	4
	54	3	7
	32	9	2
	12	8	4
	34	7	7
	56	8	2
	99	4	6

	£	s.	d.
(8)	37	4	7
	19	7	8
	70	3	9
	59	6	7
	46	9	8
	39	8	9
	68	8	8

	£.	s.	d.
(9)	42	15	7
	35	2	4¼
	73	5	10
	98	15	3½
	32	17	2¼
	14	5	6¾
	36	8	5½
	42	18	6

	£.	s.	d.
(10)	57	12	11½
	71	17	4
	98	5	2¾
	35	13	6
	79	16	9¼
	26	15	5½
	30	19	11¾
	99	6	2

	£.	s.	d.
(11)	74	13	7¾
	63	4	11½
	79	6	5
	42	15	2¼
	37	12	8
	98	8	5¾
	98	11	9¼
	30	3	6

	£.	s.	d.
(12)	98	17	6
	24	13	11¼
	37	7	8
	45	18	10¾
	78	13	4¼
	94	15	8¾
	34	2	6½
	18	18	8

	£	s.	d.
(13)	74	14	7½
	41	5	4
	26	2	11¾
	13	6	8
	69	12	4¼
	92	8	10
	87	4	3¼
	38	17	7¾
	55	5	4

	£	s.	d.
(14)	37	15	7¾
	15	8	4½
	91	4	2¼
	38	12	11
	82	15	8
	24	3	4¾
	79	7	6¼
	33	2	9¾
	66	19	10¼

	£	s.	d.
(15)	47	14	4¼
	23	16	2
	91	12	8½
	52	9	3
	13	3	7½
	34	5	10¾
	85	15	4
	68	7	6¾
	89	9	7

	£	s.	d.
(16)	73	19	10¼
	16	8	7
	29	4	4¼
	61	3	11
	42	9	7¾
	94	2	6
	38	7	9½
	55	6	10
	87	14	4¾

	£	s.	d.
(17)	12	13	$11\frac{1}{4}$
	34	5	$7\frac{1}{2}$
	56	7	3
	78	19	8
	90	1	4
	87	14	$7\frac{1}{4}$

	£	s.	d.
(18)	93	16	10
	37	4	8
	15	3	$3\frac{1}{2}$
	61	7	$7\frac{1}{4}$
	46	12	$11\frac{3}{4}$
	82	13	$5\frac{1}{4}$

	£	s.	d.
(19)	41	7	4
	35	11	7
	78	14	9
	14	16	$6\frac{3}{4}$
	62	19	$11\frac{1}{4}$
	27	17	$3\frac{1}{2}$

	£	s.	d.
(20)	27	13	$4\frac{1}{4}$
	53	9	1
	29	8	$3\frac{1}{2}$
	16	3	$7\frac{3}{4}$
	91	17	$6\frac{1}{4}$
	35	15	2

	£	s.	d.
(21)	792	4	$7\frac{1}{4}$
	484	7	$4\frac{1}{2}$
	176	13	$2\frac{3}{4}$
	568	17	$1\frac{1}{2}$
	251	12	$6\frac{1}{4}$
	640	18	$9\frac{3}{4}$

	£	s.	d.
(22)	714	12	$7\frac{1}{4}$
	268	14	1
	314	11	$4\frac{3}{4}$
	672	16	$6\frac{1}{2}$
	485	19	2
	141	13	$3\frac{3}{4}$

	£	s.	d.
(23)	147	13	$7\frac{1}{4}$
	216	19	$4\frac{1}{2}$
	371	12	$3\frac{1}{4}$
	498	4	$6\frac{3}{4}$
	137	13	$5\frac{1}{2}$
	582	17	$8\frac{1}{4}$

	£	s.	d.
(24)	714	16	$8\frac{1}{4}$
	241	18	3
	376	13	$11\frac{3}{4}$
	662	19	$4\frac{1}{2}$
	927	17	$2\frac{1}{2}$
	153	15	$7\frac{3}{4}$

Of WEIGHTS and MEASURES.

Troy Weight.

	lbs.	oz.	dwts.
(25)	11	11	19
	10	6	5
	8	4	11
	9	2	12
	7	3	8
	5	7	13
	53	0	8

	oz.	dwts.	gra.
(26)	6	16	10
	8	10	18
	5	5	16
	3	15	12
	9	14	9
	2	3	7

	lbs.	oz.	dwts.
(27)	5	9	13
	6	7	6
	8	3	15
	7	8	7
	3	11	9
	6	10	4

	oz.	dwts.	gra.
(28)	3	11	15
	4	5	3
	6	13	10
	2	19	2
	7	6	12
	9	14	16

Avoirdupois Weight.

	tons	cwts.	qr.
(29)	6	13	1
	7	6	0
	5	3	3
	8	9	2
	9	11	0
	4	15	3
	42	4	1

	cwts.	qr.	lbs.
(30)	16	1	15
	14	3	7
	12	0	6
	15	2	5
	18	1	13
	10	0	12

	lbs.	oz.	dra.
(31)	18	13	5
	13	9	8
	15	11	13
	11	10	2
	12	8	7
	10	4	8

	cwts.	qr.	lbs.
(32)	3	1	8
	6	2	9
	2	0	7
	5	3	5
	4	3	6
	3	0	4

Apothecaries' Weight.

	lbs.	oz.	dra.
(33)	6	10	7
	8	5	6
	4	8	4
	5	11	5
	6	9	2
	9	7	3
	42	5	3

	oz.	dra.	scr.
(34)	5	5	1
	4	3	2
	2	6	0
	6	4	2
	3	2	0
	7	7	1

	lbs.	oz.	dra.
(35)	5	10	3
	3	9	7
	2	6	6
	0	5	0
	4	11	3
	3	8	2

	dra.	scr.	gr.
(36)	1	1	12
	3	0	11
	4	2	5
	7	1	16
	6	2	10
	2	0	9

Cloth Measure.

	yds.	qrs.	nls.
(37)	16	3	2
	18	0	1
	19	2	0
	25	1	3
	32	2	2
	21	3	1
	134	1	1

	E.E.	qrs.	nls.
(38)	10	4	3
	16	3	0
	14	0	2
	12	2	3
	7	2	2
	8	1	0

	F.E.	qrs.	nls.
(39)	7	1	2
	6	2	0
	2	0	1
	3	1	1
	8	0	2
	9	2	3

	qrs.	nls.	in.
(40)	2	3	2
	6	2	$0\frac{1}{2}$
	1	1	$1\frac{1}{4}$
	3	0	$2\frac{1}{2}$
	9	2	2
	2	3	$0\frac{3}{4}$

Long Measure.

	mls.	fur.	po.
(41)	10	7	10
	16	3	8
	12	6	9
	15	4	16
	20	2	13
	19	7	39
	95	7	15

	lea.	mls.	fur.
(42)	18	2	1
	17	1	1
	13	0	5
	16	1	6
	72	2	7
	16	1	4

	yds.	feet.	in.
(43)	18	2	7
	27	1	6
	32	0	8
	45	1	11
	61	2	10
	12	1	9

	feet	in.	bar.
(44)	11	3	1
	3	5	0
	24	7	2
	3	9	0
	70	8	2
	10	4	1

Land Measure.

	ac.	r.	po.
(45)	12	2	11
	16	3	15
	24	0	25
	18	1	18
	30	3	32
	16	2	8
	119	1	29

	ac.	r.	po.
(46)	16	3	19
	12	0	7
	13	1	18
	16	0	10
	15	2	16
	16	3	30

	ac.	r.	po.
(47)	8	1	15
	9	2	10
	7	3	16
	1	3	13
	2	2	20
	6	1	30

	ac.	r.	po.
(48)	9	0	9
	8	2	7
	7	1	8
	5	1	6
	3	3	10
	6	2	5

Wine Measure.

	pip.	hhds.	gal.
(49)	10	1	8
	6	0	9
	8	1	10
	12	1	16
	16	0	20
	8	0	18
	62	0	18

	tuns	hhds.	gal.
(50)	16	1	12
	24	2	10
	36	0	11
	18	3	14
	17	2	29
	9	1	30

	hhds.	gal.	qts.
(51)	3	11	1
	2	5	2
	4	7	0
	6	9	3
	5	16	2
	4	20	1

	gal.	qts.	pts.
(52)	9	1	1
	7	2	0
	5	0	1
	10	3	1
	8	2	0
	9	0	1

Ale and Beer Measure.

	hhds.	gal.	qts.
(53)	7	16	3
	10	7	0
	15	9	2
	24	14	1
	8	21	0
	9	35	3
	74	50	1

	bar.	fir.	gal.
(54)	8	3	8
	9	1	7
	7	0	5
	6	1	6
	5	2	4
	10	3	2

	fir.	gal.	pts.
(55)	16	8	7
	21	7	2
	34	5	5
	18	4	6
	27	8	3
	16	2	4

	bts.	hhds.	gal.
(56)	3	1	30
	2	0	16
	7	1	35
	8	1	10
	9	1	8
	5	0	4

Dry Measure.

	cha.	bus.	pks.
(57)	31	12	3
	21	18	1
	35	13	2
	42	14	0
	17	10	2
	21	35	3
	169	32	3

	qrs.	bus.	pks.
(58)	10	7	3
	11	0	1
	15	5	0
	8	6	2
	7	3	1
	9	0	3

	bus.	pks.	gal.
(59)	6	1	1
	5	2	0
	4	3	0
	3	0	1
	2	2	1
	1	1	1

	las.	we.	qts.
(60)	3	1	4
	2	0	2
	9	0	3
	6	1	0
	5	1	2
	4	0	4

Time.

	yrs.	mo.	wks.
(61)	6	3	2
	8	4	3
	9	12	1
	7	7	2
	5	12	1
	4	8	3
	42	10	0

	mo.	wks.	da.
(62)	11	2	6
	13	3	5
	21	1	4
	6	2	3
	5	3	5
	4	1	6

	wks.	da.	ho.
(63)	6	6	18
	8	5	6
	9	0	23
	7	4	12
	8	3	14
	5	2	20

	ho.	min.	sec.
(64)	5	30	11
	6	45	18
	3	59	20
	2	16	31
	7	28	59
	8	19	12

MISCELLANEOUS QUESTIONS.

(65) Suppose the rent of my house 100*l.* per annum; poor's rates, 15*l.* 10*s.*; window and house tax, 12*l.* 15*s.*; other taxes and rates, 10*l.* 5*s.*; what is the whole sum?

Ans. 138*l.* 10*s.*

(66) A gentleman's steward received for rents of A. 210*l.* 6*s.*; of B. 169*l.* 17*s.*; of C. 150*l.* 15*s.*; of D. 260*l.* 12*s.*; of E. 300*l.* 10*s.*; and of F. 75*l.* 16*s.* 6*d.*; what was the whole sum? *Ans.* 1167*l.* 16*s.* 6*d.*

(67) In taking an account of debts owing to me, I find that Mr. W. owes me 16*l.* 17*s.* 8¼*d.*; Mr. X. 27*l.* 15*s.* 3½*d.*; Mr. Y. 111*l.*; Mr. Z. 77*l.* 17*s.* 9*d.*; and there are other small sums amounting to 35*l.* 12*s.* 3¾*d.*; what is the whole sum due to me? *Ans.* 269*l.* 3*s.* 0½*d.*

(68) Paid the carrier for the following freights; viz. hops, 12 cwt. 2 qrs. 10lb.; wool, 5 cwt. 2 qrs.; teas, 1 cwt. 2 qrs. 14 lb.; sugars, 10 cwt. 1 qr. 10 lb.; and salt, weighing 2 qrs. 21 lb.; for how much weight was he paid?

Ans. 30 cwt. 2 qrs. 27 lb.

(69) Just received 4 parcels of cloth—in the first parcel, 150 yds. 3 qrs. 2 nls.; in the second, 120 yds. 1 qr. 1 nl.; in the third, 99 yds.; and in the fourth, 305 yds. 3 qrs.; how many yards in the 4 parcels? *Ans.* 675 yds. 3 qrs. 3 nls.

(70) Paid the following bills for the repairs of my house, the mason's, 7*l.* 3*s.* 6*d.*; the bricklayer's, 9*l.* 8*s.* 7*d.*; the carpenter's, 12*l.* 13*s.* 10*d.*; and the painter's, 15*l.* 15*s.*; what did the whole of the repairs cost me?

Ans. 45*l.* 0*s.* 11*d.*

(71) The measurement of my Leasows' estate is as follows, viz. the site of the house, garden, and fold, 1 acre 3 roods 20 poles; the great orchard, 12 acres 2 roods 12 poles; the little close, 4 acres 3 roods; the arable land, 30 acres 1 rood 19 poles; the meadow land, 53 acres 2 roods, 30 poles; and the wood lands, 5 acres 2 roods; how many acres in the whole? *Ans.* 108 acres 3 roods 1 pole

(72) A farmer sold at market, wheat to the amount of 18*l.* 6*s.* 4*d.*; barley, 12*l.* 6*s.*; beans, 9*l.* 8*s.* 9*d.*; oats, 13*l.* 15*s.* 3*d.*; and turnip seed, 10*l.* 18*s.* 4*d.*; what was the whole amount? *Ans.* 64*l.* 14*s.* 8*d.*

(73) Bought goods at Birmingham to the amount of 560*l.* 15*s.* 6*d.*; paid packing and porterage, 1*l.* 10*s.*; carriage, 2*l.* 6*s.* 8*d.*; expenses of journey, 3*l.* 8*s.* 6*d.*; what did the goods stand me in? *Ans.* 568*l.* 0*s.* 8*d.*

COMPOUND SUBTRACTION.

COMPOUND SUBTRACTION is the method of finding the *difference* between any *two* given *numbers* of different denominations.

RULE 1st. Place the *less* number *under* the *greater*, so that the parts which are of the same denomination may stand directly *under each other;* then beginning at the *right* hand, subtract each number in the *lower* line from that *above it*, and set down the *remainder*.

2nd. When any of the *lower* numbers are *greater* than the *upper*, increase the *upper number* by as many as make *one* of the next *higher denomination*, from which take the *lower* number; set down the *difference*, and carry *one* to the next number in the *lower* line, which *subtract* from that above it, in the same manner as before.

PROOF. As in integers.

EXAMPLES.

	£.	s.	d.
From (1)	12	9	$6\frac{1}{2}$
Take	8	5	$4\frac{1}{4}$
Remains	4	4	$2\frac{1}{4}$
Proof	12	9	$6\frac{1}{2}$

	£.	s.	d.
(2)	27	12	$9\frac{3}{4}$
	13	4	$3\frac{1}{4}$
	14	8	$6\frac{1}{2}$
	27	12	$9\frac{3}{4}$

	£.	s.	d.
(3)	19	10	$7\frac{1}{4}$
	4	16	$9\frac{1}{2}$
	14	13	$9\frac{3}{4}$
	19	10	$7\frac{1}{4}$

	£.	s.	d.
(4)	126	17	$8\frac{1}{2}$
	113	12	$3\frac{1}{4}$

	£.	s.	d.
(5)	473	14	$9\frac{1}{2}$
	251	8	4

	£.	s.	d.
(6)	276	10	$6\frac{3}{4}$
	134	8	$2\frac{1}{2}$

	£	s.	d.
(7)	472	16	$8\frac{1}{4}$
	397	15	$2\frac{1}{2}$

	£	s.	d.
(8)	126	18	$4\frac{3}{4}$
	86	17	$7\frac{1}{4}$

	£	s.	d.
(9)	714	18	$3\frac{1}{4}$
	276	4	$8\frac{3}{4}$

	£	s.	d.
(10)	345	2	4
	186	12	$8\frac{1}{2}$

	£	s.	d.
(11)	483	16	$5\frac{1}{2}$
	297	8	$10\frac{3}{4}$

	£	s.	d.
(12)	247	3	4
	185	17	$8\frac{3}{4}$

	£	s.	d.
(13)	74	4	5
	16	8	$9\frac{1}{2}$

	£	s.	d.
(14)	9	11	5
	3	15	$7\frac{1}{4}$

	£	s.	d.
(15)	22	8	4
	15	12	$7\frac{3}{4}$

	£	s.	d.
(16)	8	9	6
	7	13	$7\frac{1}{4}$

	£	s.	d.
(17)	10	10	1
	9	10	$1\frac{1}{4}$

	£	s.	d.
(18)	8	0	$0\frac{1}{4}$
	2	0	$0\frac{1}{2}$

	£	s.	d.
(19)	15	15	$0\frac{1}{4}$
		15	$0\frac{3}{4}$

	£	s.	d.
(20)	7	7	$7\frac{1}{2}$
	4	9	9

Borrowed . . . (21)	£	s.	d.
	365	16	$8\frac{3}{4}$
Paid at different times.	50	0	$9\frac{1}{2}$
	20	10	0
	30	15	$6\frac{1}{4}$
	37	10	8
	100	0	0
	50	12	10
Paid in all . . .	289	9	$9\frac{3}{4}$
Remains unpaid .	76	6	11

Lent . . . (22)	£	s.	d.
	500	0	0
Received at different times.	120	6	8
	50	9	4
	36	12	6
	100	0	0
	50	10	0
	75	16	6
Received in all			
Remains . .			

Of WEIGHTS and MEASURES.

Troy Weight.

	lbs.	oz.	dwts.
(23)	30	7	8
	9	8	12
	20	10	16

	oz.	dwts.	gra.
(24)	12	7	16
	5	10	18

	lbs.	oz.	dwts.
(25)	15	8	6
	10	11	4

	oz.	dwts.	gra.
(26)	8	13	9
	7	17	0

Avoirdupois Weight

	tons	cwts.	qr.
(27)	13	7	2
	8	12	3
	4	14	3

	cwts.	qr.	lbs.
(28)	17	1	17
	7	1	27

	lbs.	oz.	dra.
(29)	25	3	12
	16	11	5

	cwts.	qr.	lbs.
(30)	5	2	13
	4	2	20

Apothecaries Weight.

	lbs.	oz.	dra.
(31)	13	5	6
	0	8	7
	12	8	7

	oz.	dra.	scr.
(32)	9	7	1
	5	2	2

	lbs.	oz.	dra.
(33)	9	3	4
	6	6	1

	drs.	scr.	gr.
(34)	12	2	15
	5	0	17

Cloth Measure.

	yds.	qrs.	nls.
(35)	16	3	1
	8	1	3
	8	1	2

	E.E.	qrs.	nls.
(36)	10	3	2
	5	2	0

	F.E.	qrs.	nls.
(37)	7	2	1
	5	2	2

	qrs.	nls.	in.
(38)	8	1	$1\frac{1}{2}$
	7	2	$0\frac{1}{2}$

Long Measure.

	mls.	fur.	po.
(39)	24	3	7
	17	5	29
	6	5	18

	lea.mls.	fur.	
(40)	19	2	5
	9	0	7

	yds.	feet	in.
(41)	18	1	4
	10	2	11

	feet	in	bar.
(42)	13	5	2
	8	7	0

Land Measure.

	ac.	r.	po.
(43)	24	2	20
	5	1	30
	19	0	30

	ac.	r.	po.
(44)	16	3	13
	8	0	3

	ac.	r.	po.
(45)	18	1	12
	10	2	18

	ac.	r.	po.
(46)	12	3	16
	2	3	27

Wine Measure.

	pip.	hhd.	gal.
(47)	24	1	18
	12	0	10
	12	1	8

	tuns	hhd.	gal.
(48)	14	1	10
	7	2	23

	hhd.	gal.	qts.
(49)	8	4	3
	5	12	0

	gal.	qts.	pts.
(50)	36	2	1
	29	3	0

Ale and Beer Measure.

	hhd.	gal.	qts.
(51)	12	11	2
	7	24	3
	4	40	3

	bar.	fir.	gal.
(52)	16	2	5
	9	3	2

	fir.	gal.	pts.
(53)	19	5	5
	9	8	7

	bts.	hhd.	gal.
(54)	14	1	53
	8	0	50

Dry Measure.

	cha.	bus.	pks.
(55)	15	16	3
	8	25	0
	6	27	3

	qrs.	bus.	pks.
(56)	18	0	1
	5	4	2

	bus.	pks.	gals.
(57)	13	1	0
	7	2	1

	las.	wys.	qrs.
(58)	11	1	3
	7	0	4

Time.

	yrs.	mo.	wks.
(59)	12	12	1
	7	5	3
	5	6	2

	mo.	wks.	dys.
(60)	2	0	2
	1	3	6

	wks.	dys	ho.
(61)	3	6	11
	2	0	23

	ho.	mi.	sec.
(62)	23	59	29
	11	10	59

MISCELLANEOUS QUESTIONS.

(63) From 100*l.* take 99*l.* 19*s.* $11\frac{3}{4}$*d.*, what remains?
Ans. 0*l.* 0*s.* $0\frac{1}{4}$*d.*

(64) Take 146*l.* 11*s.* $9\frac{1}{4}$*d.* from 150*l.* *Ans.* 3*l.* 8*s.* $2\frac{3}{4}$*d.*

(65) Subtract 372*l.* 12*s.* $8\frac{3}{4}$*d.* from 423*l.* 11*s.* $7\frac{1}{2}$*d.*
Ans. 50*l.* 18*s.* $10\frac{3}{4}$*d.*

(66) How much does 50 guineas exceed 25*l.* 10*s.* $6\frac{1}{2}$*d.*?
Ans. 26*l.* 19*s.* $5\frac{1}{2}$*d.*

(67) What is the difference between 30*l.* and 19 guineas?
Ans. 10*l.* 1*s.*

(68) If I have a bill to pay of 7*l.* 17*s.* 6*d.*, and I deliver a 10*l.* bank-note for that purpose, what change ought I to receive? *Ans.* 2*l.* 2*s.* 6*d.*

(69) A person sends a note of 20*l.* to discharge a bill, and receives in change 4*l.* 14*s.* 6*d.*, what was the bill?
Ans. 15*l.* 5*s.* 6*d.*

(70) A servant's wages are 12 guineas per year, and having received in part 7*l.* 19*s.* 6*d.*, what remains due?
Ans. 4*l.* 12*s.* 6*d.*

(71) Borrowed of my friend 50*l.*, and paid in part 37*l.* 5*s.* 8*d.*, how much remains to pay? *Ans.* 12*l.* 14*s.* 4*d.*

(72) For my estate, which is 500*l.* per year, I pay rates and taxes to the amount of 56*l.*, what is my clear income?
Ans. 444*l.*

(73) Bought 24 yards of muslin, out of which I sold two dresses of 8 yds. 2 qrs. 2 nls. each; what quantity have I left? *Ans.* 6 yds. 3 qrs.

(74) The great bell at Oxford weighs 7 tons 11 cwt. 3 qrs. 4 lb., and that at St. Paul's, 5 tons 2 cwt. 1 qr. 22 lb.; how much does the former in weight exceed the latter?
Ans. 2 tons 9 cwt. 1 qr. 10 lb.

(75) A youth has served 5 yrs. 3 mo. 2 wks. 5 days of his 7 years apprenticeship, how much longer has he yet to serve? *Ans.* 1 yr. 9 mo. 1 wk. 2 days

(76) Borrowed of A. B. 2000*l.*, and paid at 3 different times 500*l.* each, and at another time 265*l.*, what remains due? *Ans.* 235*l.*

(77) Between the towns A. and B. there are two roads, the one measures 16 miles 2 furlongs 10 poles, and the other 14 miles 7 furlongs 39 poles, what is the difference?
Ans. 1 mile 2 furlongs 11 poles

(78) Purchased 3 pipes 46 galls. of wine, and sold 1 pipe and 120 galls. (allowing 136 gallons to the pipe); I demand the quantity that remains? *Ans.* 1 pipe 62 galls.

COMPOUND MULTIPLICATION.

COMPOUND MULTIPLICATION is the method of finding what any given number, of different denominations, will amount to, when repeated any proposed number of times.

I. When the *multiplier* does *not exceed* 12.

RULE. Set the *multiplier* under the *lowest* denomination of the multiplicand; multiply *separately* each figure of the multiplicand by the multiplier, and carry the several products, as they occur, to the next higher denomination. Set down the several *remainders*, and carry the *integers* to the next product; with which proceed as before.

EXAMPLES.

	£	s.	d.		£	s.	d.		£	s.	d.
Multiply (1)	21	2	$8\frac{1}{2}$	(2)	42	10	$4\frac{1}{4}$	(3)	354	8	$6\frac{3}{4}$
by . . .			2				3				4
	42	5	5		127	11	$0\frac{3}{4}$		1417	14	3

	£	s.	d.		£	s.	d.		£	s.	d.
(4)	16	5	8	(5)	9	10	$7\frac{1}{4}$	(6)	13	8	$6\frac{1}{4}$	(7)	10	12	$7\frac{1}{2}$
			5				6				7				8

	£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.
(8)	0	19	$6\frac{1}{2}$	(9)	0	17	$9\frac{3}{4}$	(10)	0	14	$5\frac{1}{4}$	(11)	0	18	$10\frac{1}{2}$
			9				10				11				12

(12) 2 lbs. at 5*s.* 6*d.* per lb.

(13) 3 yds. at 4*s.* 10*d.* per yd.

(14) 4 ells at 6*s.* 2*d.* per ell.

(15) 5 pair at 3*s.* 9*d.* per pair.

(16) 6 doz. at 8*s.* 3*d.* per doz.

(17) 7 hhds. at 14*s.* 6*d.* pr hhd.

(18) 8 lbs. at 12*s.* 9*d.* per lb.

(19) 9 cwt. at 13*s* 1*d.* pr. cwt.

(20) 5 tons at 1*l.* 4*s.* 6*d.* per ton.

(21) 6 hhds. at 2*l.* 3*s.* 4*d.* per hogshead.

(22) 7 gals. at 5*l.* 2*s.* 4*d.* per gallon.

(23) 8 qrs. at 1*l.* 6*s.* 8*d.* per quarter.

(24) 9 bushels at 1*l.* 1*s.* 9*d.* per bushel.

(25) 10 lbs. at 2*l.* 11*s.* 8*d.* per lb.

(26) 11 dozens at 3*l.* 13*s.* 9*d.* per dozen.

(27) 12 cwt. at 5*l.* 16*s.* 11*d* per cwt.

II. If the multiplier exceeds 12, multiply by any two numbers which, multiplied together, will make the same number.

(28) 16 lbs. at 7*s.* 6*d.* per lb.

			4
1	10	0	
			4
6	0	0	

(29) 24 ells at 3*l.* 4*s.* 8*d.* per ell.

			3
9	14	0	
			8
77	12	0	

(30) 16 bushels of barley, at 10*s.* 6*d.* per bushel?
Ans. 8*l.* 8*s.* 0*d.*

(31) 18 yards of satin, at 12*s.* 8½*d.* per yard?
Ans. 11*l.* 8*s.* 9*d.*

(32) 20 gallons of ale, at 2*s.* 6*d.* per gallon?
Ans. 2*l.* 10*s.* 0*d.*

(33) 32 lbs. of tea, at 8*s.* 6*d.* per lb? *Ans.* 13*l.* 12*s.* 0*d.*

(34) 35 bushels of oats, at 5*s.* 6*d.* per bushel?
Ans. 9*l.* 12*s.* 6*d.*

(35) 36 ells of Holland, at 5*s.* 10¾*d.* per ell?
Ans. 10*l.* 12*s.* 3*d.*

(36) 48 gallons of porter, at 1*s.* 8*d.* per gallon?
Ans. 4*l.* 0*s.* 0*d.*

(37) 60 reams of paper, at 2*l.* 6*s.* per ream?
Ans. 138*l.* 0*s.* 0*d.*

(38) 72 ells of dowlas, at 2*s.* 3¾*d.* per ell? *Ans.* 8*l.* 6*s.* 6*d.*

(39) 84 lbs. of candles, at 1*s.* 1¾*d.* per lb.? *Ans.* 4*l.* 16*s.* 3*d.*

(40) 96 qrs. of barley, at 4*l.* 14*s.* 6*d.* per qr.?
Ans. 453*l.* 12*s.* 0*d.*

(41) 100 lbs. of butter, at 1*s.* 9½*d.* per lb.?
Ans. 8*l.* 19*s.* 2*d.*

(42) 108 cwt. of cheese, at 3*l.* 19*s.* 6*d.* per cwt.
Ans. 429*l.* 6*s.* 0*d.*

(43) 120 pair of shoes, at 9*s.* 6*d.* per pair? *Ans.* 57*l.* 0*s.* 0*d.*

(44) 121 lbs. of tobacco, at 5*s.* 11½*d.* per. lb.?
Ans. 36*l.* 0*s.* 11½*d.*

(45) 132 qrs. of wheat, at 5*l.* 7*s.* per quarter?
Ans. 706*l.* 4*s.* 0*d.*

(46) 144 yards of cloth, at 3*s.* 9½*d.* per yard?
Ans. 27*l.* 6*s.* 0*d.*

III. If no two numbers can be found whose product will be equal to the given quantity, multiply, as before, by the numbers that come *nearest to it;* to this product add that of the first line *multiplied* by the *quantity remaining;* the *sum* of these will give the *answer.*

When the quantity of $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$, or any other fractional parts are required, take parts of the given price, and add to the former work; or *multiply* by the *upper* figure, and *divide* by the *under.*

(47) 26 yds. at 5*s.* 8½*d.* per yd.

				5
1	8	6½	=	5
		5		
7	2	8½	=	25
	5	8½	=	1
£7	8	5	=	26

(48) 29¾ lbs. at 4*l.* 8*s.* 6*d.* per lb.

				4
	17	14	0	
			7	
	123	18	0	
½ | ½	4	8	6	
¼ | ½	2	3	3	
	1	2	1½	
£	131	12	10½	

(49) 29 firkins, at 1*l.* 7*s.* 9*d.* per firkin? *Ans.* 40*l.* 4*s.* 9*d.*
(50) 31 yards, at 11*s.* 10*d.* per yard? *Ans.* 18*l.* 6*s.* 10*d.*
(51) 34 ells, at 10*s.* 4½*d.* per ell? *Ans.* 17*l.* 12*s.* 9*d.*
(52) 37 puncheons, at 9*l.* 8*s.* 6*d.* per puncheon? *Ans.* 348*l.* 14*s.* 6*d.*
(53) 41 firkins, at 2*l.* 1*s.* 8*d.* per firkin? *Ans.* 85*l.* 8*s.* 4*d.*
(54) 43 yards, at 12*s.* 8*d.* per yard? *Ans.* 27*l.* 4*s.* 8*d.*
(55) 46 ells, at 16*s.* 4½*d.* per ell? *Ans.* 37*l.* 13*s* 3*d.*
(56) 51 puncheons, at 11*l.* 11*s.* per puncheon? *Ans.* 589*l.* 1*s.* 0*d.*
(57) 93¼ butts, at 3*l.* 11*s.* 6*d.* per butt? *Ans.* 333*l.* 7*s.* 4½*d.*
(58) 99⅕ acres, at 3*l.* 19*s.* per acre? *Ans.* 393*l.* 0*s.* 6*d.*
(59) 103¾ firkins, at 3*l.* 4*s.* per firkin? *Ans.* 332*l.* 0*s.* 0*d.*
(60) 111¾ gallons, at 1*l.* 7. 6*d.* per gall.? *Ans.* 153*l.* 13*s.* 1½*d.*
(61) 124¼ butts, at 4*l.* 6*s.* 8*d.* per butt? *Ans.* 538*l.* 8*s.* 4*d.*
(62) 135⅕ acres, at 4*l.* 10*s.* per acre? *Ans.* 609*l.* 15*s* 0*d.*
(63) 136¾ firkins, at 4*l*, 8*s.* per firkin? *Ans.* 601*l.* 14*s.* 0*d.*
(64) 147¾ gallons, at 1*l.* 12*s.* 6*d.* per gallon? *Ans.* 240*l.* 1*s.* 10½*d.*

Of WEIGHTS and MEASURES.

Troy and Apothecaries' Weight.

	lbs.	oz.	dwts.		oz.	dwts.	gr.		lbs.	oz.	dra.		dra.	scr.	gr.
(65)	8	4	7	(66)	5	6	3	(67)	4	2	3	(68)	5	2	6
			2				3				4				5
	16	8	14												

Avoirdupois Weight.

	tons.	cwts.	qrs.		cwts.	qrs.	lbs.		lbs.	oz.	dra.		cwts.	qrs.	lbs.
(69)	5	7	2	(70)	8	2	10	(71)	4	5	7	(72)	8	3	12
			6				7				8				9
	32	5	0												

Cloth Measure.

	yds.	qrs.	nls.		E.E. qrs.	nls.		F.E. qrs.	nls.		yds.	qrs.	nls.
(73)	10	3	2	(74)	6	1	2	(75)	8	0	0	(76)	12	1	2
			10				11				12				2
	108	3	0												

Long and Land Measure.

	mls.	fur.	po.		yds.	feet	in.		feet	in.	b.co.		acr.	r.	po.
(77)	12	3	12	(78)	8	2	7	(79)	9	11	2	(80)	24	3	22
			3				4				5				6
	37	1	36												

Wine, Ale, and Beer Measure.

	tuns	hhd.	gal.		hhd.	gal.	qts.		bar.	fir.	gal.		fir.	gal.	pts.
(81)	12	1	2	(82)	9	2	3	(83)	11	3	2	(84)	15	8	7
			7				8				9				10
	85	3	14												

Dry Measure.

	cha.	bus.	pks.		qrs.	bus.	pks.		bus.	pks.	gal.		las.	wys.	qrs.
(85)	7	30	2	(86)	9	7	3	(87)	16	3	1	(88)	24	1	4
			11				12				2				3
	86	11	2												

Time.

	yrs.	mo.	wks.		mo.	wks.	dys.		wks.	dys.	ho.		ho.	mi.	sec.
(89)	17	12	3	(90)	23	3	6	(91)	12	6	23	(62)	23	6	59
			4				5				6				7
	71	12	0												

MISCELLANEOUS QUESTIONS.

(93) If 1 cwt. of cheese cost 2*l.* 4*s.* 6*d.* what will 36 cwt. cost? *Ans.* 80*l.* 2*s.*

(94) Bought 1 cwt. of tobacco for 16 guineas, I demand the worth of 48 cwt.? *Ans.* 806*l.* 8*s.*

(95) Gave 2*l.* 5*s.* for 1 piece of cloth, I demand the worth of 48 pieces? *Ans.* 108*l.*

(96) If a servant's wages be 7*s.* 9*d.* per week, what is that per year? *Ans.* 20*l.* 3*s.*

(97) Bought a gallon of wine for 13*s.* 9*d.*, what will a pipe (containing 126 galls.) come to at that rate?

Ans. 86*l.* 12*s.* 6*d.*

(98) If I lay up half a guinea per day, what will it amount to in a year? *Ans.* 191*l.* 12*s.* 6*d.*

(99) If 1 lb. of cheese cost 6½*d.* what will 1 hundred weight cost? *Ans.* 3*l.* 0*s.* 8*d.*

(100) Gave 11*s.* 6*d.* for a ream of paper, I demand the price of 108 reams? *Ans.* 62*l.* 2*s.*

(101) If 1 ell cost 6*s.* 8*d.* what will 63 ells cost? *Ans* 21*l.*

(102) Bought 1000 gallons of oil at 9*s.* per gallon, what did it cost me? *Ans.* 450*l.*

(103) Sold a quarter of wheat, at 9*s.* 11*d.* per bushel, what did I receive for the 8 bushels? *Ans.* 3*l.* 19*s.* 4*d.*

(104) What will 1 cwt. of sugar cost, at 11½*d.* per lb.?

Ans. 5*l.* 7*s.* 4*d.*

(105) If my income be 1*l.* 18*s.* 6*d.* per day, what is that per year? *Ans.* 702*l.* 12*s.* 6*d.*

(106) Bought 1500 feet of deal, at 11*d.* per foot, what did it cost me? *Ans.* 68*l.* 15*s.*

(107) Gave 25*l.* per acre for 200 acres of freehold land, what did the estate cost me? *Ans.* 5000*l.*

(108) Suppose a person to clear by trade 392*l.* per year, on an average, for 50 years, what would be the amount?

Ans. 19,600*l.*

(109) If a person travel, on an average, 12 miles per day, how many miles would he travel in seven years.* *Ans.* 30,660

(110) What is the weight of 6 bars of silver, each weighing 3 lb. 10 oz. 8 dwts. 16 gr.? *Ans.* 23 lb. 2 oz. 12 dwts.

(111) What does the painter charge for 1000 yards, who is paid 6¾*d.* per square yard? *Ans.* 28*l.* 2*s.* 6*d.*

(112) What sum was divided among 24 brothers and sisters, so that each had but 833*l.* 6*s.* 8*d.*? *Ans.* 20,000*l.*

(113) Bought 120 gallons of cider at 1*s.* 3*d.* per gallon, what did the whole cost me? *Ans.* 7*l.* 10*s.*

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* Not computing a leap year.

COMPOUND DIVISION.

COMPOUND DIVISION is the method of finding how often *one* given number is contained in *another* of different denominations.

I. *When the divisor does not exceed* 12.

RULE. Place the divisor on the *left hand* of the dividend. Divide the *highest* denomination of the dividend by the divisor, and write down the *quotient;* reduce the *remainder*, if any, into the *next lower* denomination, *adding to it* the number that stands under the same denomination of the dividend, which divide as before.

PROOF. By compound multiplication.

EXAMPLES.

(1) 2)£46 8 $6\frac{1}{2}$

23 4 $3\frac{1}{4}$

2

46 8 $6\frac{1}{2}$

(2) 3)£36 12 $9\frac{3}{4}$

3

(3) 4)£84 16 $8\frac{1}{4}$

4

(4) 5)£5 15 $10\frac{1}{2}$

(5) 6)£2 18 $6\frac{1}{4}$

(6) 7)£9 14 $7\frac{3}{4}$(

(7) 8)£9 8 $7\frac{1}{2}$(6 over

1 3 $6\frac{3}{4}$

(8) 9)£8 6 $4\frac{1}{4}$

(9) 10)£7 4 $2\frac{3}{4}$(

II. If the divisor exceeds 12, divide by any two numbers, which multiplied together, will make the same number.

EXAMPLES.

(10) Divide 248*l*.12*s*.8*d*. by 25

5) 248 12 8 (3 over

5) 49 14 $6\frac{1}{4}$(2 over

9 18 $10\frac{3}{4}$

(11) Divide 275*l*.17*s*.$7\frac{3}{4}$*d*. by 108.

)275 17 $7\frac{3}{4}$(

)

(12) Divide 186*l*.10*s*.6*d*. by 32.

(13) Divide 168*l*.14*s*.4*d*. by 84

III. If the divisor cannot be exactly produced by small numbers, divide after the manner of long division.

(14) Divide 396*l.* 12*s.* 6¾*d.* by 365.

365) 396 12 6¾ (1*l.*
365
31
20
365) 632 (1*s.*
365
267
12
365) 3210 (8*d.*
2920
290
4
365) 1163 (¾
1095
68

(15) Divide 1000*l.* by 52.

52) 1000 (19*l.*
52
480
468
12
20
52) 240 (4*s*
208
32
12
52) 384 (7*d.*
364
20
4
52) 80 (¼
52
28

(16) Divide 4*l.* 11*s.* by 112 ? *Ans.* 9¾*d.*

(17) Divide 62*l.* 9*s.* 6*d.* by 53 ? *Ans.* 1*l.* 3*s.* 6¾*d.*—33

(18) Divide 28*l.* 19*s.* 6*d.* by 78 ? *Ans.* 7*s.* 5*d.*—12.

(19) Divide 36*l.* 10*s.* 8*d.* by 67 ? *Ans.* 10 10¾*d.*—31

(20) Divide 38*l.* 11*s.* 6*d.* by 85 ? *Ans.* 9*s.* 0¾*d.*—57.

(21) Divide 112*l.* by 71 ? *Ans.* 1*l.* 11*s.* 6½*d.*—26

(22) Divide 124*l.* 10*s.* by 87 ? *Ans.* 1*l.* 8*s.* 7¼*d.*—69

(23) Divide 200*l.* by 105 ? *Ans.* 1*l.* 18*s.* 1*d.*—15

Of WEIGHTS and MEASURES.

Troy Weight.

(24) lbs. oz. dwt.
2) 5 9 6 (
2 10 13

(25) oz. dwt. gr.
3) 13 18 16 (

(26) lb. oz. dwt.
4) 11 10 12 (

Avoirdupois Weight.

(27) tons cwt. qr.
5) 31 11 2 (1 over.
6 6 1

(28) cwt. qr. lb.
6) 8 3 21 (

(29) lb. oz. dr.
7) 60 8 10 (

Apothecaries Weight.

(30) 8) lbs. oz. dr.
15 9 0 (
1 11 5

(31) 9) oz. dr. sc.
10 3 1 (

(32) 10) dr. sc gr.
11 2 12 (

Cloth Measure.

(33) 11) yds. qr. nls.
11 3 3 (4
1 0 1

(34) 12) E. E. qrs. nls.
14 2 3 (

(35) 2) yds. qrs. nls.
18 1 3 (

Long Measure.

(36) 3) lea. mi. fur.
8 2 6 (1
2 2 7

(37) 4) mi. fur. po.
9 6 18 (

(38) 5) ft. in. b.c.
18 11 2 (

Land Measure.

(39) 6) ac. ro. po.
20 3 11 (1
3 1 35

(40) 7) ac. ro. po.
18 1 32 (

(41) 8) ac. ro. po.
10 0 29 (

Wine Measure.

(42) 9) tuns hhds gal.
24 3 21 (

(43) 10) hhds. gal. qts.
36 2 3 (

(44) 11) gal. qts. pt.
12 2 1 (

Ale and Beer Measure.

(45) 12) butts hds. gal.
18 0 12 (

(46) 2) hhds. gal. qts.
16 8 3 (

(47) 3) fir. gal. qts.
9 6 2 (

Corn and Coal Measure.

(48) 4) qrs. bu. pks.
11 6 2 (

(49) 5) cha. bus. pks.
60 30 3 (

(50) 6) qrs. bus. pks.
17 0 1 (

Time.

(51) 7) yrs. mo. wks.
17 0 0 (

(52) 8) mo. wks. da.
18 0 0 (

(53) 9) ho. min. sec.
19 0 0 (

MISCELLANEOUS QUESTIONS.

(54) If 36 cwt. of cheese cost 80*l.* 2*s.* what will 1 cwt cost? *Ans.* 2*l.* 4*s.* 6*d*

(55) Bought 48 cwt. of tobacco for 1081*l.* 4*s.* I demand the worth of 1 cwt.? *Ans* 22*l.* 10*s.* 6*d*

(56) Gave 108*l.* for 48 pieces of cloth; what is the value per piece? *Ans.* 2*l* 5*s.*

(57) If a servant's wages be 20*l.* 3*s.* per year, what is that per week? *Ans.* 7*s.* 9*d*

(58) Bought a pipe of wine (126 gallons) for 86*l.* 12*s.* 6*d* what is the worth of one gallon? *Ans.* 13*s.* 9*d.*

(59) What must I lay up per day, to save 150*l.* per ann.? *Ans.* 8*s.* 2½*d.* 190 rem.

(60) If 1 cwt. of cheese cost 3*l.* 0*s.* 8*d.* what will 1 lb. cost? ***Ans.*** 6½***d.***

(61) Gave 62*l.* 2*s.* for 108 reams of paper, I demand the price per ream? *Ans.* 11*s.* 6*d.*

(62) If 63 ells of Holland cost 21*l.* what will 1 ell cost? *Ans.* 6*s.* 8*d.*

(63) What is oil per gallon, if 1000 gallons cost 450*l.* *Ans.* 9*s.*

(64) Sold wheat at 3*l.* 19*s.* 4*d.* per quarter, what is that per bushel? *Ans.* 9*s.* 11*d.*

(65) What is sugar per lb. at 5*l.* 7*s.* 4*d.* per cwt. *Ans.* 11½*d.*

(66) If my income be 700*l.* per year, what is it per day? *Ans.* 1*l.* 18*s.* 4¼*d.*—35

(67) Bought 1500 feet of deal for 68*l.* 15*s.* what is the value per foot? *Ans.* 11*d.*

(68) Gave 5000*l.* for 200 acres of freehold land, what is the value per acre? *Ans.* 25*l.*

(69) Suppose a person trading, to clear 19,600*l.* in 50 years, I demand his yearly increase? *Ans.* 392*l.*

(70) If a person travel 4380 miles in a year, what is the average per day? *Ans.* 12 *miles*

(71) What does the painter charge per square yard, who is paid 28*l.* 2*s.* 6*d.* for 1000 yards? *Ans.* 6¾*d.*

(72) Divide 20,000*l.* equally among 24 brothers and sisters. *Ans.* 833*l.* 6*s.* 8*d.*

(73) Bought 120 gallons of cider for 7*l.* 10*s* what is that per gallon? *Ans.* 1*s.* 3*d.*

(74) Sold 1 cwt. of tea for 32*l.* 4*s.* what did I charge per lb. *Ans.* 5*s.* 9*d.*

(75) What is wool per stone, if 77 stone cost 56*l.* 15*s* 9*d*? *Ans.* 14*s.* 9*d.*

BILLS OF PARCELS.

No. 1. A Mercer's Bill.

Mr. John Jones, Jan. 1st, 1847.

Bought of Thomas Perry.

		£.	s.	d.	
4	Yards of Lawn	at 0	2	6	per yard
12	Yards of Silk.....	at 0	14	3	per yard
9	Yards of Cambric	at 0	5	2	per yard
3	Yards of Velvet.....	at 1	4	6	per yard
15	Yards of Brocade	at 0	15	3	per yard
27	Yards of Lace	at 0	12	2	per yard

£42 18 3

No. 2. A Stationer's Bill.

Mr. Edwin Thomas, Feb. 1st, 1847.

Bought of James Dixon.

		£.	s.	d.	
24	Reams of Demy.....	at 2	12	6	per ream
75	Reams of wove Post ...	at 2	0	0	per ream
27	Reams of Crown	at 1	13	0	per ream
13	Reams of Hot Pressed.	at 2	3	0	per ream
52	Reams of Foolscap ...	at 1	5	6	per ream
70	Reams of thin Post ...	at 1	8	9	per ream

£452 8 6

A Wine Merchant's Bill.

Mr. Abraham Jeynes, March 1st, 1847.

Bought of Henry Thomson.

		£.	s.	d.	
10	Gallons of Sherry	at 0	16	8	per gall.
7	Gallons of Oporto.....	at 0	13	6	per gall.
13	Gallons of Claret	at 0	12	0	per gall.
9	Gallons of Malaga.....	at 0	11	3	per gall.
4	Gallons of Lisbon	at 0	14	6	per gall.
15	Gallons of Brandy	at 1	3	6	per gall.

£46 8 11

No. 4. A Carpenter's Bill.

Mr. Jonathan Johnson, April 1st, 1847.

Bought of James Lawson.

		s.	d.	
57 Feet of wainscot Sashes.	at	0	10½	per foot
560 Feet of Ash	at	0	3½	per foot
79 Cubic feet of Oak	at	4	2	per foot
136 Do. of framed Deal	at	3	9	per foot
95 Do. of Oak	at	5	6	per foot
9 Men's labour, for 153 days	at	4	9	per day

£115 1 7½

No. 5. A Grocer's Bill.

Mr. Timothy Wall, May 1st, 1847.

Bought of Eliza Saunders.

		s.	d.	
3 lbs. of superfine sugar	at	1	0	per lb.
7 lbs. of raw ditto	at	0	8	per lb.
¼ lb. of black Tea	at	7	4	per lb.
½ lb. of London Soap	at	0	11	per lb.
3 lbs. of Mould Candles	at	0	10	per lb.
7 lbs. of Carolina Rice	at	0	5	per lb.

£0 15 4½

No. 6. A Hosier's Bill.

Mr. Eginton, June 1st, 1847.

Bought of Mark Rawson.

		s.	d.	
16 Pair of Stockings	at	4	6	per pair
9 Ditto of Worsted	at	5	3	per pair
8 Ditto of Thread	at	3	10	per pair
12 Ditto of Men's Silk	at	15	0	per pair
3 Ditto of Gloves	at	3	6	per pair
6 Ditto of Cotton	at	2	6	per pair

£17 15 5

REDUCTION.

REDUCTION is the method of converting numbers from *one name* or denomination, to *another*, without altering their value. It is divided into REDUCTION DESCENDING, and REDUCTION ASCENDING.

I. When the numbers are to be *reduced* from a *greater* denomination to a *less*, it is called Reduction *descending*, and is performed by *multiplication*.

RULE. *Multiply* the given number by as *many* of the less denomination as make *one* of the greater.

II. When the numbers are to be brought *from a less* denomination *to a greater*, it is called Reduction *Ascending*, and is performed by *division*.

RULE. *Divide* the given number by as many of the *less* denomination as make one of the next *greater*.

N. B. *Ascending* and *descending* sums are *proofs* to each other.

REDUCTION DESCENDING.

EXAMPLES.

(1) Reduce 36*l.* 12. 4¼*d.* into shillings, pence, farthings.

20	Proof 4	35153
732 *shillings*	12	8788¼
12		
8788 *pence*	2,0	73,2 4¼*d.*
4		
35153 *farthings.*		36 12 4¼

(2) Bring 30*l.* 1*s.* 1¼*d.* into farthings? *Ans.* 28853 *qrs.*

(3) In 100*l.* 19*s* 11¾*d.* how many farth.? *Ans.* 96959 *qrs*

(4) How many farth. in 111*l.* 11*s.* 11¾*d.*? *Ans.* 107135 *qrs*

(5) In 47*l.* 12*s.* 10*d.* how many farthings? *Ans.* 45736 *qrs.*

(6) In 3456 shillings how many farthings? *Ans.* 165888 *qrs.*

(7) How many pence and half-pence are there in 48*l.*12*s.*2½*d.*?

48*l.* 12*s.* 2½*d.*	2	23333
20		
972	12	11666½
12		
11666 *pence*	2,0	97,2 2½*d.*
2		
23333 *half-pence.*		48 12 2½

(8) Reduce 76*l.* 16*s.* 8*d.* into pence? *Ans.* 18440*d.*

(9) In 430*l.* 11*s.* 11*d.* how many half-pence? *Ans.* 206686

(10) In 19*l.* how many pence and half-pence? *Ans.* 4560–9120

(11) Reduce 76*l.* 0*s.* 0½*d.* into half-pence? *Ans.* 36481*h. p.*

(12) Reduce 365*l.* 8*s.* to half-pence? *Ans.* 175392

(13) In 136 guineas, how many shillings, pence, and farthings?

136		Proof, 4	137088
21			
136		12	34272
272			
2856 *shillings*		21	2856
12			
34272 *pence*			136 *guineas*
4			
137088 *farthings*			

(14) Reduce 769 guineas into shillings, pence, and farthings. *Ans.* 16149*s.*—193788*d.*—775152*f.*

(15) In 128 guineas, 9*s.* 6*d.*, how many farthings? *Ans.* 129480

(16) Bring 72 guineas and 12*s.* 6*d.* into sixpences. *Ans.* 3049

(17) In 186 marks, each 13*s.* 4*d.*, how many groats? *Ans.* 7440

18) Reduce 738 half-guineas into quarter-guineas and pence. *Ans.* 1476 *qr. g.*—92988*d.*

(19) Bring 4325 guineas into seven-shilling pieces and sixpences. *Ans.* 12975 *pieces*—181650 *sixp.*

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(20) In 84*l.* and a crown, how many crowns, half-crowns, sixpences, and twopences?

84*l.* 5*s.* or 1 *cr.*		Proof, 3	10110
4			
337 *crowns.*		5	3370
2			
674 *half-crowns.*		2	674
5			
3370 *sixpences.*		4	337
3			
10110 *twopences.*			84*l.* 5*s.*

(21) In 120*l.* 10*s.* how many crowns and pence? *Ans.* 482 *crowns*—28920 *pence*

(22) In 56*l.* 2*s.* 6*d.* how many half-crowns and sixpences? *Ans.* 449 *half-crowns*—2245 *sixpences*

(23) Reduce 27*l.* and a crown into shillings and threepences? *Ans.* 545 *shillings*—2180 *threepences*

(24) In 360 crowns, how many sixpences and half-pence? *Ans.* 3600 *sixpences*—43200 *half-pence*

(25) Bring 100 half-crowns into threepences and farthings. *Ans.* 1000 *threepences*—12000 *farthings*

(26) How many sixpences in 85*l.* 12*s.* 6*d.*? *Ans.* 3425 *six.*

REDUCTION ASCENDING.

(27) In 36459 farthings, how many pence, shillings, and pounds.

	farthings
4	36459
12	9114 3/4
2,0	75,9 6 3/4
	£37 19 6 3/4

Proof,

£.	s.	d.
37	19	6 3/4
20		
759		
12		
9114		
4		
36459 *farthings*		

(28) In 321457 farthings, how many pence, shillings, and pounds? *Ans.* 80364*d.*—6697*s.*—334*l.* 17*s.* 0¼*d.*

(29) Reduce 100003 farth. into £'s. *Ans.* 104*l.* 3*s.* 4¾*d.*

(30) Bring 21120 pence into shillings and £'s.

Ans. 1760*s.*—88*l.*

(31) Change 4320 half-pence into sixpences and £'s.

Ans. 360 *sixpences*—9*l.*

(32) How many crowns and £'s in 63840 pence.

Ans. 1064 *crowns*—266*l.*

(33) In 9840 groats, how many shillings and £'s?

Ans. 3280*s.*—164*l.*

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(34) Change 241920 farthings into pence, threepences and guineas.

	4	241920 *farthings*
	3	60480 *pence*
84	7	20160 *threepences*
	12	2880
		240 *guineas*

Proof,

240	*guineas*
84	
960	
1920	
20160	
3	
60480	
4	
241920	*farthings*

(35) In 36288 half-pence, how many threepences and guineas? *Ans.* 6048 *threepences*—72 *guineas.*

(36) In 368172 pence, how many groats and guineas?

Ans. 92043 *gr.*—1461 *guin.*

(37) Bring 48960 half-pence into sixpences and seven-shilling-pieces. *Ans.* 4080 *sixpences*—291 *pieces* 3*s. over.*

(38) In 15246 twopences, how many seven-shillings-pieces and guineas? *Ans.* 363 *pieces*—121 *guin.*

(39) Change 2268 groats into shillings and guineas.

Ans. 756*s.*—36 *guineas*

(40) Bring 3024 threepences into quarter guineas and guineas. *Ans.* 144 *qr.-guin.*—36 *guin.*

ASCENDING AND DESCENDING.

(41) In 1050*l.* how many guineas?

		Proof	
	1050		1000
	20		21
21)	21000	2,0)	2100,0
Ans.	1000 *guineas*		1050

(42) Change 840*l.* into guineas? *Ans.* 800 *guineas*

(43) Bring 8000 guineas into pounds? *Ans.* 8400 *pounds*

(44) In 80 moidores (each 27*s.*), how many £'s? *Ans.* 108*l.*

(45) How many moidores in 324*l.*? *Ans.* 240 *moidores*

(46) Change 182*l.* into seven-shilling-pieces. *Ans.* 520

(47) In 18 pieces of 36 shillings each, how many moidores of 27*s.* each? *Ans.* 24 *moidores*

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(48) In 4200*l.* how many crowns, sixpences, half-guineas, and guineas?

			Proof,	4000 *guineas*
		4200		2
		16800 *crowns*		8000 *half-guineas*
		10		21
21 {	3	168000 *sixpences*	1,0	16800,0 *sixpences*
	7	56000	4	16800 *crowns*
	2	8000 *half-guineas*		4200*l.*
		4000 *guineas*		

(49) Bring 2800 guineas into half-guineas, sixpences, and crowns? *Ans.* 5600 *h. g.*—117600 *six.*—11760 *cr.*

(50) In 36*l.* 15*s.* how many sixpences, half-crowns, and crowns? *Ans.* 1470 *six.*—294 *h. c.*—147 *cro.*

(51) In 888 quarter-guineas, how many pence and seven-shilling-pieces? *Ans.* 55944*d.*—666 *seven-shil. pieces*

(52) In 1000 guineas how many crowns? *Ans.* 4200 *cr.*

(53) Change 420 crowns into guineas. *Ans.* 100 *guin.*

(54) In 90 six-and-thirty shillings how many half-crowns and pounds? *Ans.* 1296 *h. c.*—162*l.*

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(55) In 780 nobles, how many groats, shillings, crowns, and pounds?

