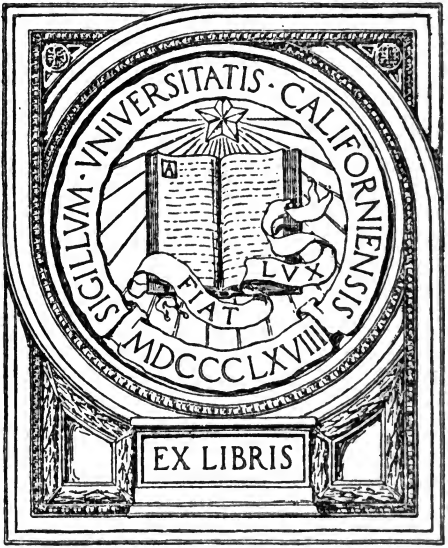

Florian Cajori

From Charles Tweedie,
Edinburgh, Scotland. James
Gray died in 1810, but his work
lived all through the 19th century, be
in use in every parish school in
Scotland about 1860. as remembered
with enthusiasm by any old man
of 70 and over, to whom I have men
tioned it. It is still in use in out
of the way corners; and so might I recal
from Mr. Thin of Oliver & Boyd, the
publishers, two copies fresh from
Tweeddale Court, of the 101st. edition
One of these I am ~~sending~~ taking
the liberty of sending you as a
curiosity. Thin tells me the firm
must have sold 500,000 copies of
it. I think this beats Cocker. Gray
was a schoolmaster in Peebles
& gave the elementary instruction
to Wm & Rob. Chambers, the
founders of the well known

# GRAY'S ARITHMETIC.

publishing firm, but otherwise
next to nothing is known about
him. If I can arrange what I
have gathered about him in a
form for publication I hope to
send you a copy of my writing.
But I fear I shall not be able
to do much more serious work.

From Tweedie's letter, Dec. 14, 192

Florian Cajori

AN

# INTRODUCTION

TO

# ARITHMETIC.

By JAMES GRAY,
Late of Peebles and Dundee

WITH TABLES AND EXERCISES ON DECIMAL COINAGE AND THE METRIC SYSTEM.

**One Hundred and First Edition.**

EDINBURGH:
OLIVER AND BOYD, TWEEDDALE COURT.
LONDON: SIMPKIN, MARSHALL, HAMILTON, KENT, AND CO., LIM.

# CONTENTS.

## SIGNS USED IN ARITHMETIC.

$+$ Plus, the sign of Addition.
$-$ Minus, the sign of Subtraction.
$\infty$ The sign of the difference when it is not known which is the greater.
$\times$ The sign of Multiplication.
$\div$ The sign of Division.
$:\ ::\ :$ The sign of Proportion.
$\surd$ or $\surd^2$ The sign of the Square Root.
$\surd^3$ The sign of the Cube Root.
$\surd^4$ The sign of the Fourth Root.

---

## ARITHMETICAL TABLES.

### NUMERATION TABLE.

| *Old Style.* | C M Billions | X M Billions | M Billions | C Billions | X Billions | Billions | C M Millions | X M Millions | M Millions | C Millions | X Millions | Millions | C Thousands | X Thousands | Thousands | Hundreds | Tens | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 1 | 9, | 8 | 7 | 6. | 5 | 4 | 8, | 9 | 8 | 7. | 6 | 5 | 4, | 3 | 2 | 1 |

| *New Style.* | C Quadrillions | X Quadrillions | Quadrillions | C Trillions | X Trillions | Trillions | C Billions | X Billions | Billions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 1 | 9, | 8 | 7 | 6, | 5 | 4 | 8, | 9 | 8 | 7, | 6 | 5 | 4, | 3 | 2 | 1 |

## ADDITION TABLE.

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

## SUBTRACTION TABLE.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2 | – | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3 | – | – | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4 | – | – | – | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | – | – | – | – | 0 | 1 | 2 | 3 | 4 | 5 |
| 6 | – | – | – | – | – | 0 | 1 | 2 | 3 | 4 |
| 7 | – | – | – | – | – | – | 0 | 1 | 2 | 3 |
| 8 | – | – | – | – | – | – | – | 0 | 1 | 2 |
| 9 | – | – | – | – | – | – | – | – | 0 | 1 |
| 10 | – | – | – | – | – | – | – | – | – | 0 |

## MULTIPLICATION TABLE.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
| 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 |
| 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 |
| 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 |
| 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 | 108 |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 11 | 22 | 33 | 44 | 55 | 66 | 77 | 88 | 99 | 110 | 121 | 132 |
| 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 |

## DIVISION TABLE.

| 12 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 11 | 22 | 33 | 44 | 55 | 66 | 77 | 88 | 99 |
| 10 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 9 | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 |
| 8 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 |
| 7 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 |
| 6 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 |
| 5 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| 4 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| 3 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 |
| 2 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

## Pence Table.

| Pence | s. | d. | Pence | s. | d. | Pence | s. | d. | Pence | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 are | 1 | 0 | 48 are | 4 | 0 | 84 are | 7 | 0 | 120 are | 10 | 0 |
| 13 ,, | 1 | 1 | 49 ,, | 4 | 1 | 85 ,, | 7 | 1 | 121 ,, | 10 | 1 |
| 14 ,, | 1 | 2 | 50 ,, | 4 | 2 | 86 ,, | 7 | 2 | 122 ,, | 10 | 2 |
| 15 ,, | 1 | 3 | 51 ,, | 4 | 3 | 87 ,, | 7 | 3 | 123 ,, | 10 | 3 |
| 16 ,, | 1 | 4 | 52 ,, | 4 | 4 | 88 ,, | 7 | 4 | 124 ,, | 10 | 4 |
| 17 ,, | 1 | 5 | 53 ,, | 4 | 5 | 89 ,, | 7 | 5 | 125 ,, | 10 | 5 |
| 18 ,, | 1 | 6 | 54 ,, | 4 | 6 | 90 ,, | 7 | 6 | 126 ,, | 10 | 6 |
| 19 ,, | 1 | 7 | 55 ,, | 4 | 7 | 91 ,, | 7 | 7 | 127 ,, | 10 | 7 |
| 20 ,, | 1 | 8 | 56 ,, | 4 | 8 | 92 ,, | 7 | 8 | 128 ,, | 10 | 8 |
| 21 ,, | 1 | 9 | 57 ,, | 4 | 9 | 93 ,, | 7 | 9 | 129 ,, | 10 | 9 |
| 22 ,, | 1 | 10 | 58 ,, | 4 | 10 | 94 ,, | 7 | 10 | 130 ,, | 10 | 10 |
| 23 ,, | 1 | 11 | 59 ,, | 4 | 11 | 95 ,, | 7 | 11 | 131 ,, | 10 | 11 |

| Pence | s. | d. | Pence | s. | d. | Pence | s. | d. | Pence | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 are | 2 | 0 | 60 are | 5 | 0 | 96 are | 8 | 0 | 132 are | 11 | 0 |
| 25 ,, | 2 | 1 | 61 ,, | 5 | 1 | 97 ,, | 8 | 1 | 133 ,, | 11 | 1 |
| 26 ,, | 2 | 2 | 62 ,, | 5 | 2 | 98 ,, | 8 | 2 | 134 ,, | 11 | 2 |
| 27 ,, | 2 | 3 | 63 ,, | 5 | 3 | 99 ,, | 8 | 3 | 135 ,, | 11 | 3 |
| 28 ,, | 2 | 4 | 64 ,, | 5 | 4 | 100 ,, | 8 | 4 | 136 ,, | 11 | 4 |
| 29 ,, | 2 | 5 | 65 ,, | 5 | 5 | 101 ,, | 8 | 5 | 137 ,, | 11 | 5 |
| 30 ,, | 2 | 6 | 66 ,, | 5 | 6 | 102 ,, | 8 | 6 | 138 ,, | 11 | 6 |
| 31 ,, | 2 | 7 | 67 ,, | 5 | 7 | 103 ,, | 8 | 7 | 139 ,, | 11 | 7 |
| 32 ,, | 2 | 8 | 68 ,, | 5 | 8 | 104 ,, | 8 | 8 | 140 ,, | 11 | 8 |
| 33 ,, | 2 | 9 | 69 ,, | 5 | 9 | 105 ,, | 8 | 9 | 141 ,, | 11 | 9 |
| 34 ,, | 2 | 10 | 70 ,, | 5 | 10 | 106 ,, | 8 | 10 | 142 ,, | 11 | 10 |
| 35 ,, | 2 | 11 | 71 ,, | 5 | 11 | 107 ,, | 8 | 11 | 143 ,, | 11 | 11 |

| Pence | s. | d. | Pence | s. | d. | Pence | s. | d. | Pence | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 are | 3 | 0 | 72 are | 6 | 0 | 108 are | 9 | 0 | 144 are | 12 | 0 |
| 37 ,, | 3 | 1 | 73 ,, | 6 | 1 | 109 ,, | 9 | 1 | 145 ,, | 12 | 1 |
| 38 ,, | 3 | 2 | 74 ,, | 6 | 2 | 110 ,, | 9 | 2 | 150 ,, | 12 | 6 |
| 39 ,, | 3 | 3 | 75 ,, | 6 | 3 | 111 ,, | 9 | 3 | 156 ,, | 13 | 0 |
| 40 ,, | 3 | 4 | 76 ,, | 6 | 4 | 112 ,, | 9 | 4 | 168 ,, | 14 | 0 |
| 41 ,, | 3 | 5 | 77 ,, | 6 | 5 | 113 ,, | 9 | 5 | 180 ,, | 15 | 0 |
| 42 ,, | 3 | 6 | 78 ,, | 6 | 6 | 114 ,, | 9 | 6 | 192 ,, | 16 | 0 |
| 43 ,, | 3 | 7 | 79 ,, | 6 | 7 | 115 ,, | 9 | 7 | 200 ,, | 16 | 8 |
| 44 ,, | 3 | 8 | 80 ,, | 6 | 8 | 116 ,, | 9 | 8 | 204 ,, | 17 | 0 |
| 45 ,, | 3 | 9 | 81 ,, | 6 | 9 | 117 ,, | 9 | 9 | 216 ,, | 18 | 0 |
| 46 ,, | 3 | 10 | 82 ,, | 6 | 10 | 118 ,, | 9 | 10 | 228 ,, | 19 | 0 |
| 47 ,, | 3 | 11 | 83 ,, | 6 | 11 | 119 ,, | 9 | 11 | 240 ,, | 20 | 0 |

STERLING MONEY.

| *Marked* | | |
|---|---|---|
| f. | 4 Farthings | = 1 Penny, |
| d. | 12 Pence | = 1 Shilling, |
| s. | 20 Shillings | = 1 Pound. |

$\frac{1}{4}$ = 1 farthing; $\frac{1}{2}$ = 2 farthings; $\frac{3}{4}$ = 3 farthings; crown = 5s; guinea (not now coined) = 21s.

*Obsolete Coins.*—Noble = 6s. 8d.; mark sterling = 13s. 4d.; angel = 10s.; Jacobus = £1, 5s.; moidore = £1, 7s.; Joannes = £1, 16s.

TROY WEIGHT.

| *Marked* | | | | *Troy grains.* |
|---|---|---|---|---|
| gr. | 24 Grains | = 1 Penny-weight | | = 24 |
| dwt. | 20 Penny-weights | = 1 Ounce | | = 480 |
| oz. | 12 Ounces | = 1 Pound, | ℔ | = 5760 |

Gold is supposed to be divided into 24 equal parts called carats. When pure it is said to be 24 carats fine; when, say, 18 parts are pure and 6 are alloy, it is said to be 18 carats fine.

The brass Troy pound, made in 1758, is the standard unit, from which all weights are taken; it contains 5760 grains, each grain being the $\frac{1}{252\cdot458}$ part of a cubic inch of distilled water, at the temperature of 62° of Fah. thermometer, the barometer being at thirty inches. 7000 of such grains are equal to the Avoirdupois pound.

By this weight are weighed gold, silver, jewels, and liquors.

APOTHECARIES' WEIGHT.*

| *Marked* | | | | | *Troy grs.* | |
|---|---|---|---|---|---|---|
| gr. | 20 Grains | = 1 Scruple | = | 20 | | ℈ |
| scr. | 3 Scruples | = 1 Dram | = | 60 | | ʒ |
| dr. | 8 Drams | = 1 Ounce | = | 480 | | ℥ |
| oz. | 12 Ounces | = 1 Pound | = | 5760 | | ℔ |

AVOIRDUPOIS WEIGHT.

| *Marked* | | | | *Troy grs.* |
|---|---|---|---|---|
| dr. | 16 Drams | = 1 Ounce | = | 437·5 |
| oz. | 16 Ounces | = 1 Pound | = | 7000 |
| lb. | 28 Pounds | = 1 Quarter | = | 196000 |
| qr. | 4 Quarters, or 112 lb. | = 1 Cwt. | = | 784000 |
| cwt. | 20 Hundreds | = 1 Ton, T. | = | 15680000 |

14 lbs. = 1 stone; 8 stones = 1 cwt.; 100 lbs. = 1 cental.

*Note.*—144 lb. Avoirdupois are equal to 175 lb. Troy.

* In the British Pharmacopœia (1864), the oz. Troy of 480 grains has been abolished, while the lb. avoir. of 7000 grains, and the oz. avoir. of 437½ grs., have been adopted. 1864

## WOOL WEIGHT.

| *Marked* | | | | *Troy grs.* |
|---|---|---|---|---|
| lb. | 7 Pounds Avoir. | = 1 Clove | = | 49000 |
| cl. | 2 Cloves | = 1 Stone | = | 98000 |
| st. | 2 Stones | = 1 Tod | = | 196000 |
| td. | 6½ Tods | = 1 Wey | = | 1274000 |
| wy. | 2 Weys | = 1 Sack | = | 2548000 |
| sk. | 12 Sacks | = 1 Last, la. | = | 30576000 |

A Score = 20 lb. and a Pack = 240 lb.

## HAY AND STRAW WEIGHT.

| *Marked* | | | | *Troy grs.* |
|---|---|---|---|---|
| lb. | 36 Pounds avoirdupois of Straw | = 1 Truss | = | 252000 |
| | 56 Pounds of old Hay | = 1 Truss | = | 392000 |
| | 60 Pounds of new Hay | = 1 Truss | = | 420000 |
| tr. | 36 Trusses | = 1 Load, ld. | | |

The hay of any year is reckoned new until the 31st of August.

## CLOTH MEASURE.

| *Marked* | | | *Inches.* |
|---|---|---|---|
| in. | 2¼ Inches | = 1 Nail | 2¼ |
| nl. | 4 Nails | = 1 Quarter | 9 |
| qr. | 4 Quarters | = 1 Yard, yd. | 36 |

5 Quarters = 1 Eng. ell; 3 Quarters = 1 Flem. ell; 6 Quarters = 1 French ell; 4 Quarters and 1 inch = 1 Scotch ell.

## LONG MEASURE.

| *Marked* | | | *Inches.* |
|---|---|---|---|
| in. | 12 Inches | = 1 Foot | 12 |
| f. | 3 Feet | = 1 Yard | 36 |
| yd. | 5½ Yards | = 1 Pole or Perch | 198 |
| po. | 40 Poles | = 1 Furlong | 7920 |
| fur. | 8 Furlongs, or 1760 yds. | = 1 Mile | 63360 |
| m. | 69 English Miles | = 1 Degree, deg. | 4371840 |

A Geographical or Nautical mile is = 72909·72 Inches, 3 Geographical miles = 1 league; 20 leagues = 1 Degree; 4 inches = 1 Hand; 6 Feet = 1 Fathom; 2½ Feet = 1 Military pace; 5 Feet = 1 Geometrical pace; 9 Inches = 1 Span; 1½ Foot = 1 Cubit; 66 Feet or 100 Links = 1 Chain.

The brass yard made by Bird, in 1760, is the standard unit from which all lineal measures are taken; it contains 36 inches, each inch being the $\frac{1}{36.1393}$ part of a pendulum vibrating seconds of mean time in the latitude of London in a vacuum at the level of the sea, Fah. thermometer being at 62°. A standard yard and a standard Avoirdupois pound are deposited in the Exchequer Office, London.

## ENGLISH LAND, OR SQUARE MEASURE.

| *Marked* | | | | *Square in.* |
|---|---|---|---|---|
| sq. in. | 144 Square inches | = 1 Square foot | = | 144 |
| sq. f. | 9 Square feet | = 1 Square yard | = | 1296 |
| yd. | 30¼ Square yards | = 1 Square pole | = | 39204 |
| po. | 40 Square poles | = 1 Rood | = | 1568160 |
| ro | 4 Roods | = 1 Acre | = | 6272640 |
| ac | 640 Acres | = 1 Square mile | | |

272¼ square feet = 1 Rood brick work; 100 square feet = 1 square of flooring, &c.; 36 square yards = 1 Rood of Mason-work, &c.

By this Measure every thing that has length and breadth is estimated.

## SOLID MEASURE.

| *Marked* | | | | *Solid in* |
|---|---|---|---|---|
| s. in. | 1728 Solid inches | = 1 Solid foot | = | 1728 |
| s. ft. | 27 Solid feet | = 1 Solid yard | = | 46656 |

40 solid feet of rough or 50 of hewn timber = 1 Load; 42 solid Feet = 1 Ton of shipping.

By this Measure every thing which has length, breadth, and thickness, or depth, is estimated.

## MEASURE OF CAPACITY.

| *Marked* | | | | *Cubic in.* |
|---|---|---|---|---|
| | | 1 Pint | = | 34·65923 |
| pt. | 2 Pints | = 1 Quart | = | 69·31846 |
| qt. | 4 Quarts | = 1 Gallon | = | 277·27384 |
| gal. | 2 Gallons | = 1 Peck | = | 554·54768 |
| pk. | 4 Pecks | = 1 Bushel | = | 2218·19074 |
| bush. | 8 Bushels | = 1 Quarter | = | 17745·52595 |
| qr. | 4 Quarters | = Chaldron, ch. | = | 70982·10380 |

This is now the only measure allowed by law for all liquids and all dry goods not measured by heaped measure. 100 gallons of this measure are very nearly equal to 120 old wine gallons, to 98·3 old ale gallons, or to 103·12 gallons old dry measure.

## HEAPED MEASURE.

| *Marked* | | | | *Cubic inches.* |
|---|---|---|---|---|
| | | 1 Peck | = | 703·87148 |
| pk. | 4 Pecks | = 1 Bushel | = | 2815·48592 |
| bush. | 3 Bushels | = 1 Sack | = | 8446·45776 |
| sk. | 12 Sacks | = 1 Chaldron, ch. | = | 101357·49309 |

The diameter of the exterior brim of the bushel is 19¼ inches, and the height of the heap at least 6 inches; the con-

tent of the heap is therefore 597·29518 cubic inches, which, added to 2218·19074, the content of the bushel, gives 2815·48592 cubic inches for the content of the heaped bushel, and the contents of the others are in proportion.

This Measure is used for Coals, Culm, Lime, Fish, Potatoes, Fruit; and all goods sold by heaped measure.

YARN MEASURE.

| *Marked* | | |
|---|---|---|
| in. | 90 Inches | = 1 Thread |
| th. | 120 Threads | = 1 Cut |
| ct. | 2 Cuts | = 1 Heer |
| h. | 6 Heers | = 1 Slip, hank, or hasp |
| sl. | 4 Slips | = 1 Spindle, sp. |

CIRCLE.

| *Marked* | | | *Sec.* |
|---|---|---|---|
| ″ | 60 Seconds | = 1 Minute = | 60 |
| ′ | 60 Minutes | = 1 Degree = | 3600 |
| ° | 30 Degrees | = 1 Sign = | 108000 |
| *s* | 12 Signs or 360° | = 1 Circle = | 1296000 |

TIME.

| *Marked* | | | *Sec.* |
|---|---|---|---|
| sec. | 60 Seconds | = 1 Minute = | 60 |
| min. | 60 Minutes | = 1 Hour = | 3600 |
| ho. | 24 Hours | = 1 Day = | 86400 |
| da. | 365 Days, 6 Hours | = 1 Julian year, Y. = | 31557600 |

365 days, 5 hours, 48 minutes, 48 seconds = 1 solar year; 30 days = 1 month; 12 months = 1 year; 7 days = 1 week; 4 weeks = 1 month; 52 weeks and 1 day = 1 year.

30 days have September,
April, June, and November;
All the rest have 31;
February 28 alone; but in leap years 29.

QUARTERLY TERMS.

| *In England.* | | *In Scotland.* | |
|---|---|---|---|
| Lady-day | 25 March | Candlemas | 2 February |
| Midsummer | 24 June | Whitsunday | 15 May |
| Michaelmas | 29 Sept. | Lammas | 1 August |
| Christmas | 25 Dec. | Martinmas | 11 November |

## *Old Measures now abolished.*

Although the following measures are now entirely abolished, it is necessary to attend to their subdivisions, and the proportion which they bear to the imperial standards.

OLD WINE MEASURE.

| | | *Cub. In.* | | *Imp. Galls.* |
|---|---|---|---|---|
| | 1 Pint | = 28$\frac{7}{8}$ | = | 0·10414 |
| 2 Pints | = 1 Quart | = 57$\frac{3}{4}$ | = | 0·20828 |
| 4 Quarts | = 1 Gallon | = 231 | = | 0·83311 |
| 63 Gallons | = 1 Hogshead | | = | 52·48602 |
| 2 Hogsheads | = 1 Pipe | | = | 104·97204 |
| 2 Pipes | = 1 Tun | | = | 209·94408 |

10 Gallons make 1 Anker, 18 Gallons 1 Rundlet, 31$\frac{1}{2}$ Gallons 1 Barrel, 42 Gallons 1 Tierce, and 84 Gallons 1 Puncheon.

OLD ALE AND BEER MEASURE.

| | | *Cub. In.* | | *Imp. Galls.* |
|---|---|---|---|---|
| | 1 Pint | = 35$\frac{1}{4}$ | = | 0·12713 |
| 2 Pints | = 1 Quart | = 70$\frac{1}{2}$ | = | 0·25426 |
| 2 Quarts | = 1 Pottle | = 141 | = | 0·50852 |
| 2 Pottles | = 1 Gallon | = 282 | = | 1·01705 |
| 9 Gallons | = 1 Firkin | | = | 9·15341 |
| 2 Firkins | = 1 Kilderkin | | = | 18·30681 |
| 2 Kilderkins | = 1 Barrel | | = | 36·61362 |
| 1$\frac{1}{2}$ Barrel | = 1 Hogshead | | = | 54·92043 |
| 2 Barrels | = 1 Puncheon | | = | 73·22725 |
| 2 Hogsheads | = 1 Pipe or Butt | | = | 109·84087 |
| 2 Pipes | = 1 Tun | | = | 219·68174 |

OLD DRY MEASURE.

| | | *Cub. In.* | | *Imp. Galls* |
|---|---|---|---|---|
| | 1 Pint | = 33$\frac{3}{5}$ | = | 0·12118 |
| 2 Pints | = 1 Quart | = 67$\frac{1}{5}$ | = | 0·24236 |
| 2 Quarts | = 1 Pottle | = 134$\frac{2}{5}$ | = | 0·48472 |
| 2 Pottles | = 1 Gallon | = 268$\frac{4}{5}$ | = | 0·96945 |
| 2 Gallons | = 1 Peck | = 537$\frac{3}{5}$ | = | 1·93890 |
| 4 Pecks | = 1 Bushel | = 2150$\frac{2}{5}$ | = | 7·75558 |
| 4 Bushels | = 1 Coom | | = | 31·02233 |
| 2 Cooms | = 1 Quarter | | = | 62·04465 |
| 5 Quarters | = 1 Wey or Load | | = | 310·22328 |
| 2 Weys | = 1 Tun | | = | 620·44655 |

## *Old Monies, Weights, and Measures of Scotland.*

SCOTCH MONEY.

| | | | |
|---|---|---|---|
| 2 Pennies | = 1 Bodle | = | $\frac{1}{6}d.$ Sterling. |
| 2 Bodles | = 1 Plack | = | $\frac{1}{3}d.$ |
| 3 Placks or 12 Pennies | = 1 Shilling | = | 1$d.$ |
| 20 Shillings | = 1 Pound | = | 20$d.$ |

3 Placks = 1 Penny Sterling, 4 Pennies = 1 Groat, 13⅓ Pence = 1 Mark Scotch, 18 Marks or 12 Pounds Scotch = 1 Pound Sterling.

SCOTCH, TROY, OR DUTCH WEIGHT.

| *Marked* | | | | *Troy grs.* |
|---|---|---|---|---|
| dro. | 16 Drops | = 1 Ounce | = | 475·55935 |
| oz. | 16 Ounces | = 1 Pound | = | 7608·9496 |
| lb. | 16 Pounds | = 1 Stone | = | 121743·1936 |

The Tron Pound kept at Edinburgh is equal to 9622·67 Troy Grains; it varies, however, in different places and for different purposes, but is always divided as above.

SCOTCH LAND MEASURE.

| *Marked* | | | | *Sq: Eng. in.* |
|---|---|---|---|---|
| sq. ft. | 9 Square Feet | = 1 Square Ell | = | 1369 |
| sq. e. | 36 Square Ells | = 1 Square Fall | = | 49284 |
| fall | 40 Falls | = 1 Rood | = | 1971360 |
| ro. | 4 Roods | = 1 Acre, | ac. = | 7885440 |

The Scotch standard ell, which was formerly divided into 36 of its own inches, is equal to 37·0598 English inches, but by act of Parliament it ought only to be 37.

SCOTCH WHEAT MEASURE.

| | | *Cubic Eng. inch. for wheat.* | | *Cub. Eng. in. for barley.* |
|---|---|---|---|---|
| 4 Lippies | = 1 Peck | = 553·5625 | = | 807·55 |
| 4 Pecks | = 1 Firlot | = 2214·25 | = | 3230·2 |
| 4 Firlots | = 1 Boll | = 8857· | = | 12920·8 |
| 16 Bolls | = 1 Chalder | = 141712· | = | 206732·8 |

The Linlithgow wheat firlot contained 21¼ Scotch pints; it was also used for rye, pease, beans, salt, and grass-seeds. The barley firlot contained 31 Scotch pints, and was also used for malt, oats, fruit, and potatoes, and divided as above.

SCOTCH LIQUID MEASURE.

| *Marked* | | | | *Cubic Eng. inches.* |
|---|---|---|---|---|
| | | 1 Gill | = | 6·5125 |
| g. | 4 Gills | = 1 Mutchkin | = | 26·05 |
| mut. | 2 Mutchkins | = 1 Chopin | = | 52·1 |
| ch. | 2 Chopins | = 1 Pint | = | 104·2 |
| pt. | 2 Pints | = 1 Quart | = | 208·4 |
| qt. | 4 Quarts | = 1 Gallon | = | 833·6 |
| gall. | 16 Gallons | = 1 Hogshead | = | 13337·6 |

Three Scotch pounds, of the Water of Leith, was the standard of the above pint.

# ARITHMETIC

Is the art of Computation, and the fundamental Rules are, NUMERATION, ADDITION, SUBTRACTION, MULTIPLICATION, and DIVISION.

## NUMERATION

Is the Art of Reading and Writing any Number.

TABLE.

| | |
|---|---|
| 9 | Units. |
| 9 8 | Tens. |
| 9 8 7 | Hundreds. |
| 9 8 7 6 | Thousands. |
| 9 8 7 6 5 | Tens of Thousands. |
| 9 8 7 6 5 4 | Hundreds of Thousands. |
| 9 8 7 6 5 4 3 | Millions. |
| 9 8 7 6 5 4 3 2 | Tens of Millions. |
| 9 8 7, 6 5 4, 3 2 1 | Hundreds of Millions. |

CHARACTERS OF FIGURES.

1, one; 2, two; 3, three; 4, four; 5, five; six, 6; 7, seven; 8, eight; 9, nine; 0, cipher.

ROMAN NUMERAL LETTERS.

I, one; V, five; X, ten; L, fifty; C, one hundred; D, five hundred; M, one thousand.

To read any number expressed in figures.

RULE. Divide the number into periods and half periods, if necessary, from right to left; then begin at the left hand, and read towards the right.

EXAMPLES.

1. Read 83068. | 4. Write in words 14065708.
2. Read 976705. | 5. Write in words 980679120.
3. Read 8067900. | 6. Write in words 800854029.

To write any number in figures.

RULE. Write every figure in its proper place, and supply vacant places with ciphers.

EXAMPLES.

1. Write in figures, one thousand and eighty.
2. Write in figures, sixty-four thousand and ninety.
3. Write in figures, seventy millions, two thousand and ten.
4. Write in figures, one hundred millions, sixty-two thousand, eight hundred and eleven.
1. Write in letters, eight hundred and seventy-nine.
2. Write in letters, one thousand nine hundred and eighty-eight.

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## ADDITION

Is the collecting of two or more numbers into one sum.

### SIMPLE ADDITION.

RULE 1. Place units under units, tens under tens, &c., and draw a line under them.

2. Add the Figures in the units column, and find how many times 10 that sum contains.

3. Set down the remainder, if any, at the foot of the column, and, for every 10 in that sum, carry 1 to the next column: proceed thus with every remaining column, and, under the last, write down the full sum.

PROOF. Draw a line under the uppermost number, add all the rest together, then add this last-found number and the uppermost; that sum will be the same as the first.

EXAMPLES.

| (1.) | (2.) | (3.) | (4.) |
|---|---|---|---|
| 34 | 456 | 5784 | 6745 |
| 26 | 543 | 2673 | 2564 |
| 72 | 374 | 4645 | 4785 |
| 43 | 268 | 2476 | 7643 |
| 52 | 451 | 3524 | 2876 |
| * | | | |

| (5.) | (6.) | (7.) | (8.) |
|---|---|---|---|
| 75426 | 28769 | 84623 | 54962 |
| 57264 | 49384 | 46238 | 12845 |
| 38572 | 57263 | 67965 | 83453 |
| 92486 | 32765 | 75679 | 35276 |
| 37218 | 41834 | 84213 | 27637 |
| 13853 | 23413 | 34275 | 87698 |

9. Add 12, 34, 56, 78, 91, 23, 45, 67, and 89 together. Ans. 495.

10. Add 234, 567, 891, 234, 567, 892, 345, 678, and 906 together. Ans. 5314.

11. Add 9876, 5432, 1987, 6543, 2198, 7654, 3210, 6786, and 4693 together. Ans. 48379.

12. Add 6408, 3467, 5986, 7642, 8569, 2398, 8675, 21904, and 686 together. Ans. 65735.

13. Add 6845, 2867, 8490, 684, 1267, 4681, 20680, and 8045 together. Ans. 53559.

14. Add 5408, 1467, 4500, 89, 423, 60456, 8401, and 96 together. Ans. 80840.

* Ans. (1.) 227. (2.) 2092. (3.) 19102. (4.) 24613. (5.) 314819. (6.) 233428. (7.) 392993. (8.) 301871.

15. What is the sum of 54936, 789, 45, 3100, 7093, 84506, 379, and 480? Ans. 151328.

16. Add 79685, 37986, 48798, 76548, 497634, 56783, 698796, 49768, and 9873 together. Ans. 1555871.

17. Add 4869, 75486, 98743, 486, 97, 54868, 79633, 976854, and 796877 together. Ans. 2087913.

18. Add 987548, 69537, 6548, 898756, 48687, 796843, 6854868, 5487695, and 76854876 together. Ans. 92005358.

19. What is the sum of two hundred and eighty three, four hundred and seventy-six, three thousand five hundred and fifty-two, seven thousand six hundred and eighty-four, twenty-seven, eight hundred and seventy-six, two thousand nine hundred and eighty-five? Ans. 15883.

20. A man was born in the year 1761, when would he be 69 years of age? Ans. in 1830.

21. A lent B 30*l.* C 48*l.* D 120*l.* E 209*l.* F 44*l.* and G 1340*l.* how much did he lend in all? Ans. 1791*l.*

22. A owes B 2359*l.* C 549*l.* D 875*l.* E 965*l.* F 1897*l.* G 1231*l.* H 2197*l.* I 978*l.* and K 841*l.* how much does he owe in all? Ans. 11892*l.*

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## SUBTRACTION

Is the method of taking a less number from a greater in order to find their difference.

### SIMPLE SUBTRACTION.

Rule 1. Place the less number under the greater; units under units, tens under tens, &c., and draw a line under them.

