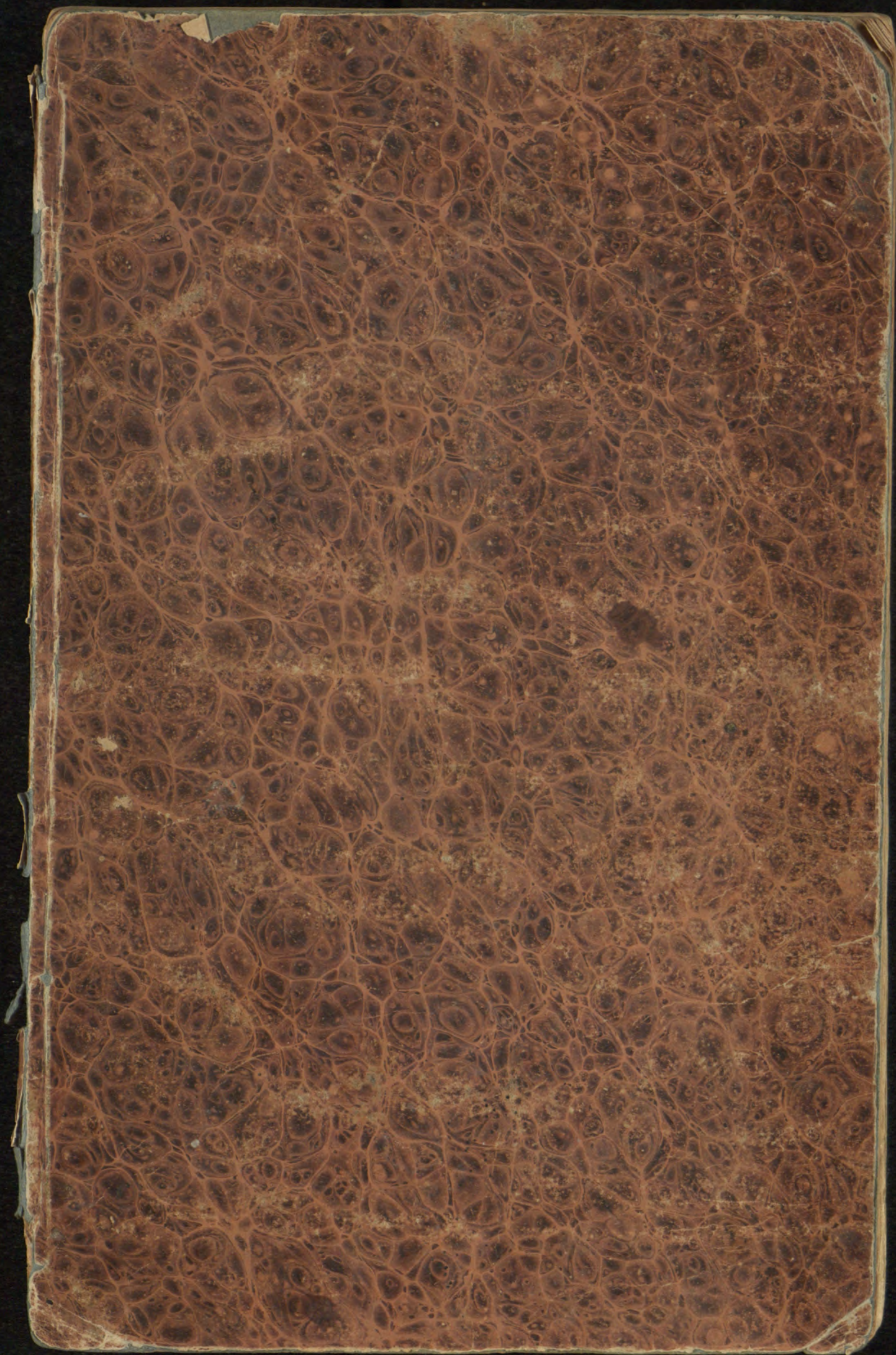
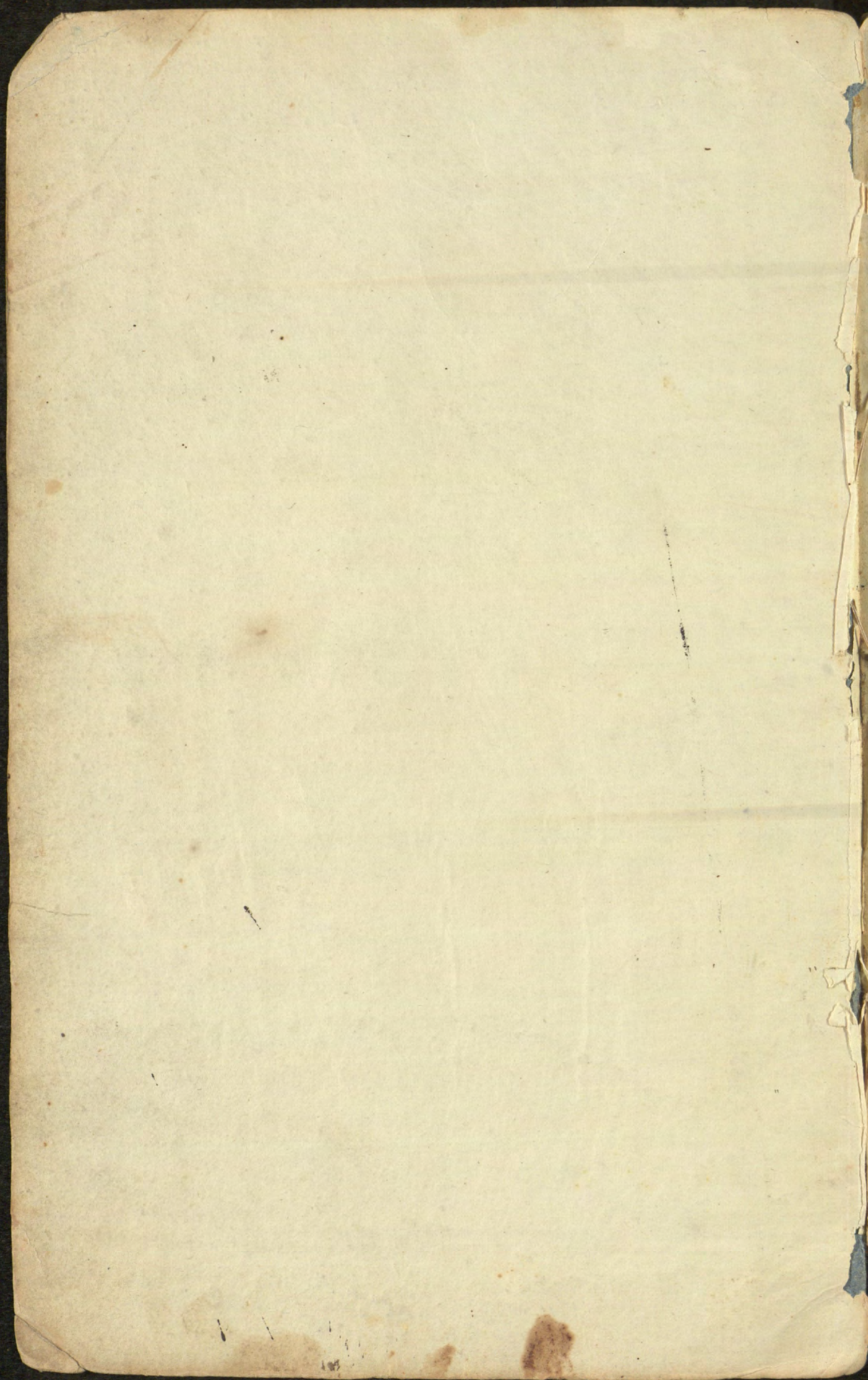






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JOHN H. HARRIS, ESQ.

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Illustrative Notes.

I. *Origin and Progress of the Science of Arithmetick.*

HISTORY fixes neither the time, nor the author, of the invention of Arithmetick. Some knowledge of numbers, however, must have existed in the earliest ages of mankind ; as it would be suggested to them, whenever they opened their eyes, by their own fingers, by their flocks and herds, and by the variety of objects that surrounded them. But, though some kind of computation must have commenced at a very early period, the introduction of arithmetick, as a science, depended upon the establishment of commerce ; and as commerce was gradually extended, and other sciences were discovered and cultivated, arithmetick would be improved likewise.

Proclus, in his commentary on the first book of Euclid, says the Phœnicians were the first inventors of arithmetick ; and Strabo also informs us that in his time it was attributed to the Phœnicians. Others have traced its origin to Egypt ; and it has been a general opinion, sanctioned by the authority of Socrates and of Plato, that Thuet or Thot was the inventor of numbers. From Asia it passed into Egypt, as Josephus says, by means of Abraham ; where it was greatly cultivated and improved. From Egypt arithmetick was transmitted to the Greeks, by Pythagoras and his followers ; and among them it was the subject of particular attention, as we perceive in

the writings of Euclid, Archimedes, and others. With the improvements derived from them, it passed to the Romans ; and from them it came to us.

The introduction of the Arabian or Indian notation into Europe, about the tenth century, made a material alteration in the state of arithmetick ; and this, indeed, was one of the greatest improvements which the science had received since its first discovery.— This method of notation, now universally used, was probably derived from the Indians, by the Arabians ; from whom it was brought into Spain by the Moors or Saracens in the tenth century ; and in the beginning of the eleventh century, it was known in England.

The next considerable improvement after the introduction of the Arabian figures, was that of decimal parts, invented in 1464, by Regiomontanus. The first person, however, who professedly treated on this subject, and introduced the name of “disme” or “decimals,” was Simon Stevinus, whose treatise, in French, was published at Leyden in 1585 ; since which the method of decimals has become almost universal.

The last, and one of the greatest improvements which the art of computation ever received, was the invention of Logarithms, by Baron Napier, of Scotland, in 1614.

II. *Remarks on the Roman Notation, Numeration, &c.*

The practice of counting on the fingers doubtless originated the method of Notation by Roman Letters. The letter I, was taken for one finger, or *one* ; and hence II, for *two* ; III, for *three* ; IIII, for *four* ; and V, representing the opening between the thumb and fore-finger, was taken for *five*. IV, being a simpler expression for *four* than IIII, was adopted on the general principle that a less literal number placed before a greater, should diminish the greater so much.— *Fifty* was expressed by L, because it is half of C, (or E, as it was anciently written,) and C is the initial of the Latin *centum*, one hundred. *Five hundred* was expressed by D, because it is half of the Gothick *Q* or M., the initial of *mille*, one thousand.

Nature has furnished the great and universal standard for computation in the fingers of the hand. All

nations have accordingly reckoned by *fives* ; and some barbarous tribes have scarcely advanced any further. After the fingers of one hand had been counted once, it was a second and perhaps a distant step to proceed to those of the other. The primitive words, expressing numbers, did not probably exceed five. To denote *six*, *seven*, *eight*, and *nine*, the North American Indians repeat the five with the successive addition of one, two, three, and four ; could we safely trace the descent and affinity of the abbreviated terms denoting the numbers from five to ten, it seems highly probable, that we should discover a similar process to have taken place in the formation of the most refined languages.

The ten digits of both hands being reckoned up, it then became necessary to repeat the operation.—

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Such is the foundation of our decimal scale of arithmetick. Language still betrays by its structure the original mode of proceeding. To express the numbers beyond ten, the Laplanders combine an ordinal with a cardinal digit. Thus, eleven, twelve, &c. they denominate *second* ten and one, *second* ten and two, &c. and in like manner they call twenty one, twenty two, &c. *third* ten and one, *third* ten and two, &c. Our term *eleven* is supposed to be derived from *ein* or *one*, and *liben*, to remain, and to signify *one, leave or set aside ten*. *Twelve* is of the like derivation, and means *two, laying aside the ten*. The same idea is suggested by our termination *ty* in the words *twenty, thirty, &c.* This syllable, altogether distinct from *ten*, is derived from *ziehen*, to draw, and the meaning of *twenty* is, strictly speaking, *two drawings*, that is, the hands have been twice closed and the fingers counted over.

After ten was firmly established, as the standard of numeration, it seemed the most easy and consistent to proceed by the same repeated composition. Both hands being closed ten times would carry the reckoning up to a *hundred*. This word, originally *hund*, is of uncertain derivation; but the term *thousand*, which occurs at the next stage of the progress, or the hundred added ten times, is clearly traced out, being only a contraction of *duis hund*, or *twice hundred*, that is, the repetition, or collection of *hundreds*. See Edinburgh Review, vol. XVIII. art. VII.

It is the fundamental law of our written numeration, that a removal, of one place, towards the left, increases the value of a figure ten times.

If it were required to express fifty, or five tens, as there are no units in this number, there would be

nothing to write but the figure 5, and consequently it would be necessary to show, by some particular mark, that in the expression of this number, the figure ought to occupy the first place on the left. To do this we place on the right the character 0, *cipher* or *nought*, which of itself has no value, and serves only to fill the place of the units, which are wanting in the enunciation of the proposed number.

Thus with ten characters, we can express all possible numbers.

With two figures only, we can write all, as far as to nine tens and nine units, making 99, or ninety nine. After this comes the hundred, which is expressed by the figure 1, put one place farther towards the left, than it would be, if used to express tens only; and to denote this place, two ciphers are placed on the right, making 100.

The units and tens, afterwards added to form numbers greater than 100, take their proper places; thus a hundred and one will be written in figures 101; a hundred and eleven, 111. Here the same figure is three times repeated, and with a different value each time; in the first place on the right it expresses an unit, in the second, a ten, in the third, a hundred. It is the same with the number 222, 333, 444, &c.—Thus, the same figure expresses units ten times greater, in proportion as it is removed from right to left, and by a simple change of place, acquires the power of representing, successively, all the different collections of units, which can enter into the expression of a number.

III. The Principles of Progression and Proportion illustrated.

[For this article, illustrating the first principles of the science, the publisher is indebted to the politeness of Mr. BENJAMIN M. TYLER, the able Preceptor of Noyes' Publick School in Andover, N. H.]

PROGRESSION is a series of numbers regularly increasing or decreasing.

Progression is divided into two kinds—ARITHMETICAL and GEOMETRICAL.

ARITHMETICAL PROGRESSION.

ARITHMETICAL PROGRESSION is a series of numbers increasing or decreasing regularly, by the continual adding or subtracting of some particular number. Thus, 2, 4, 6, 8, 10, 12, is a series of numbers in Arithmetical Progression, made by continually add-

ing the number 2; or, 15, 12, 9, 6, 3, is a series decreasing by constantly subtracting the number 3.

The first and last terms of a series, are called Extremes; and those between the extremes are called Means.

The number which is added or subtracted to make out the series, is named the Common Difference.

PROBLEM 1.

To find the last term.

RULE. Multiply the common difference by one less than the number of terms, and add the first term to the product.

Illustration.—When a series of numbers, in Arithmetical Progression, is made out at full length, the common difference is added to, or subtracted from, all the terms except the last one; consequently the last term, in an increasing series, or the first term, in a decreasing, contains the common difference as many times as the series has terms wanting one. But, as the product of a number, multiplied by any number of units, is equal to the multiplicand added together as many times as the multiplier contains units, we obtain the same result, whether we add the common difference as many times as the series has terms wanting one, or multiply it by the same number.

NOTE. All questions are considered to be in Increasing Progression, unless otherwise mentioned in the question.

EXAMPLES.

1. Let the first term of an Arithmetical series be 4, the common difference 2, and the number of terms 22, to find the last term.

Ans. 46.

2. What is the last term of a series, which has 1001 terms, a common difference of 7, and the first term 19?

Ans. 7019.

3. Given the first term of a series 111111, the number of terms 1111, and the common difference 11; what is the last term, if the series decrease?

Ans. 98901.

4. If a vessel sail 100 days successively, and sail 100 miles the first day; how far will she sail the last day, allowing that she decreases each day's sail $\frac{1}{3}$ of a mile?

Ans. 67 miles.

5. If a man work 10 years, and save \$100 the first year, \$111 the second year, increasing \$11 each year; how much will he save the 10th year?

Ans. \$199.

The following examples are given to find the last terms.

	First Terms.	Com. Diff.	No. Terms.	Ans.
6.	20202,	5,	202.	21207.
7.	60000,	10,	100.	60990.
8.	675,	$\frac{1}{2}$,	224.	730 $\frac{1}{2}$.
9.	112,	$\frac{1}{2}$,	101.	162.
10.	1909,	$\frac{1}{3}$,	20.	1912 $\frac{2}{3}$.
11.	821,	$\frac{1}{2}$,	28.	828 $\frac{1}{2}$.

NOTE. To find the product of a fraction multiplied by a whole number; multiply the numerator of the fraction by the whole number, and place the product over the given denominator; or divide the denominator by the whole number, if it will divide it without a remainder.

PROBLEM 2.

To find the sum of all the terms.

RULE. Multiply the sum of the extremes by the number of terms, and divide by 2; or, multiply half the sum of the extremes by the number of terms.

NOTE. In any odd number of terms, the middle term is equal to half the sum of any two terms equally distant from it.

Illustration.—The sum of any two terms of an Arithmetical series, equally distant from the centre, is equal to double the sum, which all the terms will average; or if the number of terms be odd, equal to double the middle term; consequently multiplying the sum of the

extremes by the number of terms, gives double the sum of the series.

Thus in the series, 1, 3, 5, 7, 9, it is evident, that by subtracting from the great and adding to the less term, the sum of the series will contain 5, as many times as there are terms.

EXAMPLES.

1. If the first term of an Arithmetical series be 2, the last term 122, and the number of terms 29; what is the sum of all the terms?

Ans. 1798.

2. A man paid a debt at 41 several payments; the first payment being \$26,01, the last \$100,01; what was the debt?

Ans. \$2583, 41.

3. What is the sum of 1000 terms in Arithmetical Progression, the last term being 500, and the common difference $\frac{1}{2}$, if the series decrease?

Ans. 583250.

4. Required the sum of 390 terms of the numbers, 2, 5, 8, 11, &c.

Ans. 1470645.

Given the following examples, to find the sum of the series in each.

	First terms.	Last terms.	No. terms.	Ans.
5.	1011,	28,	66,	34287.
6.	1000000,	999,	555,	277777222 $\frac{1}{2}$.
7.	12,	$\frac{1}{2}$,	66,	412 $\frac{1}{2}$.
8.	111,	$\frac{1}{3}$,	31,	1721 $\frac{2}{3}$.
9.	96,	$\frac{2}{15}$,	23,	1105 $\frac{1}{3}$.

Given the following questions in Arithmetical Progression, to find the sum of the series.

	First terms.	Com. diff.	No. terms.	Ans.
10.	50,	2,	26.	1950.
11.	159,	9,	19.	4560.
12.	201,	$\frac{1}{2}$,	29.	5896 $\frac{1}{2}$.
13.	971,	$\frac{1}{2}$,	27.	26467 $\frac{1}{2}$.
14.	11	$\frac{1}{11}$,	101.	1381 $\frac{1}{11}$.

Find the sum of all the terms in the following examples, in decreasing Arithmetical Progression.

	First term.	Com. diff.	No. terms.	Ans.
15.	1000,	3,	33,	35891.
16.	120,	6,	11,	990.
17.	1,	$\frac{1}{15}$,	40,	24 $\frac{4}{15}$.
18.	10,	$\frac{1}{2}$,	5,	35.

PROBLEM 3.

To find the common difference.

RULE. Divide the difference of the extremes by one less than the number of terms.

Illustration.—The greater term is made up of the less, and the common difference taken as many times as the series contains terms wanting one; therefore by subtracting the less from the greater extreme, and dividing the difference by one less than the number of terms, the quotient will be the common difference of the terms.

EXAMPLES.

1. Given the extremes of an Arithmetical series 3 and 97, and the number of terms 48; to find the common difference.

Ans. 2.

2. If a man perform a journey in eight days, increasing each day's travel by a certain number of miles, and

travel the first day 21 miles, and the last 70; how many miles does he increase daily?

Ans. 7 miles.

PROBLEM 4.

To find the number of terms.

RULE. Divide the difference of the extremes by the common difference, and add one to the quotient.

Illustration.—The greatest term is made up of the common difference added together as many times as the series has terms wanting one, together with the less term; therefore by subtracting the less term from the greater, and dividing the remainder by the common difference, the quotient expresses the number of times the common difference was added together to make the dividend.

Thus, in the series 1, 3, 5, 7; 7 is made up of two, the common difference, 3 times taken, and the first term once: so that, $7-1 \div 2=3$, one less than the number of terms.

EXAMPLES.

1. The extremes of an Arithmetical series are 8 and 88, the common difference 10; what is the number of terms?

Ans. 9.

2. If a boy buy a number of oranges, and give 17 cents for the first, $15\frac{1}{2}$ cents for the second, &c. decreasing the price of each $1\frac{1}{2}$ cents, until the last cost but two cents; how many oranges did he buy?

Ans. 11.

3. A spendthrift spent his estate amounting to \$1262,25, in 15 years; spending each year \$20,22 more than in the preceding; how much did he expend the 9th year?

Ans. \$104,37.

Questions to be performed by the principles laid down in the preceding problems.

1. If two men start from the same place at the same time, one travelling 21 miles each day, the other 3 miles the first day, 5 the second, increasing his speed each day by the excess of 2 miles; how many days before the latter will come up with the former, and how many miles will each travel?

Ans. 19 days.
399 miles.

2. Estimating the distance between London and Boston at 3000 miles; if a ship perform a voyage from one city to the other in 26 days, sailing the first day 80 miles, and increase each day's sail in Arithmetical Progression; how far will she sail the last day; what will be the daily increase; and how much farther does she sail the 25th day of the voyage, than the second?

Ans. { Last day's sail, $1501\frac{1}{2}$ miles.
Daily increase, $2\frac{1}{2}$ miles.
The 25th day's sail more than the 2d, $65\frac{1}{2}$ miles.

3. Two divisions of labourers commence work upon a canal at the same time, 500 rods apart; one division completes one half of the intervening distance in 7 days; the other the remaining half in 9 days. Now if each division increase each day's work 4 rods more than the last, how many rods does each division complete in each day?

Ans. { The first, $23\frac{1}{2}$, $27\frac{1}{2}$, $31\frac{1}{2}$, $35\frac{1}{2}$, $39\frac{1}{2}$,
 $43\frac{1}{2}$, $47\frac{1}{2}$.
The second, $11\frac{1}{2}$, $15\frac{1}{2}$, $19\frac{1}{2}$, $23\frac{1}{2}$,
 $27\frac{1}{2}$, $31\frac{1}{2}$, $35\frac{1}{2}$, $39\frac{1}{2}$, $43\frac{1}{2}$.

ARITHMETICAL PROPORTION.

When two numbers are compared together, the first is called the Antecedent, the second the Consequent; both taken together a couplet.

If the difference between the Antecedent and Consequent of two or more couplets, be the same number, this equality of difference is termed Arithmetical Proportion; and each number, considered in connexion with the others, is called an Arithmetical Proportional.

The proportion of numbers is expressed, by placing a colon between the antecedent and consequent of each couplet, and a double colon between the couplets.

Thus, $2:4::6:8$ are four numbers in Arithmetical Proportion; and are read, as 2 is to 4 so is 6 to 8.

Proportion is distinguished into Continued and Discontinued.

When the difference between the Consequent of one couplet and the Antecedent of the next, is the same number as the common difference of the couplets, the Proportion is Continued; but when the difference between the Consequent of one couplet and the Antecedent of the next, is not the same number as the common difference of the couplets, the proportion is Discontinued.

Thus, $2:4::6:8$ is Continued Proportion; but, $2:4::10:12$ is Discontinued Proportion.

PROBLEM 1.

To find a mean proportional between two given extremes.

RULE. Take half the sum of the two extremes; the quotient will be an Arithmetical mean proportional between the two given extremes.

EXAMPLES.

1. Find a mean proportional between 7 and 17.

Ans. 12.

2. A certain debt can be discharged at three payments in Arithmetical Proportion. If the first payment be \$11, and the third \$31,17, what is the second?

Ans. \$21,085.

PROBLEM 2.

To find any number of Arithmetical means between two given terms.

RULE. Subtract the less extreme from the greater, and divide the difference by one more than the number of means required; this quotient added to the first term, if the proportion is increasing, or subtracted, if it be decreasing, will give the first mean; added to, or subtracted from the first mean, will give the second. Continue the same process till all the means are found.

EXAMPLES.

1. Required to find four Arithmetical means between 1 and 96.

Ans. 20, 39, 58, 77.

2. If a man work 6 days for wages in Arithmetical proportion, and receive 29 cents for his first day's work, and 79 for the last; what does he receive for the intervening days?

Ans. 39, 49, 59, 69.

GEOMETRICAL PROGRESSION.

When a series of numbers is produced by continually multiplying or dividing by the same number, it is called Geometrical Progression. The number by which a series in Geometrical Progression is increased or decreased, is called the Ratio.

Thus, 1, 2, 4, 8, 16, 32, is an increasing series in Geometrical Progression, having 2 for its Ratio; and, 81, 27, 9, 3, 1, is a decreasing series, having 3 for its Ratio.

All the other terms have the same names, as the corresponding terms in Arithmetical Progression.

PROBLEM 1.

To find the last term.

RULE 1. Raise the ratio to a power denoted by one less than the number of terms, and multiply that power by the first term, if the series be increasing, but, if the series be decreasing, divide by the same power.

Illustration.—When the first term of an increasing series is one, the second term will always be the same number as the ratio; consequently multiplying by the ratio, to find the last term, is only raising the ratio to a power denoted by one less than the number of terms. But when the first term is any number more than one, the second term will contain the ratio as many times as the first term contains a unit; so that the last term will contain such a power of the ratio, as is denoted by one less than the number of terms, as many times as the first term contains a unit.

Thus, in the series 1, 2, 4, 8; 3, the last term, is simply the third power of the ratio. But in the series 2, 4, 8, 16; the last term contains twice the third power of the ratio.

When the progression is decreasing it may be considered as increasing from the last term; consequently, dividing the first term by that power of the ratio denoted by one less than the number of terms, will give the last term.

EXAMPLES.

1. Let the first term of a Geometrical series be 5, the ratio 3, number of terms 10; what is the last term?
Ans. 98415.

2. Given the first term of a decreasing series, 1000, number of terms 5, the ratio 4, to find the last term.
Ans. $3\frac{2}{3}$.

3. Given the first term of a series $\frac{1}{16}$, the ratio $\frac{1}{16}$, the number of terms 4; to find the last term.
Ans. $\frac{1}{83336}$.

4. A man agrees to sell 10 bushels of wheat, at one mill for the first bushel, and 5 times as much for each succeeding bushel, as what he receives for the preceding one; what will he receive for the last bushel?
Ans. \$1953,125.

RULE 2. Set down any convenient number of terms in the given Geometrical Progression; and, if the first term be the same as the ratio of the Geometrical Progression, place a series of numbers in Arithmetical Progression, having one for its common difference, over the Geometrical series; putting 1 over the first term, 2 over the second, &c.

But if the first term of the Geometrical series be different from the ratio, place a cipher over the first term, and 1 over the second term, 2 over the third, &c.

If the figure 1 stand over the first term of the Geometrical series, add together as many of the terms in the Arithmetical series, (which are called Indices) as will express the number of the term required; but, if a cipher stand over the first term, take so many only of the numbers in the Arithmetical series, whose sum will equal one less than the number of the required term; then the continued product of those terms in the Geometrical series standing under the terms taken in the Arithmetical, will be the last term.

NOTE. If the first term in the Geometrical series be different from 1, divide each product by it.

FORMULA.

1, 2, 3, 4, 5, 6, Indices.
2, 4, 8, 16, 32, 64, Geometrical series.
0, 1, 2, 3, 4, 5, 6, Indices.
1, 2, 4, 8, 16, 32, 64, Geometrical series.

EXAMPLES.

1. Given the first term of a Geometrical series 2, number of terms 12, and the ratio 2; to find the last term.
Ans. 4096.

2. What is the last term of 9 terms of the series $\frac{1}{3}, \frac{1}{6}, \frac{1}{12}$, &c.
Ans. $\frac{1}{10633}$.

3. If a balloon descend from a certain height in 6 minutes of time, and descend $\frac{1}{12}$ of a mile the first minute, three times that distance the second, 9 times as far the third minute as the first, and increase its velocity during the remainder of its descent, by the same ratio; how many feet will it descend the last minute?
Ans. 10264 $\frac{8}{25}$.

Find the last terms to the following examples.

First terms.	Ratio.	Number of terms.	Ans.
4. 2,	3,	16.	28697814
5. $\frac{1}{2}$,	4,	14.	33554432
6. $2\frac{1}{2}$,	$\frac{1}{2}$,	19.	$\frac{524288}{324140625}$
7. 4,	$\frac{1}{3}$,	13.	$\frac{244140625}{324140625}$

PROBLEM 2.

To find the sum of all the terms.

RULE. If the series be increasing, multiply the last term by the ratio, subtract the first term from the product, and divide the difference by the difference between one and the ratio. But if the series be decreasing, multiply the first term by the ratio, subtract the last term from the product, and divide the remainder by the difference between one and the ratio.

EXAMPLES.

1. Find the sum of the terms in the following proportion, 2 : 4 :: 8 : 16.

Here $16 \times 2 - 2 \div (2 - 1) = 30$ the sum.

2. Given 8, the number of terms of a Geometrical Progression, first term 3, the ratio 4, to find the sum of the series.
Ans. 65535.

3. A certain gentleman gave his whole estate to six sons; giving to the youngest \$1000, to the second once and a half as much, and to the others, sums increasing by the same ratio; how much was the estate?
Ans. \$20781,25.

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Required the sum of the terms in the following examples.

	First terms.	Ratios.	No. of terms.	Ans.
4.	1,	2,	9.	511.
5.	20,	3,	8.	65600,
6.	7,	$\frac{2}{3}$,	7.	19232,
7.	$\frac{2}{7}$,	$\frac{1}{7}$,	9.	3954653288,
				11863960433.

GEOMETRICAL PROPORTION.

When two or more couplets of numbers have equal quotients or ratios, this equality is named Proportion; or, when the Antecedents of two or more couplets are the same parts of their respective Consequents, or are the same multiples of their Consequents, the numbers are said to be in Proportion; and the terms themselves are called Proportionals.

Thus, in the Proportion $2 : 4 :: 8 : 16$; 2, the Antecedent of the first couplet, is the same part of 4 its Consequent, that 8, the Antecedent of the second couplet, is of 16 its Consequent; and the Proportion, $81 : 27 :: 9 : 3$; 81 is the same multiple of 27, that 9 is of 3.

When the ratio between the Consequent of the first couplet and the Antecedent of the second, is the same number as the ratio between the Antecedent and Consequent of each couplet, the Proportion is said to be Continued; but when this is not the case, the Proportion is called Discontinued.

The same numbers are in proportion in all the following forms:

1. Directly;	as	$2 : 6 :: 4 : 12$
2. Inversely;	"	$6 : 2 :: 12 : 4$
3. Alternately;	"	$2 : 4 :: 6 : 12$
4. Compoundedly;	"	$2 : 8 :: 4 : 16$
5. Dividedly;	"	$2 : 4 :: 4 : 8$
6. Mixed;	"	$8 : 4 :: 16 : 8$
7. Multiplication;	"	$6 : 18 :: 4 : 12$
8. Division;	"	$1 : 3 :: 4 : 12$

THEOREM. When four numbers are in Geometrical Proportion, the product of the extremes is equal to the product of the two means. But when the number of terms is odd, the product of the extremes is equal to the square of the middle term.

Illustration.—When four numbers are in Geometrical Proportion, if one extreme be 1, the proportional next to it will always be the same as the ratio; consequently, multiplying the other mean by that which is equal to the ratio, gives the greater extreme; and this product of the means is evidently equal to the product of the extremes; for multiplying the greater extreme by the less, when that is 1, does not increase it.

But when three terms are in proportion, and one of the extremes is 1, the mean is the same as the ratio, and multiplying the mean by itself, gives the other extreme, which is also the square of the mean.

If three or more numbers in proportion, be multiplied by the same number, their products will also be in proportion; for, whatever part any Antecedent is of its Consequent, the product of the Antecedent will be the same part of the product of the Consequent, when both are multiplied by the same number; so that, when the less extreme is greater than one, the product of the means will equal the product of the extremes; for, in this case, each term must be considered as the product of some

other terms, multiplied by the number of units contained in the less extreme, when the less extreme of the terms so multiplied, is 1.

PROBLEM 1.

To find any number of Geometrical means between two given extremes.

RULE. Divide the greater extreme by the less, and extract such a root of the quotient, whose index is one more than the number of means required.

Then, if the series be increasing, multiply the first term by the root just found, continually; but if the series be decreasing, divide the first term continually by the same root, the products or quotients will be the means required.

Illustration.—As the greater extreme of any number of proportionals, is made up of as many times of that power of the ratio denoted by one less than the number of terms, as the less extreme contains units; dividing the greater extreme by the less, gives that power of the ratio for a quotient; and consequently extracting such a root of this quotient, as is denoted by one less than the number of terms, or, (which is the same thing,) one more than the number of means, gives the ratio. See the solution of the first example below.

EXAMPLES.

1. Required two Geometrical means between 3 and 81. Here, $81 \div 3 = 27$; and $\sqrt[3]{27} = 3$ the ratio; then the first term $3 \times 3 = 9$, the first mean, and $9 \times 3 = 27$, the second mean.

2. Find three Geometrical means between 5 and 80. Ans. 10, 20, 40.

3. If a merchant sell 7 yards of cloth; and is to receive prices for the same in Geometrical Proportion, what will he receive for the second, third, fourth, fifth, and sixth yards, if he receive 1 cent for the first yard, and \$7.29 for the seventh? Ans. .03, .09, .27, .81, 2.43 cents.

PROBLEM 2.

To find one extreme, when one or two means, and one extreme are given.

RULE. When two means are given, divide their product by the given extreme. If but one mean is given, divide the square of the mean by the given extreme.

NOTE. The answers to most questions in Proportion, are found by this rule.

Illustration.—As the product of two means is equal to the product of the two extremes, it may be considered as the product of the extremes; and if the product of two numbers be divided by either of those numbers, the quotient will be the other.

EXAMPLES.

1. Given 4 the last extreme of four proportionals, and 676 the product of the means, to find the other extreme. Ans. 169.

2. Suppose two companies of men spend money in proportion to the number of individuals in each company; and one company to consist of 11, and the product of the larger number into what the less company expend,

equal \$14595; what is the expense of the larger company?

Ans. \$1326,818.4

3. The first term of three Geometrical Proportionals, is 9, the square of the mean 256; what is the third Proportional?

Ans. 284.

4. Let the product of two means be $\frac{3}{4}$, the first term $\frac{1}{2}$; to find the fourth term.

Ans. $\frac{2}{3}$.

5. If a board, 30 feet long, be 4 feet wide at one end, and decrease with a true taper to a point at the other end; how many more square feet will there be in 6 feet in length, at the widest end, than in the same length at the other?

Ans. 19 $\frac{1}{2}$ feet.

6. Find a third proportional to 8 and 13.

Ans. 21 $\frac{1}{2}$.

7. Find a third proportional to $\frac{2}{3}$ and $\frac{1}{2}$.

Ans. 38 $\frac{2}{3}$.

8. If the square of a mean proportional, be $\frac{3}{4}$, and the first term be $\frac{1}{2}$; what is the last term?

Ans. 16 $\frac{2}{3}$.

NOTE. When different quantities of goods are sold at the same price per unit, the prices of different quantities, are in the same proportion to each other, as the quantities themselves.

9. If 15 yards of cloth cost \$16, what will 90 yards cost?

Ans. \$96.

10. If a man sell two pounds of butter for 31 cents, what will 1000 pounds come to?

Ans. \$155.

11. The Earth turns upon its axis once in 23 hours and 56 minutes, and its circumference is 25,000 miles—How far will a person be carried on the equator in one second of time?

Ans. 92 $\frac{1}{10}$ rods.

12. A was unable to pay his debts. His creditors, B, to whom he owed \$65, and C, to whom he owed \$71, agreed to submit to a loss in proportion as 5 to 4; what would each receive?

Ans. B receives \$52, and C receives \$56.80.

13. Two men, A and B, commence a journey at the same time and from the same place. A's speed, which is 5 $\frac{1}{2}$ miles an hour, bears the same proportion to B's, that 5 does to 7; how far does B travel in 9 hours?

Ans. 65 $\frac{1}{2}$ miles.

14. A gentleman having a lot of land in the form of a parallelogram, wishes to set off fifty acres from one end, which is 100 rods wide. How many rods will it require on the other side to contain fifty acres?

Ans. 80 rods.

15. What number is that which bears the same proportion to 79, that 17 does to 15?

Ans. 89 $\frac{2}{3}$.

16. A owes B \$500; but not being able to pay the whole, B offers to compound with him for a sum, which shall bear the same proportion to his debt, as $\frac{3}{4}$ does to $\frac{2}{3}$; what does B receive?

Ans. \$357,142.4.

NOTE. The numerator of a fraction bears the same proportion to that part of a quantity expressed by the fraction, as the denominator bears to the whole quantity.

17. If a man fill one $\frac{1}{3}$ of a cask with brandy, $\frac{1}{4}$ with wine, and $\frac{1}{5}$ with water; and it lack 21 $\frac{1}{2}$ gallons of being full, how many gallons will such a cask contain?

Ans. 96 $\frac{2}{3}$.

18. If a gamester at the first game lose $\frac{1}{2}$ of his money, and win 3 shillings at the second; lose $\frac{1}{3}$ of his first stock at the third, and win 6 shillings at the fourth; now if what he has won, bears the same proportion to what he has lost, as what he has left of his first stock, does to his first stock, how much money had he when he commenced playing?

Ans. 52 $\frac{1}{2}$ shillings.

NOTE. The proportion between the diameter and circumference of circles, is as 7 to 22.

19. If the diameter of a circle is 100 feet, what is the circumference?

Ans. 314 $\frac{1}{2}$ feet.

20. The diameter of the sun is 883246 miles; what is its circumference?

Ans. 2775916 miles.

21. The diameters of Jupiter and Mercury, are to each other, as 44585 is to 1612; allowing the circumference of Mercury to be 10132 $\frac{1}{2}$ miles, what is the diameter of Jupiter?

Ans. 89170 miles.

NOTE. Circles are to each other as the squares of their diameters.

22. How many rods of land will it require to make a walk, one rod in width, around a circular pond, whose diameter is 10 rods?

Ans. 34 $\frac{1}{2}$ rods.

NOTE. The spaces passed over by bodies falling freely in vacuo, are as the squares of the times.

It is found by experiment, that bodies falling in vacuo descend 16 $\frac{1}{2}$ feet in the first second of time.

23. If a body fall freely in vacuo 4 seconds of time, how much farther will it descend during the fourth second than the first?

Ans. 96 $\frac{1}{2}$ feet.

24. If a body fall 16 $\frac{1}{2}$ feet in the first second of its descent, how far will it have descended at the end of 5 seconds?