			Proof,	260*l.*
		780		4
		20 *groats* = 1 *noble*		1040 *crowns*
3		15600 *groats*		5
5		5200 *shillings*		5200 *shillings*
4		1040 *crowns*		3
		260 *pounds*	2,0)	1560,0 *groats*
				780 *nobles*

(56) In 1364 guineas, how many groats, pence, and seven-shilling-pieces?

Ans. 85932 *gro.*—343728*d.*—4092 *seven-shill. pieces.*

(57) How many French francs, or livres of 10*d.* each, are there in 120*l.*? *Ans.* 2880 *F. fr.*

(58) In 30 marks, each 13*s.* 4*d.*, how many pounds? *Ans.* 20*l.*

(59) Change 2268 groats into threepences? *Ans.* 3024 *threepences*

(60) How many six-and-thirties in 30*l.* 12*s.*? *Ans.* 17 *six.*

(61) In 24 moidores of 27*s.* each, how many pieces of 36*s.* each. *Ans.* 18 *pieces*

Troy Weight.

(62) In 3 lb. 6 oz. 9 dwt. 2 gr. of gold, how many grains?

lb.	*oz.*	*dwt.*	*gr.*
3	6	9	2
12			
42			
20			
849			
24			
3398			
1698			
20378			

Proof, * 24 | 20378 ——— 2 *gra.*
20 | 849 ——— 9 *dwts.*
12 | 42
3 *lb.* 6 *oz.* 2 *dw.* 2 *g.*

* The pupil may divide by 24 in *Long Division*, or by two figures in Short Division —as by 4 and 6, or by 3 and 8.

(63) Reduce 130 lb. 10 oz. to penny-weights and grains. *Ans.* 31400 *dwts.* 753600 *gra.*

(64) How many grains of gold are there in a cup weighing 8 oz. 4 dwts.? *Ans.* 3936 *gra.*

(65) Bought 7 ingots of silver, each containing 22 lb. 8 oz. 10 dwts. how many grains? *Ans.* 915600 *gra.*

(66) How many pounds Troy, in 6530 penny-weights? *Ans.* 27 *lb.* 2 *oz.* 10 *dwts.*

Avoirdupois Weight.

(57) How many lbs. are there in 75 tons 12 cwt. 3 qrs.?

tons	*cwt.*	*qrs.*
75	12	3
20		
1512		
4		
6051		
28		
48408		
12102		
Ans. 169425		

Proof.
28) 169428 (4) 6051
168 ——— 3
——— 2,0) 151,2
142 ———
140 75 *t.* 12 *cwt* 3 *qr.*
———
28
28
———

(68) In 146 tons, how many quarters and lbs ?
Ans. 11680 *qrs.*—327040 *lbs*

(69) How many quarters in 111 tons 11 cwt. ? *A.* 8924 *qrs*

(70) Reduce 12 lbs. 11 oz. 10 dr. into drams. *A.* 3258 *dra*

(71) In 6 tons 0 cwt. 3 qrs. how many lbs. ? *Ans.* 13524 *lbs.*

(72) How many lbs. are there in 98765 drams ?
Ans. 385 *lb.* 12 *oz.* 13 *dra.*

(73) In 36540 drams, how many lbs. and quarters ?
Ans. 142 *lbs.* or 5 *qrs.* 2 *lbs.* 11 *oz.* 12 *dra.*

Apothecaries' Weight.

(74) Reduce 3 lb. 4 oz. 6 dr. 1 sc. 17 gr. into grains ?

lb.	*oz.*	*dr.*	*sc.*	*gr.*
3	4	6	1	17
12				
40				
8				
326				
3				
979				
20				
19597 *grains.*				

Proof.

2,0	1959,7	
		17 *gr.*
3	979	
		1 *sc.*
8	326	
		6 *dr.*
2	40	

3 *lb.* 4 *oz.* 6 *dr.* 1 *sc.* 17 *gr.*

Ans. 19597 *grains.*

(75) How many grains of rhubarb are there in 37 lb. 2 oz. 7 dr. 2 sc. 12 gr. ? *Ans.* 214552 *gr.*

(76) How many scruples are there in 321 lb. 5 oz. 2 dr. 2 scr. of opium ? *Ans* 92576 *scr.*

(77) In 1 lb. 1 oz. 1 dr. of Ipecacuhana, how many drams ? *Ans.* 105 *dra.*

(78) In 40320 grains, how many scruples, drams, ounces, and pounds ? *Ans.* 2016 *scr.*—672 *dr.*—84 *oz.*—7 *lb.*

(79) In 120960 grains, how many ounces ? *Ans.* 252 *oz.*

(80) How many ounces and lbs. in 3456 scruples ?
Ans. 144 *oz.*—12 *lb.*

Cloth Measure.

(81) In 36 yds. 3 qrs. 3 nls. how many nails and inches ?

yds.	*qrs.*	*nls.*
36	3	3
4		
147		
4		
591 *nails.*		
$2\frac{1}{4}$		
1182		
$147\frac{3}{4}$		
$1329\frac{3}{4}$ *inches.*		

Proof.

$2\frac{1}{4}$	$1329\frac{3}{4}$
4	4
9	5319
4	591
	3 *nails.*
4	147

36 *yds.* 3 *qrs.* 3 *nls.*

(82) How many yards in 11616 nails? *Ans.* 726 *yds.*

(83) In 365 Eng. ells 2 qrs. 3 nls. how many nails?
Ans. 7311 *nls.*

(84) In 5008 nails, how many yards? *Ans.* 313 *yds.*

(85) In 2000 nails, how many ells English? *Ans.* 100 E.E.

Long Measure.

(86) In 1760 yards, how many inches and barley-corns?

1760
36

63360 *inches*
3

190080 *b. corns*

3 | 190080
---
36 | 63360 (1760 *yards*
36

273, &c.

(87) How many barley-corns will reach 200 miles?
Ans. 38016000 *b. c.*

(88) In 876 miles, how many yards and feet?
Ans. 1541760 *yds.*—4625280 *feet.*

(89) In 18 miles 5 fur. 16 poles, how many yards?
Ans. 32868 *yds.*

(90) In 792000 feet, how many leagues? *Ans.* 50 *leagues*

(91) How many furlongs in 158400 feet? *Ans.* 240 *fur.*

(92) In 95040 poles, how many leagues? *Ans.* 99 *lea.*

(93) How often will a wheel 16 feet in circumference turn round in 15 miles? *Ans.* 4950 *times*

Land Measure.

(94) In 1069 acres, how many square roods, perches, and yards?

1069
4

4276 *roods*
40

171040 *poles.*
30¼

5131200
42760

5173960 *yards*

30¼ | 5173960
4 | 4
---
121 | 20695840 (
4,0 | 17104,0
4 | 4276

1069 *acres*

(95) In 2831 acres, how many yards? *Ans.* 13702040 *yds.*

(96) How many perches are there in 736 ac. 3 ro. 12 po.?
Ans. 117892 *perches*

(97) Bring 75 acres, 2 roods, and 30 perches, into yards.
Ans. 366327½ *yds.*

(98) In 6272640 square inches, how many square yards?
Ans. 4840 *yds.*

(99) How many square inches in 36 square yards?
Ans. 46656 *inch.*

Wine, Ale, and Beer Measure.

(100) In 12 pipes 36 gal. of wine, how many pints?

12 *p.* 36 *gal.*
126
1548
8
Ans. 12384 *pints.*

Proof. 8 | 12384
126 | 1548 (12 *pip.* 36 *gal*
1512
36

(101) In 5 tuns 1 hhd. 18 gal. how many quarts?
Ans. 5364 *qts.*

(102) In 765 butts of beer, how many pints? *A.*660960 *p.*

(103) Reduce 79 hhds. to quarts. *Ans.* 17064 *qts.*

(104) In 6912 qts. of ale, how many hhds.? *Ans.* 32 *hhds.*

(105) How many kilderkins of 18 gals. each, are there in 2880 pints? *Ans.* 20 *kild.*

Dry Measure.

(106) In 36 bus. 3 pks. 1 gal. of wheat, how many gallons and quarts?

36 *bus.* 3 *pks.* 1 *gal.*
4
147 *pecks.*
2
295 *gallons*
4
1180 *quarts*

Proof.
4 | 1180
2 | 295 — 1 *gal.*
4 | 147
36 *bus.* 3 *pks.* 1 *gal.*

(107) In 12 weys 3 qrs. 6 bus. of barley, how many bus. and pecks? *Ans.* 510 *bus.*—2040 *pks.*

(108) How many weys and bushels, in 72 lasts?
Ans. 144 *weys*—5760 *bus.*

(109) In 33 bus. 3 pks. of oats, how many quarts and pints? *Ans.* 1080 *qts.*—2160 *pts.*

(110) How many barleycorns will fill a bushel, supposing 9210 to fill a pint? *Ans.* 589440

(111) In 71680 quarts, how many weys and lasts?
Ans. 56 *weys*—28 *lasts*

(112) How many quarters of corn in 10,000 gallons?
Ans. 156 *qrs.* 2 *bus.*

Time.

(113) In one year consisting of 365 d. 5 ho. 48 min. 49 sec. how many seconds?

365 *d.* 5 *h.* 48 *m.* 49 *sec.*
24
8765
60
525948
60
31556929 *seconds*

Proof.
6,0 | 3155692,9 — 49 *sec.*
6,0 | 52594,8 — 48 *min.*
24 | 8765

(114) In 63113858 seconds, how many days?
Ans. 730 *da.* 11 *ho.* 37 *min.* 38 *sec.*

(115) How many days since the birth of Christ to Christmas 1856? *Ans.* 677904

(116) How many days from May 1st till Nov. 1st?
Ans. 184 *days*

(117) From March 20th till September 29th, how many hours? *Ans.* 4623 *hours*

(118) If you are now ten years old, how many minutes and seconds have you lived? *A.* 5259600 *min.*—315576000 *sec.*

PROPORTION,

Or, THE RULE OF THREE,

Is so called, because by *three numbers* given we find a *fourth;* and it is either the Rule of Three Direct or Inverse.

The RULE of THREE DIRECT

Teaches from *three* given numbers to find a *fourth,* which shall have the same ratio to the *second,* as the *third* has to the *first.*

Rule 1st. *State the question;* that is, place the numbers so that the *first* and *third* may be of the *same name;* and the *second* the same as the *fourth* number required.*

2nd. Bring the *first* and *third* numbers into the *same denomination;* and the *second* into the *lowest* name mentioned.

3rd. *Multiply* the *second* and *third* numbers *together,* and *divide* the *product* by the *first;* and the *quotient* will be the *answer* to the question, in the same denomination you left the second number in: which *quotient* may be then brought into *any other denomination required.*

The method of proof is by inverting the question.

Examples.

(1) If 7 yards of cloth cost 3*l.* 10*s.* what will 65 yds. cost.?

yds.	£ *s.*	*yds.*
As 7	: 3 10	:: 65
	20	
	70	
	65	
7	4550	
2,0	65,0	
	£32 10*s.* *Ans.*	

Proof.

yds.	£ *s.*	*yds.*
As 65	: 32 10	:: 7
	20	
	650	
	7	
65)	4550	(70*s.* = £3 10*s.*
	455	
	0	

* If rightly placed, the *first* and *second* terms will be the *worth of each other.*

(2) If 11 lb. of sugar cost 9*s.* 6*d.* what will 123 lb. cost ?
Ans. 5*l.* 6*s.* $2\frac{1}{2}d.$—10

(3) Bought 75 gallons of brandy for 65*l.*; I demand the worth of 15 gallons ? *Ans.* 13*l.*

(4) If 9 ells of cloth cost 6*l.* 12*s.* what will 84 ells cost ?
Ans. 61*l.* 12*s.*

(5) How much will 18 bushels of wheat cost, if 7 bushels are worth 3*l.* 4*s.* 6*d.* ? *Ans.* 8*l.* 5*s.* $10\frac{1}{4}d.$—1

(6) What will 144 cwt. of cheese cost, if 9 cwt. be worth 23*l.* 6*s.* 6*d.* ? *Ans.* 373*l.* 4*s.*

(7) If 24 lb. of soap cost 1*l.* 1*s.* 6*d.*, what will 112 lb. cost ?
Ans. 5*l.* 0*s.* 4*d.*

---

(8) How many yards can I procure for 10*l.* 8*s.* 4*d.* at the rate of 2*l.* 12*s.* 1*d.* for 7 yards ?

	£	s.	d.		yds.		£	s.	d.
As	2	12	1	:	7	::	10	8	4
	20						20		
	52						208		
	12						12		
	625						2500		
							7		

625)17500 (28 *yds. Ans.*
1250

5000

(9) If 3*l.* 10*s.* will buy 14 yards, what will 32*l.* 10*s.* buy ?
Ans. 130 *yds.*

(10) Bought 9 ells for 6*l.* 12*s.* I demand how many ells 61*l.* 12*s.* will buy ? *Ans.* 84 *ells*

(11) How many hundred weight of sugar can I purchase for 206*l.* 4*s.* 3*d.* at 5*l.* 5*s.* 9*d.* per cwt. ? *Ans.* 39 *cwt.*

(12) How many tons of iron can I procure for 121*l.* 5*s.* 4*d.* at the rate of 212*l.* 4*s.* 4*d.* per 7 tons ? *Ans.* 4 *tons*

(13) Gave 19*s.* 6*d.* for 8 bushels of coals, how many can be bought for 11*l.* 14*s.*? *Ans.* 96 *bush.*

(14) How many yards of silk ribbon can be purchased with 56*l.* at the rate of 3*s.* 4*d.* for 9 yards ? *Ans* 3024 *yds.*

(15) Sold $13\frac{1}{2}$ yds. of velvet for 9*l.* 8*s.*, how much must $2\frac{1}{4}$ yds. be sold for at the same rate?

yds.		£ *s.*		*yds.*
As $13\frac{1}{2}$	:	9 8	::	$2\frac{1}{4}$
4		20		4
54		188		9
		9		

54) 1692 (31*s.*
162
£1 11 4 *Ans.*
72
54
18
12

54) 216 (4*d.*
216

(16) Purchased $7\frac{1}{2}$ yards of broadcloth for 7*l.* 10*s.* what would $13\frac{3}{4}$ yds. of the same piece be worth? *Ans* 13*l.* 15*s.*

(17) Sold $15\frac{1}{2}$ bushels of wheat for 6*l.* 19*s.* 6*d.*, what were $22\frac{3}{4}$ bushels sold for? *Ans.* 10*l.* 4*s.* 9*d.*

(18) What are $38\frac{3}{4}$ yds. of cloth worth, if $46\frac{1}{2}$ yds. be valued at 2*l.* 6*s.* 6*d.*? *Ans.* 1*l.* 18*s.* 9*d.*

(19) If $7\frac{3}{4}$ cwt. cost 3*l.* 7*s.* 6*d.* what will $54\frac{1}{4}$ cwt. cost? *Ans.* 23*l.* 12*s.* 6*d.*

(20) Bought $27\frac{3}{4}$ bushels of oats for 6*l.* 12*s.* 3*d.*, what must I sell $9\frac{1}{4}$ bushels for at the same rate? *Ans.* 2*l.* 4*s.* 1*d.*

(21) What will $24\frac{3}{8}$ yards cost, if $18\frac{5}{8}$ yards are purchased for 2*l.* 6*s.*? *Ans.* 3*l.* 0*s.* $2\frac{1}{4}$*d.*—99

---

(22) If 10 bushels of wheat cost 4*l.* 15*s.* how many quarters can I buy for 49*l.* 8*s.*?

£ *s.*		*bush.*		£ *s.*
As 4 15	:	10	::	49 8
20				20
95				988
				10

95) 9880 (8) 104 *bushels*
95
380 13 *qrs. Ans.*
380
...

(23) Sold 3 pecks of potatoes for 1*s.* 9*d.* how many sacks of 2 bushels each, must I sell to receive 4*l.* 4*s.*? *Ans.* 18 *sa.*

(24) How many pockets of hops of 2 cwt. each, can I buy for 382*l.* 8*s.* if 7 cwt. cost 47*l.* 16*s.*? *Ans.* 28 *pock.*

(25) How many casks of raisins, each 2 cwt. 3 qrs., can be bought for 77*l.*, if 3 qrs. of a cwt. cost 2*l.* 2*s.*? *Ans.* 10 *casks*

(26) Purchased 3 qrs. of a yard of Holland for 5*s.* 6*d.*, how many yards may be bought for 6*l.* 17*s.* 6*d.*? *Ans.* $18\frac{3}{4}$ *yds.*

(27) Laid out 10*l.* 16*s.* 8*d.* in muslins, I demand the quantity of English ells purchased at the rate of 6*s.* 6*d.* for 3 qrs. of a yard? *Ans.* 20 *Eng. ells*

(28) If 3 paces or common steps of a person be equal to 2 yds., how many yards will 180 of his paces make? *A.* 120 *yds.*

---

(29) If 12 oz. of pepper cost 2*s.* 6*d.*, what must be paid for 1 cwt. 2 qrs.?

oz.		*s.*	*d.*		*cwt.*	*qrs.*		
As 12	:	2	6	::	1	2	12 | 80640	
		12			4			
		30			6		12 | 6720	*pence*
					28			
					168		2,0 | 56,0	
					16		£28	*Ans.*
					2688			
					30			
					80640 carried up.			

(30) If 7 oz. of gold be worth 35*l.* 2*s.* 6*d.*, what is the worth of 3 lb. 8 oz.? *Ans.* 220*l.* 15*s.* $8\frac{1}{2}d.$—2

(31) Bought 12 lb. of butter for 14*s.* 6*d.*; I demand the worth of 1 cwt. 2 qrs. 7 lb.? *Ans.* 10*l.* 11*s.* $5\frac{1}{2}d.$

(32) What will 12 dozen and 7 pair of stockings come to if 5 pair cost 1*l.* 12*s.* 6*d.*? *Ans.* 49*l.* 1*s.* 6*d.*

(33) Sold 3 cwt. 2 qrs. 18 lb. of cheese, at the rate of 18*s.* 6*d.* for 24 lb., what did I sell it for? *Ans.* 15*l.* 16*s.* $0\frac{1}{2}d.$

(34) Purchased 7 firkins and 5 gallons of porter for 5*l.* 13*s.* 4*d.*, the value of 6 gallons is required? *Ans.* 10*s.*

(35) Bought tallow at 3*s.* 8*d.* per stone of 8 lb., what is the worth of 10 tons? *Ans.* 513*l.* 6*s.* 8*d.*

---

(36) If the carriage of 6 cwt. 2 qrs. 14 lb. cost 2*l.* 19*s.* 6*d.* what should be paid for 1 ton 19 cwt. 3 qr. at the same rate?

cwt.	*qr.*	*lb.*	£	*s.*	*d.*		*ton*	*cwt.*	*qr.*			
As 6	2	14	: 2	19	6	::	1	19	3	742	3178728	(12) 4284
4			20				20				2968	
26			59				39				2107	2,0) 35,7
28			12				4				1484	
212			714				159				6232	£17 17*s.*
53							28				5936	
742 *lb.*							1272				2968	
							318				2968	
							4452				..	
							714					
							3178728 carried up.					

(37) If 11 cwt. 3 qrs. 15 lb. of butter cost 66*l.* 12*s.*, 1 demand the value of 2 cwt. 3 qr. 25 lb. ? *Ans.* 16*l.* 13*s.* 3*d.*—3

(38) Bought 3 tons 12 cwt. 3 qrs. of sugar for 236*l.* 9*s.* what is the worth of 1 cwt. 3 qrs. 12 lb. ?

Ans. 6*l.* 0*s.* 8½*d.*—4824 rem.

(39) If 7 oz. 12 dwts. of gold be worth 34*l.* 10*s.*, what is the value of 21 lb. 11 oz. 6 dwts. ? *Ans.* 1195*l.* 4*s.* 10¼*d.*—104 r.

(40) What will 28 lb. 8 oz. of honey cost, if 3 lb. 8 oz. are purchased for 4*s.* 8*d.* ? *Ans.* 1*l.* 18*s.*

(41) I demand the worth of 7 yds. 0 qr. 3 nls. of cloth, if 35 yds. 3 qrs. 3 nls. be sold for 12*l.* 7*s.* 1*d.* *Ans.* 2*l.* 9*s.* 5*d.*

(42) If 4 oz. 15 dwts. of silver plate cost 1*l.* 11*s.* 6*d.*, what will 5 articles, each 3 oz. 12 dwts. cost ? *A.* 5*l.* 19*s.* 4¼*d.*—65 r.

---

(43) How many dozen of table spoons can be manufactured from 57 lb. 8 oz. of silver, each doz. weighing 22 oz. 16 dwts. ?

oz.	*dwt.*		*doz.*		*lb.*	*oz.*
22	16	:	1	::	57	8
20					12	
456					692	
					20	
					456) 13840 (30 *doz.*	
					1368	
					160	
					12	
					456) 1920 (4 *spoons*	
					1824	
					96 *rem.*	

Ans. 30 *doz.* 4 *spoons* 96 *rem.*

(44) If 3*l.* 6*s.* 2¼*d.* will purchase 4 tons 9 cwt. of coals, what quantity will 26*l.* 9*s.* 6*d.* purchase ? *Ans.* 35 *tons* 12 *cwt.*

(45) If 18*s.* 6¼*d.* be the price of 5 qts. 1 pt. of wine, how much will 10*l.* 3*s.* 8¾*d.* buy ? *Ans.* 60 *qts.* 1 *pt.*

(46) Suppose a servant's wages to be 10*l.* 16*s.* for 42 wks. 6 days, how long will he be earning 3*l.* 12*s.* ? *A.* 14 *wks.* 2 *d.*

(47) If I pay three half-crowns for 10 lbs. of butter, how much can I have for 9 crowns and 9*d.* ? *Ans.* 61 *lbs.*

(48) At a noble per week, how many months' board can I have for 17*l.* 6*s.* 8*d.* ? *Ans.* 13 *months*

(49) Gave 2½*d.* per lb. for useful articles of old iron, what weight did I buy for 25*l.* 16*s.* 8*d.* ? *Ans.* 22 *cwt.* 0 *qr.* 16 *lb.*

(50) How many English ells can I procure for 360*l.* 16*s.* 8*d.* at the rate of 6*s.* 8*d.* per yard?

s.	*d.*		*yd.*		*£*	*s.*	*d.*
As 6	8	:	1	::	360	16	8
12			4		20		
80			4		7216		
					12		
					86600		
					4		
				8,0)	34640,0		
				5)	4330		

Ans. 866 *Eng. ells.*

(51) How many yards can I procure for 500*l.* 10*s.*, at the rate of 7*s.* 6*d.* per Eng. ell? *Ans.* 1668 *yds.* 1 *qr.* 1 *nl.*—30 rem.

(52) How many tons of iron can be procured for 841*l.* 6*s.* 8*d.* at 37*l.* 6*s.* 8*d.* per ton and half? *Ans.* 33 *tons* 16 *cwt.* 0 *qrs.* 8*lb.*

(53) How many cwt. of sugar at 5*l.* 5*s.* 9*d.* per cwt. can be purchased for 206*l.* 4*s.* 3*d.*? *Ans.* 39 *cwt.*

(54) If 15*s.* 8*d.* will purchase 1 yard, how many Flemish ells can be bought for 7*l.* 10*s*? *Ans.* 12 *F.E.* 2 *qrs.* 1 *nl.*—36 rem.

(55) What quantity of hops can I purchase for 300*l.* at 6*l.* 10*s.* 6*d.* per cwt.? *Ans.* 45 *cwt.* 3 *qrs.* 25 *lbs.*—666 rem.

(56) If 3*l.* 10*s.* be paid a servant for 18 weeks' service, how long will he be earning 8*l.* 15*s.*? *Ans.* 45 *weeks.*

---

(57) If 7 pair of boots cost 12*l.* 16*s.* what will 12 dozen pair of similar articles come to?

pr.		*£*	*s.*		*pr.*	
As 7	:	12	16	::	144	N.B. 12 doz. = 144
		20				
		256				
		144				
7)		36864				

$3\frac{1}{4}d.$—5 remainder

2,0) 526,6

£ 263 6*s.* $3\frac{1}{4}d.$—5 *Ans.*

(58) Bought 10 doz. pair of silk stockings for 92*l.* what will half a dozen pair be worth? *Ans.* 4*l.* 12*s.*

(59) Sold 12 doz. of wine for 28*l.* 16*s.*, what will 8 bottles of the same be worth? *Ans.* 1*l.* 12*s.*

(60) What will a score of oranges cost, if 50 dozens be sold for 3*l.* 15*s.*? *Ans.* 2*s.* 6*d.*

(61) If 35 yards of cloth will make 10 shirts, how many can be made out of 7 pieces, each 27 yards? *Ans.* 54 *shirts*

(62) I demand the value of 3 casks of raisins, each 2 cwt. 3 qr. 14 lb. at 4*l.* 14*s.* 6*d.* per cwt.? *Ans.* 40*l.* 15*s.* $0\frac{3}{4}d.$

(63) Bought 12 cwt of sugar for 48*l.* 15*s.* what is the worth of 8 casks, each 3 cwt. 3 qr. 7 lb.? *Ans.* 123*l.* 18*s.* $1\frac{1}{2}d.$

---

(64) If a servant's wages for 65 days come to 3*l.* 18*s.* what will be the amount of his wages for a year?

days *£* *s.* *days*
65 : 3 18 :: 365

20
78
365

65) 28470 (2,0) 43,8
260
247
95
520
520
...

£21 18*s. Ans.*

(65) If my rent and taxes amount to 5*s.* $7\frac{3}{4}d.$ per day, what will be the payment per year? *Ans.* 103*l.* 0*s.* $8\frac{3}{4}d.$

(66) If I pay my landlord 100*l.* per year, what is that per day? *Ans.* 5*s.* $5\frac{3}{4}d.$—5 *rem.*

(67) Suppose my housekeeping to amount to 6*l.* 17*s.*, in 5 days, what will it cost me per year? *Ans.* 500*l.* 1*s.*

(68) If my horse stands me in 10*s.* 9*d.* for 6 days' keeping, what will be the charge for a year? *Ans.* 32*l.* 13*s.* $11\frac{1}{2}d.$

(69) If my income be 1000*l.* a year, what may I expend daily, and lay by at the year's end 270*l.*? *Ans.* 2*l.*

(70) What sum can I spend daily out of an income of 1200*l.* per annum, so as to lay by 50 moidores, 50 guineas, and 50 sovereigns? *Ans.* 2*l.* 16*s.* $5\frac{1}{4}d.$—15 rem.

---

(71) My year's rent of 350 acres of land is 300*l.* and sundry taxes and rates 36*l.* 8*s.* what does my farm lie me in per acre?

The rent . . £300 0
The taxes, &c. 36 8

acres *acre*
As 350 : £336 8 :: 1

20

350) 6728 (19*s.*
350
3228
3150
78
12
350) 936 carried up.

350) 936 (2*d.*
700
236
4
350) 944 (2 Far.
700
244 *remainder.*

Ans. 19*s.* $2\frac{1}{2}d.$ *per acre, and* 244 *remainder.*

(72) If 100*l.* in 12 months gain 5*l.* interest, what will 375*l.* gain in the same time? *Ans.* 18*l.* 15*s.*

(73) A merchant failing for 10,000*l.* has in goods, debts, &c. but 3760*l.* what will that be in the pound?

Ans. 7*s.* 6*d.*—24 rem.

(74) If a person earns 7*l.* 10*s.* in three weeks, and lays by the half of it, how much will he save per year? *Ans.* 65*l.*

(75) The rental of a parish is 3680*l.* and it has to pay 245*l.* 6*s.* 8*d.*, how much is that in the pound? *Ans.* 1*s.* 4*d.*

(76) Bought 420 galls. of oil for 76*l.* 10*s.* 7½*d.* of which 25 gallons were found damaged, how must I sell the remainder so as neither to gain nor lose? *Ans.* 3*s.* 10½*d.* per. gall.

(77) What is a quarter's rent of 350 acres of land, if 11*s.* 5*s.* 9*d.* per ann. be given for 9 acres? *A.* 109*l.* 14*s.* 9½*d.*

THE RULE OF THREE INVERSE.

Inverse Proportion is when *more* requires *less*, and *less* requires *more*, *i. e. two* of the four proposed numbers *increase* in the same proportion as the *other* two *diminish.*

Rule. State the question as in Direct; and *when needful* reduce the terms, as before: then *multiply* the *first* and *second* terms together, and *divide* their product by the *third;* the *quotient* will be the *answer* to the question, and will bear such proportion to the *second* as the *first* does to the *third.*

The method of Proof is by inverting the question.

Examples.

(1) If 12 men can reap a field in 18 days, how many days will 36 men do it in?

men		*days*		*men*		*days*		Proof. *men*		*days*
As 12	:	18	::	36		6	:	36	::	18
		12						6		
		36)216(6 *days. Ans.*						18)216(12 *men*		
		216						216		
		..						..		

(2) Suppose 100 workmen to finish a piece of work in 96 days, how many are sufficient to finish it in 64 days?

Ans. 150 *men*

(3) If 18 men can perform a piece of work in 28 days, how many men can do it in a fourth part of the time?

Ans. 72 *men*

(4) Suppose 120 men to complete a building in 15 months, how many could finish it in 18 months? *Ans.* 100 *men*

(5) If I lend my friend 300*l.* for 8 months, how long ought he to lend me 200*l.* to requite my kindness ?

£		*mon.*		£
300	:	8	::	200
		300		

2,00) 24,00

12 *months. Ans.*

(6) In what time will 336*l.* gain 84*l.* interest, when 280*l.* will gain it in 6 years ? *Ans.* 5 *years*

(7) If 250*l.* gain 11*l.* 5*s.* interest in 12 months, what principal will gain an equal sum in 8 months ? *Ans.* 375*l.*

(8) A lends B 75*l.* 4*s.* for 9 months, how long ought B to lend A 225*l.* 12*s.* to requite his kindness ? *Ans.* 3 *months*

(9) How many pieces of 20 shillings value are equal to 300 pieces of 7*s.* each ?

s.		*pieces*		*s.*
As 7	:	300	::	20
		7		

2,0) 210,0

Ans. 105 *pieces of* 20*s. value.*

(10) How many sovereigns, or pounds, are equal to a thousand guineas ? *Ans.* 1050*l*

(11) How many marks, each 160*d.* are equal to 186*l.* 240*d.* each ? *Ans.* 279 *marks*

(12) How many nobles, each 80*d.* are equal to 1000 angels, each 120*d.* ? *Ans.* 150 *nobles*

(13) In 72 sovereigns, how many pieces of 36*s.* each ? *Ans.* 40 *pieces*

(14) How many yards of stuff 3 qrs. wide, are equal in measure to 60 yards of 7 qrs. wide ?

qrs.		*yds.*		*qrs.*
7	:	60	::	3
		7		

3) 420

Ans. 140 *yards.*

(15) What must be the breadth of a court yard, which is 50 yards long, to be equal in measure to another that is 125 yards long and 20 yards broad ? *Ans.* 50 *yards broad*

(16) If 12 inches long require 12 inches broad to make a square foot, what length will 8 inches broad require?

Ans. 18 *inches.*

(17) How many yards of paper 27 inches wide, will hang a room that measures 50 feet round and 9 feet high?

Ans. 66 *yds.* 2 *ft.*

(18) If 10,000 yards of 5 quarters wide will make coats for 4,000 men, how many yards of shalloon of 3 qrs. wide will line them? *Ans.* 16666⅔ *yds.*

(19) If 220 yards in length, and 22 in breadth make an acre, what must be the length when the breadth is 33yds.?

Ans. 146 *yds.* 2 *ft.*

---

(20) If for a certain sum 1 can have 15 cwt. 2 qrs. carried fifty miles, what distance would 66 cwt. be carried for the same money?

cwt.	*qrs.*		*mil.*		*cwt.*
16	2	:	50	::	66
4			66		4
66	264		3300 (12½ *Ans.*		264
			264		
			660		
			528		
			132		

$\frac{132}{264} \div 132 = \frac{1}{2}$

Or thus,

cwt.		*mil.*		*cwt.*
16½	:	50	::	66
2		33		2
33		132)1650 (12½ *m. Ans.*		132
		132		
		330		
		264		
		66		

$66) \frac{66}{132} = \frac{1}{2}$

(21) If the carriage of 18½ cwt. for 56 miles come to 10*s.* 6*d.*, how far can I have 129½ cwt. carried for the same sum? *Ans.* 8 *miles*

(22) If 14¼ cwt. be carried 100 miles for 36*s.*, how many lbs. can I have carried 36 miles, for the same money?

Ans. 4433⅓ *lbs.*

(23) If 27 men earn 13*l.* 17*s.* in 2 days, how long will 12 men be earning the same? *Ans.* 4½ *days*

---

(24) If the penny loaf weighed 14 oz. when wheat was 4*s.* per bushel, what must it weigh when wheat is at 7*s.* per bushel?

	s.		*oz.*		*s.*
As	4	:	14	::	7
			4		

7) 56 (8 *ounces, Ans.*

(25) If a pasture serves 36 horses for 75 days, how many horses would eat it in 25 days? *Ans.* 108 *horses.*

(26) If a common field will feed 520 sheep 90 days, how long may I turn out 600 sheep? *Ans.* 78 *days*

(27) Suppose a hay-mow to be sufficient for 40 head of cattle 18 weeks, how long would it serve 60 head of cattle? *Ans.* 12 *weeks*

---

(28) If 1,000 men, in a garrison, have provision for 6 months, how long would the same provisions last 1,500 men?

men		*mon.*		*men*
1000	:	6	::	1500

1000

15,00) 6,000 (4 *months, Ans.*

60

..

(29) If a certain number of men can throw up an entrenchment in 9 days, when the day is 16 hours long; what time will it take when the day is 12 hours long? *Ans.* 12 *days*

(30) If a person can perform a journey in 6 days, riding 9 hours each day, how long will it take him if he rides 12 hours a day? *Ans.* 4½ *days*

(31) Travelled from London to York in 4 days of 12 hours each, in how many days of 8 hours each can the same be performed? *Ans.* 6 *days*

---

(32) How many perches in length, with 12 in breadth, must I receive in exchange for 40 perches in length and 18 in breadth?

	p. b.		*p. l.*		*p. b.*
As	18	:	40	::	12

18

12) 720

Ans. 60 *perches*

(33) There are two rooms, the floors of which have an equal number of square feet; the one is 50 feet by 30, the other is 40 in length; what is the breadth? *Ans.* 37 *ft.* 6 *in.*

(34) How many yards of paper, 3 qrs. wide, will cover a chamber that is 60 feet round, and 10 feet 1½ inches high? *Ans.* 90 *yds.*

(35) How much stuff 2½ quarters wide, will face 15 yards of silk, 3 qrs. wide? *Ans.* 18 *yards*

(36) How many yards of brown drugget that is yard and half wide, will cover a room that is 15 feet long and 14 feet broad? *Ans.* 15 *yds.* 1 *foot* 8 *in.* Or 15 *yds.* 2 *qrs.* 0 *nls.* 2 *in.*

COMPOUND PROPORTION,

OR THE

DOUBLE RULE OF THREE.

IS so called because it is the method of resolving at one operation such questions as by the common Rule of Three would require two or more statings to be worked separately. It teaches from *five* numbers given to find a *sixth*. Three of the numbers contain a *supposition*, and the other two a *demand*.

RULE 1st. Place two of the terms of *supposition*, one above another, in the *first place*; and that which is of the *same name* as the *term sought*, must be put in the *second* place.

2nd. Place the terms of *demand* one above another in the *third* place, in the *same order* as those in the *first* place.

3rd. The first and third term in every row will be of the *same name*, and must be reduced to the *same denomination*: and the *middle* term must be brought to the *lowest* denomination mentioned.

4th. Examine each row *separately*, using the *middle* term as common to both, in order to know if the proportions be *direct* or *inverse*; by saying, if the *first* term give the *second*, does the *third* require *more* or *less*. If *direct*, mark the *first* term with an asterisk; if *inverse*, mark the *third* term.

5th. Multiply the numbers marked for *a divisor;* and those which are not marked for a *dividend;* and the quotient will be the answer.

N.B. *There is another method of stating questions in this rule, which, though not so scientific as the former, is preferred by some teachers as more easy for learners: for the use of such it is here subjoined.*

RULE II. 1st. Let the principal *cause* of loss or gain, interest or decrease, action or passion, be put in the *first* place.

2nd. Let that which betokeneth *time*, distance of *place*, and the like, be put in the *second* place, and the remaining one in the *third*.

3rd. Place the other terms under their like, in the supposition.

4th. If the *blank* falls under the *third term*, multiply the *first* and *second* terms for a *divisor* and the *other three* for a *dividend;* and the quotient will be the answer. But if the *blank* falls under the *first* or *second* term, multiply the *third* and *fourth* terms for a *divisor*, and the other three for a *dividend;* the quotient will be the answer.

PROOF. By two single rules of three.

EXAMPLES.

(1) If 6 men reap 18 acres of wheat in 5 days, how many acres will 10 men reap in 12 days?

By the first rule.

men		*acres*		*men*
* 6	:	18	::	10
* 5 *days*:		—	::	12 *days*

6
5

Divisor 30

18
10

180
12

3,0)216,0

Ans. 72 *acres*

By the second rule.

men		*days*		*acres*
6	:	5	::	18
10	:	12	::	—

(2) If 8 persons spend 100*l.* in 4 months, how much will 20 persons spend in 6 months? *Ans.* 375*l.*

(3) If the carriage of 5 cwt. for 48 miles be 7*s.* 6*d.*, what will be the carriage of 15 cwt. for 24 miles? *Ans.* 11*s.* 3*d.*

(4) If 48*l.* be the wages of 36 men for 9 days, what will be earned by 12 men in 90 days? *Ans.* 160*l.*

---

(5) If a person travels 240 miles in 7 days, when the day is 14 hours long, in how many days of 7 hours each will he travel 120 miles?

By the first rule.

miles		*days*		*miles*
* 240	:	7	::	120
14 *ho.*:		—	::	7 *ho.**

120
14

1680
7

Divisor 1680

168,0)1176,0(7 *days Ans.*
1176

..

By the second rule.

days		*hours*		*miles*
7	:	14	::	240
—	:	7	::	120

(6) If 14 men can dig 360 cubical yards of earth in 5 days, how many men can dig 144 cubical yards in 7 days?

Ans. 4 *men*

(7) If 75 men can throw up an entrenchment in 5 days, when the day is 12 hours long, in what time will 50 men do it, when the day is 18 hours? *Ans.* 5 *days*

(8) If a barrel of ale will last a family of 6 persons 2 months, how many persons would drink 9 barrels in a year?

Ans. 9 *persons*

(9) Suppose 84 gallons of brandy will serve 220 seamen 8 days, how much will 380 seamen drink in 12 days?

seamen		*galls.*		*seamen*		*seamen*		*days*		*galls.*
* 220	:	84	::	380		220	:	8	::	84
* 8 *da.*:		—	::	12 *da.*		380	:	12	::	—

220 × 8 × 380 × 84 × 12

1760 | 31920

176,0) 38304,0 ($217\frac{112}{176}$ *galls.*

(10) If 150*l.* in 12 months gain 6*l.* 15*s.*, what will be the interest of 700*l.* for 7 years? *Ans.* 220*l.* 10*s.*

(11) If 7 horses eat 25 bushels of oats in 10 days, how many horses will eat up 100 bushels in a fortnight?

Ans. 20 *horses*

(12) If 6 horses plough 10 acres of land in 5 days, how many horses will plough 16 acres in 12 days? *Ans.* 4 *horses*

(13) How many bushels of wheat will serve 54 people 14 days, when 3 bushels will serve 6 people 21 days?

Ans. 18 *bushels*

(14) Lent a friend 800*l.* for 9 months at 5*l.* per cent., how long ought he to lend me 1250*l.* at 4*l.* per cent. to requite my kindness?

By the first rule.

£		*mo.*		£	
800	:	9	::	1250	*
5	:	—	::	4	*

1250 × 800 × 4 × 9 × 5000 × 7200 × 5 × 5,000) 36,000

7 *mo.* $\frac{1}{5}$ = 7 *mo.* 6 *da.*

The truth of this operation may be proved by the rule of Interest, thus:

800*l.* 5 pr. c. 1250*l.* 4 per cent.

mo.			mo.		
6	½	40 (00	6	½	50 (00
			1	⅙	25
3	½	20	d.		
		10	6	⅕	4 3 4
					0 16 8

30*l.* for 9 *mo.* £30 0 0 for 7 *mo.*

Hence it is evident that the 800*l.* for 9 months at 5*l.* per cent. is 30*l.* interest; and of 1250*l.* for 7 months 6 days, at 4*l.* per cent. amounts to the same.

(15) If 756 bricks, 14 inches long and 10 broad, will pave a floor; how many bricks would it take 15 inches long and 2 inches broad? *Ans.* 784 bricks

(16) If 12 inches in length, 12 inches in breadth, and 12 in thickness, make a solid foot, what length of a plank that is 6 inches broad and 4 inches thick will make the same?

Ans. 72 *inches*

PRACTICE.

PRACTICE is so called from its general use to all persons concerned in trade and business; it being a compendious method of ascertaining the value of any quantity of goods or other commodities.

All questions in this rule might be worked by *Multiplication*, or the *Rule of Three*; but they are here more expeditiously performed, *by taking aliquot* or *even parts*.

TABLES OF ALIQUOT PARTS.

Of a Pound.				*Of a Shilling.*			*Of a Ton.*			*Of a Hundred.*		
10*s.*	0*d.*	is	$\frac{1}{2}$	6*d.*	is	$\frac{1}{2}$	10 *cwt.*	is	$\frac{1}{2}$	2 *qrs.* or 56 *lb.*		$\frac{1}{2}$
6	8	...	$\frac{1}{3}$	4	.....	$\frac{1}{3}$	5	.....	$\frac{1}{4}$	1 *qr.* or 28 *lb.*		$\frac{1}{4}$
5	0	...	$\frac{1}{4}$	3	.....	$\frac{1}{4}$	4	.....	$\frac{1}{5}$		16 ...	$\frac{1}{7}$
4	0	...	$\frac{1}{5}$	2	.....	$\frac{1}{6}$	$2\frac{1}{2}$	.....	$\frac{1}{8}$		14 ...	$\frac{1}{8}$
3	4	...	$\frac{1}{6}$	$1\frac{1}{2}$	.....	$\frac{1}{8}$	2	.....	$\frac{1}{10}$		7 ...	$\frac{1}{16}$
2	6	...	$\frac{1}{8}$	1	.....	$\frac{1}{12}$	1	.....	$\frac{1}{20}$		4 ...	$\frac{1}{28}$
2	0	...	$\frac{1}{10}$	$\frac{1}{2}$	.....	$\frac{1}{24}$	*Parts of a lb.*			*Of a Quarter.*		
1	8	...	$\frac{1}{12}$	$\frac{1}{4}$	.....	$\frac{1}{48}$	8 *oz.*	is	$\frac{1}{2}$	14 *lb.*	is	$\frac{1}{2}$
1	4	...	$\frac{1}{16}$	*Of a Penny.*			4	....	$\frac{1}{4}$	7	...	$\frac{1}{4}$
1	3	...	$\frac{1}{16}$	2 *farthings* ...		$\frac{1}{2}$	2	.....	$\frac{1}{8}$	4	...	$\frac{1}{7}$
1	0	...	$\frac{1}{20}$	1 *farthing* ...		$\frac{1}{4}$	1	.....	$\frac{1}{16}$	$3\frac{1}{2}$	...	$\frac{1}{8}$

RULE I.—*When the price is less than a penny*—Divide the given number by the aliquot parts that are in a penny; then by 12 and 20 for the answer.

(1) $\frac{1}{4}$ | $\frac{1}{4}$ | 3857 at $\frac{1}{4}$

12 | 964$\frac{1}{4}$

2,0 | 8,0 4$\frac{1}{4}$

Ans. 4 0 4$\frac{1}{4}$

(2) 2794 at $\frac{1}{4}$
Ans. 2*l.* 18*s.* 2$\frac{1}{2}$*d.*

(3) 4657 at $\frac{1}{4}$
Ans. 4*l.* 17*s.* 0$\frac{1}{4}$*d.*

(4) 6120 at $\frac{1}{4}$
Ans. 6*l.* 7*s.* 6*d.*

(5) $\frac{1}{2}$ | $\frac{1}{2}$ | 5687 at $\frac{1}{2}$

12 | 2843$\frac{1}{2}$

2,0 | 23,6 11$\frac{1}{2}$

Ans. 11 16 11$\frac{1}{2}$

(6) 3987 at $\frac{1}{2}$
Ans. 8*l.* 6*s.* 1$\frac{1}{2}$*d.*

(7) 6055 at $\frac{1}{2}$
Ans. 12*l.* 12*s.* 3$\frac{1}{2}$*d.*

(8) 8317 at $\frac{1}{2}$
Ans. 17*l.* 6*s.* 6$\frac{1}{2}$*d.*

(9) $\frac{1}{2}$ | $\frac{1}{2}$ | 7459 at $\frac{3}{4}$

$\frac{1}{4}$ | $\frac{1}{2}$ | 3729$\frac{1}{2}$

1864$\frac{3}{4}$

12 | 559,4$\frac{1}{4}$

2,0 | 46,6 2$\frac{1}{4}$

Ans. 23 6 2$\frac{1}{4}$

(10) 3649 at $\frac{3}{4}$
Ans. 11*l.* 8*s.* 0$\frac{3}{4}$*d.*

(11) 3078 at $\frac{3}{4}$
Ans. 9*l* 12*s.* 4$\frac{1}{2}$*d.*

(12) 7580 at $\frac{3}{4}$
Ans. 23*l.* 13*s.* 9*d.*

II.—*When the price is less than a shilling*—divide the given number by the aliquot part or parts of a shilling, add them together, and divide by 20 for the answer.

(1) 1*d.* | $\frac{1}{12}$ | 3537 at 1*d.*
2,0 | 29,7 3*d.*
14 17 3

(2) 1*d.* | $\frac{1}{12}$ | 4359 at 1$\frac{1}{4}$*d.*
$\frac{1}{4}$ | $\frac{1}{4}$ | 363 3
90 9$\frac{3}{4}$
2,0 | 45,4 0$\frac{3}{4}$
22 14 0$\frac{3}{4}$

(3) 1$\frac{1}{2}$*d.* | $\frac{1}{8}$ | 5137 at 1$\frac{1}{2}$*d.*
2,0 | 64,2 1$\frac{1}{3}$
32 2 1$\frac{1}{3}$

(4) 1$\frac{1}{2}$*d.* | $\frac{1}{8}$ | 6259 at 1$\frac{3}{4}$*d.*
$\frac{1}{4}$ | $\frac{1}{6}$ | 782 4$\frac{1}{2}$
130 4$\frac{3}{4}$
2,0 | 91,2 9$\frac{1}{4}$
45 12 9$\frac{1}{4}$

(5) 2*d.* | $\frac{1}{6}$ | 7385 at 2*d.*
2,0 | 123,0 10
61 10 10

(6) 2*d.* | $\frac{1}{6}$ | 8479 at 2$\frac{1}{4}$*d.*
$\frac{1}{4}$ | $\frac{1}{8}$ | 1413 2
176 7$\frac{3}{4}$
2,0 | 158,9 9$\frac{3}{4}$
79 9 9$\frac{3}{4}$

(7) 2*d.* | $\frac{1}{6}$ | 9876 at 2$\frac{1}{2}$*d.*
$\frac{1}{2}$ | $\frac{1}{4}$ | 1646
411 6
2,0 | 205,7 6
102 17 6

(8) 2345 at 2$\frac{3}{4}$*d.*
Ans. 26*l.* 17*s.* 4$\frac{3}{4}$*d.*

(9) 1342 at 3*d.*
Ans. 16*l.* 15*s.* 6*d.*

(10) 4320 at 3$\frac{1}{4}$*d.*
Ans. 58*l.* 10*s.*

(11) 5627 at 3$\frac{1}{2}$*d.*
Ans. 82*l.* 1*s.* 2$\frac{1}{2}$*d.*

(12) 4396 at 3$\frac{3}{4}$*d.*
Ans. 68*l.* 13*s.* 9*d.*

(13) 5069 at 4*d.*
Ans. 84*l.* 9*s.* 8*d.*

(14) 6908 at 4$\frac{1}{4}$.
Ans. 122*l.* 6*s.* 7*d.*

(15) 8005 at 4$\frac{1}{2}$*d.*
Ans. 150*l.* 1*s.* 10$\frac{1}{2}$*d.*

(16) 2759 at 4$\frac{3}{4}$*d.*
Ans. 54*l.* 12*s.* 1$\frac{1}{4}$*d.*

(17) 7952 at 5*d.*
Ans. 165*l.* 13*s.* 4*d.*

(18) 6327 at 5$\frac{1}{4}$*d.*
Ans. 138*l.* 8*s.* 0$\frac{3}{4}$*d.*

(19) 3254 at 5$\frac{1}{2}$*d.*
Ans. 74*l.* 11*s.* 5*d.*

(20) 4968 at 5$\frac{3}{4}$*d.*
Ans. 119*l.* 0*s.* 6*d.*

(21) 3219 at 6*d.*
Ans. 80*l.* 9*s.* 6*d.*

(22) 2468 at 6$\frac{3}{4}$*d.*
Ans. 69*l.* 8*s.* 3*d.*

(23) 5321 at 7$\frac{1}{2}$*d.*
Ans. 166*l.* 5*s.* 7$\frac{1}{2}$*d.*

(24) 6019 at 7$\frac{3}{4}$*d.*
Ans. 194*l.* 7*s.* 3$\frac{1}{4}$*d.*

(25) 5068 at 8$\frac{1}{2}$*d.*
Ans. 179*l.* 9*s.* 10*d.*

(26) 8271 at 9*d.*
Aus. 310*l.* 3*s.* 3*d.*

(27) 4564 at 9$\frac{3}{4}$*d.*
Ans. 185*l.* 8*s.* 3*d*

(28) 8765 at 10$\frac{1}{4}$*d.*
Ans. 374*l.* 6*s.* 9$\frac{1}{4}$*d.*

(29) 6213 at 10$\frac{3}{4}$*d.*
Ans. 278*l.* 5*s.* 9$\frac{3}{4}$*d.*

(30) 5986 at 11*d.*
Ans. 274*l.* 7*s.* 2*d.*

(31) 7328 at 11$\frac{1}{4}$*d.*
Ans. 343*l.* 10*s.*

(32) 4537 at 11$\frac{1}{2}$*d.*
Ans. 217*l.* 7*s.* 11$\frac{1}{2}$*d.*

(33) 9765 at 11$\frac{3}{4}$*d.*
Ans. 478*l.* 1*s.* 6$\frac{3}{4}$*d.*

III.—*When the price is more than one shilling and less than two*—take the aliquot part or parts for so much of the given price as is *more than a shilling*, which add to the given quantity, and divide by 20 for the answer.

(1) $\frac{1}{4}$ | $\frac{1}{48}$ | 5364 at 1*s.* $\frac{1}{4}$
111 9
2,0 | 547,5 9
273 15 9

(2) 3620 at 1*s.* 0$\frac{1}{2}$*d.*
Ans. 188*l.* 10*s.* 10*d.*

(3) 5426 at 1*s.* 0$\frac{3}{4}$*d.*
Ans. 288*l.* 5*s.* 1$\frac{1}{2}$*d.*

(4) 6421 at 1*s.* 1*d.*
Ans. 347*l.* 16*s.* 1*d.*

(5) 7536 at 1*s.* 1$\frac{1}{4}$*d.*
Ans. 416*l.* 1*s.*

(6) 5897 at 1*s.* 1$\frac{1}{2}$*d.*
Ans. 331*l.* 14*s.* 1$\frac{1}{2}$*d.*

(7) 6230 at 1*s.* 1$\frac{3}{4}$*d.*
Ans. 356*l.* 18*s.* 6$\frac{1}{2}$*d.*

(8) 4586 at 1*s.* 2*d.*
Ans. 267*l.* 10*s.* 4*d.*

(9) 6329 at 1*s.* 2$\frac{1}{4}$*d.*
Ans. 375*l.* 15*s.* 8$\frac{1}{4}$*d.*

(10) 7638 at 1*s.* 2$\frac{1}{2}$*d.*
Ans. 461*l.* 9*s.* 3*d.*

(11) 4006 at 1*s.* 2$\frac{3}{4}$*d.*
Ans. 246*l.* 4*s.* 0$\frac{1}{2}$*d.*

(12) 7068 at 1*s.* 3*d.*
Ans. 441*l.* 15*s.*

(13) 4320 at 1*s.* 3$\frac{1}{4}$*d.*
Ans. 274*l.* 10*s.*

(14) 3*d.* | $\frac{1}{4}$ | 6547 at 1 3$\frac{3}{4}$
$\frac{3}{4}$ | $\frac{1}{4}$ | 1636 9
409 2$\frac{1}{4}$
2,0 | 859,2 11$\frac{1}{4}$
429 12 11$\frac{1}{4}$

(15) 3249 at 1*s.* 4*d.*
Ans. 216*l.* 12*s.*

(16) 7060 at 1*s.* 4$\frac{1}{4}$*d.*
Ans. 478*l.* 0*s.* 5*d.*

(17) 6391 at 1*s.* 4$\frac{1}{2}$*d.*
Ans. 439*l.* 7*s.* 7$\frac{1}{2}$*d.*

(18) 8325 at 1*s.* 4$\frac{3}{4}$*d.*
Ans. 581*l.* 0*s.* 3$\frac{3}{4}$*d.*

(19) 7510 at 1*s.* 5*d.*
Ans. 531*l.* 19*s.* 2*d.*

(20) 4238 at 1*s.* 5$\frac{1}{4}$*d.*
Ans. 304*l.* 12*s.* 1$\frac{1}{2}$*d.*

(21) 6266 at 1*s.* 5$\frac{1}{2}$*d.*
Ans. 456*l.* 17*s.* 11*d.*

(22) 4326 at 1*s.* 5$\frac{3}{4}$*d*
A. 319*l.* 18*s.* 10$\frac{1}{2}$*d.*

(23) 6007 at 1*s.* 6*d.*
Ans. 450*l.* 10*s.* 6*d.*

(24) 7805 at 1*s.* 6$\frac{1}{4}$*d.*
Ans. 593*l.* 10*s.* 1$\frac{1}{4}$*d.*

(25) 4265 at 1*s.* 6$\frac{1}{2}$*d.*
Ans. 328*l.* 15*s.* 2$\frac{1}{2}$*d.*

(26) 3654 at 1*s.* 7*d.*
Ans. 289*l.* 5*s.* 6*d.*

(27) 6*d.* | $\frac{1}{2}$ | 3679 at 1 7$\frac{1}{4}$
1*d.* | $\frac{1}{6}$ | 1839 6
$\frac{1}{4}$ | 306 7
76 7$\frac{3}{4}$
2,0 | 590,1 8$\frac{3}{4}$
295 1 8$\frac{3}{4}$

(28) 4326 at 1*s.* 7$\frac{3}{4}$*d.*
A. 355*l.* 19*s.* 10$\frac{1}{2}$*d.*

(29) 5432 at 1*s.* 8*d.*
Ans. 452*l.* 13*s.* 4*d.*

(30) 6548 at 1*s.* 8$\frac{3}{4}$*d.*
Ans. 566*l.* 2*s.* 7*d.*

(31) 7464 at 1*s.* 9$\frac{1}{4}$*d.*
Ans. 660*l.* 17*s.* 6*d.*

(32) 4263 at 1*s.* 9$\frac{1}{2}$*d.*
Ans. 381*l.* 17*s.* 10$\frac{1}{2}$*d.*

(33) 6791 at 1*s.* 10*d.*
Ans. 622*l.* 10*s.* 2*d.*

(34) 1169 at 1*s.* 10$\frac{1}{2}$*d.*
Ans. 109*l.* 11*s.* 10$\frac{1}{2}$*d.*

(35) 5544 at 1*s.* 10$\frac{3}{4}$*d.*
Ans. 525*l.* 10*s.* 6*d.*

(36) 7590 at 1*s.* 11*d.*
Ans. 727*l.* 7*s.* 6*d.*

(37) 4674 at 1*s.* 11$\frac{1}{4}$*d.*
A. 452*l.* 15*s.* 10$\frac{1}{2}$*d.*

(38) 3000 at 1*s.* 11$\frac{1}{2}$*d.*
Ans. 293*l.* 15*s.*

(39) 4433 at 1*s.* 11$\frac{3}{4}$*d.*
Ans. 438*l.* 13*s.* 7$\frac{3}{4}$*d.*

IV.—*If the price be an even number of shillings, under* 20—multiply the quantity by *half the number, doubling* the *first* figure of the product for *shillings*, and the rest will be *pounds*.