2. Then begin at the right hand, and take each figure of the less number from the figure above it, and place the remainder directly under.

3. When the lower figure is equal to the upper write down

a cipher ; if greater than that above it, suppose 10 added to the upper figure ; then subtract the lower figure from the sum : but you must add 1 to the next lower figure before you subtract it.

PROOF. Add the two undermost numbers together, their sum will be equal to the uppermost when the work is right.

EXAMPLES.

| | | | |
|---|---|---|---|
| From | (1.) 756 | (2.) 5476 | (3.) 64276 |
| Take | 294 | 2563 | 27354 |

*

| | | | |
|---|---|---|---|
| From | (4.) 104723 | (5.) 1004724 | (6.) 2904731 |
| Take | 58631 | 34865 | 1207648 |

7. From 6894 take 4086. Ans. 2808.
8. From 1000 take 850. Ans. 150.
9. From 1480 take 996. Ans. 484.
10. From 5809 take 4080. Ans. 1729.
11. From 846789 take 242316. Ans. 604473.
12. From 6805389 take 950178. Ans. 5855211.
13. From 4000000 take 2300681. Ans. 1699319.
14. From 5400001 take 60084. Ans. 5339917.
15. From 7654869 take 3976540. Ans. 3678329.
16. From 25486974 take 19548796. Answer 5938178.
17. What is the difference between 786278456 and 257564257? Ans. 528714199.
18. What is the difference between 7976540 and 10548796? Ans. 2572256.
19. How much does 847684536 exceed 371547682? Ans. 476136854.

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* (1.) 462. (2.) 2913. (3.) 36922. (4.) 46092. (5.) 969859. (6.) 1697083.

20. What is the difference between six hundred and forty-three thousand two hundred and eighty-five, and two hundred and fifty-six thousand seven hundred and forty-two? Ans. 386543.

21. A man was born in the year 1832, what is his age this present year? Ans.

22. A person whose present age is 73, was 37 years old at the birth of his eldest daughter, what is his daughter's age? Ans. 36 years.

## MULTIPLICATION

Is a compendious method of adding any number.

The number to be multiplied is called the *Multiplicand;* the number by which you multiply is called the *Multiplier;* and the amount is called the *Product.*

NOTE. The Multiplicand and Multiplier are called Factors.

### SIMPLE MULTIPLICATION.

RULE 1. Place the Multiplier under the Multiplicand, units under units, &c., and draw a line under them.

2. Multiply each figure in the Multiplicand, first by the units of the Multiplier, then by the other figures in their order, placing the first figure of each Product directly under the figure by which you multiply, and carry by 10, as in ADDITION; add these Products.

NOTE. If there is a cipher or ciphers at the right of one or of both Factors, multiply by the significant figures, and annex the ciphers to the Product.

PROOF. Make the former Multiplicand the Multiplier, and the Multiplier the Multiplicand; if this Product is equal to the former, the operation is right. Or thus:

1. Cast the nines out of the two Factors, and set down the Remainders.

2. Multiply the two Remainders together, and if the excess of nines in their Product is equal to the excess of nines in the total Product, the work is right.

EXAMPLES.

| | (1.) | (2.) |
|---|---|---|
| Multiplicand | 68945734 | 48096784 |
| Multiplier | 2 | 3 |
| Product | * | |

3. Multiply 48679048 by 6. Ans. 292074288.
4. Multiply 80670912 by 9. Ans. 726038208.
5. Multiply 98765432 by 12. Ans. 1185185184.
6. Multiply 4606870 by 18. Ans. 82923660.
7. Multiply 2345678 by 47. Ans. 110246866.
8. Multiply 8970681 by 96. Ans. 861185376.
9. Multiply 459068 by 185. Ans. 84927580.
10. Multiply 7549636 by 345. Ans. 2604624420.
11. Multiply 3276894 by 672. Ans. 2202072768.
12. Multiply 9768458 by 894. Ans. 8733001452.
13. Multiply 7280473 by 289. Ans. 2104056697.
14. Multiply 809601 by 2400. Ans. 1943042400.
15. Multiply 601570 by 3068. Ans. 1845616760.
16. Multiply 406894 by 85237. Ans. 34682423878.
17. Multiply 238906 by 216894. Ans. 51817277964.
18. Multiply 54986304 by 729634.
Ans. 40119876932736.

RULE II. When the Multiplier is the product of two or more numbers, neither of which exceeds 12, multiply continually by these numbers.

EXAMPLES.

1. Multiply 68094568 by 24. Ans. 1634269632.
2. Multiply 4096731 by 36. Ans. 147482316.
3. Multiply 748695 by 48. Ans. 35937360.
4. Multiply 947658 by 54. Ans. 51173532.
5. Multiply 386909 by 81. Ans. 31339629.

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* Ans. (1.) 137891468. (2) 144290352.

6. Multiply 729654 by 112. Ans. 81721248.

7. Multiply 8976543 by 108. Ans. 969466644.

8. A gentleman has 45*l.* a-week, how much is that in 52 weeks? Ans. 2340*l.*

9. How many seeds in a plant which consists of 9 stalks, on each of which are 45 flowers, and each flower bears 549 seeds? Ans. 222345.

10. How many square yards in a garden which is 53 yards long, and 32 yards broad? Ans. 1696.

## DIVISION

Is a compendious method of subtracting any number.

The number to be divided is called the *Dividend.* The number you divide by is called the *Divisor.* The number of times the Dividend contains the Divisor is called the *Quotient.*

### SIMPLE DIVISION.

RULE 1. 1. Draw a line on the right and left of the Dividend; write the Divisor on the left hand, and the Quotient as it arises on the right.

2. From the left hand of the Dividend point off as many figures as will contain the Divisor once or oftener; find how many times these figures contain the Divisor, and place the figure which represents the number of times in the Quotient.

3. Multiply the Divisor by the Quotient figure, and place the product under the figure or figures pointed off.

4. Draw a line, and subtract the Product from the figures under which it stands.

5. To the right hand of the Remainder bring down the next figure of the Dividend, and point it off; which number divide as before, and proceed in the same manner till all the Dividend be brought down.

NOTE. If the Divisor is 12, or under, the operation may be performed mentally, by putting down only the Quotient.

PROOF. Multiply the Quotient and Divisor together, adding the Remainder, if any; this Product will be equal to the Dividend.—Or, divide the Dividend after subtracting the Remainder, if

any, by the Quotient; the result will be equal to the Divisor.

EXAMPLES.

1. Divide 84667 by 2. Ans. $42333\frac{1}{2}$
2. Divide 489764 by 3. Ans. $163254\frac{2}{3}$
3. Divide 386457 by 4. Ans. $96614\frac{1}{4}$
4. Divide 490680 by 5. Ans. 98136
5. Divide 867059 by 6. Ans. $144509\frac{5}{6}$
6. Divide 732845 by 7. Ans. $104692\frac{1}{7}$
7. Divide 411678 by 8. Ans. $51459\frac{6}{8}$
8. Divide 4912037 by 9. Ans. $545781\frac{8}{9}$
9. Divide 8695340 by 14. Ans. $621095\frac{10}{14}$
10. Divide 1234567 by 20. Ans. $61728\frac{7}{20}$
11. Divide 7865432 by 38. Ans. $206985\frac{2}{38}$
12. Divide 75846972 by 46. Ans. $1648847\frac{10}{46}$
13. Divide 54906734 by 59. Ans. $930622\frac{36}{59}$
14. Divide 48372864 by 75. Ans. $644971\frac{39}{75}$
15. Divide 9876540 by 87. Ans. $113523\frac{39}{87}$
16. Divide 14680598 by 108. Ans. $135931\frac{50}{108}$
17. Divide 81407910 by 384. Ans. $211999\frac{294}{384}$
18. Divide 72986543 by 563. Ans. $129638\frac{419}{563}$
19. Divide 987213472 by 747. Ans. $1321570\frac{682}{747}$
20. Divide 428638726 by 1374. Ans. $311964\frac{1020}{1374}$
21. Divide 729684786 by 4726. Ans. $154397\frac{4564}{4726}$
22. Divide 40608370 by 1809. Ans. $22447\frac{1717}{1809}$
23. Divide 51406745 by 314689. Ans. $163\frac{112458}{314689}$

RULE II. When the Divisor is the product of two or more numbers, none of which exceeds 12, divide successively by these numbers.

NOTE. To find the true Remainder, multiply the last Remainder into all the preceding Divisors (the last excepted), adding the several Remainders to the Products to which they belong.

EXAMPLES.

1. Divide 459323 by 48. Ans. $9569\frac{11}{48}$
2. Divide 287536 by 56. Ans. $5134\frac{4}{7}$

3. Divide 679195 by 84. Ans. 8085$\frac{5}{84}$
4. Divide 7384675 by 96. Ans. 76923$\frac{67}{96}$
5. Divide 5498653 by 108. Ans. 50913$\frac{49}{108}$
6. Divide 8965437 by 121. Ans. 74094$\frac{63}{121}$
7. Divide 3846973 by 112. Ans. 34347$\frac{109}{112}$
8. Divide 549657 by 168. Ans. 3271$\frac{129}{168}$

RULE III. When there are ciphers annexed to the Divisor, cut them off; and cut off as many figures from the Dividend as annex these figures to the Remainder.

EXAMPLES.

1. Divide 41285 by 30. Ans. 1376$\frac{5}{30}$
2. Divide 72400 by 100. Ans. 724
3. Divide 45973 by 240. Ans. 191$\frac{133}{240}$
4. Divide 39768 by 7000. Ans. 5$\frac{6888}{7000}$
5. Divide 39768438 by 73000. Ans. 544$\frac{6438}{73000}$
6. The area of a room 16 feet broad is 512 feet, what is its length? Ans. 32 feet.

SUPPLEMENT TO MULTIPLICATION AND DIVISION.

I. When the Multiplier contains a fraction.

RULE. First multiply by the upper figure of the fraction, and divide the Product by the under figure, then multiply by the whole number, and add the Product to the Quotient.

EXAMPLES.

1. Multiply 7854769 by 9$\frac{3}{4}$. Ans. 76583997$\frac{3}{4}$
2. Multiply 3768473 by 16$\frac{7}{8}$. Ans. 61708745$\frac{7}{8}$
3. Multiply 2965497 by 26$\frac{7}{9}$. Ans. 79409419$\frac{8}{9}$
4. Multiply 3864738 by 312$\frac{6}{11}$.
Ans. 1207906294$\frac{10}{11}$
5. Multiply 3846768 by 416$\frac{1}{4}$. Ans. 1601217180
6. Multiply 7486742 by 98$\frac{1}{2}$. Ans. 737444087

II. When the Divisor contains a fraction.

RULE. Multiply the Divisor by the under figure of the fraction, and add the upper figure to the Product; multiply the Dividend also by the under figure of the fraction, and then divide.

EXAMPLES.

1. Divide 785476 by $9\frac{1}{4}$. Ans. $84916\frac{4}{37}$
2. Divide 3876549 by $16\frac{2}{5}$. Ans. $232592\frac{7}{80}$
3. Divide 5469874 by $21\frac{3}{5}$. Ans. $253234\frac{98}{105}$
4. Divide 7321095 by $41\frac{7}{8}$. Ans. $174832\frac{40}{335}$
5. Divide 5486953 by $29\frac{1}{2}$. Ans. $185998\frac{2}{59}$
6. Divide 7654869 by $31\frac{11}{16}$. Ans. $241573\frac{95}{507}$

## REDUCTION

Is the changing of numbers from one name to another, without altering their value.

### To bring a greater name into a less.

RULE. Multiply the given number by as many of the less name as make one of the greater; adding to the Product the parts of the second name, if any; proceed in the same manner, till you have brought it as low as is required.

### To bring a less name into a greater.

RULE. Divide by as many of the less name as make one of the greater; and thus proceed till you have brought it into that name required; the last Quotient, together with the several Remainders, if any, will be the answer.

### Mixed Reduction is when both Multiplication and Division are used.

RULE. Reduce the given numbers into one name; then divide the one by the other.

PROOF. Reverse the Question.

STERLING MONEY.

EXAMPLES.

1. Reduce 12*s.* $11\frac{1}{2}$*d.* into farthings. Ans. 622.
2. In 1 pound, how many shillings, pence, and farthings? Ans. 20*s.* 240*d.* 960*f.*
3. In 7343 farthings, how many pounds? Ans. 7*l.* 12*s.* $11\frac{3}{4}$*d.*
4. In 40*l.* 10*s.* 6*d.* how many pence, halfpence, and farthings? Ans. 9726*d.* 19452 halfpence, 38904 farthings.

5. In 12*s.* 2½*d.* how many halfpence? Ans. 293.

6. In 900 guineas, how many sixpences and pence? Ans. 37800 sixpences, 226800*d.*

7. Reduce 309*l.* 15*s.* 10¾*d.* into farthings. Ans. 297403.

8. In 912 farthings, how many shillings? Ans. 19*s.*

9. In 4089 farthings, how many pounds? Ans. 4*l.* 5*s.* 2¼*d.*

10. In 4009 halfpence, how many pounds? Ans. 8*l.* 7*s.* 0½*d.*

11. In 42336 farthings, how many guineas? Ans. 42.

12. In 7200 farthings, how many crowns? Ans. 30.

13. Reduce 736*l.* 17*s.* 11½*d.* to halfpence. Ans. 353711.

14. Reduce 275*l.* 10*s.* 10¾*d.* to farthings. Ans. 264523.

15. Reduce 205*l.* 16*s.* 2¼*d.* to farthings. Ans. 197577.

16. Reduce 210*l.* 10*s.* 6*d.* to sixpences. Ans. 8421.

17. Reduce 2000*l.* 17*s.* 8*d.* to fourpences. Ans. 120053.

18. Reduce 74867 farthings to pounds. Ans. 77*l.* 19*s.* 8¾*d.*

19. Reduce 650967 halfpence to guineas. Ans. 1291 guineas, 12*s.* 7½*d.*

20. Reduce 74894 threepences to pounds. Ans. 936*l.* 3*s.* 6*d.*

21. Reduce 7486*l.* to guineas. Ans. 7129 guineas, 11*s.*

22. In 10864 farthings, how many crowns, half-crowns, sixpences, and pence, and of each an equal number? Ans. 28 of each.

23. In 40 guineas, how many pounds? Ans. 42*l.*

24. In 283*l.* 9*s* 6*d.* how many shillings, half-

crowns, and crowns, and of each an equal number? Ans. 667 of each.

25. In 842 crowns, how many guineas? Ans. 200 guineas, 10*s*.

TROY WEIGHT.

26. In 6 lb. 10 oz. 5 gr., how many grains? Ans. 39365.

27. In 213212 grains, how many pounds? Ans. 37 lb. 3 dwt. 20 gr.

28. In 9120 gr. of silver, how many teaspoons, each half an ounce? Ans. 38.

29. In 9 ingots of silver, each 2 lb. 10 oz. 10 dwt., how many grains? Ans. 149040 gr.

APOTHECARIES' WEIGHT.

30. In 2 lb., how many oz. dr. scr. and gr.? Ans. 24 oz. 192 dr. 576 scr. 11520 gr.

31. In 546 lb. 18 gr., how many grains? Ans. 3144978 gr.

32. In 56789 scruples, how many lb.? Ans. 197 lb. 2 oz. 1 dr. 2 scr.

AVOIRDUPOIS WEIGHT.

33. In 6 cwt. 1 qr. 18 lb., how many drams? Ans. 183808.

34. In 30 tons, 18 cwt. 2 qr. 20 lb. 12 oz. 15 dr., how many drams? Ans. 17738959 dr.

35. In 215040 oz., how many tons? Ans. 6 tons.

36. In 540 parcels of sugar, each 18¼ lb., how many cwt.? Ans. 87 cwt. 3 qr. 27 lb.

WOOL WEIGHT.

37. In 2 weys, how many pounds of wool? Ans. 364 lb.

38. In 13104 lb., how many lasts? Ans. 3.

39. In 8 lasts, how many stones? Ans. 2496.

HAY AND STRAW WEIGHT.

40. In two loads of straw, how many pounds? Ans. 2592.

41. In 10080 lb. of old hay, how many loads? Ans. 5.

42. In 3 loads, 30 trusses, 42 lb. of new hay, how many lb.? Ans. 8322 lb.

CLOTH MEASURE.

43. In 400 yds., how many nails? Ans. 6400 nails.

44. In 500 nails, how many yds.? Ans. 31 yds. 1 qr.

45. In 764 ells English, how many yds.? Ans. 955 yards.

46. In 6 pieces of cloth, each 20½ yards, how many nails and inches? Ans. 1968 nails, 4428 inches.

LONG MEASURE.

47. Reduce 1 mile into inches. Ans. 63360.

48. In 1362240 inches, how many miles? Ans. 21½.

49. Reduce 360 miles, 4 furlongs, 27 poles, 2½ yards, to inches. Ans. 22846716 inches.

50. Reduce 7486973 feet to miles. Ans. 1417 miles, 7 furlongs, 35 poles, 5 yards, 6 inches.

51. How often will a wheel, of 18½ feet circumference, turn in running betwixt Edinburgh and Glasgow, the distance being 44 miles? Ans. 12557$\frac{3}{37}$.

52. How many inches will reach round the world, which is 360 degrees, and each degree 69 miles? Ans. 1573862400.

53. How many inches will reach round the moon, of which the circumference is 6817 miles, 2 furlongs, 7 poles? Ans. 431942346 inches.

LAND MEASURE.

54. In 20½ acres, how many poles? Ans. 3280 poles.

55. In 172425 yards, how many acres? Ans. 35 acres, 2 roods, 20 poles.

56. In 674 acres, 6 poles, how many yards? Ans. 3262341½ yards.

57. In 20047964 square inches, how many acres? Ans. 3 acres, 31 poles, 11 yards, 3 feet, 32 inches.

58. In 740 acres, 5½ yards, how many square feet? Ans. 32234449½ square feet.

59. In 7854796 square feet, how many acres? Ans. 180 acres, 1 rood, 11 poles, 12 yards, 3¼ feet.

SOLID MEASURE.

60. In 52 solid yards, how many solid inches? Ans. 2426112.

61. In 13856832 solid inches, how many solid yards? Ans. 297 yards.

MEASURE OF CAPACITY.

62. In 840 quarters, 3 pecks, how many pecks? Ans. 26883.

63. In 47 quarters, 6 bushels, how many pecks? Ans. 1528.

64. In 649 pecks of wheat, how many quarters? Ans. 20 quarters, 2 bushels, 1 peck.

65. In 6750 pecks of barley, how many quarters? Ans. 210 quarters, 7 bushels, 2 pecks.

YARN MEASURE.

66. In 7 spindles, how many cuts? Ans. 336.

67. In 48960 threads, how many slips? Ans. 34 slips.

68. In 27 spindles, 80 threads, how many threads? Ans. 155600.

69. In 71 slips, 4 heers, 1 cut, 64 threads, 25 inches, how many inches? Ans. 9304585.

CIRCLE.

70. In 36°, 24′, 35″, how many seconds? Ans. 131075″.

71. In 120836″, how many signs? Ans. $1^s$, 3°, 33′, 56″.

72. In $4^s$, 14°, 15′, 44″, how many seconds? Ans. 483344.

TIME.

73. In a year of 365 days, 6 hours, how many seconds? Ans. 31557600 seconds.

74. How many hours from the birth of Christ to Christmas 1818; reckoning 365 days 6 hours to a year? Ans. 15936588.

75. How many seconds are there in a solar year, which consists of 365 days, 5 hours, 48 minutes, and 48 seconds? Ans. 31556928.

76. From March 10 to December 25 (both days included), how many days and hours? Ans. 291 days = 6984 hours.

77. How long would it require to count five hundred millions of money, at the rate of 100*l.* a-minute, without intermission? Ans. 9 years, 187 days, 5 hours, 20 minutes.

MISCELLANEOUS QUESTIONS.

1. Reduce 17 tons, 13 cwt. 1 qr. 25 lb. 12 oz. 15 dr. to drams. Ans. 10134991 drs.

2. In 47875640 inches, how many miles, &c.? Ans. 755 ml. 4 fu. 36 p. 2 ft. 8 in.

3. In 3670 Julian years, 315 days, 16 ho. 35 m. 47 s., how many seconds? Ans. 115843667747 sec.

4. In 47872198 sq. in., how many acres? Ans. 7 ac. 2 ro. 21 per. $2\frac{3}{4}$ yd. 3 ft. 118 in.

5. In 359 solid yd. 21 s. ft. 1047 s. in., how many solid inches? Ans. 16786839 s. in.

6. In 4768 guin. 12*s.*, how many half-crowns? Ans. 40056 half-crowns.

7. In 3186*l.* 15*s.* 8*d.*, how many guineas? Ans. 3035 gu. 8*d.*

8. In 36840 pounds Scotch, each 1*s.* 8*d.*, how many pounds sterling? Ans. 3070*l.*

9. In 3879 English ells, how many Scotch ells, each 37 imperial inches? Ans. 4717 S. e. 26 in.

10. In 874867 gallons, how many qrs.? Ans. 13669 qrs. 6 bu. 1 pk. 1 gal.

11. In 784 gal. 2 qt. 1 pt., how many pints? Ans. 6277 pints.

12. Reduce 746 ml. 5 fu. 37 po. 2 ft. 11 in., into inches. Ans. 47313521 inches.

13. Reduce 475 ac. 2 ro. 24 per. 29 yd. 7 ft. 138 in., into inches. Ans. 2983619946 sq. in.

14. How many lbs. of old hay in 25 loads? Ans. 50400 lbs.

15. In 5740 yds., how many French ells? Ans. 3826 Fr. ells, 4 qrs.

16. How many seconds in 7875 solar years? Ans. 248510808000″.

17. Reduce 2 cir. 7 s. 17°, 25′, 57″ to seconds. Ans. 3410757″.

18. How many pints are in 74 qr. 3 bu. 2 pk. 1 gal. 3 qt. 1 pt.? Ans. 38127 pts.

19. In 7485 marks Scotch, each 13⅓*d.*, how many crowns and guineas? Ans. 1663 cr. 1*s.* 8*d.*; 396 gu. 8*d.*

20. In 786*l.* 12*s.*, how many crowns, half-crowns, shillings, and sixpences, and of each an equal number? Ans. 1748.

21. How many pounds Scotch, each 1*s.* 8*d.*, are in 729 gu. 3*s.* 4*d.*? Ans. 9187 pounds Scotch and 8*d.*

22. In 7486 half-guineas, how many marks, each 13*s.* 4*d.*? Ans. 5895 marks, 3*s.*

23. In 25 roods, 34 yds. of mason work, how many yards? Ans. 934 yds.

24. In 480 lbs. Scotch tron weight, each 22 oz., how many lbs. avoirdupois? Ans. 660 lbs.

## COMPOUND ADDITION.

RULE 1. Place all numbers of the same denomination directly under one another, and draw a line under them.

2. Add the figures in the lowest denominations, and find how many of the next higher denomination that sum contains.

3. Write down the remainder, if any, at the foot of the column, and carry 1, for each of the higher denomination, to the next column.

4. Proceed in the same manner through all the denominations till you come to the highest, the sum of which, together with the several remainders, will give the answer required.

PROOF. As in Simple Addition.

### STERLING MONEY.

EXAMPLES.

| | 10 | 20 | 12 |
|---|---|---|---|
| | £ | s. | d. |
| (1.) | 6 | 6 | 8 |
| | 4 | 8 | 9 |
| | 3 | 5 | 6 |
| | 4 | 9 | 7 |
| | 5 | 6 | 6 |
| | 7 | 5 | 4 |

| | 10 | 20 | 12 |
|---|---|---|---|
| | £ | s. | d. |
| (2.) | 10 | 10 | $8\frac{1}{4}$ |
| | 24 | 14 | $4\frac{1}{2}$ |
| | 36 | 18 | $8\frac{3}{4}$ |
| | 41 | 14 | 4 |
| | 69 | 15 | 5 |
| | 36 | 16 | 2 |

| | 10 | 20 | 12 |
|---|---|---|---|
| | £ | s. | d. |
| (3.) | 360 | 19 | $10\frac{3}{4}$ |
| | 496 | 14 | $11\frac{1}{2}$ |
| | 306 | 18 | $9\frac{1}{4}$ |
| | 459 | 19 | 6 |
| | 304 | 16 | $8\frac{3}{4}$ |
| | 1900 | 10 | $10\frac{1}{4}$ |

| | £ | s. | d. |
|---|---|---|---|
| (4.) | 27 | 19 | $6\frac{1}{2}$ |
| | 35 | 18 | $2\frac{3}{4}$ |
| | 43 | 16 | $11\frac{1}{4}$ |
| | 72 | 15 | $10\frac{1}{2}$ |
| | 84 | 17 | $9\frac{1}{2}$ |
| | 96 | 14 | $10\frac{1}{4}$ |

| | £ | s. | d. |
|---|---|---|---|
| (5.) | 321 | 16 | $11\frac{3}{4}$ |
| | 213 | 17 | $10\frac{1}{4}$ |
| | 312 | 18 | $6\frac{1}{4}$ |
| | 476 | 13 | $3\frac{1}{2}$ |
| | 764 | 15 | $5\frac{1}{4}$ |
| | 897 | 11 | $11\frac{3}{4}$ |

| | £ | s. | d. |
|---|---|---|---|
| (6.) | 329 | 11 | $7\frac{3}{4}$ |
| | 48 | 17 | $10\frac{3}{4}$ |
| | 189 | 19 | $9\frac{1}{2}$ |
| | 45 | 13 | $6\frac{1}{2}$ |
| | 789 | 16 | $8\frac{1}{4}$ |
| | 978 | 12 | $2\frac{1}{2}$ |

* Ans. (1.) 31*l.* 2*s.* 4*d.*—(2.) 220*l.* 9*s.* $8\frac{1}{2}$*d.*—(3.) 3830*l.* 0*s.* $8\frac{1}{4}$*d.*—(4.) 362*l.* 3*s.* $2\frac{3}{4}$*d.*—(5.) 2987*l.* 14*s.* $0\frac{3}{4}$*d.*—(6.) 2382*l.* 11*s.* $9\frac{1}{4}$*d.*

**7.** A owes B 450*l.* 16*s.* 10*d.*, C 34*l.* 18*s.* 9*d.*, D 545*l.* 16*s.* 7¾*d.*, E 44*l.* 14*s.* 8½*d.*, F 300*l.* 9*s.* 10*d.*, and G 84*l* 14*s.* Required A's debt? Ans. 1461*l.* 10*s.* 9¼*d.*

8. Add 326*l.* 12*s.* 3¼*d.*; 274*l.* 15*s.* 4*d.*; 432*l.* 16*s.* 5¾*d.*; 376*l.* 19*s.* 8½*d.*; 741*l.* 14*s.* 5¼*d.*; 279*l.* 2*s.* 4*d.* Ans. 2432*l.* 0*s.* 6¾*d.*

9. Add 471*l.* 15*s.* 2¼*d.*; 296*l.* 17*s.* 8½*d.*; 1432*l.* 15*s.* 4¼*d.*; 273*l.* 12*s.* 6*d.*; 354*l.* 14*s.* 5¼*d.*; 2471*l.* 13*s.* 4*d.* Ans. 5301*l.* 8*s.* 6¼*d.*

10. Add 28*l.* 12*s.* 5½*d.*; 437*l.* 16*s.* 3*d.*; 7328*l.* 12*s.* 5¼*d.*; 456*l.* 14*s.* 10*d.*; 3284*l.* 17*s.* 8¾*d.*; 27*l.* 16*s.* 3*d.* Ans. 11564*l.* 9*s.* 11½*d.*

11. What is the sum of 246*l.* 14*s.* 3½*d.*; 741*l.* 13*s.* 2¼*d.*; 79*l.* 2*s.* 8d.; 4284*l.* 16*s.* 2¼*d.*; 456*l.* 15*s.* 3*d.*; 36*l.* 8*s.* 4¾*d.*; 2841*l.* 12*s.* 9*d.*? Ans. 8687*l.* 2*s.* 8¾*d.*

12. Add 287*l.* 14*s.* 5½*d.*; 742*l.* 9*s.* 4*d.*; 28*l.* 17*s.* 5¼*d.*; 4684*l.* 12*s.* 9½*d.*; 356*l.* 14*s.* 6*d.*; 3284*l.* 16*s.* 5¾*d.*; 4721*l.* 15*s.* 2½*d.* Ans. 14107*l.* 0*s.* 2½*d.*

13. What is the sum of 38*l.* 14*s.* 6½*d.*; 276*l.* 13*s.* 5*d.*; 29*l.* 10*s.* 7¼*d.*; 4324*l.* 17*s.* 9½*d.*; 742*l.* 6*s.* 2¾*d.*; 5426*l.* 15*s.* 3*d.*; 45*l.* 4*s.* 10½*d.*; 2143*l.* 14*s.* 5*d.*? Ans. 13027*l.* 17*s.* 1½*d.*

14. What is the sum of 1568*l.* 16*s.* 9¼*d.*; 5769*l.* 17*s.* 10½*d.*; 8769*l.* 19*s.* 4¾*d.*; 7698*l.* 15*s.* 4*d.*; 49987*l.* 17*s.* 6½*d.*; 50987*l.* 14*s.* 7¾*d.*; 97854*l.* 8*s.* 6½*d.*; 9768*l.* 3*s.* 5¼*d.*; 376*l.* 9*s.* 7½*d.*; 88768*l.* 15*s.* 6¾*d.*? Ans. 321550*l.* 18*s.* 8¾*d.*

15. Bought a parcel of goods for 100*l.* 10*s.*, paid for packing them 18*s.* 6*d.*, for carriage 1*l.* 18*s.*, and spent about the bargain 12*s.* 8¾*d.* What do these goods stand me? Ans. 103*l.* 19*s.* 2¾*d.*

16. A servant went to market and laid out on beef 10*s.* 10½*d.*, on mutton 5*s.* 9½*d.*, on lamb 16*s.* 6*d.*, on

greens $5\frac{1}{2}d.$, on fish 10*s.* 3*d.*, on eggs $10\frac{3}{4}d.$, and on butter 6*s.* 8*d.* How much was laid out in all? Ans. 2*l.* 11*s.* $5\frac{1}{4}d.$

17. A owes B for bread 8*l.* 9*s.* $6\frac{1}{4}d.$, for cheese 5*l.* 10*s.*, for tea 3*l.* 11*s.* $9\frac{1}{2}d.$, for sugar 12*l.* 10*s.* $8\frac{3}{4}d.$, and for other articles 20*l.* 8*s.* $4\frac{1}{4}d.$ What is the amount of A's debt? Ans. 50*l.* 10*s.* $4\frac{3}{4}$d.

| | Avoirdupois Weight. | | | | Troy Weight. | | | |
|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 4 | | 10 | 12 | 20 | 24 |
| | T. | cwt. | qr. | | lb. | oz. | dwt. | gr. |
| (18.) | 40 | 16 | 2 | (19.) 25 14 12 | (20.) | 20 | 10 | 14 | 16 |
| | 56 | 18 | 0 | 30 15 14 | | 14 | 11 | 19 | 18 |
| | 45 | 14 | 1 | 24 14 11 | | 50 | 8 | 16 | 21 |
| | 34 | 19 | 3 | 16 10 8 | | 34 | 6 | 18 | 22 |
| | 54 | 16 | 2 | 8 7 10 | | 68 | 4 | 16 | 20 |
| | 36 | 15 | 1 | 13 6 9 | | 46 | 1 | 10 | 4 |
| | 88 | 14 | 2 | 4 14 10 | | 14 | 10 | 16 | 12 |
| | 10 | 10 | 0 | 8 10 15 | | 50 | 8 | 14 | 6 |

*

21. What is the sum of 50 lb. 11 oz. 14 dwt. 20 gr.; 40 lb. 10 oz. 15 dwt.; 62 lb. 8 oz. 20 gr.; 34 lb. 8 oz. 14 dwt.; 36 lb. 4 oz. 10 dwt. 19 gr.; and 54 lb. 15 gr.? Ans. 279 lb. 7 oz. 16 dwt. 2 gr.

22. What is the sum of 45 lb. 6 oz. 5 dr. 1 scr. 14 gr.; 23 lb. 8 oz. 6 dr. 12 gr.; 31 lb. 4 oz. 3 dr. 2 scr.; 27 lb. 10 oz. 2 dr.; 3 dr. 1 scr. 15 gr.; 2 lb. 5 oz. 7 dr. 2 scr. 10 gr.? Ans. 131 lb. 4 dr. 2 scr. 11 gr.

