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TROY WEIGHT.

Gold Silver, and Jewels are weighed by this Table.

24 Grains	1 pennyweight.
20 Pennyweights	1 ounce.
12 Ounces	1 pound.

AVOIRDUPOIS WEIGHT.

Bread, Groceries, with all coarse Articles are weighed by this Table.

16 Drams	1 ounce.
16 Ounces	1 pound.
28 Pounds	1 quarter.
4 Quarters	1 hundredwt.
20 Hundredweight	1 ton.

APOTHECARIES' WEIGHT.

Medicines are mixed by this Table.

20 Grains	1 scruple.
3 Scruples	1 dram.
8 Drams	1 ounce.
12 Ounces	1 pound.

CLOTH MEASURE.

2¼ *Inches*	1 *nail.*
4 Nails	1 quar. of a yd.
4 Quarters	1 yard.
5 Quarters	1 ell English.

WINE MEASURE.

All liquors, except ale and beer, were measured by this Table.

2 Pints	1 quart.
4 Quarts	1 gallon.
10 Gallons	1 anker.
18 Gallons	1 rundlet.
42 *Gallons*	1 *tierce.*
63 Gallons	1 hogshead.
84 Gallons	1 puncheon.
2 Hogsheads	1 pipe.
2 Pipes	1 tun.

ALE AND BEER MEASURE.

2 Pints	1 quart.
4 Quarts	1 gallon.
9 *Gallons*	1 *firkin.*
2 Firkins	1 kilderkin.
2 Kilderkins	1 barrel.
54 Gallons	1 hogshead.
2 Hogsheads	1 but.

DRY MEASURE.

Thus were measured all dry goods.

2 Pints	1 quart.
2 Quarts	1 pottle.
2 Pottles	1 gallon.
2 Gallons or 8 quarts	1 peck.
4 Pecks	1 bushel.
8 Bushels	1 quarter.
36 Bushels	1 chaldron of coals.

N. B. Of other articles 32 bushels make a chaldron.

LONG MEASURE.

3 Barleycorns	1 inch.
4 Inches	1 hand.
12 Inches	1 foot.
3 Feet	1 yard.
6 Feet	1 fathom.
5½ Yards	1 rod or pole.
40 Poles	1 furlong.
8 Furlongs	1 mile.
3 Miles	1 league.
69½ Miles	1 degree on the Equator.

SQUARE MEASURE.

144 Square inches		1	square foot.
9 — feet		1 —	yard.
30¼ — yards		1 —	pole.
40 — poles		1 —	rood.
4 — roods		1 —	acre.
640 — acres		1 —	mile.

SOLID OR CUBE MEASURE.

1728 Cubic inches	1 cubic foot
27 — feet	1 cubic yard.
231 — inches	1 gallon of wine
282 — *inches*	1 *gallon of ale.*
2150 — inches	1 bushel of malt

HAY.

56 lbs. of old, or 60 lbs new hay	1 truss.
36 Trusses	1 load.

STRAW.

36 lbs. make	1 truss.
36 Trusses	1 load.
54 Trusses	1 ton.

ARTICLES SOLD BY TALE.

12 Articles of any kind	1 dozen.
13 Do. do.	1 long dozen.
12 Dozen	1 gross.
20 Articles	1 score.
5 Score	1 hundred.
6 Do.	1 great hund.
5 Dozen skins of parchment	1 roll.
72 Words in common law	1 sheet.
80 Words in the Exchequer	1 do.
90 Words in Chancery	1 do.
24 Sheets of paper	1 quire.
20 Quires	1 ream.
21½ Quires, or 516 sheets	1 printer's ream
2 Reams	1 bundle.

Folio is the largest size of books, of which
2 leaves, or 4 pages, make a sheet.
Quarto, 4to.—4 leaves, or 8 pages.
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MEASURES OF CAPACITY.

Imperial Measure of CAPACITY for all liquids, and for all dry goods, except such as are comprised in the second Table.

4 Gills* make	1 pint,	equal 34⅔	cub. in., nearly.
2 Pints ..	1 quart ..	69⅓	———
4 Quarts ..	1 gallon	277¼	———
2 Gallons ..	1 peck ..	554½	———
8 Gallons	1 bushel	2218½	———
8 Bushels ..	1 quarter ..	10¼	cub feet nearly.

The four last denominations are used for dry goods only.

In London, 4 gills make a pint in wine measure. In the country, the fourth part of a pint is termed a noggin, and half a pint is called a gill of wine, spirits, or ale.

Imperial Measure of CAPACITY for potatoes, fruit, and other goods.

2 Gall. make	1 peck,	equal 704	cub. in. nearly.
8 Gall. ..	1 bushel ..	2815½	———
3 Bush. ..	1 sack.. ..	4⅘	cub. ft. nearly.
12 Sacks ..	1 chald. ..	..58⅔	———

The Imperial Gallon contains exactly 10lbs. Avoirdupois of pure water: consequently the pint will hold 1¼ lb., and the bushel 80lbs.

ANGULAR MEASURE; OR, DIVISIONS OF THE CIRCLE.

60 Seconds make	....1 minute.
60 Minutes....	1 degree.
30 Degrees	....1 sign.
90 Degrees....	1 quadrant.
360 Degrees, 12 Signs	....1 circumference.

Formerly, the subdivisions were carried on by sixties; thus, the second division was divided into 60 thirds, the third into 60 fourths, &c. At present, the second is more generally divided decimally into 10ths, 100ths, &c. The degree is frequently so divided.

MEASURE OF TIME.

60 Seconds make ..	....1 minute.
60 Minutes....	1 hour.
24 Hours..	....1 day.
7 Days	1 week.
28 Days	....1 lunar month.
28, 29, 30, or 31 Days ..	1 calendar month.
365 Days	....1 common year.
366 Days	1 leap year.

In 400 years, 97 are leap years, and 303 common.

The same remark, as in the case of angular measure, applies to the mode of subdividing the second of time.

LENGTH OF A MILE

In different Countries.

	yards
Mile of Russia contains	1100
—— Italy	1467
—— England	1760
—— Scotland, Ireland,	2200
Small League of France,	2853
Mean	3666
Great	4400
Mile of Poland	
—— Spain	5028
—— Germany	5866
—— Sweden	7333
—— Denmark ..	
—— Hungary	8800

A TABLE OF DISCOUNT PER CENT.

2½	per cent is	0s.	6d. in a pound
5	———	1	0 ———
7½	———	1	6 ———
10	———	2	0 ———
15	———	3	0 ———
20	———	4	0 ———
25	———	5	0 ———
30	———	6	0 ———
35	———	7	0 ———

CUSTOMARY WEIGHT OF GOODS.

	lbs.
A firkin of butter is	56
A firkin of soap	64
A barrel of potashes	200
A barrel of anchovies	30
A barrel of soap	256
A barrel of butter	224
A fother of lead, 19c. 2q. or	2184
A barrel of candles	120
A stone of iron or shot	14
A gallon of train oil	7¼
A fagot of steel	120
A stone of glass	5
A seam of Glass, 24st. or	120
A barrel of figs from nearly 96 to	360

BREAD.

	lb.	oz
A peck loaf weighs	17	6
A half ditto	8	11
A peck of flour weighs..	14	0
A bushel	56	0
A sack, or 5 bushels	280	0

SAVINGS' BANK INTEREST TABLE.

Table of Interest of Money, at £3. 8s. 5d. per cent. from £1. to £100. for 1 year.

Principal.	Interest.			Principal.	Interest.			Principal.	Interest.			Principal.	Interest.		
£	£	s.	d.	£	£	s.	d.	£	£	s.	d.	£	£	s.	d.
1	0	0	8	7	0	4	9	20	0	13	8	70	2	7	10
5	0	3	5	10	0	6	10	50	1	14	2	100	3	8	5

MULTIPLICATION, PENCE, AND SHILLING TABLE.

Pence.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1	0 0 2	0 0 3	0 0 4	0 0 5	0 0 6	0 0 7	0 0 8	0 0 9	0 0 10	0 0 11	0 1 0	0 1 1
Shills.	0 2 0	0 3 0	0 4 0	0 5 0	0 6 0	0 7 0	0 8 0	0 9 0	0 10 0	0 11 0	0 12 0	0 13 0
2	0 4 0	0 6 0	0 8 0	0 10 0	0 12 0	0 14 0	0 16 0	0 18 0	1 0 0	1 2 0	1 4 0	1 6 0
3	0 6 0	0 9 0	0 12 0	0 15 0	0 18 0	1 1 0	1 4 0	1 7 0	1 10 0	1 13 0	1 16 0	1 19 0
4	0 8 0	0 12 0	0 16 0	1 0 0	1 4 0	1 8 0	1 12 0	1 16 0	2 0 0	2 4 0	2 8 0	2 12 0
5	0 10 0	0 15 0	1 0 0	1 5 0	1 10 0	1 15 0	2 0 0	2 5 0	2 10 0	2 15 0	3 0 0	3 5 0
6	1 0 0	1 6 0	1 12 0	1 18 0	2 4 0	2 10 0	2 16 0	3 2 0	3 8 0	3 14 0	4 0 0	4 6 0
7	1 1 0	1 8 0	1 15 0	2 2 0	2 9 0	2 16 0	3 3 0	3 10 0	3 17 0	4 4 0	4 11 0	5 0 0
8	1 2 0	1 12 0	2 0 0	2 8 0	2 16 0	3 4 0	3 12 0	4 0 0	4 8 0	4 16 0	5 4 0	5 12 0
9	1 3 0	1 16 0	2 5 0	2 14 0	3 3 0	3 12 0	4 1 0	4 10 0	4 19 0	5 8 0	5 17 0	6 6 0
10	1 4 0	1 18 0	2 10 0	3 0 0	3 10 0	4 0 0	4 10 0	5 0 0	5 10 0	6 0 0	6 10 0	7 0 0
11	1 5 0	2 1 0	2 15 0	3 5 0	3 15 0	4 5 0	4 15 0	5 5 0	5 15 0	6 5 0	6 15 0	7 5 0
12	1 6 0	2 4 0	3 0 0	3 12 0	4 4 0	4 16 0	5 8 0	6 0 0	6 12 0	7 4 0	7 16 0	8 8 0
13	1 7 0	2 6 0	3 5 0	3 18 0	4 11 0	5 4 0	5 17 0	6 10 0	7 3 0	7 16 0	8 9 0	9 2 0
14	1 8 0	2 8 0	3 10 0	4 4 0	4 18 0	5 12 0	6 6 0	7 0 0	7 14 0	8 8 0	9 2 0	9 16 0
15	1 10 0	2 10 0	3 15 0	4 10 0	5 5 0	6 0 0	6 15 0	7 10 0	8 5 0	9 0 0	9 15 0	10 10 0
16	1 12 0	2 12 0	4 0 0	4 16 0	5 12 0	6 8 0	7 4 0	8 0 0	8 16 0	9 12 0	10 8 0	11 4 0
17	1 14 0	2 11 0	4 5 0	5 2 0	5 19 0	6 16 0	7 13 0	8 10 0	9 7 0	10 4 0	11 1 0	11 18 0
18	1 16 0	2 14 0	4 10 0	5 8 0	6 6 0	7 4 0	8 2 0	9 0 0	9 18 0	10 16 0	11 14 0	12 12 0
19	1 18 0	2 17 0	4 15 0	5 14 0	6 13 0	7 12 0	8 11 0	9 10 0	10 9 0	11 8 0	12 7 0	13 6 0
20	2 0 0	3 0 0	5 0 0	6 0 0	7 0 0	8 0 0	9 0 0	10 0 0	11 0 0	12 0 0	13 0 0	14 0 0

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BY ISAAC BUTLER,

MASTER OF THE HIGH SCHOOL, SELBY.

LONDON:

WEBB, MILLINGTON, AND CO.,

WINE OFFICE COURT, FLEET-STREET;

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1860.

ADVERTISEMENT.

The extensive sale of Walkingame's Tutor's Assistant, and the approbation it has received from Teachers in general, have caused several new editions to issue from the press;—all of which have their respective merits: too many attempts therefore cannot be made to render a work of this kind, not only suitable for a Text-book, but also practical as regards the matter it contains.

It is a complaint generally made against youths, when first entering a counting-house, that they were ignorant of the shorter and more practical methods of calculating, attempting to reduce every thing to their own standard, or rule in some arithmetic; hence their operations are lengthy and tedious, and frequently produce uncertain results. To obviate this evil is the object of the present work. The writer has added a complete system of Mental Arithmetic, calculated to draw forth the thinking powers of the pupil, and to fit him for that promiscuous mode of calculation necessarily connected with the counting-house, and other business transactions.

Various practical methods for calculating Interest are also appended, with remarks on the nature of Proportion illustrated by numerous examples, additional rules, tables, &c.

The editor of this edition of Walkingame wishes to combine theory with practice, having found by experience that it is a thorough knowledge of the fundamental parts, or first principles of figures, and a perfect acquaintance with slate arithmetic, united with that of Mental Calculations, which form the complete arithmetician.

The whole has been revised, and collected into one volume; and as it contains the same as the best edition of Walkingame it is presumed that so much additional matter, partly original, and partly selected, will render it a desirable text-book, and also recommend it to public notice.

January, 1841.

PREFACE.

Having, some time ago, drawn up a set of rules and proper questions with their answers annexed, for the use of my own school, and divided them into several books, as well for more ease to myself, as the readier improvement of my scholars, I found them by experience of infinite use: for when a master takes upon him that laborious (though necessary) method of writing out the rules and questions in the children's books, he must either be toiling and slaving himself after the toil of the school is over, to get ready the books for the next day, or else he must lose that time which would be much better spent in instructing and opening the minds of the pupils.—There was, however, still an inconvenience which hindered them from giving me the satisfaction I at first expected; *i. e.* where there are several boys in a class, some one or other must wait till the boy who first has the book, finishes the writing out those rules and questions he wants, which detains the others from making that progress they otherwise might, had they a proper book of rules and examples for each; to remedy which I was prompted to compile one, in order to have it printed, that it might not only be of use to my own school, but to such others as would have their scholars make a quick progress. It will also be of great use to such gentlemen as have acquired some knowledge of numbers at school, to make them more perfect; likewise to such as have completed themselves therein, it will prove, after an impartial perusal, on account of its great variety and brevity, a most agreeable and entertaining exercise book. I shall not presume to say any thing more in favour of this work, but beg leave to refer the unprejudiced reader to the remarks of a certain author* concerning compositions of this nature His words are as follow:

"And now, after all, it is not impossible that some who like best to "tread the old beaten path, and to sweat at their business, when they may "do it with pleasure, may start an objection against the use of this well-

* Mr. Thomas Dilworth

"intended ASSISTANT, because the course of ARITHMETIC is always the "same; and therefore say, *that some boys, lazily inclined, when they see "another at work upon the same question, will be apt to make his operation "pass for their own.* But these little forgeries are soon detected by the "diligence of the tutor: therefore as different questions to different boys "do not in the least promote their improvement, so neither do the "questions hinder it. Neither is it in the power of any master, (in the "course of his business,) how full of spirit soever he may be, to frame "new questions at pleasure, in any rule; but the same question will fre-"quently occur in the same rule, notwithstanding his greatest care and "skill to the contrary."

"It may also be further objected, *That to teach by a printed book, is "an argument of ignorance and incapacity:* which is no less trifling than "the former. He, indeed (if any such there be) who is afraid his scho-"lars will improve too fast, will undoubtedly decry this method: but that "master's ignorance can never be brought in question who can begin and "end it readily; and most certainly that scholar's non-improvement can "be as little questioned who makes a much greater progress by this, than "by the common method."

To enter into a long detail of every rule would tire the reader, and swell the preface to an unusual length; I shall, therefore, only give a general idea of the method of proceeding, and leave the rest to speak for itself; which, I hope, the kind reader will find to answer the title, and the recommendation given it. As to the rules, they follow in the same manner as the table of contents specifies, and much in the same order as they are generally taught in schools. I have gone through the four fundamental rules of Integers first, before those of the several denominations, in order that they being well understood, the latter will be performed with much more ease and dispatch according to the rules shewn, than by the customary method of dotting. In Multiplication, I have shewn both the beauty and use of that excellent rule, in resolving most questions that occur in merchandising, and have prefixed before reduction, several Bills of Parcels, which are applicable to real business. In working Interest by Decimals, I have added tables to the rules, for the readier calculation of annuities, &c., and have not only shewn the use, but the method of making them. I have also added to this *edition* a NEW RULE for extracting the *Cube Root*, being a much shorter way than any already published: as likewise an Interest Table, calculated for the easier finding

the interest of any sum of money, at any rate per cent, by multiplication and addition only: it is also useful in calculating rents, incomes, and servants' wages, for any number of months, weeks, or days: and I may venture to say, I have gone through the whole with so much plainness and perspicuity, that there is none better extant.

I have nothing further to add, but a return of my sincere thanks to all these Gentlemen, Schoolmasters, and others, whose kind approbation and encouragement have now established the use of this book in almost every school of eminence throughout the kingdom; and I think my gratitude more especially due to those who have favoured me with their remarks; though I must still beg of every candid and judicious reader, if he should, by chance, find a transposition of a letter, or a false figure, to excuse it; for, notwithstanding there has been great care taken in correcting, yet errors of the press will inevitably creep in; and some may also have escaped my observation; in either of which cases, the admonition of a good-natured reader will be very acceptable to his

Much obliged,
and most obedient
humble Servant,
F. WALKINGAME.

EXPLANATION

OF THE

CHARACTERS MADE USE OF IN THIS WORK.

$=$ *Equal.*	The sign of Equality; as, 4 qrs. = 1 cwt. signifies, that 4 qrs. are equal to 1 cwt.
$-$ *Minus or less.*	The sign of Subtraction; as, $8 - 2 = 6$; that is 8 lessoned by 2 is equal to 6.
$+$ *Plus or more.*	The sign of Addition; as, $4 + 4 = 8$; that is, 4 added to 4 more is equal to 8.
$\times$ *Multiplied by.*	The sign of Multiplication; as, $4 \times 6 = 24$; that is, 4 multiplied by 6 is equal to 24.
$\div$ *Divided by.*	The sign of Division; as, $8 \div 2 = 4$; that is, 8 divided by 2 is equal to 4.
$\frac{2537}{63}$	Numbers placed like a fraction, likewise denote division; the upper number being the dividend, and the lower the divisor.
: *is* :: *So is*	The sign of proportion; as, 2 : 4 :: 8 : 16; that is, as 2 is to 4 so is 8 to 16.
$\overline{7-2+5=10}$	Shews that the difference between 2 and 7 added to 5, is equal to 10. The line drawn over 7 and 2 is called a vinculum.
$\overline{9-2+5=2}$	Signifies that the sum of 2 and 5 taken from 9 is equal to 2.
$::$	The sign of Geometrical Proportion.
$\surd$	Prefixed to any number, signifies the Square Root of that number is required.
$\sqrt[3]{}$	Signifies the Cube, or third power.
$\sqrt[4]{}$	Denotes the Biquadrate, or the fourth power, &c.
i. e.	*id est*, that is.

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ARITHMETIC.

PART I.

ARITHMETIC IN WHOLE NUMBERS.

INTRODUCTION.

ARITHMETIC is the art or science of computing by numbers, and consists both in theory and practice.

The theory considers the nature and quality of numbers, and demonstrates the reason of practical operations.

The practice is that which shews the method of working by numbers, so as to be the most useful and expeditious for business, and has five principal or fundamental rules for the operations, *viz.*,

NOTATION OR NUMERATION, ADDITION, SUBTRACTION, MULTIPLICATION, AND DIVISION.

NUMERATION

TEACHETH the different value of figures by their different places, and to read or write any sum or number.

1,	9,	8,	7,	6,	5,	4,	3,	2,	1,	9,	8,	7,	6,	5,	4,	3,	2,	1.
TRILLIONS ..	..	..	..	..	..	..												
Hundreds of Thousands of Billions																		
Tens of Thousands of Billions..	..	..	..	..	..	..												
Thousands of Billions ..	..	..	..	..	..	..												
Hundreds of Billions	..	..	..	..	..	..												
Tens of Billions	..	..	..	..	..	..												
BILLIONS..	..	..	..	..	..	..												
Hundreds of Thousands of Millions																		
Tens of Thousands of Millions																		
Thousands of Millions ..	..	..	..	..	..	..												
Hundreds of Millions	..	..	..	..	..	..												
Tens of Millions	..	..	..	..	..	..												
MILLIONS	..	..	..	..	..	..												
Hundreds of Thousands																		
Tens of Thousands ..	..	..	..	..	..	..												
Thousands ..	..	..	..	..	..	..												
Hundreds ..	..	..	..	..	..	..												
Tens ..	..	..	..	..	..	..												
UNITS ..	..	..	..	..	..	..												

NUMERATION is of great importance in Arithmetic, as it enables us to understand rightly the value of figures, and their increase and ratio according to the order in which they are placed.

Beginning with units, the first six figures are called the unit period, the next six the million period, the next the billion, &c., and may be extended *ad infinitum*.

THE APPLICATION.

Write down in proper figures the following numbers:

(1) *Twenty-three.

(2) Two hundred and fifty-four.

(3) Three thousand, two hundred and four.

(4) Twenty-five thousand, eight hundred and fifty-six.

(5) One hundred and thirty-two thousand, two hundred and forty-five.

(6) Four millions, nine hundred and forty-one thousand, four hundred.

(7) Twenty-seven millions, one hundred and fifty-seven thousand, eight hundred, and thirty-two.

(8) Seven hundred and twenty-two millions, two hundred and thirty-one thousand, five hundred and four.

(9) Six hundred and two millions, two hundred and ten thousand, five hundred.

Write down in words at length, the following numbers.

(10) 35	(14) 5201	(18) 5900030	(22) 65700047
(11) 59	(15) 20760	(19) 5204054	(23) 90006157
(12) 172	(16) 519007	(20) 2071909	(24) 201900790
(13) 2016	(17) 750058	(21) 70054008	

Notation by ROMAN Letters.

I.	One.	XV.	Fifteen.	C.	One hundred.
II	Two.	XVI.	Sixteen.	CC.	Two hundred.
III.	Three.	XVII.	Seventeen.	CCC.	Three hundred.
IV.	Four.	XVIII.	Eighteen.	CCCC.	Four hundred.
V.	Five.	XIX.	Nineteen.	D.	Five hundred.
VI.	Six.	XX.	Twenty.	DC.	Six hundred.
VII.	Seven.	XXX.	Thirty.	DCC.	Seven hundred.
VIII.	Eight.	XL.	Forty.	DCCC.	Eight hundred.
IX.	Nine.	L.	Fifty.	DCCCC.	Nine hundred.
X.	Ten.	LX.	Sixty.	M.	One thousand.
XI.	Eleven.	LXX.	Seventy.	M,DCCC,LI.	One thousand eight hundred and fifty-one.
XII.	Twelve.	LXXX.	Eighty.		
XIII.	Thirteen.	XC	Ninety.		
XIV.	Fourteen.				

*The figures placed between parenthesis refer to the Key, in which the solution will be found.

ADDITION OF INTEGERS

TEACHETH to add two or more sums together, to make one whole or total sum.

RULE.—There must be due regard had in placing the figures one under the other, *i. e.*, units under units, tens under tens, &c.; then beginning with the first row of units, add them up to the top; when done set down the units, and carry the tens to the next, and so on; continuing to the last row, at which set down the total amount.

PROOF.—Begin at the top of the sum, and reckon the figures downwards, the same as you add them up, and if the same as the first, the sum is supposed to be right.

ADDITION AND SUBTRACTION TABLE.

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

£	*Cwt.*	*Qrs.*	*Months.*	£	*Years.*
(1)2	(2)27	(3)276	(4)1234	(5)7524	(6)27104
5	35	110	7098	3750	2547
7	47	473	3314	9147	0758
9	35	354	6732	3215	2590
2	41	271	2546	4725	5408
5	36	352	3709	2147	7973
4	39	471	4152	3254	5421
3	57	310	3705	2716	12706
7	14	437	1076	1047	10471
44	331				

SUBTRACTION OF INTEGERS

TEACHETH to take a less number from a greater, and shews the remainder or difference.

RULE.—This being the reverse of Addition, you must borrow here (if it requires) what you stopped at there, always remembering to pay it to the next.

PROOF.—Add the remainder and less line together, and if the same as the greater, it is right.

	£	*Hund.*	*Hours.*	*Weeks.*	*Hhds.*
From	(1)271	(2)4754	(3)42087	(4)432705	(5)271508
Take	154	2725	34096	327616	152741
Rem.	117				
Proof	271				

MULTIPLICATION OF INTEGERS

TEACHETH how to increase the greater of two numbers given, as often as there are units in the less; and compendiously performs the office of many additions.

To this rule belong three principal members *viz.*,

1. The multiplicand, or number to be multiplied.
2. The multiplier, or number by which you multiply.
3. The product, or number produced by multiplying.

RULE.—Begin with that figure which stands in the unit's place of the multiplier, and with it multiply the first figure in the unit's place of the multiplicand. Set down the units, and carry the tens in mind, till you have multiplied the next figure in the multiplicand by the same figure in the multiplier; to the product of which add the tens you kept in mind, setting down the units, and proceed as before, till the whole line is multiplied.

PROOF.—The usual way of proving multiplication is, by casting out the nines from the multiplicand and multiplier; the remainders put on each side of a cross; multiply the figures on each side together, cast out the nines from the product and put the overplus at the top; then cast out the nines from the product of the multiplication, and its remainder place at the bottom; if it agree with the top, the work is supposed to be right: but the surest way is to divide the product by the multiplicand, and the quotient will be the same as the multiplier.

MULTIPLICATION AND DIVISION 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

(1) *Multiplicand* 25104736 (2)52471021 (3)7925437521
Multiplier 2 3 4
Product 50209472

4)27104107 (5)231037 (6)7062526 (7)3723104
5 6 7 8

(8)4214406 (9)2701047 (10)31040171 (11)35210472
9 10 11 12

When the multiplier is more than 12, and less than 20, multiply by the unit figure in the multiplier, adding to the product the back figure to that you multiplied.

(12)4710572 (13)5107252 (14)6653210 (15)92057165
13 14 15 16

16)8251721 (17)9215324 (18)2571341 (19)3592104
17 18 19 19

When the multiplier consists of several figures, there must be as many products as there are figures in the multiplier, observing to put the first figure of every product under that figure you multiply by. Add the several products together, and their sum will be the total product.

0	(20)271041	(21)32104	(22)2710432	(23)27501976
6+0	27	25	375	271
0	1897287	802600	1016412000	7453035496
	542082			
	7318107			

When ciphers are placed between the significant figures in the multiplier, they may be omitted; but great care must be taken that the next figure be put one place more to the left hand, *i. e.*, under the figure you multiply by.

(24)571204	(25)7104325	(26)5271094
27009	57020	590030
15427648836	405088611500	3110103592820

When there are ciphers at the end of the multiplicand or multiplier they may be omitted, by only multiplying by the rest of the figures, and setting down on the right-hand of the total product, as many ciphers as were omitted.

(27)27100	(28)379500	(29)265000	(30)574000
52600	274000	7200	630
1425460000	103983000000	1908000000	361620000

When the multiplier is a composite number, *i. e.*, if any two figures being multiplied together will make that number, then multiply by one of those figures, and that product by the other will give the answer.

(31)771039 by 35	(32)921563 by 32	(33)715241 by 56
26986365	29490016	40053496

DIVISION OF INTEGERS

TEACHETH to find how often one number is contained in another, or to divide any number into what parts you please.

In this rule there are three numbers real and the fourth accidental, *viz.*,

1. The dividend, or number to be divided.
2. The divisor, or number by which you divide.
3. The quotient, or number that shews how often the divisor is contained in the dividend.
4. Or accidental number, is what remains when the work is finished, and is of the same name with the dividend.

RULE.—When the divisor is less than 12, find how often it is contained in the first figure of the dividend, set it down under the figure you divided, and carry the overplus (if any) to the next in the dividend, as so many tens: then find how often the divisor is contained therein, set it down, and continue the same till you have gone through the line, but when the divisor is more than 12, multiply it by the quotient figure; subtract the product from the dividend, and to the remainder bring down the next figure in the dividend, and proceed as before, till the figures are all brought down.

PROOF.—Multiply the divisor and quotient together, adding the remainder (if any) and the product will be the same as the dividend.

	Divid.	*Rem.*		
(1) *Divisor* 2	725107	1	(2) 3)721472	(3) 4)7210416
Quotient	362553			
	2			
Proof	725107		(4) 5)7203287	(5) 6)5231037
(6) 7)233701			(7 8)2547325	(8) 9)25048306
(9) 10)2750012			(10) 11)2710513	(11) 12)27100732

Divis.	Divid.	Quot.
(12) 29	4172377	143875
29		29
127	1294875	
116	287750	
112	2	Rem.
87	4172377	Proof.
253		
232		
217		
203		
147		
145		
Rem.	.2	

(13) 37)7210473(194877
(14) 473)2104721(4449
(15) 275)3720147(13527
(16) 3701)72109521(19483
(17) 3576)72104725(20163
(18) 2510)63210476(25183
(19) 25204)321047217(12737
(20) 31709)521047321(16432
(21) 2701234)7210472532(2669
(22) 210472)352107193214(1672940
(23) 3721071)21071921473(5662

When there are ciphers at the end of the divisor, they may be cut off, and as many places from off the dividend, but must be annexed to the remainder at last.

(24) 271.00)254732.21(939 (25) 5721.00)7253472.16(1267
(26) 373.000)752473.719(2017 (27) 215.000)6325104.997(29419

When the divisor is a composite number (*i. e.* if any two figures being multiplied together will make that number) then by dividing the dividend by one of those figures, and that quotient by the other, it will give the quotient required. But as it sometimes happens that there is a remainder to each of the quotients, and neither of them the true one, it may be found by this

Rule.—Multiply the first divisor into the last remainder; to that product add the first remainder, which will give the true one.

(28)	(29)	(30)	(31)
Div. 3210473 by 27	7210473 by 35	6251043 by 42	5761034 by 54
118906 11 R.	206013 18 R.	148834 15 R.	106685 44 R.

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

Farthings.

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

SHILLINGS.

s.		£	*s.*
20	are	1	0
30		1	10
40		2	0
50		2	10
60		3	0
70		3	10
80		4	0
90		4	10
100		5	0
110		5	10
120		6	0
130		6	10

d.		*s.*	*d.*
20	are	1	8
24		2	0
30		2	6
36		3	0
40		3	4
48		4	0
50		4	2
60		5	0
70		5	10
72		6	0
80		6	8
84		7	0

PENCE TABLE.

d.		*s.*	*d.*
90	are	7	6
96		8	0
100		8	4
108		9	0
110		9	2
120		10	0
130		10	10
132		11	0
140		11	8
144		12	0
150		12	6
160		13	4

TROY WEIGHT.

			Marked
24 Grains	make	1 Pennyweight.....	*gr.* / *dwt.*
20 Pennyweights	——	1 Ounce	*oz.*
12 Ounces	——	1 Pound	*lb.*

Grains.

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

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

☞ The standard for gold coin is 22 carats of fine gold, and 2 carats of copper, melted together; for silver, 11 oz. 2 dwts. of fine silver, and 18 dwts. of copper.

25 lbs. is a quarter of a cwt. 100 lbs. = 1 cwt.
20 cwt. = 1 ton of gold or silver.

AVOIRDUPOIS WEIGHT.

			Marked.
16 Drams	make	1 Ounce	*dr.* / *oz.*
16 Ounces	——	1 Pound	*lb.*
28 Pounds	——	1 Quarter	*qr.*
4 Quarters, or 112 lbs.	—	1 Hundred-weight	*cwt.*
20 Hundred-weight	——	1 Ton	*ton.*

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

There are several other denominations in this weight that are used in some particular goods, *viz.*,

	lbs.		*lbs.*
A firkin of butter	56	A stone of iron shot, or horseman's weight....	14
——— soap	64	A stone of butcher's meat	8
A barrel of anchovies ..	30	A stone of train oil	7½
——— soap	256	A gallon of train oil	7½
——— raisins	112	A truss of straw.....	36
A puncheon of prunes	1120	——— new hay	60
A fother of lead ....19 cwt. 2 qrs.		——— old hay	56
		36 trusses a load.	

N. B. As 7000 grains Troy, are equal to 1 lb. Avoirdupois, and as the pound Troy contains 5760 grains, the proportion between Avoirdupois and Troy weight will be as follows:

Troy.	*Avoirdupois.*
175 lbs.	= 144 lbs.
1 lb.	= 13 oz. 2½ drs.
1 lb. 2 oz., 11 d., 16 grs,	= 1 lb,

N. B. The pound Avoirdupois is heavier than the lb. Troy, in the proportion of 175 to 144; but the oz. Avoirdupois is lighter than the oz. Troy by 42½ grs., or in the proportion of 437½ to 480.

CHEESE AND BUTTER.

A clove, or half a stone, 8 lbs.

	lbs.		*lbs.*
A wey in Suffolk, 32 cloves, or	256	A wey in Essex, 42 cloves, or.....	336

WOOL.

	lbs.		*lbs.*
A clove	7	A wey is six tods and 1 stone, or	182
A stone	14	A sack is 2 weys, or ..	364
A tod	28	A last is 12 sacks, or ..	4368

This weight is used for any thing of a coarse or drossy nature, such as groceries or chandlery wares, and bread; likewise all metals but silver and gold.

APOTHECARIES' WEIGHT.

			Marked.
20 Grains	make	1 Scruple	℈
3 Scruples	——	1 Dram	ʒ
8 Drams	——	1 Ounce	℥
12 Ounces	——	1 Pound	lb

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

Note.—The Apothecaries mix their medicines by this rule, but buy and sell their commodities by Avoirdupois weight.

The Apothecaries' pound and ounce, and the pound and ounce Troy, are the same, only differently divided and subdivided.

CLOTH MEASURE.

			Marked.
4 Nails	make	1 Quarter of a yard	*n.* / *qr.*
3 Quarters	——	1 Flemish ell	*F.E.*
4 Quarters	——	1 Yard	*yd.*
5 Quarters	——	1 English ell	*E.E.*
6 Quarters	——	1 French ell	*Fr.E.*

Inches.				
2¼ =	1 Nail.			
9 =	4 =	1 Quarter.		
36 =	16 =	4 =	1 Yard.	
27 =	12 =	3 =	1 Flemish ell.	
45 =	20 =	5 =	1 English ell.	
54 =	24 =	6 =	1 French ell.	

LONG MEASURE.

			Marked
3 Barleycorns	make	1 Inch	*bar.* / *in.*
12 Inches	——	1 Foot	*ft.*
3 Feet	——	1 Yard	*yd.*
6 Feet	——	1 Fathom	*fth.*
5½ Yards	——	1 Rod, Pole, or Perch	*rod, p.*
40 Poles	——	1 Furlong	*furl.*
8 Furlongs	——	1 Mile	*mile.*
3 Miles	——	1 League	*leag.*
60 Miles	——	1 Degree	*deg.*

Barleycorns.

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

☞ Besides these denominations, we have the palm of 3 inches, the hand of 4 inches used in taking the height of horses, and the span of 9 inches.

A degree is 69 miles, 4 furlongs nearly, though commonly reckoned but 60 miles.

This measure is used for distances of places, or any thing else that has length only.

LIQUID MEASUBE.

			Marked.
2 Pints	make	1 Quart	*pts.* / *qts.*
4 Quarts	——	1 Gallon	*gal.*
10 Gallons	——	1 Anker of Brandy ...	*ank.*
18 Gallons	——	1 Runlet	*run.*
31½ Gallons	——	Half a Hogshead	½ *hhd.*
42 Gallons	——	1 Tierce	*tierce.*
63 Gallons	——	1 Hogshead	*hhd.*
84 Gallons	——	1 Puncheon	*pun.*
2 Hogsheads	——	1 Pipe or Butt .....*p.* or *butt*	
2 Pipes, or 4 Hogsheads	—	1 Tun	*tun.*

Cubic Inches.

34⅔¼ =	1 Pint.			
69⅓⅔ =	2 =	1 Quart.		
277¼ =	8 =	4 =	1 Gallon.	
2772¾ =	80 =	40 =	10 =	1 Anker.
4991 =	144 =	72 =	18 =	1 Runlet.
11645½ =	336 =	168 =	42 =	1 Tierce.
17468¼ =	504 =	252 =	63 =	1½ = 1 Hogshead.
23291 =	672 =	336 =	84 =	2 = 1⅓ = 1 Puncheon.
34936½ =	1008 =	504 =	126 =	3 = 2 = 1½ = 1 Pipe.
69873 =	2016 =	1008 =	252 =	6 = 4 = 3 = 2 = 1 Tun.

Note.—To understand the solutions to some of the questions in this work, it is necessary to remark, that a pipe of Claret contains 126 gallons; Port, 138; Sherry 130 Lisbon, 140; Buccilas 140; Madeira, 110; and Vidonia, 120.

All brandies, spirits, perry, cider, mead, vinegar, honey, and oil, are measured by this measure.

The imperial gallon is the standard of capacity for liquids as well as dry goods, not measured by heaped measure; from which all other measures of capacity are computed; it contains 277.274+cubic inches.

ALE AND BEER MEASURE.

		Marked.
2 Pints	make 1 Quart.....	*pts.* / *qts.*
4 Quarts	—— 1 Gallon	*gal.*
9 Gallons	—— 1 Firkin	*fir.*
2 Firkins, or 18 Gallons	—— 1 Kilderkin ..	*kil.*
4 Firkins, or 2 Kilderkins	—— 1 Barrel	*bar.*
1½ Barrel, or 54 Gallons	—— 1 Hogshead ..	*hhd.*
2 Barrels	—— 1 Puncheon ..	*pun.*
3 Barrels, or 2 Hogsheads	—— 1 Butt	*butt.*

Cubic inches.

34½	=	1 Pint.					
69	=	2	=	1 Quart.			
277¼	=	8	=	4	=	1 Gallon.	
2495½	=	72	=	36	=	9	= 1 Firkin.
4991	=	144	=	72	=	18	= 2 = 1 Kilderkin.
9982	=	288	=	144	=	36	= 4 = 2 = 1 Barrel.
14973	=	432	=	216	=	54	= 6 = 3 = 1½ = 1 Hogshead.
19964	=	576	=	288	=	72	= 8 = 4 = 2 = 1 Puncheon.
29946	=	864	=	432	=	108	= 12 = 6 = 3 = 2 = 1 Butt.

In London, and all parts of the country, they now compute 9 gallons to the firkin, both of beer and ale, and 36 gallons to the barrel.

A barrel of Salmon, or eels, is 42 gallons.
A barrel of Herrings..... 32 gallons.
A keg of Sturgeon ..... 4 or 5 gallons.
A firkin of Soap ..... 8 gallons.

DRY MEASURE.

			Marked.
2 Pints	make	1 Quart	*pts.* / *qts.*
4 Quarts	——	1 Gallon	*gal.*
2 Gallons	——	1 Peck.....	*pk.*
2 Pecks	——	1 Strike	*strike.*
2 Strikes, or 4 Pecks	——	1 Bushel	*bush.*
4 Bushels	——	1 Coomb	*coomb.*
2 Coombs, *or* 8 Bushels	—	1 Quarter	*qr.*
4 Quarters	——	1 Chaldron	*chald.*
5 Quarters	——	1 Wey	*wey.*
2 Weys	——	1 Last	*last.*

Cubic inches.

$277\frac{1}{4}$ = 1 Gallon.
$554\frac{1}{2}$ = 2= 1 Peck.
1109 = 4= 2= 1 Strike.
$2218\frac{19}{100}$= 8= 4= 2= 1 Bushel.
$8872\frac{76}{100}$= 32= 16= 8= 4= 1 Coomb.
$17745\frac{1}{2}$ = 64= 32= 16= 8= 2= 1 Quarter.
70982 =256=128= 64=32= 8= 4=1 Chaldron.
$88727\frac{1}{2}$ =320=160= 80=40=10= 5=1 Wey.
177455 =640=320=160=80=20=10=2=1 Last.

Dry measure is used for all dry goods, such as grain, seed, coal, lime, potatoes, fruit, &c. The imperial standard measure for dry goods, sold by heaped measure, is the bushel; for others, the gallon, as used for liquids. The said bushel contains 2218.192 cubic inches, is 7.427 inches deep, and $19\frac{1}{2}$ inches in diameter, and is made round, with an even bottom: in using it for heaped measure, the goods must be duly heaped in the form of a cone, not less than six inches in height, and the outside of the bushel must be the extremity of the base of such cone.

The bushel in water measure is 5 Pecks.

A score of coals*	is 21 chaldrons.
A sack of coals	- 3 bushels.
A chaldron of coals	- 12 sacks, or 36 bushels.
A load of corn	- 5 bushels.
A cart load of corn	- 40 bushels.

This measure is applied to all dry goods.

* Coals are now sold by the ton in London.

TIME.

		Marked.
60 Seconds	make 1 Minute.....	″ / *m.*
60 Minutes	—— 1 Hour	*hour.*
24 Hours	—— 1 Day	*day.*
7 Days	—— 1 Week	*week.*
4 Weeks	—— 1 Month	*mo.*
13 Months, 1 day, 6 hours	—— 1 Julian Year..	*yr.*

Seconds.

60= 1 Minute.
3600= 60= 1 Hour.
86404= 1440= 24= 1 Day.
604800=10080=168= 7=1 Week.
2419200=40320=672=28=4=1 Month.

d. h. w. d. h.
31557600=525960=8766=365:6=52:1:6=1 Julian year.

d. h. m. ″
31556937=525948=8765=365:5:48:57=1 Solar year.

To know the days in each month observe,

Thirty days have September,
April, June, and November;
February hath twenty-eight alone,
And all the rest have thirty-one;
Except in leap year, then's the time
February's days are twenty and nine.

SQUARE MEASURE.

144 Inches	make 1 Foot
9 Feet	—— 1 Yard.
100 Feet	—— 1 Square of Flooring.
272¼ Feet	—— 1 Rod.
40 Rods	—— 1 Rood.
4 Roods, or 160 Rods, or 4840 yards	—— 1 Acre of Land.
640 Acres	—— 1 Square Mile.

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

By this measure all things that have length and breadth are measured; such as land, painting, plastering, flooring, thatching, plumbing, glazing, &c.

SOLID MEASURE.

1728 Inches make 1 Solid Foot.
27 Feet —— 1 Yard, or load of earth.
40 Feet of round timber, or 50 Feet of hewn timber } is 1 Ton, or Load.

108 solid feet, *i. e.* 12 feet in length, 3 in breadth, and 3 deep; or, commonly, 14 feet long, 3 feet 1 inch broad, and 3 feet 1 inch deep, is a stack of wood.

128 solid feet, *i. e.*, 8 feet long, 4 feet broad, and 4 feet deep, is a cord of wood.

By this measure all things that have length, breadth, and depth, are measured.

ADDITION

OF MONEY, WEIGHTS, AND MEASURES

RULE.—Add the first row or denomination together, as in integers; then divide the sum by as many of the same denomination as make one of the next greater, setting down the remainder under the row added, and carry the quotient to the next superior denomination, continuing the same to the last, which add as in Simple Addition.

MONEY.

£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
(1)2	13	5½	(2)27	7	2	(3)35	17	3	(4)75	3	7
7	9	4¼	34	14	7¼	59	14	7½	54	17	1½
5	15	4½	57	19	2¼	97	13	5¼	91	15	4¼
9	17	6¼	91	16	1	37	16	8¼	35	16	5¼
7	16	3	75	18	7¾	97	15	7	29	19	7¼
5	14	7¾	97	13	5	59	16	5½	91	17	3¼
39	6	7¼									

MONEY.

	£	s.	d.
(5)	257	1	5½
	734	3	7¾
	595	5	3
	159	14	7½
	207	5	4
	798	16	7¼

	£	s.	d.
(6)	525	2	4¾
	179	3	5
	250	4	7½
	975	3	5¼
	254	5	7
	379	4	5¾

	£	s.	d.
(7)	21	14	7¼
	75	16	0
	79	2	4½
	57	16	5½
	26	13	8¾
	54	2	7

	£	s.	d.
(8)	73	2	1½
	25	12	7
	96	13	5½
	76	17	3½
	97	14	1
	54	11	7¾

	£	s.	d.
(9)	127	4	7½
	525	3	5
	271	0	5
	524	9	1
	379	4	3½
	215	5	8¾

	£	s.	d.
(10)	261	17	1¾
	379	13	5
	257	16	7¾
	184	13	5
	725	2	3¼
	359	6	5

	£	s.	d.
(11)	31	1	1¼
	75	13	1
	39	19	7½
	97	17	3½
	36	13	5
	24	16	3½

	£	s.	d.
(12)	27	13	5
	16	12	9½
	9	13	3
	15	2	7½
	37	19	0
	56	19	1¾

TROY WEIGHT.

	oz.	dwt.	gr.
(1)	7	15	21
	3	17	6
	2	5	15
	3	16	19
	9	18	23
	7	15	14

	oz.	dwt.	gr.
(2)	5	11	4
	7	19	21
	3	15	14
	7	19	22
	9	18	15
	8	13	12

	lb.	oz.	dwt.
(3)	7	1	2
	3	2	7
	5	1	5
	2	7	3
	7	10	1
	3	11	7

	lb.	oz.	dt.
(4)	5	2	15
	13	11	17
	13	7	15
	13	9	7
	19	1	12
	15	2	15

AVOIRDUPOIS WEIGHT.

	lb.	oz.	dr.
(1)	151	15	15
	272	14	10
	353	15	11
	255	10	4
	173	6	2
	635	13	13

	lb.	oz.	dr.
(2)	17	12	3
	23	15	6
	31	11	14
	97	0	9
	48	7	15
	79	10	6

	cwt.	qr.	lb.
(3)	25	1	17
	72	3	26
	54	1	16
	24	1	16
	17	0	19
	55	2	16

	t.	cwt.	qr
(4)	7	17	2
	5	5	3
	2	4	1
	3	18	2
	7	9	3
	8	5	1

APOTHECARIES' WEIGHT.