(1) 3643 at 2*s*.
1

Ans. 364 6

(2) 3752 at 4*s*.
Ans. 750*l*. 8*s*.

(3) 6543 at 6*s*.
Ans. 1962*l*. 18*s*.

(4) 7134 at 8*s*.
Ans. 2853*l*. 12*s*.

(5) 3592 at 10*s*.
5

Ans. 1796 0

Or thus:
10*s*. | ½ | 3876 at 10*s*.

Ans. 1938

(6) 3908 at 12*s*.
Ans. 2344*l*. 16*s*.

(7) 7766 at 14*s*.
Ans. 5436*l*. 4*s*.

(8) 3609 at 14*s*.
7

Ans. 2526 6

(9) 8372 at 16*s*.
Ans. 6697*l*. 12*s*.

(10) 17654 at 18*s*.
Ans. 15888*l*. 12*s*.

(11) 12346 at 18*s*.
Ans. 11111*l*. 8*s*.

V.—*If the price consists of odd shillings*—1st. Multiply the given quantity by the price, and divide by 20 for the answer. Or, 2nd. Find the greatest even number as in the last rule; to which add $\frac{1}{20}$th of the given number for the odd shilling, and their sum will be the answer.

By the first rule.
(1) 7462 at 7*s*.
7

2,0 | 5223,4

Ans. 2611 14

(2) 3264 at 9*s*.
Ans. 1468*l*. 16*s*.

(3) 4689 at 11*s*.
Ans. 2578*l*. 19*s*.

(4) 7626 at 13*s*.
Ans. 4956*l*. 18*s*.

(5) 4258 at 15*s*.
Ans. 3193*l*. 10*s*.

(6) 6384 at 17*s*.
Ans. 5426*l*. 8*s*.

(7) 1234 at 19*s*.
Ans. 1172*l*. 6*s*.

By the second rule.
(8) 73641 at 17*s*.
8

58912 16
3682 1

Ans. 62594 17

(9) 3258 at 17*s*.
Ans. 2769*l*. 6*s*

(10) 1069 at 19*s*.
Ans. 1015*l*. 11*s*.

VI.—*When the price is shillings and pence*—if they are the *aliquot part* of a pound, *divide* the quantity *by that part*, and the *quotient* will be the *answer* in pounds.

But 2ndly. If they are *not an aliquot part*, find first for the *shillings*, then take parts for the *pence*, and add them together.

3rdly. When the price is shillings, pence, and *farthings*, find for the shillings and pence as before, and *for the farthings*, take parts from a preceding line.

(1) 3*s*. 4*d* | $\frac{1}{6}$ | 3625 at 3*s*. 4*d*.

Ans. 604 3 4

(2) 5731 at 6*s*. 8*d*.
Ans. 1910*l*. 6*s*. 8*d*.

(3) 2437 at 2*s*. 6*d*.
Ans. 304*l*. 12*s*. 6*d*.

(4) 4675 at 5*s*.
Ans. 1168*l*. 15*s*.

(5) 6543 at 10*s*.
Ans. 3271*l*. 10*s*.

(6) 1206 at 3*s*. 4*d*.
Ans. 201*l*.

(7) 9876 at 1*s*. 4*d*.
Ans. 658*l*. 8*s*.

(8) 5*s*. | $\frac{1}{4}$ | 4709 at 5*s*. 8*d*.

6*d*. | $\frac{1}{10}$ | 1177 5
2*d*. | $\frac{1}{3}$ | 117 14 6
39 4 10

£ 1334 4 4

(9) 7890 at 7*s*. 6*d*.
Ans. 2958*l*. 15*s*.

(10) 6234 at 4*s*. 8*d*.
Ans. 1454*l*. 12*s*.

(11) 4327 at 5*s*. 9*d*.
Ans. 1244*l*. 0*s*. 3*d*.

(12) 6432 at 10*s*. 10*d*.
Ans. 3484*l*.

(13) 6974 at 9*s*. 6*d*.
Ans. 3312*l*. 13*s*. 0*d*.

(14) 3*d*. | $\frac{1}{4}$ | 6745 at 3*s*. 3*d*.

3
20235
1686
2,0)2192,1 3

Ans. 1096 1 3

(15) 6308 at 7*s*. 5*d*.
Ans. 2339*l*. 4*s*. 4*d*.

(16) 9085 at 11*s*. 6*d*.
Ans. 5223*l*. 17*s*. 6*d*.

(17) 8712 at 15*s*. 9*d*.
Ans. 6860*l*. 14*s*.

(18) 3240 at 18*s*. 8*d*.
Ans. 3024*l*.

(19) 6267 at 19*s*. 6*d*.
Ans. 6110*l*. 6*s*. 6*d*.

(20) 6*d*. | $\frac{1}{2}$ | 3866 at 11*s*. 9$\frac{1}{2}$*d*.

11
42526
3*d*. | $\frac{1}{2}$ | 1933
$\frac{1}{2}$ | 966 6
161 1
2,0)4558,6 7

Ans. 2279 6 7

(21) 4275 at 12*s*. 8$\frac{3}{4}$*d*.
Ans. 2720*l*. 17*s*. 2$\frac{1}{4}$*d*

(22) 2508 at 9*s*. 10$\frac{1}{2}$*d*.
Ans. 1238*l*. 6*s*. 6*d*.

(23) 4597 at 15*s*. 6$\frac{1}{2}$*d*.
Ans. 3572*l*. 5*s*. 0$\frac{1}{2}$*d*

(24) 1060 at 16*s*. 2$\frac{1}{4}$*d*.
Ans. 857*l*. 18*s*. 9*d*.

(25) 6324 at 18*s*. 3$\frac{1}{4}$*d*.
Ans. 5777*l*. 4*s*. 9*d*

VII. *When the price is pounds and shillings; or pounds, shillings, pence, and farthings.*

Rule. Multiply the quntity by the *pounds*, and proceed for the *shillings*, *pence*, &c. according to the preceding rules; then these sums *added together* will give the answer.

6*s.* 8*d.* | $\frac{1}{3}$ | 547 at 7*l.* 6*s.* 8*d.*

7

3829

182 6 8

£4011 6 8

(2) 456 at 8*l.* 5*s.*
Ans. 3762*l.*

(3) 7960 at 9*l.* 4*s.*
Ans. 73232*l.*

(4) 4069 at 11*l.* 3*s.* 4*d.*
Ans. 45437*l.* 3*s.* 4*d.*

(5) 897 at 12*l.* 2*s.* 6*d.*
Ans. 10876*l.* 2*s.* 6*d.*

(6) 5*s.* | $\frac{1}{4}$ | 1287 at 3*l.* 7*s.* 6*d.*

3

3861

2*s.* 6*d.* | $\frac{1}{2}$ | 321 15

160 17 6

£4342 12 6

(7) 4685 at 6*l.* 9*s.* 4*d.*
Ans. 30296*l.* 6*s.* 8*d.*

(8) 2397 at 10*l.* 15*s.* 10*d.*
Ans. 25867*l.* 12*s.* 6*d.*

(9) 1234 at 1*l.* 14*s.* 7*d.*
Ans. 2133*l.* 15*s.* 10*d.*

(10) 4538 at 5*l.* 17*s.* 9*d.*
Ans. 26717*l.* 9*s.* 6*d.*

		£	*s.*	*d.*
(11) 10*s.*	$\frac{1}{2}$	1396 at 1	19	$11\frac{3}{4}$
5*s.*	$\frac{1}{2}$	698		
4*s.*	$\frac{1}{5}$	349		
6*d.*	$\frac{1}{8}$	279	4	
4*d.*	$\frac{1}{12}$	34	18	
$1\frac{1}{2}$*d.*	$\frac{1}{4}$	23	5	4
$\frac{1}{4}$	$\frac{1}{16}$	8	14	6
		1	9	1
		£2790	10	11

(12) 3256 at 1*l.* 15*s.* $5\frac{1}{2}$*d.*
Ans. 5772*l.* 12*s.* 4*d.*

(13) 2568 at 1*l.* 19*s.* $6\frac{1}{2}$*d.*
Ans. 5077*l.* 3*s.*

(14) 4400 at 1*l.* 13*s.* $4\frac{1}{2}$*d.*
Ans. 7342*l.* 10*s.*

(15) 6432 at 2*l.* 17*s.* $7\frac{1}{2}$*d.*
Ans. 18532*l.* 4*s.*

(16) 432 at 3*l.* 13*s.* $4\frac{1}{2}$*d.*
Ans. 1584*l.* 18*s.*

(17) 1006 at 4*l.* 11*s.* $4\frac{1}{2}$*d.*
Ans. 4596*l.* 3*s.* 3*d*

(18) 1436 at 5*l.* 5*s.* $5\frac{3}{4}$*d.*
Ans. 7573*l.* 8*s.* 1*d*

(19) 326 at 6*l.* 16*s.* $9\frac{3}{4}$*d.*
Ans. 2230*l.* 0*s.* $10\frac{1}{2}$*d.*

(20) 1281 at 7*l.* 7*s.* $7\frac{1}{2}$*d.*
Ans. 9455*l.* 7*s.* $7\frac{1}{2}$*d.*

VIII. *When the quantity is a whole number and a fraction.*

RULE. Work for the whole number by the former rules; to which *add* $\frac{1}{4}$, $\frac{1}{2}$, or any other part of the *price*, and add as before for the answer.

Or, for the *fractional parts*, multiply the price by the *upper* figure, and divide by the *under*, as in Example the 11th.

			£	s.	d.
(1) 5*s.*	$\frac{1}{4}$	$628\frac{3}{4}$ at	1	7	$10\frac{1}{2}$*d.*
2*s.* 6*d.*	$\frac{1}{2}$	157			
3*d.*	$\frac{1}{10}$	78	10		
$1\frac{1}{2}$*d.*	$\frac{1}{2}$	7	17		
		3	18	6	
for the $\frac{1}{2}$			13	$11\frac{1}{4}$	
for the $\frac{1}{4}$			6	$11\frac{1}{2}$	
		£	876	6	$4\frac{3}{4}$

(2) $435\frac{1}{2}$ at 2*l.* 12*s.* 6*d.*
Ans. 1143*l.* 3*s.* 9*d.*

(3) $608\frac{1}{4}$ at 3*l.* 2*s.* 6*d.*
Ans. 1900*l.* 15*s.* $7\frac{1}{2}$*d.*

(4) $439\frac{3}{4}$ at 4*l.* 5*s.* 6*d.*
Ans. 1879*l.* 18*s.* $7\frac{1}{2}$*d.*

(5) $532\frac{1}{4}$ at 5*l.* 1*s.* 4*d.*
Ans. 2696*l.* 14*s.* 8*d.*

(6) $276\frac{1}{2}$ at 17*s.* 6*d.*
Ans. 241*l.* 18*s.* 9*d.*

(7) $426\frac{3}{4}$ at 18*s.* 4*d.*
Ans. 391*l.* 3*s.* 9*d.*

(8) $1234\frac{1}{4}$ at 4*s.* $6\frac{1}{2}$*d.*
Ans. 280*l.* 5*s.* $6\frac{1}{2}$*d.*

(9) $321\frac{1}{2}$ at 5*s.* $10\frac{1}{2}$*d.*
Ans. 94*l.* 8*s.* $9\frac{3}{4}$*d.*

(10) $987\frac{3}{4}$ at 11*s.* 11*d.*
Ans. 588*l.* 10*s.* $8\frac{1}{4}$*d.*

			£	s.	d.
(11) 10*s.*	$\frac{1}{2}$	$364\frac{3}{8}$			
		2			
		728			
		at 2	12		$6\frac{3}{4}$
					3
		8)7	17		$8\frac{1}{4}$
2*s.*	$\frac{1}{10}$	182			
6*d.*	$\frac{1}{40}$	36	8		
$\frac{3}{4}$	$\frac{1}{8}$	9	2		
		1	2	9	
For $\frac{3}{8}$		0	19	$8\frac{1}{2}$	
		£	957	12	$5\frac{1}{2}$

(12) $246\frac{3}{8}$ at 4*l.* 10*s.* 6*d.*
Ans. 1114*l.* 16*s.* $11\frac{1}{4}$*d.*

(13) $345\frac{3}{8}$ at 16*s.* 6*d.*
Ans. 284*l.* 18*s.* $8\frac{1}{4}$*d.*

(14) $987\frac{3}{8}$ at 7*s.* $8\frac{1}{2}$*d.*
Ans. 380*l.* 11*s.*

(15) 10*s.*	$\frac{1}{2}$	$684\frac{5}{8}$ at	18*s.*	$6\frac{1}{2}$*d.*	
5*s.*	$\frac{1}{2}$	342			
3*s.* 4*d.*	$\frac{1}{6}$	171			
2*d.*	$\frac{1}{20}$	114			
$\frac{1}{2}$	$\frac{1}{4}$	5	14		
		1	8	6	
$\frac{4}{8}$	$\frac{1}{2}$		9	$3\frac{1}{4}$	
$\frac{1}{8}$	$\frac{1}{4}$		2	$3\frac{3}{4}$	
		£	634	14	1

(16) $189\frac{5}{8}$ at 15*s.* 6*d.*
Ans. 146*l.* 19*s.* $2\frac{1}{4}$*d.*

(17) $365\frac{5}{8}$ at 1*l.* 15*s.* 6*d.*
Ans. 648*l.* 19*s.* $8\frac{1}{4}$*d.*

(18) 1000 at 2*l.* 7*s.* 6*d.*
Ans. 2375*l.*

IX. *When both the* price *and the quantity are of several denominations.*

Rule. Multiply the price by the *highest* denomination, and take parts for the *lower* denominations: then add them together for the answer.

(1) At 5*l.* 15*s.* 6*d.* per cwt., what is the value of 75 cwt. 3 qrs. 21 lb. of hops?

		£	s.	d.		cwt.	qr.	lb.
2 qrs.	½	5	15	6 × 3				
				6 × 12 + 3 = 75				
		34	13	0 = 6				
				12				
		415	16	0	=	72	0	0
		17	6	6	=	3	0	0
1 qr.	½	2	17	9	=	0	2	0
14 lb.	½	1	8	10½	=	0	1	0
7 lb.	½	0	14	5¼	=	0	0	14
		0	7	2⅝	=	0	0	7
Ans.		438	10	9¼	=	75	3	21

(2) At 3*l.* 18*s.* 6*d.* per cwt., what is the value of 36 cwt. 1 qr. 7lb. of sugar? *Ans.* 142*l.* 10*s.* 6¼*d.*

(3) Sold 28 cwt. 3 qrs. 14 lb. of cheese, at 2*l.* 12*s.* 6*d.* per cwt., what does it come to? *Ans.* 75*l.* 15*s.* 11¼*d.*

(4) Bought 29 cwt. 1 qr. 11 lb. of tea at 10*l.* 18*s.* 8*d.* per cwt., what was the cost of the whole? *Ans.* 320*l.* 17*s.* 5½*d.*

(5) What is the value of 13 cwt. 3 qr. 4 lb. of butter at 2*l.* 18*s.* 4*d.* per cwt.? *Ans.* 40*l.* 4*s.* 2*d.*

(6) At 4*l.* 16*s.* 9*d.* per cwt., what is the worth of 11 cwt. 0 qr. 14 lb. of double refined sugar? *Ans.* 53*l.* 16*s.* 4*d.*

(7) What must I pay for 34 acres 2 roods 20 poles of land, at 2*l.* 11*s.* 6*d.* per acre? *Ans.* 89*l.* 3*s.* 2¼*d*

(8) Bought 37 qrs. 4 bush. 2 pecks of wheat, at 4*l.* 16*s.* 6*d.* per quarter, what does the whole cost? *Ans.* 181*l.* 4*s.* 9¼*d.*

(9) At 1*l.* 6*s.* 4*d.* per gallon, what will 17 gall. 2 qts. 1 pint of brandy come to? *Ans.* 23*l.* 4*s.* 1½*d.*

(10) Sold 17 tons 5 cwt. 2 qrs. at 12*l.* 10*s.* 4*d.* per ton, how much did they realize? *Ans.* 216*l.* 4*s.* 6*d.*

(11) Soap at 4*l.* 2*s.* 8*d.* per cwt., what is the worth of 19 cwt. 3 qrs. 7 lb.? *Ans.* 81*l.* 17*s.* 10*d.*

(12) Tobacco at 5*l.* 16*s.* 8*d.* per cwt., what is the worth of 42 cwt. 0 qr. 16 lb.? *Ans.* 245*l.* 16*s.* 8*d.*

(13) At 3*l.* 14*s.* per cwt., what is the value of 18 cwt. 1 qr. 4lb. of currants? *Ans.* 67*l.* 13*s.* 1½*d.*

TARE AND TRETT.

THIS Rule teaches the method of deducting such allowances as are usually made by merchants and tradesmen in selling their goods; and the terms in general use are *gross weight, tare, trett, cloff, suttle, and neat weight.*

Gross weight is the *whole weight* of the goods, and of that *which contains them*, whether box, barrel, bag, chest, hamper, &c.

Tare is an allowance made to the buyer for the weight of the box, barrel, &c. This is charged either at so much per box, &c., or at so much per cwt., or at so much in the whole.

Trett is an allowance of 4 lb. per 104 (*i. e.* a 26th part of the whole) for waste, dust, &c.

Suttle weight is when part of the allowance is deducted from the *gross.*

Cloff is an allowance (after tare and trett are deducted) of 2 lb. in every 3 cwt. (or 1 lb. in every 168 lb.) to make the weight hold out when sold by retail.

Neat or *net weight* is the pure weight, when all allowances are deducted from the gross weight.

Examples.

CASE I. *When the tare is so much in the whole.*

Rule. *Subtract* the *tare* from the *gross*, and the remainder will be the *neat weight.*

(1) If the gross weight of several barrels of raisins be 130 cwt. 2 qrs. 18 lb., and the tare be 3 cwt. 3 qrs. 24 lb., what is the neat weight?

	cwt.	*qrs.*	*lbs.*	
	130	2	18	*gross*
	3	3	24	*tare*
Ans.	126	2	22	*neat weight*

(2) If the gross weight of several bags be 31 cwt. 1 qr. 10 lb. and the tare be 3 cwt. 1 qr. 16 lb., what is the neat weight? *Ans.* 27 *cwt.* 3 *qrs.* 22 *lb.*

(3) If the gross weight of 20 frails of raisins be 11 cwt. 2 qrs. and the tare be 1 cwt. 3 qrs. 5lb., what will be the neat weight? *Ans.* 9 *cwt.* 2 *qr.* 23 *lb.*

(4) What is the neat weight of a quantity of goods, if the gross is 1 ton 3 cwt. 3 qrs. 5 lb. and the tare 7 cwt. 3 qrs. 16 lb.? *Ans.* 15 *cwt.* 3 *qrs.* 17 *lb.*

(5) In 17 barrels, weighing in the whole 36 cwt. 3 qrs. 16 lb. gross, and tare in the whole 3 cwt. 0 qr. 19 lb. how much neat weight? *Ans.* 33 *cwt.* 2 *qr.* 25 *lb.*

---

(6) In 7 frails of raisins, each weighing 3 cwt. 2 qr. 15 lb. gross, tare in the whole 3 qrs. 18lb., how much neat weight?

cwt.	*qrs.*	*lb.*	
3	2	15	
		7	
25	1	21	*gross*
	3	18	*tare*
Ans. 24	2	3	*neat weight*

(7) In 8 barrels of figs, each 3 qrs. 27 lb. gross, and tare in the whole 2 qrs. 11 lbs., how much neat weight?

Ans. 7 *cwt.* 1 *qr.* 9 *lb.*

(8) In 9 hhds. of nutmegs, each weighing gross 6 cwt. 3 qrs. 16lb., and tare in the whole 1 cwt. 0 qr. 17 lb., how much neat weight? *Ans.* 60 *cwt.* 3 *qrs.* 15 *lb.*

(9) What is the neat weight of 20 casks of argol, weighing each 7 cwt. 2 qrs. 10 lb., and tare in the whole 1 cwt. 3 qrs. 16 lb.? *Ans.* 149 *cwt.* 3 *qrs.* 16 *lb.*

---

(10) The gross weight is 3 cwt. 1 qr. 11 lb. per hhd., and tare in the whole 182 lb., what is the neat weight of 12 hhds.?

cwt.	*qr.*	*lb.*	
3	1	11	
		12	
40	0	20	*gross*
1	2	14	*tare*
Ans. 38	2	6	*neat weight*

28) 182 (4) 6
168
14

1 2 14 *tare*

(11) If the gross weight of 5 loads be 3 tons 2 cwt. 1 qr. per load, and the whole tare be 1760 lb., how much neat weight? *Ans.* 14 *tons,* 15 *cwt.* 2 *qrs.* 4 *lb.*

(12) What is the neat weight of 14 hhds. of tobacco, each weighing 5 cwt. 3 qr. 12 lb., tare in the whole 1260 lb.?

Ans. 70 *cwt.* 3 *qrs.*

II. *When the tare is at so much per bag, barrel, box &c.*

RULE. Multiply the tare of each box, barrel, &c. by the number of boxes, barrels, &c., then subtract the product from the gross, and the remainder will be the neat weight.

(13) What will be the neat weight of 7 bags of hops, weighing in the whole 12 cwt. 2 qrs. 9 lb., and tare 18 lb. per bag?

cwt	*qr.*	*lb.*	
12	2	9	
1	0	14	*tare*
Ans. 11	1	23	*neat weight*

lb.
18
7
28)126(4 *qr.* = 1 0 14 *tare*
112
14

(14) What is the neat weight of 36 bales of silk, weighing in the whole 74 cwt. 0 qr. 16 lb., tare 17 lb. per bale?
Ans. 68 *cwt.* 2 *qrs.* 20 *lb.*

(15) In 14 bags of pepper, weighing in the whole 9 cwt. 2 qrs. 13 lb. gross, tare per bag, 4 lb. 4 oz., how much neat weight? *Ans.* 9 *cwt.* 0 *qrs.* 9 *lb.* 8 *oz.*

---

(16) What is the neat weight of 12 chests of sugar, each weighing 14 cwt. 1 qr. 5 lb. gross, and tare 19 lb. per chest?

cwt.	*qr.*	*lb.*	
14	1	5	
		12	
171	2	4	*gross*
2	0	4	*tare*
Ans. 169	2	0	*neat*

lb.
19
12
28)228(8
224
2 0 4 *tare*

Shorter, thus:

cwt.	*qr.*	*lb.*	
14	1	5	*gr. of* 1 *chest*
		19	*tare of ditto*
14	0	14	*n. w. of* 1 *c.*
		12	
169	2	0	*neat weight*

(17) What is the neat weight of 25 barrels, each weighing gross 5 cwt. 3 qrs. 7 lb., and tare per barrel 2 qrs. 12 lbs.?
Ans. 130 *cwt.* 0 *qr.* 15 *lb.*

(18) The gross weight of 21 hogsheads is 3 cwt. 1 qr. 8 lb. per hogshead, and the tare is 3 qrs. 10 lbs. per hogshead; what is the neat weight? *Ans.* 52 *cwt.* 0 *qr.* 14 *lb.*

(19) If there are 7 casks of goods, and the gross weight of each cask is 4 cwt. 3 qrs. 16 lb. and the tare 1 qr. 21 lb. per cask, what is the neat weight? *Ans.* 31 *cwt.* 0 *qr.* 21 *lb.*

III. *When the tare is at so much per cwt.*

RULE. *Divide* the gross weight by the *aliquot part* or *parts* of a cwt., which *subtract* from the gross, the remainder is neat.

(20) What is the neat weight of 12 barrels of potash, each weighing 287 lb. gross; the tare being 10 lb. per cwt.?

lb.
287
12

8 *lb.* | $\frac{1}{14}$ | 3444 *gross*

2 *lb.* | $\frac{1}{2}$ | 246
$61\frac{1}{2}$

$307\frac{1}{2}$ *tare*

Ans. $3136\frac{1}{2}$ *lb. neat*

(21) In 136 barrels of figs, each 126 lb. gross, tare 12 lb. per cwt., how many lbs. neat? *Ans.* 15300 *lb.*

(22) How many lbs. neat in 5 hhds., each 1 cwt. 3 qrs. 5 lb. gross, the tare being 14 lbs. per cwt.? *Ans.* $879\frac{1}{2}$ *lb.*

---

(23) In 11 frails, each 3 qrs. 16 lb. gross, and tare 16 lb. per cwt., how much neat weight?

qrs. *lb.*
3 16
11

16 *lb.* | $\frac{1}{7}$ | 9 3 8 *gross*
1 1 17 *tare*

Ans. 8 1 19 *neat weight*

(24) In 36 hogsheads, each 2 cwt. 3 qrs. 24 lb. gross; and tare 18 lb. per cwt., how much neat weight?

Ans. 89 *cwt.* 2 *qrs.* 7 *lb.* 3 *oz.*

(25) What is the neat weight of 21 casks, each weighing 2 cwt. 3 qrs. 18 lb. gross; and tare 13 lb. per cwt.?

Ans. 54 *cwt.* 0 *qrs.* $3\frac{1}{2}$ *lb.*

(26) In 33 parcels each weighing 2 cwt. 1 qr. gross; and tare 8 lb. per cwt., how much neat weight?

Ans. 68 *cwt.* 3 *qrs.* 22 *lb.*

IV. *When both tare and trett are allowed.*

RULE. Find the tare as before, *subtract* it from the gross, and call the remainder *suttle:* then *divide* the suttle by 26, the quotient will be the *trett;* which subtract from the suttle, the remainder will be the *neat weight.*

(27) In 112 cwt. 1 qr. 25 lb. gross, tare 184 lb., trett 4 lb. per 104, how many pounds neat?

cwt.	*qr.*	*lb.*	
112	1	25	
4			
449			
28			
12597			*gross*
184			*tare*
26 | 12413			*suttle*
477			*trett*
Ans. 11936			*lb. neat weight*

(28) In 36 cwt. 2 qrs. 4 lb. gross, tare 36 lb., trett 4 lb. per 104, how many lbs. neat? *Ans.* 3900 *lb.*

(29) What is the neat weight in lbs. of 3 hhds. each weighing 2 cwt. 3 qrs. 21 lb., tare 38 lb. per hhd., and trett as usual? *Ans.* 839½ *lb.*

(30) In 16 frails, each 3 qrs. 27 lb. gross, tare 7 lbs. per cwt., and trett 4 lb. per 104, how many lbs. neat?

Ans. 1601 *lb.*

---

(31) How much is the neat weight of 9 butts, each 7 cwt. 1 qr. 21 lb., tare 3 qrs. 14 lb. per butt, and trett as usual?

cwt.	*qr.*	*lb.*	
7	1	21	
		9	
66	3	21	*gross*
7	3	14	*tare*
26 | 59	0	7	*suttle*
2	1	2	*trett*
Ans. 56	3	5	*neat weight*

qr.	*lb.*	
3	14	
	9	
7	3	14 *tare*

Shorter, thus:

7	1	21	*gross*
	3	14	*tare*
6	2	7	
		9	
26 | 59	0	7	
2	1	2	
Ans. 56	3	5	

(32) How much neat weight in 3 butts, each 3 cwt. 2 qrs. 8 lb., tare 1 qr. 26 lb. per butt, and trett 4 lb. per 104? *Ans.* 8 *cwt.* 3 *qrs.* 18 *lb.*

(33) In 136 cwt. 2 qrs. 14 lb. gross, tare 12 lb. per cwt. and trett 4 lb. per 104, how much neat weight? *Ans.* 117 *cwt.* 1 *qr.* 5½ *lb.*

(34) What is the neat weight of a hogshead which weighs 3 cwt. 3 qrs. 10 lb.; tare 2 qrs. 8 lb. in the whole, and trett as usual? *Ans.* 3 *cwt.* 0 *qr.* 16 *lb.*

V.—*When tare, trett, and cloff, are allowed.*

Rule.—Work for the tare and trett as before; then divide the remainder, or suttle, by 168; the quotient will be *cloff*, which *subtract* from the suttle, the remainder will be the *neat weight*.

N.B. Instead of dividing by 168 for the cloff, the more common and ready way is to multiply the cwts. suttle by *two*, and divide the product by *three*, and the quotient will be the pounds cloff.

(35) What is the neat weight of 7 hhds., each weighing 5 cwt. 2 qrs. 16 lb. gross, tare in the whole 2 cwt. 1 qr. 8 lb., trett 4 lb. per 104, and cloff as usual?

	cwt.	*qr.*	*lb.*	
	5	2	16	
			7	
	39	2	0	*gross*
	2	1	8	*tare*
26)	37	0	20	*suttle*
	1	1	20	*trett*
168)	35	3	0	*suttle*
			23	*cloff*
Ans.	35	2	5	*neat wt.*

35
2
3) 70
23 *lb. cloff*

(36) In 17 chests, each weighing, gross 4 cwt. 3 qrs., tare in the whole 3 cwt. 3 qrs. 14 lb., trett and cloff as usual, how much neat weight? *Ans.* 73 *cwt.* 1 *qr.* 26 *lb.*

(37) In 25 cwt. 3 qrs. 16 lb. gross, tare 16 lb. per cwt., trett 4 lb. per 104, and cloff as usual, how much neat weight?
Ans. 21 *cwt.* 0 *qr.* 24¼ *lb.*

(38) What is the neat weight of 14 barrels of molasses, each containing 5 cwt. 1 qr. 12 lb. gross, tare 14 lb. per cwt., trett 4 lb. per 104, and cloff 2 lb. per 3 cwt.?

	cwt.	*qr.*	*lb.*	
	5	1	12	
			2	
	10	2	24	
			7	
14 *lb.*) ⅛)	75	0	0	*gross*
	9	1	14	*tare*
26)	65	2	14	*suttle*
	2	2	2½	*trett*
168)	63	0	11½	*suttle*
	0	1	14	*cloff*
Ans.	62	2	25½	*neat weight*

63
2
3) 126
42=1 *qr.* 14 *lb. cloff*

(39) What is the neat weight of 29 barrels, each 3 cwt. 2 qrs. 25 lb. gross, tare 16 lb. per cwt., trett 4 lb. per 104, and cloff as usual? *Ans.* 88 *cwt.* 1 *qr.* 24 *lb.*

INTEREST.

INTEREST is the profit obtained by lending a sum of money for a certain time, and at a fixed rate.

INTEREST IS EITHER SIMPLE OR COMPOUND.

SIMPLE INTEREST

Is that which is reckoned on the principal *only*.

The PRINCIPAL is the money lent.

The RATE PER CENT. is the sum per cent. agreed on, to be paid for the use of the principal per annum.

The AMOUNT is the principal and interest added together.

INTEREST is also applied to Commission, Brokerage, Purchasing of Stock, and Insurance.

CASE I.—*To find the Interest of any sum of money for a year.*

RULE.—Multiply the *principal* by the *rate* per cent.; that product divided by 100 will give the *interest* required.

Or, take the aliquot part or parts with the given rate that are in 100: viz. $5l. = \frac{1}{20}$; $4l. = \frac{1}{25}$; $2\frac{1}{2}l. = \frac{1}{40}$, &c. of 100.

EXAMPLES.

(1) What is the interest of 252*l.* 10*s.* 6*d.* for a year, at $4\frac{1}{2}$ per cent per annum.

$\frac{1}{2}$ |	252	10	6
			$4\frac{1}{2}$
	1010	2	0
	126	5	3
£	11/36	7	3
	20		
shill.	7/27		
	12		
pence	3/27		
	4		
far.	1/08		

Or thus:

4*l.* |	$\frac{1}{25}$ |	252	10	6
10*s.* |	$\frac{1}{8}$ |	10	2	$0\frac{1}{4}$
		1	5	3
Ans. £		11	7	$3\frac{1}{4}$

(2) What is the interest of 384*l.* 12*s.* 10*d.* for a year, at 5*l.* per cent.? *Ans.* 19*l.* 4*s.* $7\frac{1}{2}d.$

(3) What is the interest of 756*l.* 10*s.* for a year, at 4*l.* per cent.? *Ans.* 30*l.* 5*s.* $2\frac{1}{4}d.$

(4) What is the interest of 856*l.* for a year, at $3\frac{1}{2}$ per cent.? *Ans.* 29*l.* 19*s.* $2\frac{1}{4}d.$

II.—*To find the Interest of any sum for several years.*

RULE.—*Multiply* the interest of *one* year by the *number* of years given, and the product will be the answer.

Or, Multiply the *principal* by the *rate and time;* and that product divide by 100 for the answer.

EXAMPLES.

(5) What is the interest of 285*l.* 15*s.* for $3\frac{1}{2}$ years, at 5*l.* per cent.?

285 15
5 | 5*l.* | $\frac{1}{20}$ | 235 15

£ 14/28 15
20

s. 5/75
12

d. 9/00

Or thus:

14 5 9

Then for the years, multiply, &c.

$\frac{1}{2}$ | 14 5 9
3

42 17 3
7 2 $10\frac{1}{2}$

Ans. £ 50 0 $1\frac{1}{2}$

(6) At $4\frac{1}{2}$ per cent. per annum, what is the interest of 450*l.* 12*s.* for 5 years? *Ans.* 101*l.* 7*s.* $8\frac{1}{4}$*d.*

(7) What is the interest of 500 guineas for 7 years, at $3\frac{1}{2}$ per cent. per annum? *Ans.* 128*l.* 12*s.* 6*d.*

(8) What is the interest of 1000*l.* for $5\frac{1}{4}$ years, at 3 per cent.? *Ans.* 157*l.* 10*s.*

(9) What is the interest of 365*l.* 10*s.* for 3 months, at 5*l.* per cent. per annum?

365 10
5 3 *mo.* | $\frac{1}{4}$ | 18 5 6

£ 18/27 10
20

s. 5/50
12

d. 6/00

4 11 $4\frac{1}{2}$

(10) What is the interest of 1240*l.* for 1 year and 10 months, at $4\frac{1}{2}$ per cent.?

$\frac{1}{2}$ | 1240
4

4960
620

£ 55/80
20

s. 16/00

6 *mo.* | $\frac{1}{2}$ | 55 16
4 *mo.* | $\frac{1}{3}$ | 27 18
18 12

Ans. £102 6

(11) What is the interest of 256*l.* 10*s.* 6*d.* for $\frac{1}{2}$ a year, at $3\frac{3}{4}$ per cent.? *Ans.* 4*l.* 16*s.* $2\frac{1}{4}$*d.*

(12) What is the interest of 486*l.* 15*s.* for 9 months, at $4\frac{1}{2}$ per cent.? *Ans.* 16*l.* 8*s.* $6\frac{1}{4}$*d.*

(13) What is the interest of 500*l.* for 3 years and 8 months, at 5*l.* per cent.? *Ans.* 91*l.* 13*s.* 4*d.*

(14) What is the amount of 1000*l.* for two years and 10 months, at 3 per cent.?

£	m.		£
1000	6	½	30
3			2
30|00			60
	4	⅓	15
			10
			£ 85 *interest*

£
1000 *principal*
85 *interest*
Ans. 1085 *amount*

(15) What is the amount of 500*l.* for 3 years 8 months, at 5 per cent. per annum? *Ans.* 591*l.* 13*s.* 4d.

III.—*When interest is required for any number of weeks.*

Rule. Find the interest of the given sum *for one year;* then state—As 52 weeks are to that interest, so are the weeks given to the interest required.

Examples.

(16) What is the interest of 348*l.* 13*s.* 4*d.* for 25 weeks, at 4½ per cent. per annum?

£	s.	d.	
½ | 348	13	4	
		4½	
1394	13	4	
174	6	8	
£ 15/69	0	0	
20			
s. 13/80			
12			
d. 9/60			
4			
far. 2/40			

wks. As 52 : £ 15 13 9½ :: *wks.* 25

20
313
12
3765
4
15062
25

52) 376550 (4) 7241

rem. 18 12) 1810¼

2,0) 15,0 10¼

Ans. 7 10 10¼—18 *rem.*

(17) What is the interest of 237*l.* 16*s.* 6*d.* for 20 weeks, at 3½ per cent. per annum? *Ans.* 3*l.* 4*s.* 0¼*d.*

(18) Find the interest of 500*l.* for 37 weeks, at 5 per cent. per annum? *Ans.* 17*l.* 15*s.* 9*d*

(19) Lent 250*l.* on a mortgage at 4½ per cent. per ann., what interest will be due for 48 weeks? *Ans.* 10*l.* 7*s.* 8¼*d.*—12

(20) I demand the interest of 750*l.* 15*s.* for three years and 12 weeks at $4\frac{3}{4}$ per cent per annum?

£.	s.		wks.
½ | 750	15		52
	4		
	3003	0	
¼ | ½ | 375	7	6	
	187	13	9
£	35/66	1	3
	20		
s.	13/21		
	12		
d.	2/55		
	4		
far.	2/20		

£.	s.	d.		wks.
£35	15	2½	:	12
		3		
	106	19	7½	
	8	4	7	
£115	4	2½	*Ans.*	

52) 427 18 6 (8*l.* 4*s.* 7*d.*
416
11
20
52) 238 (4*s.*
208
30
12
52) 366 (7*d.*
364
2

(21) What is the interest of 680*l.* for 2 years and 25 weeks, at 5 per cent per annum? *Ans.* 84*l.* 6*s.* 11*d.*—4 r.

(22) Lent 1250*l.* on a mortgage at $4\frac{1}{2}$ per cent per annum, what interest will be due for 7 years and 35 weeks?

Ans. 431*l.* 12*s.* $2\frac{1}{2}$*d.*—8 r.

(23) I demand the interest of 1000*l.* for 5 years and 40 weeks, at 4 per cent per annum? *Ans.* 230*l.* 15*s.* $4\frac{1}{2}$*d.*—24r

IV. *When interest is required for any number of days.*

RULE. Find the *interest* of the given sum for a *year;* and then state—As 365 days are to that interest, so are the days given to the interest required.

EXAMPLES.

(24) What is the interest of 370*l.* 18*s.* 6*d.* for 150 days, at $4\frac{1}{2}$ per cent per annum?

£.	s.	d.		days
½ | 370	18	6	As 365	
		4		
	1483	14	0	
	185	9	3	
£	16/69	3	3	
	20			
s.	13/83			
	12			
d.	9/99			
	4			
far.	3/96			

£.	s.	d.			days
	16	13	:	:	150
	20				
	333				
	12				
	4005				
	4				
	16023				
	150				

365) 2403450 (4) 6584
2190 12) 1646
2134 2,0) 13,7 2
&c. £ 6 17 2 *Ans.*

If the *remainder* (96) were incorporated with the *stating* (thus, 16*l* 13*s.* $9\frac{3}{4}$*d.*—96) the true answer would be a ¼ more.

(25) Find the interest of 680*l.* for 250 days, at 5 per cent per annum. *Ans.* 23*l.* 5*s.* 9*d.*—15 rem.

(26) What is the interest of 365*l.* 10*s.* for 280 days, at 3 per cent per annum? *Ans.* 8*l.* 8*s.* 2½*d.*—54 rem.

(27) What is the amount of 1600*l.* for 3 years and 73 days, at 4 per cent per annum?

£.		days		£.		days
1600	64	As 365	:	64	::	73
4	3			73		
£ 64/00	192			192		Or, 73 being one-fifth of 365, only divide by 5,
	12 16			448		
The interest	204 16			365)46[0]2(12*l.*16*s.* thus:—		
The principal	1600					5)64
The amount	1804 16 *Ans.*					£ 12 16

(28) Borrowed on the 1st of January 1200*l.* and paid it on the 1st of August twelvemonth (1 year and 212 days), with interest at 5 per cent per annum, I demand the amount?

Ans. 1294*l.* 16*s.* 11¾*d.*—125 rem.

(29) Required the interest of 250 guineas at 3½ per cent, for 7 years and 100 days? *Ans.* 66*l.* 16*s.* 7*d.*

(30) What is the interest of 1780*l.* for 5 years and 120 days, at 3½ per cent per ann.? *Ans.* 331*l.* 19*s.* 7½*d.*—330 r.

(31) What is the amount of 500 guineas, at 4½ per cent per annum, for 7 years and 73 days? *Ans.* 695*l.* 2*s.* 0*d.*

V. *When the amount, time, and rate per cent, are given to find the principal.*

Rule. As the amount of 100*l.* at the rate, and for the time given, is to 100, so is the amount given to the principal required.

Examples.

(32) What principal being put to interest, will amount to 430*l* 14*s.* in 4 years, at 4½ per cent per annum?

4½ × 4=18+100=118*l.*=the amount of 100 for the rate and time.

Then say—As 118*l.* : 100*l.* :: 430*l.* 14*s.*

20 20

2360 8614

100

236,0) 86140,0 (365 *Ans.*

708

1534

1416

1180

1180

(33) What principal being put to interest will amount to 540*l.* in 5 years, at 4 per cent. per annum? *Ans.* 450*l.*

(34) What principal being put to interest for 7 years at 5 per cent. per annum, will amount to 708*l.* 15*s.*? *Ans.* 525*l.*

VI. *When the principal, rate per cent, and amount, are given, to find the time.*

RULE. As the interest of the principal for one year is to one year, so is the whole interest to the time required.

EXAMPLES.

(35) In what time will 365*l.* amount to 430*l.* 14*s.* at 4½ per cent. per annum?

£		£ s. d.		yr.		£ s.
½ | 365	As	16 8 6	:	1	::	65 14
4½		20				20
1460		328				1314
182 10		12				12
£ 16/42 10		3942				3942)15768(4 *yrs. Ans.*
20	£ s.					15768
s. 8/50	430 14 *amount*					: :
12	365 0 *principal*					
d. 6/00	65 14 *interest*					

(36) In what time will 450*l.* amount to 540*l.* at 4 per cent. per annum? *Ans.* 5 *years*

(37) In what time will 525*l.* amount to 708*l.* 15*s.* at 5 per cent. per annum? *Ans.* 7 *years*

VII. *When the principal, amount, and time are given, to find the rate per cent.*

RULE. As the principal is to the interest for the whole time, so is 100*l.* to its interest for the same time. *Divide* that *interest* by the *time*, and the quotient will be the rate per cent.

EXAMPLES.

(38) At what rate per cent. will 365*l.* amount to 430*l.* 14*s.* in 4 years' time?

£ s.		£		£ s.		£
430 14	As	365	:	65 14	::	100
365 0				20		
65 14 *interest*				1314		
				100		

365) 131400 (360*s.* = 18*l.* and
18*l.* ÷ 4 *yrs.* = 4½ per cent.

(39) At what rate per cent. will 450*l.* amount to 540*l.* in 5 years' time? *Ans.* 4 *per cent*

(40) At what rate per cent. will 525*l.* amount to 708*l* 15*s.* in 7 years' time? *Ans.* 5 *per cent.*

COMMISSION.

COMMISSION is an allowance of so much per cent from merchants to their factors, for the buying or selling of goods. The term is also applied by bankers to drawing bills and managing accounts.

RULE I. If the commission be *above* one per cent, multiply the principal by the rate per cent (as in interest), and divide by 100.

2nd. If *under* one per cent, divide the given sum by 100, and take aliquot parts from the quotient, with the commission.

EXAMPLES.

(1) What does the commission come to on 845*l.* 18*s.* 6*d.* at $3\frac{3}{4}$ per cent?

	£	s.	d.
	845	18	6
			3
	2537	15	6
½ | ¼ |	422	19	3
	211	9	7½
100)	31/72	4	4½
Ans.	31	14	5¼

(2) What must I allow my correspondent for disbursing on my account, 389*l.* 17*s.* 9*d.* at $2\frac{1}{4}$ per cent?

Ans. 8*l.* 15*s.* 5¼*d.*

(3) What is the commission of 768*l.* 12*s.* 6*d.* at $2\frac{1}{2}$ per cent? *Ans.* 19*l.* 4*s.* 3¾*d.*

(4) My correspondent writes me word that he has bought goods on my account to the value of 890*l.* 10*s.* 4*d.*; what does his commission come to at $2\frac{3}{4}$ per cent?

Ans. 24*l.* 9*s.* 9¼*d*

(5) If I allow my factor $\frac{5}{8}$ per cent., what will be the commission for disbursing on my account 385*l.* 10*s.* ?

		£	*s.*	*d.*
$\frac{4}{8}$	$\frac{1}{2}$	385	10	0
$\frac{1}{8}$	$\frac{1}{4}$	192	15	0
		48	3	9
1,00)6,26		8	9	
£ 6	5	$3\frac{1}{4}$	*Ans.*	

(6) What will the commission of a country banker amount to on 1650*l.* at $\frac{3}{8}$ per cent. ?

1,00)16,50

$\frac{2}{8}$	$\frac{1}{4}$	16	10		
$\frac{1}{8}$	$\frac{1}{2}$	4	2	6	
		2	1	3	
Ans. £ 6		3	9		

Or thus :

16 10
3
8 | 49 10
6 3 9

(7) What will be the commission of 1000*l.* at $\frac{1}{4}$ per cent. ?
Ans. 2*l.* 10*s.*

(8) What will a banker's commission for 7860*l.* 16*s.* 10*d.* amount to, at $\frac{3}{4}$ per cent. ? *Ans.* 58*l.* 19*s.* $1\frac{1}{2}d.$

(9) Suppose I allow my correspondent $1\frac{3}{8}$ for his commission, what will it amount to for disbursing on my account 758*l.* 18*s.* ? *Ans.* 10*l.* 8*s.* $8\frac{1}{4}d.$

BROKERAGE.

BROKERAGE is a small allowance per cent. to a person called a broker, for assisting merchants or factors in buying or selling of goods.

RULE. The same as for Commission.

EXAMPLES.

(1) What is the brokerage of 562*l.* 10*s.* at 6*s.* 6*d.* per cent.

		£	*s.*
1,00)5,62		10	
5*s.*	$\frac{1}{4}$	5 12	6
1*s.*	$\frac{1}{5}$	1 8	$1\frac{1}{2}$
6*d.*	$\frac{1}{2}$	5	$7\frac{1}{2}$
		2	$9\frac{3}{4}$
Ans. £ 1	16	$6\frac{3}{4}$	

(2) If I allow a broker $\frac{6}{7}$ per cent., what will his brokerage come to on 1456*l.* 12*s.* 6*d.* ?

	£	*s.*	*d.*
1,00)14,56	12	6	
	14	11	$3\frac{3}{4}$
			6
7)87	7	$10\frac{1}{2}$	
Ans. £ 12	9	$8\frac{1}{4}$	

N.B. When aliquot parts are not easily found, multiplying by the upper figure and dividing by the lower, will give the answer.

(3) What is the brokerage of 487*l.* 18*s.* at 12*s.* 6*d.* per cent. ? *Ans.* 3*l.* 0*s.* $11\frac{3}{4}$*d.*

(4) Find the brokerage of 1350*l.* 16*s.* 8*d.* at 2*s.* 9*d.* per cent. ? *Ans.* 1*l.* 17*s.* $1\frac{3}{4}$*d.*

(5) If I allow a broker $\frac{3}{8}$ per cent., what will his brokerage come to on 964*l.* 14*s.* ? *Ans.* 5*l.* 15*s.* 9*d.*

(6) A broker sold goods to the amount of 525*l.* 12*s.*, what will his brokerage come to at $2\frac{3}{8}$ per cent.? *Ans.* 12*l.* 9*s.* $7\frac{3}{4}$*d.*

(7) If a broker sells goods to the amount of 1000 guineas, what is his demand at $1\frac{5}{8}$ per cent. ? *Ans.* 18*l.* 7*s.* 6*d.*

(8) What is the claim of a broker, at $\frac{1}{4}$ per cent., on 1760*l.* 12*s.* ? *Ans.* 4*l.* 8*s.* $0\frac{1}{4}$*d.*

PURCHASING OF STOCKS.

STOCK is a name given to the money borrowed by government; and also to the property of our trading companies. The rules for buying or selling shares in these stocks are as follow:

Rule 1st. If the sum given is *above par* (*i. e.* above 100), multiply the sum to be purchased *by the excess* above 100; divide the product by 100, and add the quotient to the given sum.

2nd. If the sum given is *under par*, multiply it *by the price;* and that product divided by 100, will give the answer.

Or, 3rdly, Instead of multiplying, take parts for the whole price.

Examples.

(1) What is the purchase of 736*l.* 10*s.* South Sea Stock at $111\frac{3}{8}$ per cent. ?

	£	s.	
	736	10	
		11	
	8101	10	
$\frac{2}{8}$ | $\frac{1}{4}$	184	2	6
$\frac{1}{8}$ | $\frac{1}{2}$	92	1	3
1,00	83,77	13	9
	83	15	$6\frac{1}{4}$
	736	10	0
Ans. £	820	5	$6\frac{1}{4}$

Or thus:

		£	s.	
10 | $\frac{1}{10}$		736	10	
1 | $\frac{1}{10}$		73	13	
$\frac{2}{8}$ | $\frac{1}{4}$		7	7	$3\frac{1}{2}$
$\frac{1}{8}$ | $\frac{1}{2}$		1	16	$9\frac{3}{4}$
			18	$4\frac{3}{4}$
Ans. £		820	5	6

Or take the parts thus:

	£	s.	
10 | $\frac{1}{10}$	736	10	
$1\frac{2}{8}$ | $\frac{1}{8}$	73	13	
$\frac{1}{8}$ | $\frac{1}{10}$	9	4	$1\frac{1}{2}$
	0	18	$4\frac{3}{4}$
Ans. £	820	5	$6\frac{1}{4}$

(2) Bought 782*l.* 16*s.* 6*d.* Bank annuities, at 91$\frac{1}{8}$ per cent., what did it cost me?

£	s.	d.	
782	16	6	
		9	
7045	8	6	= 9
		10	
70454	5	0	= 90
782	16	6	= 1
97	17	0$\frac{3}{4}$	= $\frac{1}{8}$
1,00) 713,34	18	6$\frac{3}{4}$	
Ans. £ 713	6	11$\frac{3}{4}$	

Or thus:

		£	s.	d.
50	$\frac{1}{2}$	782	16	6
25	$\frac{1}{4}$	391	8	2
10	$\frac{1}{10}$	195	14	1$\frac{1}{2}$
5	$\frac{1}{2}$	78	5	7$\frac{3}{4}$
1	$\frac{1}{10}$	39	2	9$\frac{3}{4}$
$\frac{1}{8}$	$\frac{1}{8}$	7	18	6$\frac{1}{2}$
			19	6$\frac{3}{4}$
Ans. £ 713		6	11$\frac{1}{4}$	

(3) What is the purchase of 1340*l.* 12*s.* East India stock, at 110$\frac{1}{4}$ per cent.? *Ans.* 1478*l.* 0*s.* 2$\frac{1}{2}$*d.*

(4) Sold 2365*l.* 18*s.* 6*d.* India stock, at 104$\frac{5}{8}$ per cent., what sum did I receive? *Ans.* 2475*l.* 6*s.* 11$\frac{1}{2}$*d.*

(5) Bought 758*l.* 18*s.* Three per cent. consolidated annuities, at 88$\frac{1}{4}$ per cent.? *Ans.* 669*l.* 14*s.* 7*d.*

(6) What is the purchase of 1000*l.* Consols, at 84$\frac{3}{8}$ per cent.? *Ans.* 843*l.* 15*s.*

(7) At 103$\frac{3}{8}$ per cent., what is the purchase of 5620*l.* Three per cent. reduced annuities? *Ans.* 5809*l.* 13*s.* 6*d.*

INSURANCE.

INSURANCE is an allowance per cent. paid by the proprietors of goods, &c., to certain persons or offices, who engage to make good the loss of ships, houses, goods, &c., which may happen by storms, fire, or other accidents: the *security* the insurer receives, as well as the *premium* he pays, is also called INSURANCE.

RULE.—Multiply the sum to be insured by the rate, and the product divided by 100 is the per centage to be paid.—Or, instead of multiplying, take parts for the rate.

Examples.

(1) What is the insurance of 658*l.* 12*s.* 6*d.* at $15\frac{5}{8}$ per cent.?

		£	s.	d.
$\frac{1}{8}$ | $\frac{1}{2}$ |		658	12	6
			15	
		9879	7	6
$\frac{1}{8}$ | $\frac{1}{4}$ |		329	6	3
		82	6	$6\frac{3}{4}$
1,00)		102,91	0	$3\frac{3}{4}$
Ans.	£	102	18	$2\frac{1}{4}$

Or thus, by *taking parts* of the rate:

£		£	s.	d.
10	$\frac{1}{10}$	658	12	6
5	$\frac{1}{2}$	65	17	3
$\frac{5}{8}$	$\frac{1}{8}$	32	18	$7\frac{1}{2}$
		4	2	$3\frac{3}{4}$
Ans. £		102	18	$2\frac{1}{4}$

(2) What is the insurance of 850*l.* at $12\frac{3}{4}$ per cent.?
Ans. 108*l.* 7*s.* 6*d.*

(3) What is the insurance of a ship's cargo valued at 24630*l.* at $18\frac{1}{4}$ per cent.? *Ans.* 4494*l.* 19*s.* 6*d.*

(4) What is the insurance of 1000*l.* at $6\frac{3}{8}$ per cent.?
Ans. 63*l.* 15*s.*

(5) What is the insurance of 1784*l.* 12*s.* at $1\frac{5}{8}$ per cent.?
Ans. 28*l.* 19*s.* $11\frac{3}{4}d.$

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(6) What is the insurance of 364*l.* 15*s.* at 3*s.* 8*d.* per cent., and at 14*s.* 8*d.*?

			£	s.	d.
		1,00)	3,64	15	0
3*s.* 4*d.*	$\frac{1}{6}$		3	12	$11\frac{1}{4}$
4*d.*	$\frac{1}{10}$		12	2	
			1		$2\frac{1}{2}$
Ans.	£		0	13	$4\frac{1}{2}$ *nearly*

			£	s.	d.
		1,00)	3,64	15	0
10*s.*	$\frac{1}{2}$		3	12	$11\frac{1}{4}$
4*s.*			1	16	$5\frac{1}{2}$
8*d.*	$\frac{1}{6}$			14	7
				2	5
2*nd. Ans.*	£		2	13	$5\frac{1}{2}$

(7) What is the insurance of 584*l.* 16*s.* 6*d.* at 2*s.* 9*d.* per cent.? *Ans.* 16*s.* $0\frac{3}{4}d.$

(8) Required the insurance of 1234*l.* at 3*s.* 4*d.* per cent.?
Ans. 2*l.* 1*s.* $1\frac{1}{2}d.$

(9) What is an underwriter to receive for insuring 5000*l.* at 10 guineas per cent.?* *Ans.* 525*l.*

* When the premium is at so many *guineas*, work as for pounds, and add a twentieth part to the answer.

COMPOUND INTEREST

COMPOUND INTEREST is that which arises both from the principal and interest; that is, the interest due at *each* payment is added to the principal, to bear interest for the *next* payment.

RULE. Find the *amount* of the principal for the time of the first payment, by Simple Interest. Call this amount the principal for the second payment, and find its amount as before; and so on for the number of payments required.

2nd. *Subtract* the *first principal* from the *last amount*, and it will give the *compound interest* required.

3rd. When the interest is *half-yearly*, *quarterly*, &c., find the interest for *one payment more* than the number given; and *take the parts* from that payment, which add to the sum before found.

EXAMPLES.

(1) What is the amount of 250*l.* for 3 years at 5 per cent. ?