23. A shopkeeper retails of sugars 3 qr. 4 lb. 12 oz. 4 dr.; of teas 1 qr. 15 lb. 10 oz.; of coffee

* Ans. (18.) 369 tons, 4 cwt. 3 qr.—(19.) 133 lbs. 15 oz. 9 dr.—(20.) 301 lb. 4 oz. 7 dwt. 23 gr.

4 cwt. 1 qr. 6 lb. 14 oz.; of tobacco 5 cwt. 3 qr., and of snuff 2 cwt. 2 qr. 26 lb. 10 oz. 12 dr. What is the weight of the whole? Ans. 13 cwt. 3 qr. 25 lb. 15 oz.

24. A draper bought 308 yds. 2 qr. 1 nail; 500 yds. 1 qr. 3 nl.; 54 yds. 3 qr.; and 60 yds. 3 qr. 3 nls. How many yards did the whole contain? Ans. 924 yds. 2 qr. 3 nl.

25. From A to B is 5 miles, 1 fur. 8 po.; from B to C 19 m. 18 po.; from C to D 6 fur. 18 po. 4 yds.; and from D to E 5 m. 36 po. 4 yds. What is the distance from A to E? Ans. 30 mil. 1 fur. 1 po. $2\frac{1}{2}$ yds.

26. A wine merchant imported 378 gal. 2 qt. 1 pt. of claret, 310 gal. 1 qt. 1 pt. of sherry, 71 gal. 3 qt. 1 pt. Lisbon, 239 gal. 1 qt. of port, 356 gal. 3 qt. Madeira, and 219 gal. 2 qt. 1 pt. Champagne; how much did he import in all? Ans. 1576 gal. 2 qts.

27. A surveyor having measured 5 pieces of land, found the first to contain 6 ac. 2 ro. 20 po.; the second, 20 ac. 1 ro. 15 po.; the third, 15 ac. 3 ro. 4 po.; the fourth, 2 ac. 2 ro. 24 yds. 8 feet; and the fifth, 1 ac. 1 ro. 39 po. 28 yds. 5 feet. How many English acres were surveyed in all? Ans. 46 ac. 2 ro. 39 po. $22\frac{3}{4}$ yds. 4 ft.

## COMPOUND SUBTRACTION.

RULE 1. Place the less number under the greater, so that those parts which are of the same denomination may stand directly under each other, and draw a line under them.

2. Begin at the right hand, and subtract the number of each denomination in the lower line from the number above it, and set the remainder under it.

3. But if the lower number of any denomination is greater than the upper, add as many to the upper as make one of the next higher denomination, then subtract the lower from that sum, and add 1 to the lower number of the next denomination

before you subtract it; proceed in this manner till the whole is finished.

PROOF. As in Simple Subtraction.

STERLING MONEY.

EXAMPLES.

| | £ | s. | d. |
|---|---|---|---|
| (1.) | 10 | 20 | 12 |
| Borrowed | 6 | 14 | 6 |
| Paid | 4 | 15 | 8 |
| Balance | | | * |
| Proof | | | |

| | £ | s. | d. |
|---|---|---|---|
| (2.) | 10 | 20 | 12 |
| From | 20 | 10 | $10\frac{1}{2}$ |
| Take | 14 | 14 | $8\frac{3}{4}$ |
| Rem. | | | |
| Proof | | | |

| | £ | s. | d. |
|---|---|---|---|
| (3.) | 209 | 17 | $2\frac{1}{4}$ |
| | 189 | 19 | $9\frac{1}{2}$ |

| | £ | s. | d. |
|---|---|---|---|
| (4.) | 1004 | 12 | $2\frac{1}{2}$ |
| | 847 | 12 | $2\frac{3}{4}$ |

| | £ | s. | d. |
|---|---|---|---|
| (5.) | 1543 | 10 | $10\frac{1}{4}$ |
| | 896 | 13 | $5\frac{3}{4}$ |

6. From 14*l.* 10*s.* 8*d.* take 10*l.* 11*s.* $10\frac{1}{4}d.$ Ans. 3*l.* 18*s.* $9\frac{3}{4}d.$

7. From 40*l.* 16*s.* take 30*l.* 18*s.* $6\frac{1}{4}d.$ Ans. 9*l.* 17*s.* $5\frac{3}{4}d.$

8. From 436*l.* 17*s.* $4\frac{1}{2}d.$ take 298*l.* 14*s.* $6\frac{3}{4}d.$ Ans. 138*l.* 2*s.* $9\frac{3}{4}d.$

9. From 978*l.* 5*s.* $2\frac{1}{2}d.$ take 284*l.* 16*s.* $4\frac{3}{4}d.$ Ans. 693*l.* 8*s.* $9\frac{3}{4}d.$

10. From 3045*l.* take 3000*l.* 10*s.* 8*d.* Ans. 44*l.* 9*s.* 4*d.*

11. A borrowed from B 100*l.* and paid him 48*l.* 16*s.* $10\frac{3}{4}d.$ What is due to B? Ans. 51*l.* 3*s.* $1\frac{1}{4}d.$

12. What is the difference between 2843*l.* 12*s.* $8\frac{1}{4}d.$ and 1761*l.* 13*s.* $4\frac{1}{2}d.$? Ans. 1081*l.* 19*s.* $3\frac{3}{4}d.$

13. What is the difference between 471*l.* 12*s.* $9\frac{1}{2}d.$ and 7846*l.* 0*s.* $4\frac{1}{4}d.$? Ans. 7374*l.* 7*s.* $6\frac{3}{4}d.$

14. A merchant, who had owing him 1000*l.* 8*s.* 9*d.*,

* Ans. (1.) 1*l.* 18*s.* 10*d.*—(2.) 5*l.* 16*s.* $1\frac{3}{4}d.$—(3.) 19*l.* 17*s.* $4\frac{3}{4}d.$—(4.) 156*l.* 19*s.* $11\frac{3}{4}d.$—(5.) 646*l.* 17*s.* $4\frac{1}{2}d.$

received at one time 108*l.* 14*s.* 4*d.*, at another 112*l.* 10*s.* 6$\frac{3}{4}$*d.*, and at a third 258*l.* 8*s.* 5$\frac{1}{2}$*d.* What remains due to him? Ans. 520*l.* 15*s.* 4$\frac{3}{4}$*d.*

15. A merchant has in cash 480*l.* 6*s.* 7*d.*, goods, value 3005*l.* 14*s.* 8*d.*, a house 788*l.* 10*s.* 6$\frac{3}{4}$*d.*, debts due to him 850*l.* 18*s.* 9$\frac{1}{4}$*d.* He owes A 100*l.* 6*s.* 8*d.*, B 70*l.* 19*s.* 8*d.*, and C 169*l.* 16*s.* 10$\frac{3}{4}$*d.* Required his stock? Ans. 4784*l.* 7*s.* 4$\frac{1}{4}$*d.*

16. Two women and a man received 30*l.* 5*s.* 6$\frac{1}{2}$*d.* for their yearly wages; the oldest woman and the man received 22*l.* 7*s.* 6$\frac{1}{4}$*d.*, and the youngest woman and the man, 21*l.* 3*s.* 5*d.* Required the wages of each? Ans. the man's, 13*l.* 5*s.* 4$\frac{3}{4}$*d.*, the oldest woman's, 9*l.* 2*s.* 1$\frac{1}{2}$*d.*, the youngest woman's, 7*l.* 18*s.* 0$\frac{1}{4}$*d.*

17. Bought 20 lb. 8 oz. 10 dwt. of silver plate, and sold 14 lb. 8 oz. 14 dwt. 16 grains. What remains? Ans. 5 lb. 11 oz. 15 dwt. 8 gr.

18. Bought 4 tons, 6 cwt. 1 qr. of sugar, and sold at one time, 1 ton, 20 lb., and at another, 1 ton, 10 cwt. 1 qr. 4 lb. 14 oz. What remains? Ans. 1 ton, 15 cwt. 3 qr. 3 lb. 2 oz.

19. From 850 yards take 500 yds. 2 qr. 1 nl. Ans. 349 yds. 1 qr. 3 nl.

20. A person intending to make a journey of 50 miles, was only able to go 30 miles, 6 fur. 21 po. 3 yds. What part of the journey remains unfinished? Ans. 19 m. 1 fur. 18 po. 2$\frac{1}{2}$ yds.

21. A farmer bought 111 qr. 7 bush. 2 pks. of barley, and afterwards sold 54 qr. 4 bush. 3 pks., How much did he retain in his possession? Ans. 57 qr. 2 bush. 3 pks.

22. A field of 25 ac. 2 ro. 17 per. 5 yds. is sown with wheat and oats; 14 ac. 3 ro. 27$\frac{3}{4}$ yds. are wheat, and the remainder oats; how much is that? Ans 10 ac. 3 ro. 16 per. 7$\frac{1}{2}$ yds.

**23.** From 84 qr. 2 bu. 2 pks. take 66 qr. 3 bu. 3 pks. 1 gal., and how much remains? Ans. 17 qr. 6 bu. 2 pks. 1 gal.

**24.** Subtract one farthing from 100*l.* Ans. 99*l.* 19*s.* 11¾*d.*

25. An Account of Household Expenses.

| 1882. | Received. £ | s. | d. | Paid. £ | s. | d. |
|---|---|---|---|---|---|---|
| Jan. 1. On hand, | 4 | 6 | 8½ | | | |
| 3. Paid for tea, | | | | | 4 | 6 |
| for sugar, | | | | | 3 | 10½ |
| for butter, | | | | | 1 | 6 |
| 10. for cheese, | | | | | 9 | 8¾ |
| for butcher meat, | | | | 1 | 10 | 0 |
| 14. Received, | 4 | 10 | 6 | | | |
| 20. Paid Baker's account, | | | | 1 | 14 | 6 |
| 21. Tailor's do. | | | | | 10 | 6½ |
| Shoemaker's do. | | | | 1 | 18 | 9 |
| 28. Brewer's do. | | | | 1 | 19 | 11¾ |
| **31.** On hand, | £0 | 3 | 10 | | | |

## COMPOUND MULTIPLICATION.

RULE I. 1. When the Multiplier does not exceed 12, write it under the lowest denomination of the Multiplicand.

2. Multiply its several denominations in order, beginning at the lowest, and carry according to the value of the next higher.

3. When the Multiplier exceeds 12, and is the product of two or more numbers, none of which exceeds 12, multiply successively by these numbers.

PROOF. By Division.

EXAMPLES.

**1.** What cost 2 yards at 1*s.* 4½*d.*? Ans. 2*s.* 8½*d.*

**2.** What cost 3 yards at 2*s.* 8¾*d.*? Ans. 8*s.* 2¼*d.*

3. What cost 4 lb. of sugar at $9\frac{1}{2}d.$? Ans. $3s.\ 2d.$

4. What cost 6 lb. of tea at $4s.\ 6d.$? Ans. $1l.\ 7s.$

5. What cost 8 lb. of butter at $10\frac{1}{4}d.$? Ans. $6s.\ 10d.$

6. What cost 10 lb. of cheese at $5\frac{1}{2}d.$? Ans. $4s.\ 7d.$

7. What cost 12 lb. of beef at $4\frac{1}{4}d.$? Ans $4s.\ 3d.$

8. What cost 14 lb. of mutton at $3\frac{1}{2}d.$? Ans. $4s.\ 1d.$

9. What cost 16 lb. of veal at $5\frac{3}{4}d.$? Ans. $7s.\ 8d.$

10. What cost 24 gallons of brandy at $12s.\ 6d.$? Ans. $15l.$

11. What cost 28 firkins of herring at $7s.\ 3\frac{1}{2}d.$? Ans. $10l.\ 4s.\ 2d.$

12. What cost 30 lb. of candle at $9\frac{1}{2}d.$? Ans. $1l.\ 3s.\ 9d.$

13. What cost 32 ells of holland at $8s.\ 4\frac{1}{4}d.$? Ans. $13l.\ 7s.\ 4d.$

14. What cost 36 bolls of meal at $14s.\ 6\frac{1}{4}d.$? Ans. $26l.\ 2s.\ 9d.$

15. What cost 56 firkins of butter at $16s.\ 3\frac{1}{2}d.$? Ans. $45l.\ 12s.\ 4d.$

16. What cost 60 bolls of wheat at $1l.\ 4s.\ 6d.$? Ans. $73l.\ 10s.$

17. What cost 72 stones of wool at $8s.\ 6d.$? Ans. $30l.\ 12s.$

18. What cost 100 stones of coals at $1\frac{3}{4}d.$? Ans. $14s.\ 7d.$

19. What cost 108 cwt. of cheese at $1l.\ 5s.\ 3d.$? Ans. $136l.\ 7s.$

20. What cost 120 cwt. of hops at $4l.\ 7s.\ 6d.$? Ans. $525l.$

21. What is the weight of 35 hhds. of sugar, each 14 cwt. 2 qr. 17 lb.? Ans. 512 cwt. 3 qr. 7 lb.

22. What quantity of land is there in 27 fields, each 15 ac. 2 ro. 19 poles, $22\frac{1}{2}$ yards? Ans. 421 ac. 3 ro. 13 po. $2\frac{1}{2}$ yds.

23. What quantity of ale is there in 49 casks,

each containing 54 gal. 3 qts. 1½ pint? Ans. 2691 gal. 3 qts. 1½ pt.

24. How much silver in 5 dozen dessert-spoons, each 2 oz. 11 dwt. 17 grains, and 6 dozen tea-spoons, each 19 dwt. 23 grains? Ans. 18 lbs. 10 oz. 19 dwt. 12 grains.

RULE II. If the Multiplier is not the Product of any two or more numbers, first, Multiply by two such numbers as come nearest the given Multiplier, either greater or less. Next, Multiply the Multiplicand by the difference between this number and the Multiplier; then add or subtract the Product from that before found, according as the given number was greater or less than the assumed number.

25. What is the price of 17 pair of shoes at 6*s*. 3*d*.? Ans. 5*l*. 6*s*. 3*d*.

26. What is the value of 29 pair of stockings at 2*s*. 6*d*.? Ans. 3*l*. 12*s*. 6*d*.

27. What cost 37 pair of buckles at 4*s*. 4½*d*.? Ans. 8*l*. 1*s*. 10½*d*.

28. What cost 46 gallons of whisky at 10*s*. 6*d*.? Ans. 24*l*. 3*s*.

29. What will the rent of a shop amount to in a year, at 14*s*. 8½*d*. a-week? Ans. 38*l*. 4*s*. 10*d*.

30. What cost 92 stones of flax at 9*s*. 8¾*d*.? Ans. 44*l*. 15*s*. 1*d*.

31. What cost 105 puncheons of rum at 24*l*. 6*s*. 2*d*.? Ans. 2552*l*. 7*s*. 6*d*.

32. What will 29 men's wages amount to in a year at 16*s*. 11¾*d*. each per week? Ans. 1280*l*. 4*s*. 7*d*.

33. What is the value of 39 oxen at 15*l*. 7*s*. 11¼*d*. each? Ans. 600*l*. 9*s*. 6¾*d*.

34. What is the value of 23 acres of turnips at 19*l*. 17*s*. 9¾*d*. per acre? Ans. 457*l*. 9*s*. 8¼*d*.

35. What must a farmer pay for cutting down his crop, supposing that he employs 63 reapers for 3 weeks at 2*s*. 5¾*d*. per day? Ans. 140*l*. 11*s*. 4½*d*.

RULE 111. When the Multiplier is large, multiply as many times by 10 as there are figures in the Multiplier above the unit's place; then multiply the Product of the last 10 by the left-hand figure, and the Product above that of the last 10 by the next figure, and so on till you have multiplied by all the figures in the Multiplier; then add the Products.

36. What will a man's wages amount to in 253 days at 1*s.* 4½*d.* a-day? Ans. 17*l.* 7*s.* 10½*d.*

37. A gentleman's yearly income is 500*l.* and he spends daily 19*s.* 1*d.*, reckoning 365 days to a year; how much does he spend? and how much does he save yearly? Ans. Spends 348*l.* 5*s.* 5*d.*; saves 151*l.* 14*s.* 7*d.*

38. If a traveller's expenses are 2*l.* 13*s.* 4½*d.* a-day, what will they amount to in 486 days? Ans. 1297*l.* 0*s.* 3*d.*

39. What cost 4880 cwt. at 18*s.* 7¼*d.*? Ans. 4539*l.* 8*s.* 4*d.*

40. What cost 3789 quarters of wheat at 3*l.* 17*s.* 6¼*d.*? Ans. 14686*l.* 6*s.* 5¼*d.*

41. What is the rent of a farm containing 1786 acres at 2*l.* 11*s.* 2¾*d.* p. acre? Ans. 4574*l.* 15*s.* 3½*d.*

42. What is the weight of 345 hogsheads of sugar, each 14 cwt. 1 qr. 20 lb.? Ans. 4977 cwt. 3 qr. 12 lb.

43. If a fleece of wool weigh 3 st. 1 clove, 5 lb., what will be the weight of 2430 fleeces, each fleece being supposed to contain the same quantity of wool? Ans. 9372 st. 1 clove, 5 lb.

44. How much wine will 46 casks contain, each holding 243 gallons, 2 qts. 1 pint? Ans. 11206 gal. 3 qts.

45. How much will a mill grind in a year at 2 qr. 3 bush. 3 pks. a-day? Ans. 901 qr. 3 pks.

46. What is the weight of 20 hogsheads of tobacco, each 4 cwt. 1 qr. 18 lb. 12 oz.? Ans. 4 ton 8 cwt. 1 qr. 11 lb.

# BILLS OF PARCELS.

## 1. A Hosier's Bill.

Mr John Grant

Bought of James Brown,

| 1882. | | | s. | d. |
|---|---|---|---|---|
| Jan. 4. | 8 pair worsted stockings, | at | 2 | 6 |
| | 9 pair thread ditto, | at | 3 | 1 |
| | 7 pair silk ditto, | at | 12 | 10½ |
| | 10 pair cotton ditto, | at | 5 | 8¾ |
| | 4 pair hose, | at | 1 | 9 |

Ans. £10 2 2

## 2. A Stationer's Bill.

Mr George Young

1882. Bought of David Scott,

Feb. 15. 20 reams post paper, at 1*l.* 1*s.*
18 reams foolscap, at 14*s.* 6*d.*
24 reams printing demy, at 18*s.* 10*d.*
30 reams royal, at 2*l.* 4*s.* 2*d.*
6 reams cartridge, at 12*s.* 8*d.*
4 cwt. pasteboard, at 17*s.* 6½*d.*

Ans. £130 4 2

## 3. A Woollen Draper's Bill.

Mr Richard Reid

1882. Bought of Joseph Black,

Feb. 24. 13 yards serge, at 3*s.* 6*d.*
18 yards drugget, at 1*s.* 4½*d.*
25 yards scarlet cloth, at 18*s.* 9*d.*
14 yards black ditto, at 17*s.* 11¾*d.*
20 yards shalloon, at 1*s.* 10*d.*
17 yards drab, at 3*s.* 2*d.*

Ans. £44 1 2½

# COMPOUND DIVISION.

**Rule** 1. Place the Divisor and Dividend as in Simple Division.

2. Begin at the highest denomination of the Dividend, divide as in Simple Division; and reduce the Remainder, if any, to the next lower denomination, adding the given number of that name; divide this sum, and proceed in the same manner with all the denominations. The several parts of the Quotient, thus found, will be the answer required.

## Proof. By Multiplication.

EXAMPLES.

1. Divide 3*l.* 10*s.* by 2. Ans. 1*l.* 15*s.*
2. Divide 8*l.* 6*s.* 6*d.* by 3. Ans. 2*l.* 15*s.* 6*d.*
3. Divide 9*l.* 10*s.* 10*d.* by 4. Ans. 2*l.* 7*s.* $8\frac{1}{2}d.$
4. Divide 18*l.* 16*s.* $9\frac{1}{4}d.$ by 5. Ans. 3*l.* 15*s.* $4\frac{1}{4}d.$
5. Divide 17*l.* 13*s.* by 6. Ans. 2*l.* 18*s.* 10*d.*
6. Divide 20*l.* 6*s.* 7*d.* by 7. Ans. 2*l.* 18*s.* 1*d.*
7. Divide 21*l.* 8*s.* by 8. Ans. 2*l.* 13*s.* 6*d.*
8. Divide 271*l.* 1*s.* $2\frac{1}{4}d.$ by 9. Ans. 30*l.* 2*s.* $4\frac{1}{4}d.$
9. Divide 43*l.* 16*s.* $0\frac{1}{2}d.$ by 10. Ans. 4*l.* 7*s.* $7\frac{1}{4}d.$
10. Divide 340*l.* 10*s.* by 16. Ans. 21*l.* 5*s.* $7\frac{1}{2}d.$
11. Divide 248*l.* 17*s.* $3\frac{1}{2}d.$ by 35. Ans. 7*l.* 2*s.* $2\frac{1}{2}d.$
12. Divide 3590*l.* 12*s.* 6*d.* by 53. Ans. 67*l.* 14*s.* $11\frac{1}{4}d.$ $\frac{52}{53}.$
13. Divide 5672*l.* 14*s.* by 96. Ans. 59*l.* 1*s.* $9\frac{2}{4}d.$
14. Divide 630*l.* 7*s.* $8\frac{1}{2}d.$ by 365. Ans. 1*l.* 14*s.* $6\frac{1}{2}d.$
15. Divide 17843*l.* 18*s.* $10\frac{1}{2}d.$ by 801. Ans. 22*l.* 5*s.* $6\frac{1}{2}d.$
16. Divide 345 cwt. 1 qr. 8 lb. by 11. Ans. 31 cwt. 1 qr. 16 lb.
17. Divide 47 lb. 2 oz. 13 dwt. by 7. Ans. 6 lb. 8 oz. 19 dwt.
18. Divide 19 lb. 6 oz. 3 dr. 2 scr. by 5. Ans. 3 lb. 10 oz. 7 dr. 8 gr.

19. The proprietor of a vineyard sold in equal quantities to 25 of his customers, 42834 gal. 1 qt. 1 pt. of wine; how much did each purchase? Ans. 1713 gal. 1 qt. 1 pt.

20. Divide 540 yards, 3 qr. 1 nl. by 28. Ans. 19 yards, 1 quarter, $1\frac{1}{8}$ nail.

21. Divide 51 acres, 1 rood, 11 poles, by 51. Ans. 1 acre, 1 pole.

22. Divide 307 gallons, 1 pint, by 63. Ans. 4 gallons, 3 quarts, 1 pint.

23. If seven casks weigh 2 tons, 7 cwt. 3 quarters, 14 lb., what does 1 cask weigh? Ans. 6 cwt. 3 quarters, 10 lb.

24. If 6 lb. of tea cost 1*l.* 7*s.*, what will 1 lb. cost? Ans. 4*s.* 6*d.*

25. If 9 pair of gloves cost 1*l.* 8*s.* $10\frac{1}{2}d.$, what is that per pair? Ans. 3*s.* $2\frac{1}{2}d.$

26. Bought 12 lb. of beef for 4*s.* 3*d.* What did it cost the lb.? Ans. $4\frac{1}{4}d.$

27. Bought 24 gallons of rum for 16*l.* 15*s.* 6*d.* What did it cost per gallon? Ans. 13*s.* $11\frac{3}{4}d.$

28. If 29 yards of cloth cost 5*l.* 2*s.* $1\frac{1}{4}d.$, what cost 1 yard? Ans. 3*s.* $6\frac{1}{4}d.$

29. A piece of land containing 45 acres is let for 113*l.* 12*s.* 6*d.* What is it let at per acre? Ans. 2*l.* 10*s.* 6*d.*

30. If a man spends 128*l.* 11*s.* 2*d.* in 12 months, what is that per month? Ans. 10*l.* 14*s.* $3\frac{2}{12}d.$

31. Three men make an adventure, each equally concerned, whereby they clear 740*l.* What was each man's share of the gain? Ans. 246*l.* 13*s.* 4*d.*

32. What is the value of 1 yard of cloth, when 4 yards cost 51*l.* 7*s.* 3*d.*? Ans. 12*s.* $2\frac{3}{4}d.$

33. A prize of 3850*l.* is to be equally divided among 742 sailors. What is each man's share. Ans. 5*l.* 3*s.* $9\frac{1}{4}d.$ $\frac{98}{742}$.

34. A gentleman has 560*l.* 12*s.* a-year. How

much is that a-month, a-week, and a-day? Ans. 46*l.* 14*s.* 4*d.* a-month; 10*l.* 15*s.* $7\frac{1}{4}d.$ $\frac{2}{5}\frac{8}{2}$. a-week; 1*l.* 10*s.* $8\frac{1}{2}d.$ $\frac{1}{3}\frac{6}{6}\frac{6}{3}$. a-day.

When the Divisor is of different denominations.

RULE. Reduce both the Divisor and Dividend to the same denomination, and then proceed as in Simple Division.

35. A gentleman distributed 6*l.* 12*s.* among some poor people, and gave each 5*s.* 6*d.* How many poor were there? Ans. 24.

36. The revenues of an infirmary amount to 1152*l.* 10*s.* 6*d.* How many patients will it maintain, when each patient requires 9*l.* 10*s.* 6*d.*? Ans. 121.

37. A farm is let at 1*l.* 2*s.* 6*d.* per acre, and the rent amounts to 569*l.* 16*s.* 3*d.* How many acres does it contain? Ans. 506 acres, 2 roods.

38. How long must a tradesman work, who gains 1*s.* 4*d.* a-day and spends $7\frac{1}{2}d.$, in order to pay a debt of 20*l.* 17*s.* $2\frac{1}{2}d.$? Ans. 589 days.

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## SUPPLEMENT TO COMPOUND MULTIPLICATION AND DIVISION.

I. When the Multiplier contains a fraction.

RULE. First multiply by the whole number, then multiply by the upper figure of the fraction, and divide by the lower figure, and add the Quotient to the former Product.

39. What cost $8\frac{3}{8}$ yds. at 14*s.* $6\frac{1}{2}d.$? Ans. 6*l.* 1*s* $9\frac{1}{4}d.$ $\frac{3}{4}$.

40. What cost $12\frac{3}{4}$ lb. at 6*s.* 2*d.*? Ans. 3*l.* 18*s.* $7\frac{1}{2}d.$

41. What cost $14\frac{5}{8}$ yards at 11*s.* $9\frac{3}{4}d.$? Ans. 8*l.* 12*s.* $9\frac{9}{4}d.$ $\frac{5}{8}$.

42. What cost $29\frac{1}{3}$ bushels of wheat at 15*s.* $6\frac{3}{4}d.$? Ans. 22*l.* 16*s.* 6*d.*

43. What cost $46\frac{3}{8}$ cwt. of hay at 6*s.* $7\frac{3}{4}d.$? Ans. 15*l.* 8*s.* $2\frac{1}{4}d.$ $\frac{5}{8}$.

44. Multiply 20 lb. 2 oz. 7 dwt. 21 gr. by $4\frac{2}{5}$. Ans. 92 lb. 11 oz. $5\frac{2}{5}$ grs.

45. Multiply 24 cwt. 1 qr. 14 lb. 10 oz. by $8\frac{4}{7}$. Ans. 202 cwt. 1 lb. $2\frac{6}{7}$ oz.

46. Multiply 20 m. 3 fur. 30 po. 2 yds. by $9\frac{2}{3}$. Ans. 197 m. 7 fur. 1 yd.

47. Multiply 120 yds. 2 qr. 1 nl. by $10\frac{1}{3}$. Ans. 1259 yds. $3\frac{1}{2}$ nl.

48. Multiply 40 ac. 3 ro. 30 po. by $11\frac{3}{7}$. Ans. 467 ac. 3 ro. $17\frac{1}{7}$ po.

49. Multiply 57486 gallons, 3 quarts, 1 pint of wine by $7\frac{2}{3}$. Ans. 440732 gallons, 2 quarts, $1\frac{2}{3}$ pint.

## II. When the Divisor contains a fraction.

RULE. Multiply both the Divisor and Dividend by the under figure of the fraction, adding the upper figure to the Product of the Divisor, then divide the Product of the Dividend by the sum.

50. Bought $17\frac{1}{4}$ bolls of potatoes for 8*l.* 12*s.* 6*d.* What did they cost per boll? Ans. 10*s.*

51. Bought $13\frac{1}{3}$ yds. of cloth for 15*l.* What did it cost per yard? Ans. 1*l.* 2*s.* 6*d.*

52. Bought $22\frac{3}{4}$ stones of beef for 12*l.* 6*s.* $8\frac{1}{2}d.$ What did it cost per stone? Ans. 10*s.* 10*d.* $\frac{1}{9}\frac{2}{1}$.

53. Divide 276*l.* 16*s.* 8*d.* among 5 men and a boy, and give the boy $\frac{2}{5}$ of a man's share. Ans. A man's share, 48*l.* 17*s.* $0\frac{1}{2}d.$ $\frac{1}{1}\frac{1}{4}$. Boy's share, 32*l.* 11*s.* $4\frac{1}{4}d.$ $\frac{1}{1}\frac{5}{7}$.

54. Divide 200*l.* 14*s.* 6*d.* among 9 men and 7 women; and give a woman $\frac{5}{6}$ of a man's share. Ans. A man's share, 13*l.* 10*s.* $7\frac{1}{2}d.$ $\frac{6}{8}\frac{6}{9}$. A woman's 11*l.* 5*s.* $6\frac{1}{4}d.$ $\frac{5}{8}\frac{5}{9}$.

55. A, B, and C, have a ship in company: A has $\frac{5}{8}$, B $\frac{1}{4}$, and C $\frac{1}{8}$: they receive of freight for a voyage, 114*l.* 8*s.* 4*d.* What is each man's share of the freight? Ans. A's share, 71*l.* 10*s.* $2\frac{1}{2}d.$ B's 28*l.* 12*s.* 1*d.* C's 14*l.* 6*s.* $0\frac{1}{2}d.$

# BILLS OF PARCELS.

## 4. A Grocer's Bill.

Mr Robert Ross

1882. Bought of William Smith,

| | | | |
|---|---|---|---|
| March 1. | 24 lb. lump sugar, | at | $10\frac{1}{2}d.$ |
| | 26 lb. powder do., | at | $8\frac{3}{4}d.$ |
| | 16 lb. soap, | at | $7\frac{1}{4}d.$ |
| | 4 lb. starch, | at | 1*s.* 2d. |
| | 15 lb. tea, | at | 4*s.* 6*d.* |

Ans. £6 1 $9\frac{1}{2}$

## 5. A Leather Merchant's Bill.

Mr Gilbert Bruce

1882. Bought of James Skinner,

| | | | |
|---|---|---|---|
| April 5. | 28 calf skins, | at | 4*s.* $8\frac{1}{2}d.$ |
| | 29 lamb do., | at | $8\frac{1}{4}d.$ |
| | 34 sheep do., | at | 1*s.* 3*d.* |
| | 17 buck do., | at | 8*s.* 6*d.* |
| | 18 cow hides, | at | 12*s.* $7\frac{3}{4}d.$ |
| | 110 lb. leather, | at | 2*s.* 8*d.* |

Ans. £42 19 8

## 6. A Linen-Draper's Bill.

Mr Charles Russel

1882. Bought of Adam Waugh,

| | | | |
|---|---|---|---|
| May 20. | $45\frac{3}{8}$ yards cambric, | at | 11*s.* 6*d.* |
| | $35\frac{5}{8}$ yards muslin, | at | 4*s.* $8\frac{3}{4}d.$ |
| | $26\frac{7}{8}$ yards linen, | at | 3*s.* 4*d.* |
| | $23\frac{1}{4}$ yards holland, | at | 5*s.* 3*d.* |
| | $10\frac{1}{2}$ ells diaper, | at | 1*s.* $4\frac{1}{2}d.$ |
| | $13\frac{3}{4}$ ells dowlas, | at | 1*s.* 6*d.* |

Ans. £46 16 $11\frac{3}{4}$ $\frac{7}{8}$

## 7. A Druggist's Bill.

Mr Samuel Orr

1882. Bought of Jones Paul,

| | | | |
|---|---|---|---|
| June 4. | $18\frac{1}{2}$ lb. rhubarb, | at | 1*l.* 10*s.* per lb. |
| | 14 lb. opium, | at | 18*s.* $11\frac{1}{4}d.$ |
| | $37\frac{1}{4}$ lb. gum-arabic, | at | 1*s.* 10*d.* |
| | $112\frac{3}{4}$ lb. jesuit's bark, | at | 3*s.* 6d. |

Ans. £64 3 $0\frac{1}{2}$

## SIMPLE PROPORTION

Teaches from three given numbers to find a fourth.