	℥	ʒ	*gr.*		℥	ʒ	℈	*gr.*		lb	℥	ʒ	℈		lb	℥	ʒ	℈
(1)	7	0	17	(2)	9	2	0	17	(3)	7	10	7	1	(4)	7	2	1	0
	3	1	18		3	5	2	19		9	5	2	2		3	1	7	1
	6	2	16		9	2	1	14		7	11	1	2		9	10	2	0
	5	1	15		3	5	0	18		9	5	6	1		7	5	7	1
	7	0	18		7	7	2	15		7	10	5	2		3	9	5	2
	3	1	9		3	3	0	0		9	0	7	0		7	1	4	1

CLOTH MEASURE.

	F.E.qrs.		*n.*		*yds.qrs.*		*n.*		*yds.*	*qrs.*	*n.*		*E.E.qrs.*		*n.*
(1)	27	2	1		2)35	3	3	(3)	73	3	2	(4)	71	2	1
	15	1	3		70	2	2		97	1	3		52	1	2
	37	0	2		35	3	0		54	0	2		79	0	1
	52	1	3		76	1	3		76	2	0		56	2	0
	76	2	1		26	0	1		59	1	3		79	3	1
	97	1	3		79	2	1		76	2	2		54	2	1

LONG MEASURE.

	feet.	*in.*	*bar.*		*yds.*	*ft.*	*in.*		*m.*	*fur.*	*p.*		*lea.*	*m.*	*fur*
	1)27	1	2	(2)	25	1	9	(3)	35	7	3	(4)	72	2	1
	35	10	1		71	0	3		27	5	27		27	1	7
	17	2	0		52	2	3		52	0	35		53	2	5
	35	11	1		97	0	10		97	1	17		79	0	6
	97	2	2		54	2	7		56	7	18		51	1	6
	54	8	1		37	1	4		91	5	27		72	0	5

LAND MEASURE.

	a.	*r.*	*p.*		*a.*	*r.*	*p.*		*a.*	*r.*	*p.*		*a.*	*r.*	*p.*
(1)	75	3	27	(2)	27	1	35	(3)	26	1	51	(4)	32	1	14
	36	2	15		29	2	19		19	2	17		27	0	19
	97	1	16		3	1	15		55	3	14		31	2	15
	35	2	15		95	2	27		79	1	21		19	1	18
	27	1	14		62	0	13		95	2	14		59	2	17

LIQUID MEASURE.

	run.	*gal.*	*qts.*
(1)	27	17	2
	35	15	3
	56	14	1
	97	10	3
	12	15	0
	79	3	1

	tier.	*gal.*	*qts.*
(2)	25	36	2
	75	41	2
	62	15	1
	94	13	2
	15	24	3
	19	16	1

	hhd.	*gal.*	*qts.*
(3)	31	57	1
	97	18	2
	76	13	1
	55	46	2
	87	38	3
	55	17	1

	t.	*hhd*	*gal.*
(4)	14	3	27
	19	2	56
	17	0	39
	75	2	16
	54	1	19
	97	3	54

ALE AND BEER MEASURE.

	b.	*fir.*	*gal.*
(1)	25	2	7
	17	3	5
	96	2	6
	75	1	4
	96	3	7
	75	0	5

	b.	*fir.*	*gal.*
(2)	37	2	8
	54	1	7
	97	3	8
	78	2	5
	47	0	7
	35	2	5

	hhd.	*gal.*	*qts.*
(3)	76	51	2
	57	3	3
	97	27	3
	22	17	3
	32	19	3
	55	38	0

	hhd.	*gal.*	*qts.*
(4)	76	2	1
	95	35	2
	57	16	3
	22	14	1
	32	37	3
	55	16	1

DRY MEASURE.

	qr.	*bu.*	*p.*
(1)	75	7	2
	36	2	3
	51	2	0
	79	7	1
	55	0	3
	96	2	1

	qr.	*bu.*	*p.*
(2)	86	2	1
	71	0	3
	53	6	0
	82	4	1
	95	3	3
	78	2	1

	ch.	*bu.*	*p.*
(3)	75	27	2
	57	3	1
	95	25	3
	76	35	2
	97	25	2
	75	16	3

	ch.	*bu.*	*p.*
(4)	73	2	1
	41	24	1
	92	16	1
	70	13	2
	54	17	3
	79	25	1

TIME.

	h.	*m.*	*″*
(1)	52	57	35
	97	16	27
	16	51	54
	96	18	31
	75	34	21

	d.	*h.*	*m.*
(2)	72	23	26
	54	14	35
	97	12	31
	58	21	45
	96	20	48

	w.	*d.*	*h.*
(3)	71	3	11
	51	2	9
	76	0	21
	95	3	21
	79	1	15

	w.	*d.*	*h.*
(4)	57	2	15
	95	3	21
	76	0	15
	53	2	21
	98	2	18

THE APPLICATION.

(1) A man born in the year 1785—when will he be 54 years of age? Ans. 1839.

(2) A, B, C, and D, went partners in the purchase of a quantity of goods; A laid out £7, half a guinea, and a crown; B 49s.; C 54s. 6d.; and D 87d.—what was laid out in all? Ans. £13 : 6 : 3.

(3) Bought a parcel of goods for which I paid £54. 17s. packing 13s. 8d.; carriage £1. 5s. 4d.; and spent about the bargain 14s. 3d.—what do these goods stand me in?

Ans. £57 : 10 : 3.

(4) A man lent his friend at different times these several sums, *viz.*, £63.; £25. 15s.; £32. 7s.; £15. 14s. 10d.; and four score and nineteen pounds, half a guinea, and a shilling—how much did he lend in all? Ans. £236 : 8 : 4.

(5) In taking an account of debts owing to me, I find that Mr. A. owes me £104. 5s. 2d.; Mr. B. £37. 8s. 6d.; Mr. C. £48. 13s.; Mr. D. £19. 7s. 4.; and Mr. E. £5. 0s. 6½d.—what is the whole amount? Ans. £214 : 14 : 6½.

(6) If I pay for the rent of my house £75. per annum; poor's rates £12. 17s. 6d.; window and house tax ten guineas; lighting and watching £2. 17s. 3d.; and other rates £1. 7s. 11d.—how much do I pay in the whole?

Ans. £102 · 12 : 8.

(7) Paid for the repairs of my house as follows: joiner's bill £26. 5s. 11d.; bricklayer's and plasterer s £15. 3s. 7d.; mason's £9. 14s. 3d.: slater's £7. 12s. 4½d.; painter's and glazier's £9. 5s. 7d.—what did the whole repairs cost me?

Ans. £68 : 1 : 8¾.

(8) A merchant owes to A £346. 18s. 4d.; to B £712. 18s. 9d.; to C £209. 6s. 3d.; to D £417. 16s. 8d.: to E £200. 13s. 7d.; to F £817. 0s. 3d.; and to G £512. 13s. 6d — how much does the whole of his debts amount to?

Ans. £3217 : 7 : 4.

(9) A banker's clerk having been out with his bills, brings home an account that A paid him £7. 5s. 2d.; B £15. 18s. 6½d.; C £150. 13s. 2¼d.; D £17. 6s. 8d.; E 5 guineas, 2 crowns, 4 half-crowns, and 4s. 2d.; F paid him only 20 groats; G £76. 15s. 9½d.; and H £121. 12s. 4d.—I desire to know how much the whole amounted to that he received?

Ans. £396 : 7 : 6¼.

(10) Having just received the following parcels of cloth, *viz.*, 446 yds. 3 qrs. 2 n. of blue; 376 yds. 3 qrs. 3 n. of black; 638 yds. 2 qrs. 2 n. of brown; 129 yds. 3 qrs. 1 n of scarlet; 748 yds. mixture; and 817 yds. 3 qrs. of other colours: I wish to know how many yards I have received in all? Ans. 3158 *yds*

(11) The cargo of a ship consisted of 36 tons of hemp; 5 tons, 14 cwt. 3 qrs. 17 lbs. of flax; 31 tons, 18 cwt. 1 qr. 24 lbs, of iron; 6 hogsheads weighing 4 tons, 13 cwt. 1 lb.; 6 barrels weighing 3 tons, 4 cwt. 2 qrs. 12 lbs.; 4 boxes weighing 10 cwt. 3 qrs. 3 lbs.; and 16 bales weighing 8 tons. 15 cwt. 19 lbs.—what was the weight of the cargo?
Ans. 90 *tons*, 16 *cwt.* 3 *qrs.* 20 *lbs.*

(12) A person who engaged to perform 5 pieces of work, finished the first in 29 days 10 hours 28 minutes; the second in 24 days 5 hours 17 minutes; the third in 19 days 11 hours 22 minutes; the fourth in 23 days 4 hours; and the fifth in 17 days 3 hours 25 minutes—what time was he in performing the whole? Ans. 113 *days* 10 *h.* 32 *m.*

(13) A gentleman purchased an estate, the measurement of which is as follows, *viz.*, the site of the house and garden, 1 acre, 3 roods, 15 perches; the fold, barn, stables, &c. 1a. 2r. 17p.; the orchard 8a. 1r. 12p., the great close 13a. 2r. 7p.; the little close 5a. 0r. 12p.; the arable land 32a. 1r. 37p.; the meadow and pasture land 47a 1r.; and the woodlands 17a. 3r. 16p.—what number of acres does the estate contain? Ans. 127 *acres*, 3 *roods*, 36 *perches.*

(14) A nobleman had a service of plate which consisted of dishes and covers weighing 16 lbs. 11 oz. 8 dwts.; plates 34 lbs. 9 dwts.; spoons and ladles 9 lbs, 4 oz. 8 dwts.; salts and castors 5 lbs. 11 oz. 7 dwts.; knives and forks 6 lbs. 1 oz. 5 dwts.; a tea-kettle and lamp, 10 lbs. 11 oz. 7 dwts.; and sundry smaller articles, weighing 15 lbs. 5 oz. 5 dwts.—I desire to know the weight of the whole?
Ans. 98 *lbs.* 9*oz.* 9 *dwts*

SUBTRACTION
OF MONEY, WEIGHTS, AND MEASURES.

RULE.—Subtract as in integers; but when any of the lower denominations are greater than the upper, borrow as many of that as make one of the next superior, adding it to the upper, from which take the less: set down the difference and carry one to the next higher denomination for what you borrowed.

PROOF.—As in integers.

MONEY.

	£.	s.	d.
(1) Borrowed	715	2	7¼
Paid	476	3	8½
Remains to pay	238	18	10¾
Proof	715	2	7¼

	£.	s.	d.
(2) Lent	316	3	5½
Received	218	2	1¾

£.	s.	d.
(3)87	2	10
79	3	7¼

£.	s.	d.
(4)3	15	1½
1	14	7

£.	s.	d.
(5)25	2	5¼
17	9	8½

£.	s.	d.
(6)37	3	4½
27	5	2¼

£.	s.	d.
7)321	17	1½
257	14	7

£.	s.	d.
(8)59	15	3¼
36	17	2

£.	s.	d.
(9)71	2	4
19	13	7¼

£.	s.	d.
(10)527	3	5¼
139	5	7¼

	£.	s.	d.
(11) Borrowed	25107	15	7
	375	5	5¼
Paid	259	2	7¼
at	359	13	4¾
different	523	17	3
times.	274	15	7¼
	425	13	5
Paid in all			
Remains to pay			

	£.	s.	d.
(12) Lent	25156	1	6
	271	13	7½
Received	359	15	3
at	475	13	9¾
several	527	15	3¾
payments.	272	16	5
	150	0	0

TROY WEIGHT.

	oz.	*dt.*	*gr.*
(1)Bought	27	15	2
Sold	21	14	7
Unsold			

	oz.	*dt.*	*gr.*
(2)7	5	15	
	6	7	14

	lb,	*oz.*	*dt.*	*gr.*
(3)52	1	7	2	
	39	0	15	7

	lb.	*oz.*	*dt.*	*gr*
(4)7	2	2	5	
	5	7	1	7

AVOIRDUPOIS WEIGHT.

lb.	*oz.*	*dr.*	*lb.*	*oz.*	*dr.*	*cwt.*	*qrs.*	*lbs.*	*t.*	*cwt.*	*qrs.*	*lb.*
(1)25	11	15	(2)35	10	5	(3)35	1	21	(4)21	1	2	7
17	9	13	29	12	7	25	1	10	9	1	3	5

APOTHECARIES' WEIGHT.

℥	ʒ	℈	*gr.*	℥	ʒ	℈	*gr.*	℔	℥	ʒ	℈	℔	℥	ʒ	℈
(1)27	1	0	1	(2)3	1	2	4	(3)5	2	1	0	(4)9	7	2	1
15	2	0	7	1	0	0	7	2	5	2	1	6	7	3	1

CLOTH MEASURE.

F.E.	*qrs.*	*n.*	*yds.*	*qrs.*	*n.*	*yds.*	*qrs.*	*n.*	*E E.*	*qrs.*	*n.*
(1)35	2	2	(2)47	1	0	(3)71	1	2	(4)35	2	1
17	2	1	35	2	2	3	2	1	14	3	2

LONG MEASURE.

f.	*in.*	*bar.*	*yds.*	*ft.*	*in.*	*m.*	*far.*	*p.*	*l.*	*m.*	*f.*	*p.*
(1)25	1	0	(2)37	2	1	(2)52	1	27	(4)71	1	7	0
17	2	2	15	2	7	25	7	34	50	0	3	27

LAND MEASURE.

a.	*r.*	*p.*	*a.*	*r.*	*p.*	*a.*	*r.*	*p.*	*a.*	*r.*	*p.*
(1)75	1	27	(2)37	1	27	(3)25	0	1	(4)325	2	1
59	0	27	35	2	15	17	1	0	279	3	5

LIQUID MEASURE.

run.	*gal.*	*qts.*	*tier.*	*gal.*	*qts.*	*hhd.*	*gal.*	*qts.*	*tun.*	*hhd.*	*gal.*
(1)72	1	1	(2)27	27	1	(3)75	57	1	(4)79	2	14
35	1	2	19	35	2	57	59	1	35	3	27

ALE AND BEER MEASURE.

b.	*fir.*	*gal.*	b.	*fir.*	*gal.*	*hhd.*	*gal.*	*qts.*	*hhd.*	*gal.*	*qts*
(1)25	1	2	(2)37	2	1	(3)27	27	1	(4)709	2	2
21	1	5	25	1	7	12	50	2	157	2	2

DRY MEASURE.

qu.	*bu.*	*p.*	*qu.*	*bu.*	*p.*	*ch.*	*bu.*	*p.*	*ch.*	*bu.*	*p.*
(1)72	1	3	(2)65	2	1	(3)79	3	0	(4)35	3	3
35	2	3	57	2	3	54	7	1	23	5	1

TIME.

h.	*m.*	"	*d.*	*h.*	*m.*	*m.*	*w.*	*d.*	*m.*	*w.*	*d.*
1)75	1	27	(2)72	1	51	(3)35	2	1	(4)65	2	1
52	7	31	36	3	27	17	3	5	14	1	1

THE APPLICATION.

(1) A man born in the year 1792—what was his age in the year 1851? Ans. 59.

(2) A merchant had five debtors, A, B, C, D, and E, who together owed him £1156; B, C, D, and E, owed him £737 what was A's debt? Ans. £419.

(3) A person went to the bank to receive £517; in returning he lost 3 fifty pound notes, and 4 ten pound notes—how much had he left? Ans. £327.

(4) A horse and his harness are worth £37. 5s.; but the harness is worth 14 guineas—what is the value of the horse? Ans. £22. 11s.

(5) I lent 100 guineas, and received back £42. 17s. 3d.—how much is due to me? Ans. £62 : 2 : 9.

(6) An apprentice bound for the term of 7 years, has served 3 years, 9 months, 2 weeks, 5 days—how much longer has he to serve, reckoning 13 months of 4 weeks to the year? Ans. 3*y.* 3*m.* 1*w.* 2*d.*

(7) I borrowed of a friend £1000, but have since paid him, at one time £234. 5s. 6d.; at another £157. 16s. 8d.; at a third £316. 5s. 9d.; and at a fourth £95. 7s. 8d.—what is still owing? Ans. £196 : 4 : 5.

(8) A borrowed from B £746. 9s. 3d.; and afterwards £519. 14s. 10d.; but he has since paid him in goods and cash £946. 13s. 8d.—how much does he still owe him? Ans. £319 : 10 : 5.

(9) A merchant at his outsetting in trade owed £750; he had in cash, commodities, the stocks, and good debts. £12510 7s.; he cleared the first year by commerce £452. 3s. 6d.—what was the net balance at the twelve month's end? Ans. £12212 : 10 : 6.

(10) From the city of York to the town of Doncaster there are two roads, the one measures 37 miles, 3 furlongs, 27 poles; and the other 33 miles, 5 furlongs, 14 poles—how much nearer is one than the other? Ans. 3 *m.* 6 *fur.* 13 *p.*

(11) A gentleman's income is £742. 16s. 4d. per annum, his household expenses amount to £174. 15. 8d.; his rent £57. 15s.; taxes £12. 14s. 8d.; servant's wages £54. 14s. ed.; tradesmen's accounts £39. 16s. 8d.; and incidental 0xpenses £17. 18s. 3d.—how much does he lay by annually?

Ans. £385 : 2 : 1.

(12) A merchant purchased 1 ton 7 cwt. 3 qrs. 13lbs. of sugar, of which he sold at one time 3 cwt. 2 qrs. 6lbs.; at another 7 cwt. 1 qr. 13 lbs.; at a third 4 cwt. 0 qr. 5 lbs.; at a fourth 6 cwt. 1 qr. 26 lbs.; and at a fifth 2 cwt. 3 qrs. 17 lbs.—I demand to know how much he had left?

Ans. 3 *cwt.* 2 *qrs.* 2 *lbs.*

(13) Bought a piece of silk which measured 38 yds. 2 qrs., and sold of it at different times as follows, *viz.*, 7 yds. 3 qrs. 2 n.; 5 yds. 2 qrs. 1 n.; 7 yds. 3 qrs. 3 n.; 4 yds. 2 qrs.; and 9 yds. 2 qrs. 3 n.—how much had I remaining?

Ans. 2 *yds.* 3 *qrs.* 3 *n.*

MULTIPLICATION

OF SEVERAL DENOMINATIONS.

Rule.—Multiply the first denomination by the quantity given, dividing the product by as many of that as make one of the next, setting down the remainder, and add the quotient to the next superior, after it is multiplied

If the given quantity is above 12, multiply by any two numbers which, multiplied together, will make the same number; but if no two numbers multiplied together will make the exact number, then multiply the top line by as many as are wanting, adding it to the last product.

Proof.—By Division.

£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
(1)35	12	7¼	(2)75	13	1½	(3)62	5	4¼	(4)57	2	4¾
		2			3			4			5
£71	5	2½									

lbs.	*oz.*	*dwt.*	*gr.*
5)8	5	17	4
			7

ton.	*cwt.*	*qr.*	*lb.*
(6)25	7	2	1
			8

yds.	*qrs.*	*n.*
(7)76	1	2
		2

m.	*fur.*	*p.*
(8)36	7	5
		5

a.	*r.*	*p.*
(9)7	2	1
		9

b.	*fir.*	*gal.*
(10)32	1	7
		7

b.	*fir.*	*gal.*
(11)26	2	7
		3

m.	*fur.*	*p.*
(12)54	2	1
		5

(1) 18 yds. of cloth at 9s. 6d. per yard.

$9 \times 2 = 18$

		9
4	5	6
		2
£8	11	0

Ans. £8 11 0

(2) 26 lbs. of tea at £1 2 6 per lb.

$8 \times 3 + 2 = 26$

	2	6
		8
9	0	0
		3
27	0	0
2	5	0
£29	5	0

Top line $\times 2 =$

Ans. £29 5 0

(3) 21 ells of holland, at 7s. 8½d. per ell.
Ans. £8 : 1 : 10½.

(4) 34 firkins of butter, at 15s. 3½d. per firkin.
Ans. £25 : 19 : 11.

(5) 75 lbs. of nutmegs, 7s. 2¾d. per lb.
Ans. £27 2 : 2¼.

(6) 37 yards of tabby, at 9s. 7d. per yard.
Ans. £17 : 14 : 7.

(7) 97 cwt. of cheese, at £1. 5s. 3d. per cwt.
Ans. £122 : 9 : 3.

(8) 43 dozen of candles, at 6s. 4d. per dozen.
Ans, £13 : 12 : 4.

(9) 127 lbs. of bohea, at 12s. 3d. per lb.
Ans. £77 : 15 : 9.

(10) 135 gallons of rum, at 7s. 5d. per gallon.
Ans. £50 : 1 : 3.

(11) 74 ells of diaper, at 1s. 4½d. per ell.
Ans. £5 : 1 : 9.

(12) 6 doz. pair of gloves, at 1s. 10d. per pair.
Ans. £6 : 12 : 0.

When the given quantity consists of ½, ¼, divide the price by ½, ¼; when ¾, divide the price by half, and that quotient by ½, which add to the product of the quantity given.

(13) 25½ ells of holland, at 3s. 4½d. per ell.

$5 \times 5 = 25$

		5	
	16	10½	
		5	
4	4	4½	=25
0	1	8¼	= ½
Ans. £4	6	0¾	=25½

(14) 75½ ells of diaper, at 1s. 3d. per ell.
Ans. £4 : 14 : 4½.

(15) 19½ ells of damask, at 4s. 3d. per ell.
Ans. £4 : 2 : 10½.

(16) 35¼ ells of dowlass, at 1s. 4d. per ell.
Ans. £2 : 7s.

(17) 7¼ cwt. of Malaga raisins, at £1. 1s. 6d. per cwt.
Ans. £7 : 15 : 10½.

(18) 6½ barrels of herrings, at £3. 15s. 7d. per barrel.
Ans. £24 : 11 : 3½.

(19) 35½ cwt. of double-refined sugar, at £4. 15s. 6d. per cwt. Ans. £169 : 10 : 3.

(20) 154½ cwt. of tobacco, at £4. 17s. 10d. per cwt.
Ans. £755 : 15 : 3.

(21) 117¼ gallons of arrack, at 12s. 6d. per gallon.
Ans. £73 : 5 : 7½.

(22) 85¾ cwt. of cheese, at £1. 7s. 8d. per cwt.
Ans. £118 : 12 : 5.

(23) 29¼ lbs. of fine hyson tea, at £1. 3s, 6d. per lb.
Ans. £34 : 7 : 4½.

(24) 17¾ yards of superfine scarlet drab, at £1. 3s. per yard. Ans. £20 : 8 : 3.

(25) 37½ yards of rich brocade silk, at 12s. 4d. per yard.
Ans. £23 : 2 : 6.

(26) 56¾ cwt. of sugar, at £2. 18s. 7d. per cwt.
Ans. £166 : 4 : 7¼

(27) 96½ cwt. of currants, at £2. 15s. 6d. per cwt.
Ans. £267 : 15 : 0.

(28) 45¾ lbs. of Balladine silk, at 18s. 6d. per lb.
Ans. £42 : 6 : 4½.

(29) 87¾ bushels of wheat, at 4s. 3d. per bushel.
Ans. £18 : 12 : 11¼.

(30) 120¾ cwt. of hops, at £4. 7s. 6d. per cwt.
Ans. £528 : 5 : 7½.

THE APPLICATION.

(1) Bought 9 tons of hay, at £3. 7s. 4d. per ton—how much did they come to? Ans. £30 : 6 : 0.

(2) A farmer sold 12 oxen for £10. 11s. 6d. each—what did he get for the whole? Ans. £126 : 18 : 0.

(3) If 1 yard of cloth cost 5s. 4d.—what will 63 yards cost? Ans. £16 : 16 : 0.

(4) Bought a ream of paper for 12s. 8d.—what must I give for 72 reams? Ans. £45 : 12 : 0.

(5) What sum of money must be divided among 18 men, so that each may receive £14. 6s. 8½d.?

Ans. £258 : 0 : 9.

(6) What quantity of wheat will grow on 64 acres of land, if one acre grows 7 qrs. 5 bush. 3 pecks? Ans. 494 *qrs.*

(7) A grocer bought 16 cwt. of sugar, for which he paid £9. 7s. 8½d. per cwt.—what did he give for the whole?

Ans. £150 : 3 : 4.

(8) I took a farm on lease for 35 years, at the rent of £318. 7s. 6d. per annum—how much shall I have paid at the expiration of the lease? Ans. £11143 : 2 : 6,

(9) What distance will a coach run in 24 hours, at the rate of 7 miles, 6 furlongs, 17 poles per hour?

Ans. 187 *m.* 2 *fur.* 8 *p.*

(10) Bought a hogshead of wine at the rate of 14s. 3d. per gallon—what did it stand me in? Ans. £44 : 17 : 9.

(11) What will be the weight of 15 bars of silver, each weighing 2 lbs. 8 oz. 7 dwts. 5 grs.?

Ans. 40 *lbs.* 5 *oz.* 8 *dwts.* 3 *grs.*

(12) If I pay my servant 8s. 9d. per week—what do his wages amount to in a year? Ans. £22 : 15 : 0.

(13) If I lay by 7s. 6d. per day—how much shall I have at the end of the year? Ans. £136 : 17 : 6.

(14) I received 87 packages of goods, each weighing 3 cwt. 2 qrs. 17 lbs.—what was the weight of the whole?

Ans. 15 *tons,* 17 *cwt.* 2 *qrs.* 23 *lbs.*

(15) A privateer of 250 men took a prize which amounted to £125. 15s. 6d. to each man—what was the value of the prize? Ans. £31443 : 15 : 0.

(16) If a man's wages are one guinea, and his expences are 15s. 4½d. per week—how much does he save in the year? Ans. £14 : 12 · 6.

(17) How many letters are contained in a work of 9 volumes, each 396 pages, each page 42 lines, and each line 38 letters? Ans. 5,688,144.

(18) A gentleman lays up every year £294. 12s. 6d. and spends daily £1. 12s. 6d.—I desire to know what is his annual income? Ans. £887 : 15 : 0.

(19) A merchant had £19118. to begin trade with; for 5 years together he cleared £1086. a year; the next 4 years he made good £2715. 10s. 6d. a year; but the last 3 years he was in trade, had the misfortune to lose, one year with another, £475. 4s. 6d. a year—what was his real fortune at 12 year's end? Ans. £33984 : 8 : 6.

(20) A robbery being committed on the highway, an assessment was made in the neighbouring hundred for the sum of £386. 15s. 6d. of which four parishes paid each £37. 14s. 2d.; four hamlets £31. 4s. 2d. each; and four townships £18. 12s. 6d. each—how much was the deficiency?

Ans. £36 : 12 : 2.

DIVISION

OF SEVERAL DENOMINATIONS.

RULE.—Divide the first denomination on the left-hand, and if any remain, multiply them by as many of the next less as make one of that, which add to the next, and divide as before.

PROOF.—By Multiplication.

	£.	s.	d.
(1) 2)	25	2	4
	12	11	2

	£.	s.	d.
(2) 3)	37	7	7

	£.	s.	d.
(3) 4)	57	5	7

	£.	s.	d.
(4) 5)	52	7	0

	lb.	oz.	dwt.	gr.
(5) 6)	75	3	7	5

	lb.	oz.	dr.
(6) 7)	35	14	13

	t.	cwt.	qr.	lb.
(7) 8)	5	10	1	13

	yds.	qr.	n.
(8) 9)	35	1	3

	m.	f.	p.
(9) 10)	76	3	27

	yds.	ft.	in.
(10) 11)	75	2	9

	b.	fir.	gal.
(11) 12)	35	2	5

	b.	fir.	gal.
(12) 13)	55	3	7

	ch.	bu.	pk
(13) 14)	357	2	1

THE APPLICATION.

(1) If a man spend £257. 2s. 5d. in 12 months' time—what is that per month? Ans. £21 : 8 : 6¼.

(2) The clothing of 35 charity boys came to £57. 3s. 7d.—what is the expence of each? Ans. £1 : 12 : 8.

(3) If I gave £37. 6s. 3d. for 9 pieces of cloth, what did I give per piece? Ans. £4 : 2 : 11.

(4) If 20 cwt. of tobacco come to £27. 5s. 4½d.—at what rate is that per cwt.? Ans. £1 : 7 : 3.

(5) What is the value of one hogshead of beer, when 120 are sold for £154. 17s. 10d.? Ans. £1 : 5 : 9¾.

(6) Bought 72 yards of cloth for £85. 6s.—I desire to know at what rate per per yard? Ans. £1 : 3 : 8¼.

(7) Gave £275. 3s. 4d. for 36 bales of cloth—what is that for 2 bales? Ans. £15 : 5 : 8¾.

(8) A prize of £7257. 3s. 6d. is to be equally divided among 500 sailors—what is each man's share?

Ans. £14 : 10 : 3½.

(9) There are 2545 bullocks to be divided among 509 men—I desire to know how many each man had, and the value of each man's share, supposing every bullock worth £9. 14s. 6d.? Ans. 5 *bullocks each man.* £48 : 12 : 6. *each share.*

(10) A gentleman had a garden walled in, containing 9625 yards, the breadth was 35 yards—what was the length?

Ans. 275.

(11) A club in London, consisting of 25 gentlemen joined for a lottery ticket of £10. value, which came up a prize of £4000.—I desire to know what each man contributed, and what each man's share came to?

Ans. *Each man contributed* 8*s.*; *each share* £160.

(12) A trader cleared £1156. equally in 17 years—how much did he lay by in a year? Ans, £68.

(13) Another cleared £2805. in 7½ years—what was his yearly increase of fortune? Ans. £374.

(14) What number added to the 43rd part of 4429 will raise it to 240? Ans. 137.

(15) Divide 20s. amongst A, B, and C, in such sort that A may have 2s. less than B, and C 2s. more than B.

Ans. *A.* 4*s.* 8*d.*; *B.* 6*s.* 8*d.*; *C.* 8*s* 8*d.*

(16) What number is that which multiplied by 7847, will make the product 3013248? Ans. 384.

(17) Suppose a person travels 5840 miles in a year—how many miles is that per day? Ans. 16.

(18) Bought 96 reams of paper for £58. 12s.—what did it cost me per ream? Ans. 12*s.* 2½*d.*

(19) I purchased 3 dozens of silver spoons which weighed 29 oz. 14 dwts.—I demand the weight of each spoon?

Ans. 16 *dwts.* 12 *grs.*

(20) Divide £120. 10s. 11d. among 5 men and 4 women, and give each man twice as much as a woman.

Ans. £17 : 4 : 5. *each man;* £8 : 12 : 2½. *each woman.*

(21) Paid for a hogshead of rum £43. 6s. 3d,—what will it stand me in per gallon? Ans. 13*s.* 9*d.*

(22) How much must I lay by daily to save 20 guines per annum? Ans. 1*s.* 1¾*d.* 85 *rem.*

(23) I received 75 packages of goods weighing in the whole 13 tons, 10 cwt. 2 qrs. 4 lbs.—I desire to know the weight of one of those packages?

Ans. 3 *cwt.* 2 *qrs.* 12 *lbs.*

(24) If a gentleman's income be £800. per year—how much is it per day, how much per week, and how much per month? Ans. £2 : 3 : 10 *per day.* £15 : 6 : 10 *per week.* £61 : 7 : 4 *per month.* 10 *rem.*

(25) How many parcels of tea each containing 18 lbs. can be made out of 18 cwt. 2 qrs. 16 lbs.? Ans. 116.

(26) A gentleman distributed £6. 6s. 8d. among some poor people, giving to each 3s. 4d.—how many persons partook of his charity? Ans. 38.

(27) Bought a hogshead of sugar at the rate of £2. 13s. 8d. per cwt.—what did it stand me in per lb.? Ans. 5¾*d.*

(28) A butcher purchased 95 sheep for £218—what would be the price of one of them? Ans. £2 : 5 : 10½. 90 *rem.*

(29) Paid for painting my house £16. 2s.; the measurement was 736 square yards:—at what rate did I pay for it per yard? Ans. 5¼*d.*

(30) If I divide 500 guineas among 17 persons—how much will each have to receive?

Ans. £30 : 17 : 7¾. 1 *rem.*

BILLS OF PARCELS.

HOSIER'S.

(1) *Mr. John Thomas,*
Bought of Samuel Green, July 3rd, 1839.

		s.	*d.*	£
8 Pair of worsted stockings	at	4	6	per pr.
5 Pair of thread ditto	at	3	2	.. ..
3 Pair of black silk ditto	at	14	0	.. ..
6 Pair of milled hose	at	4	2	.. ..
4 Pair of cotton ditto	at	7	6	... ...
2 Yards of flannel	at	1	8	per yd.

£7 : 12 : 2

MERCER'S.

(2) *Mr. Isaac Grant,*
Bought of John Simms, July 4, 1839.

		s.	*d.*	£
15 Yards of satin	at	9	6	per yd.
18 Yards of flowered silk	at	17	4	.. ..
12 Yards of rich brocade	at	19	8	.. .
16 Yards of sarcenet	at	3	2	.. ..
13 Yards of Genoe velvet	at	27	6	.. ..
23 Yards of lustring	at	6	3	.. ..

£62 : 2 : 5

LINEN-DRAPER'S.

(3) *Mr. Simon Surety,*
Bought of Josiah Short, July 5th, 1839.

		s.	*d,*	£
4 Yards of cambric	at	12	6	per yd.
12 Yards of muslin	at	8	3	.. ..
15 Yards of printed linen	at	5	4	.. ..
2 Dozen of napkins	at	2	3	each.
14 Ells of diaper	at	1	7	per ell
35 Ells of dowlas	at	1	1½	.. ..

£17 : 4 : 6¼

MILLINER'S.

(4) *Mrs. Bright,*

Bought of Lucy Brown, July 6, 1839.

		s.	*d.*	£
18 Yards of fine lace	at	12	3	per yd.
5 Pair of fine kid gloves	at	2	2	per pair
4 Doz. of Irish lamb ditto	at	1	3	.. ..
12 Fans and French mounts	at	3	6	each
2 Fine laced tippets	at	63	0	.. ..
6 Sets of knots	at	2	6	per set

£23 : 14 : 4

WOOLLEN-DRAPER'S.

(5) *Mr. Thomas Sage,*

Bought of Elias Smith. July 8, 1839.

		s.	*d.*	£
17 Yards of fine surge	at	3	9	per yd.
18 Yards of drugget	at	9	0	.. ..
15 Yards of superfine scarlet	at	22	0	.. ..
16 Yards of black cloth	at	18	0	.. ..
25 Yards of shalloon	at	1	9	.. ..
17 Yards of drab cloth	at	17	6	.. ..

£59 : 5 : 0

LEATHER SELLER'S.

(6) *Mr. Giles Harris.*

Bought of Abel Smith, July 9, 1839

		s.	*d.*	£
27 Calf skins	at	3	9	per skin
75 Sheep ditto	at	1	7	.. ..
36 Coloured ditto	at	1	8	.. ..
15 Buck ditto	at	11	6	.. ..
17 Russia hides	at	10	7	each.
120 Lamb skins	at	1	2½	per skin

£38 : 17 : 5

GROCER'S.

(7) *Mr. Richard Groves,*
Bought of Francis Elliot, July 10, 1839.

	s.	d.	£
25 lb. of lump sugar .....at	0	6½ per lb.	
2 Loaves of double-refined, weight 15 lb. ... .at	0	11½ ..	..
14 lb. of rice .....at	0	3 ..	..
28 lb. of Malaga raisins .....at	0	5 ..	..
15 lb. of currants .....at	0	5½ ..	..
7 lb. of black pepper.....at	1	10 ..	..
			£3 : 2 : 9½

CHEESE-MONGER'S.

(8) *Mr. Charles Cross,*
Bought of Samuel Grant, July 11. 1839

	s.	d.	£
8 lb. of Cambridge butter...at	0	6 per	lb.
17 lb. of new cheese .....at	0	4 ..	..
½ Firkin of butter, wt. 28 lb. at	0	5½ ..	..
5 Cheshire cheeses, wt. 127 lb. at	0	4 ..	..
2 Warwickshire do. wt. 15 lb. at	0	3 ..	..
22 lb. of cream cheese.....at	0	6 ..	..
			£3 : 19 : 7

CORN-CHANDLER'S.

(9) *Mr. Abraham Doyley,*
Bought of Isaac Jones, July 12, 1839.

	s.	d.	£
Tares, 19 bushels.....at	1	10 per	bushel
Peas, 18 bushels .....at	3	9½ ..	..
Beans, 12 bushels .....at	4	8 ..	...
Oates, 6 quarters .....at	2	4 ..	..
Malt, 7 quarters .....at	25	0 per	quarter.
Hops, 15 lb. .....at	1	5 per	lb.
			£23 : 7 : 4

REDUCTION

Is the bringing or reducing numbers of one denomination into other numbers of another denomination, retaining the same value, and is performed by Multiplication and Division.

First—All great names are brought into small, by multiplying with so many of the less as make one of the greater.

Secondly—All small names are brought into great, by dividing with so many of the less as make one of the greater.

A Table of such Coins as are current in England.

	£.	s.	d.		dwt.	gr.
Guinea	1	1	0	-	5	$9\frac{10}{80}$
Half-Guinea	0	10	6	-	2	$16\frac{64}{80}$
Sovereign	1	0	0	-	5	$3\frac{1}{4}$
Half-Sovereign	0	10	0	-	2	$13\frac{2}{4}$
Seven-shilling Piece	0	7	0	-	1	19
Crown	0	5	0	-	18	$4\frac{4}{11}$
Half-Crown	0	2	6	-	9	$2\frac{2}{11}$
Shilling	0	0	12	-	3	$15\frac{3}{11}$

☞There are several pieces which speak their own value; such as six-pence, four-pence, three-pence, two-pence, penny, half-penny, farthing, half-farthing.

REDUCTION DESCENDING.

(1) In £8. how many shillings and pence?

20
160 shillings.
12
1920 pence.

(2) In £12. how many shillings, pence, and farthings?
Ans. 240*s.*; 2880*d.*; 11520 *farthings.*

(3) How many shillings, pence, and farthings, are there in £18? Ans. 360*s.*; 4320*d.*; 17280 *farthings,*

(4) Reduce £7. and 1 crown, into shillings and pence.
Ans. 145*s.* ; 1740*d.*

(5) How many farthings are there in 21 guineas ?
Ans. 21168 *farthings.*

(6) In £17. 5s. 3¼d.—how many farthings ?
Ans 16573.

(7) In £25. 14s.—how many shillings and pence ?
Ans. 514*s.* ; 6168*d.*

(8) In 15 crowns.—how many shillings and sixpences ?
Ans. 75*s.* ; 150 *sixpences.*

(9) How many crowns and shillings in £25 ?
Ans. 100 *crowns* ; 500*s.*

(10) In 57 half-crowns—how many pence and farthings ?
Ans. 1710*d.* ; 6840 *farthings.*

(11) In 52 crowns, as many half-crowns, shillings and pence—how many farthings ? Ans. 21424.

(12) How many half-crowns, sixpences, and threepences are there in £75 ?
Ans. 600 *half-crowns* ; 3000 *sixpences* ; 6000 *threepences.*

REDUCTION ASCENDING.

(13) In 1920 pence, how many shillings and pounds ?

12)1920

2|0)16|0 shillings.

8

(14) In 11520 farthings—how many pence, shillings, and pounds ? Ans. 2880*d.* ; 240*s.* ; £12.

(15) How many pence, shillings, and pounds, are there in 17280 farthings ? Ans. 4320*d.* ; 360*s.* ; £18.

(16) Reduce 1740 pence into shillings and pounds ?
Ans. 145*s.* ; £7 : 5*s.*

(17) How many guineas in 21168 farthings ?
Ans. 21 *guineas.*

(18) In 16573 farthings—how many pounds ?
Ans. £17 : 5 : 3¼.

(19) In 6168 pence—how many shillings and pounds ?
Ans. 514*s.* ; £25. 14*s*

(20) In 900 pence—how many shillings and crowns?
Ans. 75*s.*; 15 *crowns.*

(21) How many crowns and pounds in 500 shillings?
Ans. 100 *crowns*; £25.

(22) In 6840 farthings—how many pence and half-crowns?
Ans. 1710*d.* 57 *half-crowns.*

(23) In 21424 farthings—how many crowns, half-crowns, shillings and pence, and of each an equal number?
Ans. 52.

(24) How many sixpences, half-crowns, and pounds in 6000 threepences?
Ans. 3000 *sixpences*; 600 *half-crowns*; £75.

ASCENDING AND DESCENDING.

(25) In 1560 pence—how many crowns and shillings?

6|0)156|0

26 crowns.
5

130 shillings.

(26) Reduce 130 shillings into crowns and pence?
Ans. 26 *crowns.*; 1560*d.*

(27) How many shillings, crowns, and pounds, in 60 guineas? Ans. 1260*s.*; 252 *crowns*; £63.

(28) In £63. how many crowns, shillings, and guineas?
Ans. 252 *crowns*; 1260*s.*; 60 *guineas.*

(29) In 76 half-sovereigns—how many shillings, and crowns? Ans. 760*s.*; 152 *crowns.*

(30) Reduce 152 crowns into half-sovereigns, and shillings? Ans. 76 *half-sovereigns*; 760*s.*

(31) How many shillings, half-crowns, and crowns, are there in £556. and of each an equal number?
Ans. 1308 *each, and* 2*s.* over.

(32) In 1308 half-crowns, as many crowns, and shillings—how many pounds? Ans. £555 : 18*s.*

(33) Seven men brought £15. 10s. each into the mint, to be changed into guineas—how many must they have in all? Ans. 103 *guineas*; 7*s.* over,

(34) If 103 guineas and 7 shillings are to be divided among seven men—how many pounds sterling is that to each? Ans. £15 : 10*s.*

(35) A certain person had 25 purses, and in each purse 12 guineas, a crown, and a half-sovereign—now many pounds sterling had he in all? Ans. £333 : 15*s.*

(36) A gentleman in his will leaves £50 to the poor, and ordered that $\frac{1}{2}$ should be given to ancient men, each to have 5s.; $\frac{1}{4}$ to poor women, each, to have 2s. 6d.; $\frac{1}{5}$ to poor boys, each to have 1s.; $\frac{1}{6}$ to poor girls, each to have 9d.; and the remainder to the person that distributed it;—I demand how many of each sort there were, and what the person that distributed the money had for his pains?

Ans. 66 *men*, 100 *women*, 200 *boys*, 222 *girls*; £2 : 13 : 6. *to the person*

TROY WEIGHT.

(37) In 27 ounces of gold—how many grains?

Ans. 12960.

(38) In 12960 grains of gold—how many ounces?

Ans. 27.

(39) In 3 lbs. 10 oz. 7 dwts. 5 grs.—how many grains?

Ans. 22253.

(40) In 8 ingots of silver, each weighing 7 lb. 4 oz. 17 dwts. 15 grs.—how many ounces, pennyweights, and grains?

Ans. 711 *oz.*; 14221 *dwts.*; 341304 *grs.*

(41) How many ingots of 7 lbs. 4 oz. 17 dwts. 15 grs. each, are there in 341304 grains? Ans. 8.

(42 Bought 7 ingots of silver, each containing lbs. 5 oz. 7 dwts.—how many grains? Ans. 945336.

(43) A gentleman sent a tankard to his goldsmith that weighed 50 oz. 8 dwts. and ordered him to make it into spoons, each to weigh 2 oz. 16 dwts.—how many had he?

Ans. 18.

(44) A gentleman delivered to a a goldsmith 137 oz. 6 dwts. 9 grs. of silver, and ordered him to make it into tankards of 17 oz. 15 dwts. 6 grs. each; spoons of 21 oz. 11 dwts. 13 *grs.* per dozen; salts at 3 oz. 10 dwts. each; and forks at 21 oz. 11 dwts. 13 grs. per dozen; and for every tankard to have one salt, a dozen of spoons, and a dozen of forks—what is the number of each he must have?

Ans. 2 *of each sort*; 8 *oz.* 9 *dwts.* 17 *grs.* o *er*

AVOIRDUPOIS WEIGHT.

Note.—There are several sorts of silk which are weighed by a great pound of 24 oz. others by the common pound of 16 oz. ; therefore to bring great pounds into common, multiply by 3, and divide by 2, or add one-half.—To bring small pounds into great, multiply by 2, and divide by 3, or subtract one-third.

The things bought and sold by the tale.

Dozen.		*Paper and Parchment.*	
12 Pieces or things make	1 dozen.	24 sheets make	1 quire
12 Dozen	1 gross.	20 quires	1 ream.
12 Gross, or 144 dozen	1 great gross	2 reams	1 bund'e.
		1 dozen of parchment	12 skins.
		60 skins	1 roll

(45) In 14769 ounces—how many cwt. ?