£	£	s.		£	s.	d.		£	s.	d.	
250	250	0	=1*st yr.'s prin.*	262	10	0	=2*nd yr.'s prin.*				
5	12	10	=1*st yr.'s interest*	13	2	6	=2*nd yrs. int.*				
12/50	262	10	=2*nd yr.'s prin.*	275	12	6	=3*rd yr.'s prin.*				
20		5				5					
10/00	13/12	10		13/78	2	6					
	20			20				£	s.	d.	
	2/50			15/62				275	12	6	
	12			12				13	15	$7\frac{1}{2}$	
	6/00			7/50				29	8	$1\frac{1}{2}$	=3*rd yr.'s am.*
				4							
				2/00							

Or thus :*

	£	s.	d.	
$\frac{1}{20}$	250	0	0	=*given principal*
	12	10	0	=1 *year's interest*
$\frac{1}{20}$	262	10	0	=2*nd year's principal*
	13	2	6	=2*nd year's interest*
$\frac{1}{20}$	275	12	6	
	13	15	$7\frac{1}{2}$	
Ans. £	289	8	$1\frac{1}{2}$	

(2) What is the amount of 384*l.* 10*s.* for 5 years, at 4 per cent. per annum ? *Ans.* 467*l.* 16*s.* 0*d.*

* N.B. When the *interest* is any *equal part* of a hundred, as 5 per cent. is $\frac{1}{20}$, 4 per cent. $\frac{1}{25}$, &c., the answer may be more expeditiously found by successive divisions.

(3) What is the amount of 1000*l.* for 3 years, at 5 per cent. per annum? *Ans.* 1157*l.* 12*s.* 6*d.*

(4) Required the amount of 750*l.* 16*s.* 8*d.* for 4 years, at $4\frac{1}{2}$ per cent. per annum? *Ans.* 895*l.* 7*s.* $7\frac{1}{4}$*d.*

(5) What is the amount of 100*l.* for 3 years, at $3\frac{1}{2}$ per cent. per annum? *Ans.* 110*l.* 17*s.* 5*d.*

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(6) What is the amount of 570*l.* 10*s.* for $3\frac{1}{4}$ years, at $4\frac{1}{2}$ per cent. per annum?

£	s.
½ | 570	10
	$4\frac{1}{2}$
2282	0
285	5
25/67	5
	20
	45
	12
	5/40
	4
	1/60

£	s.	d.
570	10	0
25	13	$5\frac{1}{4}$
½ | 596	3	$5\frac{1}{4}$
		4
2384	15	9
298	1	$8\frac{1}{2}$
26/82	15	$5\frac{1}{2}$
	20	
	16/55	
	12	
	6/65	
	4	
	2/62	

£	s.	d.
596	3	$5\frac{1}{4}$
26	16	$6\frac{1}{2}$
½ | 622	19	$11\frac{3}{4}$
		4
2491	19	11
311	9	$11\frac{3}{4}$
28/03	9	$10\frac{3}{4}$
	20	
	/69	
	12	
	8/38	
	4	
	1/55	

£	s.	d.
622	19	$11\frac{3}{4}$
28	0	$8\frac{1}{4}$
½ | 651	0	8
		4
2604	2	8
325	10	4
29/29	13	0
	20	
	5/93	
	12	
	11/16	

£	s.	d.
¼ | 29	5	11
7	6	$5\frac{3}{4}$
651	0	8
Ans. 658	7	$1\frac{1}{4}$

(7) What is the amount of 500*l.* for $4\frac{1}{2}$ years, at 4 per cent. per annum? *Ans.* 596*l.* 12*s.* $6\frac{1}{4}$*d.*

(8) What is the amount of 368*l.* 12*s.* for $3\frac{3}{4}$ years, at 3 per cent. per annum? *Ans.* 411*l.* 16*s.* $9\frac{3}{4}$*d.*

(9) What is the compound interest of 400*l.* for 2 years 10 months and 15 days, at $3\frac{1}{2}$ per cent. per annum?

£	£	£	s.	d.
$\frac{1}{2}$ | 400	400	414	0	0
3	14	14	9	$9\frac{1}{2}$
1200	$\frac{1}{2}$ | 414	$\frac{1}{2}$ | 428	9	$9\frac{1}{2}$
200	3	3		
14/00	1242	1285	9	$4\frac{1}{2}$
	207	214	4	$10\frac{3}{4}$
	14/49	14/99	14	$3\frac{1}{4}$
	20	20		
	9/80	19/94		
	12	12		
	9/60	11/31		
	4	4		
	2/40	1/25		

		£	s.	d.
6	$\frac{1}{2}$	14	19	$11\frac{1}{4}$
3	$\frac{1}{2}$	7	9	$11\frac{1}{2}$
$1\frac{1}{2}$	$\frac{1}{2}$	3	14	$11\frac{3}{4}$
		1	17	$5\frac{3}{4}$
		13	2	5
		428	9	$9\frac{1}{2}$
Amount,		441	12	$2\frac{1}{2}$
1*st. prin.*		400	0	0
Comp. int.		41	12	$2\frac{1}{2}$ *Ans.*

(10) What is the compound interest of 100*l.* for 3 years 4 months and 10 days, at $4\frac{1}{2}$ per cent. per annum?

Ans. 15*l.* 19*s.* $4\frac{3}{4}$*d.*

(11) What is the compound interest of 765*l.* 10*s.* for $5\frac{1}{2}$ years, at 4 per cent. per annum? *Ans.* 184*l.* 9*s.* $5\frac{1}{4}$*d.*

(12) What is the compound interest of 250*l.* for $2\frac{1}{2}$ years, at 4 per cent. per annum, payable half-yearly?

	£	s.	d.	
50)	250	0	0	*the given principal*
	5	0	0	*first half-year's interest*
50)	255	0	0	*second half-year's principal*
	5	2	0	*second half-year's interest*
50)	260	2	0	*third half-year's principal*
	5	4	0	*third half-year's interest*
50)	265	6	0	*fourth half-year's principal*
	5	6	$1\frac{1}{4}$	*fourth half-year's interest*
50)	270	12	$1\frac{1}{4}$	*fifth half-year's principal*
	5	8	$2\frac{3}{4}$	*fifth half-year's interest*
	276	0	4	*five half-years' amount*
	250	0	0	*first principal, subtracted*
Ans.	26	0	4	*compound interest*

N.B. 4 per cent. for a *year* is $\frac{1}{25}$ of a hundred — consequently, per half-year will be $\frac{1}{50}$. [See the *note* to the first sum in this rule.]

(13) Find the compound interest of 280*l.* 10*s.* for $1\frac{1}{2}$ year, at 5 per cent. payable half-yearly? *Ans.* 21*l.* 11*s.* 4*d.*

(14) What is the compound interest of 760*l.* 15*s.* for 2 yrs. payable half-yearly, at 4 per cent. per ann.? *A.* 62*l.* 14*s.* 2*d.*

(15) What is the amount of 100*l.* payable quarterly, supposing it to have been forborne 2 years, at 3 per cent.?

£	s.	d.
100		
3 *per cent.*		
¼ | 3,00		
/75		
20		
15/00		

£	s.	d.
100	0	
	15	
100	15	*amount*
	3	
4) 302	5	
/75	11	3
20		
15/11		
12		
1/35		
4		
1/40		

£	s.	d.
100	15	0
	15	1¼
101	10	1¼ *amt.*
		3
4) 304	10	3¾
/76	2	6¾
20		
15/22		
12		
2/70		
4		
2/83		

£	s.	d.
101	10	1¼
	15	2½
102	5	3¾ *amt.*
		3
4) 306	15	11¼
/76	13	11¾
20		
15/33		
12		
4/07		

£	s.	d.
102	5	3¾
	15	4
103	0	7¾ *amt.*
		3
4) 309	1	11¼
77	5	5¾
20		
15/45		
12		
5/45		
4		
1/83		

£	s.	d.
103	0	7¾
	15	5¼
103	16	1 *amt.*
		3
4) 311	8	3
/77	17	0¾
20		
15/57		
12		
6/84		
4		
3/39		

£	s.	d.
103	16	1
	15	6¾
104	11	7¾ *amt.*
		3
4) 313	14	11¼
/78	8	8¾
20		
15/68		
12		
8/24		
4		
/99 = ¼, nearly		2/64

£	s.	d.
104	11	7¾
	15	8¼
105	7	4 *amt*
		3
4) 316	2	0
/79		
20		
15/80		
12		
9/66		
4		

£	s.	d.
105	7	4
	15	9½
106	3	1½

Ans. 106 3 1½ *amount of* 2 *years by quarterly payments*

(16) What is the amount of 50*l.* payable quarterly, supposing it to have been forborne 2½ years, at 3½ per cent. per annum? *Ans.* 54*l.* 10*s.* 11¼*d.*

DISCOUNT.

DISCOUNT is the allowance made to a person for paying money *before it is due;* and is so much as that money, if put to interest, would gain in the same time and at the same rate.

Thus 100*l.* present money, will discharge a debt of 105*l.* to be paid a year to come, rebate being made at 5 per cent.

The *present worth*, then, is the *sum to be paid* when the *discount is taken off.*

RULE 1st. *When the present worth is required;* say, As the amount of 100*l.* for the given rate and time is to 100*l.*, so is the sum given to the *present worth.*

2nd. *When the rebate or discount is required;* say, As the amount of 100*l.* for the given rate and time, is to its *interest*, so is the given sum to its *discount.*

EXAMPLES.

(1) What is the present worth of 360*l.* 10*s.* for 11 months, at 6 per cent.?

m.		£	*s.*
6	½	6	0
4	⅓	3	0
1	¼	2	0
		10	
		5	10
		100	0
		105	10

amount of 100*l.*

Then, As £ *s.* 105 10 : £ 100 :: £ *s.* 360 10

105 10 | 100 | 360 10
20 | | 20
2110 | | 7210
| | 100

211,0)72100,0(341 £ *s.* *d.*
633 14 1¼
880
844
360
211
149
20
211)2980 (14*s.* 1¼*d.*—
&c. 193 rem.

Ans. 341*l.* 14*s.* 1¼*d. present worth*

(2) What is the present worth of 365*l.* 10*s.* for 7 months, at 4½ per cent. per annum? *Ans.* 356*l.* 3*s.*—51 rem.

(3) What is the present worth of 465*l.* 12*s.* for 6 months, at 3½ per cent. per annum? *Ans.* 457*l.* 11*s.* 10*d.*—230 rem.

(4) Sold goods for 384*l.* 15*s.* to be paid 10 months hence, what is the present worth at 6 per cent. discount?

Ans. 366*l.* 8*s.* $6\frac{3}{4}d.$—45 rem.

(5) How much ready money can I receive for a note of 150*l.* due 18 months hence, at 5 per cent.?

Ans. 139*l.* 10*s.* $8\frac{1}{4}d.$—105 rem.

(6) What is the present worth of 210*l.* payable in a quarter of a year, discounting at $4\frac{1}{2}$ per cent.?

Ans. 207*l.* 13*s.* $3\frac{1}{4}d.$—187 rem.

---

(7) What is the discount of 750*l.* for 1 year and 9 months, at $4\frac{1}{2}$ per cent.?

m.	£	*s.*
6 | $\frac{1}{2}$	4	10 = 1 *year*
3 | $\frac{1}{2}$	2	5
	1	2 6
	7	17 6
	100	0 0
	107	17 6

Then, As

£	*s.*	*d.*
107	17	6
	20	
	2157	
	12	
	25890	

:

£	*s.*	*d.*
7	17	6
	20	
	157	
	12	
	1890	
	180000	
	151200000	
	1890	

::

£
750
20
15000
12
180000

Or, as $17s.\ 6d. = \frac{7}{8}$ of a £. say

As $107\frac{7}{8}$: $7\frac{7}{8}$: 750

8 8

863 63

750

863) 47250 (54*l.* 15*s.* *Ans.*

15 *rem.*

2589,0) 34020000,0 (12) 13140

2589

813 &c.

2,0) 109,5

Ans. 54 15

(8) What is the discount of 120*l.* 10*s.* 6*d.* for $1\frac{1}{4}$ year, at $4\frac{1}{2}$ per cent.? *Ans.* 6*l.* 8*s.* $4\frac{1}{4}d.$—1905 rem.

(9) Find the discount of 150*l.* due 2 years hence, at 5 per cent.? *Ans.* 13*l.* 12*s.* $8\frac{3}{4}d.$ *nearly.*

(10) Sold goods to the value of 300*l.* to be paid in 18 months, what would be the discount for present payment at $3\frac{1}{2}$ per cent.? *Ans.* 14*l.* 19*s.* $3\frac{1}{4}d.$—1675 rem.

(11) What is the discount of 500*l.* for 12 months, deducting 6 per cent.? *Ans.* 28*l.* 6*s.* $0\frac{1}{4}d.$—86 rem.

(12) Sold goods to the value of 1500*l.* to be paid in 15 months, what must be the discount for present payment at $12\frac{1}{2}$ per cent.? *Ans.* 202*l.* 14*s.* $0\frac{1}{2}d.$—1650 rem.

(13) What is the present worth of 150*l.* payable as follows —50*l.* at 3 months, 50*l.* at 6 months, and 50*l.* at 9 months, discounting at 6 per cent.?

m.	£		£	*s.*		£		£
3 | ¼ |	6	Then, As	101	10	:	100	: :	50
	1	10		20				20
	100	0		2030				1000
	101	10						100
								2030) 100000 (49*l.* 5*s* 10½*d.*
								8120
								18800
								18270
								530 &c.

49l. 5s. 2½d. present worth

m.	£		£		£	£
6 | ½ |	6	Then. As	103	.	100	: : 50
	3				50	
	100					103) 5000 (48*l.* 10*s.* 10¼*d. present worth*
	103					

m.	£		£	*s.*		£		£
6 | ½ |	6	Then, As	104	10	.	100	: :	50
				20		1000		20
3 | ½ |	3							1000
	1	10	2090			2090) 100000 (47*l.* 16*s.* 11¼*d. present worth*		
	4	10	£	*s.*	*d.*			
	100		49	5	2½			
	104	10	48	10	10¼			
			47	16	11¼			
		Ans.	145	13	0			

(14) What is the present worth of 120*l.* 10*s.* due 1st May, this being Jan. 1st, reckoning interest at 5 per cent?

Ans. 118*l.* 10*s.* 5¾*d.*

(15) Sold goods to the amount of 1000*l.* due ½ at 6 months and ½ at 12 months; required the discount at 10 per cent?

Ans. 69*l.* 5*s.* 3¼*d.*

(16) What is the present worth of 750*l.* payable one-third at 4 months, one-third at 8 months, and one-third at 12 months, reckoning the discount at 7½ per cent?

Ans. 714*l.* 11*s.* 1*d.*

EQUATION OF PAYMENTS.

EQUATION OF PAYMENTS is a rule for finding the *equated time* to pay *at one payment* several sums due at *different times.*

RULE. *Multiply each payment* by the *time* at which it becomes due; add the products together, and *divide* their sum by the sum of the payments; the quotient is accounted the mean time.*

EXAMPLES.

(1) A owes B 560*l.*; of which 200*l.* is to be paid at 3 months, 200*l.* at 5 months, 100*l.* at 6 months, and the rest at 9 months; I demand the equated time for the whole payment.

$200 \times 3 = 600$
$200 \times 5 = 1000$
$100 \times 6 = 600$
The rest $60 \times 9 = 540$

56,0) 274,0(4*mo.* 26 *days*
224

50
30

56) 1500 (26 *days*
112

380
336

44

N.B. The months are multiplied by 30, to bring them into days.

(2) Y owes Z a certain sum, $\frac{1}{3}$ of which is to be paid in 2 months, $\frac{1}{4}$ in 3 months, $\frac{1}{5}$ in 4 months, $\frac{1}{6}$ in 5 months, and the rest in 6 months, I demand the equated time.

N.B. *We may suppose any sum.*

Suppose 240*l.*

$\frac{1}{3} = 80 \times 2 = 160$
$\frac{1}{4} = 60 \times 3 = 180$
$\frac{1}{5} = 48 \times 4 = 192$
$\frac{1}{6} = 30 \times 5 = 150$
The rest $22 \times 6 = 132$

240) 814 (3*m.* 11 *days*
720

94
30

24,0) 282,0 (11 *days*
264

18

(3) I have to pay 356*l.* at three payments, viz.: 120 at 3 months, 150*l.* at 6 months, and the rest at 9 months; for what length of time must a single note be given, to pay the whole at once? *Ans.* 5 *mo.* 21 *days*—144 rem.

(4) I have to receive 684*l.* in notes as follow, viz.: 130*l.* at 2 months, 180*l.* at 3 months, 300*l.* at 4 months, and 74*l.* at 5 months, but preferring to have the whole in one note, for what time must it be given? *Ans.* 3 *mo.* 13 *da.*—648 rem.

* Though *accounted* the *mean time,* and deemed near enough for business, yet if the learner's judgment be sufficiently mature, he may be shown, that as some of the debt is paid *before* and some *after* it is due, for the one *interest* is reckoned, but for the other only *discount;* on which account the rule is not mathematically correct.

(5) A owes B a certain sum, $\frac{1}{4}$ of which is to be paid in 4 months, $\frac{1}{2}$ in 6 months, and the rest in 8 months; but they agree that the whole shall be paid at one equated time: what is that time? *Ans.* 6 *months.*

(6) Bought goods to the value of 750*l.* which were to have been paid for as follows: 220*l.* in 3 months, 350*l.* in 4 months, and the rest in 6 months; but afterwards agreeing to make but one payment of the whole, I demand what that time must be? *Ans.* 4 *mo.* 5 *days*—450 rem.

(7) A debt is to be paid as follows: viz. $\frac{1}{4}$ at 3 months, $\frac{1}{3}$ at 4 months, $\frac{1}{5}$ at 5 months, and $\frac{1}{6}$ at 6 months, and the rest at 7 months; what is the equated time for the whole? *Ans.* 4 *mo.* 13 *days*

---

(8) I have one bill of 436*l.* 12*s.* 6*d.* payable in 75 days, one of 284*l.* 10*s.* 9*d.* payable at 66 days; and one of 335*l.* 16*s.* 8*d.* payable in 90 days; if I receive one bill for the whole, what must be the date?

£436	12	6	× 75 = 32746	17	6	
284	10	9	× 66 = 18779	9	6	
335	16	8	× 90 = 30225	0	0	
1056	19	11		81751	7	0
20				20		
21139				1635027		
12				12		
253679		253679	) 19620324 (77 *days. Ans.*			

N.B. When either the *time* or the *debts* are of *different denominations*, as months, weeks, or days, or £ *s. d.*, they may be reduced to the *same denomination*, before the several operations take place.

(9) I have in my possession one bill for 123*l.* 10*s.* 4*d.* due in 55 days; one for 99*l.* 8*s.* 6*d.* due in 60 days; and one of 100*l.* due in 30 days; at what date ought one bill to be given for the whole sum? *Ans.* 48 *days*

(10) Bought a quantity of goods to the value of 756*l.* 16*s.* 3*d.* for which I gave the following bills: viz. 120*l.* 10*s.* at 90 days; 200*l.* 14*s.* 6*d.* at 75 days; 300*l.* at 60 days; and the rest at 30 days; I demand the equated time for the whole at one payment? *Ans.* 63 *days*

---

(11) A debt of 1500*l.* is to be paid as follows: viz. $\frac{1}{4}$ at $6\frac{1}{2}$ months; $\frac{1}{2}$ at $12\frac{1}{2}$ months; and the rest in 1 year 6 mo. and 15 days: what is the equated time for the whole payment?

£1500

$\frac{1}{4}$	375 × $6\frac{1}{2}$ =	2437 10
$\frac{1}{2}$	750 × $12\frac{1}{2}$ =	9375 0
The rest	375 × $18\frac{1}{2}$ =	6937 10
150,0	) 1875,0 0 (12*mo.* 15 *days. Ans.*	

Note.—1 year 6 mo. 15 days = $18\frac{1}{2}$ mo.

Each line is multiplied thus:—

$\frac{1}{2}$ | 375
6
2250
187 10
2437 10

(12) A owes B 1000*l.* to be paid as follows: 200*l.* at 4 months; 300*l.* at 8 months; 200*l.* at 12 months; 200*l.* at 15 months; and the rest at the end of two years: the equated time for one payment is required? *Ans.* 11 *months*

(13) A person has owing to him 36*l.* 10*s.* to be paid in $3\frac{1}{2}$ months; 48*l.* 12*s.* to be paid in $6\frac{1}{2}$ months; and 100*l.* payable in $8\frac{1}{2}$ months; what would be the equated time for the payment of the whole? *Ans.* 6 *mo.* 29 *days*

(14) A owes B a certain sum, of which $\frac{1}{3}$ is to be paid in 4 months; $\frac{1}{4}$ in 6 months; $\frac{1}{5}$ in 8 months; $\frac{1}{8}$ in 10 months; and the rest in 12 months: I demand the equated time? *Ans.* 6 *mo.* 23 *days*

BARTER.

BY this rule traders are directed how to *exchange one commodity for another*, so that neither party may sustain loss.

RULE. Find the value of that commodity whose quantity is given; then find what *quantity* of the other at the rate proposed, may be had for the same money. This is done by *dividing the value of the quantity* exchanged, by the *price of a unit* returned.

EXAMPLES.

(1) How many yards of cloth at 6*s.* per yard, must be delivered in barter for 99 lb. of tobacco, at 4*s.* per lb.?

lb.
99
4
6)396
Ans. 66 *yards of cloth.*

N.B. Here the value of the tobacco is divided by the price of one yard, which gives the answer.

(2) What quantity of chocolate at 4*s.* 6*d.* per lb. must be given in barter for 2 cwt 1 qr. 13 lb. of tea at 7*s.* per lb.?

cwt.qr. lb. *lb.* 4*s.* 6*d.* = 9 *six.*
2 1 13 = 265
14 *sixpences in* 7*s.*
9)3710—3$\frac{5}{9}$ *oz.*
28)412(4)14
28 3 2 20 3$\frac{5}{9}$
132
112
20 *lb.*

Ans. 3 *cwt.* 2 *qr.* 20 *lb.* 3$\frac{5}{9}$ *oz.*

N.B. As the *divisor* must be brought into the lowest name mentioned (sixpences) so must the *dividend.*

(3) How much cloth at 7*s.* 6*d.* per yard, must be given in barter for 84 reams of paper, at 1*l.* 12*s.* 6*d.* per ream?

Ans. 364 *yds.*

(4) How much cheese at 2*l.* 7*s.* 6*d.* per cwt. must be bartered for 20 cwt. of hops, at 5*l.* 11*s.* 7½*d.* per cwt.?

Ans. 47 *cwt.*

(5) How much tobacco at 6*l.* 18*s.* 6*d.* per cwt is equal in value to 5 cwt. 3 qr. 14 lb. of snuff, at 4*s.* 6*d.* per lb.?

Ans. 21 *cwt.* 1 *qr.* 14 *lb.*—756 rem.

(6) How many dozens of wine, at 2*l.* 8*s.* 4*d.* per dozen, must be received in exchange for 3 puncheons of rum, at 60*l.* 8*s.* 4*d.* per puncheon? *Ans.* 75 *dozens*

II. *When part of the value is returned in cash, and the remainder in goods.*

Rule. *Deduct the cash* from the value of the given commodity; and then work for the remaining commodity as before.

(7) How many yards of velvet, at 9*s.* 8*d.* per yard, must I give, with 26*l.* 8*s.* 8*d.* in cash, for 50 gallons of Geneva, at 18*s.* 6*d.* per gallon?

10*s.*	½	50				£.	*s.*	*d.*
						19	16	4
1*s.*	1/10	25				20		
4*s.*	1/10	10						
6*d.*	1/8	10			9*s.* 8*d.*	396		
		1	5		12	12		
		46	5	0	116)	4756 (41 *galls. Ans.*		
Deduct the Cash		26	8	8		464		
		19	16	4		116		
						116		

(8) A sold to B 30 cwt. of rice, at 2*l.* 4*s.* per cwt. for which B returned him 15*l.* 11*s.* 8*d.* in cash, and the rest in serges, at 4*s.* 2*d.* per yard; how many yards did A receive?

Ans. 242 *yds.*

(9) Bought 12 quarters of wheat, at 2*l.* 16*s.* per quarter, for which I paid in cash 13*l.* 12*s.* and the remainder in beans at 5*s.* per bushel, how many bushels had I to return?

Ans. 80 *bush.*

(10) A and B barter. A has 84 galls. of brandy at 18*s.* 6*d.* per gallon, for which B gives him 30*l.* in money, and the rest in raisins at 9*d.* per lb.; what quantity of raisins must A receive? *Ans.* 1272 *lb.*—or 11 *cwt.* 1 *qr.* 12 *lb.*

(11) A has a quantity of pepper, weighing neat 1800 lb. at 19*d.* per lb. for which Z gives him 80*l.* in money, and the rest in goods at 9½*d.* per lb.; how many pounds weight must A receive? *Ans.* 1578$\frac{8}{19}$ *lb.*—or 1579 *lb. nearly*

(12) Received in barter 1200 yards of linen at 3*s.* 4*d.* per yard, and returned 84 lb. of tea at 6*s.* 8*d.* per lb. and the rest in wine at 40*s.* per dozen; the quantity of wine is required.* *Ans.* 86 *doz. of wine*

III. *The rate of one commodity being given, to find how the other should be rated.*

RULE. Divide the *value* of the one commodity by the *quantity* of the other.

(13) Bartered 2 pieces of cloth containing 64 ells, at 7*s.* 6*d.* per ell, for 4 yards of velvet; I demand what the velvet was rated at per yard?

5*s.*	¼	64
2*s.* 6*d.*	½	16
		8
		24

24
20
4,0) 48,0
Ans. 12*s. per yard*

Received of A 12 cwt. 2 qrs. of cheese, at 2*l.* 12*s.* 1*d.* per cwt. and returned him as an equivalent a tierce (42 galls.) of rum; I demand the value of the rum per gallon?
Ans. 15*s.* 6*d.*

(15) X sends to Y 260 yards of drugget, and receives in return 4 cwt. 3 qrs. of hops, at 4*l.* 2*s.* 6*d.* per cwt.; the price of the drugget per yard is required? *Ans.* 1*s.* 6*d.* $\frac{2}{260}$ *per yd.*

(16) C delivered 84 gallons of brandy, at 25*s.* per gallon, to D, for 450 yards of cloth; what was the cloth per yard?
Ans. 4*s.* 8*d. per yd.*

IV. *When the ready money price of one commodity has been raised in barter, to find how to raise the other in proportion.*

RULE. As the *ready money price* of the one commodity is *to its bartering price*, so is the *ready money price of the other* to its *bartering price.*

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* Ex. 12. In this case we deduct the 28*l.* for the *tea*, as we did before for *cash.*

(17) A has wines at 48*s.* per doz. ready money, but in barter advances it to 54*s.*; B has brandy at 24*s.* per galion ready money; how much must B raise his brandy per gall. to be equivalent to A's?

As 48 : 24 :: 54
54

96
120

48) 1296 (27*s. per gall. Ans.*
96

336
336

(18) A tradesman has velvets at 10*s.* 6*d.* per yard ready money, which he raises to 12*s.* in bartering with me for Welsh flannels, which I sell at 1*s.* 9*d.* per yard ready money; how must I rate them per yard in barter to be an equivalent to the velvet? *Ans.* 2*s. per yard*

(19) Y has linen cloth worth 2*s.* 6*d.* per ell ready money, but in barter he will have 3*s.*; Z has broad cloth worth 1*l.* 5*s.* per yard ready money; at what price ought the broad cloth to be rated in barter? *Ans.* 30*s. per yard*

(20) A merchant with whom I bartered tea for sugar, raised his sugar from 1*s.* to 13½*d.* per lb.; what ought I to have charged him for tea which I sold, ready money, for 5*s.* 6*d.* per lb.? *Ans.* 6*s.* 2¼*d.*

PROFIT AND LOSS.

PROFIT and LOSS is a rule that discovers what is gained or lost in the buying or selling of goods; and also teaches how to raise or fall the price, so as to make a giver gain or lose by them.

This rule has several variations, but the questions are mostly performed either by the rule of Proportion or Practice.

Examples.

CASE I. *To find the* WHOLE GAIN *or* LOSS *on any quantity of goods.*

(1) Bought 19 cwt. 3 qrs. 14 lbs. of cheese at 2*l.* 18*s.* 6*d.* per cwt., and sold it out at 3*l.* 3*s.* per cwt., what was the profit on the whole?

Then by Practice.

£	s.	d.				
3	3	0	*qrs.*	*s.*	*d.*	
2	18	6	2 ½	4	6	*gain per cwt.*
						3×6+1=19
	4	6				
				13	6	
					6	
			4	1	0	= 18 *cwt.*
				4	6	= 1 *cwt.*
1 *qr.*		½		2	3	= ½
14 *lb.*		½		1	1½	= ¼
				0	6¾	= 14 *lb.*

Ans. £ 4 9 5¼ *gain in the whole.*

Or by Proportion.

lb.	*s.*	*d.*	*cwt.*	*qrs.*	*lb.*
As 112	: 4	6	: : 19	3	14
			4		
			79		
			28		
			2226		
			54		

112) 120204 (12) 1073

) 28 (¼ 2,0) 8,9 5¼

Ans. 4 9 5¼

(2) Bought 7 lbs. of tobacco for 1*l.* 8*s.* 6*d.* and sold it for 1*l.* 11*s.* 6*d.*, what was the gain per cwt? *Ans.* 2*l.* 8*s.*

(3) If butter be bought at 9½*d.* per lb. and sold at 1*s.* per lb., what would be gained by 2 cwt. 1 qr. 7 lbs. at that rate? *Ans.* 2*l.* 13*s.* 11½*d.*

(4) Purchased 1000 yards of cloth at the rate of 4*s.* 6*d.* per yard, and sold the whole at 5*s.* 9*d.* per yard, what was the whole gain? *Ans.* 62*l.* 10*s.*

(5) Paid 56*l.* for one ton of steel, which I retailed at 6½*d.* per lb., what was the profit or loss by the sale of 10 tons? *Ans.* 46*l.* 13*s.* 4*d. gain*

II. *To find the* SELLING PRICE *of goods, at a certain* GAIN.

(6) At what price must I sell raisins per cwt. which cost 2*l.* 10*s.* per cwt. to gain 12 per cent.: and also at what rate per lb.?

First, for the price per cwt. say,

£		£	s.		£	
As 100	:	2	10	: :	112	
		20				
		50				
		112				

1,00) 56,00

Ans. 2*l.* 16*s. per cwt.*

Or thus:

10	⅒	2	10	
2	½	0	5	
		0	1	

56s.=2*l* 16*s. per cwt.* 1*st Ans.*

Then, for the price per lb. say,

lb.		£	s.		*lb.*
As 112	:	2	16	: :	1
		20			
		56			
		12			

112) 672 (6*d. per lb.* 2*nd Ans.*

" "

(7) Bought soap at 70*s.* per cwt.; at how much per lb. must I retail it, to gain 10 per cent. profit? *Ans.* 8¼*d.*

(8) Purchased cotton stockings at 4*s.* 2*d.* per pair; how must I sell them per pair to gain 20 per cent. profit?

Ans. 5*s.*

(9) If 107 Flemish ells 1 qr. of Cambric cost 64*l.* 8*s.* how must I sell it per yard to gain 15 per cent.? *Ans.* 18*s.* 4¾*d.*⅕

(10) Bought sugar at 3*l.* 18*s.* 6*d.* per cwt.; how must I retail it per cwt. to gain 12 per cent.? *Ans.* 4*l.* 7*s.* 11*d.* ½*s*

III. *To sell at a* CERTAIN LOSS.

(11) Bought 120 yards of drugget for 9*l.* 10*s.* which I find much damaged; how must I sell it per yard, so as to lose 30*s.* by the whole?

	£	*s.*
Cost . . .	9	10
To lose . .	1	10

As 120 *yds.* : 8 0 :: 1 *yd.*

20

12,0)16,0(1*s.* 4*d. per yard. Ans.*

12

4

(12) I gave 38*l.* for 2 cwt. 2 qrs. of tobacco; but becoming damaged, at what rate must I sell it per lb. to lose 10*l.* by the whole? *Ans.* 2*s.*

(13) Sold bacon at 7½*d.* per lb. which I bought at 9¾*d.*; what shall I lose by the sale of 3 cwt. 2 qrs. 12 lb.?

Ans. 3*l.* 15*s.* 9*d.*

(14) A quantity of tea cost me 6*s.* 8*d.* per lb. but proving damaged, how must I sell it per lb. to lose 10 per cent.?

Ans. 6*s.*

(15) Lost 14 per cent. on pepper, which I bought at 2*s.* 2½*d.* per lb. how did I sell it per lb.? *Ans.* 1*s.* 10¾*d.* $\frac{16}{100}$

IV. *To find the gain or loss per* CENT.

(16) If rum cost 15*s.* 6*d.* per gallon, how should it be sold per gallon to clear 15 per cent.?

£	*s.*	*d.*	£	*d.*
100	: 15	6	:: 115	
	12			
	186			
	115			
1,00)213/90				

12)213 — 90

17 9¾ 3/60

Ans. 17*s.* 9¾*d.*

4

Or thus.

10	½	15	6
5	½	1	6½
		0	9¼
		17	9¾

(17) How much is gained per cent. at the rate of 1*s.* 8*d.* in the £? *Ans.* 8*l.* 6*s.* 8*d.*

(18) If 2*s.* 6*d.* is gained in a guinea, how much is that per cent.? *Ans.* 11*l.* 18*s.* 1*d.* $\frac{3}{21}$

(19) Bought coffee at 2*s.* 2*d.* per lb. and sold it at 2*s.* 8½*d.* per lb., required the gain per cent.? *Ans.* 25*l.*

(20) If I sell cheese at 6½*d.* per lb. which cost me 7¾*d.* per lb., what do I lose per cent.? *Ans.* 16*l.* 2*s.* 7*d.* nearly.

V. *To find the* PRIME COST *of* GOODS.

(21) If 350 yards of cloth be sold for 210*l.* 12*s.* at 20 per cent. profit, what did it cost per yard?

£	£ s.		£		yds.	£ s.		yd.
As 120	: 210 12	::	100	Then, As 350		: 175 10	::	1
	20			Or shorter, thus:		20		
	4212			20 of 120 = $\frac{1}{6}$		35,0)351,0(10*s.*		
	100		$\frac{1}{6}$	210 12		350		
	12,0)42120,0(			35 2		1		
	2,0)351,0			175 10		48		
	175 10 *first cost.*		*Ans.* 10*s.* 0¼*d.*—13 rem.			35)48($\frac{1}{4}$		
						35		
						13 rem.		

(22) Sold wines at 58*s.* per dozen, by which I cleared 16 per cent.; required the prime cost per dozen? *Ans.* 50*s.*

(23) Sold broad cloth at 26*s.* 4*d.* per yard, by which I gained 12 per cent.; required the prime cost per yard? *Ans.* 1*l.* 3*s.* 6*d.* $\frac{16}{112}$

(24) Sold a fother of lead (19½ cwt.) for 18*l.* and gained after the rate of 20 per cent.; what did it cost me per cwt.? *Ans.* 15*s.* 4½*d.*—18 rem.

(25) Sold a pipe of wine (126 gallons) for 95*l.* 12*s.* and gained 20*l.* by the bargain; I demand the prime cost per gallon? *Ans.* 12*s.*

VI. *Promiscuous examples.*

(26) Sold 1 cwt. of hops for 3*l.* 16*s.* 6*d.* at the rate of 20 per cent. profit; what would have been the gain per cent., if I had sold them at 4*l.* 9*s.* 3*d.* per cwt.?

£	s.	d.	
4	9	3	
3	16	6	12*s.* 9*d.* of 3 16 6 = $\frac{1}{6}$ of 120 = 20, and 20 + 20 = 40 per cent.
	12	9	

The usual way.

£ s. d.		£		£ s. d.
As 3 16 6	:	120	::	4 9 3
20		1071		20
76		918)128520(140		89
12				12
918		. . .		1071
		140		
		100		

Ans. £40 *per cent.*

Or the truth of this stating may be demonstrated by the adjoining operations in two statings.

The same by two statings.

As 120 : 3 16 6 :: 100

		£ s. d.
918		4 9 3
100		3 3 9
12,0)9180,0		1 5 6
12)765		
2,0) 6,3 9		
3 3 9		

Then,

£ s. d.		£		£ s. d.
As 3 3 9	:	100	::	1 5 0
		306		
765*d.*				306*d.*

765)30600(40*l. Ans.*

(27) Bought goods at $7\frac{3}{4}d.$ per lb. and sold them at the rate of 4*l.* 10*s.* 5*d.* per cwt.; what was the gain per cent.?

Ans. 25 *per cent.*

(28) Purchased goods at 2*l.* 16*s.* per cwt. and sold them again retail at $7\frac{1}{2}d.$ per lb.; what was the gain per cent.?

Ans. 25 *per cent.*

(29) If when I sell cloth at 4*s.* 6*d.* per yard, I gain 12 per cent., what will be the gain per cent. when it is sold for 6*s.* per yard? *Ans.* 49*l.* 6*s.* 8*d.*

(30) Bought 96 gallons of porter for 5*l.*, but by accident 16 gallons of it were lost; how must I sell the remainder per gallon so as neither to get nor lose? *Ans.* 1*s.* 3*d.*

FELLOWSHIP.

FELLOWSHIP or PARTNERSHIP is a rule by which merchants, &c., trading together in company with a joint stock, ascertain their proper shares of the gain or loss, in proportion to their stock.

By this rule a *bankrupt's estate* may be divided among his creditors; *legacies* are also adjusted by it, when there is a deficiency of assets or effects.

Fellowship is either *with* or *without* time.

FELLOWSHIP WITHOUT TIME,

Or, SINGLE FELLOWSHIP,

Is when the calculations are made in proportion to the shares only, without any regard to time.

RULE. As the *whole stock* is to the *whole gain* or *loss*, so is *each man's share* in *stock* to his share of the *gain* or *loss*.

PROOF. *Add* all the shares together, and if the work be right, the sum will be equal to the given gain or loss.

EXAMPLES.

(1) Three persons trade together; A puts in 500*l*., B 750*l*., and C 1000*l*., and they gain 1200*l*.; what is each person's share of the profit?

£		£		£		£
A 500	Then, as 2250	:	1200	::	500	
B 750			500			
C 1000						
2250			2250) 600000 (266*l*. 13*s*. 4*d*.			*A's share*

£		£		£	£		£		£
As 2250	:	1200	::	750	As 2250	:	1200	::	1000
		750					1000		
2250) 900000 (400*l*. *B's share*					2250) 1200000 (533*l*. 6*s*. 8*d*.				*C's share*

Proof.

A's share	266	13	4
B's share	400	0	0
C's share	533	6	8
£	1200	0	0 = *to the given gain*

(2) Two merchants trade together; A puts into stock 120*l*. and B 240*l*., and they gain 150*l*.; what is each person's share of the profit? *Ans. A* 50*l*., *B*. 100*l*.

(3) A, B, and C enter into partnership; A puts in 762*l*. 10*s*., B 850*l*. 15*s*., and C 910*l*. 12*s*., and in one year they gain 536*l*. 10*s*.; I demand each person's share of the gain? *Ans. A* 162*l*. 1*s*. 8½*d*.—37846. *B* 180*l*. 16*s*. 10¾*d*.—43153. C 193*l*. 11*s*. 4¼*d*.—19955.

(4) Four merchants, W, X, Y, Z made a stock; W put in 1000*l*., X 2000*l*., Y 3000*l*., Z 4000*l*.; by trading they gained in 3 years 5000*l*.; I demand each person's gain?

Ans. W 500*l*., *X* 1000*l*., *Y* 1500*l*, *and Z* 2000*l*.

(5) Four persons traded and gained 950*l*., which was to be so divided that their shares might be to each other as 1, 2, 3, and 4 respectively; what had each to receive?

Ans. the 1*st* 95*l*., *the* 2*nd* 190*l*., *the* 3*rd* 285*l*., *the* 4*th* 380*l*.

(6) A merchant at his decease owed to D 126*l.* 12*s.*, to E 241*l.* 10*s.*, to F 350*l.* 15*s.*, to G 470*l.* 10*s.*, and to H 550*l.* 13*s.*; but he left property to the amount of only 580*l.*; how much may each creditor receive?

	£	s.
D ...	126	12
E ...	241	10
F ...	350	15
G ...	470	10
H ...	550	13
	1740	0

As 1740 : 580 :: 126 12
20 20 2532
34800 34800) 1468560 (42*l.* 4*s.* *D's share.* 2532
. . . .

As 1740 : 580 :: 241 10
20 4830
34800) 2801400 (80*l.* 10*s.* *E's share.*

As 1740 : 580 :: 380 15
20 7015
34800) 4068700 (116*l.* 18*s.* 4*d.* *F's share.*

As 1740 : 580 :: 740 10
20 9410
34800) 5457800 (156*l.* 16*s.* 8*d.* *G's share.*

As 1740 : 580 :: 550 13
20 20
34800 11013
580
34800) 6387540 (183*l.* 11*s.* *H's share.*

Proof.

	£		
D ...	42	4	0
E ...	80	10	0
F ...	116	18	4
G ...	156	16	8
H ...	183	11	0
	£ 580	0	0

(7) A bankrupt is indebted to P 384*l.* 12*s.*, to Q 786*l.* 15*s.*, and to R 850*l.* 13*s.*, and his estate is worth but 1348*l.*; if the whole were divided how much would each creditor receive? *Ans. P* 256*l.* 8*s.* *Q* 524*l.* 10*s.* *R* 567*l* 2*s.*

(8) A ship worth 8000*l.* being entirely lost, of which $\frac{1}{8}$ belonged to A, $\frac{1}{8}$ to B, $\frac{1}{4}$ to C, and $\frac{1}{2}$ to D; what loss will each sustain supposing 2000*l.* of her to have been insured? *Ans. A* 750*l.* *B* 750*l.* *C* 1500*l.* *D* 3000*l.*

(9) Four merchants, E, F, G, and H freight a ship with 360 tons of wine: E loaded 95 tons, F 100, G 110, and H the rest; in a storm the seamen threw 72 tons overboard; how much must each sustain of the loss?

Ans. E 19. *F* 20. *G* 22. *H* 11 *tons.*

(10) A person ignorant of numbers left 3000*l.* among his 4 children, and ordered that A should have $\frac{1}{3}$, B $\frac{1}{4}$, C $\frac{1}{5}$, and D $\frac{1}{6}$; what will be the just share of each, according to the intention of the donor?

Ans. A 1052*l.* 12*s.* 7$\frac{1}{2}$*d.*—90. *B* 789*l.* 9*s.* 5$\frac{1}{2}$*d.*—210.
C 631*l.* 11*s.* 6$\frac{3}{4}$*d.*—225. *D* 526*l.* 6*s.* 3$\frac{3}{4}$*d.*—45.

---

(11) Four persons join in the purchase of a house and premises for 1000*l.*; Q paid $\frac{1}{3}$, R $\frac{1}{4}$, S $\frac{1}{5}$, and T the remainder; but the house and premises being afterwards burnt down, and only 750*l.* insured, I demand what each *subscribed* and what each *lost*?

	£ 1000			
Q $\frac{1}{3}$	333	6	8	The sums subscribed by each.
R $\frac{1}{4}$	250	0	0	
S $\frac{1}{5}$	300	0	0	
T rem.	216	13	4	
£	1000	0	0	Proof.

	£ 1000 *purchased* 750 *insured*			
£ 250 *total loss*				
Q $\frac{1}{3}$	83	6	8	The loss of each.
R $\frac{1}{4}$	62	10	0	
S $\frac{1}{5}$	50	0	0	
T rem.	54	3	4	
£	250	0	0	Proof.

(12) A gentleman leaves by will to A 1000*l.*, to B 950*l.*, to C 800*l.*, and to D 750*l.*, but his effects are found to amount only to 2900*l.*; how much will each legatee have to receive?

Ans. A 828*l.* 11*s.* 5*d.*— 20. *B* 787*l.* 2*s.* 10$\frac{1}{4}$*d.*—5.
C 662*l.* 17*s.* 1$\frac{1}{2}$*d.*—30. *D* 621*l.* 8*s.* 6$\frac{3}{4}$*d.*—15.

(13) Purchased a ship for 3700*l.*; A paid 1000*l.*, B 1500*l.*, and C the rest; they afterwards sold her for 4500*l.*; required the gain of each?

Ans. A 216*l.* 4*s.* 3$\frac{3}{4}$*d.*—21. *B* 324*l.* 6*s.* 5$\frac{3}{4}$*d.*—13.
C 259*l.* 9*s.* 2$\frac{1}{4}$*d.*—3.

(14) A and B venturing equal sums of money, cleared by trade 550*l.*; by agreement A was to have 8 per cent. on account of the time he spent in the execution of the project, and B was to have only 5 per cent.; what was A allowed for his trouble? *Ans. A* 126*l.* 18*s.* 5$\frac{1}{2}$*d.*—2 rem.

(15) X, Y, and Z join their stocks in trade, the amount of their stock is 1500*l.* in the proportion of 3, 4, and 5 to each other; what is each man's stock?

Ans. X 375*l.*, *Y* 500*l.*, *and Z* 625*l.*

FELLOWSHIP WITH TIME,

Or, DOUBLE FELLOWSHIP,

IS when the different shares are employed for *different terms* of time.

Rule 1st. Multiply each man's *stock* and *time* together.

2nd. *Add together* the several products thence arising.

3rd. Then say, As the *sum* of these *products* is to the *whole gain* or *loss*, so is *each man's* particular *product* to *his share* of the *gain* or *loss*.

Proof. As in Fellowship without Time.

Examples.

(1) Three merchants join in company; A puts into stock 565*l.* for 6 months, B 400*l.* for 9 months, and C 300*l.* for 10 months, and they gained 660*l.*; what is each man's share of the gain?

£		£		£		£
565 × 6 = 3390	As 999	90	:	660	::	3390
400 × 9 = 3600				3390		
300 × 10 = 3000						
9990				999,0)223740,0(223*l.* 19*s.* 3¼*d.*—405 r.		
				405 rem.		

	As 9990	:	660	::	3600	
			3600			
			999,0)237600,0(237*l.* 16*s.* 9*d.*—324 r.			
			324 rem.			

Ans.

£	s.	d.				
A. .	223	19	3¼	—405		
B. .	237	16	9	—324		
C. .	198	3	11½	—270		
£660	0	0	Proof.			

	As 9990	:	660	::	3000	
			3000			
			999,0)198000,0(198*l.* 3*s.* 11½*d.*			
			270 rem.			

N.B. The *sum* of these *remainders*, being *equal to the divisor* 999, is consequently equal to a *farthing*.

(2) D and E enter into partnership; D puts into stock 750*l.* for 15 months, and E 600*l.* for 18 months, and they gained 360*l.*; the share of each is required?

Ans. D 183*l.* 13*s.* 5½*d.*—1170. *E* 176*l.* 6*s.* 6¼*d.*—1035

(3) Three merchants trade together; A puts in 120*l.* for 9 months, B 100*l* for 16 months, and C 100*l.* for 14 months, and they gained 150*l.*; how must it be divided?

Ans. A. 39*l.* 14*s.* 1¼*d.*—264. *B* 58*l.* 16*s.* 5½*d.*—240
C 51*l.* 9*s.* 4¾*d.*—312 rem.

(4) Two persons put 2000*l.* into trade; their stock is in the proportion of 3 to 2, *i. e.* A puts in 1200*l.* and B 800*l.* A leaves his money in the concern 18 months, and B 27 months; what profits belong to each supposing they gain 700*l.*? *Ans.* 350*l.* each

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(5) X, Y, and Z hold a piece of ground, in common, for which they agree to pay 22*l.* 10*s.*, X puts in 35 oxen for 30 days, Y 25 oxen for 35 days, and Z 40 oxen for 25 days; what has each man to pay of the rent?

$35\times30=1050$
$25\times35=\ 875$
$40\times25=1000$
2925

£		£ s.		£
As 2925	:	22 10	::	1050
		20		
		450		
		1050		

2925)472500(2,0)16,1

2475 rem. 8*l.* 1*s.* 6¼*d.*—1575

As 2925	:	22 10	::	875
		20		
		450		
		875		

2925)393750(2,0)13,4

1575 rem. 6*l.* 14*s.* 7¼*d.*—1575

As 2925	:	22 10	::	1000
		20		
		450		
		1000		

2925)450000(2,0)15,3

1800 rem. 7*l.* 13*s.* 10*d.*

Ans.

	£	s.	d.	
X	8	1	6¼	—2475
Y	6	14	7¼	—1575
Z	7	13	10	—1800
£	22	10	0	Proof.

(6) Three graziers hired a piece of pasture land for 50*l.*; A put in 30 sheep for 3 months, B 25 for 3½ months, and C 20 for 4 months; what is each person's proportion of the rent? *Ans. A* 17*l.* 9*s.* 6*d.*—360. *B* 16*l.* 19*s.* 9½*d.*—350. *C* 15*l.* 10*s.* 8*d.*—320.

(7) A, B, and C hold a pasture, in common, for which they pay 30*l.* In this pasture A had 40 oxen for 76 days,

B had 36 oxen for 50 days, and C had 50 oxen for 90 days; what had each to pay? *Ans. A* 9*l.* 15*s.* $3\frac{1}{4}$*d.*—818
B 5*l.* 15*s.* $7\frac{1}{2}$*d.*—300. *C* 14*l.* 9*s.* $0\frac{3}{4}$*d.*—750

(8) Two troops of horse rented a field, for which they were to pay 75*l.*; one of the troops sent 84 horses for 28 days, and the other 60 horses for 35 days; how much of the rent had each troop to pay?
Ans. The 1*st troop* 39*l.* 12*s.* $5\frac{1}{4}$*d.*—3276
The 2*nd* ,, 35*l.* 7*s.* $6\frac{1}{2}$*d.*—1176

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(9) Three merchants, D, E, and F, trade with a common stock of 5000*l.*; D gains 230*l.* in 9 months, E 250*l.* in 10 months, and F 300*l.* in 12 months; what was each person's particular stock?

$230 \times 9 = 2070$
$250 \times 10 = 2500$
$300 \times 12 = 3600$
8170

As 8170 : 5000 :: 2070
2070
817,0) 1035000,0 (1266*l.* 16*s.* 7*d.*—548
548 rem.

As 8170 : 5000 :: 2500
2500
817,0) 1250000,0 (1529*l.* 19*s.* 9*d.*—204
204 rem.

Ans.

	£.	s.	d.	
D ..	1266	16	7	—548
E ..	1529	19	9	—204
F ..	2203	3	$7\frac{3}{4}$	— 65
	£5000	0	0	Proof.

As 8170 : 5000 :: 3600
3600
817,0) 1800000,0 (2203*l.* 3*s.* $7\frac{3}{4}$*d.*—65
65 rem.

(10) The joint stock of 3 tradesmen was 1800*l.*; K gained 300*l.* in 18 months, L 350*l.* in 21 months, and M. 400*l.* in 2 years: I demand how much was the stock of each?
Ans. K 434*l.* 17*s.* $11\frac{3}{4}$*d.*—795. *L* 591*l.* 18*s.* 11*d.*—1020.
M 773*l.* 3*s.* 1*d.*—420.

(11) Three merchants join in trade; A puts in 560*l.* for $3\frac{1}{2}$ years, B 700*l.* for $3\frac{1}{4}$ years, and C 800*l.* for $2\frac{3}{4}$ years, but by misfortune they lost goods to the value of 525*l.*; what must each man sustain of the loss? *Ans. A* 159*l.* 18*s.* $1\frac{1}{2}$*d.*—3150
B 185*l.* 12*s.* $1\frac{1}{4}$*d.*—5265. *C* 179*l.* 9*s.* $8\frac{3}{4}$*d.*—4455

FRACTIONS.

FRACTIONS are a part or parts of a unit, or of any whole quantity expressed by a unit. They are divided into two sorts, *Vulgar* and *Decimal*.

VULGAR FRACTIONS.

A VULGAR, or COMMON FRACTION is so called because any number may be its denominator, and is represented by two numbers with a line between them, as $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$. The *upper* number is called the *numerator*, and the *lower* or *under one* the *denominator*.

The denominator shows how many parts the unit is divided into; and the numerator, how many of these parts are to be taken.

There are *four kinds* of Vulgar Fractions: *Simple, Compound, Mixed*, and *Complex*.

A *simple* or *single* Fraction has only *one* numerator, and one denominator, as, $\frac{3}{8}$, $\frac{6}{6}$, $\frac{12}{16}$, $\frac{14}{8}$; when the numerator is *less* than the denominator it is termed a *proper fraction*, as $\frac{3}{5}$, $\frac{12}{16}$;—when the numerator is *equal to*, or *greater* than the denominator, it is called an *improper fraction*, as $\frac{6}{6}$, $\frac{14}{8}$.

A *compound fraction* is the fraction of a fraction, and is known by the word *of*, as $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$, &c.

A *mixed number*, or fraction, is composed of a whole number and a fraction, as $4\frac{5}{8}$, $6\frac{7}{8}$, $84\frac{3}{4}$, &c.

A *complex fraction* has a fraction, or a mixed number, for its numerator or denominator, or both as $\frac{\frac{1}{3}}{6}$, $\frac{5}{7\frac{1}{2}}$, $\frac{4\frac{3}{4}}{12}$, $\frac{3\frac{1}{2}}{9\frac{2}{3}}$, &c.

Note. Any whole number may be expressed like a fraction by writing 1 under it as a denominator; thus, 6, 18, 240, may be written, $\frac{6}{1}$, $\frac{18}{1}$, $\frac{240}{1}$, &c.

REDUCTION OF VULGAR FRACTIONS.

REDUCTION of Vulgar Fractions is the method of changing them from one form or denomination to another, without altering their value; in order to prepare them for Addition, Subtraction, Multiplication, and Division.

CASE I. *To reduce fractions of different denominations to others of equal value, having a common denominator.*

RULE 1st. Multiply *each numerator* into *all the denominators except its own*, for a new *numerator;* and *all* the *denominators* for a common denominator. Or,

2ndly. Multiply the common denominator by the several given numerators separately, and divide the product by the several denominators; the quotients will be the new numerators.

EXAMPLES.

(1) Reduce $\frac{2}{3}$ and $\frac{4}{5}$ to a common denominator?

$2\times5=10$, $4\times3=12$ } *new numerators.*

$3\times5=15$ *common denominator.*

By Rule II.

$\frac{15\times2}{3}=10$, $\frac{15\times4}{5}=12$ } *new numerators.*

Ans. $\frac{10}{15}$ *and* $\frac{12}{15}$.

(2) Reduce $\frac{3}{5}$ and $\frac{4}{6}$ to a common denominator.

Ans. $\frac{18}{30}$ *and* $\frac{20}{30}$.

(3) Reduce $\frac{5}{7}$ and $\frac{6}{8}$ to a common denominator.

Ans. $\frac{40}{56}$ *and* $\frac{42}{56}$.

(4) Reduce $\frac{3}{5}$, $\frac{5}{9}$, and $\frac{7}{10}$ to a common denominator.

Ans. $\frac{270}{450}$, $\frac{400}{450}$, *and* $\frac{315}{450}$.

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(5) Reduce $\frac{3}{7}$, $\frac{2}{5}$, $\frac{4}{6}$, $\frac{5}{8}$, and 2 a common denominator.

$3\times9\times6\times8\times1=1296$
$2\times7\times6\times8\times1=672$
$4\times7\times9\times8\times1=2016$
$5\times7\times9\times6\times1=1890$
$2\times7\times9\times6\times8=6048$ } *new numerators.*

$7\times9\times6\times8\times1=3024$ *common denominator.*

Ans. $\frac{1296}{3024}$, $\frac{672}{3024}$, $\frac{2016}{3024}$, $\frac{1890}{3024}$, *and* $\frac{6048}{3024}$.

(6) Reduce $\frac{3}{5}$, $\frac{1}{4}$, $\frac{2}{3}$, and 4, to a common denominator.

Ans. $\frac{36}{60}$, $\frac{15}{60}$, $\frac{40}{60}$, *and* $\frac{240}{60}$.

(7) Reduce $\frac{2}{9}$, $\frac{1}{6}$, 7, $\frac{6}{8}$, and 3, to a common denominator.