Of the three given numbers two are always of the same kind; the other is of the same kind as the fourth, or number required in the question.

RULE 1. Put down that number which is of the same kind with the number required for the third term.

2. Consider whether the answer ought to be greater or less than this number; if greater, make the greater of the two remaining numbers the second term, and the less the first; but if less, make the less of the two remaining numbers the second, and the greater the first term.

3. If the first and second terms are of different denominations, reduce them to the same, and the third to the lowest denomination mentioned in it.

4. Multiply the second and third terms together, and divide their product by the first; the quotient will be the answer in the same denomination to which the third term was reduced, and it may either be brought to a higher or reduced to a lower denomination, according as the answer requires.

PROOF. Invert the question.

NOTE 1. Multiply and divide as in Compound Multiplication and Division, when found convenient.

2. When the first number is 1, the answer is found by Multiplication. When the second or third number is 1, then the answer is found by Division.

3. If the first number, and either the second or third, can be exactly divided by the same divisor, let them be divided, and the quotients used instead of the original numbers.

4. To find a common measure: Divide the Divisor by the Remainder continually till nothing remain; the last Divisor is the common measure: then divide the Remainder and Divisor by it, and the quotient will be the lowest terms.

[The Method of Unity may also be employed. Thus, to find the answer to the question, "If 12 yards of cloth cost 1*l.* 7*s.*, what will 96 yards cost?"

If 12 yards cost 1*l.* 7*s.*,

Then, 1 yard will cost $\frac{27s.}{12} = 2s.\ 3d.$

96 yards will therefore cost $2s.\ 3d. \times 96 = 10l.\ 16s.$]

EXAMPLES.

1. If 2 yards of cloth cost 4*s.* 6*d.*, what will 16 yards cost? Ans. 1*l.* 16*s.*

2. If 16 yards of cloth cost 1*l.* 16*s.*, what will 2 yards cost? Ans. 4*s.* 6*d.*

3. If $4\frac{1}{2}$ yards cost 12*s.* $8\frac{1}{2}d.$, what will 20 yards cost? Ans. 2*l.* 16*s.* $5\frac{5}{4}d.$ $\frac{1}{9}$.

4. If 20 yards cost 2*l.* 16*s.* $5\frac{3}{4}d.$ $\frac{1}{9}$., what will $4\frac{1}{2}$ yards cost? Ans. 12*s.* $8\frac{1}{2}d.$

5. If $1\frac{1}{4}$ yard cost 2*s.* 6*d.*, what cost $24\frac{1}{2}$ yards? Ans. 2*l.* 9*s.*

6. If $24\frac{1}{2}$ yards cost 2*l.* 9*s.*, what will $1\frac{1}{4}$ yard cost? Ans. 2*s.* 6*d.*

7. If 1 lb. of sugar cost $10\frac{1}{2}d.$, what will $1\frac{1}{2}$ cwt. cost? Ans. 7*l.* 7*s.*

8. If $1\frac{1}{2}$ cwt. of sugar cost 7*l.* 7*s.*, what will 1 lb. cost? Ans. $10\frac{1}{2}d.$

9. If $1\frac{1}{4}$ oz. of tea cost $6\frac{3}{4}d.$, what will 24 lb. cost? Ans. 8*l.* 12*s.* $9\frac{1}{2}d.$ $\frac{2}{3}$.

10. If 24 lb. cost 8*l.* 12*s.* $9\frac{1}{2}d.$ $\frac{2}{3}$., what will $1\frac{1}{4}$ oz. cost? Ans. $6\frac{3}{4}d.$

11. If 1 oz. of coffee cost $6\frac{1}{2}d.$, what will $2\frac{1}{2}$ cwt. cost? Ans. 121*l.* 6*s.* 8*d.*

12. If $2\frac{1}{2}$ cwt. of coffee cost 121*l.* 6*s.* 8*d.*, what will 1 oz. cost? Ans. $6\frac{1}{2}d.$

13. If three quarters of cloth cost 3*s.* 6*d.*, how much will three pieces, each $30\frac{1}{2}$ yards, cost? Ans. 21*l.* 7*s.*

14. If three pieces of cloth, each $30\frac{1}{2}$ yards, cost 21*l.* 7*s.*, what will $\frac{3}{4}$ of a yard cost? Ans. 3*s.* 6*d.*

15. If 4 cwt. 1 qr. 14 lb. of tobacco cost 40*l.* 16*s.* 8*d.*, what cost 1 ounce? Ans. $1\frac{1}{4}d.$

16. If 1 oz. cost $1\frac{1}{4}d.$, what will 4 cwt. 1 qr. 14 lb. cost? Ans. 40*l.* 16*s.* 8*d.*

17. If $1\frac{1}{2}$ oz. of snuff cost $2\frac{1}{2}$d., what cost 5 cwt. 3 qr. 18 lb.? Ans. 73*l.* 11*s.* $1\frac{1}{4}$*d.* $\frac{1}{3}$.

18. If 5 cwt. 3 qr. 18 lb. cost 73*l.* 11*s.* $1\frac{1}{4}$*d.* $\frac{1}{3}$., what cost $1\frac{1}{2}$ oz.? Ans. $2\frac{1}{2}$*d.*

19. If $1\frac{1}{2}$ lb. cost $1\frac{1}{2}$*d.*, what will 2 tons weight cost? Ans. 18*l.* 13*s.* 4*d.*

20. What must I pay for 126 gallons of wine at 13*s.* 6*d.* the gallon? Ans. 85*l.* 1*s.*

21. If $3\frac{1}{2}$ cwt. of cheese cost 8*l.* 11*s.* 6*d.*, what is that per lb.? Ans. $5\frac{1}{4}$*d.*

22. What is the price of 10 cheeses, each $15\frac{1}{4}$ lb., at $6\frac{3}{4}$*d.* the lb.? Ans. 4*l.* 5*s.* $9\frac{1}{4}$*d.* $\frac{1}{2}$.

23. A gentleman spends 17*l.* 13*s.* $9\frac{1}{2}$*d.* a-week, and puts into the bank, at the year's end, 500*l.* What is his yearly income? Ans. 1422*l.* 7*s.* $8\frac{1}{2}$*d.*

24. If the daily expenses of the inhabitants of Edinburgh and Leith be 3240*l.* 9*s.* $9\frac{1}{2}$*d.* for maintenance, how much will support them $2\frac{1}{2}$ years? Ans. 2956946*l.* 14*s.* $10\frac{3}{4}$*d.*

25. If 1 yard of cloth cost 6*s.* 2*d.*, what cost 5 quarters? Ans. 7*s.* $8\frac{1}{2}$*d.*

26. If a ton of iron cost 23*l.* 6*s.* 8*d.*, what will $2\frac{1}{2}$ lb. cost? Ans. $6\frac{1}{4}$*d.*

27. If a manufacturer receives 1*s.* $6\frac{1}{2}$*d.* a-day for every week-day, how much will his wages amount to in a year? Ans. 24*l.* 2*s.* $6\frac{1}{2}$*d.*

28. A farm, containing 400 acres, 2 ro. 20 poles, is let at 2*l.* 2*s.* per acre, what is the yearly rent of that farm? Ans. 841*l.* 6*s.* 3*d.*

29. If 1 quarter of oats cost 18*s.* 8*d.*, how much will 61 quarters 7 bushels cost? Ans. 57*l.* 15*s.*

30. If 100 yards of cloth cost 20*l.* 9*s.* 4*d.*, how many yards may I buy for 6*s.* $4\frac{3}{4}$*d.*? Ans. 1 yd. 2 qr. 1 nl.

31. If 4 casks of raisins, each weighing 1 cwt.

2 qr. 16 lb. cost 23*l.*, I demand the value per cwt.? Ans. 3*l.* 10*s.*

32. What will a tax on 900*l.* amount to at 2*s.* 6*d.* the pound? Ans. 112*l.* 10*s.*

33. A bankrupt owes his creditors 1200*l.*, pays them only 750*l.* How much does he pay them per pound? Ans. 12*s.* 6*d.*

34. A bankrupt pays his creditors 12*s.* 6*d.* per pound, pays them in all 750*l.* What was his debt? Ans. 1200*l.*

35. A bankrupt owes his creditors 9000*l.* 10*s.* How much will he pay them at 15*s.* 6*d.* per pound? Ans. 6975*l.* 7*s.* 9*d.*

36. If 1 dwt. of gold costs 4*s.*, what cost 6 pieces each $2\frac{1}{4}$ lb.? Ans. 648*l.*

37. If $1\frac{3}{4}$ oz. of silver plate cost 9*s.* $7\frac{1}{2}$*d.*, what is the price of $24\frac{1}{2}$ lb.? Ans. 80*l.* 17*s.*

38. If 14 packs of wool, each 18 stones, cost 109*l.* 4*s.*, what is that per lb.? Ans. $7\frac{1}{4}$*d.* $\frac{6}{7}$.

39. A trader bought 100 lb. of tea at 5*s.* 6*d.* per lb., but finding it of an inferior quality, he is willing to lose 2*l.* 10*s.* upon the whole. At what rate must he retail it per ounce? Ans. $3\frac{3}{4}$*d.*

40. If 30 gallons of water in 1 hour fall into a cistern containing 200 gallons, and there run out $22\frac{1}{2}$ gallons in one hour, in how many hours will the cistern be filled, if both the cocks keep running? Ans. 26 hours, 40 minutes.

41. If 2 cwt. 2 qr. 24 lb. of soap be bought for 8*l.* 13*s.* 4*d.*, at how much must it be sold per lb. to gain 2*l.* 2*s.* on the whole? Ans. $8\frac{1}{2}$*d.*

42. A merchant bought 1008 gallons of oil for 640*l.*; it leaked out 48 gallons: at what rate must he sell it per gallon, so as to be no loser by it? Ans. 13*s.* 4*d.*

43. A draper bought 240 yards of broad cloth, and gave for it after the rate of 16*s.* 10½*d.* the ell English. How much did he pay for the whole? Ans. 162*l.*

44. The valued rent of a parish amounts to 5840*l.* and a rate is granted of 109*l.* 10*s.* for the poor. What is that per pound? Ans. 4½*d.*

45. A garrison has provisions for eight months, at the rate of 14 oz. to each person per day. How much must be allowed per day, in order that the provisions may last 10½ months? Ans. 10 oz. 10⅔ dr.

46. What is the interest of 47*l.* for a year at 4½*l.* per cent.? Ans. 2*l.* 2*s.* 3½*d.* ⅔.

47. If 14 men perform a piece of work in 6 days, working 10 hours a-day, in what time will 24 men perform it? Ans. 3 days, 5 hours.

48. If the sixpence loaf weighs 3 lb. when wheat is at 30*s.*, how much should it weigh when wheat is at 1*l.* 4*s.*? Ans. 3 lb. 12 oz.

49. What cost 50 pints of whisky, at 3½*d.* per gill? Ans. 2*l.* 18*s.* 4*d.*

50. Bought 4 cwt. 2 qr. 20 lb. of coffee for 113*l.* 10*s.* 8*d.* and retailed it at 3¾*d.* the ounce. What was the net gain? Ans. 17*l.* 9*s.* 4*d.*

51. If 1½ peck of potatoes cost 10½*d.*, what will be the value of 40 qrs. 4 bu. 3 pks. of the same? Ans. 37*l.* 17*s.* 9*d.*

52. What is the value of 900½ acres of land at three farthings the square yard? Ans. 13620*l.* 1*s.* 3*d.*

53. How much cloth at 6*s.* 8*d.* per yard ought to be given in barter for 15 cwt. 2 qr. of sugar, at 3*l.* 2*s.* 6*d.* per cwt.? Ans. 126 yards, 2 qr. 1 nl.

54. If a tailor can make a coat and vest with 3¾ yards of cloth, which is 1½ yard broad, how many yards will he require to make the same when the breadth is only 3 qr.? Ans. 7½ yards.

**55.** Bought for ready money 400½ yards of shalloon, at 1*s.* 8¼*d.* a-yard—54¼ yards of flannel, at 1*s.* 6*d.*—20 bushels of meal, at 14*s.* 6½*d.*—106 lb. clover seed, at 8¾*d.*—14⅓ stones iron, at 3*s.* 9½*d.*, and 31 casks train oil, at 1*l.* 4*s.* 6*d.* I demand the price of the whole? Ans. 96*l.* 19*s.* 9¾*d.* ½.

56. Bartered 20½ cwt. of sugar, at 3*l.* 4*s.* and 150 lb. tea, at 4½*d.* per ounce, for 96¼ yards calico, at 4*s.* 2*d.* and 144¾ yards diaper, at 2*s.* 4½*d.* How much money must be received besides the above? Ans. 73*l.* 7*s.* 2¾*d.* ½.

8. BOOK DEBTS.

Mr James Brown, Dr.

1882. To John Green.

June 3. To 305½ bushels salt, at 2*s.* 6*d.* per bushel.

24. To 40¼ reams paper, at 17*s.* 6¾*d.* per ream.

July 20. To 409½ gals. rum, at 13*s.* 4*d.* per gal.

28. To 24 tons, 10 cwt. 2 qrs. cheese, at 6¼*d.* per lb.

Aug. 1. To 1 ton, 1 qr. 7½ lb. sugar, at 8½*d.* per lb.

15. To 283½ gal. whisky, at 2¼*d.* per gill.

Sept. 7. To 59 qrs. 5 bush. 2½ pks. of meal, at 10½*d.* per peck.

Ans. £2026 7 7½ ⅜

## COMPOUND PROPORTION

Teaches from five given numbers to find a sixth. Of the five given numbers two are always of the

same kind with other two, and the remaining one the same as the number required.

RULE I. Put down that number which is of the same kind with the number required for the third term.

2. Take two terms of the same kind with each other, and state them as in Simple Proportion; then take other two terms of the same kind, and state them in the same manner under the former, and so on till all the terms are stated.

3. Reduce like terms to the same name, and the third to the lowest name in it.

4. Multiply together the terms which stand below each other, which will reduce them to three; then multiply the second by the third, and divide the Product by the first, the Quotient will be the answer in the same name with the third term.

PROOF. Invert the question.

1. If 100*l.* in 12 months gain 5*l.* of interest, what will 60*l.* gain in 9 months? Ans. 2*l.* 5*s.*

2. If 100*l.* in 12 months gain 5*l.* interest, what principal will gain 2*l.* 5*s.* in 9 months? Ans. 60*l.*

3. If 100*l.* gain 5*l.* in 12 months, in what time will 60*l.* gain 2*l.* 5*s.*? Ans. 9 months.

4. If the interest of 60*l.* for 9 months be 2*l.* 5*s.* required the rate per cent. per annum? Ans. 5*l.*

5. If 24 acres of grass be mowed by 16 men in 21 days, how many acres may be mowed by 48 men in 84 days? Ans. 288.

6. If 3 horses in 7 days eat 14 pecks of corn, what quantity will serve 24 horses 52 weeks? Ans. 1456 bushels.

7. If 12 reapers cut 14 acres of corn in 6 days, how many acres will 48 reapers cut in 24 days? Ans. 224 acres.

8. If the wages of 8 men for 6 days be 3*l.* 10*s.*, how much will pay 64 men for 32 days' work? Ans. 149*l.* 6*s.* 8*d.*

9. If 2 horses plough $4\frac{1}{2}$ acres of land in 6 days, when they work eight hours a-day, how many acres

will 16 horses plough in 156 days, when they work $12\frac{1}{2}$ hours a-day? Ans. 1462 ac. 2 ro.

10. If a regiment of 654 soldiers consume 117 quarters of wheat in 45 days, how many soldiers will consume 468 quarters in 9 days? Ans. 13080.

11. If 20 roods of ditching be wrought by 4 men in 12 days, working 14 hours a-day, how many will be done by 6 men in 4 days, when they work only 8 hours a-day? Ans. 5 roods, 25 yds. $6\frac{3}{7}$ feet.

12. If a carrier receives 6*l.* 8*s.* for the carriage of 4 cwt. 248 miles, how much ought he to receive for the carriage of 8 cwt. 3 qr. 14 lb. for 62 miles? Ans. 3*l.* 11*s.*

13. If 20 masons build a wall 50 feet long, 2 feet thick, and 14 feet high, in 12 days, in how many days will 60 masons build a wall 500 feet long, 4 thick, and 16 high? Ans. $91\frac{3}{7}$ days.

14. If a thousand men besieged in a town with provisions for 5 weeks, allowing each man 16 oz. a-day, be reinforced with 500 men more, and hearing that they cannot be relieved till the end of 8 weeks, how many ounces a-day must each man have, that the provisions may last that time? Ans. $6\frac{2}{3}$ oz.

15. If 660 yards of a road, which was to be 1 mile in length, be done by 24 men in 30 days, in what time will 30 men finish it? Ans. 40 days.

16. A farmer engaged 60 reapers to cut down his crop in 30 days, but after 10 days' work he engaged 40 more. In what time will it be cut down? Ans. 22 days.

17. If 24 men perform a piece of work in 20 days, how many men must be employed upon a piece of work 6 times as large, that it may be finished in one-fifth of the time? Ans. 720 men.

18. If a chest, 12 feet long, 6 deep, and 5 broad,

contains 40 quarters of oats, what must be the length of another, 5 feet deep and 3 broad, to contain 30 quarters? Ans. 18 feet.

## RULES OF PRACTICE.

Practice is so called from the great use thereof by persons concerned in trade and business.

TABLE OF ALIQUOT PARTS

| *of a Shilling.* | | | *of a Pound.* | | | *of a Cwt.* | |
|---|---|---|---|---|---|---|---|
| d. | | s. | s. | d. | £ | lb. | cwt. |
| 1 | = | $\frac{1}{12}$ | 1 | 3 | = $\frac{1}{16}$ | 56 = | $\frac{1}{2}$ |
| $1\frac{1}{2}$ | = | $\frac{1}{8}$ | 1 | 4 | = $\frac{1}{15}$ | 28 = | $\frac{1}{4}$ |
| 2 | = | $\frac{1}{6}$ | 1 | | = $\frac{1}{20}$ | 16 = | $\frac{1}{7}$ |
| 3 | = | $\frac{1}{4}$ | 1 | 8 | = $\frac{1}{12}$ | 14 = | $\frac{1}{8}$ |
| 4 | = | $\frac{1}{3}$ | 2 | | = $\frac{1}{10}$ | 8 = | $\frac{1}{14}$ |
| 6 | = | $\frac{1}{2}$ | 2 | 6 | = $\frac{1}{8}$ | 7 = | $\frac{1}{16}$ |
| *of a Sixpence.* | | | 3 | 4 | = $\frac{1}{6}$ | lb. of a qr. | |
| d. | | | 4 | | = $\frac{1}{5}$ | 14 = | $\frac{1}{2}$ |
| 3 | = | $\frac{1}{2}$ | 5 | | = $\frac{1}{4}$ | 7 = | $\frac{1}{4}$ |
| 2 | = | $\frac{1}{3}$ | 6 | 8 | = $\frac{1}{3}$ | 4 = | $\frac{1}{7}$ |
| $1\frac{1}{2}$ | = | $\frac{1}{4}$ | 10 | | = $\frac{1}{2}$ | $3\frac{1}{2}$ = | $\frac{1}{8}$ |
| $\frac{3}{4}$ | = | $\frac{1}{8}$ | | | | | |

RULE 1. If the price is an aliquot part of a penny, shilling, or pound, the same part of the given quantity will be the answer in pence, shillings, or pounds, accordingly.

2. If the price is not an aliquot part of a penny, shilling, or pound, divide it into divisions and subdivisions, so that each of them shall either be an aliquot part of a penny, shilling, or pound, or of a greater division, and the same parts of the given quantity added together will be the answer as formerly.

3. If the price contains pounds, multiply the given quantity by the number of them, take parts for the shillings, pence, and farthings, if there be any, as directed in the preceding rules, and the sum of the whole will be the answer.

4. If the given quantity contains a fraction, find the value of the integral part by any of the rules already given, then multiply the price by the numerator of the fraction, and divide the product by the denominator, and the result added to the value of the integral part will be the answer.

NOTE. In the same manner aliquot parts of weights and measures may be taken.

EXAMPLES.

1. 348 at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}d.$ Ans. 7*s.* 3*d.*? 14*s.* 6*d.*; 1*l.* 1*s.* 9*d.*

2. 560 at 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}d.$ Ans. 2*l.* 6*s.* 8*d.*; 2*l.* 18*s.* 4*d.*; 3*l.* 10*s.*; 4*l.* 1*s.* 8*d.*

3. 430 at 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}d.$ Ans. 3*l.* 11*s.* 8*d.*; 4*l.* 0*s.* $7\frac{1}{2}d.$; 4*l.* 9*s.* 7*d.*; 4*l.* 18*s.* $6\frac{1}{2}d.$

4. 96 at 3, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}d.$ Ans. 1*l.* 4*s.*; 1*l.* 6*s.*; 1*l.* 8*s.*; 1*l.* 10*s.*

5. 84 at 4, $4\frac{1}{4}$, $4\frac{1}{2}$, $4\frac{3}{4}d.$ Ans. 1*l.* 8*s.*; 1*l.* 9*s.* 9*d.*; 1*l.* 11*s.* 6*d.*; 1*l.* 13*s.* 3*d.*

6. 54 at 5, $5\frac{1}{4}$, $5\frac{1}{2}$, $5\frac{3}{4}d$ Ans. 1*l.* 2*s.* 6*d.*; 1*l.* 3*s.* $7\frac{1}{2}d.$; 1*l.* 4*s.* 9*d.*; 1*l.* 5*s.* $10\frac{1}{2}d.$

7. 45 at 6, $6\frac{1}{4}$, $6\frac{1}{2}$, $6\frac{3}{4}d.$ Ans. 1*l.* 2*s.* 6*d.*; 1*l.* 3*s.* $5\frac{1}{4}d.$; 1*l.* 4*s.* $4\frac{1}{2}d.$; 1*l.* 5*s.* $3\frac{3}{4}d.$

8. 58 at 7, $7\frac{1}{4}$, $7\frac{1}{2}$, $7\frac{3}{4}d.$ Ans. 1*l.* 13*s.* 10*d.*; 1*l.* 15*s.* $0\frac{1}{2}d.$; 1*l.* 16*s.* 3*d.*; 1*l.* 17*s.* $5\frac{1}{2}d.$

9. 85 at 8, $8\frac{1}{4}$, $8\frac{1}{2}$, $8\frac{3}{4}d.$ Ans. 2*l.* 16*s.* 8*d.*; 2*l.* 18*s.* $5\frac{1}{4}d.$; 3*l.* 0*s.* $2\frac{1}{2}d.$; 3*l.* 1*s.* $11\frac{3}{4}d.$

10. 88 at 9, $9\frac{1}{4}$, $9\frac{1}{2}$, $9\frac{3}{4}d.$ Ans. 3*l.* 6*s.*; 3*l.* 7*s.* 10*d.*; 3*l.* 9*s.* 8*d.*; 3*l.* 11*s.* 6*d.*

11. 57 at 10, $10\frac{1}{4}$, $10\frac{1}{2}$, $10\frac{3}{4}d.$ Ans. 2*l.* 7*s.* 6*d.*; 2*l.* 8*s.* $8\frac{1}{4}d.$; 2*l.* 9*s.* $10\frac{1}{2}d.$; 2*l.* 11*s.* $0\frac{3}{4}d.$

12. 94 at 11, $11\frac{1}{4}$, $11\frac{1}{2}$, $11\frac{3}{4}d.$ Ans. 4*l.* 6*s.* 2*d.*; 4*l.* 8*s.* $1\frac{1}{2}d.$; 4*l.* 10*s.* 1*d.*; 4*l.* 12*s.* $0\frac{1}{2}d.$

13. 96 at 12, $12\frac{1}{4}$, $12\frac{1}{2}$, $12\frac{3}{4}d.$ Ans. 4*l.* 16*s.*; 4*l.* 18*s.*; 5*l.*; 5*l.* 2*s.*

14. 100 at 1*s.* $1\frac{1}{4}d.$ Ans. 5*l.* 10*s.* 5*d.*

15. 200 at 2*s.* $2\frac{1}{2}d.$ Ans. 22*l.* 1*s.* 8*d.*

16. 256 at 3*s.* $3\frac{3}{4}d.$ Ans. 42*l.* 8*s.*

17. 40 at 4*s.* $4\frac{1}{4}d.$ Ans. 8*l.* 14*s.* 2d.

18. 37 at 5*s.* $5\frac{1}{2}d.$ Ans. 10*l.* 1*s.* $11\frac{1}{2}d.$

19. 24 at 6*s.* $6\frac{1}{4}d.$ Ans. 7*l.* 16*s.* 6*d.*

20. 19 at 7*s.* $7\frac{1}{2}d.$ Ans. 7*l.* 4*s.* $10\frac{1}{2}d.$

21. 12 at 8*s*. 8¾*d*. Ans. 5*l*. 4*s*. 9*d*.
22. 18 at 9*s*. 9¼*d*. Ans. 8*l*. 15*s*. 10½*d*.
23. 300 at 10*s*. 10⅛*d*. Ans. 163*l*. 2*s*. 6*d*.
24. 408 at 11*s*. 11¾*d*. Ans. 244*l*. 7*s*. 6d.
25. 50 at 12*s*. 1¼*d*. Ans. 30*l*. 5*s*. 2½*d*.
26. 55 at 13*s*. 2⅛*d*. Ans. 36*l*. 6*s*. 5½*d*.
27. 68 at 14*s*. 3¼*d*. Ans. 48*l*. 10*s*. 5*d*.
28. 54 at 15*s*. 4½*d*. Ans. 41*l*. 10*s*. 3*d*.
29. 490 at 16*s*. 5¼*d*. Ans. 402*l*. 14*s*. 4½*d*.
30. 454 at 17*s*. 6⅛*d*. Ans. 398*l*. 3*s*. 11*d*.
31. 898 at 18*s*. 7¾*d*. Ans. 837*l*. 3*s*. 11½*d*.
32. 405 at 19*s*. 8¼*d*. Ans. 398*l*. 13*s*. 5¼*d*.
33. 276 at 1*l*. 14*s*. Ans. 469*l*. 4*s*.
34. 358 at 3*l*. 18*s*. 4*d*. Ans. 1402*l*. 3*s*. 4d.
35. 541 at 2*l*. 6*s*. 8¼*d*. Ans. 1262*l*. 17*s*. 11¼*d*.
36. 256 at 5*l*. 12*s*. 2½*d*. Ans. 1436*l*. 5*s*. 4*d*.
37. 842 at 4*l*. 2*s*. 6¾*d*. Ans. 3475*l*. 17*s*. 7½*d*.
38. 273¼ at 1*l*. 9*s*. 4*d*. Ans. 400*l*. 15*s*. 4*d*.
39. 751⅕ at 2*l*. 17*s*. 10*d*. Ans. 2173*l*. 1*s*. 9*d*.
40. 408¾ at 15*s*. 6*d*. Ans. 316*l*. 15*s*. 7½*d*.
41. 762⅖ at 1*l*. 12*s*. 6*d*. Ans. 1239*l*. 4*s*. 6*d*.
42. 231⅝ at 7*s*. 9½*d*. Ans. 90*l*. 4*s*. 8¾*d*. ⅝.
43. 7 bushels, 3 pecks, at 14*s*. 6*d*. Ans. 5*l*. 12*s*. 4½*d*.
44. 30 acres, 3 roods, 20 poles, at 2*l*. 10*s*. 6*d*. Ans. 77*l*. 19*s*. 2¼*d*.
45. 20 gallons, 3 quarts, 1 pint, at 2*l*. 8*s*. 6*d*. Ans. 50*l*. 12*s*. 5¼*d*.
46. 24 cwt. 2 quarters, 14 lb., at 4*l*. 5*s*. 8*d*. Ans. 105*l*. 9*s*. 6½*d*.
47. 8 cwt. 3 quarters, 16 lb., at 3*l*. 18*s*. 6*d*. Ans. 34*l*. 18*s*. 1¼*d*. ⅔.
48. 16 cwt. 1 quarter, 18 lb., at 2*l*. 16*s*. 10*d*. Ans. 46*l*. 12*s*. 8¼*d*. ⅗.
49. 87 cwt. 3 quarters, 20 lb., at 3*l*. 18*s*. 4½*d*. Ans. 344*l*. 11*s*. 4¾*d*. ⅔.

50. 129 cwt. 2 quarters, 27 lb., at 4*l.* 1*s.* 7½*d.* Ans. 529*l.* 10*s.* 1¼*d.* $\frac{2}{5}\frac{9}{6}$.

51. 29 lb. 4 oz. 16 dwt., at 3*l.* 6*s.* 0*d.* Ans 97*l.* 0*s.* 4$\frac{3}{4}$*d.* $\frac{1}{3}$.

52. 31 lb. 7 oz. 12 dwt. 16 gr., at 0*l.* 8*s.* 6*d.* Ans. 13*l.* 8*s.* 10$\frac{3}{4}$*d.* $\frac{8}{15}$.

53. 36 yds. 3 qr. 1 nl., at 1*l.* 12*s.* 6½*d.* Ans. 59*l.* 17*s.* 11¼*d.* $\frac{1}{8}$.

54. 59 qr. 3 bush. 3 pks., at 3*l.* 17*s.* 10½*d.* Ans. 231*l.* 11*s.* 1½*d.* $\frac{3}{16}$.

55. 540 acres, 2 roods, 38 perches, at 4*l.* 15*s.* 6*d.* Ans. 2582*l.* 0*s.* 5$\frac{2}{4}$*d.* $\frac{7}{10}$.

56. 784 yards, 6 feet, 36 inches, at 0*l.* 15*s.* 6½*d.* Ans. 609*l.* 15*s.* 5½*d.* $\frac{1}{18}$.

57. 963 cwt. 2 qr. 25 lb., at 4*l.* 18*s.* 6$\frac{3}{4}$*d.* Ans. 4749*l.* 6*s.* 11½*d.* $\frac{59}{112}$.

58. 798$\frac{4}{15}$ at 3*l.* 17*s.* 6*d.* Ans. 3093*l.* 5*s.* 8*d.*

59. 206$\frac{5}{17}$ at 1*l.* 16*s.* 10*d.* Ans. 379*l.* 18*s.* 6*d.*

60. 509$\frac{3}{20}$ at 15*l.* 16*s.* 8*d.* Ans. 8061*l.* 10*s.* 10*d.*

## TARE AND TRET.

*Gross weight* is the full weight of any merchandise, together with that of the cask, or other package in which it is contained.

*Tare* is an allowance made to the purchaser for the weight of the package.

*Tret* is an allowance of 4 lb. on 104 lb. or $\frac{1}{26}$ on goods subject to waste.

*Cloff* is an allowance of 2 lb. on every 3 cwt. or $\frac{1}{56}$, for the turn of the scale after tare and tret are deducted.

*Suttle* is when part of the allowance is deducted from the gross.

Net weight is what remains after all allowances are made.

1. In 15 hhds. of tobacco, each 2 cwt. 1 qr. 12 lb. gross; tare 1 qr. 4 lb. per hhd.; how much net weight? Ans. 31 cwt. 8 lb.

2. What is the net weight of 6 hhds. of tobacco, weighing 95 cwt. 2 qr. 8 lb. gross; tare 7 lb. per

cwt., tret 4 lb. per 104 lb., cloff 2 lb. for every 3 cwt.? Ans. 85 cwt. 2 qr. $15\frac{8\,7\,9}{14\,3\,6}$ lb.

3. Suppose $17\frac{1}{2}$ lb. per cwt. tare, and 4 lb. per 104 lb. tret, were allowed on seven casks of prunes, each 3 cwt. 1 qr. 5 lb. gross, what would their ne weight be? Ans. 18 cwt. 2 qr. $23\frac{4\,8\,5}{5\,3\,2}$ lb.

4. What is the net weight of 14 hhds. of sugar, each 15 cwt. 3 qr. 14 lb. gross, tare 1 qr. 14 lb. per hhd., and allowing tret and cloff? Ans. 207 cwt. 1 qr. $18\frac{5}{9}$ lb. net.