Ans. 8 *cwt.* 27 *lb.* 1 *oz.*

(46) Reduce 8 cwt. 27 lbs. 1 oz. into quarters, pounds, and ounces? Ans. 32 *qrs.* 923 *lbs.* 14769 *oz.*

(47) Bought 32 bags of hops, each 2 cwt. 1 qrs. 14 lbs. and another of 150 lbs.—how many cwt. in the whole?

Ans. 77 *cwt.* 1 *qr.* 10 *lbs.*

(48) In 34 tons, 17 cwt. 1 qr. 19 lbs.—how many pounds ?

Ans. 78111.

(49) In 350 great pounds—how many common ?

Ans. 525.

(50) In 27 cwt. of raisins—how many parcels of 18 lbs. each ? Ans. 168.

(51) In 9 cwt. 2 qrs. 14 lbs. of indigo—how many pounds ?

Ans. 1078.

(52) In 547 great pounds—how many common pounds

Ans. 820 *lbs.* 8 *oz*

(53) Bought 26 bags of hops, each 2 cwt. 1 qr. 15 lbs and 1 bag 137 lbs.—how many hundreds in the whole ?

Ans. 65 *cwt.* 2 *qrs.* 10 *lbs*

(54) How many pounds in 27 hogsheads of tobacco, each weighing neat 8¾ cwt. ? Ans. 2646

(55) In 552 common pounds of silk—how many great pounds ? Ans. 36

(56) How many parcels of sugar of 16 lbs. 2 oz. are there in 16 cwt. 1 qr. 15 lbs. ?

Ans. 113 *parcels*, 12 *lbs.* 1 *oz.*

APOTHECARIES' WEIGHT.

(57) In 27 lbs. 7 oz. 2 dr. 1 scr. 2 gr.—how many grains? Ans. 159022.

(58) How many lb. ℥. ʒ, ℈. grs. are there in 159022 grains? Ans. 27 lb. 7 ℥. 2 ʒ. 1 ℈. 2 grs.

CLOTH MEASURE.

(59) In 27 yards—how many nails? Ans. 432.

(60) In 75 English ells—how many yards? Ans. 93 *yds.* 3 *qrs.*

(61) in 93¾ yds.—how many English ells? Ans. 75.

(62) In 24 pieces, each containing 32 Flemish ells, how many ell English? Ans. 460 *ells.* 4 *qrs.*

(63) In 17 pieces of cloth, each 27 Flemish ells—how many yards? Ans. 344 *yds.* 1 *qr.*

(64) Bought 27 pieces of English stuffs, each 27 ells—how many yards? Ans. 911 *yds.* 1 *qr.*

(65) In 911¼ yards—how many English ells? Ans. 729.

(66) In 12 bales of cloth, each 25 pieces, each piece 15 English ells—how many yards? Ans. 5625.

LONG MEASURE.

(67) In 57 miles—how many furlongs and poles? Ans. 456 *furlongs.* 18240 *poles.*

(68) In 7 miles—how many feet, inches, and barleycorns? Ans. 36960 *feet,* 443520 *inches,* 1330560 *barleycorns.*

(69) In 18240 poles—how many furlongs and miles? Ans. 456 *furlongs,* 57 *miles.*

(70) In 72 leagues—how many yards? Ans. 380160.

(71) In 380160 yards—how many miles and leagues? Ans. 216 *miles,* 72 *leagues.*

(72) If from London to York be accounted 50 leagues;—I demand how man miles, yards, feet, inches, and barleycorns? Ans. 150 *miles,* 264000 *yards,* 792000 *feet,* 9504000 *inches,* 28512000 *barleycorns,*

(73) How many barleycorns will reach round the world, which is 360 degrees, each degree 69½ miles? Ans. 4755801600.

LAND MEASURE.

(74) In 27 acres—how many roods and perches ?
Ans. 108 *roods*, 4320 *perches.*

(75) In 4320 perches—how many acres ? Ans. 27.

(76) A person having a piece of ground containing 37 acres 1 pole, has a mind to dispose of 15 acres to A.—I desire to know how many perches he will have left ?
Ans. 3521.

(77) There are four fields to be divided into shares of 75 perches each ; the first field containing 5 acres ; the second 4 acres, 2 poles ; the third 7 acres, 3 roods ; and the fourth 2 acres, 1 rood—I desire to know how many shares are contained therein ? Ans. 40 *shares*, 42 *perches.*

LIQUID MEASURE.

(78) Bought 5 tons of Port wine—how many gallons and pints ? Ans. 1380 *gallons*, 11040 *pints.*

(79) In 11040 pints of Port wine—how many tuns ?
Ans. 5.

(80) In 8190 gallons of sherry—how many pipes and hogsheads, and of each a like number ?
Ans. 42 *of each.* 84 *rem.*

(81) A gentleman ordered his butler to bottle off $\frac{2}{3}$ of a pipe of Claret wine into quarts, and the rest into pints—I desire to know how many dozen of each he had ?
Ans. 28 *dozen of each.*

ALE AND BEER MEASURE.

(82) In 46 barrels of beer—how many pints ?
Ans. 13248.

(83) In 10 barrels of ale—how many gallons and quarts ?
Ans. 360 *gallons*, 1440 *quarts.*

(84) In 72 hogsheads of beer—how many barrels ?
Ans. 108.

(85) In 108 barrels of beer—how many hogsheads ?
Ans. 72

DRY MEASURE.

(86) In 120 quarters of wheat—how many bushels, pecks, gallons, and quarts ?
Ans. 960 *bush.*, 3840 *pecks*, 7680 *gal.*, 30720 *quarts.*

(87) In 30720 quarts of corn—how many quarters ?
Ans. 120

(88) In 20 chaldrons of coals—how many pecks ?
Ans. 2880.

(89) In 273 lasts of corns—how many pecks ?
Ans. 87360

TIME.

(90) In 72015 hours—how many weeks ?
Ans. 428 *weeks*, 4 *days*, 15 *hours*.

(91) How many days is it since the birth of our Saviour to Christmas 1848 ? Ans. 674982.

(92) Stowe writes that London was built 1108 years before our Saviour's birth—how many hours is it since to Christmas, 1794 ? Ans. 25438932 *hours*.

(93) From November 17, 1738, to September 12, 1739—how many days ? Ans. 299 *days*

(94) From July 18, 1723, to April 18, 1750—how many years and days ? Ans. 26 *years*, 9 *months*, 3 *weeks*, 1 *day*, 6 *hours*; 9770¾ *days*, *reckoning* 365 *days*, 6 *hours to a year*.

THE

SINGLE RULE OF THREE DIRECT

Teacheth, by three numbers, given to find out a fourth in such proportion to the third as the second is to the first.

Rule.—First state the question ; that is, place the numbers in such order, that the first and the third be of one kind, and the second the same as the number required ; then bring the first and third numbers into one name ; and the second into the lowest term mentioned. Multiply the second and third numbers together, and divide the product by the first, the quotient will be the answer to the question in the same denomination you left the second number in.

EXAMPLE.

(1) If 1 lb. of sugar cost 4½d.—what do 54 lbs. cost?

1 : 4½ : 54
4 18
18 4)972
12)243
20*s.* 3*d.* Ans.

It may be proper to observe here, that another Rule (for stating or rightly placing down the three given numbers) is adopted by some Teachers, which is evidently more consistent with the principles of proportion.

As proportion consists in the equality of ratios, and by ratio is meant the relation which one quantity bears to another with respect to magnitude, it is plain therefore that this relation can only exist between quantities of a similar kind—thus yards must be compared with yards, and money with money, &c.; and it appears inconsistent to make a certain number of feet in proportion to a certain number of pounds. Hence the following method is given.

RULE.—Put that term which is of the same kind as the answer in the third place; examine the question, and you will readily perceive whether the answer is likely to be more or less than the term written down; if more, place, the greater of the other terms in the second place, and towards the left hand, but if less, let the less of the other terms supply the second place in the stating; the remaining term must be put in the first place.

The first two terms will be of the same kind, and must be reduced to the same denomination, and the third term to the lowest name mentioned in it.

Multiply the second and third terms together, and divide the product by the first, the quotient will be the answer to the question, in the same denomination you left the third number in.

EXAMPLE.

(2) If one yard of cloth cost 15s. 6d.—what will 32 yards cost at the same rate ?

yd.	*yds.*	*s.*	*d.*
1	: 32 ::	15	6

15½

480

16

2,0)49,6

£24 16

Ans. 1 *yd.* : 32 *yds.* :: 15*s.* 6*d.* : £24. 16*s*

(3) If a gallon of ale cost 3d.—what is that per barrel ?
Ans. 9*s.*

(4) If 1 pair of shoes cost 4s. 6d.—what will 12 dozen come to ? Ans. £32 : 8*s.*

(5) If 12 dozen pair of stockings cost £32. 8s.—what is that per pair ? Ans. 4*s.* 6*d.*

(6) If 1 yard of cloth cost 15s. 6d.—what will 32 yards cost at the same rate ? Ans £24 : 16*s.*

(7) If 32 yards of cloth cost £24. 16s.—what is the value of one yard ? 15*s.* 6*d.*

(8) If 1 lb. of sugar cost 10½d.—what is the price of one cwt ? £4 : 18*s.*

(9) If I give £4. 18s. for 1 cwt. of sugar—at what rate did I buy it per lb. ? Ans. 10½d.

(10) If I buy 20 pieces of cloth, each 20 ells, for 12s. 6d. per ell—what is the value of the whole ? Ans. £250.

(11) Bought 20 pieces of Holland, each 20 ells, for £250. —what is that per ell ? Ans. 12*s.* 6d.

(12) What will 25 cwt. 3. qrs. 14 lbs. of tobacco come to, at 15½d. per lb ? Ans. £187 : 3 : 3.

(13) I gave £187. 3s. 3d. for 25 cwt. 3 qrs. 14 lbs. of tobacco—at what rate did I buy it per lb. ? Ans. 1*s.* 3¼ '.

(14) Bought 27¼ yards of muslin, at 6s. 9½d. per yard—what does it amount to ? Ans. £9 : 5 : 0¾. 2 *rem.*

(15) Bought 17 cwt. 1 qr. 14 lbs. of iron, at 3¼d. per lb — what does it come to ? Ans £26 : 7 : 0½.

(16) If coffee be sold for 5½d. per ounce—what must be given for 2 cwt. ? Ans. £82 : 2 : 8.

(17) How many yards of cloth may be bought for £21 11s. 1½d. when 3½ yards cost £2. 14s. 3d.?
Ans. 27 *yards*, 3 *qrs.* 1 *nail.* 84 *rem.*

(18) If 3½ lbs. of Cheshire cheese cost 1s. 1d.—what is the cost of 1 cwt.? Ans. £1 : 14 : 8.

(19) If 1 cwt. of Cheshire cheese cost £1. 14s. 8d.—what must I give for 3½ lbs.? Ans. 1*s.* 1*d.*

(20) Bought 1 cwt. 24 lbs. 8 oz. of old lead, at 9s. per cwt.—what does it come to? Ans. 10*s.* 11½*d.* 896 *rem.*

(21) If 1 cwt. 24 lbs. 8 oz. of lead be worth 10s. 11½d. $\frac{896}{1792}$—what is that per cwt.? Ans. 9*s.*

(22) If a gentleman's income be £500 a year, and he spends 19s. 4d. per day—how much does he lay by at the year's end? Ans. £147 : 3 : 4.

(23) If I buy 14 yards of cloth for 10 guineas—how many Flemish ells can I buy for £283. 17s. 6d. at the same rate?
Ans. 504 *Flemish ells*, 2 *qrs.*

(24) If £283. 17s. 6d. will buy 504 Flemish ells, 2 quarters—what quantity of yards can I have for £10. 10s.?
Ans. 14 *yards*

(25) If 504 Flemish ells, 2 qrs. cost £283. 17s. 6d. at what rate must I purchase 14 yards? Ans. £10 : 10.

(26) If I give £1. 1s. 8d. for 3 lbs. of coffee—what must be given for 29 lbs. 4 oz.? Ans. £10 : 11 : 3.

(27) Bought 29 lbs. 4 oz. of coffee for £10. 11s. 3d.—what is the value of 3 lbs.? Ans. £1 : 1 : 8.

(28) If 1½ oz. of coffee cost 6¼d.—what will 3¼ oz. cost at the same rate? Ans. 1*s.* 1½*d.* 1 *rem.*

(29) If 1 English ell, 2 qrs. cost 4s. 7d.—what will 39½ yards cost at the same rate?
Ans. £5 : 3 : 5¼. 5 *rem.*

(30) If 1 oz. of gold be worth £5. 4s. 2d.—what is the worth of 1 grain? Ans. 2½*d.* 200 *rem.*

(31) If 14 yards of broad cloth cost £9. 12s.—what is the purchase of 75 yards? Ans. £51 : 8 : 6¾. 6 *rem.*

(32) If 27 yards of Holland cost £5. 12s. 6d.—how many ells English can I buy for £100.? Ans. 384.

(33) If 1 cwt. cost £12. 12s. 6d.—what must I give for 14 cwt. 1 qr. 19 lbs. Ans. £182 : 0 : 11½. 8 *rem.*

(34) Bought 7 yards of cloth for 17s. 8d.—what must be given for 5 pieces, each containing 27½ yards?
Ans. £17 : 7 : 0¼. 1 *rem.*

(35) If 7 oz. 11 dwts. of gold be worth £35.—what is the value of 14 lbs. 9 oz. 12 dwts. 16 grs. at the same rate ?

Ans. £823 : 9 : 3¾. 552 *rem*

(36) A draper bought 420 yards of broad cloth at the rate of 14s. 10¾d. per ell English—how much did he pay for the whole ? Ans. £250 : 5*s.*

(37) A gentleman bought a wedge of gold, which weighed 14 lbs. 3 oz. 8 dwts. for the sum of £514. 4s.—at what rate did he pay for it per ounce ? Ans. £3.

(38) A grocer bought 4 hogsheads of sugar, each weighing neat 6 cwt. 2 qrs. 14 lbs. which cost him £2. 8s. 6d. per cwt. —what is the value of the four hogsheads ?

Ans. £64 : 5 : 3.

(39) A draper bought 8 packs of cloth, each containing 4 parcels, each parcel 10 pieces, and each piece 26 yards, and gave after the rate of £4. 16s. for 6 yards—I desire to know what the 8 packs stood him in ? Ans. £6656.

(40) If 24 lbs. of raisins cost 6s. 6d.—what will 18 frails cost, each weighing neat 3 qrs. 18 lbs. ? Ans. £24 : 17 : 3.

(41) If 1 oz. of silver be worth 5s.—what is the price of 14 ingots, each weighing 7 lbs. 5 oz. 10 dwts. ?

Ans £313 : 5*s.*

(42) What is the price of a pack of wool weighing 2 cwt. 1 qr. 19 lbs. at 8s. 6d. per stone ?

Ans. £8 : 4 : 6¼. 10 *rem.*

(43) Bought 59 cwt. 2 qrs. 24 lbs. of tobacco, at £2. 17s. 4d. per cwt.—what does it come to ?

Ans. £171 : 3 : 7¼. 80 *rem.*

(44) What is the half-year's rent of 547 acres of land, at 15s. 6d. per acre per annum ? Ans. £211 : 19 : 3.

(45) Bought 171 tons of lead, at £14. per ton ; paid carriage and other incidental charges, £4. 10s.—I require the value of the lead, and what it stands me in per lb ?

Ans. £2398 : 10*s. value.* 1½*d. per lb.* 4320 *rem.*

(46) If a pair of stockings cost 10 groats—how many dozen may I buy for £43. 5s. ? Ans. 21 *dozen,* 7½ *pair.*

(47) Bought 27 dozen, 5 lbs. of candles, after the rate of 1s. 5d, per 3 lbs.—what did they cost me ?

Ans. £7 : 15 : 4¼. 1 *rem.*

(48) If 1 oz. of fine gold be sold for £3. 10s.—what do 7 ingots come to, each weighing 3 lb. 7 oz. 14 dwts. 21 grs. at the same price ? Ans. £1071 : 14 : 5¼.

(49) If my horse stands me in 9½d. per day keeping, what will be the charge of 11 horses for the year ?

Ans. £158 : 18 : 6½

(50) A factor bought 86 pieces of stuff, which cost him £517. 19s. 4d. at 4s. 10d. per yard—I demand how many yards there were, and how many ells English in a piece ?

Ans. 2143¼ *yards.* 14 *rem.*
and 19 *ells,* 4 *quarters,* 2 *nails in a piece.* 64 *rem.*

(51) A gentleman had an annuity of £896. 17s. per annum—I desire to know how much he may spend daily, that at the year's end he may lay up 200 guineas and give to the poor quarterly 10 half-sovereigns ?

Ans. £1 : 16 : 6¼. 331 *rem.*

RULE OF THREE INVERSE.

INVERSE PROPORTION is when more requires less, and less requires more. More requires less, is when the third term is greater than the first, and requires the fourth term to be less than the second. And less requires more, when the third term is less than the first, and requires the fourth term to be greater than the second.

RULE.—Multiply the first and second terms together and divide the product by the third ; the quoitent will bear such proportion to the second as the first does to the third.

EXAMPLE.

(1) If 8 men can do a piece of work in 12 days—in how many days can 16 men perform the same ?

men. days. men. days
8 : 12 :: 16 : 6

8
16)96(6 *days.*
96

(2) If 54 men can build a house in 90 days—how many men can do the same in 50 days ? Ans. 97⅕ *men.*

(3) If when a peck of wheat is sold for 2s. the penny

loaf weighs 8 oz.—how much must it weigh when the peck is worth but 1s. 6d.? Ans. 10 *oz.* 10⅔ *dr.*

(4) How many pieces of money of 20s. value, are equal to 240 pieces of 12s. each? Ans. 144.

(5) How many yards of 3 quarters wide, are equal in measure to 30 yards of 5 quarters wide? Ans. 50.

(6) If I lend my friend £200. for 12 months—how long ought he to lend me £150. to requite my kindness?

Ans. 16 *months.*

(7) If for 24s. I have 1200 lbs. carried 36 miles—how many pounds can I have carried 24 miles for the same money? Ans. 1800 *lbs.*

(8) If 100 workmen finish a piece of work in 12 days—how many are sufficient to finish it in 3 days? Ans. 400.

(9) An army besieging a town, in which where 1000 soldiers, with provisions for 3 months—how many soldiers departed, when the provisions lasted them 6 months?

Ans. 500.

(10) If £20. worth of wine be sufficient to serve an ordinary of 100 men, when the tun is sold for £30.—how many will £20. worth suffice when the tun is sold but for £24.?

Ans. 125 *men.*

(11) A courier makes a journey in 24 days when the day is but 12 hours long—how many days will he be in going the same journey when the days are 16 hours long?

Ans. 18 *days.*

(12) How much plush is sufficient for a cloak, which has in it 4 yards, of 7 quarters wide, of stuff for the lining; the plush being but 3 quarters wide?

Ans. 9⅓ *yards.*

(13) If 14 pioneers make a trench in 18 days—how many days will 34 men take to do the same?

Ans. 7 *days,* 9 *hours,* 52 *min.* 32 *rem*

(14) Borrowed of my friend £64. for 8 months, and he had occasion another time to borrow of me for 12 months—how much must I lend him to requite his former kindness to me? Ans. £42 : 13 : 4.

(15) A regiment of soldiers, consisting of 1000 men, are to have new coats, each coat to contain 2¼ yards of cloth, 5 quarters wide, and to be lined with shallon of 3 quarters wide—I demand how many yards of shalloon will line them?

Ans. 4166 *yards,* 2 *quarters,* 2 *nails.* 2 *rem.*

THE DOUBLE RULE OF THREE

Is so called, because it is composed of five numbers given to find a sixth; which, if the proportion is Direct, must bear such proportion to the fourth and fifth, as the third bears to the first and second. But if Inverse, the sixth number must bear such proportion to the fourth and fifth, as the first bears to the second and third. The first three terms are a *supposition:* the last two a *demand.*

RULE 1.—Let the principal cause of loss or gain, interest or decrease, action or passion, be put in the first place.

2.—Let that which betokens time, distance of place, and the like, be in the second place, and the remaining one in the third.

3.—Place the other terms under their like in the supposition.

4.—If the blank falls under the third term, multiply the first and second terms for a divisor, and the other three for a dividend. But,

5.—If the blank falls under the first or second term, multiply the third and fourth terms for a divisor, and the other three for a dividend, and the quotient will be the answer,

PROOF.—By two Single Rules of Three.

EXAMPLES.

(1) If 14 horses eat 56 bushels of oats in 16 days—how many bushels will be sufficient for 20 horses 24 days?

By two Single Rules.				*or in one stating worked thus:*
	hor.	*bu.*	*da.*	*bu.*
1. As	14	: 56 ::	20	: 80
	da.	*bu.*	*da.*	*bu.*
2. As	16	: 80 ::	24	: 120

hor. da. bu.
14. : 16 : 56
20 : 24

$$\frac{56 \times 20 \times 24}{14 \times 16} = 120.$$

(2) If 8 men in 14 days can mow 112 acres of grass, how many must there be to mow 2000 acres in 10 days?

	ac.	*d.*	*ac.*	*d.*
1. As	112	: 14 ::	2000	: 250
	da.	*m.*	*da.*	*m.*
2. As	250	: 8 ::	10	: 200

m. da. ac.
8 : 14 : 112
- - 10 : 2000

$$\frac{8 \times 14 \times 2000}{112 \times 10} = 200$$

In the Double Rule of Three, there are generally five numbers given to find a sixth; but sometimes examples are met with in this Rule, containing 7, 9, 11, or 13, &c. terms, to find another in proportion to them: such questions may be solved by the following method.

RULE.—Put that number in the third place, which is of the same kind as the answer or term required; take the first term of *supposition*, and its corresponding term of *demand*, and write them in the first and second place, as in the second Rule for Simple Proportion: in like manner proceed with all the other *similar* terms of *supposition* and *demand*.

Reduce like numbers to the same denomination, and the third term to the lowest name mentioned; multiply all the first terms together for a general first term, and all the second terms for a general second term.

The question being reduced to three numbers, it may be worked out as in Single Rule of Three.

The terms of *supposition* are those first mentioned in the example, and include that which is of the same kind as the answer. The terms of *demand* are those which succeed, they are connected with the answer, and evidently demand or ask what it will be.

EXAMPLE.

(3) If 12 men build a wall 60 feet long, 4 thick, and 20 in height, in 24 days, working 12 hours per day, what length of wall, 3 feet thick, and 12 high, will 18 men build in 18 days, working 8 hours per day?

men.		*men.*		*feet.*
12	:	18	::	60
feet.		*feet.*		
3	:	4	::	+
12	:	20	::	+
days.		*days.*		
24	:	18	::	+
hours.		*hours.*		
12	:	8	::	+
124416	:	207360	::	60

60

124416)12441600(100 *feet.* Ans.

124416

00

(4) If £100 in 12 months gain £6 interest—how much will £75 in 9 months? Ans. £3 : 7 : 6.

(5) If a carrier receive £2. 2s. for the carriage of 3 cwt. 150 miles—how much ought he to receive for the carriage of 7 cwt. 3 qrs. 14lbs. for 50 miles?

Ans. £1 : 16 : 9.

(6) If a regiment of soldiers, consisting of 136 men, consume 351 quarters of wheat in 108 days—how many quarters of wheat will 11232 soldiers consume in 56 days?

Ans. 15031. 864 *rem.*

(7) If 40 acres of grass be mowed by 8 men in 7 days—how many acres can be mowed by 24 men in 28 days?

Ans. 480.

(8) If 40s. will pay 8 men for 5 days' work—how much will pay 32 men for 24 days' work? Ans. £38 : 8.

(9) If £100 in 12 months gain £6 interest—what principal will gain £3. 7s. 6d. in 9 months?

Ans. £75.

(10) If a regiment consisting of 939 soldiers, consume 351 quarters of wheat in 168 days—how many soldiers will consume 1404 quarters in 56 days?

Ans. 11268.

(11) If in a family consisting of 7 persons, there are drunk out 2 kilderkins of beer in 12 days—how many kilderkins will there be drunk out by another family of 14 persons in 8 days? Ans. 2 *kil.* 12 *gal.*

(12) If the carriage of 60 cwt. 20 miles, cost £14. 10s.—what weight can I have carried 30 miles, for £5. 8s. 9d. at the same rate of carriage? Ans. 15 *cwt.*

(13) If 2 horses eat 8 bushels of oats in 16 days—how many horses will eat 3000 quarters in 24 days?

Ans. 4000.

(14) If £100 in 12 months gain £7 interest—what is the interest of £571. for 6 years?

Ans. £239 : 16 : 4¾. 20 *rem.*

(15) If I pay 10s. for the carriage of 2 tons 6 miles—what must I pay for the carriage of 12 tons, 17 cwt. for 17 miles?

Ans. £9 : 2 : 0½.

(16) If 756 bricks, 14 inches long and 10 broad, will pave a floor—how many bricks would it take 15 inches long and 9 inches abroad? Ans. 784 *bricks.*

PRACTICE

Is so called, from the general use thereof by all persons concerned in trade and business.

All questions in this rule are performed by taking aliquot or even parts, by which means many tedious reductions are avoided; the Table of which is as follows:

Of a Pound.				*Of a Shilling.*			*Of a Ton.*			*Of a Hundred.*		
10*s.*	0*d.*	is	$\frac{1}{2}$	6*d.*	is	$\frac{1}{2}$	10 *cwt.*	is	$\frac{1}{2}$	*qrs.*	*lbs.*	
6	8	...	$\frac{1}{3}$	4	.....	$\frac{1}{3}$	5		$\frac{1}{4}$	2 or 56	is	$\frac{1}{2}$
5	0	...	$\frac{1}{4}$	3	.....	$\frac{1}{4}$	4		$\frac{1}{5}$	1 or 28	..	$\frac{1}{4}$
4	0	...	$\frac{1}{5}$	2	.....	$\frac{1}{6}$	$2\frac{1}{2}$		$\frac{1}{8}$		14 ..	$\frac{1}{8}$
3	4	...	$\frac{1}{6}$	$1\frac{1}{2}$	.....	$\frac{1}{8}$	2		$\frac{1}{10}$	*Of a Quarter.*		
2	6	...	$\frac{1}{8}$	1	.....	$\frac{1}{12}$	*Of a lb.*			14lbs.	is	$\frac{1}{2}$
2	0	...	$\frac{1}{10}$	$\frac{3}{4}$	.....	$\frac{1}{16}$	8 *oz*	is	$\frac{1}{2}$	7		$\frac{1}{4}$
1	8	...	$\frac{1}{12}$	$\frac{1}{2}$	.....	$\frac{1}{24}$	4		$\frac{1}{4}$	4		$\frac{1}{7}$
1	4	...	$\frac{1}{15}$	$\frac{1}{4}$	.....	$\frac{1}{48}$	2		$\frac{1}{8}$	$3\frac{1}{2}$		$\frac{1}{8}$

RULE 1.—When the price is less than a penny, divide by the aliquot parts that are in a penny; then by 12 and 20, and it will be the answer.

(1) $\frac{1}{4}$ is $\frac{1}{4}$ 5704lbs. at $\frac{1}{4}$

12)1426

2|0)11|8 10

£5 18 10

(2) 7695 at $\frac{1}{2}$
Ans. £16 0 $7\frac{1}{2}$

(3) 5740 at $\frac{1}{2}$
Ans. £11 19 2

(4) 6547 at $\frac{3}{4}$
Ans. £20 9 $2\frac{1}{4}$

(5) 4573 at $\frac{3}{4}$
Ans. £14 5 $9\frac{3}{4}$

RULE 2.—When the price is less than a shilling, take the aliquot part or parts that are in a shilling, add them together, and divide by 20, as before.

(1) 1 is $\frac{1}{12}$ 7547 at 1d

2|0)62|8 11

£31 8 11

(2) 1 is $\frac{1}{12}$ 3751 at $1\frac{1}{4}$

$\frac{1}{4}$ is $\frac{1}{4}$)312 7

78 $1\frac{3}{4}$

2|0)39|0 $8\frac{3}{4}$

£19 10 $8\frac{3}{4}$

(3) 54325 at $1\frac{1}{2}$d.
Ans. £339 10 $7\frac{1}{2}$

(4) 6254 at $1\frac{3}{4}$d.
Ans. £45 12 $0\frac{1}{2}$

(5) 2351 at 2d.
Ans. £19 11 10

(6) 7210 at $2\frac{1}{4}$d.
Ans. £67 11 $10\frac{1}{2}$

(7) 2710 at $2\frac{1}{2}$d.
Ans. £28 4 7

(8) 3250 at $2\frac{3}{4}$d.
Ans. £37 4 $9\frac{1}{2}$

(9) 2715 at 3d.
Ans. £33 18 9

(10) 7062 at $3\frac{1}{4}$d.
Ans. £95 12 $7\frac{1}{2}$

(11) 2147 at $3\frac{1}{2}$d.
Ans. £31 6 $2\frac{1}{4}$

(12) 7000 at $3\frac{3}{4}$d.
Ans. £109 7 6

(13) 3257 at 4d. Ans. £54 5 8

(14) 2056 at 4¼d. Ans. £36 8 2

(15) 3752 at 4½d. Ans. £70 7 0

(16) 2107 at 4¾d. Ans. £41 14 0¼

(17) 3210 at 5d. Ans. £66 17 6

(18) 2715 at 5¼d. Ans. £59 7 9¾

(19) 3120 at 5½d. Ans. £71 10 0

(20) 7521 at 5¾d. Ans. £180 3 9¾

(21) 3271 at 6d. Ans. £81 15 6

(22) 7914 at 6¼d. Ans. £206 1 10½

(23) 3250 at 6½d. Ans. £88 0 5

(24) 2708 at 6¾d. Ans. £76 3 3

(25) 3271 at 7d. Ans. £95 8 1

(26) 3254 at 7¼d. Ans. £98 5 11½

(27) 2701 at 7½d. Ans. £84 8 1½

(28) 3714 at 7¾d. Ans. £119 18 7½

(29) 2710 at 8d. Ans. £90 6 8

(30) 3514 at 8¼d. Ans. £120 15 10½

(31) 2759 at 8½d. Ans. £97 14 3½

(32) 9872 at 8¾d. Ans. £359 18 4

(33) 5272 at 9d. Ans. £197 14 0

(34) 6325 at 9¼d. Ans. £243 15 6¼

(35) 7924 at 9½d. Ans. £313 13 3

(36) 2150 at 9¾d Ans. £87 6 10½

(37) 6825 at 10d. Ans. £263 10 10

(38) 5724 at 10¼d. Ans. £244 9 3

(39) 6327 at 10¼d. Ans. £270 4 3¾

(40) 3254 at 10½d. Ans. £142 7 3

(41) 7291 at 10¾d. Ans. £326 11 6¼

(42) 3256 at 11d. Ans. £149 4 8

(43) 7254 at 11¼d. Ans. £340 0 7½

(44) 3754 at 11½d. Ans. £179 17 7

(45) 7972 at 11¾d Ans. £390 5 11

RULE 3.—When the price is more than 1 shilling and less than 2, take the part or parts, with so much of the given price as is more than 1 shilling, which add to the given quantity, and divide by 20, and it will give the answer.

(1) $\frac{1}{4}\frac{1}{12}$ 2106 at 12½d.

43 10½

2|0)214|9 10½

£107 9 10½

(2) $\frac{1}{2}\frac{1}{24}$ 3715 at 12½d.

154 9½

2|0)386|9 9½

£193 9 9½

(3) 2712 at 12¾d. Ans. £144 1 6

(4) 2107 at 1s. 1d. Ans. £114 2 7

(5) 3215 at 1s. 1¼d.
Ans. £177 9 10¾.

(6) 2790 at 1s. 1½d.
Ans. £156 18 9

(7) 7904 at 1s. 1¾d.
Ans. £452 16 8

(8) 3750 at 1s. 2d.
Ans. £218 15 0

(9) 3291 at 1s. 2¼d.
Ans. £195 8 0¾

(10) 9254 at 1s. 2½d.
Ans. £559 1 11

(11) 7250 at 1s. 2¾d.
Ans. £445 11 5½

(12) 7591 at 1s. 3d.
Ans. £474 8 9

(13) 6325 at 1s. 3¼d.
Ans. £401 18 0¼

(14) 5271 at 1s. 3½d.
Ans. £340 8 4½

(15) 3254 at 1s. 3¾d.
Ans. £213 10 10½

(16) 2915 at 1s. 4d.
Ans. £194 6 8

(17) 3270 at 1s. 4¼d.
Ans. £221 8 1½

(18) 7059 at 1s. 4½d.
Ans. £485 6 1½

(19) 2750 at 1s. 4¾d.
Ans £191 18 6½

(20) 3725 at 1s. 5d.
Ans. £263 17 1

(21) 7250 at 1s. 5¼d.
Ans. £521 1 10½

(22) 2597 at 1s. 5½d.
Ans. £189 7 3½

(23) 7210 at 1s. 5¾d.
Ans. £533 4 9½

(24) 7524 at 1s. 6d.
Ans. £564 6 0

(25) 7103 at 1s. 6¼d.
Ans. £540 2 5¾

(26) 3254 at 1s. 6½d.
Ans. £250 16 7

(27) 7925 at 1s. 6¾d.
Ans. £619 2 9¾

(28) 9271 at 1s 7d.
Ans. £733 19 1

(29) 7210 at 1s. 7¼b.
Ans. £578 6 0½

(30) 2310 at 1s 7½d.
Ans. £187 13 9

(31) 2504 at 1s. 7¾d.
Ans. £206 1 2

(32) 1752 at 1s. 8d.
Ans. £146 0 0

(33) 2905 at 1s. 8¼d.
Ans. £245 2 2½

(34) 7104 at 1s. 8½d.
Ans. £606 16 0

(35) 1004 at 1s. 8¾d.
Ans. £86 16 1

(36) 2104 at 1s. 9d.
Ans. £184 2 0

(37) 2571 at 1s. 9¼d.
Ans. £227 12 9¾

(38) 2104 at 1s. 9½d.
Ans. £188 9 8

(39) 7506 at 1s. 9¾d.
Ans. £680 4 7½

(40) 1071 at 1s. 10d.
Ans. £98 3 6

(41) 5200 at 1s. 10¼d.
Ans. £482 1 8

(42) 2117 at 1s. 10½d.
Ans. £198 9 4½

(43) 1007 at 1s. 10¾d.
Ans. £95 9 1½

(44) 5000 at 1s. 11d.
Ans. £479 3 4

(45) 2105 at 1s. 11¼d
Ans. £203 18 5¼

(46) 1006 at 1s. 11½d
Ans. £98 10 1

(47) 2705 at 1s. 11¾d.
Ans. £267 13 7¾

(48) 5000 at 1s. 11¼d.
Ans. £489 11 8

(49) 4000 at 1s. 11¾d.
Ans. £395 16 8

RULE 4.—When the price consists of any even number of shillings under 20, multiply the given quantity by half the price, doubling the first figure of the product for shillings, and the rest of the product will be pounds.

☞ When the price is 10s. take half of the quantity, and if any remain, it is 10s.

(1) 2750 at 2s.
Ans. £275 0 0

(2) 3254 at 4s.
Ans. £650 16 0

(3) 2710 at 6s.
Ans. £813 0 0

(4) 1572 at 8s.
Ans. £628 16 0

(5) 2102 at 10s.
Ans. £1051 0 0

(6) 2101 at 12s.
Ans £1260 12 0

(7) 5271 at 14s.
Ans. £3689 14 0

(8) 3123 at 16s.
Ans. £2498 8 0

(9) 1621 at 18s.
Ans. £1458 18 0

RULE 5.—When the price consists of odd shillings, multiply the given quantity by the price, and divide by 20; the product will be the answer.

☞ When the price is 5s. divide the quantity by 4, and if any remain it is 5s.

(1) 2703 at 1s.
Ans. £135 3 0

(2) 3270 at 3s.
3
2)0981|0
£490 10 0

(3) 3271 at 5s.
Ans. £817 15 0

(4) 2715 at 7s.
Ans. £950 5 0

(5) 3214 at 9s.
Ans. £1446 6 0

(6) 2710 at 11s.
Ans. £1490 10 0

(7) 3179 at 13s.
Ans. £2066 7 0

(8) 2150 at 15s.
Ans. £1612 10 0

(9) 3142 at 17s.
Ans. £2670 14 0

(10) 2150 at 19s.
Ans. £2042 10 0

11) 7157 at 19s.
Ans. £6799 3

RULE 6.—When the price is shillings and pence, they are the aliquot parts of a pound, divide by the ali parts, which will give the answer at once; but if they not aliquot parts, then multiply the quantity by the shillings, and take parts for the rest, add them together, and divide by 20.

s.	*d*		
6-8	⅓	(1) 2710 at 6s. 8d. Ans. £903 6 8	(10) 2547 at 7s. 3½d. Ans. £928 11 10½
		(2) 3150 at 3s. 4d. Ans. £525 0 0	(11) 3271 at 5s. 9½d. Ans. £947 4 6½
		(3) 2715 at 2s. 6d. Ans. £339 7 6	(12) 2103 at 15s. 4½d. Ans. £1616 13 7½
		(4) 7150 at 1s. 8d. Ans. £595 16 8	(13) 7152 at 17s. 6¾d. Ans. £6280 7 0
		(5) 3215 at 1s. 4d. Ans. £214 6 8	(14) 2510 at 14s. 7¼d. Ans. £1832 16 5½
		(6) 7211 at 1s. 3d. Ans. £450 13 9	(15) 3715 at 9s. 4½d. Ans. £1741 8 1½
d			(16) 2572 at 13s. 7½d.
2	⅙	(7) 2710 at 3s. 2d. 3	Ans £1752 3 6
		8130	(17) 7251 at 14s. 8¼d.
		451 8	Ans. £5324 19 0¾
	2|0	858|1 8	(18) 3210 at 15s. 7¾d.
		£429 1 8	Ans. £2511 3 1½
		(8) 7514 at 4s. 7d. Ans. £1721 19 2	(19) 271 at 19s. 2½d. Ans. £2602 14 7
		(2) 2517 at 5s. 3d. Ans. £660 14 3	(20) 5746 at 19s. 7½d. Ans. £5638 5 3

RULE 7.—1st. When the price is pounds and shillings, multiply the quantity by the pounds, and proceed with the shillings, if they are even, as in the 4th rule; if odd, take the aliquot parts, add them together, and the sum will be the answer.

2ndly. When the price is pounds, shillings, and pence, and the shilling and pence are the aliquot parts of a pound, multiply the quantity by the pounds, and take parts for the rest.

3rdly. When the price is pounds, shillings, pence, and farthings, and the shillings and pence not the aliquot parts of a pound, reduce the pounds and shillings into shillings, multiply the quantity by the shillings, take parts for the rest, add them together, and divide by 20.

When the given quantity is no more than three figures, proceed as in Compound Multiplication.

4*s.* | $\frac{1}{5}$ | (1) 7215 at £7 4 0
7
50505
1443
£51948.

s.d.
2 6 | $\frac{1}{8}$ | (2) 2104 at £5 3 0
5
10520
6*d.* | $\frac{1}{5}$ | 263
52 12
£10835 12

(3) 2107 at £2 8 0
Ans. £5056 16

(4) 7156 at £5 6 0
Ans. £37926 16

6*d.* | $\frac{1}{2}$ | (5) 2710 at £2 3 7½
43
d.
1½ | $\frac{1}{4}$ | 116530
1355
338 9
2|0 | 11822|3 9
£5911 3 9

(6) 3125 at £1 17 0
Ans. £5781 5

(7) 2107 at £1 13 0
Ans. £3476 11

(8) 3215 at £4 6 8
Ans. £13931 13 4

(9) 2154 at £7 1 3
Ans. £15212 12 6

(10) 2701 at £2 3 4
Ans. £5852 3 4

(11) 2715 at £1 17 2½
Ans. £5051 0 7½

(12) 2517 at £3 15 2¼
Ans. £9462 6 11¼

(13) 3210 at £1 18 6¾
Ans. £6189 5 7½

(14) 2157 at £2 7 4½
Ans. £5109 7 10½

(15) 142 at £1 15 2¾
Ans. £250 2 6½

(16) 95 at £15 14 7½
Ans. £1494 7 4¾

(17) 87 at £1 17 5¾
Ans. £69 6 8¾

(18) 2175 at £2 15 4½
Ans. £6022 0 7½

(19) 2150 at £17 16 1½
Ans. £38283 8 9

RULE 8.—When the price and quantity given are of several denominations, multiply the price by the integers, and take parts of the integers for the rest.

(1) At £3. 17s. 6d. per cwt.—what is the value of 25 cwt. 2 qrs. 14 lbs. of tobacco?

qrs.		£	*s.*	*d.*	
2	½	3	17	6	5×5=25
				5	
		19	7	6	
				5	
		96	17	6	
lb.		1	18	9	
14	¼		9	8¼	
		99	5	11¼	Ans.

(2) At £1. 4s. 9d. per cwt.—what will 17 cwt. 1 qr. 17 lbs. of cheese come to? Ans. £21 : 10 : 8.

(3) Sold 85 cwt. 1 qr. 10 lbs. of cheese, at £1. 7s. 8d. per cwt.—What does it come to? Ans. £118 : 1 : 0¼

(4) Hops at £4. 5s. 8d. per cwt.—what must be given for 72 cwt. 1 qr. 18 lbs.? Ans. £310 : 3 : 2.

(5) At £1. 1s. 4d. per cwt.—what is the value of 27 cwt. 2 qrs. 15 lbs. of Malaga raisins? Ans. £29 : 9 : 6¼.

(6) Bought 78 cwt. 3 qr. 12 lbs. of currants, at £2. 17s. 9d. per cwt.—what did I give for the whole?

Ans. £227 : 14.

(7) Sold 56 cwt. 1 qr. 17 lbs. of sugar, at £2. 15s. 9d. per cwt.—what does it come to? Ans. £157 : 4 : 4¼.

(8) Tobacco at £3. 17s. 10d. per cwt.—what is the worth of 97 cwt. 15 lbs.? Ans. £378 : 0 : 3.

(9) At £4. 14s. 6d. per cwt.—what is the value of 37 cwt. 2 qrs. 13 lbs. of double-refined sugar?

Ans. £177 : 14 : 8¼.

(10) Bought sugar at £3. 14s. 6d. per cwt.—what did I give for 15 cwt. 1 qr. 10 lbs? Ans. £57 : 2 : 9.

(11) At £4. 15s. 4d. per cwt.—the value of 172 cwt. 3 qrs. 12 lbs. of tobacco is required? Ans. £823 : 19 : 0¼.

(12) Soap at £3. 11s. 6d. per cwt.—what is the value of 53 cwt. 17 lbs.? Ans. £190 : 0 : 4.

MENTAL ARITHMETIC.

When the price is less than one shilling, calculate for the given number of yards, gallons, lbs., &c. at 1 penny, and multiply by the given price. When farthings occur, add ¼ of what it comes to at a penny, for a half-penny add one half, and for three farthings three quarters.

When quarters, halves, &c. occur in the quantity take ½d. for half a yard, ¾d. for three quarters, &c.

EXAMPLES.

(1) What will 84 lbs. cost at 7d. per lb. ?

84 at 1 penny equal to 7s.

7

£2 9 Ans.

(2) What will 120 yards come to at 11d. per yard ?

10s. at 1 penny.

11

£5 10 Ans.

(3) What will 126¼ oz. cost at 7d. per oz. ?

10s. 6¼d.

7

£3 13 7¾ Ans.

(4) What will 52 yards come at 6½d. per yard ?

4s. 4d.

6½

Here in multiplying by 6, one half of 4s. 4d. is taken in.

£1 8 2 Ans.

(5) What will 77 lbs. cost at 8½d. per lb. ?

6s. 5d.

8½

£2 14 6½ Ans.

(6) What will 126¼ gallons cost at 11d. per gallon ?

10s. 6¼d.

11

£5 15 8¾ Ans.

(7) What will 960 gallons come to at 10½d. per gallon?

£4
10½
£40 10 Ans.

When the quantity is an even number of dozens, take the price in pence as shillings, (because 12 articles at 1 penny cost 1 shilling,) and multiply by the number of dozens in the quantity. Add 3d. for 1 farthing, 6d. for a half-penny, &c.

EXAMPLES.

(8) What will 144 yards cost at 9½d. per yard?
The price taken as shillings=9s. 6d.
12 doz.
£5 14 0 Ans.

(9) What will 78 lbs. come to at 8½d. per lb.?
8s. 3d. ½ of 8s. 3d. taken in
6½
£2 13 7½ Ans.

(10) What will 80 yards cost at 11¾d. per yard?
80 yards at 1s.....£4 0s.
80 farthings deducted 1 8
£3 18 4 Ans.

(11) What will 100 ells come to at 11d. per ell?
100 ells at 1s.....£5 0s.
100 pence deducted 8 4
£4 11 8 Ans.

To find the value of 100 articles having the price of one given.

Rule.—For every farthing take as many pence, and twice as many shillings.

EXAMPLES.