Ans. $\frac{80}{360}$, $\frac{72}{360}$, $\frac{2520}{360}$, $\frac{270}{360}$, *and* $\frac{1080}{360}$.

(8) Reduce $\frac{3}{5}$, $\frac{2}{6}$, $\frac{5}{7}$, and 4, to a common denominator.

Ans. $\frac{126}{210}$, $\frac{70}{210}$, $\frac{150}{210}$, *and* $\frac{840}{210}$.

II. *To reduce fractions to their lowest terms.*

RULE 1st. *Divide* both the numerator and denominator of the fraction by *any number* that will divide them *without a remainder;* and *these again* in the same manner *till no number* greater than *unity will divide them;* and the *last fraction* will be in its *lowest terms.* Or,

2nd. Find a common measure by *dividing* the *greater* term by the *less*, and that divisor by the but remainder, and so

on till nothing remains: the *last divisor* is the common measure: then if the numerator and denominator of the given fraction be divided by this common measure, it will reduce it to its lowest terms.

N. B. When fractions have ciphers to the right hand, they may be cut off, as $\frac{36}{84}\frac{|00}{|00}$.

EXAMPLES—*by the 1st Rule.*

(9) Reduce $\frac{1680}{2016}\frac{|20}{|60}$ to its lowest terms.

Divisors, 6) 7) 4) 3)

$\frac{1680}{2016}\frac{|20}{|60}=\frac{280}{336}\frac{|20}{|60}=\frac{40}{48}\frac{|20}{|60}=\frac{10}{12}\frac{|20}{|60}=\frac{3}{4}$ *Ans.*

(10) Reduce $\frac{144}{168}$ to it lowest terms. *Ans.* $\frac{6}{7}$

(11) Reduce $\frac{1800}{4320}$ to its lowest terms. *Ans.* $\frac{5}{12}$

By the 2nd Rule.

(12) Reduce $\frac{1800}{4320}$ to its lowest terms.

180,0) 432,0 (2
360
72) 180 (2
144
The common meas. 36) 72 (2
72

Then $36)\frac{1800}{4320}\frac{|0}{|0}(=\frac{5}{12}$ *Ans.*

(13) Reduce $\frac{136}{248}$ to its lowest terms. *Ans.* $\frac{17}{31}$

(14) Reduce $\frac{3400}{30060}$ to its lowest terms. *Ans.* $\frac{1}{9}$

(15) Reduce $\frac{3566}{10006}$ to its lowest terms. *Ans.* $\frac{809}{2270}$

(16) Reduce $\frac{3200}{8400}$ to its lowest terms. *Ans.* $\frac{8}{21}$

(17) Reduce $\frac{270}{360}$ to its lowest terms. *Ans.* $\frac{3}{4}$

III. *To reduce a mixed number to an equivalent improper fraction.*

RULE. Multiply the whole number by the denominator of the fraction, and to that product add the numerator for a new numerator, under which place the denominator, and it will form the fraction required.

EXAMPLES.

(18) Reduce $64\frac{8}{11}$ to an improper fraction.

64
11
704
8
New numerator 712
Ans.
11

Or it may be expressed thus,
$64\times11+8=712$, *new numerator.*

Or thus, $64\frac{8}{11}=\frac{64\times11+8}{11}=\frac{712}{11}$ *Ans.*

(19) Reduce $84\frac{9}{12}$ to an improper fraction. *Ans.* $\frac{1009}{12}$.
(20) Reduce $96\frac{11}{13}$ to an improper fraction. *Ans.* $\frac{1259}{13}$.
(21) Reduce $100\frac{5}{18}$ to an improper fraction. *Ans.* $\frac{1805}{18}$.
(22) Reduce $346\frac{7}{10}$ to an improper fraction. *Ans.* $\frac{3467}{10}$.
(23) Reduce $27\frac{3}{27}$ to an improper fraction. *Ans.* $\frac{753}{27}$.

IV. *To reduce an improper fraction to a whole or mixed number.*

Rule. Divide the upper term by the lower, and the quotient will be the whole or mixed number required.

Examples.

(24) Reduce $\frac{712}{11}$ to its proper terms.

11) 712
64 $\frac{8}{11}$ *Ans.*

Or, expressed thus:
$712 \div 11 = 64\frac{8}{11}$ *Ans.*
Or more technicallly thus:
$\frac{712}{11} = 64\frac{8}{11}$ *Ans.*

(25) Reduce $\frac{11712}{11}$ to its proper terms. *Ans.* $1064\frac{8}{11}$.
(26) Reduce $\frac{1012}{12}$ to its proper terms. *Ans.* $84\frac{9}{12}$ or $84\frac{3}{4}$.
(27) Reduce $\frac{1259}{13}$ to its proper terms. *Ans.* $96\frac{11}{13}$.
(28) Reduce $\frac{1805}{18}$ to its proper terms. *Ans.* $100\frac{5}{18}$.
(29) Reduce $\frac{34627}{10}$ to its proper terms. *Ans.* $346\frac{7}{10}$.

V. *To reduce a compound fraction to a single one.*

Rule. 1st. If any of the proposed quantities be either whole or mixed numbers, reduce them to improper fractions by Case 3rd.

2ndly. Multiply all the numerators together for a new numerator, and all the denominators for a new denominator: then reduce the new fraction to its lowest terms.

Examples.

(30) Reduce $\frac{2}{3}$ of $\frac{4}{6}$ of $\frac{5}{8}$ to a simple fraction.
$\frac{2}{3} \times \frac{4}{6} \times \frac{5}{8} = \frac{40}{144} = \frac{5}{18}$. *Ans.* in its lowest term.
(31) Reduce $\frac{3}{7}$ of $\frac{5}{8}$ of $\frac{6}{10}$ to a simple fraction.
Ans. $\frac{90}{560} = \frac{9}{56}$.
(32) Reduce $\frac{3}{11}$ of $\frac{6}{8}$ of $\frac{9}{13}$ of $\frac{3}{4}$ to a simple fraction.
Ans. $\frac{243}{2288}$.
(33) Reduce $\frac{1}{8}\frac{8}{4}$ of $\frac{11}{20}\frac{6}{0}$ to a simple fraction. *Ans.* $\frac{88}{700}$.

EXAMPLES, *with whole or mixed numbers.*

(34) Reduce $\frac{3}{4}$ of $2\frac{3}{4}$ of 8 of $\frac{10}{4}$ of $6\frac{2}{3}$ to a simple fraction.
First prepare the fractions $2\frac{3}{4}=\frac{11}{4}$; $8=\frac{8}{1}$; $6\frac{2}{3}=\frac{20}{3}$.
then $\frac{3}{4}\times\frac{11}{4}\times\frac{8}{1}\times\frac{10}{4}\times\frac{20}{3}=\frac{\overset{5}{\cancel{2}}\overset{1}{\cancel{8}}\overset{1}{\cancel{0}}\overset{1}{\cancel{0}}}{\underset{1}{\cancel{1}}\underset{9}{\cancel{9}}\underset{2}{\cancel{2}}}=275$ *Ans.*

(35) Reduce $\frac{5}{6}$ of $\frac{8}{2}$ of $3\frac{4}{5}$ of 9 to a simple fraction.
Ans. $\frac{68\overset{2}{\cancel{4}}0}{\underset{1}{\cancel{6}}\underset{1}{\cancel{0}}}=114$.

(36) Reduce $\frac{9}{10}$ of 7 of $5\frac{8}{5}$ of 12 to a simple fraction.
Ans. $\frac{21\overset{2}{\cancel{1}}68}{\underset{1}{\cancel{5}}\underset{1}{\cancel{0}}}=423\frac{\overset{4}{\cancel{8}}}{\underset{1}{\cancel{5}}\underset{1}{\cancel{0}}}$.

N.B. If the same figures are found both in the numerator and the denominator, they may be struck out of each. *Note also*, if in the numerator and denominator there are such numbers as the same figure will divide, the quotients may be used instead of them.

(37) Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$ to a simple fraction.

$$\frac{1}{\cancel{2}}\times\frac{\cancel{2}}{\cancel{3}}\times\frac{\cancel{3}}{4}\times\frac{5}{6}=\frac{5}{24}\ \textit{Ans.}$$

(38) Reduce $\frac{3}{4}$ of $\frac{4}{8}$ of $\frac{8}{12}$ of $\frac{24}{36}$ to a simple fraction.

$$\frac{3}{\cancel{4}}\times\frac{\cancel{4}}{\cancel{8}}\times\frac{\overset{2}{\cancel{8}}}{\cancel{12}}\times\frac{\cancel{24}}{36}=\frac{\cancel{3}\times 2}{\underset{12}{\cancel{36}}}=\frac{2}{12}=\frac{1}{6}\ \textit{Ans.}$$

(39) Reduce $\frac{5}{7}$ of $1\frac{1}{2}$ of $\frac{7}{11}$ of $\frac{36}{40}$ to a simple fraction.

$$\frac{\cancel{5}}{7}\times\frac{\cancel{11}}{\cancel{12}}\times\frac{\cancel{7}}{\cancel{11}}\times\frac{\overset{3}{\cancel{36}}}{\underset{8}{\cancel{40}}}=\frac{3}{8}\ \textit{Ans.}$$

(40) Reduce $\frac{2}{8}$ of $\frac{6}{11}$ of $\frac{8}{9}$ of $\frac{9}{12}$ of $\frac{9}{12}$ to a simple fraction.
Or thus: $\frac{2}{8}\times\frac{6}{11}\times\frac{8}{9}\times\frac{9}{12}=\frac{2\times 6}{11\times 12}=\frac{1\times 6}{11\times 6}=\frac{1}{11}$ *Ans.*

VI. *To reduce the fraction of one denomination to the fraction of another*, BUT GREATER, *retaining the same value.*

RULE. Reduce the given fraction to a compound one, and that to a single one; that is, multiply the *denominator* by all the denominations, from that given to the one sought. Thus one farthing, reduced to the fraction of a £, would be $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}=\frac{1}{960}$ of a £.

EXAMPLES.

(41) Reduce $\frac{1}{2}$ of a penny to the fraction of a £.

$\frac{1}{2}$ of $\frac{1}{12}$ of $\frac{1}{20} = £$. *Ans.*

Or thus: $\frac{1}{2 \times 12 \times 20} = \frac{1}{480}$ £. *Ans.*

(42) Reduce $\frac{5}{6}$ of a penny to the fraction of a £. *Ans.* $\frac{1}{288}$.

(43) Reduce $\frac{3}{4}$ of a shilling to the fraction of a £. *Ans.* $\frac{3}{80}$.

(44) Reduce $\frac{3}{4}$ of a penny to the fraction of a shilling.

Ans. $\frac{1}{16}$.

(45) Reduce $\frac{1}{4}$ of a penny to the fraction of a guinea.

Ans. $\frac{1}{1008}$.

(46) Reduce $\frac{2}{3}$ of a shilling to the fraction of a moidore.

Ans. $\frac{2}{81}$.

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(47) Reduce $\frac{5}{6}$ of a dram to the fraction of a ton.

$\frac{5}{6}$ of $\frac{1}{16}$ of $\frac{1}{16}$ of $\frac{2}{28}$ of $\frac{1}{4}$ of $\frac{1}{20} = \frac{5}{3440640} = \frac{1}{688128}$ *Ans.*

(48) Reduce $\frac{7}{8}$ of a lb. to the fraction of a hundred weight.

Ans. $\frac{1}{128}$.

(49) Reduce $\frac{2}{3}$ of a grain to the fraction of a lb. Troy.

Ans. $\frac{1}{8640}$.

(50) Reduce $\frac{1}{2}$ of a pint of wine to the fraction of a hhd.

Ans. $\frac{1}{1008}$.

(51) Reduce $\frac{3}{4}$ of a yard to the fraction of a mile.

Ans. $\frac{3}{7040}$.

(52) Reduce $\frac{5}{4}$ of a second to the fraction of a week.

Ans. $\frac{1}{806400}$.

VII. *To reduce the fraction of one denomination to the fraction of another*, BUT LESS, *retaining the same value.*

RULE. Multiply the *numerator* by all the denominations, from that given to the one sought, for a new numerator, and place it over the given denominator.—Reduce the new fraction to its lowest terms.

EXAMPLES.

(53) Reduce $\frac{1}{2880}$ of a £ to the fraction of a farthing.

$\frac{1}{2880} \times 20 \times 12 \times 4 = \frac{960}{2880} = \frac{8}{24} = \frac{1}{3}$ *of a farth.* *Ans.* $\frac{1}{3}$.

Or thus: $\frac{1}{2880}$ £ $= \frac{1 \times 20 \times 12 \times 4}{2880} = \frac{960}{1880} = \frac{1}{3}$ *of a farth.*

(54) Reduce $\frac{3}{960}$ of a pound to the fraction of a penny.

Ans. $\frac{3}{4}$.

(55) Reduce $\frac{1}{3^2_6}$ of a shilling to the fraction of a farthing.
Ans. $\frac{1}{2}$ *of a farthing.*

(56) Reduce $\frac{2}{8^1_1}$ of a moidore to the fraction of a shilling.
Ans. $\frac{2}{3}$.

Reduce $\frac{5}{3\,4\,4\,0\,6\,4\,0}$ of a ton to the fraction of a dram.

$5 \times 20 \times 4 \times 28 \times 16 \times 16 = \frac{2\,2\,6\,7\,2\,0}{3\,4\,4\,0\,6\,4\,0} \Big| \frac{0}{0} =$ when reduced, $= \frac{5}{8}$.

(58) Reduce $\frac{3}{1\,0\,8}$ of a yard to the fraction of a nail. *Ans.* $\frac{4}{9}$.

(59) Reduce $\frac{1}{3\,2\,0}$ of a wey to the fraction of a peck. *Ans.* $\frac{1}{2}$.

(60) Reduce $\frac{2}{1\,7\,2\,8\,0}$ of a lb. Troy to the fraction of a grain.
Ans. $\frac{2}{3}$.

VIIII. *To reduce a fraction of one denomination to another of the same value, having either the numerator or denominator of the required fraction given.*

Rule 1. *When the new numerator is given,* say, As the *numerator* of the given fraction is to its denominator, so is the new numerator to its denominator.

2nd. *When the new denominator is given,* say, As the *denominator* of the given fraction is to its numerator, so is the new denominator to its numerator.

Examples.

(61) Reduce $\frac{5}{3}$ to a fraction of the same value, whose numerator shall be 9.

Say, As 3 : 5 : : 9 to 15. *i. e.* $\frac{5 \times 9}{3} = 15$. *Ans.* $\frac{9}{1^5}$.

(62) Reduce $\frac{4}{7}$ to a fraction of the same value, whose numerator shall be 12. *Ans.* $\frac{1}{2}\frac{2}{1}$.

(63) Reduce $\frac{5}{9}$ to a fraction of the same value, whose numerator shall be 45. *Ans.* $\frac{4}{8}\frac{5}{1}$.

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(64) Reduce $\frac{6}{1^1_1}$ to a fraction of the same value, whose denominator shall be 44.

Say, As 11 : 6 : : 44 to 24. *Ans.* $\frac{2}{4}\frac{4}{4}$.

(65) Reduce $\frac{4}{7}$ to a fraction of the same value, whose denominator shall be 21. *Ans.* $\frac{1}{2}\frac{2}{1}$.

(66) Reduce $\frac{5}{9}$ to a fraction of the same value, whose denominator shall be 81. *Ans.* $\frac{4}{8}\frac{5}{1}$.

IX. *To reduce a complex fraction to a single one.*

Rule. If the numerator or denominator be whole or mixed numbers, reduce them to improper fractions; then multiply the *numerator* of the *upper* fraction into the *denominator* of the *lower* for a new *numerator:* and the *denominator*

of the *upper* into the *numerator* of the *lower*, for the new *denominator;* which reduce to its lowest terms.

EXAMPLES.

(67) Reduce $\frac{24\frac{3}{4}}{38}$ to a simple fraction.

$$24\tfrac{3}{4} = \frac{24 \times 4 + 3}{38 \times 4} = \tfrac{99}{152} \text{ Ans.}$$

(68) Reduce $\frac{12\frac{2}{3}}{18}$ to a simple fraction. *Ans.* $\frac{19}{27}$

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(69) Reduce $\frac{16}{24\frac{4}{5}}$ to a simple fraction.

$$\frac{16}{24\frac{4}{5}} = \frac{\frac{16}{1}}{\frac{124}{5}} = \frac{16 \times 5}{1 \times 124} = \frac{80 \text{ numerator.}}{124 \text{ denominator.}}$$

Ans. $\tfrac{80}{124} = \tfrac{20}{31}$

(70) Reduce $\frac{14}{30\frac{5}{6}}$ to a simple fraction. *Ans.* $\tfrac{84}{185}$

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(71) Reduce $\frac{8\frac{1}{4}}{12\frac{2}{3}}$ to a simple fraction.

$$\frac{8\frac{1}{4}}{12\frac{2}{3}} = \frac{\frac{33}{4}}{\frac{38}{3}} \text{ then } \frac{33 \times 3}{38 \times 4} = \tfrac{99}{152} \text{ Ans.}$$

(72) Reduce $\frac{4\frac{1}{3}}{6\frac{1}{6}}$ to a simple fraction. *Ans.* $\frac{26}{37}$

X. *To reduce fractions to their proper quantities in money, weights, or measures.*

RULE. Multiply the numerator by the common parts of the integer, and divide by the denominator.

EXAMPLES.

(73) What is the value of $\frac{5}{8}$ of a £

$$\begin{array}{r} 5 \\ 20 \\ \hline 8 \,)\, 100 \\ \hline 12s.\ 6d. \end{array} \qquad \text{Or thus: } = \pounds\tfrac{5}{8} \times 20 = \frac{100}{8} = 12s.\ 6d.\ \textit{Ans.}$$

(74) What is the value of $\frac{4}{5}$ of a £? *Ans.* 16*s.*

(75) What is the value of $\frac{3}{8}$ of a shilling? *Ans.* $4\frac{1}{2}d.$

(76) What is the value of $\frac{1}{2}\frac{5}{7}$ of a £? *Ans.* $11s.\ 1\frac{1}{4}d.-\frac{1}{2}$

(77) What is the value of $\frac{7}{12}$ of a guinea? *Ans.* $12s.\ 3d.$

(78) What is the value of $\frac{1}{4}\frac{6}{8}\frac{1}{0}$ of a £? *Ans.* $6s.\ 8\frac{1}{2}d.$

(79) Reduce $\frac{5}{8}$ of a ton to its proper quantity

$$\begin{array}{r} 5 \\ 20 \\ \hline 8\,)\,100 \\ \hline \textit{Cwt.}\ 12\ 2\ \textit{qrs.} \end{array}$$

Or thus: $5 \times 20 = 100$ and $\div 8 = 12$ *cwt.* 2 *qrs.* *Ans.*

Or thus: $\frac{5 \times 20}{8} = \frac{100}{8} = 12$ *cwt.* 2 *qrs.*

(80) Reduce $\frac{9}{16}$ of a lb. Troy to its proper quantity.
Ans. 6 *oz.* 15 *dwts.*

(81) Reduce $\frac{9}{12}$ of a yard to its proper quantity.
Ans. 3 *qrs.*

(82) Reduce $\frac{33}{114}$ of a bushel to its proper quantity.
Ans. 1 *peck* 1 *qt.* $\frac{5}{19}$.

(83) Reduce $\frac{19}{24}$ of a chaldron to its proper quantity.
Ans. 15 *bus.*

(84) Reduce $\frac{7}{15}$ of a day to its proper time.
Ans. 11 *ho.* 12 *min.*

XI. *To reduce money, weights, and measures to fractions.*

Rule. Reduce the given quantity to the lowest denomination mentioned, for a *numerator;* and the specified *integer* or *whole number* into the same name for a *denominator.* This fraction reduced to its lowest terms, will be the answer required.

Examples.

(85) Reduce 4*s.* 8½*d.* to the fraction of a £

s.	*d.*		*s.*
4	8½		20 = 1*l.*
12			12
56			240
4			4
226	*numerator.*		960 *denominator*

$\frac{226}{960} = \frac{113}{480}$ *Ans.*

(86) Reduce 12*s.* 8½*d.* to the fraction of a £.
Ans. $\frac{190}{960} = \frac{19}{96}$

(87) Reduce 6 oz. 15 dwts. to the fraction of a lb. Troy
Ans. $\frac{9}{16}$.

(88) Reduce 12 cwt. 2 qrs. to the fraction of a ton *Ans.* $\frac{5}{8}$.

(89) Reduce 16 bus. 2 pecks to the fraction of a chaldron of coals. *Ans.* $\frac{66}{144} = \frac{11}{24}$

(90) Reduce 16¾ cwt to the fraction of a ton. *Ans.* $\frac{67}{80}$.

(91) Reduce $9\frac{3}{4}d.$ $\frac{1}{3}$ to the fraction of a shilling.

d.	*d.*	
$9\frac{3}{4}\cdot\frac{1}{3}$	12	
4	4	
39	48	*Ans* $\frac{11\,3}{144} = \frac{59}{72}$
3	3	
118 *numerator*	144 *denominator*	

(92) Reduce 6*s.* $8\frac{1}{2}d.$ $\frac{2}{5}$ to the fraction of a £. *Ans.* $\frac{1\,6\,1\,2}{4\,8\,0\,0}$.

(93) Reduce 8 oz. $6\frac{1}{2}$ dr. to the fraction of a lb. avoirdupois? *Ans.* $\frac{2\,6\,9\,2}{5\,1\,2}$.

(94) Reduce 2 qrs. $3\frac{1}{2}$ nails to the fraction of a yard. *Ans.* $\frac{2\,3}{3\,2}$.

(95) Reduce 6 days 6 ho. $15\frac{1}{6}$ min. to the fraction of a week. *Ans.* $\frac{1\,9\,8\,1\,9\,6}{1\,0\,0\,8\,0}$.

(96) Reduce 2 roods $16\frac{3}{4}$ poles to the fraction of an acre. *Ans.* $\frac{3\,8\,7}{6\,4\,0}$.

XII. *To reduce a fraction of an integer to an* equivalent fraction *of* another *integer, differing in value.*

Rule. Multiply the *numerator* of the fraction by the integer in its *next lower* denomination; and the *denominator* by the value of the integer sought, in the *same denomination*, and it will produce the answer required.

Examples.

(97) Reduce $\frac{4}{5}$ of a £. to the fraction of a guinea.

$\frac{4}{5}$ of $\frac{2\,0}{1} = \frac{8\,0}{5}$ *of a shill.; and* $\frac{8\,0}{5} \times \frac{1}{2\,1} = \frac{8\,0}{1\,0\,5} = \frac{1\,6}{2\,1}$ *of a guin.*

Or thus: $\frac{4}{5}$ of $\frac{2\,0}{1}$ of $\frac{1}{2\,1} = \frac{8\,0}{1\,0\,5} = \frac{1\,6}{2\,1}$ *Ans. as before.*

(98) Reduce $\frac{2}{7}$ of a guinea to the fraction of a £.

$\frac{2}{7}$ of $\frac{2\,1}{1}$ of $\frac{1}{2\,0} = \frac{4\,2}{1\,4\,0} = \frac{2\,1}{7\,0}$ *of a £. Ans.*

(99) Reduce $\frac{3}{7}$ of a guinea to the fraction of a moidore.

$\frac{3}{7}$ of $\frac{2\,1}{1}$ of $\frac{1}{2\,7} = \frac{6\,3}{1\,8\,9} = \frac{2\,1}{6\,3} = \frac{3}{9} = \frac{1}{3}$ *of a moidore. Ans.*

(100) Reduce $\frac{3}{1\,4}$ of a crown to the fraction of a seven-shilling piece. $\frac{3}{1\,4}$ of $\frac{5}{1}$ of $\frac{1}{7} = \frac{1\,5}{9\,8}$ *Ans.*

(101) Reduce $\frac{3}{4}$ of a yard to the fraction of an ell English.

$\frac{3}{4}$ of $\frac{4}{1}$ of $\frac{1}{5} = \frac{1\,2}{2\,0} = \frac{3}{5}$ *of an English ell. Ans.*

(102) Reduce $\frac{3}{8}$ of a barrel to the fraction of a hogshead of beer.

$\frac{3}{8}$ of $\frac{3\,6}{1}$ of $\frac{1}{5\,4} = \frac{1\,0\,8}{4\,3\,2} = \frac{1}{4}$ *of a hogshead. Ans.*

(103) Reduce $\frac{5}{8}$ of 6*s.* $8\frac{1}{2}d.$ to the fraction of 10*s.*

6*s.* $8\frac{1}{2}d.$ = 322 *farth.* and 10*s.* = 480 *farth.*

Then, $\frac{5}{8}$ of $\frac{3\,2\,2}{4\,8\,0}$ of $\frac{1}{1} = \frac{1\,6\,1\,0}{3\,8\,4\,0} = \frac{1\,6\,1}{3\,8\,4}$ *the Ans.*

ADDITION OF VULGAR FRACTIONS.

CASE I. Bring *compound* fractions, if any, to *single* ones.
2ndly. Reduce these fractions to a *common denominator*, by Case 1st, and *add* all the *numerators* together, under which place the common denominator.

N.B. When *large mixed numbers* are to be added, *reduce only the fractional part* for a common denominator, and add the whole numbers separately.

Examples.

(1) Add $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{6}$ together.

$2\times4\times6 = 48$
$3\times3\times6 = 54$
$5\times3\times4 = 60$

$162 = 2\frac{18}{72} = 2\frac{1}{4}$ *Ans.*

$3\times4\times6 = 72$

(2) Add $\frac{3}{5}$, $\frac{6}{7}$, $\frac{4}{5}$, and $\frac{2}{3}$, together. *Ans.* $2\frac{179}{105}$.
(3) What is the sum of $\frac{5}{8}$ and $\frac{9}{11}$? *Ans.* $1\frac{32}{88}$.
(4) Required the sum of $\frac{11}{19}\frac{7}{5}$ and $\frac{13}{24}\frac{5}{0}$.
Ans. $1\frac{760}{456}\frac{05}{00}$ or $1\frac{13}{80}$.
(5) What is the sum of $\frac{3}{7}$, $\frac{5}{8}$, $\frac{9}{11}$, $\frac{2}{3}$, and $\frac{4}{5}$? *Ans.* $2\frac{247}{7}\frac{81}{20}$.

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(6) Add $\frac{1}{3}$ of $\frac{2}{3}$, $1\frac{5}{6}$, and $\frac{3}{7}$ of $\frac{6}{11}$ together.
First, $\frac{1}{3}$ of $\frac{2}{3} = \frac{2}{6} = \frac{1}{3}$ $1\frac{5}{6} = \frac{11}{6}$. $\frac{3}{7}$ of $\frac{6}{11} = \frac{18}{77}$.
Then the simple fractions are $\frac{1}{3}$, $\frac{11}{6}$, and $\frac{18}{77}$.

Therefore $1 \times 6 \times 77 = 462$
$11 \times 3 \times 77 = 2541$
$18 \times 3 \times 6 = 324$

$3327 = 2\frac{555}{1386} = 2\frac{185}{462}$ *Ans.*

$3 \times 6 \times 77 = 1386$

(7) What is the sum of $\frac{3}{7}$, $2\frac{3}{4}$, $\frac{9}{14}$, and $\frac{1}{3}$ of $\frac{2}{5}$. *Ans.* $3\frac{49}{420}$.
(8) Required the sum of $\frac{6}{7}$ of $\frac{8}{9}$, $3\frac{1}{3}$, $\frac{4}{5}$, and $\frac{1}{2}$ of $\frac{2}{3}$.
Ans. $5\frac{8}{35}$.
(9) Add $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{8}{9}$, $\frac{2}{3}$ of 6, $1\frac{1}{5}$, $\frac{5}{7}$ of $\frac{3}{2}$, and $\frac{2}{9}$ together.
Ans. $6\frac{73}{315}$.

(10) Add $12\frac{1}{2}$, $16\frac{2}{3}$, and $26\frac{3}{4}$ together.

The fractional parts are $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$.

Therefore $1\times3\times4=12$
$2\times2\times4=16$
$3\times2\times3=18$
46
$2\times3\times4=24$

12
16
26
$=1\frac{22}{24}=1\frac{11}{12}$

$55\frac{11}{12}$ *Ans.*

(11) Add $10\frac{1}{5}$, $9\frac{6}{7}$, $12\frac{8}{9}$ together. *Ans.* $33\frac{17}{315}$

(12) What is the sum of $18\frac{2}{11}$ and $56\frac{11}{13}$? *Ans.* $75\frac{285}{143}$

(13) Required the sum of $\frac{5}{6}$, $85\frac{1}{8}$, $\frac{2}{3}$ of $\frac{1}{3}$, and $9\frac{1}{2}$. *Ans.* $95\frac{49}{72}$

II. When the fractions are of various denominations, reduce them to their proper quantities, and add their sums.

Or 2ndly. The fractions may be first reduced to the same integer, and added together, before being reduced to the proper quantity.

Examples.

(14) Add $\frac{1}{8}$ of a guinea, $\frac{5}{8}$ of a £, and $\frac{7}{8}$ of a shilling together.

1	5	7	*s.* *d.*
21	20	12	2 $7\frac{1}{2}$
			12 6
8)21	8)100	8)84	0 $10\frac{1}{2}$
$2s.\ 7\frac{1}{2}d.$	12 6	$10\frac{1}{2}$	16 0 *Ans.*

Or thus: $\frac{1}{8}$ of a guinea $= {}^{s.}_{2}\,{}^{21}_{8}$ and $\frac{5}{8}$ of a £. $= {}^{100}_{8}$

Then, ${}^{21}_{8} + {}^{100}_{8} + \frac{7}{8} = {}^{s.}_{12}\,{}^{8}_{8} = 16s.$ *Ans. as before.*

(15) Required the sum of $\frac{5}{7}$ of a guinea, $\frac{6}{8}$ of a £, and $\frac{3}{4}$ of a shilling. *Ans.* 1*l.* 10*s.* 9*d.*

(16) What is the sum of ${}_{1}{}^{6}_{5}$ of a £, ${}_{1}{}^{4}_{2}$ of a shilling, and $\frac{6}{8}$ of a penny? *Ans.* 8*s.* $4\frac{3}{4}d.$

(17) Add ${}_{1}{}^{6}_{0}$ of a crown, ${}_{1}{}^{4}_{4}$ of seven shillings, and $\frac{2}{7}$ of a guinea together. *Ans.* 14*s*

(18) What is the sum of $\frac{4}{5}$ of a ton $\frac{4}{16}$ of a cwt. $\frac{3}{8}$ of a quarter, and $\frac{2}{3}$ of $\frac{3}{4}$ of a lb.?

4	$\frac{4}{16} = \frac{1}{4}$ or 1 *qr. of cwt.*	3	$\frac{2}{3}$ of $\frac{3}{4} = \frac{6}{12} = \frac{1}{2}$ *of a lb.*
20		28	
5) 80		8) 84	
16 *cwt.*		$10\frac{1}{2}$ *lb.*	

And 16 *cwt.* + 1 *qr.* + $10\frac{1}{2}$ *lb.* + $\frac{1}{2}$ *lb.* = 16 *cwt.* 1 *qr.* 11 *lb.* *Ans.*

(19) Add $\frac{2}{3}$ of a lb. Troy, $\frac{3}{8}$ of an ounce, and $\frac{5}{6}$ of a dwt. together. *Ans.* 8*oz.* 8 *dwts.* 8 *grs.*

(20) Find the sum of $\frac{1}{4}$ of a mile, $\frac{1}{3}$ of a yard, and $\frac{3}{4}$ of a foot. *Ans.* 440 *yds.* 1 *ft.* 9 *in.*

(21) Required $\frac{8}{12}$ of a chaldron of coals, $\frac{5}{8}$ of a bushel, and $\frac{3}{4}$ of a peck. *Ans.* 24 *bus.* $3\frac{1}{4}$ *pecks*

(22) Add $\frac{2}{4}$ of a week, $\frac{3}{4}$ of a day, and $\frac{1}{5}$ of an hour together. *Ans.* 1 *day*, 18 *ho.* 12 *min.*

SUBTRACTION OF VULGAR FRACTIONS.

RULE. Reduce the fractions, if needful, to a *common denominator*, as in Addition: then subtract the less numerator from the greater, and place the remainder over the common denominator.

2nd. When the *lower* fraction is *greater than the upper*, subtract the numerator of the lower fraction from the common denominator, and to that difference add the upper numerator, carrying one to the unit's place of the lower whole number.

N. B. This is the principle upon which farthings are subtracted in money; suppose it be required to subtract $4\frac{3}{4}d.$ from $6\frac{1}{4}d.$ we should take the numerator 3 from 1—saying, 3 from 1 you cannot, but 3 from 4 (the common denominator) leaves 1, and $1 = \frac{1}{2}$; put down $\frac{1}{2}$, and carry one to the whole number.

EXAMPLES.

(1) From $\frac{6}{7}$ subtract $\frac{3}{5}$.

$5 \times 6 = 30$
$3 \times 7 = 21$

9 *Ans.*

Or thus: $\frac{30-21}{35} = \frac{9}{35}$. *Ans.*

$5 \times 7 = 35$

Or, $\frac{3}{5} - \frac{6}{7} = \frac{30-21}{35} = \frac{9}{35}$. *Ans.*

(2) From $\frac{1}{2}$ take $\frac{2}{7}$. *Ans.* $\frac{1}{2\,1}$.
(3) Required the difference of $\frac{3}{7}$ and $\frac{8}{11}$. *Ans.* $\frac{2\,3}{7\,7}$.
(4) Subtract $\frac{7\,5}{1\,0\,0}$ from $\frac{6}{8}$. *Ans.* 0.
(5) What is the difference between $\frac{6}{14}$ and $\frac{3}{5}$ of $\frac{5}{7}$ of $\frac{7}{8}$? *Ans.* $\frac{3}{5\,6}$.

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(6) From $16\frac{9}{11}$ take $8\frac{7}{12}$.

$9 \times 12 = 108$ *num.*
$7 \times 11 = 77$ *num.*

$11 \times 12 = 132$ *den.*

Then, from $16\frac{108}{132}$
take $8\frac{77}{132}$

Ans. $8\frac{31}{132}$

And from $6\frac{2}{3}$ take $4\frac{3}{4}$.

$2 \times 4 = 8$ *num.*
$3 \times 3 = 9$ *num.*

$3 \times 4 = 12$ *den.*

Then, from $6\frac{8}{12}$
take $4\frac{9}{12}$

$1\frac{11}{12}$ *Ans.*

(7) Required the difference between $12\frac{5}{8}$ and $8\frac{2}{5}$. *Ans.* $4\frac{9}{4\,0}$.
(8) Subtract $110\frac{3}{4}$ from $250\frac{1}{5}$. *Ans.* $140\frac{1}{20}$.
(9) What is the difference between $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ and $24\frac{1}{4}$? *Ans.* 24.
(10) From 185 take $67\frac{3}{7}$. *Ans.* $117\frac{3}{7}$

N.B. When the fractions are of several denominations, reduce them to their proper quantities, or to fractions of the same integer, and subtract as before.

(11) From $\frac{1}{3}$ of a £ take $\frac{3}{4}$ of a shilling.

1 / 20 — 3) 20 — 6*s.* 8*d.*

3 / 12 — 4) 36 — 9*d.*

Then, from 6*s.* 8*d.*
take 0 9

5*s.* 11*d.* *Ans.*

Or thus, $\frac{3}{4}$ of a shilling $= \frac{3}{8\,0}$ of a £.
Then the fractions would be $\frac{1}{3}$ £ and $\frac{6}{8\,0}$ £.

$1 \times 80 = 80$ *num.*
$3 \times 3 = 9$ *num.*

$3 \times 80 = 240$ *den.*

and $\frac{8\,0-9}{2\,4\,0} = \frac{7\,1}{2\,4\,0} = 5s.\ 11d.$ *Ans.*

(12) From $\frac{5}{8}$ of a £ take $\frac{1}{8}$ of a guinea. *Ans.* 9*s.* $10\frac{1}{5}$*d.*
(13) From $\frac{2}{3}$ of a lb. Troy take $\frac{3}{5}$ of an ounce.
Ans. 7 *oz.* 12 *dwts.* 12 *grs.*
(14) From $\frac{8}{12}$ of a chaldron take $\frac{5}{8}$ of a bushel.
Ans. 23 *bus.* 1 *peck*, 1 *gal.*
(15) From 15 weeks take $6\frac{2}{6}$ days *Ans.* 12 *w.* 0 *d.* 16 *h.*

MULTIPLICATION OF VULGAR FRACTIONS.

RULE 1. Prepare the fractions, if needful, by the rules of Reduction; then multiply all the numerators together for a new numerator, and all the denominators for a new denominator.

2. When any number, either whole or mixed, is multiplied by a fraction, the *product* will be always *less than the multiplicand*, in the same proportion as the multiplying fraction is less than the unit.

EXAMPLES.

(1) Multiply $\frac{3}{5}$, $\frac{2}{7}$, and $\frac{4}{9}$ together.

$\frac{3}{5} \times \frac{2}{7} \times \frac{4}{9} = \frac{24}{315}$ *Ans.*

(2) Multiply $1\frac{6}{11}$ by $\frac{5}{7}$, and $\frac{4}{5}$ by $1\frac{2}{12}$. *Ans* $\frac{80}{77}$ *and* $1\frac{2}{5}$.

(3) Multiply $\frac{2}{5}$, $\frac{3}{5}$, $\frac{3}{6}$, and $\frac{2}{7}$ together.

Ans $\frac{36}{1050} = \frac{12}{350} = \frac{6}{175}$.

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(4) Multiply $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{4}{5}$ of $\frac{3}{4}$.

$\frac{2}{3} \times \frac{3}{4} \times \frac{1}{2} \times \frac{4}{5} \times \frac{3}{4} = \frac{72}{480} = \frac{3}{20}$ *Ans.*

(5) Multiply $\frac{3}{7}$ of $\frac{8}{9}$ by $\frac{8}{11}$ of $\frac{7}{8}$. *Ans.* $\frac{8}{33}$.

(6) What is the product of $\frac{3}{9}$ of $\frac{9}{12}$ and $\frac{2}{11}$ of $\frac{11}{12}$. *Ans.* $\frac{1}{24}$.

N.B. If the same figures are found in the numerator as in the denominator, they may be left out in multiplying; or if any figure in one line will divide a number in the other, it may be done, and the work will be abbreviated. Thus, in the following figures—

$\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{12}{24}$ may be abbreviated thus: $\frac{2 \times 2}{24} = \frac{4}{24} = \frac{1}{6}$.

(7) Multiply $\frac{9}{11}$ of $\frac{22}{29}$ by $\frac{33}{36}$ of $\frac{11}{22}$. *Ans.* $\frac{3}{8}$.

(8) Multiply $\frac{5}{16}$ of $\frac{32}{35}$ by $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$. *Ans.* $\frac{1}{28}$.

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(9) Multiply $4\frac{2}{3}$, $1\frac{3}{9}$, and $3\frac{1}{3}$ of 8 together.

$4\frac{2}{3} = \frac{14}{3}$; $1\frac{3}{9} = \frac{12}{9}$; $3\frac{1}{3}$ of $8 = \frac{10}{3}$ of $\frac{8}{1}$.

Then $\frac{14}{3} \times \frac{12}{9} \times \frac{10}{3} \times \frac{8}{1} = 134\frac{272}{297}$. *Ans.*

(10) What is the product of $\frac{4}{7}$, $\frac{3}{8}$, $6\frac{2}{3}$, $5\frac{4}{5}$, and 12?

Ans. $99\frac{3}{5}$.

(11) How many yards of cloth in $12\frac{3}{4}$ pieces, each containing $26\frac{1}{2}$ yards? *Ans.* $337\frac{7}{8}$.
(12) How many lbs. are there in $9\frac{1}{2}$ parcels, each containing $11\frac{3}{4}$ lbs.? *Ans.* $111\frac{5}{8}$.
(13) How many lbs. are there in $7\frac{1}{4}$ sugar loaves, each weighing $12\frac{5}{8}$ lbs.? *Ans.* $91\frac{1}{32}$.

DIVISION OF VULGAR FRACTIONS.

RULE. Prepare the fractions, if needful, by the former rules, then *invert the divisors*, and proceed as in multiplication.

EXAMPLES.

(1) Divide $\frac{12}{38}$ by $\frac{15}{49}$.

$\frac{12}{38} \div \frac{15}{49} = \frac{12}{38} \times \frac{49}{15} = \frac{588}{570} = 1\frac{18}{570} = 1\frac{3}{95}$ *Ans.*

(2) Divide $\frac{10}{11}$ by $\frac{6}{9}$. *Ans.* $1\frac{4}{11}$.
(3) Divide $\frac{12}{15}$ by $\frac{4}{5}$. *Ans.* $1\frac{1}{12}$.

(4) Divide $\frac{3}{5}$ of $\frac{2}{7}$ by $\frac{2}{5}$ of $\frac{1}{3}$.

$\frac{3}{5} \times \frac{2}{7} \times \frac{2}{5} \times \frac{3}{1} = \frac{1262}{700} = 2\frac{262}{700} = 2\frac{11}{35}$ *Ans.*

(5) Divide $\frac{3}{4}$ of $\frac{5}{6}$ by $\frac{9}{11}$ of $\frac{3}{4}$. *Ans.* $1\frac{1}{64}$.
(6) Divide $\frac{3}{7}$ of $\frac{6}{11}$ by $\frac{8}{11}$. *Ans.* $\frac{9}{28}$.

(7) Divide $5\frac{3}{4}$ by $6\frac{2}{3}$.

$5\frac{3}{4} = \frac{23}{4}$ and $6\frac{2}{3} = \frac{20}{3}$.

Then $\frac{23}{4} \div \frac{20}{3} = \frac{23}{4} \times \frac{3}{20} = \frac{69}{80}$ *Ans.*

(8) Divide $3\frac{1}{2}$ by $\frac{2}{5}$. *Ans.* $\frac{35}{4}$.
(9) Divide $4\frac{1}{4}$ by $8\frac{1}{8}$. *Ans.* $\frac{34}{65}$.

(10) Divide $\frac{3}{4}$ of 9 by 7. First, $9 = \frac{9}{1}$ and $7 = \frac{7}{1}$.

$\frac{3}{4}$ of $\frac{9}{1} \div \frac{7}{1} = \frac{3}{4} \times \frac{9}{1} \times \frac{1}{7} = \frac{27}{28}$ *Ans.*

(11) Divide $17\frac{3}{8}$ by 8. *Ans.* $2\frac{11}{64}$.
(12) Divide $654\frac{1}{2}$ by 9. *Ans.* $72\frac{13}{18}$.

(13) What part of 54 is $\frac{3}{5}$ of 9.

$\frac{54}{1} \div \frac{3}{5}$ of $\frac{9}{1} = \frac{54}{1} \times \frac{5}{3} \times \frac{1}{9} = \frac{270}{27} = 10$ *Ans.*

(14) Divide 72 by $\frac{2}{3}$ of 9. *Ans.* 12.
(15) Divide $\frac{1}{3}$ of 16 by $\frac{2}{3}$ of $\frac{4}{5}$. *Ans.* 30.

With abbreviations.

(16) Divide $\frac{3}{5}$ of $\frac{5}{7}$ by $\frac{3}{7}$ of $\frac{5}{3}$.

$$\frac{\cancel{3}}{\cancel{5}} \times \frac{\cancel{5}}{7} \times \frac{7}{2} \times \frac{5}{\cancel{3}} = \frac{5}{2} = 2\tfrac{1}{2} \textit{ Ans.}$$

(17) Divide $\frac{5}{9}$ of 12 by $\frac{1}{2}\frac{5}{7}$ of 24. *Ans.* $\frac{1}{2}$.

(18) Divide $\frac{4}{7}$ of $1\frac{7}{12}$ by $1\frac{3}{12}$ of $\frac{6}{7}$. *Ans.* $1\frac{1}{18} = 1\frac{5}{9}$.

THE RULE OF THREE DIRECT IN VULGAR FRACTIONS.

RULE. *Prepare the fractions* (if needful) as in the preceding rules, and *state the question* as in the Rule of Three in whole numbers. Then *invert the first term* (being the *divisor*), and proceed as in multiplication.

Lastly, reduce the new fraction to its *proper quantity* for the answer.

EXAMPLES.

(1) If $\frac{3}{8}$ of a yard cost $\frac{4}{5}$ of a £ what will $\frac{3}{4}$ of a yard cost?

yd.		£		*yd.*	3
As $\frac{3}{8}$	:	$\frac{4}{5}$	::	$\frac{3}{4}$	20
					5) 60
					12*s.*

$\frac{8}{3} \times \frac{4}{5} \times \frac{3}{4} = \frac{96}{60} = \frac{8}{5} = 1\frac{3}{5}l. = 1l.\ 12s.$ *Ans.*

(2) If $1\frac{3}{5}$ of a lb. cost $\frac{6}{6}$ of a shilling, what will $\frac{3}{5}$ of a lb. cost? *Ans.* 2*s.* 6*d.*

(3) If $\frac{4}{5}$ of a shilling will buy $1\frac{3}{10}$ of a lb. Troy, what will $\frac{8}{5}$ of a shilling buy? *Ans.* 7 *oz.* 4 *dwts.*

(4) If $\frac{1}{2}$ of $\frac{3}{5}$ of a lb. be worth $\frac{19}{160}l.$ what are 6 lb. worth? *Ans.* 2*l.* 7*s.* 6*d.*

---

(5) If $3\frac{1}{2}$ ells cost $1\frac{5}{12}$ of a £, what will $10\frac{1}{2}$ ells cost?

First, $3\frac{1}{2} = \frac{7}{2}$ *ells.* $10\frac{1}{2} = \frac{21}{2}$ *ells.*

ells.		£		*ells.*
Then, As $\frac{7}{2}$	:	$1\frac{5}{12}$	::	$\frac{21}{2}$

$$\text{And, } \frac{\cancel{2}}{\cancel{7}} \times \frac{8}{12} \times \frac{\cancel{21}^{3}}{\cancel{2}} = \frac{8 \times 3}{12} = \frac{24}{12} = 2l. \textit{ Ans.}$$

(6) Bought $10\frac{3}{4}$ lbs. of butter for $12\frac{5}{6}s.$ I demand the wort of $16\frac{1}{3}$ lbs.? *Ans.* 19*s.* 3*d*

(7) Sold $8\frac{1}{4}$ lbs. of cheese for $6\frac{7}{12}s.$, what is the worth of $12\frac{3}{8}$ lbs.? *Ans.* 9*s.* $10\frac{1}{2}d.$

(8) If 7 lb. cost 1*l.* 6*s.* 8*d.* what will $12\frac{3}{4}$ lbs. cost?

First 7 *lb.*$=\frac{7}{1}$ *lb.* 1*l.* 6*s.* 8*d.*$=1\frac{1}{3}l.=\frac{4}{3}l.$ $12\frac{3}{4}=\frac{51}{4}$ *lb.*

Then, As $\frac{7}{1}$ *lb.* : $\frac{4}{3}l.$ :: $\frac{51}{4}l.$

$\frac{1}{7}\times\frac{4}{3}\times\frac{51}{4}=\frac{51}{7\times3}=\frac{51}{21}=\frac{17}{7}=2\frac{3}{7}l.=2l.\ 8s.\ 6\frac{3}{7}d.$—3 *rem*

(9) If $3\frac{3}{8}$ yards cost 2*l.* 13*s.* 4*d.*, what will $18\frac{6}{8}$ yards cost? *Ans.* 14*l.* 14*s.* $3\frac{3}{4}d.$ $\frac{3}{8}$.

(10) Bought $\frac{8}{15}$ lbs. for 7*s.* 6*d.*, I demand the worth of $\frac{4}{15}$ lbs. at the same rate? *Ans.* 13*s.* $1\frac{1}{2}d$

---

(11) If $1\frac{4}{5}$ of a £ will buy 3 lbs. $8\frac{1}{2}$ oz. (troy), what will $5\frac{6}{8}$ of a £ buy?

First, $1\frac{4}{5}=\frac{9}{5}l.$ 3 *lbs.* $8\frac{1}{2}$ *oz.*$=3\frac{17}{24}$ *lbs.*$=\frac{89}{24}$ *lb.* $5\frac{6}{8}=\frac{46}{8}=\frac{23}{4}l.$

Then, As £ $\frac{9}{5}$: *lb.* $\frac{89}{24}$ :: £ $\frac{23}{4}$

$\frac{5}{9}\times\frac{89}{24}\times\frac{23}{4}=\frac{10235}{864}=11lb.\ 10oz.\ 3dwt.\ 1gra.\frac{235}{864}$ *Ans.*

864)10235(11 *lb.*
864
1595
864
731
12 &c.

(12 If $\frac{3}{8}$ of a shilling will buy $3\frac{1}{5}$ yards, what will $\frac{3}{8}$ of a £ buy? *Ans.* 76 *yds.*

(13) If $3\frac{1}{4}$ cwt. of sugar cost $12\frac{8}{10}l.$, what will $1\frac{5}{8}$ cwt. cost at that rate? *Ans.* 6*l.* 9*s.*

---

(14) If 3 yards of broad cloth cost $3\frac{7}{8}l.$, what will 4 pieces cost, each $26\frac{3}{4}$ yards?

First, $3=\frac{3}{1}$ £ $3\frac{7}{8}=\frac{31}{8}$ yds. $26\frac{3}{4}=\frac{107}{4}$ yds. $\frac{4}{1}\times\frac{107}{4}=\frac{428}{4}=\frac{107}{1}$

Then, As yd. $\frac{3}{1}$: £ $\frac{31}{8}$ :: yd. $\frac{107}{1}$

$\frac{1}{3}\times\frac{31}{8}\times\frac{107}{1}=\frac{3317}{24}$

24)3317(138*l.* 4*s.* 2*d.*
...

(15) Bought $3\frac{3}{4}$ pieces, each $25\frac{5}{8}$ ells, at 6*s.* 3*d.* per ell, what did it cost me? *Ans.* 30*l.* 0*s.* $7d.\frac{1}{2}$.

(16) If one ell Flemish cost $4_1\frac{5}{2}s.$, what will $7\frac{1}{2}$ yards come to? *Ans.* 2*l* 4*s.* 2*d.*

THE RULE OF THREE INVERSE IN VULGAR FRACTIONS.

RULE.—Proceed in all respects as in the preceding rule; except that in Inverse Proportion the *third* term (being the *divisor*) must be *inverted.*

EXAMPLES.

(1) If 12 men in $10\frac{1}{2}$ days can mow $120\frac{1}{2}$ acres, in how many days will 15 men do the same?

men.		*days.*		*men.*
$\frac{12}{1}$	:	$\frac{21}{2}$	::	$\frac{15}{1}$

And supposing they work 16 hours per day, then 16 × by 2

$5\overline{)32}$ (6 *hours.*
2 rem.

$\frac{12}{1} \times \frac{21}{2} \times \frac{1}{15} = \frac{252}{30} = \frac{42}{5} = 8\frac{2}{5}$ *days* = 8 *days* 6 *hours.* *Ans.*

(2) If 6 men will mow $18\frac{3}{4}$ acres in $3\frac{1}{2}$ days, how many men will do the same in $10\frac{1}{2}$ days? *Ans.* 2 *men.*

(3) If a traveller performs a journey in 6 days, when the days are $10\frac{1}{2}$ hours long, how many days will he require of $15\frac{3}{4}$ hours each? *Ans.* 4 *days.*

(4) If 28 men can build a house in $50\frac{3}{4}$ days, how many men could do the same in $12\frac{11}{16}$ days? *Ans.* 112 *men.*

(5) How many pieces of cloth, at $34\frac{3}{4}s.$ per piece, are to be given for $136\frac{1}{2}$ pieces at $50\frac{1}{2}s.$ a piece? *Ans.* $198\frac{6}{13}$ *pieces.*

---

(6) A lends B $75\frac{1}{5}l.$ for 9 months; how long ought B to lend A $225\frac{3}{5}l.$ to requite his kindness?

First, $75\frac{1}{5} = \frac{376}{5}$ $\quad 9 = \frac{9}{1}$ $\quad 225\frac{3}{5} = \frac{1128}{5}$

Then, As $\frac{376}{5}$: $\frac{9}{1}$ :: $\frac{1128}{5}$

$\frac{376}{5} \times \frac{9}{1} \times \frac{5}{1128} = \frac{3384}{1128} = 3$ *months.* *Ans.*

(7) If the penny loaf weighs $12\frac{1}{2}$ ounces, when wheat is $4\frac{2}{5}s.$ per bushel, what must it weigh when wheat is at $6\frac{3}{5}s.$ per bushel? *Ans.* $8\frac{1}{3}$ *oz.*

(8) In what time will $336\frac{1}{2}l.$ gain $84\frac{3}{4}l.$ interest, if $280\frac{1}{2}l.$ will gain it in 6 years? *Ans.* $5\frac{1}{7}\frac{1}{8}$ *years*

(9) If 4 men in $12\frac{3}{4}$ days mow a field of barley of 39 acres, in how many days will 18 men do the same? *Ans.* $2\frac{5}{6}$ *days.*

$$\begin{array}{ccccc} \textit{men.} & & \textit{days.} & & \textit{men.} \\ \frac{4}{1} & : & \frac{51}{4} & :: & \frac{18}{1} \end{array}$$

$$\frac{4}{1} \times \frac{51}{4} \times \frac{1}{18} = \frac{204}{72} = 2\frac{5}{6} \textit{ days.} \quad \textit{Ans.}$$

(10) How much in length that is $8\frac{1}{2}$ broad, will be equal in measure to another piece $12\frac{3}{4}$ broad and $24\frac{3}{4}$ long?
Ans. $37\frac{1}{8}$ *yards.*

(11) What quantity of shalloon that is 3 quarters wide, will line $12\frac{3}{4}$ yards that is $2\frac{1}{4}$ yards wide? *Ans.* $38\frac{1}{4}$ *yards.*

THE DOUBLE RULE OF THREE IN VULGAR FRACTIONS.

RULE. Having prepared the fractions as before directed, state the question and work as in whole numbers (*see* page 64).

EXAMPLES.

(1) If 6 men can reap $18\frac{3}{4}$ acres in $5\frac{1}{2}$ days, how many acres will 10 men reap in $12\frac{1}{2}$ days?

First, $18\frac{3}{4}$ *acres* $= \frac{75}{4}$ *acres.* $\quad 5\frac{1}{2} = \frac{11}{2}$ *da.* $\quad 12\frac{1}{2} = \frac{25}{2}$ *da.*

$$\begin{array}{ccccc} \textit{men.} & & \textit{acres.} & & \textit{men.} \\ * \frac{6}{1} & : & \frac{75}{4} & :: & \frac{10}{1} \\ \textit{days.} & & & & \textit{days.} \\ * \frac{11}{2} & : & — & :: & \frac{25}{2} \end{array}$$

$$\frac{1}{6} \times \frac{75}{4} \times \frac{10}{1} \times \frac{2}{11} \times \frac{25}{2} = \frac{18750}{264} = \frac{9375}{132} = 71\frac{1}{44} \textit{ acres.} \quad A.$$

(2) If the carriage of $3\frac{1}{2}$ cwt. for $20\frac{3}{4}$ miles cost $2\frac{1}{3}s.$, what will the carriage of $10\frac{1}{2}$ cwt. cost, being carried $62\frac{1}{4}$ miles?
Ans. 1*l.* 1*s.*

(3) If 150*l.* in 12 months gain $7\frac{1}{2}l.$ interest, what principal will gain 5*l.* in $1\frac{1}{2}$ years? *Ans.* 66*l.* 13*s.* 4*d.*

(4) If 12 men in $9\frac{1}{3}$ days mow 100 acres, how many men can mow 150 acres in $18\frac{2}{3}$ days? *Ans.* 6 *men.*

DECIMAL FRACTIONS.

NUMERATION.

DECIMAL FRACTIONS are so called from the Latin *decem*, ten, because their *denominators* are 10, 100, 1000, and so on, in a tenfold proportion; the number of noughts being always equal to the number of figures in the numerator, thus: $\frac{5}{10}$, $\frac{25}{100}$, $\frac{123}{1000}$, $\frac{4321}{10000}$, &c.