Ans. 402 $\frac{1}{2}$ feet.

NOTE. The squares of the periodical times of the Planets, bear the same proportion to each other as the cubes of their mean distances from the sun.

25. If two balls revolve about a common centre, one at the distance of 3 inches, the other at the distance of 5, and the ball nearest the centre, revolve once in 3 seconds of time; how long will the other be completing a revolution, if both observe the same laws of motion, as the Planets which revolve about the sun?

Ans. 6,45+ seconds.

NOTE. Per cent. is what is gained or lost on 100.

26. If a merchant buy tea at 45 cents per lb. and sell it at 55 cents; what does he gain per cent?

Ans. 22 $\frac{1}{2}$ per cent.

27. If a merchant buy tea at 45 cents per lb. and sell it so as to gain 25 per cent.; what does he receive per lb.?

Ans. 56 $\frac{1}{4}$ cents.

28. If a merchant buy brandy at \$1.00 a gallon, and sell it so as to lose 5 $\frac{1}{2}$ per cent. what does he receive per gallon?

Ans. 94 $\frac{3}{4}$ cents.

29. A, B, and C united stocks in trade, A put in \$160, B, \$200, and C, \$150; and they gain a sum equal to $\frac{1}{4}$ of their whole stock, how much does each gain?

Ans. $\left\{ \begin{array}{l} A \text{ gains } \$32. \\ B \text{ gains } \$40. \\ C \text{ gains } \$30. \end{array} \right.$

30. What number is the same part of 27, that 13 is of 19?

Ans. 18 $\frac{2}{3}$.

31. What number is the same multiple of 7, that 61 is of 9?

Ans. 47 $\frac{1}{2}$.

446475
29705216
91848000

14
91822229

26197
64059

Useful Tables.

Decimal Tables of Coin, Weight and Measure.

TABLE I. ENGLISH COIN. £. 1 the Integer.				10		0.01736		1-4 oz.		9		0.142857			
sh.	dec.	sh.	dec.	9	0.01562	3	decimals.	8	0.00418	8	0.126694	7	0.111111		
19	.95	9	.45	8	0.01389	2	0.00279	7	0.00139	6	0.095238	5	0.079365		
18	.9	8	.4	7	0.01215	1	0.000139	6		5	0.063492	4	0.047619		
17	.85	7	.35	6	0.01042	TABLE V. AVOIRDUPOIS WEIGHT. 1 lb. the Integer.								3	0.03174
16	.8	6	.3	5	0.00808	ounces.	decimals.	2 <td>0.015873</td> <th>pints.</th> <th>decimals.</th> <th>2<td>0.005952</td></th>	0.015873	pints.	decimals.	2 <td>0.005952</td>	0.005952		
15	.75	5	.25	4	0.00694	8	.5	1	0.001684	3		1	0.003968		
14	.7	4	.2	3	0.00521	7	.4375	TABLE VII. MEASURE.						1	0.01684
13	.65	3	.15	2	0.00347	6	.375	Liquid.							
12	.6	2	.1	1	0.00173	5	.3125	1 Gallon.						1 Quarter	
11	.55	1	.05	1 oz. the Integer. Penny weight the same as Shillings in the first Table.				4	.25	Integer.					
10	.5			grams.	decimals.	3 <td>.1875</td> <th>drams.</th> <th>decimals.</th> <th>3<td>.125</td><th>q. pints.</th><th>decimals.</th><th>pecks.</th></th>	.1875	drams.	decimals.	3 <td>.125</td> <th>q. pints.</th> <th>decimals.</th> <th>pecks.</th>	.125	q. pints.	decimals.	pecks.	
	pence.	decimals.		12	.025	2	.115	8	.03125	2	.0625	4	.5	4	
	6	.025		11	.022916	1		7	.027343	1		3	.375	3	
	5	.020823		10	.020833			6	.023437			2	.25	2	
	4	.016666		9	.01875			5	.019531			1	.125	1	
	3	.0125		8	.016666			4	.015625						
	2	.008333		7	.014583			3	.011718						
	1	.004166		6	.0125			2	.007812						
	farthings.	decimals.		5	.010416			1	.003906						
	3	.003125		4	.008333			TABLE VI. LIQUID MEASURE. 1 tun the Integer.							
	2	.0020833		3	.00625			gallons.	decimals.	decimals.	q. pecks.				
	1	.0010416		2	.0054166			100	.396825	0.234375	3				
TABLE II. ENGLISH COIN. 1 shilling. LONG MEASURE. 1 foot. The Integer.				TABLE IV. AVOIRDUPOIS WEIGHT. 112 lb. the Integer.				gallons.				decimals.	q. pecks.		
pence and inches.	decimals.			qrs.	decimals.	100				.396825	0.15625	2			
6	.5			3	.75	90				.357141	0.078125	1			
5	.416666			2	.5	80				.317460	decimals.	pints.			
4	.333333			1	.25	70				.27	0.05859	3			
3	.25			14	decimals.	60				.238095	0.003906	2			
2	.166666			13	.125	50				.198412	0.01953	1			
1	.083333			12	.107143	40				.158730	TABLE VIII. LONG MEASURE. 1 Mile the Integer.				
farthings.	decimals.			11	.098214	30				.119047	yards.	decimals.			
3	.0625			10	.089286	20				.079365	1000	.568182			
2	.041666			9	.080357	10				.039682	900	.511364			
1	.020833			8	.071428	9				.035714	800	.454545			
TABLE III. TROY WEIGHT. 1 lb. the Integer.				7	.0625	8				.031746	700	.397727			
Ounces the same as Pence in the last Table.				6	.053571	7				.027	600	.340909			
penny weight.	decimals.			5	.044643	6				.023808	500	.284091			
10	.041666			4	.035714	5				.019841	400	.227272			
9	.0375			3	.026786	4				.015873	300	.170454			
8	.033333			2	.017857	3				.011904	200	.113636			
7	.029166			1	.008928	2				.007936	100	.056818			
6	.025			ounces.	decimals.	1				.003962	90	.051136			
5	.020833			8	.004464	pints.				decimals.	80	.045454			
4	.016666			7	.003906	4				.001984	70	.039773			
3	.0125			6	.003348	3				.001488	60	.034091			
2	.008333			5	.002790	2				.000992	50	.028409			
1	.004166			4	.002232	1				.000496	40	.022727			
grains.	decimals.			3	.001674	A Hhd. the Integer.									
12	.002083			2	.001116	gallons.				decimals.	30	.017045			
11	.001910			1	.000558	30				.476190	20	.011364			
						20				.317460	10	.005682			
						10				.158730					

9	005114	90	246575	3	125	hundred.	decimals.				
8	004545	80	219178	2	083333	10	512820				
7	003977	70	191781	1	041666	9	461538				
6	003409	60	164383	minutes.	decimals.	8	410256				
5	002841	50	136986	30	020833	7	358974				
4	002273	40	109589	20	013000	6	307692				
3	001704	30	082192	10	006944	5	256410				
2	001139	20	054794	9	00625	4	205128				
1	000568	10	027397	8	00555	3	153846				
feet.	decimals.	9	024657	7	004861	2	102564				
2	0003787	8	021918	6	004161	1	051281				
1	0001894	7	019178	5	003472	quarters.	decimals.				
inches.	decimals.	6	016438	4	002777	2	025641				
6	0000947	5	013698	3	002083	1	012820				
5	000079	4	010959	2	001388	pounds.	decimals.				
4	0000631	3	008219	1	000694	14	0064102				
3	0000474	2	005479	TABLE X. CLOTH MEASURE. 1 Yard the Integer. Quarters the same as Table IV.							
2	0000319	1	002739								
1	0000158										
TABLE IX. TIME. 1 Year the Integer. Months the same as Pence in the second Table.											
days.	decimals.	hours.	decimals.	nails.	decimals.	13	0059523				
365	1.000000	12	.5	2	.125	12	0054945				
300	.821918	11	.458333	1	.0625	11	0050366				
200	.547945	10	.416666	TABLE XI. LEAD WEIGHT. 1 Fother the Integer.							
100	.273973	9	.375								
		8	.333333								
		7	.291666								
		6	.25								
		5	.208333								
		4	.166666								

A TABLE

For receiving and paying the Gold Coins of Great Britain and Portugal, of their Present Standard. According to an Act of Congress, passed April 29, 1816.

Gr.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts
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A TABLE

For receiving and paying the Gold Coins of France, of their present Standard. According to an Act of Congress, passed April 29, 1816.

A TABLE

For receiving and paying the Gold Coins of Spain and the dominions of Spain, of their present Standard. According to an act of Congress, passed April 29, 1816.

A TABLE showing the weight of any required sum of Spanish Gold.

Grs.		Dls.		Grs.		Dls.		Grs.		Dls.		Grs.		Dls.	
Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.	Cts.	Dwts.
1	4	11	9	1	3	11	9	1	3	11	9	1	3	11	9
2	7	12	10	2	7	12	10	2	7	12	10	2	7	12	10
3	11	13	11	3	11	13	11	3	11	13	11	3	11	13	11
4	15	14	12	4	15	14	12	4	15	14	12	4	15	14	12
5	18	15	13	5	18	15	13	5	18	15	13	5	18	15	13
6	22	16	13	6	22	16	13	6	22	16	13	6	22	16	13
7	25	17	14	7	25	17	14	7	25	17	14	7	25	17	14
8	29	18	15	8	29	18	15	8	29	18	15	8	29	18	15
9	33	19	16	9	33	19	16	9	33	19	16	9	33	19	16
10	36	20	17	10	36	20	17	10	36	20	17	10	36	20	17
11	40	21	18	11	40	21	18	11	40	21	18	11	40	21	18
12	44	22	19	12	44	22	19	12	44	22	19	12	44	22	19
13	47	23	20	13	47	23	20	13	47	23	20	13	47	23	20
14	51	24	20	14	51	24	20	14	51	24	20	14	51	24	20
15	55	25	21	15	55	25	21	15	55	25	21	15	55	25	21
16	58	26	22	16	58	26	22	16	58	26	22	16	58	26	22
17	62	27	23	17	62	27	23	17	62	27	23	17	62	27	23
18	65	28	24	18	65	28	24	18	65	28	24	18	65	28	24
19	69	29	25	19	69	29	25	19	69	29	25	19	69	29	25
20	73	30	26	20	73	30	26	20	73	30	26	20	73	30	26
21	76	31	27	21	76	31	27	21	76	31	27	21	76	31	27
22	80	32	27	22	80	32	27	22	80	32	27	22	80	32	27
23	83	33	28	23	83	33	28	23	83	33	28	23	83	33	28
Dwts.		Dwts.		Dwts.		Dwts.		Dwts.		Dwts.		Dwts.		Dwts.	
Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.		Cts.	
1	0	87	38	1	0	87	38	1	0	87	38	1	0	87	38
2	1	75	39	2	1	75	39	2	1	75	39	2	1	75	39
3	2	62	40	3	2	62	40	3	2	62	40	3	2	62	40
4	3	49	41	4	3	49	41	4	3	49	41	4	3	49	41
5	4	36	42	5	4	36	42	5	4	36	42	5	4	36	42
6	5	23	43	6	5	23	43	6	5	23	43	6	5	23	43
7	6	11	44	7	6	11	44	7	6	11	44	7	6	11	44
8	7	85	45	8	7	85	45	8	7	85	45	8	7	85	45
9	8	73	46	9	8	73	46	9	8	73	46	9	8	73	46
10	8	73	47	10	8	73	47	10	8	73	47	10	8	73	47

TABLE FOR REDUCING NEW-ENGLAND CURRENCY TO FEDERAL MONEY.

Pence.	0	1	2	3	4	5
0	16	18	19	20	22	23
1	17	19	20	22	23	25
2	18	20	22	23	25	26
3	19	21	23	24	26	27
4	20	22	24	25	27	28
5	21	23	25	26	28	29
6	22	24	26	27	29	30
7	23	25	27	28	30	32
8	24	26	28	29	31	33
9	25	27	29	30	32	34
10	26	28	30	31	33	35
11	27	29	31	32	34	36

To find by these Tables the Cents and Mills in any sum of shillings and pence under one dollar, look for the shillings at top, and the pence in the left hand columns; then under the former, and on a line with the latter, will be found the cents and mills sought.

TABLE FOR REDUCING NEW-YORK CURRENCY TO FEDERAL MONEY.

Pence.	0	1	2	3	4	5
0	12	13	14	15	16	17
1	13	14	15	16	17	18
2	14	15	16	17	18	19
3	15	16	17	18	19	20
4	16	17	18	19	20	21
5	17	18	19	20	21	22
6	18	19	20	21	22	23
7	19	20	21	22	23	24
8	20	21	22	23	24	25
9	21	22	23	24	25	26
10	22	23	24	25	26	27
11	23	24	25	26	27	28

TABLE

FOR REDUCING THE CURRENCIES OF THE SEVERAL
UNITED STATES TO FEDERAL MONEY.

	N. Hamp. Mass. Rh. Island. Conn. and Virginia.	New-York and N. Carolina.	N. Jersey, Pennsylvania, Delaware, and Maryland.	S. Carolina, and Georgia.
	D. cts. m.	D. cts. m.	D. cts. m.	D. cts. m.
1 Farthings.	3	3	3	4
2	7	5	6	9
3	10	8	8	14
1 Pence.	14	10	11	18
2	28	21	22	36
3	42	31	33	54
4	56	42	44	71
5	69	52	56	89
6	83	62	67	107
7	97	73	78	125
8	111	82	89	143
9	125	94	100	161
10	139	104	111	179
11	153	114	122	196
1 Shillings.	167	125	133	214
2	333	250	267	429
3	500	375	400	643
4	666	500	533	857
5	833	625	667	1071
6	1000	750	800	1285
7	1167	875	933	1500
8	1333	1000	1067	1714
9	1500	1125	1200	1929
10	1667	1250	1333	2143
11	1833	1375	1467	2357
12	2000	1500	1600	2571
13	2167	1625	1733	2785
14	2333	1750	1867	3000
15	2500	1875	2000	3214
16	2667	2000	2133	3428
17	2833	2125	2267	3643
18	3000	2250	2400	3857
19	3167	2375	2533	4071
1 Pence.	3333	2500	2666	4286
2	6667	5000	5333	8571
3	10000	7500	8000	12857
4	13333	10000	10667	17143
5	16667	12500	13333	21429
6	20000	15000	16000	25714
7	23333	17500	18667	30000
8	26667	20000	21333	34286
9	30000	22500	24000	38571
10	33333	25000	26667	42857
20	66667	50000	53333	85714
30	100000	75000	80000	128571
40	133333	100000	106667	171429
50	166667	125000	133333	214286
60	200000	150000	160000	257143
70	233333	175000	186667	300000
80	266667	200000	213333	342857
90	300000	225000	240000	385714

100	333-333	250.	266 667	428-571
200	666-667	500.	533-333	857-143
300	1000-000	750.	800 000	1285-714
400	1333-333	1000.	1066-667	1714-286
500	1666-667	1250.	1333-333	2142-857
600	2000-000	1500.	1600-000	2571-429
700	2333-333	1750.	1866-667	3000-000
800	2666 667	2000.	2133-333	3428-571
900	3000-000	2250.	2400-000	3857-143
1000	3333-333	2500.	2666-667	4285-714

TABLE

FOR REDUCING FEDERAL MONEY TO THE CURRENCIES
OF THE SEVERAL UNITED STATES.

	New-Hamp. &c. &c. DOLL. 6s.	New-York, &c. DOLL. 8s.	New-Jersey, &c. &c. DOLL. 7s. 6d.	S. Carolina, &c. DOLL. 4s. 6d.
D. cts.	£ s. d. q.	£ s. d. q.	£ s. d. q.	£ s. d. q.
01	3	10	10	2
02	12	20	13	10
03	21	30	23	13
04	30	33	32	21
05	32	43	42	23
06	41	53	52	31
07	50	63	61	40
08	53	73	71	42
09	62	83	80	50
10	71	92	90	52
20	122	171	160	111
30	192	243	230	143
40	243	322	300	1102
50	300	400	390	240
60	371	492	460	292
70	422	571	530	331
80	492	643	600	388
90	543	727	690	422
1	600	800	760	480
2	1200	1600	1500	940
3	1800	1400	1260	1400
4	1400	1200	1100	1880
5	1000	2000	1760	1340
6	1600	2800	2500	1800
7	2200	2600	21260	11280
8	2800	3400	3000	11740
9	2400	3200	376	2200
10	3000	4000	3150	2680
20	6000	8000	7100	4134
30	9000	12000	11500	7000
40	12000	16000	15000	9680
50	15000	20000	18150	11134
60	18000	24000	22100	14000
70	21000	28000	26200	16680
80	24000	32000	30000	18134
90	27000	36000	33700	21000
100	30000	40000	37500	23368
200	60000	80000	75000	46134
300	90000	120000	112500	70000
400	120000	160000	150000	93680
500	150000	200000	187500	116134
600	180000	240000	225000	140000
700	210000	280000	262500	163680
800	240000	320000	300000	186134
900	270000	360000	337500	210000
1000	300000	400000	375000	233680

3464765

2970821 6
3124500

272
311226229

26197
64059

TABLE I.

Showing the Sum to which \$1, or £1 Principal, will increase, in any given number of years, not exceeding 35, at any Rate of Compound Interest, from 4 to 7 per cent.

Years.	4 per cent.	5 per cent.	6 per cent.	7 per cent.
1	1.040000	1.050000	1.060000	1.070000
2	1.081600	1.102500	1.123600	1.144900
3	1.124864	1.157625	1.191016	1.225040
4	1.169858	1.215506	1.262476	1.310290
5	1.216652	1.276281	1.338215	1.402550
6	1.265319	1.340095	1.418519	1.500730
7	1.315931	1.407100	1.503630	1.605780
8	1.368569	1.477455	1.593848	1.718180
9	1.423311	1.551328	1.689478	1.838450
10	1.480244	1.628394	1.790847	1.967150
11	1.539454	1.710339	1.898298	2.104850
12	1.601032	1.795856	2.012196	2.252190
13	1.665073	1.885649	2.132928	2.409840
14	1.731676	1.979931	2.260903	2.578530
15	1.800943	2.078928	2.396558	2.759030
16	1.872981	2.182875	2.540352	2.952160
17	1.947900	2.292018	2.692772	3.158810
18	2.025816	2.406619	2.854339	3.372930
19	2.106849	2.526950	3.025599	3.616520
20	2.191123	2.653297	3.207135	3.869680
21	2.278768	2.785962	3.399563	4.140560
22	2.369919	2.925260	3.603537	4.430400
23	2.464716	3.071523	3.819749	4.740520
24	2.563304	3.225099	4.048934	5.072360
25	2.665836	3.386354	4.291870	5.427430
26	2.772470	3.555672	4.549382	5.807350
27	2.883369	3.733456	4.822345	6.213860
28	2.998703	3.920129	5.111686	6.648830
29	3.118651	4.116135	5.418387	7.114250
30	3.243398	4.321442	5.743491	7.612250
31	3.373133	4.538039	6.088100	8.145110
32	3.508058	4.764941	6.453386	8.715270
33	3.648381	5.003188	6.840589	9.325330
34	3.794316	5.253847	7.251025	9.978110
35	3.946088	5.516015	7.686086	10.676500

TABLE II.

Showing the present value of \$1, or £1, to be received at the end of any number of years not exceeding 35, discounting at any Rate of Compound Interest, from 4 to 7 per cent.

Years.	4 per cent.	5 per cent.	6 per cent.	7 per cent.
1	.961538	.952381	.943396	.934579
2	.924556	.907029	.889996	.873438
3	.888996	.863838	.839619	.816297
4	.854806	.822702	.792094	.762895
5	.821927	.783526	.747258	.712986
6	.790315	.746215	.704961	.666042
7	.759318	.710681	.665057	.622749
8	.730690	.676839	.627412	.582009
9	.702587	.644609	.591898	.543933
10	.675564	.613913	.558395	.508349
11	.649581	.584679	.526788	.475092
12	.624597	.556837	.499969	.444012
13	.600574	.530321	.468839	.414964
14	.577475	.505068	.442301	.387817
15	.555265	.481017	.417265	.362446
16	.533908	.458112	.393646	.338734
17	.513373	.436297	.371364	.316574
18	.493208	.415521	.350344	.295864
19	.474642	.395734	.330513	.276508
20	.456387	.376889	.311805	.258419
21	.438834	.358942	.294155	.241513
22	.421955	.341850	.277505	.225713
23	.405726	.325571	.261797	.210947
24	.390121	.310068	.246979	.197146
25	.375117	.295303	.232999	.184249
26	.360639	.281241	.219810	.172195
27	.346817	.267848	.207368	.160930
28	.333477	.255094	.195630	.150402
29	.320651	.242946	.184557	.140562
30	.308319	.231777	.174110	.131367
31	.296460	.220359	.164255	.122773
32	.285058	.209866	.154957	.114741
33	.274094	.199873	.146186	.107234
34	.263552	.190355	.137912	.100219
35	.253415	.181290	.130105	.093663

A Table of the Measure of Length of the principal places in Europe, compared with the American yard.

100 Aunes or Ells of England,	= 125	100 — of ditto for cloths,	= 67
100 — of Holland or Amsterdam, Haarlem, Leyden, the Hague, Rotterdam, Nuremberg, and other cities of Holland,	= 75	100 — of Geneva	= 124 $\frac{3}{4}$
100 — of Brabant, or Antwerp,	= 76	100 Canes of Marseilles and Montpellier,	= 214 $\frac{1}{2}$
100 — of France and Osnaburg,	= 128 $\frac{1}{2}$	100 — of Thoulouse and High Languedoc,	= 200
100 — of Hamburg, Frankfurt, Leipsick, Bern, and Basil,	= 62 $\frac{1}{2}$	100 — of Genoa, of 9 palms,	= 245 $\frac{1}{4}$
100 — of Breslau,	= 60	100 Varas of Spain,	= 227 $\frac{1}{4}$
100 — of Dantzick,	= 66 $\frac{3}{4}$	100 — of Portugal,	= 123
100 — of Bergen and Drantheim,	= 68 $\frac{1}{2}$	100 Cavidos of Portugal,	= 75
100 — of Sweden and Stockholm,	= 65 $\frac{1}{2}$	100 Brasses of Venice,	= 73 $\frac{1}{2}$
100 — of St. Gall, for linens,	= 87 $\frac{1}{2}$	100 — of Bergamo,	= 71 $\frac{1}{4}$
		100 — of Florence and Leghorn,	= 64
		100 — of Milan,	= 58 $\frac{1}{2}$

A Comparison of the American Foot with the Feet of other Countries.

The American Foot being divided into 1000 parts, or into 12 inches, the feet of several other countries will be as follows.

	Parts.	Inch. Dec.
America,	1000	12.
London,	1000	12.
Antwerp,	946	11.352
Bologna,	1204	14.448
Bremen,	964	11.568
Cologne,	954	11.448
Copenhagen,	965	11.580
Amsterdam,	942	11.304
Dantzick,	944	11.328
Dort,	1184	14.208
Frankfort on the Main,	948	11.376
The Greek,	1007	12.084
Lorrain,	958	11.496
Mantua,	1569	18.828
Macklin,	949	11.028
Middleburg,	991	11.892
France,	1066	12.792
Prague,	1026	12.312
Rhyneland or Leyden,	1033	12.396
Riga,	1331	21.972
Roman,	967	11.604
Old Roman,	970	11.640
Scotch,	1005	12.060
Strasburgh,	920	11.040
Toledo,	899	10.788
Turin,	1062	12.744
Venice,	1162	13.944

A Table representing the Conformity of the weights of the principal trading Cities of Europe with those of America.

lb.	of America.
100 of England, Scotland and Ireland,	= 100lb. 0oz.
100 of Amsterdam, Paris, Bordeaux, &c.	= 109 8
100 of Antwerp, or Brabant,	= 104 2 $\frac{1}{2}$
100 of Rouen, the Viscounty,	= 113 14
100 of Lyons, the city,	= 94 3
100 of Rochelle,	= 110 9
100 of Thoulouse, and Upper Languedoc,	= 92 6
100 of Marseilles and Provence,	= 88 11
100 of Geneva,	= 123
100 of Hamburg,	= 107 4
100 of Frankfort,	= 11 11
100 of Leipsick,	= 104 5
100 of Bremen,	= 110 0
100 of Russia,	= 88 4
100 of Vienna and Trieste,	= 123 0
100 of Genoa,	= 73
100 of Leghorn,	= 77 4
100 of Milan,	= 65 3
100 of Venice,	= 65 11
100 of Naples,	= 64 10
100 of Serville, Cadiz, &c.	= 103 2
100 of Portugal,	= 77 4
100 of Liege,	= 104
100 of Spain,	= 97
Note, The Spanish Arroba is 25 Spanish pounds,	= 24 4

TO MEASURE WOOD BY INSPECTION.

A TABLE of Breadth, Height, and Content.

Breadth. ft. in.	Height in feet.				Inches.											
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12
2 6	15	30	45	60	1	2	3	4	5	6	7	8	9	10	11	12
7	16	31	47	62	1	3	4	5	6	8	9	10	12	13	14	15
8	16	32	48	64	1	3	4	5	7	8	9	11	12	13	15	16
9	17	33	49	66	1	3	4	6	7	8	9	11	12	14	15	16
10	17	34	51	68	2	3	4	6	7	9	10	11	13	14	16	17
11	18	35	53	70	2	3	4	6	7	9	10	12	13	15	16	18
3 0	18	36	54	72	2	3	5	6	8	9	11	12	14	15	17	19
1	19	37	56	74	2	3	5	6	8	9	11	12	14	16	17	20
2	19	38	57	76	2	3	5	6	8	10	11	13	14	16	17	20
3	19	39	59	78	2	3	5	7	8	10	11	13	15	16	18	21
4	20	40	60	80	2	3	5	7	8	10	12	13	15	17	18	22
5	21	41	62	82	2	3	5	7	8	10	12	14	16	17	19	22
6	21	42	63	84	2	4	5	7	9	11	12	14	16	18	19	23
7	22	43	64	86	2	4	5	7	9	11	13	14	16	18	20	24
8	22	44	66	88	2	4	6	7	9	11	13	15	17	18	20	24
9	23	45	68	90	2	4	6	7	9	11	13	15	17	19	21	25
10	23	46	69	92	2	4	6	7	9	12	13	15	17	19	21	25
11	23	47	70	94	2	4	6	8	10	12	14	16	18	20	22	26
4 0	24	48	72	96	2	4	6	8	10	12	14	16	18	20	22	26

TO USE THE FOREGOING TABLE.

First measure the breadth and height of your load to the nearest average inch; then find the breadth in the left hand column of the table; then move to the right on the same line till you come under the height in feet, and you will have the content in inches, answering the feet, to which add the content of the inches on the right and divide the sum by 12, and you will have the true content of the load in feet and inches.

NOTE.—The contents answering the inches being always small, may be added by inspection.

EXAMPLES.

1. Admit a load of wood is 3 feet 4 inches wide, and 2 feet 10 inches high; required the content—

Thus, against 3 feet 4 inches, and under 2 feet, stands 40 inches; and under 10 inches at top, stands 17 inches: then $40 + 17 = 57$ true content in inches, which divide by 12 gives 4 feet 9 inches, the answer.

2. The breadth being 3 feet, and height 2 feet 8 inches; required the contents—

Thus, with breadth 3 feet 0 inches, and under 2 feet at top stands 36 inches; and under 8 inches, stands 12 inches: now 36 and 12, make 48, the answer in inches; and $48 \div 12 = 4$ feet, or just half a cord.

3. Admit the breadth to be 3 feet 11 inches, and height 3 feet 9 inches; required the content.

Under 3 feet at top, stands 70; and under 9 inches, is 18: 70 and 18 make $88 \div 12 = 7$ feet 4 inches, or 7 feet 1 qr. 2 inches, the answer.

5464765
29705216
91545600

277
911526229
26197
64059

Addition

Addition is the putting together of two or more numbers or sums, to make them one total or whole sum.

Simple Addition

Is the adding of several numbers together, which are all of one sort, or kind; as, 7 pounds, 12 pounds, being added together, make a sum total, or aggregate, of 39 pounds.

Rule

Place units under units, tens under tens, &c.: draw a line underneath, and begin with the units. After adding up every figure in that column, consider how many tens are contained in their sum, and placing the excess under the units, carrying so many as you have tens to the next column of tens. Proceed in the ~~same~~ same manner through every column on row, and set down the whole amount of the last row. *

Proof

Begin at the top of each column, and add the figures down wards, in the same manner as they were added upwards, and, if it be right, the aggregate will be equal to the first amount. Or, cut off the upper line of figures, and find the amount of the rest; then if this amount and upper line, when added together, be equal to the sum total, the work is supposed to be right.

Examples.

2 th	3 th	1 th	5 th
389261	2196784	97696941	97856
789794	829769	49760829	975
549795	829769	45697615	1234
487697	829769	82132435	14
999996	487669	48769206	5612
948219	1294697	48769209	2075
4464765	7092692	97826229	16282
3075504	31845600	274129288	64053
5464765	29705216	911226229	26197
	91545600		64053

Continued.

6 th	7 th
378269	141
202607	2672
707	82971
1246	34876
2132	1459
35478	427
10276	12
640415	122952
262126	122217
640415	122952

What is the amount of three hundred and sixty-five, eight hundred and seven, five hundred and sixty, twenty-five, thirty seven, and one hundred one?

8 th
365
807
580
25
37
101

1595 Ans.

The hind quarters of a cow one hundred and three pounds each; the four quarters weigh ninety-seven seven pounds each; the hide sixty-three pounds, and the tallow fifty-six pounds; what is the whole weight of the cow?

9 th
103
103
97
97
63
56

519

A man had four farms; the first is worth two thousand seven hundred twenty-five dollars; the second is worth three thousand eight hundred and nineteen dollars; the third is worth one thousand six hundred and ten dollars; the fourth is worth five hundred and twenty-two dollars; what are they all worth?

10 th
2725
3819
1610
512
8666 Ans.

It man possesses a tract of land, which contains forty-nine thousand eight hundred and thirty-five acres; suppose he had six tracts of equal denominations, how many acres would the whole contain?

11 th
49895
49895
49895
49895
49895
49895

299070 Ans.

What is the amount of three hundred seventy-five, two, forty-seven, thirty-three, nine thousand seven hundred and eighty-four, twenty-five thousand one hundred and fifty-seven hundred and sixty-five thousand and ninety-one, and one million seventy-five thousand and forty-seven?

12 th
300
75
2
47
99
9784
20150
765091
1075047

1870529 Ans.

Add seventy-five millions nine hundred and sixty thousand eight hundred, two hundred and twenty-five thousand and one hundred and forty together

13 th
75960800
225000
140
76185940 Ans.

Continued

being set down, you must add one to the lower figure of the next column for that which you borrowed; and thus proceed through the whole.

Proof.

Add the remainden and the lesser number together; if the work be right, the amount will be equal to the greater number: Or, subtract the remainden from the greater sum, and the difference will be equal to the less.

2d	3d
58934	879667
6182	164349
52752	715304
58934	879667
11	11
9187641	10000
91843	9999
2045790	10001
9191841	10000
	6
1000200340000	
2189918304	
1098010421696	
1000200340000	

10th
15850
2350
13490
4500
08990
3225
5765 Ans.

A man died, leaving an estate of 12,650 dollars, which he bequeathed as follows: 2500 dollars to each of his three sons daughters, and the remainder to his son; what was the sons share?

11th
12650
2500
10150
2500
7650
2500
5150 Ans.

- 7th
100200300400400600700800900
98076054092011023045067039
102124246368389576655739861
100200300400400600700800900

The Arabian or Indian method of notation was first known in England in 1150 how long is it since to the present time?

8th
1150
1820
9922
1150

What number must be added to 6892, so that sum shall be 8265

9th
6892
1373

8265 Ans. A gentleman purchased fifteen thousand eight hundred and forty acres of land; he sold two thousand and fifty to one man; four thousand five hundred to another; and three thousand two hundred and twenty five to a third; how many acres had he left

If the greater of two numbers be seven hundred and fifty millions, and the less five hundred and forty thousand; what will be the remainder or difference?

12th
700000000
5004000
79460000 Ans.

A man's property is worth 10,650 dollars; but he owes A 1,800, B 1,260 dollars, C 750 dollars, D 500 dollars; - what will remain after his debts are paid?

10650
1800
8850
1260
7590
750
6840
500
6340

Simple Multiplication

Multiplication teaches how to increase the greater of two numbers given, as often as there are units in the less; performs the work of many additions in the most compendious manner, brings numbers of great denominations into small, as pounds into shillings, pence, or farthings, &c.; and, by knowing the value of one thing, we find the value of many.

There are three parts in multiplication, viz.
 The sum to be multiplied is called the Multiplicand.
 The sum by which you multiply is called the Multiplier.
 The result of the operation is called the Product.
 The multiplicand and Multiplier are likewise called both together factors, on that by which the operation is performed.

Simple Multiplication

Is the multiplien of any two numbers together, without having regard to their significations; as, 7 times 2 are fifty 6, &c.

Rule.

1. Place the multiplier under the multiplicand, so that units stand under units, and tens under tens, &c.; and draw a line under them.
 2. Begin at the right hand, multiply each figure in the multiplicand by each in the multiplier, placing the first figure of the every line directly under its respective multiplier, and to the product of the next figure carry one for every ten, as in addition.
 3. Add the several products together, and their sum will be the total product required.
- Proof.— Multiply the multiplier by the multiplicand.

$$\begin{array}{r}
 \text{2d} \\
 769'308 \\
 \underline{3} \\
 3 \overline{) 2307924} \\
 \underline{769308}
 \end{array}
 \qquad
 \begin{array}{r}
 \text{3d} \\
 4980076 \\
 \underline{5} \\
 4 \overline{) 19926304} \\
 \underline{4980076}
 \end{array}$$

$$\begin{array}{r}
 \text{4th} \\
 769896 \\
 \underline{5} \\
 5 \overline{) 3819480} \\
 \underline{769896}
 \end{array}$$

What will be the product of 25,375, multiplied by 109?

$$\begin{array}{r}
 \times 25,375 \\
 \quad 10 \\
 \hline
 10 \overline{) 253750} \\
 \underline{25375} \text{ Ans.}
 \end{array}$$

Multiply 750.005 by 11.

$$\begin{array}{r}
 750.005 \\
 \underline{11} \\
 118250055 \\
 \underline{750055} \text{ Ans.}
 \end{array}$$

Multiply 900.301.399 by 12

$$\begin{array}{r}
 900.301.399 \\
 \underline{12} \\
 12 \overline{) 10833615788} \\
 \underline{900301399} \text{ Ans.}
 \end{array}$$

Multiply 989000 by 9

$$\begin{array}{r}
 989000 \\
 \underline{9} \\
 9 \overline{) 8901000} \\
 \underline{989000} \text{ Ans.}
 \end{array}$$

Continued

Multiply 568,098 by 8.

$$\begin{array}{r} 9^{\text{th}} \\ 568098 \\ \times 8 \\ \hline 4544784 \end{array}$$

Multiply 699,408 by 10.

$$\begin{array}{r} 10^{\text{th}} \\ 699408 \\ \times 10 \\ \hline 6994080 \end{array}$$

Multiply 789,795 by 7.

$$\begin{array}{r} 11^{\text{th}} \\ 789795 \\ \times 7 \\ \hline 5528565 \end{array}$$

Multiply 7654 by 543

$$\begin{array}{r} 1^{\text{st}} \\ 7654 \\ \times 543 \\ \hline 32270 \\ 30616 \\ 22962 \\ \hline 4156122 \text{ Ans.} \end{array}$$

$$\begin{array}{r} 2^{\text{d}} \\ 647406 \\ \times 4003 \\ \hline 1949718 \\ 259162400 \end{array}$$

2599567718 Ans.

$$\begin{array}{r} 3^{\text{d}} \\ 46293845 \\ \times 106 \\ \hline 277763070 \\ 462938450 \\ \hline 1064907147570 \end{array}$$

46293845 Ans.

When there are cyphers on the right hand of either the multiplier and on multiplier, on both.

$$\begin{array}{r} 1^{\text{st}} \quad 2^{\text{d}} \\ 67910 \quad 956700 \\ \times 5600 \quad 920 \\ \hline 4074600 \quad 1919300 \\ 33955 \quad 1919300 \\ \hline 380,296,000 \text{ Prod. } 28101 \end{array}$$

$$\begin{array}{r} 3^{\text{d}} \\ 990137000 \\ \times 9500 \\ \hline 4650685000 \\ 8971239 \\ \hline 95008836301500000 \end{array}$$

990137000000 Ans.

50750,000

78000

253750000

35525

3806250000000. Ans.

To multiply by 10, 100, 1000, &c.

$$\begin{array}{r} 1^{\text{st}} \quad 2^{\text{d}} \\ 57935 \quad 84935 \\ \times 10 \quad \times 100 \\ \hline 579350 \text{ Ans.} \quad 8493500 \end{array}$$

84935 Ans.

$$\begin{array}{r} 3^{\text{d}} \\ 619975 \\ \times 1000 \\ \hline 619975000 \end{array}$$

619975 Ans.

8473965

8473965000

8473965 Ans.

91861284

6875

When the multiplier is a composite number, (or exactly equal to the product of any two figures in the multiplication) -

Multiply 54375

$$\begin{array}{r} 1^{\text{st}} \quad 2^{\text{d}} \\ 7 \times 5 = 35 \\ 54375 \times 5 = 271875 \end{array}$$

2078125 Ans.

$$\begin{array}{r} 2^{\text{d}} \quad 3^{\text{d}} \\ 39187 \quad 91132 \\ \times 8 \quad \times 6 \\ \hline 313496 \quad 546792 \end{array}$$

1243984 Ans.

2799960 Ans.

Continued

To multiply by 9, 99, 999.

Rule.— Annex as many ciphers to the right of the multiplicand as there are figures in the multiplier, and from under then thus proceed, subtract the given multiplicand, and the remainder will be the product.