(12) What will 100 buttons cost at 2¼d. each?
2¼ = 100-farthings.
As many pence..... £0 0s. 10d.
Twice as many shillings 1 0 0
£1 0 10 Ans.

(13) What will 100 lbs. cost at 5½d. per lb.?

1s. 9d.
2 2 0
£2 3 9 Ans.

(14) What will 100 doz. of pens cost at 11½d. per doz.?

3s. 10d.
4 12 0
£4 15 10 Ans.

By taking farthings as pence the value is increased 4 times; and by taking two shillings for every farthing, it is increased 96 times, and 96+4=100.

To find what one lb. will come to any price per ounce

RULE.—Reduce the price into farthings, consider them as shillings, and divide by 3.

EXAMPLES.

(15) What will 1 lb. of coffee cost at 8¼d. per oz.?

8¼d.=33 far. = 11s. Ans
3

(16) What will 1 lb. of tea cost at 7¾d. per ounce?

3)31
10s. 4d. Ans.

48 farthings make 1 shilling, and 16 oz. make 1 lb.—hence 48÷16=3 divisor.

To find the value of an ounce when the price per lb. is given.

RULE.—Take the shillings as farthings and multiply by 3.

EXAMPLE

(17) What must be given for 1 ounce, if 1 lb. cost 7s. 6d.

7½ farthings.
3
22½=5½-½d. Ans.

To find what one cwt. will come to at any number of pence per lb.

RULE.—Multiply 9s. 4d. by the number of pence in the price, because 9s. 4d. are equal to 112d. or cwt. at 1 penny per lb.

EXAMPLES.

(18) What will 1 cwt. cost at 9½d. per lb. ?

9s.	4d.
	9½
£4 8	8 Ans.

(19) What will 1 cwt. cost at 10¼d per lb. ?

9s.	4d.
	10¼
£4 15	8 Ans.

When the price is more than one shilling, find the amount at a shilling, and multiply by the price ; should pence occur take aliquot parts; if they be not aliquot parts, proceed as in the rule for pence, and add to the product.

EXAMPLES.

(20) What will 88 yards come to at 1s. 3d. per yard ?

3d.=¼)£4 8s. at 1 shilling.

1 2

£5 10 Ans.

(21) What will 4000 ells cost at 1s. 2d. per ell. ?

£200

33 6 8

£233 6 8

(22) What will 118 lbs. come to at 16½d per lb. ?

£5 18s.

2 4 3

£8 2 3 Ans.

(23) What will 64 yds. of cloth cost at 1s. 11¾d. per yd

£6 8s. at 2s. per yard.

64 farthings deducted 1 4

£6 6 8 Ans.

(24) What will 108 cwt. cost at 3s. 11½d. per cwt. ?

£21 12s.
4 6 deducted
£21 7 6 Ans.

Should the shillings and pence be an even part of a pound, divide the quantity by the even part for the answer.

EXAMPLES.

(25) What will 84 cwt. cost at 6s. 8d. per cwt. ?

6s. 8d.=⅓)84
£28 Ans.

(26) What will 76 lbs. cost at 2s. 6d. per lb. ?

2s. 6d.=⅛)76
£9 10 Ans.

When the quantity is 240, the pence in the price taken as pounds will be the answer, because 240d. make £1. : the same may be done with any number divisible by 240.

EXAMPLES.

(27) What will 240 cwt. of coals cost at 7¼d. per cwt. ?

7¼d. = £7 5s. Ans. ¼ = 5s.

(28) What will 240 tons of steel cost at 1s. 5½d. per ton ?

£17. 10s. Ans.

(29) What will 240 yards of cloth come to at 9s. 7½d. per yard?

£115 10s. Ans.

(30) What will 120 lbs. of tea cost at 3s. 9½d. per lb. ?

½)£45 10s.
£22 15 Ans.

(31) What will 60 cwt. of coals cost at 9¼d. per cwt. ?

¼)£9 5s.
£2 6 3 Ans.

(22) What will 480 lbs. of sugar cost at 7½d. per lb. ?

£7 10s.
2
£15 0 Ans.

(33) What will 960 lbs. of tea come to at 4s. 6d. per lb.?

£54
4
£216 Ans.

When the price consists of pounds, shillings, pence, and farthings.

RULE.—Find the amount at £1, and multiply by the number of pounds in the price; calculate for the shillings and pence as in the preceding rules, and add the whole together.

EXAMPLES.

(34) What will 168 gallons of rum cost at £1. 11s. 3d. per gallon?

£168 at £1. per gal.
84 at 10s. do.
10 10 at 1s. 3d. do.
£262 10 Ans.

(35) What will 360 cwt. of cheese cost at £3. 19s. 6d. per cwt.?

£1440 at £4 per cwt.
9 deducted.
£1431 Ans.

To find what any number of cwts. qrs. and lbs. will come to at a given price per lb.

RULE.—Write down the cwts., and to the right hand of these place all the lbs. contained in the qrs. and lbs. together, to this last number, add 12 lbs. for each cwt. which will reduce the whole to pounds, then multiply by the price for the answer.

EXAMPLES.

(36) What will 3 cwt. 1 qr. 16 lbs. cost at 1s. 3d. per lb.?

344 lbs.
36
3d.=¼)380 at 1s.
95
475s. = £23. 15s. Ans.

(37) What will 7 cwt. 2 qrs. 24 lbs. of steel cost at 2s. 6d. per lb.?

780 lbs.
84
2s. 6d. = $\frac{1}{8}$)864
£108 Ans.

12 lbs. are added for every cwt. which is the difference between a numeral hundred (100) and 112 lbs.

The method for calculating tons, cwts., qrs. and lbs. commonly called the Iron Rule.

RULE.—Consider the tons as pounds, and call the cwts. shillings, then every qr. will equal 3d. and every lb. equal nearly $\frac{1}{9}$ of a penny; to three times the qrs. add $\frac{1}{9}$ of the lbs. for pence, put down the tons and cwts as pounds and shillings, and the quantity is calculated at £1. per ton, or 1s. per cwt., then multiply by the price for the answer.

EXAMPLES.

(38) What will 431 tons, 13 cwt. 1 qr. 10 lbs. of iron cost at £3. 6d. 8d. per ton.

£431	13s.	4d.
		$3\frac{1}{3}$ = £3. 6s. 8d.
1295	0	0
143	17	$9\frac{1}{4}$
£1438	17	$9\frac{1}{4}$ Ans.

(39) What will 696 tons, 15 cwt. 1 qr. 12lbs. of iron come to at 7s. 6d per cwt.?

£696	15s.	$4\frac{1}{4}$d.
		$7\frac{1}{2}$d
4877	7	$5\frac{3}{4}$
348	7	8
£5225	15	$1\frac{3}{4}$

QUESTIONS TO BE ANSWERED MENTALLY.

(1 What will 240 cwt. cost at 7s. $6\frac{3}{4}$d. per cwt.?
Ans. £90 : 15*s*

(2) What will 99 yards of cloth cost at 6s. 8d. per yard ?
Ans. £33.

(3) What will 1800 lbs. of coffee cost at 1s. 8d. per lb. ?
Ans. £150.

(4) What will 72 oz. of tea come to at 8½d. per oz. ?
Ans. £2 : 11*s.*

(5) What will 48 lbs. of sugar cost at 9½d. per lb. ?
Ans. £1 : 18*s.*

(6) What will 56 lbs. of coffee cost at 2s. 6d. per lb. ?
Ans. £7.

(7) What will 36 gross of buttons cost at 11¾d. per gross ?
Ans. £1 : 15 : 3.

(8) What will 64 yards of calico come to at 1s. 1½d. per yard ? Ans. £3 : 12*s.*

(9) What will 1600 yards of cloth cost at £1. 2s. 6d. per yard ? Ans. £1800.

(10) What will 1200 ells come to at 5s. per ell ?
Ans. £300.

(11) What will 240 cwt. of lead cost at 5s. 9¾d. per cwt. ?
Ans. £69 : 15*s.*

(12) What will 366 cwt. of cheese cost at 2s. 6d. per cwt. ?
Ans. £45 : 15*s.*

(13) What will 240 books cost at 7s. 6½d. each ?
Ans. £90 : 5*s.*

(14) What will 216 ells of cambric cost at 3s. 4d. per ell ?
Ans. £36.

(15) What will 3 cwt. of salt at 1d. per lb. ?
Ans. £1 : 8*s.*

(16) What will 108 yards of calico come to at 1s. 8d. per yard ? Ans. £9.

(17) What will 240 lbs. of tea cost at 4s. 10¾d. per lb. ?
Ans. £58 : 15*s.*

(18) What will 600 firkins of butter cost at £3. 6s. 8d. per firkin ? £2000.

(19) What will 144 oz. of pepper cost at 5½d. per oz. ?
Ans. £3 : 6*s.*

(20) What will 240 yards of cloth cost at 9s. 6¾d per yard ? Ans. £114 : 15*s.*

(21) What will 900 gross of pens cost at 4s. per gross?
Ans. £180.

(22) What will 48 cwt. of lead come to at 19s. 11¾d. per cwt. ? Ans. £47 : 19*s.*

(23) What will 240 cwt. of raisins cost at 8s. 10½d. per cwt.? Ans. £106 15*s.*

(24) What will 99 fother of lead cost at £1. 6s. 8d. per fother? Ans. £132.

As it would require numerous examples (like the above) to exercise sufficiently the thinking faculties of the pupil, the teacher may ask them from a Ready-Reckoner, or from memory, as he may deem best. To multiply them here would increase the size of the present work beyond its prescribed limits.

TARE AND TRET.

TARE is an allowance made to the buyer of any commodity, for the weight of the box, cask, &c. containing the same.

TRET is an allowance of 4 lbs. in every 104 lbs. or 1 lb. in 26 lbs. on account of waste, dust, &c.

CLOFF is an allowance of 2 lbs. in every 3 cwt., or 1 lb. in every 168 lbs. to make the weight hold out when retailed.

GROSS WEIGHT is the whole weight of any sort of goods, and that which contains it.

SUTTLE WEIGHT is when part of the allowance is deducted from the gross.

NEAT WEIGHT is the pure weight, when all allowances are deducted.

RULE 1.—When the rate is at so much per bag, barrel, &c. multiply the number of bags, barrels, &c. by the tare, and subtract the product from the gross: the remainder is neat.

To reduce pounds into gallons, multiply by 2, *and divide by* 15.

(1) In 7 frails of raisins, each weighing 5 cwt. 2 qrs. 5 lbs. gross, tare at 23 lbs. per frail—how much neat weight?

Ans. 37 *cwt.* 1 *qr.* 14 *lbs.*

	Or thus:	
23	5 2 5	5 2 5
7(4	7	23
28)161(5—	38 3 7=gross.	5 1 10
140 1 1	1 1 21=tare.	7
21	37 1 14=neat.	37 1 14

(2) In 241 barrels of figs, each 3 qrs. 19 lbs. gross, tare 10 lbs. per barrel—how many pounds neat ?

Ans. 22413.

(3) What is the neat weight of 25 hogsheads of tobacco, weighing gross 163 cwt. 2 qrs. 15 lbs. tare 100 lbs. per hogshead ? Ans. 141 *cwt.* 1 *qr.* 7 *lbs.*

(4) In 16 bags of pepper, each 85 lbs. 4 oz. gross, tare 3 lbs. 5 oz. per bag—how many pounds neat ?

Ans. 1311.

RULE 2.—When the tare is at so much in the whole gross weight, subtract the given tare from the gross, the remainder is neat.

(2) What is the neat weight of 5 hogsheads of tobacco, weighing gross 75 cwt. 1 qr. 14 lbs.—tare in the whole 752 lbs. ? Ans. 68 *cwt.* 2 *qrs.* 18 *lbs.*

(6) In 75 barrels of figs, each 2 qrs. 27 lbs. gross; tare in the whole 597 lbs.—how much neat weight ?

Ans. 50 *cwt.* 1 *qr.*

RULE 3.—When the tare is at so much per cwt., divide the gross weight by the aliquot parts of a cwt. which subtract from the gross, the remainder is neat.

Note.—7 lbs. is $\frac{1}{16}$; 8 lbs. is $\frac{1}{14}$ lb. 14 lbs. is $\frac{1}{8}$; 16 lbs. is $\frac{1}{7}$.

(7) What is the neat weight of 18 butts of currants, each 8 cwt. 2 qrs. 5 lbs. ; tare at 14 lbs. per cwt. ?

	8	2	5	
			9	$\times 2 = 18$
	76	3	17	
			2	
$14 = \frac{1}{8}$)	153	3	6	
	19	0	$25\frac{1}{4}$	
Ans.	134	2	$8\frac{3}{4}$	

(8) In 25 barrels of figs, each 2 cwt. 1 qr. gross, tare 16 lbs. per cwt.—how much neat weight ?

Ans. 48 *cwt.* 24 *lbs.*

(9) What is the neat weight of 9 hogsheads of nutmegs, each weighing gross 8 cwt. 3 qrs. 14 lbs. ; tare 16 lbs. per cwt. ? Ans. 68 *cwt.* 1 *qr.* 24 *lbs.*

(10) What is the neat weight of 12 casks of argol, gross 84 cwt. 2 qrs. 14 lbs. per cwt. ?

Ans. 74 *cwt.* 5¼ *lbs.*

RULE 4.—When tret is allowed with tare, divide the pounds suttle by 26, the quotient is the tret, which subtract from the suttle, the remainder is neat.

(11) In 1 butt of currants, weighing 12 cwt. 2 qrs. 24 lbs. gross; tare 14 lbs. per cwt.; tret 4 lbs. per 104 lbs.—how many pounds neat?

12 2 24
4
50
28
14=1/8)1424 gross.
178 tare.
(26)1246 suttle.
47
Ans. 1199 neat.

(12) In 7 cwt. 3 qrs. 27 lbs. gross; tare 36 lbs.; tret 4 lbs. per 104 lbs.—how many pounds neat? Ans. 826 *lbs.*

(13) In 152 cwt. 1 qr. 3 lbs. gross; tare 10 lbs. per cwt.; tret 4 lbs. per 104 lbs.—how much neat weight?

Ans. 133 *cwt.* 1 *qr.* 12 *lbs.*

(14) In 15 chests of sugar, weighing 117 cwt. 21 lbs. gross; tare 173 lbs.; tret 4 lbs. 104 lbs.—how many cwt. neat? Ans. 111 *cwt.* 22 *lbs.*

RULE 5.—When cloff is allowed, multiply the cwt. suttle by 2, divide the product by 3; the quotient will be the pounds cloff, which subtract from the suttle, the remainder will be neat.

(15) What is the neat weight of 3 hogsheads of tobacco, weighing 15 cwt. 3 qrs. 20 lbs. gross; tare 7 lbs. per cwt.; tret 4 lbs. per 104 lbs.; cloff 2 lbs. per 3 cwt. ?

7=1/61)15 3 20 gross.
3 27½ tare.
1/26)14 3 20½ suttle.
2 8 tret.
14 1 12½ suttle.
9½ cloff.
Ans. 14 1 3 neat.

(16) In 7 hogsheads of tobacco, each weighing gross 5 cwt. 2 qrs. 7 lb. ; tare 8 lbs. per cwt. ; tret 4 lbs. per 104 lbs. ; cloff 2 lbs. per 3 cwt.—how much neat weight ?

Ans. 34 cwt. 2 qrs. 8lb.

INTEREST.

INTEREST IS EITHER SIMPLE OR COMPOUND.

SIMPLE INTEREST

Is the Profit allowed in lending or forbearance of any sum of money for a determined space of time.

The PRINCIPAL is the money lent, for which interest is to be received.

The RATE PER CENT is a certain sum agreed on between the borrower and the lender, to be paid for every £100 for the use of the principal for 12 months.

The AMOUNT is the principal and interest added together.

INTEREST is also applied to Commission, Brokage, Purchasing of Stock, and Insurance.

To find the interest of any sum of money for a year.

RULE.—Multiply the principal by the rate per cent ; that product, divided by 100, will give the interest required.

For several years.

RULE 2.—Multiply the interest of one year by the number of years given in the question, and the product will be the answer.

EXAMPLE.

(1) What is the interest of £375. for a year, at 5 per cent. per annum ?

5

18|75

20

10|00 Ans. £18 15s.

(2) What is the interest of £268. for 1 year at 4 per cent. per annum? Ans. £10 : 14 : 4¾.

(3) What is the interest of £945. 10s. for 1 year at 4 per cent. per annum! Ans. £37 : 16 : 4¾.

(4) What is the interest of £547. 15s. at 3 per cent. per annum for 3 years? Ans. £49 : 5 11¼.

(5) What is the interest of £254. 17s. 6d. for 5 year, at 4 per cent. per annum? Ans. £50 : 19 : 5¾.

(6) What is the interest of £556. 13s. 4d. at 5 per cent. per annum for 5 years? Ans. £139 : 3 : 4.

COMMISSION

Is an allowance from merchants to their factors or correspondents, in the buying or selling of goods, and is generally at a certain rate per cent, according to the custom of the country where the factor resides.

RULE.—Multiply the principal by the rate per cent as before; and for ¼, ½, or ¾, take the part or parts from the principal, which, added to the product, and divided by 100, will give the answer.

(7) What is the commission of £287. 10s. at 3½ per cent.?

¼ ½ £287. 10s.

3

862 10=3

143 15= ½

10|06 5=3½

20

1|25

12

3 00 Ans. £10 : 1 : 3

(8) What must I allow my correspondent for disbursing on my account £529. 18s. 5d. at 2½ per cent.?

Ans. £11 : 18 : 5½.

(9) My correspondent writes me word, that he has bought goods to the amount of £754. 16s. on my account—what does his commission amount to at 2½ per cent.?

Ans. £18 : 17 : 4¾.

(10) If I allow my factor 3¾ per cent for commission—what may he demand on the laying out of £876. 5s. 10d.?

Ans £32 : 17 : 2½

PURCHASING OF STOCK.

RULE.—Multiply the sum to be purchased by the excess above 100; divide the product by 100, the produce of which added to the given sum, is the purchase required.

If under par, (that is, under 100,) multiply by the rate per cent.; that product, divided by 100, gives the purchase thereof.

(11) What is the purchase of £575. 10s. Bank stock, at 1¾ per cent.?

$\times 5+1=31$

£	s.	d.	
575	10		
		6	
3453	0		
5			
17265	0	0	=30
½ 575	10	0	= 1
½ 287	15	0	= ½
143	17	6	= ¼
182|72	2	6	=31¾
20			
14|42			
12			
5|10			

£.	s.	d.	
575	10	0	
182	14	5	
Ans. £758	4	5	

(12) What is the purchase of £254. 17s. Bank annuities at 97¼ per cent.?

$12\times 8+1=97$

£	s.	d.	
254	17		
		12	
3058	4		
8			
24465	12	0	=96
¼ ¼ 254	17	0	= 1
63	14	3	= ¼
247|84	3	3	=97¼
20			
16|83			
12			
9|99			
4			
3|96			

Ans. £247 : 16 : 9¾.

(13) At 110¼ per cent.—What is the purchase of £2054 16s. South-Sea Stock? Ans. £2265 : 8 : 4.

(14) At 104⅜ per cent. South-Sea annuities—what is the purchase of £1797. 14s.? Ans. £1876 : 6 : 11¾+

(15) What is the purchase of £2750. 17s. South-Sea old annuities, at 102⅝ per cent? Ans. £2823 : 1 : 2¼+

BROKAGE

Is an allowance to Brokers, for helping merchants or factors to persons, to buy or sell them goods.

RULE.—Divide the sum given by 100, and take parts from the quotient with the rate per cent.

(16) If I employ a broker to sell goods for me to the value of £2575. 17s. 6d.—what is the brokage at 4s. per cent. ?

£.	s.	d.	
25	75	17	6
	20		
15	17		
	12		
2	10		

	£.	s.	d.
4s. $\frac{1}{5}$	25	15	2
Ans.	£5	3	$0\frac{1}{4}$

(17) What is the brokage of £796. 14s. 7d. at 6s. per cent. ?
Ans. £2 : 7 : $9\frac{1}{2}$.

(18) When a broker sells goods to the amount of £7105. 5s. 10d.—what may he demand for brokage, if he be allowed 5s. 6d. ? Ans. £19 : 10 : $9\frac{1}{4}$.

(19) If a broker is employed to buy a quantity of goods to the value of £975. 6s. 4d.—what is the brokage at 6s. 6d. per cent. ? Ans. £3 : 3 : $4\frac{1}{2}$.

When the time is $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of a year, besides a number of years given.

RULE.—Take parts of the interest for a year, which add to the interest of the several years given, and it will give the answer.

(20) What is the interest of £554. 10s. for 3 months, at 4 per cent. per annum ?

£.	s.	
554	10	
	4	
22	18	0
	20	
3	60	
	12	
7	20	

	£.	s.	d.
$3\frac{1}{4}$	22	3	7
Ans.	£5	10	$10\frac{3}{4}$

(21) What is the interest of £336. 15s. 6d. for $2\frac{3}{4}$ years, at 5 per cent. per annum ?

£.	s.	d.	
336	15	6	
		5	
16	83	17	6
	20		
16	77		
	12		
9	30		
	4		
1	20		

	£.	s.	d.
$\frac{1}{2}$ $\frac{1}{2}$	16	16	$9\frac{1}{2}$
			2
	33	13	$6\frac{1}{2}$
$\frac{1}{4}$ $\frac{1}{2}$	8	8	$4\frac{1}{2}$
	4	4	$2\frac{1}{4}$
	£46	6	$1\frac{1}{4}$

(22) What is the interest of £325. 7s. 6d. at 6 per cent. per annum, for 3½ years? Ans. £68 : 6 : 6¼.

(23) What is the interest of £547. 2s. 4d. for 5½ years, at 4 per cent, per annum? Ans. £120 : 7 : 3¼.

(24) What is the interest of £257. 5s. 1d. at 4 per cent. for one year and 3 quarters? Ans. £18 : 0 : 1½.

(25) What is the interest of £479. 5s. for 5 years and a quarter, at 5 per cent. per annum? Ans. £125 : 16 : 0¾.

When the rate per cent is ¼, ½, or ¾, *more than the pounds given in the rate,* proceed as in Commission, and it will give the answer for 1 year; and for several, proceed as in the last rule.

(26) What is the interest of £175. 17s. for two years and 3 quarters, at 4½ per cent. per annum?

		£.	s.	d.
½	½	175	17	0
				4
		703	8	0
		87	18	6
		7|91	6	6
		20		
		18|26		
		12		
		3|18		

		£.	s.	d.
½	½	7	18	3
				2
		15	16	6
¼	½	3	19	1½
		1	19	6¾
Ans.		£21	15	2¼

(27) What is the interest of £397. 9s. 5d. for 2 years and a quarter at 3½ per cent. per annum?

Ans. £31 : 6.

(28) What is the interest of £576. 2s. 7d. for 7 years and a quarter, at 4½ per cent. per annum?

Ans. £187 : 19 : 1½.

(29) What is the interest of £279. 13s. 8d. at 5¼ per cent. per annum, for 3½ years? Ans. £51 : 7 : 10.

When the interest is required for any number of weeks.

RULE.—As 52 weeks are to the interest of the given sum for a year : so are the weeks given to the interest required.

(30) What is the interest of £379. 13s. 2d. for four weeks, at $4\frac{1}{2}$ per cent. per annum?

w.	£.	*s.*	*d.*	*w.*
As 52	: 15	3	$8\frac{1}{2}$	:: 4

20
303
12
3644
4
14578
4
52)58312(1121
52
63
52
111
104
72
52
20

12)280¼
2|0)2|3 4¼
£1 3 4¼

£.	*s.*	*d*
379	13	2
		4
15|18	12	8

20
3|72
12
8 72
4
2|88

Or thus: multiply by the number of weeks, and divide the product by 4 and 13 being $4 \times 13 = 52$

£	*s.*	*d.*
13)15	3	$8\frac{1}{2}$
£1	3	$4\frac{1}{4}$

☞ As it is 4 weeks, I do not multiply, but only divide by 13.

(31) What is the interest of £259. 13s 5d. for 20 weeks, at 5 per cent. per annum? Ans. £4 : 19 : $10\frac{1}{4}$.

(32) What is the amount of £375. 0s. 1d. for 12 weeks, at $4\frac{1}{2}$ per cent. per annum? Ans. £379 : 4 : $0\frac{1}{4}$.

(33) What is the amount of £256. 5s. 3d. for 25 weeks, at $2\frac{3}{4}$ per cent. per annum? Ans. £259 : 13

When the interest is for any number of days.

Rule.—Multiply the pence of the principal by the days and rate per cent. for a dividend, cut off two figures on the right-hand, and divide by 365: the quotient will be the answer in pence. Or,

As 365 days are to the interest of the given sum for a year, so are the days given, to the interest required.

(34) What is the interest of £240. for 120 days, at 4 per cent. per annum ?

```
          £                          Or thus :
         240                           d.   £.  s.   d.
         240                     240 As 365 : 9  12 :: 120
      --------                     4         20
       57600                     ----      -----
         120                     9|60       192
      --------                    20        120 2|0
     6912000                     -----     ------
           4 12)                 12|00  365)23040(6|3
   ------------                              2190  £3 3 1¼
365)276480|00(757                            ----  -------
    2555       2|0)6|3 1                     1140
    ----       ----------                    1095
     2098       £3 3 1¼                      ----
     1825       =======                        45
     ----                                      12
     2730                                    -----
     2555                                    )540(1
     ----                                     365
      175                                    ----
        4                                     175
     ----                                       4
     )700(1                                  ----
      365                                    )700(1
     ----                                     365
      335                                    ----
     ====                                     335
                                             ====
```

(35) What is the interest of £379. 5s. 4d. for 3 years and 75 days, at 5 per cent. per annum ?

Ans. £60 : 15 : 8

(36) At 5½ per cent. per annum—what is the interest of £985. 2s. 7d. for 5 years, 127 days ?

Ans. £289 : 15 : 3.

(37) What is the interest of £2726. 1s. 4d. at 4½ per cent. per annum, for 3 years, 154 days ?

Ans. £419 : 15 : 6¼

When the amount, time, and rate per cent. are given, to find the principal.

Rule.—As the amount of £100. at the rate and time given, is to 100, so is the amount given, to the principal required.

(38) What principal being put to interest will amount to £402. 10s. in 5 years, at 3 per cent. per annum?

£. £. £. s.
$3 \times 5 + 100 = 115 : 100 :: 402\ 10$
20 20
2300 8050
100

23)8050(350*l.* Ans.

(39) What principal being put to interest for 9 years, will amount to £734. 8s. at 4 per cent. per annum?

Ans. £540.

(40) What principal being put to interest for 7 years, at 5 per cent. per annum will amount to £334. 16s. ?

Ans. £248

When the principal, rate per cent., and amount are given, to find the time.

RULE.—As the interest of the principal for 1 year is to 1 year, so is the whole interest to the time required.

(41) In what time will £350. amount to £402. 10s. at 3 per cent. per annum?

£. £. *s.* *yr.* £. *s.* *yr.*
350 As 10 10 : 1 :: 52 10 : 5
3 20 20
10,50 210 21)105(5 *yrs.* Ans.
20 105
10,00 ...

£. s.
402 10
350 0
£52 10

(42) In what time will £540. amount to £734. 8s. at 4 per cent. per annum? Ans. 9 *years.*

(43) In what time will £248. amount to £334. 16s. at 5 per cent. per annum? Ans. 7 *years.*

When the principal, amount, and time are given, to find the rate per cent.

RULE.—As the principal is to the interest for the whole time, so is £100. to the interest for the same time. Divide that interest by the time, and the quotient will be the rate per cent ?

(44) At what rate per cent. will £350. amount to £402 10s. in five years' time?

£.	£.	s.	£.	£.
As 350	: 52	10 :: 100	: 15	
	20			
	1050			
	100			

35)10500(300s. £15÷5=3 *per cent.*

£.	s.
402	10
350	0
Interest £52	10

(45) At what rate per cent. will £248. amount to £334 16s. in 7 years' time? Ans. 5 *per cent.*

(46) At what rate per cent. will £540. amount to £734. 8s. in 9 years' time? Ans. 4 *per cent.*

SHORT AND PRACTICAL METHODS OF

FINDING THE INTEREST OF ANY SUM,

For years, months, and days, at any rate per cent.

RULE.—Multiply the principal by double the rate, cut off the unit figure from the pounds, and you have the answer in shillings for one year.

EXAMPLES.

(47) What is the interest of £360. 10s. at 4½ per cent. per annum?

	£360.	10s.
		9=double the rate.
	324,4	10
In multiplying by 12	12	
take in 6d. for 10s.	5,4	
	4	
	1,6	

Ans. £16 : 4 : 5½.

(48) What is the interest of £214. 12s. 6d. at 3½ per cent.?

£214.	12s.	6d.
		7
150,2	7	6
Take in 4d. for 7s 6d. 12		
2,8		
4		
3,2		

Ans. £7 : 10 : 2¾.

Rejecting the unit figure is equal to dividing by 10, and taking the pounds as shillings, equal to dividing by 20. Hence $10 \times 20 = 200$ the divisor when the rate per cent. is doubled.

Should the rate be an aliquot part of 100, divide the principal by the aliquot part, and the quotient will be the interest for one year.

5	per cent	$=\frac{1}{20}$	of 100
4	ditto	$=\frac{1}{25}$	ditto
$3\frac{1}{3}$	ditto	$=\frac{1}{30}$	ditto
$2\frac{1}{2}$	ditto	$=\frac{1}{40}$	ditto
2	ditto	$=\frac{1}{50}$	ditto
$1\frac{1}{4}$	ditto	$=\frac{1}{80}$	ditto

When the time and rate (multiplied together) make an aliquot part of 100,

EXAMPLE.

(49) Find the interest of £432. 5s. for $3\frac{3}{4}$ years at 4 per cent. ?

$3\frac{3}{4} \times 4 = 15$

		£	s.	d.
10	$\frac{1}{10}$	432	5	
5	$\frac{1}{2}$	43	4	6
		21	12	3
Ans.		464	16	9

To find the interest for years at 5 per cent.

RULE.—Take the pounds of the principal as shillings, and multiply by the years ; because the interest of £1. for 1 year is 1s.

EXAMPLE.

(50) What is the interest of £380. 10s. for 3 years and 4 months ?

	£	s.	d.
	19	0	6
			$3\frac{1}{3}$
	57	1	6
$\frac{1}{3}=$	6	6	10
Ans.	£63	8	4

To calculale the interest for any rate per cent.

RULE.—Multiply the interest at 5 per cent. by the rate proposed. and divide by 5, or for

$2\frac{1}{2}$	per cent.	take $\frac{1}{2}$	of the	interest	at 5 per cent.
4	....	deduct $\frac{1}{5}$	..	..	..
6	....	add $\frac{1}{5}$	..	..	..
3	....	take $\frac{2}{5}$	..	..	..
2	....	— $\frac{2}{5}$	..	..	..

To find the interest for months at 5 per cent.

RULE.—Take the pounds of the principal as pence, and multiply by the months.

The reason for this rule is evident, because the interest of £1. at 5 per cent. is 1s. per year, or 1d. per month.

EXAMPLES.

(51) What is the interest of £148. for 7 months?

148d.=12s. 4d.

7

Ans. £1 6 4

(52) What is the interest of £76. 16s. for 11 months?

6s. $4\frac{3}{4}$d.

11

Ans. £3 10 $4\frac{1}{4}$

To find the interest for years and months at 5 per cent.

RULE.—Take the years and months as shillings and pence, and take such parts of the principal, as those shillings and pence are of £1.; because any sum of money will double itself, if left at simple interest for 20 years at 5 per cent.

EXAMPLE.

(53) What is the interest of £70. 10s. 6d. for 3 years and 4 months?

		£70	10s.	6d.
3 yrs. 4 mo.	$\frac{1}{6}$	11	15	1 Ans.

To find the interest for any number of days at 5 per cent.

RULE.—Multiply the pounds of the principal by the number of days, and divide the product by 365 for the interest in shillings, or 7300 for the interest in pounds.

$365 \times 20 = 7300$

'54) What is the interest of £584. 10s. for 42 days at 5 per cent. ?

$$
\begin{array}{r}
584\frac{1}{2} \\
42 \\
\hline
1169 \\
2338 \\
\hline
7300)24549(\text{£3. } 7s.\ 3d.\ \text{Ans.} \\
21900 \\
\hline
2649 \\
20 \\
\hline
7300)52980(7 \\
51100 \\
\hline
1880 \\
12 \\
\hline
7300)22560(3 \\
21900 \\
\hline
660
\end{array}
$$

To find the interest for days at any rate per cent.

Rule.—Multiply the principal by the days, also by double the rate, and divide by 73000 or 365×200.

EXAMPLE.

(55) Required the interest of £291. 17s. 6d. for 72 days at 3 per cent ?

$$
\begin{array}{r}
\text{£}291\frac{7}{8} \\
72 \\
\hline
582 \\
2037 \\
63=\frac{7}{8} \\
\hline
21015 \\
6 \\
\hline
73000)126099(\text{£1. } 14s.\ 6\tfrac{1}{2}d.\ \text{Ans.}
\end{array}
$$

The rate of interest generally allowed in Saving's Banks is $3\frac{1}{2}$ per cent. which may be calculated by the following Rule.

Find the interest at 5 per cent. and deduct $\frac{1}{3}$.

EXAMPLE.

(56) Required the interest of £84. 10s. for 9 months at $3\frac{1}{3}$ per cent. ?

$84\frac{1}{2}$d.$=$7s. $0\frac{1}{2}$d.

9

$\frac{1}{3}$)3	3	$4\frac{1}{2}$
	1	1	$1\frac{1}{2}$
Ans. £2	2	3	

To calculate the interest of any sum at 6 per cent. which is the legal rate of Interest in Scotland and Ireland.

RULE.—Multiply the principal by the number of months, and take the pounds in the product as shillings, cut off the unit figure and multiply it by $1\frac{1}{5}$ for pence; should years occur, reduce them to months, and for days take aliquot parts of a month.

EXAMPLES.

(57) What is the interest of £325. 7s. 6d. at 6 per cent. for 3 years and 6 months ?

$325\frac{3}{8}$

42

650

1300

15 for $\frac{3}{8}$

1366,5 $\quad 5\times1\frac{1}{5}=6$d.

Ans. £68 6 6

(58) Required the interest of £257. 5s. 1d. at 6 per cent. for 1 year and 4 months ?

$257\frac{1}{4}$

16

411,6 $\quad 6\times1\frac{1}{5}=7\frac{1}{5}$d.

Ans. £20 11 $7\frac{1}{5}$

(59) Required the interest of £848. for 7 months and 8 days at 6 per cent. per annum ?

848
$7\frac{1}{4}$
5936
212 $8 \times 1\frac{1}{5} = 9\frac{3}{5}$d.
614,8
Ans £30 14 $9\frac{3}{5}$

DEMONSTRATION.

THE interest of £1. for 1 month at 6 per cent. $1\frac{1}{5}$d. ; cutting off the unit figure divides it by 10, and considering the figures left as shillings, which being reduced to pounds and shillings, divides again by 20, and $10 \times 20 = 200$: therefore 200d. and $\frac{1}{5}$ of 200 equal the number of pence in £1.

For 2 per cent. take $\frac{1}{3}$ of the interest at 6 per cent.
... $1\frac{1}{2}$ ditto $\frac{1}{4}$ ditto ditto
... 3 ditto $\frac{1}{2}$ ditto ditto
... 4 ditto deduct $\frac{1}{3}$ ditto ditto

When the months are an even number, the operation may be materially shortened.

For $4\frac{1}{2}$ per cent. multiply by $\frac{3}{4}$ of the time, and proceed as at 6 per cent.

For 4 per cent. multiply by $\frac{2}{3}$ of the time.
... 3 ditto ditto $\frac{1}{2}$ ditto
... 2 ditto ditto $\frac{1}{3}$ ditto
... $1\frac{1}{2}$ ditto ditto $\frac{1}{4}$ ditto

EXAMPLES.

(60) What is the interest of £88. 6s. 8d. for 4 months at $4\frac{1}{2}$ per cent. ?

£88 6s. 8d.
$3 = \frac{3}{4}$ of 4 months.
26,5 0 0
Ans. 1 6 6

(61) Required the interest of £117. 10s. at 4s. per cent. for 6 months ?

£117. 10s.
$4 = \frac{2}{3}$ of 6 months.
47,0 0
Ans. £2 7 0

(62) Required the interest of £763. 12s. at 3 per cent. for 10 months?

£763 12s.
5=½ of 10 months.
381,8 0
Ans. £19 1 9⅗

(63) Required the interest of £118. 13s. 4d. at 2 per cent. for 9 months?

£118 13s. 4d.
3=⅓ of 9 months.
35,6 0 0
Ans. £1 15 7⅕

(64) Required the interest of £199. 10s. at 1½ per cent. for 8 months?

£199 10s.
2=¼ of 8 months.
39,9 0
Ans. £1 19 10⅘

The discount of any sum of money, is something less than the interest of the same sum, at the same rate, and for the same time; nevertheless in business, Bankers and others who discount bills, generally charge interest at 5s. per cent., on the amount of the bill, for the time it has to run, which they deduct, and the remainder is the present worth. Hence the preceding rules for interest may also be used for discounting bills, &c.

COMPOUND INTEREST

Is that which arises both from the principal and interest; that is, when the interest on money becomes due, and is not paid, the same rate of interest is allowed on that unpaid interest, as on the principal before.

RULE 1.—Find the first year's interest, which add to the principal, then find the interest of that sum, which add as before; and so on for a number of years.

2.—Subtract the given sum from the last amount, and it will give the compound interest required.

EXAMPLE.

(1) What is the compound interest of £500. forborne 3 years, at 5 per cent. per annum?

£.	£.	£.			
500	500	525			
5	25	26	5		
5|00	525	1*st year* 551	5	2*nd year.*	
	5	5		£.	*s.*
	26|25	27|56	5	551	5
	20	20		27	11 3
	5|00	11|25		578	16 3 *3rd year.*
		12		500	0 0 *prin. sub.*
		3|00		£78	16 3=*interest for* 3 *yrs.*

(2) What is the amount of £400. forborne 3½ years, at 6 per cent. per annum, compound interest?

Ans. £490 : 13 : 11¼.

(3) What will £650. amount to in 5 years, at 5 per cent. per annum, compound interest? Ans. £829 : 11 : 7½.

(4) What is the amount of £550. 10s. for 3 years and 6 months, at 6 per cent. per annum, compound interest?

Ans. £675 : 6 : 5.

(5) What is the compound interest of £764. for 4 years and 9 months, at 6 per cent. per annum?

Ans. £243 : 18 : 8.

(6) What is the compound interest of £57. 10s. 6d. for 5 years, 7 months, and 15 days, at 5 per cent. per annum?

Ans. £18 : 3 : 10¾.

(7) What is the compound interest of £259. 10s. for 3 years, 9 months, and 10 days, at 4½ per cent. per annum?

Ans. £47 : 0 : 4¾.

REBATE OR DISCOUNT

Is the abating so much money on a debt to be received before it is due, as that money, if put to interest, would gain in the same time, and at the same rate. As £100,

present money will discharge a debt of £105. to be paid year to come, rebate being made at 5 per cent.

RULE.—As £100. with the interest for the time given, is to that interest, so is the sum given to the rebate required.

Subtract the rebate from the given sum, and the remainder will be the present worth.

EXAMPLE.

(1) What is the discount and present worth of £487. 12s for 6 months, at 6 per cent. per annum?

£.		£	£.	s.
6 m. ½)	6	As 103 :	3 :: 487	12
	3		20	
	100		9752	
	103		3	

206|0)2925'6(14*l.* 4*s.* *rebate.*
206
865
824
416=4s.

£.	s.
487	12
14	4
£473	8 *present worth.*

(2) What is the present worth of £357. 10s. which was agreed to be paid 9 months hence, at 5 per cent. per annum?
Ans. £344 : 11 : 6¾.

(3) What is the discount of £275. 10s. for 7 months at 5 per cent. per annum? Ans. £7 : 16 : 1¾.

(4) Bought goods to the value of £109. 10s. to be paid at 9 months—what present money will discharge the same, if I am allowed 6 per cent. per annum discount?
Ans. £104 : 15 : 8¼.

(5) What is the present worth of £527. 9s. 1d. payable 7 months hence, at 4½ per cent.? Ans. £514 : 13 : 10½.

(6) What is the discount of £85. 10s. due September the 8th, this being July the 4th, rebate at 5 per cent. per annum? Ans. 15*s.* 3½*d.*

(7) Sold goods for £875. 5s. 6d. to be paid 5 months hence—what is the present worth at 4½ per cent.?
Ans. £859 : 3 : 3¾.+

(8) What is the present worth of £500. payable in 10 months, at 5 per cent. per annum? Ans. £480

(9) How much ready money can I receive for a note of £75. due 15 months hence, at 5 per cent. ?

Ans. £70 : 11 : 9.

(10) What will be the present worth of £150. payable at three 4 months ; *i. e.* one-third at 4 months, one-third at 8 months, and one-third at 12 months, at 5 per cent. discount ?

Ans. £145 : 3 : 8¼.

(11) Sold goods to the value of £575 10s. to be paid at two 3 months—what must be discounted for the present payment at 5 per cent. ? Ans. £10 : 11 : 4¾.

(12) What is the present worth of £500. at 4 per cent. £100 being to be paid down, and the rest at two 6 months ?

Ans. £488 : 7 : 8½.

EQUATION OF PAYMENTS

Is when several sums are due at different times, to find a mean time for paying the whole debt; to do which this is the common

RULE.—Multiply each payment by its time of continuance, and divide the sum of the products by the whole debt ; the quotient is accounted the mean time.

EXAMPLE.

(1) A owes B £200, whereof £40 is to be paid at 3 months £60. at 5 months, and £100. at 10 months—at what time may the whole debt be paid together, without prejudice to either ?

£.		*m.*		£
40	×	3	=	120
60	×	5	=	300
100	×	10	=	1000
				2|00)14|20

Ans. 7 *months.* 10

(2) B owes C £800. whereof £200. is to be paid at 3 months, £100. at 4 months, £300. at 5 months, and £200. at 6 months ; but they agreeing to make but one payment of the whole—I demand what that time must be ?

Ans. 4 *months,* 17½ *days.*

(3) I bought of K a quantity of goods, to the value of £360, which was to have been paid as follows : £120. at 2

months, £200. at 4 months, and the rest at 5 months; but we afterwards agreed to have it paid at one mean time—the time is demanded?

Ans. 3 *months*, $12\frac{4}{9}$ *days*.

(4) A merchant bought goods to the value of £500, to pay £100. at the end of 3 months, £150, at the end of 6 months, and £250. at the end of 12 months; but they afterwards agree to discharge the debt at one payment—in what time was the payment made?

Ans. 8 *months*, $11\frac{1}{5}$ *days*.

(5) H is indebted to L a certain sum, which is to be paid at 6 different payments; that is, $\frac{1}{4}$ at 2 months, $\frac{1}{8}$ at 3 months, $\frac{1}{8}$ at 4 months, $\frac{1}{4}$ at 5 months, $\frac{1}{8}$ at 6 months, and the rest at 7 months; but they agree that the whole shall be paid at one equated time—what is that time?

Ans. $4\frac{1}{4}$ *months*.

(6) A is indebted to B £120., whereof $\frac{1}{3}$ is to be paid at 3 months, $\frac{1}{4}$ at 6 months, and the rest at 9 months—what is the equated time of the whole payment?

Ans. 5 *months*, 7 *days*.

BARTER

Is the exchanging one commodity for another, and informs the traders so to proportion their goods, that neither may sustain loss.

Rule 1.—Find the value of that commodity whose quantity is given; then find what quantity of the other, at the rate proposed, you may have for the same money.

2.—When one has goods at a certain price, *ready money*, but in bartering, advances it to something more, find what the other ought to rate his goods at, in proportion to that advance and then proceed as before.

EXAMPLES.

(1) What quantity of chocolate, at 4s. per lb. must be delivered in barter for 2 cwt. of tea at 9s. per lb. ?

cwt.
2
112
224
9
4)2016 *the value of the tea.*
504 *lbs of chocolate.*

(2) A and B barter; A hath 20 cwt. of prunes, at 4d. per lb. ready money, but in barter will have 5d. per lb. and B hath hops worth 32s. per cwt. ready money;—what ought B to rate his hops at in barter, and what quantity must be given for the 20 cwt. of prunes ?

lb. *d.* *d.* *s.*
112 As 4 : 5 :: 32
s. 20 5
40 2240 4)160
12 5 *c. q. lb.* 40s
48|0)1120|0(23 1 9$\frac{16}{48}$ Ans.
96
160
144
16=1 *qr.* $\frac{16}{48}$ *lb.*

(3) How much tea at 9s. per lb. can I have in barter for 4 cwt. 2 qrs. of chocolate, at 4s per lb. ? Ans. 2 *cwt.*

(4) Two merchant's barter; A hath 20 cwt. of cheese at 21s. 6d. per cwt.; B hath 8 pieces of Irish cloth, at £3. 14s. per piece—I desire to know who must receive the difference, and how much ?

Ans. *B must receive of A* £8 : 2*s.*

(5) A and B barter; A hath 3½ lbs. of pepper, at 13½d. per lb.; B hath ginger at 15¼d. per lb.—how much ginger must be delivered in barter for the pepper ?