And as it is evident that the *denominator* of a decimal fraction is always known, it is never set down; the numerator being distinguished from the whole number by a comma prefixed. Hence $7\frac{5}{10}$, $12\frac{25}{100}$, $36\frac{365}{1000}$, are expressed as 7,5; 12,25; 36,365, &c.; and read thus: Seven and five-tenths, twelve and 25 hundredths, thirty-six and 365 thousandths

Decimals express the *parts* of a unit, in the same manner as whole numbers express the *number* of units; which may appear plainer by the following table:—

Whole Numbers.							Decimal Parts.				
7	6	5	4	3	2	1	,2	3	4	5	6	7
Millions.	C of Thousands.	X of Thousands.	Thousands.	Hundreds.	Tens.	Units.	Parts of Tens.	Parts of Hundreds.	Parts of Thousands.	Parts of X Thousands.	Parts of C Thousands.	Parts of Millions.

From the above table it may be observed—1st. That as *whole numbers* increase in a *tenfold* proportion to the *left hand, decimal parts* decrease in a *tenfold* proportion to the *right hand.*

2nd. *Cyphers* placed *before* decimal parts *decrease* their value, by removing them farther from the comma or unit's place; thus ,5 is 5 parts of 10, or $\frac{5}{10}$; but ,05 is 5 part of 100, or $\frac{5}{100}$; ,005 is 5 parts of 1000, or $\frac{5}{1000}$, &c.

3rd. Cyphers *after* decimal parts do not alter their value, for .5 ,50 ,500 &c., are each but $\frac{5}{10}$ of the unit.

Decimals are of different kinds, and are termed *finite* or *terminate; infinite* or *interminate; single repetends* or *recurring; compound repetends* or *circulate;* also *pure, similar,* and *dissimilar* repetends, &c.

A FINITE OR TERMINATE DECIMAL, is that which ends at some certain number of places; but an INFINITE or INTERMINATE has no end.

A RECURRING DECIMAL is that in which one or more figures are continually repeated.

A SINGLE REPETEND, or *recurring decimal*, is one in which the *same* figure is repeated, as ,3333, &c.

A COMPOUND REPETEND, or *circulate*, is when *more than one figure* is repeated, as ,275275275, &c.

PURE REPETENDS have no figures in them but what are repeated, as ,364364, &c.

MIXED REPETENDS have significant figures between the repetend and the decimal point, as ,645321321, &c.

SIMILAR REPETENDS begin at an *equal distance* from the decimal point; and DISSIMILAR REPETENDS begin at *different places* from the decimal point.

ADDITION OF DECIMALS.

RULE. Write down the numbers so that the *decimal points* may stand in a line directly *under each other*, and find their sum as in whole numbers.

EXAMPLES.

(1) Add 36,432 + 532,1234 + 26,019 + 160,0876 + 86,2015 + 8,9765 together.

36,432
532,1234
26,019
160,0876
86,2015
8,9765
849,8400

(2) Add 3,005 + 100,6 + 31,976 + 4,35 + 7,0865 + 4321, together.

3,005
100,6
31,976
4,35
7,0865
4321,
4468,0175

(3) Add 73,143+46,32+7,905+46,731+500,5001 together. *Ans.* 674,5991

(4) Add 234,6 + 3210 + 54,321+ 9,001+ 7,1324 +1000 together. *Ans.* 4515,0544

(5) Add 46,5094 + 6,123 + 8564, + ,6982 + 360,063 + 1231,2312 together. *Ans.* 10208,6248

SUBTRACTION OF DECIMALS.

RULE. Place the numbers as in Addition, having the decimal points under each other; then subtract as in whole numbers.

EXAMPLES.

(1) From 36,243 take 4,8941
Take 4,8941

Ans. 31,3489 *difference*

(2) From 650,231 take 9,765
(3) From 32,402 take 15,43
(4) From 132,3461 take ,987
(5) From 2341, take ,2341
(6) From 10, subtract ,324
(7) From ,00623 take ,00094

(8) From 3960,0076
Take 578,900864

Ans. 3381,106736 *differ.*

(9) From 679,2 take 6,792
(10) From584,312take58,4312
(11) From 234,5 take 2,3567
(12) From 4300, take ,0003
(13) From ,3205 subtr. ,27981
(14) From12,3123take1,23123

MULTIPLICATION OF DECIMALS.

RULE 1. Place and multiply the factors as in whole numbers.

2ndly. Point off as many figures from the product for decimal places, as there are decimals in both the factors.

3rdly. If there should not be so many figures in the product, supply the defect by prefixing ciphers.

EXAMPLES.

(1) Multiply 243,21 by 35,6

243,21
35,6

145926
121605
72963

8658,276

(2) Multiply 34,56 by 2,437
(3) Multiply 27,16 by 467,1
(4) Multiply 2000, by ,203
(5) Multiply 1209,6 by 6,032
(6) Multiply 254, by ,032
(7) Multiply 376, by ,0025

(8) Multiply ,0234 by ,123

,0234
,123

702
468
234

,0028782

(9) Multiply ,2345 by ,0015
(10) Multiply ,0123 by ,0152
(11) Multiply ,071 by ,124
(12) Multiply ,321 by ,321
(13) Multiply 3,42 by ,001
(14) Multiply ,2634 by ,0054

When any number is to be multiplied by 10, 100, 1000, &c., it is done by only *removing the separating point* in the multiplicand, so many places towards the *right hand*, as there are ciphers in the multiplier, thus, $5,432 \times 10 = 54,32$; and $5,432 \times 100 = 543,2$ and $543,2 \times 1000 = 5432$; and $5,432 \times 10000 = 54320$.

CONTRACTED MULTIPLICATION OF DECIMALS.

When only a certain number of decimal places are to be retained.

RULE 1st. Write the multiplier under the multiplicand in a *contrary order* to what is usual; and to ascertain their exact position, consider *how many* decimal places are to be retained in the product, and place the *unit's place* of the multiplier under the *last decimal* in the multiplicand which is to be reserved.

2ndly. In multiplying, *reject* all the figures that stand to the *right* of the figure you are multiplying by; and place the figures of each line so that the right hand figures may form an even column.

3rdly. But when you multiply the rejected figures, carry 1 at 5 and upwards; at 15 and upwards carry 2; at 25 and upwards carry 3; at 35 and upwards carry 4, &c.

EXAMPLES.

(15) Multiply 32,542163 by 23,5463, and retain only 4 places of decimals in the product.

Contracted way.	*Common way.*
32,542163	32,542163
3645,32	23,5463
6508433	97 626489
976265	1952 52978
162711	13016 8652
13017	162710 815
1952	976264 89
98	6508432 6
766,2476	766,2475326469

(16) Multiply 276,4301 by 64,3265, and leave only 2 places of decimals in the product. *Ans.* 17781,79

(17) Multiply 3124,0651 by 123,456, and leave only 2 places of decimals in the product. *Ans.* 385674,57

(18) Multiply 2,41342 by 5432,1, and leave 5 places of decimals in the product. *Ans.* 13109,93878

(19) Multiply 4,252603 by 63,8549, and leave only 4 places of decimals. *Ans.* 271,5495

(20) Multiply 3242,431 by 324,5164, having *no decimal* fractions in the product.

3242,431	3242,431
4615,423	324,5164
972729	1 2969724
64849	19 454586
12970	32 42431
1622	1621 2155
32	12969 724
19	64848 62
1	972729 3
1052222	1052222,0353684

DIVISION OF DECIMALS.

Rule 1st. Divide as in whole numbers; and point off from the quotient as many figures for decimals as the *dividend* has *more than* the *divisor*.

2nd. If the dividend has not so many places of decimal parts as are in the divisor, or if there be a remainder, then annex cyphers to the dividend, and carry on the quotient further to any extent required.

3rd. If the quotient, when carried, have not the number of decimal parts wanted, the number must be made up by putting a cypher or cyphers on its *left hand*.

4th. If both the *divisor* and *dividend* have the *same number* of *decimal parts*, the quotient will be a *whole number*.

Examples.

(1) Divide 42,576 by 1,2.

1,2)42,576

35,48

(2) Divide 6,7342 by 1,1
Ans. 6,122

(3) Divide 67,342 by 11
Ans. 6,122

(4) Divide 425,84 by 8
Ans. 53,23

(5) Divide 5,25784 by 120

120)4,25784

,035482

(6) Divide 67,837 by 1,1
Ans. 61,67

(7) Divide 8,97658 by ,7
Ans. 12,8236 +

(8) Divide 463,26 by ,6
Ans. 772,1

(9) Divide 425,76 by ,12

,12) 425,76

3548,

(10) Divide 32684. by ,8
Ans. 40855.

(11) Divide 9876. by 7
Ans. 1410,8+

(12) Divide 3254. by 11.
Ans. 295,8+

(13) Divide 3264,36 by ,12

,12) 3264,36

27203,

(14) Divide 21321,9 by .9
Ans. 23691

(15) Divide 342361,2 by ,6
Ans. 570602

(16) Divide 1000,02 by ,07
Ans. 14286,

N.B. When the divisor is either 10, 100, 1000, 10000, &c. it is only necessary to remove the decimal point *so many places* towards the *left hand*, as there are cyphers in the *divisor*.

Thus, 9876. ÷ 10 = 987,6 12,34 ÷ 10 = 12,34
5432. ÷ 100 = 54,32 43,21 ÷ 100 = ,4321
3540, ÷ 1000 = 3,540 534,2 ÷ 1000 = ,5342

Long Division.

(17) Divide 73,89785 by 42,5

42,5) 73,89785 (17,387 *Ans.*
425
3139
2975
1647
1275
3728
3400
3285
2975
310

(18) Divide 72,3456 by 54,32
Ans. 1,3318+

(19) Divide 13,426 by 12,4
Ans. 1,0827+

(20) Divide ,5982 by 126.
Ans. ,004747+

(21) Divide 12,54 by 6789.
Ans. ,00184+

(22) Divide 34574. by 3162
Ans. 10,934+

(23) Divide 6978,6 by 3,24

3,24) 6978,600 (2153,8 *Ans.*
648
498
324
1746
1620
1260
972
2880
2592
288

(24) Divide 3765,4 by ,284
Ans. 13258+

(25) Divide 11269,8 by 1,116
Ans. 10098,3+

(26) Divide 76, by ,1254
Ans. 606

(27) Divide 467,2 by 11,4
Ans. 40,982+

(28) Divide 92563. by 7,214
Ans. 12831.+

CONTRACTED DIVISION OF DECIMALS.

RULE 1st. Consider how many of the *left hand* figures of the *divisor* are equal to the number of whole numbers and decimals that are wanted in the quotient, and with these *divide;* omitting one figure of the divisor at each succeeding operation.

2nd. In multiplying the figures left out in the divisor, carry 1 at 5, and upwards; carry 2 at 15, and upwards; 3 at 25, &c.

EXAMPLES.

(29) Divide 36,45413 by 3,54621, and leave only 3 places of decimals.

```
35,4621 ) 36,45413 ( 10,279
            35462
            -----
            ..992
              709
              ---
              283
              248
              ---
              .35
               32
               --
                3
```

By the common way.

```
3,54621 ) 36,45413000 ( 10,279
            3546210
            -------
            ..992030
              709242
              ------
              282 7880
              248 2347
              --------
              .34 55330
               31 91589
               --------
               .2 63741
```

(30) Divide 735,851 by 42,5, and leave only 3 places of decimals. *Ans.* 17,314+

(31) Divide 72,3456 by 54,32, and leave 4 places of decimals. *Ans.* 1,3318+

(32) Divide 6978,6 by ,324, and leave 1 place of decimals. *Ans.* 21538,8+

REDUCTION OF DECIMALS.

CASE I. *To reduce a Vulgar Fraction to a Decimal of the same value.*

RULE. Annex *cyphers* to the *numerator*, and divide by the *denominator*, continuing the operation as far as may be needful; the quotient will be the decimal fraction required.

EXAMPLES.

(1) Reduce $\frac{3}{8}$ to a decimal.

8)3,000

,375 *Ans.*

(2) Reduce $\frac{1}{4}$ to a decimal. *Ans.* ,25

(3) Reduce $\frac{1}{2}$ to a decimal. *Ans.* ,5

(4) Reduce $\frac{3}{4}$ to a decimal. *Ans.* ,75

(5) Reduce $7\frac{6}{9}$ to a decimal.

9)6,0000

Ans. 7,6666 &c.

,6666 &c.

(6) Reduce $8\frac{3}{9}$ to a decimal. *Ans.* 8,3333 &c.

(7) Reduce $110\frac{3}{14}$ to a decimal. *Ans.* 110,5714 &c.

(8) Reduce $158\frac{12}{181}$ to a decimal. *Ans.* 158,066298

---

(9) Reduce $\frac{5}{6}$ of $\frac{8}{9}$ of $\frac{3}{4}$ to a decimal.

$\frac{5}{6} \times \frac{8}{9} \times \frac{3}{4} = \frac{120}{216} = \frac{5}{9}$

9)5,0000

,5555 &c. *Ans.*

(10) Reduce $\frac{3}{12}$ of $\frac{11}{16}$ to a decimal. *Ans.* ,171875+

(11) Reduce $\frac{1}{25}$ of $\frac{1}{2}$ to a decimal. *Ans.* ,02

(12) Reduce $\frac{5}{9}$ of 8 to a decimal. *Ans.* 4,44+

(13) Reduce $\frac{3685}{4769}$ to a decim.

8469)368,0000(,04345 &c. *Ans.*

33876

.29240

25407

38330

33876

.44540

42345

2195 &c. &c.

(14) Reduce $\frac{345}{678}$ to a decimal. *Ans.* ,050854+

II. *To reduce money, weights, measures, &c., to equivalent decimals.*

RULE 1st. If the quantity given be but of *one denomination*, divide it by as many as make one of the denomination sought, and the quotient will be the answer required.

2nd. If the quantity given be of *different denominations*, reduce it to the *lowest name* mentioned for a *dividend;* then reduce the *integer* into the *same denomination* for a *divisor;* the quotient will be the decimal required.

Or 3rdly. Write the given numbers perpendicularly *under each other*, for dividends; then divide each line (beginning with the uppermost) by that figure which will raise it to the next superior name; and the last quotient will give the decimal required.

By Rule 1st.

(15) Reduce 5*s.* to the decimal of a £.

20)5,00

,25 *Ans.*

(16) Reduce 7*s.* to the decimal of a £. *Ans.* ,35

(17) Reduce 10*d.* to the decimal of a shilling. *A.* ,83$\dot{3}$+

(18) Reduce 7*d.* to the decimal of a shilling. *A.* ,583$\dot{3}$+

(19) Reduce 3 farth. to the decimal of a penny. *Ans.* ,75

(20) Reduce 1 farth. to the decimal of a penny. *Ans.* ,25

(21) Reduce 9*d.* to the decimal of a £.

In a £=240)9,0000

$\frac{9}{240}=\frac{3}{80}$,0375 *Ans.*

(22) Reduce 8*d.* to the decimal of a £. *Ans.* ,0333+

(23) Reduce 10*d.* to the decimal of a crown. *A.* ,1666+

(24) Reduce 3 farth. to the decim. of a shilling. *A.* ,0625

(25) Reduce $\frac{1}{4}$ to the decimal of a crown. *A.* ,004166+

(26) Reduce 16*s.* 10$\frac{1}{2}$*d.* to the decimal of a pound.

By Rule the 2nd.

20*s.*	16*s.* 10$\frac{1}{2}$*d.*
12	12
240	202
4	4
960	960)810,00000(,84375 *Ans.*
	7680
	420 &c.

Or, by Rule the 3rd.

4	2,0
12	10,500
20	16,87500

,84375 *Ans.*

(27) Reduce 3*s.* 4$\frac{1}{2}$*d.* to the decimal of a £. *Ans.* ,16875

(28) Reduce 18*s.* 11$\frac{3}{4}$*d.* to the decimal of a £. *Ans.* ,9489583

(29) Reduce 16*s.* 6$\frac{1}{4}$*d.* to the decimal of a £. *Ans.* ,82604166

(30) Reduce 3*s.* 7$\frac{1}{2}$*d* to the decim. of a guinea. *Ans.* ,172619

(31) Reduce 3*s.* 6*d.* to the decimal of a crown. *Ans.* ,7

(32) Reduce 2*s.* 10$\frac{3}{4}$*d.* to the decim. of a moidore. *A.* ,107253

(33) Reduce 12 dwts. 20 gr. to the decim. of an ounce Troy.

First, 12 *dwts.* 20 *gr.* = 308 *grains.*—and 1 *ounce* = 480 *grains.*

Whence $\frac{308}{480}$ = ,641666+ *Ans.*

(34) Reduce 3 qrs. 16 lbs. to the decim. of a cwt. *A.* ,892857+

(35) Reduce 2 feet 4 in. to the decimal of a yard. *A.* ,777+

(36) Reduce 1 mile 2 fur. to the dec. of a league. *A.* ,4166$\dot{6}$+

(37) Reduce 8 oz. 10 dwts. to the decimal of a lb. Troy. *Ans.* ,708$\dot{3}$+

(38) Reduce 4 qts. 1 pt. to the decimal of a barrel. (36 galls.) *Ans.* ,03125

(39) Reduce 3 qts. 1 pt. to the decimal of a gallon. *A.* ,875

(40) Reduce 7$\frac{1}{2}$ inches to the decimal of a foot. *Ans.* ,625

(41) Reduce 75 days to the decimal of a year. *Ans.* ,20547

III. *To find the value of a decimal fraction.*

Rule. Multiply the decimal by the number of parts in the next inferior denomination, cutting off the decimals from the product: then multiply the *remaining decimals* by the *next inferior* denomination, and cut off the decimals as before; thus proceeding to the least known parts of the integer; and the *several figures cut off* on the *left hand* will be the answer.

Examples.

(42) What is the value of ,568 of a £ sterling?

£
,568
20
11,360
12
4,32
4
1,28 *Ans.* 11*s.* 4¼*d.* ,28

(43) What is the value of ,3625 of a £? *Ans.* 7*s.* 3*d.*

(44) What is the value of ,485 of a £? *Ans.* 9*s.* 8¼*d.*

(45) What is the value of ,086 of a moidore? *A.* 2*s.* 3¾*d.*

(46) What is the value of ,3188 of a shilling?

s.
3,188
12
3,8256
4
3,3024
Ans. 3¾*d.* ,3024

(47) What is the value of ,6376 of a shilling?
Ans. 7½*d.* ,6048

(48) What is the value of ,3225 of a shilling? *Ans.* 3¾*d.*

(49) What is the value of ,75 of a penny? *Ans* ¾*d.*

---

(50) What is the value of ,8638 of a ton?

ton.
,8638
20
cwt. 17,2760
4
qr. 1,1104
28
lb. 2,9712
16
oz. 14,5792
16
dra. 9,4672

(51) What is the value of ,8625 of a ton?
Ans. 17 *cwt.* 1 *qr.*

(52) What is the value of ,0087 of a lb. troy?
Ans. 2 *dwt.* 2 *gra.*

(53) What is the value of ,305 of a pipe of wine?

pipe.
,305
126
1830
3660
gall. 38,430
4
quart 1,72
2
pint 1,44

(54) What is the value of ,6789 of a mile?
Ans. 1194 *yds.* 2 *ft.* 7 *in.*

(55) What is the value of ,58 of a year?
Ans. 211 *da.* 16 *ho.* 48 *min.*

Decimal Tables of Coins, Weights, and Measures.

TABLE I.

ENGLISH COIN.

£1 the Integer.

sh.	*dec.*	*sh.*	*dec.*
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence.	*Decimals.*
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Farth.	*Decimals.*
3	,003125
2	,0020833
1	,0010416

TABLE II.

ENG. COIN, 1*s.*

LONG MEASURE,

1 *foot* the Integer.

Pence and Inches.	*Decimals.*
6	,5
5	,416666
4	,333333
3	,25
2	,166666
1	,083333

Farth.	*Decimals.*
3	,0625
1	,041666
1	,020833

TABLE III.

TROY WEIGHT,

1 *lb.* the Integer.

Ounces the same as Pence in the last Table.

Penny-weights	*Decimals.*
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Grains.	*Decimals.*
12	,002083
11	,001910
10	,001736
9	,001562
8	,001389
7	,001215
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173

1 *oz.* the Integer.

Pennyweights the same as Shillings in the first Table.

Grains.	*Decimals.*
12	,025
11	,022916
10	,020833
9	,01875
8	,016666
7	,014583
6	,0125
5	,010416
4	,008333
3	,00625
2	,004166
1	,002083

TABLE IV.

AVOIRDU. WT.

112 *lb.* the Integer.

Qrs.	*Decimals.*
3	,75
2	,5
1	,25

Pounds	*Decimals.*
14	,125
13	,116071
12	,107143
11	,098214
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Ounces.	*Decimals.*
8	,004464
7	,003906

Decimal Tables of Coins, Weights, and Measures.

6	,003348
5	,002790
4	,002232
3	,001674
2	,001116
1	,000558

¼ *Oz.*	*Decimals.*
3	,000418
2	,000279
1	,000139

TABLE V.

AVOIRDU. WT.

1 *lb.* the Integr.

Ounces.	*Decimals.*
8	,5
7	,4375
6	,375
5	,3125
4	,25
3	,1875
2	,125
1	,0625

Drams.	*Decimals.*
8	,03125
7	,027343
6	,023437
5	,019531
4	,015625
3	,011718
2	,007812
1	,003906

TABLE VI.

LIQUID MEASURE.

1 *Tun* the Integr.

Galls	*Decimals.*
100	,396825
90	,357141
80	,317460
70	,277777
60	,238095
50	,198412
40	,158730
30	,119047
20	,079365
10	,039682
9	,035714
8	,031746
7	,027777
6	,023809
5	,019841
4	,015873
3	,011904
2	,007936
1	,003968

Pints	*Decimals.*
4	,001984
3	,001488
2	,000992
1	,000496

A

Hogshead

the Integer.

Galls.	*Decimals.*
30	,476190
20	,317460
10	,158730
9	,142857
8	,126984
7	,111111
6	,095238
5	,079365
4	,063492
3	,047619
2	,031746
1	,015873

Pints.	*Decimals.*
3	,005952
2	,003968
1	,001984

TABLE VII.

MEASURES.

LIQUID. DRY.

1 *Gallon*, 1 *Quarter*, the Integer.

Pts.	*Dec.*	*Bus.*
4	,5	4
3	,375	3
2	,25	2
1	,125	1

Q. pt.	*Dec.*	*Peck.*
3	,09375	3
2	,0625	2
1	,03125	1

Decimals.	*Q. Pk.*
,0234375	3
,015625	2
,0078125	1

Decimals.	*Pints*
,005859	3
,003906	2
,001953	1

TABLE VIII.

LONG MEASURE.

1 *Mile* the Integer.

Yards.	*Decimals.*
1000	,568182
900	,511364
800	,454545
700	,397727
600	,340909

Decimal Tables of Coins, Weights, and Measures.

500	,284091
400	,227272
300	,170454
200	,113636
100	,056818
90	,051136
80	,045454
70	,039773
60	,034091
50	,028409
40	,022727
30	,017045
20	,011364
10	,005682
9	,005114
8	,004545
7	,003977
6	,003409
5	,002841
4	,002273
3	,001704
2	,001136
1	,000568

Feet.	*Decimals.*
2	,0003787
1	,0001894

Inches.	*Decimals.*
6	,0000947
3	,0000474
1	,0000158

TABLE IX.

TIME.

1 *Year* the Integer.

Months the same as pence in the 2nd Table.

Days.	*Decimals.*
365	1,000000
300	,821918
200	,547945
100	,273973
90	,246575
80	,219178
70	,191781
60	,164383
50	,136986
40	,109589
30	,082192
20	,054794
10	,027397
9	,024657
8	,021918
7	,019178
6	,016438
5	,013698
4	,010959
3	,008219
2	,005479
1	,002732

1 *Day* the Integer.

Hours.	*Decimals.*
12	,5
11	,458333
10	,416666
9	,375
8	,333333
7	,291666
6	,25
5	,208333
4	,166666
3	,125
2	,083333
1	,041666

Min.	*Decimals.*
30	,020833
20	,013888
10	,006944
9	,00625
8	,005555
7	,004861
6	,004166
5	,003472
4	,002777
3	,002083
2	,001388
1	,000694

TABLE X.

CLOTH MEASURE.

1 *Yard* the Integer.

Qrs. the same as Table 4.

Nails.	*Decimals.*
3	,1875
2	,125
1	,0625

TABLE XI.

LEAD WEIGHT.

A Foth. the Integer.

Hund.	*Decimals.*
10	,512820
9	,461538
8	,410256
7	,358974
6	,307692
5	,256410
4	,205128
3	,153846
2	,102564
1	,051282

Qr.	*Decimals.*
2	,025641
1	,012820

Pound.	*Decimals.*
14	,0064102
13	,0059523
12	,0054945
11	,0050366
10	,0045787
9	,0041208
8	,0036630
7	,0032051
6	,0027472
5	,0022893
4	,0018315
3	,0013736
2	,0009157
1	,0004578

THE RULE OF THREE IN DECIMALS.

Examples.

(1) If $34\frac{3}{4}$ yards cost 5*l.* 12*s.* 6*d.*, what will $104\frac{1}{4}$ yards cost?

First, $\frac{3}{4}$ =,75 12*s.* 6*d.* =,625£. $\frac{1}{4}$ =,25

	yds.		£		*yds*
Then, As	34,75	:	5,625	::	104,25
			104,25		

34,75)586,40625(16,875
3457 20

23890 17,500
20850 12

30406 &c. 6,0 *Ans.* 16*l.* 17*s.* 6*d.*

(2) If $12\frac{1}{2}$ yards cost 3*l.* 6*s.* 8*d.*, what will $18\frac{3}{4}$ yards cost at the same rate? *Ans.* 5*l.*

(3) Bought 24 lb. 4 oz. of tea for 8*l.* 16*s.*, what will 60 lb. 10 oz. cost at that rate? *Ans.* 22*l.*

(4) If 1 cwt. 2 qrs. of coffee sell for 30*l.* 15*s.*, what will 3 cwt. 3 qrs. sell for? *Ans.* 76*l.* 17*s.* 6*d.*

(5) What is the price of a tankard that weighs 32 oz. 5 dwts. at the rate of 5*s.* 4*d.* per oz.? *Ans.* 8*l.* 12*s.*

(6) If $12\frac{3}{4}$ lb. of butter cost 10*s.* 4*d.*, what will be the worth of 1 cwt.? *Ans.* 4*l.* 10*s.* $9\frac{1}{4}$*d.*

---

(7) If I buy $12\frac{5}{8}$ yards for 10 guineas, how many Flemish ells can I purchase for 52*l.* 10*s.*?

First, $12\frac{5}{8}$ *yds.* $=\frac{101}{8}$ *yds* and $\frac{\frac{101}{8}}{2}$ of $\frac{4}{1}$ of $\frac{1}{3}=\frac{101}{6}=16\frac{5}{6}$ *Flem. ells*$=16,83333$ &c. and 10*l.*10*s.*$=10\frac{1}{2}=10,5$*l.* 52*l.*10*s.*$=52,5$*l.*

	£		*F. E.*		£
Then, As	10,5	:	16,8333	::	52,5
			52,5		

841666
3366666
84166666

Fl. Ells.
10,5)88374999(84,1666 +
840

487 &c.

Or shorter, thus—Finding the third term to be just 5 times the first, I need only multiply by 5.

16,8333
5

Fl. Ells. 84,1666

(8) How many yards of Holland can be bought for 32*l.* 15*s.* 6*d* if $3\frac{1}{2}$ yards cost 1*l.* 1*s.* 6*d.*?

Ans. 106 *yds.* 2 *qrs.* 3 *nls.*

(9) How many yards of muslin may be purchased for 27*l.* 13*s.* 4*d.* at the rate of 6*s.* 8*d.* per yard? *Ans.* 83 *yds.*

(10) How many gallons of brandy may be bought for 50 guineas, if $7\frac{3}{4}$ gallons cost $8\frac{3}{4}l.$? *Ans.* $46\frac{1}{2}$ *galls.*

(11) If 12*s.* 9*d.* will pay the carriage of 12 cwt. 3 qrs. from London to Bath, what weight can be carried for 1*l.* 16*s.* $10\frac{1}{2}d.$? *Ans.* 36 *cwt.* 3 *qrs.* 14 *lbs.*

---

(12) If a chest of sugar, weighing 6 cwt. 3 qrs. 7 lb. cost 75*l.* 16*s.* 8*d.*, what will 3 cwt. 1 qr. 21 lb. be worth?

First, 6 *cwt.* 3 *qrs.* 7 *lb.* = 6,8125 *cwt.* 75*l.* 16*s.* 8*d.* = 75,8333 +

3 *cwt.* 1 *qr.* 21 *lb.* = 3,4375 *cwt.*

Then, As *cwt.* 6,8125 : £ 75,8333 3,4375 :: *cwt.* 3,4375

3791666
5308333
2274999
3033333
2274999

6,8125)260,67697896(38,2645 £
204375 20

563019 5,2900
545000 12

18019 &c. 3,4800
4

Ans. 38*l.* 5*s.* $3\frac{1}{2}d.$ 1,9200 = $\frac{1}{2}$ *nearly*

(13) Bought a quantity of tobacco, which was found to weigh 1 cwt. 3 qrs. 14 lb. 6 oz. for 21*l.* 0*s.* 9*d.*, I demand the worth of 2 qrs. 14 lbs. 2 oz. *Ans.* 7*l.* 0*s.* 3*d.*

(14) What is the worth of 1 lb. 8 oz. 10 dwts. of gold, at 3*l.* 4*s.* 6*d.* per ounce? *Ans.* 66*l.* 2*s.* 3*d.*

(15) If $1\frac{4}{5}$ of a £ will buy 3 lb. $8\frac{1}{2}$ oz. avoirdupois, what will $5\frac{6}{8}$ of a £ buy? *Ans.* 11 *lb.* 4 *oz.* 7 *dra.* +

(16) If 6 cwt. 2 qrs. 14 lb. cost 2*l.* 19*s.* 6*d.*, what will 1 ton 19 cwt. 3 qrs. cost? *Ans.* 17*l.* 17*s.*

INVERSE PROPORTION IN DECIMALS.

(1) If the carriage of 12 cwt. 3 qrs. of goods for $100\frac{3}{8}$ miles cost 1*l.* 5*s.* 6*d.*, how much ought I to have carried $75\frac{3}{4}$ miles for the same money?

cwt. qrs.
First, 12 3 = 12,75 $100\frac{3}{8}$ = 100,375 *mi.* $75\frac{3}{4}$ = 75,75 *mi.*
miles. *cwts.* *miles.*
Then, as 100,375 : 12,75 :: 75,75
100,375

75,75) 1279,78125 (16,8948 = 16 *cwt.* 3 *qrs.* 16 *lb.* 3 *oz.*
150 rem.
. . . .

(2) If $18\frac{3}{4}$ yards of carpeting that is $1\frac{1}{2}$ yards broad will cover a room, how much that is 1 yard broad will cover the same? *Ans.* 28,125 = $28\frac{1}{8}$ *yards*

(3) If I lend my friend 100*l.* for $\frac{5}{8}$ of a year, how much ought he to lend me $\frac{7}{12}$ of a year to requite my kindness?
Ans. 107*l.* 2*s.* $10\frac{1}{4}$*d.* +

(4) How much stuff that is $\frac{5}{8}$ of a yard wide, will line $27\frac{3}{4}$ yards of cloth that is $\frac{7}{8}$ wide?
Ans. 38,85 = 38 *yds.* 3 *qrs.* 1 *nl.* +

(5) If 530*l.* 15*s.* will gain 17*l.* 10*s.* in $10\frac{1}{2}$ months, what principal will gain an equal sum in $15\frac{1}{4}$ months?
Ans. 365*l.* 8*s.* $8\frac{1}{4}$*d.*

(6) If 4 men in $12\frac{3}{4}$ days will mow a field, in how many days will 18 men do the same? *Ans.* 2,8333 + *days*

DOUBLE RULE OF THREE IN DECIMALS.

If $24\frac{3}{4}$ bushels of flour be sufficient for 20 men $10\frac{1}{4}$ days, how many men will consume $148\frac{1}{2}$ bushels in $20\frac{1}{2}$ days?

$24\frac{3}{4}$ = 24,75 $10\frac{1}{4}$ = 10,25 $148\frac{1}{2}$ = 148,5 $20\frac{1}{2}$ = 20,5

bus.	*men.*	*bus.*	Or thus :		
* 24,75 :	20 ::	148,5	*men.*	*days.*	*bus.*
days.		*days.*	20 :	10,25 ::	24,75
10,25 :	— ::	20,5	— :	20,5 ::	148,5

Then $\frac{20 \times 148{,}5 \times 10{,}25}{24{,}75 \times 20{,}5}$ = 60 *men. Ans.*

N.B. If more questions be wanted in this rule, they may be taken from the Double Rule of Three in Vulgar Fractions, and worked decimally.

ALLIGATION.

ALLIGATION is a rule that teaches either to find the *value* of any compound; or how to mix things of different values, so as to ascertain the *quantities*. The whole may be comprised in four cases, viz.:—

MEDIAL, ALTERNATE, PARTIAL, and TOTAL.

CASE I. ALLIGATION MEDIAL—Is when the rates and quantities of the several ingredients are given, to find the *value* of the mixture.

RULE. *Multiply* each *quantity* of the mixture by its *rate*; then *divide* the *sum* of the *products* by the sum of the *quantities*, and the quotient will give the rate of the mixture required.

EXAMPLES.

(1) A tobacconist would mix 60 lb. of tobacco at 3*s.* per lb. with 70 lb. at 3*s.* 6*d.*, 75 lb. at 4*s.*, and 80 lb. at 4*s.* 6*d.* per lb.: what will 1 lb. of the mixture be worth?

d.	*d.*
60 × 36 =	2160
70 × 42 =	2940
75 × 48 =	3600
80 × 54 =	4320
285	13020

285) 13020 (12)45
1140
3*s.* $9\frac{1}{2}$*d.* $\frac{42}{57}$
1620
1425
195
4
285) 780 ($\frac{1}{2}$
rem. 210
$= \frac{42}{57}$
285

Or thus:

s.	*d.*
60 × 3	0 = 180
70 × 3	6 = 245
75 × 4	0 = 300
80 × 4	6 = 360
285	285) 1085 (3

s. *d.*
$9\frac{1}{2}$ $\frac{42}{57}$

(2) A farmer would mix 12 bushels of wheat at 6*s.* 6*d.* per bushel with 10 bushels of barley at 4*s.* 6*d.* per bushel, and 8 bushels of rye at 3*s.* 6*d.* per bushel; what is the worth of a bushel of this mixture? *Ans.* 5*s.* $0\frac{1}{4}$*d.* $\frac{3}{5}$

(3) A vintner makes with a compound a pipe of wine, viz. 36 galls. at 12*s.* per gall. with 40 galls. at 13*s.* per gall. and 50 galls. at 14*s.* per gall.; what will a gallon of this mixture be worth? *Ans.* 13*s.* $1\frac{1}{4}$*d.* $\frac{1}{3}$

(4) A maltster mixes 20 bushels of high-dried malt at 5*s.* 6*d.* per bushel with 15 bushels of pale at 5*s.* per bushel, and 12 bushels at 4*s.* 9*d.* per bushel; what is the value of 1 bushel of this mixture? *Ans.* 5*s.* $1\frac{3}{4}$*d.* $\frac{7}{7}$

(5) A flour dealer mixes 15 bushels of fine flour at 9*s.* 6*d.* per bushel, and 18 bushels at 10*s.* 4*d.* per bushel, with 20 bushels of seconds at 7*s.* per bushel, and 24 ditto at 6*s.* 8*d.* per bushel; I demand the worth of a bushel of this mixture?

Ans. 8*s.* $1\frac{3}{4}$*d.* $\frac{6}{7}$.

(6) A composition is made of 18 lb. of tea at 5*s.* 6*d.* per lb. with 20 lb. at 5*s.* 9*d.*, 24 lb. at 6*s.* 3*d.*, and 16 lb. at 6*s.* 6*d.* per lb.; what is the worth of 3 lb. of this mixture? *Ans.* 18*s.**

CASE II. ALLIGATION ALTERNATE is when the *rates* of several things are given, to find *what quantity of each* must be taken, to make a mixture of a *certain mean value.*

RULE 1st. Place the rates of the ingredients under each other; and place the *mean rate* on the *left hand* of them.

2nd. *Link the several rates together,* so that one *greater* than the mean rate may be joined to one that is *less.*

3rd. Take the *difference* between each price and the mean rate, and place it opposite to the rate to which it is linked.

4th. If only *one* difference stand against any rate, that *difference* will be the answer; but if *more than one,* their *sum* will be the answer.

PROOF. By Alligation Medial.

EXAMPLES.

(1) A grocer would mix sugar at 10*d.*, 9*d.*, 7*d.*, and 6*d.* per lb. to make a mixture worth 8*d.* per lb.; how much of each sort must he take?

d.	*lb.*	*d.*	
10	... 2 at	10	
9	... 1 at	9	1*st Ans.*
7	... 1 at	7	
6	... 2 at	6	

(8)

Or they may be linked thus:

d.	*lb.*	*d.*	
10	... 1 at	10	
9	... 2 at	7	2*nd*† *Ans.*
7	... 2 at	7	
6	... 1 at	6	

(8)

(2) A tobacconist would mix tobacco at 3*s.* 6*d.*, 3*s.*, 2*s.*, and 18*d.* per lb.; what quantity of each must he take to make a mixture worth 2*s.* 6*d.* per lb.?

1*st Ans.* 12 *lb. at* 3*s.* 6*d.*, 6 *lb. at* 3*s.*, 6*lb. at* 2*s.*, 12 *lb. at* 18*d.*

2*nd Ans.* 6 *lb. at* 3*s.* 6*d.*, 12 *lb. at* 3*s.*, 12 *lb. at* 2*s.*, 6 *lb. at* 18*d.*

---

* Where the worth of *more* than 1 lb. &c. is wanted, find the value of 1 lb. &c. as before, and multiply it by the number of lbs. &c. required.

† Note—Questions in this rule admit of *different answers,* according to the manner of linking them. *Also,* instead of so many lbs. each, they may be reduced to *ounces* each, or increased to *cwts.* each, or any quantity whatsoever in like proportion.

(3) A maltster has several sorts of malt, viz. 4*s.*, 5*s.*, 6*s.*, and 6*s.* 6*d.* per bushel; how much of each sort must be taken to make a mixture worth 5*s.* 6*d.* per bushel?

1*st Ans.* 12 *bus. at* 4*s.*, 6 *b. at* 5*s.*, 6 *b. at* 6*s.*, 18 *b. at* 6*s.* 6*d.*

2*nd Ans.* 6 *bus. at* 4*s.*, 12 *b. at* 5*s.*, 18 *b. at* 6*s.*, 6 *b. at* 6*s.* 6*d.*

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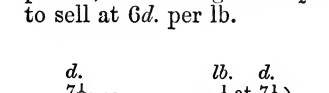
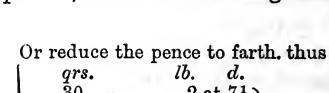
(4) What quantity of raisins of the sun at 7½*d.* and 6½*d.* per lb., with Malagas at 5½*d.* per lb., must be mixed together to sell at 6*d.* per lb.



Or reduce the pence to farth. thus:



(5) How much rye at 5*s.* per bushel, barley at 4*s.* and oats at 3*s.* per bush., will make a mixture worth 3*s.* 6*d.* per bush.?

Ans. 6 *bus. at* 5*s.*, 6 *at* 4*s.*, *and* 24 *at* 3*s. per bus.*

(6) A victualler had ale at 16*d.*, 12*d.*, and 8*d.* per gallon; how much of each sort must he take to sell at 10*d.* per gall.?

Ans. 2 *gal. at* 16*d.*, 2 *gal at* 12*d.*, *and* 8 *gal. at* 8*d. per gal.*

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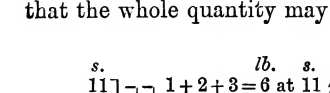
(7) A tea dealer has several sorts of tea, viz. at 11*s.*, 9*s.*, 8*s.*, and 7*s.* per lb.; how much of each sort must be used that the whole quantity may be afforded at 10*s.* per lb.?



Proof.

lb.	s.	£	s.
6 at	11	= 3	6
1 at	9	= 0	9
1 at	8	= 0	8
1 at	7	= 0	7
9	9)	4	10

10*s. per lb.*

(8) How many ounces of gold of 22, 18, 17, and 16 carats fine must be mixed, so that the composition may be 20 carats fine?

Ans. 9 *oz. of* 22 *carats*, 2 *oz. of* 18, 2 *oz. of* 17, *and* 2 *oz. of* 16 *carats fine.*

(9) How much wine at 7*s.*, 8*s.*, 9*s.*, and 16*s.* per gallon, must be mixed together, to make a mixture that may be sold at 10*s.* per gallon?

Ans. 6 *galls.* (*or any* equal quantity, *more or less*) *of each*

CASE III. ALLIGATION PARTIAL is when *one* of its ingredients is limited to a *certain quantity.*

RULE 1st. Take the difference between each price and the mean rate, as before.

2ndly. State, As the difference of that commodity whose quantity is given is to the rest of the differences severally so is the quantity given, to the several quantities required.

EXAMPLES.

(1) A farmer would mix 54 bushels of wheat at 7*s.* 6*d.* per bushel, with rye at 4*s.* 6*d.* and barley at 5*s.* 3*d.* per bushel, to make a mixture worth 6*s.* per bushel.

90 ⎫	18+9×27	As 27 : 18 :: 54
72)54 ⎬	 18	54
63 ⎭	 18	—
		72
		90
		27)972(36 *bus.*

N.B. As both the lines are the same (viz. 18) *one stating* will serve for both.

Proof.

bus.	*s.*	*d.*		£	*s.*
54 at	7	6	=	20	5
36 at	4	6	=	8	2
36 at	5	3	=	9	9
126				£37	16

As 126 : 37 16 : : 1 to 6*s.* Proof.

(2) A distiller would mix 30 gallons of French brandy at 24*s.* per gallon, with English at 12*s.* and spirits at 8*s.* per gallon; what quantity of each must be taken to be afforded at 16*s.* per gallon?

Ans. 30 *at* 24*s. per gal.*; 20 *at* 12*s.*; *and* 20 *at* 8*s. per gal.*

(3) A grocer mixes 24 lb. of fine tea at 18*s.* per lb. with others at 13*s.* and 12*s.* per lb. to make a mixture worth 15*s.* per lb.; what quantity of each does he take?

Ans. 24 *lb. at* 18*s.*; $14\frac{2}{3}$ *lb. at* 13*s. per lb.*; *and* $14\frac{2}{3}$ *at* 12*s. per lb.*

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(4) How much rum at 10*s.* 6*d.*, 12*s.* 6*d.*, and 18*s.* per gal. must be mixed with 18 gallons at 16*s* 6*d.* per gallon, to make a composition worth 15*s.* per gallon?

198 ⎫	36	As 36 : 30 : : 18 to 15 *galls.*
180) 126 ⎬	30	36 : 54 : : 18 to 27 *galls.*
150 ⎭	54	36 : 18 : : 18 to 9 *galls.*
216	18	

The prices are here reduced to *pence*, for the greater convenience in working.

Ans.

galls.	*s.*	*d.*	
18 at	16	6	*per g.*
15 at	10	6	—
27 at	12	6	—
9 at	18	0	—

(5) A tobacconist would mix 56 lb. of tobacco at 3*s.* per lb. with others at 3*s.* 9*d.*, 4*s.* 3*d.*, and 4*s.* 6*d.*, to make a composition worth 4*s.* per lb.; how much of each must he take?

1*st Ans.* 28 *lb. at* 3*s.* 9*d.*; 28 *lb. at* 4*s.* 3*d.*; *&* 112 *lb. at* 4*s.* 6*d.*

2*nd Ans.* 112 *lb. at* 3*s.* 9*d.*; 224 *lb. at* 4*s.* 3*d.*; *&* 56 *lb. at* 4*s.* 6*d.*

(6) A mealman mixes 60 bushels of flour at 10*s.* 6*d.* with others at 9*s.*, 8*s.*, and 7*s.* 6*d.*, to make a mixture worth 9*s.* 6*d.* per bushel: what quantity of each does he take?

Ans. 15 *bushels of each, at* 9*s.*, 8*s.*, *and* 7*s.* 6*d.*

CASE IV. ALLIGATION TOTAL is when the *whole of the ingredients* is *limited* to a *certain quantity.*

RULE 1st. Take the difference between each price and the mean rate as before.

2ndly. State, As the *sum* of the *differences* is to *each particular difference,* so is the *quantity given* to the quantity required.

EXAMPLES.

(1) A brewer has ale at 12*d.*, 10*d.*, and 8*d.* per gallon, and he would make a composition of a hogshead (54 gallons) to sell for 9*d.* per gallon: how much of each must he take?

		gallons.	*s.*	*d.*
12-	 1	As 6 : 1 :: 54 to 9 at 1*s.* =	9	0
9) 10-	 1	6 : 1 :: 54 to 9 at 10*d.* =	7	6
8-	3+1= 4	6 : 4 :: 54 to 36 at 8*d.* =	24	0
	6	And 54 galls. at 9*d.* are £2	0	6 Proof.

(2) A druggist who has drugs of 8*s.*, 5*s.*, and 4*s.* per lb., would make a composition of 112 lb. worth 6*s.* per lb.; what quantity of each must he take?

Ans. 48 *lb. of* 8*s.*; 32 *lb. of* 5*s.*; *and* 32 *lb. of* 4*s. per lb.*

(3) A goldsmith has several sorts of gold: viz. some of 24 carats fine; some 22, and some 18 carats fine, with which he would make a compound of 30 oz. of 20 carats fine; I demand how much of each sort he must take?

Ans. 6 *oz. of* 24 *carats;* 6 *oz. of* 22; *and* 18 *oz. of* 18 *carats fine.*

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(4) A person has raw sugars at 12*d.*, 7*d.*, 6*d.*, and 5*d.* per lb., with which he makes a composition of a quarter of a cwt. worth 8*d.* per lb. what quantity of each does he take?

			lb.	*oz.*	*d.*
12-	1+2+3=6	As 18 : 6 :: 28 to 9		$5\frac{6}{18}$	at 12
8) 7-	 4	18 : 4 :: 28 to 6		$3\frac{10}{18}$	at 7
6-	 4	18 : 4 :: 28 to 6		$3\frac{10}{18}$	at 6
5-	 4	18 : 4 :: 28 to 6		$3\frac{10}{18}$	at 5
	18		28 *lb.*		

(5) A wine merchant has four sorts of wine, viz., Canary at 14*s.* per gallon, Malaga at 13*s.*, Rhenish at 11*s.*, and Oporto at 10*s.* per gallon; and he is desirous of making a composition of a pipe (126 galls.) to sell for 12*s.* per gal.; the quantity of each is required ?

1*st Ans.* 42 *of Canary*, 21 *of Malaga*, 21 *of Rhenish*, *and* 42 *of Oporto.*

2*nd Ans.* 21 *of Canary*, 42 *of Malaga*, 42 *of Rhenish*, *and* 21 *of Oporto.*

(6) I have teas at 4*s.*, 5*s.*, 7*s.*, and 9*s.* per lb. and I would make a mixture of ½ a cwt. (56 lb.) to sell at 6*s.* per lb.; what quantity of each will be required ?

1*st Ans.* 24 *lb. at* 4*s.*, 8 *lb. at* 5*s.*, 8 *lb. at* 7*s.*, 16 *lb. at* 9*s.*

2*nd Ans.* 8 *lb. at* 4*s.*, 24 *lb. at* 5*s.*, 16 *lb. at* 7*s.*, 8 *lb. at* 9*s.*

EXCHANGE.

EXCHANGE is bartering the money of one place for that of another, by means of a *Bill of Exchange;* and the rule teaches how to find what quantity of one kind of money will be equal to a proposed quantity of another, according to the course of exchange.

The *course of exchange* is the value agreed on by merchants, and is almost daily *fluctuating* above or below the *par* of exchange.

The *par of exchange* is always *fixed and certain;* it being the *intrinsic value* of the money of one place compared with that of another.

Agio is a term used in some countries abroad, especially in Amsterdam and Italy; and denotes the difference between *Bank money* (usually called *Banco*) and *current money;* the *former* being something *finer* than the *latter.*

Usance is a certain time allowed by one country to another, for the payment of bills of exchange.

Days of grace are a certain number of days allowed for payment, beyond the time specified in the bill.

Questions in Exchange are performed either by the Rule of Three or Practice.

1. England with France.

In France, before the Revolution, accounts were kept in livres, sols, and deniers, and they exchanged with England by the crown Tournois. But at present they are kept in francs and centimes, and they exchange by the franc.

12 deniers ..... make 1 sol, or sou = 1 half-penny.
20 sols ..... 1 livre = 10*d.* nearly.
3 livres ..... 1 écu, or crown Tournois.

Also,

10 centimes.....make 1 décime.
10 décimes, or 100 cents 1 franc.

Exchange at par 25 francs 20,8 centimes per £ sterling.

Examples.

(1) How many crowns must be paid in Paris, to receive in London 540*l.*, Exchange at 4*s.* 6*d.* per crown ?

d.		*cr.*		£.
As 54	:	1	::	540
				240
				Ans.

54)129600(2400 *cr.*
108
216
216

(2) A merchant in Paris remits to his correspondent in London 2400 crowns, at 4*s.* 6*d.* each ; what is the value in sterling ?

cr.		*d.*		*cr.*
As 1	:	54	::	2400
				54
		12)		129600
		2,0)		1080,0
				£540 *Ans.*

(3) How much sterling must be paid in London to receive in Paris 1000 crowns, exchange at 54½*d.* per crown ?

Ans. 227*l.* 1*s.* 8*d.*

(4) A merchant in London remits 227*l.* 1*s.* 8*d.* to his correspondent in Paris ; what is the value in French crowns at 54½*d.* per crown ? *Ans.* 1000 *crowns.*

(5) Change 566 cr. 17 sols, 5½ den. at 55*d.* per crown, into sterling ; what is the sum ? *Ans.* 129*l.* 15*s.* 6*d*

(6) Change 389*l.* 6*s.* 6*d.* sterling into French crowns, exchange at 55*d.* per crown.

Ans. 1698 *crowns*, 52 *sols*, 4 $\frac{2}{5}\frac{2}{5}$ *deniers.*

2. Spain.*

In general, they keep their accounts in Spain in piastres, rials, and maravedis, and exchange by the piastre or peso.

34 maravedis ..... make 1 real *or* rial.
8 reales *or* rials ..... 1 piastre, peso, piece of eight, or dollar.
4 piastres ..... 1 pistole of exchange.
375 maravedis ..... 1 ducat.

Examples.

(1) Spain draws on London for 2354 piastres 4 rials, exchange at 3*s.* 4½*d.* per piastre, how much sterling is the sum?

piastre *s.* *d.* *piast.* *rials*

1 : 3 4½ :: 2354 4
8 8
— —
8 162 *farth.* 18836
162
8) 3051432
4) 381429
12) 95357¼
2,0) 794,6—5
Ans. £ 397 6 5¼

(2) In 350*l.* 10*s.* 9½*d.* sterling, how many rials, &c., exchange at 3*s.* 3½*d.* per piece of eight?

s. *d.* *piastre* £ *s.* *d.*

As 3 3½ : 1 :: 350 10 9½
12×2 8 20×12×2
— — —
79 *rials* 8 168259
8
——— *rials*
79) 1346072 (17038
70
34
79) 2380 (30 *mara.*
10 rem.
Ans. 17038 *rials* 30 *marav.*

(3) In 9876 piastres 4 rials of plate, how many £ sterling, exchange at 42*d.* per piastre? *Ans.* 1728*l.* 7*s.* 9*d.*

(4) How many piastres should I receive for 1728*l.* 7*s.* 9*d.* exchange at 42*d.* per piastre? *Ans.* 9876 *pias.* 4 *rials*

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* Note—They have *two kinds of money* in Spain, called *plate* and *vellon;* The *real* of *plate* or *silver* = 4⅔*d.* nearly; and the *real vellon* = 2½ nearly: hence 17 reales of plate = 32 reales vellon. In exchanges with England, plate only is used. When the *dollar* or *peso of exchange* with London = 37½*d.*, then the *peso fuento* or *Spanish dollar* = 50⅛*d.* nearly.

In some parts of Spain accounts are kept in rials and maravedis vellon, and exchange by the ducat. The ducat is worth 4*s.* 11½*d.* The piastre 3*s.* 7*d.* at par.

(5) In 8768 rials of plate, how many £ sterling, exchange at 40½*d.* per piece of eight?

p. eight : *d.* :: *rials*
1 : 40½ :: 8768
8 — 40½
8 — 8) 355104
12) 44388
2,0) 369,9
Ans. £ 184 19

(6) In 184*l.* 19*s.* sterling, how many rials of plate, exchange at 40½*d.* per piece of eight?

d. : *p. eight* :: £ *s.*
40½ : 1 :: 184 19
4 — 44388*d.*
162 — 4
p.cig.
162) 177552 (1096
8
. . . . —
rials 8768
Ans. 8768 *rials.*

(7) In 2345*l.* how many rials, exchange at 50*d.* per piastre or peso? *Ans.* 90048 *rials*

(8) In 90048 rials how many £ sterling, exchange at 50*d.* per piastre? *Ans.* 2345*l.*

(9) In 67530 rials vellon, how many rials of plate? Multiply by 17, and divide by 32 (see note 1). *A.* 35875 *ri.* $\frac{5}{16}$.

(10) In 35875 $\frac{5}{16}$ rials of plate, how many rials vellon? *Ans.* 67530 *rials vellon*

3. Portugal.

Accounts are kept in Portugal in *reas* and *milreas*, and the exchange is by the milrea, at from 60*d.* to 68*d.* sterling. Its value at *par* is 5*s.* 7½*d.*

400 reas.....make 1 crusado.
1000 reas, or 2½ crusadoes..... 1 milrea.

Note.—13⅓ reas are equal to 1*d.* English.

(1) If a bill be drawn from Lisbon, of 5432 milreas 346 reas, at 6*s.* 6*d.* per milrea, what is the value in English money?

1000 : 6*s.* 6*d.* :: 5432,346
1000
5432346
6½
1,000) 35310/249 249
12
2,0) 3531,0 *d.* 2/988
4
£ 1765 10 2¾ 3/952

(2) If a bill be drawn from London of 1765*l.* 10*s.* 2¾*d.* how many milreas at 6*s.* 6*d.* each are equal in value to the sum?

s. *d.* : *mil.* :: £ *s.* *d.*
6 6 : 1 :: 1765 10 2¾
312 *farth.* 1694891 *far.*

mil. *reas.*
312) 1694891 (5432 342²⁹⁶/₃₁₂
. . . .

(3) In 1000 milreas 100 reas, how many pounds sterling, exchange at 5*s.* 5*d.* per milrea? *Ans.* 270*l.* 17*s.* 2½*d.*

(4) How many milreas must be given for 758*l.* 8*s.* 6*d.* sterling, exchange at 5*s.* 4½*d.* per milrea?

Ans. 2822 *mil.* 46 *re.*—66.

(5) Reduce 1234 crusadoes 67 reas, into sterling, exchange at 67½*d.* per milrea? *Ans.* 138*l.* 16*s.* 10½*d.*—90.

(6) In 138*l.* 16*s.* 10½*d.* how many crusadoes, exchange at 67½*d.* per milrea? *Ans.* 1234 *cru.* 66 *reas.*—18 rem.

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4. Italy.

At Genoa and Leghorn some keep their accounts in *piastres* or *pezzos*, *soldi*, and *denarii*; and others in *lires*, *soldis*, and *denarii*; and they exchange by the piastre or pezzo, which is equal to 4*s.* 6*d.* at *par*.

The course of exchange is from 47*d.* to 58*d.* sterling per piastre or pezzo.

12 denarii .....make 1 soldi.
20 soldi ..... 1 lire, piastre, or pezzo.
Exchange from 45*d.* to 54*d.* per piastre.