5. What is the net weight of 19 bales of cotton, each 1 cwt. 3 qr. 10 lb. gross, tare 8 lb. per cwt., allowing also tret and cloff? Ans. 31 cwt. 0 qr. $1\frac{2\,8\,7\,9}{2\,3\,2}$ lb. net.

6. What is the net weight of 30 tierces of coffee, each 8 cwt. 3 qr. 16 lb. gross, tare 18 lb. per cwt., allowing tret and cloff? Ans. 214 cwt. 0 qr. $1\frac{8\,0\,7\,7}{1\,0\,1\,9\,2}$ lb.

7. What is the value of 12 bales of pepper, each weighing 2 cwt. 2 qr. 22 lb., tare 3 lb. per bale, allowing also tret and cloff, at 1*s.* $3\frac{1}{4}$*d.* per lb.? Ans. 217*l.* 18*s.* $3\frac{1}{4}$*d.* $\frac{9}{2\,8}$.

8. In three casks of oil weighing 10 cwt. 1 qr. 11 lb., how many gallons, allowing 18 lb. per cwt. tare, and $7\frac{1}{2}$ lb. net, to a gallon? Ans. $129\frac{2\,9\,3}{4\,7\,6}$ gal.

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## PARTNERSHIP.

RULE. As the whole stock or sum : is to the whole gain or loss, or the number to be divided : : so is each particular stock, or number : to the parts sought.

PROOF. Add the quotients.

1. Divide 140*l.* among 3 persons, so that their shares shall be to each other as 1, 2, and 3? Ans. 23*l.* 6*s.* 8*d.*—46*l.* 13*s.* 4*d.*—70*l.*

2. Three merchants trade together, A puts in 30*l.*,

40*l.*, and C 56*l.*, they gain 130*l.*, what is each man's share of the gain? Ans. A's 30*l.* 19*s.* $0\frac{1}{2}d.$ $\frac{6}{21}$. B's 41*l.* 5*s.* $4\frac{3}{4}d.$ $\frac{1}{21}$. C's 57*l.* 15*s.* $6\frac{1}{2}d.$ $\frac{14}{21}$.

3. A bankrupt is indebted to B 250*l.*, to C 280*l.*, to D 300*l.*, and to E 102*l.* 10*s.*, his estate is worth only 600*l.*, how must it be divided among his creditors? Ans. B's 160*l.* 17*s.* $1\frac{3}{4}d.$ $\frac{8}{13}\frac{8}{13}$. C's 180*l.* 3*s.* $2\frac{1}{2}d.$ $\frac{1}{3}\frac{4}{9}\frac{8}{13}$. D's 193*l.* 0*s.* 7*d.* $\frac{1}{3}\frac{1}{9}\frac{6}{13}$. E's 65*l.* 19*s.* $0\frac{1}{4}d.$ $\frac{2}{3}\frac{5}{9}\frac{1}{13}$.

4. A common, consisting of 200 acres, is to be divided among R, S, and T, in proportion to their estates; R's estate is worth 300*l.*, S's 350*l.*, and T's 200*l.*, what is each man's share of the common? Ans. R's 70 ac. 2 ro. $14\frac{6}{17}$ po. S's 82 ac. 1 ro. $16\frac{8}{17}$ po. T's 47 ac. 9 $\frac{7}{17}$ po.

5. A, B, and C join stocks in trade; their stocks amount to 200*l.* A's gain was 3*l.*, B's 5*l.*, and C's 8*l.*, what was each man's stock? Ans. A's 37*l.* 10*s.*, B's 62*l.* 10*s.*, and C's 100*l.*

6. The stock of a trading company is 21804*l.* 16*s.* $0\frac{1}{2}d.$ and consists of 84 shares, what is C's stock, who has 7 shares? Ans. 1817*l.* 1*s.* $4\frac{2}{4}d.$ $\frac{1}{6}$.

NOTE. Multiply the stock by 7, and divide by 84. Or divide by 12.

When the times of continuing the stock in company are unequal.

RULE. Multiply each sum into its respective time.

7. Three graziers rent a piece of land at 30*l.* 10*s.*, A puts in 12 sheep for $3\frac{1}{2}$ months, B puts in 8 sheep for $8\frac{1}{2}$ months, and C puts in 10 for 5 months, how much must each pay of the rent? Ans. A 8*l.* 0*s.* $1\frac{1}{2}d.$, B 12*l.* 19*s.* 3*d.*, and C 9*l.* 10*s.* $7\frac{1}{2}d.$

8. Two merchants enter into partnership for 16 months, A put in at first 250*l.*, and at 8 months' end he put in 80*l.* more, B put in at first 360*l.*, and

at 12 months' end took out 90*l.*, they gained 510*l.*, what was each man's share? Ans. A's 235*l.* 13*s.* $11\frac{1}{4}d.$ $\frac{81}{251}$*l.*, B's 274*l.* 6*s.* $0\frac{1}{2}d.$ $\frac{170}{251}$*l.*

9. A, B, and C enter into partnership, A puts in at first 500*l.*, and 4 months after 150*l.* more, but 2 months after he takes out 350*l.*; B puts in at first 300*l.*, and 6 months after 400*l.* more, but 3 months after he takes out 600*l.*; C puts in 200*l.*, and is to have 150*l.* for managing the business. At the end of 12 months they gain 500*l.* Required each man's share? Ans. A's 152*l.* 11*s.* 3*d.* $\frac{5}{13}$., B's 125*l.* 12*s.* 9*d.* $\frac{1}{13}$., and C's 221*l.* 15*s.* 10*d.* $\frac{10}{13}$.

10. A common, consisting of 500 acres, 2 roods, 30 perches, is to be divided among 6 persons, whose estates upon which their claims are founded are respectively 1500*l.*, 2000*l.*, 3000*l.*, 3600*l.*, 4000*l.*, and 4800*l.*, and the values of the land allotted to each are respectively 20*s.*, 25*s.*, 30*s.*, 40*s.*, 50*s.*, and 60*s.*, per acre. Required the quantity each receives? Ans. 1st, 74 acres, 1 rood, $17\frac{53}{101}$ perches; 2d, 5th, and 6th, each 79 acres, 1 rood, $10\frac{79}{101}$ perches; 3d, 99 acres, $23\frac{37}{101}$ perches; and the 4th, 89 acres, $37\frac{3}{101}$ perches.

11. Four graziers rented a grass-park for six months, for which they paid 40*l.* Now, A put in 20 oxen, and paid 8*l.*; B put in 25 oxen, and paid 12*l.*; C put in 16 oxen, and paid 10*l.*; and D put in 30 oxen and paid 10*l.* Required the time that each person's oxen continued? Ans. A's continued $1\frac{537}{1103}$ month, B's $1\frac{625}{1103}$ month, C's $2\frac{144}{1103}$ months, and D's $1\frac{927}{1103}$ month.

## INTEREST

Is the allowance given by the borrower of any sum of money to the lender.

*Principal* is the money lent.

*Rate per cent.* is the sum agreed on.

*Amount* is the principal and interest added together.

I. To find the interest for one year.

RULE. Multiply the principal by the rate per cent., and divide by 100.

NOTE. If the rate per cent. is an aliquot part of 100, take the same part of the principal for the interest.

II. To find the interest for several years.

RULE. Multiply the interest for one year by the number of years.

NOTE. If there is a fraction annexed to the years or the rate per cent., take aliquot parts for it.

III. To find the commission, brokerage, insurance, and value of stock.

RULE. Multiply the sum by the rate, and divide the product by 100.

IV. To find the quantity of stock that can be purchased for a given sum.

RULE. Multiply the sum by 100, and divide by the rate.

## SIMPLE INTEREST.

1. What is the interest of 85*l.* for a year, at 5*l.* per cent.? Ans. 4*l.* 5*s.*

2. What is the interest of 108*l.* 10*s.* for a year, at 4*l.* per cent.? Ans. 4*l.* 6*s.* 9½*d.* ⅖.

3. What is the interest of 1000*l.* for a year, at 4½*l.* per cent.? Ans. 45*l.*

4. What is the amount of 40*l.* 10*s.* for three years, at 3½*l.* per cent.? Ans. 44*l.* 15*s.* 0½*d.* ⅖.

5. What is the interest of 119*l.* 1*s.* 8*d.* for five years, at 4*l.* per cent.? Ans. 23*l.* 16*s.* 4*d.*

6. What is the interest of 450*l.* 8*s.* 6*d.* for 4¾ years, at 5*l.* per cent.? Ans. 106*l.* 19*s.* 6¾*d.* $\frac{8}{10}$.

7. What is the interest of 342*l.* 16*s.* 9*d.* for 5 years, at 5*l.* per cent.? Ans. 85*l.* 14*s.* 2¼*d.*

8. What is the interest of 845*l.* 10*s.* for $\frac{1}{4}$ of a year, at 5*l.* per cent.? Ans. 10*l.* 11*s.* $4\frac{1}{2}d.$

9. What is the interest of 248*l.* 10*s.* 10*d.* for 8 months, at 2*l.* per cent.? Ans. 3*l.* 6*s.* $3\frac{1}{4}d.$ $\frac{1}{3}$.

10. What is the commission on 345*l.*, at $2\frac{1}{2}$*l.* per cent.? Ans. 8*l.* 12*s.* 6*d.*

11. What is the interest of 295*l.* 8*s.* 4*d.* for 10 months, at 3*l.* per cent.? Ans. 7*l.* 7*s.* $8\frac{1}{2}d.$

12. What is the interest of 360*l.* for 26 weeks, at $2\frac{1}{2}$*l.* per cent.? Ans. 4*l.* 10*s.*

13. What is the brokerage on 152*l.*, at 4*s.* 6*d.* per cent.? Ans. 6*s.* $10\frac{9}{4}d.$ $\frac{8}{3\,3}$.

14. What is the interest of 240*l.* for 28 weeks, at $4\frac{1}{4}$*l.* per cent.? Ans. 5*l.* 9*s.* $10\frac{2}{1\,3}d.$

15. What is the insurance of 195*l.* 5*s.*, at $10\frac{1}{2}$*l.* per cent.? Ans. 20*l.* 10*s.* $0\frac{1}{4}d.$ $\frac{1}{5}$.

16. What is the purchase of 710*l.* South Sea stock, at $103\frac{5}{8}$*l.* per cent.? Ans. 735*l.* 14*s.* 9*d.*

17. What is the purchase of 918*l.* 14*s.* Bank stock, at $127\frac{3}{4}$*l.* per cent.? Ans. 1173*l.* 12*s.* $9\frac{1}{4}d.$ $\frac{17}{2\,3}$.

18. What is the purchase of 816*l.* Bank annuities, at $85\frac{3}{8}$*l.* per cent.? Ans. 696*l.* 13*s.* $2\frac{1}{4}d.$ $\frac{3}{5}$.

19. What is the purchase of 2018*l.* 15*s.* 6*d.* India stock, at $140\frac{1}{4}$*l.* per cent.? Ans. 2831*l.* 6*s.* $7\frac{1}{2}d.$ $\frac{3}{5\,5}$.

20. How much Bank stock, at 213*l.* per cent., can be purchased for 8000*l.*? Ans. 3755*l.* 17*s.* $4\frac{1}{4}d.$ $\frac{5}{9\,7}$.

21. How much stock in the 3 per cents., at $72\frac{1}{4}$*l.* per cent., can be purchased for 1000*l.*? Ans. 1384*l.* 1*s.* $7\frac{3}{4}d.$ $\frac{2}{2\,8\,9}$.

22. How much stock in the 4 per cent. consols at $96\frac{1}{2}$*l.* per cent., can be purchased for 8500*l.*? Ans. 8808*l.* 5*s.* $9\frac{1}{2}d.$ $\frac{1}{1\,9\,3}$.

23. What interest will be obtained by purchasing 3 per cents., at $63\frac{1}{3}$*l.* per cent.? Ans. $4\frac{1}{1\,9}$*l.*

24. What interest will be obtained by purchasing 4 per cents., at $90\frac{3}{8}$*l.* per cent.? Ans. $4\frac{5}{7\,2}\frac{0}{3}\frac{8}{3}$*l.*

25. At what price should I purchase in the 4 per cents. to obtain 5*l.* per cent. interest? Ans. 80*l.*

26. At what price should I purchase in the 3 per cents. to obtain 5*l.* per cent. interest? Ans. 60*l.*

To calculate interest for days.

RULE. Multiply the principal by the number of days, and by double of the rate per cent., then divide the Product by 73000.

27. What is the interest of 1000*l.* 10*s.* 6*d.* for 12 days, at 5*l.* per cent.? Ans. 1*l.* 12*s.* $10\frac{1}{2}d.$ $\frac{1}{1}\frac{6}{8}\frac{2}{2}\frac{2}{5}$.

28. What is the interest of 345*l.* for 80 days, at 5*l.* per cent.? Ans. 3*l.* 15*s.* $7\frac{1}{4}d.$ $\frac{4}{7}\frac{5}{3}$.

29. What is the amount of 250*l.* 10*s.* 6*d.* for 40 days, at $3\frac{1}{2}l.$ per cent.? Ans. 251*l.* 9*s.* $8\frac{1}{2}d.$ $\frac{8}{1}\frac{7}{8}\frac{8}{2}\frac{5}{5}$.

30. What is the interest of 184*l.* from 12th May to 19th November, at 5*l.* per cent.? Ans. 4*l.* 16*s.* $3\frac{1}{4}d.$ $\frac{2}{3}\frac{4}{6}\frac{7}{5}$.

31. What is the interest of 408*l.* for 60 days, at 4*l.* per cent.? Ans. 2*l.* 13*s.* $7\frac{3}{4}d.$ $\frac{1}{3}\frac{5}{6}\frac{7}{5}$.

32. What is the interest of 245*l.* 16*s.* for 73 days, at $2\frac{1}{2}l.$ per cent.? Ans. 1*l.* 4*s.* $6\frac{3}{4}d.$ $\frac{2}{2}\frac{1}{5}$.

33. What is the interest of 351*l.* from 5th March to 6th August, at $4\frac{1}{2}l.$ per cent.? Ans. 6*l.* 13*s.* $3\frac{1}{4}d.$ $\frac{1}{1}\frac{1}{8}\frac{5}{2}\frac{9}{5}$.

When partial payments are made.

RULE. Multiply the principal and the different balances by the number of days they are at interest, and by double of the rate per cent. Add these Products, and divide the sum by 73000.

34. A bill of 400*l.* was due April 20, of which 110*l.* was paid June 15, 28*l.* August 4, and the balance October 2. Required how much interest is due, at 5*l.* per cent.? Ans 7*l.* 3*s.* $5\frac{1}{4}d.$ $\frac{1}{3}\frac{5}{6}\frac{9}{5}$.

35. A bill of 350*l.* was due January 10, of which 70*l.* was paid on the 10th of each succeeding month till the whole was paid. Required how much interest was due, at $4\frac{1}{2}l.$ per cent.? Ans. 3*l.* 17*s.* $10\frac{46}{365}d.$

36. A bill of 1000*l.* was due April 4, of which 150*l.* was paid May 10; 250*l.* July 12; 300*l.* September 18; 100*l.* November 10; 150*l.* January 20, and the balance March 4. Required the amount of the last payment, including the interest at $4\frac{1}{2}$*l.* per cent.? Ans. 70*l.* 0*s.* $11\frac{3}{7}$*d.*

To calculate interest on accounts-current.

RULE. Add and subtract the sums paid and received in the order of their dates; and if the balance is sometimes due to the one party, and sometimes to the other, the Products must be extended in different columns.

37. Required the interest on the following account from January 8 to July 30, allowing 5*l.* per cent. when the balance is due to B. D., and 4*l.* per cent. when due to M. N.

Dr. Mr B. D. his acccount-current with M. N. Cr.

| | | | |
|---|---|---|---|
| Jan. 8. To balance | 100*l.* | Mar. 15. By cash | 250*l.* |
| Feb. 14. To cash | 114*l.* | May 30. By cash | 100*l.* |
| April 24. To cash | 400*l.* | July 2. By cash | 400*l.* |
| June 18. To cash | 70*l.* | | |

Ans. Balance due by B. D. 3*l.* 2*s.* 8*d.* $\frac{48}{365}$.

38. Required the interest on the following account from April 3 to March 31, allowing 5*l.* per cent. when the balance is due to A. B., and $4\frac{1}{2}$*l* when due to C. D.

Dr. A. B's account-current with C. D. Cr.

| | | | |
|---|---|---|---|
| April 3. To balance | 135*l.* | June 1. By cash | 397*l.* |
| July 16. To cash | 270*l.* | Sept. 8. By cash | 214*l.* |
| Oct. 20. To cash | 258*l.* | Nov. 13. By cash | 128*l.* |
| Dec. 15. To cash | 460*l.* | Jan. 30. By cash | 296*l.* |
| Jan. 1. To cash | 231*l.* | Mar. 18. By cash | 374*l.* |

Ans. 2*l.* 16*s.* $2\frac{1}{4}$*d.* $\frac{831}{1825}$ due to C. D.

To calculate interest on bills or bonds when the intervals between the payments are greater than a year.

RULE. Add the interest due at the date of each payment to the principal, and deduct the payment from the amount.

**39.** A bond of 500*l.* became due January 1, 1864, of which 100*l.* were paid May 14, 1865; 200*l.* April 10, 1866; 150*l.* June 1, 1867; and the balance August 1, 1868. Required the sum then due, interest at 5*l.* per cent.? Ans. 125*l.* 3*s.* $10\frac{1}{2}d.$

40. Borrowed on bond at $1\frac{1}{2}$*l.* per cent. May 14, 1865, 700*l.*, of which I paid June 1, 1866, 250*l.*; June 30, 1867, 200*l.*; July 10, 1868, 200*l.*; and retired the bond September 20, 1869. How much was then paid? Ans. 127*l.* 3*s.* $9\frac{3}{4}d.$

## DISCOUNT

Is an allowance given for the payment of any sum of money before it becomes due.

### To find the present worth.

RULE. As the amount of 100*l.* for the given rate and time: is to 100 : : so is the debt : to the present worth.

### To find the discount.

RULE. As the amount of 100*l.* for the given rate and time: is to the interest of 100*l.* for that time : : so is the given sum or debt: to the discount.

NOTE. These rules give the true discount or present worth; but bankers in discounting bills charge the interest upon the amount of the bill for the time it has to run, including three days of grace, by which means the holder loses the interest of the true discount.

1. What is the present worth of 240*l.* due 100 days hence, at 5*l.* per cent.? Ans. £236*l.* 15*s.* $1\frac{1}{2}d.$ $\frac{1}{37}$.

2. What ready money will discharge a debt of 560*l.* 10*s.* due 48 days hence, at 5*l.* per cent.? Ans. 556*l.* 16*s.* $9\frac{1}{4}d.$ $\frac{2}{1837}$.

3. Required the discount of 1000*l.* due 70 days hence, at 5*l.* per cent.? Ans. 9*l.* 9*s.* $11\frac{1}{2}d.$ $\frac{34}{737}$.

4. What is the discount of 284*l.* 8*s.* 6*d.* for 184 days, at $3\frac{1}{2}$*l.* per cent.? Ans. 4*l.* 18*s.* $7\frac{1}{2}d.$ $\frac{402}{6423}$.

5. Sold goods for 842*l.* 5*s.* to be paid 350 days hence, what is the present worth at 5*l.* per cent.? Ans. 803*l.* 14*s.* $3\frac{3}{4}d.$ $\frac{1}{17}$.

## EQUATION OF PAYMENTS

Is the finding a time at which a debt due at different times may be discharged at once, without disadvantage to either party.

RULE. Multiply each payment by the time at which it is due; divide the sum of the products by the amount of the debt: the quotient is the time required.

1. I owe B 100*l.* payable in 50 days, 130*l.* in 40 days, 230*l.* in 140 days; at what time should I pay the whole together? Ans. $92\frac{4}{23}$ days.

2. Paid 480*l.* as follows: 60*l.* in 40 days, 180*l.* in 96 days, 50*l.* in 200 days, and the rest in a year and 45 days; required the equated time for paying the whole? Ans. $224\frac{1}{8}$ days.

3. A owes B 100*l.* payable in 60 days, 200*l.* in 80 days, 350*l.* in 180 days, and 500*l.* in a year; at what time may he pay the whole without loss to either party? Ans. $232\frac{14}{23}$ days.

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## COMPOUND INTEREST

Is calculated by making the amount at each stated time of payment the principal for the next.

1. What is the compound interest of 200*l.* for three years, at 5*l.* per cent.? Ans. 31*l.* 10*s.* 6*d.*

2. What is the amount of 300*l.* in 4 years, at 5*l.* per cent. per annum? Ans. 364*l.* 13*s.* $0\frac{1}{4}d.$ $\frac{4}{7}$.

3. Required the interest of 500*l.* for three years, at 4*l.* per cent.? Ans 62*l.* 8*s.* $7\frac{1}{2}d.$ $\frac{8}{25}$.

4. What is the amount of 240*l.* 10*s.* for two years, six months, at 3 per cent.? Ans. 258*l.* 19*s.* $5\frac{1}{2}d.$

5. What is the interest of 129*l.* 15*s.* for three years, 9 months, and 10 days, at $4\frac{1}{2}$*l.* per cent.? Ans. 23*l.* 9*s.* 11*d*

## PROFIT AND LOSS.

CASE I. Given the buying and selling price, to discover the profit or loss per cent.

RULE. As the prime cost :
Is to the profit or loss on it : :
So is 100 :
To the profit or loss on it.

1. Bought a hogshead of wine for 50*l.* 8*s.* and sold it for 63*l.*, what did I gain per cent.? Ans. 25*l.*

2. Bought cloth at 4*s.* 6*d.* per yard, and sold it at 4*s.* 10*d.*, what was the gain per cent.? Ans. $7\frac{1}{2}\frac{1}{7}l.$

3. Bought cloth at 18*s.* 6*d.* per yard, and sold it at 15*s.* 4*d.*, what was the loss per cent.? Ans. $17\frac{13}{111}l.$

4. How much per cent. is $3\frac{1}{2}d.$ per shilling? Ans. $29\frac{1}{6}l.$

CASE II. Given the prime cost and rate per cent. to find the selling price.

RULE. As 100 :
Is to 100 with the rate per cent. added in case of gain, or subtracted in case of loss : :
So is the prime cost :
To the selling price.

5. If I gained 25*l.* per cent. by wine which I bought at 50*l.* 8*s.* per hhd., at what did I sell it? Ans. 63*l.* per hhd.

6. Bought cloth at 4*s.* 6*d.* per yard, at what must I sell it to gain $7\frac{1}{2}\frac{1}{7}l.$ per cent.? Ans. 4*s.* 10*d.*

7. Bought a cwt. of sugar, for 3*l.* 3*s.*, at what rate must I sell it per lb. to gain 12*l.* per cent.? Ans. $7\frac{1}{2}d.$ $\frac{6}{25}$.

8. Bought sugar at $8\frac{1}{2}d.$ per lb., at what must I sell it per lb. to gain $17\frac{1}{1}\frac{1}{7}l.$ per cent by it? Ans. 10*d.*

CASE III. Given the selling price and rate per cent. profit or loss, to find the prime cost.

RULE. As 100, with the rate per cent. added, or subtracted :
Is to 100 : :
So is the selling price :
To the prime cost.

9. If I gain $17\frac{1}{17}l.$ per cent. on sugar I sold at $10d.$ the lb., what was the prime cost? Ans. $8\frac{1}{2}d.$

10. Lost $8l.$ per cent. on tea which I sold at $5s.$ $6d.$ per lb., what was the prime cost? Ans. $5s.$ $11\frac{1}{2}d.$ $\frac{2}{3}\frac{2}{3}$.

11. Gained $34\frac{2}{7}l.$ per cent. on sugar which I sold at $5l.$ $9s.$ $8d.$ per cwt., what was the prime cost per lb.? Ans. $8\frac{3}{4}d.$

CASE IV. Given two selling prices and the rate per cent. of one of them, in order to find the rate per cent. of the other selling price.

RULE. As the price whose rate per cent. is given :
Is to 100, with the given rate added or subtracted :
So is the other given price :
To a fourth number ;
From which number subtract 100 in case of gain ; but which
Subtract from 100 in case of loss.

12. By selling cheese at $5s.$ $9d.$ per stone, I gained $15l.$ per cent., what did I gain per cent. by selling it at $6s.$? Ans. $20l.$

13. A merchant selling wool at $8s.$ per stone, gained $12l.$ per cent., what will he gain or lose per cent. by selling the same wool at $7s.$ the stone? Ans. He will lose $2l.$ per cent.

14. By selling cloth at $18s.$ $4d.$ per yard, I gained $12l.$ per cent., what will I gain or lose per cent. by selling it at $16s.$ $10d.$ per yard? Ans. $24\frac{6}{13}l.$ per cent. gain.

15. By selling muslin at $5s.$ $10d.$ per yard, I lost $16l.$ per cent., how much will I gain or lose per cent. by selling it at $6s.$ $3d.$ per yard? Ans. $10l.$ per cent. loss.

## VULGAR FRACTIONS.

A Fraction is a part or parts of a unit, written thus $\frac{5}{8}$ numerator, denominator.

The numerator is the remainder after division, and the denominator the divisor.

1. A proper fraction is when the numerator is less than the denominator, as $\frac{3}{4}$.

2. An improper fraction is when the numerator is equal to, or greater than, the denominator, as $\frac{6}{6}, \frac{1}{2}$.

3. A simple fraction has but one numerator and one denominator, as $\frac{3}{8}$.

4. A compound fraction is a fraction of a fraction, as $\frac{1}{2}$ of $\frac{3}{5}$.

5. A mixed number is composed of a whole number and a fraction, as $4\frac{1}{4}$.

NOTE 1. Any whole number may be expressed like a fraction, by writing 1 under it.

2. Multiplying or dividing both terms of a fraction by the same number does not change its value.

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### REDUCTION OF VULGAR FRACTIONS.

PROB. 1. To reduce a fraction to its lowest terms.

RULE. Find a common measure thus: Divide the denominator by the numerator, and that divisor by the remainder continually, till nothing remain. The last divisor is the common measure; then divide both the numerator and denominator by this measure:

Or divide the numerator and denominator by any number which will divide them without a remainder.

NOTE. Any number ending with 5 or 0 is divisible by 5. Any number is divisible by 3 or 9, if the sum of its digits be divisible by 3 or 9. Any number is divisible by 11, if the sums of its alternate digits are equal to each other.

1. Reduce $\frac{60}{120}$ to its lowest terms. Ans. $\frac{1}{2}$.
2. Reduce $\frac{46}{368}$ to its lowest terms. Ans. $\frac{25}{175}$.
3. Reduce $\frac{126}{1260}$ to its lowest terms. Ans. $\frac{63}{630}$.

4. Reduce $\frac{8225}{27009}$ to its lowest terms. Ans. $\frac{25}{81}$.
5. Reduce $\frac{7209}{65061}$ to its lowest terms. Ans. $\frac{1}{9}$.
6. Reduce $\frac{7862250}{9435000}$ to its lowest terms. Ans. $\frac{1}{12}$.

PROB. 2. To reduce a mixed number to an improper fraction.

RULE. Multiply the whole number by the denominator adding the numerator; under this sum write the denominator.

1. Reduce $5\frac{3}{4}$ to an improper fraction. Ans. $\frac{23}{4}$.
2. Reduce $7\frac{1}{5}$ to an improper fraction. Ans. $\frac{36}{5}$.
3. Reduce $6\frac{1}{9}$ to an improper fraction. Ans. $\frac{55}{9}$.
4. Reduce $8\frac{16}{17}$ to an improper fraction. Ans. $\frac{152}{17}$.
5. Reduce $19\frac{5}{27}$ to an improper fraction. Ans. $\frac{518}{27}$.
6. Reduce $29\frac{11}{19}$ to an improper fraction. Ans. $\frac{562}{19}$.

PROB. 3. To reduce an improper fraction to a whole or mixed number.

RULE. Divide the numerator by the denominator.

1. Reduce $\frac{101}{4}$ to a whole or mixed number. Ans. $25\frac{1}{4}$.
2. Reduce $\frac{146}{4}$ to a whole or mixed number. Ans. $36\frac{1}{2}$.
3. Reduce $\frac{341}{14}$ to a whole or mixed number. Ans. $24\frac{5}{14}$.
4. Reduce $\frac{1425}{24}$ to a whole or mixed number. Ans $59\frac{3}{8}$.
5. Reduce $\frac{7854}{27}$ to a whole or mixed number. Ans. $290\frac{8}{9}$.
6. Reduce $\frac{5486}{371}$ to a whole or mixed number. Ans. $147\frac{39}{371}$.

PROB. 4. To reduce a compound fraction to a simple one.

RULE. Multiply all the numerators together for the numerator, and all the denominators together for the denominator.

1. Reduce $\frac{2}{3}$ of $\frac{3}{4}$ to a simple fraction. Ans. $\frac{1}{2}$.
2. Reduce $\frac{5}{8}$ of $\frac{2}{7}$ to a simple fraction. Ans. $\frac{10}{56}$.

3. Reduce $\frac{4}{5}$ of $\frac{10}{13}$ of $\frac{7}{12}$ to a simple fraction. Ans. $\frac{14}{39}$.

4. Reduce $\frac{11}{12}$ of $\frac{15}{14}$ of $\frac{16}{23}$ to a simple fraction. Ans. $\frac{220}{483}$.

5. Reduce $\frac{2}{3}$ of $\frac{4}{7}$ of $\frac{5}{11}$ of $4\frac{1}{2}$ to a simple fraction. Ans. $\frac{60}{77}$.

6. Reduce $\frac{5}{9}$ of $\frac{4}{11}$ of $\frac{3}{16}$ of $8\frac{2}{13}$ to a simple fraction. Ans. $\frac{265}{858}$.

PROB. 5. To reduce fractions to a common denominator.

RULE. Multiply each numerator into all the denominators, except its own, for a new numerator; and multiply all the denominators together for a common denominator.

NOTE. Fractions may often be reduced to a common denominator, by multiplying their numerators and denominators by such numbers as will make the denominators in both equal.

1. Reduce $\frac{2}{5}$ and $\frac{7}{8}$ to a common denominator. Ans. $\frac{16}{40}$, $\frac{35}{40}$.

2. Reduce $\frac{5}{6}$ and $\frac{2}{7}$ to a common denominator. Ans. $\frac{35}{42}$, $\frac{12}{42}$.

3. Reduce $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{9}$, to a common denominator. Ans. $\frac{36}{72}$, $\frac{54}{72}$, $\frac{40}{72}$.

4. Reduce $\frac{5}{8}$, $\frac{4}{9}$, $\frac{8}{15}$, and $\frac{11}{21}$, to a common denominator. Ans. $\frac{14175}{22680}$, $\frac{10080}{22680}$, $\frac{12096}{22680}$, $\frac{11880}{22680}$.

5. Reduce $\frac{1}{2}$ of $\frac{3}{4}$, $\frac{4}{9}$, $4\frac{1}{2}$, and $\frac{5}{7}$, to a common denominator. Ans. $\frac{378}{1008}$, $\frac{448}{1008}$, $\frac{4536}{1008}$, $\frac{720}{1008}$.

6. Reduce $\frac{1}{3}$ of $\frac{3}{4}$ of $3\frac{1}{2}$, $\frac{7}{12}$, $\frac{11}{16}$, $7\frac{5}{6}$, and $\frac{1}{2}$ of $\frac{3}{4}$ of $7\frac{5}{8}$ to a common denominator. Ans. $\frac{168}{192}$, $\frac{112}{192}$, $\frac{132}{192}$. $\frac{1504}{192}$, $\frac{549}{192}$.

PROB. 6. To reduce a fraction from one denomination to another, which shall have the same value.

RULE. Find how many of the less denomination make one of the greater; if from a higher to a lower, multiply the numerator by that number: or the denominator, if to a greater.