3 *lb.* 1$\frac{35}{61}$ *oz.*

(6) How many dozen of candles at 5s. 2d. per dozen must be delivered in barter for 3 cwt. 2 qrs. 16 lbs. of tallow at 37s. 4d. per cwt. ? Ans. 26 *doz.* 3$\frac{54}{62}$ *lb.*

(7) A hath 608 yards of cloth, worth 14s. per yard, for which B gives him £125. 12s. in ready money, and 85 cwt. 2 qrs. 24 lbs. of bees'-wax. The question is—what did B reckon his bee's-wax at per cwt. ? Ans. £3 : 10*s.*

(8) A and B barter; A hath 320 dozen of candles, at 4*s.* 6d. per dozen, for which B gives him £30. in money, and the rest in cotton, at 8d. per lb.—I desire to know how much cotton B gives A besides the money?

Ans. 11 *cwt.* 1 *qr.*

(9) If B hath cotton at 1s. 2d. per lb.—how much must he give A for 114 lbs. of tobacco, at 6d. per lb.?

Ans. $48\frac{1}{14}$ *lbs.*

(10) C hath nutmegs worth 7s. 6d. per lb. ready money, but in barter will have 8s. per lb. and D hath leaf-tobacco, worth 9d. per lb. ready money—how much must D rate his tobacco at per lb. that his profit may be equivalent with C's.?

Ans. $9\frac{1}{2}d.$ $\frac{4}{10}$

PROFIT AND LOSS

Is a rule that discovers what is got or lost in the buying or selling of goods: and instructs us to raise and fall our price, so as to gain or lose so much per cent. or otherwise.

The questions in this rule are performed by the Rule of Three.

EXAMPLES.

(1) If a yard of cloth be bought for 11s. and sold for 12s. 6d.—what is the gain per cent.?

s.	*s.*	*d.*	£.
As 11	: 1	6	:: 100
	12		20
	18		2000
			18
s.	*d.*	11	36000
12	6	12	3572
11	0	2|0	27|2 8
1	6	Ans.	£13 12 $8\frac{8}{11}$

(2) If 60 ells of Holland cost £18.—What must 1 ell be sold for, to gain 8 per cent.?

£.	£.	£.
As 100	: 18	:: 108
	108	$12 \times 5 = 60$
1|00	19|44	£. *s.* *d.*
	20	12|19 8 $9\frac{1}{2}$
	8|80	5|1 12 $4\frac{3}{4}$
	12	Ans. 0 6 $5\frac{3}{4}$
	9|60	
	4	
	2|40	

(3) If lb. of tobacco cost 16d. and be sold for 20d.—what is the gain per cent ? Ans. £25.

(4) If a parcel of cloth be sold for £560. and at 12 per cent. gair—what is the prime cost ? Ans. £500

(5) If a yard of cloth be bought for 13s. 4d. and sold again for 16s.—what is the gain per cent ? Ans. £20.

(6) If 112 lbs of iron cost 27s. 6d.—what must 1 cwt. be sold for to gain £15. per cent. ? Ans. £1 : 11 : $7\frac{1}{4}$.

(7) If 375 yards of broad cloth be sold for £490. and 20 per cent. profit—what did it cost per yard ?

Ans. £1 : 1 : $9\frac{1}{4}$.

(8) Sold 1 cwt of hops for £60. 15s. at the rate of 25 per cent. profit—what would have been the gain per cent. if I had sold them for £80 per cwt.?

Ans. £64 : 12 : 2+

(9) If 90 English ells of cambric cost £60.—what must I sell it at per yard, to gain £18 per cent. Ans. 12*s.* 7*d.*

(10) A plumber sold 10 fother of lead for £204. 15s. (the fother being $19\frac{1}{2}$ cwt.) and gained after the rate of £12. 10s. per cent.—what did it cost him per cwt. ? Ans. 18*s.* 8*d.*

(11) Bought 436 yards of cloth at the rate of 8s. 6d. per yard, and sold it for 10s. 4d. per yard.—what was the gain of the whole ? Ans. £39 : 19 : 4.

(12) Paid £69. for 1 ton of steel, which is retailed at 6d. per lb.—what is the profit or loss by the sale of 14 tons ?

Ans. £182. *loss.*

(13) Bought 124 yards of linen for £32.—how should the same be retailed per yard to gain £15 per cent. ?

Ans. 5*s.* 11*d.* $\frac{28}{124}$.

(14) Bought 249 yards of cloth, at 3s. 4d. per yard, retailed the same at 4s. 2d. per yard—what is the profit in the whole, and how much per cent. ?

Ans. £10 : 7 : 6 *profit, and* 25 *per cent.*

FELLOWSHIP

Is when two or more join their stocks and trade together so to determine each other's particular share of the gain or loss, in proportion to his principal in the Joint Stock.

By this rule a bankrupt's estate may be divided amongst his creditors ; as also legacies may be adjusted when there is a deficiency of assets or effects.

FELLOWSHIP is either *with or without* TIME.

FELLOWSHIP WITHOUT TIME.

RULE.—As the whole stock is to the whole gain or loss, so is each man's share in stock, to his share of the gain or loss.

PROOF.—Add all the shares together, and the sum will be equal to the given gain or loss : but the surest way is, as the whole gain or loss is to the whole stock, so is each man's share of the gain or loss, to his share in stock.

EXAMPLE.

(1) Two merchants traded together; A put into stock £20. and B £40., and they gained £50.—what was each person's share thereof?

$20 \times 40 = 60$

£.	£.	£.	£.	£.	£.	£.	s.	d.	
As 60	: 50	:: 20	As 60	: 50	:: 40	33	6	8	B's share.
	20			40		16	13	4	A's share.
6|0)100|0			6|0)200|0			£50	0	0	Proof.
£16	13	4	£33	6	8				

(2) Three merchants trade together, A, B, and C ; A puts in £20, B£30, and C £40 ; they gained £180.—what is each man's share of the gain ?

Ans. *A* £40 ; *B* £60 ; *C* £80.

(3) A, B, and C, enter into partnership : A puts in £364, B £482, and C £500, and they gained £867.—what is each man's share in proportion to his stock ?

Ans. *A's* £234 : 9 : 3¼—*rem.* 70 ; *B's* £310 : 9 : 5—*rem.* 248 ; *C's* £322 : 1 : 3½—*rem.* 1028.

(4) Four merchants, B, C, D, and E, made a stock ; B puts in £227, C £349, D £115, and E £439 ; in trading they gained £428—I demand each merchant's share of the gain ?

Ans. *B's* £85 : 19 : 6¾—690 ; *C's* £132 3 : 9—120 ; *D's* £43 : 11 : 1¾—250 ; *E's* £166 : 5 : 6¼—70.

(5) Three persons D, E, and F, joined in company ; D's stock was £750, E's £460, and F's £500, and at the end of 12 months, they gained £684.—what was each man's particular share of the gain ?

Ans *D's* £300 ; *E's* £184 ; *F's* £200.

(6) A merchant is indebted to B £275. 14s. ; to C £304. 7s. ? to D £152. ; and E £104. 6s. ; but upon his decease his estate is found to be worth but £675. 15s.—how must it be divided amongst his creditors ?

Ans *B's* £222 : 15 : 2—6584 ; *C's* £245 : 18 : 1½—15750 ; *D's* £122 : 16 : 2¾—12227 ; *E's* £84 : 5 : 5—15620.

(7) Four persons trade together in a joint stock, of which A has ⅓, B ¼, C ⅕, D ⅙, and at the end of 6 months they gained £100.—what is each man's share of the said gain ?

Ans. *A's* £35 · 1 : 9—48 ; *B's* £26 : 6 : 3¾—36 ; *C's* £21 : 1 : 0½—120 ; *D's* £17 : 10 : 10½—24.

(8) Two persons purchased an estate of £1700. per annum freehold, for £27200, when money was at 6 per cent. interest, and 4s. per pound land tax, whereof D paid £15000. and E the rest ; some time after the interest of the money falling to 5 per cent. and 2s per pound land tax, they sold the said estate for 24 years' purchase—I desire to know each person's share ? Ans. *D's* £22500 ; *E's* £18300.

(9) D, E, and F, join their stocks in trade ; the amount of their stocks is £647. and are in proportion as 4, 6, and 8 are to one another, and the amount of their gains is equal to D's stock—what is each man's stock and gain ?

Ans. *D's stock* £143 : 15 : $6\frac{12}{18}$ *gain* £31 : 19 : 0—207040.
E's .. 215 : 13 : 4 .. 47 : 18 : 6—310560.
F's .. 287 : 11 : $1\frac{6}{18}$ .. 63 : 18 : 0—414080.

FELLOWSHIP WITH TIME.

Rule.—As the sum of the product of each man's money and time is to the whole gain or loss, so is each man's product to his share of the gain or loss.

Proof.—As in Fellowship without Time.

EXAMPLE.

(1) D and E enter into partnership, D puts in £40. for 3 months, and E £75. for 4 months, and they gain £70.—what is each man's share of the gain ?

Ans. *D's* £20 ; *E's* £50.

$10 \times 3 = 120$
$75 \times 4 = 300$
420

As 420 : 70 :: 120
120
42|0)840|0(20
840

As 420 : 70 :: 300
300
42|0)2100|0(50
2100

(2) Three merchants join in company ; D puts in stock £195. 14s. for three months, E £179. 18s. 3d. for 5 months, and F £59. 14s. 10d. for 11 months ; they gain £364. 18s. —what is each man's part of the gain ?

Ans. *D's* £99 : 18 : 7¼—75455 ; *E's* £153 : 2 : 3½—28250; *and F's* £111 : 17 : 1—410812.

(3) Three merchants join in company for 18 months : D puts in £500. and at 5 months' end takes out £200 ; at 10 months' end puts in £300. and at the end of 14 months takes out £130. E puts in £400. and at the end of 3 months £270. more at 9 months he takes out £140. but puts in £100. at the end of 12 months, and withdraws £99. at the end of 15 months. F puts in £900. and at 6 months takes out £200; and at the end of 11 months puts in £500. but takes out that, and £100. more at the end of 13 months. They gain £200.—I desire to know each man's share of the gain ?

Ans. *D's* £50 : 7 : 6—21720; *E's* £62 : 12 : 5½—29859; *and F's* £87 : 0 : 0½—14167.

(4) D, E, and F, hold a piece of ground in common, for which they are to pay £36. 10s. 6d. D puts in 23 oxen 27 days ; E 21 oxen 35 days ; and F 16 oxen 23 days—what is each man to pay of the said rent ?

Ans. *D* £13 : 3 : 1½—624 ; *E* £15 : 11 : 5—1688 ; *and F* £7 · 15 : 11—1136.

ALLIGATION.

ALLIGATION IS EITHER MEDIAL OR ALTERNATE.

ALLIGATION MEDIAL

Is when the price and quantities of several simples are given to be mixed, to find the mean price of that mixture.

RULE.—As the whole composition is to its total value, so is any part of the composition to its mean price.

PROOF.—Find the value of the whole mixture at the mean rate, and if it agrees with the total value of the several quantities at their respective prices, the work is right.

EXAMPLE.

(1) A farmer mixed 20 oushels of wheat, at 5s. per bushel, and 36 bushels of rye, at 3s. per bushel, with 40 bushels of barley, at 2s. per bushel—I desire to know the worth of one bushel of this mixture ?

$20 \times 5 = 100$		As 96 : 288 :: 1 : 3
$36 \times 3 = 108$		
$40 \times 2 = 80$		Ans. 3*s.*
96	288	

(2) A vintner mingles 15 gallons of Canary, at 8s. per gallon, with 20 gallons at 7s. 4d. per gallon, 10 gallons of Sherry, at 6s. 8d. per gallon, and 24 gallons of white wine at 4s. per gallon—what is the worth of 1 gallon of this mixture ? Ans. 6*s.* $2\frac{1}{2}$*d.* $\frac{4\,6}{6\,9}$.

(3) A grocer mingled 4 cwt. of sugar, at 56s. per cwt, 7 cwt. at 43s. per cwt. and 5 cwt. at 37s. per cwt.—I demand the price of 2 cwt. of this mixture ? Ans. £4 : 8 : 9.

(4) A maltster mingles 30 quarters of brown malt, at 28s. per quarter, with 46 quarters of pale, at 30s. per quarter, and 25 quarters of high dried ditto, at 25s. per quarter—what is the value of 8 bushels of this mixture ?

Ans. £1 : 8 : $2\frac{1}{4}$ $\frac{6}{10}$.

(4) If I mix 27 bushels of wheat, at 5s. 6d. per bushel, with the same quantity of rye, at 4s. per bushel, and 14 bushels of barley, at 2s. 8d. per bushel—what is the worth of 1 bushel of this mixture ? Ans. 4*s.* $3\frac{3}{4}$*d.* $\frac{2\,8}{6\,5}$.

(6) A grocer mingled 3 cwt. of sugar, at 56s. per cwt., 6 cwt. at £1. 17s. 4d. per cwt., and 3 cwt. at £3. 14s. 8d. per cwt.—what is 1 cwt. of this mixture worth ?

Ans. £2 : 11 : 4.

(7) A mealman has flour of several sorts, and would mix 3 bushels at 3s. 5d. per bushel, 4 bushels at 5s. 6d. per bushel, and 5 bushels at 4s. 8d. per bushel—what is the worth of 1 bushel of this mixture ? Ans 4*s.* $7\frac{1}{2}d.$ $\frac{4}{12}$.

(8) A vintner mixes 20 gallons of Port, at 5s. 4d. per gallon, with 12 gallons of white wine, at 5s. per gallon, 30 gallons of Lisbon, at 6s. per gallon, and 20 gallons of Mountain at 4s. 6d. per gallon—what is 1 gallon of this mixture worth ?

Ans. 5*s.* $3\frac{3}{4}d.$ $\frac{5}{8}\frac{0}{2}$.

(9) Suppose 10 bushels of wheat at 7s. per bushel and 20 bushels of rye, at 4s. per bushel, and 30 bushels of barley, at 3s. per bushel, were mixed together ; how must the compound be sold per bushel, without loss or gain ? 4*s.*

(10) A person mixing a quantity of oats, at 2s. 6d. per bushel, with the like quantity of beans, at 4s. 6d. per bushel —would be glad to know the price of 1 bushel of that mixture ? Ans. 3*s.* 6*d*

(11) A refiner having 12 lbs. of silver bullion, of 6 oz. fine would melt it with 8 lbs. of 7 oz. fine, and 10 lbs. of 8 oz. fine—I require the fineness of 1 lb. of that mixture ?

Ans. 6 *oz.* 18 *dwts.* 16 *grs.*

(12) If with 40 bushels of corn, at 4s. per bushel, there are mixed 10 bushels at 6s. per bushel, 30 bushels at 5s. per bushel, and 20 bushels at 3s. per bushel—what will 10 bushels of that mixture be worth ? Ans. £2. 3*s.*

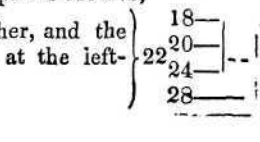
(13) A tobacconist will mix 50 lbs. of tobacco, at 11d. per lb., with 30 lbs. at 14d. per lb., 25 lbs. at 2 d. per lb., and 37 lbs. at 2s. per lb.,—what will 1 lb. of this mixture be worth ? Ans. $16\frac{3}{4}d.$ $\frac{1}{1}\frac{1}{4}\frac{8}{2}$.

ALLIGATION ALTERNATE

Is when the price of several things are given, to find such quantities of them to make a mixture, that may bear a price propounded.

In ordering the rates and given prices observe,

1. Place them one under the other, and the propounded price, or mean rate, at the left-hand of them, thus,



2. Link the several rates together by 2 and 2; always observing to join a greater and less than the mean.

3. Against each extreme, place the difference of the mean and its yoke fellow.

When the price of the several simples and the mean rate are given without any quantity, to find how much of each simple is required to compose the mixture.

RULE.—Take the difference between each price and the mean rate, set them alternately, and they will be the answer required.

PROOF.—By Alligation Medial.

EXAMPLES.

(1) A vintner would mix four sorts of wine together, at 18d., 20d., 24d., and 28d. per quart—what quantity of each must he take, to sell the mixture at 22d. per quart?

	Answer.	*Proof.*	*Or thus.*	*Proof.*
18	2	2 of 18d. = 36d.	18 — 6	6 of 18d. = 108d.
22 20	6	6 of 20d. = 120	22 20 — 2	2 of 20d. = 40
24	4	4 of 24d. = 96	24 — 2	2 of 24d. = 48
28	2	2 of 28d. = 56	28 — 4	4 of 28d. = 112
	14	)308	14	)308
		22d.		22d.

Note. Questions in this rule admit of a great variety of answers, according to the manner of linking them.

(2) A grocer would mix sugar at 4d., 6d., and 10d. per lb. so as to sell the compound at 8d. per lb.—what quantity of each must he take?

Ans. 2 *lbs. at* 4*d.*; 2 *lbs. at* 6*d.*; *and* 6 *lbs. at* 10*d.*

(3) I desire to know how much tea at 16s., 14s., 9s., and 8s. per lb. will compose a mixture worth 10s. per lb.?

Ans. 1 *lb. at* 16*s.*; 2 *lbs. at* 14*s.*; 6 *lbs. at* 9*s.*; *and* 4 *lbs. at* 8*s.*

(4) A farmer would mix as much barley at 3s. 6d. per bushel, rye at 4s. per bushel, and oats at 2s. per bushel, as to make a mixture worth 2s. 6d. per bushel—how much is that of each sort? Ans. 6 *of barley*, 6 *of rye, and* 30 *of oats.*

(5) A grocer would mix raisins of the Sun at 7d. per lb. with Malagas at 6d., and Smyrnas, at 4d. per lb.—I desire to know what quantity of each sort he must take to sell them at 5d. per lb.? Ans. 1 *lb. of raisins of the Sun*, 1 *lb. of Malagas, and* 3 *lbs. of Smyrnas.*

(6) A tobacconist would mix tobacco at 2s., 18d., and 15d. per lb. so as the compound may bear a price of 1s. 8d. per b.—what quantity of each must he take?

Ans. 7 *lbs. at* 2*s.*, 4 *lbs. at* 1*s.* 6*d.*, *and* 4 *lbs. at* 1*s.* 3*d.*

ALLIGATION PARTIAL

Is when the price of all the simples, the quantity of but one of them, and the mean rate, are given to find the several quantities of the rest in proportion to that given.

RULE.—Take the difference between each price, and the mean rate as before. Then,

As the difference of that simple, whose quantity is given, is to the rest of the differences severally, so is the quantity given, to the several quantities required.

EXAMPLE.

(1) A tobacconist being determined to mix 20 lbs. of tobacco, at 15d. per lb. with others at 16d. per lb., 18d. per lb., and 22d. per lb.—how many pounds of each sort must he take, to make 1 lb. of that mixture worth 17d.?

		Ans.	*Proof.*	
15——	5	20 lbs. at 15d.	=300d.	As 5 : 1 :: 20 : 4.
17 16—	1	4 lbs. at 16d.	= 64d.	As 5 : 1 :: 20 : 4.
18—	1	4 lbs. at 18d.	= 72d.	As 5 : 2 :: 20 : 8.
22——	2	8 lbs. at 22d.	=176d.	
		46 lbs.	: 612 :: 1 lb. : 17d.	

(2) A farmer would mix 20 bushels of wheat at 60d. per bushel, with rye at 36d., barley at 24d., and oats at 18d. per bushel—how much of each sort must he take to make the composition worth 32d. per bushel?

Ans. 20 *bushels of wheat*, 35 *bushels of rye*, 70 *bushels of barley*, *and* 10 *bushels of oats.*

(3) A person is desirous of mixing wheat at 4s. per bushel, rye at 3s. per bushel, and barley at 2s. per bushel, with 12 bushels of oats, at 18d. per bushel—I would be glad to know how many bushels of each sort he must take to make the composition worth 3s. 6d. per bushel?

Ans. 96 *bushels of wheat*, 12 *bushels of rye*, 12 *bushels of barley*, *and* 12 *bushels of oats.*

(4) A distiller would mix 40 gallons of French brandy at 12s. per gallon, with English at 7s., and spirits at 4s. per

gallon—what quantity of each sort must he take to afford it for 8s. per gallon?

Ans. 40 *gallons French*, 32 *English, and* 32 *spirits.*

(5) A grocer would mix teas of 12s., 10s., and 6s. with 20 lbs. at 4s. per lb.—how much of each sort must he take to make the composition worth 8s. per lb.

Ans. 20 *lbs. at* 4*s.*, 10 *lbs. at* 10*s.*, 10 *lbs. at* 6*s., and* 20 *lbs. at* 12*s.*

(6) A wine merchant is desirous of mixing 18 gallons of Canary, at 6s. 9d. per gallon, with Malaga, at 7s. 6d. per gallon, Sherry at 5s. per gallon, and white wine at 5s. 3d. per gallon—how much of each sort must he take that the mixture may be sold for 6s. per gallon?

Ans. 18 *gallons of Canary,* 13½ *Malaga,* 13½ *of Sherry, and* 27 *of white wine.*

ALLIGATION TOTAL

Is when the price of each simple, the quantity to be compounded, and the mean rate are given, to find how much of each sort will make the quantity.

RULE.—Take the difference between each price, and the mean rate as before; then,

As the sum of the differences is to each particular difference, so is the quantity given, to the quantity required.

EXAMPLE.

(1) A grocer has four sorts of sugar, *viz.*, 12d., 10d., 6d., and 4d. per lb., and would make a composition of 144 lbs. worth 8d. per lb.—I desire to know what quantity of each he must take?

12	4	48 at 12d. = 576d.	As 12 : 4 :: 144 : 48.
8 10	2	24 at 10d. = 240d.	As 12 : 2 :: 144 : 24
6	2	24 at 6d. = 144d.	
4	4	48 at 4d. = 192d.	
	12 144	)1152(8d.	

(2) A druggist having four sorts of tea, of 5s., 6s., 8s., and 9s. per lb., would have a composition of 87 lbs. worth 7s. per lb.—what quantity must there be of each?

Ans. 14½ *lbs. of* 5*s.*, 29 *lbs. of* 6*s.*, 29 *lbs. of* 8*s.*, *and* 14½ *lbs. of* 9*s.*

(3) A vintner had four sorts of wine, viz., white wine at 4s. per gallon; Flemish at 6s. per gallon; Malaga at 8s.

per gallon; and Canary at 10s. per gallon; and would make a mixture of 60 gallons, to be worth 5s. per gallon—what quantity of each must he take?

Ans. 45 *gallons of white wine,* 5 *gallons of Flemish,* 5 *gallons of Malaga, and* 5 *gallons of Canary.*

(4) A grocer having four sorts of currants, at 11d., 9d., 6d., and 4d. per lb., is desirous of making a composition of 240 lbs. worth 8d. per lb.—how much of each sort must he take? Ans. 96 *lbs. at* 11*d.*, 48 *lbs. at* 9*d.*, 24 *lbs. at* 6*d.*, *and* 72 *lbs. at* 4*d.*

(5) A silversmith had four sorts of gold, *viz.*, of 24 carats fine, of 22, 20, and 15 carats fine; and would make as much of each sort together, so as to have 42 oz. of 17 carats fine—how much must he take of each?

Ans. 4 *of* 24, 4 *of* 22, 4 *of* 20, *and* 30 *of* 15 *carats fine.*

(6) A druggist having some drugs of 8s., 5s., and 4s. per lb. made them into two parcels; one of 28 lbs. at 6s. per lb. the other of 42 lbs. at 7s. per lb.—how much of each sort did he take for each parcel?

Ans. 12 lbs. of 8s.	Ans. 30 lbs. of 8s.
8 lbs. of 5s.	6 lbs. of 5s.
8 lbs. of 4s.	6 lbs. of 4s.
28 lbs. at 6s.	42 at 7s. per lb.

POSITION;

Or, THE RULE OF FALSE,

Is a rule, that by false or supposed numbers, taken at pleasure, discovers the true one required. It is divided into two parts, Single and Double.

SINGLE POSITION

Is by using one supposed number, and working with it as the true one, you find the real number required, by the following

Rule.—As the total of the errors is to the true total, so is the supposed number, to the true one required.

Proof.—Add the several parts of them together, and if it agrees with the sum, it is right

EXAMPLE.

(1) A school-master being asked how many scholars he had, said, if I had as many, half as many, and one quarter, as many more, I should have 88—how many had he?

Suppose he had 40	As 110 : 88 :: 40	32
As many 40	40	32
Half as many 20	11|0)352|0(32 Ans.	16
¼ as many 10	33	8
110	22	88 proof.
	22	
	..	

(2) A person having about him a certain number of Portugal pieces, said, if the third, fourth, and sixth of them were added together, they would make 54—I desire to know how many he had? Ans. 72.

(3) A gentleman bought a chaise, horse, and harness, for £60.; the horse came to twice the price of the harness, and the chaise to twice the price of the horse and harness—what did he give for each?

Ans. *Horse* £13 : 6 : 8, *harness* £6 : 13 : 4, *chaise* £40.

(4) A, B, and C, being determined to buy a quantity of goods which would cost them £120, agreed among themselves that B should pay a third part more than A, and C a fourth part more than B—I desire to know what each man must pay? Ans. *A* £30, *B* £40, *C* £50.

(5) A man meeting a maid driving a flock of geese, said, Where are you going, sweetheart, with these 50 geese? She replied, I have not 50, but if I had ½ as many more, a third and a quarter as many more, I should have 50—how many had she? Ans. 24.

(6) A person delivered to another a sum of money unknown, to receive the interest for the same at 6 per cent. per annum, simple interest, and at the end of 10 years, received for principal and interest, £300.—what was the sum lent?

Ans. £187 : 10*s*.

DOUBLE POSITION

Is by making use of two supposed numbers; and if both prove false, (as it generally happens,) they are, with their errors, to be thus ordered:

Rule 1.—Place each error against its respective position.

2. Multiply them cross-wise.

3. If the errors are alike, *i. e.*, both greater, or both less than the given number, take their difference for a divisor, and the difference of the products for a dividend. But if unlike, take their sum for a divisor, and the sum of the products for a dividend; the quotient will be the answer.

EXAMPLE.

(1) A, B, and C, would divide £200. among them, so that B may have £6. more than A, and C £8. more than B—how much must each have?

Suppose A had	40	then suppose A had	50
then B	46	then B must have	56
and C	54	and C	64
	140, too little by 60.		170, too little by 30.

sup.	errors.		
40	V—60		
50	Λ—30	60	60 A
3000	1200	30	66 B
1200	= = =	30 divisor	74 C
3|0)180|0			200 proof.
60 Ans. for A.			

(2) A man had two silver cups of unequal weight, having one cover to both, of 5 oz.; now if the cover be put on the least cup, it will be double the weight of the greater cup, and set on the greater cup, it will be thrice as heavy as the least cup—what is the weight of each cup?

Ans. 3 *ounces least*, 4 *greater*.

(3) A, B, and C, playing at hazard together, the money staked was 196 guineas; but disagreeing, each seized as many as he could; A got a certain quantity; B as many as A and 16 more; and C the sixth part of both their sums—how many had each? Ans. *A* 76, *B* 92, *C* 28.

(4) A gentleman bought a house with a garden, and a horse in the stable, for £500; now he paid four times the price of the horse for the garden, and five times the price of the garden for the house—what was the value of the house, garden, and horse separately?

Ans. *Horse* £20., *garden* £80., *and house* £400.

(5) Three persons discoursing concerning their ages, says H, I am 30 years of age; says K, I am as old as H and ¼ of L; and says L, I am as old as you both—what was the age of each person? Ans. *H* 30, *K* 50, *and L* 80.

(6) D, E, and F, playing at cards, staked 324 crowns, but disputing about the tricks, each man took as many as he could; D got a certain number; E as many as D, and 15 more; and F got a fifth part of both their sums added together—how many did each get?

Ans. *D* 127½, *E* 142½, *and F* 54.

(7) A, stealing apples, was taken by B, and to appease him, gave him half of what he had, and B gave him back 10; going farther, he met C, who took from him half of what he had left, and gave him back 4; after that, meeting with D he gave him half of what he had, and he returned him back 1. At last getting safe away, he found he had 13 left—how many had he at first? Ans. 60.

(8) A gentleman going into a garden, meets with some ladies, and says to them, good morning to you, 10 fair maids: Sir, you mistake, answers one of them, we are not 10; but if we were twice as many more as we are, we should be as many above 10 as we are now under—how many were they?

Ans. 5.

EXCHANGE

Is the receiving money in one country for the same value paid in another.

The par of exchange is always fixed and certain, it being the intrinsic value of foreign money, compared with sterling, but the course of exchange rises and falls upon various occasions.

I. FRANCE.

They keep their accounts at Paris, Lyons, and Rouen, in livres, sols, and deniers, and exchange by the crown—4s. 6d. at par.

Note.—12 deniers make 1 sol.
20 sols —— 1 livre.
3 livres —— 1 crown.

To change French into Sterling.

RULE.—As 1 crown is to the given rate, so is the French sum to the sterling required.

To change sterling into French.

RULE.—As the rate of exchange is to 1 crown, so is the sterling sum to the French required.

EXAMPLES.

(1) How many crowns must be paid at Paris, to receive in London £180., exchange at 4s. 6d. per crown?

d. *cr.* £.
As 54 : 1 :: 180 :
240
54)43200 800 *cr.*
432
...

(2) A merchant at Paris remits to his correspondent in London 800 crowns, at 4s. 6d. each, what is the value in sterling?

cr. *d.* *cr.*
As 1 : 54 :: 800
54
12)43200
2|0)360|0
£180

(3) How much sterling must be paid in London, to receive in Paris 758 crowns, exchange at 56d. per crown?

Ans. £176 : 17 : 4.

(4) A merchant in London remits £176. 17s. 4d. to his correspondent at Paris—what is the value in French crowns, at 56d. per crown? Ans. 758.

(5) Change 725 crowns, 17 sols, 7 deniers, at 54½d. per crown, into sterling—what is the sum?

Ans. £164 : 14 : $0\frac{1}{4}.\frac{6}{7}\frac{3}{2}\frac{8}{0}$.

(6) Change £164. 14s. $0\frac{1}{4}$d. $\frac{6}{7}\frac{3}{2}\frac{8}{0}$. sterling into French crowns, exchange at 54½d. per crown—what is the sum?

Ans. 725 *crowns*, 17 *sols*, 7 *deniers*.

II. SPAIN.

They keep their accounts at Madrid, Cadiz, and Seville, in dollars, rials, and maravedies, and exchange by the piece of eight=4s. 6d. at par.

Note.—34 maravedies make 1 rial.
8 rials —— 1 piastre, or piece of eight.
10 rials —— 1 dollar.

RULE.—As with France.

(7) A merchant at Cadiz remits to London 2547 pieces of eight, at 56d. per piece—how much sterling is the sum?

Ans. £594 : 6*s*

(6) How many pieces of eight at 56d. each, will answer a bill of £594. 6s. sterling? Ans. 2547.

(9) If I pay a bill of £2500.—what Spanish money may I draw my bill for at Madrid, exchange at 57½d. per piece of eight? Ans. 10434 *pieces of eight*, 6 *rials*, 8$\frac{2}{3}^{0}$ *mar.*

III. ITALY.

They keep their accounts at Genoa and Leghorn, in livres, sols, and deniers, and exchange by the piece of eight, or dollar=4s. 6d. at par.

Note.—12 deniers make 1 sol.
20 sols —— 1 livre.
5 livres —— 1 piece of eight, at Genoa.
6 livres —— 1 piece of eight, at Leghorn.

☞ The exchange at Florence is by ducatoons; the exchange at Venice by ducats.

Note.—6 solidi make 1 gross.
24 gross —— 1 ducat.

RULE.—The same as before.

(10) How much sterling money may a person receive in London, if he pays in Genoa, 976 dollars, at 53d. per dollar? Ans. £215 : 10 : 8.

(11) A merchant remitted £215. 10s. 8d. sterling to Leghorn—how many dollars will he receive there, the exchange being at 53d. per dollar? Ans. 976.

(12) A factor having sold goods at Florence, for 250 ducatoons, at 54d. each—what is the value in pounds sterling? Ans. £56 : 5*s.*

(13) A bill of £56. 5s. is remitted to Florence to be paid in ducatoons, at 54d. each—how many will be received? Ans. 250.

(14) If 275 ducats at 4s. 5d. each, be remitted from Venice to London—what is the value in pounds sterling? Ans. £60 : 14 : 7.

(15) A gentleman travelling, would exchange £60. 14s. 7d. sterling, for Venice ducats, at 4s. 5d. each—how many must he receive? Ans. 275.

IV. PORTUGAL.

They keep their accounts at Oporto and Lisbon, in reas, and exchange on the milrea=6s. 8½d. at par.

Note.—1000 reas make 1 milrea.

RULE.—The same as with France

(16) A gentleman being desirous to remit to his correspondent in London 2750 milreas, exchange at 6s. 5d. per milrea —how much sterling will he be creditor for in London?

Ans. £882 : 5 : 10.

(17) If a bill be drawn from London of £882. 5s. 10d. sterling—how many milreas, at 6s. 5d. each, is equal in value to the said sum? Ans. 2750.

(18) A merchant at Oporto remits to London 4366 milreas and 183 reas, at 5s. 5⅛d. exchange per milrea—how much sterling must be paid in London for this remittance?

Ans. £1193 : 17 : 6¾. $\frac{71}{1000}$.

(19) If I pay at London a bill of £1193. 17s. 6¾d. $\frac{71}{1000}$. what must I draw for on my correspondent at Lisbon, exchange at 5s. 5⅛d. per milrea?

Ans. 4366 *milreas*, 183 *reas*.

V. HOLLAND, FLANDERS, AND GERMANY.

They keep their accounts at Antwerp, Amsterdam, Brussels, Rotterdam, and Hamburg; some in pounds, shillings, and pence as in England; others in guilders, stivers, and pennings; and exchange with us on our pound at 33s. 4d. Flemish at par.

Note.—8 pennings make.....1 groat.
2 groats, or 16 pennings...1 stiver.
20 stivers .....1 guilder or florin.
Also 12 groats, or 6 stivers .....1 schelling.
20 schellings or 6 guilders 1 pound.

To change Flemish into Sterling.

RULE.—As the given rate is to 1 pound, so is the Flemish sum to the sterling required.

To change Sterling into Flemish.

RULE.—As. £1. sterling is to the given rate so is the sterling given to the Flemish sought.

(20) Remitted from London to Amsterdam a bill of £754. 10s. sterling—how many pounds Flemish is the sum, the exchange being at 33s. 6d. Flemish per pound sterling?

Ans. £1263 : 15 : 9. *Flemish.*

(21) A merchant at Rotterdam remits £1263. 15s. 9d. Flemish to be paid in London—how much sterling money must he draw for, the exchange being at 33s. 6d. Flemish per pound sterling? Ans. £754 : 10*s*.

(22) If I pay in London £852. 12s. 6d. sterling—how many guilders must I draw for at Amsterdam, exchange at 34 schellings, $4\frac{1}{2}$ groats per pound sterling?

Ans. 8792 *guilders*, 13 *stivers*, $14\frac{1}{2}$ *pennings*.

(23) What must I draw for at London, if I pay at Amsterdam 8792 guilders, 13 stivers, $14\frac{1}{2}$ pennings, exchange at 34 schellings, $4\frac{1}{2}$ groats per pound sterling?

Ans. £852 : 12 : 6.

To convert Bank money into current, and the contrary.

Note.—The bank money is worth more than the current. The difference between the one and the other is called *agio* and is generally from 3 to 6 per cent, in favour of the bank.

To change Bank into Current Money.

RULE.—As 100 guilders bank, is to 100 with the agio added, so is the bank given, to the current required.

To change Current into Bank Money.

RULE.—As 100 with the agio added, is to 100 bank, so is the current money given, to the bank required.

(24) Change 794 guilders, 15 stivers, 4 pennings, current money into the bank florins, agio $4\frac{3}{8}$ per cent.

Ans. 761 *guilders*, $8\frac{3}{5}\frac{2}{3}\frac{8}{4}$ *stivers*.

(25) Change 761 guilders, $8\frac{3}{5}\frac{2}{3}\frac{8}{4}$ stivers, bank, into current money, agio $4\frac{3}{8}$ per cent.

Ans. 794 *guilders*, 15 *stivers*, 4 *pennings*.

VI. IRELAND.

(26) A gentleman remits to Ireland £575. 15s. sterling—what will he receive there, the exchange being at 10 per cent.? Ans. £633 : 6 : 6.

(27) What must be paid in London for a remittance of £633. 6s. 6d. Irish, exchange being at 10 per cent.?

Ans. £575 : 15s.

COMPARISON OF WEIGHTS AND MEASURES.

(1) If 50 Dutch pence be worth 65 French pence—how many Dutch pence are equal to 350 French pence?

Ans. $269\frac{15}{65}$.

(2) If 12 yards at London make 8 ells at Paris—how many ells at Paris will make 64 yards at London?

Ans. $42\frac{8}{12}$.

(3) If 30 lbs. at London, make 28 lbs. at Amsterdam, how many lbs. at London will be equal to 350 lbs. at Amsterdam?
Ans. 375.

(4) If 95 lbs. Flemish make 106 lbs. English—how many lbs. English are equal to 275 lbs. Flemish? Ans. $306\frac{80}{95}$.

CONJOINED PROPORTION

Is when the coin, weight, or measure, of several countries are compared in the same question; or it is linking together a variety of proportions.

When it is required to find how many of the first sort of coin, weight, or measure, mentioned in the question, are equal to a given quantity of the last.

RULE.—Place the numbers alternately, beginning at the left-hand, and let the last number stand on the left-hand; then multiply the first row continually, for a dividend, and the second for a divisor.

PROOF.—By as many single Rules of Three as the question requires.

EXAMPLE.

(1) If 20 lbs. at London make 23 lbs. at Antwerp, and 155 lbs. at Antwerp make 180 lbs. at Leghorn—how many lbs. at London are equal to 72 lbs. at Leghorn?

Left.	Right.	
20	23	$20 \times 155 \times 72 = 223200$
155	180	$23 \times 180 = 4140$, and
72		$223200 \div 4140 = 53\frac{378}{414}$. Ans.

(2) If 12 lbs. at London make 10 lbs. at Amsterdam, and 100 lbs. at Amsterdam, 120 lbs. at Toulouse—how many lbs. at London are equal to 40 lbs. at Toulouse? Ans. 40.

(3) If 140 braces at Venice are equal to 156 braces at Leghorn, and 7 braces at Leghorn equal to 4 ells English—how many braces at Venice are equal to 16 ells English?
Ans. $25\frac{80}{624}$.

(4) If 40 lbs. at London make 36 lbs. at Amsterdam, and 90 lbs. at Amsterdam make 116 lbs. at Dantzic—how many lbs. at London are equal to 130 lbs. at Dantzic?
Ans. $112\frac{288}{4176}$.

When it is required to find how many of the last sort of coin, weight, or measure, mentioned in the question, are equal to a quantity of the first.

RULE.—Place the numbers alternately, beginning at the left-hand, and let the last number stand on the right-hand; then multiply the first row for a divisor, and the second for a dividend.

(5) If 12 lbs. at London make 10 lbs. at Amsterdam, and 100 lbs. at Amsterdam 120 lbs. at Toulouse—how many lbs. at Toulouse are equal to 40 lbs. at London? Ans. 40 *lbs.*

(6) If 40 lbs. at London make 36 lbs. at Amsterdam, and 90 lbs. at Amsterdam 116 lbs. at Dantzic—how many lbs. at Dantzic are equal to 122 lbs. at London? Ans. $141\frac{1872}{3000}$.

PROGRESSION

CONSISTS OF TWO PARTS,

ARITHMETICAL AND GEOMETRICAL.

ARITHMETICAL PROGRESSION

Is when the rank of numbers increases or decreases regularly by the continual adding or subtracting of the equal numbers; as 1, 2, 3, 4, 5, 6, are in Arithmetical Progression, by the continual increasing or adding of one; 11, 9, 7, 5, 3, 1, by the continual decreasing or subtracting of two.

Note.—When any even number of terms differs by Arithmetical Progression, the sum of the two extremes will be equal to the two middle numbers, or any two means equally distant from the extremes, as 2, 4, 6, 8, 10, 12, where 6+8, the 2 middle numbers, are=12+2 the two extremes, and =10+4 the two means=14.

When the number of terms is odd, the double of the middle term will be equal to the two extremes or any two means equally distant from the middle term; as 1, 2, 3, 4, 5, where the double of 3=5+1=2+4=6.

In Arithmetical Progression five things are to be observed, *viz.*,

1. The first term,	called the extremes,	F.
2. The last term,		L.
3. The number of terms,		N.
4. The common difference,		D.
5. The sum of all the terms,		S.

Any three of which being given, the other two may be found.

1. The first term, the last term, and the number of terms being given, to find the sum of all the terms.

RULE.—Multiply the sum of the extremes by half the number of terms, and the product is the total or sum of all the terms: Or thus,

F, L, N, are given to find S.

$$\overline{F+L} \times \frac{N}{2} = S$$

EXAMPLE.

(1) How many strokes does the hammer of a clock strike in 12 hours?

$12+1=13$, then $13 \times 6=78$. Ans.

(2) A man bought 17 yards of cloth, and gave for the first yard 2s. for the last 10s. what did the 17 yards amount to?

Ans. £5 : 2*s.*

(3) If 100 eggs were placed in a right line, exactly a yard asunder from one another, and the first a yard from a basket, what length of ground does that man go who gathers up the hundred eggs singly, returning with every egg to the basket to put it in? Ans. 5 *miles*, 1300 *yards.*

II. The first term, the last term, and the number of terms given, to find the common difference.

RULE.—Take one from the number of terms, divide the difference of the extremes by the remainder, and the quotient will be the common difference: Or thus,

F, L, N, are given to find D.

$$\frac{L-F}{N-1} = D.$$

EXAMPLE.

(4) A man had 8 sons, the youngest was 4 years old and the eldest 32; they increased in Arithmetical Progression—what was the common difference of their ages?

$32-4=28$, then, $28 \div \overline{8-1}=4$, common difference.

(5) A man is to travel from London to a certain place in 12 days, and to go about 3 miles the first day, increasing every day by an equal excess, so that the last day's journey may be 58 miles—what is the daily increase, and how many miles distant is that place from London?

Ans. 5 *daily increase, and distant from London* 366.

III. Given the first term, the last term, and common difference, to find the number of terms.

RULE.—Divide the difference of the extremes by the common difference; add one to the quotient, and the sum is the number of terms: Or thus,

F, L, D, are given to find N.

$$\frac{L-F}{D}+1=N.$$

EXAMPLE.

(6) A person travelling into the country, went 3 miles the first day, and increased every day by 5 miles, till at last he went 58 miles in 1 day—how many days did he travel?

$58-3=55$, then $55\div5=11$ and $+1=12$, *number of days.*

(7) A man being asked how many sons he had, said the youngest was 4 years old, and the oldest 32, and that he increased 1 in his family every 4 years—how many had he?

Ans. 8.

IV. Given the last term, number of terms, and common difference. to find the first term.

RULE.—Multiply the common difference by one less than the number of terms, which product subtract from the last term, the difference will be the first: Or thus,

L, N, D, are given to find F.

$$L-\overline{D\times N-1}=F.$$

EXAMPLE.

(8) A man in 10 days went from London to a certain town in the country, every day's Journey increasing the former by 4, and the last he went was 46 miles—what was the first?

$4\times10-1=36$, then $46-36=10$, *the first day's journey.*

(9) A man takes out of his pocket, at 8 several times, so many different numbers of shillings, every one exceeding the former by 6, the last 46—what was the first? Ans. 4.

V. Given the common difference, the number of terms, and the sum of the series, to find the first term.

RULE.—Divide the sum of the series by the number of terms, subtract half the product of the common difference, multiplied by the number of terms less one, gives the first term. Or thus.

N, D, S, are given to find F.

$$\frac{S}{N} \quad \frac{D \times \overline{N-1}}{2} = F.$$

EXAMPLE.

(10) A man is to receive £360. at 12 several payments, each to exceed the former by £4, and is willing to bestow the first payment on any one who can tell him what it is—what will the person have for his pains?

$360 \div 12 = 30$, then $30 - \frac{4 \times \overline{12-1}}{2} = 8$, the first payment.

VI. Given the first term, the common difference, and the number of terms, to find the last term.

RULE.—Multiply the common difference, by one less than the number of terms, which product added to the first term, gives the last: Or, thus,

F, N, D, are given to find L

$ND - D + F = L$.

EXAMPLE.

(11) What is the last number of an Arithmetical Progression beginning at 6, and continuing by the increase of 8 to 20 places?

$20 \times 8 - 8 = 152$, then $152 + 6 = 158$, the last number.

GEOMETRICAL PROGRESSION

Is the increasing or decreasing of any rank of numbers by some common ratio; that is, by the continual multiplication or division of some equal number; as, 2, 4, 8, 16, increase by the multiplier 2; and 16, 8, 4, 2, decrease by the divisor 2

Note.—When any number of terms is continued in Geometrical Progression, the product of the two extremes will be equal to any two means equally distant from the extremes; as, 2, 4, 8, 16, 32, 64, where 64×2 are $= 4 \times 32$, and $8 \times 16 = 128$.