At Venice in dollars, soldi, and denarii, and exchange by the *ducat* and *piastre*.

12 deniers d'or.....make 1 sol d'or.
20 sols d'or ..... 1 ducat.

Also, *some* here keep their accounts in ducats, grossi, and soldi.

5⅓ soldi.....make 1 grossi.
24 grossi ..... 1 ducat.
Agio from 20 to 30 per cent.

Examples.

(1) In 368*l.* 12*s.* 6*d.* sterling, how many piastres of Genoa, exchange at 47½*d.* per piastre?

d.	*piastre.*	£	*s.*	*d.*
47½	: 1 ::	368	12	6
95				

95)176940(1862 *p.*
50
20
95)1000(10 *soldi.*
50
12
95)600(6 *denarii.*
80

(2) How much sterling money is equal to 2345 pezzos 10 soldi of Genoa, exchange at 50⅜ per pezzo?

pezzo.	*d.*		*pezzo*	*sol.*
1	: 50⅜	::	2345	10
20	8		20	
20	403		46910	
			403	

20)1890473,0
8)94523610
12)11815458=½
2,0 (984,6 2*d.*
£492 6 2½—1/17

(3) If I pay in London 500*l.* sterling, for how many piastres may I draw my bill to be paid at Leghorn, exchange at 4*s.* 5*d.* per piastre? *Ans.* 2264 *pias.* 3 *soldi.*—1 rem.

(4) How much sterling money is equal to 8765 lires 15 soldi of Leghorn, at 4*s.* 2*d.* per piastre?

Ans. 186*l.* 3*s.* 11½*d.*

---

(5) How many ducats banco at Venice are equal to 789*l.* 15*s.* sterling, exchange at 48*d.* per ducat banco?

d.	*duc.*		£	*s.*
As 46	: 1	::	789	15

48)189540(3948 *d.*
36
20
48)720(15 *sols.*
. . .

Ans. 3948 *duc.* 15 *sol.*

(6) How much sterling money is equal to 896 ducats 12 sols 6 deniers, banco money of Venice, exchange at 4*s.* 5½*d.* sterling per ducat?

duc.	*s.*	*d.*		*duc.*	*sol.*	*den.*
1 :	4	5½	::	896	12	6

240 *d.* 214 *far.* 20×12
215190
214
24,0)4605066,0(4)19187″
18 rem. 12)47969¼
2,0)399,7 5
£199 17 5¼

(7) London remits to Venice 385*l.* 16*s.* sterling, exchange at 4*s.* 4*d.* per ducat banco, how many ducats banco will he receive at Venice? *Ans.* 1780 *duc.* 12 *sol.* 3⅗.

(8) In 1960 ducats 10 sols 9 den. banco at Venice, how many £. sterling, exchange at 49½*d.* per ducat banco?

Ans. 404*l.* 7*s.* 2½*d.* 5/120

(9) In 1243 duc. 16 sol. 10 den. current money, how many pounds sterling, exchange at 49*d.* per ducat banco, and agio 20 per cent?

	duc.		*d.*		*duc.*	*sol.*	*den.*	£	*s.*
1st.	As 1	:	49	::	1243	16	10 to	253	19—58 rem.
	£		*s.*		£	*s.*	£	*s.*	*d.*
2nd.	As 120	:	100	::	253	19	to 211	12	6 *Ans.*

Note. They have *three sorts of money* at Venice: the *Banco*, the *current* money, and the *paoli:* the *banco* is that in which they keep their accounts; the *current* is the standard of their coin; and the *paoli* is used for the purchase.

5. Holland, Flanders, and Germany.

They keep their accounts at Amsterdam, Rotterdam, Antwerp, Brussels, various parts of Germany, &c., some in guilders, stivers, and pennings; others in pounds, shillings, and pence, as in England, but distinguished by the name of *Flemish;* and they exchange by the £ sterling.

8 pennings ..... make 1 grote or penny Flemish.
2 grotes, or pence ..... 1 stiver.
6 stivers ..... 1 schilling.
20 stivers ..... 1 guilder, or florin.
2½ florins ..... 1 rix-dollar.
6 guilders, or florins ... 1 pound Flemish.

Or thus, for £ *s.* and *d.* Flemish, as in England:

12 grotes or pence ..... 1 schilling.
20 schillings ..... 1 pound Flemish.

Exchange from 33*s.* 6*d.* to 36*s.* 6*d.* Flemish, per £ sterling, and *Agio* from 3 to 6 per cent. for current.

To change Flemish money into sterling.

Rule. As the given rate of exchange is to 1*l.* sterling, so is the given Flemish to the sterling required.

To change sterling money into Flemish.

Rule. As 1*l.* sterling is to the given rate of exchange, so is the sterling given to the Flemish sought.

Examples.

(1) Remitted from London to Amsterdam a bill of 1250*l.* 15*s.* sterling; how many pounds Flemish is the sum, the exchange being at 34*s.* 6*d.* Flemish per £ sterling?

s.	*s.* *d.*	£ *s.*
As 20	: 34 6	: : 1250 15
	12	20
	414	25015
		414
	20)1035621,0	
	12)517810—$\frac{10}{20}=\frac{1}{2}$	
	2,0)4315,0—10	
	£ 2157 10 10½	

Or by Practice, thus:

		£	*s.*	*d.*
10*s.*	½	1250	15	0
4*s.*	⅕	625	7	6
6*d.*	⅛	250	3	0
		31	5	4½
		£ 2157	10	10½ *Ans.*

Note. There are *two sorts of money* in these countries, *bank money* and *current;* the difference between them is from 3 to 6, or even more than 8 per cent. in favour of the bank money.

(2) Rotterdam remits 2157*l.* 10*s.* 10½*d.* Flemish, to be paid in London; how much sterling money can he draw for exchange being at 34*s.* 6*d.* Flemish per £ sterling?

Ans. 1250*l.* 15*s.*

(3) If I pay in London 500*l.* sterling, how many guilders must I draw for at Amsterdam, exchange at 33*s.* 6*d.* Flemish per £ sterling? *Ans.* 5025 *guilders*

(4) If I pay at Amsterdam 5025 guilders, what must I draw for in London, exchange at 33*s.* 6*d.* Flemish per £ sterling? *Ans.* 500*l.*

(5) In 365*l.* 15*s.* 6*d.* sterling, how many Dutch rix-dollars, exchange at 35*s.* 4*d.* Flemish per £ sterling?

Ans. 1550 *rix-dol.* 44 *stiv.* 4 *penn.* ½ $\frac{28}{100}$.

To change Bank into Current Money.

RULE. As 100 is to 100 with the agio added to it, so is any given sum banco to the current required.

To change Current Money into Bank.

RULE. As 100 with the agio added to it is to 100, so is any given sum current to its value in bank money.

(6) Change 835 guilders 12 stivers bank, into current money, agio 4⅝ per cent.

guil.	*gu. sti. pe.*	*guil. sti.*
As 100 :	104 12 8 ::	835 12
20	20	20
2000	2092	16712
	16	
	33480	
	16712	
8000) 559517760		
16) 279758—1760 rem.		
2,0) 1748,4 14 *pennings.*		

Ans. 874 *guil.* 4 *sti.* 14 *pen. bank.*

(7) Change 874 guild. 4 sti. 14 penn. current money into bank money, exchange at 4⅝ per cent.

guil.	*guil.*	*guil.sti. pe.*
As 104⅝ :	100 ::	874 4 14
Or, As 104⅜ :	874 4 14 ::	100
8	20	8
837	17484	800
	16	
	279758	
	800	
837) 223806400 (267391		
133 rem.		
16) 267391		
2,0) 1671,2 nearly.		

Ans. 835 *guil.* 12 *sti. cur.*

(8) How much current money can I have for 2345 guilders banco, the agio being 5 per cent.? *Ans.* 2462¼ *guilders.*

(9) How much bank money can I receive for 5421 florins, the agio being 4 per cent.? *Ans.* 5212½ *florins*

(10) In 1456 Flemish current, how many £ sterling, the agio being 4 per cent., and the exchange 34*s.* 6*d.* Flemish per £ sterling?

	£		£		£	£
1st. As	104	:	100	::	1456	to 1400 *Flemish.*

	s.		£ *ster.*		£	
2nd. As	34½	:	1	::	1400	
	2				20×2	
	69				69) 56000 (811*l.* 12*s.* nearly.	

N.B. 34*s.* 6*d.* = 34½*s.*

(11) In 438*l.* 7⅐*s.* sterling, how many rix-dollars current, agio 4⅝, exchange at 36*s.* 6*d.* Flemish per £ sterling?

	s. ster.		*s.*	*d.*		£	*s.*	£
1st. As	20	:	36	6	::	438	7⅐	to 800
	£		£			£	£	
2nd. As	100	:	104⅜			800	to 837	*current.*

3rd. For the *rix-dollars*, the table says, 2½ florins = 1 rix-dol.; and 6 flor. = 1*l.* Flem.

Hence the proportion is $\frac{2\frac{1}{2}}{6} = \frac{5}{12}$. Therefore, multiply the 837*l.* by 12, and divide by 5 = 2008⅘ *rix-dollars.—Ans.*

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6. Hamburgh.

At Hamburgh the accounts are kept in marks, sol (or schilling) lubs,* and pfennings; and they exchange by the pound Flemish, as in Holland.

8 pfennings.....make	1 schilling or penny.
12 pfennings	1 groschen.
6 sol-lubs (or 12*d.* Flemish, or 72 deniers)	1 sol gros.
16 schillings	1 mark = 1*s.* 2¼*d.* nearly.
2 marks, or 32 schillings ..	1 Hambro' dollar.
3 marks (or 48 sol-lubs)....	1 rix-dollar.
6 marks banco, or 7½ marks cur.	1 ducat = 8*s.* 11*d.*
7½ marks	1 liver gross, or £ Flemish.

The *par of exchange* is 35*s.* 6⅔*d.* Flemish for 1*l.* sterling; and the *course of exchange* is from 32*s.* to 36*s.* Flemish per

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* Sol-lub, schilling or schillings lub, means the same. The word *lub* (so called from *Lubeck*, where it was first coined) is now falling into disuse, and the word *Hambro'* substituted.

£ sterling. Agio from 18 to 20 per cent. for currency; and from 30 to 35 per cent. for light coin.*

EXAMPLES.

(1) In 3021 rix-dollars 35 sol-lubs, how many £ sterling, exchange 36*s.* 4*d.* Flemish per £ sterling.

s.	*d.*	£		*rix-d.*	*sol-lubs.*
36	4	1	::	3021	35
12				48	
436				24173	
				12087	
				145043	
				2	
				436)290086(	665 6 8¼
				204 rem.	

(2) How many marks must be received at Hambro' for 250*l.* 15*s.* sterling, exchange at 34*s.* 6*d.* per £ sterling.

s.		*s.*	*d.*		£	*s.*
20	:	34	6	::	250	15
		12			20	
		414			5015	
		5015				
		2,0)207621,0				
		32)103810½				

Ans. 3244 *marks* 2½ *den.*

(3) Reduce 4321 marks 12 schill. into £ sterl. exchange at 34*s.* 4*d.* Flemish per £ sterling? *Ans.* 335*l.* 13*s.* 4¾*d.*—44.

(4) Reduce 335*l.* 13*s.* 4¾*d.* sterling, into marks and sol-lubs banco, exchange at 34*s.* 4*d.* Flemish per £ sterling.

Ans. 4321 *marks* 11 *schill.* 11 *pfenn.*—348.

(5) In 665*l.* 6*s.* 8½*d.* sterling, how many rix-dollars, exchange at 36*s.* 4*d.* Flemish per £ sterling?

Ans. 3021 *rix-dol.* 35 *schil.* 0*d.* 1 *pfen.* $\frac{21}{48}$.

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(6) Reduce 8766 marks current into £ sterling, exchange at 35*s.* 3*d.* Flemish per £ sterling, and agio 20 per cent.

						marks.	*marks.*
1st.	As 120		:	100	::	8766	to 7305 *banco.*
	s.	*d.*		£.		*marks.*	
2nd.	As 35	3	:	1	::	7305	
	12					32	
	423*d.*					423)233760(	552*l.* 12*s.* 5¾*d.* *Ans.*
						63 rem.	

* The different moneys of Hamburgh are, 1st, *bank money;* 2nd, *specie;* 3rd, *the gold ducat;* 4th, *light coin;* 5th, *currency.*

(7) In 552*l.* 12*s.* 6*d.* sterling, how many marks current, exchange at 35*s.* 3*d.* Flemish per £ sterling, and agio 20 per cent.?

	d.		*s.*	*d.*		£	*s.*	*d.*	£		
1st. As	240	:	35	3	::	552	12	6	to 974	*Flem.*	
	£		£			£					
2nd. As	100	:	120		::	974					

$7\frac{1}{2}$ *marks.* = 1*l. Flem.*

7305
120

1,00)8766,00(8766 *marks. Ans.*

. . . .

(8) How much sterling money will a bill of 1830 rix-dollars current amount to, exchange at 35*s.* 6*d.* Flemish per £ sterling, and agio 18 per cent?

Ans. 349*l.* 9*s.* $8\frac{3}{4}$*d.*—1177 *rem.*

(9) How many Hambro' marks must be received for a bill of 349*l.* 9*s.* 9*d.* sterling, exchange at 35*s.* 6*d.* Flemish per £ sterling, and agio 18 per cent?

	marks	*pf.*
Ans.	5490	2—518.

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7. Poland and Prussia.

At Dantzig and Konigsberg accounts are kept in florins, gross (groshen) penins, and exchange by the gross; 270 of which are supposed equal to 1*l.* Flemish, and 110 to a rix-dollar at Hamburgh. Exchange is made with Poland and Prussia by way of Holland.

The *course of exchange* is from 240 to 295 gross per £ Flemish.

6 penins	.....make	1 shelon.
18 penins	.....	1 gross.
18 grossi	.....	1 oort.
30 grossi	.....	1 florin, or Polish guilder.
3 florins, or 90 grossi	.....	1 rix-dollar.
2 rix-dollars	.....	1 gold ducat.

EXAMPLES.

(1) In 1000*l.* sterling, how many Prussian florins, exchange 270 grossi per £ Flemish, and 34*s.* 4*d.* Flemish per £ sterling?

	£	*s.*	*d.*		£
1st. As	1	34	4	::	1000

412
1000

412000 *Fl. pence.*

	d. Flem.	*grossi.*	*d. Flem.*
2nd. As	240	270	412000

412000

240)111240000

3,0)46350,0 *gross.*

Ans. 15450 *Pruss. flor.*

(2) How many £ sterling for 3456 rix-dollars 40 grossi, exchange at 280 Polish grossi per £ Flemish, and 33*s.* 4*d.* Flemish per £ sterling?

	gross.	*d. Fl.*	*r-doll.*	*gro.*
1st. As	280	: 240	:: 3456	40

90

311080
240

280)74659200(266640 *d. Fl.*

	s.	*d.*	£	*d.*
2nd. As	33	4	: 1	:: 266640

d. 40,0(26664,0(

£666—240
20

Ans. 666*l.* 12*s.* 4,00)48,00(12*s.*

(3) Change 1760 florins into sterling money, 275 Polish grossi being equal to the £ Flem. and 34*s.* 4*d.* Flem. to one £ sterling. *Ans.* 111*l.* 16*s.* $10\frac{1}{2}d.$—$\frac{90}{105}$.

(4) In 111*l.* 16*s.* $10\frac{3}{4}d.$ sterling, how many Polish guilders, exchange at 275 Polish grossi per £ Flem. and 34*s.* 4*d.* Flem. per £ sterling? *Ans.* 1760 *Pol. guilders*—143 rem.

9. SWEDEN.

They keep their accounts in Sweden in copper dollars and oorts, or in silver dollars, and exchange by the copper dollar.

The *par of exchange* is one £ sterling for $34\frac{4}{7}$ copper dollars; and the *course of exchange* is from 40 to 50 copper dollars per £ sterling.

8 penins	make	1 runstychen.
8 runstychens		1 copper marc.
3 copper marcs		1 silver marc.
4 copper marcs		1 copper dollar.
9 copper marcs		1 caroline.
3 copper dollars		1 silver dollar.
3 silver dollars		1 rix-dollar.
2 rix-dollars		1 ducat.

EXAMPLES.

(1) In 480*l.* 5*s.* 6*d.* sterling, how many copper dollars, &c., exchange at 48¼ copper dollars, per £ sterling?

£	*c. d.*	£	*s.*	*d.*
As 1	: 48¼	:: 480	15	6
				193
240*d.*	193		115386	

240) 22269498 (4) 92789

138 rem. 23197¼

(2) In 756 ducats, how much sterling money, exchange at 42½ copper dollars per £ sterling?

c. d.	£	*duc.*
As 42½	: 1	:: 756
2		18 *cop. d.* = 1 *duc.*
85		13608
		2

Ans.

85) 27216 (320*l.* 3*s.* 9*d.*

15 rem.

(3) In 738*l.* sterling, how many copper dollars, exchange at 48 copper dollars per £ sterling?

Ans. 35424 *copper dollars.*

(4) Reduce 320*l.* 3*s.* 9*d.* sterling into rix-dollars, &c., exchange at 42½ copper dollars per £ sterling?

Ans. 1512 *rix-dollars, nearly.*

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(5) In 1034 silver dollars 16 run. 6 pen. how many £ sterling, exchange at 49 copper dollars, per £ sterling?

c. d. £	*s. dol. run. pen.*
As 49 : 1	:: 1034 16 6
32	3
1568	3102
8	32 *run.* = 1 *cop. dol.*
12544	99280
	8

12544) 794246 (63*l.* 6*s.* 4*d.* *Ans.*

416 rem.

(6) In 158*l.* 16*s.* 8*d.* sterling, how many silver marcs, exchange 48 copper dollars per £ sterling?

d.	*c. dol.*		£ *s.* *d.*
240	: 48	::	158 16 8
	4		
	3) 192		38120*d.*
			64

sil. marcs.

s. marcs 64 240)2439680(10165 *A.*

8 rem.

N.B. 3 cop. dol. are = 4 silver marks (see the Table). Hence, a sil. mark is ¾ of a cop. dol.

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8. DENMARK.

In Denmark accounts are kept in rix-dollars, marcs, and schillings; and the exchange from 4 to 5 rix-dollars per £ sterling.

16 schillings..... make 1 marc.
6 marcs ..... 1 rix-dollar.

EXAMPLES.

(1) How many £ sterling in 1765 rix-dollars Danish, exchange at 4*s*. 9*d*. per rix-dollar ?

r.-dol. *s.* *d.* *r.-dol.*
As 1 : 4 9 :: 1765

57
1765

12) 100605

2,0) 838,3 9

£419 3 9 *Ans.*

(2) In 133*l*. 14*s*. 4*d*. sterling, how many Danish marcs, exchange at 4*s*. 8½*d*. per rix-dollar ?

s. *d.* *r.-dol.* £ *s.* *d.*
As 4 8½ : 1 :: 133 14 4

113 *half-pence.* 64184 *half-p.*

113) 64184 (568 *rix-dollars.*
6

Ans. 3408

(3) In 3408 Danish marcs, how many £ sterling, exchange at 4*s*. 8½*d*. per rix-dollar ? *Ans.* 133*l*. 14*s*. 4*d*.

(4) How many Danish marcs in 419*l*. 3*s*. 9*d*. sterling, exchange at 4*s*. 9*d*. per rix-dollar ? *Ans.* 10590 *marcs*.

10. RUSSIA.

In Russia they keep their accounts in rubles and copecs; and exchange by the ruble.

The *par of exchange* is 4*s*. 6*d*. ster. per ruble; and the *course of exchange* is from 48*d*. to 60*d*. per ruble; or from 48 to 59 stivers per ruble by way of Hamburgh and Amsterdam.

3 copecs ..... make 1 altin.
10 copecs ..... 1 grievener.
25 copecs ..... 1 polpolitin.
2 polpolitins ..... 1 poltin.
2 poltins ..... 1 ruble.
2 rubles ..... 1 ducat.

EXAMPLES.

(1) In 500*l*. 17*s*. ster. how many rubles, exchange at 4*s*. 5*d*. ster. per ruble ?

s. *d.* *rub.* £ *s.* *d.*
As 4 5 : 1 :: 500 17 0

53 120204

53) 120204 (2268 *rubles. Ans.*

(2) In 1896 rubles, how many £ ster. exchange at 4*s*. 6*d*. per ruble ?

rub. *s.* *d.* *rub.*
As 1 : 4 6 :: 1896
4½

7584
948

£
Ans. 426*l*. 12*s*. 2,0) 853,2(426 12*s*.

(3) What is the value of 1572 rubles and 60 copecs, at 4*s.* 9½*d.* per ruble? *Ans.* 376*l.* 15*s.* 4½*d.*

(4) How many rubles, &c., must be received in Petersburgh for 376*l.* 15*s.* 4½*d.*, exchange at 4*s.* 9½*d.* per ruble? *Ans.* 1572 *rubles, and* 60 *copecs*

---

(5) London remits to Petersburgh 725*l.* sterling, exchange at 34*s.* 6*d.* Flem. per £ sterling, and the exchange from thence 50 stivers per ruble, how many rubles must be received in Petersburgh?

	£	s.	d.		£		£	s.	d.
1st. As	1	: 34	6	::	725	to	1250	12	6

	stiv.	rub.		£	s.	d.
2nd. As	50	: 1	::	1250	12	6

2*d.* = 1 *stiv.* 20 × 12

100 | 10,0)3001,50

Ans. 3001 *rub.* 50 *cop.*

(6) Archangel remits to London, per bill of exchange, 5000 rubles 4 copecs, exchange 122 copecs per rix-dollar of 50 stivers, and 34*s.* 7*d.* Flem. per £ ster.; how much sterling is the sum?

	cop.	stiv.		rub.	cop.	stiv.
1st.	122	: 50	::	5000	4	to 204919½

	s.	d.	£	stivers.
2nd.	34	7	: 1	:: 204919½
	12			2

		£	s.	d.
415	415) 409839 (	987	11	3¼

125 rem.

---

11. Ireland.

In Ireland accounts are kept in pounds, shillings, and pence, Irish, divided as in England.—The *par of exchange* is 108⅓*l.* (108*l.* 6*s.* 8*d.*) Irish, for 100*l.* sterling; or 1*l.* 1*s.* 8*d.* Irish per £ sterling.—The *course of exchange* is from 5 to 12 per cent, according as the balance of trade favours Ireland or England.

Examples.

(1) London remits to Ireland 786*l.* 12*s.* sterling, what money must be received there, exchange at 10½ per cent?

	£		£	s.		£	s.
As	100	:	110	10	::	786	12

2000 | 2210 | 15732

15732

200,0) 3476772,0 (2,0) 1738,3

$\frac{56}{200} = \frac{7}{25}$ £869 3 10¼ $\frac{7}{25}$

(2) Dublin remits to London 1500*l.* Irish, how much sterling must Ireland be credited for, exchange at 12 per cent?

	£		£		£
As	112	:	100	::	1500

1500

112) 150000 (1339*l.* 5*s.* 8½*d.*

32 rem.

(3) Purchased in Ireland goods to the amount of 869*l.* 3*s.* 10½*d.* Irish, how much money must I pay in London to settle the account, exchange at 10½ per cent?

Ans. 786*l.* 12*s. sterling*

(4) London remits to Dublin 1339*l.* 5*s.* 8¾*d.* sterling; for how much Irish must London be credited, exchange at 12 per cent? *Ans.* 1500*l. Irish*

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12. America and the West Indies.

Accounts are kept in these places in pounds, shillings, and pence, as in England. Here is no fixed *par* in consequence of the fluctuation of the *agio:* the money is called *currency*, and, on account of the scarcity of cash, 5*l.* sterling is worth 7*l.* of the currency of the West Indies.

Examples.

(1) America is indebted to England 850*l.* 18*s.* sterling; with how much currency will England be credited in America, exchange at 35 per ct.?

£	£	£	s.	
As 100	: 135	:: 850	18	
		17018		rem. 30
		135		12
				d. 3/60
	1,00)	22974,30		4
				½/40
	2,0)	2297,4	= 1148	14 3½

(2) London receives from Jamaica 1756*l.* 10*s.* currency, what will be its value here in sterling, exchange at 30 per cent?

£	s.		£	s.	d.
130 : 100	::	1756	10 to	1351	3 0 $\frac{9}{13}$

Or thus, as the proportion in fractions is $\frac{100}{130}=\frac{10}{13}$

	£	s.
Multiply	1756	10
by		10
and divide by 13)	17565	0

gives the *Ans.* £1351 3 0 $\frac{9}{13}$

(3) Bought goods in the West Indies to the amount of 486*l.* 15*s.* sterling, how much is that in their currency, exchange at 25 per cent? *Ans.* 608*l.* 8*s.* 9*d.*

(4) London receives a bill of exchange from Philadelphia for 750*l.* sterling, for how much currency was London indebted, exchange being at 33⅓ per cent? *Ans.* 1000*l.*

ARBITRATION OF EXCHANGES.

THE *course of exchange* varying, as we have seen, between one nation and another, as the balance of trade varies; this rule teaches how to draw upon, or remit, to, foreign places, in a way the most profiable.

This is done by finding such a rate of exchange between any *two places*, as shall be in proportion with the rates assigned between each of them and a *third* place.

Arbitration of exchange is either *Single* or *Compound.*

SINGLE ARBITRATION.

Single Arbitration is when the course of exchange between one place and *two others* is given, to find the rate between them.*

EXAMPLES.

(1) If the exchange between London and Petersburgh be 50*d.* per ruble, and between London and Amsterdam be 34*s.* 5*d.* Flem. per £ sterling, what is the *par* of arbitration between Petersburgh and Amsterdam?

d.		*s.* *d.*		*d.*
As 240	:	34 5	::	50
		413		
		50		
		24,0) 2065,0 (86$\frac{1}{24}$ *per ruble.* *Ans.*		
		192		
		145		
		144		
		1		

(2) London exchanges on Amsterdam at 33*s.* 9*d.* per £ sterling, and on Paris 40*d.* sterling per ecu, what is the par of arbitration between Amsterdam and Paris? *Ans.* 67$\frac{1}{2}$*d.*

(3) If the exchange between Amsterdam and Paris be 58*d.* per crown, and between Amsterdam and London 34*s.* 4*d.* per £ sterling, required the arbitrated par between Paris and London? *Ans.* 33$\frac{3}{4}$*d.* $\frac{6}{11}$$\frac{0}{2}$ *sterl. per ecu.*

(4) If Amsterdam remits to Cadiz at 39*d.* per piastre, and to London at 35*s.* 5$\frac{1}{2}$*d.* per £ sterling, how stands the par of arbitration between Cadiz and London? *Ans.* 22 *nearly*

(5) If London remits to Lisbon at 5*s.* 3*d.* per milrea, and to Paris at 56*d.* per ecu, what is the par of arbitration between Lisbon and Paris? *Ans.* 67$\frac{1}{2}$ *sol. per milrea*

* This rate is termed either the *arbitrated price, arbitrated par,* or *par arbitration.*

(6) London exchanges with Amsterdam at 33*s.* 9*d.* per £ sterling, and with Genoa at 48*d.* per pezzo, what is the *par* of arbitration between Amsterdam and Genoa?

Ans. 81 *Flem. pence per pezzo of Genoa*

COMPOUND ARBITRATION.

Compound Arbitration is when the *exchange* is to be conducted *through several places;* and the rule shows how much a remittance will amount to at the *last place.* This amount is termed the *arbitrated price,* or *par of arbitration* between the *first* and *last* place.

Questions of this kind are solved either *by the Rule of Proportion,* or by arranging the terms into *antecedents* and *consequents.*

Rule 1st. Place the *antecedents* in *one column,* and the *consequents* in *another;* observing that the *second* antecedent must be of the *same kind* with the *first* consequent; and the *third* antecedent of the *same kind* with the *second* consequent, &c.

2. The *first* antecedent and the *last* consequent must be of the *same kind.*

3. Multiply the *antecedents* together for a *divisor,* and the *consequents* for a *dividend,* and the *quotient* will be the *arbitrated price of exchange.*

Examples.

(1) A merchant in London intends to remit 1000*l.* to Cadiz in Spain, by way of Holland, at 36*s.* Flemish per £ sterling, thence to France at 56*d.* Flemish per ecu; thence to Venice, at 100 ecus for 60 ducats; thence to Cadiz at 360 maravedis per ducat; how many piastres of 272 maravedis each, will the 1000*l.* sterling amount to in Cadiz?

Antecedents.	*Consequents.*
1*l.* sterling, 36*s.* Flem.....	432*d.* Flem.
56 Flem.....	1 ecu.
100 ecus	60 ducats.
1 ducat.....	360 maravedis.
272 marav.	1 piastre.
How many piastres = 1000*l.* ?	

Omitting the units, we have by the rule $\frac{432 \times 60 \times 360 \times 1000}{56 \times 100 \times 272}$

And further reduced,* gives $\frac{27 \times 60 \times 45 \times 10}{7 \times 17} = 6126\ \frac{6}{119}$ *piastres. Ans.*

* The operation may be abridged, by *dividing* any of the *antecedents* and *consequents* by their *common measure.* See under N.B. Case 5th, Vulgar Fractions, page 118.

(2) If 100 lbs. at London are equal to 96 lbs. at Amsterdam, and 135 at Amsterdam equal to 168 at Toulouse, how many lbs at Toulouse are equal to 175 lbs. at London?

If 100 lbs. London = 96 lbs. Amsterdam.
135 lbs. Amsterdam = 168 lbs. Toulouse.
How many lbs. at Toulouse = 175 lbs. London.

$$\frac{\overset{24}{\not 96} \times \overset{56}{\not 168} \times \overset{7}{\not 175}}{\underset{4}{\not 100} \times \underset{45}{\not 135}} = \frac{\overset{8}{\not 24} \times 56 \times 7}{5 \times \underset{3}{\not 9}} = \frac{3136}{15} = 209 \text{ lbs. } \tfrac{1}{15} \text{ Ans.}$$

POSITION.

POSITION, sometimes termed the RULE OF FALSE, is a rule which, by *supposed numbers*, enables us to find the *real ones*. It consists of two parts, *single* and *double*.

SINGLE POSITION.

SINGLE POSITION is when only *one supposed number* is requisite to obtain the answer.

RULE 1st. Suppose *any fit number*, and work with it as if it were the true one.*

2nd. Then say, As the *result* of *this work* is to the *true total*, so is the *supposed number* to the *true one* required.†

EXAMPLES.

(1) A schoolmaster being asked how many scholars he had, said, if I had as many more, half as many, and a quarter as many, I should have 330; how many had he?

		Proof.
Suppose.... 60	Then, As 165 : 330 :: 60	120
As many more 60	60	120
½ as many.... 30		60
¼ as many.... 15	165) 19800 (120 *Ans.*	30
165		330

(2) A person, after spending ⅓, ¼, and ⅕ of his money, had 216⅔*l.* left; how much had he at the first? *Ans.* 1000*l.*

* Any supposed number will produce the true answer; but for convenience in working, those numbers are to be *preferred*, from which *all the parts* can be taken *without remainders*. Some, however, recommend the number 1 to be made the constant supposition.

† Only those questions belong to SINGLE POSITION, whose parts are certain proportions of the suppositions, or of some power or root of their suppositions.

(3) A gentleman bought a chaise, horse, and harness for 72*l.*; the horse came to twice the price of the harness, and the chaise to thrice the price of the horse; what did he give for each? *Ans. For the harness,* 8*l.*; *for the horse,* 16*l.*; *for the chaise,* 48*l.*

(4) A, B, and C purchased a ship for 3300*l.*; A paid a certain sum, B paid twice as much as A, and C four times as much as B; how much did each man pay?

Ans. A paid 300*l.*; *B* 600*l.*; *and C* 2400*l.*

(5) A man meeting a maid driving a flock of geese, said, Where are you going, sweetheart, with these 50 geese? she replied, I have not 50, but if I had ½ as many more, a third and a quarter as many more, I should have 50; how many had she? *Ans.* 24 *geese.*

(6) Lent a sum of money to receive 6 per cent. per annum simple interest, and at the end of ten years received for principal and interest 1000*l.*; what was the sum lent?

Ans. 625*l.*

Suppose 100 Then, As 160 : 1000 :: 100 to 625*l.*
10 yrs. int. at 6*l.* per ct. 60

160

(7) Borrowed a sum of money, for which I paid 5*l.* per cent. per ann. simple interest; in 7 years it amounted to 810*l.*; what was the sum borrowed? *Ans.* 600*l.*

DOUBLE POSITION.

Double Position is when *two supposed* false *numbers* are requisite to obtain the true answer.

Rule 1st. Take *any two* convenient numbers, and proceed with each according to the nature of the question, noticing how much *each result differs* from the *true result*, and call this difference its *error*.

2nd. Place *each error* against its *respective position*, and multiply them cross-ways.

3rd. If the *errors* are *alike*, that is, both greater or both less than the given number, take their *difference* for a *divisor*, and the *difference* of their *products* for a *dividend*. But if *unlike*, that is, one *too much*, and the other *too little*, take their *sum* for a *divisor*, and the *sum* of their *products* for a *dividend*; the *quotient* will be the answer

Examples.

(1) A, B, and C would divide 1200*l.* between them so that B may have 100*l.* more than A, and C 100*l.* more than B; how much must each have?

Suppose A had.....500 Suppose again A...400
Then B would have 600 Then B...500
And C .....700 And C...600

1800, too much by 600 1500, too much by 300

Here the *errors* are of *one kind:* therefore, by the rule,—

sup.	*error.*		Proof.	
500	600	600	A's share	300
		sub. 300	B's	400
400	300		C's	500
240000	150000	300 *divisor.*		£1200
sub. 150000		Shorter, thus...1200		
		B extra 100		
3,90) 900,00		C 200		
		300		
300 *A's share.*		900÷3 = *A's share, &c.*		

(2) Divide 500*l.* between two persons, A and B, so that A may have 120*l.* more than B; what is each person's share?

Ans. A 310*l. and B.* 190*l.*

(3) A, B, and C built a house which cost 1500*l.* of which A paid a certain sum, B paid 200*l.* more than A, and C paid 200*l.* more than B; what sum did each pay?

Ans. A paid 300*l.; B* 500*l.; C* 700*l.*

(4) A person dying, bequeathed to three of his friends 600*l.* which he had in his chest, in this manner, to the first a certain portion, to the second half as much more, wanting 10*l.* and to the third double the sum, wanting 30*l.*; what sum did each receive?

Ans. The 1*st*, 142$\frac{2}{3}$*l.; the* 2*nd*, 203$\frac{1}{3}$*l.; the* 3*rd*, 254$\frac{1}{3}$*l.*

---

(5) A, B, and C are indebted to D in certain sums; A's and B's debts united amount to 500*l.*, B's and C's to 700*l.*, and A's and C's to 600*l.*; what is each man's particular debt?

Suppose A's... 190 Suppose again, A's...220
Then B's... 310 Then B's...280
And C's... 390 And C's...420
Therefore A and C 580, too little by 20. Therefore A and C 640, too much by 40.

Here the errors are *unlike*—therefore, by the rule,—

sup. 190 — 20 too little.
220 — 40 too much.

				Proof.	£
add	20	4400	7600	A's debt 200 + B's 300 =	500
	40	7600		B's ..... 300 + C's 400 =	700
				C's ..... 400 + A's 200 =	600
6,0) 1200,0					
200 *Ans. A's debt.*					

(6) Three persons discoursed concerning their ages; said A, I am 20 years of age; said B, I am as old as A, and half of C; and said C, I am as old as you both; the age of each person is required.

Ans. A 20, *B* 60, *and C* 80 *years of age.*

(7) A man left his estate to his 3 sons thus; to the eldest one half, wanting 50*l.*; to the second one third; and to the youngest the rest, which was 10*l.* less than the share of the second; I demand the sum left, and each son's part?

Ans. The sum left was 360*l.*, *of which the eldest had* 130*l.*, *the second* 120*l.*, *and the third* 110*l.*

(8) A gentleman bought a house, orchard, and garden, for 1000*l.*; he paid three times the price of the garden for the orchard, and 30*l.* more; and four times the price of the orchard for the house, and 40*l.* more; what was the value of each?

Ans. The garden 50*l.* 12*s.* 6*d.*; *the orchard* 181*l.* 17*s.* 6*d.*; *and the house* 767*l.* 10*s.*

PROGRESSION*

Consists of two parts, ARITHMETICAL and GEOMETRICAL.

ARITHMETICAL PROGRESSION

Is when a series of numbers increases or decreases regularly, by the continual *adding* or *subtracting* of the equal numbers; as 1, 2, 3, 4, 5, 6, &c., are in Arithmetical Progression by the continual *addition* of *one*; and 11, 9, 7, 5, 3, 1, by the continual *decreasing* or *subtracting* of *two*.

The *numbers* which form the *series* are called the *terms* of the Progression, of which there are *five*—

First term.
The *last* term.
The *number* of terms.
The common *difference*.
The *sum* of all the terms.

Any three of these being given, the *other two* may be found.

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* The most useful parts of Progression, as far as the Rule relates to common arithmetical purposes, are comprised in this treatise; but as it is for the exercise of the juvenile capacity, to whom Algebra is unknown, it has been thought proper to divest it of all symbolic characters.

CASE I. The *first* term, the *last* term, and the *number* of terms given to find the *sum* of all the terms.

RULE. Multiply the *sum* of the *two extremes* by *half the number* of terms, or, multiply *half the sum* of the extremes by the *whole* number of terms; the product is the answer.

EXAMPLES.

(1) How many strokes do the clocks of Venice strike in 24 hours; where they strike from one to 24?

To the first term $1+24=25$
Then, 25 multiplied by half the number of hours.
Or $25\times12=300$ *the Answer.*

(2) If 100 stones are placed in a right line 3 yards asunder, and the first 3 yards from a basket, what length of ground will a man go over who gathers them up one by one, returning with each to the basket?

To fetch the first he will walk 6 yards, and the last 600; hence, the first term is 6, and the last 600.
Therefore $6+600=606$
Multiplied by $50=\frac{1}{2}$ the No. of terms.
Ans. He will walk 30300 *yds.* = 17 *miles* 38 *yds.*

(3) The first term of an arithmetical progression is 5, the last is 74, and the number of terms 24; what is the sum of the series?

$5+74=79$, and $79\times12=948$ *Ans.*

(4) What debt may be discharged in a year by weekly payments in arithmetical progression, of which the first payment is 3*s.* and the last 105*s.*? *Ans.* 140*l.* 8*s.*

(5) A mercer bought 30 yards of silk, and gave for the first yard 3*s.* and for the last 3*l.* 1*s.* increasing in arithmetical progression; what did the whole cost him? *Ans.* 48*l.*

CASE II. The *first* term, the *last* term, and the *number* of terms, given to find the *common difference.*

RULE. From the *last* term *subtract* the *first;* the remainder divided by the *number of terms*, less one, gives the *common difference.*

EXAMPLES.

(6) The extremes are 1 and 24, and the number of terms 24; required the common difference?

No. of terms 24	From last term 24
Subtract 1	Sub. the first 1
Divisor 23	23

23 | 23 (1 *the com. diff Ans.*

(7) The first term is 6, the last term 600, and the number of terms 100; what is the common difference?

No. of terms 100	From last term 600
Subtract 1	Sub. the first 6
Divisor 99	594

99) 594 (6 *the com. diff. Ans.*

(8) The first term of an arithmetical progression is **5**, the last is 74, and the number of terms 24; what is the common difference? *Ans.* 3.

(9) The first and last terms of an arithmetical series are 3 and 105, and the number of terms 52; what is the common difference? *Ans.* 2.

(10) Bought 30 yards of cloth, and gave for the first yard 3*s.* and for the last 61*s.*; what is the common difference of the price of each yard? *Ans.* 2.

CASE III. The *first* term, the *last* term, and the *common difference*, given to find the *number of terms*.

RULE. From the *last* term subtract the *first;* divide the remainder by the *common difference*, and the quotient increased by *one*, gives the *number of terms*.

EXAMPLES.

(11) A person travelling went 4 miles the first day, and increased every day by 5 miles, till at last he went 64 miles in one day; how many days did he travel?

The last term 64
Subtract the first 4

Com. diff. 5) 60

12
Add 1

Ans. 13 *number of days.*

(12) A man being asked how many sons he had, said the youngest was 5 years old, and the eldest 29; and that he increased one in his family every 3 years; how many had he?

The last term 29
Sub. the first 5

Com. diff. 3) 24

8
Add 1

Ans. 9 *sons.*

(13) If the extremes be 5 and 74, and the common difference 3, what is the number of terms? *Ans.* 24.

(14) If the first and last terms of an arithmetical progression are 3 and 105, and the common difference 2, what is the number of terms? *Ans.* 52.

(15) Bought cloth, and gave for the first yard 3*s.* and for the last 61*s.*, the common difference of the price of each yard is 2*s.*; required the number of yards. *Ans.* 30 *yds.*

CASE IV. The *last* term, the *number* of terms, and the *common difference*, given to find the *first* term.

RULE. Multiply the *number of terms*, less one, by the *common difference*, the product ***subtracted from the last*** term gives the *first*.

EXAMPLES.

(16) A person in 13 days travelled to a certain place, every day's journey increasing the former by 5, and the last he went was 64 miles; what was the first?

Number of terms	13	From	64
Less one	1	Take	60
	12	*Ans.*	4 *first term.*
Common diff.	5		
	60		

Ans. 4 *miles, the* 1*st day's journey.*

(17) A person had 9 sons, his family having increased 1 every 3 years; the eldest was 29 years of age: what was the age of the youngest?

Number of terms	9	From	29
Deduct	1	Subt.	24
	8	*Ans.*	5
Common diff.	3		
	24		

Ans. the youngest was 5 *yrs. old.*

(18) If the last term be 74, the number of terms 24, and the common difference 3, what is the first term? *Ans.* 5.

(19) If the last term be 105, the number of terms 52, and the common difference 2, what is the first term? *Ans.* 3.

(20) Purchased 30 yards of cloth, and gave for the last yard 61*s.*, the common difference of the price of each yard was 2*s.*; how much was given for the first yard? *Ans.* 3*s.*

CASE V. The *common difference*, the *number* of terms, and the *sum* of all the terms given, to find the first *term*.

RULE. Divide the *sum* of all the terms by the *number* of terms, and from the quotient subtract *half* of the product of the common difference, multiplied by the *number* of terms less one, for the answer.

EXAMPLES.

(21) A man is to receive 540*l.* at 12 several payments, each exceeding the former by 6; what will be the first payment?

12) 540 (45
33 } sub.
3 = ½ *the com. diff.*

Ans. 12 *first payment.*

(22) A person had 9 sons, his family having had an increase of 1 every 3 years, and the amount of all their ages was 153; what was the age of the youngest?

9) 153 (17
12 } sub.
1½ = ½ *c. diff.*

Ans. 5 *age of the youngest.* 12 − 8 = 4.

(23) If the common difference be 2, the number of terms 52, and the sum of all the terms 2808, what will be the first term? *Ans.* 3.

CASE VI*. The *first* term, the *number* of terms, and the *common difference* given, to find the *last*.

RULE. *Multiply* together the *number of terms* and the *common difference;* from that product *subtract* the common difference; to that remainder *add* the *first term*, and it will give the *last*.

EXAMPLES.

(24) A person received a sum at 12 several payments, the first was 12*l.* and each succeeding payment exceeded the former by 6, what was the last payment?

Number of terms	12	mult.
Common diff.	6	
	72	sub.
	6	
	66	add.
The first term	12	
Ans.	78	*the last term.*

(25) The first term of an arithmetical series is 5, the number of terms is 24, and the common difference is 3; what is the last term?

Number of terms	24	mult.
Common diff.	3	
	72	sub.
	3	
	69	add.
	5	
Ans.	74	*the last term.*

(26) What is the last number of an arithmetical progression beginning with 3, and continuing by the increase of 2 to 30 places? *Ans.* 61.

GEOMETRICAL PROGRESSION

IS when any rank or series of numbers *increases* by one common *multiplier*, or *decreases* by one common *divisor:* as, 1, 2, 4, 8, 16, 32, &c. increase by the constant *multiplication* of 2: and 81, 27, 9, 3, 1, $\frac{1}{3}$, $\frac{1}{9}$, &c. decrease by the constant *division* or ratio of 3.

In Geometrical Progression, the same five things are to be observed, as in Arithmetical; viz.

The *first* term.
The *last* term.
The *number* of terms.
The *equal difference* or *ratio.*
The *sum* of all the terms.

Any three of these terms being given, the *others* may be found.

* This rule might be extended to *ten* cases, each containing *two propositions;* but some teachers will deem what has been already introduced *more* than sufficient, till the pupil enters upon Algebra. For the Algebraic Formulæ, see Nicholson and Rowbotham's Algebra.

Note 1st. As the *last term* in a long series of numbers is very tedious to come at by continual multiplication, so, for the more readily finding it out, a series of numbers is made use of in *Arithmetical Proportion*, called *Indices*, beginning with a unit, whose common difference is one: also, whatever number of indices you may make use of, set as many numbers, in *Geometrical Proportion, under them*, thus:

1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 *Indices.**
2 . 4 . 8 . 16 . 32 . 64 . 128 . 256 *Numbers in Geometrical Proportion.*

2nd. But if the *first term* in *Geometrical Proportion* be *different* from the *ratio*, the indices must begin with a *cypher*, thus:

0 . 1 . 2 . 3 . 4 . 5 . 6 . 7 *Indices.*
1. 2 . 4 . 8 . 16 . 32 . 64 . 128 *Numbers in Geometrical Proportion.*

3rd. When the indices begin with a *cypher*, the *sum of the indices* made choice of, must always be *one less* than the *number of terms* given in the question; for *one* in the indices stands over the *second* term, and *two* in the indices over the *third*, &c.

4th. *Add any two* of the indices together, and that *sum* will agree with the *product* of their respective terms; thus,

In either table of indices $2 + 5 = 7$ & $2 + 4 = 6$
So in the Geometrical Proportion $4 \times 32 = 128$ & $4 \times 16 = 64$.

5th. If any number of terms be continued in Geometrical Progression, the *product* of the *two extremes* will be *equal* to the *product* of any *two means*, equally distant from the extremes, as in 2, 4, 8, 16, 32, 64, where $2 \times 64 = 4 \times 32 = 8 \times 16$, each product being 128. Also, if the number of terms be *odd*, then the *square of the mean* will be equal to *any two terms* equally distant, as in 1, 3, 9, 27, 81, 243, 729, where $1 \times 729 = 3 \times 243 = 9 \times 81 =$ the square of the mean 27, the product of each being 729.

6th. The *common multiplier*, or *divisor*, is called the *ratio:* thus in 2, 4, 8, 16, 32, &c., the ratio is 2, because each succeeding term is increased by multiplying by 2; and in 81, 27, 9, 3, 1, $\frac{1}{3}$, &c., the ratio is 3, because each succeeding term is decreased by dividing by 3.

CASE I. Given the *first* term, the *last* term, and the common *ratio*, to find the *sum* of the series.

RULE. Multiply the *last term* by the *ratio*, and from the product subtract the *first* term; the remainder *divided* by the *ratio, less one*, will give the *sum of the series.*

---

* By the *help of these indices*, and a *few of the first terms*, in any series of Geometrical Progression, any term, whose distance from the first term is assigned, however remote, may speedily be obtained, without producing all the intermediate terms.

EXAMPLES.

(1) The first term of a series in geometrical progression is 2, the last term is 13122, and the ratio 3; what is the sum of the series?

13122 last term.
Multiplied by 3 ratio.

39366
Subtract 2 first term.

Ratio 3 − 1 = 2) 39364

19682 *Ans.*

(2) Sold 12 bushels of wheat, and received for the first bushel one farthing, and for the last 1048576 farthings; the ratio of each bushel is 4, what were the 12 bushels sold for?

1048576 last term.
4 ratio.

4194304
1 first term.

Ratio 4 − 1 = 3) 4194304

Ans. farth. 1398101 = £ 1456 7 1¼

(3) The extremes of a geometrical series are 20 and 10,000, and the ratio is 2, what is the sum of the series?

Ans. 19980.

(4) A thresher worked at a farmer's 24 days during the winter months, and received for his first day's work 2 barley-corns, for the second 4, for the third 8, &c., doubling them each day, and for the last day's work 16777216 barley-corns; the sum of the series is required. *Ans.* 33554430 *barley-c.**

CASE II. Give the *first* term, the *number* of terms, and the common *ratio*, to find the *last* term.

The *last term* might be obtained by a long series of continual multiplication, but to avoid so tedious a process, observe the following rules.

1. When the *first* term is *equal* to *ratio*.

RULE 1st. Find *a few* of the leading terms, over which place their indices.

2nd. Find *what figures* of these indices, when *added* together, will give the *index* of the term wanted.

3rd. *Multiply the numbers* standing *under* such indices, into each other; and the *last product* will be the *term required*.

EXAMPLES.

(5) A man agrees for 20 fat oxen, to pay only the *price of the last*, reckoning 3 farthings for the first, 9 farthings for the second, &c., trebling the price to the last (the common ratio being 3), what must he give?

---

* Supposing 493447 barleycorns to fill a bushel, the answer is equal to 68 bush., which, at 5*s.* per bushel, would amount to 17*l.* sterling.

1 . 2 . 3 . 4 . 5 . 6 . 7 *Indices.*
3 . 9 . 27 . 81 . 243 . 729 . 2187 *Terms in Geomet. Prop.*

Take any of the indices, which *added together* make 20, and multiply by the terms underneath.

Thus, 7+7+6=20, therefore,
Multiply 2187=7
by 2187=7

4782969
and by 729=6

farth. 3486784401=20

Or take 5+5+5+5 that is
5+5=10, and 10+10=20
243=5
243=5

59049=10
59049=10

3486784401=20

Which when divided by 4, 12, and 20, will give 3632067*l.* 1*s.* 8¼*d. for the Answer.*

(6) What is the last term of a geometrical series, having 12 terms, of which the first term is 2, and the ratio 2?

Ans. 4096.

(7) A draper sells 21 yds. of cloth, the first yard for 3*d.*, the second for 9*d.*, the third for 27*d.*, &c., in a triple proportion geometrical; I demand the price of the last yard?

Ans. 435848051*l.* 0*s.* 3*d.*

2nd. When the *first term* is *not equal* to the *ratio.*

Rule 1st. Write down *a few* of the leading terms, as before, and place over them their indices, *beginning with a cypher.*

2nd. Find what figures of the indices, when *added* together, *less one,* will give the index to the term wanted.

3rd. Multiply the numbers standing under such indices, into each other; observing to *divide every product* by the *first* term.

Examples.

(8) The first term of a geometrical series is 5, the ratio 3, and the number of terms 15, what is the last term?

0 . 1 . 2 . 3 . 4 . 5
5 . 15 . 45 . 135 . 405 . 1215

1215=5
1215=5

5)1476225

295245
405=4

5)119574225=14

23914845 *Ans.*

(9) A man agrees to purchase 22 yards of velvet, at 3 farth. for the first yard, 6 farth. for the second, 12 farth. for the third, &c., (the ratio being 2) geometrical proportion; what was the charge for the last yard?

0 . 1 . 2 . 3 . 4 . 5 . 6 . 7
3 . 6 . 12 . 24 . 48 . 96 . 192 . 384

Then as *one less* 22=21, take three sevens,

$\frac{384\times384}{3}=49152$

and $\frac{49152\times384}{3}=6291456$ *farth. the Ans.*

which divided by 4, 12, and 20 = 6553*l.* 12*s. Ans.*

(10) A sum of money is to be divided among 9 persons; the first is to have 30*l.*, the second 60*l.*, the third 120*l.*, &c., what will the last receive? *Ans.* 7680*l.*

(11) A moneyed man, ignorant of numbers, and unjust in the distribution of his property, left 12 sons, and bequeathed his estate thus; to his executor 50*l.*, to his youngest son double that sum, and each son was to exceed the next younger by as much more; what was the eldest son's portion? *Ans.* 204800*l.*

CASE III. The *first term*, the *number* of terms, and the *ratio* given, to find the *sum of all the terms*.

RULE. Find the last term, as before, then subtract the first from it, and divide the remainder by the ratio less one; to the quotient of which add the greater, and it will give the sum required.

EXAMPLES.

(12) A servant agreed to serve his master 12 months, for a farthing the first month, 3 farthings the second month, 9 farthings for the third, &c., (the common ratio being 3); what did his wages amount to?

0 . 1 . 2 . 3 . 4 . 5 . 6 *Indices.*
1 . 3 . 9 . 27 . 81 . 243 . 729 *Terms in Geomet. Proportion.*
729=6 177147=11
243=5 1

2187 ratio 3 − 1 = 2) 177146
2916
1458 88573
the last term 177147
177147=11*th or last term.* 265720 *farth.* = 276*l.* 15*s.* 10*d.*

(13) A man bought a horse, and by agreement was to give a farthing for the first nail, a halfpenny for the second, a penny for the third, &c., (the common ratio being 2) the number of nails was 32; what was the price of the horse?
Ans. 4473924*l.* 5*s.* 3¾*d.*

(14) One new year's day a gentleman married, and received of his father-in-law a sovereign, with a promise that it should be doubled on the first day of every month for one year; what was the lady's portion? *Ans.* 4095*l.*

(15) A person agrees to purchase 15 yards of lace, for 3 pins the first yard, 9 pins the next, &c., in treble propor-

tion; reckoning 100 pins for a halfpenny, what is the amount?

Here, the first term 3, being = the ratio 3, proceed according to Case II. Rule 1st, to place 1 in the indices over the *first term*, thus—

1 . 2 . 3 . 4 . 5 . 6
3 . 9 . 27 . 81 . 243 . 729

Then, as the indices $4+5+6=15$. We multiply the respective terms $81 \times 243 = 729 = 14348907$ *pins*, which at 100 for a halfpenny = 298*l.* 18*s.* 8½*d.* *Ans.*

(16) A goldsmith, when his customer refused to give 40*l.* per lb. for gold, offered to sell it him at a farthing for the first ounce, a penny for the second, &c., in quadruple proportion geometrical, to which he agreed; I demand what the lb. of gold cost him? *Ans.* 5825*l.* 8*s.* 5¼*d.*

CASE IV. The *first* term, the *last* term, and the *sum* of the series being given to find the *ratio*.

RULE. From the sum of the series subtract the first term, and divide the remainder by the difference between the sum of the series and the last term, and the quotient will be the ratio required.

EXAMPLES.

(17) If the extremes of a series be 2 and 13122, and the sum of the series be 19682, what is the ratio?

19682 19682 sum of the series.
13122 2 first term to be sub.

6560) 19680 (3 *the ratio.* *Ans.*
19680

. . . .

(18) Sold wheat, and received for the first bushel 1 farthing, and for the last 1048576 farthings; and for the whole 1398101 farthings; required the ratio?

1398101 1398101
1048576 1

349525) 1398100 (4 *the ratio.*
1398100

. . . .

(19) A person bought 10 acres of land, and gave for the first acre 3*d.* for the last 59049*d.* and for the whole 88572*d.*; what was the equal difference or ratio? *Ans.* 3.

(20) A gentleman received as his wife's portion, in one year 4095*l.* by monthly payments in geometrical progression; his first receipt was 1*l.* and his last 2048*l.*; what was the ratio? *Ans.* 2.

PERMUTATION.

PERMUTATION is the changing of the relative *position* of things, so that *no two* may have all their parts placed *twice* in the same situation.

Thus, the figures 1, 2, 3, may have six different positions, viz. 123, 132, 213, 231, 312, and 321.

To find all the variations of position that can take place in any given number of things:—

RULE. Multiply into each other, successively, *as many* of the numbers 1, 2, 3, 4, &c., *as there are things* to be varied, and the *last product* will give the *number of permutations.*

EXAMPLES.

(1) How many changes may be rung on 6 bells?

1
2
2
3
6
4
24
5
120
6
720

Ans. 720 *changes.*

Or $1\times2\times3\times4\times5\times6=720$ *Ans.*

(2) For how many days can 7 persons be placed in different positions round a table at dinner?

1
2
2
3
6
4
24
5
120
6
720
7
5040

Ans. 5040 *days.*

(3) How many different ways can 7 notes in music be varied? *Ans.* 5040.