1. Reduce $\frac{5}{8}$ of a farthing to the fraction of a pound. Ans. $\frac{1}{1728}$.

2. Reduce $\frac{1}{1728}$ of a pound to the fraction of a farthing. Ans. $\frac{6}{9}$.

3. Reduce $\frac{2}{3}$ of a penny to the fraction of a pound. Ans. $\frac{1}{360}$.

4. Reduce $\frac{6}{8}$ of a farthing to the fraction of a guinea. Ans. $\frac{5}{6048}$.

5. Reduce $\frac{2}{4}$ of a crown to the fraction of a pound. Ans. $\frac{5}{160}$.

6. Reduce $\frac{4}{5}$ of a farthing to the fraction of a shilling. Ans. $\frac{1}{60}$.

7. Reduce $\frac{2}{7}$ of a pound to the fraction of a guinea. Ans. $\frac{40}{147}$.

8. Reduce $\frac{1}{3}$ of half a crown to the fraction of a pound. Ans. $\frac{1}{24}$.

9. Reduce $\frac{5}{8}$ lb. to the fraction of a ton. Ans. $\frac{1}{2688}$.

10. Reduce $\frac{3}{5}$ dwt. to the fraction of a lb. Ans. $\frac{1}{400}$.

11. Reduce $\frac{6}{7}$ oz. to the fraction of a cwt. Ans. $\frac{3}{872}$.

12. Reduce $\frac{6}{11}$ yd. to the fraction of a mile. Ans. $\frac{3}{3960}$.

13. Reduce $\frac{1}{360}$ of a pound to the fraction of a penny. Ans. $\frac{2}{3}$.

14. Reduce $\frac{1}{448}$ of a ton to the fraction of a lb. Ans. $\frac{1}{2}$.

NOTE. When the given number is of different denominations, reduce it to the lowest for a numerator, and reduce the denominator to the same name.

1. Reduce 6*s*. 4*d*. to the fraction of a pound. Ans. $\frac{19}{60}$.

2. Reduce $2\frac{1}{4}d$. to the fraction of a shilling. Ans. $\frac{3}{16}$.

3. Reduce $8\frac{1}{2}d$. to the fraction of a crown. Ans. $\frac{17}{120}$.

4. Reduce 2 roods, 15 poles, to the fraction of an acre. Ans. $\frac{19}{32}$.

5. Reduce 3 cwt. 14 lb. to the fraction of a ton. Ans. $\frac{5}{32}$.

6. Reduce $6\frac{3}{4}$ inches to the fraction of a foot. Ans. $\frac{9}{16}$.

PROB. 7. To find the value of a fraction.

RULE. Multiply the numerator by the next lower denomination, and divide the product by the denominator. Reduce the remainder, if any, into the next lower denomination; and divide as before, and so on as far as is necessary.

Or, consider the numerator as so many of the same name as the fraction, and divide it by the denominator as in Compound Division.

1. What is the value of $\frac{2}{3}l.$? Ans. 13*s.* 4*d.*

2. What is the value of $\frac{5}{8}l.$? Ans. 12*s.* 6*d.*

3. What is the value of $\frac{3}{4}$ of a guinea? Ans. 15*s.* 9*d.*

4. What is the value of $\frac{4}{5}$ of half a crown? Ans. 2*s.*

5. What is the value of $\frac{3}{7}$ lb. avoirdupois? Ans. 6 oz. $13\frac{5}{7}$ dr.

6. What is the value of $\frac{4}{9}$ of a cwt.? Ans. 1 qr. 21 lb. 12 oz. $7\frac{1}{9}$ dr.

7. What is the value of $\frac{3}{4}$ lb. troy? Ans. 5 oz. 2 dwt. $20\frac{4}{7}$ gr.

8. Reduce $\frac{3}{8}$ of an ell English to its proper quantity. Ans. 1 qr. $3\frac{1}{2}$ nl.

9. What is the proper quantity of $\frac{4}{5}$ of a mile? Ans. 6 fur. 16 po.

10. What is the value of $\frac{5}{8}$ of 63 gallons of port wine? Ans. 52 gal. 2 qts.

11. What is the value of $\frac{3}{8}$ of an acre? Ans. 1 rood, 20 po.

12. What is the proper quantity of $\frac{3}{5}$ of a day? Ans. 14 ho. 24 min.

## ADDITION OF VULGAR FRACTIONS.

RULE. Reduce compound fractions to simple ones; mixed numbers to improper fractions; fractions of different denomi-

nations to those of the same ; and all of them to a common denominator ; then add the numerators together, and under their sum place the common denominator.

1. Add $\frac{2}{5}$ and $\frac{3}{4}$ together. Ans. $1\frac{23}{20}$.
2. Add $\frac{5}{8}$ and $\frac{2}{3}$ together. Ans. $1\frac{14}{24}$.
3. Add $\frac{3}{4}$, $\frac{2}{5}$, and $\frac{5}{6}$ together. Ans. $1\frac{59}{60}$.
4. Add $\frac{2}{3}$, $\frac{5}{6}$, and $\frac{3}{5}$ together. Ans. $2\frac{1}{10}$.

NOTE 1. When mixed numbers are given, find the sum of the fractions, to which add the whole numbers.

5. Add $4\frac{1}{3}$ and $6\frac{1}{8}$ together. Ans. $10\frac{8}{15}$.
6. Add $6\frac{1}{4}$, $2\frac{1}{2}$, and $3\frac{3}{4}$ together. Ans. $12\frac{1}{2}$.
7. What is the sum of $5\frac{1}{2}$, $6\frac{7}{9}$, and $4\frac{3}{4}$? Ans. $17\frac{1}{36}$.
8. Add $\frac{2}{3}$, $4\frac{1}{2}$, and $\frac{1}{4}$ of $\frac{6}{7}$ together. Ans. $5\frac{8}{21}$.

2. When the fractions are of different denominations, reduce them into the same; and add their numerators together; or find their value, and add as in Compound Addition.

9. Add $\frac{2}{5}s.$ and $\frac{3}{5}d.$ together. Ans. $8\frac{1}{2}d.$ $\frac{2}{5}$.
10. Add $\frac{2}{5}l.$ $\frac{3}{5}s.$ and $\frac{4}{5}$ of a penny together. Ans. $13s.$ $11\frac{2}{4}d.$ $\frac{1}{4\,5}$.
11. Add $\frac{5}{8}$ of a guinea to $\frac{3}{4}$ of a crown, $\frac{4}{7}$ of a shilling, and $\frac{4}{9}$ of a penny. Ans. $12s.$ $1\frac{9}{4}d.$ $\frac{2}{6}\frac{2}{3}$.
12. What is the sum of $\frac{3}{4}$ of a foot, $\frac{2}{3}$ of a yard, and $\frac{7}{8}$ of a mile? Ans. 1540 yds. 2 feet, 9 inches.
13. Required the sum of $5\frac{1}{2}$ yards, $4\frac{3}{5}$ English ells, and $\frac{2}{5}$ of a nail. Ans. 11 yds. 1 qr. $0\frac{2}{3}$ nl.
14. What is the sum of $\frac{5}{1\,2}$ of a ton, and $\frac{9}{1\,1}$ of a cwt.? Ans. 9 cwt. 16 lb. 15 oz. $\frac{1}{5}\frac{7}{5}$.
15. Add $\frac{1}{3}$ of a day and $\frac{5}{2\,4}$ of an hour together? Ans. 8 hours, 12 minutes, 30 seconds.

## SUBTRACTION OF VULGAR FRACTIONS.

RULE. Prepare the fractions as in Addition ; then take the difference of the numerators, and place it over the common denominator.

1. What is the difference of $\frac{3}{4}$ and $\frac{5}{9}$? Ans. $\frac{7}{3\,6}$.
2. What is the difference of $\frac{4}{5}$ and $\frac{9}{2\,0}$? Ans. $\frac{7}{2\,0}$.
3. From $\frac{2}{3}$ of $\frac{5}{4}$, take $\frac{1}{5}$ of $\frac{2}{3}$. Ans. $\frac{5}{1\,0}$.

4. From $\frac{2}{3}$ of 9, take $1\frac{1}{9}$. Ans. $2\frac{2}{45}$.
5. From $16\frac{1}{4}$ take $\frac{2}{9}$ of 18. Ans. $4\frac{1}{4}$.
6. From $\frac{3}{4}$ of a pound, take $\frac{2}{3}$ of a shilling. Ans. 14*s.* $7\frac{9}{4}$*d.* $\frac{4}{3}$.
7. From $\frac{4}{7}$ of a guinea, take $\frac{1}{3}$ of a pound. Ans. 5*s.* 4*d.*
8. From $\frac{7}{8}$ of a pound, take $\frac{1}{2}$ of $\frac{2}{3}$ of a shilling. Ans. 17*s.* 2*d.*
9. From $\frac{4}{5}$ oz. take $\frac{5}{8}$ dwt. Ans. 15 dwt. 15 gr.
10. From $3\frac{1}{2}$ cwt. take $15\frac{9}{10}$ lb. Ans. 3 cwt. 1 qr. $12\frac{1}{10}$ lb.

## MULTIPLICATION OF VULGAR FRACTIONS.

RULE. Prepare the fractions as in Addition; then multiply all the numerators together, for the numerator of the product, and all the denominators for the denominator.

NOTE. When the same number is found in the numerators and denominators of any of the fractions, strike them out before multiplication.

1. Multiply $\frac{3}{4}$ by $\frac{4}{7}$. Ans. $\frac{3}{7}$.
2. Multiply $\frac{4}{9}$ by $\frac{3}{8}$. Ans. $\frac{1}{6}$.
3. Multiply $1\frac{5}{16}$ by $1\frac{5}{8}$. Ans. $3\frac{5}{6}$.
4. Multiply $4\frac{7}{9}$ by $\frac{2}{3}$ of $\frac{3}{4}$. Ans. $2\frac{7}{18}$.
5. Multiply $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{6}$ together. Ans. $\frac{5}{12}$.
6. Multiply $48\frac{1}{4}$ by 7. Ans. $337\frac{3}{4}$.
7. Multiply $\frac{1}{7}$ of 9 by $\frac{3}{7}$. Ans. $1\frac{3}{14}$.
8. Multiply $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{1}{9}$ of $\frac{2}{5}$. Ans. $\frac{1}{45}$.
9. Multiply $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{5}{9}$ of $2\frac{1}{4}$. Ans $\frac{5}{4}$.
10. What cost $14\frac{1}{4}$ yds. at $\frac{1}{4}\frac{1}{0}$*l.*? Ans. 3*l.* 18*s.* $4\frac{1}{2}$*d.*

## DIVISION OF VULGAR FRACTIONS.

RULE. Prepare the fractions as before; then invert the divisor, and proceed exactly as in Multiplication.

1. Divide $\frac{4}{5}$ by $\frac{2}{5}$. Ans. $\frac{2}{3}$.
2. Divide $\frac{3}{4}$ by $\frac{1}{2}$. Ans. $1\frac{1}{2}$.
3. Divide $\frac{1}{1}\frac{1}{2}$ by $\frac{5}{8}$. Ans. $1\frac{1}{10}$.

4. Divide 18 by $\frac{3}{8}$. Ans. 48.
5. Divide $14\frac{3}{4}$ by $\frac{2}{3}\frac{4}{8}\frac{1}{2}$. Ans. $18\frac{4}{6}\frac{5}{4}$.
6. Divide $456\frac{1}{4}$ by $3\frac{1}{2}$. Ans. $130\frac{1}{4}\frac{6}{9}$.
7. Divide $\frac{2}{3}$ of $\frac{4}{7}$ by $\frac{4}{9}$. Ans. $\frac{6}{7}$.
8. Divide $8\frac{3}{4}$ by $\frac{1}{3}$ of $\frac{9}{11}$. Ans. $32\frac{1}{12}$.
9. Divide $\frac{1}{3}$ of 4 by $\frac{2}{5}$ of $\frac{5}{8}$. Ans. 4.
10. Divide a prize of $2450\frac{1}{8}l.$ into $40\frac{2}{5}$ shares. Ans. $60l.$ $12s.$ $11d.$ $\frac{20}{101}$.

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## PROPORTION OF VULGAR FRACTIONS.

RULE. State the terms as in whole numbers, and prepare them by the former rules: invert the first term of the proportion, then multiply as directed in Multiplication.

1. If $\frac{3}{4}$ yard cost $\frac{7}{8}l.$, what cost $5\frac{1}{4}$ yards? Ans. $5l.$ $8s.$ $10\frac{1}{2}d.$ $\frac{2}{3}$.

2. If $\frac{5}{6}$ of a gallon cost $\frac{5}{8}l.$, what will $\frac{5}{8}$ of 252 gal. cost? Ans. $105l.$

3. If $\frac{1}{8}$ of a ship cost $445l.$ $15s.$, what is $\frac{7}{3}\frac{2}{2}$ of her worth? Ans. $780l.$ $1s.$ $3d.$

4. If $\frac{3}{4}$ of a yard cost $\frac{5}{8}l.$, what is the price of $31\frac{1}{3}$ ells Flemish? Ans. $19l.$ $11s.$ $8d.$

5. If $1\frac{5}{7}$ lb. of gold is worth $61\frac{5}{7}l.$ Sterling, what is 2 grains worth? Ans. $3d.$

6. If $\frac{1}{1}\frac{1}{2}$ of a ship cost $390l.$ $6s.$ $4d.$, what will $\frac{1}{1}\frac{3}{8}$ of the same cost? Ans. $345l.$ $19s.$ $3d.$

7. A can perform a piece of work in 10 days, B in 12 days, and C in 16 days: in what time will they perform it working together? Ans. $4\frac{4}{5}\frac{4}{9}$ days.

8. A, B, and C together can perform a piece of work in 12 days; A and B together can do it in 18 days, and B and C together can do it in 16 days: in what time could A and C together do it, and in what time could each do it separately? Ans. A and C in $20\frac{4}{7}$ days. A in 48 days, B in $28\frac{4}{5}$ days, C in 36 days.

## DECIMAL FRACTIONS

Are such as have a unit for their denominator, with as many ciphers annexed as there are figures in the numerators; as $\frac{2}{10}$ $\frac{34}{100}$, $\frac{564}{1000}$, usually written with a point prefixed without the denominator ·2, ·34, ·564, and read thus: ·2, two tenths; ·34, thirty-four hundredth parts; ·564, five hundred and sixty-four thousand parts; and so on.

NOTE. Ciphers on the right hand of decimals do not alter their value.

### REDUCTION OF DECIMALS.

PROB. 1. To reduce a vulgar fraction to a decimal.

RULE. Annex ciphers to the numerator, and divide by the denominator.

1. What is the decimal of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$? Ans. ·25, ·5, ·75.
2. Reduce $\frac{3}{5}$ to a decimal. Ans. ·6.
3. What is the decimal of $\frac{1}{8}$? Ans. ·125.
4. Reduce $\frac{3}{8}$ to a decimal. Ans. ·375.
5. What is the decimal of $\frac{5}{8}$? Ans. ·625.
6. Reduce $\frac{7}{12}$ to a decimal. Ans. ·583$\frac{4}{12}$.
7. Reduce $\frac{5}{44}$ to a decimal. Ans. ·3409$\frac{4}{44}$.
8. What is the decimal of $\frac{124}{1264}$? Ans. ·0981$\frac{16}{1264}$.

NOTE. If there are not as many figures in the quotient as ciphers annexed, supply the defect by writing ciphers on the left hand.

PROB. 2. If the given number consists of several denominations.

RULE. Reduce it to the lowest denomination for a numerator, and reduce the denominator to the same; then annex ciphers, and divide as before. Or:

Begin at the lowest, and reduce them in their order.

1. Reduce 15*s*. 6$\frac{3}{4}$*d*. to the decimal of a pound. Ans. ·778125*l*.

2. Reduce 9*d.* to the decimal of a pound. Ans. ·0375*l.*

3. Reduce 8*s.* 6*d.* to the decimal of a pound. Ans. ·425*l.*

4. Reduce 12*s.* 8½*d.* to the decimal of a guinea. Ans. ·605158$\frac{736}{}$.

5. Reduce 6½*d.* to the decimal of a shilling. Ans. ·5416$\frac{32}{}$.

6. Reduce 8 oz. 12 dwt. 16 gr. to the decimal of a lb. troy. Ans. ·719444$\frac{256}{}$.

7. Reduce 2 qr. 16 lb. to the decimal of a cwt. Ans. ·642857$\frac{16}{}$.

8. Reduce 20 yds. 2 f. 6 in. to the decimal of a mile. Ans. ·0118371$\frac{1344}{}$.

9. Reduce 2 qr. 2 nl. to the decimal of a yard. Ans. ·625.

10. Reduce 1 rood, 20 po. to the decimal of an acre. Ans. ·375.

11. Reduce 3 bush. 1 pk. to the decimal of a quarter. Ans. ·40625.

12. Reduce 15 gallons of wine to the decimal of 252 gallons. Ans. ·0595238$\frac{24}{}$.

13. Reduce 6$\frac{3}{4}$ inches to the decimal of a foot. Ans. ·5625.

PROB. 3. To find the value of a decimal.

RULE. Multiply it by the value of the given denomination, and point off as many decimals from the right hand of the product as there are places in the given decimal. The figures on the left hand are integers of the next lower denomination; reduce the figures pointed off into the next lower denomination; proceed in this manner till you come to the lowest.

1. What is the value of ·85 of a £? Ans. 17*s.*

2. What is the value of ·1875*l.*? Ans. 3*s.* 9*d.*

3. What is the value of ·125*s.*? Ans. 1½*d.*

4. What is the value of ·6845 cwt.? Ans. 2 qr. 20 lb. 10 oz. 9 dr. $\frac{984}{}$.

5. What is the value of ·121 of 252 gallons? Ans. 30 gal. 1 qt. 1 pt. $\frac{256}{}$.

6. What is the value of ·03125 of 36 gallons? Ans. 1 gal. 1 pt.

7. What is the value of ·28 of a mile? Ans. 2 fur. 9 po. 3 yds. 10 in. $\frac{80}{}$.

PROB. 4. To find the decimal of Sterling money by inspection.

RULE. Take half the even number of shillings for the first decimal figure; and the number of farthings in the remainder, increased by 1, if they amount to 24, or upwards; by 2, if they amount to 48, or upwards; and by 3, if they amount to 72, or upwards, for the second and third figures; if there is but one figure, prefix a cipher to it.

To complete the decimal, call these two figures or their excess above 25, 50, or 75, pence; the farthings in them increased by 1 for every 24, give other two figures; continue this method till the decimal ends or repeats.

1. Reduce 6*s.* $4\frac{1}{2}d.$ to the decimal of a pound. Ans. ·31875*l.*

2. Reduce 9*s.* $6\frac{3}{4}d.$ to the decimal of a pound. Ans. ·478125*l.*

3. Find by inspection the decimal of 10*s.* $8\frac{1}{4}d.$ Ans. ·534375*l.*

4. Reduce 12*s.* $7\frac{3}{4}d.$ to the decimal of a pound. Ans. ·6322916$\dot{}$*l.*

5. Reduce 16*s.* $11\frac{1}{4}d.$ to the decimal of a pound. Ans. ·846875*l.*

6. Reduce 19*s.* $11\frac{3}{4}d.$ to the decimal of a pound. Ans. ·9989583$\dot{}$*l.*

PROB. 5. To value the decimal of a pound Sterling by inspection.

RULE. Double the figure next the point for shillings, if the next figure is 5, or upwards, take 5 from it, and add 1 to the shillings; then the second and third figures are farthings, after deducting 1 for every 25 in them.

| | | |
|---|---|---|
| 1. Value ·318*l.* | Ans. 6*s.* | $4\frac{1}{2}d.$ |
| 2. ·478*l.* | 9*s.* | $6\frac{3}{4}d.$ |
| 3. ·534*l.* | 10*s.* | $8\frac{1}{4}d.$ |
| 4. ·769*l.* | 15*s.* | $4\frac{3}{4}d.$ |
| 5. ·984*l.* | 19*s.* | $8\frac{1}{4}d.$ |
| 6. ·994*l.* | 19*s.* | $10\frac{3}{4}d.$ |

## ADDITION AND SUBTRACTION OF DECIMALS.

RULE. Write down the given numbers, placing the decimal points directly under each other; then proceed as in whole numbers.

### ADDITION.

1. What is the sum of 2·64, 85·6, ·945, 14·8, 5·3456, and 84? Ans. 193·3306.

2. What is the sum of 785·1, 84·35, 1·654, ·8956, ·009, and 10·161? Ans. 882·1696.

3. What is the sum of 25·3, 2·78, 324·67, 1·294, 63·14, and 345·6? Ans. 762·784.

4. What is the sum of 325·7, 63·451, 275·34, 6·473, 25·68, and 287·435? Ans. 984·079.

5. What is the sum of 3285·64, 287·458, 4550·67, 38·4526, 324·578, and 4761·29? Ans. 13248·0886.

### SUBTRACTION.

1. What is the difference between ·8406 and ·58975? Ans. ·25085.

2. What is the difference of 84·95 and 3·6954? Ans. 81·2546.

3. What is the difference of 246 and ·8154? Ans. 245·1846.

4. L borrowed from M 20·78125*l.* and afterwards paid him 14*l.* 18*s.* 9*d.* What remains due to M? Ans. 5*l.* 16*s.* $10\frac{1}{2}d.$

5. Find the difference between 40 yards, 2 quarters, and 29·625 yards? Ans. 10 yds. 3 qr. 2 nl.

## MULTIPLICATION OF DECIMALS.

RULE 1. Place the factors, and multiply as in whole numbers.

2. Point off as many decimal places in the product towards the right hand as there are in both factors; and if the product has not so many, supply the defect by writing ciphers on the left hand.

1. Multiply 346·549 by 3·15. Ans. 1091·62935.
2. Multiply 516·8945 by 44·89. Ans. 23203·394105.
3. Multiply ·84615 by ·065. Ans. ·05499975.
4. Multiply ·346809 by ·00546. Ans. ·00189357714.
5. A gentleman has ·83125*l.* a-day, how much is that a-year? Ans. 303*l.* 8*s.* 1½*d.*

## DIVISION OF DECIMALS.

RULE. Divide as in whole numbers, and point off as many decimal places in the quotient as the dividend has more than the divisor.

NOTE 1. If there are not as many decimal places in the quotient as required, supply the defect by writing ciphers on the left hand.

2. If there is a remainder, the quotient may be carried to any degree of exactness by annexing ciphers; or, if the decimal places in the divisor are more than those in the dividend, ciphers may be annexed to the dividend.

3. If the dividend will not contain the divisor, annex ciphers, or suppose them to be annexed, to the dividend.

1. Divide 176·4 by 24. Ans. 7·35.
2. Divide 45·3496 by 3·68. Ans. $12{\cdot}32\frac{120}{368}$.
3. Divide 24·694 by ·45. Ans. $54{\cdot}8\frac{34}{45}$.
4. Divide 8496 by ·546. Ans. $15560\frac{240}{546}$.
5. Divide ·21468 by 2·5. Ans. $\cdot0858\frac{18}{25}$.
6. Divide ·80468 by ·075. Ans. $10{\cdot}72\frac{68}{75}$.
7. Divide 8·4567 by 25. Ans. $\cdot3382\frac{17}{25}$.
8. Divide ·06548 by 215. Ans. $\cdot00030\frac{98}{215}$.
9. Divide 216·4 by 100. Ans. $2{\cdot}1\frac{64}{100}$.
10. A merchant bought a cwt. of sugar for 3·85*l.* and intends to gain 1½*d.* on each lb., at what rate must he retail it per lb.? Ans. 9¾*d.*

## PROPORTION OF DECIMALS.

1. If 1·25 yard of cloth cost ·625*l.*, what cost $30\frac{3}{4}$ yards? Ans. 15*l.* 7*s.* 6*d.*

2. If 1 stone of cheese cost ·33125*l.*, what cost $50\frac{1}{2}$ stones? Ans. 16*l.* 14*s.* $6\frac{3}{4}$*d.*

3. If $\frac{1}{4}$ of a pound of silk cost 8*s.* 6*d.*, what will 20·5 pounds cost? Ans. 34·85*l.*

4. A grocer bought 3 cwt. 1 qr. 14 lb. of sugar, at ·034375*l.* per lb., and sold it in wholesale for 16·5375*l.*, what did he gain or lose by the bargain, and how much per cent.? Ans. Gained 3*l.* 10*s.* $10\frac{1}{2}$*d.* and $27\frac{3}{11}$*l.* per cent.

## INTERMINATE DECIMALS.

When a vulgar fraction is reduced to a decimal, if nothing at last remains, it is called *finite* or *terminate;* if not, it is called *interminate.*

An interminate decimal is called a *repeater*, when the same figure is constantly repeated; and when several figures recur in the same order, it is called a *circulate.* When the repeating figures begin at the point, the decimal is called pure, but when there are other figures before them, it is said to be mixed, and the figures before the repeating ones are called the finite part.

A repeater is marked with a point above it, and a circulate with a point above the first and last figures of the circle.

### REDUCTION.

I. To reduce an interminate decimal to a vulgar fraction.

Rule. If it is a pure repeater, or circulate, place nine for the denominator of the repeater, or nine for every figure of the circle.

If the decimal is mixed, subtract the finite part from the whole for the numerator, and place a nine for every repeating figure, with a cipher annexed for every finite place for the denominator.

1. Reduce $\cdot\dot{5}$, $\cdot\dot{7}$, $\cdot\dot{3}\dot{7}$, $\cdot\dot{4}\dot{5}$, $\cdot\dot{3}2\dot{7}$, and $\cdot\dot{7}14285\dot{7}$ to vulgar fractions. Ans. $\frac{5}{9}$, $\frac{7}{9}$, $\frac{37}{99}$, $\frac{5}{11}$, $\frac{109}{333}$, and $\frac{5}{7}$.

2. Reduce $\cdot 27\dot{6}$, $\cdot 38\dot{4}$, $\cdot 34\dot{5}$, $\cdot 9\dot{7}142857\dot{}$ to vulgar fractions. Ans. $\frac{83}{300}$, $\frac{173}{450}$, $\frac{19}{55}$, $\frac{54}{55}$.

## II. To value an interminate decimal.

RULE. If it is a repeater, carry at 9 instead of 10 on the right hand; and if there is a cipher on the right hand of the multiplier, annex the repeating figure of the product instead of it.

If it is a circulate, multiply as usual; but to the right-hand figure of the product add the carriage from the left-hand figure of the circle. And when there are more lines than one of the product, the circles, or repeaters, must be carried the same length in them all; and the carriage from the left of the circles must be added to the right-hand figure of the sum.

1. What is the value of $\cdot 756\dot{l}$.? Ans. 15*s*. $1\frac{1}{2}d$. $\frac{2}{5}$.

2. What is the value of $\cdot 47\dot{9}$ of a cwt.? Ans. 1 qr. 25 lb. $12\frac{4}{25}$ oz.

3. What is the value of $\cdot 87\dot{6}$ of an acre? Ans. 3 roods, $20\frac{4}{15}$ perches.

4. What is the value of $\cdot 36\dot{3}4\dot{}$ of a pound? Ans. 7*s*. $3\frac{77}{375}d$.

5. What is the value of $\cdot 5\dot{3}07\dot{}$ of a guinea? Ans. 11*s*. $1\frac{1}{2}d$. $\frac{5}{5}\frac{42}{5}$.

6. What is the value of $\cdot 73\dot{8}\dot{6}$ of a cwt.? Ans. 2 qr. 26 lb. 11 oz. $11\cdot 62\dot{9}8$ drams.

## III. To make circles similar.

RULE. Point off by a comma on the right as many figures from the left of each as there are places in the longest finite part; then extend each of them as many places to the right as is denoted by the least common multiple of the number of places in the several repetends.

1. Make $\cdot 4\dot{3}\dot{6}$ and $\cdot 573\dot{6}8\dot{9}$ similar.

2. Make $\cdot 72\dot{9}$, $\cdot 5\dot{4}8\dot{6}$, and $\cdot 736\dot{5}\dot{4}$ similar.

3. Make $\cdot 75\dot{4}$, $\cdot \dot{3}$, $\cdot 7\dot{2}9\dot{8}$ and $\cdot \dot{7}486\dot{9}$ similar.

### ADDITION.

RULE. When there are only repeaters, extend them one place beyond the finite ones, and carry at 9 when you add the right-hand column.

When there are circulates, make them similar, and to the right of the sum add the carriage from the left of the circle.

1. Add $\cdot 471\dot{2}$, $3\cdot\dot{7}$, $\cdot 54\dot{6}$, and $\cdot\dot{3}$ together? Ans. 5·129.

2. Add $4\cdot 78\dot{3}$, $54\cdot 72\dot{1}$, $7\cdot\dot{6}$, $\cdot\dot{3}$ and $\cdot 5476\dot{9}$ together. Ans. 68·05214.

3. Add $16\frac{1}{9}$, $24\frac{1}{7}$, $3\frac{1}{6}$, $5\frac{11}{24}$, and $256\frac{7}{18}$ together. Ans. 305·267857142.

4. Add $\cdot 71\dot{8}6$, $34\cdot 67\dot{3}4$, $\cdot 21\dot{8}9\dot{3}$, and $25\cdot 712\dot{6}\dot{3}$ together. Ans. 61·323667394.

5. Add $\frac{25}{28}$, $3\frac{1}{14}$, $56\frac{10}{11}$, $49\frac{8}{9}$, and $257\frac{49}{52}$ together. Ans. 369·41885891.

### SUBTRACTION.

RULE. Extend repeaters one place beyond the finite ones, and borrow 9 on the right when the under figure is the greater. Make circulates similar; and when there is a carriage from the left of the circle, it must be added to the right-hand figure of the under line before subtracting.

1. From $74\cdot 528\dot{3}$ take $5\cdot\dot{6}$. Ans. $68\cdot 861\dot{6}$.

2. From $21\cdot 546\dot{2}$ take $18\cdot 7\dot{5}$. Ans. $2\cdot 790\dot{6}$.

3. From $27\cdot 38\dot{3}\dot{6}$ take $7\cdot 1\dot{8}6\dot{9}$. Ans. $20\cdot 19\dot{6}6493\dot{7}$.

4. From $1\cdot 8726\dot{3}$ take $\cdot 7542\dot{8}$.

Ans. $1\cdot 118\dot{3}488207\dot{6}0\dot{9}$.

### MULTIPLICATION.

RULE. When the multiplicand is interminate, carry at 9 on the right of a repeater; or multiply as usual in a circulate, and to the right of the product add the carriage from the left of the circle; and, before adding the several products, extend the repeaters the same length in each, and make the circulates similar.

When the multiplier is also interminate, reduce it to a vulgar fraction; then multiply by the numerator, and divide the product by the denominator.

1. Multiply $74{\cdot}738\dot{6}$ by 258 Ans. $19282{\cdot}576$.
2. Multiply $38{\cdot}543\dot{6}$ by 29. Ans. $1117{\cdot}765\dot{4}$.
3. Multiply $384{\cdot}576\dot{3}$ by $47{\cdot}5$. Ans. $18267{\cdot}37\dot{6}9\dot{8}$.
4. Multiply $7{\cdot}384\dot{6}$ by $2{\cdot}\dot{3}$. Ans. $17{\cdot}23084175$.
5. Multiply $5{\cdot}476\dot{3}$ by $21{\cdot}\dot{7}\dot{2}$. Ans. $118{\cdot}9857\dot{8}$.
6. Multiply $38{\cdot}72\dot{9}$ by $45{\cdot}\dot{4}\dot{5}$. Ans. 1760·4224, &c.

DIVISION.

Rule. When the dividend only is interminate, divide as usual, but annex the repeating figures instead of ciphers in order to carry out the quotient. But when the divisor is interminate it must be reduced to a vulgar fraction, and the dividend multiplied by the denominator, and the product divided by the numerator.

1. Divide $7{\cdot}384\dot{6}7$ by 21. Ans. $\cdot35165\frac{246}{2097}\dot{5}$.
2. Divide $3{\cdot}48\dot{6}$ by $15{\cdot}\dot{3}$. Ans. $\cdot22739\frac{5}{23}\dot{3}$.
3. Divide $27{\cdot}65\dot{4}$ by $16{\cdot}\dot{6}$. Ans. $1{\cdot}65926\dot{4}$.
4. Divide $8{\cdot}\dot{1}$ by $\cdot\dot{9}\dot{3}$. Ans. $8{\cdot}6344\frac{8}{93}\dot{8}$.
5. Divide $27{\cdot}\dot{3}$ by $2{\cdot}7\dot{6}$. Ans. $9{\cdot}879518\frac{6}{83}\dot{6}$.
6. Divide $4{\cdot}73\dot{6}$ by $82{\cdot}7\dot{3}$. Ans. $05724855\frac{43965}{136571}\dot{1}$.