Multiply 5984976 by 9999

$$\begin{array}{r} 1^{\text{st}} \\ 59849760000 \\ 5984976 \\ \hline 59844375024 \text{ Ans.} \end{array}$$

371967 by 999

$$\begin{array}{r} 2^{\text{nd}} \\ 371967000 \\ 371967 \\ \hline 3347703 \\ 3347703 \\ 3347703 \\ \hline 371595099 \text{ Ans.} \end{array}$$

What is the product of 237856, multiplied by 3729?

$$\begin{array}{r} 1^{\text{st}} \\ 237856 \\ 3729 \\ \hline 2140704 \\ 775712 \\ 1664992 \\ 713568 \\ \hline 886965024 \text{ Ans.} \end{array}$$

If 4 bushels of wheat make 1 barrel of flour, and the price of wheat be one dollar a bushel, what will 225 barrels of flour cost?

$$\begin{array}{r} 225 \\ 4 \overline{)900} \\ \hline 225 \text{ Ans.} \end{array}$$

Multiply 308879 by twenty thousand five hundred and three.

$$\begin{array}{r} 3^{\text{rd}} \\ 308879 \\ 20503 \\ \hline 926697 \\ 1544395 \\ 617758 \\ \hline 6332946197 \text{ Ans.} \end{array}$$

Multiply 876956 by 990000

$$\begin{array}{r} 4^{\text{th}} \\ 876956 \\ 990000 \\ \hline 78926040000 \\ 7892604 \\ \hline 868186449000 \text{ Ans.} \end{array}$$

If a man rise an hour earlier every day, how much useful time will he gain for or before in 20 years, there being 365 days in a year?

$$\begin{array}{r} 5^{\text{th}} \\ 365 \\ 20 \\ \hline 2 \overline{)7300} \\ 365 \\ \hline \end{array}$$

What will be the total product of ninety-eight millions seven hundred and forty-two, multiplied by the same sum?

$$\begin{array}{r} 98469542 \\ 98469542 \\ \hline 197527084 \\ 9846954168 \\ 493817710 \\ 296291626 \\ 592521252 \\ 691344794 \\ 790048996 \\ 888277872 \\ \hline 9754297228385764 \text{ Ans.} \end{array}$$

Division

Division is the method of finding how many times a lesser number is contained in a greater; or dividing a quantity given, into any number of parts assigned; and is a concise way of performing several subtractions.

There are four parts to be noted in division.

1. The dividend, or number given to be divided.
2. The divisor, or number given to divide by.
3. The quotient, or answer to the question, which how often the divisor is contained in the dividend.
4. The remainder (which is always less than the divisor, and of the same name with the dividend) is very uncertain, as there as there is sometimes a remainder, and sometimes none.

Simple Division

1. Rule Draw a line ^{across} on each side of the dividend, and write the divisor at the left hand.
 2. Take the same number of the first left hand figures in the dividend that there are in the divisor, if they be equal to or greater than the divisor; but if they be less than the divisor, take one more find the number of times the divisor is contained in them, and write figure representing the number at the right hand of the, which will be the first figure of the quotient.
 3. Multiply the divisor by this ~~quotient~~ figure, and write the product under that part of the dividend taken.
 4. Subtract this product from that part of the dividend taken, and bring down the next figure of the next dividend taken; and bring down the next place it at the right hand of the remainder; then find a quotient figure, multiply and subtract as before directed; proceed in the same manner untill all the figures in the dividend are brought down and divided.
 5. When a figure has been brought down and placed at the right hand of the remainder, if the number be less than the write down a nought in the quotient, and bring down another figure.
- Multiply the divisor Proof and quotient together, and add the remainders, if there be any, to the product. If the work be right, that sum will be equal to the dividend.

Continued

$$\begin{array}{r} 3) 175817 \text{ (58605)} \\ \underline{15} \\ 25 \\ \underline{23} \\ 18 \\ \underline{18} \\ 17 \\ \underline{15} \\ 2 \text{ Rem.} \end{array}$$

$$\begin{array}{r} 29) 159598 \text{ (5296 } \frac{14}{27} \text{ Ans.)} \\ \underline{145} \\ 85 \\ \underline{52} \\ 279 \\ \underline{261} \\ 188 \\ \underline{174} \\ 14 \end{array}$$

Short Division, or when the division does not exceed 12.

$$\begin{array}{r} 1\frac{1}{2} \\ 2) 71935 \\ \underline{35917} - 1 \text{ Rem.} \end{array}$$

$$\begin{array}{r} 2d \\ 12) 1196437847536 \\ \underline{99703153961} - 4 \\ 199406307922 \\ \underline{99703153961} \\ 1196437847536 \text{ Ans.} \end{array}$$

$$\begin{array}{r} 3d \\ 65/00) 9794326/75 \text{ (52977)} \\ \underline{325} \\ 544 \\ \underline{520} \\ 243 \\ \underline{195} \\ 482 \\ \underline{455} \\ 276 \\ \underline{260} \\ 1675 \text{ Rem.} \end{array}$$

$$\begin{array}{r} 5193000) 8937643893 \text{ (1721)} \\ \underline{5193} \\ 37446 \\ \underline{36951} \\ 10954 \\ \underline{10386} \\ 5689 \\ \underline{5193} \\ 490899 \end{array}$$

$$\begin{array}{r} 5193000 \\ 1721 \\ \hline 5193000 \\ 10386 \\ 36951 \\ 5193 \\ \hline 8937153000 \\ 490899 \end{array}$$

8937643893 Proof.

That is the quotient of 196473 divided by 727

$$\begin{array}{r} 9) 196473 \\ \underline{81} \\ 21890 \\ \underline{2728} - 6 \end{array}$$

Divide 6975 by 52

$$\begin{array}{r} \text{Divide } 848 \text{ by } \frac{1}{4} \\ \underline{4} \\ 3392 \text{ Ans.} \end{array}$$

In one rod there are 5 1/2 yards; how many are there 1700 yards?

$$\begin{array}{r} \text{Divide } 496 \text{ by } \frac{3}{8} \\ \underline{8} \\ 9) 9968 \\ \underline{1322} \frac{2}{3} \text{ Ans.} \end{array}$$

Divide 699 by 2 1/2

$$\begin{array}{r} 1\frac{1}{2} \\ 2\frac{1}{2}) 699 \\ \underline{4} \quad \underline{4} \\ 99) 272 \text{ (28)} \\ \underline{198} \\ 792 \\ \underline{792} \\ 11 \end{array}$$

Federal Money

Note 1. To write any number of cents less than ten - Write a figure representing the number of cents, then write a cypher at the left hand in the ^{10s} place. Five cents are written thus, 05.

2. To write any number of mills less than ten, when there are no cents in the sum - Write a figure representing the number of mills, then write two cyphers at the left hand in the place of cents. Five mills are written thus, 005.

3. Parts of fractions of a cent are sometimes used instead of mills and and tenths of a mill; as, $12\frac{1}{2}$ cents for, 125, 06 $\frac{1}{2}$ cents, 0625.

Rules 1. To reduce dollars to mills: Add two cyphers to the given number.

2. To reduce dollars to mills: Annex three cyphers to the given number.

3. To reduce any sum of several figures to the lowest denomination mentioned: Reduce the whole sum in the lowest denomination.

4. To reduce cents to dollars: Cut off the two right hand figures of the given number, which will be cents - those remaining on the left hand are dollars.

5. To reduce mills to dollars: Cut off the three right hand figures; those at the left are dollars - the two first on the right are cents, the third mills.

Case 1.

To reduce Lawful Money, or the Currency of New-England, Virginia, Kentucky, and Tennessee, to Federal Money - the dollar being 6 shillings.

Rule - As the value of a dollar is equal to three tenths of a pound, when pounds are given to be changed, annex three cyphers to the sum, and divide the whole by 3; the quotient is the answer in cents.

Examples

1. Change £59 18s to federal money

$$\begin{array}{r} 3 \overline{) 529000} \\ 174999 \frac{1}{3} \text{ cts.} \end{array}$$

$$\begin{array}{r} 3 \overline{) 29000} \\ 9666 \frac{2}{3} \text{ cts.} \end{array}$$

When pounds and shillings are given to be changed, to the pounds annex half the number of shillings and two cyphers, if the number of shillings in the given sum be even; but if the number be odd, annex half the number, and then 5 and one cypher, and divide by 3; the quotient is the answer in cents.

1. Change £59 18s. to Federal money.

$$\begin{array}{r} 3 \overline{) 59900} \\ 19966 \frac{2}{3} \text{ cts.} \end{array}$$

2. Change £99 13s. to Federal Money.

$$\begin{array}{r} 3 \overline{) 99650} \\ 33216 \frac{2}{3} \text{ cts.} \end{array}$$

Change the following sums, viz.

$$\begin{array}{r} 3 \overline{) 12913} \\ 43043 \frac{1}{3} \end{array}$$

$$\begin{array}{r} 3 \overline{) 129650} \\ 43216 \frac{2}{3} \text{ cts.} \end{array}$$

$$\begin{array}{r} 3 \overline{) 69750} \\ 23250 \text{ cts.} \end{array}$$

Continued

When there are shillings, pence &c. in the given sum, annex for the shillings as before directed, and to three add the farthings in the given pence and farthings, observing to increase their number by one when they exceed 12, and by two when they exceed 32, and divide as before.

Examples.

Change £21 ss. 4½ d. to Federal Money.

$$\begin{array}{r} 921419 \\ 7139\frac{2}{3} \text{ Ans.} \\ \hline \text{Change } £721 \text{ ss. } 11\frac{1}{4} \text{ d. to} \\ \text{Federal Money.} \end{array}$$

$$\begin{array}{r} 9721497 \\ 240499 \text{ Ans.} \\ \hline \text{Change } £2\frac{1}{2}, 11 \text{ s. } 7\frac{3}{4} \text{ d. to} \\ \text{Federal Money.} \end{array}$$

$$\begin{array}{r} 24550 \quad 7\frac{3}{4} \\ 32 \quad 1 \\ \hline 924582 \quad 91 \\ 8194 \quad 1 \\ \hline 92 \\ \hline \text{Change } £2001 \text{ ss. } 3\frac{1}{2} \text{ d. to Federal} \\ \text{Money.} \end{array}$$

$$\begin{array}{r} 2001050 \\ 15 \\ \hline 92001065 \\ 6667021\frac{2}{3} \text{ Ans.} \end{array}$$

Case 11.

To reduce New-York and North-Carolina Currency to Federal Money - the dollar being 8 shillings.

Rule - Add a cipher, and divide by 8.
1. Reduce £44 New-York currency to Federal Money.

$$\begin{array}{r} 4440 \\ 110 \text{ Ans.} \\ \hline \text{Reduce } £2\frac{1}{2}, 12 \text{ s. to Federal} \\ \text{Money} \end{array}$$

$$\begin{array}{r} 2912 \\ 6 \\ \hline 924600 \\ 6150 \text{ Ans.} \end{array}$$

Case 111.

To reduce Pennsylvania, New-Jersey Delaware Maryland, and Ohio currency to Federal Money - the dollar being 7s. 6d.

Rule - Multiply by 8, and divide the product by 3, the quotient will be the answer.
And Reduce £243 New-Jersey to Federal Money.

$$\begin{array}{r} 243 \\ 8 \\ \hline 91944 \\ 642 \text{ Ans.} \end{array}$$

Case 11V.

To reduce South Carolina and Georgia currency to Federal Money the dollar being 4s. 8d.

Rule - Multiply by 30, and divide the product by 7, the will be the answer.

$$\begin{array}{r} 300 \\ 30 \\ \hline 9000 \\ 1285, 71, 4\frac{2}{7} \text{ Fed.} \end{array}$$

In £347 Sterling how much Lawful?

$$\begin{array}{r} 9347 \\ 11\frac{1}{2}, 13, 4 \\ \hline 46213\frac{1}{2} \text{ Lawful.} \end{array}$$

Continued

Case VI.

To change Lampel to sterling
Money

Rule - from the lampel sub-
tract $\frac{1}{4}$ the remainder
will be sterling.

$$\begin{array}{r} 9) 462 \ 13 \ 4 \\ \underline{115 \ 13 \ 4} \\ 347 \ 00 \ 0 \text{ sterling} \end{array}$$

Case VII.

To change Canada and
Nova-Scotia currency to
Federal Money the dollar
being 5 shillings

Rule - As the value of a dollar
is equal to one fourth of a
pound, multiply the sum,
when in pounds, by 4, for
dollars.
When then are shillings, &c.
reduce the given sum to pence,
omit two ciphers, and divide by
60, for cents

$$\begin{array}{r} 100 \\ 40 \\ \hline 9) 4000 \\ \underline{444, 44 \frac{2}{3} \text{ Ans.}} \end{array}$$

1. Change £36 Canada cur-
rency to Federal Money.

36

14 $\frac{1}{2}$ dolls.

2. Change £528 12s. 6d. Canada
currency to Federal Money.

528 12 6

20

10572

12

$$\begin{array}{r} 6) 12687000 \\ \underline{211450 \text{ etc.}} \end{array}$$

Case VIII.

To reduce English or sterling
Money to Federal Money.

Rule - Multiply English money
by 405 divide the product by
9, and the quotient will be
dollars, on dollars, cents and
mills.

Reduce £100 English to
Federal money.

$$\begin{array}{r} 100 \\ 405 \\ \hline 9) 40500 \\ \underline{444, 44 \frac{2}{3} \text{ Ans.}} \end{array}$$

Compound Addition.

Compound Addition is the adding together of several numbers having different denominations, as, pounds, shillings, pence, &c.; tons, hundreds, quarters, &c.

1. Rule Place the numbers, so that those of the same denomination may stand directly under each other.
2. Add the first column or denomination together as in whole numbers; then, divide the sum by as many of the same denomination as make one of the next greater, setting down the remainder under the column added; carry the quotient to the next superior denomination, continuing the same to the last column, which add as in simple addition.

Proof - The same as in simple addition.

Examples

1. £
 £. s. d. c. m.
 7. 3. 2. 9. 5
 2. 1. 2. 5
 9. 0. 0. 5
 3. 6. 2. 5
 7. 1. 4. 0. 8
 24 1 1 0 9 Ans.

2. d.
 £. s. d. c. m.
 375
 29, 18
 7, 12, 5
 199, 18, 7
 30, 01
 642, 50, 2
 265, 50, 2
 642, 50, 2

3. £.
 £. s. d.
 47, 17, 11
 24, 13, 9
 36, 10, 6
 21, 15, 7
 17, 14, 6
 15, 11, 5
 10, 10, 2
 154, 13, 10
 126, 15, 11
 174 13 10

ad
 £. s. d. ars.
 547, 11, 11, 1
 491, 19, 6, 1
 59, 6, 10, 0
 747, 16, 1, 2
 2146, 13, 7, 1
 1299, 2, 5, 0
 2146, 13, 7, 1

3d
 £. s. d. m.
 915, 10, 10, 2
 64, 9, 9, 1
 419, 2, 10, 2
 491, 17, 6, 1
 462, 17, 6, 1
 9, 16, 11, 3
 2663 15, 6, 2
 1748, 4, 8, 0
 2663 15, 6, 2

Troy Weight

By this weight are weighed gold, silver, jewels, Electrum, &c.

lb. oz. pwt.
 767, 10, 17
 99, 6, 9
 417, 11, 16
 995, 9, 8
 2161, 2, 10
 1998, 3, 13
 2161, 2, 10

Continued

lb. ^{act} _{dy} pint. grs.
649, 11, 19, 20

32. 9, 6, 5

841, 10, 11, 20

473, 9, 4, 9

1998, 5, 2, 6

1338, 5, 2, 10

1998, 5, 2, 6

lb. ^{act} _{dy} pint. grs.
859, 6, 15, 20

437, 10, 17, 22

642, 3, 7

738, 9, 4, 23

2678, 6, 5, 17

1820, 11, 9, 21

2678, 6, 5, 37

lb. ^{act} _{dy} pint. grs.
19, 13, 12

21, 9, 6

4, 15, 15

22, 10, 5

67, 21, 6

18, 7, 10

67, 21, 6

3. Avoirdupois weight.

By Avoirdupois are weighed
all coarse and drasy goods, gro-
ceries, bread, tallow, hay, leather,
and all metals, except gold and
silver.

lb. ^{act} _{dy} pint. grs.
59, 13, 2, 17

6, 17, 1, 21

45, 11, 3, 25

57, 16, 2, 19

169, 19, 2, 26

110, 6, 0, 9

169, 19, 2, 19

lb. ^{act} _{dy} pint. grs.
41, 17, 2, 25, 13, 15

19, 9, 0, 17, 10, 12

14, 13, 2, 80, 9, 11

47, 11, 3, 19, 14, 0

173, 12, 1, 18, 0, 6

81, 14, 2, 10, 2, 7

173, 12, 1, 18, 0, 6

4. Apothecaries Weight

By this weight, apothecaries and
physicians mix their medi-
cines but they buy and sell
their commodities by avoirdupois.

lb. ^{act} _{dy} pint. grs.
4, 1, 17

3, 2, 14

6, 1, 17

3, 0, 6

3, 1, 7

5, 2, 0

33, 1, 1

29, 2, 4

33, 1, 1

lb. ^{act} _{dy} pint. grs.
10, 7, 2, 19

6, 3, 0, 12

7, 6, 1, 17

9, 5, 2, 12

8, 3, 1, 11

7, 6, 0, 4

55, 7, 0, 15

44, 2, 0, 16

32, 55, 7, 0, 15

lb. ^{act} _{dy} pint. grs.
12, 11, 6, 1, 15

4, 4, 1, 0, 12

4, 10, 7, 2, 16

4, 8, 1, 2, 19

9, 6, 9, 0, 7

3, 5, 5, 2, 9

128, 6, 2, 7, 18

114, 0, 4, 1, 9

128, 6, 2, 1, 18

5. Cloth Measure

yd. ^{act} _{dy} m. na.
76, 2, 3

3, 3, 1

42, 3, 3

57, 2, 2

183, 0, 1

104, 1, 2

183, 0, 1

83, 6, 2, 3, 1

75, 2, 1

7, 1, 3

84, 0, 2

76, 2, 3

243, 3, 1

368, 1, 0

243, 3, 1

28, 2, 2

91, 3, 2

49, 4, 3

6, 2, 3

84, 4, 1

243, 3, 1

368, 1, 0

Continued

15

Long Measure

The use of long measure is to measure the distance of places, on any thing, where length is considered without regard to breadth.

ft.	in.	mi.	fur.	pol.
12.11.10		9.7.36		
9.10.9		7.3.19		
8.12.11		4.1.24		
7.15.1		6.5.12		
37.10.7		18.2.11		
45.39.9		18.2.15		
37.10.7		18.2.11		

Deg.	mi.	fur.	pol.	ft.	in.	haz.
759.56.6.29				15.10.2		
217.39.1.36				11.6.1		
497.63.7.24				9.8.1		
562.17.0.11				13.00.0		
2037.56.0.29				1.1.1		
1277.59.1.32				1.2.2		
2037.56.0.29				1.1.1		

Time

W.	d.	h.	m.	s.
36.22.54.32				
1.5.19.31.28				
2.3.17.49.15				
3.0.9.17.58				

11.2.20.56.25

8.2.21.58.41

11.2.20.56.25

4. 2d

4. mi. d.

19.10.19

7.9.27

4.8.16

1.11.14

34.2.14

14.4.9

34.2.14

4. mo. m. d. h. m. s.

57.11.3.6.2329.55

4. 5.1.1.19.45.38

29.9.2.3.17.18.19

46.10.2.5.11.50.13

139.1.2.4.0.24.5

8.1.2.2.4.10.54.10

139.1.2.4.0.24.5

8. Motion or circular measure

This measure is used in reckoning latitude and longitude, also in computing the revolution of the earth and other planets round the sun.

°	'	"
17.55.48		
1.37.51		
29.19.45		
19.19.37		
69.13.1		
50.17.13		
69.13.1		
sig. 2d		
10.5.37.42		
102.7.25.72		
148.26.11		
72.4.32.17		
157.6.0.47		
311.2.3.9		
300.26.25.27		
311.2.3.9		
sig. 3d		
104.7.26.16		
648.5.27.4		
293.6.17.13		
136.3.32.24		
498.5.42.19		

9. Land or square Measure

15	100
pole. feet. inch.	yard. feet. inch.
36.179.197	28.7.119
19.248.119	9.3.75
12.96.75	29.6.120
13.110.122	4.8.62
82.92.21	73.8.88
45.184.28	34.0.113
82.92.21	73.8.88

Acres. rods. pole. feet. inch.

356.3.37.245.128
29.1.20.99.25
416.3.31.128.199
37.1.19.218.20
830.2.29.142.4
483.2.31.168.20
840.2.29.142.4

Continued

10. Solid Measure.

This Measure is used to measure things that have length, breadth and thickness.

Long. ft. 1 st in.	Yard. ft. in.
29, 56, 1229	75, 22, 1412
12, 19, 64	9, 26, 195
18, 11, 917	3, 19, 1091
19, 8, 1002	28, 15, 1722
80, 5, 1484	119, 3, 964
79, 39, 255	41, 21, 1280
80, 5, 1484	119, 3, 964

Long. ft. in.
37, 119, 1015
9, 110, 159
48, 127, 1017
8, 125, 956
105, 98, 1719
67, 107, 404
105, 98, 1719

11. Wine Measure

All Alb. brandies, spirits, perry, cider, mead, winegar, honey and oil, are measured by wine measure

866. gal. qt. pt.	866. gal. qt. pt.
37, 29, 3.1	51, 53, 1.1
9, 17, 2.1	27, 39, 3.0
4, 28, 0.0	9, 18, 0.1
32, 19, 1.1	0, 9, 2.1
85, 7, 3.1	88, 58, 3.1
47, 9, 0.0	37, 5, 2.0
85, 1, 3.1	88, 58, 3.1

Long. hhd. gal. qt.
37, 2, 37, 2
19, 1, 59, 1
28, 2, 0, 0
19, 0, 47, 1
106, 3, 18, 0
67, 0, 43, 2
106, 3, 18, 0

12. Ale or beer measure.

A.B. fir. gal. B.B. fir gal. Shhd. gal.

49, 3.7	29, 78	379, 5-3, 3
26, 2, 3	19, 3, 5	79, 0, 0.2
9, 0, 4	16, 0, 3	121, 5, 7, 2
17, 3, 0	9, 1, 8	467, 19, 1
102, 0, 6	76, 2, 6	1048, 5, 0
52, 5, 7	36, 1, 7	668, 14, 1
102, 0, 6	76, 2, 6	1048, 5, 0

13. Dry Measure.

2 nd bu. pk. qt.
64, 7, 3, 7
9, 3, 1, 5
19, 6, 2, 1
4, 0, 2, 0
106, 0, 2, 1
38, 0, 0, 0
106, 0, 2, 1

Bu. pk. qt. pt.
37, 2, 5, 1
19, 3, 7, 0
16, 2, 0, 1
5, 1, 6, 1
79, 2, 3, 1
41, 3, 8, 0
79, 2, 3, 1

Chal. bu. pk. qt.
37, 2, 7, 3, 5
6, 29, 1, 7
15, 30, 0, 0
4, 11, 3, 0
62, 3, 0, 4
25, 11, 0, 7
62, 3, 0, 4

Compound Subtraction

Compounding Subtraction teaches to find the difference between any two sums of divers denominations

Rule. Place the numbers under each other, which are of the same denomination, the less being below the greater; being with with the least denomination, and if it exceed the figure over it, borrow as many units as make one of the next greater; subtract it there from; and to the difference add the upper figure, remembering always, to add one to the next superior denomination, for that which you borrowed.

Proof. The same as in simple subtraction.

1. Federal Money.

D. C. m.	D. C. m.
39.15.5	7159.12.9
28.17.2	245.37.5
10.98.3	3112.17.7
59.15.5	2000.00.0
	1092.92.0
	6449.45.2
	7159.21.8
	8290.32.3
	6449.45.2

E. D. C. m.	
21.8.1.2	100.00.0
10.7.5.0	48.87.5
11.0.6.2	51.12.5
21.8.1.2	100.00.0

Troy Weight

lb. oz. pwt. gr.	lb. oz. pwt. gr.
794.5.19.16	189.8.12.10
91.9.19.13	143.4.11.19
702.6.99.103	046.4.01.91
794.5.13.16	189.8.12.10

lb. oz. pwt. gr.
543.3.9.13
179.1.15.18
364.2.4.95
543.3.9.13

Avoirdupois Weight

lb. oz. dr.	lb. oz. dr.
7.9.12	8.2.13
3.12.9	4.1.15
4.6.8	4.0.98
7.9.12	8.2.13
7.11.3.17.5.12	
3.12.1.19.10.9	

6.99.298.5.3
9.113.17.5.12

Apothecaries Weight

lb. 3. 3. 2. gr.	lb. 3. 3. 2. gr.
71.93.1.13	65.10.6.2.1
37.5.4.1.16	34.8.4.2.0
34.0.9.0.97	34.2.2.0.1
71.93.1.13	65.10.6.2.1
84.1.1.1.1	
65.9.3.1.17	
19.1.7.9.4	
84.1.1.1.1	

Cloth Measure

yd. ar. n.	88. ar. n.	8. 1/2. ar. n.	8. 1/2. ar. n.
35.1.2	467.3.1	765.1.3	849.4.2
19.1.3	291.3.2	149.2.1	195.4.3
16.0.9	176.0.9	616.9.2	322.0.9
35.1.2	467.3.1	765.1.3	849.4.2

Continued

Long Measure.

yd. ft. in.	Mil. fur. pol.
28.2.10	76.3.11
15.2.11	27.3.21
110.99	49.0.90
28.2.10	76.3.11

Deq. mil. fur. pol. yd. ft. in. bare.
38.4.1.3.29.2.1.7.2
19.35.5.31.3.1.9.1
19.06.8.98.9.0.8.1
38.4.1.3.29.2.1.7.2

W. d. h. Time.

W. d. h. m. s.	y. mo. d.
6.17.13.27.19	7.3.13
1.21.16.41.35	4.3.19
5.96.97.86.84	3.9.93
6.17.13.27.19	7.3.13

y. mo. m. d. h. m. s.
38.92.5.19.27.81
19.9.3.4.20.19.49
29.0.9.1.9.9.08.32
48.9.2.5.19.27.81

Motion.

79.21.31	6.11.17.48
41.41.52	3.8.39.29
98.80.79	3.3.78.19
79.21.31	6.11.17.48

4.19.41.22
1.22.19.45
3.97.22.77
4.19.41.22

Land or squar measure.

Ac. roo. pol.	Ac. roo. pol.	Ac. roo. pol. ft. in.
29.1.10	29.3.19	56.2.16.27.110
24.1.25	17.1.36	29.0.21.210.129
05.0.85	12.2.83	27.2.95.217.981
29.1.10	29.3.19	56.2.16.27.110

Solid measure.

Lon. ft. in.	3d. ft. in.
49.19.1100	79.11.917
38.36.1296	17.25.1095
11.83.9804	62.86.326
49.19.1100	79.11.917

bord. ft. in.
349.97.1250
192.122.1349
157.70.9901
349.97.1250

Wine measure.

Shhd. gal. qt. pt.	Scen. gal. qt.
79.21.2.1	19.17.1
38.61.3.1	12.29.2
41.60.9.0	7.88.9
79.21.2.1	19.17.1

Lon. shhd. gal.
532.1.19
194.1.47
335.0.72

Ale and beer measure.

Shhd. fur. gal. qt. pt.	Shhd. fur. gal. qt. pt.	Shhd. gal. qt. pt.
39.1.2.1	21.3.5.20	769.17.1
24.3.6.2	14.1.7.24	391.42.3
15.8.6.9	07.28.09	769.17.1
39.1.2.1	21.3.5.20	

Lon. bu. pk. at	Bu. pk. at pt
56.2.2.1	91.1.3.2
39.3.1.2	29.2.1.4
179.1.19	62.9.2.1
56.2.2.1	91.1.3.2
	39.12.2.1
	24.25.3.2
	1587.9.9
	39.12.2.1

Problems

Problem 1. Having the sum of two ^{numbers} given, to find the other.

Rule. Subtract the given number from the given sum, and the remainder will be the sum required.

Let 28 be the sum of two numbers, one of which is 11, the other is required.

$$\begin{array}{r} 11 \\ 28 \\ \hline 17 \end{array}$$

17 is the other

Let the greater number be 25, and the difference between that and the other 19. What is the other?

25

32

19

127

the difference

What are those two numbers, whose sum is 48 and difference 14?

$$\begin{array}{r} 24 \\ 24 \\ \hline 48 \end{array}$$

Divide the difference of their squares by the sum of the numbers, and the quotient will be the difference.

What two numbers are those, whose sum is 32, and the difference of whose squares is 256?

$$\begin{array}{r} 32 \\ 256 \\ \hline 256 \end{array}$$

Rule. Divide the difference of their squares by the difference of the numbers, and the quotient will be their sum.

What are those two numbers, whose difference is 20, and the difference of whose squares is 2000?

$$\begin{array}{r} 20 \\ 2000 \\ \hline 2000 \end{array}$$

Divide the product given number.

Let the product of two numbers be 288, and one of them 8; we demand the other.

$$\begin{array}{r} 8 \\ 288 \\ \hline 36 \end{array}$$

36 Ans.

Having the dividend and quotient, and quotient to find the divisor.

Rule. Divide the dividend by the quotient

$$\begin{array}{r} 36 \\ 288 \\ \hline 288 \end{array}$$

Having the divisor and the quotient given, to find the dividend.

Rule. Multiply them together.

$$\begin{array}{r} 36 \\ 8 \\ \hline 288 \text{ Ans.} \end{array}$$

Reduction

Reduction is the method of changing numbers of one denomination into others of different denominations, without altering their value.

It is of two sorts, viz. Descending and Ascending.
Reduction Ascending teaches to change numbers from the higher denomination to a lower; and is performed by multiplication.

Rule—Multiply the highest denomination given, by so many of the next less, as make one of the greater, and thus continue till you have brought it down as low as your question requires.

Proof.—Change the question, and divide your last product by the last multiplier, and so on.

Examples,

1. In 3 eagles 2 dollars, how many mills?

$$\begin{array}{r} 32 \\ 10 \\ \hline 320 \\ 10 \\ \hline 32000 \text{ m.} \end{array}$$

2. In 91 dollars 75 cts. how many cents?

$$\begin{array}{r} 9175 \\ 10 \\ \hline 917500 \end{array}$$

3. In 50 Eagles, how many dollars?

$$\begin{array}{r} 50 \\ 10 \\ \hline 500 \end{array}$$

4. In 44 dollars 1 cent 4 mills, how many mills?

$$\begin{array}{r} 44.14 \\ 10 \\ \hline 11033140 \\ 10 \\ \hline 4413 \end{array}$$

5. In 9 dollars 31 cts, 7 mills, how many mills?

$$\begin{array}{r} 9317 \\ 10 \\ \hline 93170 \\ 10 \\ \hline 9317 \end{array}$$

6. How many cents in 99 dollars 5 cents?

$$\begin{array}{r} 995 \\ 10 \\ \hline 9950 \\ 10 \\ \hline 995 \end{array}$$

7. In £27, 15, 5 qd, 2 ans. how many farthings?

$$\begin{array}{r} £ \quad s \quad d \quad \text{ans.} \\ 27 \quad 15 \quad 5 \quad 2 \\ 20 \\ \hline 555 \\ 12 \\ \hline 6669 \\ 4 \\ \hline 66678 \text{ Ans.} \\ \text{Proof.} \end{array}$$

$$\begin{array}{r} 4) 26678 \\ 12) 6669 - 2 \text{ qrs.} \\ 2) 555 - 9 \text{ d.} \end{array}$$

8. In £36 12s. 10d. 1qr. how many farthings?

$$\begin{array}{r} £ \quad s \quad d \quad \text{qr.} \\ 36 \quad 12 \quad 10 \quad 1 \\ 20 \\ \hline 732 \\ 12 \\ \hline 8792 \\ 4 \\ \hline 35177 \text{ Ans.} \\ \text{Proof.} \end{array}$$

$$\begin{array}{r} 3) 35177 \\ 12) 8792 - 1 \text{ qr.} \\ 2) 732 - 10 \text{ d.} \\ 4) 3612, 10, 1 \text{ Ans.} \end{array}$$

9. In £719, 5s. 11d how many half pence?

$$\begin{array}{r} £ \quad s \quad d \\ 719 \quad 5 \quad 11 \\ 20 \\ \hline 14389 \\ 12 \\ \hline 177658 \\ 11 \\ \hline 177679 \text{ Pence.} \\ 2 \\ \hline 345358 \end{array}$$

Continued

21

10. In 37 pistoles, at 22 s. how many shillings pence and farthings?

$$\begin{array}{r} \text{Pistoles } s. \\ 37 \cdot 22 \\ \underline{22} \\ 77 \\ \underline{77} \\ 0 \end{array}$$

976 s. Pence.

39072 Farthings

11. In 53 moidores, at 36 s. how many shillings, pence and farthings?

$$\begin{array}{r} \text{moid.} \\ 53 \\ \underline{36} \\ 178 \\ \underline{159} \\ 1908 \text{ Shill.} \\ \underline{12} \end{array}$$

92896 d.

91584 qrs.

12. Reduce 47 guineas, (at 22 s. each,) and one fourth of a guinea into shillings, six-pences, groats, (4d.) three-pences, two pence and farthings.

$$\begin{array}{r} 47 \frac{1}{4} \\ \underline{28} \\ 376 \\ \underline{94} \\ 1316 \\ \underline{7} \end{array}$$

1323 shil.

2646 1/2 pences

$$\begin{array}{r} 15876 \text{ pence.} \\ \underline{3969 \text{ groats.}} \end{array}$$

315876

5292 three pences

215876

7938 two pences.

15876 d.

69504 qrs.

Reduction Ascending

Teaches how to change numbers from a lower to a higher denomination; and is performed by division.

Rule: Divide the lowest denomination given, by so many of that name, as make one of the next higher, and thus continue, till you have brought it into that denomination, which your question requires.

Examples.

1. How many eagles in 32000 mills?

$$\begin{array}{r} 10 \overline{) 32000} \\ \underline{3200} \end{array}$$

2. In 9175 cents, how many ~~mills~~ dollars?

$$\begin{array}{r} 10 \overline{) 9175} \\ \underline{9175} \end{array}$$

3. In 500 dollars, how many eagles?

$$\begin{array}{r} 10 \overline{) 500} \\ \underline{50} \end{array}$$

4. In 4414 mills, how many ~~cents~~ dimes?

$$\begin{array}{r} 10 \overline{) 4414} \\ \underline{4414} \end{array}$$

5. In 9317 mills, how many dollars?

$$\begin{array}{r} 10 \overline{) 9317} \\ \underline{9317} \text{ Ans.} \\ 10 \\ \underline{9317} \text{ Proof.} \end{array}$$

6. In 39050 mills, how many dollars?

$$\begin{array}{r} 10 \overline{) 39050} \\ \underline{39050} \text{ Ans.} \\ 10 \end{array}$$

39050 Proof.

7. In 537325 farthings, how many pence, shillings, and pounds?

Continued

$$\begin{array}{r} 4) 547925 \\ 127136831-14m. \end{array}$$

$$90) 11402-7d.$$

8. Bring 35177 farthings into pounds.

$$4) 35177$$

$$12) 8794-1$$

$$20) 732-10$$

$$36-12-10\frac{1}{4} \text{ Ans.}$$

$$20$$

$$732$$

$$12$$

$$8794$$

$$4$$

9. Bring 365358 half pence into pence, shillings and pounds.

$$35177 \text{ Proof.}$$

$$365358$$

$$12) 730716$$

$$20) 60898$$

$$30449 \text{ Proof.}$$

$$30449$$

$$12$$

$$60898$$

$$30448$$

$$365358 \text{ Proof.}$$

10. In 39072 farthings, how many pistoles at 22s, 3

$$22) 39072 \text{ (1776 Ans.}$$

$$170$$

$$154$$

$$167$$

$$154$$

$$132$$

$$132$$

$$22$$

$$3552$$

$$3552$$

$$29072 \text{ Proof.}$$

In 63504 farthings, how many pence, two-pences, three-pence, groats, six-pences, shillings, and guineas?

$$4) 63504$$

$$2) 15876 \text{ Pence.}$$

$$7938 \text{ Two pences.}$$

$$3) 15876 \text{ Pence.}$$

$$5292 \text{ Shillings.}$$

$$2) 7938 \text{ Two pences.}$$

$$3) 3969 \text{ Groats.}$$

$$1323 \text{ Shillings.}$$

$$28) 1323 \text{ (47\frac{1}{2} guineas}$$

$$112$$

$$203$$

$$196$$

$$7$$

Reduction Ascending and descending.

1. Money

In 97, how many pence, and English or French crowns, at 6s, 8d, 3

$$97$$

$$20$$

$$1940$$

$$12$$

$$80) 2328,0 \text{ d.}$$

$$291 \text{ crowns.}$$

In 735 French crowns, how many shillings and French guineas at 26s, 8d, 3

$$2d.$$

$$735$$

$$80$$

$$12) 58800$$

$$4900$$

Continued — 1829.

In 275 half johannes, how many moineas, guineas, pistoles, dollars, shillings, and six-pences, of each the like number?

A moine is 36 s. = 72 six pences.
A guinea is 28 s. = 56 do.
A pistole is 22 s. = 44 do.
A dollar is 6 s. 12 do.
One shilling is 2 do.
One penny is 1 do.

Divisor 57 six pences.

275 half joes.
48 s. in a 1/2 john.

2200
1100
13200

Dividend 6300 six pences.

187) 16400 (141
187
770
748
220
187
33

A gentleman distributed £37, 10s. between 4 persons in the following manner, viz. that as the first had 20s the second should have 15s. the third 10s. and the fourth 5s. What did each person receive?

20s.	37.10	750
15s.	20	15
10s.	750	
5s.	750	
50	501500,0	3750
	20300	750

The first 15 £5,01125,0
2,0225

750 The second 1,55.
10

5,0750,0
2,015,0
5,0375,0

The third 7-10s. 2,07,5
The fourth 3,15s.

2. Troy Weight.

1. How many grains in a silver bowl, that weighs 3 lb. 10 oz. 12 pmt.?

lb. oz. pmt.
3, 10, 12
12
36 ounces
20
932 pennyweights.
24
3728
1863

Ans. 22368 grains, Ans.

20932
12) 46-12 pmt.
3lb. 10 oz. 12 pmt.

2. In 13 ingots of gold, each weighing 9 oz 5 pmt. how many grains?

95
20
185
13
555
185
2405
24
9628
4810

Ans. 57720 grains.

3. In 97397 grains, how many pounds?

24) 97397
209058-5 grs.
12) 202-18 pmt.
Ans. 16 oz. 10 lb. 18 pmt. 5 grs.

How many rings, each weighing 5 pmt. 7 grs. may be made of 3 lb. 5 oz. 16 pmt. 2 grs. of gold?

Continued

lb. oz. pint. qrt.
3, 5, 16, 2

$$\begin{array}{r}
 12 \\
 41 \\
 20 \\
 \hline
 896 \\
 24 \\
 \hline
 920 \\
 1672 \\
 \hline
 127 \text{ binison}
 \end{array}$$

127) 20066 (158 Ans,
127

$$\begin{array}{r}
 796 \\
 635 \\
 \hline
 1016 \\
 1016 \\
 \hline
 0
 \end{array}$$

3. Etvoirdupois Weight

In 91 cent. 3 qrs. 17 lb. 14 oz. how
many ounces.

Cent. qrs. lb. oz.
91. 3. 17. 14

367 quarters,

$$\begin{array}{r}
 28 \\
 2949 \\
 735 \\
 \hline
 10299 \text{ pounds.}
 \end{array}$$

16

$$\begin{array}{r}
 61762 \\
 10299 \\
 \hline
 61762
 \end{array}$$

$$\begin{array}{r}
 10299 \\
 10299
 \end{array}$$

Ans. 164702 ounces.