(4) How many permutations can be made of any 9 letters of the alphabet? *Ans.* 362880.

(5) How many transmutations can be made of the letters in the word *Britannia?* *Ans.* 362880.

(6) A scholar wishing to reside with a gentleman whose family consisted of five persons besides himself, offered him 30*l.* for his board, for only so long as they could be all seated differently every day at dinner: this being accepted, how long did he continue? *Ans.* 5040 *days.*

(7) How many transpositions can be made of the following words, "Dic quibus in terris, tres pateat cœli spatium non amplius ulnas?" *Ans.* 39916800.

(8) I demand how many changes may be rung upon 12 bells; and also how long they would be in ringing them but once over, suppose 24 changes to be rung in one minute, and the year to consist of 365 days and one quarter?

Ans. The number of changes is 479001600; *the time is* 37 *years*, 49 *weeks*, 2 *days*, 18 *hours*.

(9) Seven gentlemen travelling met at an inn, and being pleased with each other's company, and with their host, offered him 50*l*. if he would board them so long as they could sit every day at dinner with him in a different order, to which he readily consented; I demand how long they stayed, and how many different positions they sat?

Ans. The number of positions was 40320; *and the time they stayed was* 110 *yrs.* 142½ *days*.

The preceding rules of *Progression*, together with this of *Permutation*, and those of *Combinations*, and *Composition of Numbers*, might be greatly extended, by many interesting questions, not merely as subjects of curiosity, but of real utility; but they may be solved much more easily and neatly by symbolic characters, when the student arrives at Algebra; a study which, if he has a taste for, will afford him a high source of entertainment, and reward him for the research. See *Progression* in "Nicholson and Rowbotham's Algebra."

INVOLUTION.

INVOLUTION is *multiplying* any number *by itself*, and that product by the same number, and so on to any assigned number of places. This is also termed *The raising of Powers*.*

Any number may be called the *first power*; the *product* of that number *multiplied by itself*, is called the *second power*, or *square*; if this be multiplied by the first power again, the product is called the *third power* or *cube*: and if by the same again, the product is called the *fourth power* or *biquadrate*.

Thus, suppose 3 to be the *first* power, then 3×3 gives 9, the *second* power, or *square*; and 9×3 gives 27, the *third* power, or *cube*; and $27 \times 3 = 81$, the *fourth* power, or *biquadrate*. The *small number* denoting the power, is called the *index* or *exponent* of that power; thus 3^2 is the square or second power; 3^3 the cube or third power, &c.

---

* This rule, though not found in some treatises, is a useful preliminary to the Square and Cube Roots, &c.

EXAMPLES.

(1) What is the square of 24?

24
24

96
48
---
576 *Ans.*

(2) What is the square and cube of 64?

64
64

256
384

4096 *the square.*
64

16384
24576

262144 *the cube.*

(3) Required the 9th power of 2.

2 = 1*st power.*
2
---
4 = 2*nd power.*
2
---
8 = 3*rd power.*
2
---
16 = 4*th power.*
2
---
32 = 5*th power.*
2
---
64 = 6*th power.*
2
---
128 = 7*th power.*
2
---
256 = 8*th power.*
2
---
512 = 9*th power.*

Or thus, 2 = 1*st.*
2
---
4 = 2*nd.*
4
---
16 = 4*th.*
16

96
16
---
256 = 8*th.*
2
---
512 = 9*th.*

When a power higher than a cube is wanted; the operation may be shortened, as above.

(4) What is the square of 144? *Ans.* 20736.
(5) What is the cube of 72? *Ans.* 373248.
(6) Required the third power of 36. *Ans.* 46656.
(7) It is required to find the fourth power of 24? *Ans.* 331776.
(8) What is the biquadrate of 48? *Ans.* 5308416.
(9) What is the 6th power of 7? *Ans.* 117649.
(10) Required the 9th power of 3. *Ans.* 19683.

(11) What is the square and cube of 602?

6,02
6,02

1204
3612

36,2404
6,02

724808
21744240

218,167208 *Ans.*

(12) What is the square of $\frac{3}{4}$?

$\frac{3}{4} + \frac{3}{4} = \frac{9}{16}$ *Ans.*

(13) What is the cube of $3\frac{3}{4}$?

First, $3\frac{3}{4} = \frac{15}{4}$

Hence, $\frac{15}{4} \times \frac{15}{4} + \frac{15}{4} = \frac{1350}{64} = 49\frac{27}{64}$ *Ans.*

(14) What is the 4th power of ,08 ? *Ans.* ,00004096.
(15) What is the 5th power of ,74 ? *Ans.* ,2219006624.
(16) What is the 6th power of 4,2 ? *Ans.* 5489,031744.
(17) Required the 7th power of $\frac{1}{2}$? *Ans.* $\frac{1}{128}$.
(18) Required the cube of $2\frac{1}{3}$? *Ans.* $12\frac{19}{27}$.
(19) Required the biquadrate of $\frac{5}{6}$? *Ans.* $\frac{625}{1296}$.
(20) What is the 5th power of 1,1 ? *Ans.* 1,61051.
(21) What is the 6th power of 2,01 ? *A.* 65,944160601201.
(22) What is the 7th power of $1\frac{1}{4}$? *Ans.* $4\frac{125}{1638}\frac{89}{4}$.

EVOLUTION.

EVOLUTION, the *reverse* of Involution, is the method of finding the *root* of any number; as the *square-root*, the *cube-root*, &c., and hence called the *extraction of roots*.

The *root* of any number or power, is such a number, as being *multiplied into itself* a given number of times, *produces that power*.

Thus, 3 is the square root of 9, because $3 \times 3 = 9$; and 4 is the cube root of 64, because $4 \times 4 \times 4 = 64$. Also, 2 is the biquadrate root of 16, because $2 \times 2 \times 2 \times 2 = 16$*

EXTRACTION OF THE SQUARE ROOT.

Extracting the *Square Root* of any number, is finding such a number as, being multiplied *once* in itself, will produce the *given number*.

Rule 1st. Begin at the *unit's place*, and point the given numbers into *periods of two figures each*. If the figures consist of whole numbers and decimals, the *whole numbers* must be pointed from *right* to *left*, the *decimals* the *contrary way*

* The *power* of any given number may be found exactly; but there are many numbers from which the *root* cannot be exactly obtained, as the square root of 5, 7, 10, &c., because no two numbers multiplied into themselves will give 5, 7, 10, &c.; although, by means of decimals, we may attain to any degree of exactness.

Roots are often denoted by writing $\surd$ before the power, with the index against it; thus the square root of 24 is described by $\sqrt[2]{24}$, or only $\surd 24$, without the 2; for 2 is always meant when no index is written. The cube root of 24 is expressed thus, $\surd 24$. Sometimes the roots are expressed with a small figure above; as $24^{\frac{1}{2}}$ is the square root of 24, and $125^{\frac{1}{3}}$ is the cube root of 125.

2nd. Find the *greatest square* number that is contained in the *first period* towards the left-hand; placing the square number *under the first point*, and set its *root* in the *quotient.*

3rd. Subtract the square number from the first point; and to the remainder bring down the two figures under the next point, for a dividend.

4th. Double the quotient, and place it for a divisor on the left-hand of the dividend; see how often it is contained in the dividend (exclusive of the unit's place) and put the answer in the quotient, and also on the right-hand of the divisor.

5th. Multiply the divisor by the last figure put in the quotient, and subtract the product from the dividend; to the remainder bring down the next period, and proceed thus till all the periods are brought down.

6th. If any thing remain, add two cyphers thereto, and repeat the work, and for every two thus added, you will have one *decimal* in the root.

Roots	1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9
Squares	1 . 4 . 9 . 16 . 25 . 36 . 49 . 64 . 81

Examples.

(1) What is the square root of 54756?

```
  54756 (234 root.
  4
  ---
43 ) 147
     129
  ---
464 ) 1856
      1856
  ----
  ...
```

(2) Required the square root of 321489?

```
  321489 (567 root.
  25
  ---
106 ) .714
       636
  ---
1127 ) .7889
       7889
  ----
```

(3) What is the square root of 1234,56?

```
  . . .
  1234.56 (35,1363 +
  9
  ---
65 ) 334
     325
  ---
701 ) . . 956
        701
  ---
7023 ) 25500
       21069
  ---
70266 ) .443100
        421596
  ---
702723 ) .2150400
         2108169
  ---
  . . 42231
  =====
```

Ans. 35,1363 + *the required root.*

(4) What is the square root of 7056? *Ans.* 84.

(5) What is the square root of 9216? *Ans.* 96.

(6) What is the square root of 119025 ? *Ans.* 345.
(7) What is the square root of 459684 ? *Ans.* 678.
(8) What is the square root of 27394756 ? *Ans.* 5234.
(9) What is the square root of 18671041 ? *Ans.* 4321.

Note. When the given number consists of a *whole number* and *decimals* together, make the number of decimals *even* (if they are not so), by *adding cyphers* to them, so that a point may fall on the *unit's place* of the *whole number*.

(10) What is the sq. root of 4712,81261 ? *Ans.* 68,649+
N.B. See the 3rd example that is worked at length.
(11) What is the sq. root of 3,1721812 ? *Ans.* 1,78106+
(12) What is the sq. root of 761,801261 ? *Ans.* 27,6007+
(13) What is the sq. root of 9712,718051 ? *Ans.* 98,553+
(14) What is the sq. root of ,0007612816 ? *Ans.* ,02759+
(15) What is the sq. root of 4,000067121 ? *Ans.* 2,000016+

CASE II. *To extract the Square Root of a Vulgar Fraction.*

RULE. Reduce the *fraction* to its *lowest terms;* then extract the square root of the *numerator* for a *new numerator*, and the square root of the *denominator* for a *new denominator*.

If the fraction be a SURD (*i. e.* a number whose root cannot be exactly found), *reduce it to a decimal*, and extract the root from it.

EXAMPLES.

(1) What is the square root of $\frac{3044}{6849}$? *Ans.* $\frac{2}{3}$.

3044) 6849 (2
6088

Com. measure 761) $\frac{3044}{6849} = \frac{4}{9}$ *lowest terms.*

.761) 3044 (4 — 3044

4 (2 *num.* — 4

9 (3 *den. or* $\sqrt{\frac{4}{9}} = \frac{2}{3}$. — 9

Ans. $\frac{2}{3}$.

(2) What is the square root of $\frac{8456}{6400}$? *Ans.* $\frac{4}{5}$.
(3) What is the square root of $\frac{7056}{9216}$? *Ans.* $\frac{7}{8}$.

SURDS.

(4) What is the square root of $\frac{3168}{61992}$?
$\frac{3168}{61992}$=,5116279069, *the square root of which is* ,71528+
(5) What is the square root of $\frac{2028}{2072}$? *Ans.* ,87447+
(6) What is the square root of $\frac{3873}{7385}$? *Ans.* ,72414+

CASE III. *To extract the Square Root of a Mixed Number.*

RULE 1st. Reduce the *fractional part* of the mixed number to its *lowest terms*, and then the *mixed number* to an *improper fraction*.

2nd. Extract the roots of the *numerator* and *denominator* for a *new numerator* and *denominator*.

If the mixed number given be a *surd*, reduce the *fractional part* to a decimal, annex it to the whole number, and extract the root from the whole.

EXAMPLES.

(7) What is the square root of $5\frac{7}{16}\frac{2}{2}$?

$5\frac{7}{16}\frac{2}{2} = 5\frac{3}{8}\frac{6}{1} = \frac{4}{8}\frac{4}{1}\frac{1}{1}$ 441 (21 *num.* 81 (9 *den.* $\frac{21}{9} = 2\frac{3}{9} = 2\frac{1}{3}$.

81

41) 41

41

Ans. $2\frac{1}{3}$.

(8) What is the square root of $17\frac{6}{10}\frac{4}{0}$? *Ans.* $4\frac{1}{5}$.

(9) What is the square root of $37\frac{3}{4}\frac{6}{9}$? *Ans.* $6\frac{1}{7}$.

SURDS.

(10) What is the square root of $8\frac{3}{5}$?

$8\frac{3}{5} = 8{,}6$ 8,60 (2,9325 + *Ans.*

4

460

441

512) 1900

1749

15100 &c.

(11) What is the square root of $76\frac{2}{3}\frac{8}{4}$? *Ans.* 8,7649+

(12) What is the square root of $7\frac{9}{11}$? *Ans.* 2,7961+

CASE IV. *To find a Mean Proportional between two given Numbers.*

RULE. *Multiply* together the *two given numbers*, and extract the square root of the *product;* which root will be the *mean proportional* sought.

EXAMPLES.

(13) What is the mean proportional between 4 and 9?

$4 \times 9 = 36$. Then, 36 (6 *the mean proportional.* *Ans.* 6.

36

(14) What is the mean proportional between 8 and 18?

Ans. 12

(15) What is the mean proportional between 12 and 48?

Ans. 24.

(16) Required the mean proportional between 15 and 35?

Ans. 22,912+

CASE V. *To find the side of a Square equal in area to any given Superficies.*

RULE. The *square root* of any given *superficies* will be the *side of the square* sought.

EXAMPLES.

(17) If the area of a given triangle be 9876 yards, I demand the side of a square equal in area thereto?

9876 (91,378+
81
Ans. 99,378+

189) 1776
1701

...7500 &c

(18) If the area of a given circle be 961, what is the side of a square equal in area? *Ans.* 31.

(19) If the area of a given circle be 1000, what is the side of a square equal in area? *Ans.* 31,6+

(20) If an oval fish-pond contain 1 acre (=4840 square yards); required the side of a square fish-pond of equal dimensions. *Ans.* 69,57+*yds.*

CASE VI. Any *two sides* of a right-angled triangle given, to find the *third side.*

RULE. *If the hypothenuse or longest side be required.*—The *square root* of the *sum* of the *squares* of the *base* and *perpendicular*, will be the hypothenuse sought. But *if either of the other two sides be wanted*, extract the *square root* of the *difference of the squares* of the given sides, for the answer.

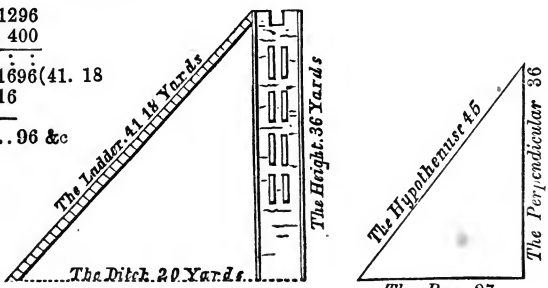
EXAMPLES.

(21) The top of a tower from the ground is 36 yards, and surrounded with a moat 20 yards broad; what must be the length of a ladder to reach from the outside of the moat to the top of the tower?

$36 \times 36 = 1296$
$20 \times 20 = 400$

1696(41. 18
16

81) ..96 &c



Ans. 41½ *yds. nearly.*

(22) The two shortest sides of a right-angled triangle are 27 and 36 yards; required the length of the hypothenuse? *Ans.* 45 *yards.*

(23) The base of a right-angled triangle is 30, and the perpendicular 40 feet; required the length of the hypothenuse?

Ans. 50 *feet.*

(24) A river, 30 feet in breadth, flows round the base of a tower, and if a line of 50 feet will reach from the opposite bank to the top of the tower, what is its height?

Here $50 \times 50 = 2500$ *the line, or hypothen. squared.*
Subt. $30 \times 30 = 900$ *the river, or base do.*

1600 (40 *the height of the tower.*
16
00

Ans. 40 *feet.*

(25) If from the opposite bank of the river to the top of the tower be 50 feet, and the height of the tower be 40 feet, what is the breadth of the river? *Ans.* 30 *feet.*

MISCELLANEOUS QUESTIONS.

(26) If an army were placed rank and file (that is, in the form of a square) each side having 356 men, how many men would the square contain?

$356 \times 356 = 126736$ *men, the Ans.*

(27) If each side of a square pavement contains 120 feet how many square feet are contained therein?

Ans. 14400 *sq. feet.*

(28) A kitchen garden which is to contain 4 acres (=19360 sq. yards), is to be a complete square; the length of each side is required. *Ans.* 139, 14 *yards,* or 139 *yds.* 0 *ft.* 5 *in.*+

(29) How long must a ladder be to reach a window 36 feet high, when the bottom stands 15 feet from the building?

Ans. 39 *feet.*

(30 Two ships sail from the same port; the one sails north 24 leagues, the other west 18 leagues; the distance from each other is required. *Ans.* 30 *leagues distant.*

N.B. The *courses* of the 2 ships are as the *base* and *perpendicular* of a right-angled triangle—hence the *distance* will be equal to the *hypothenuse.*

EXTRACTION OF THE CUBE ROOT.

Extracting the Cube Root is finding out a number which, being multiplied by its square, will produce the given number.

Rule 1st. Begin at the *unit's* place and *point* the given numbers into *periods* of *three figures* each; towards the *left hand* in *whole numbers,* and towards the *right* in *decimals.*

2nd. Find the greatest *cube* in the first left-hand period,

and subract it therefrom, put the *root* in the quotient, and bring down the figures in the next period to the remainder for a *resolvend.*

3rd. To find a *divisor*, square the quotient, and multiply it by 3. See how often it is contained in the resolvend, rejecting the units and tens, and put the answer in the quotient.

4th. To find the *subtrahend.*—1st. *Cube* the *last figure* in the *quotient.* 2nd. Multiply *all the figures* in the quotient *by* 3, except the last, and *that product* by the *square of the last.* 3rd. Multiply the *divisor* by the *last figure;* adding their products together, gives the *subtrahend,* which subtract from the resolvend. To the remainder bring down the next period, and proceed as before.

Roots	1	2	3	4	5	6	7	8	9
Cubes	1	8	27	64	125	216	343	512	729

EXAMPLES.

(1) What is the cube root of 12812904 ?

12812904 (234 *Ans.*
8 = *cube of* 2.
Square of 2 × 3 = 12 *divisor.*) 4812 *resolvend.*
27 = *cube of* 3.
54 = 2 × 3 × *by square of* 3, *i. e.* 9.
36 = *divisor* × *by* 3.
4167 *subtrahend.*

Square of 23 × 3 = *divisor* 1587) 645904 *resolvend.*
64 = *cube of* 4.
1104 = 23 × 3 × *by sq. of* 4, *i. e.* 16.
6348 = *divisor* × 4.
645904 *subtrahend.*

CASE II. *Another method of Extracting the Cube Root.**

RULE 1st. Find by trials the nearest cube to the given number, and call it the assumed cube.

2nd. Say, as *twice* the assumed cube added to the given number, is to twice the number, added to the assumed cube, so is the *root* of the assumed cube to the *root required,* nearly.

EXAMPLES.

(2) What is the cube root of 64484 ?

Here the nearest root that is a whole number is 40, the cube of which is 64000. Therefore,

* For a general and easy method of extracting the roots of all powers, see "Nicholson and Rowbotham's Algebra."

Assumed cube 64000 — 64484
2 — 2
128000 — 128968
Given number 64484 — 64000
Then say, As 192484 : 192968 :: 40
40
192484) ,718720 (40,1 + *Ans.*
769936
. .193600
192484
. .1116 &c.

(3) What is the cube root of 13824? *Ans.* 24.
(4) What is the cube root of 110592? *Ans.* 48.
(5) What is the cube root of 884736? *Ans.* 96.
(6) What is the cube root of 1860867? *Ans.* 123.
(7) What is the cube root of 14886936? *Ans.* 246.
(8) What is the cube root of 8120601000? *Ans.* 2010.
(9) What is the cube root of 64964808000? *Ans.* 4020.

When the given number consists of a whole number *and decimals together*, make the decimals consist of either 3, 6, 9, &c. places, by *adding* ciphers thereto, if needful.

(10) What is the cube root of 7612,812161? *Ans.* 19,67+
(11) What is the cube root of 61218,00121? *Ans.* 39,41+
(12) What is the cube root of 7121,1021698? *Ans.* 19,238+

CASE III. *To extract the Cube Root of a Vulgar Fraction.*

Rule 1st. Reduce the fraction to its lowest terms; then extract the cube roots of its *numerator* and *denominator*, for a *new* numerator and denominator.

2nd. But if the fraction be a *surd*, reduce it to a *decimal*, and then extract the root from it.

Examples.

(13) What is the cube root of $\frac{343}{1331}$? *Ans.* $\frac{2}{3}$.
Here $\frac{343}{1331} = \frac{8}{27}$ *the cube of which is* $\frac{2}{3}$.
(14) What is the cube root of $\frac{1728}{4096}$? *Ans.* $\frac{3}{4}$.
(15) What is the cube root of $\frac{64}{8000}$? *Ans.* $\frac{4}{20}$.

SURDS.

(16) What is the cube root of $\frac{4}{9}$? *Ans.* ,763+
Here $\frac{4}{9} = ,444444444$ *the cube root of which is* ,763+
(17) What is the cube root of $\frac{6}{7}$? *Ans.* ,949+
(18) What is the cube root of $\frac{1}{3}$? *Ans.* ,693+

CASE IV. *To extract the Cube Root of a Mixed Number.*

RULE 1st. Reduce the *fractional part* to its *lowest terms*, and then the *mixed number* to an *improper fraction;* then extract the cube roots of the *numerator* and *denominator* for a *new* numerator and denominator.

2nd. But if the mixed number be a *surd*, reduce the fractional part to a *decimal, annex* it to the *whole number* and extract the root from it.

EXAMPLES.

(19) What is the cube root of $578\frac{19}{27}$? *Ans.* $8\frac{1}{3}$.

$578\frac{19}{27} = \frac{15625}{27}$ *the cube root of which is* $\frac{25}{3} = 8\frac{1}{3}$.

(20) What is the cube root of $42\frac{3}{4}$? *Ans.* $3\frac{1}{2}$.

(21) What is the cube root of $5\frac{104}{125}$ *Ans.* $1\frac{4}{5}$.

SURDS.

(22) What is the cube root of $8\frac{3}{12}$? *Ans.* 2,013+

$8\frac{3}{12} = 8\frac{1}{6} = 8{,}166666666$ *the cube root of which is* 2,013+

(23) What is the cube root of $7\frac{3}{8}$? *Ans.* 1,966+

(24) What is the cube root of $9\frac{3}{8}$? *Ans.* 2,13+

CASE V. *Between two numbers given, to find two Mean Proportionals.*

RULE. *Divide* the *greater* extreme by the *less*, and the cube root of the quotient, *multiplied* by the *less extreme*, gives the *less mean.* Multiply the *said cube* root by the *less mean*, and the *product* will be the *greater mean* proportional.

EXAMPLES.

(25) Find two mean proportionals between 8 and 512.

8) 512 (64 *the cube root of which is* 4.

64 — then 4 × 8 = 32 *the less mean.* and 4 × 32 = 128 *the greater mean.* } *Ans.*

The truth of which may be proved thus:—

As 8, the less extreme : 32, the less mean :: 128, the greater mean : 512 the greater extreme.

(26) What are the two mean proportionals between 7 and 189? *Ans.* 21 *and* 63.

(27) Find two geometric means between 5 and 1715? *Ans.* 35 *and* 245.

CASE VI. *To find the side of a Cube that shall be equal in solidity to any given solid.*

RULE. The *cube root* of the *solid content* of the given body will be the *side* of the cube required.

(28) The solid content of a given cylinder is 1860867 inches; required the size of a cube that is equal in area thereto? *Ans.* 123.

PROMISCUOUS QUESTIONS.

(29) If a cubical piece of stone contains 46656 solid feet, what is the superficial content of one of its sides? *Ans.* 36.

(30) If a cubical piece of timber be 36 inches long, 36 inches broad, and 36 inches deep, how many cubical inches does it contain? *Ans.* 46656.

(31) How many solid feet of earth must be dug out, to form a cellar 16 feet in length, breadth, and depth? *Ans* 4096.

(32) The content of a globe is 3375 inches, what is the side of a cube of equal dimensions? *Ans.* 15 *inches.*

(33) There is a cube whose side is 4 feet: I demand the side of another cube whose solid content is *treble* the former?

Here 4 cubed is 64; which *trebled* = 192; the cube *root* of which is 5,76 *feet* + *Ans.* or rather more than 5 *feet* 9 *inches.*

EXTRACTION OF THE BIQUADRATE ROOT.

RULE. First extract the *square root* of the given number; then extract the square root *of that square root* for the biquadrate root.

EXAMPLES.

(1) What is the biquadrate root of 16777216? *Ans.* 64.

First, 16777216 (4096 *square root.*

16

809) ..7772

7281

8186) 49116

49116

Then, 4096 (64 *Ans.*

36

124) .496

496

...

Ans. 64 *the biquadrate root.*

(2) What is the biquadrate root of 5308416? *Ans.* 48.

(3) What is the biquadrate root of 84934656? *Ans.* 96.

TO EXTRACT THE ROOTS OF ALL POWERS.

A general Rule, given by Wm. Mountaine, Esq., F.R.S.

RULE 1st. Prepare the given number for extraction, by pointing off from the *unit's place*, as the *root required* directs.

2. Find the *first figure* of the root by trial, and *subtract* the power from the given number.

3. To the remainder bring down the *first figure* in the next period, and call it the *dividend.*

4. Involve the root to the next inferior power to that which is given; and multiply it by the index of the given power for a *divisor*.

5. Find a *quotient* figure by *common division*, and *annex it to the root*.

6. Involve the *whole root* into the *given power* for a subtrahend; and *subtract it* from as many points of the given power as are brought down.

7. To the remainder bring down the *first figure* of the next period, for a *new dividend*.

8. Find a *new divisor*, *as before*, and proceed in like manner till the whole is finished.

EXAMPLE.

What is the cube root of 115501303?

115501303 (487 *the root.* *Ans.*
64 = 4^3
$4^2 \times 3 = 48$) 515 *dividend.*
48^3 = 110592 *subtrahend.*
48^2 3 = 6912) 49093 *dividend.*
487^3 = 1155010303 *subtrahend.*

DUODECIMALS.

DUODECIMALS, or *Cross Multiplication*, is a rule much used by workmen and artificers, for finding the contents of their works.*

12 fourths (″″)	1 third	‴
12 thirds.....	1 second	″
12 seconds	1 inch or prime	′
12 inches or primes	1 foot	(*ft.*)

RULE 1st. *Under* the *multiplicand* write the *corresponding denominations* of the *multiplier*; that is, set *feet* under *feet*, *inches* under *inches*, &c.

* It is called *Duodecimals*, because the feet, inches, &c., are divided into *twelve parts:* and *Cross Multiplication*, because the factors were *formerly* multiplied *cross ways*.

Note—Feet multiplied by feet give feet.
Feet multiplied by inches give inches.
Feet multiplied by seconds give seconds.
Inches multiplied by inches give seconds.
Inches multiplied by seconds give thirds.
Seconds multiplied by seconds give fourths.

2nd. Multiply *each term* in the *multiplicand*, beginning at the *lowest* by the *feet* in the *multiplier*, write each product under its respective term; observing to *carry one for every* 12, from each *lower* denomination to its *next superior*.

3rd. Multiply in the same manner with the *inches:* and set the product of each term *one remove* farther to the *right-hand*, and carry one for every 12 as before.

4th. Work in like manner with the *seconds*, &c.. and the *sum of the lines* will be the product required.

EXAMPLES.

(1) Multiply 8 feet 9 inches by 4 ft. 6 inches.

ft.	*in.*		
8	9		
4	6		
35	0		= × 4 *ft.*
4	4	6″	= × 6 *in.*
39	4	6	*Ans.*

(2) Multiply 7 ft. 8 in. 9″ by 3 ft. 5 in. 6″.

7	8	9		
3	5	6		
23	2	3		= × by 3 *ft.*
3	2	7	9	= × by 5 *in.*
	3	10	4	6‴ = × by 6″.
26	8	9	1	6 *Ans.*

		feet	*in.*			*feet*	*in.*			*feet*	*in.*	″		
(3)	Mult.	8	6		by	5	9		*Ans.*	48	10	6		
(4)	Mult.	6	4		by	6	2		...	39	0	8		
(5)	Mult.	7	5		by	3	6		...	25	11	6		
(6)	Mult.	12	3		by	7	6		...	91	10	6		
(7)	Mult.	14	6		by	9	3		...	134	1	6		
(8)	Mult.	3	4	6	by	2	4	3	...	7	11	4	1‴	6⁗
(9)	Mult.	4	6	9	by	3	6	4	...	16	1	1	9	
(10)	Mult.	5	9	3	by	4	3	8	...	24	10	1	11	
(11)	Mult.	7	8	10	by	6	9	6	...	52	6	5	11	
(12)	Mult.	9	0	11	by	1	2	3	...	10	9	4	0	9
(13)	Mult.	18	2	0	by	4	3	6	...	77	11	7		
(14)	Mult.	20	3	9	by	12	2	3	...	247	6	8	5	3

N.B. The 1st question may be *proved* by the *five* following methods.

By Cross Mult.

ft.	*in.*	
8	9	
4	6	
32	0	0 = 4 × 8
3	0	0 = 4 × 9
4	0	0 = 8 × 6
	4	6 = 9 × 6
39	4	6

By Practice.

	ft.	*in.*	
½	8	9	
		4½	
35			
	4	4	6
39	4	6	

By Vulgar Fractions.

$8\frac{9}{12} = 8\frac{3}{4} = \frac{35}{4}$

$4\frac{6}{12} = 4\frac{2}{4} = \frac{18}{4}$

$\frac{35}{4} \times \frac{18}{4} = \frac{630}{16} =$

39 *ft.* 4 *in.* 6″

By Decimals.

8,75
4,5
ft. 32,375
12
in 4,500
12
″6,0

And lastly by *whole numbers*, thus 8 *ft.* 9 *in.* = 105 *in.* and 4 *ft.* 6 *in.* = 54 *in.* Therefore 105 × 54 = 5670 *square inches;* which, divided by 144, gives 39 *ft.* 4 *in.* 6″.

ARTIFICER'S work is computed by different measures, viz.

1st. Glazing and mason's flat work by the *foot.*

2nd. Painting, plastering, paving, &c., by the *yard.*

3rd. Partitioning, flooring, roofing, tiling, &c., by the *square of* 100 *feet.*

4th. Brickwork, &c., by the *rod,* or $16\frac{1}{2}$ feet, the square of which is $272\frac{1}{4}$.

I. *Glazing, Mason's Work, &c., by the Foot.*

EXAMPLES.

(15) What will be the expense of glass for a window that measures in the clear 9 feet 8 in. in height, and 4 ft. 3 in. in width, at 2*s.* 3*d.* per foot. *Ans.* 4*l.* 12*s.* $5\frac{1}{4}d.$

9	8		
4	3		
83	8		
2	5	0	
41	1	0	

2*s.*	$\frac{1}{12}$	41 *feet.*
3*d.*	$\frac{1}{8}$	4 2
		10 3
		$2\frac{1}{4}$ = *for* 1 *inch.*
		£4 12 $5\frac{1}{4}$

(16) What must I give for 3 marble slabs, measuring in the whole 12 feet 9 inches in length, and 1 foot 3 inches in breadth, at 7*s.* 6*d.* per foot? *Ans.* 5*l.* 19*s.* $6\frac{1}{4}d.$—,5.

(17) If a pane of glass be 2 ft. 6 in. long, and 1 ft. 9 in. broad, how many feet does it contain? *Ans.* 4*ft.* 4*in.* 6″.

II. *Painting, Plastering, Paving, &c., by the Yard.*

RULE. Divide the square feet by 9, for the answer in square yards.

(18) What will the ceiling of a room come to, that measures 30 ft. 9 in. in length, and 20 ft. 6 in. in breadth, at 1*s.* 3*d.* per square yard?

ft.	*in.*		
30	9		
20	6		
615	0		
15	4	6	
630	4	6	

1*s.* 3*d.* = $\frac{1}{16}$ | 9 | 630

70 *yds.*

4 7 6

0 0 $0\frac{1}{2}$ for the 4 *in.* 6″

£4 7 $6\frac{1}{2}$ *Ans.*

Then for the value of 4 *in.* 6″

4 *in.* 6″ = $\frac{1}{2\frac{1}{4}}$ of a sq. yd.

and 15*d.* ÷ 24 = $\frac{1}{2}$.

(19) A room is to be painted, that measures 88 ft. 6 in. about, and 10 ft. 9 in. in height; what will it come to at 3*s.* 4*d.* per yard? *Ans.* 17*l.* 12*s.* $4\frac{1}{4}d.$—,332.

(20) What will the paving of a court-yard come to at 1*s.* 3*d.* per ft. whose length is 120 ft. and width $65\frac{1}{2}$ ft. *A.* 491*l.* 5*s.*

(21) A piece of wainscoating round a room is 63 ft. 8 in. and height 3 ft. 9 in.; what will it come to, at 5*s.* 6*d.* per yard? *Ans.* 7*l.* 5*s.* $10\frac{3}{4}d.$—,333.

III. *Partitioning, Roofing, &c., by the square of* 100 *feet.*

(22) What will the tiling of a house cost at 27*s.* 9*d.* per square, each side of the roof being 40 feet by 15 ?

40		1,00) 12,00	
15	5*s.*	¼	12 *sq. of* 100 *feet.*
600 = *one side.*	2*s.* 6*d.*	½	3 0
2	3*s.*	1/10	1 10
1200 = *both sides.*			3
			£16 13 *Ans.*

(23) There is a range of houses, the whole length of whose roof is 324 ft. 6 in. and the whole breadth 32 ft. 9 in.; what will the whole come to at 26*s.* 8*d.* per square ?

Ans. 141*l.* 13*s.* 11½*d.*—4.

IV. *Bricklayer's Work, &c., by the rod of* 272¼ *feet.*

Bricklayers always value their work at the rate of a *brick and a half thick;* and if the wall be *more* or *less*, it must be *reduced to that thickness;* thus :—

RULE. Multiply the *area* by the *number of half bricks*, and divide by *three.*

(24) How many square rods are there in a wall 84½ fee long, 12 feet 6 inches in height, and 2½ bricks thick ?

ft.	*in.*					*rods.*
84	6	1056	3	272¼ = 272,25)	1760,41666 (	6,466 + *Ans.*
12	6		5 = 2½ *bricks*		163350	
1014	0	3)5281	3		126916	
42	3	1760	5 = 1760,41666 +		108900	
1056	3				180166, &c.	

(25) If the area of a wall be 14085 feet, and the thickness one brick and a half, how many rods does it contain ?

Ans. 51,73 *rods, or* 51¾ *nearly.*

---

(26) A brick building is 50 feet long and 25 feet wide (consequently measuring 150 feet round); the cellars and foundation are 15 feet deep and 2½ bricks thick; the ground floor 12 feet in height and 2 bricks thick; the chamber floor 10 feet in height and a brick and ½ thick; and the attic floor 9 feet in height, and one brick thick: the number of square rods of brickwork is required ?

First, the cellars, &c.
150 × 15 = 2250
5 = ½ *bricks.*
3) 11250
3750

2nd, the ground floor.
150 × 12 = 1800
4 = 2 *bricks*
3) 7200
2400

3rd, chamber floor 150 × 10 = 1500 at a brick and ½, the standard thickness.

4th attic floor,
150 × 9 = 1350
2 = 1 *brick.*
3) 2700
900

Then 3750 + 2400 + 1500 + 900 = 8550 feet of brickwork, which being divided by 272¼, or by 272,25 gives 31,4 + *rods. Ans.*

APPENDIX.

MISCELLANEOUS QUESTIONS.

(1) Write down in figures, one hundred billions, one hundred millions, one hundred thousand, one hundred, and one.

(2) Write down in figures, nine hundred and eighty-seven billions, six hundred and fifty-four millions, three hundred and twenty-one thousand, one hundred and twenty-three.

(3) Write down the year 1857 in the Roman method of notation by letters.

(4) If the distance from London to Jamaica be 1330 leagues, how many miles per day will a ship go that makes the voyage in 50 days?

(5) In a printed book that shall contain 200 pages, each page 45 lines, and in each line 43 letters, how many letters will it take to compose the whole book?

(6) What number is that which, multiplied by 1234, will make the product 1522756?

(7) What number added to the cube of 25, will make the sum equal to the square of 125?

(8) If Moses was born when Aaron was 15 years old, how old would Aaron be when Moses was 80?

(9) A horse in his harness is worth 45*l.* and out of it 35 guineas; how much is the price of the harness less than that of the horse?

(10) The sum of two numbers is 560, the least of them is 144; what is their product and the square of their difference?

(11) There are two numbers, the greater of them is 14 times 40, and their difference is 19 times 9; their sum and product are required?

(12) My purse and money, said Dick, are worth a mark, but the money is worth seven times the purse; what did the purse contain?

(13) A captain and 160 sailors took a prize worth 1360*l*, of which the captain had $\frac{1}{5}$ for his share, and the rest was equally divided among the sailors; what was each man's share?

(14) How many minutes have elapsed since the birth of Christ to the year 1857 inclusive, allowing the year to consist of 365 days 5 hours 49 minutes?

(15) Divide 100 shillings between A, B, and C, so that A may have 5*s.* less than B, and C 5*s.* more than B?

(16) How long would it take to count one hundred millions of money, at the rate of 100*l.* per minute?

(17) From January 1st, 1800, to July 1st, 1856, how many days, reckoning the year to consist of $365\frac{1}{4}$ days?

(18) Bought a pipe of wine (containing 136 gallons) for 80*l.*, but in the conveyance it leaked 18 gallons; what shall I gain or lose by the pipe, if I sell the remainder at 12*s.* 6*d.* per gallon?

(19) A can do a piece of work in 14 days, B alone in 12 days; if both work together, in what time will it be finished?

(20) Supposing 32 bricks will pave a yard square, how many will it take to pave a passage 25 feet long and 7 feet wide?

(21) If the cock of a large cistern will empty it in $29\frac{3}{4}$ minutes, how many such cocks will empty it in 4 minutes and $\frac{1}{4}$?

(22) If 12 ells of cloth $\frac{3}{4}$ wide cost *5l.* *3s.* *6d.*, what will 36 ells of the same stuff cost if 5 qrs. wide?

(23) A wall that is to be built to the height of 21 feet, was raised 7 feet by 6 men in 8 days, how many men must be employed to finish the wall in 4 days at the same rate of working?

(24) If I pay 1*s.* for 7 lbs. of bread, when corn is worth 6*s.* per bushel, what must I pay for $10\frac{1}{2}$ lbs. when corn is 4*s.* the bushel?

(25) If a person spends as much in four months as he gains in three, how much can he lay by annually with an income of 150*l.* a year?

(26) What quantity of water must I add to a pipe of wine (126 galls.) value 70*l.*, to reduce it to 9*s.* per gal.?

(27) A company at a tavern spent 7*l.* 4*s.*, and each of them had as many shillings to pay as there were persons in company; how many persons were there?

(28) Sold goods for 500*l.* to be paid for thus: 100*l.* down, and the rest at two four months (that is $\frac{1}{2}$ at four months, and $\frac{1}{2}$ at 8 months), what is their present worth, discounting at 5*l.* per cent.?

(29) A factor takes 1*l.* per cent. for his commission; what must he receive for 743*l.* 17*s.* 3*d.*?

(30) What is the amount of 1000*l.* for $5\frac{1}{2}$ years, at $4\frac{3}{4}$ per cent. simple interest?

(31) Two men depart from one place, and both go the same road; the one travels 15 miles a day, and the other 22 miles; how far are they distant at the fortnight's end, both resting on Sundays?

(32) The 4 sides of a room measure 150 feet in length, and the height is 12 feet; how much paper 2 feet 3 inches wide will cover it, and what is the value at 8*d.* per yard?

(33) A man kept a one-horse chaise, value 50*l.* with two horses of unequal value; when the younger horse was put to the chaise, their value was double that of the older horse, and when the older was in, their value was treble that of the younger; what was the value of each?

(34) A servant at market purchased for half a guinea, an equal number of fowls at 9*d.* each, rabbits at 6*d.*, pigeons at 4*d.*, and larks at 2*d.* each; how many of each had he?

(35) If by selling goods at 2*s.* 9*d.* per lb. I clear 50*l.* per cent., what do I clear per cent. by selling them at 3*s.* per lb.?

(36) Bought 127 pieces of cloth, for which I delivered 3589 ells of Holland, at 7*s.* 11*d.* per Eng. ell; what did the cloth cost per piece?

(37) Divide 1000*l.* among three men, so that for every 3*l.* which A had, B shall have 4*l.* and C 5*l.*; how much must each receive?

(38) Two merchants enter into partnership for 18 months: A puts into stock at first 1000*l.* and at the end of 12 months takes out 200*l.*; B puts in at first 700*l.* and at the end of nine months puts in 300*l.* more; at the expiration of the time they find they have gained 750*l.*, what is each man's share?

(39) Two merchants trade in company; the first advanced 640*l.* and took $\frac{5}{8}$ of the gain; how much did the other advance?

(40) What is $\frac{1}{4}$ the $\frac{1}{8}$ of?

(41) What part of 4*d.* is a third part of 3*d.*

(42) What number is that of which 12 is $\frac{3}{4}$ of it?

(43) What must be paid for $\frac{3}{16}$ of a ship that is valued at 2500*l.*?

(44) Shipped for Jamaica 550 pair of stockings at 11*s.* 6*d.* per pair, 460 yards of stuff at 14*d.* per yard; in return for which I received 46 cwt. 3 qrs. of sugar at 24*s.* 6*d.* per cwt., and 1570 lbs. of indigo at 2*s.* 4*d.* per lb.; what remains due to me of my adventure?

(45) If a tower which was originally 384 feet high, had, through a convulsion of nature, a sixth part at the base surrounded with earth, and an eighth part above with water, how much in height is visible?

(46) If I lend my friend 800*l.* for 9 months at 5 per cent., what sum at 4 per cent. for $7\frac{1}{2}$ months, should he lend me, to requite my kindness?

(47) From a marble slab 20 inches broad, what distance from the end must I cut a piece that shall measure 4 square feet?

(48) A person bought 150 eggs at the rate of 3 for a penny, and 150 at the rate of 5 for a penny; what does he get or lose by selling them all out at 8 for 2*d.*?

(49) What will the tiling of a stable cost at 15*s.* 6*d.* per square, the length 45 feet 6 inches, and the breadth of the building 30 feet, the eave-boards projecting 16 inches on each side?

(50) How many ducats must I deliver at Venice, to receive at London 178*l.* 2*s.* exchange at 4*s.* 4*d.* per ducat?

(51) A garrison of 1000 men can allow each man 14 ounces a day for 12 weeks; now suppose them reduced to 750 men, how much must each man have per day to last them 18 weeks?

(52) If the third of 6 were 3, what would the fourth of 60 be?

(53) If a regiment of 1000 soldiers consume 256 quarters of wheat in 148 days, how many soldiers will consume 64 quarters in 74 days?

(54) Suppose a person who possessed a $\frac{5}{8}$ share of a copper mine, to sell $\frac{3}{4}$ of his share for 1500*l.*, what was the value of his $\frac{3}{8}$ share at that rate, and also the worth of the whole mine?

(55) A hundred hurdles may be so placed as to enclose 200 sheep, and with 4 hurdles more, the fold may be made to hold 600; how is this to be done?

(56) A garden wall 1000 feet in circuit, was raised 12 feet above, and sunk 4 feet below the surface; the 4 feet below 2 bricks thick, the first 6 above a brick and a half, and the upper 6 one brick thick, how many rods of brickwork did the wall contain?

(57) If the distance between the earth and sun be 95 millions of miles, and between the earth and moon 240 thousand miles, how far are the sun and moon asunder in an eclipse of the sun? and how far also is an eclipse of the moon?

*** *Many other Miscellaneous Questions, somewhat more difficult of solution, are inserted at the end of the Key, for the exercise of the senior classes.*

Numeration Table.

Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thous.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.
9	8	7	6	5	4	3	2	1

Pence Table.

d.	*s.*	*d.*	*d.*	*s.*	*d.*
20 are	1	8	90 are	7	6
24 ...	2	0	96 ...	8	0
30 ...	2	6	100 ...	8	4
36 ...	3	0	108 ...	9	0
40 ...	3	4	110 ...	9	2
48 ...	4	0	120 ...10		0
50 ...	4	2	130 ...10		10
60 ...	5	0	132 ...11		0
70 ...	5	10	140 ...11		8
72 ...	6	0	144 ...12		0
80 ...	6	8	150 ...12		6
84 ...	7	0	156 ...13		0

Shilling Table.

s.	£	*d.*
20 are	1	0
30 ...	1	10
40 ...	2	0
50 ...	2	10
60 ...	3	0
70 ...	3	10
80 ...	4	0
90 ...	4	10
100 ...	5	0
110 ...	5	10
120 ...	6	0

Farth. Tab.

f.	*s.*	*d.*
4 are	0	1
8 ...	0	2
12 ...	0	3
16 ...	0	4
20 ...	0	5
24 ...	0	6
28 ...	0	7
32 ...	0	8
36 ...	0	9
40 ...	0	10
44 ...	0	11
48 ...	1	0

Multiplication Table.

twice	5 times	8 times	11 times
2 are 4	2 are10	2 are 16	2 are 22
3 ... 6	3 ...15	3 .. 24	3 ... 33
4 ... 8	4 ...20	4 ... 32	4 ... 44
5 ...10	5 ...25	5 ... 40	5 ... 55
6 .. 12	6 ...30	6 ... 48	6 ... 66
7 ...14	7 ...35	7 ... 56	7 ... 77
8 ...16	8 ...40	8 ... 64	8 ... 88
9 ...18	9 ...45	9 ... 72	9 ... 99
10 ...20	10 ...50	10 ... 80	10 ... 110
11 ...22	11 ...55	11 ... 88	11 ... 121
12 ...24	12 ...60	12 ... 96	12 ... 132

3 times	6 times	9 times	12 times
2 are 6	2 are12	2 are 18	2 are 24
3 ... 9	3 ...18	3 ... 27	3 ... 36
4 ...12	4 ...24	4 ... 36	4 ... 48
5 ...15	5 ...30	5 .. 45	5 ... 60
6 ...18	6 ...36	6 ... 54	6 ... 72
7 ...21	7 ...42	7 ... 63	7 ... 84
8 ...24	8 ...48	8 ... 72	8 ... 96
9 ...27	9 ...54	9 ... 81	9 ... 108
10 ...30	10 ...60	10 ... 90	10 ... 120
11 ...33	11 ...66	11 ... 99	11 ... 132
12 ...36	12 ...72	12 ...108	12 ... 144

4 times	7 times	10 times	*Characters.*
2 are 8	2 are14	2 are 20	= equal.
3 ...12	3 ...21	3 ... 30	— less.
4 ...16	4 ...28	4 ... 40	+ plus.
5 ...20	5 ...35	5 ... 50	× multiply
6 ...24	6 ...42	6 .. 60	÷ divide.
7 ...28	7 ...49	7 ... 70	: is to.
8 ...32	8 ...56	8 ... 80	: : so is.
9 ...36	9 ...63	9 ... 90	: to.
10 ...40	10 ...70	10 ...100	¼ quarter.
11 ...44	11 ...77	11 ...110	½ half.
12 ...48	12 ...84	12 ...120	¾ 3 quarters

Addition Table.

1 and	2 and	3 and	4 and	5 and	6 and	7 and	8 and	9 and	10 and
1 are2	1 are3	1 are4	1 are5	1 are6	1 are7	1 are8	1 are9	1 are10	1 are11
2... 3	2... 4	2... 5	2... 6	2... 7	2... 8	2.. 9	2...10	2 ...11	2 ..12
3... 4	3... 5	3... 6	3... 7	3... 8	3... 9	3...10	3...11	3 ...12	3 ...13
4... 5	4... 6	4... 7	4... 8	4... 9	4...10	4...11	4...12	4 ...13	4 ...14
5... 6	5... 7	5... 8	5... 9	5...10	5...11	5...12	5...13	5 ...14	5 ...15
6... 7	6... 8	6... 9	6...10	6...11	6...12	6 ..13	6...14	6 ...15	6 ...16
7... 8	7... 9	7...10	7...11	7...12	7...13	7...14	7...15	7 ...16	7 ...17
8... 9	8...10	8...11	8...12	8...13	8...14	8...15	8...16	8 ...17	8 ...18
9...10	9...11	9...12	9...13	9...14	9...15	9...16	9...17	9 ...18	9 ...19

Troy Weight.

Gold, Silver, and Jewels, are weighed by this Table.

24 Grains.....1 Pennyweight.
20 Pennyweights...1 Ounce.
12 Ounces .....1 Pound.

Avoirdupois Weight.

Bread, Groceries, with all coarse Articles, are weighed by this Table.

16 Drams .....1 Ounce.
16 Ounces .....1 Pound.
28 Pounds .....1 Quarter.
4 Quarters.....1 Hundred wt.
20 Hundred wt. ...1 Ton.

Apothecaries' Weight.

Medicines are mixed by this Table.

20 Grains.. .....1 Scruple ℈
3 Scruples .....1 Dram ʒ
8 Drams.....1 Ounce ℥
12 Ounces .....1 Pound ℔

Cloth Measure.

2¼ Inches .....1 Nail.
4 Nails .....1 Quarter of a Yd.
4 Quarters .....1 Yard.
5 Quarters .....1 Ell English.

Wine Measure.

All Liquors, except Ale and Beer, were measured by this Table.

2 Pints.....1 Quart.
4 Quarts .....1 Gallon.
10 Gallons.....1 Anker.
18 Gallons .....1 Rundlet.
42 Gallons .....1 Tierce.
63 Gallons.....1 Hogshead.
84 Gallons ..... 1 Puncheon.
2 Hogsheads... .....1 Pipe.
2 Pipes .....1 Ton.

Ale and Beer Measure.

2 Pints.....1 Quart.
4 Quarts .....1 Gallon.
9 Gallons.....1 Firkin.
2 Firkins.....1 Kilderkin.
2 Kilderkins.....1 Barrel.
54 Gallons.....1 Hogshead.
2 Hogsheads .....1 Butt.

Dry Measure.

Thus were measured all dry goods

2 Pints.....1 Quart.
2 Quarts.....1 Pottle.
2 Pottles ..... 1 Gallon.
2 Galls. or 8 Quarts1 Peck.
4 Pecks .....1 Bushel.
8 Bushels .....1 Quarter.
36 Bushels .....1 Chaldron of Coals.

N.B. Of other articles, 32 Bushels make a Chaldron.

Long Measure.

3 Barleycorns ...1 Inch.
4 Inches .....1 Hand.
12 Inches .....1 Foot.
3 Feet .....1 Yard.
6 Feet.....1 Fathom.
5½ Yards.....1 Rod or Pole.
40 Poles .....1 Furlong.
8 Furlongs.....1 Mile.
3 Miles... .....1 League.
69½ Miles.....1 Degree on the Equator.

N.B.—A Hand is 4 Inches, and a Fathom 2 Yards.

Square Measure.

144 Square Inches 1 Square Foot.
9 Square Feet ...1 Square Yard.
30¼ Square Yards 1 Square Pole.
40 Square Poles...1 Square Rood.
4 Square Roods ..1 Square Acre.
640 Square Acres ..1 Square Mile.

Solid or Cubic Measure.

1728 Cubic Inches 1 Cubic Foot.
27 Cubic Feet ...1 Cubic Yard.
231 Cubic Inches 1 Gall. of Wine.
282 Cubic Inches 1 Gall. of Ale.
2150 Cubic Inches 1 Bush. of Malt.

Time.

60 Seconds..... 1 Minute.
60 Minutes .. .. 1 Hour.
24 Hours ..... 1 Day.
7 Days..... 1 Week.
4 Weeks..... 1 Month.
12 Calendar Months, or 365 Days and 6 Hours.....1 Year.

Thirty days hath September
April, June, and November;
February hath twenty-eight alone,
And all the rest have thirty-one,
Except in Leap-year, at which time
February's days are twenty-nine.

"*An Act for establishing Uniformity of Weights and Measures,*" passed in June, 1824, and its operations commenced Jan. 1, 1826.

By this Act the distinction between the *Ale, Wine,* and *Corn* gallon is abolished, and an *Imperial gallon* is established, as well for liquids as for dry goods, not measured by heaped measure; this gallon must contain precisely "10 pounds, avoirdupois weight, of distilled water, weighed in air, at the temperature of 63° of Fahrenheit's thermometer, the barometer standing at 30 inches." The Act prescribes the scientific modes of determining the principal measures, in case they should be lost. By this Act—

The pound *Troy* contains 5760 grains.

The pound *Avoirdupois* contains 7000 grains.

The *Imperial Gallon* contains 277·274 cubic inches.

The *Corn Bushel*, eight times the above.

With respect, therefore, to *Ale, Wine,* and *Corn,* it will be useful to possess a

TABLE OF FACTORS,

For converting Old Measures into New, and the contrary.

	By Decimals.			Vulgar Fractions, nearly.		
	Corn Measure.	Wine Measure.	Ale Measure.	Corn Measure.	Wine Measure.	Ale Measure.
To convert Old Measures to New	·96943	·83311	·101704	$\frac{31}{32}$	$\frac{5}{6}$	$\frac{60}{59}$
To convert New Measures to Old	1·03153	1·20032	·98324	$\frac{32}{31}$	$\frac{6}{5}$	$\frac{59}{60}$

N.B.—For reducing the *Prices*, these numbers must be all reversed.

The subjoined Tables will serve to facilitate computations:—

Comparison between the Old WINE Measures and those of the New Imperial Standard.

Old Wine Measures.	New Standard. gls.	qts.	pts.	gills & 100 parts.
A Gill is equal to.....	0	0	0	0—83
Half Pint	0	0	0	1—66
Pint	0	0	0	3—33
Quart	0	0	1	2—66
1 Gallon.....	0	3	0	2—65
10 Do. or Anker	8	1	0	2—58
18 Do. or Rundlet	14	3	1	3—87
42 Do. or Tierce	34	3	1	3—70
63 Do. or Hogshead	52	1	1	3—55
84 Do. or Puncheon....	69	3	1	3—10
126 Do. or Pipe 104	3	1	3—11	
252 Do. or Tun.....209	3	1	2—22	

The New Standards being about 1-5th larger than the Old Wine Measures, will occasion an advance of about twopence halfpenny in every shilling on the old price.

Comparison between the Old BEER Measures and those of the New Imperial Standard.

Old Beer Measure.	New Standard. gls.	qts.	pts.	gills & 100 parts.
A Gill is equal to	0	0	0	1— 2
Half Pint.....	0	0	0	2— 3
Pint	0	0	1	0— 7
Quart.....	0	1	0	0—13
1 Gallon	1	0	0	0—54
9 Do. or Firkin	9	0	1	0—91
18 Do. or Kilderkin ...	18	1	0	1—82
36 Do. or Barrel.....	36	2	0	3—64
54 Do. or Hogshead ...	54	3	1	1—45
72 Do. or Puncheon ...	73	0	1	3—27
108 Do. or Butt 109	3	0	2—91	

The New Standards being only about 1/60th part more than the Old Beer Measures, will scarcely affect the retail prices.

Comparison between the old DRY Measures and those of the new Imperial Standard.

Old Dry Measure.	New Standard. bu.	pks.	gls.	qts.	pts.	gills & 100parts
A Gill is equal to	0	0	0	0	0	0—97
Half Pint	0	0	0	0	0	1—94
Pint	0	0	0	0	0	3—88
Quart	0	0	0	0	1	3—75
Gallon	0	0	0	3	1	3— 2
2 Galls. or 1 Peck	0	0	1	3	1	2— 4
1 Bushel	0	3	1	3	0	0—17
2 Do. or Strike ...	1	3	1	2	0	0—35
4 Do. or Coomb ...	3	3	1	0	0	0—70

Old Dry Measure.	New Standard. bu.	pks.	gls.	qts.	pts.	gills & 100parts
8 Do. or Quarter	7	3	0	0	0	1—41
32 Do. or Chaldron	31	0	0	0	1	1—64
36 Do. or Chaldron of Coals	34	3	1	0	1	2—34
40 Do. or Wey ...	38	3	0	0	1	3— 6
80 Do. or Last ...	77	2	0	1	1	2—18

The New Dry Measures being about 1-32nd part larger than the Old, may naturally be expected to occasion an advance of about 3 per cent. upon the old prices.

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