When the number of terms is odd, the middle term multiplied into itself will be equal to the two extremes or any two means equally distant from the mean; as, 2, 4, 8, 16, 32, where $2 \times 32 = 4 \times 16 = 8 \times 8 = 64$.

In Geometrical Progression, the same five things are to be observed as in Arithmetical, *viz.*.

1. The first term.
2. The last term.
3. The number of terms.
4. The equal difference, or ratio.
5. The sum of all the terms.

Note.—As the last term in a long series of numbers is very tedious to come at by continual multiplication, therefore, for the readier finding it out, there is a series of numbers made use of in Arithmetical Proportion, called *indices*, beginning with an unite, whose common difference is one; whatever number of indices you make use of, set as many numbers (in such Geometrical Proportion as is given in the question) under them.

As 1, 2, 3, 4, 5, 6, indices.
2, 4, 8, 16, 32, 64, numbers in Geometrical Proportion.

But if the first term in Geometrical Proportion be different from the ratio, the indices must begin with a cypher.

As 0, 1, 2, 3, 4, 5, 6, indices.
1, 2, 4, 8, 16, 32, 64, numbers in Geometrical Proportion.

When the indices begin with a cypher, the sum of the indices made choice of must always be one less than the number of terms given in the question: for 1 in the indices is over the second term, and 2 over the third, &c.

Add any two of the indices together, and that sum will agree with the product of their respective terms.

As in the first table of indices	$2+5=$	7
Geometrical Proportion	$4\times32=$	128
Then in the second	$2+4=$	6
	$4\times16=$	64

I. In any Geometrical Progression proceeding from unity, the ratio being known, to find any remote term without producing all the intermediate terms.

RULE.—Find what figures of the indices, added together, would give the exponent of the term wanted; then multiply the numbers standing under such exponent into each other, and it will give the term required.

When the exponent 1 stands over the second term, the number of exponents must be one less than the number of terms.

EXAMPLE.

(1) A man agrees for 12 peaches, to pay only the price of the last, reckoning a farthing for the first and a half

penny for the second, &c., doubling the price to the last what must he give for them?

16= 4
0, 1, 2, 3, 4, exponents. 16= 4
1, 2, 4. 8, 16, No. of terms 256= 8
For 4+4+3=11, No. of terms less 1. 8= 3

4)2048=11 No. of far.
12) 512
2|0) 4|2 8
Ans. £2 2 8

(2) A country gentleman going to a fair to buy some oxen, met with a person who had 23; he demanded the price of them, was answered £16. a head: the gentleman bid him £15. a-head, and would buy all; the other told him it could not be taken; but if he would give what the last ox would come to at a farthing for the first, and double it to the last, he should have all—what was the price of the oxen?

Ans. £4369 : 1 : 4.

II. In any Geometrical Progression, not proceeding from unity, the first term and the ratio being given, to find any remote term, without producing all the intermediate terms.

RULE.—Proceed as in the last rule, only observe that every product must be divided by the first term.

EXAMPLE.

(3) A sum of money is to be divided amongst 8 persons, the first to have £20., the second £60., and so on in triple proportion—what will the last have?

0, 1, 2, 3, $\frac{540\times540}{20}$=14580, then $\frac{14580\times60}{20}$=43740 Ans.
20,60,180,540,20
3+3+1=7, one less than the number of the terms.

(4) A gentleman dying, left 9 sons, to whom and to his executors he bequeathed his estate in the following manner:—To his executors £50.; his youngest son was to have as much more as the executors, and each son to exceed the next younger by as much more—what was the oldest son's portion?

Ans. £25600

III. The first term, ratio, and number of terms given, to find the sum of all the terms.

RULE.—Find the last term as before; then subtract the first from it, and divide the remainder by the ratio, less 1, to the quotient of which add the greater, and this gives the sum required.

EXAMPLE.

(5) A servant, skilled in numbers, agreed with a gentleman to serve him twelve months, provided he would give him a farthing for the first month's service, a penny for the second, and fourpence for the third, &c.—what did his wages amount to? Ans. £5825 : 8 : 5¼.

$256 \times 256 = 65536$, then $65536 \times 64 = 4194304$.

0, 1, 2, 3, 4, $\frac{4194304-1}{4-1} = 1398101$, then $4+4+$
1, 4, 16, 64, 256,

$3 = 11$, No. of terms less 1: 1398101+4194304= 5592405 farthings.

(6) A man bought a horse, and by agreement was to give a farthing for the first nail, 3 for the second, &c.: there were 4 shoes, and in each shoe 8 nails—what was the worth of the horse? Ans. £965114681693 : 13 : 4.

(7) A certain person married his daughter on New-year's day, and gave her husband 1s. towards her portion, promising to double it on the first day of every month, for one year—what was her portion? Ans. £204 : 15*s.*

(8) A laceman well versed in numbers agreed with a gentleman to sell him 22 yards of rich gold brocade lace, for 2 pins the first yard, 6 pins the second, &c., in triple proportion—I desire to know what he sold the lace for, if the pins were valued at 100 for a farthing; also what the laceman got or lost by the sale thereof, supposing the lace stood him in £7. per yard?

Ans. *The lace sold for* £326886 : 0 : 9.
Gained £326732 : 0 : 9.

PERMUTATION

Is the changing or varying the order of things.

RULE.—Multiply all the given terms one into another, and the last product will be the number of changes required.

EXAMPLE.

(1) How many changes may be rung upon 12 bells, and how long would they be ringing but once over, supposing 10 changes might be rung in one minute, and the year to contain 365 days, 6 hours?

$1\times2\times3\times4\times5\times6\times7\times8\times9\times10\times11\times12=479001600$ changes, which $\div10=47900160$ minutes; and if reduced is=91 years, 3 weeks, 5 days, 6 hours.

(2) A young scholar coming into town for the convenience of a good library, demanded of a gentleman with whom he lodged, what his diet would cost for a year; who told him £10; but the scholar not being certain what time he would stay, asked him what he must give him for so long as he should place his family, consisting of 6 persons, (besides himself,) in different positions every day at dinner. The gentleman thinking it would not be long, tells him £5, to which the scholar agrees—what time did the scholar stay with the gentleman? Ans 5040 *days*.

PART II.

VULGAR FRACTIONS.

INTRODUCTION.

A FRACTION is a part or parts of a unit, and written with two figures, with a line between them, as, $\frac{1}{4}$, $\frac{5}{6}$, $\frac{3}{8}$, &c.

The figure above the line is called the *numerator*, and the under one the *denominator*: which shews how many parts the unit is divided into; and the numerator shews how many of those parts are meant by the fraction.

There are four sorts of Vulgar Fractions; *proper*, *improper*, *compound*, and *mixed*, viz.,

1. A PROPER FRACTION is when the numerator is less than the denominator, as, $\frac{2}{4}$, $\frac{3}{6}$, $\frac{7}{8}$, $\frac{9}{11}$, $\frac{101}{761}$, &c.

2. An IMPROPER FRACTION is when the numerator is equal to or greater than the denominator, as, $\frac{5}{2}$, $\frac{8}{4}$, $\frac{12}{11}$, $\frac{857}{2}$, &c.

3 A COMPOUND FRACTION is the fraction of a fraction, and known by the word *of*, as, $\frac{1}{2}$ *of* $\frac{2}{3}$ *of* $\frac{7}{9}$ *of* $\frac{8}{17}$ *of* $\frac{9}{12}$, &c.

4. A MIXED NUMBER or FRACTION is composed of a whole number and a fraction, as $8\frac{2}{7}$, $17\frac{1}{2}$, $8\frac{71}{97}$, &c.

REDUCTION OF VULGAR FRACTIONS.

1. *To reduce fractions to a common denominator.*

RULE 1.—Multiply each numerator into all the denominators, except its own, for a new numerator; and all the denominators, for a common denominator. Or,

2.—Multiply the common denominator by the several given numerators separately, and divide the product by their several denominators; the quotients will be the new numerators.

EXAMPLES.

(1) Reduce $\frac{2}{4}$ and $\frac{4}{7}$ to a common denominator.

Ans. $\frac{14}{28}$ *and* $\frac{16}{28}$.

1st num, 2nd num.
$2\times7=14$, $4\times4=16$, then $4\times7=28$ den.$=\frac{14}{28}$ and $\frac{16}{28}$.

(2) Reduce $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{8}$, to a common denominator.

Ans. $\frac{32}{64}$, $\frac{48}{64}$, $\frac{40}{64}$.

(3) Reduce $\frac{3}{5}$, $\frac{8}{9}$, and $\frac{7}{10}$, to a common denominator.

Ans. $\frac{270}{450}$, $\frac{400}{450}$, $\frac{315}{450}$

(4) Reduce $\frac{6}{10}$, $\frac{2}{4}$, $\frac{1}{7}$, and $\frac{3}{6}$, to a common denominator.

Ans. $\frac{1008}{1680}$, $\frac{840}{1680}$, $\frac{240}{1680}$, $\frac{840}{1680}$.

(5) Reduce $\frac{4}{5}$, $\frac{2}{3}$, $\frac{3}{7}$, and $\frac{1}{8}$, to a common denominator.

Ans. $\frac{672}{840}$, $\frac{560}{840}$, $\frac{360}{840}$, $\frac{105}{840}$

(6) Reduce $\frac{2}{6}$, $\frac{5}{9}$, $\frac{2}{8}$, and $\frac{3}{5}$, to a common denominator.

Ans. $\frac{720}{2160}$, $\frac{1200}{2160}$, $\frac{540}{2160}$, $\frac{1296}{2160}$

2. *To reduce a vulgar fraction to its lowest term.*

RULE.—Find a common measure by dividing the lower term by the upper, and that divisor by the remainder following, till nothing remains; the last divisor is the common measure; then divide both parts of the fraction by the common measure, and the quotient will give the fraction required.

☞ If the common measure happens to be 1, the fraction is already in its lowest term; and when a fraction hath cyphers at the right hand, it may be abreviated by cutting them off; as, $\frac{34}{141}\frac{0}{0}$.

EXAMPLES.

(7) Reduce $\frac{24}{32}$ to the lowest terms.

24)32(1
24
8)24(3
24
==

com. measure 8 — then $8)\frac{24}{32}(=\frac{3}{4}$ Ans.

(8) Reduce $\frac{30}{125}$ to its lowest terms. Ans. $\frac{6}{25}$.
(9) Reduce $\frac{200}{624}$ to its lowest terms. Ans. $\frac{52}{156}$.
(10) Reduce $\frac{192}{576}$ to its lowest terms. Ans. $\frac{1}{3}$.
(11) Reduce $\frac{825}{900}$ to its lowest terms. Ans. $\frac{55}{60}$.
(12) Reduce $\frac{518}{691}\frac{4}{2}$ to its lowest terms. Ans. $\frac{3}{4}$

3. *To reduce a mixed number to an improper fraction.*

RULE.—Multiply the whole number by the denominator of the fraction, and to the product add the numerator for a new numerator, which place over the denominator.

☞ To express a whole number fraction ways, set 1 for the denominator given.

EXAMPLES.

(13) Reduce $18\frac{3}{7}$ to an improper fraction. Ans. $^{1}\frac{2}{7}{}^{9}$.

$18\times7+3=129$, new numerator.

(14) Reduce $56\frac{13}{25}$ to an improper fraction. Ans. $^{1}\frac{2}{25}{}^{45}$.
(15) Reduce $183\frac{5}{21}$ to an improper fraction. Ans. $^{3}\frac{8}{21}{}^{48}$.
(16) Reduce $13\frac{4}{5}$ to an improper fraction. Ans. $\frac{69}{5}$.
(17) Reduce $27\frac{2}{9}$ to an improper fraction. Ans. $^{2}\frac{4}{9}{}^{5}$.
(18) Reduce $514\frac{5}{16}$ to an improper fraction. Ans. $^{8}\frac{2}{16}{}^{9}$.

4. *To reduce an improper fraction to its proper terms.*

RULE.—Divide the upper term by the lower.

EXAMPLES.

(19) Reduce $^{1}\frac{2}{7}{}^{9}$ to its proper terms.

$129\div7=18\frac{3}{7}$.

(20) Reduce $^{1}\frac{2}{2}{}^{45}$ to its proper terms. Ans. $56\frac{13}{25}$.
(21) Reduce $^{3}\frac{8}{21}{}^{48}$ to its proper terms. Ans. $183\frac{5}{21}$.
(22) Reduce $\frac{69}{5}$ to its proper terms. Ans. $13\frac{4}{5}$.
(23) Reduce $^{2}\frac{4}{9}{}^{5}$ to its proper terms. Ans. $27\frac{2}{9}$.
(24) Reduce $^{8}\frac{2}{16}{}^{9}$ to its proper terms. Ans. $514\frac{5}{16}$

5. *To reduce a compound fraction to a single one.*

RULE.—Multiply all the numerators for a new numerator, and all the denominators for a new denominator.

Reduce the new fraction to its lowest terms by RULE 2.

EXAMPLES.

(25) Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a single fraction.

$2\times3\times5=30$
$3\times5\times8=123$ reduce to the lowest term$=\frac{1}{4}$. Ans.

(26) Reduce $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$ to a single fraction.

Ans. $\frac{220}{756}=\frac{35}{180}$.

(27) Reduce $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$ to a single fraction.

Ans. $\frac{3003}{4872}=\frac{143}{232}$.

(28) Reduce $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ to a single fraction.

Ans. $\frac{135}{240}=\frac{9}{16}$.

(29) Reduce $\frac{4}{5}$ of $\frac{6}{8}$ of $\frac{7}{9}$ to a single fraction.

Ans. $\frac{168}{360}=\frac{7}{15}$.

(30) Reduce $\frac{2}{7}$ of $\frac{5}{9}$ of $\frac{8}{10}$ to a single fraction.

Ans. $\frac{80}{630}=\frac{8}{63}$.

6 *To reduce fractions of one denomination to the fraction of another,* but greater, *retaining the same value.*

RULE.—Reduce the given fraction to a compound one, by comparing it with all the denominations between it and the denomination which you would reduce it to; then reduce that compound fraction to a single one.

EXAMPLE.

(31) Reduce $\frac{7}{8}$ of a penny to the fraction of a pound.

Ans. $\frac{7}{8}$ of $\frac{1}{12}$ of $\frac{1}{20}=\frac{7}{1920}$.

(32) Reduce $\frac{1}{4}$ of a penny to the fraction of a pound.

Ans. $\frac{1}{960}$.

(33) Reduce $\frac{4}{5}$ of a dwt. to the fraction of a pound troy.

Ans. $\frac{4}{5760}$.

(34) Reduce $\frac{7}{8}$ of a lb. Avoirdupois to the fraction of a cwt.

Ans. $\frac{1}{128}$.

To reduce fractions of one denomination to the fraction of another, but less, *retaining the same value.*

RULE.—Multiply the numerator by the parts contained in the several denominations between it and that you would reduce it to, for a new numerator, and place it over the given denominator.

Reduce the new fraction to its lowest terms.

EXAMPLES.

(35) Reduce $\frac{7}{1\,0\,2\,0}$ of a pound to the fraction of a penny.
$7 \times 20 \times 12 = 1680$, $\frac{1\,6\,8\,0}{1\,9\,2\,0}$ reduced to its lowest term $= \frac{7}{8}$

(36) Reduce $\frac{1}{0\,6\,0}$ of a pound to the fraction of a penny.
Ans. $\frac{1}{5}$.

(37) Reduce $\frac{4}{1\,2\,0\,0}$ of a lb. Troy to the fraction of a penny-weight. Ans. $\frac{4}{5}$.

(38) Reduce $\frac{4}{7\,0\,4}$ of a cwt. Avoirdupois to the fraction of a lb. Ans. $\frac{4}{7}$.

8. *To reduce fractions of one denomination to another of the same value having the numerator given of the required fraction.*

RULE.—As the numerator of the given fraction is to its denominator, so is the numerator of the intended fraction to its denominator.

EXAMPLES.

(39) Reduce $\frac{2}{3}$ to a fraction of the same value, whose numerator shall be 12. As $2 : 3 :: 12 : 18$. Ans. $\frac{12}{18}$.

(40) Reduce $\frac{5}{7}$ to a fraction of the same value, whose numerator shall be 25. Ans. $\frac{25}{35}$.

(41) Reduce $\frac{5}{7}$ to a fraction of the same value, whose numerator shall be 47.

Ans. $\frac{47}{65\frac{5}{7}}$

9. *To reduce fractions of one denomination to another of the same value having the denominator given of the fraction required.*

RULE.—As the denominator of the given fraction is to its numerator, so is the denominator of the intended fraction to its numerator.

EXAMPLES.

(42) Reduce $\frac{2}{3}$ to a fraction of the same value, whose denominator shall be 18. As. $3 : 2 :: 18 : 12$. Ans. $\frac{12}{18}$.

(43) Reduce $\frac{5}{7}$ to a fraction of the same value, whose denominator shall be 35. Ans. $\frac{25}{35}$.

(44) Reduce $\frac{5}{7}$ to a fraction of the same value, whose denominator shall be $65\frac{5}{7}$.

Ans. $\frac{47}{65\frac{5}{7}}$

10. *To reduce a mixed fraction to a single one.*

RULE.—When the numerator is the integral part, multiply it by the denominator of the fractional part, adding in the numerator of the fractional part for a new numerator; then multiply the denominator of the fraction by the denominator of the fractional part for a new denominator.

EXAMPLES.

45) Reduce $\frac{36\frac{2}{3}}{48}$ to a simple fraction. Ans. $\frac{110}{144}=\frac{55}{72}$.

$36\times3+2=110$ numerator.
$48\times3\ \ =144$ denominator.

(46) Reduce $\frac{23\frac{5}{7}}{38}$ to a simple fraction. Ans. $\frac{166}{266}=\frac{83}{133}$.

When the denominator is the integral part, multiply it by the denominator of the fractional part, adding in the numerator of the fractional part for a new denominator; then multiply the numerator of the fraction by the denominator of the fractional part for a new numerator.

EXAMPLES.

(47) Reduce $\frac{47}{65\frac{4}{5}}$ to a simple fraction. Ans. $\frac{235}{329}=\frac{5}{7}$.

(48) Reduce $\frac{19}{44\frac{1}{3}}$ to a simple fraction. Ans. $\frac{57}{133}=\frac{3}{7}$.

11. *To find the proper quantity of a fraction in the known parts of an integer.*

RULE.—Multiply the numerator by the common parts of the integer, and divide by the denominator.

EXAMPLES.

(49) Reduce $\frac{3}{4}$ of a pound sterling to its proper quantity.
$3\times20=60$, and $\div4=15s$. Ans.

(50) Reduce $\frac{3}{8}$ of a shilling to its proper quantity.
Ans. $4\frac{1}{2}d$.

(51) Reduce $\frac{2}{7}$ of a lb. Avoirdupois to its proper quantity.
Ans. 9 *oz.* $2\frac{2}{7}$ *dr.*

(52) Reduce $\frac{7}{9}$ of a cwt. to its proper quantity.
Ans. 3 *qrs.* 3 *lb.* 1 *oz.* $12\frac{4}{9}$ *dr.*

(53) Reduce $\frac{3}{5}$ of a lb. Troy to its proper quantity.
Ans. 7 *oz.* 4 *dwts*

(54) Reduce $\frac{1}{5}$ of an ell English to its proper quantity.
Ans. 2 *qrs.* $3\frac{1}{9}$ *nails.*

(55) Reduce $\frac{4}{5}$ of a mile to its proper quantity.
Ans. 6 *furl.* 16 *poles*

(56) Reduce $\frac{3}{8}$ of an acre to its proper quantity.
Ans. 2 *roods*, 20 *poles.*

(57) Reduce $\frac{6}{7}$ of a hogshead of wine to its proper quantity.
Ans. 54 *gallons.*

(58) Reduce $\frac{3}{9}$ of a barrel of beer to its proper quantity.
Ans. 12 *gallons.*

(59) Reduce $\frac{5}{12}$ of a chaldron of coals to its proper quantity.
Ans. 15 *bushels.*

(60) Reduce $\frac{3}{5}$ of a month to its proper time.
Ans. 2 *weeks.* 2 *days*, $19\frac{1}{5}$ *hour.*

12. *To reduce any given quantity to the fraction of any greater denomination, retaining the same value.*

RULE.—Reduce the given quantity to the lowest term mentioned for a numorater, under which set the integral part (reduced to the same term) for a denominator, and it will give the fraction required.

EXAMPLES.

(61) Reduce 15s. to the fraction of a pound sterling.
Ans. $\frac{15}{20}$=$\frac{3}{4}$£.

(62) Reduce 4d. $3\frac{1}{5}$ qrs. to the fraction of a shilling.
Ans. $\frac{2}{5}$.

(63) Reduce 9 oz. $2\frac{3}{7}$ dr. to the fraction of a lb. Avoirdupois.
Ans. $\frac{4}{7}$.

(64) Reduce 3 qrs. 8 lbs. 1 oz. $12\frac{4}{9}$ dr. to the fraction of a cwt.
Ans. $\frac{7}{9}$.

(65) Reduce 6 oz. 5 dwts. to the fraction of a lb. Troy.
Ans. $\frac{9}{16}$.

(66) Reduce 2 qrs. $3\frac{1}{9}$ nails, to the fraction of an English ell.
Ans. $\frac{1}{5}$.

(67) Reduce 6 furlongs, 16 poles, to the fraction of a mile.
Ans. $\frac{4}{5}$.

(68) Reduce 2 roods, 20 poles, to the fraction of an acre.
Ans. $\frac{5}{8}$.

(69) Reduce 54 gallons to the fraction of a hogshead of wine.
Ans. $\frac{6}{7}$.

(70) Reduce 12 gallons to the fraction of a barrel of beer.
Ans. $\frac{1}{3}$.

(71) Reduce 15 bushels to the fraction of a chaldron of coals. Ans. $\frac{5}{7}$.

(72) Reduce 2 weeks, 2 days, $19\frac{1}{5}$ hours, to the fraction of a month. Ans. $\frac{3}{7}$.

ADDITION OF VULGAR FRACTIONS.

RULE.—Reduce the given fractions to a common denominator, then add all the numerators together, under which place the common denominator.

EXAMPLES.

(1) Add $\frac{2}{3}$ and $\frac{5}{7}$ together. $\frac{14}{21}+\frac{15}{21}=\frac{29}{21}=1\frac{8}{21}$. Ans

(2) Add $\frac{3}{4}$, $\frac{2}{7}$, and $\frac{5}{6}$ together. Ans. $1\frac{46}{168}$.

(3) Add $\frac{1}{5}$, $4\frac{1}{2}$, and $\frac{2}{5}$ together. Ans. $4\frac{70}{75}$.

(4) Add $7\frac{2}{3}$ and $\frac{2}{5}$ together. Ans. $8\frac{1}{15}$.

(5) Add $\frac{2}{7}$ and $\frac{2}{3}$ of $\frac{3}{4}$ together. Ans, $\frac{11}{14}$.

(6) Add $5\frac{2}{3}$, $6\frac{7}{8}$, and $4\frac{1}{2}$ together. Ans. $17\frac{1}{24}$.

When the fractions are of several denominations, reduce them to their proper quantities, and add as before.

(7) Add $\frac{3}{4}$ of a pound to $\frac{5}{6}$ of a shilling. Ans. 15*s.* 10*d.*

(8) Add $\frac{1}{3}$ of a penny to $\frac{2}{3}$ of a pound. Ans. 13*s.* $4\frac{1}{2}$*d.*

(9) Add $\frac{3}{4}$ of a lb. Troy to $\frac{1}{6}$ of an ounce.
Ans. 9 *oz.* 3 *dwts.* 8 *grs.*

(10) Add $\frac{4}{5}$ of a ton to $\frac{5}{6}$ of a lb. Ans. 16 *cwt.* 13 *oz.* $5\frac{1}{3}$ *dr.*

(11) Add $\frac{2}{3}$ of a chaldron to $\frac{3}{4}$ of a bushel.
Ans. 24 *bush.* 3 *pecks.*

(12) Add $\frac{1}{6}$ of a yard to $\frac{2}{3}$ of an inch.
Ans. 6 *inches*, 2 *bar. c.*

SUBTRACTION OF VULGAR FRACTIONS.

RULE 1.—Reduce the given fractions to a common denominator, then subtract the less numerator from the greater, and place the remainder over the common denominator.

2.—When the lower fraction is greater than the upper, subtract the numerator of the lower fraction from the denominator, and to that difference add the upper numerator, carrying one to the unit's place of the lower whole number.

EXAMPLES.

(1) From $\frac{3}{4}$ take $\frac{5}{7}$.
$3\times7=21, 5\times4=20, 21-20=1$ numerator.
$4\times7=28$ denominator $=\frac{1}{28}$ Ans.
(2) From $\frac{5}{6}$ take $\frac{3}{5}$ of $\frac{5}{8}$. Ans. $\frac{1}{8}\frac{1}{6}$.
(3) From $5\frac{2}{3}$ take $\frac{9}{10}$. Ans. $4\frac{23}{30}$.
(4) From $\frac{3}{7}\frac{8}{9}$ take $\frac{3}{5}$. Ans. $\frac{49}{315}$.
(5) From $\frac{19}{20}$ take $\frac{1}{7}$ of $\frac{3}{5}$. Ans. $\frac{113}{140}$.
(6) From $64\frac{1}{4}$ take $\frac{2}{3}$ of $\frac{3}{4}$. Ans. $63\frac{3}{4}$.

When the fractions are of several denominations, reduce them to their proper quantities, and subtract as before.

(7) From $\frac{3}{4}$ of a pound take $\frac{3}{4}$ of a shilling. Ans. 14*s.* 3*d.*
(8) From $\frac{2}{3}$ of a shilling take $\frac{1}{2}$ of a penny. Ans. $7\frac{1}{2}d.$
(9) From $\frac{3}{4}$ of a pound Troy, take $\frac{1}{6}$ of an ounce.
Ans. 8 oz. 16 *dwts.* 16 *grs.*
(10) From $\frac{4}{5}$ of a ton take $\frac{5}{6}$ of a lb.
Ans. 15 *cwt.* 3 *qrs.* 27 *lbs.* 2 *oz.* $10\frac{2}{3}$ *dr.*
(11) From $\frac{2}{3}$ of a chaldron take $\frac{3}{4}$ of a bushel.
Ans. 23 *bushels,* 1 *peck.*
(12) From $\frac{1}{6}$ of a yard take $\frac{2}{3}$ of an inch. Ans. 5 *in.* 1 *b.c.*

MULTIPLICATION OF VULGAR FRACTIONS.

RULE.—Prepare the given numbers (if they require it) by the rules of Reduction; then multiply the numerators together for a new numerator, and the denominators for a new denominator.

When any number, either whole or mixed, is multiplied by a fraction, the product will always be less than the multiplicand, in the same proportion as the multiplying fraction is less than the unit.

EXAMPLES.

(1) Multiply $\frac{3}{4}$ by $\frac{3}{5}$. Ans. $3\times3=9$ num. $4\times5=20$ den. $=\frac{9}{20}$.
(2) Multiply $\frac{7}{9}$ by $\frac{3}{8}$. Ans. $\frac{14}{27}$.
(3) Multiply $48\frac{3}{5}$ by $13\frac{1}{8}$. Ans. $672\frac{9}{40}$.
(4) Multiply $430\frac{6}{10}$ by $18\frac{3}{7}$. Ans. $7935\frac{2}{5}$.
(5) Multiply $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{1}{7}$ of $\frac{4}{5}$. Ans. $\frac{96}{2940}=\frac{16}{490}$.
(6) Multiply $\frac{9}{10}$ by $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$. Ans. $\frac{3}{8}$
(7) Multiply $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{3}{3}$ of $\frac{1}{3}$. Ans. $\frac{1}{6}$.
(8) Multiply $\frac{1}{4}$ of $\frac{2}{8}$ by $\frac{1}{2}$. Ans. $\frac{1}{32}$.
(9) Multiply $5\frac{6}{7}$ by $\frac{5}{6}$. Ans. $4\frac{37}{42}$.

(10) Multiply 24 by $\frac{2}{3}$. Ans. 16.
(11) Multiply $9\frac{1}{8}$ by $\frac{2}{6}$. Ans. $3\frac{1}{8}$.
(12) Multiply £3. 3s. 4d. by itself. Ans. £10 : 0 : $6\frac{1}{9}$.$\frac{4}{6}$.

DIVISION OF VULGAR FRACTIONS.

RULE.—Prepare the given numbers (if they require it) by the rules of Reduction; then multiply the denominator of the divisor into the numerator of the dividend for a new numerator, and the numerator of the divisor into the denominator of the dividend for a new denominator.

When any whole number is divided by a fraction less than unity, the quotient will be greater than the dividend; but if any fraction be divided by a whole number greater than unity, the quotient will be less than the dividend.

EXAMPLES.

(1) Divide $\frac{9}{10}$ by $\frac{3}{5}$. $5 \times 9 = 45$ num. $3 \times 20 = 60$ den $\frac{45}{60} = \frac{3}{4}$.
(2) Divide $\frac{14}{27}$ by $\frac{2}{3}$. Ans. $\frac{7}{9}$.
(3) Divide $672\frac{9}{30}$ by $13\frac{5}{6}$. Ans. $48\frac{3}{5}$.
(4) Divide $7935\frac{24}{70}$ by $18\frac{3}{7}$. Ans. $430\frac{3}{5}$.
(5) Divide $\frac{3}{8}$ by $\frac{3}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$. Ans. $\frac{9}{10}$.
(6) Divide $\frac{3}{5}$ of 16 by $\frac{5}{7}$ of $\frac{3}{4}$. Ans. $19\frac{4}{15}$.
(7) Divide $\frac{1}{2}$ of $\frac{2}{3}$ by $\frac{2}{3}$ of $\frac{3}{4}$. Ans. $\frac{24}{36} = \frac{2}{3}$.
(8) Divide $9\frac{2}{12}$ by $\frac{1}{2}$ of 7. Ans. $2\frac{13}{21}$.
(9) Divide 5 by $\frac{7}{10}$. Ans. $7\frac{1}{7}$.
(10) Divide 16 by 24. Ans. $\frac{2}{3}$.
(11) Divide $5205\frac{2}{10}$ by $\frac{4}{5}$ of 91. Ans. $71\frac{1}{2}$.
(12) Divide $3\frac{1}{6}$ by $9\frac{1}{2}$. Ans. $\frac{1}{3}$.

THE SINGLE RULE OF THREE DIRECT IN VULGAR FRACTIONS.

RULE.—Reduce the numbers as before directed in Reduction, so that the first and third may be of the same name; multiply the numerator of the first fraction by the denominator of the second and third, for a new denominator; then multiply the denominator of the first fraction by the numerator of the second and third, for a new numerator; that fraction will be the answer to the question, which reduca

to its proper quantity.—Or, when the three terms are properly reduced, proceed as in the Rule of Three in whole numbers.

EXAMPLES.

(1) If $\frac{3}{4}$ of a yard cost £$\frac{5}{8}$—what will $\frac{9}{10}$ of a yard come to at that rate? Ans. $\frac{1}{2}\frac{8}{4}$=15*s.*

$\frac{3}{4}$ yd. : $\frac{5}{8}$ £. :: $\frac{9}{10}$ yd. : £$\frac{1}{2}\frac{8}{4}$.

for $4\times5\times9=180$ num.
and $3\times8\times10=240$ den. or $\frac{3}{8}\times\frac{9}{10}=\frac{4}{8}\frac{5}{0}$ $\frac{3}{4})\frac{4}{8}\frac{5}{0}(\frac{1}{7}\frac{5}{0}$.

(2) If $\frac{5}{6}$ of a yard cost £$\frac{2}{3}$—what will $\frac{1}{12}$ of a yard cost? Ans. 14*s.* 8*d*

(3) If $\frac{5}{7}$ of a cwt. cost £$\frac{1}{12}$—what will 1 cwt. cost? Ans. £1 : 5 : 8.

(4) If $\frac{7}{8}$ of a lb. cost $\frac{3}{4}$s.—how many pounds will $\frac{8}{9}$ of 1s. buy? Ans. $1\frac{1}{7}$, *lb.*

(5) If $\frac{3}{5}$ of an ell of holland cost £$\frac{1}{3}$—what will $12\frac{2}{3}$ ells cost at that rate? Ans. £7 : 0 : $8\frac{3}{4},\frac{5}{7}$.

(6) If $12\frac{1}{2}$ yards of cloth cost 15s. 9d.—what will $48\frac{1}{4}$ yards cost at the same rate? Ans. £3 : 0 : $9\frac{1}{2}.\frac{4}{2}\frac{4}{5}$.

(7) If $\frac{9}{10}$ of a cwt. cost 284s.—what will $7\frac{1}{2}$ cwt. cost at the same rate? Ans. £118 : 6 : 8.

(8) If 3 yards of broad cloth cost £$2\frac{4}{5}$—what will $10\frac{3}{7}$ yards cost? Ans. £9 : 12*s.*

(9) If $\frac{1}{4}$ of a yard cost £$\frac{2}{3}$—what will $\frac{3}{5}$ of an ell English come to at the same rate? Ans. £2.

(10) If 1 lb. of cochineal cost £1. 5s.—what will $36\frac{7}{10}$ lbs. come to? Ans. £45 : 17 : 6.

(11) If 1 yard of broad cloth cost $15\frac{5}{8}$s.—what will 4 pieces cost, each containing $27\frac{3}{7}$ yards? Ans. £85 : 14 : $3\frac{1}{4}.\frac{5}{7}$.

(12) Bought $3\frac{1}{2}$ pieces of silk, each containing $24\frac{3}{8}$ ells, at 6s. $0\frac{3}{4}$d. per ell—I desire to know what the whole quantity cost? Ans. £25 : 17 : $2\frac{1}{4}.\frac{1}{1}\frac{5}{6}$.

THE SINGLE RULE OF THREE INVERSE IN VULGAR FRACTIONS.

EXAMPLES.

(1) If 28 men can build a house in $50\frac{3}{4}$ days—how many men can do the same in 12 days? Ans. $118\frac{1}{2}$ *men.*

(2) If $25\frac{2}{7}$s. will pay for the carriage of 1 cwt. $145\frac{1}{4}$ miles—how far may $6\frac{1}{2}$ cwt. be carried for the same money? Ans. $22\frac{9}{2}\frac{9}{0}$ *miles.*

(3) If $3\frac{1}{4}$ yards of cloth, that is $1\frac{1}{2}$ yard wide, be sufficient to make a cloak—how much must I have of that sort which is $\frac{4}{5}$ yard wide, to make another of the same size?

Ans. $4\frac{7}{8}$ *yards.*

(4) If 8 men can do a piece of work in $4\frac{1}{2}$ hours—in how many hours will 10 men do the same work?

Ans. $1\frac{7}{20}$ *hours.*

(5) If a penny white loaf weighs 7 oz. when a bushel of wheat costs 5s. 6d.—what is the bushel worth when the penny white loaf weighs but $2\frac{1}{2}$ oz.? Ans. 15*s.* $4\frac{4}{5}$*d.*

(6) What quantity of shaloon that is $\frac{3}{4}$ yard wide will line $7\frac{1}{2}$ yards of cloth that is $1\frac{1}{2}$ yards wide?

Ans. 15 *yards.*

THE DOUBLE RULE OF THREE

IN VULGAR FRACTIONS.

EXAMPLES.

(1) If a carrier receives £$2\frac{1}{10}$ for the carriage of 3 cwt. 150 miles—how much ought he to receive for the carriage of 7 cwt. $3\frac{1}{2}$ qrs. 50 miles?

Ans. £1 : 16 : 9.

(2) If £100. in 12 months gain £6. interest—what principal will gain £$3\frac{3}{8}$ in 9 months? Ans. 75.

(3) If 9 students spend £$10\frac{7}{9}$ in 18 days—how much will 20 students spend in 30 days?

Ans. £39 : 18 : $4\frac{360}{1453}$.

(4) A man and his wife having laboured 1 day earned $4\frac{5}{8}$s. —how much must they have for $10\frac{1}{2}$ days when their 2 sons helped them? Ans. £4 : 17 : $1\frac{1}{2}$.

(5) If £50. in 5 months gain £$2\frac{37}{144}$—what time will £$13\frac{1}{2}$ require to gain £$1\frac{1}{12}$?

Ans. 9 *months.*

(6) If the carriage of 60 cwt. 20 miles cost £$14\frac{1}{2}$—what weight can I have carried 30 miles for £$5\frac{7}{10}$?

Ans. 15 *cwt.*

PART III.

DECIMAL FRACTIONS.

NUMERATION.

In Decimal Fractions the integer, or whole thing, as one pound, one yard, one gallon, &c. is supposed to be divided into ten equal parts, and those parts into tenths, and so on without end.

So that the denominator of a decimal, being always known to consist of a unit, with as many cyphers as the numerator has places, is therefore never set down; the parts being only distinguished from the whole numbers by a comma prefixed; thus, ,5 which stands for $\frac{5}{10}$; ,25 $\frac{25}{100}$; ,123 for $\frac{123}{1000}$.

But the different value of figures appears plainer by the following table.

Whole numbers.							Decimal parts.						
7	6	5	4	3	2	1	2	3	4	5	6	7	
Millions.	C Thousands.	X Thousands.	Thousands.	Hundreds.	Tens.	Units.	Parts of Tens.	Parts of Hundreds.	Parts of Thousands.	Parts of X Thousands.	Parts of C Thousands.	Parts of Millions.	

From which it plainly appears. that as whole numbers increase in a tenfold proportion to the left-hand, decimal parts decrease in a tenfold proportion to the right-hand; so that cyphers placed before decimal parts decrease their value by removing them farther from the comma. or unit's place: thus, ,5 is 5 parts of 10 or $\frac{5}{10}$; ,05 is 5 parts of 100, or $\frac{5}{100}$; ,005 is 5 parts of 1000, or $\frac{5}{1000}$; ,0005 is 5 parts of 10000, or $\frac{5}{10000}$. But cyphers after decimal parts do not alter their value, for ,5 ,50 ,500 &c. are each but $\frac{5}{10}$ of the unit.

A FINITE DECIMAL is that which ends at a certain number of places; but an INFINITE is that which nowhere ends.

ADDITION OF DECIMALS.

RULE.—In setting down the proposed numbers to be added, great care must be taken in placing every figure directly underneath those of the same value, whether they be mixed numbers, or pure decimal parts: and to perform which there must be a due regard had to the commas, or separating points, which ought always to stand in a direct line, one under another; and to the right-hand of them carefully place the decimal parts, according to their respective values; then add them as in whole numbers.

EXAMPLES.

(1) Add 72,5+32,071+2,1574+371,4+2,75+480,8784.
(2) Add 30,07+2,0071+59,4+3207,1.
(3) Add 3,5+47,25+927,01+2,0073+1,5.
(4) Add 52,75+47,21+724+31,452+3075.
(5) Add 3275+27,514+1,005+725+7,32,
(6) Add 27,5+52+3,2075+5741+2720.

SUBTRACTION OF DECIMALS.

RULE.—Subtraction of decimals differs but little from whole numbers, only in placing the numbers, which must be carefully observed, as in Addition.

EXAMPLES.

(1) From ,2754 take	,2371	(5) From 571 take	54,72
(2) From 2,37 take	1,76	(6) From 625 take	76,91
(3) From 271 take	215,7	(7) From 23,415 take	,3742
(4) From 270,2 take	76,4075	(8) From ,107 take	,0007

MULTIPLICATION OF DECIMALS.

RULE.—Place the factors, and multiply them as in whole numbers, and from the product towards the right-hand, cut off as many places for decimals as there are in both factors

together; but if there should not be so many places in the product, supply the defect with cyphers to the left-hand.

EXAMPLES

(1) Multiply ,2365 by ,2435. Ans. ,05758775.

(2) Mult. 2,071 by	2,27	(7) Mult. 27,35 by	7,70071
(3) Mult. 27,15 by	25,3	(8) Mult. 5,721 by	,0075
(4) Mult. 79347 by	23,15	(9) Mult. 2,07 by	,007
(5) Mult. 17105 by	,3257	(10) Mult. 20,15 by	,2705
(6) Mult. 17105 by	,0237	(11) Mult. ,907 by	,0025

When any number of decimals is to be multiplied by 10, 100, 1000, &c., it is only removing the separating point in the multiplicand so many places towards the right-hand as there are cyphers in the multiplier; thus ,578 × 10=5,78, ,578 × 100=57,8. ,578 × 1000=578. ,578 × 10000=5780.

CONTRACTED MULTIPLICATION OF DECIMALS.

RULE.—Put the unit's place of the multiplier under that place of the multiplicand that is intended to be kept in the product; then invert the order of all the other figures *i. e.* write them all the contrary way; then in multiplying, begin at the figure in the multiplicand, which stands over the figure you are then multiplying with, and set down the first figure of each particular product directly one under the other, and have a due regard to the increase arising from the figures on the right-hand of that figure you begin to multiply at in the multiplicand.

☞ That in multiplying the figure left out every time next the right-hand in the multiplicand, if the product be 5, or upwards to 15, carry 1; if 15, or upwards to 25, carry 2; and if 25, or upwards to 35, carry 3, &c.

EXAMPLES.

(12) Multiply 384,672158 by 36,8345, and let there be only 4 places of decimals in the product.

Contracted way.	*Common way.*
384,672158	384,672158
5438,63	36,8345
115401647	1923 360790
23080329	15386 88632
3077377	115401 6474
115402	3077377 264
15387	23080329 48
1923	115401647 4
14169,2065	14169,2066 038510

(13) Multiply 3,141592 by 52,7438, and leave only 4 places of decimals. Ans. 165,6994.

(14) Multiply 2,38645 by 8,2175, and leave only 4 places of decimals. Ans. 19,6107.

(15) Multiply 375,13758 by 16,7324, and let there be only 1 place of decimals. Ans. 6276,9.

(16) Multiply 375,13758 by 16,7324, and leave only 4 places of decimals. Ans. 6276,952.

(17) Multiply 395,3756 by ,75642, and let there be only 4 places of decimals. Ans. 299,07

DIVISION OF DECIMALS.

THIS rule is also worked as in whole numbers: the only difficulty is in valuing the quotient, which is done by any of the following rules.

RULE 1.—The first figure in the quotient is always of the same value with that figure of the dividend, which answers or stands over the place of units in the divisor.

2.—The quotient must always have so many decimal places as the dividend has more than the divisor.

Note. 1.—If the divisor and dividend have both the same number of decimal parts, the quotient will be a whole number.

2.—If the dividend hath not so many places of decimals as are in the divisor, then so many cyphers must be annexed to the dividend as will make them equal and the quotien will then be a whole number.

3.—But if, when the division is done, the quotient has not so many figures as it should have places of decimals, then so many cyphers must be prefixed as there are places wanting.

EXAMPLES.

(1) Divide 8564,825 by 6,321. Ans. 1354,9.

(2) Divide 48 by 1,44
(3) Divide 217,75 by 65
(4) Divide 125 by ,1045
(5) Divide 709 by 2,574
(6) Divide 5,714 by 8275
(7) Divide 7382,54 by 6,4252
(8) Divide ,0851648 by 4323
(9) Divide 267,15975 by 1,25
(10) Divide 72,1564 by ,1347
(11) Divide 715 by ,3075

When the numbers are to be divided by 10, 100, 1000, 10000, &c., it is performed by placing the separating point in the dividend so many places towards the left-hand, as there are cyphers in the divisor.

Thus, $5784 \div 10 = 578,4$ | $5784 \div 1000 = 5,784$
$5784 \div 100 = 57,84$ | $5784 \div 10000 = ,5784$

CONTRACTED

DIVISION OF DECIMALS.

RULE.—By the first rule find what is the value of the first figure in the quotient; then, by knowing the first figure's denomination, the decimal places may be reduced to any number, by taking as many of the left-hand figures of the dividend as will answer them; and in dividing omit one figure of the divisor at each following operation.

Note.—That in multiplying every figure left out in the divisor, you must carry 1, if it be 5 or upwards to 15; if 15 or upwards to 25, carry 2,; if 25 or upwards to 35, carry 3, &c.

EXAMPLES.

(12) Divide 721,17562 by 2,257432, and let there be only 3 places of decimals in the quotient.

Contracted way.	*Common way.*
2,257432)721,17562)319,467	2,257432)721.17562(319,467
6772296	6772296
439460.	439460 | 2
225743.	225743 | 2
213717..	213717 | 00
203169..	203168 | 88
10548...	10548 | 120
9030..	9029 | 728
1518....	1518 | 3920
1354....	1354 | 4592
164.....	163 | 93280
158....;	158 | 92824
6	5 | 91256

(13) Divide 8,758615 by 5,2714167.
(14) Divide 51717591 by 8,7586.
(15) Divide 25,1367 by 217,35.
(16) Divide 51,47542 by ,123415,
(17) Divide 70,23 by 7,9863.
(18) Divide 27.104 by 3,712.

REDUCTION OF DECIMALS.

1. *To reduce a Vulgar Fraction to a Decimal*

RULE.—Add cyphers to the numerator, and divide by the denominator: the quotient is the decimal fraction required.

EXAMPLES.