Proof.

$$\begin{array}{r}
 16164702 \\
 2810299-14 \text{ oz.} \\
 \hline
 4367-17 \text{ lb.}
 \end{array}$$

91 cent. 3 qrs. 17 lb. 14 oz.

In 12 tons, 15 cent. 14 qrs. 19 lb. 6 oz.
12 drs. how many drams?

lb. oz. dr.
15, 1, 19, 6, 12

$$\begin{array}{r}
 20 \\
 255 \\
 1021 \\
 28 \\
 \hline
 8177
 \end{array}$$

$$\begin{array}{r}
 2049 \\
 28607 \\
 16
 \end{array}$$

2 cent. 4 qrs. lb. oz. dr.
12, 15, 1, 19, 6, 12.

$$\begin{array}{r}
 20 \\
 255 \\
 1021 \\
 28
 \end{array}$$

$$\begin{array}{r}
 8177 \\
 2049 \\
 \hline
 28607
 \end{array}$$

$$\begin{array}{r}
 171648 \\
 28607 \\
 \hline
 457718
 \end{array}$$

$$\begin{array}{r}
 16 \\
 2746910 \\
 457719
 \end{array}$$

Ans. 7323500 drams.

In 44800 pounds, how many
drams and tons?

$$\begin{array}{r}
 44800 \\
 16
 \end{array}$$

$$\begin{array}{r}
 268800 \\
 44800 \\
 \hline
 716800
 \end{array}$$

$$\begin{array}{r}
 716800 \\
 16
 \end{array}$$

$$\begin{array}{r}
 4300800 \\
 716800
 \end{array}$$

Ans. 11468800 drs.

$$\begin{array}{r}
 2844800 \\
 41600 \\
 \hline
 29300
 \end{array}$$

$$\begin{array}{r}
 29300 \\
 20 \text{ tons.}
 \end{array}$$

Continued

In 27 lbs. 9 oz. 13 pwt. 17 grs.
 Troy how many pounes.
 Aroundupois?

lbs. oz. mut grs.
 27. 9, 13, 17
 12

579
 20

11479
 24

15899
 22937

7000) 275369 (39 lbs.
 21

65
 63

2369

16

14214

2369

7,000) 37904 (5 oz.
 35

2904

16

17424

2904

7,000) 46464 (6 4464 drams.
 42
 7000

4464

4 Long Measure.

How many barley-corns
 will reach from Kenilworth
 port to Boston, it being
 43 miles?

Miles.

43

92 1/2 furlongs.

40

19760 rods.

5 1/2

68800

6880

75680 yards

3

227040 feet.

12

2724480 inches.

3

8173440 Ans.

Proof.

3) 8173440

12) 2724480

3) 227040

11) 75680

6880

2

40) 19760

8) 344

43

How many barley-corns
 will reach round the globe,
 it being 360 degrees?

Long

360

69 1/2

3240

2160

180

25020 deg.

200160

40

8006400

16 1/2

48038400

8006400

40032

192105600

12

1585267200

9

5755801600

Continued

How many inches from New-
buryport to London, it being
2700 miles?

$$\begin{array}{r}
 2700 \\
 \times 8 \\
 \hline
 21600 \\
 \times 40 \\
 \hline
 864000 \\
 \times 16 \\
 \hline
 5184000 \\
 864000 \\
 432 \\
 \hline
 13256000 \\
 \times 12 \\
 \hline
 171072000 \text{ Ans.}
 \end{array}$$

How many yards, feet
and inches from Concord,
Mass. to the city of Washington,
it being 498 miles?

$$\begin{array}{r}
 498 \\
 \times 1\frac{1}{2} \\
 \hline
 2490 \\
 249 \\
 \hline
 2739 \\
 \times 16\frac{1}{2} \\
 \hline
 16434 \\
 2739 \\
 1369 \\
 \hline
 45193 \\
 \times 12 \\
 \hline
 542316 \text{ Ans.}
 \end{array}$$

Proof.

$$\begin{array}{r}
 12 \overline{) 542316} \\
 \underline{16434} \\
 16434 \\
 \underline{16434} \\
 0 \\
 33 \overline{) 90386} \\
 \underline{33} \\
 57 \overline{) 2738} \\
 \underline{57} \\
 11 \overline{) 5376} \\
 \underline{44} \\
 97
 \end{array}$$

5. Time.

In 20 years how many
seconds?

$$\begin{array}{r}
 \text{d. h. in a yr.} \\
 365, 6 \\
 \times 24 \\
 \hline
 1466 \\
 730 \\
 \hline
 8766 \text{ hours in} \\
 20 \text{ years.} \\
 175320 \text{ hours in 20} \\
 60 \\
 \hline
 10519200 \text{ minutes in do.} \\
 60 \\
 \hline
 631152000 \text{ seconds in do} \\
 \text{Proof.}
 \end{array}$$

$$\begin{array}{r}
 6,0 \overline{) 631152000} \\
 6,0 \overline{) 10519200} \\
 2,0 \overline{) 175320} \\
 3 \times 6 \overline{) 8766} \\
 3 \overline{) 1466}
 \end{array}$$

Suppose your age to be 15 y
19 d. 11 h. 37 m. 45 s., how many
seconds are there in it, al-
lowing 365 days 6 hours
to the year?

$$\begin{array}{r}
 \text{y. d. h. m. s.} \\
 15, 19, 11, 37, 45 \\
 365, 6 \\
 \hline
 1825 \\
 365 \\
 \hline
 5375 \\
 3 \\
 \hline
 19, 18 \\
 5398, 5 \\
 \times 24 \\
 \hline
 41947 \\
 10996 \\
 \hline
 131957 \\
 60 \\
 \hline
 7117357 \\
 60 \\
 \hline
 475047365
 \end{array}$$

Continued

The war of the Revolution commenced

April 19, 1775, and Independence was declared July 4, 1776: how many seconds between?

$$\begin{array}{r} 366 \\ 76 \\ \hline 442 \\ 24 \\ \hline 1768 \\ 884 \\ \hline \end{array}$$

April 11
May 31
June 30
July 4
76 days

$$\begin{array}{r} 10608 \text{ hours.} \\ 60 \\ \hline 636480 \text{ minutes.} \\ 60 \\ \hline 88188800 \text{ seconds.} \end{array}$$

Measure.

Land or Square

In 29 acres, 3 rods, 19 poles, how many rods, and perches?

$$\begin{array}{r} 29 \text{ ac. } 3 \text{ rds. } 19 \text{ p. } 40 \text{ } 4779 \\ \hline 119 \\ 40 \\ \hline \end{array}$$

Ans 4779 perches.

2. In 1997 poles, how many acres?

$$\begin{array}{r} 40 \text{ } 1997 \\ \hline 4 \text{ } 49 \text{ } - 37 \\ \hline 12 \text{ ac. } 1 \text{ rd. } 37 \text{ p.} \end{array}$$

How many square feet, square yards, and square poles, in a square mile?

How many square feet, square yards, and square poles, in a square mile?

$$\begin{array}{r} 6640 \\ 4840 \\ \hline 25000 \\ 4400 \\ \hline \end{array}$$

$$\begin{array}{r} 640 \\ 4840 \\ \hline \end{array}$$

$$25600$$

$$5120$$

$$2560$$

$$\begin{array}{r} 30976000 \\ 9 \\ \hline \end{array}$$

$$9) 27878300 \text{ feet.}$$

$$30 \frac{1}{2}) 3097600 \text{ yards.}$$

$$121) 12990400$$

$$102400 \text{ poles.}$$

Solid Measure

In fifteen tons of hewn timber, how many solid inches? Proof.

$$\begin{array}{r} 15 \\ 50 \\ \hline 750 \text{ feet. } 1728 \text{ } 1296000 \text{ } (75/0) \\ 1728 \\ \hline 12096 \\ 8640 \\ 8640 \\ \hline \end{array}$$

$$1296000 \text{ inches. } \dots \text{Ans.}$$

2. In 25 cords of wood, how many inches?

$$\begin{array}{r} 25 \\ 128 \\ \hline 200 \\ 50 \\ \hline 25 \\ 3200 \\ 1728 \\ \hline \end{array}$$

$$25600$$

$$6400$$

$$22400$$

$$3200$$

$$\text{Ans. } 5529600$$

Continued.

What is the solid content of a grind stone
32 inches in diameter, and three inches thick?

$$\begin{array}{r} 32 \\ 16 \\ \hline 48 \\ 16 \\ \hline 288 \\ 48 \\ \hline 768 \\ 3 \\ \hline 2304 \end{array}$$

2304 solid inches. $\frac{1}{3}$ ft.

Proof.

$$\begin{array}{r} 1728 \overline{) 2304} \text{ (1 foot.} \\ \underline{1728} \\ 576 \\ 3 \\ \hline 1728 \text{ (1} \\ \underline{1728} \end{array}$$

Wine Measure.

In 9 hhd. 15 gal. 3 qts. of wine, how many quarts?

$$\begin{array}{r} 9, 15, 3 \\ 63 \\ 32 \\ \hline 55 \\ 582 \\ 4 \end{array}$$

233 1/4 quarts. ... Ans.

OR 0000

$$\begin{array}{r} 3 \overline{) 2331} \\ \underline{69589} - 3 \text{ qts.} \\ 9 \text{ hhd. 15 gal.} \end{array}$$

In twelve pipes of wine, how many pints?

$$\begin{array}{r} 12 \\ 63 \\ \hline 36 \\ 72 \\ \hline 756 \text{ hhd.} \\ 2 \\ \hline 1512 \text{ qts.} \\ 4 \\ \hline 6048 \text{ gal.} \\ 2 \\ \hline 12096 \text{ pints.} \end{array}$$

Vulgar Fractions.

A vulgar fraction is that which can have any denominator, and is expressed by two numbers, written one above another, thus $\frac{5}{8}$, with a line between.

The figure above the line is called the numerator. The figure below the line is called the denominator.

The figure below the line is called the denominator. Rule. - 1. If there be two numbers only, divide the greater by the less, and the division by the remainder, and so on, always dividing the less last division by the last remainder, till nothing remain; then will the last division be the greatest common measure required.

2. When there are more than two numbers, find the greatest common measure of two of them, as before; then of that common measure and one of the other numbers, and so on, through all the numbers, to the last; then will the greatest common measure, last found, be the answer.

3. If one happens to be the common measure, the given the given numbers are prime to each other, and found to be incommensurable, or in their lowest terms.

What is the greatest common measure of 36 and 96?

$$\begin{array}{r} 36 \overline{) 96} \\ \underline{72} \\ 24 \end{array}$$

$$\begin{array}{r} 24 \overline{) 36} \\ \underline{24} \\ 12 \end{array}$$

Greatest common measure 12

What is the greatest common measure of 1224 and 1080?

$$\begin{array}{r} 1080 \overline{) 1224} \\ \underline{1080} \\ 144 \end{array}$$

$$\begin{array}{r} 144 \overline{) 1080} \\ \underline{1080} \\ 0 \end{array}$$

$$\begin{array}{r} 72 \overline{) 144} \\ \underline{72} \\ 72 \end{array}$$

Prob. II.

To find the least common multiple of two or more numbers.

What is the least common multiple of 6, 10, 16, and 20?

$$\begin{array}{r} 6 \overline{) 6, 10, 16, 20} \\ 2 \overline{) 6} \\ \underline{2} \\ 3 \end{array}$$

$$\begin{array}{r} 2 \overline{) 10} \\ \underline{2} \\ 5 \end{array}$$

$$\begin{array}{r} 2 \overline{) 16} \\ \underline{2} \\ 8 \end{array}$$

$$\begin{array}{r} 2 \overline{) 20} \\ \underline{2} \\ 10 \end{array}$$

Ans.

What is the least number which can be divided by the nine digits separately without a remainder?

$$\begin{array}{r} 3 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 3 \overline{) 123456789} \\ \underline{3} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

$$\begin{array}{r} 4 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 4 \overline{) 123456789} \\ \underline{4} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

$$\begin{array}{r} 5 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 5 \overline{) 123456789} \\ \underline{5} \\ 12 \\ \underline{10} \\ 2 \end{array}$$

$$\begin{array}{r} 6 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 6 \overline{) 123456789} \\ \underline{6} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

$$\begin{array}{r} 7 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 7 \overline{) 123456789} \\ \underline{7} \\ 12 \\ \underline{14} \\ 2 \end{array}$$

$$\begin{array}{r} 8 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 8 \overline{) 123456789} \\ \underline{8} \\ 12 \\ \underline{16} \\ 4 \end{array}$$

$$\begin{array}{r} 9 \overline{) 1, 2, 3, 4, 5, 6, 7, 8, 9} \\ 9 \overline{) 123456789} \\ \underline{9} \\ 12 \\ \underline{18} \\ 6 \end{array}$$

Ans.

Reduction Of Vulgar Fractions.

Is the bringing them out of one form into another, in order to prepare them for the operation, of Addition, Subtraction &c.

Case I.
To abridge or reduce fractions to their lowest terms.

Examples.

1. Reduce $\frac{288}{380}$ to its lowest terms.

$$\frac{288}{380} = \frac{36}{47.5} = \frac{72}{95} = \frac{8}{11.875} \text{ Ans.}$$

2. Reduce $\frac{57}{456}$ to its lowest terms.

$$\frac{57}{456} = \frac{19}{152} = \frac{1}{8} \text{ Ans.}$$

3. Reduce $\frac{46}{184}$ to its lowest terms.

$$\frac{46}{184} = \frac{1}{4} \text{ Ans.}$$

4. Reduce $\frac{1429}{2858}$ to its lowest terms.

$$\frac{1429}{2858} = \frac{1}{2} \text{ Ans.}$$

Case II

To reduce a mixed number to its equivalent improper fraction.

Rule.—Multiply the whole number by the denominator of the fraction, and add the numerator of the fraction to the product;

Examples.

1. Reduce $36\frac{5}{8}$ to its equivalent improper fraction.

$$\begin{array}{r} 36 \\ \times 8 + 5 \\ \hline 293 \end{array}$$

Ans.

- Reduce $127\frac{3}{17}$ to its equivalent improper fraction

$$\begin{array}{r} 127 \\ \times 17 + 3 \\ \hline 2163 \end{array} \text{ Ans.}$$

Reduce $653\frac{9}{19}$ to its equivalent improper fraction

$$\begin{array}{r} 653 \\ \times 19 + 9 \\ \hline 12410 \end{array} \text{ Ans.}$$

Case III.

To reduce an improper fraction to its equivalent whole or mixed number.
Rule.—Divide the numerator by the denominator, the quotient will be the whole number, and the remainder, if any written over the given denominator, will form the fractional part.

Examples.

Reduce $\frac{293}{17}$ to its equivalent whole or mixed number.

$$\frac{293}{17} = 17 \frac{3}{17} \text{ Ans.}$$

Reduce $\frac{2163}{17}$ to its equivalent whole or mixed number.

$$\frac{2163}{17} = 127 \frac{3}{17} \text{ Ans.}$$

Reduce $\frac{293}{17}$ to its equivalent whole or mixed number.

$$\frac{293}{17} = 17 \frac{3}{17} \text{ Ans.}$$

Case IV.

To reduce compound fractions to an equivalent simple one.
Rule.—Multiply all the numerators continually together for a new numerator, and all the denominators, and they will form the simple fraction required.

Examples.

1. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a simple fraction

$$\frac{1}{2} \times \frac{2}{3} = \frac{2}{6} \times \frac{3}{4} = \frac{6}{24} \times \frac{4}{5} = \frac{24}{120} = \frac{1}{5} \text{ Ans.}$$

2. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{6}$ of $\frac{11}{12}$ to a simple one.

$$\frac{2}{3} \times \frac{3}{5} = \frac{12}{15} \times \frac{5}{6} = \frac{60}{90} \times \frac{11}{12} = \frac{660}{1080} = \frac{11}{18}$$

3. Reduce $\frac{1}{2}$ of $\frac{1}{3}$ of $\frac{2}{5}$ of $12\frac{1}{2}$ to a simple fraction.

$$\frac{1}{2} \times \frac{1}{3} = \frac{1}{6} \times \frac{2}{5} = \frac{2}{30} \times 12\frac{1}{2} = \frac{2}{30} \times \frac{25}{2} = \frac{25}{15} = 1\frac{11}{30}$$

denominator will form the fraction required in their lowest terms.

31

Examples.

1. Reduce $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{3}{4}$ to fractions having the least common denominator possible.

$$2) 3 \ 4 \ 8$$

$$3 \ 1 \ 2$$

$$4$$

$$3$$

$$12$$

$$2$$

12 = least common denominator

$$3) 2 \ 3$$

3 x 1 = 3 first numerator

$$4) 2 \ 3$$

6 x 3 = 12 the second.

$$8) 2 \ 4$$

8 x 7 = 21 third.

Ans. $\frac{2}{12}$, $\frac{4}{12}$, $\frac{3}{12}$

Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$ to fractions having the least common denominator.

$$2) 2 \ 3 \ 4 \ 5$$

$$1 \ 3 \ 2 \ 5$$

$$2$$

$$6$$

$$12$$

$$2$$

60 least common denominator

$$2) 60$$

30 x 1 = 30 first numerator.

$$3) 60$$

20 x 2 = 40 second.

$$4) 60$$

15 x 3 = 45 third.

$$5) 60$$

12 x 4 = 48 fourth.

Ans. $\frac{30}{60}$, $\frac{40}{60}$, $\frac{45}{60}$, $\frac{48}{60}$

Case VII.

To reduce a fraction of one denomination to an equivalent fraction of a higher denomination.

Rule. - Reduce the given fraction to a compound one by comparing it with all the denominations between it and that denomination you would reduce it to; lastly, reduce this compound fraction to a single one, by case V, and you will have a fraction of the required denomination equal in value to the given fraction.

Examples

Reduce $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{3}{4}$ to equivalent fractions having a common denominator.

1 x 5 x 8 = 40 the new numerator for $\frac{1}{2}$

2 x 4 x 8 = 64 ditto

5 x 4 x 8 = 100 ditto

3 x 5 x 8 = 120 the common denominator.

Therefore, the new equivalent fractions are $\frac{40}{120}$, $\frac{64}{120}$ and $\frac{100}{120}$

Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$ and $\frac{5}{8}$ to fractions having a common denominator.

$\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{8}$ = 1152 common

$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{2}{3}$
$\frac{576}{1152}$	$\frac{768}{1152}$	$\frac{864}{1152}$	$\frac{960}{1152}$	$\frac{1008}{1152}$

Ans. $\frac{576}{1152}$, $\frac{768}{1152}$, $\frac{864}{1152}$, $\frac{960}{1152}$, $\frac{1008}{1152}$

Case VI.

To reduce any given fractions to others, which shall have the least common denominator

Rule. - Find the least common multiple (by problem II, page 72,) of all the denominators of the given fractions, and it will be the common denominator; then divide the common denominator by the denominator of each fraction, and multiply the quotient by the numerator for a new numerator; the new numerators written over the common denominator

Examples.

1. Reduce $\frac{1}{4}$ of a cent to the fraction of a dollar.

$$\frac{1}{4} \times \frac{10}{10} = \frac{10}{40}$$

$$\frac{1}{4} \times \frac{10}{10} = \frac{10}{40}$$

2. Reduce $\frac{3}{4}$ of a penny to the fraction of a pound.

$$\frac{3}{4} \times \frac{1}{12} = \frac{3}{48} = \frac{1}{16} \text{ Ans.}$$

3. Reduce $\frac{1}{2}$ of an ounce to the fraction of a lb. avoirdupois.

$$\frac{1}{2} \times \frac{1}{16} = \frac{1}{32} \text{ Ans.}$$

- Reduce $\frac{1}{2}$ of a pennyweight to the fraction of a lb. Troy.

$$\frac{1}{2} \times \frac{1}{20} = \frac{1}{40} \text{ Ans.}$$

Case VIII.

To reduce a fraction of one denomination to an equivalent fraction of a higher denomination.

Rule. Multiply the given numerator by the parts of the denominations between it and that denomination you would reduce it to, for a new numerator, which place over the given denominator: Or, only insert the parts contained in the integer, and make of them a compound fraction as before; then reduce it to a simple one.

Examples.

- Reduce $\frac{1}{175}$ of a dollar to the fraction of a cent.

$$\frac{1}{175} \times \frac{10}{1} \times \frac{10}{1} = \frac{100}{175} = \frac{4}{7} \text{ Ans.}$$

- Reduce $\frac{1}{500}$ of a pound to the fraction of a penny.

$$\frac{1}{500} \times \frac{12}{1} = \frac{12}{500} = \frac{3}{125} \text{ Ans.}$$

- Reduce $\frac{1}{28}$ of a lb. avoirdupois, to the fraction of an ounce.

$$\frac{1}{28} \times \frac{16}{1} = \frac{16}{28} = \frac{4}{7} \text{ Ans.}$$

- Reduce $\frac{1}{1920}$ of a lb. Troy to the fraction of a sub.

$$\frac{1}{1920} \times \frac{12}{1} \times \frac{20}{1} = \frac{24}{1920} = \frac{1}{80} \text{ Ans.}$$

Case 9th
to find the value of a fraction in the known parts of the integer, as of coin, weight, measure, &c.
Rule. Multiply the numerator by the parts in the next inferior denomination, and divide the product by the denominator; and if any thing remain, multiply it by the next inferior denomination, and divide by the denomination as before, and so on, as far as needed, and the quotient placed one another, in their order, will be the answer required.

Examples.

- What is the value of $\frac{1}{5}$ of a dollar?

$$\frac{1}{5} \text{ of a dollar} = 20 \text{ cts.} \text{ or } 2 \text{ d.} \text{ or } 5 \text{ m.}$$

- What is the value of $\frac{17}{64}$ of a dollar?

$$\frac{17}{64} \text{ of a dollar} = 2 \text{ d. } 6 \text{ cts. } 5 \text{ m.}$$

- What is the value of $\frac{1}{7}$ of a pound?

$$\frac{1}{7} \text{ of a pound} = 1 \text{ s. } 3 \text{ d. } 11 \text{ m.}$$

- What is the value of $\frac{1}{5}$ of a pound avoirdupois?

$$\frac{1}{5} \text{ of a pound} = 12 \frac{1}{2} \text{ dms.}$$

Case x.

To reduce any given quantity to the fraction of any greater denomination of the same kind.

Rule- Reduce the given quantity to the lowest term mentioned, for a numerator; then reduce the integral part to the same lowest term for a denominator; which will be the fraction required.

Examples.

Reduce 6d. 2c. 5m. to the fraction of a dollar.

By the general rule.

$$\begin{array}{r} 6d. \quad 10d \text{ int. part.} \\ \times 10 + 2 \quad 10 \\ \hline 62 \quad 100 \\ \times 10 + 5 \quad 100 \\ \hline 625 \quad 1000 \end{array}$$

$$\text{And } \frac{625}{1000} = \frac{5}{8}$$

Reduce 26c. 5m. to the fraction of a dollar.

$$\begin{array}{r} 26 \quad 100c. \\ \times 10 + 5 \quad 10 \\ \hline 265 \quad 100 \\ \times 8 + 5 \quad 1000 \\ \hline 2125 \quad 8000 \end{array}$$

$$\frac{2125}{8000} = \frac{17}{64} \text{ Ans.}$$

Reduce 26c. 5m. to the fraction of a dollar.

$$\begin{array}{r} 12 \quad 12 \\ \times 12 + 3 \quad 20 \\ \hline 171 \quad 240 \\ \times 4 + 1 \quad 2 \\ \hline 685 \quad 242 \\ \times 7 + 5 \quad 7 \\ \hline 4800 \quad 6720 \end{array}$$

$$\frac{4800}{6720} = \frac{5}{7} \text{ Ans.}$$

Reduce 12 oz. 12 dr. to the fraction of a lb. Avin-
dupois

$$\begin{array}{r} 12 \quad 16 \\ 16 + 12 \quad 16 \\ \hline 84 \quad 96 \\ 12 \quad 16 \\ \hline 204 \quad 256 \\ 5 \quad 5 \\ \hline 1022 \quad 1280 \end{array}$$

$$\begin{array}{r} (3) \quad (2) \quad (8) \\ 1022 \quad 256 \quad 99 \quad 4 \text{ Ans. lb.} \\ 1280 \quad 320 \quad 40 \quad 5 \end{array}$$

Addition of Vul.

Rule- Reduce compound fractions to single ones; mixed ones to improper fractions; to fractions of different integers; to those of the same; and all of them to a common denominator; then the sum of the numerators written over the common denominator will be the sum of the fractions required.

Examples.

Add $\frac{3}{4}$, $\frac{2}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, and $1\frac{1}{10}$ together.
First, $1\frac{1}{10}$ of $\frac{3}{4} = \frac{3}{4}$; $4 = \frac{4}{1}$; and $1\frac{1}{10} = \frac{11}{10}$.
Then the fractions are $\frac{3}{4}$, $\frac{2}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{11}{10}$.

$$2) \frac{3}{4} \quad \frac{2}{5} \quad \frac{1}{6} \quad \frac{11}{10}$$

$$\begin{array}{l} 2 \times 3 \times 1 \times 1 \times 2 = 12 \text{ least common denom} \\ 12 \div 4 = 3 \times 3 = 9 \\ 12 \div 5 = 2 \times 2 = 4 \\ 12 \div 6 = 2 \times 1 = 2 \\ 12 \div 8 = 1 \times 1 = 1 \\ 12 \div 10 = 1 \times 1 = 1 \end{array} \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} \text{new numeration}$$

$$\frac{127}{12} \text{ sum of the numerations}$$

$$\frac{127}{12} = 10 \frac{7}{12} \text{ Ans.}$$

What is the sum of $\frac{7}{10}$ of $\frac{1}{8}$, $\frac{3}{5}$ of $\frac{1}{3}$ and $9\frac{1}{2}$?

$$\frac{7}{10} \times \frac{37}{8} = \frac{259}{80}$$

$$\frac{3}{5} \times \frac{1}{3} = \frac{1}{5}$$

$$9\frac{1}{2} = \frac{19}{2}$$

$$\begin{array}{r} 80 \text{ common denominator} \\ 20 \times 37 = 740 \\ 20 \times 1 = 20 \\ 1 \times 259 = 259 \\ \hline 1019 \end{array}$$

$$80) 1019 (12 \frac{59}{80} \text{ Ans.}$$

34 Add together $\frac{1}{5}$, $\frac{5}{8}$, $\frac{3}{16}$ and $\frac{7}{8}$ m.

$$\frac{1}{5} \times \frac{16}{16} = \frac{16}{80}, \quad \frac{5}{8} \times \frac{10}{10} = \frac{50}{80}, \quad \frac{3}{16} \times \frac{5}{5} = \frac{15}{80}, \quad \frac{7}{8} \times \frac{10}{10} = \frac{70}{80}$$

$$\begin{array}{r} 1000 \quad 50 \quad 30 \quad 7 \\ 8 \overline{) 5 \quad 8 \quad 16 \quad 8} \\ 5 \quad 1 \quad 2 \quad 1 \end{array}$$

$$\begin{array}{r} 2 \\ 2 \\ 5 \\ 10 \\ 2 \end{array}$$

	80	common denom.
5	16 x 1000 =	16000
8	10 x 50 =	500
16	5 x 30 =	150
8	10 x 7 =	70
	<u>16720</u>	

$$\begin{array}{r} 80 \overline{) 16720} \text{ Ans.} \\ 160 \\ \hline 720 \\ 720 \end{array}$$

add $\frac{1}{9}$, $\frac{2}{7}$ s. and $\frac{3}{8}$ d. together.

$$\frac{1}{9} \times \frac{12}{12} = \frac{12}{108}, \quad \frac{2}{7} \times \frac{1}{1} = \frac{2}{7}, \quad \frac{3}{8} \times \frac{1}{1} = \frac{3}{8}$$

$$\begin{array}{r} 1 \quad 3 \quad 1 \\ 9 \overline{) 900 \quad 140 \quad 9} \\ 10 \overline{) 100 \quad 140 \quad 9} \\ 2 \overline{) 10 \quad 14 \quad 9} \\ 5 \quad 7 \quad 9 \\ 3 \\ 21 \\ 5 \\ 105 \\ 2 \\ \hline 2100 \\ 3 \end{array}$$

$$\begin{array}{r} 6900 \\ 900 \quad 21 \times 1 = 21 \\ 140 \quad 45 \times 9 = 135 \\ 9700 \times 1 = 700 \\ \hline 85620 \\ 6900 \overline{) 17120} (25. \\ 13800 \\ \hline 3320 \\ 12 \end{array}$$

6900 com denom. 6900) 57240 (8

Add $\frac{1}{2}$ of a week, $\frac{1}{3}$ of a day, $\frac{1}{4}$ of an hour, and $\frac{1}{5}$ of a minute together.

$$\frac{1}{2} \times \frac{7}{1} = \frac{7}{2}, \quad \frac{1}{3} \times \frac{1}{1} = \frac{1}{3}, \quad \frac{1}{4} \times \frac{1}{1} = \frac{1}{4}, \quad \frac{1}{5} \times \frac{1}{1} = \frac{1}{5}$$

$$\begin{array}{r} 7 \quad 1 \quad 1 \quad 3 \\ 4 \overline{) 28 \quad 12 \quad 14 \quad 12} \\ 3 \overline{) 12 \quad 14 \quad 12} \\ 4 \overline{) 1 \quad 1 \quad 12} \\ 1 \quad 1 \quad 1 \quad 120 \\ 4 \\ 480 \\ 3 \\ 1440 \\ 4 \end{array}$$

5760) 12129 sum of the numerators, 2 d.

$$\begin{array}{r} 11520 \\ 609 \\ 24 \\ \hline 2412 \\ 1206 \\ \hline 5760 \overline{) 13472} (2 h. \\ 11520 \\ \hline 2952 \\ 60 \end{array}$$

$$\begin{array}{r} 5760 \text{ com denom.} \\ 4 \quad 1440 \times 7 = 10080 \\ 3 \quad 1920 \times 1 = 1920 \\ 48 \quad 120 \times 1 = 120 \\ 5760 \quad 1 \times 9 = 9 \\ \hline 12129 \\ 5760 \overline{) 25920} (45 h. \\ 23040 \\ \hline 28800 \\ 28800 \end{array}$$

35

20.
vol.

Q.
C
S

ruk.
22 ruk.

$$\begin{array}{r} 95 \\ 95 \\ \hline 190 \end{array}$$

$$\begin{array}{r} 5 \\ 1 \\ \hline 5 \\ 15 \times 95 = 175 \\ 51 \times 99 = 99 \\ \hline 76 \\ \hline 5 \end{array}$$

$$\begin{array}{r} 5 \overline{) 76} \\ \underline{152} \end{array}$$

$$\begin{array}{r} 5 \overline{) 24} \\ 4h. \quad 4 \text{ min.} \\ 60 \text{ min.} \\ \hline 5 \overline{) 240} \\ 38 \text{ min.} \end{array}$$

Multiplication
of vulgar fractions
Rule

Rule
Reduce compound fractions to simple ones, and mixed numbers to improper fractions; the product of the numerators will be the numerator, and the product of the ~~numerators~~ denominators, the denominator of the product required.

Examples.

What is the continued product of $4\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{4}$ of $\frac{7}{8}$ and 6!

$$\begin{array}{r} 480 \overline{) 536} \quad (1 \frac{11}{80}) \\ \underline{480} \\ 56 \\ \underline{480} \\ 80 \end{array}$$

Multiply $\frac{4}{27}$ by $\frac{5}{27}$.

$$\frac{4}{17} \times \frac{5}{27} = \frac{20}{459}$$

Multiply $5\frac{1}{2}$ by $\frac{1}{6}$

$$\begin{array}{r} 5\frac{1}{2} \\ \times \frac{1}{6} \\ \hline 5 \\ 10 \\ \hline 5\frac{1}{6} \end{array} \text{ Ans.}$$

Multiply $\frac{1}{3}$ of 5 by $\frac{3}{4}$ of $\frac{2}{7}$

$$\frac{1}{3} \times 5 = \frac{5}{3} \times \frac{3}{4} = \frac{15}{12} \times \frac{2}{7} = \frac{30}{84} = \frac{5}{14} \text{ Ans.}$$

Division Of Vulgar Fractions

Rule - Prepare the fractions as before; then invent the division and proceed exactly as in multiplication: The product will be the quotient required

Examples.

Divide $\frac{1}{2}$ of 17 by $\frac{2}{3}$ of $\frac{6}{8}$.
 $\frac{1}{2}$ of $17 = \frac{1}{2} \times 17 = \frac{17}{2}$ and $\frac{2}{3}$ of $\frac{6}{8} = \frac{2}{3} \times \frac{6}{8} = \frac{12}{24} = \frac{1}{2}$; therefore $\frac{17}{2} \div \frac{1}{2} = \frac{17}{2} \times \frac{2}{1} = 17$, the quotient required

Divide $\frac{5}{7}$ by $\frac{3}{8}$. invented
 $\frac{5}{7} \times \frac{8}{3} = \frac{40}{21} = 1\frac{19}{21} \text{ Ans.}$

Divide $\frac{5}{8}$ by $\frac{7}{9}$.

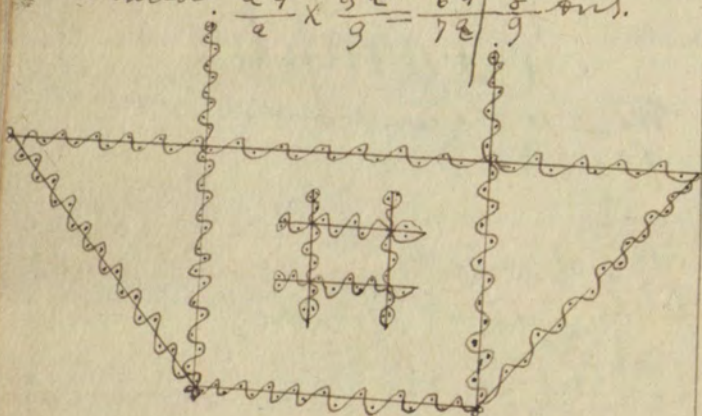
$$\begin{array}{r} 5\frac{1}{8} \\ \times \frac{9}{7} \\ \hline 45 \\ 45 \\ \hline 45\frac{9}{8} = 45\frac{11}{8} = 46\frac{3}{8} \end{array} \text{ invented } \frac{45}{16} \div \frac{7}{9} = \frac{45}{16} \times \frac{9}{7} = \frac{405}{112} = 3\frac{69}{112} \text{ Ans.}$$

Divide $\frac{3}{7}$ by 9 .

$$\frac{3}{7} \times \frac{1}{9} = \frac{3}{63} = \frac{1}{21} \text{ Ans.}$$

Divide $\frac{1}{2}$ of $\frac{1}{4}$ of $\frac{2}{3}$ of $\frac{1}{5}$ of $\frac{3}{4}$.

$$\frac{1}{2} \times \frac{1}{4} = \frac{1}{8} \times \frac{2}{3} = \frac{2}{24} = \frac{1}{12} \text{ and } \frac{1}{12} \times \frac{3}{4} = \frac{3}{48} = \frac{1}{16} \text{ and } \frac{1}{16} \times \frac{1}{5} = \frac{1}{80} \text{ invented } \frac{1}{80} \times \frac{3}{4} = \frac{3}{320} \text{ Ans.}$$



Decimals Fractions

A Decimal Fraction is a fraction whose denominator is a unit with so many ciphers annexed as the numerator has places of figures.

Addition Of

1. Rule - Place the numbers, whether mixed, or pure decimals, under each other, according to the value of their places.
2. Find their sums, as in whole numbers, and point off so many places for decimals, as are equal to the greatest number of decimal places in any of the given numbers.

Examples.

1. Find the sum of $19.078 + 2.3597 + 22.9 + 0.197581 + 3.1781 + 12.358$

$$\begin{array}{r} 19.078 \\ 2.3597 \\ 22.90197581 \\ 3.1781 \\ 12.358 \\ \hline 58.97535681 \end{array}$$

2. Required the sum of $429 + 21.37 + 955.009 + 1.07 + 1.7$

$$\begin{array}{r} 429. \\ 21.37 \\ 955.009 \\ 1.07 \\ 1.7 \\ \hline 1407.156 \end{array}$$

3. Required the sum of $979 + 19 + 175 + 93.7164 + 95.01$

$$\begin{array}{r} 979. \\ 19. \\ 175. \\ 93.7164 \\ 95.01 \\ \hline 1361.7264 \end{array}$$

1088.4165 Ans.

4. Required the sum of $5.9 + 11.979 + 49 + 9 + 1.7914 + 35.3$

$$\begin{array}{r} 5.9 \\ 11.979 \\ 49. \\ 9. \\ 1.7914 \\ 35.3 \\ \hline 109.9704 \end{array}$$

109.203 Ans.

Subtn ^{raction} Of Decimals.

Rule - Place the numbers according to their value: Then subtract as in whole numbers, and point off the decimals as in Addition.

Examples.

1. Find the difference of 1793.13 and 817.05693

$$\begin{array}{r} 1793.13 \\ 817.05693 \\ \hline 976.07307 \end{array} \text{Ans}$$

2. From 171.195 take 125.9176

$$\begin{array}{r} 171.195 \\ 125.9176 \\ \hline 45.2774 \end{array} \text{Ans}$$

3. From 219.1384 take 195.91

$$\begin{array}{r} 219.1384 \\ 195.91 \\ \hline 23.2284 \end{array} \text{Ans}$$

2. From 480 take 245.0075

$$\begin{array}{r} 480. \\ 245.0075 \\ \hline 234.9925 \end{array} \text{Ans}$$

Multiplication Of Decimals.

1. Rule - Whether they be mixed numbers, or pure decimals, place the factors and multiply them as in whole numbers.
2. Point off so many figures from the product as there are decimal places in both the factors; and if there be not so many places in the product, supply the defect by prefixing ciphers.

Examples.

Multiply .02345
by .00163

$$\begin{array}{r} .02345 \\ \times .00163 \\ \hline 7095 \\ 14070 \\ 2345 \\ \hline .000382235 \end{array} \text{the prod.}$$

Multiply 25.238 by 12.17

$$\begin{array}{r} 25.238 \\ \times 12.17 \\ \hline 176666 \\ 25238 \\ 50476 \\ 25238 \\ \hline 30714646 \end{array} \text{Ans}$$

Multiply 3759 by .945

$$\begin{array}{r} 3759 \\ \times .945 \\ \hline 18795 \\ 15096 \\ 33831 \\ \hline 3552255 \end{array} \text{Ans}$$

Multiply .83179 by .0385

$$\begin{array}{r} .83179 \\ \times .0385 \\ \hline 320895 \\ 673492 \\ 252597 \\ \hline .032308915 \end{array} \text{Ans}$$

Division Of Decimals

Rule.