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## EXTRACTION OF THE SQUARE ROOT.

Rule 1. Divide the given number into periods of two figures each, beginning at the right hand, and pointing toward the left in integers, and toward the right in decimals. Every period will give one figure in the root.

2. Find the greatest square number contained in the left-hand period, place its root in the quotient, subtract its square from the said period, and to the remainder bring down the second period for a dividend.

3. Write the double of the part of the root found on the

left hand of the dividend, divide by it, omitting the units place; set the result in the quotient, and annex it also to the divisor.

4. Multiply the divisor thus completed by the last figure placed in the root: subtract the product from the dividend, and to the remainder bring down the third period for a new dividend; proceed in the same manner till all the periods are brought down.

NOTE 1. The root consists of as many whole numbers and decimals as there are periods belonging to each.

2. If there is a remainder after all the periods are used, the operation may be continued at pleasure by annexing periods of ciphers.

3. Roots of vulgar fractions are found by extracting the root of the numerator for a new numerator, and the root of the denominator for a new denominator; but, if that cannot be done exactly, reduce the vulgar fraction to a decimal, and proceed as before.

1. Required the square root of 144? Ans. 12.
2. What is the square root of 1728? Ans. $41{\cdot}5^{575}$.
3. What is the square root of 40804? Ans. 202.
4. What is the root of 531118116? Ans. 23046.
5. What is the square root of 56085121? Ans. 7489.
6. What is the square root of 100040004? Ans. 10002.
7. What is the square root of 1020304030201? Ans. 1010101.
8. What is the square root of 00002209? Ans. ·0047.
9. What is the root of ·2916? Ans. ·54.
10. What is the root of 42·1685? Ans. $6{\cdot}49^{484}$.
11. What is the root of $\frac{2}{5}\frac{8}{7}\frac{0}{6}$? Ans. $\frac{1}{2}\frac{7}{4}$.
12. What is the root of $51\frac{2}{25}\frac{1}{9}$? Ans. $7\frac{1}{5}$.

To find a mean proportional between two given numbers extract the square root of their product.

13. What is the mean proportional between 16 and 9? Ans. 12.

14. What is the mean proportional between 64 and 9? Ans. 24.

To find the side of a square, equal in area to any given superficies, extract the square root of the given area.

15. In a square plantation, containing 505521 trees, each six feet distant, what is the length of the side? Ans. 4266 feet.

16. A gentleman has two fields; the first contains 8 acres, 2 roods, 1 pole,—the second 6 acres, 2 roods; he wishes to exchange them for a square field; required the side of the square? Ans. 49 po.

NOTE. Circles are to each other as the squares of their diameters.

17. A gentleman has two circular ponds in his pleasure grounds; the diameter of the one is 200 feet, and the other three times as large; what is its diameter? Ans. $346{\cdot}4\frac{704}{}$.

18. A maltster has a kiln, 14 feet in diameter, which is too little by $\frac{4}{5}$ for his business, what is the diameter of one that will answer his purpose? Ans. 18·78 feet.

Given any two sides of a right-angled triangle, to find the other side.

The square of the hypothenuse, or longest side, is equal to the sum of the squares of the other two sides; therefore the difference of the squares of the hypothenuse, and either of the other sides, is the square of the remaining side.

19. A wall is 48 feet high, and a ditch before it is 36 feet wide, required the length of a ladder that will reach from the opposite side of the ditch to the top of the wall? Ans. 60 feet.

20. A line, of 205 feet in length, reaches from the top of a steeple to a point 140 feet from its foundation, what is the height of the steeple? Ans. 149·75 feet.

## EXTRACTION OF THE CUBE ROOT.

RULE 1. Divide the given number into periods of three figures each, beginning at the right hand in integers, and pointing toward the left. But in decimals, begin at the place of thousands, and point toward the right.

2. Find the greatest cube number, in the left-hand period, and place the root of that number as the first figure of the root sought: subtract the number itself from the said period, and to the remainder bring down the next period for a dividend.

3. Find a divisor by multiplying the square of the part of the root found by 300, divide the dividend by it, and put the quotient figure for the next figure of the root.

4. Multiply the part of the root formerly found by the last figure placed in it, and this product by 30; place this last product under the divisor, and under this product write the square of the figure last placed in the root.

5. Multiply the sum of these three by the figure last placed in the root, and subtract the product from the dividend.

6. To the remainder bring down the next period for a new dividend, with which proceed as before.

Or add up the three last numbers, reckoning the middle one twice in the operation; to this sum annex two ciphers, the result will be the next trial-divisor, with which divide and complete as before.

Required the Cube Root of the following numbers?

| | | |
|---|---|---|
| 1. | 1728 | Ans. 12 |
| 2. | 54872 | Ans. 38 |
| 3. | 48228544 | Ans. 364 |
| 4. | 41063625 | Ans. 345 |
| 5. | 40107047967 | Ans. 3423 |
| 6. | 12821119155125 | Ans. 23405 |
| 7. | 14706·125 | Ans. 24·5 |
| 8. | 51·064811 | Ans. 3·71 |
| 9. | $\frac{1}{4}\frac{3}{2}\frac{8}{8}\frac{2}{7}\frac{4}{5}$ | Ans. $\frac{2}{3}\frac{4}{5}$ |
| 10. | $91\frac{1}{8}$ | Ans. $4\frac{1}{2}$ |

To find the side of a cube, equal in solidity to any given solid, extract the cube root of its solid content.

11. The solid content of a globe is 32768 feet, what is the side of a cube of equal solidity? Ans. 32 feet.

12. Required the side of a cubical mound equal to one whose length is 840 feet, breadth 500 feet, and depth 340 feet? Ans. 522·68 feet.

13. Required the side of a cubical vessel which will contain 100 imperial gallons? Ans. 30·267 inches.

Similar solids are to each other as the cubes of their diameters, sides, &c.

14. A ball, 12 inches diameter, weighs 30 lb., what will a ball weigh whose diameter is 18 inches? Ans. 101¼ lb.

15. A ball, 16 inches diameter, weighs 56 lb., what will be the diameter of a ball which weighs 6 times as much? Ans. 29·07 inches.

16. The length of a stone is 10 feet, breadth 4½ feet, and thickness 3 feet, required the dimensions of another 6 times as large? Ans. 18·17 feet long, 8·177 broad, 5·45 thick.

## SLIDING RULE.

### Rules for working on the Carpenter's Sliding Rule and on Gunter's Scale.

Note. The Rules are commonly marked with A on the Rule, B and C on the Slider, and D on the Girt or Square Line.

To multiply by the Sliding Rule.

Rule. Set 1 on B to one of the factors on A; then against the other factor on B, you have the product on A.

By Gunter's Scale.

Rule. Extend the compasses from the beginning of the line of numbers to one of the factors; the same distance shall reach from the other factor to the product.

To divide by the Sliding Rule.

Rule. Set the divisor on B to the dividend on A; then against 1 on B, you have the quotient on A.

By Gunter's Scale.

RULE. Extend the compasses from the dividend to the divisor; the same distance will reach from 1 to the quotient.

Proportion by the Sliding Rule.

RULE. Set the first number on B to the second on A; then against the third number on B is the answer on A.

By Gunter's Scale.

RULE. Extend the compasses from the first number to the second; that extent will reach in the same direction from the third number to the fourth.

Superficial Measure by the Sliding Rule.

RULE. Set the breadth in inches on B to 12 on A; then against the length in feet on A is the content on B, in square feet, &c.

By Gunter's Scale.

RULE. Extend the compasses from 12 to the breadth; that extent set the same way will reach from the length to the content.

Solid Measure by the Sliding Rule.

RULE. Set the length in feet on C to 12 on D, or girt line; then against the side of the square on D you have the answer on C.

By Gunter's Scale.

RULE. Extend the compasses from 12 to the side of the Square; that extent twice set will reach from the length to the answer.

To extract the Square Root by the Sliding Rule.

RULE. Set the middle division on C to 10 on D; then opposite to the given number on C you have the answer on D.

NOTE. If the given number consists of 2, 4, 6, &c. figures, the answer is to be found on the left hand of the line C; but if it consists of 3, 5, 7, &c. figures, it is found on the right hand of the line C.

To find a Mean Square by the Sliding Rule.

RULE. Multiply the breadth and depth together, and extract the square root of the product; the root is the mean square. Or set the breadth in inches on C to ditto on D; then against the depth or thickness in inches on C you have the mean square in inches on D, or girt line.

By Gunter's Scale.

RULE. The middle point, between the breadth and depth is the mean square.

## DUODECIMALS, OR CROSS MULTIPLICATION,

### Is a rule by which artificers cast up the contents of their work.

RULE 1. Write the multiplier under the multiplicand, feet under feet, inches under inches, seconds under seconds, &c.

2. Multiply each denomination of the length by the feet of the breadth, beginning at the lowest, and place each product under that denomination of the multiplicand from which it arises, always carrying one for every 12.

3. Multiply by the inches, and set each product one place farther to the right hand.

4. Multiply by the seconds or parts, and set each product another place toward the right hand.

5. Proceed in this manner with all the rest of the denominations, and their sum will be the answer.

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.

12 Fourths = 1 Third,
12 Thirds = 1 Second, or part,
12 Seconds = 1 Inch,
12 Inches = 1 Foot.

1. Multiply 6 feet, 3 inches, by 3 feet, 2 inches. Ans. 19 feet, 9 in. 6 s.

2. Multiply 4 feet, 5 inches, by 3 feet, 6 inches. Ans. 15 f. 5 in. 6 s.

3. Multiply 5 feet, 6 in. by 4 feet, 3 in. Ans. 23 f. 4 in. 6 s.

4. Multiply 6 feet, 6 in. by 3 feet, 8 in. Ans. 23 f. 10 in.

5. Multiply 24 feet, 3 in. by 16 feet, 7 in. Ans. 402 f. 1 in. 9 s.

6. Multiply 48 feet, 7 in. by 36 feet, 6 in. Ans. 1773 f. 3 in. 6 s.

7. Multiply 6 feet, 4 in. 3 s. by 4 feet, 3 in. 6 s. Ans. 27 f. 3 in. 2 s. 10 th. 6 fourths.

8. Multiply 56 feet, 1 in. 4 s. by 48 feet, 3 in. 6 s. Ans. 2709 f. 8 in. 4 s. 8 th.

9. Multiply 68 feet, 8 in. by 9 feet, 10 in. 11 s. Ans. 680 f. 5 in. 7 s. 4 th.

## MENSURATION

Is of three kinds; lineal, superficial, and solid. Lineal measure respects length only. Superficial includes length and breadth. Solid measure comprehends length, breadth, and thickness.

PROB. I. To find the superficial content of a board or plank.

RULE. Multiply the length by the breadth.

10. In a board 12 feet long, and $8\frac{1}{2}$ inches broad, how many square feet? Ans. 8 feet, 6 in.

11. Required the area of a plank 14 in. broad, and 16 feet, 6 in. long? Ans. 19 feet, 3 in.

12. In a deal 15 feet, 6 in. long, and 10 in. 6 sec. broad, how many square feet? Ans. 13 f. 6 in. 9 s.

13. Required the content of a plank $20\frac{3}{4}$ feet long, and $12\frac{1}{2}$ inches broad? Ans. 21 f. 7 in. 4 s. 6 th.

14. In a deal $10\frac{1}{3}$ feet long, and $8\frac{1}{4}$ in. broad, how many square feet? Ans. 7 f. 1 in. 3 sec.

NOTE. If the two ends of a plank or board differ in breadth, add the two breadths and multiply the length by half the sum.

15. How many square feet in a board 12 feet, 9 inches long, the breadth at one end being 15 in., and at the other 10? Ans. 13 f. 3 in. 4 s. 6 th.

PROB. II. To find the solid content of square or unequal-sided timber or stone.

RULE. Multiply the length, breadth, and thickness together.

16. Required the solid content of a tree 16 feet long, and 14 inches the side of the square? Ans. 21 f. 9 in. 4 s.

17. Required the solid content of a tree 14 feet long, and $10\frac{1}{2}$ in. the side of the square? Ans. 10 f. 8 in. 7 s. 6 th.

18. What is the solid content of a tree 24 feet, 6 in. long, and 20 in. the side of the square? Ans. 68 f. 8 s.

19. A piece of timber is $18\frac{1}{2}$ feet long, 14 inches broad, and 9 deep, what is its solid content? Ans. 16 f. 2 in. 3 s.

20. What is the solid content of a piece of timber or stone whose sides are 10 in. by 18, and the length 18 feet? Ans. 22 f. 6 in.

21. What is the solid content of a piece of timber 15 feet, 3 in. in length, breadth 15 in. and depth $4\frac{1}{2}$ in.? Ans. 7 f. 1 in. 9 s. 4 th. 6 fourths.

22. How much timber is there in a tree 2 feet, 6 in. by 1 foot, 10 in. and $38\frac{3}{4}$ feet long? Ans. 177 f. 7 in. 3 p.

NOTE 1. The usual way to measure round timber is to girt the tree in the middle with a small cord, then $\frac{1}{4}$ of the girt is considered as the side of the square.

2. Tapering timber is measured by girting it in two or more places, and dividing the sum of the girts by their number, for the mean girt.

23. What is the solid content of a round tree 25 feet long, and girt in the middle 45 inches? Ans. 21 f. 11 in. 8 s. 9 fourths.

24. How much timber in a round tree 30 feet

long, and the girt 42 inches? Ans. 22 f. 11 in. 7 s. 6 th.

25. How many solid feet in a round tree 28 feet, 6 in. long, and the girts 48 in. 42 in. and 36 in.? Ans. 21 f. 9 in. 10 s. 1 th. 6 fo.

3. A more accurate way to measure round timber is to multiply the square of $\frac{1}{5}$ of the girt by twice the length for the solidity.

26. If the length of a tree is 24 feet, and the girt 8 feet, what is the content? Ans. 122·88 feet.

27. The girts of a tree, in 5 different places, are 9·43 ft. 7·92 ft. 6·15 ft. 4·74 ft. and 3·16 ft. and the length of it $17\frac{1}{4}$ feet, what is its solidity? Ans. 54·424992 feet.

BOARD OR SUPERFICIAL MEASURE.

| | Length in feet. | Breadth in inches. | Content in sq. feet, &c. |
|---|---|---|---|
| 28. | 14 | 18 | 21 |
| 29. | 9 | $17\frac{1}{2}$ | 13 1′ 6″ |
| 30. | $11\frac{1}{4}$ | $7\frac{3}{4}$ | 7 3′ 2″ 3‴ |
| 31. | $9\frac{3}{4}$ | $13\frac{1}{4}$ | 10 9′ 2″ 3‴ |
| 32. | $8\frac{1}{4}$ | 22 | 15 1′ 6″ |
| 33. | $14\frac{1}{2}$ | 20 | 24 2′ |
| 34. | $18\frac{1}{2}$ | 14 | 21 7′ |
| 35. | $24\frac{3}{4}$ | $21\frac{1}{4}$ | 43 9′ 11″ 3‴ |
| 36. | $12\frac{1}{4}$ | 9 | 9 2′ 3″ |
| 37. | 30 | 22 | 55 |

EQUAL-SIDED OR ROUND TIMBER.

| | Length in feet. | Side square in inches. | Solid Content in feet, &c. |
|---|---|---|---|
| 38. | 18 | 15 | 28 1′ 6″ |
| 39. | 14 | 16 | 24 10′ 8″ |
| 40. | $16\frac{1}{4}$ | $9\frac{1}{2}$ | 10 2′ 2″ 6‴ 9⁗ |
| 41. | 18 | 8 | 8 |

EQUAL-SIDED OR ROUND TIMBER.

| | Length in feet. | Side square in inches. | Solid Content in feet, &c. |
|---|---|---|---|
| 42. | 12 | 15 | 18 9′ |
| 43. | 22 | $8\frac{1}{2}$ | 11 0′ 5″ 6‴ |
| 44. | $27\frac{1}{2}$ | 19 | 68 11′ 3″ 6‴ |
| 45. | $6\frac{3}{4}$ | $22\frac{1}{4}$ | 23 2′ 5″ 8‴ $0\frac{3}{4}$⁗ |
| 46. | $24\frac{1}{2}$ | $30\frac{3}{4}$ | 160 10′ 6″ 3‴ $4\frac{1}{2}$⁗ |
| 47. | 34 | $6\frac{1}{2}$ | 9 11′ 8″ 6‴ |
| 48. | 9 | 14 | 12 3′ |
| 49. | 4 | 16 | 7 1′ 4″ |
| 50. | 13 | 17 | 26 1′ 1″ |
| 51. | $15\frac{1}{2}$ | $18\frac{1}{2}$ | 36 10′ 0″ 10‴ 6⁗ |
| 52. | 17 | 13 | 19 11′ 5″ |
| 53. | $19\frac{1}{2}$ | 28 | 106 2′ |
| 54. | 24 | $32\frac{1}{4}$ | 173 4′ 1″ 6‴ |
| 55. | $29\frac{1}{4}$ | 31 | 195 2′ 5″ 3‴ |
| 56. | $40\frac{3}{4}$ | 19 | 102 1′ 10″ 9‴ |

UNEQUAL-SIDED TIMBER OR STONE.

| | Breadth in inches. | Depth or Thickness in inches. | Length in feet. | Content in Solid feet, &c. |
|---|---|---|---|---|
| 57. | 32 | 18 | $14\frac{1}{2}$ | 58 |
| 58. | 13 | 10 | 18 | 16 3′ |
| 59. | $8\frac{1}{2}$ | $7\frac{1}{2}$ | 14 | 6 2′ 4″ 6‴ |
| 60. | 14 | $11\frac{1}{2}$ | 9 | 10 0′ 9″ |
| 61. | 19 | $8\frac{3}{4}$ | 24 | 27 8′ 6″ |
| 62. | $15\frac{1}{2}$ | $3\frac{1}{4}$ | 16 | 5 7′ 2″ |
| 63. | 11 | 9 | 16 | 11 |
| 64. | 17 | 11 | 41 | 53 2′ 11″ |
| 65. | 30 | 19 | $18\frac{3}{4}$ | 74 2′ 7″ 6‴ |

A CARPENTER'S ACCOUNT.

James Donaldson, Esq. Dr.

1882. To John Wood.

July 15. To 753 yds. 3 f. 8 in. flooring at 3*s.* 6*d.*
To 151 yds. 9 in. painting at 7½*d.*
To 158 yds. 1 f. 3 in. plastering at 4½*d.*

Aug. 3. To 1737 feet of timber at 1*s.* 6½*d.*
To 6 roods, 6 yds. 6 f. slating at 14*s.* 6*d.*
To 196 feet, 10 in. 6 p. sawing at ½*d.*

Sept. 7. To 12 deals, each 14 feet, 8 in. long, and 10½ inches broad, at 2½*d.* per foot.
To 6 Memel logs, each 14½ feet long, and 11¾ inches the side of the square, at 1*s.* 8*d.* the solid foot.

Ans. £286 17 5¼

66. In a piece of tapering unequal-sided timber, 24 feet 9 inches long, the base at the greater end being 34 inches by 20, and at the other end 17 inches by 10, how many solid feet? Ans. 62 f. 7 in. 9 s. 4 th. 6 fourths.

NOTE. Add the length and the breadth of the bases separately; divide each of the sums by 2, then multiply the quotients together, and that product by the length.

67. How many square feet in the floor, roof, and walls of a house 50 feet long, 18 feet broad, and 15 feet high? Ans. 3840 feet.

68. What is the weight of a plank 24½ feet long, 2 broad, and 1¼ thick, at 25 lb. the solid foot? Ans. 1531¼ lb.

69. Required the price of the same, viz. 61¼ feet, at 1*s.* 2*d.* per foot, and the expense of carrying it at ½*d.* per lb.? Ans. Price 3*l.* 11*s.* 5½*d.*; carriage 3*l.* 3*s.* 9½*d.* ½.

70. How many square feet of paving in a court-

yard, 68 feet 4 inches, by 60 feet 6 inches, and what will it cost at $3\frac{1}{4}d.$ the square yard? Ans. 4134 feet, 2 in. cost $6l.$ $4s.$ $4\frac{3}{4}d.$ $\frac{3}{5}\frac{1}{4}$.

71. A house has three rows of windows, 5 in a row; the height of the first is 5 feet 6 in., the second 5 feet 3 in., and the third 4 feet 9 in.; the breadth of each is 2 feet 6 in. Required the number of feet, and the expense of glazing at $9\frac{1}{2}d.$ per square foot? Ans. 193 f. 9 in.; expense $7l.$ $13s.$ $4\frac{1}{2}d.$ $\frac{1}{2}$.

72. How many square yards of flooring are in a house of 4 floors, the ground one included, 60 feet by 30 within the walls, deducting from each floor the vacancy for the stair, 12 feet 4 in. by 8 feet 6 in.; required also the value at $3s.$ $6d.$ the square yard? Ans. 753 yds. 3 f. 8 in.; value, $131l.$ $16s.$ $11\frac{1}{9}d.$

73. How many square yards of painting in a room 40 feet 6 inches long, 24 feet 3 in. broad, and 10 feet 6 in. high; and how much does it come to at $7\frac{1}{2}d.$ the yard? Ans. 151 yds. 9 in. comes to $4l.$ $14s.$ $5\frac{9}{4}d.$ $\frac{1}{2}$.

74. How many yards of plastering in the roof and walls of a room, 32 feet 6 in. long, 16 feet 6 in. broad, and 9 feet 3 in. high, deducting a door 6 feet 6 in. by 3 feet; and what will it cost at $4\frac{1}{2}$d. the square yard? Ans. 158 yds. 1 f. 3 in. cost $2l.$ $19s.$ $3\frac{1}{2}d.$ $\frac{1}{2}$.

75. A log of wood, 12 feet 6 inches long, was sawed into 9 deals, each 1 foot 9 in. broad; how many superficial feet did they contain? and what is the sawer's wages at $\frac{1}{2}d.$ per square foot? Ans. 196 feet, 10 in. 6 s.; and sawer's wages $8s.$ $2\frac{1}{4}l.$ $\frac{3}{4}$.

76. How many deals, 12 feet 6 in. long, and $8\frac{1}{2}$ in. broad, will floor a room 50 feet by 16? Ans. $90\frac{6}{17}$.

77. How many roods of mason-work in a wall $50\frac{1}{2}$ feet long and $24\frac{1}{4}$ feet high? and what will it cost at 40*s*. per rood? Ans. 3 ro. 28 yds. $7\frac{1}{2}$ in. cost 7*l*. 11*s*. $2\frac{1}{4}d$. $\frac{1}{7}$.

NOTE. Two feet thick is generally accounted the standard for stone walls, and three half-bricks is reckoned the standard for brick walls: Walls of any other thickness must be reduced to the above standards.

78. What is the expense of a wall 64 feet long, 20 feet high, and three feet thick, at 40*s*. per rood? Ans. 11*l*. 17*s*. $0\frac{1}{4}d$. $\frac{7}{8}$.

79. How many square yards of brick-work in a wall 48 feet long, 28 feet high, and $2\frac{1}{2}$ bricks thick? Ans. 248 yds. 8 feet.

NOTE. In the following question one foot is added to the height of the side-walls as an allowance for levelling.

The content of the gables above the side-walls is found by multiplying $\frac{1}{2}$ the sum of the breadth of the house, and the breadth of the chimney-stalk by the height from the level of the side-walls to the bottom of the chimney-stalk; and the content of the chimney-stalk is found by multiplying the sum of its breadth and thickness by its height.

80. A house 41 feet long, 20 feet 9 inches wide, and 18 feet 9 inches high; the gables above the side-walls 8 feet 6 inches; the gables are $2\frac{1}{2}$ feet thick; the two chimney-stalks 4 feet wide, $2\frac{1}{2}$ feet thick, and 5 feet 1 inch high.

THE BROACHED HEWN WORK

Of said house is, four skews, each 11 feet 6 inches by 1 foot 7 inches. Four corners, each 18 feet 9 inches by 2 feet 6 inches. Two chimney-stalks, the girt of each 13 feet, and the height 5 feet 3 in.

THE DROVED HEWN WORK.

The rybats and lintels of 6 windows, each 13 feet 11 inches, by 1 foot 3 inches; 6 soles of ditto, each 3 feet 11 inches, by 1 foot 7 inches; one window,

the rybats and lintel 9 feet 3 inches, by 1 f. 3 in.; sole of ditto 3 f. 3 in. by 1 f. 7 in. The rybats and lintel of a door 19 f. 3 in. by 1 f. 3 in.; the sole of ditto 4 f. 3 in. by 1 f. 7 in. Three pair of jambs, each 6 f. by 2 f.; the lintels of ditto, each 4 f. 5 in. by 1 f. 3 in. Three inner hearths, each 3 f. 1 in. by 1 f. 6 in. Three outer hearths, each 3 f. 8 in. by 1 f. 8 in. Kitchen-jambs, 8 f. 8 in. by 2 f. 3 in.; lintel of ditto 5 f. 8 in. by 1 f. 3 in.; hearth 4 f. by 1 f. 9 in.; likewise 106½ feet of vents.

How many roods of building are in said house? how many feet of broached hewn work? and how many feet of droved ditto? Also, what are the expenses for workmanship, the building being at 30*s.* per rood? the broached hewn work at 4*d.* per square foot, the droved ditto at 5*d.* and the vents at 6*d.* per lineal foot? Ans. 9 ro. 5 f. 2⅓ in. building; 396 f. 10 in. broached hewn work; 307 f. 5¼ in. droved ditto;—29*l.* 4*s.* 1¼*d.* $\frac{25}{108}$ expenses for workmanship.

81. How many roods in a slated roof, the length of the ridge being 41 f. 9 in.; and girt from eave to eave, 46 f. 6 in.; allowing 9 in. additional on each side for the eaves; and what will the expense of slating come to at 14*s.* 6*d.* the rood? Ans. 6 ro. 6 yds. 6 feet. Expense 4*l.* 9*s.* 8⅔*d.*

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## FORMS OF BILLS AND PROMISSORY NOTES.

### INLAND BILL.

£100. Edinburgh, December 25, 1882.

Three months after date, pay to me or order, at the Royal Bank of Scotland here, the sum of one hundred pounds sterling, value received.

To Mr Robert Wilson, Merchant, Leith. } JOHN ALLAN. ROBERT WILSON.

BILL PAYABLE BY INSTALMENTS.

£150. Edinburgh, December 25, 1882.

At three, six, and nine months after date, by equal instalments, pay to me or my order, at your house, the sum of one hundred and fifty pounds sterling, for value received.

To Mr John Williams, merchant, High Street, Edinburgh. — Robert Dundas. John Williams.

FOREIGN BILL.

£1356, 16*s*. Demerara, May 10, 1882.

Two months after sight of this my first of exchange, (second and third of the same tenor and date unpaid,) pay to the order of Messrs Brisbane & Co. one thousand three hundred and fifty-six pounds sixteen shillings sterling, value of John Ritchie, Esq., and place it to the account of, as per advice, from James White.

To Mr James Elliot, merchant, Edinburgh. — Accepted Dec. 25, 1882, James Elliot.

A PROMISSORY NOTE.

£50, 10*s*. Edinburgh, December 25, 1882.

Sixty days after date, I promise to pay to Mr James Brown or order, at my office here, the sum of fifty pounds ten shillings sterling, value received. John Young.

RECEIPTS.

Edinburgh, December 25, 1882.

Received from William Anderson, Esq., the sum of thirty-five pounds ten shillings and sixpence halfpenny, in full of his account to this date. John Grieve.

Edinburgh, November 11, 1882.

Received from William Brown, Esq., the sum of thirty guineas, being the half-year's rent, ending at Martinmas, of that house possessed by him, No 10, North St David Street.

John Oliphant.

## MISCELLANEOUS QUESTIONS.

1. A merchant, on balancing his books, finds he has in cash 412*l*. 10*s*. 6*d*.; goods to the value of 650*l*. 16*s*. 7*d*.; and in the stocks 1509*l*. 16*s*. 10$\frac{3}{4}$*d*. At that same time he owes A 47*l*. 15*s*. 8*d*., B 105*l*. 18*s*. 9$\frac{1}{2}$*d*., C 14*l*. 15*s*. 2$\frac{3}{4}$*d*., and D 304*l*. 10*s*., and his household and personal expenses

amounted to 216*l.* 18*s.* 6*d.*, what is his net estate? Ans. 1883*l.* 5*s.* 9½*d.*

2. A privateer takes a prize to the value of 2851*l.* 4*s.*, of which the captain gets $\frac{1}{16}$, each of 6 officers $\frac{1}{32}$ of the remainder, and the private men, being 45 in number, get the rest equally divided among them: what is each man's share?

Ans. Captain's share, 178*l.* 4*s.*
Each officer's share, 83*l.* 10*s.* 7½*d.*
Each private man's share, 48*l.* 5*s.* 3*d.*

3. There is a prize of 212*l.* 14*s.* 7*d.* to be divided among a captain, four men, and a boy; the captain is to have a share and a half, the men each a share, and the boy $\frac{1}{3}$ of a share; what ought each person to have? Ans. The captain 54*l.* 14*s.* 0¼*d.* $\frac{5}{7}$., each man 36*l.* 9*s.* 4¼*d.* $\frac{1}{7}$., and the boy 12*l.* 3*s.* 1¼*d.* $\frac{5}{7}$.

4. How many planks will floor a house 60½ feet long, 33½ feet wide, when the planks are 15 feet long, and 15 inches wide? Ans. 108 $\frac{7}{75}$.

5. Queen Elizabeth came to the throne of England the 17th of November, 1558, and died the 24th of March, 1603, in the 70th year of her age; in what year was she born, and how many months, of 28 days each, did she reign, reckoning 365 days, 6 hours to a year? Ans. She was born in the year 1533, and reigned 578 months, 2 weeks, and one day.

6. A stationer sold quills at 11*s.* a-thousand, by which he cleared $\frac{3}{8}$ of the money: but growing scarce, he raised them to 13*s.* 6*d.* a-thousand: what did he clear per cent. by the latter price? Ans. 96*l.* 7*s.* 3¼*d.* $\frac{1}{11}$.

7. A grocer bought 2 hhds. of sugar, the one weighed net 17 cwt. 3 qr. 14 lb. at 2*l.* 6*s.* 8*d.* per cwt., the other weighed net 18 cwt. 1 qr. 21 lb. at 4½*d.* per lb., which he mingled together; I demand

how much a cwt. of this mixture is worth? Ans. 2*l.* 4*s.* $3\frac{1}{2}d.$ $\frac{1}{4}\frac{0}{6}\frac{7}{7}\frac{8}{8}$.

8. Shipped for Jamaica 550 pair of stockings at 11*s.* 6*d.* per pair, and 460 yards of stuff at 14*d.* per yard; in return for which I had 46 cwt. 3 qr. of sugar at 1*l.* 4*s.* 6*d.* per cwt., and 1570 lb. of indigo at 2*s.* 4*d.* per lb.; what remains due to me of my adventure? Ans. 102*l.* 12*s.* $11\frac{1}{2}d.$

9. My correspondent writes me that he has purchased goods on my account to the amount of 560*l.* 10*s.*, what does his commission come to at $2\frac{1}{2}$*l.* per cent.? Ans. 14*l.* 0*s.* 3*d.*

10. A manufacturer having an equal number of men, women, boys, and girls employed, distributes 14*l.* among them per day; to each man he gave 1*s.* 2*d.*, to each woman $7\frac{1}{2}d.$, to each boy $3\frac{1}{2}d.$, and to each girl 3*d.*; how many had he of each? Ans. 120.

11. If the expenses of building a church that holds 2400 persons amount to 1600*l.*, and if $\frac{1}{4}$ of the seats are let at 3*s.* 6*d.*, $\frac{1}{4}$ at 2*s.* 6*d.*, $\frac{1}{4}$ at 1*s.* 6*d.*, and the remaining fourth at 1*s.*, how much per cent. do the heritors receive for their money, after paying their minister yearly 120*l.* of stipend? Ans. 8·4375*l.* or $8\frac{7}{16}$.