(1) Reduce $\frac{1}{4}$.....to a decimal — 4)1,06(,25 Ans
(2) Reduce $\frac{1}{2}$.....to a decimal — Ans. ,5.
(3) Reduce $\frac{3}{4}$.....to a decimal — Ans. ,75.
(4) Reduce $\frac{3}{8}$.....to a decimal — Ans. ,375.
(5) Reduce $\frac{5}{26}$ ....to a decimal — Ans. ,1923076+
(6) Reduce $\frac{11}{14}$ of $\frac{10}{13}$ to a decimal — Ans. ,6043956+

Note 1.—If the given parts are of several denominations, they may be reduced by so many distinct operations as there are different parts, or by first reducing them into their lowest denominations, and then divide as before. Or,

2.—Write the given numbers perpendicularly under each other for dividends; proceed orderly from the least to the greatest; on the left thereof draw a line, and place opposite to every denomination such a number for a divisor as will reduce each of them to the next superior name; then proceed to divide by the first and every divisor as in Division, and the last quotient will be the decimal required. Or,

3.—Write half the greatest even number of shillings for the first decimal figure, and let the farthings in the given pence and farthings possess the second and third places; observing to increase the 2 place by 5, if the shillings are odd, and the third place by 1, when the farthings exceed 12, and by 2 when they exceed 37, which will give the decimal required.

(7) Reduce 5s. to the decimal of a £. Ans. ,25.
(8) Reduce 9s. to the decimal of a £. Ans. ,45.
(9) Reduce 16s. to the decimal of a £. Ans. ,8.
(10) Reduce 12s. 6d. to the decimal of a £. Ans. ,625.
(11) Reduce 12s. 8¼d. to the decimal of a £.
Ans. ,634375.

First.	*Second.*	*Third.*
12s. : 8¼	4 | 1,	2)12
12	12 | 8,25	,634 8¼
152	20 | 12,6875	4
4	,634375	34
960)609(,634375		

(12) Reduce 4s. 6d. to the decimal of a crown. Ans. ,9
(13) Reduce 11 oz. 17 dwts. to the decimal of a lb. Troy.
Ans. ,9875
(14) Reduce 12 drams to the decimal of a lb. Avoirdupois
Ans. ,046875
(15) Reduce 2 qrs. 14 lbs. to the decimal of a cwt.
Ans. ,625

(16) Reduce 6 furlongs, 4 poles, to the decimal of a mile.
Ans. ,7625.

(17) Reduce 2 quarts, 1 pint, to the decimal of a gallon.
Ans. ,625.

(18) Reduce 4 gallons, 2 quarts of wine, to the decimal of a hogshead. Ans. ,071428+.

(19) Reduce 2 gallons, 1 quart of beer, to the decimal of a barrel. Ans. ,0625.

(20) Reduce 52 days to the decimal of a year.
Ans. ,142465+.

2. *To find the value of a Decimal Fraction, in the known parts of an integer.*

RULE.—Multiply the decimal given by the number of parts of the next inferior denomination cutting off the decimals from the product; then multiply the remainder by the next inferior denomination; thus proceeding, till you have brought the least known parts of the integer.

EXAMPLES.

(21) What is the value of ,634375 of a £.

,634375
20
12,687500
12
8,250000
4
1,000000

(22) What is the value of ,9875 of a lb. Troy?
Ans. 11 *oz.* 17 *dwts.*

(23) What is the value of ,046875 of a lb. avoirdupois?
Ans. 12 *drams*

(24) What is the value of ,625 of a cwt?
Ans. 2 *qrs.* 14 *lbs*

(25) What is the value of ,625 of a gallon?
Ans. 2 *quarts*, 1 *pint*

(26) What is the value of ,071428+ of a hogshead of wine?
Ans. 4 *gallons*, 2 *quarts*

(27) What is the value of ,0625 of a barrel of beer?
Ans. 2 *gallons*, 1 *quart.*

(28) What is the value of ,142465+ of a year?
Ans. 52 *days*,

TABLE I.

English Coin.

£1. the Integer.

Sh.	*dec.*	*Sh.*	*dec.*
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence.	*Decimals.*
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Farth.	*Decimals.*
3	,003125
2	,0020833
1	,0010416

TABLE II.

Eng. Coin. 1 *Sh.*

Long Meas. 1 *Foot* the Integer.

Pence and Inches.	*Decimals.*
6	,5
5	,416666
4	,333333
3	,25
2	,166666
1	,083333

Farth.	*Decimals.*
3	,0625
2	,041666
1	,020833

TABLE III.

Troy Weight.

1 lb. the Integer.

Ounces the same as Pence in the last Table.

Penny-weights	*Decimals.*
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Grs.	*Decimals.*
12	,002083
11	,001910
10	,001736
9	,001562
8	,001389
7	,001215
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173

1 oz. the Integer.

Pennyweights the same as Shillings in the first Table.

Grs.	*Decimals.*
12	,055
11	,022916
10	,020833
9	,01875
8	,016666
7	,014583
6	,0125
5	,010416
4	,008333
3	,00625
2	,004166
1	,002083

TABLE IV.

Avoirdupois Weight.

112 lbs. the Integer.

Qrs.	*Decimals.*
3	,75
2	,5
1	,25

lbs.	*Decimals.*
14	,125
13	,116071
12	,107143
11	,098214
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Oz.	*Decimals.*
8	,004464
7	,003906

1	,003348
2	,002790
3	,002232
4	,001674
5	,001116
6	,000558

¼ Oz.	Decimals.
3	,000418
2	,000279
1	,000139

TABLE V.

AVOIRDUP. WT.

1 lb. the Integer.

Ounces	Decimals.
8	,5
7	,4375
6	,375
5	,3125
4	,25
3	,1875
2	,125
1	,0625

Drams.	Decimals.
8	,03126
7	,027343
6	,023437
5	,019531
4	,015625
3	,011718
2	,007812
1	,003906

TABLES VI.

LIQ. MEASURE.

1 Tun the Integer.

Gals.	Decimals.
100	,396825
90	,357141
80	,317460
70	,277777
60	,238095
50	,198412
40	,158730
30	,119047
20	,079365
10	,039682
9	,035714
8	,031746
7	,027777
6	,023809
5	,019841
4	,015873
3	,011904
2	,007936
1	,003968

Pints.	Decimals.
4	,001984
3	,001488
2	,000992
1	,000496

1 Hogshead the Integer.

Gals.	Decimals.
30	,476190
20	,317460
10	,158730
9	,142857
8	,126984
7	,111111
6	,095238
5	,079365
4	,063492
3	,047619
2	,031746
1	,015873

Pints.	Decimals.
3	·005952
2	·003968
1	·001984

TABLE VII.

MEASURE.

Liquid. *Dry.*
1 Gallon 1 Quarter Integers.

Pints	Dec.	Bush.
4	,5	4
3	,375	3
2	,25	2
1	,125	1

Q.pt.	D c.	Pk.
3	,09375	3
2	,0625	2
1	,03125	1

Decimals.	Q. pks
,0234375	3
,015625	2
,0078125	1

Decimals.	Pints.
,005859	3
,003906	2
,001953	1

TABLE VIII.

LONG MEASURE.

1 Mile the Integer.

Yards.	Decimals.
1000	,568182
900	,511364
800	,454545
700	,397727
600	340909

500	,284091
400	,227272
300	,170454
200	,113636
100	,056818
90	,051136
80	,045454
70	,039773
60	,034091
50	,028409
40	,022727
30	,017045
20	,011364
10	,005682
9	,005114
8	,004545
7	,003977
6	,003409
5	,002841
4	,002273
3	,001704
2	,001136
1	,000568

Feet.	*Decimals.*
2	0003787
1	0001894

Inches.	*Decimals.*
6	,0000947
3	,0000474
1	,0000158

TABLE IX.

TIME.

1 Year the Integer. Months the same as Pence in the second Table.

365	1,000000
300	,821918
200	,547945
100	,273973
90	,246575
80	,219178
70	,191781
60	,164383
50	,136986
40	,109589
30	,082192
20	,054794
10	,027397
9	,024657
8	,021918
7	,019178
6	,016438
5	,013698
4	,010959
3	,008219
2	,005479
1	,002739

1 Day the Integer.

Hours.	*Decimals.*
12	,5
11	,458333
10	,416666
9	,375
8	,333333
7	,291666
6	,25
5	,208333
4	,166666
3	,125
2	,083333
1	,041666

Min.	*Decimals.*
30	,020833
20	,013888
10	,006944
9	,00625
8	,005555
7	,004861
6	,004166
5	,003472
4	,002777
3	,002083
2	,001388
1	,000694

TABLE X.

CLOTH MEASURE.

1 Yard the Integer. Qrs. the same as the fourth Table.

Nails.	*Decimals.*
3	,1875
2	,125
1	,0625

TABLE XI.

LEAD WEIGHT.

1 Fother the Integ.

Hund.	*Decimals.*
10	,512820
9	,461538
8	,410256
7	,358974
6	,307692
5	,256410
4	,205128
3	,153846
2	,102564
1	,051282

Qrs.	*Decimals.*
2	,025641
1	,012820

lbs.	*Decimals.*
14	,0064102
13	,0059523
12	,0054945
11	,0050366
10	,0045787
9	,0041208
8	,0036630
7	,0032051
6	,0027472
5	,0022893
4	,0018315
3	,0013736
2	,0009157
1	,0004578

THE RULE OF THREE IN DECIMALS.

EXAMPLES.

(1) If 26½ yards cost £3. 16s. 3d.—what will 32¼ yards come to? *Yds.* *£.* *Yds.*

26,5 : 3,8125 :: 32, 25

32,25

26,5)122,953125(4,63974=£4 : 12 : 9½.

(2) What will the pay of 540 men come to at £1. 5s. 6d. per man? Ans. £688 : 10*s.*

(3) If 7¾ yards of cloth cost £2. 12s. 9d.—what will 140½ yards of the same cost? Ans. £47 : 16 : 3½.+

(4) If 1 chest of sugar weighing 7 cwt. 2 qrs. 14 lbs. cost £36. 12s. 9d.—what will 2 cwt. 1 qr. 21 lbs. of the same cost? Ans. £11 : 14 : 2¾.+

(5) A grocer buys 24 tons, 12 cwt. 2 qrs. 14 lb. 12 oz. of tobacco for £3678. 6s. 4d.—what will 1 oz. come to?

Ans. 1*d.*

(6) What will 326 lbs. 1 qr. of tobacco come to when 1½ lbs. are sold for 3s. 6d.? Ans. £38 : 1 : 3.

(7) What is the worth of 19 oz. 3 dwts. 5 grs. of gold, at £2. 19s. per oz.? Ans. £56 : 10 : 5½.

(8) What is the worth of 827¾ yards of painting, at 10½d. per yard? Ans. £36 : 4 : 3½.+

(9) If I lent my friend £34. for ⅝ of a year—how much ought he to lend me $\frac{5}{12}$ of a year to requite my kindness?

Ans. £51.

(10) If 3½ yards of cloth cost £1. 1s. 6d.—how many yards may be bought for £32. 15s. 6d.?

Ans. 106 *yds.* 2 *qrs.* 3 *nails.*

(11) If 1 oz. of silver cost 5s. 6d.—what is the price of a tankard that weighs 1 lb. 10 oz. 10 dwts. 4 grs.?

Ans. £6 : 3 : 9½.+

(12) If 1 lb. of tobacco cost 15d.—what cost 3 hogsheads, weighing together 15 cwt. 1 qr. 19 lbs.?

Ans. £107 : 18 : 9.

(13) If 1 cwt. of currants cost £2. 9s. 6d.—what will 45 cwt. 3 qrs. 14 lbs. cost at the same rate? Ans. £113 : 10 : 9¾.

(14) Bought 6 chests of sugar, each 6 cwt. 3 qrs. at £2. 16s. per cwt.—what do they come to? Ans. £113 : 8*s.*

(15) Bought a tankard for £10 12s. at the rate of 5s. 4d. per ounce—what is the weight? Ans. 39 *oz.* 15 *dwts.*

(16) Gave £187. 3s. 3d. for 25 cwt. 3 qrs. 14 lbs. of tobacco—what rate did I buy it per lb.? Ans. 15½*d.*

(17) Bought 29 lbs. 4 oz. of coffee for £10. 11s. 3d.—what was the value of 3 lbs.? Ans. £1 : 1 : 8.

(18) If I give 1s. 1d. for 3½ lbs. of cheese—what will be the value of 1 cwt.? Ans. £1 : 14 · 8.

EXTRACTION OF THE SQUARE ROOT.

EXTRACTING the Square Root is to find out such a number as being multiplied into itself, the product will be equal to the given number.

RULE. 1.—Point the given number, beginning at the unit's place, then to the hundreds, and so upon every second figure throughout.

2.—Seek the greatest square number in the first point towards the left-hand, placing the square number under the first point, and the root thereof in the quotient; subtract the square number from the first point, and to the remainder bring down the next point, and call that the *Resolvend.*

3.—Double the quotient, and place it for the divisor on the left-hand of the resolvend, seek how often the divisor is contained in the resolvend, (preserving always the unit's place,) and put the answer in the quotient, and also on the right-hand side of the divisor: then multiply by the figure last put in the quotient, and subtract the product from the resolvend; bring down the next point to the remainder, (if there be any more,) and proceed as before.

ROOTS.	1.	2.	3.	4.	5.	6.	7.	8.	9.
SQUARES.	1.	4.	9.	16.	25.	36.	49.	64.	81.

EXAMPLES.

(1) What is the square root of 119025?

```
1|19025(345 Ans.
 9
64)290
   256
685)3425
   3425
```

(2) What is the square root of 106929? Ans. 327.
(3) What is the square root of 2268741? Ans. 1506,23+.
(4) What is the square root of 7596796? Ans. 2756,228+.
(5) What is the square root of 36372961? Ans. 6031.
(6) What is the square root of 22071204? Ans. 4698.

When the given number consists of a whole number and decimals together, make the number of decimals even, by adding cyphers to them, so that there may be a point fall in the unit's place of the whole number.

(7) What is the square root of 3271,4207? Ans. 57,19+.
(8) What is the square root of 4795,25731? Ans. 69,247+.
(9) What is the square root of 4,372594? Ans. 2,091+.
(10) What is the square root of 2,2710957?
Ans. 1,50701+.
(11) What is the square root of ,00032754?
Ans. ,01809+.
12) What is the square root of 1,270054? Ans. 1,1269+.

To extract the Square Root of a Vulgar Fraction.

RULE.—Reduce the fraction to its lowest terms: then extract the square root of the numerator for a new numerator, and the square root of the denominator for a new denominator.

If the fraction be a surd, *i. e.*, a number where a root can never be exactly found, reduce it to a decimal and extract the root of it.

EXAMPLES.

(13) What is the square root of $\frac{2304}{5184}$? Ans. $\frac{2}{3}$.
(14) What is the square root of $\frac{2704}{4225}$? Ans. $\frac{4}{5}$.
(15) What is the square root of $\frac{9216}{12544}$? Ans. $\frac{6}{7}$.

SURDS.

(16) What is the square root of $\frac{275}{341}$? Ans. ,89802+.
(17) What is the square root of $\frac{357}{476}$? Ans. ,86602+.
18) What is the square root of $\frac{478}{549}$? Ans. ,93309+.

To extract the Square Root of a Mixed Number.

RULE 1.—Reduce the fractional part of the mixed number to its lowest term, and then the mixed number to an improper fraction.

2.—Extract the roots of the numerator and denominator for a new numerator and denominator.

If the mixed number given be a surd, reduce the fractional part to a decimal, annex it to the whole number, and extract the square root thereof.

EXAMPLES.

(19) What is the square root of $51\frac{2}{5}\frac{1}{5}$? Ans. $7\frac{1}{5}$.
(20) What is the square root of $27\frac{9}{16}$? Ans. $5\frac{1}{4}$.
(21) What is the square root of $9\frac{4}{49}\frac{3}{9}$? Ans $3\frac{1}{7}$.

SURDS.

(22) What is the square root of $85\frac{1}{1}\frac{4}{5}$? Ans. 9,27+.
(23) What is the square root of $8\frac{5}{7}$? Ans. 2,9519+.
(24) What is the square root of $6\frac{2}{5}$? Ans. 2,5298+.

THE APPLICATION.

(1) There is an army consisting of a certain number of men, who are placed rank and file (that is in the form of a square, each side having 576 men)—I desire to know how many the whole square contains? Ans. 331776.

(2) A certain pavement is made exactly square, each side of which contains 97 feet—I demand how many square feet are contained therein? Ans. 9409.

To find a mean proportional between any two given nnmbers.

RULE.—The square root of the product of the given numbers is the mean proportional sought.

EXAMPLES.

(3) What is the mean proportional between 3 and 12?
$3 \times 12 = 36$, then $\sqrt{36} = 6$, the mean proportional.
(4) What is the mean proportional between 4276 and 842?
Ans. 1897,4+.

To find the side of a sq are equal in area to any given superficies.

RULE.—The square root of the contents of any given superficies, is the side of a square equal in area.

EXAMPLES.

(5) If the contents of a given circle be 160—what is the side of the square? Ans. 12,649+.
(6) If the area of a cirele be 750—what is the side of the square equal? Ans. 27,38612+.

The area of a circle given to find the diameter.

RULE.—As 355 : 452, or as 1 : 1,273239 :: the area to the square of the diameter: or, multiply the square root of the area by 1,12837, and the product will be the diameter.

EXAMPLE.

(7) What length of cord will be fit to tie to a cow's tail, the other end fixed in the ground, to let her have the liberty of eating an acre of grass, and no more, supposing the cow and tail to be 5½ yards?

Ans. 6,1[illegible] +*perches.*

The area of a circle given to find the periphery or circumference.

RULE.—As 113 : 1420, or as 1 : 12,56637 :: the area to the square of the periphery;—or, multiply the square root of the area by 3,5449, and the product is the circumference.

EXAMPLES.

(8) When the area is 12—what is the circumference?

Ans. 12, 2799+.

(9) When the area is 160— what is the periphery?

Ans. 44,839+

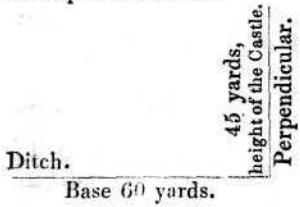
Any two sides of a right-angled triangle given to find the third side.

1. *The base and perpendicular given to find the hypothenuse.*

RULE.—The square root of the sum of the squares of the base and perpendicular is the length of the hypothenuse.

EXAMPLES.

(10) The top of a castle from the ground is 45 yards high, and surrounded with a ditch 60 yards broad; what length must a ladder be to reach from the outside of the ditch to the top of the castle? Ans. 75 *yards.*



(11) The wall of a town is 25 feet high, which is surrounded by a moat of 30 feet in breadth—I desire to know the length of a ladder that will reach from the outside of the moat to the top of the wall? Ans. 39,05+ *feet*

2. *The hypothenuse and perpendicular given to find the base.*

RULE.—The square root of the difference of the squares of the hypothenuse and perpendicular is the length of the base.

3. *The base and hypothenuse given to find the perpendicular.*

RULE.—The square root of the difference of the squares of the hypothenuse and base is the height of the perpendicular.

☞ The last two questions may be varied for examples to the last two propositions.

Any number of men being given, to form them into a square batalia, or to find the number of rank and file.

RULE.—The square root of the number of men given, is the number of men either rank or file.

(12) An army consisting of 331776 men—I desire to know how many rank and file? Ans. 576.

(13) A certain square pavement contains 48841 square stones, all of the same size—I demand how many are contained in one of the sides? Ans. 221.

EXTRACTION OF THE CUBE ROOT.

To extract the cube root of any given number is to find a number which when multiplied twice by itself will produce the given number.

RULE 1.—Point every third figure of the cube given, beginning at the unit's place, seek the greatest cube in the first point and subtract it therefrom, put the root in the quotient, and bring down the figures in the next point for a dividend.

2.—To find a divisor multiply the square of the figure placed in the quotient by 300, find how often it is contained in the dividend, and put the answer in the quotient for the second figure of the root.

3. Multiply the part of the root formerly found by the first figure placed in the root, and the product by 30, add this and the square of the last figure placed in the root to the divisor, multiply the sum of these by the last figure placed in the root, and subtract the product from the dividend, bring down another point for a new dividend, and proceed in the same manner.

Roots.	1.	2.	3.	4.	5.	6.	7.	8.	9.
Cubes.	1.	8.	27.	64.	125.	216.	343.	512.	729.

EXAMPLES.

(1) What is the cube root of 14886936 ?

$$\begin{array}{rl} & 14886936(246 \\ & 8 \\ \hline 2\times 2\times 300= & 1200 \quad)6886 \\ 2\times 4\times 30= & 240 \\ 4\times 4\times = & 16 \\ \hline & 1456\times 4=5824 \\ \hline 24\times 24\times 300= & 172800 \quad)1062936 \\ 24\times 6\times 30= & 4320 \\ 6\times 6\times = & 36 \\ \hline & 177156\times 6=1062936 \end{array}$$

(2) What is the cube root of 389017 ? Ans. 73.
(3) What is the cube root of 5735339 ? Ans. 179.
(4) What is the cube root of 32461759 ? Ans. 319.
(5) What is the cube root of 84604519 ? Ans. 439.
(6) What is the cube root of 259694072 ? Ans. 638.
(7) What is the cube root of 48228544 ? Ans. 364.
(8) What is the cube root of 27054036008 ? Ans. 3002.
(9) What is the cube root of 22069810125 ? Ans. 2805.
(10) What is the cube root of 122615327232 ? Ans. 4968.
(11) What is the cube root of 219365327791 ? Ans. 6031.
(12) What is the cube root of 673373097125 ? Ans. 8765.

When the given number consists of a whole number and decimal together, make the number of decimals consist of 3, 6, 9, &c. places, by adding cyphers thereto, so that there may be a point fall in the unit's place of the whole number

(13) What is the cube root of 12,977875 ? Ans. 2,35.
(14) What is the cube root of 36155,027576 ? Ans. 33,06.+
(15) What is the cube root of .001906624 ? Ans. ,124.

To extract the Cube Root of a Vulgar Fraction.

RULE.—Reduce the fraction to its lowest terms, then extract the cube root of its numerator and denominator for a new numerator and denominator.

EXAMPLES.

(16) What is the cube root of $\frac{250}{686}$? Ans. $\frac{5}{7}$.
(17) What is the cube root of $\frac{324}{1500}$? Ans. $\frac{3}{5}$.
(18) What is the cube root of $\frac{1520}{5130}$? Ans. $\frac{2}{3}$.

To extract the Cube Root of a Mixed Number.

RULE.—Reduce the fractional part to its lowest terms, and then the mixed number to an improper fraction: extract the cube roots of the numerator and denominator for a new numerator and denominator.

EXAMPLES.

(19) What is the cube root of $12\frac{19}{27}$? Ans. $2\frac{1}{3}$.
(20) What is the cube root of $31\frac{5}{343}$? Ans. $3\frac{1}{7}$.
(21) What is the cube root of $405\frac{28}{125}$? Ans. $7\frac{2}{5}$.

THE APPLICATION.

(1) If a cubical piece of timber be 47 inches long, 47 inches broad, and 47 inches deep—how many cubical inches doth it contain? Ans. 103823.

(2) There is a cellar dug, that is 12 feet every way, in length, breadth, and depth—how many solid feet of earth were taken out of it? Ans. 1728

(3) There is a stone of a cubic form, which contains 389017 solid feet—what is the superficial contents of one of ts sides? Ans. 5329.

Between two numbers given, to find two mean proportionals.

RULE.—Divide the greater extreme by the less, and the cube root of the quotient, multiplied by the less extreme, gives the less mean; multiply the said cube root by the less mean, and the product will be the greater mean proportional.

EXAMPLES.

(4) What are the two mean proportionals between 6 and 162? Ans. 18 *and* 54.

(5) What are the two mean proportionals between 4 and 108? Ans 12 *and* 36.

To find the side of a Cube that shall be equal in solidity to any given solid as, a globe, cylinder, prism, cone, &c.

RULE.—The cube root of the solid content of any solid body given is the side of a cube of equal solidity.

EXAMPLE.

(6) If the solid content of a globe be 10648—what is the side of a cube of equal solidity? Ans. 22.

The side of a cube being given, to find the side of the cube that shall be double, treble, &c., in quantity to the cube given.

RULE.—Cube the side given, and multiply it by 2, 3, &c. the cube root of the product is the side sought.

EXAMPLE.

(7) There is a cubical vessel, whose side is 12 inches, and it is required to find the side of another vessel that is to contain three times as much? Ans. 17,307.

EXTRACTING OF THE

BIQUADRATE ROOT.

To extract the biquadrate root, is to find out a number which being involved four times into itself, will produce the given number.

RULE.—First extract the square root of the given number, and then extract the square root of that square root, and it will give the biquadrate root required.

EXAMPLES.

(1) What is the biquadrate of 27? Ans. 531441.
(2) What is the biquadrate of 76? Ans. 33362176.
(3) What is the biquadrate of 275? Ans. 5719140625.
(4) What is the biquadrate root of 531441? Ans. 27.
(5) What is the biquadrate root of 33362176? Ans. 76.
(6) What is the biquadrate root of 5719140625? Ans. 275.

A GENERAL RULE FOR EXTRACTING THE ROOTS OF ALL POWERS.

1.—PREPARE the number given for extraction, by pointing off from the unit's place, as the root required directs.

2.—Find the first figure in the root by the table of powers, which subtract from the given number.

3.—Bring down the first figure in the next point to the remainder and call it the *dividend.*

4.—Involve the root into the next inferior power to that which is given, multiply it by the given power, and call it the *divisor.*

5.—Find a quotient figure by common division, and annex it to the root; then involve the whole root into the given power, and call it the *Subtrahend.*

6.—Subtract that number from as many points of the given power as are brought down, beginning at the lowest place, and to the remainder bring down the first figure of the next point for a new dividend.

7.—Find a new divisor, and proceed in all respects as before.

EXAMPLES

1) What is the square root of 141376?

1̇4̇1̇3̇7̇6̇(376	
9	$3\times 2=6$ divisor.
6)51 dividend.	$37\times 37=1369$ subtrahend.
1369 subtrahend.	$37\times 2=74$ divisor.
4) 447 dividend.	$376\times 376=141376$ subtrahend.
141376 subtrahend.	

(2) What is the cube root of 53157376?

```
                53157376(376
                27
             27)261 dividend.
                50653 subtrahend.
           4107)25043 dividend.
                53157376 subtrahend.
```

```
 3  ×   3  ×   3  =  27 divisor.
37  ×  37  ×  37  =  50653 subtrahend.
37  ×  37  ×   3  =  4107 divisor.
376 × 376 × 376 =  53157376 subtrahend.
```

(3) What is the biquadrate root of 19987173376?

```
              19987173376(376
               81
          108)1188 dividend.
              1874161 subtrahend.
       202612)1245563 dividend.
              19987173376 subtrahend.
```

```
 3× 3× 3× 4=108 divisor.
37× 37× 37× 37=1874161 subtrahend.
37× 37× 37× 4=202612 divisor.
376× 376× 376× 376=19987173376 subtrahend.
```

SIMPLE INTEREST.

THERE are five letters to be observed in Simple Interest, *viz.*

P. the principal.
T. the time.
R. the ratio or rate per cent.
I. the interest.
A, the amount.

A TABLE OF RATIOS.

3	,03	5½	,055	8	,08
3½	,035	6	,06	8½	,085
4	,04	6½	,065	9	,09
4½	,045	7	,07	9½	,095
5	,05	7½	,075	10	,1

☞ The ratio is the simple interest of £1. for 1 year, at the rate per cent. proposed, and is found thus:

As 100 : 3 :: 1 : ,03. As 100 : 3,5 :: 1 : ,035.

When the principal, time, and rate per cent. are given, to find the interest

RULE.—Multiply the principal, time, and ratio together and it will give the interest required.

Note.—The proposition and rule are better expressed thus:

I. *When* P, R, T, *are given to find* I.

RULE. *prt*=I.

*** When two or more letters are put together like a word, they are to be multiplied one into another.

EXAMPLES.

(1) What is the interest of £945. 10s. for 3 years, at 5 per cent. per annum?

945,5 × ,05 × 3 = 141,825, *or* £141 : 16 : 6. Ans.

(2) What is the interest of £547. 14s. at 4 per cent. per annum for 6 years? Ans. £131 : 8 : 11. 2,08 *qrs.*

(3) What is the interest of £796. 15s. at 4½ per cent. per annum for 5 years? Ans. £179 : 5 : 4. 2 *qrs.*

(4) What is the interest of £397. 9s. 5d. for 2½ years at 3½ per cent. per annum? Ans. £34 : 15 : 6. 3,5499 *qrs.*

(5) What is the interest of £554. 17s. 6d. for 3 years, 6 months, at 4½ per cent. per annum? Ans. £87 : 7 : 10. 1,1 *qrs.*

(6) What is the interest of £236. 18s. 9d. for 3 years, 9 months, at 5½ per cent. per annum?

Ans. £48 : 17 : 4. 1,625 *qrs.*

When the interest is for any number of days only.

RULE.—Multiply the interest of one pound for one day at the given rate, by the principal and number of days, and it will give the answer.

INTEREST OF £1. FOR ONE DAY.

per cent.	*Decimals.*	*per cent.*	*Decimals.*
3	,00008219178	6½	,00017808219
3½	,00009589041	7	,00019178082
4	,00010958904	7½	,00020547945
4½	,00012328767	8	,00021917808
5	,00013698630	8½	,00023287671
5½	,00015068493	9	,00024657534
6	,00016438356	9½	,00026027397

Note.—The above table is thus found.

As 365 : ,03 :: 1 : ,00008219178. And as 365 : ,035 :: 1 : ,00009589041, &c.

EXAMPLES.

(7) What is the interest of £240. for 120 days, at 4 per cent. per annum?

,00010958904 × 240 × 120 = £3 : 3 : 1¼. Ans.

(8) What is the interest of £563. at 6 per cent. per annum, for 126 days? Ans. £11 : 13 : 2½.+

(9) What is the interest of £560. for 60 days, at 5 per cent. per annum? Ans. £4 : 12 : 0½.+

(10) What is the interest of £364. 18s. for 154 days, at 5 per cent. per annum? Ans. £7 : 13 : 11¼.+

(11) What is the interest of £725. 15s. for 74 days, at 4 per cent. per annum? Ans. £5 : 17 : 8½.+

(12) What is the interest of £100. from the 1st. of June, 1849, to the 9th. of March following, at 5 per cent. per annum? Ans. £3 : 16 11¾.+

II. *When* P, R, T, *are given to find* A.

RULE. $prt+p=A$.

EXAMPLES.

(13 What will £279. 12s. amount to in 7 years, at 4½ per cent. per annum?

279,6 × ,045 × 7 + 279,6 = £367 : 13 : 5. 3,04 *qrs.* Ans.

(14) What will £320. 17s. amount to in 5 years, at 3½ per cent. per annum? Ans. £376 : 19 : 11. 2,8 *qrs.*

(15) What will £679. 13s. amount to in 6 years, at 5 per cent. per annum? Ans. £883 : 10 : 10. 3,2 *qrs.*

When there is any odd time given with the whole years, reduce the odd time into days, and work with the decimal parts of a year, which are equal to those days.

16) What will £926. 12s. amount to in 5½ years, at 4 per cent. per annum? Ans. £1130 : 9 : 0. 1,92 *qrs.*

(17) What will £368. 16s. amount to in 7¼ years, at 6½ per cent. per annum? Ans. £554 : 11 : 7. 3,68 *qrs.*

(18) What will £273. 18s. amount to in 4 years, 175 days, at 3 per cent. per annum?

Ans. £310 : 14 : 1. 3,35080064 *qrs.*

III. *When* A, R, T, *are given to find* P.

RULE. $\frac{a}{tr+1}=P.$

EXAMPLES.

(19) What principal being put to interest will amount to £367. 13s. 5d. 3,04 qrs. in 7 years, at 4½ per cent. per annum?

,045 × 7 + 1 = 1,315, then 367,674 ÷ 1,315 = £279 : 12*s.*

(20) What principal being put to interest will amount to £376. 19s. 11d. 2,8 qrs. in 5 years, at 3½ per cent. per annum? Ans. £320 : 17*s.*

(21) What principal being put to interest will amount to £883. 10s. 10d. 3,2 qrs. in 6 years, at 5 per cent. per annum? Ans. £679 : 13*s.*

(22) What principal being put to interest will amount to £1130. 9s. 0d. 1,92 qrs. in 5½ years, at 4 per cent. per annum? Ans. £926 : 12*s.*

(23) What principal will amount to £554. 11s. 7d. 3,68 qrs. in 7¼ years, at 6½ per cent. per annum? Ans. £368 : 16*s.*

(24) What principal will amount to £310. 14s. 1d. 3,35080064 qrs. in 4 years, 175 days, at 3 per cent. per annum? Ans. £273 : 18*s.*

IV. *When* A, P, T, *are given to find* R.

RULE. $\frac{a-p}{pt}=R.$

EXAMPLES.

(25) At what rate per cent. will £279. 12s. amount to £367. 13s. 5d. 3,04 qrs. in 7 years?

367,674 − 279,6 = 88,074, and 279,6 × 7 = 1957,2, then 88,074 ÷ 1957,2 = ,045, or 4½ per cent. Ans.

(26) At what rate per cent. will £320. 17s. amount to £376. 19s. 11d. 2,8 qrs. in 5 years? Ans. 3½ *per cent.*

(27) At what rate per cent. will £679. 13s. amount to £883. 10s. 10d. 3,2 qrs. in 6 years? Ans. 5 *per cent.*

28) At what rate per cent. will £926. 12s. amount to £1130. 9s. 0d. 1,92 qrs. in 5½ years? Ans. 4 *per cent.*

(29) At what rate per cent. will £368. 16s. amount to £554. 11s. 7d. 3,68 qrs. in 7¾ years? Ans. 6½ *per cent.*

(30) At what rate per cent. will £273. 18s. amount to £310. 14s. 1d. 3,35080064 qrs. in 4 years, 175 days? Ans. 3 *per cent.*

V. *When* A, P, R, *are given to find* T.

RULE. $\frac{a-p}{pr}=T.$

EXAMPLES.

(31) In what time will £279. 12s. amount to £367. 13s. 5d. 3,04 qrs. at 4½ per cent.?

367,674—279,6=88,074, and 279,6×,045=12,5820, then 88,074÷12,5820=7 *years* Ans.

(32) In what time will £320. 17s. amount to £376. 19s. 11d. 2,8 qrs. at 3½ per cent.? Ans. 5 *years.*

(33) In what time will £679. 13s. amount to £883. 10s. 10d. 3,2 qrs. at 5 per cent.? Ans. 6 *years.*

(34) In what time will £926. 12s. amount to £1130. 9s. 0d. 1,92 qrs. at 4 per cent.? Ans. 5½ *years.*

(35) In what time will £368 16s. amount to £554. 11s. 7d. 3,68 qrs. at 6½ per cent.? Ans. 7¾ *years.*

(36) In what time will £273. 18s. amount to £310. 14s. 1d. 3,35080064 qrs. at 3 per cent.? Ans. 4 *years*, 175 *days.*

ANNUITIES OR PENSIONS, &c., IN ARREARS.

Annuities or pensions, &c. are said to be in arrears, when they are payable, or due, either yearly, half-yearly, or quarterly, and are unpaid for any number of payments.

Note.—U represents the annuity, pension, or yearly rent; T, R, A, as before.

I. *When* U, R, T, *are given to find* A.

RULE. $\frac{ttu-tu}{2}\times r:+tu=A.$

EXAMPLES.

(37) If a salary of £150. be forborne 5 years, at 5 per cent. what will it amount to?

$\overline{5\times5\times150}-\overline{5\times150}=3000$, then $\frac{3000}{2}\times,05+\overline{5\times150}=$ £825. Ans.

(38) If £250. yearly pension be forborne 7 years—what will it amount to in that time at 6 per cent.? Ans. £2065.

(39) There is a house let upon a lease for 5½ years, at £60. per annum—what will be the amount of the whole time at 4½ per cent.? Ans. £363 : 8 : 3

(40) Suppose an annual pension of £28. remains unpaid for 8 years—what would it amount to at 5 per cent.?

Ans. £263 : 4*s*

Note.—When the annuities, &c., are to be paid half-yearly or quarterly, then

For *half-yearly payments*, take half of the ratio, half of the annuity, &c., and twice the number of years, and

For *quarterly payments*, take a fourth part of the ratio, a fourth part of the annuity, &c., and four times the number of years, and work as before.

EXAMPLES.

(41) If a salary of £150. payable every half-year, remains unpaid for 5 years—what would it amount to in that time at 5 per cent.? Ans. £834 : 7 : 6.

(42) If a salary of £150. payable every quarter, was left unpaid for 5 years—what would it amount to in that time at 5 per cent.? Ans. £839 : 1 : 3.

Note.—It may be observed, by comparing these last examples, that the amount of the half-yearly payments is more advantageous than the yearly, and the quarterly more than the half-yearly.

II. *When* A, R, T, are given to find U.

RULE. $\frac{2a}{ttr-tr+2t}=U$

EXAMPLES.

(43) If a salary amounted to £825. in 5 years, at 5 per cent.—what was the salary?

$825\times2=1650$, $\overline{5\times5\times,05}-\overline{5\times,05}+\overline{5\times2}=11$, then

$1650\div11=£150$ Ans.

(44) If a house be let upon a lease of 5½ years, and the amount for that time be £363. 8s. 3d. at 4½ per cent.—what is the yearly rent? Ans. £60.

(45) If a pension amounted to £2065. in seven years, at 6 per cent.—what is the pension? Ans. £250.

(46) Suppose the amount of a pension be £263. 4s. in 8 years, and at 5 per cent.—what is the pension? Ans. £28.

Note.—When the payments are half-yearly then take 4 a, half of the ratio, and twice the number of years; and if quarterly then take 8 a, one-fourth of the ratio, and four times the number of years; and proceed as before.

(47) If the amount of the salary, payable half-yearly for 5 years, and at 5 per cent. be £834. 7s. 6d.—what is the salary? Ans. £150.

(48) If the amount of the annuity, payable quarterly, be £839. 1s. 3d. for 5 years, at 5 per cent.—what is the annuity? Ans. £150.

III. *When* U, A, T, *are given to find* R.

RULE. $\frac{2u-2ut}{utt-ut}=R.$

EXAMPLES.

(49) If a salary of £150. per annum, amount to £825. in 5 years—what is the rate per cent.? Ans. 5 *per cent.*

$825\times2-150\times5\times2=150$, then $\frac{150}{150\times5\times5-150\times5}=,05$

(50) If a house be let upon a lease for 5½ years, at £60. per annum, and the amount for that time be £363. 8s. 3d.—what is the rate per cent.? Ans. 4½ *per cent.*

(51) If a pension of £250. per annum amounts to £2065. in 7 years—what is the rate per cent.? Ans. 6 *per cent.*

(52) Suppose the amount of a yearly pension of £28. be £263. 4s. in 8 years—what is the rate per cent.? Ans. 5 *per cent.*

Note.—When the payments are half-yearly, take 4 a,—4ut for a dividend, and work with half the annuity, and double the number of years for the divisor; if quarterly, take 8a—8ut, and work with a fourth of the annuity, and four times the number of years.

(53) If a salary of £150. per annum, payable half-yearly, amount to £834. 7s. 6d. in 5 years—what is the rate per cent.? Ans. 5 *per cent.*

(54) If an annuity of £150. per annum, payable quarterly, amount to £839. 1s. 3d. in 5 years—what is the rate per cent.? Ans. 5 *per cent.*

IV. *When* U, A, R, *are given to find* T.

RULE. First $\frac{2}{r} - 1 = x$ then $\sqrt{\frac{2a}{ur} + \frac{xx}{4} - \frac{x}{2}} = T$.

EXAMPLES.

(55) In what time will a salary of £150. per annum amount to £825. at 5 per cent.?

$\frac{2}{,05} - 1 = 39, \quad \frac{825 \times 2}{150 \times ,05} = 220, \quad \frac{39 \times 39}{4} = 380,25$, then

$\sqrt{220 + 380,25} = 24,5$, and $24,5 - \frac{39}{2} = 5$ years Ans.

(56) In what time will a yearly pension of £28. amount to £263. 4s. at 5 per cent.? Ans. 8 *years.*

Note.—If the payments are half-yearly, take half of the ratio and half of the annuity; if quarterly, one fourth of the ratio and one-fourth of the annuity; and T will be equal to those half-yearly or quarterly payments.

(57) If an annuity of £150. per annum, payable half-yearly amount to £834. 7s. 6d. at 5 per cent.—what time was the payment forborne? Ans. 5 *years.*

(58) If a yearly pension of £150. payable quarterly, amount to £839. 1s. 3d. at 5 per cent.—what was the time of forbearance? Ans. 5 *years.*

PRESENT WORTH OF ANNUITIES.

Note.—P represents the present worth; U, T, R, as before.

1. *When* U, T, R, *are given to find* P.

RULE. $\frac{ttr - tr + 2t}{2tr + 2} : \times u = P$.

EXAMPLES.

(59) What is the present worth of £150. per annum, to continue 5 years, at 5 per cent.?

$5 \times 5 \times ,05 - 5 \times ,05 + 5 \times 2 = 11$. $5 \times ,05 \times 2 + 2 = 2,5$, then $11 \div 2,5$ and $\times\ 150 = £660$. Ans.

(60) What is the yearly rent of a house of £60. to continue $5\frac{1}{2}$ years, worth in ready money, at $4\frac{1}{2}$ per cent.?
Ans. £291 : 6 : 3.

(61) What is the present worth of £250. per annum, to continue 7 years, at 6 per cent.? Ans. £1454 : 4 : 6.

(62) What is a pension of £28. per annum, worth in ready money, at 5 per cent. for 8 years? Ans. £188.

☞ The same thing is to be observed as in the first rule of annuities in arrears, concerning half-yearly and quarterly payments.

(63) What is the present worth of £150. payable half-yearly, for 5 years, at 5 per cent.? Ans. £667 : 10*s*.

(63) What is the present worth of £150. payable quarterly for 5 years, at 5 per cent.? Ans. £671 : 5*s*.

Note.—By comparing the last examples it will be found that the present worth of half-yearly payments is more advantageous than yearly; and quarterly than half-yearly.

II. *When* P, T, R, *are given to find* U

RULE. $\frac{tr+1}{ttr-tr+2t} : \times 2p = \mathrm{U}.$

EXAMPLES.

(65) If the present worth of a salary be £660. to continue 5 years, at 5 per cent.—what is the salary?

$\overline{5\times,05}+1=1,25 \qquad \overline{5\times5\times,05}-\overline{5\times,05}+10=11,$

then $\frac{1,25}{11}\times660\times2=£150.$ Ans.

(66) There is a house to be let upon a lease for $5\frac{1}{2}$ years to come—I desire to know the yearly rent, when the present worth at $4\frac{1}{2}$ per cent. is £291. 6*s*. 3*d*.? Ans. £60.

(67) What annuity is that which for 7 years' continuance at 6 per cent. produces £1454. 4*s*. 6*d*. present worth?
Ans. £250.

(68) What annuity is that which for 8 years' continuance produces £188. for the present worth, at 5 per cent.?
Ans. £28.

Note.—When the payments are half-yearly, take half the ratio, twice the number of years, and multiply by $4p.$; and when quarterly, take one-fourth of the ratio, four times the number of years, and multiply by $8p$.

(69) There is an annuity, payable half-yearly, for 5 years come—what is the yearly rent, when the present worth, at per cent., is £667. 10s. ? Ans. £150.

(70) There is an annuity payable quarterly, for 5 years to me—I desire to know the yearly income, when the present orth, at 5 per cent., is £671. 5s. ? Ans. £150

III. *When* U, P, T, *are given to find* R.

RULE. $\frac{tu-p\times 2}{2pt+tu-ttu}=\mathrm{R}$.

EXAMPLES.

(71) At what rate per cent. will an annuity of £150. per nnum, to continue 5 years, produce the present worth of 660 ?

$\overline{50\times 5-\overline{660\times 2}}=180$, $\overline{2\times 660\times 5+\overline{150\times 5}-\overline{150\times 5\times 5}}$ $=3600$, then $180\div 3600=,05=5$ per cent.

(72) If a yearly rent of £60. per annum, to continue $5\frac{1}{2}$ ears, produce £291. 6s. 3d. for the present worth, what is ne rate per cent. ? Ans. $4\frac{1}{2}$ *per cent.*

(73) If an annuity of £250. per annum, to continue 7 ears, produce £1454. 4s. 6d. for the present worth, what is ne rate per cent. ? Ans. 6 *per cent.*

(74) If a pension of £28. per annum, to continue 8 years, roduce £188. for the present worth—what is the rate per ent. ? Ans. 5 *per cent.*

Note.—When the annuities are rents, &c., are to be paid alf yearly or quarterly, then,

For *half-yearly payments*, take half of the annuity, &c., nd twice the number of years, the quotient will be the ratio f half the rate per cent. ; and,

For *quarterly payments*, take a fourth part of the annuity, zc., and four times the number of years, the quotient will be he ratio of the fourth part of the rate per cent.