1. The place of decimal parts in the divisor and quotient, counted together, must always be equal to those in the dividend; therefore, divide as in whole numbers, and, from the right hand of the quotient, point off so many places for decimals, as the decimal places in the dividend exceed those in the divisor.
2. If at any the place of the quotient be not so many as the rule requires, supply the defect by prefixing ciphers to the left hand.
3. If at any time there be a remainder on the decimal places in the divisor be more than those in the dividend, ciphers may be annexed to the dividend on to the remainder, and the quotient carried on to any degree of exactness.

Examples.

1. $219 \overline{) 117831075} (000538027$

$$\begin{array}{r}
 1095 \\
 893 \\
 657 \\
 1771 \\
 1752 \\
 \hline
 1907 \\
 1752 \\
 \hline
 1555 \\
 1593 \\
 \hline
 \end{array}$$

22 rem.

2. $3719 \overline{) 98.0000} (02.178 \text{ Ans.}$

$$\begin{array}{r}
 3719 \\
 8100 \\
 7338 \\
 \hline
 6620 \\
 9719 \\
 \hline
 29010 \\
 26039 \\
 \hline
 29770 \\
 29752 \\
 \hline
 \end{array}$$

18 rem.

$317 \overline{) 29317} (92 \text{ Ans.}$

$$\begin{array}{r}
 2853 \\
 887 \\
 634 \\
 \hline
 253 \text{ rem.}
 \end{array}$$

$133 \overline{) 5737} (33.1353 \text{ Ans.}$

$$\begin{array}{r}
 532 \\
 317 \\
 399 \\
 \hline
 180 \\
 133 \\
 \hline
 370 \\
 399 \\
 \hline
 710 \\
 665 \\
 \hline
 450 \\
 399 \\
 \hline
 \end{array}$$

51 rem.

$23.7 \overline{) 65321} (2756.16 \text{ Ans.}$

$$\begin{array}{r}
 374 \\
 1792 \\
 1659 \\
 \hline
 1931 \\
 1185 \\
 \hline
 1360 \\
 1222 \\
 \hline
 320 \\
 237 \\
 \hline
 1330 \\
 1322 \\
 \hline
 \end{array}$$

8 rem.

$$\begin{array}{r}
 72 \overline{) 918.217} \text{ (12753 Ans)} \\
 \underline{72} \\
 198 \\
 \underline{144} \\
 542 \\
 \underline{504} \\
 381 \\
 \underline{360} \\
 217 \\
 \underline{216} \\
 1 \text{ rem.}
 \end{array}$$

$$\begin{array}{r}
 25.17 \overline{) 315.6293} \text{ (1253 Ans)} \\
 \underline{2517} \\
 6392 \\
 \underline{5034} \\
 13589 \\
 \underline{12585} \\
 10033 \\
 \underline{7551} \\
 2492 \text{ rem.}
 \end{array}$$

Reduction Of Decimals.

Case. 1.

To reduce a vulgar fraction to its equivalent decimal.

Rule.

Divide the numerator by the denominator, as in division of decimals, and the quotient will be the decimal required. Or, so many places ciphers as you annex to the given numerator, so many places must be pointed off in the quotient, and if there be not so many places of figures in the quotient, the deficiency must be supplied by prefixing so many ciphers before the quotient figures.

Examples.

1. Reduce $\frac{1}{2}$ to a decimal.

$$\begin{array}{r}
 8 \overline{) 1.000} \\
 \underline{.800} \\
 .200 \text{ Ans}
 \end{array}$$

2. Reduce $\frac{3}{4}, \frac{5}{8}, \frac{2}{3}$ to decimals.

$$\begin{array}{r}
 8 \overline{) 3.000} \\
 \underline{.375}
 \end{array}$$

3. Reduce $\frac{1}{2}, \frac{2}{3}, \frac{1}{4}, \frac{3}{5}, \frac{5}{6}$, and $\frac{7}{8}$ to decimals.

$$\begin{array}{r}
 4 \overline{) 1.00} \\
 \underline{.25}
 \end{array}$$

$$\begin{array}{r}
 2 \overline{) 1.00} \\
 \underline{.50}
 \end{array}$$

$$\begin{array}{r}
 3 \overline{) 3.00} \\
 \underline{.75}
 \end{array}$$

$$\begin{array}{r}
 3 \overline{) 1.00} \\
 \underline{.333}
 \end{array}$$

$$\begin{array}{r}
 5 \overline{) 4.00} \\
 \underline{.80}
 \end{array}$$

$$\begin{array}{r}
 6 \overline{) 5.00} \\
 \underline{.833}
 \end{array}$$

$$\begin{array}{r}
 8 \overline{) 7.00} \\
 \underline{.875}
 \end{array}$$

Reduce $\frac{5}{19}, \frac{27}{99}, \frac{12}{580}$, and $\frac{9}{36}$ to decimals.

$$\begin{array}{r}
 19 \overline{) 5.00} \text{ (263)} \\
 \underline{38} \\
 120 \\
 \underline{114} \\
 60 \\
 \underline{57} \\
 3
 \end{array}$$

$$\begin{array}{r}
 39 \overline{) 2700} \text{ (692)} \\
 \underline{234} \\
 360 \\
 \underline{351} \\
 90 \\
 \underline{78} \\
 12
 \end{array}$$

$$\begin{array}{r}
 36 \overline{) 900} \text{ (25)} \\
 \underline{72} \\
 180 \\
 \underline{180} \\
 0
 \end{array}$$

Case II.

To reduce numbers of different denominations, as of money, weight, and measure, to their equivalent decimal fractions

1. Write straight the given numbers perpendicularly under each other, for dividends, proceeding on always from the least to the greatest.
2. Opposite to each dividend, on the left hand, place such a number, for a divisor, as will bring it to the next superior denomination, and draw a line perpendicularly between them.
3. Begin with the highest, and write the quotient of each division as decimal parts on the right hand of the dividend next below it and so on, until they are all used, and the last quotient will be the decimal sought.

Examples.

1. Reduce 17s. 2 3/4 d. to the decimal of a pound.

$$\begin{array}{r} 4 \overline{) 3.00} \\ 12 \overline{) 8.75} \\ 20 \overline{) 17.729166 \text{ \&c.}} \end{array}$$

886458 &c. the decimal required.

Reduce 1, 2, 3, 4, and so on to 19 shillings, to decimals.

$$\begin{array}{r} 20 \overline{) 1.00} \quad 20 \overline{) 2.00} \quad 20 \overline{) 3.00} \quad 20 \overline{) 4.00} \\ \quad .05 \quad \quad .1 \quad \quad .15 \quad \quad .2 \\ 20 \overline{) 5.00} \quad 20 \overline{) 6.00} \quad 20 \overline{) 7.00} \quad 20 \overline{) 8.00} \\ \quad .25 \quad \quad .3 \quad \quad .35 \quad \quad .4 \\ 20 \overline{) 9.00} \quad 20 \overline{) 10.00} \quad 20 \overline{) 11.00} \quad 20 \overline{) 12.00} \\ \quad .45 \quad \quad .5 \quad \quad .55 \quad \quad .6 \\ 20 \overline{) 13.00} \quad 20 \overline{) 14.00} \quad 20 \overline{) 15.00} \\ \quad .65 \quad \quad .7 \quad \quad .75 \\ 20 \overline{) 16.00} \quad 20 \overline{) 17.00} \quad 20 \overline{) 18.00} \quad 20 \overline{) 19.00} \\ \quad .8 \quad \quad .85 \quad \quad .9 \quad \quad .95 \end{array}$$

Thus Hence

Reduce 1, 2, 3 and so on to 11 pence, to the decimals of a shilling.

$$\begin{array}{r} 12 \overline{) 1000} \quad 12 \overline{) 2000} \quad 12 \overline{) 3000} \\ \quad 83 \quad \quad 166 \quad \quad 25 \\ 12 \overline{) 4000} \quad 12 \overline{) 5000} \quad 12 \overline{) 6000} \\ \quad 0333 \quad \quad 0416 \quad \quad 50 \\ 12 \overline{) 7000} \quad 12 \overline{) 8000} \quad 12 \overline{) 9000} \\ \quad 583 \quad \quad 666 \quad \quad 75 \\ 12 \overline{) 10000} \quad 12 \overline{) 11000} \\ \quad 833 \quad \quad 916 \end{array}$$

Reduce 1, 2, 3, &c. to 11 pence, to the decimals of a pound.

$$\begin{array}{r} 12 \overline{) 100000} \quad 12 \overline{) 200000} \\ \quad 200899 \quad \quad 201660 \\ \quad .0316 \quad \quad .0089 \\ 12 \overline{) 300000} \quad 12 \overline{) 400000} \\ \quad 201250 \quad \quad 203333 \\ \quad .0125 \quad \quad .0166 \end{array}$$

$$\begin{array}{r} 12 \overline{) 500000} \quad 12 \overline{) 600000} \\ \quad 203317 \quad \quad 205000 \\ \quad .0208 \quad \quad .025 \\ 12 \overline{) 700000} \quad 12 \overline{) 800000} \\ \quad 205833 \quad \quad 206666 \\ \quad .029966 \quad \quad .0333 \end{array}$$

$$\begin{array}{r} 12 \overline{) 900000} \quad 12 \overline{) 1000000} \\ \quad 207500 \quad \quad 208333 \\ \quad .0375 \quad \quad .0833 \end{array}$$

$$\begin{array}{r} 12 \overline{) 1100000} \\ \quad 209166 \\ \quad .09166 \end{array}$$

Find the decimal of 13s. 9 3/4 d. by inspection

6. shillings
5 for the odd farthings
39 farthings in 9 3/4 d.
Add 2 for the excess of 36.
691

Find by inspection the decimal expression of 18s. 9 1/4 d. and 17s. 2 1/2 d. and 1 for the excess.

913 for 18s. and 9 1/4 d. $\times 3 = 13d.$
85 for 17s. and 2 1/2 d. and 5 for odd number
35 $\times 3$ in in penny $\times 3 = 2d.$

Case IV.

To find the value of any given decimal in the of the integer

1. Rule. 1. Multiply the decimal by the number of parts in the next less denomination, and cut off so many places for a remainder, to the right hand, as there are places in the given decimal.
2. Multiply the remainder by the next inferior denomination, and cut off as many places as before.
3. Proceed in this manner through all the parts of the integer - and the several denominations, standing on the left hand, make the answer.

Examples.

1. Find the value of 73968 of a pound.

$$\begin{array}{r} 73968 \\ 20 \\ \hline 5,14,79360 \\ 12 \\ \hline d.9,152320 \end{array}$$

2109280 Ans 145.9 1/2 d.

2. What is the value of .679 of a shilling?

$$\begin{array}{r} 679 \\ 12 \\ \hline \end{array}$$

Ans. 8,13 2d.

What is the value of .617 of a cent?

$$\begin{array}{r} 617 \\ 100 \\ \hline \end{array}$$

$$\begin{array}{r} dms. 2,368 \\ 28 \\ \hline 3734 \\ 996 \\ \hline lb. 13,103 \\ 16 \\ \hline 624 \\ 104 \\ \hline \end{array}$$

$$\begin{array}{r} oz. 1664 \\ 16 \\ \hline 3984 \\ 664 \\ \hline \end{array}$$

$$\begin{array}{r} dms. 10,624 \end{array}$$

What is the value of 397 of 41 d. year?

$$\begin{array}{r} 397 \\ 41 \\ \hline 1,588 \\ 41 \\ \hline 2,352 \end{array}$$

What is the value of .8469 of a degree?

$$\begin{array}{r} 8469 \\ 60 \\ \hline 50814 \\ 60 \\ \hline 284884 \\ 60 \\ \hline 1709304 \end{array}$$

What is the value of .8469 of a degree?

$$\begin{array}{r} 8469 \\ 60 \\ \hline 50814 \\ 60 \\ \hline 284884 \\ 60 \\ \hline 1709304 \end{array}$$

$$\begin{array}{r} 76221 \\ 50814 \\ \hline 8234 \end{array}$$

miles 8,859 5/8

$$\begin{array}{r} fur 6,8760 \\ 40 \\ \hline \end{array}$$

$$\begin{array}{r} 1035,0300 \\ 3 \\ \hline \end{array}$$

$$\begin{array}{r} ft. 0,1200 \\ 12 \\ \hline \end{array}$$

$$\begin{array}{r} in 13300 \end{array}$$

What is the value of .569 of a year?

$$\begin{array}{r} 569 \\ 365 \\ \hline 2845 \\ 365 \\ \hline 1707 \end{array}$$

$$\begin{array}{r} d. 207,625 \\ 24 \\ \hline 2740 \\ 1970 \\ \hline \end{array}$$

$$\begin{array}{r} h. 16,330 \\ 60 \\ \hline \end{array}$$

$$\begin{array}{r} m. 6,300 \\ 60 \\ \hline \end{array}$$

$$\begin{array}{r} sec. 2,4000 \end{array}$$

Continued Compound Multiplication

Compound Multiplication is the multiplying of sums of different denominations, it is useful in finding the value of goods, &c. And, as in compound Addition, we carry from the lowest denomination to the next higher, so we begin and carry in compound Multiplication; one general rule being to multiply the price by the quantity.

Case I.

When the multiplier or quantity does not exceed 12. Multiply the price of one yard, pound &c. by the whole quantity, or number of yards, pounds, the product will be the answer.

Examples.

1. What will 5 yards of broad cloth amount to, at £1, 12s. 4½d. a yard?

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 1. \quad 12. \quad 4\frac{1}{2} \\ \times 5 \\ \hline 8. \quad 1. \quad 10\frac{1}{2} \end{array}$$

2. Multiply £4. 13s. 4¾d. by 10.

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 4. \quad 13. \quad 4\frac{3}{4} \\ \times 10 \\ \hline \end{array}$$

Proof. $10 \overline{) 46. 3. 1. 11\frac{1}{2}}$

3. Multiply £8. 15s. 11¾d. by 11.

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 8. \quad 15. \quad 11\frac{3}{4} \\ \times 11 \\ \hline \end{array}$$

$$11 \overline{) 96. 15. 9\frac{1}{4}}$$

4. Multiply £13. 12s. 11d. by 4.

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 13. \quad 12. \quad 11 \\ \times 4 \\ \hline \end{array}$$

$$7 \overline{) 95. 10. 5}$$

$$13. 12. 11$$

5. Multiply £14. 17s. 8½d. by 9.

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 14. \quad 17. \quad 8\frac{1}{2} \\ \times 9 \\ \hline \end{array}$$

$$9 \overline{) 133. 19. 2\frac{1}{2}}$$

$$14. 17. 8\frac{1}{2}$$

The general rule is—

Multiply as in simple multiplication, and from the product point off so many places for cents and mills, as there are places of cents and mills in the price.

In pounds, shillings, &c.

What will 9 yards of cloth amount to, at 8s. 4d. per yard?

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 0. \quad 8. \quad 4 \\ \times 9 \\ \hline \end{array}$$

$$9 \overline{) 2. 8. 0} \text{ Ans.}$$

$$0. 8. 4 \text{ proof.}$$

Six yards at 9s. 10d. per yard?

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 6. \quad 9. \quad 10 \\ \times 6 \\ \hline \end{array}$$

$$6 \overline{) 2. 19. 0} \text{ Ans.}$$

$$9. 10 \text{ proof.}$$

In Dollars, cents and Mills.

What will 9 yards of cloth amount to, at \$8c. 9m. per yard?

$$\begin{array}{r} \text{d.} \quad \text{m.} \\ 88. \quad 9 \\ \times 9 \\ \hline \end{array}$$

$$880. 81$$

24 yds at \$1.22c 9m. per
yard? \$ c. m.
1.22.9
6
\$7.37, 4m.

\$ c. m.
10.5.2
24
24 08
2104
\$25.23, 8m.

43

Case II.

What when the multiplier,
that is, the quantity, is above 12.
Multiply by two such num-
bers, as, when multiplied
together, will produce the giv-
en quantity, or multiplier.

Examples.

In pounds, Shillings, &c.
What will 144 yds of cloth
cost, at 3s 5d. per yard?

£ s. d.
0. 3. 5 1/2 price 1 yard.
12

product 1, 1, 6 price 12 yds.
Multiply by 12

£24, 18, 0 price 144 yds.

24 yds, at 6s. 9 3/4d.?

yds. s. d.
0. 6. 9 3/4
4
1 15. 3
6

£7. 15. 6d.

27 yds. at 9s. 10d.?

£ s. d.
0. 9. 10
3
1.9. 6
9

19. 5. 6

In Dollars, cents, and mills.

What will 144 yds of cloth
cost, at 57c 6m. per yard?

\$ c. m.
0. 576 6
144

2 9056
23 056
5766

\$83,001.6

24 yds. at \$1.22c 9m.

24 yds. at \$1.50c 2m.?

27 yds. at \$1.22c 9m.

\$ c. m.
1.22.9
27

8 6 03
24 58
27)39 1 2 3 (1229 Proof
27

61
53
78
54
2 33
2 33
12

Case III.

When the quantity is such a
number that no two num-
bers in the table will pro-
duce it exactly.

Multiply by two such numbers,
as come the nearest to it; and
for the number wanting,
multiply the given price of 1
yard by the said number
of yards wanting and add
the products together for the
answer; but if the product
of the two numbers exceeds the
given quantity then find the
value of the overplus, which
subtract from the last product
it, and the remainder will
be the answer.

Examples.

What will 47 yds of cloth
cost at 17s 9d. per yard amount to?

£ s. d.
0. 17. 9
5

3. 8. 9
9

39. 18. 9
add 1. 15. 6 per 2 yds.
£41. 14. 3

£ s. d.
0. 17. 9
2
1. 15. 6

67½ yds. at 16s. 3d

$$\begin{array}{r} \text{£. s. d.} \\ 0, 16, 3 \\ \hline 6, 10, 8 \\ \hline 52, 5, 14 \\ 2, 9, 0 \\ \hline \text{half } 8, 2 \end{array} \quad \begin{array}{r} 16s. 3d. \\ 55, 2, 6 \end{array}$$

59 yards, at 10s. 1

$$\begin{array}{r} \text{£. s.} \\ 0, 10 \\ \hline 7 \times 8 = 56 \\ 9, 10 \\ \hline 28, 0 \\ \hline 1, 10 \\ \hline \text{£ } 29, 10s. \end{array} \quad \begin{array}{r} \text{£. s.} \\ 0, 10 \\ \hline 9 \text{ three from } 56 \\ \hline 1, 10 \end{array}$$

What will 47 yards of cloth, at 2, 9s. 8m. per yard amount to?

$$\begin{array}{r} \text{£. s. d.} \\ 2, 9, 8 \\ 47 \\ \hline 207, 06 \\ 1189, 2 \\ \hline \text{£ } 1390, 26 \end{array}$$

67½ yards at 2, 4c.?

$$\begin{array}{r} \text{£. s. d.} \\ 2, 4 \\ \hline 16, 8 \\ \hline 190, 56 \\ \hline \text{Added } 6, 12 \\ \hline \text{Added } 1, 2 \\ \hline \text{£ } 197, 70c. \end{array} \quad \begin{array}{r} \text{£. s. d.} \\ 2, 4 \\ \hline 6, 12 \end{array}$$

Added 6, 12
Added 1, 2
£ of 2 is 1, ½ of 4 is 2

59 yards at 1, 33½c.?

$$\begin{array}{r} \text{£. s. d.} \\ 1, 33, 5 \\ \hline 12, 5 \times = 60 \\ \hline 16, 00 \\ \hline 80, 00 \\ \hline \text{sub } 1, 33, 5 \text{ pc. of } 1 \text{ yd.} \\ \hline 78, 66 \frac{1}{2} = 6m. \end{array}$$

Case IV.

When the quantity is any number above the multiplication table.

Multiply the price of 1 yard by 10, which will produce the price of 10 yards: This product, multiplied by 10 will give the price of 100 yards; then you must multiply the price of 100 by the number of hundreds in your question: the price of 10 by the number of 10s; and the price of unity on 1, by the number of units: lastly add these several products together, and the sum will be the answer.

Examples.

1. What will 359 yards of cloth at 2s. 7½d. per yard, amount to?

$$\begin{array}{r} \text{£. s. d.} \\ 2, 7, 6 \\ \hline 10 \\ \hline \text{£ } 2, 6, 3 \text{ pc. of } 10 \text{ yds.} \\ \hline 28, 2, 6 \text{ pc. of } 100 \\ \hline 3 \\ \hline 69, 7, 6 \text{ pc. } 300 \text{ yds.} \\ 11, 11, 3 \text{ pc. of } 50 \text{ yds.} \\ 2, 1, 7 \frac{1}{2} \text{ pc. of } 9 \text{ yds.} \\ \hline \text{£ } 83, 0, 4 \frac{1}{2} \text{ pc. } 359 \text{ yds.} \end{array}$$

2. 297 at 17s. 8½d. per yd.?

$$\begin{array}{r} \text{£. s. d.} \\ 17, 8, 6 \\ \hline 10 \\ \hline 8, 17, 1 \text{ price of } 10 \text{ yds.} \\ \hline 10 \\ \hline 88, 10, 10 \text{ price of } 100 \text{ yds.} \\ \hline 3 \\ \hline 265, 12, 6 \text{ price of } 300 \text{ yds.} \\ \hline \text{Subtract } 2, 19, 1 \frac{1}{2} \text{ price of } 3 \text{ yds.} \\ \hline 262, 19, 4 \frac{1}{2} \text{ price of } 297 \text{ yds.} \end{array}$$

297 yards at $\$2.88c.$
 2 m. per yard
 $\begin{array}{r} \$ \quad c. \quad m. \\ 2.88, 2 \\ 297 \\ \hline 20173 \\ 25938 \\ 5763 \\ \hline \$855,95c,4m \end{array}$

Case V.

To find the value of a hundred weight on 112 pounds, having the price of 1 pound given.

Multiply the price of 1 pound by 7, the product will be the price of 7 pounds; multiply the price of 7 pounds by 4, the product will be the price of 28 pounds, or 1 qr. of a cwt.; then multiply the price of 28 pounds by 4, and the product will be the price of 112 pounds, or a cwt.

Examples.

What will 1 cwt. of lead come to, at $6\frac{1}{2}d.$ per pound?

$\begin{array}{r} d. \\ 6\frac{1}{2} \text{ of } 1 \text{ lb.} \\ 7 \\ \hline 9.9\frac{1}{2} \text{ of } 7 \text{ lb.} \\ 4 \\ \hline 15.2 \text{ of } 28 \text{ lbs. or } \frac{1}{4} \text{ cwt.} \end{array}$

$\begin{array}{r} 4 \\ \hline £9.0.8 \text{ of } 1 \text{ cwt.} \end{array}$

1 cwt. of tin at $2\frac{1}{4}d.$ per lb.

$\begin{array}{r} d. \\ 2\frac{1}{4} \\ 7 \\ \hline 1.9\frac{3}{4} \\ 4 \\ \hline 5.9 \\ 4 \\ \hline £1.13.0d. \end{array}$

1 cwt. of chalk at $1\frac{1}{2}d.$ per lb.

$\begin{array}{r} d. \\ 1\frac{1}{2} \\ 7 \\ \hline 10\frac{1}{2} \\ 3 \\ \hline 3.6 \\ 3 \\ \hline 1.3s. \end{array}$

1 cwt. of chalk at $2c.$ per lb.

$\begin{array}{r} c. \quad m. \\ 2, 1 \\ 7 \\ \hline 13, 7 \\ 4 \\ \hline 58.8 \\ 4 \end{array}$

$\$2,95c,2m.$

Practical Questions In Weights and measures.

What is the weight of 4 hogsheads of sugar, each weighing 7 cwt. 3 qrs. 19 lb.

$\begin{array}{r} \text{cwt. qr. lb.} \\ 7, 3, 19 \\ 4 \\ \hline 31.2.20 \end{array}$

What is the weight of 6 chests of tea, each weighing 3 cwt. 2 qrs. 9 lb.

$\begin{array}{r} 3, 2, 9 \\ 6 \\ \hline 21.12.6 \end{array}$

46 If I am possessed of 4 dozen
 of silver spoons, each
 weighing 9 oz. 5 pwt. —
 2 dozen of teaspoons, each
 weighing 15 pwt. 13 grs. —
 3 silver cans, each 9 oz. 7 pwt. —
 — 2 silver tankards, each
 21 oz. 15 pwt. — and 24 sil-
 ver powningens, each 11 oz.
 18 pwt.; what is the wt. of
 the whole?

oz. pwt.	oz. pwt. gr.
3, 5	0, 15, 14
9	9
9, 15	2, 6, 18
6	8
58, 10	18, 14, 0
oz. pwt.	oz. pwt.
9, 7	21, 15
9	8
28, 1	29, 10
	oz. pwt.
	11, 18
	6
	71, 8
	49, 10
	28, 1
	18, 14
	58, 10
12	220, 8
	18, 4, 3
	lb. oz. pwt.

In 35 reines of cloth, each
 measuring $27\frac{3}{4}$ yards, how
 many yards?

$$\begin{array}{r}
 3, 5 \\
 2, 7\frac{3}{4} \\
 \hline
 1, 7\frac{1}{2} \\
 8\frac{3}{4} \\
 24, 5 \\
 70 \\
 \hline
 971\frac{1}{2}
 \end{array}$$

How many brandy in 9
 casks, each containing
 45 gallons, 3 qt. 1 pt?

gal.	qt.	pt.
45	3	1
		9
412	3	1

If I have 9 fields, each of
 which contains 12 acres, 2
 roods, and 25 poles; how
 many acres are there
 in the whole?

Acres	roods	poles
12	2	25
		9
119	3	25

Compound Division.

Compound Division is the dividing of numbers of different denominations: in doing which, always being at the highest, and when you have divided that if any thing remain, reduce it to the next lower denomination, and so on, till you have divided the whole, taking care to set down your quotient figures under their respective denominations.

Examples.

Divide £ 59 17 9 by 5

$$\begin{array}{r} 5 \overline{) 59 \text{ } 17 \text{ } 9} \\ 109 \text{ } 19 \text{ } 6 \frac{1}{2} \text{ Ans.} \end{array}$$

£. s. d. lb. oz. dr.
29, 13, 2; 25, 1, 13

$$\begin{array}{r} 9 \text{ } 17 \text{ } 9 \text{ } 17 \text{ } 11 \text{ } 4-1 \text{ Ans.} \\ 3 \end{array}$$

9, 13, 2, 25, 1, 13 Proof.

$$\begin{array}{r} 10 \overline{) 849 \text{ } 11 \text{ } 12 \text{ } 13} \\ 84 \text{ } 12 \text{ } 3 \text{ } 6-2 \text{ Ans.} \\ 10 \end{array}$$

849, 11, 12, 13 Proof.

$$\begin{array}{r} 11 \overline{) 58 \text{ } 19 \text{ } 11 \frac{1}{2}} \\ 5 \text{ } 7 \text{ } 3-2 \frac{1}{2} \\ 11 \\ 58 \text{ } 19 \text{ } 11 \frac{1}{2} \end{array}$$

$$\begin{array}{r} 7 \overline{) 37 \text{ } 17 \text{ } 4 \frac{2}{3}} \\ 5 \text{ } 8 \text{ } 2-2 \frac{2}{3} \\ 7 \\ 37 \text{ } 17 \text{ } 4 \frac{2}{3} \end{array}$$

Case I.

Having the price of any number of yards, &c. within pencil table, to find the price of 1 yard, &c.
If the quantity does not exceed 12, proceed by setting down the price, and dividing it by the quantity; which quotient will be the price of 1 yard, required; but if the quantity exceed 12, then divide by two such numbers as, when multiplied together, will produce the quantity, and the last quotient will be the value of 1 yard, required.

Examples.

If 849 yards of cloth £ 4. 3 s. 7 1/2 d. what is it per yard?

$$\begin{array}{r} \text{£. s. d.} \\ 9 \overline{) 4 \text{ } 3 \text{ } 7 \frac{1}{2}} \\ 0 \text{ } 9 \text{ } 3 \frac{1}{2} \text{ Ans.} \end{array}$$

If 84 cows cost £ 259. 13 s. what is the price of each?

$$\begin{array}{r} \text{£. s.} \\ 7 \overline{) 259 \text{ } 13} \\ 12 \text{ } 36 \text{ } 4 \text{ } 8 \text{ } \frac{2}{3} \\ 9 \text{ } 0 \text{ } 4 \text{ } \frac{2}{3} \end{array}$$

$$\begin{array}{r} \$13,9375 \\ 1,5386-1 \end{array} \quad \frac{3}{7} = 75$$

If 24 cows cost \$45,500. what is the price of each?

$$\begin{array}{r} \$45,50 \\ 12 \overline{) 127, 8-4} \\ 10, 6 \text{ £} \end{array} \quad \begin{array}{r} 7 \overline{) 45, 127} \\ 13 \\ 13 \\ 50 \\ 49 \\ 1 \text{ to } 50 = 60 \end{array}$$

If 35 yards cost £37, 11s. what is the price of 1 yard?

$$\begin{array}{r} £ \quad s \\ 5 \overline{) 37, 11} \\ 7 \overline{) 7, 10-21 \frac{3}{5}} \\ 1, 1, 5 \frac{133}{35} \end{array}$$

$$\cdot \frac{6}{5} \times \frac{5}{7} + 3 - \frac{33}{35}$$

Case II.

Having the price of 1 cent. or 12 lbs. to find the price of one pound.

Divide the price of 1 cent. by 8, that quotient by 7, and this quotient by 2, and the last quotient will be the price of one pound, required. The reason is, $8 \times 7 \times 2 = 112$ lbs on 1 cent.

Examples.

If 1 cent. of flat cost £2 7s. 8d. what is that per lb.

$$\begin{array}{r} £ \quad s \quad d. \\ 2 \overline{) 2, 7, 8} \\ 0, 5, 11 \frac{1}{2} \quad 1 \frac{1}{2} \text{ of } 4, \text{ rem.} \\ 7 \overline{) 0, 5, 10, 0 \frac{1}{2} \text{ an.}} \quad \frac{1}{2} = 2 + 3 = 5 \\ 0, 0, 5, 9 \end{array}$$

At \$156 per cent. what is the price per lb?

$$\begin{array}{r} 8 \overline{) 156} \quad 2 \text{ rem} = \frac{1}{2} = 50 \text{ c.} \\ 7 \overline{) 19, 50} \\ 2 \overline{) 2, 78} \quad \frac{2}{7} \text{ m. min.} \\ 1, 39 \frac{2}{7} \quad \frac{1}{2} \text{ of } \frac{3}{7} = \frac{3}{7} \end{array}$$

At \$3, 33, 3 m. per cent. what is the cost of 1 lb.

$$\begin{array}{r} \$ \quad c. \quad m. \\ 8 \overline{) 3, 33, 3} \\ 7 \overline{) 41, 6 \frac{5}{8}} \\ 2 \overline{) 5, 9 \frac{29}{56}} \\ 2, 9 \frac{25}{112} \end{array}$$

$$\frac{1}{7} \times \frac{29}{2} = \frac{29}{56} \quad \frac{56}{29}$$

$$\frac{1}{2} \times \frac{25}{56} = \frac{25}{112}$$

If 1 cent. of shugan cost £9, 7s. 6d. what is that per lb.?

$$\begin{array}{r} £ \quad s \quad d. \\ 8 \overline{) 9, 7, 6} \\ 7 \overline{) 8, 5 \frac{1}{2}} \\ 2 \overline{) 1, 2 \frac{13}{22}} \\ 7 \frac{1}{4} \end{array}$$

Case III.

Having the price of several hundred weight to find the price per lb.

Divide the whole price by the number of hundreds, which will give the price per cent and then proceed as in the last case.

Examples.

Insurance... Simple Interest By

Insurance is a security by contract, to indemnify for a specified sum, the insured for such loss or damage as may happen to the property, for a limited time. The premium is the sum paid by the insured for the insurance of his property, and is general at so much per cent. Multiply the sum to be insured by the rate per cent. and divide the product by 100; - the quotient will be the premium on answer.

Examples.

What will be the annual premium for insuring a house against loss by fire, valued at \$5600, at $\frac{3}{4}$ per cent.?

$$\begin{array}{r} 5600 \\ \frac{3}{4} = 75 \\ \hline 28000 \\ 99200 \\ \hline \$42000 \end{array}$$

Simple Interest By Decimals
 1. Rule. Multiply the principal by the ratio, the product will be the interest for one year.
 To find the interest for more years than one, multiply the interest of one year by the given number of years, and the product will be the interest for that number of years.
 To find the interest for months, or months and days, multiply the interest of one year by the decimal parts which are equal to the given number of months and days, and the product will be the interest for that time.

Examples.

What is the interest and amount of \$475.50 for 4 years, 9 months, 25 days at 6 per cent.?

$$\begin{array}{r} 9 \text{ mo} = .75 \\ 20 \text{ da} = .054794 \\ 5 \text{ da} = .018699 \\ \hline \text{years, } \frac{1}{4} = .818493 \\ \hline 475.50 \\ .06 \\ \hline 285900 \\ 818493 \\ \hline 855900 \\ 2867700 \\ 1141200 \\ 2282400 \\ 2282400 \\ 2282400 \\ 1141200 \\ \hline 137.4716052900 \\ 475.50 \\ \hline \$612.9716 \text{ Amount on answer.} \end{array}$$

If a factor sell a cargo for me, to the amount of \$175, on commission at $2\frac{1}{4}$ per cent, and purchase me another cargo of the value of \$2500, on commission at $1\frac{3}{4}$ per cent, what will his commission on both cargoes amount to?

$$\begin{array}{r} \$1750 \\ \frac{1}{4} \\ \hline 3500 \\ 437\frac{1}{2} \\ \hline 3937\frac{1}{2} \\ \\ 2500 \\ 1\frac{3}{4} \\ \hline 2500 \text{ for } \frac{1}{4} = 625 \\ 1250 \text{ for } \frac{1}{4} = 312\frac{1}{2} \\ \hline 625 \\ 312\frac{1}{2} \\ \hline 937\frac{1}{2} \\ 3937\frac{1}{2} \\ \hline \$83,12\frac{1}{2} = 5 \end{array}$$

Compound Interest

Compound Interest is that which arises from the interest being added to the principle at the end of each year, and making the amount the principle for the next succeeding year.

Rule. Find the interest of the given sum for one year, and add it to the principle, the amount is the principle for one year for the second year, then find the interest of that amount, and add as before, and thus proceed for any number of years required.

Subtract the interest the first principal from the last amount, and the remainder will be the compound interest for the whole time.

What is the compound interest of \$680 for 3 years, at 6 per cent?

$$\begin{array}{r}
 680 \\
 40.80 \\
 \hline
 720.80 \\
 43.248 \\
 \hline
 764.048 \\
 45.803 \\
 \hline
 809.851 \\
 48.593 \text{ Total.} \\
 858.444 \text{ subtract.} \\
 680.000 \\
 \hline
 \text{Ans. } \$178.44
 \end{array}$$

$$\begin{array}{r}
 858.444 \\
 680.000 \\
 \hline
 178.444
 \end{array}$$

What is the compound interest of \$400 for 3 years, at 5 per cent?

$$\begin{array}{r}
 400 \\
 20.00 \\
 \hline
 420 \\
 21.00 \\
 \hline
 441 \\
 22.1 \\
 \hline
 463.1 \\
 23.165 \\
 \hline
 486.265
 \end{array}$$

$$\begin{array}{r}
 \$400 \\
 20.00 \\
 \hline
 \$420 \\
 21.00 \\
 \hline
 \$441 \\
 22.1 \\
 \hline
 \$463.1 \\
 23.165 \\
 \hline
 \$486.265
 \end{array}$$

$$\begin{array}{r}
 \$1000 \\
 60.00 \\
 \hline
 \$1060 \\
 63.60 \\
 \hline
 \$1123.60 \\
 67.416 \\
 \hline
 \$1191.016 \\
 71.55096 \\
 \hline
 \$1262.566 \\
 75.75396 \\
 \hline
 \$1338.320
 \end{array}$$

$$\begin{array}{r}
 1338.320 \\
 1000.000 \\
 \hline
 338.320 \text{ comp. int.}
 \end{array}$$

Compound Interest By Decimals

Rule. Multiply the given principle continually by the amount of one dollar, on one pound, for one year, at the rate per cent. given, untill the number of multiplications be equal to the given number of years, the last product will be the product amount for the whole time; from which subtract the given principle, and the remainder will be the compound interest.

What is the amount and compound interest of \$500 for 3 years, at 6 per cent?

$$\begin{array}{r}
 500 \\
 1.06 \\
 \hline
 530.00 \\
 1.06 \\
 \hline
 561.8000 \\
 1.06 \\
 \hline
 595.508000
 \end{array}$$

$$\begin{array}{r}
 500 \\
 1.06 \\
 \hline
 530.00 \\
 1.06 \\
 \hline
 561.8000 \\
 1.06 \\
 \hline
 595.508000
 \end{array}$$

Ans. \$595.508000

What will be the compound interest of £320 for 4 years, at 5 per cent

$$\begin{array}{r}
 320 \\
 1.05 \\
 \hline
 16.00 \\
 320 \\
 \hline
 336.00 \\
 1.05 \\
 \hline
 1680.00 \\
 33600 \\
 \hline
 35280.00 \\
 1.05 \\
 \hline
 176400.00 \\
 3528000 \\
 \hline
 3704400.00 \\
 1.05 \\
 \hline
 185220000.00 \\
 370440000 \\
 \hline
 3829620000.00 \\
 \text{Sub } 320 \times 20 \text{ Multiplies} \\
 \hline
 68,192.40 \\
 12 \\
 \hline
 2,880 \\
 4 \\
 \hline
 352.0
 \end{array}$$

What will \$50 amount to in 20 years, at 6 per cent compound interest

$$\begin{array}{r}
 3207135 \\
 50
 \end{array}$$

What will be the compound interest of \$1500 for 15 years at 6 per cent?

$$\begin{array}{r}
 2396558 \\
 15 \\
 \hline
 11982790 \\
 2396558 \\
 \hline
 35948370 \\
 1500 \\
 \hline
 20948370
 \end{array}$$

Duodecimals.

1. Rule - 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, and the result of each under its respective term, observing to carry an unit for every 12, from each lower denomination to its superior.

In the same manner multiply the multiplicand by the inches in the multiplier, and write the result of each term in the multiplicand, thus multiplied, and place to the right hand in the product.

3. Proceed in the same manner with the other parts in the multiplier, which if seconds, write the result two places to the right hand; if thirds, three places, &c. and their sum will be the answer required.

Multiply 7 feet, 9 inches, 2 seconds, by 1 foot 7 inches and 9 seconds.

$$\begin{array}{r}
 7 \text{ f. } 9 \text{ i. } 2 \text{ s.} \\
 1 \text{ f. } 7 \text{ i. } 9 \text{ s.} \\
 \hline
 792 \\
 4240.2 \\
 19996 \\
 \hline
 11.7.9.116 \text{ Ans.}
 \end{array}$$

Examples.

To find the superficial content of boards, &c. when length and breadth only are considered

Rule - Multiply the length by the breadth and the product will be the superficial content.

Examples.