12. A labourer receives 14*d.* for every week-day from 5th March (beginning on the 6th) to 4th November inclusive, and $11\frac{1}{2}d.$ per day during the rest of the year; how much do his wages amount to in a year? Ans. 17*l.* 4*s.* 8*d.*

13. A ship's crew took a prize of 1000*l.*, which they agreed to divide among them according to their pay and the time they had been on board: the officers and midshipmen were 6 months on board, and the sailors 3 months: the officers had 40*s.* a-month, the midshipmen 30*s.*, and the sailors 22*s.*; the crew consisted of 4 officers, 12 midshipmen,

and 110 sailors; what share of the prize was each man entitled to?

Ans. Each officer's share, £23 2 $5\frac{9}{4}\ \frac{99}{173}$
Each midshipman's, 17 6 $9\frac{3}{4}\ \frac{69}{173}$
Each sailor's, 6 7 $2\frac{0}{4}\ \frac{3}{173}$

14. The silk-mill at Derby contains 26586 wheels, and 97746 movements, which wind off or throw 73726 yards of silk every time the great water-wheel, which gives motion to all the rest, goes about, which is three times in a minute. The question is, how many yards of silk may be thrown by this machine in a day, reckoning 10 hours to a day's work; and how many in the compass of a year, deducting for Sundays and holidays 63 days, provided no part of it stands still? Ans. 40077453600 yards.

15. A merchant sends to Spain 1300 pieces of broad cloth, each 47 yards, at 15*s.* 6*d.* per yard, to have returns from thence, the one half in wine, at 65*l.* per 252 gallons, and the other half in oranges, at 3*l.* 10*s.* per chest; what quantity of each will he have? Ans. 91791 gallons of wine, and $6764\frac{9}{14}$ chests of oranges.

16. Three farmers, A, B, and C, hired a shepherd for 12*l.* 10*s.* a-year; they are to pay his wages in proportion to the number of sheep each commits to his care; A has 608, B 1200, and C 1500; what part of the wages must each farmer pay? Ans. A 2*l.* 5*s.* $11\frac{1}{4}d.\ \frac{185}{527}$, B 4*l.* 10*s.* $8\frac{1}{4}d.\ \frac{69}{527}$, and C 5*l.* 13*s.* $4\frac{1}{4}d.\ \frac{293}{527}$.

17. How much cloth at 5*s.* 6*d.* per yard must be given in barter for 14 cwt. 3 qrs. of sugar at 3*l.* 10*s.* per cwt.? Ans. 187 yards, 2 qrs. $3\frac{7}{11}$ nls.

18. If 2 qts. of linseed sow 121 sq. yds., how much will sow an acre? and what will it cost at 1*s.* $5\frac{1}{2}d.$ for 2 qts.? Ans. 10 pks.; cost 2*l.* 18*s.* 4*d.*

19. If a peck of potatoes plant $84\frac{1}{3}\frac{1}{6}$ sq. yds., how many will plant an acre? Ans. 1 qr. 6 bu. 1 pk. $1\frac{1}{5}$ gal.

20. If the half of a mark buy the fourth of a pound, how much cochineal can I have for a crown? Ans. 3 ounces.

21. If a soldier is allowed 12 lb. of bread in 8 days, how much will serve a regiment, consisting of 750 privates, a year? Ans. 183 tons, 6 cwt. 1 qr. 5 lb.

22. There is gained by trading with a ship 120*l*. 14*s*.; now suppose that $\frac{1}{4}$ of her belongs to S, $\frac{3}{8}$ to T, $\frac{1}{8}$ to V, and the rest to W, what must each have of the gain? Ans. S 30*l*. 3*s*. 6*d*., T 45*l*. 5*s*. 3*d*., V 15*l*. 1*s*. 9*d*., and W 30*l*. 3*s*. 6*d*.

23. An apothecary mixes 2 oz. 5 dr. of syrup with 3 oz. 4 dr. of rectified spirit of wine, and also 5 dr. 2 scr. 15 gr. of the bark with 4 oz. 3 dr. 1 scr. 8 gr. of mint-water; how much do all these weigh? Ans. 11 oz. 2 scr. 1 dr. 3 gr.

24. A gentleman has an estate consisting of $12{,}000\frac{1}{2}$ acres; what is his yearly and daily income at $3\frac{3}{4}d.$ for every square pole? Ans. 30,001*l*. 5*s*. yearly; 82*l*. 3*s*. $10\frac{3}{4}d.$ $\frac{2}{7}\frac{9}{3}$ daily income.

25. There is a lodging of 5 rooms; the circumference of the first is 95 feet 7 inches, of the second 84 feet 9 inches, of the third 79 feet 11 inches, of the fourth 71 feet 6 inches, and of the fifth 59 feet; the height of each room is 10 feet 8 inches; how many yards of paper $32\frac{1}{2}$ inches wide will paper the lodging? Ans. 512 yards, $35\frac{9}{5}\frac{9}{5}$ inches.

26. How many allowances for seamen, each 7 oz. 14 dr., may be cut out of 73 cheeses, each weighing 17 lb. $10\frac{1}{2}$ oz.? Ans. $2618\frac{6}{6}\frac{6}{5}$.

27. A draper sells cloth for 350*l*., and gains at the rate of 10*l*. per cent.; what was the principal

and clear gain? Ans. Principal, 318*l.* 3*s.* $7\frac{1}{2}d.$ $\frac{6}{11}$. Gain, 31*l.* 16*s.* $4\frac{1}{4}d.$ $\frac{5}{11}$.

28. A and B, venturing equal sums of money, clear by joint trade 154*l.*; by agreement A was to have 8*l.* per cent., because he spent his time in the execution of the project, and B was only to have 5*l.* per cent.; what was A allowed for his trouble? Ans. 35*l.* 10*s.* $9\frac{9}{4}d.$ $\frac{1}{5}\frac{2}{5}$.

29. A grocer bought an equal quantity of sugar, tea, and tobacco, for 704*l.* 3*s.* 4*d.*; he gave $10\frac{1}{2}d.$ per pound for the sugar, 5*s.* 9*d.* per pound for the tea, and 1*s.* $8\frac{1}{2}d.$ per pound for the tobacco; I demand how many pounds he had of each sort? Ans. 1690 lb. of each.

30. A cheesemonger bought 650 cheeses weighing one with another 10 lb. each, which cost him 80 guineas; now he sold them by retail in his shop for $3\frac{1}{2}d.$ per lb.; I demand what he gained or lost by them? Ans. He gained 10*l.* 15*s.* 10*d.*

31. A tobacconist sent abroad 20 hogsheads of tobacco, each weighing 11 cwt. 3 qr., and sold them at the rate of 7*l.* 10*s.* per cwt.; his correspondent remitted him in part payment 1500 guineas; I demand the balance? Ans. 187*l.* 10*s.*

32. A wine merchant imported 2268 gallons of wine, which cost him at first purchase 549*l.* 10*s.* 6*d.*, the freight of it cost him 33*l.* 12*s.*, customs, 61*l.* 1*s.*, loading and unloading, carts and porters, 17*l.* 6*s.* 6*d.*; I demand what this wine stood him per gallon? Ans. 5*s.* 10*d.*

33. Bought a ton of iron and steel, (there being in number 130 bars,) which cost me 29*l.* 3*s.* 4*d.*; there were 70 bars of steel, which weighed each 8 lb. and cost 5*d.* per lb.; I demand what the iron and steel weighed each? what they cost separately? what the iron cost per lb.? and what each bar

weighed one with another? Ans. There were 15 cwt. of iron, and 5 cwt. of steel; the iron cost 17*l.* 10*s.* and the steel cost 11*l.* 13*s.* 4*d.*, and each bar of iron weighed 28 lb. and cost $2\frac{1}{2}d.$ per lb.

34. Bought 1000 ells of holland by the Flemish ell, and paid down 90*l.*; how must I charge it per ell English to gain 10*l.* on the whole? Ans. 3*s.* 4*d.*

35. A butcher buys an ox for 10*l.* 16*s.* and after feeding him with 24 pecks of oats at 18*s.* per qr., and 20 trusses of hay at 1*s.* 4*d.*, slaughters him and sells the beef, being 36 stones, at $5\frac{1}{2}d.$ per lb., 6 stones tallow at 7*d.* per lb. allowing 14 lb. per stone, and the hide for 1*l.* 5*s.*; required his gain or loss? Ans. Gain 2*l.* 8*s.* 10*d.*

36. A tradesman engages an apprentice for 5 years, and receives 25*l.* of apprentice-fee. He agrees to maintain him, the expense of which is reckoned at 8*d.* per day, and allow him 3*l.* each of the three first years, 5*l.* the fourth, and 8*l.* the fifth, for clothes. Now if nothing is reckoned for his work the first year, but the second year the value of it amounts to 6*l.*, the third year to 12*l.*, and the two remaining years always to 6*l.* more than the year preceding, what does the master gain or lose by his service? Ans. He gains 2*l.* 3*s.* 4*d.*

37. I bought stockings in London at 3*s.* 10*d.* per pair, and sold them afterwards in Dublin for 5*s.* 6*d.*? in remitting my money home I lost $8\frac{1}{3}l.$ per cent., and the charges attending the freight, &c. of the stockings at an average was $1\frac{1}{2}d.$ per pair; what did I gain or lose per cent. by them? Ans. I gained 27*l.* 7*s.* $4\frac{1}{4}d.$ $\frac{1}{19}$ per cent.

38. Divide 43*l.* 12*s.* 9*d.* among 7 men, 9 women, and 3 boys, and give a woman $\frac{3}{4}$ of a man's share, and a boy $\frac{2}{3}$ of a woman's. Ans. A boy's share 1*l.*

12*s.* $2\frac{1}{4}d.$ $\frac{24}{132}$; a woman's 1*l.* 17*s.* $6\frac{1}{2}d.$ $\frac{89}{132}$; and a man's 3*l.* 2*s.* $7\frac{3}{4}d.$ $\frac{67}{132}$.

39. A person paved a court-yard 42 feet 9 in. in front, and 68 feet 6 inches in depth, and in this he laid a footpath, the depth of the court, of 5 feet 6 inches in breadth; the footpath is laid with Purbeck stone, at 3*s.* 6*d.* per yard, and the rest with pebbles, at 3*s.* per yard; what will the whole come to? Ans. 49*l.* 17*s.* $0\frac{1}{2}d.$ $\frac{2}{3}$.

40. Suppose 2*l.* and $\frac{3}{8}$ of $\frac{1}{3}$ of a pound sterling will buy 3 yds. and $\frac{2}{5}$ of $\frac{3}{5}$ of a yard of cloth, how much will $\frac{3}{4}$ of a yd. cost? Ans. 9*s.* $4\frac{1}{2}d.$

41. A ladder 40 feet long may be so placed as to reach a window 33 feet from the ground on one side of the street, and by only turning it over, without moving the foot out of its place, it will do the same by a window 21 feet high on the other side; required the breadth of the street? Ans. 56 f. 7·788 inches.

42. If 36 oxen eat up the grass of 10 acres in 4 weeks, and 21 oxen eat up the same in 9 weeks, how many oxen will it maintain for 18 weeks, supposing the grass to grow uniformly during the time? Ans. 15 oxen.

43. A tradesman increased his estate annually a third part, abating 100*l.*, which he usually spent in his family, and at the end of $3\frac{1}{4}$ years he found that he was worth 3179*l.* 11*s.* 8*d.*; required how much he had at beginning? Ans. 1421*l.* 7*s.* $6\frac{1}{2}d.$

44. A person making his will, gave to one son $\frac{2}{5}\frac{9}{0}$ of his estate, and to another $\frac{1}{3}\frac{1}{9}$. The first turned out 540*l.* 10*s.* more than the other; what did the testator leave? Ans. 1538*l.* 12*s.* $11\frac{3}{4}d.$ $\frac{2}{4}\frac{6}{1}\frac{7}{1}$.

45. When the hour and minute hands of a clock are exactly together, between 4 and 5 o'clock, what is the time? Ans. $21\frac{9}{11}$ minutes past 4.

46. A hare is 100 of her own leaps before a greyhound, and she takes 5 leaps for the dog's 4, but 3 of the dog's leaps are equal to 4 of the hare's; how many leaps must the dog make before he catches her? Ans. 1200 leaps.

47. A and B can perform a piece of work in 6 days, A and C in 8 days, and B and C in 12 days; in what time would each do it separately? Ans. A would take $9\frac{3}{5}$ days, B 16 days, and C 48 days.

48. In a straight line between two columns, the one 64 feet high, and the other 50 feet, stands a small statue, the head of which is 97 feet from the summit of the higher and 86 feet from that of the lower column, of which the base is just 76 feet from the centre of the base of the statue; what is the distance between the tops of the two columns? Ans. 157·0368 feet.

49. What ought I to charge per yard for cloth which cost me 19*s.* per English ell, that I may have 25 per cent. profit, after allowing a discount of 5 per cent. and 6 months' credit? Ans. 1*l.* 0*s.* $5\frac{1}{4}d.$ $\frac{3}{5}\frac{7}{5}$.

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## DECIMAL COINAGE.

TABLE OF DECIMAL MONEY.

| | | |
|---|---|---|
| 1 mil (*m.*) | $= \frac{1}{1000}l.$ | $= \frac{2}{25}f.$ |
| 10 mils = 1 cent (*c.*) | $= \frac{1}{100}l.$ | $= 2\frac{2}{5}d.$ |
| 100 mils = 10 cents = 1 florin (*fl.*) | $= \frac{1}{10}l.$ | $= 2s.$ |
| 1000 mils = 100 cents = 10 florins | $= 1l.$ | $= 20s.$ |

This system is the one most likely, in course of time, to be adopted in this country; the pound sterling will thus be divided into 1000 parts or mils, instead of 960 parts or farthings as at present. Calculations would then be

performed, as in Simple Numbers, by placing a point after the pounds and then writing the florins, cents, and mils in their order.

EXAMPLE 1. Express 4*l.* 5*fl.* 3*c.* 7*m.*, and 2*l.* 5*c.* 8*m.* as decimals of 1*l.* Ans. 4·537*l.*; 2·058*l.*

Express in the decimal form,

| | |
|---|---|
| 1. 7*fl.* 8*c.* 5*m.* = ·785*l.* | 5. 4*l.* 9*fl.* 7*c.* 5*m.* = 4·975*l.* |
| 2. 5 0 8 = ·508 | 6. 7 0 6 4 = 7·064 |
| 3. 6 7 0 = ·670 | 7. 8 3 6 0 = 8·360 |
| 4. 0 5 4 = ·054 | 8. 9 0 0 2 = 9·002 |

Ex. 2. Write 8·475*l.* in pounds, florins, &c. Ans. 8*l.* 4*fl.* 7*c.* 5*m.*

Write in pounds, florins, &c.,

| | |
|---|---|
| 9. ·478*l.* = 4*fl.* 7*c.* 8*m.* | 13. 2·674*l.* = 2*l.* 6*fl.* 7*c.* 4*m.* |
| 10. ·063 = 0 6 3 | 14. 4·705 = 4 7 0 5 |
| 11. ·407 = 4 0 7 | 15. 5·820 = 5 8 2 0 |
| 12. ·540 = 5 4 0 | 16. 7·042 = 7 0 4 2 |

ADDITION, SUBTRACTION, MULTIPLICATION, AND DIVISION.

RULE. Express the amounts decimally, proceed as in the Simple Rules, and point off 3 figures from the right of the result.

Ex. 3. Add 79*l.* 8*fl.* 4*c.* 5*m.*; 97*l.* 4*fl.* 5*m.*, and 87*l.* 9*m.*; also from 247*l.* 3*fl.* 4*m.* take 189·458*l.*

(1.)
79·845*l.*
97·405
87·009
Sum, 264·259*l.*

(2.)
247·304*l.*
189·458
Diff. 57·846*l.*

Ex. 4. 4*l.* 8*fl.* 4*m.* × 26; 339*l.* 2*fl.* 5*c.* 5*m.* ÷ 15.

(1.)
4·804*l.*
26
28824
9608
Product, 124·904*l.*

(2.)
15 { 5 ) 339·255*l.*
3 ) 67·851
Quotient, 22·617*l.*

17. Add 27*l.* 5*fl.* 6*c.* 7*m.*; 72*l.* 5*fl.* 8*m.*; 56*l.* 7*c.* 5*m.*; 65*l.* 4*fl.* 5*c.*; 49*l.* 6*c.* 8*m.*; 94*l.* 6*m.* Ans. 364·674*l.*

18. Add 79*l.* 5*fl.* 7*c.* 5*m.*; 97*l.* 4*fl.* 3*c.* 2*m.*; 67*l.* 3*c.* 4*m.*; 45*l.* 5*fl.* 6*m.*; 54*l.* 8*fl.*; 76*l.* 2*c.* Ans. 420·367*l.*

19. Add 95*l.* 2*m.*; 59*l.* 7*c.* 3*m.*; 84*l.* 5*fl.* 2*c.* 5*m.*; 48*l.* 2*fl.* 4*m.*; 68*l.* 2*fl.* 3*c.* 5*m.*; 86*l.* 7*c.* 5*m.* Ans. 441·114*l.*

20. 148*l.* 2*c.* 5*m.*; 184*l.* 9*c.* 8*m.*; 841*l.* 7*fl.* 8*c.* 9*m.*; 481*l.* 7*c.* 4*m.*; 418*l.* 9*fl.* 9*c.* 9*m.*; 814*l.* 2*fl.* 1*c.* 3*m.* Ans. 2888·198*l.*

21. From 184*l.* 2*fl.* 5*m.* take 98*l.* 4*fl.* 5*c.* 8*m.* Ans. 85·747*l.*

22. From 463*l.* 2*fl.* 5*c.* 2*m.* take 278*l.* 3*fl.* 8*m.* Ans. 184·944*l.*

23. 685*l.* 2*c.*—398*l.* 4*fl.* 7*m.* Ans. 286·613*l.*

24. 401*l.* 2*c* 5*m.*—197*l.* 3*fl.* 8*m.* Ans. 203·717*l.*

25. Mult. 5*l.* 8*fl.* 7*c.* 5*m.* by 25. Ans. 146·875*l.*

26. Multiply 7*fl.* 8*c.* 4*m.* by 47. Ans. 36·848*l.*

27. Mult. 8*l.* 4*fl.* 5*m.* by 131. Ans. 1101·055*l.*

28. Mult. 2*l.* 5*c.* 7*m.* by 542. Ans. 1114·894*l.*

29. Divide 487*l.* 5*fl.* 7*c.* 5*m.* by 25. Ans. 19·503*l.*

30. Divide 847*l.* 8*fl.* 7*c.* 2*m.* by 36. Ans. 23·552*l.*

31. Divide 963*l.* 8*fl.* 2*c.* 9*m.* by 47. Ans. 20·507*l.*

32. Divide 796*l.* 8*c.* 1*m.* by 143. Ans. 5·567*l.*

Ex. 5. Reduce 7*l.* 9*s.* 9*d.* from the present to the decimal system. Ans. 7·4875*l.*

By Prob. 4, p. 79, 7*l.* 9*s.* 9*d.* = 7·4875*l.*

Reduce from the present to the decimal system,

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 33. | 7*s.* | 6*d.* | = ·375*l.* | 37. | 4*l.* | 5*s.* | 4*d.* | = | 4·2666̇*l.* |
| 34. | 9 | 9 | = ·4875 | 38. | 10 | 8 | 4 | = | 10·416̇6̇ |
| 35. | 10 | 3 | = ·5125 | 39. | 12 | 6 | 8 | = | 12·333̇3̇ |
| 36. | 13 | $7\frac{1}{2}$ | = ·68125 | 40. | 14 | 10 | 7 | = | 14·52916̇ |

Ex. 6. 4*l.* 8*fl.* 2*c.* 5*m.* from the decimal to the present system. Ans. 4*l.* 16*s.* 6*d.*

By Prob. 5, p. 79, 4*l.* 8*fl.* 2*c.* 5*m.*, or 4·825*l.* = 4*l.* 16*s.* 6*d.*

Reduce from the decimal to the present system,

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41. | 9*fl.* | 7*c.* | 5*m.* | = | 19*s.* | 6*d.* | 45. | 4*l.* | 7*fl.* | 8*c.* | 5*m.* | = | 4*l.* 15*s.* 8½*d.* |
| 42. | 7 | 2 | 5 | = | 14 | 6 | 46. | 7 | 8 | 6 | 3 | = | 7 17 3 |
| 43. | 5 | 3 | 1 | = | 10 | 7½ | 47. | 9 | 9 | 3 | 6 | = | 9 18 8¾ |
| 44. | 6 | 9 | 8 | = | 13 | 11½ | 48. | 12 | 6 | 6 | 6 | = | 12 13 4 |

PRACTICAL EXERCISES.

1. Find the value of 87 lbs. of tea at 1*fl.* 7*c.* 4*m.* per lb. Ans. 15·138*l.*

2. What is the yearly rent of a house at the rate of 1*l.* 6*fl.* 7*c.* 5*m.* per week? Ans. 87·100*l.*

3. If 45 quarters of wheat cost 106*l.* 8*fl.* 7*c.* 5*m.*, what will one quarter cost? Ans. 2·375*l.*

4. A bankrupt who owed 3125*l.*, paid his creditors 8*fl.* 2*c.* 5*m.* per 1*l.*; what was the amount of his effects? Ans. 2578·125*l.*

5. If a traveller's expenses are 2*l.* 5*fl.* 6*c.* 8*m.* per day, what will they be in a year? Ans. 937·320*l.*

6. A farm is let at 1*l.* 3*fl.* 7*c.* 5*m.* per acre, and the whole is 680*l.* 6*fl.* 2*c.* 5*m.*; how many acres does it contain? Ans. 495 acres.

7. If a pound of sugar cost 2*c.* 5*m.*, what will 2½ cwt. cost? Ans. 7*l.*

8. If 15 men earn 242*l.* 5*fl.* 7*c.* 5*m.*, how much will 48 men earn? Ans. 776·240*l.*

9. How much should a man receive for 438 days' work, if he receives 49*l.* 8*fl.* 5*c.* 5*m.* for a year's service? Ans. 59·826*l.*

10. If the wages of 10 men for 24 days be 41*l.* 2*fl.* 6*c.* 4*m.*, what should 36 men receive for 15 days? Ans. 92·844*l.*

11. What is the commission on 560*l.* 4*fl.* 2*c.* 4*m.* at $2\frac{1}{2}$ per cent.? Ans. 14·010,6*l.*

12. What is the interest upon 485*l.* 8*fl.* 9*c.* 6*m.* for 5 years at $2\frac{1}{2}$ per cent.? Ans. 60·737*l.*

13. Required the amount of 363*l.* 6*fl.* 2*c.* 5*m.* for 4 years at 4 per cent.? Ans. 421·805*l.*

14. Find the amount of 500*l.* 3*fl.* 7*c.* 5*m.* for a year and 292 days, at 4 per cent. Ans. 536·402*l.*

15. How much should be paid for insuring 1050*l.* at $3\frac{1}{2}$ per cent.? Ans. 36·750*l.*

16. What is the present worth of 75*l.* 8*fl.* 5*c.* 2*m.* due 3 years hence at $2\frac{1}{2}$ per cent.? Ans. 70·560*l.*

17. Find the discount allowed for present payment of 699*l.* 8*fl.* 7*c.* 5*m.* due 219 days hence, at 3 per cent. Ans. 12·375*l.*

18. At what rate should goods which cost 548*l.* 9*fl.* 4*c.* be sold to gain $6\frac{2}{3}$ per cent.? Ans. 585·536*l.*

19. What part of 28*l.* 3*fl.* 6*c.* 8*m.* is 2*l.* 3*fl.* 6*c.* 4*m.*? Ans. $\frac{1}{12}$.

20. Find the value of 21 cwt. 2 qrs. 14 lbs. of tea at 20*l.* 2*fl.* 5*c.* 6*m.* per cwt. Ans. 438·036*l.*

21. Reduce 18*l.* 1*fl.* 4*c.* 4*m.* to the decimal of 24*l.* Ans. ·756.

22. Bought goods for 497*l.* 8*fl.* 7*c.* 5*m.*, and sold them for 537*l.* 7*fl.* 5*m.*; what was the gain per cent.? Ans. 8 per cent.

23. In 403*l.* 2*fl.* 9*c.* 3*m.*, how many pounds, florins, cents, and mils, and the same number of each? Ans. 363 of each.

## THE METRIC SYSTEM

DERIVES its name from the *metre*, which is the unit of length, and is the ten-millionth part of a quadrant of the meridian, or the ten-millionth part of the distance between the poles and the equator.

The principle on which it is founded is, that *ten* of any name make *one* of the next higher name; hence arithmetical operations in this system are performed as in simple numbers.

In the following tables the unit of length is the *metre;* of surface, the *are;* of solidity, the *stere;* of capacity, the *litre;* of weight, the *gram.* The Latin derivatives—*deci,* tenth of; *centi,* hundredth of; and *milli,* thousandth of—are prefixed to the several units to denote their subdivisions: while the Greek derivatives—*decca* or *deka,* ten; *hecto,* hundred; *kilo,* thousand; and *myria,* ten thousand—are prefixed to the several units to denote their multiples.

TABLES OF THE METRIC OR DECIMAL SYSTEM.

I. Measures of Length.

| | | | | |
|---|---|---|---|---|
| 10 millimetres | = | 1 centimetre | = | ·394 inches. |
| 10 centimetres | = | 1 decimetre | = | 3·937 „ |
| 10 decimetres | = | 1 metre | = | 39·371 „ |
| 10 metres | = | 1 dekametre | = | 10·936 yards. |
| 10 dekametres | = | 1 hectometre | = | 109·363 „ |
| 10 hectometres | = | 1 kilometre | = | 1093·633 „ |
| 10 kilometres | = | 1 myriametre | = | 6·2138 miles. |

100 yd. = 91·438 metres; 100 ml. = 160·932 kilometres.

Long distances are stated in kilometres.

II. Measures of Surface.

| | | | |
|---|---|---|---|
| 10 centiares | = 1 deciare | = | 11·960 sq. yards. |
| 10 deciares | = 1 are | = | 119·603 „ |
| 10 ares | = 1 dekare | = | 39·538 sq. poles. |
| 10 dekares | = 1 hectare | = | 2·471 acres. |

| | | |
|---|---|---|
| 100 square metres | = | 1 are. |
| 100 square yards | = | 83·610 square metres. |
| 100 square poles | = | 25·292 ares. |
| 100 acres | = | 40·467 hectares. |

Large surfaces are stated in hectares.

### III. Measures of Solidity.

10 centisteres = 1 decistere = 3·532 cu. feet.
10 decisteres = 1 stere = 35·317 „
10 steres = 1 dekastere = 353·167 „

1 cubic metre = 1 stere; 1 dekastere = 13 c. yards.

### IV. Measures of Capacity.

10 centilitres = 1 decilitre = ·704 gill.
10 decilitres = 1 litre = 1·761 pint.
10 litres = 1 dekalitre = 2·201 gallons.
10 dekalitres = 1 hectolitre = 2·751 bushels.
10 hectolitres = 1 kilolitre = 3·439 quarters.

1 cubic decimetre = 1 litre = 61 cu. inches nearly.

100 gallons = 454·346 litres.
100 bushels = 36·348 hectolitres.

### V. Measures of Weight.

10 milligrams = 1 centigram = ·154 grain.
10 centigrams = 1 decigram = 1·543 „
10 decigrams = 1 gram = 15·432 „
10 grams = 1 dekagram = 5·644 drams av.
10 dekagrams = 1 hectogram = 3·527 ounces „
10 hectograms = 1 kilogram = 2·205 pounds „
10 kilograms = 1 myriagram = 22·046 „ „

1 cubic centimetre of distilled water, at its greatest density, weighed in a vacuum = 1 gram.

100 kilograms = 1 quintal; 1000 kilog. = 1 millier.
100 lb. av. = 45·359 kilograms; 100 tons = 101·605 milliers.

### VI. Measures of Value.

10 centimes = 1 decime.
10 decimes = 1 franc = 9½d. ster. nearly.

The par of exchange with London, deduced from the gold coins, is 25 francs 22½ centimes per £1. The decime is seldom mentioned, accounts being kept in francs and centimes.

## EXERCISES ON THE METRIC SYSTEM.

1. How many centimetres are in a dekametre, and in a kilometre? Ans. 1000 and 100,000 centim.

2. Write in words—403·035 metres. Ans. 4 hectom., 3 metres, 3 centim., 5 millimetres.

3. Write in metres—75 hectometres and 7·325 myriametres. Ans. 7500 and 73250 metres.

4. How many centiares are in 10 hectares? Ans. 100000 centiares.

5. Write in words—2034·05 ares. Ans. 20 hectares, 3 dekares, 4 ares, 5 centiares.

6. Write in ares—4457 centiares and 425 hectares. Ans. 44·57 ares and 42500 ares.

7. How many centisteres are in 10 dekasteres? Ans. 10000 centisteres.

8. Write in words—33·75 steres. Ans. 3 dekasteres, 3 steres, 7 decisteres, 5 centisteres.

9. Write in centisteres—371 dekasteres. Ans. 371000 centisteres.

10. How many decilitres are in a hectolitre and in a kilolitre? Ans. 1000 and 10000 decilitres.

11. Write in words—307·25 litres. Ans. 3 hectolitres, 7 litres, 2 decilitres, 5 centilitres.

12. Write in litres—37 kilolitres and 75432 centilitres. Ans. 37000 and 754·32 litres.

13. How many centigrams are in a kilogram? Ans. 100000 centigrams.

14. Write in words—4053·025 grams. Ans. 4 kilograms, 5 dekagrams, 3 grams, 2 centigr., 5 milligrams.

15. Write in grams—5 quintals and 73452 milligrams. Ans. 500000 and 73·452 grams.

16. How many centimes are in 100 francs? Ans. 10000 centimes.

17. Write in words—240·75 francs. Ans. 240 francs, 7 decimes, 5 centimes.

18. Write in francs—21542 centimes. Ans. 215·42 francs.

Find the sum of,—

19. 7 kilom., 5 dekam., 9 centim.; 79 hectom., 7 metres, 5 millim.; 44 dekam., 8 centim., 3 millim.; 3

myriam., 19 hectom., 12 metres, 15 centim.; and 347 dekam., 15 decim., 15 millim. Ans. 50780·843 metres.

20. 29·575 hectares; 3759 centiares; 1155 deciares; 9·75 ares; and 37·675 dekares. Ans. 3497·09 ares.

21. 14·692 dekasteres; 341·75 steres; 19745 centisteres; 1734 decisteres; and 17·975 dekasteres. Ans. 1039·27 steres.

22. 347 kilol., 17 dekal., 15 decil.; 19 hectol., 15 litres, 25 centil.; 17 kilol., 8 dekal., 7 decil.; 125 kilol., 7 litres, 25 centil.; and 47 hectol. Ans. 495874·7 litres.

23. 55 quintals, 5 kilog., 9 dekag., 5 decig.; 5 quintals, 7 myriag., 9 hectog., 5 grams; 25 dekag., 17 decig., 25 millig.; and 14 kilog., 8 dekag., 7 grams, 8 centig. Ans. 6090334·305 grams.

24. 14 hectog., 4 grams, 8 centig.; 327 dekag., 17 decig., 2 centig.; 9 kilog., 7 hectog., 4 decig.; 141 grams, 17 centig.; 9 dekag., 7 grams, 10 decig. Ans. 14615·37 grams.

25. 17·43 grams; 1·729 decig.; 14 hectograms; 17·9 dekag.; 1735 millig.; 2134 decig. Ans. 1811·7379 grams.

26. 1750 francs, 75 cents.; 17·49 fr.; 379 fr., 25 cts.; 1743 decimes; 197450 cents. Ans. 4296·29 francs.

27. 9 myriam., 5 dekam., 7 decim.—24 kilom., 7 hectom., 19 decim., 4 millim. Ans. 65348·796 metres.

28. 7569 francs, 75 cents.—789 francs, 3 decimes. Ans. 6780·45 francs.

29. 73 hectom., 5 metres, 75 decim.—219 dekam. 75 decim., 6 centim. Ans. 5114·94 metres.

30. 175·45 hectares—1695 centiares.
Ans. 17528·05 ares.

31. 5 hectog., 7 grams, 15 centig. × 25 and 47. Ans. 12678·75 and 23836·05 grams.

32. 25 kilolit., 7 litres, 15 centilit. × 96 and 205. Ans. 2400686·4 and 5126465·75 litres.

33. 7 myriag., 8 hectog., 15 decig. ÷ 35 and 52. Ans. 2022·9 and 1361·56$\frac{12}{26}$ grams.

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