(75) An annuity of £150. per annum, payable half-yearly, aving 5 years to come, is sold for £667. 10s. what is the ate per cent. ? Ans. 5 *per cent*

(76) If an annuity of £150. per annum, payable quarterly aving 5 years to come, be sold for £671. 5s. what is the ate per cent. ? Ans. 5 *per cent.*

IV. *When* U, P, R, *are given to find* T.

RULE. $\frac{2}{r}\frac{2p}{u}-1=x$, then, $\sqrt{\frac{2p}{ur}+\frac{xx}{4}}-\frac{x}{2}=\mathrm{T}$.

EXAMPLES.

(77) If an annuity of £150. per annum, produce £660. for the present worth, at 5 per cent.—what is the time of its continuance?

$$\frac{2}{,05}\frac{660\times2}{150}-1=30,2 \qquad \frac{660\times2}{150\times,05}=176$$

$$\frac{30,2\times30,2}{4}=228,01, \text{ then } \sqrt{228,01+176}=20,1$$

$$\text{and } 20,1-\frac{30,2}{2}=5 \textit{ years} \text{ Ans.}$$

(78) For what time may a salary of £60. be purchased for £291. 6s. 3d. at 4½ per cent.? Ans. 5½ *years.*

(79) For how long a time may £250. per annum be purchased for £1454. 4s. 6d. at 6 per cent.? Ans. 7 *years.*

(80) What time may a pension of £28. per annum be bought for £188. at 5 per cent.? Ans. 8 *years.*

Note.—When the payments are half-yearly, then U will be equal to half the annuity, &c., R half the ratio, and T the number of payments; and

When the payments are quarterly, U will be equal to a fourth part of the annuity, &c., R the fourth of the ratio, and T the number of payments.

(81) If an annuity of £150. per annum, payable half-yearly, be sold for £667. 10s. at 5 per cent.—I desire to know the number of payments, and the time to come?

Ans. 10 *payments*, 5 *years.*

(82) An annuity of £150. per annum, payable quarterly is sold for £671. 5s. at 5 per cent.—what is the number of payments, and time to come? Ans. 20 *payments*, 5 *years.*

ANNUITIES, ETC., TAKEN IN REVERSION.

1. ***To find the present worth of an annuity, &c., taken in reversion.***

RULE 1.—Find the present worth of the yearly sum at the given rate, and for the time of its continuance thus, $\frac{ttr-tr+2}{2tr+2}:\times u=P.$

2. Change P into A, and find what principal being put to interest will amount to A, at the same rate, and for the time to come before the annuity, &c. commences; thus, $\frac{a}{tr.+1}=P$

EXAMPLES.

(83) What is the present worth of an annuity of £150. per annum, to continue 5 years, but not to commence till the end of 4 years, allowing 5 per cent. to the purchaser?

$\frac{5\times5\times,05-5\times,05+2\times5}{5\times,05\times2+2}\times150=660$, then $\frac{660}{4\times05+1}$ =£550. Ans.

(84) What is the present worth of a lease of £50. per annum, for 4 years, but not to commence till the end of 5 years, allowing 4 per cent. to the purchaser?

Ans. £152 : 5 : 11. 3 *qrs.*

(85) A person having the promise of a pension of £20. per annum, for 8 years, but not to commence till the end of 4 years, is willing to dispose of the same at 5 per cent.—what will be the present worth?

Ans. £111 : 18 : 1. 14*d.*+

2. *To find the yearly income of an annuity, &c., in reversion.*

Rule 1.—Find the amount of the present worth, at the given rate, and for the time before the reversion thus, $ptr+p=A$.

2.—Change A into P, and find what annuity being sold will produce P, at the same rate, and for the time of its continuance, thus, $\frac{tr+1}{ttr-tr+2t}:\times2p=U$.

EXAMPLE.

(86) A person having an annuity left him for 5 years, which did not commence till the end of 4 years, disposed of it for £550. allowing 5 per cent. to the purchaser—what was the yearly income?

$550\times4\times,05+550=660\frac{5\times,05+1}{5\times5\times,05-5\times,05+5\times2}$ =,113636; then $113636\times660\times2$=£150. Ans.

A TABLE

FOR CALCULATING INTEREST, & DISCOUNTING BILLS OF EXCHANGE.

The manner of using this table is so plain and simple that it cannot be misunderstood by the commonest capacity, and so little trouble is necessary in the calculation, that it cannot be objected to on that account; for instance—multiply the sum on which interest is required by the rate per cent., then by the multiplier opposite the number of days; or by the multiplier and then by the rate per cent.; strike off the number of figures in the multiplier, and two figures more on the right hand, and the remaining figures on the left will be the sum in pounds; then multiply by 20, 12, and 4, and the amount of interest will be obtained.

EXAMPLES.

What is the interest of £987. at 2 and 5 per cent. for 73 days?

£987			£987	
2	rate p. ct.		5	rate p. ct.
1974			4935	
2	multiplier.		2	multiplier.
3,948			9,870	
20			20	
18,960			17,400	
12			12	
11,520			4,800	
4			4	
½,080	£3 : 18 : 11½.		¾,200	£9 : 17 : 4¾.

What is the interest of £1000. at 3 per cent. for 35 days?

09589	multiplier.	
1000		
9589000		
3	rate p. ct.	
2,8767000		
20		
17,534		
12		
6,408		
4		
¼,632		£2 : 17 : 6¼d.

Days	Multipliers	Days	Multipliers.	Days	Multipliers.	Days.	Multipliers.
1	00274	47	128767	93	254795	139	380822
2	00548	48	131507	94	257534	140	383562
3	008219	49	134247	95	260274	141	386301
4	010959	50	136986	96	263014	142	389041
5	013699	51	139726	97	265753	143	391781
6	016438	52	142466	98	268493	144	39452
7	019178	53	145205	99	271233	145	39726
8	021918	54	147945	100	273973	146	4
9	024658	55	150685	101	276712	147	40274
10	027397	56	153425	102	279452	148	40548
11	030137	57	156164	103	282192	149	408219
12	032877	58	158904	104	284932	150	410959
13	035616	59	161644	105	287671	151	413699
14	038356	60	164384	106	290411	152	416438
15	041096	61	167123	107	293151	153	419177
16	043835	62	169863	108	29589	154	421918
17	046575	63	172603	109	29863	155	424658
18	049315	64	175342	110	30137	156	427397
19	052055	65	178082	111	30411	157	430137
20	054795	66	180822	112	306849	158	432877
21	057534	67	183562	113	309589	159	435616
22	060274	68	186301	114	312329	160	438356
23	063014	69	189041	115	315068	161	441096
24	065753	70	191781	116	317808	162	443835
25	068493	71	19452	117	320548	163	446575
26	071233	72	19726	118	323288	164	449315
27	073973	73	2	119	326027	165	452055
28	076712	74	20274	120	328767	166	454795
29	079452	75	20548	121	331507	167	457534
30	082192	76	208219	122	334247	168	460274
31	084932	77	210959	123	336986	169	463014
32	087671	78	213699	124	339726	170	465753
33	090411	79	216438	125	342466	171	468493
34	093151	80	219178	126	345205	172	471233
35	09589	81	221918	127	347945	173	473973
36	09863	82	224658	128	350685	174	476712
37	10137	83	227397	129	353425	175	479452
38	10411	84	230137	130	356164	176	482192
39	106849	85	232877	131	358904	177	484932
40	109589	86	235618	132	361644	178	487671
41	112329	87	238356	133	364384	179	490411
42	115068	88	241096	134	367123	180	493151
43	117808	89	243835	135	369863	181	49589
44	120548	90	246575	136	372603	182	49863
45	123288	91	249315	137	375342	183	50137
46	126027	92	252055	138	378082	184	50411

Days.	Multipliers.	Days.	Multipliers.	Days.	Multipliers.	Days.	Multipliers.
185	506849	230	630137	275	753425	320	876712
186	509589	231	632877	276	756164	321	879452
187	512329	232	635616	277	758904	322	882192
188	515068	233	638356	278	761644	323	884932
189	517808	234	641096	279	764384	324	887671
190	520548	235	643835	280	767123	325	890411
191	523288	236	646575	281	769863	326	893151
192	526027	237	649315	282	772603	327	89589
193	528767	238	652055	283	775342	328	89863
194	531507	239	654795	284	778082	329	90137
195	534247	240	657534	285	780822	330	90411
196	536985	241	660274	286	783562	331	906849
197	539726	242	663014	287	786301	332	909589
198	542466	243	665753	288	789041	333	912329
199	545205	244	668493	289	791781	334	915068
200	547945	245	671233	290	79452	335	917808
201	550685	246	673973	291	79726	336	920548
202	553425	247	676712	292	8	337	923288
203	556164	248	679452	293	80274	338	926027
204	558904	249	682192	294	805479	339	928767
205	561644	250	684932	295	808219	340	931507
206	564384	251	687671	296	810959	341	934247
207	567123	252	690411	297	813699	342	936986
208	569863	253	693151	298	816438	343	939726
209	572603	254	69589	299	819178	344	942466
210	575342	255	69863	300	821918	345	945205
211	578082	256	70137	301	824658	346	947945
212	580822	257	70411	302	827397	347	950685
213	583562	258	706849	303	830137	348	953425
214	586301	259	709589	304	832877	349	956164
215	589041	260	712329	305	835616	350	958904
216	591781	261	715068	306	838356	351	961644
217	59452	262	717808	307	841096	352	964384
218	59726	263	720548	308	843836	353	967123
219	6	264	723288	309	846575	354	969863
220	60274	265	726027	310	849315	355	972603
221	60548	266	728767	311	852055	356	975342
222	608219	267	731507	312	854795	357	978082
223	610959	268	734247	313	857534	358	980822
224	613699	269	736986	314	860274	359	983562
225	616438	270	739726	315	863014	360	986301
226	619178	271	742466	316	865753	361	989041
227	621918	272	745205	317	868493	362	991781
228	624658	273	747945	318	871233	363	99452
229	627397	274	750685	319	873973	364	99726

PART IV.

DUODECIMALS;

OR WHAT ARE GENERALLY CALLED

Cross-Multiplication, and Squaring of dimensions by Artificer, and Workmen.

RULES FOR MULTIPLYING DUODECIMALLY.

1.—UNDER the multiplicand write the corresponding denominations of the multiplier.

2.—Multiply each term in the multiplicand (beginning at the lowest) by the feet in the multiplier; write each result under its respective term, observing to carry a unit under every 12 from each lower denomination to its next superior.

3.—In the same manner multiply the multiplicand by the primes in the multiplier, and write the result of each term one place more to the right hand of those in the multiplicand.

4.—Work in the same manner with the seconds in the multiplier, setting the result of each term two places to the right hand of those in the multiplicand, and so on for thirds, fourths, &c.

EXAMPLES.

(1) Multiply *ft. in.* 7 9 by *ft. in.* 3 6

Cross-Multiplication.	*Practice.*	*Duodecimals.*	*Decimals.*
7 9	6 ½ 7 9	7 9	7,75
3 × 6	3 : 6	3 6	3,5
21 0 0 = 7 × 3	23 3	23 3 ×3	3,875
2 3 0 = 9 × 3	3 10 6	3 10 6 ×6	23,25
3 6 0 = 7 × 6	27 1 6	27 1 6	27,125
0 4 6 = 9 × 6			
27 1 6			

	ft.	in.	p.		ft.	in.	p.		ft.	in.	p.		
(2) Mult.	8	5		by	4	7		*Ans.*	38	6	11		
(3) Mult.	9	8		by	7	6		*a.*	72	6	0		
(4) Mult.	8	1		by	3	5		*a.*	27	7	5		
(5) Mult.	7	6		by	5	9		*a.*	43	1	6		
(6) Mult.	4	7		by	3	10		*a.*	17	6	10		
(7) Mult.	7	5	9	by	3	5	3	*a*	25	8	6	2	3.
(8) Mult.	10	4	5	by	7	8	6	*a*	79	11	0	6	6.
(9) Mult.	75	7		by	9	8		*a*	730	7	8		
(10) Mult.	97	8		by	8	9		*a.*	854	7	0		
(11) Mult.	57	9		by	9	5		*a.*	543	9	9		
(12) Mult.	75	9		by	17	7		*a.*	1331	11	3		
(13) Mult.	87	5		by	35	8		*a.*	3117	10	4		
(14) Mult.	179	3		by	38	10		*a.*	6960	10	6		
(15) Mult.	259	2		by	48	11		*a.*	12677	6	10		
(16) Mult.	257	9		by	39	11		*a.*	10288	6	3		
(17) Mult.	311	4	7	by	36	7	5	*a.*	11402	2	4	11	11
(18) Mult.	321	7	3	by	9	3	6	*a.*	2988	2	10	4	6

THE APPLICATION.

Artificers' work is computed by different measures, viz.,

1. Glazing and masons' flat work by the foot.
2. Painting, plastering, paving, &c. by the yard.
3. Partitioning, flooring, roofing, tiling, &c. by the square of 100 feet.
4. Brick-work, &c. by the rod of $16\frac{1}{2}$ feet, whose square is $272\frac{1}{4}$.

1. MEASURING BY THE FOOT SQUARE. AS GLAZIERS AND MASONS' FLAT WORK.

EXAMPLES.

(19) There is a house with 3 tiers of windows, 3 in a tier; the height of the first tier is 7 feet 10 inches, the second is 6 feet 8 inches, and the third 5 feet 4 inches, the breadth of each is 3 feet 11 inches—what will the glazing come to at 14d. per foot?

Duodecimals.

ft.	*in.*	
7	10	the
6	8	heights
5	4	added
19	10	
	3	= windows
59	6	in a tier
3	11	in a breadth.
178	6	
54	6	6
233	0	6

feet	*in.*	*pts.*	
	233	0	6 at 14d. p. foot.
2d.	$\frac{1}{6}$233		= 1s.
	38	10	= 2d.
			$\frac{1}{2}$ = 6 parts.
2	0	27	1 $10\frac{1}{2}$

Ans. £13 11 $10\frac{1}{2}$

(20) What is the worth of 8 squares of glass, each measuring 4 feet 10 inches long, and 2 feet 11 inches broad, at $4\frac{1}{2}$d. per foot? Ans. £2 : 2 : $3\frac{1}{4}$.

(21) There are 8 windows to be glazed, each measures 1 foot 6 inches wide, and 3 feet in height—how much will they come to at $7\frac{3}{4}$d. per foot? Ans. £1 : 3 : 3.

(22) What is the price of a marble slab, whose length is 5 feet 7 inches, and the breadth 1 foot 10 inches, at 6s. per foot? Ans. £3 : 1 : 5.

2. MEASURING BY THE YARD SQUARE, AS PAVIERS, PAINTERS, PLASTERERS, AND JOINERS.

☞ Divide the square feet by 9, and it will give the number of square yards.

EXAMPLES.

(23) A room is to be ceiled, whose length is 74 feet 9 inches, and width 11 feet 6 inches—what will it come to at 3s. $10\frac{1}{2}$d. per yard? Ans. £18 : 10 : $1\frac{1}{4}$.+

(24) What will the paving of a court-yard come to at $4\frac{3}{4}$d. per yard, the length being 58 feet 6 inches, and breadth 54 feet 9 inches? Ans. £7 : 0 : $10\frac{1}{4}$.+

(25) A room painted 97 feet 8 inches about, and 9 feet 10 inches high—what does it come to at 2s. $8\frac{3}{4}$d. per yard? Ans. £14 : 11 : $2\frac{1}{2}$.+

(26) What is the content of a piece of wainscotting in yards square, that is 8 feet 3 inches long, and 6 feet 6 inches broad, and what will it come to at 6s. $7\frac{1}{2}$d. per yard? Ans. £1 : 19 : $5\frac{1}{2}$.+

(27) What will the paving of a court-yard come to at 3s. 2d. per yard, if the length be 27 feet 10 inches, and the breadth 14 feet 9 inches? Ans. £7 : 4 : 5½.+

(28) A person has paved a court-yard, 42 feet 9 inches in front, and 68 feet 6 inches in depth, and in this he has laid a foot-way the depth of the court, of 5 feet 6 inches in breadth; the foot-way is laid with Purbeck-stone, at 3s. 6d. per yard, and all the rest with pebbles at 3s. per yard—what will the whole come to? Ans. £49 : 17 : 0½.+

(29) What will the plastering of a ceiling at 10d. per yard come to, supposing the length at 21 feet 8 inches, and the breadth 14 feet 10 inches? Ans. £1 : 9 : 9.+

(30) What will the wainscotting of a room come to at 6s. per square yard, supposing the height of the room (taking in the cornice and moulding) be 12 feet 6 inches, and the compass 83 feet 8 inches; and three window shutters each 7 feet 8 inches, by 3 feet 6 inches; and the door 7 feet, by 3 feet 6 inches? The shutters and door being worked on both sides, is reckoned work and half work.

Ans. £36 : 12 : 2½.+

3. MEASURING BY THE SQUARE OF ONE HUNDRED FEET, AS FLOORING, PARTITIONING, ROOFING, TILING, ETC.

EXAMPLES.

(31) In 173 feet 10 inches in length, and 10 feet 7 inches in height, of partitioning—how many squares?

Ans. 18 *squares*, 39 *feet*, 8 *inches*, 10 *parts*.

(32) If a house of three stories, besides the ground floor, was to be floored at £6. 10s. per square, and the house measures 20 feet 8 inches, by 16 feet 9 inches; there are 7 fire places, whose measures are two of 6 feet, by 4 feet 6 inches each, two of 6 feet, by 5 feet, 4 inches each, and two of 5 feet 8 inches by 4 feet 8 inches, and the seventh of 5 feet 2 inches, by 4 feet, and the well hole of the stairs is 10 feet 6 inches, by 8 feet 9 inches—what will the whole come to?

Ans. £53 : 13 : 3½.+

(33) If a house measures within the walls 52 feet 8 inches in length, and 30 feet 6 inches in breadth, and the roof be of a true pitch—what will its roofing come to at 10s. 6d. per square? Ans. £12 : 12 : 11¾.+

Note.—In tiling, roofing, and slating, it is customary to reckon the flat and half of any building, within the walls, to be the measure of the roof of that building, when the said roof is of a true pitch, *i. e.* when the rafters are ¾ of the breadth of the building; and if the roof be more or less than the true pitch, they measure from one side to the other with a rod or string.

(34) What will the tiling of a barn cost, at 25s. 6d. per square, the length being 43 feet 10 inches, and breadth 27 feet 5 inches on the flat, the eave-boards projecting 16 inches on each side? Ans. £24 : 9 : 5¼.+

4. MEASURING BY THE ROD.

Note.—Bricklayers value their work at the rate of a brick and a half thick; and if the thickness of the wall be more or less, it must be reduced to that thickness by this.

RULE.—Multiply the area of the wall by the number of half bricks the thickness the wall is of; the product divided by 3, gives the area.

EXAMPLES.

(35) If the area of a wall be 4085 feet, and the thickness 2 bricks and a half—how many rods doth it contain?

Ans. 25+*rods.*

(36) If a garden wall be 254 feet round, and 12 feet 7 inches high, and 3 bricks thick—how many rods doth it contain? Ans. 23 *rods*, 130 *feet*, 7 *inches.*

(37) How many square rods are there in a wall 62½ feet long, 14 feet 8 inches high, and 2½ bricks thick?

Ans. 5 *rods*, 166 *feet*, 6+*in.*

(38) If the side walls of a house be 28 feet 10 inches in length, and the height of the roof from the ground 55 feet 8 inches, and the gable, or triangular part at the top, to rise 42 course of bricks, reckoning 4 course to 1 foot: (now 20 feet high is 2½ bricks thick, 20 feet more at 2 bricks thick, 15 feet 8 inches more at 1½ bricks thick, and the gable at 1 brick thick)—what will the whole work come to at £5. 16s. per rod? Ans. £48 : 12 : 7.+

PART V.

A Collection of Questions set down promiscuously for the greater trial of the foregoing Rules.

(1) Write down two millions, five hundred and two thousand, two hundred and five.

(2) What is the value of 14 barrels of soap, at $4\frac{1}{2}$d. per lb. each barrel containing 254 lbs.? Ans. £66 : 13 : 6.

(3) If £100. principal gain £5. interest in 12 months, what principal will gain £20. in 8 months? Ans. £600.

(4) What number is that, from which if the square of 14 be deducted, and to the remainder the square of 12 be added, the sum will be 250? Ans. 302.

(5) A and B, traded together; A put in £320. for five months, B £460. for 3 months, and they gained £100.—what must each man receive?

Ans. *A* £53 : 13 : $9\frac{7}{29}\frac{9}{8}$. *and B* £46 : 6 : $2\frac{2}{29}\frac{8}{8}$.

(6) How many yards of cloth at 17s. 6d. per yard, can I have for 13 cwt. 2 qrs. of wool at 14d. per lb.?

Ans. 100 *yards*, $3\frac{1}{5}$ *qrs.*

(7) What number added to the cube of 21, will make the sum equal to 113 times 147? Ans. 7350.

(8) If I buy 1000 ells of linen, Flemish, for £90.—what may I sell it at per ell in London to gain £10. by the whole?

Ans. 3*s.* 4*d.*

(9) A has 648 yards of cloth at 14s. per yard, ready money, but in barter will have 16s.; B has wine at £42. per tun, ready money; the question is—how much wine must be given for the cloth, and what is the price of a tun of wine in barter? Ans. £48. *the tun; and* 10 *tuns*, 3 *hhds.*, $12\frac{3}{5}$ *gallons of wine must be given for the cloth.*

(10) A jeweller sold jewels to the value of £1200. for which he received in part 876 French pistoles, at 16s. 6d. each—what sum remains unpaid? Ans. £477 : 6*s.*

(11) An oilman bought 417 cwt. 1 qr. 15 lbs. gross weight, of train oil, tare 20 lbs. per 112 lbs.—how many nett gallons were there, allowing $7\frac{1}{2}$ lbs. to a gallon? Ans. 5120.

(12) I bought three score pieces of holland for three times as many pounds, and sold them again for four times as much: but if they had cost me as much as I sold them for—what should I have sold them for to gain after the same rate?

Ans. £320.

(13) What number taken from the square of 54, will leave 19 times 46? Ans. 2042.

(14) If I buy a yard of cloth for 14s. 6d. and sell it for 16s. 9d.—what do I gain per cent.?

Ans. £15 : 10 : $4\frac{24}{174}$.

(15) Bought 27 bags of ginger, each weighing gross $84\frac{3}{4}$lbs. tare $1\frac{3}{8}$lb. per bag, tret 4 lbs. per 104 lbs.—what do they come to at $8\frac{1}{2}$d. per lb.? Ans. £76 : 13 : $2\frac{1}{4}$.

(16) If $\frac{2}{3}$ of an ounce avoirdupois cost $\frac{7}{8}$ of a shilling—what will $\frac{5}{6}$ of a lb. cost? Ans. 17*s.* 6*d.*

(17) If $\frac{5}{6}$ of a gallon cost £$\frac{5}{8}$—what will $\frac{5}{9}$ of a tun cost?

Ans. £105.

(18) A young man received £210. which was $\frac{2}{3}$ of his elder brother's portion; now three times the elder brother's portion was half of the father's estate—I demand how much the estate was? Ans. £1890.

(19) If the salary of an officer be £48. per annum—what must he receive for 232 days? Ans. £30 : 10 : $2\frac{1}{4}$.

(20) A gentleman spends one day with another £1. 7*s.* $10\frac{1}{2}$d., and at the year's end layeth up £340.—what is his yearly income? Ans. £848 : 14 : $4\frac{1}{2}$.

(21) A lady's fortune consisted of a cabinet worth £200. containing 16 drawers, each having two partitions, each of which contained £37. and two crowns—pray what was her portion? Ans. £1400.

(22) A has 13 fother of lead to send abroad, each being $19\frac{1}{2}$ times 112 lbs.; B has 39 casks of tin, each 388 lbs.—how many ounces difference is there in the weight of these commodities? Ans. 212160 *oz.*

(23) A captain and 160 sailors took a prize worth £1360. of which the captain had $\frac{1}{5}$ for his share and the rest was equally divided among the sailors—what was each man's share? Ans. *The captain had* £272., *and each sailor,* £6 : 16*s.*

(24) What number is that to which if you add $7\frac{2}{3}$ the whole will be $12\frac{1}{4}$? Ans. $4\frac{7}{12}$.

(25) A usurer put out £75. for 12 months, and received for principal and interest £81.—I demand at what rate per cent. he received interest? Ans. 8 *per cent.*

(26) What will £956. amount to in $7\frac{1}{2}$ years, at 5 per cent. simple interest? Ans. £1314 : 10*s.*

(27) At what rate per cent. will £956. amount to £1314. 10*s.* in $7\frac{1}{2}$ years at simple interest? Ans. 5 *per cent.*

(28) If for £1. 4s. I have 1200 lbs. weight carried 36 miles —how many lbs. weight can I have carried 24 miles for the same money? Ans. 1800 *lbs.*

(29) If 8 cannons in one day spend 48 barrels of powder —I demand how many barrels 24 cannons will spend in 22 days? Ans. 3168.

(30) What number is that which being multiplied by $\frac{4}{5}$ will produce $\frac{1}{4}$? Ans. $\frac{5}{16}$.

(31) A has 24 kine worth 72s. each, and B 7 horses worth £13. a piece—how much will make good the difference in case they interchange their said cattle? Ans. £4 : 12*s.*

(32) A man dies, and leaves £120. to be given to 3 persons, *viz.* A, B, and C; to A a share unknown, B twice as much as A, and C as much as A and B—what was the share of each? Ans. *A* £20; *B* £40; *C* £60.

(33) A person dying, left his widow £1780. and £1250. to each of his 4 children: he had been $25\frac{1}{2}$ years in trade, and had cleared at an average £126. a year—what had he to begin with? Ans. £3567.

(34) There is a sum of £1000, to be divided among 3 men, in such a manner that if A has £3. B shall have £5. and C £8.—how much must each man have?

Ans. *A* £187 : 10*s.*; *B* £312 : 10*s.*: *and C* £500

(35) How many changes may be rung on 6 bells?

Ans. 720.

(36) A merchant at Amsterdam is indebted to another in London £642. and would pay it in spanish guilders, at 2s. per piece—how many must the English merchant receive?

Ans. 6420.

(37) If 360 men be in garrison, and have provisions for 6 months, but hear of no relief at the end of 5 months—how many men must depart, that the provisions may last as much longer? Ans. 288.

(38) The less of two numbers is 187, their difference 34, the square of the product is required?

Ans. 1707920929

(39) A butcher sends his man with £216. to a fair to buy cattle: oxen at £11., cows at 40s., colts at £1. 5s., and hogs at £1. 15s. a piece, and of each a like number—how many of each sort did he buy?

Ans. 13 *of each sort, and* £8. *over.*

(40) What number added to $11\frac{1}{7}$ will prodoce $36\frac{3}{6}\frac{3}{1}\frac{7}{6}$?
Ans. $24\frac{5}{6}\frac{1}{1}\frac{3}{6}$.

(41) What number multiplied by $\frac{3}{7}$ will produce $11\frac{9}{17}$?
Ans. $26\frac{4}{5}\frac{6}{1}$.

(42) A man had twelve sons, the youngest was 3 years old, and the oldest 58; they increased in Arithmetical Progression, what was the common difference of their ages?
Ans. 5 *years.*

(43) What is the value of 7179 hhds. of tobacco, each weighing 13 cwt. at £2. 1s. per cwt? Ans. £191320 : 7*s.*

(44) My factor sends me word that he has bought goods to the value of £500. 13s. 6d. upon my account—what will his commission come to at $3\frac{1}{2}$ per cent?
Ans. £17 : 10 : 5,2 *qrs.* $\frac{68}{100}$.

(45) Miss Kitty told her sister Charlotte, whose father had before left them £13200. apiece, that their grandmother by will had raised her fortune to £15000. and had made her own £20000.—what did the old lady leave them?
Ans. £8600.

(46) A snail in getting up a May-pole, only 20 feet high, was observed to climb 8 feet every day, but every night it came down again 4 feet—in what time by this method did it reach the top? Ans. 4 *days.*

(47) If the $\frac{1}{3}$ of 6 be 3—what will $\frac{1}{4}$ of 20 be? Ans. $7\frac{1}{2}$.

(48) What is the difference between 14676 and the fourth of itself? Ans. 11007.

(49) There is in 3 bags the sum of £1468.; *viz.*, in the first bag £461. and in the second bag £581.—what is in the third bag? Ans. £426.

(50) What is the decimal of 3 qrs. 14 lbs. of a cwt.?
Ans. ,875.

(51) How many lbs. of sugar at $4\frac{1}{2}$d. per lb. must be given in barter for 60 gross of inkle, at 8s. 8d. per gross?
Ans. $1386\frac{2}{3}$.

(52) If I buy yarn at 9d. per lb. and sell it again for $4\frac{1}{2}$d. —what is the loss per cent? Ans. £50.

(53) A tobacconist would mix 20 lbs. of tobacco, at 9d. per lb., with 60 lbs. at 12d. per lb. and 40 at 18d. per lb. with 12 lbs. at 2s. per lb.—what is 1 lb. of this mixture worth?
Ans. 1*s.* $2\frac{1}{4}$*d.* $\frac{9}{11}$.

(54) What is the value of 14 barrels of soap at $4\frac{1}{2}$d. per lb. each barrel containing 254 lbs.? Ans. £66 : 13 : 6.

(55) Two persons, A and B, are indebted; the least debt being that of A's, which is £2173. their difference is £371.—what is B's debt? Ans. £2544.

(56) What is the difference between twice eight and twenty, and twice twenty eight; as also between twice five and fifty, and twice fifty five? Ans. 20 *and* 50.

(57) What number taken from the square of 54 will leave 19 times 46? Ans. 2042.

(58) A schoolmaster being asked how many scholars he had, said, if I had as many more, half as many, and one quarter as many, I should have 99—how many had he? Ans. 36.

(59) An ancient lady being asked how old she was, to avoid a direct answer said, I have 9 children, and there are 3 years between the birth of each of them: the eldest was born when I was 19 years old, which is now exactly the age of the youngest—how old was the lady? Ans. 62.

(60) What number is that which being added to 168 makes the sum to be 706? Ans. 538.

(61) From £100. borrowed take £70. paid,
'Twas a virgin that lent it, what's due to the maid.
Ans. £30.

(62) If when wheat is 4s. per bushel, the 20 penny loaf weighs 18 lbs.—what must the said 20 penny loaf weigh when wheat is 6s. per bushel? Ans. 12 *lbs.*

(63) Whereas a noble and a mark just 15 yds. did buy,
How many ells of the same cloth for £50. had I?
Ans. 600 *E. Ells.*

(64) A broker bought for his principal in the year 1720, £400. capital stock in the South Sea, at £650. per cent., and sold it again when it was worth but £130. per cent.—how much was lost in the whole? Ans. £2080.

(65) What number added to the 43rd part of 4429 will make the sum 240? Ans. 137.

(66) What number deducted from the 26th part of 2262 will leave the 87th part of it? Ans. 61.

(67) A gentleman went to sea at 17 years of age; 8 years after he had a son born, who lived 46 years, and died before his father? after whom the father lived twice twenty years, and then died also—what was the age of the father when he died? Ans. 111 *years.*

(68) C hath candles at 6s. per dozen ready money, but in barter will have 6s. 6d. per dozen; D hath cotton at 9d. per lb. ready money—I demand what price the cotton must be at in barter; also how much cotton must be bartered for 100 dozen of candles?

Ans. *The cotton at* $9\frac{3}{4}$*d. per lb., and* 7 *cwt.* 16 *lbs. of cotton must be given for* 100 *dozen of candles.*

(69) The sum of two numbers is 360, the less 114—what is their difference, product, and quotient?

Ans. 132 *diff.*, 28044 *prod.*, $2\frac{3}{19}$ *quotient.*

(70) A brigade of horse, consisting of 384 men, is to be formed into a square body, having 32 men in front—how many ranks will their be? Ans. 12.

(71) If a clerk's salary be £73. a year—what is that per day? Ans. 4*s.*

(72) B has an estate of £53. per annum, and pays 5s. 10d. to the subsidy—what must C pay, whose estate is worth £100. per annum? Ans. 11*s.* 0*d.* $\frac{4}{53}$.

(73) If I buy 100 yards of ribband, at 3 yards for 1 shilling, and 100 more for 2 yards at 1 shilling, and sell it at the rate of 5 yards for 2 shillings—whether do I gain or lose, and how much? Ans. *Lose* 3*s.* 4*d.*

(74) What is the value of $\frac{1}{8}$ of 20s.? Ans. 12*s.* 6*d.*

(75) What number is that from which if you take $\frac{3}{5}$ the remainder will be $\frac{1}{8}$? Ans. $\frac{2}{4}\frac{9}{0}$.

(76) My purse and money, quoth Dick, are worth 12s. 8d. but the money is worth 7 times as much as the purse—pray what is the sum therein? Ans. 11*s.* 1*d.*

(77) What number is that which makes 9 to be the $\frac{2}{3}$ of it?

Ans. $13\frac{1}{2}$.

(78) A maltster had several sorts of malt, one at 4s. 6d., one at 4s., and one at 3s. 6d. per bushel, to mix an equal quantity of each, what must be the price of a bushel?

Ans. 4*s.*

(79) A farmer is willing to make a mixture of rye at 4s. a bushel, barley at 3s., and oats at 2s.—how much must he take of each to sell at 2s. 6d. per bushel?

Ans. 6 *of rye*, 6 *of barley, and* 24 *of oats.*

(80) If $\frac{3}{8}$ of a ship be worth £3740.—what is the worth of the whole? Ans. £9973 : 6 : 8.

81) A person said he had 20 children, and that it happened there was a year and a half between each of their

ages; his eldest son was born when he was 24 years old, and the age of his youngest was 21—what was the father's age?

Ans. $73\frac{1}{2}$ *years.*

(82) Bought a cask of wine for £62. 8s.—how many gallons were in the cask, when a gallon was 5s. 4d.?

Ans. 234.

(83) B owes C £296. 17s. but he compounds for 7s. 6d. in the pound—what must C receive for his debt?

Ans. £111 : 6 : $4\frac{1}{2}$.

(84) How many dozens of stockings at 11 groats per pair may I buy for £190. 12s.? Ans 86 *doz.* 7 *pair.* $\frac{7}{11}$.

(85) A sheep fold was robbed 3 nights successively; the first night half of the sheep were stolen, and half a sheep more; the second night half the remainder were lost, and half a sheep more; the last night they took half that were left and half a sheep more; by which time they were reduced to 20—how many were there at first? Ans. 167.

(86) The Spectator's club of fat people, though it consisted of 15 persons, is said to have weighed no less than 3 tons—how much at an equality, was that per man?

Ans. 4 *cwt.*

(87) A merry young fellow in a short time got the better of $\frac{1}{5}$ of his fortune. By the advice of his friends he gave £2200. for an exempt's place in the guards; his profusion continued till he had no more than 880 guineas left, which he found, by a computation, was the $\frac{3}{200}$ part of his money after the commission was bought—pray what was his fortune at first? Ans. £10450.

(88) B owes C £395. 18s. but compounds the whole debt for £100. 12s.—what was that in the pound?

Ans. 5*s.* $0\frac{3}{4}$*d.* $\frac{744}{875}$.

(89) How many dollars at 4s. 4d. each must be given for 360 guilders at 2s. 2d. each? Ans. 180.

(90) Four men have a sum of money to be divided amongst them in such a manner, that the first shall have $\frac{1}{3}$, the second $\frac{1}{4}$, the third $\frac{1}{5}$ of it, and the fourth the remainder, which is £23.—what is the sum? Ans. £112.

(91) What is the amount of £1000. for $5\frac{1}{2}$ years at $4\frac{3}{4}$ per cent. simple interest? Ans. £1261 : 5*s.*

(92) Sold goods amounting to the value of £700. for two four months—what is the present worth at 5 per cent. simple interest? Ans. £682 : 19 : 5¼.+

(93) A room 30 feet long, and 18 feet wide, is to be covered with painted cloth—how many yards of ¾ wide will cover it? Ans. 80.

(94) There are two numbers, the one 48, and the other twice as much—what is the difference between their sum and difference? Ans. 96.

(95) Betty told her brother George that though her fortune on her marriage took £19312. out of her family, it was but ⅗ of two years' rent (heaven be praised!) of his yearly income —pray what was that?

Ans. £16093 : 6 : 8 *a year.*

(96) There are two numbers, the one 25, the other the square of 25—I demand the square root of the sum of their squares? Ans. 625,4998.+

(97) Says B to C, if I had four of your sheep I should have as many as you: and says C to B, if I had four of yours, I should have twice as many as you—how many had each?

Ans. *B* 20, *C* 28.

(98) B, C, and D, trading together, gained £120. which is to be shared according to each man's stock; B puts in £140. C £300. and D £160.—what is each man's share?

Ans. *B's* £28, *C's* £60, *and D's* £32.

(99) A gentleman having 50s. to pay among his labourers for a day's work would give to every boy 6d., to every woman 8d., and to every man 16d.; the number of boys, women, and men, were the same—I demand the number of each? Ans. 20 *of each.*

(100) There are three numbers, 17, 19, and 48—I demand the difference between the sum of the squares of the first and last, and the cube of the middlemost? Ans. 4266.

(101) A stone measures 4 feet 6 inches long, 2 feet 9 inches broad, and 3 feet 4 inches deep—how many solid feet doth it contain? Ans. 41 *feet* 3 *inches.*

(102) What does the whole pay of a man of war's crew of 640 sailors amount to for 32 month's service, each man's pay being 22s. 6d. per month? Ans. £23040.

(103) If I have an estate of £470. per annum—what may I expend daily, and yet lay up £130. per annum?

Ans. 18*s.* 7½*d.* $\frac{90}{365}$.

(104) What number is that which being divided by 19, the quotient will be 72? Ans. 1368.

(105) Reduce $13\frac{1}{2}$ bushels of coals to the fraction of a chaldron? Ans. $\frac{3}{5}$.

(106) Bought 28 qrs. 2 bushels of wheat, at 4s. 6d. per bushel—what does it come to? Ans. £50 : 17*s*.

(107) How many lbs. of coffee at 5s. 9d. per lb. are equal in value to 426 lbs. of tea, at 13s. 4d. per lb.? Ans. $987\frac{7}{9}$.

(108) What is the value of 27 dozen 10 lbs. of candles, at 5d. per lb.? Ans. £6 : 19 : 2.

(109) A traveller would change 500 French crowns at 4s. 6d. per crown into sterling money, but he must pay a half-penny per crown for changing—how much must he receive? Ans. £111 : 9 : 2.

(110) There are two numbers, the one 63, and the other half as much—I demand the product of their squares, and the difference of their product and sum?

Ans. *Product of their squares* 3938240,25; *diff.* 1890.

(111) Two men depart both from one place, the one goes north, the other south; the one goes 7 miles, and the other 11 miles a day—how far are they distant at the 12th day of their departure? Ans. 216 *miles.*

(112) In 672 Spanish guilders, at 2s. each, how many French Pistoles, at 17s. 6d. per piece? Ans. $76\frac{2}{3}\frac{8}{5}$.

(113)
When first the marriage knot was tied between my wife and me,
Her age did mine as far exceed as three times three do three;
But when 7 years and half 7 years we man and wife had been,
My age came then as near to her's as eight is to sixteen.

Ques. What was each of our ages when we married?

Ans. $10\frac{1}{2}$ *years the man,* $31\frac{1}{2}$ *the woman.*

(114) If 12 oxen will eat $3\frac{1}{3}$ acres of grass in 4 weeks, and 21 oxen will eat 10 acres in 9 weeks, how many oxen will eat 24 acres in 18 weeks, the grass being allowed to grow uniformly? Ans. 36

(115) A lady was asked her age, who replied thus:

My age if multiplied by three,
Two sevenths of that product tripled be;
The square root of two-ninths of that is four;
Now tell my age or never see me more.

Ans. 28 *years.*

(116) If 48 taken from 120 leave 72, and 72 taken from 91 leaves 19, and 7 taken thence leaves 12, what number is that out of which when you have taken 48, 72, 19, and 7, 12 is left? Ans. 158

A TABLE for finding the Interest of any sum of money for any number of Months, Weeks, or Days, at any rate *per cent.*

Year.	*Calendar Months.*			*Weeks.*			*Days.*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
1	0	1	8	0	0	4½	0	0	0½
2	0	3	4	0	0	9	0	0	1¼
3	0	5	0	0	1	1¾	0	0	2
4	0	6	8	0	1	6½	0	0	2½
5	0	8	4	0	1	11	0	0	3¼
6	0	10	0	0	2	3¾	0	0	4
7	0	11	8	0	2	8¼	0	0	4½
8	0	13	4	0	3	1	0	0	5¼
9	0	15	0	0	3	5½	0	0	6
10	0	16	8	0	3	10¼	0	0	6½
20	1	13	4	0	7	8¼	0	1	1¼
30	2	10	0	0	11	6½	0	1	7¾
40	3	6	8	0	15	4½	0	2	2¼
50	4	3	4	0	19	2¾	0	2	9
60	5	0	0	1	3	1	0	3	3½
70	5	16	8	1	6	11	0	3	10
80	6	13	4	1	10	9½	0	4	4½
90	7	10	0	1	14	7¼	0	4	11¼
100	8	6	8	1	18	5¼	0	5	5¾
200	16	13	4	3	16	11	0	10	11½
300	25	0	0	5	15	4½	0	16	5¼
400	33	6	8	7	13	10	1	1	11
500	41	13	4	9	12	3½	1	7	4¾
600	50	0	0	11	10	9	1	12	10½
700	58	6	8	13	9	2¾	1	18	4¼
800	66	13	4	15	7	8¼	2	3	10
900	75	0	0	17	6	1¾	2	9	3¾
1000	83	6	8	19	4	7¼	2	14	9½
2000	166	13	4	38	9	2½	5	9	7
3000	250	0	0	57	13	10	8	4	4½
4000	333	6	8	76	18	5½	10	19	2
5000	416	13	4	96	3	0¾	13	13	11½
6000	500	0	0	115	7	8¼	16	8	9
7000	583	6	8	134	12	3½	19	3	6½
8000	666	13	4	153	16	11	21	18	4¼
9000	750	0	0	173	1	6¼	24	13	1¾
10000	833	6	8	192	6	1¾	27	7	11¼
20000	1666	13	4	384	12	3½	54	15	10½
30000	2500	0	0	576	18	5½	82	3	10

RULE.—Multiply the principal by the rate per cent. and the number of months, weeks, or days, which are required; cut off two figures on the right-hand side of the product, and collect from the table the several sums against the different numbers as, when added, will make the number remaining. Add the several sums together, and it will give the interest required.

N. B. For every 10 that is cut off in months, add 2d.; for every 10 cut off in weeks add ½d.; and for every 40 in the days, ¼d.

EXAMPLES.

(1) What is the interest of £2467. 10s. for 10 months, at 4 per cent per annum?

£.	s.
2467	10
	4
9870	0
10	
987|00	0

£	£	s.	d.
900	= 75	0	0
80	= 6	13	4
7	= 0	11	8
987	= 82	5	0

(2) What is the interest of £2467. 10s. for 12 weeks, at 5 per cent.?

£	s.
2467	10
	5
12337	10
	12
1480|50	0

£	£	s.	d.
1000	= 19	4	7¼
400	= 7	13	10
80	= 1	10	9½
50	= 0	0	2½
1480|50	= 28	9	5¼

(3) What is the interest of £2467. 10s. for 50 days, at 6 per cent.?

£	s.
2467	10
	6
14805	0
50	
7402|50	0

£	£	s.	d.
7000	= 19	3	6½
400	= 1	1	11
2	= 0	0	1¼
50	= 0	0	0¼
7402|50	= 20	5	7

To find what an estate from £1. to £60,000. per annum will come to for 1 day.

RULE.—Collect the annual rent, or income, from the table of 1 year, against which take the several sums for 1 day, add them together, and it will give the answer.

(4) An estate of £376. per annum—what is that per day?

£	£	*s.*	*d.*
300	= 0	16	5¼
70	= 0	3	10
6	= 0	0	4
376	= 1	0	7¼

To find the amount of any income, salary, or servants' wages, for any number of months, weeks, or days.

RULE.—Multiply the yearly income, or salary, by the number of months, weeks, or days, and collect the product from the table.

(5) What will £270. per annum come to for 11 months, for 3 weeks, and for 6 days?

For 11 *Months.*

£	£	£	*s.*	*d.*
270	2000	= 166	13	4
11	900	= 75	0	0
	70	= 5	16	8
2970	2970	= 247	10	0

For 3 *Weeks.*

£	£	£	*s.*	*d.*
270	800	= 15	7	8¼
3	10	= 0	3	10¼
810	810	= 15	11	6½

For 6 *Days.*

£	£	£	*s.*	*d.*
270	1000	= 2	14	9½
6	600	= 1	12	10½
	20	= 0	1	1¼
1620	1620	= 4	8	9¼

For the whole time.

£	*s.*	*d.*
247	10	0
15	11	6½
4	8	9¼
267	10	3¾

TABLE shewing the number of days from any day in the month, to the same day in the other month through the year.

From	To Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
Febru.	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	91	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
Septem.	122	153	181	212	242	273	303	334	365	30	61	91
October	92	123	151	182	212	243	273	304	335	365	31	61
Novem.	61	92	120	151	181	212	242	273	304	334	365	30
Decem.	31	62	90	121	151	182	212	243	274	304	335	365

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