How many feet in a board
10 feet 7 inches long, and 9
inches wide 26 in

$$\begin{array}{r} 10.7 \\ 9 \end{array}$$

$$7.11.3$$

What number of feet are there in
a floor 16 feet 6 inches long
and 12 feet 8 inches wide?

$$\begin{array}{r} 16.6 \\ 12.8 \\ \hline 198.0 \\ 11.0.0 \end{array}$$

II. 209 Ans.

To find the solid content of timber,
stone, bales, trunks &c.

Rule. Multiply the length
by the breadth, and the
product by the depth or
thickness, the last product
will be the content in sol-
id or cubic feet, and part
of a foot.

Examples.

What How many cubic feet
in a stick of timber 12 feet 10
inches long, 1 foot 7 inches
wide, and 1 foot 9 inches thick?

$$\begin{array}{r} 12.10 \\ 1.7 \\ \hline 12.10 \\ 7.5.10 \\ \hline 20.3.10 \\ 1.9. \end{array}$$

$$\begin{array}{r} 20.3.10 \\ 15.2.10.6 \end{array}$$

$$35.6.8.6$$

How many cubic feet are
in a cellar wall, 130 feet high
8 inches high long, 8 feet
high, and 2 feet 9 inches thick?

$$130.8$$

$$1045.4$$

$$2090.8$$

$$784.0$$

$$249 \overline{) 2874.8}$$

$$297 \overline{) 32496} \quad 116 \frac{44}{297}$$

$$479$$

$$297$$

$$1826$$

$$1782$$

III. To measure drains, vaults,
dikes cellars &c.

Rule Multiply the length,
width and depth in feet
together and divide by
216

Examples.

There is a drain 200 feet long,
3 feet wide, and 5 feet
deep, how many squares
does it contain?

$$200.3$$

$$600$$

$$100$$

$$700.3$$

$$3500$$

$$350$$

$$175$$

$$216 \overline{) 3500} \quad 16 \frac{137}{216} \text{ Ans.}$$

$$18.65$$

$$17.28$$

$$137$$

How many
squares are there
in a vault 8 feet
square and 9 feet
deep?

$$8 \text{ feet square.}$$

$$64$$

$$96$$

$$576$$

$$32$$

$$216 \overline{) 6082}$$

$$28$$

$$216 \overline{) 17688} \quad 81 \frac{22}{216} \text{ Ans.}$$

$$216 \overline{) 10827}$$

IV To measure wood

Rule- Multiply the length by the width, and the product by the height; the last product will be the content in cubic feet and parts of a foot, which are brought into cords by dividing them by 128, or into cord wood feet by dividing by 16.

How many cords are there in a pile of wood

176 feet long of 3 feet 9 inches wide, and 4 feet 3 inches high?

$$\begin{array}{r} 176 \\ 3 \frac{3}{4} \\ \hline 528 \\ 88 \\ 44 \\ \hline 660 \frac{1}{4} \end{array}$$

$$\begin{array}{r} 2640 \\ 165 \\ \hline \end{array}$$

$$\begin{array}{r} 128 \overline{) 2805} \quad 21 \frac{117}{128} \text{ Ans.} \\ 256 \\ \hline 245 \\ 128 \\ \hline 117 \end{array}$$

How many cord wood feet are there in a pile 16 feet long, 5 feet 9 inches wide and 3 feet 1 inch high?

How many cord wood feet are there in a load of wood 8 feet long 3 feet 10 inches wide, and 5 feet 4 inches high.

$$\begin{array}{r} \text{ft. in.} \\ 8, 10 \\ 5, 0 \\ \hline 30.8 \\ 5.4 \\ \hline 159.4 \end{array}$$

$$10.2.8$$

$$\begin{array}{r} 10.2.8 \quad 8 \quad 8 \quad 4 \\ 16.3 \cdot 6.8 \quad (10.512 / 64 / 8 / 2 \text{ Ans.}) \\ 12 \quad 16 \\ \hline 192 \quad 16 \\ 12 \quad 9 \\ \hline 204 \quad 12 \\ 42 \\ \hline 512 \end{array}$$

$$\begin{array}{r} \text{ft. in.} \\ 12.3 \\ 4.1 \\ 3.0 \\ \hline 12.3 \\ 16.5 \\ \hline 176.0 \\ 5.1.3 \end{array}$$

$$\begin{array}{r} 128 \overline{) 1811.9} \quad 14 \text{ cord.} \\ 128 \\ \hline 53 \text{ feet.} \end{array}$$

Note- As the superficial contents of one end of a cord of wood are exactly double to the number of cord wood feet, therefore in order to find the number of feet of cord, in any load, multiply the height by the width, duodecimally, and divide the product by 2, the quotient will be the number of cord wood feet, and parts of a foot which the load contains.

How many feet of wood in a load

3 ft. 6 inches high, and 3 feet 6 in wide?

$$\begin{array}{r} 3.6 \\ 3.6 \\ \hline 10.6 \\ 1.9.0 \\ \hline 2 \overline{) 12.90} \\ 6 \frac{1}{8} \text{ Ans. } 3 = \frac{1}{8} \end{array}$$

How many feet of wood in a load 4 ft. 3 in. high, and 3 ft. 5 in. wide?

$$\begin{array}{r} 4.3 \\ 3.5 \\ \hline 12.9 \\ 1.9.3 \\ \hline 2 \overline{) 14.6.9} \\ 7 \frac{1}{2} \text{ Ans. } 6 = \frac{1}{2} \end{array}$$

How many feet of cord
wood in load 3 ft. 9 in. high,
and 2 ft. 10 in. wide?

$$\begin{array}{r} 3.9 \\ \times 2.10 \\ \hline 7.6 \\ 3.16 \\ \hline 9 \overline{) 10.7.6} \\ 5 \frac{1}{2} \text{ Ans.} \end{array}$$

How many feet of cord wood,
in a load 4 ft. 7 in. high, and
3 ft. 8 in. wide?

$$\begin{array}{r} 4.7 \\ 3.8 \\ \hline 13.9 \\ 3.0.8 \\ \hline 2 \overline{) 16.9.8} \\ 8 \frac{9}{8} \text{ Ans. } 9 = \frac{9}{8} \end{array}$$

How many feet of cord wood
in a load 4 ft. 4 in. high, and
3 ft. 1 in. wide?

$$\begin{array}{r} 4.4 \\ 3.1 \\ \hline 13.0 \\ 0.4.4 \\ \hline 2 \overline{) 13.4.4} \\ 6 \frac{2}{3} \text{ Ans.} \end{array}$$

How many feet of cord
wood are there in a load
which is 3 ft. 11 in. high, and
3 ft. 10 in. wide?

$$\begin{array}{r} 3.11 \\ 3.10 \\ \hline 11.9 \\ 3.3.2 \\ \hline 2 \overline{) 15.0.2} \\ 7 \frac{1}{2} \text{ Ans.} \end{array}$$

Note 4. - When wood is cut
less, or more, than 4 ft. long,
find the contents of the load
by the fore going examples,
then the nett deduct or add,
as the case may require, so
many forty-eights of a foot
as the number of feet in
the load will produce when
multiplied by the number
of inches it falls short, or
overruns.

How many feet cord wood
are there in a load 4 ft. high,
and 3 ft. wide, and cut on-
ly 3 ft. 9 inches long?

$$\begin{array}{r} 4.0 \\ 3.0 \\ \hline 2 \overline{) 12.0} \\ 6 \\ \frac{3}{8} = \frac{8}{8} \frac{3}{8} - \frac{8}{8} = 5 \frac{5}{8} \\ 5 \frac{5}{8} \end{array}$$

How many feet of cord
wood in a load 4 ft
3 in. high, and 3 ft. 6 in.
wide, and cut 4 ft. 7 in
long?

$$\begin{array}{r} 4.3 \\ 3.6 \\ \hline 12.9 \\ 2.1.6 \\ \hline 2 \overline{) 14.10.6} \\ 1 + \frac{10}{24} \\ 1 \frac{1}{24} \\ = 8 \frac{11}{24} \end{array} \quad \begin{array}{r} 7 \text{ sizes} = 1 \text{ and } \frac{1}{6} \\ 7 \frac{1}{6} \\ 7 \\ \hline 48 \overline{) 501} (1 + 7 = 8 \\ 486 \\ \hline 15 \\ 2 \overline{) 15} \\ 7 \frac{1}{2} \end{array}$$

How many feet of cord wood
in a load, 3 ft. 7 in. high, and 3 ft.
8 in. wide, and cut 3 ft. 6 in. long?

$$\begin{array}{r} 3.7 \\ 3.8 \\ \hline 10.9 \\ 2.4.2 \\ \hline 2 \overline{) 13.1.2} \\ 6 \frac{1}{2} \\ 6 \\ \hline 5 \frac{1}{2} \end{array} \quad \begin{array}{r} 6 \\ 3 \frac{6}{8} \frac{3}{8} \\ 36 \overline{) 99} \\ 42 \overline{) 129} \\ 126 \\ \hline 3 \end{array}$$

How many feet of cord wood in a load,
4 ft. 2 in. high, and 3 ft. 8 in. wide?

$$\begin{array}{r} 4.2 \\ 3.8 \\ \hline 12.6 \\ 2.9.4 \\ \hline 2 \overline{) 15.3.2} \\ 7 \frac{1}{2} \\ 7 \\ \hline 5 \frac{1}{2} \end{array} \quad \begin{array}{r} 850 \\ 3 = \frac{1}{8} \\ 24 \\ \frac{1}{2} = \frac{4}{8} \end{array}$$

Single Rule Of Three.

1. Rule. Write that number which is of the same name or on kind with the answer or number required for the second term. Then consider whether the answer must be greater or less than the second term. If the answer must be greater or less than the second term, write the greater of the two remaining numbers on the right for the third, and the other on the left for the first term. — but if the answer must be less than the second term, write the less of the two remaining numbers on the right for the third term, and the other on the right left for the first term. Multiply the second and third terms together, divide by the first, and the quotient will be the answer to the answer to the question which (as also the remainder) will be in the same denomination in which you left the second term, and may be brought into any other denomination required.

If 4 yards of cloth cost 16 dollars, what will 12 yards come to at the same rate?

$$\begin{array}{r} \text{yds. } \$ \\ 4 : 16 :: 12 \\ 12 \\ \hline 3 \overline{) 192} \\ \$48 \text{ Ans.} \end{array}$$

If 5 yards of cloth cost \$10, what will 20 yds. come to?

$$\begin{array}{r} 5 : 10 :: 20 \\ 20 \\ \hline 5 \overline{) 200} \\ \$40 \text{ Ans.} \end{array}$$

If 20 yds. cost \$120, how many yards may be bought for \$30?

$$\begin{array}{r} 120 : 20 :: 30 \\ 30 \\ \hline 12 \overline{) 600} \\ 600 \end{array} \text{ 5 Ans.}$$

Here we divide the 1st. term by the third, and then the second term by the quotient for the answer.

$$\begin{array}{r} 3 \overline{) 120 : 20 :: 30} \\ 4 \overline{) 20} \\ 5 \text{ yds. Ans.} \end{array}$$

If 1 pint of tobacco cost £ 5 12 s. 9 d. what will 8 pint. do. cost?

$$\begin{array}{r} \text{pint. } £ \text{ s. d.} \\ 1 : 5 : 12 : 9 \frac{1}{2} :: 8 \\ \hline \text{Ans } £ 45 : 2 : 4 \end{array}$$

If 8 pint. of tobacco cost £45, 2 s. 4 d.; what is that per cent?

$$\begin{array}{r} £ \text{ s. d.} \\ 8 \overline{) 45 : 2 : 4} \end{array}$$

$$5 : 12 : 9 \frac{1}{2} \div 4 = \frac{1}{2} 8$$

If a pint. 1 lb. 14 lbs. of sugar be worth \$21.75, what will be the value of 42 pint. 3 lbs. at the same rate?

$$\begin{array}{r} \text{pint. dr. lb. } \$ \\ 2 : 1 : 14 : 21.75 :: 42 : 3 \\ \hline 4 \text{ Ans.} \\ 28 \\ 76 \\ 19 \\ \hline 266 \end{array}$$

$$\begin{array}{r} 171 \text{ Ans.} \\ 28 \\ \hline 1368 \\ 342 \\ \hline 4788 \\ 21.75 \end{array}$$

$$23940$$

$$93516$$

$$4788$$

$$9576$$

$$266 \overline{) 10419900} (391.50$$

$$798$$

$$2433$$

$$2394$$

$$399$$

$$266$$

$$1336$$

$$1330$$

$$111$$

If 9 cent. 3 drs. of shugan cost £27, 17s, 6d., what will 2 cent. 1 dr. 1 lb. cost?

cent. dr.	£	s.	d.	cent. gr.	lb.
9.9	27	17	6	2.	1. 1
4	20		4		
39		55	7	9	
28		12		28	
312		669	0	73	
78				19	
1092				263	

As 1092 lb. d. lb.
 6690 : 263

2007
 3014
 1338 (12)
 1092 1759 470 1611
 1092 2913 3d.
 6674 £6, 14s 3d. Ans.
 6552
 1227
 1092
 1350
 1092
 258
 4

1092 10920 dr.

If my income be 109 quin-
 cas pen annum I desire to
 know what I may spend
 pen day, so that I may
 lay up £45 at the years
 end?

109
 28 shil = quin

872	£
218	45
3052 shil	20
300	900

365:2152::1

965)2152(5 10 9 1
 1825
 327

12 d.
 965)9924(10
 965
 274

365)1096(3 ans.
 1095
 1

If my salary be £43 12s. 6d.
 pen annum, what does it
 amount to pen week?

W.	£	s.	d.
59	43	12	5
	20		
52	872	16	9 17 d. Ans.
	52		
	352		
	312		
	40		
	12		
52	485	9	
	468		

Suppose my income to be
 165, 2 283 pen week what
 is it pen annum?

7:16:8 283 :: 365
 12 Add the numerator
 200 of the fraction
 365 when x 365
 1003
 1208
 609

7)73229
 12)10469
 2,987,2 - 5
 £43, 12s. 6d. Ans.

1. Note you must first reduce
 the middle term to pen-
 2. you must multiply by
 365 (the denominator
 of the fraction) and add
 to the product the 283
 which remains
 Then divided by 7, 12, 20.

how many yards of cloth
 may be bought for \$195, 75c,
 of which 9 1/2 yds. cost \$110, 20c?
 110, 2: 9 1/2 :: 195, 75
 9 1/2

1761 75
 988 7 1/2 yds.
 1102 18596 2 1/2 (168, 3 qrs.
 1102
 7576
 6642
 9642
 8816
 826
 4
 1102 33 0 6 (3 ans.
 33 06

1/2 ans. = 2 + 24 = 26

A merchant, failing
in trade, owes in all £3475
and has in money and effects
but £2316, 13s. 4d. Ans.
suppose his effects are divided
delivered up, pray what will
each creditor receive on the
pound? £ s. d.

3475: 2316 13 4 :: 1

46999
12

3475) 556000 (160
3475

20850
20850

12) 160

13-4 Ans.

If the difference distance from
Kilbury Port to York be 11
miles; I demand how many
times a wheel whose cir-
cumference is 15½ feet, will
turn round in per-
forming the journey?

15½: 1 :: 31

2

248

40

9920

16½

59520

9920

3960

15½) 169620

31) 927960 (10560 Ans.

31

179

155

186

186

What will 37½ dozens of buttons
come to at 19 cents per dozen?

37½

12

450

19

1350

450

\$58.50, Ans.

7/18 of a ship cost \$1163m
is the whole month?

1163

16

6978

1163

7) 18608

\$2658, 28c, 4m. Ans.

A merchant bought 6 y
packages of cloth, at 3
quintals per y yards; each
package contained 8
panels, each panel 12
yards, and each piece
20 yards; how many
yards could he
make up, and how
many per yard?

yd. yd. pack
4:3 :: 9

pack.

8

72

12

864

20

17280

3 sec. tm.

fst tm. 7) 51840

7405-5

287

59240

14810

20

6 shil. dol. 6) 207960

\$34560

yd. y

3yd

7:3 :: 1

if 4 yd est so
much what will
1 yd cost; 3d tm

1

73

03 = 28 Ans.

7

A merchant brought 49
 tons of mine from 8910; freight
 cost 890; duties 840; cellar 881
 67c; other charges 850, and
 he would gain 8188 by the
 bargain; what must he give
 him per 28 tons?

8 6
 910.00
 90.00
 40.00
 31.67
 50.00
 185.00
 49,1306,67,1163
 100*
 130667
 23,3dms.
 392001
 261334 8 lbs.
 49)3005341(613,33
 294
 65
 49
 163
 147
 164
 147
 171
 147
 24 rem = nearly

* Should turn multiplied by
 100 to bring it into cents
 If the earth being 360
 degrees in circumference,
 turns round on its axis in 24
 hours; how far does it turn
 in one minute in the 43d
 parallel of latitude; the de-
 gree of longitude in this lat-
 itude being about 51 centi-
 tude miles?

h. deg. m. s.
 24:360 x 51:11
 60 51
 1440,360
 18'00 all.
 1440)1836,0(12 3/4 hrs
 144
 396
 288 ÷ 2
 108
 121 21 36 4
 ÷ 4

If a staff, 4 feet long, cast
 east a shadow on level ground
 7 feet, what is the height
 of the steeple, whose base
 at the same time measures
 198 feet?

sh. ft. sh.
 7:4:1 198
 4

1792
 1191

Said Henry to Dick,
 my purse and money, and
 worth eleven times 34 give
 us, but the money is
 worth eleven times as much
 as the purse; pray how
 much money is there in
 it?

* 3 1/2
 28 3/4 x 28 = 7

84
 7 + added.
 12,91,11

12)1001
 2,08,9
 4,3,5

5 d. s.
 12- 5 x 12 to
 note to
 value.
 12)60
 5 d.

L. S. D.

* Now the money is 11
 parts of the whole, and
 the purse is part, and
 11 + 1 = 12, the part tenon
 and 11 the proportion of the
 money is the third term
 of 3/8 of a yanel cost 2/5 of a d.
 what will 7/11 of a yanel cost?

3: 4 1/2
 8: 5 1/2

3/8 x 2/5 x 7/11

2
 4
 92
 7
 224
 165
 59
 x 20 shillings pound
 1180
 1155
 25

165)300(1
 165
 135 24
 165 93

There is a cistern, having four cocks; the first will empty it in minutes; the second in 25 minutes; the third in 40 and the fourth in 80 minutes; in what time will all four running together empty it?

$$\begin{array}{r} 10:60:1 \\ \underline{60} \\ 1060 \\ 6 \text{ times.} \end{array} \quad \begin{array}{r} 20:60:1 \\ \underline{60} \\ 2060 \\ 3 \text{ times.} \end{array}$$

$$\begin{array}{r} 40:60:1 \\ \underline{60} \\ 4060 \\ 1 \frac{1}{2} \text{ times} = \frac{1}{2} \end{array} \quad \begin{array}{r} 80:60:1 \\ \underline{60} \\ 8060 \\ 2 \frac{1}{2} \text{ times} = \frac{1}{2} \end{array}$$

*Eighty cannot be contained in 60 therefore place the 60 for a numerator and 80 for a denominator and divide by two, which will reduce it to $\frac{3}{4}$.

If the earth revolves 366 in 365 days, in what time does it perform one revolution?

$$\begin{array}{r} \text{Times. D} \\ 366:365:1 \end{array}$$

$$\begin{array}{r} 365 \\ 24 \\ \underline{1360} \\ 730 \\ 366) 8760 (23.56.3.56. \\ \underline{732} \\ 1428 \\ \underline{1098} \\ 330 \\ 60 \end{array}$$

$$\begin{array}{r} 366) 20520 (56. \\ \underline{1830} \\ 2220 \\ \underline{2196} \\ 24 \\ 60 \end{array}$$

$$\begin{array}{r} 366) 1440 (3. \\ \underline{1098} \\ 342 \\ 60 \end{array}$$

$$\begin{array}{r} 366) 20520 (56. \\ \underline{1830} \\ 2220 \\ \underline{2196} \\ 24 \end{array}$$

If the earth makes one complete revolution in 24 h. 56. 3. in what time does it pass through one degree?

$$\begin{array}{r} \text{deg. h. m. s.} \\ 360:24:56.3:1 \\ \underline{60} \\ 1436 \quad 60 \\ 366) 86169 (23.9 \\ \underline{720} \\ 1416 \quad 3,59,20 \text{ Ans.} \\ \underline{1080} \\ 3369 \\ \underline{3240} \\ 129 \\ 60 \end{array}$$

$$\begin{array}{r} 366) 7920 (\\ \underline{720} \\ 180 \\ \underline{360} \\ 20 \text{ times.} \end{array}$$

If the earth performs its diurnal revolution in a solar day, on 24 hours, in what time does it move one degree?

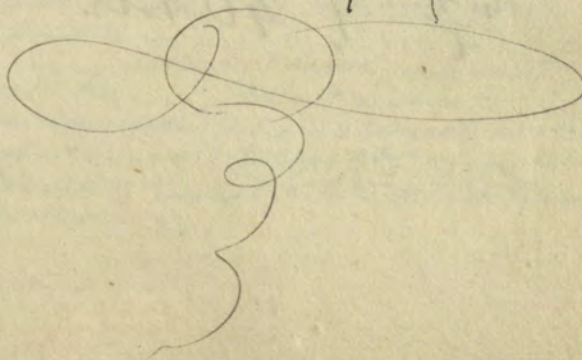
$$\begin{array}{r} \text{deg. h. m. s.} \\ 360:24:1:1 \\ \underline{60} \\ 366) 1440 (4. \text{ Ans.} \\ \underline{1440} \end{array}$$

If $\frac{3}{5}$ of yam cost \$7, what will 40 yams come to?

$$\begin{array}{r} 3'7''20\frac{1}{2} \\ \underline{5'8''11} \\ 81 \end{array}$$

$$\begin{array}{r} \text{invert } \frac{5}{3}, \frac{7}{2}, \frac{81}{2} \\ \text{the di-} \\ \text{vision.} \end{array} \quad \begin{array}{r} 81 \\ \underline{2} \\ 16 \quad 567 \\ \underline{9} \\ 38) 2335 (59.06.2\frac{1}{2} \text{ Ans.} \\ \underline{230} \\ 35 \\ \underline{292} \end{array}$$

$$\begin{array}{r} 300 \\ 288 \\ \underline{120} \\ 96 \quad 2 \\ \underline{24} \quad 9 \quad 1 \\ \div 8 \quad 48 \quad 6 \quad 2 \end{array}$$



At $\$3\frac{5}{8}$ per cent. what will $9\frac{1}{2}$ lb. come to?

$$\begin{array}{r} 112' 3\frac{5}{8}'' 9\frac{1}{2} \\ \hline 396 \quad 29 \quad 29 \\ \hline 3 \quad 8 \quad 3 \end{array}$$

$$\frac{3 \times 29 \times 10 \times 10 \times 10 \times 29 = 2529000}{396 \times 8 \times 1 \times 1 \times 1 \times 3 = 8064}$$

$$\begin{array}{r} 8064 \overline{) 2529000} (31' 3'' \text{ nearly} \\ \underline{24192} \\ 10980 \\ \underline{8064} \\ 29160 \\ \underline{16128} \\ 7032 \end{array}$$

A conduit has a cock, which fill a cistern in 2 of an hour. This cistern 8 cocks; the first will empty it in 1.25 hours, the second in .625 of an hour, and in .5 hour. In what time will the cistern be filled, if all four run together?

$$\begin{array}{r} h. \quad c. \quad h. \\ 1.25 : 1 : 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 1.25 \overline{) 1.000} (.8 \\ \underline{1.000} \end{array}$$

$$\begin{array}{r} .625 : 1 : 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} .625 \overline{) 1.000} (1.6 \\ \underline{.625} \\ 3750 \\ \underline{3750} \end{array}$$

$$\begin{array}{r} .5 : 1 : 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} .5 \overline{) 1.0} \\ \underline{.5} \end{array}$$

$$\begin{array}{r} .2 : 1 : 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} .2 \overline{) 1.0} \\ \underline{.4} \\ .6 \end{array}$$

$$\begin{array}{r} 2 \\ 1.6 \\ .8 \\ \hline 4.4 \\ h. \quad c. \quad h. \\ 6 : 1 : 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 6 \overline{) 1.0} \\ \underline{.6} \\ .4 \\ \underline{.4} \\ 0 \end{array}$$

$$\begin{array}{r} h. \quad m. \\ 1, 40 \text{ Ans.} \end{array}$$

In a certain school, $\frac{1}{10}$ of the pupils study Greek, $\frac{1}{10}$ study Latin, $\frac{2}{5}$ study Arithmetic, $\frac{1}{5}$ read and write, and 20 attend to other things; what is the number of pupils?

$$\begin{array}{r} \frac{1}{10} \quad \frac{1}{10} \quad \frac{2}{5} \quad \frac{1}{5} \\ \hline 20 \quad 10 \quad 5 \quad 4 \\ \hline 4 \quad 2 \quad 1 \quad 4 \\ \hline 1 \quad 2 \quad 1 \quad 1 \end{array}$$

$$\begin{array}{r} 20 \\ 10 \\ 5 \\ 4 \\ \hline 40 \end{array}$$

$$\begin{array}{l} 2 \times 1 = 2 \\ 2 \times 1 = 4 \\ 2 \times 2 = 16 \\ 10 \times 1 = 10 \end{array}$$

$$\frac{2 \times 32}{40} \div \frac{8}{10} \text{ fractions, ne +} \quad \text{dured} = \frac{8}{10}$$

$$\begin{array}{r} 10 : 20 : 10 \\ \hline 2 : 4 : 2 \\ \hline 9200 \\ \hline 100 \text{ Ans.} \end{array}$$

Mr. Dudley Seavitt to POST-OFFICE, ANDOVER, Dr.

To Postage of Letters for Quarter ending Jan 1, 1848 . . . \$-91

Do. Papers to Jan 1,

141
75

Received payment,

Nathl. Swift
N. Swift Post-Master.

Method Of Making Tax

Rule.—In the first place an inventory of the value of all the estates, both real and personal, and the number of polls for which each person is rateable, must be taken in separate columns: the most concise way is then to make the total value of the inventory the first term, the tax to be assessed the second, and \$1. the third, and the quotient will show the value on the dollar by 1, 2, 3, 4, &c. — 3dly, From the inventory take the real and personal items of each man, and find them separately in the table, which will show you each man's proportional share of the tax for real and personal estates.

Suppose the Genl Count should grant a tax of Examples.

\$500000, of which the town of Portsmouth is to pay \$5312.50, and, of which the polls, being 1550, are to pay \$125 each. — The town's inventory amounts to \$250000, what will it be on the dollar, and what is its tax, whose (as by the inventory) is and as follows, viz. real \$1376, personal \$1149, and he has 9 polls?

Pol. \$	Pol
1:1.25::1550	
1550	\$
6250	5312.50
625	-1937.50
125	3375 sectm.

1937500	
450000:3375::	
1	
450000	3375000 (7½ Ans.
	3150000
	2250000 = 1/2

2250000
225000

Suppose a tax of \$755 be laid on a town, and the inventory of all the estates in town amount to \$9325, what must it pay, whose estate is \$149?

\$	\$	\$
9325:755::149		
149		
6795		
3020		
755		
9325	112495	12038
	9335	
	19045	
	18690	
	85500	
	28095	
	74650	
	74760	

Rule Of Three Direct

The Rule Of Three Direct teaches, by having three numbers, given to find a fourth, which shall have the same ratio to the second, as the third has to the first.

1. *Rule.*—state the the question by making that number which asks the question the third term; that which is of the same name or kind with the answer, the second term.

2. Multiply the second and third terms together, and divide the product by the first term, and the quotient will be the fourth term or answer.

If 8 bushels of corn be worth
\$1.80 what is the value of
14 bushels?

$$\begin{array}{r} \text{bu.} \quad \$ \\ 8 \quad 1.80 \quad : \quad 14 \\ 18 \\ \hline 3 \quad 2160 \\ \hline \$7.20 \text{ Ans.} \end{array}$$

If 6 lbs. shugon cost 10s. what
will 33 lbs. cost at the same
rate?

$$\begin{array}{r} \text{lb.} \quad \text{s.} \quad \text{d.} \\ 6 \quad 10 \quad : \quad 33 \\ 33 \\ \hline 90 \\ \hline 3 \quad 30 \\ \hline 2 \quad 95 \quad 5 \\ \hline \text{£.} \quad \text{s.} \quad \text{d.} \text{ Ans.} \end{array}$$

Inverse Rule Of Three

The Rule Of Three Inverse
teaches, by having three num-
bers given to find a fourth,
which shall have the same ratio
to the second, as the first has to
the third.

Rule.—State the and reduce
the terms as in the Rule of
Three Direct; then multiply
the first and second terms to-
gether, and divide the product
by the third, the quotient will
be the fourth term, or answer.

Double Rule Of Three

The Double Rule Of Three, or Compound Proportion
is the method of resolving such questions as require two or
more operations by Simple Proportion.

Rule.—State the question, by placing the three conditional terms
in such order that that number which is the cause of gain, or
loss, or action, may possess the first place; that which denotes spe-
cies of time, or distance of place, the second, and that which is the gain,
loss, or action, the third.

1 Place the other two terms, which move the question, under
those of the same name.

2 Then, if the blank place, or term sought, fall under the third
place, the proportion is direct; therefore, multiply the third
last terms together, for a dividend, and the other two for a
divisor; then the quotient will be the answer.

3 But if the blank fall under the first or second place, the pro-
portion is inverse, wherefore multiply the first, second and
third last terms together, for a dividend, and the other
two for a divisor; the quotient will be the answer.

Examples.

Examples.

If 6 men can do a piece of work in
12 days, in what time can 12
men do it?

$$\begin{array}{r} 6 \quad : \quad 12 \quad : \quad 12 \\ 6 \\ \hline 12 \quad 108 \\ \hline 9 \text{ days Ans.} \end{array}$$

If a man perform a journey
in 15 days, when the days are
12 hours long, in how many
days will he do it, when the day
is but 10 hours?

$$\begin{array}{r} 15 \quad : \quad 12 \quad : \quad 10 \\ 15 \\ \hline 180 \\ \hline 12 \\ \hline 15 \quad 180 \\ \hline 12 \text{ days Ans.} \end{array}$$

If a principle of \$100 gain
 \$6 interest in one year, what
 will \$500 gain in 8 months?

\$	m.	\$	int.
100:	12:	6	
500:	8		

100	6
12	2
1200	48
	500
1200	240.00
	\$20 Ans.

If \$100 in 12 months will
 gain \$6 interest. in what
 time will \$750 gain \$30
 interest?

\$	m.	\$
100:	12:	6
750:		30

750	100
6	12
3500	1200
	30
3500	96000 (2 mo Ans.
	96000

If 7 men can reap 84 acres
 of wheat in 24 days; how
 many men can reap 100
 acres in 10 days?

men	acres	days
7:	100:	10
84:		24

84	100
10	7
840	700
	24
	2800
	1400
840	16800 (20 Ans men.
	1680

If 12 men can earn \$8
 in 8 days, what
 will 21 men earn in
 15 days?

m.	d.	\$
12:	8:	8
21:		15

m.	d.	\$
12:	8:	8
21:	15	168
		15
		220
12		168
8		
96		2520
		21

2520	
5040	20
96	52920 (55,1 Ans.
	280
	292
	480
	120
	98
	22
	12
96	288 (30d.
	288

If a family of 9 persons
 spend \$50 dollars in 5 months
 how much would be suf-
 ficient to maintain them 8
 months, if 5 persons more
 were added to the family

5:	9:	50
8:	5+9=14	8
		9600
		14
		14400
9		9600
5		
45		50400 (1120 Ans
		45
		52
		45
		90
		90
		10

If 2 men in 6 days at 12 hours each, build 30 walls of wall, how many hours long is the day when 2 men build 6 2 walls in 2 days?

m.	h.	m.	d.	h.	d.
2	12	2	4	3	6
2	24				
3					

$$\begin{array}{r} 30 \div 2 = 15 \\ 15 \div 2 = 7\frac{1}{2} \\ 7\frac{1}{2} \times 6 = 45 \end{array}$$

$$\begin{array}{r} 92 \\ 256 \\ \hline 90288 \text{ Ans.} \\ 270 \\ \hline 180 \\ \hline 180 \end{array}$$

Conjoined Proportion

Conjoined Proportion is when the coins, weights, or measures of several countries are compared in the same question; or in other words, it is joining many proportions together, and by the notation which several antecedents have to their consequents, the proportion between the first antecedent and last consequent is discovered as well as the proportion between the others in their several respects.

Case 1

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, that is, the antecedents at the left hand, and the consequents at the right, and write the last number on the left hand column continually together for a dividend; and all the numbers in the right hand column for a divisor; and divide; and the quotient will be the answer.

If 12 lbs. of Boston be equal to 10 lbs. of Amsterdam, and 10 lbs. of Amsterdam be equal to 12 lbs. of Paris; how many pounds of Boston are equal to 80 lbs. of Paris?

Antecedents, Consequents.

12	10
10	12
80	120

$$\begin{array}{r} 12 \\ 10 \\ \hline 120 \\ 120 \text{ lbs. Ans.} \\ 9600 \\ \hline 960 \\ \hline 0 \end{array}$$

If 140 bucks of Venice be equal to 150 bucks of Leghorn, and 4 bucks of Leghorn be equal to 2 American yards; how many Venetian bucks are equal to 36 American yards?

Antecedents, Consequents.

140	150
4	2
36	600

$$\begin{array}{r} 140 \\ 4 \\ \hline 560 \\ 980 \\ \hline 1960 \\ 600 \text{ } 31960 \text{ } 525 \text{ } 1600 \text{ } 4 \\ \hline 9060 \\ \hline 1960 \\ 1260 \\ \hline 160 \end{array}$$

Case II.

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 given quantity of the first.

Rule. Place the numbers alternately, beginning at the left hand, and write the last number on the right hand; then multiply all the numbers in the right hand column continually together for a dividend, and all the numbers in the left hand column for a divisor; divide, and the quotient will be the answer.

If 12 lbs. of Boston be equal to 10 lbs. of Amsterdam, and 100 lbs. of Amsterdam be equal to 120 lbs. of Paris; how many pounds of Paris are equal to 80 lbs. of Boston?

$$\begin{array}{r} 10 \cdot 12 \\ 120 \cdot 100 \\ 80 \cdot 1200 \end{array}$$

$$\begin{array}{r} 10 \\ 120 \\ 200 \\ 10 \end{array}$$

$$\begin{array}{r} 1200 \\ 80 \end{array}$$

$$\begin{array}{r} 9600 \\ 9600 \\ \hline 0 \end{array} \quad 80 \text{ lbs. Ans.}$$

If 140 livres of Venice be equal to 150 livres of Leghorn, and 7 livres of Leghorn be equal to 4 American yards; how many American yards are equal to 52 $\frac{3}{4}$ Venetian livres?

$$\begin{array}{r} 140 \cdot 150 \\ 7 \cdot 4 \cdot 600 \\ \hline 980 \cdot 52 \frac{3}{4} \cdot 600 \\ 150 \cdot 4 \cdot 15 \cdot 2700 \cdot 160 \\ \hline 600 \cdot 52 \cdot 90 \\ 1200 \cdot 90 \\ 9000 \cdot 0 \\ 31200 \cdot 160 \\ 160 \end{array}$$

$$\begin{array}{r} 980 \cdot 31960 \cdot 32 \text{ yards Ans.} \\ 2940 \\ \hline 1960 \\ 1960 \\ \hline 111 \end{array}$$

Practice.

Practice is a continuation of the Rule of Three Direct when the first term happens to be an unit or one, it has its name for its sake and is among Merchants and Traders being an easy and concise method of working most questions which arise in trade and business.

Proof By the single Rule of Three, compound Multiplication, or by changing the parts.

Before any advances are made in this rule, the learner should commit to memory the following table of aliquot parts, or even parts.

Case I.

To find the value of any number of pounds, &c. when the unit of one pound is an aliquot part of a dollar.

Rule. To the value of any number of pounds set one dollar a pound will be just so many dollars as there are pounds; then divide the pounds by such an aliquot as the price is of a dollar, the quotient will be the answer in dollars.

What will be the value of 360 yards of cloth, at 25cts. a yard?

$$25 = \frac{1}{4} \quad 360 \\ \hline \$90 \text{ Ans.}$$

What will be the value of 125 lbs. of butter, at 11cts. a pound?

$$11\text{cts} = \frac{1}{9} \quad 125 \\ \hline \$15, 62\frac{1}{2} \text{ Ans.}$$

What will be the value of 75 pounds of loaf sugar at 20 cents a pound?

$$20 = \frac{1}{5} \quad 75 \\ \hline \$15 \text{ Ans.}$$

What will 1250 pounds of cheese come to at $6\frac{1}{2}$ cents a pound?

$$6\frac{1}{2} = \frac{1}{16} \quad 1250 \quad 78, 125 \\ \hline 112 \\ \hline 190 \\ 128 \\ \hline 20 \\ 16 \\ \hline 40 \\ 32 \\ \hline 80 \\ 80 \\ \hline 1$$

Case II.

To find the value of any number of yards &c. when the price of 1 yard is an aliquot part of a pound.

Rule. Call the number of yards ^{so many} pounds, and divide them by such an aliquot part as the price is of a pound, the quotient will be the answer in pounds.

What will 63 gallons of wine come to, at 6s. 8d. a gallon?

$$6\text{s. } 8\text{d.} = \frac{1}{3} \quad 63 \\ \hline 21 \text{ lbs.}$$

What is the value of 500 bushels of potatoes, at 2s. 6d. a bushel?

$$2\text{s. } 6\text{d.} = \frac{1}{4} \quad 500 \\ \hline 125 \text{ lbs.}$$

What will be the value of 150 bushels of corn at 3s. 4d. a bushel?

$$3\text{s. } 4\text{d.} = \frac{1}{3} \quad 150 \\ \hline 50 \text{ lbs.}$$

What is the value of 125 yards of linen, at 5s. a yard?

$$5 = \frac{1}{2} \quad 125 \\ \hline 62\frac{1}{2} \text{ Ans.}$$

What will 37½ yards come to of sheeting and to, at 11s. 8d. a yard?

$$11\text{s. } 8\text{d.} = \frac{1}{12} \quad 37\frac{1}{2} \\ \hline 3, 2, 6 \text{ Ans.}$$

What 12 gallons of wine come to, at 10s. a gallon?

$$10 = \frac{1}{10} \quad 120 \\ \hline 12 \text{ Ans.}$$

Case III.

To find the value of any number of pounds &c. when the price of 1 pound is an aliquot part of a shilling.

Rule. Call the given number of pounds so many shillings and divide them by such an aliquot part as the price is of one shilling, the quotient will be the answer in shillings.

What will be the value of 650 pounds of cheese, at 6 pence per pound?

$$6 = \frac{1}{10} \quad 650 \\ \hline 108 \text{ s.}$$

What is the value of 97½ lbs. of mthamels at 3d. a pound?

$$3 = \frac{1}{4} \quad 97\frac{1}{2} \\ \hline 129, 3\frac{1}{2} \text{ d. Ans.}$$

What will 1862 pounds of
pork come to at 3d. a pound?

$$\begin{array}{r} d. \\ 3 = \frac{1}{4} \end{array} \overline{) 1862} \\ \underline{2062} \quad 1-2 \\ 91, 11, 2 \\ \text{£. S. d. Ans.}$$

What will 458 yards of cloth
come to at 1 $\frac{1}{4}$ d. a yard?

$$\begin{array}{r} 1 \\ 4 = \frac{1}{4} \end{array} \overline{) 458} \\ \underline{379} \\ 92\frac{3}{4} \text{ Ans.}$$

To find the value of any number of pounds yards &c.
when the price of one is shillings and the other pence and
farthings, and not an aliquot part of a pound.

Rule. - Write down the given number of yards, &c. and
call them so many pounds. Divide the given price
into aliquot parts, either of a pound, or of some other.
then divide by the several aliquot parts, and the sum of
the of the ~~quotients~~ quotients will be the answer
in pounds.

What will be the value of
36 yards of silk vesting, at
7s 6d a yard?

$$\begin{array}{r} \text{£} \\ 5 = \frac{1}{2} \end{array} \overline{) 36} \\ \underline{18} \quad 9 \\ 18, 6d = \frac{1}{4} \overline{) 9} \\ \underline{4} \quad 10 \\ \text{£13, 10s. Ans.}$$

What will 42 yards of cas-
simerie come to, at 18 shillings
a yard?

$$\begin{array}{r} \text{£} \\ 10 = \frac{1}{2} \end{array} \overline{) 42} \\ \underline{21} \quad 6 \\ 5 = \frac{1}{5} \overline{) 21} \\ \underline{4} \quad 18 \\ \text{£8 4s. Ans.}$$

What is the value of 139 gal-
lons of wine, at 9s 10d. a
gallon?

$$\begin{array}{r} \text{£} \\ 2 = \frac{1}{5} \end{array} \overline{) 139} \\ \underline{278} \quad 9 \\ 278, 6d = \frac{1}{4} \overline{) 278} \\ \underline{69} \quad 6 \\ 69, 6d = \frac{1}{4} \overline{) 69} \\ \underline{17} \quad 10 \\ 17, 6d = \frac{1}{4} \overline{) 17} \\ \underline{4} \quad 10 \\ 4, 10d = \frac{1}{4} \overline{) 4} \\ \underline{1} \quad 10 \\ \text{£13, 10s. Ans.}$$

What will 49 $\frac{1}{2}$ pounds of tea
come to, at 3s 11 $\frac{1}{2}$ d a pound?

$$\begin{array}{r} 2 = \frac{1}{5} \\ 1 = \frac{1}{10} \\ 6 = \frac{1}{2} \\ 3 = \frac{1}{3} \\ 2 = \frac{1}{5} \\ 1 = \frac{1}{10} \end{array} \overline{) 49\frac{1}{2}} \\ \underline{9} \quad 19 \\ \underline{1} \quad 9 \quad 6 \\ \underline{3} \quad 9 \quad 6 \\ \underline{6} \quad 12 \quad 2\frac{1}{2} \\ \underline{12} \quad 3 \\ \underline{2} \quad 0 \quad 3\frac{1}{2} \\ \text{£9, 15s 11 $\frac{1}{2}$ d. Ans.}$$

£ S. D.

What 146 yards of broadcloth
come to at 14s 9d. a yard?

$$\begin{array}{r} 10 = \frac{1}{10} \\ 2 = \frac{1}{5} \\ 6 = \frac{1}{3} \\ 3 = \frac{1}{3} \end{array} \overline{) 146} \\ \underline{146} \quad 9 \\ \underline{29} \quad 2 \\ \underline{3} \quad 13 \\ \underline{1} \quad 16 \quad 6 \\ 107, 13s 6d = \frac{1}{4} \overline{) 107} \\ \underline{26} \quad 13 \\ \text{£43, 13s 6d. Ans.}$$

What will 120 barrels of ap-
ples come to, at 11s 3d. a barrel?

$$\begin{array}{r} 10 = \frac{1}{10} \\ 1 = \frac{1}{10} \end{array} \overline{) 120} \\ \underline{120} \quad 3 \\ \underline{12} \quad 0 \\ \underline{12} \quad 0 \\ \text{£13, 10s. Ans.}$$

Case 8

To find the value of any number of pounds, &c. when the price of one pound is pence, or pence and farthings, and not an aliquot part of a shilling.

Rule.— Write down the given number of pounds, &c. when the price of one and call them shillings. Divide the given price into aliquot parts, either of shillings, or of one another, then divide by the several aliquot parts, and the sum of the aliquot parts will be the answer in shillings.

What will be the value of 56 pounds of madder, at 8 pence a pound?

$$\begin{array}{r} 6 = \frac{1}{2} \text{ } 56 \\ \hline 28 \\ 2 = \frac{1}{3} \text{ } 9-4 \\ \hline 18 \\ 2, 9 \text{ } 3, 7-4 \\ \hline 1, 17, 4 \\ \hline \text{£ } 8, \text{ s. } 4, \text{ d. } 0 \end{array}$$

What is the value of 541 yards of cotton shirting, at 9½d a yard?

$$\begin{array}{r} 6 = \frac{1}{2} \text{ } 541 \\ \hline 270.6 \\ 3 = \frac{1}{3} \text{ } 185.3 \\ \hline 111.3\frac{1}{3} \\ \hline 2, 0 \text{ } 41.7.0\frac{1}{3} \\ \hline 20.17.0\frac{1}{3} \text{ Ans} \end{array}$$

$$\begin{array}{r} 2 \frac{1}{2} = \frac{5}{2} \\ \hline 28 \text{ } 541 \text{ } (11 \\ \hline 140 \\ \hline 61 \\ \hline 48 \\ \hline 13 \\ \hline 12 \text{ } 12 = \frac{1}{4} 38 \\ \hline 156 \text{ } (3\frac{1}{4} \\ \hline 134 \\ \hline 12 \end{array}$$

What will 486 yards of woolen cloth come to, at 7½ pence a yard?

$$\begin{array}{r} 6 = \frac{1}{2} \text{ } 486 \\ \hline 243 \\ 1\frac{1}{2} = \frac{3}{2} \text{ } 60\frac{3}{4} \\ \hline 2, 0 \text{ } 9, 0, 3\frac{3}{4} \\ \hline 1, 10, 9\frac{3}{4} \text{ Ans} \\ \hline \text{£ } 8, \text{ s. } 4, \text{ d. } 0 \end{array}$$

What will 672 pounds of butter come to, at 11½ pence a pound?

$$\begin{array}{r} 6 = \frac{1}{2} \text{ } 672 \\ \hline 336 \\ 3 = \frac{1}{3} \text{ } 224 \\ \hline 112 \\ \hline 2, 0 \text{ } 6, 52 \\ \hline 32.12 \\ \hline \text{£ } 12, \text{ s. } 12, \text{ d. } 0 \end{array}$$

To find the value of any quantity consisting of several denominations when the price of one hundred need is given, &c. is given in several denominations.

Rule. Multiply the price of a cent &c. by the number of hundred need. Divide the remainder of the quantity into aliquot either of a hundred or of one another. Then divide by the several aliquot parts, and the sum of the product and quotients will be the answer.

What will be the value of 5 cent 3 qrs. 13 lbs. of sugar at \$9.56 a cent.

Examples

What will 12 cent. 14 qrs. 16 lbs. of hay come to, at 3 shillings 6 pence a cent.

$$\begin{array}{r} \text{qr.} \quad 9.56 \\ 2 = \frac{1}{2} \quad 9.56 \\ \hline 5 \\ \text{qr.} \quad 47.80 \\ \text{lbs.} \quad 1 = \frac{1}{100} \quad 3.78 \\ 13 \quad \frac{1}{100} \quad 2.39 \\ \hline 1.195 \\ \hline 56.165 \text{ Ans.} \end{array}$$

What cost 12 cent. 0 qrs. 7 lbs. at \$6.34 a cent.

$$\begin{array}{r} 12 \text{ cent.} \\ 7 \text{ lbs.} \\ \hline 6.34 \\ \hline 12 \\ \hline 76.08 \\ 396\frac{1}{2} \\ \hline 76.476\frac{1}{2} \end{array}$$

$$\begin{array}{r} 10633396 \\ 38 \\ \hline 153 \\ 133 \\ \hline 160 \\ 96 \\ \hline 4 = \frac{1}{3} 16 \end{array}$$

What is the value of a piece of broad cloth measuring 36 yards, 3 qrs. at \$7.75 a yard.

$$\begin{array}{r} \$ \text{ cts.} \\ 7.75 \\ \hline 36 \\ \hline 36.50 \\ 232.5 \\ 3.875 \\ \hline 1.9375 \end{array}$$

\$283.8125 Ans.

$$\begin{array}{r} \text{qr.} \quad 3 \text{ d.} \\ 12 = \frac{1}{4} \quad 4.6 \\ \hline 12 \\ \text{qr.} \quad 2.14.0 \\ \text{lbs.} \quad 1 = \frac{1}{100} \quad 1.1\frac{1}{2} \\ 16 \quad \frac{1}{100} \quad 0.6\frac{3}{4} \\ \hline 0.3\frac{6}{7} \end{array}$$

\$2.15.90 $\frac{6}{7}$ Ans. What is the value of 14 cent. 3 qrs. 7 lbs. at 18 s. 2 d. a cent?

$$\begin{array}{r} \text{qr.} \quad 18 \text{ s.} \\ 2 = \frac{1}{2} \quad 13.8 \\ \hline 13 \\ \hline 552 \\ 138 \\ \hline 199.2 \\ 1 = \frac{1}{2} \quad 6.9 \\ 7 = \frac{1}{4} \quad 3.4\frac{1}{2} \\ \hline 0.9 \end{array}$$

10.2.5 $\frac{1}{3}$ Ans.

What is the value of 14 cent. 3 qrs. 7 lbs. at 18 s. 2 d. a cent?

What is the value of a farm containing 144 acres, 3 mowds, 28 poles, at 6 pounds 10 s. an acre?

$$\begin{array}{r} \$ \text{ s.} \\ 10 = \frac{1}{2} \quad 124 \\ \hline 6 \\ \hline 562 \\ 7 \text{ c.} \text{ s.} \\ \hline 3.5 \\ 1 = \frac{1}{100} \quad 1.12.6 \\ \frac{1}{2} = \frac{1}{2} \quad 0.16.3 \\ 20 \text{ mowds} = \frac{1}{2} \quad 0.3.0\frac{3}{4} \\ 5 = \frac{1}{4} \end{array}$$

931.17.99 $\frac{3}{4}$ Ans.

Single Fellowship

Single Fellowship is when the stock of each of the several partners is contained in trade the same length of time.

Rule: As the whole amount of stock, is to the whole gain or loss, so is each one's loss the same and be equal to the whole gain or loss.

A, B and C traded in Partnership. A put in the stock 200 dls, B put in 300 dls, and C put in 200 dls; they gained 270 dollars; what must each man's share of the gain in proportion to what he put in.

$$\begin{array}{r}
 200 \\
 300 \\
 200 \\
 \hline
 700
 \end{array}
 \begin{array}{r}
 270 \\
 270 \\
 270 \\
 \hline
 810
 \end{array}
 \begin{array}{r}
 200 \\
 300 \\
 200 \\
 \hline
 700
 \end{array}
 \begin{array}{r}
 270 \\
 270 \\
 270 \\
 \hline
 810
 \end{array}$$

120 A's gain
180 B's gain
270 Proof.

Divide the number 360 into four equal parts, which shall be to each other, as 3, 4, 5, and 6.

$$\begin{array}{r}
 360 \\
 3 \\
 \hline
 120
 \end{array}
 \begin{array}{r}
 360 \\
 4 \\
 \hline
 90
 \end{array}
 \begin{array}{r}
 360 \\
 5 \\
 \hline
 72
 \end{array}
 \begin{array}{r}
 360 \\
 6 \\
 \hline
 60
 \end{array}$$

120 A's gain
180 B's gain
270 C's gain
270 Proof.

A gen

A gentleman dying left two sons and a daughter to whom he bequeathed the following sums, viz. To the first son he gave 1200 £, to the second 1000 £, and to the daughter 800 £, but it was found, that his whole estate amounted only 750 dollars; what must each child's share of the estate be in proportion to the legacies?

$$\begin{array}{r}
 1200 \\
 1000 \\
 800 \\
 \hline
 3000
 \end{array}
 \begin{array}{r}
 750 \\
 750 \\
 750 \\
 \hline
 2250
 \end{array}
 \begin{array}{r}
 1200 \\
 1000 \\
 800 \\
 \hline
 3000
 \end{array}
 \begin{array}{r}
 750 \\
 750 \\
 750 \\
 \hline
 2250
 \end{array}$$

1200 first son's part
800 second son's part
200 daughter's part
2000 Proof.

A, B, and C, traded in partnership. A put in 325 dollars, 50 cents; B put in 197 dollars, 75 cents, and C put in 175 dollars, 25 cents; they gained 343 dollars, 40 cents; what was each one's share of the gain?

\$	cts.	\$	cts.	\$	cts.
325	50	197	75	175	25
<u>325 50</u>		<u>197 75</u>		<u>175 25</u>	
325 50		197 75		175 25	
1717000		1717000		1717000	
1717000		1717000		1717000	
274720		274720		274720	
103020		103020		103020	
85850	1323207000	154.20	309060	68680	1022373500
85850	85850	85850	85850	85850	85850
365307	329250	169973	85850	78129	772650
960570	333400	78129	772650	772650	772650
171700	171700	772650	772650	772650	772650
171700	171700	772650	772650	772650	772650
0	0	0	0	0	0
\$	cts.	\$	cts.	\$	cts.
325	50	197	75	175	25
<u>325 50</u>		<u>197 75</u>		<u>175 25</u>	
325 50		197 75		175 25	
1717000		1717000		1717000	
1717000		1717000		1717000	
274720		274720		274720	
103020		103020		103020	
85850	6018085000	70.10	600950	85850	85850
85850	85850	85850	85850	85850	85850
85850	85850	85850	85850	85850	85850
0	0	0	0	0	0

Ans. { 154.20 A's gain.
119.10 B's gain.
70.10 C's gain.

333.30 Proof.

Double Fellowship. ^{Fell., ourship.}

Double Fellowship, or Fellowship with time, is when the stocks of partners are continued unequal times. *Rule.* Multiply each man's stock by the time it was continued in trade. Then, As the whole sum of the products is to the whole gain or loss, so is each man's particular product to his particular share of the loss or gain.

Examples.

A, B, and C trade in company. A put in 400 for 9 months; B put in 300 dollars, for 6 months; C put in 200 dollars for 5 months: they gained 320; what was each man's share of the gain?

400	300	200
9	6	5
3600	1800	1000
1800		
1000		
\$6400	\$3200	\$3600
3600		
192		
96		
6400	115200	\$1800 is gain.
512		
512		

\$	\$	\$
6400	3200	1800
1800		

6400	57600	\$90 is gain.
576		

\$	\$	\$
6400	3200	1000
1000		

6400	3200	1000
320		

\$180	is gain.
90	is gain.
50	is gain.

\$320 Proof.

Two merchants entered into partnership for 12 months. H first put in to stock \$400, and at the end of 3 months the put in 200 more. L at first, at first, put \$1000, and at the end of 4 months took out \$280. Now at the expiration of the time, they found they had gained \$1052. What is each man's just share?

+200	
400	1100
2	4
3200	4400
600	
10	
6000	280
3200	13
9200	3280
15280	11320
25080	1052
	9200

2102
9362

9967	2	3	00	\$325.90 is sh.
752				
215				
200				
14200				
12540				
22600				
22592				
8				

$$\begin{array}{r}
 25080:1052::15220 \\
 \hline
 15220 \\
 \hline
 82160 \\
 \hline
 2416 \\
 \hline
 5260 \\
 \hline
 1052 \\
 \hline
 25080 \quad 16705760 \quad \$666,9 \text{ L's share.} \\
 \hline
 15048 \\
 \hline
 16577 \\
 \hline
 15032 \\
 \hline
 15296 \\
 \hline
 15032 \\
 \hline
 23200 \\
 \hline
 22572 \\
 \hline
 2228
 \end{array}$$

A. B. and C. held a pasture in common, for which they pay £20 per annum. In this pasture A had 40 acres for 76 days. B had 36 acres for 50 days, and C had 50 acres for 90 days. Determine what part each of these tenants ought to pay of the £20?

$$\begin{array}{r}
 76 \quad 50 \quad 90 \\
 40 \quad 36 \quad 50 \\
 \hline
 3030 \quad 300 \quad 4500 \\
 1800 \quad 150 \\
 \hline
 4500 \quad 1800 \\
 \hline
 9340
 \end{array}$$

$$9340:20::9040 \quad \text{L. s. d. v.} \quad 2940 \text{ As part.} \\
 9340 \overline{) 6080,0} \quad (6 \quad 10 \quad 2 \quad 1 \quad 9340$$

$$9340:20::1800$$

$$9340 \overline{) 9520} \quad (10 \\
 934 \\
 \hline
 18 \\
 \hline
 12$$

$$18160 \quad (2 \\
 1868 \\
 \hline
 292 \\
 \hline
 4$$

$$1168 \quad (1 \\
 934 \\
 \hline
 234$$

$$9340:20::1800$$

$$9340 \overline{) 96000} \quad (10 \quad 17 \quad 1 \quad 0 \quad 9340 \\
 9340 \\
 \hline
 26000 \\
 \hline
 7980 \\
 \hline
 20$$

$$9340 \overline{) 159600} \quad (17 \quad 1 \\
 9340 \\
 \hline
 66200 \\
 \hline
 65980 \\
 \hline
 220 \\
 \hline
 12$$

$$9840 \quad (11 \\
 9340 \\
 \hline
 500 \\
 \hline
 4 \\
 \hline
 10000 \quad (09$$

$$\begin{array}{r}
 9340:20::3500 \\
 4500 \\
 \hline
 10000 \\
 \hline
 9340 \overline{) 90000} \quad \begin{array}{l} \text{£. s. d.} \\ 9, 12, 8, \end{array} \quad \begin{array}{l} 2, 5000 \\ 9940 \end{array} \\
 \underline{84060} \\
 5940 \\
 20 \\
 9340 \overline{) 118800} \quad (12 \text{ Ans.}) \quad \begin{array}{l} 6, 10, 2, 1 \frac{2340}{9940} \text{ As per} \\ 9, 17, 1, 0 \frac{2000}{9940} \text{ Bs per} \\ 9, 12, 8, 2 \frac{5000}{9940} \text{ Cs per} \end{array} \\
 \underline{9940} \\
 25400 \\
 \underline{18680} \\
 6720 \\
 12 \\
 \hline
 20040 \quad (8) \\
 \underline{14720} \\
 5920 \\
 4 \\
 23680 \\
 \underline{18680} \quad (2) \\
 5000
 \end{array}$$

ances.

Custom House Allowances

The only allowances which are made in the weight of goods, at the Custom House of the United States, are tare, and draft on sealage.

To find the net weight of goods, when the tare is at so much per cent, with the allowance for draft on sealage.

1. Rule When the sealage is $\frac{1}{2}$ per cent. Divide the whole weight by 200, and the quotient will be the sealage.
2. When the sealage is so much per hogshead, lot, &c. multiply the sealage of one by the number of hogsheads, boxes, &c. and the product will be the whole sealage.
3. Subtract the sealage from the gross weight, then multiply the remainder by the tare per cent. and divide the product by 100, the quotient will be the whole tare, which subtract from what remained after the sealage was deducted, and the remainder will be the net weight.

1. A merchant bought 15 boxes of brown Hannan sugar, weighing 6720 lbs. gross, tare 15 per cent. sealage $\frac{1}{2}$ lbs. per box: what was the net weight of the sugar, and what was its value at 80.25 per cent weight?

$$\begin{array}{r} 15 \\ 3 \\ \hline 60 \text{ sealage} \end{array}$$

$$\begin{array}{r} 6740 \\ - 60 \\ \hline 6680 \\ 15 \\ \hline 99400 \\ 6680 \\ \hline \end{array}$$

$$\begin{array}{r} 100 \overline{) 1009.00} \\ \underline{1009} \end{array}$$

$$\begin{array}{r} 6680 \\ - 1009 \\ \hline 5678 \text{ lbs net wt.} \end{array}$$

Gross

$$\begin{array}{r} 112: 10.95 :: 5678 \\ \hline 5678 \end{array}$$

2900

7175

6150

5195

$$\begin{array}{r} 5219950 \\ 560 \\ \hline 219 \\ 112 \\ \hline 1079 \\ 1008 \\ \hline 715 \\ 678 \\ \hline 490 \\ 396 \\ \hline 940 \\ 296 \\ \hline \end{array}$$

Ans. $5678 \text{ lbs} = 50 \text{ cent}$
 $519.692 \frac{11}{22} \text{ net wt.}$

$$\begin{array}{r} 34 \\ 112 \overline{) 22} \end{array}$$

What is the net wt
 of 4 bags of coffee, weight
 being 400 lbs. gross, al-
 lowing 2 per cent. for
 tare, and 1/2 per cent
 per sealage, and what
 is the value
 of the net weight, at
 12 cents per pound?

$$\begin{array}{r} 200 \overline{) 4800} \\ \underline{400} \\ 80 \\ \hline 480 \\ \underline{4} \\ 478 \\ \hline 2 \end{array}$$

$$\begin{array}{r} 100 \overline{) 956} \\ \underline{900} \end{array}$$

$$56 * 56 \text{ is more than } 100, \text{ therefore } + \text{ one as the rule requires } = 10.$$

Case II.

To find the net weight of goods
 when the tare is at so much
 per box, cask, chest, &c. either
 with or without the allow-
 ance for draft of sealage.

1. Rule. If draft or sealage be al-
 lowed, cast and deduct as direct-
 ed in Case 1st.

2. Multiply the tare of one by
 the other number of boxes,
 chests, &c. the product will be
 the whole tare, which sub-
 tract from what remain-
 ed after the sealage was ab-
 deducted, and from the whole
 gross weight, when no seal-
 age is allowed, and the re-
 mainder will be the net
 weight.

Examples.

What is the net weight and
 value of 4 casks of raisins
 weighing 500 lbs. gross, tare
 12 lbs. per cask, allowing 1/2
 per cent. for draft on sealage
 at 7 1/2 cents per pound?

$$\begin{array}{r} 200 \overline{) 500} \\ \underline{400} \\ 100 \end{array}$$

$$\begin{array}{r} 500 \\ 9 \\ \hline 517 \\ 12 \\ \hline 529 \end{array}$$

$$\begin{array}{r} 100 \overline{) 6904} \\ \underline{600} \\ 904 \\ \underline{204} \\ 700 \\ \underline{4} \end{array}$$

$$\begin{array}{r} 517 \\ 42 \\ \hline 469 \\ 7 \frac{1}{2} \\ \hline 9935 \\ 3929 \\ \hline 95175 \end{array}$$

Ans. $\begin{cases} 269 \text{ net wt.} \\ \$35.175 \text{ value.} \end{cases}$

Case III.

To find the net weight of goods
 when the tare on actual tare
 is allowed.

Rule. Subtract the whole
 amount of tare from the
 whole gross weight and the
 remainder will be the net
 weight.

What is the net weight and value of 5 c boxes of tea
 ten figs, weighing 1800 lbs gross, whole amount of
 tare 175 lbs, with an allowance of 1 per cent. for
 leakage, at 10 cents per pound?

$$\begin{array}{r} 200 \text{ } 1800 \\ 8 \\ \hline 1069 \end{array}$$

$$\begin{array}{r} 1800 \\ 175 \\ \hline 1025 \\ 6 \text{ Ans. } \end{array}$$

1069 lbs. net wt.
 \$106.90 value.

$$\begin{array}{r} 1069 \\ 10 \\ \hline 10690 \end{array}$$

$$\begin{array}{r} 75 \\ 12 \\ \hline 63 \\ 69 \\ \hline 21 \\ 92 \\ \hline 117 \\ 81 \\ \hline 108 \\ 21 \\ \hline 129 \end{array}$$

What the value of 4 packages
 of butter, weighing as follows.

No. 1, gross 75 lbs. tare 12 lbs.
 2, do. 83 lbs. do. 14 lbs.
 3, do. 92 lbs. do. 17 lbs.
 4, do. 120 lbs. do. 21 lbs.
 at 15 cents per pound?

$$\begin{array}{r} 75 \\ 12 \\ \hline 63 \\ 69 \\ 21 \\ 92 \\ \hline 312 \\ 15 \\ \hline 1560 \\ 312 \\ \hline 4620 \end{array}$$

Ans. { 312 lbs. net wt.
 \$46.80 value.

American Duties

To find the duty on any amount of goods, values
 on merchandise, at any given rate per centum
 ad valorem.

Rule. Reduce the cost of the goods to Federal money
 add 20 per cent. if imported from or beyond the
 Cape of Good Hope, or 10 per cent. if from any other
 place, then multiply the amount by the given
 rate per cent. and divide the product by 100, the
 quotient will be the duty required.

Examples.

What will be the duty on an invoice of uncolled
 goods, imported from London, which cost £
 1250 10s. ten shillings, at 30 per cent ad valorem?

Continued.

$\text{£}1250.5$ sterling cost.
 $\text{£}4.44 = \text{£}1$ sterling.

50000
 50000
 50000

$\text{£}5552220$

$\text{£}555.222$ cost in $\text{£}1$, Hong.

$\text{£}6107.442$
 30

$\text{£}1896.89260$ duty required.

What will be the duty on
 an invoice of silk goods, im-
 ported from France, which
 cost $\text{£}650$ francs, at 20 per
 cent. ad valorem?

What will be the duty
 on an invoice of silk goods
 imported from France
 which cost $\text{£}650$ francs,
 at 20 per cent. ad valorem?

$\text{£}650$ mult. $\frac{2}{100}$ by $\frac{3}{4}$ $650 = 1925$

$18\frac{3}{4}$

1925 half of $1925 = 662\frac{1}{2}$

$662\frac{1}{4}$

21200

2650

$49687\frac{1}{4}$

49687

546557

20

$109811\frac{1}{4}$

$10981\frac{1}{4}$ Ans

What will be the duty
 on an invoice of silk and
 cotton goods, imported
 from India, which cost
 $\text{£}2500$ rupees at 25 per cent.
 ad valorem?

$\text{£}2500$

50

$\text{£}25000$

$\text{£}25000$

$\text{£}375000$

20

$\text{£}750000$

25000

50

1091250000

12500

2500+

15000

25

75000

30000

37500 Ans.

Case II.

To find the duty on any
 amount of goods, measured
 on even channels, at any
 given rate per barrel,
 gallon, &c.

Rule. Multiply the
 given rate per barrel,
 gallon &c. by the num-
 ber of barrels, gallons, &c.
 and the product will be
 the amount of duty
 required.

Examples.

What will be the duty
 on 150 chests of Hyson tea
 imported direct from Chi-
 na in a vessel of the United
 States, weighing gross 1100
 lbs tare 20 lbs. per chest, at
 40 cts duty per pound?

150

20

$\text{£}3000$

11250

3000

2250

40

109380000

3800 Ans

What will be on 20 pipes of French brandy, 2th proof, containing 25.00 lbs. gross, allowing gallons, at 4.8 cts per gallon?

$$\begin{array}{r} 2500 \\ 48 \\ \hline 20160 \\ 10080 \\ \hline \$1008,60 \text{ Ans.} \end{array}$$

What will be the duty on 25 hogsheads of brown shugan, 43750 lbs. gross, allowing 12 per cent. tare, and 7 pounds per hogshead for draft on exchange, at 0.9 cts per pound?

$$\begin{array}{r} 25 \quad 43750 \\ 7 \quad 175 \\ \hline 178 \quad 43575 \\ \hline 109500900 \\ 1229 \\ 43575 \\ 5229 \\ \hline 98946 \\ 03 \\ \hline 98946.03 \end{array}$$

\$1159.38

Discount

Discount is an allowance made for the payment of any sum of money before it becomes due; or it is the difference between any sum due at some future time, and its present worth.

The present worth of any sum, on debt, due at any future time, is such a sum, as if put at interest, would in that time and at the rate per cent. for which the discount is to be made, amount to the given sum or debt.

Rule.—As the amount of \$100 on £100 at a given rate and time is to the interest of \$100 on £100 at the same rate and time, so is the given sum to the discount. Subtract the discount from given sum, and the remainder is to \$100 on £100 so is the given sum to the present worth.

Subtract the present worth from the given sum, and the remainder is the discount.

What will be the duty on an invoice of merchandise goods.

$$\begin{array}{r} \$ \text{ mo. } \$ \\ 100 \text{ (} 3 \frac{1}{2} \text{)} 5 \\ 1.5 \quad 1.5 \\ \hline 101.5 : 100 :: 150 \\ 20 \\ \hline 201.5 \\ 12 \\ \hline 208 \quad 3000 \\ 12 \quad 12 \end{array}$$

What is the discount and present worth of \$500 payable in 9 months, allowing discount at 6 per cent. per annum?

$$\begin{array}{r} \$ 500 : 100 :: 36000 \\ 36000 \\ 24300 \\ 24300 : 100 :: 36000 \\ 24300 \\ 1170 \\ 972 \\ 1980 \\ 1944 \\ \hline 360 \end{array}$$

What is the interest present worth of \$100 payable in 9 months, allowing discount at 6 per cent. per annum?

$$\begin{array}{r} 24300 : 100 :: 36000 \\ 36000 \\ 24300 \\ 1170 \\ 972 \\ 1980 \\ 1944 \\ \hline 360 \end{array}$$

Barter

13

Barter is the exchanging of one commodity for another, and teaches merchants is to proportion their quantities, that neither shall sustain loss.

Proof. By changing the order of the question.

Rule. - When the quantity of one commodity is given with its value on the value of its integer, as also the value of the integer of some other commodity to be exchanged for it, to find the quantity of this commodity.

Find the value of the commodity of which to the quantity is given then find how much of the commodity at the rate proposed may be had for that sum.

2^d When the quantities of two commodities are given, and the rate of selling them, to find in case of inequality, how much of one other commodity to be must be given. - Find the separate values of the two given commodities, subtract the less from the greater, and the remainder the amount of the third commodity, whose quantity and rate may be easily found.

3^d When, in bartering, one commodity is reckoned the ready money price, to find the bartering price of the other: - Say, as the ready money price of the one, is to its bartering price; so is that of the other to its bartering price. Next, find the quantity reckoned, according to either the bartering or ready money price.

What must be given in barter for 15.6 gallons of wine at 12 s. 3 1/2 d. per gal
val?

Examples

$$\begin{array}{r}
 32 \overline{) 156} \\
 \underline{12} \\
 1872 \\
 376 \\
 \underline{6.6} \\
 1917.6 \\
 114 \overline{) 1917.6} \\
 \underline{12} \\
 29010
 \end{array}$$

$$\begin{array}{r}
 114 \overline{) 123010} \\
 \underline{114} \\
 228 \\
 \underline{210} \\
 114 \\
 \underline{96} \\
 16 \\
 576 \\
 \underline{96} \\
 114 \overline{) 1596} \quad (13 \frac{5}{114}) \\
 \underline{114} \\
 996 \\
 \underline{996} \\
 0
 \end{array}$$

A and B would barter; A has 150 bushels of wheat, at \$1.25 c. per bushel, for which B gives 65 bushels of barley, worth 62 1/2 c. per bushel and the balance in oats at 37 1/2 c. per bushel. What quantity of oats must A receive from B?

$$\begin{array}{r}
 150 \times 125 = 18750 \\
 65 \times 62 \frac{1}{2} = 4062 \frac{1}{2} \\
 18750 - 4062 \frac{1}{2} = 14687 \frac{1}{2} \\
 14687 \frac{1}{2} \div 37 \frac{1}{2} = 391 \frac{2}{3} \text{ Ans.}
 \end{array}$$

$$\begin{array}{r}
 125 \\
 \underline{150} \\
 6250 \\
 125 \overline{) 18750} \\
 \underline{125} \\
 6250 \\
 \underline{125} \\
 5000 \\
 \underline{3750} \\
 1250 \\
 \underline{125} \\
 0
 \end{array}$$

$$\begin{array}{r}
 37 \frac{1}{2} \overline{) 14687 \frac{1}{2}} \\
 \underline{2} \\
 29375 \\
 \underline{29375} \\
 0
 \end{array}$$

$$\begin{array}{r}
 37 \frac{1}{2} \overline{) 29375} \quad (391 \frac{2}{3} \text{ Ans.}) \\
 \underline{225} \\
 687 \\
 \underline{675} \\
 125 \\
 \underline{125} \\
 0
 \end{array}$$

$$\begin{array}{r}
 190 \\
 \underline{390} \\
 4062 \frac{1}{2}
 \end{array}$$

$$\begin{array}{r}
 5 \overline{) 50102} \\
 \underline{15} \\
 3510 \\
 \underline{35} \\
 102 \\
 \underline{102} \\
 0
 \end{array}$$

A has linen cloth, at 30c.
per yard, newly money, in
hand 360; B has 3610
yards of nilband at 22c. per
yard, newly money and would
have of A \$2.00 in money,
and the rest in linen cloth.
what note does the note
hand have in hand per
yard, and how much lin-
en must A give B?

$$\begin{array}{r}
 30:36::22 \\
 \hline
 22 \\
 72 \\
 30 \overline{) 792} (26.4 \quad 3610 \\
 \underline{60} \quad 22 \\
 192 \\
 \underline{180} \\
 12 \\
 10 \text{ m.} \quad 7220 \\
 \underline{1120} \quad 7220 \\
 120 \quad 79420 \\
 \underline{1980} \quad 20000 \\
 59420
 \end{array}$$

$$30:1::59420:1.20$$

$$\begin{array}{r}
 3,95942.0 \\
 \underline{1980 \frac{2}{3}} \\
 3
 \end{array}$$

Yards of linen.

Loss And Gain.

Loss and gain is a rule
by which merchants and
traders find what they gain or lose by buy-
ing, and at what rate per cent. It also tea-
ches them to find the price for which any kind
of goods must be sold, in order to gain or lose
given rate per cent. The different cases are only
particular applications of the Rule of Three.

Case I.

When goods are bought at one price, and sold
at another, to find what is gained or lost,
and the gain or loss per cent.

Rule. Find the gain or loss by subtraction; then
as the price the goods cost, is to the gain or loss, so
is \$100 or £100 to the gain or loss per cent.

If I buy cloth at

\$3.50 per yard for Samples.

cash, and sell it at

\$4.12 per yard on a credit

it of 6 months, what do

I gain per cent. allowing

discount at 6 per cent.

a year on the selling

price? it

\$ 3.50

2.50

1.00

25000

25.00

1 per cent.

If I buy cloth at

\$3.50 per yard for

cash and sell it at

\$4.12 per yard on a

credit of 6 months, what do

I gain per cent. at-

allowing discount at

6 per cent. a year on

the selling price?

Bought 12 cut. 2 qrs.
of shugan at \$10.20
per cut. on a credit of 3
months, and sold
the same at \$10.25
per cut. for cash; which
was the whole gain,
and the gain percent,
allowing discount
at 6 per cent. a year
on the purchase price

$$\begin{array}{r}
 91200 \\
 50 \\
 \hline
 125 \overline{) 91250} \quad (250 \text{ gr. pint.} \\
 250 \\
 \hline
 625 \\
 625 \\
 \hline
 0
 \end{array}$$

$$\begin{array}{r}
 100 : 25 = 25 \\
 \underline{25} \\
 100 \\
 \underline{25} \\
 75 \\
 \underline{25} \\
 50 \\
 \underline{25} \\
 25 \\
 \underline{25} \\
 0
 \end{array}$$

Bought 50 gallons of
brandy, at 75 cents per
gallon, but by accident
10 gallons leaked out: At
what rate must I sell the
remainder per gallon, to
gain upon the whole precisely
prime cost, at the rate of 10
percent

$$\begin{array}{r}
 75 \quad 10 \text{ per cent} \\
 50 \quad + = 100 \\
 100 : 3750 :: 110 \\
 110 \quad 10 - 50 = 20 \\
 37500 \quad 40 : 412500 \\
 3750 \quad 109.1\frac{1}{4} \\
 412500
 \end{array}$$

Equation Of Pay-ment

Equation Of Payments is the finding
of a time to pay, at once, several debts due
at different times, so that neither party
shall sustain loss.

Rule. Multiply each payment by the time
at which it is due; then divide the sum of
the products by the sum of the payments, and
the quotient will be the equated time.

Examples
A owes £880
to be paid as follows, viz.
£100 in 6 months, £120
in 7 months, and
£160 in 10 months:

What is the equated
time for the payment
of the whole debt?

100	120	160
6	7	10
600	840	1600

100	1600
120	840
160	600
380	3040
	3040

A owes £104. 15s.
to be paid in 4 1/2
months £161 to be
paid in 3 1/2 months
and £152. 5s. to be
paid in 5 months:

What is the equated
time for the payment
of the whole?

£	s	d	
104	15	161	
	20	20	
2095	3220		
4 1/2	3 1/2		
£880	9660		
104 1/2	161		
942 7 1/2	11270		
£	s	d	
152	5	3045	15225
	20	9220	11270
	2095	9427 1/2	
3045	2960	36922 1/2	
5			
15225			
£960	95922 1/2	(4 months)	
	39440		
	24822	do, mo.	
	80		
£960	74460	(3 1/2 months)	
	66220		
	45200		

* The above solution is
correct.

There is owing to a merchant £698 to be paid £178 ready money, £200 at 3 months, and £920 in 8 months; I demand the indifferent time for the payment of the whole.

$$\begin{array}{r}
 200 \quad 920 \\
 3 \quad 8 \\
 \hline
 600 \quad 2560 \\
 200 \quad 2560 \\
 178 \quad 600 \\
 920 \quad 3160 \quad (4\frac{1}{2}) \\
 698 \quad 2792 \quad (4\frac{1}{2}) \\
 \hline
 368
 \end{array}$$

The sum of \$164 16c. 6m. is to be paid, $\frac{1}{2}$ in 6 months, $\frac{1}{2}$ in 8 months, and $\frac{1}{2}$ in 12 months. What is the mean time for the payment of the whole?

A merchant has \$960 due him, to be paid at 6 months, but the debtor agrees to pay $\frac{1}{2}$ at the present time, and $\frac{1}{2}$ at 4 months; I demand the time he must have to pay the remainder, at simple interest, so that neither party may have the advantage of the other.

$$\begin{array}{r}
 120 \quad 180 \\
 540 \quad 3 \\
 \hline
 660 \quad 540
 \end{array}$$

$$\begin{array}{r}
 \text{int. mo. } 2 \\
 301111660 \\
 1
 \end{array}$$

$$301660$$

22

+ 6 months

Ans. 28 months

$$\begin{array}{r}
 2)164.1666 \\
 \hline
 82083
 \end{array}$$

$$6)164166$$

$$27961$$

12

$$328932$$

$$82083 \quad 928932$$

$$54722 \quad 492498$$

$$27961 \quad 497776$$

$$164166 \quad 1258606 \quad (7\frac{2}{3} \text{ mo. Ans.})$$

$$1149162$$

$$109444$$

2

$$\begin{array}{r}
 928932 \quad (2 \\
 928932
 \end{array}$$

Square Root

The extraction of the square root is the method of finding a number which, being multiplied by its self, shall produce the given number.

Rule.— Distinguish the given number into periods of two figures each, by putting a point over the place of units, another over the place of hundreds, and so on, which points show the number of figures the consists of.

1. Find the greatest square number in the first or left hand period; place the root of it at the right hand of the given number (after the manner of a quotient in division,) for the first figure of the root, and the square number under the period, then subtract it there from, and to the remainder bring down the next period for a dividend.

2. Place double the root already found, on the left hand of the dividend for a divisor.

3. Seek how often the divisor is contained in the dividend, (except the right hand figure,) and place the answer in the root for the second figure of it, and likewise on the right hand of the divisor; and multiply the divisor with the figure last annexed by the figure last placed in the root, and subtract the product from the dividend: to the remainder join the next period for a new dividend.

4. Double the figures already found in the root, for a new or new divisor, (or bring down your last divisor for a new one, doubling the right hand figure of it,) and from there find the next figure of the root as last directed, and continue the operation in the same manner, till you have brought all the periods.

Examples

Required the square root of 729?

$$\begin{array}{r}
 729 \text{ } 9 \text{ (27 the root.)} \\
 4 \overline{) 329} \\
 \underline{329} \\
 \text{Proof.} \\
 27 \\
 \underline{27} \\
 189 \\
 \underline{189} \\
 54 \\
 \underline{54} \\
 729
 \end{array}$$

Required the square root of 575.5?

$$\begin{array}{r}
 575.50 \text{ (23.98 } + \text{ root)} \\
 4 \overline{) 175} \\
 \underline{129} \\
 469 \overline{) 4650} \\
 \underline{4221} \\
 4788 \overline{) 42900} \\
 \underline{38994} \\
 4896 \text{ remainder.}
 \end{array}$$

What is the square root of 10942656?

$$\begin{array}{r}
 10942656 \text{ (3216 root)} \\
 9 \overline{) 10942656} \\
 \underline{62 \overline{) 134}} \\
 \phantom{62 \overline{) 134}} 124 \\
 \phantom{62 \overline{) 134}} \underline{64 \overline{) 1026}} \\
 \phantom{62 \overline{) 134}} \phantom{64 \overline{) 1026}} 641 \\
 \phantom{62 \overline{) 134}} \phantom{64 \overline{) 1026}} \underline{6426 \overline{) 38556}} \\
 \phantom{62 \overline{) 134}} \phantom{64 \overline{) 1026}} \phantom{6426 \overline{) 38556}} 38556
 \end{array}$$

What is the square root of 9645192960241?

$$\begin{array}{r}
 9645192960241 \text{ (9105671 root)} \\
 9 \overline{) 9645192960241} \\
 \underline{61 \overline{) 64}} \\
 \phantom{61 \overline{) 64}} 61 \\
 \phantom{61 \overline{) 64}} \underline{6205 \overline{) 95192}} \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} 31025 \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \underline{2106 \overline{) 416496}} \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \phantom{2106 \overline{) 416496}} 372696 \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \phantom{2106 \overline{) 416496}} \underline{621127 \overline{) 4410002}} \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \phantom{2106 \overline{) 416496}} \phantom{621127 \overline{) 4410002}} 4947889 \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \phantom{2106 \overline{) 416496}} \phantom{621127 \overline{) 4410002}} \underline{6211941 \overline{) 62119}} \text{ square} \\
 \phantom{61 \overline{) 64}} \phantom{6205 \overline{) 95192}} \phantom{2106 \overline{) 416496}} \phantom{621127 \overline{) 4410002}} \phantom{6211941 \overline{) 62119}} 62119
 \end{array}$$

What is the root of 2793?

$$\begin{array}{r}
 2793 \text{ (52.75 root)} \\
 52 \overline{) 2793} \\
 \underline{228} \\
 \phantom{52 \overline{) 2793}} 513 \\
 \phantom{52 \overline{) 2793}} \underline{513} \\
 \phantom{52 \overline{) 2793}} 11
 \end{array}$$

$$\begin{array}{r}
 49 \overline{) 2208} \\
 \underline{49} \\
 \phantom{49 \overline{) 2208}} 144 \\
 \phantom{49 \overline{) 2208}} \underline{144} \\
 \phantom{49 \overline{) 2208}} 0
 \end{array}$$

Rule for extracting the square root of vulgar fractions and mixed numbers.

1 Reduce the fraction to its lowest terms for this and all other roots.

2 Extract the root of the numerator for a new numerator, and the root of the denominator for a new denominator.

What is the square root of 144/15129?

$$\begin{array}{r}
 9 \overline{) 144} \\
 \underline{9 \overline{) 15129}} \\
 \phantom{9 \overline{) 144}} 16 \\
 \phantom{9 \overline{) 144}} \underline{16 \overline{) 1681}} \\
 \phantom{9 \overline{) 144}} \phantom{16 \overline{) 1681}} 16 \\
 \phantom{9 \overline{) 144}} \phantom{16 \overline{) 1681}} \underline{16 \overline{) 1681}} \text{ (41 root)} \\
 \phantom{9 \overline{) 144}} \phantom{16 \overline{) 1681}} \phantom{16 \overline{) 1681}} 41 \\
 \phantom{9 \overline{) 144}} \phantom{16 \overline{) 1681}} \phantom{16 \overline{) 1681}} \underline{41 \overline{) 81}} \text{ Ans.} \\
 \phantom{9 \overline{) 144}} \phantom{16 \overline{) 1681}} \phantom{16 \overline{) 1681}} \phantom{41 \overline{) 81}} 81
 \end{array}$$

What is the square root of 42 1/4?

$$\begin{array}{r}
 42 \frac{1}{4} \text{ (6.5 root)} \\
 6 \frac{1}{2} \overline{) 42 \frac{1}{4}} \\
 \underline{168} \\
 \phantom{6 \frac{1}{2} \overline{) 42 \frac{1}{4}}} 168 \\
 \phantom{6 \frac{1}{2} \overline{) 42 \frac{1}{4}}} \underline{168} \\
 \phantom{6 \frac{1}{2} \overline{) 42 \frac{1}{4}}} 1
 \end{array}$$

Application and Use Of The Square Root.

Problem I. To find a mean proportional between two numbers.

Rule. Multiply one of the given numbers by the other, and extract the square root of the product, and the root will be the mean proportional required.

Examples

What the proportional between 36 and 144?

$$\begin{array}{r} 144 \\ \times 36 \\ \hline 864 \\ 576 \\ \hline 5184 \end{array}$$

$$\sqrt{5184} = 72$$

Problem II. To find the side of a square equal area to given superficial whatever

Rule. Find the area, and the square root is the side of the square sought.

A certain general has an army of 5625 men: pray how many must be placed in rank and file, to form them into a square

$$\begin{array}{r} 5625 \\ \times 49 \\ \hline 145725 \\ 145725 \\ \hline 277575 \end{array}$$

$$\sqrt{277575} = 525$$

If a pipe 6 inches long, will be 4 hours in running of a certain quantity of water, in what time will 3 pipes, each 4 inches long, be in discharging double the quantity?

$$\begin{array}{r} 6 \text{ pipes } 4 \text{ inches } 4 \text{ hours} \\ 3 \text{ pipes } 4 \text{ inches } x \text{ hours} \\ \hline 24 = 4x \\ x = 6 \end{array}$$

Examples

By the area of a triangle be 16, what is the side of a square equal in area thereto?

$$16 \times 4 = 64$$

$$\sqrt{64} = 8$$

$$\begin{array}{r} 22 \overline{) 60} \\ 44 \\ \hline 1600 \\ 246 \overline{) 1600} \\ 1476 \\ \hline 12400 \\ 2524 \overline{) 12400} \\ 10096 \\ \hline 230400 \\ 25289 \overline{) 230400} \\ 227601 \\ \hline 2799 \end{array}$$

A line 96 yards long will exactly reach from the top of a fort to the opposite bank of a river, known to be 24 yards broad.

The height of the wall is required?

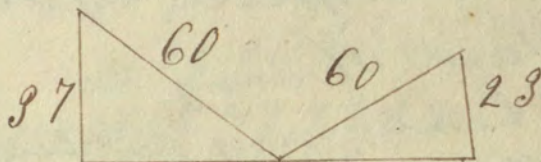
$$\begin{array}{r} 96 \\ \times 36 \\ \hline 3456 \end{array}$$

$$\sqrt{3456} = 58.8$$

$$\begin{array}{r} 46 \overline{) 320} \\ 276 \\ \hline 4400 \\ 528 \overline{) 4400} \\ 4224 \\ \hline 17600 \\ 5963 \overline{) 17600} \\ 16029 \\ \hline 1571 \end{array}$$

the height of a tree growing in the center of a circular island 44 feet in diameter, is 75 feet, and a line stretched from the top of it over to the hithen edge of the water, is 256 feet. What is the breadth of the stream, provided the land on each side of the water be level?

Suppose a ladder 60 feet long be so planted as to reach a window 37 feet from the ground on one side of the street, and without moving it at the foot, will reach a window 23 feet high on the other side. I determine the of street



$$\begin{array}{r}
 1256 \\
 256 \\
 \hline
 1596
 \end{array}
 \begin{array}{r}
 75 \\
 75 \\
 \hline
 150
 \end{array}
 \begin{array}{r}
 375 \\
 525 \\
 \hline
 5625
 \end{array}
 \begin{array}{r}
 244 \\
 22 \\
 \hline
 222
 \end{array}$$

$$\begin{array}{r}
 1280 \\
 512 \\
 \hline
 65596
 \end{array}
 \begin{array}{r}
 5625 \\
 9911 \\
 \hline
 59911
 \end{array}
 \begin{array}{r}
 244.76 \\
 22 \\
 \hline
 222.76
 \end{array}$$

$$\begin{array}{r}
 44199 \\
 176 \\
 \hline
 4841
 \end{array}
 \begin{array}{r}
 2311 \\
 1936 \\
 \hline
 37500
 \end{array}
 \begin{array}{r}
 37500 \\
 34209 \\
 \hline
 329100
 \end{array}
 \begin{array}{r}
 329100 \\
 293676 \\
 \hline
 25424
 \end{array}$$

$$\begin{array}{r}
 37 \quad 60 \\
 37 \quad 60 \\
 \hline
 259 \quad 3600 \\
 111 \quad 1369 \\
 \hline
 1369 \quad 1369
 \end{array}
 \begin{array}{r}
 223147.23 \\
 16 \\
 \hline
 27691 \\
 609 \\
 \hline
 9422200 \\
 1884 \\
 \hline
 944931600 \\
 22329 \\
 \hline
 3271
 \end{array}$$

Given the difference of two numbers, and the difference of their squares, to find their numbers.

Rule: Divide the difference of the squares by the difference, and the quotient will be their sum. Then proceed by Prob. 4 p. 57.

Examples.

$$\begin{array}{r}
 105)571102.64 \text{ feet Ans.} \\
 525 \\
 \hline
 1104)4600 \\
 4416 \\
 \hline
 1163)18400 \\
 11083 \\
 \hline
 7317
 \end{array}$$

The difference of
two numbers is 20,
and the difference of
their squares is 2000;
what are the numbers?

$$\begin{array}{r} 2,000 \\ 100 \overline{) 2000} \\ \underline{100} \\ 1000 \\ 100 \overline{) 1000} \\ \underline{100} \\ 900 \\ 100 \overline{) 900} \\ \underline{100} \\ 800 \\ 100 \overline{) 800} \\ \underline{100} \\ 700 \\ 100 \overline{) 700} \\ \underline{100} \\ 600 \\ 100 \overline{) 600} \\ \underline{100} \\ 500 \\ 100 \overline{) 500} \\ \underline{100} \\ 400 \\ 100 \overline{) 400} \\ \underline{100} \\ 300 \\ 100 \overline{) 300} \\ \underline{100} \\ 200 \\ 100 \overline{) 200} \\ \underline{100} \\ 100 \\ 100 \overline{) 100} \\ \underline{100} \\ 0 \end{array}$$

Augmenter left

- Said Harry to
Charles, my father
gave me 12 apples more
than he gave another
Jack, and the difference
of the squares of
our separate pannels
was 288. You tell
me how many he gave us,
and you shall have half
of mine.

$$\begin{array}{r} 12 \overline{) 288} \\ \underline{24} \\ 48 \\ \underline{48} \\ 0 \end{array}$$

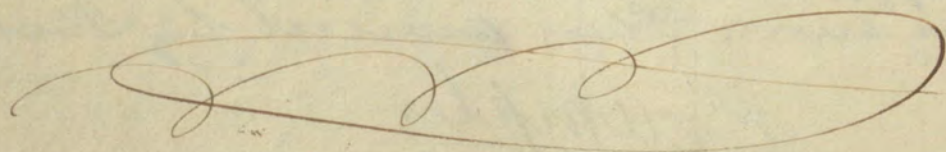
$$\begin{array}{r} 12 \\ 6 \\ \hline 18 \end{array}$$

Said Harry's 12
Jack's share 6

Cube Root

A Cube is any number multiplied by
its square. To extract the cube root is to find
a number which being multiplied into its
square, shall produce the given number.

- 1 Rule.— Separate the given number into pe-
riods of three figures each, by putting a period
over the unit figure and every third figure
beyond the place of units.
 - 2 Find the greatest cube in the left hand pe-
riod, and put root in the quotient.
 - 3 Subtract the cube thus found from the
said period, and to the remainder bring
down the next period and call this the
dividend.
- Multiply the square of the quotient



Required the cube root of
436036224287 Ans.

$$\begin{array}{r} 12910 \overline{) 93036} \\ 73500 \\ \hline 19536 \\ 125 \end{array}$$

$$75875$$

$$\begin{array}{r} 1629750 \overline{) 14161824} = 2d \text{ dividend} \\ 13500000 \\ \hline 666824 \\ 512 \end{array}$$

$$13644512 = 2d \text{ subtrahend}$$

$$\begin{array}{r} 172391940 \overline{) 517312287} = 3d \text{ dividend} \\ 517107600 \\ \hline 204687 \\ 27 \end{array}$$

$$\text{divisor } 517312287 = 3d \text{ subtrahend}$$

What is the cube root
34965729? Ans.

$$\begin{array}{r} 34965729 \overline{) 327} \\ 27 \end{array}$$

$$\begin{array}{r} 2790 \overline{) 7968} \\ 5400 \\ \hline 2568 \\ 960 \\ \hline 8 \\ 5762 \end{array}$$

$$\begin{array}{r} 302160 \overline{) 2197723} \\ 2150400 \\ \hline 47323 \\ 343 \end{array}$$

$$2197723$$

What is the square
root of $\frac{125}{343}$

$$\begin{array}{r} 125 \overline{) 343} \\ 125 \overline{) 343} \\ \hline \text{Ans. } \frac{5}{7} \end{array}$$

What is the cube root of
84604519? Root.

$$\begin{array}{r} 84604519 \overline{) 439} \\ 64 \end{array}$$

$$\begin{array}{r} 4920 \overline{) 20604} \\ 14400 \\ \hline 6204 \\ 1080 \\ \hline 27 \end{array}$$

$$15507$$

$$\begin{array}{r} 55990 \overline{) 5097519} \\ 4992300 \\ \hline 105490 \\ 729 \end{array}$$

$$5097519$$

What is the cube root of
008649? Ans. cube root

$$\begin{array}{r} 008649 \overline{) 2052} \\ 2 \end{array}$$

$$\begin{array}{r} 1260 \overline{) 649000} \\ 600000 \\ \hline 49000 \\ 15000 \\ \hline 125 \end{array}$$

$$615125$$

$$\begin{array}{r} 12613650 \overline{) 33275000} \\ 25215000 \\ \hline 8060000 \\ 22200 \\ \hline 2 \end{array}$$

$$\begin{array}{r} 25239208 \\ 2695752 \end{array}$$

Application and use of the cube root

to find two mean proportionals between any
two given numbers.

1. Rule - 1 Divide the greater number by the less, and extract the cube root of the quotient
2. Rule Multiply the root so found, by the least of the given numbers, and the product will be the less
3. Multiply this product by the same root, and it will give the greater.

Examples

What are the two mean proportionals between 6 and 750

$$\begin{array}{r} 6 \overline{) 750} \\ 125 \end{array}$$

$$\begin{array}{r} 125 \overline{) 1250} \\ 125 \end{array}$$

$$\begin{array}{r} 5 \\ 6 \overline{) 30} \end{array}$$

Ans. 30 and 050.

What are the two mean proportionals between 56 and 12096?

$$\begin{array}{r} 56 \overline{) 12096} \\ 216 \end{array}$$

$$\begin{array}{r} 29 \\ 56 \overline{) 336} \\ 336 \end{array}$$

$$\begin{array}{r} 216 \overline{) 216} \\ 216 \end{array}$$

$$\begin{array}{r} 11 \\ 336 \overline{) 336} \\ 336 \end{array}$$

$$\begin{array}{r} 56 \overline{) 336} \\ 6 \end{array}$$

Ans. 336 and 2016.

The side of a cube being given, to find the side of a cube which shall be any number of times greater or less than the given cube.

Rule. Cube the given side, and if the required cube be greater than the given one, multiply the cube of the given side by the given proportion, and the cube root of the product will be the side of the cube required. But if the required cube be less, divide the cube of the given side by the given proportion, and the cube root of the quotient will be the side of the required cube.

Examples

There is a cubick box whose side is 18 inches; what is the side of a box that will contain 8 times as much?

$$\begin{array}{r} 18 \\ 18 \end{array}$$

$$\begin{array}{r} 27 \overline{) 2790} \\ 19656 \end{array}$$

$$\begin{array}{r} 144 \\ 18 \overline{) 324} \\ 18 \end{array}$$

$$\begin{array}{r} 27 \overline{) 16200} \\ 3240 \end{array}$$

$$\begin{array}{r} 2592 \\ 324 \overline{) 5832} \\ 8 \end{array}$$

$$\begin{array}{r} 3240 \\ 216 \overline{) 19656} \end{array}$$

$$\begin{array}{r} 3244 \\ 8 \overline{) 4668} \end{array}$$

$$\begin{array}{r} 216 \overline{) 19656} \end{array}$$

$$\begin{array}{r} 4668 \end{array}$$

$$\begin{array}{r} 19656 \end{array}$$

There is a cubick box whose side is 24 inches; what is the side of a box that will contain one sixty-fourth times as much?

$$\begin{array}{r} 24 \\ 24 \end{array}$$

$$\begin{array}{r} 96 \\ 48 \overline{) 48} \\ 576 \end{array}$$

$$\begin{array}{r} 24 \overline{) 2304} \\ 1152 \end{array}$$

$$\begin{array}{r} 24 \overline{) 1982} \\ 4 \end{array}$$

$$\begin{array}{r} 64 \overline{) 13824} \\ 128 \end{array}$$

$$\begin{array}{r} 102 \\ 64 \overline{) 384} \\ 384 \end{array}$$

$$\begin{array}{r} 384 \overline{) 384} \end{array}$$

$$\begin{array}{r} 216 \overline{) 216} \end{array}$$

The diameter of a globe or ball being given, to find the diameter of a globe or ball shall be any number of times greater or less than the given one.

Rule. Cube the given side diameter, and multiply or divide it by the given proportion as the question may require: and the cube root of root of the product, or quotient, will be the diameter of the globe required.

If the diameter of a globe be 12 inches, what will be the diameter of a globe one eighth part as large?

$$\begin{array}{r} 12 \\ 12 \\ \hline 144 \\ 12 \\ \hline 1728 \end{array} \quad \begin{array}{r} 2 \overline{) 1728} \\ \underline{216} \\ 216 \end{array} \quad \begin{array}{l} \text{in.} \\ 216 (6^{\text{th}} \text{ Ans.} \\ 216 \end{array}$$

If the diameter of a globe be 6 inches, what will be the difference of globe 64 times as large?

$$\begin{array}{r} 6 \\ 6 \\ \hline 36 \\ 6 \\ \hline 216 \\ 64 \\ \hline 864 \\ 1296 \\ \hline 13824 \end{array} \quad \begin{array}{r} 13824 \overline{) 24} \\ \underline{2} \\ 1260 \overline{) 5824} \\ \underline{4800} \\ 960 \\ \underline{64} \\ 5824 \end{array}$$

A general Rule For Extracting The roots Of All Powers—

See the rule book in the book.

What is the root of 13

Examples.

21

If the diameter of a globe be 6 inches, what will be the diameter of a globe 64 times as large?

* What is the highest rate or fourth root of 19987173376?

$$\begin{array}{r} 36 \\ 6 \\ \hline 216 \\ 64 \\ \hline 864 \\ 1296 \\ \hline 13824 \end{array} \quad \begin{array}{r} 13824 \overline{) 24} \\ \underline{2} \\ 1260 \overline{) 5824} \\ \underline{4800} \\ 960 \\ \underline{64} \\ 5824 \end{array}$$

$$\begin{array}{r} 19987173376 \overline{) 141376} \\ \underline{1} \\ 24 \overline{) 998} \\ \underline{96} \\ 281 \overline{) 387} \\ \underline{281} \\ 2823 \overline{) 10617} \\ \underline{8469} \\ 22267 \overline{) 214233} \\ \underline{191269} \\ 22276 \overline{) 1696476} \\ \underline{1696476} \end{array}$$

What is the cube root of 135796744?

* Biquadrate is the square root of the square root; consequently is the fourth root.

$$\begin{array}{r} 135796744 \overline{) 514} \text{ Ans.} \\ \underline{125} \\ 75 \overline{) 107} \\ \underline{132651} \\ 2608 \overline{) 31457} \\ \underline{135796744} \end{array}$$

Meredith. D. J. D.

Alligation Medi-al.

Is when the quantities and prices of several things are given, to find the mean price of the mixture compound of those things.

Rule. As the sum of the quantities, on the whole composition, is to the whole value; so is any part of the composition to its mean price or value.

4	16	\$.80
5	4	5
3	40	4750
12	60	4750
12	60	4750
12	60	4750
12	60	4750

Examples.

A merchant mixes 12 gallons of wine at 75 cents a gallon, with 24 gallons at 90 cents and 16 gallons at \$1.10; what is a gallon of this composition worth?

75	90	\$1.10
12	24	16
900	2160	1760
120	110	
2100	1760	
12	2160	
24	900	
16		
52	4820	1

52	4820	926	12	13
468				

140
104
360
312
4812
5213

A goldsmith melted together 22 oz. of gold & 2 conats fine, 1 lb. 2 oz. of 21 conats fine, and 10 oz. of 18 conats fine; what the fineness of the composition?

22	1.8	20	1.86
2	12	18	02
176	20	10	176
21	180	38	776
420			1

95	776	20	2
76		19	19
216			19

If a bushel or of Indian of corn at 75 cents a bushel, be mixed with 5 bushels of rye at 80 cents a bushel, and 15 bushels of oats at 30 cents a bushel; what will be the value of a bushel of the mixture?

15	80	30
1	5	15
75	400	450
1	400	
5	75	
15		
21	925	1

21	925	44	12
24			
85			
24			
1			

Case II.

When the rates of all the ingredients, the quantity of but one of them, and the mean rate of the whole mixture are given, to find the several quantities of the rest, in proportion to the quantity given.

Rule. Take the difference between each price and the mean rate, and place them alternately as in Case I. Then as the difference standing against that simple, whose quantity is given, is to that quantity, so is each of the other differences, severally, the several quantities required.

A merchant

has 20 lbs. of

tea at \$1.04 a

pound, which he would

mix with some at 98

cents, some at 92 cents,

and some at 80 cents a

pound; how much of

each sort must he take

to mix with the 20

pounds, that he may sell

the mixture at 96 cents

a pound?

Examples.

Bought a pipe of brandy containing 120 gallons, at \$1.30 a gallon; how much water will must be mixed with it to reduce the price cost to \$1.10 a gallon?

$$\begin{array}{r}
 104 \\
 98 \\
 92 \\
 80
 \end{array}
 \begin{array}{r}
 16 \\
 16 \\
 8 \\
 2
 \end{array}
 \begin{array}{r}
 4:20::16 \\
 16
 \end{array}$$

$$\begin{array}{r}
 110 \overline{) 120} \\
 110 \\
 \hline
 10
 \end{array}$$

$$\begin{array}{r}
 4:20::8 \\
 8 \\
 \hline
 40
 \end{array}$$

$$\begin{array}{r}
 4 \overline{) 80} \\
 80 \\
 \hline
 0
 \end{array}$$

$$\begin{array}{r}
 4:20::2 \\
 2 \\
 \hline
 10
 \end{array}$$

How much gold of 16, 20 and 24 carats fine, and how much alloy, must be mixed with 10 oz. of 12 carats fine, that the composition may be 22 carats fine?

$$\begin{array}{r}
 16 \\
 18 \\
 20 \\
 24
 \end{array}
 \begin{array}{r}
 2 \\
 2 \\
 2 \\
 2
 \end{array}
 \begin{array}{r}
 2 \\
 2 \\
 2 \\
 2
 \end{array}$$

$$\begin{array}{r}
 2:10::32 \\
 10 \\
 \hline
 2) 320 \\
 100 \\
 \hline
 220
 \end{array}$$

$$\begin{array}{r}
 10 \text{ oz of } 16 \\
 10 \text{ of } 20 \\
 \hline
 10 \text{ oz alloy}
 \end{array}$$

~~When the~~ **Case III.** ~~notes of the several ingredients, the quantity to be compounded, and the mean rate of the whole mixture are given, to find how much of each sort will make up the quantity.~~

Rule.

Write the difference between the mean rate, and the several rates alternately, as in Case I; then, as the sum of the quantities on differences thus determined, is to the given quantity, on whole or whole comparison so is the difference of each rate, to the required quantities of each rate.

Examples.

A merchant having sugars at 12 dollars, 10 dollars, and 8 dollars a cwt. would make a mixture of 30 cwt. worth 9 dollars a cwt. what quantity of each must be taken?

$\begin{array}{r} 12 \\ 10 \\ 8 \end{array} \begin{array}{r} 1 \\ 3 \\ 4 \end{array} \begin{array}{r} 1 \\ 3 \\ 4 \end{array}$ sum. 6	$6:30::1:5$	$\begin{array}{r} 12 \\ 10 \\ 8 \end{array} \begin{array}{r} 5 \\ 10 \\ 8 \end{array}$ sum. 30	$\begin{array}{l} \text{Ans. } 5 \text{ cwt. at } 12 \\ \quad 10 \text{ " } 10 \\ \quad 5 \text{ " } 8 \end{array}$
--	-------------	---	---

A goldsmith has several sorts of gold; viz. of 15, 17, 20 and 22 carats fine, and would melt together of all these sorts, so much as may make a mass of 20 oz of 18 carats fine, how much of each sort is required?

$\begin{array}{r} 15 \\ 17 \\ 20 \\ 22 \end{array} \begin{array}{r} 1 \\ 2 \\ 1 \\ 3 \end{array}$	$10:40::1$	$10:40::2$	$10:40::1$
$\begin{array}{r} 160 \\ 16 \end{array}$	$\begin{array}{r} 80 \\ 8 \end{array}$	$\begin{array}{r} 40 \\ 4 \end{array}$	

$10:40::3$	$16: \text{oz. of } 15 \text{ carats fine.}$
$\begin{array}{r} 120 \\ 12 \end{array}$	$\begin{array}{l} 8 \text{ oz. of } 17 \text{ do. do.} \\ 4 \text{ do of } 20 \text{ do. do.} \\ 12 \text{ do of } 22 \text{ do. do.} \end{array}$

Single Position

Is the mon-
it were the

ling of one supposed number, as if
the true one, to find the true number.

Rule. Take any number and perform the same operations with it as are described to be performed in the question.

2. Then say as the sum of the errors is to the given sum, so is the supposed number to the true one required.

Proof. Add the several parts of the sum together, and if it agree with the sum, it is right.

Examples.

A schoolmaster, being asked how many school-
masters ans he had, said
if I had as many ^{more} as I now
have, three quarters as
many, half as many,
one fourth as many and
one eighth as many, I should
then have 435

I person lent his friend
 a sum of money unknown
 to receive interest from the
 same at 6 per cent. per an-
 num. simple interest, and
 and at the end of 12 years,
 received for principle and
 interest \$260. What
 was the sum lent?

Of what men he died his
school consist?

Suppose he had 20

$\frac{3}{4}$ as many = 60

$\frac{1}{2}$ as many = 40

$\frac{1}{4}$ as many = 20

$\frac{1}{8}$ as money = 10

1290

290.435.205600
20
290.440.0110
29
58
58
0

$$\begin{array}{r}
 \$10 \\
 6 \\
 \hline
 300 \\
 12 \\
 \hline
 3600 \\
 50 \\
 \hline
 3650
 \end{array}$$

A and C joined their stocks, and gained \$353
 12½% of which A took up a ~~certain~~ certain sum,
 B took up four times as much as A, and C, five
 times as much as B. What share of the gain had
 each?

$$\begin{array}{r} \$ \\ 250:353,12\frac{1}{2}::10:14,12\frac{1}{2} \text{ Ans. A's} \end{array}$$

A's 10

B's 40

C's 200

Then say, as 250:353,12½::40:56,50 B's

250:8

Then, as 250:353,12½::200:282,50 C's

A and B, talking of their ages, B said his age
 was once and a half the age of A. C said his was
 twice and one tenth the age of both, and that
 and that the sum of their ages was 93: what
 was the age of each?

A's 10 10 Say as, 77½:93::10:12 A's age.

B's 15

C's 52½

25 sum of ags

77½:93::15:18 B's do.

77½

25

50 — 10th of 25

77½:93::52½:69 C's do.

52½

Seven eighths of a certain number exceeds four fifths
 by 6: what is that number?

Suppose 40

$$\frac{8/40}{5\frac{1}{2}}$$

$$\frac{5/40}{8} = \frac{1}{5}$$

$$\frac{7}{35} = \frac{7}{5}$$

$$\frac{4}{32} = \frac{4}{5}$$

$$\text{As } 3:40::6$$

Error, on 3 to small.

$$\frac{91240}{80 \text{ Ans.}}$$

4
 C.
 ten

What number is that, which, being increased by $\frac{2}{5}$, $\frac{3}{5}$, and $\frac{5}{6}$ of itself, the sum will be $234\frac{3}{4}$?

$$\begin{array}{r} \frac{5}{8} \\ 40 \\ \hline 240^* \\ 96 \\ \hline 90 \end{array}$$

$$\begin{array}{r} 5/240 \\ 48 \\ \hline 96 \end{array}$$

$$\begin{array}{r} 8/240 \\ 30 \\ \hline 90 \end{array}$$

$$\begin{array}{r} 6/240 \\ 40 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 626 \cdot 240 \cdot 234\frac{3}{4} \\ 939 \\ \hline 2160 \\ 720 \\ \hline 2160 \end{array}$$

$$\begin{array}{r} 225960 \\ 1878 \\ \hline 9756 \\ 9756 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 36.0 \text{ quaters} \\ 90 \text{ shs.} \end{array}$$

* Multiply all the denominators of the fractions together, and that and that will form the number required.

Double Position

Double Position teaches to resolve questions by making two suppositions of some convenient numbers.

Those questions, in which the results are not proportional, to their suppositions, belonging to this rule: such are those, in which the number sought is increased or diminished by some given number, which is no known part of the number required.

Rule.—Take any two convenient numbers, and proceed according to the conditions of the questions &c. &c.

Examples

A lady bought damask for a gown, at 8 s. per yard and lining for it at 3 s. per yd. the gown and lining contained 15 yards, and the price of the whole was £8 10 s. how many yards were there of each?

Suppose 6 yards domark,
value 48s. Then she must
have 9 ds. lining, value 27s.

Again suppose
5 to 4/5 1 yds. do. 32s.
Then she must have
11 yds. lining 32 value 2250

sum of their values 65s
second error 5 to little

48 33
27 32
75 655 sum of values
5 to 4/5 on left, 5 to 5 on left 8s.

6 5+
4 5-
20 30
20 20
5+5=10 50
5 yds domark

and 15-5=10 yds. lining

A laborer was hired for
60 days upon this con-
dition, that for every day
unworked, he should re-
ceive 75c.; and for every
day he was idle, should
forfeit 37½c.; and at the
expiration of the time he
received \$18. How ma-
ny days did he work, and
how many was he idle?

unworked.
Suppose 30
75
2250
1125
1125
1800

(1) suposi	(2) do.	(3) do.
90	90	20
75	37½	75
		1500
210		
90		(4) do
15		20
1125		97½
18		280
2925		1200
		20
		1500
		1500
		0000
		18
		1800

10 2925-
20 1800-
58500
18000
40500

1125 20500 (36 worked.
3375
6750
6750 60
36
2 4 idle.

There is a fish, whose
head is 10 feet long;
his tail is as long as
his head and half the
length of his body, and
and his body as long
as the head and tail.
What is the whole len-
gth of the fish?

Suppose body 20

hd 16
tl 10
40

10
16
20
16
10-

20 10-
30 5-
900 100
100

20 say body 30

hd 10
tl 20
60

15
10
25
20
5-

200
40 body.
10 hd.
30 tl.
80 ans.

A farmer having driven his cattle to market, received for them all \$320 being paid at the rate of \$24 per ox, \$16 per cow, and \$8 per calf: there were as many oxen as cows, and 4 times as many calves as cows. How many were there of each sort?

Suppose 10
24
240
160
240
640
\$320
320

10 10 40
16 16 6
160 160 160

10 320
8 192
2560 1920
1920

20 suppose 8 8 32
24 16 32
192 128 192
192
128
512
\$320
192

128) 640 (5 oxen.
640 5 cows.
20 calves. } Ans.

Permutation.

Permutation is the method of finding how many different ways the order or position of any given number of things may be changed or varied.
Rule.- Multiply all the terms of the natural series to of numbers, from one to the given number, continually together, and the last product will be the answer required.

Examples.

How many changes or variations can be made of the three first letters of the alphabet?

$$\begin{array}{r} 1 \\ 2 \\ 2 \\ 3 \\ \hline 6 \text{ Ans.} \end{array}$$

Christ's church in Boston has 8 bells; how many changes can be rung on them?

$$\begin{array}{r} 1 \\ 2 \\ 2 \\ 3 \\ 6 \\ 4 \\ \hline 24 \\ 5 \\ \hline 120 \\ 6 \\ \hline 720 \\ 7 \\ \hline 5040 \\ 8 \\ \hline 40320 \text{ Ans.} \end{array}$$

Nine gentlemen met at an inn, and were so well pleased with their host and with each other that in frolic they agreed to stay so long as they could with their host sit every day in different position at dinner: Pray how long had they kept their agreement, would their frolic have lasted?

$$\begin{array}{r} 1 \\ 2 \\ 2 \\ 3 \\ 6 \\ 4 \\ \hline 24 \\ 5 \\ \hline 120 \\ 6 \\ \hline 720 \\ 7 \\ \hline 5040 \\ 8 \\ \hline 40320 \\ 9 \\ \hline 362880 \end{array}$$

Gauging.

Gauging is the art of measuring all sorts of casks or vessels used for liquor, and of determining the quantity they will contain.

Rule. Take the dimensions of the cask in inches, viz. the diameter at the bung and head, and the length of the cask; subtract the head diameter from the bung diameter, and note the difference, &c. &c. &c.

Ls
it
Ru
mit
2. Z.
is
Pne
ag

Dirriolond. 1062,76

35
27
8
27
56
326
326
1956
652
272

1062,76
5313,80
425104
294/47824,20
294
1842
1764
784
582
1962
1764
1980
1764
216

W.gab.
(162,66)

359/47821,20 (13321,
359
1192
1077
1154
1077
719
712
540
359
181

W.gab.
162,66
133,21
Aus.
He or, been gals.

He been

u
m
if

more

th

2

1/2
1/4
1/8

2/25/19

If the diameter of an axle 6 inches
and the diameter of the wheel, 60
inches, what weight suspended
from the axle will be balanced
by a power of 1 lb. applied
to the wheel?

$$\begin{array}{r} \text{in.} \quad \text{in.} \quad \text{lb.} \\ 6 : 60 :: 1 \\ \hline 6 \overline{) 60} \\ \text{lb. } 10 \text{ Ans} \end{array}$$

the power which will raise it abating the friction
which is not proportioned to the
There is a screw whose threads
are an inch asunder, the lever
by which it is turned 30 inches
long, and the weight to be
raised 2240 lbs. What
power on the end must be ap-
plied &c.

The lever being the semidiameter
of the circle, the diameter of the
circle &c.

$$\begin{array}{r} 113 : 355 :: 60 \\ \hline 113 \overline{) 21300} (188, 496 \\ 1000 \quad 188, 496 : 1 :: 2240 \\ 904 \quad \quad \quad * \\ 960 \quad \quad \quad * \\ 904 \quad 188, 496 \times 224000 (11,884 \\ 560 \quad \quad \quad 355040 \\ 452 \quad \quad \quad 188496 \\ \hline 1020 \quad \quad \quad 1665440 \\ 1017 \quad \quad \quad 1507968 \\ 630 \quad \quad \quad 1574720 \\ 622 \quad \quad \quad 1507968 \\ 52 \quad \quad \quad 66752 \end{array}$$

$$\begin{array}{r} 2240 : 1188 :: 288,496 \\ \hline 2240 \overline{) 288496} \\ 2240 \quad 288496 \\ \hline 64496 \\ 2240 \overline{) 64496} \\ 2240 \quad 64496 \\ \hline 42096 \\ 2240 \overline{) 42096} \\ 2240 \quad 42096 \\ \hline 19696 \\ 2240 \overline{) 19696} \\ 2240 \quad 19696 \\ \hline 7296 \\ 2240 \overline{) 7296} \\ 2240 \quad 7296 \\ \hline 5056 \\ 2240 \overline{) 5056} \\ 2240 \quad 5056 \\ \hline 2816 \\ 2240 \overline{) 2816} \\ 2240 \quad 2816 \\ \hline 576 \\ 2240 \overline{) 576} \\ 2240 \quad 576 \\ \hline 336 \\ 2240 \overline{) 336} \\ 2240 \quad 336 \\ \hline 112 \\ 2240 \overline{) 112} \\ 2240 \quad 112 \\ \hline 56 \\ 2240 \overline{) 56} \\ 2240 \quad 56 \\ \hline 28 \\ 2240 \overline{) 28} \\ 2240 \quad 28 \\ \hline 14 \\ 2240 \overline{) 14} \\ 2240 \quad 14 \\ \hline 7 \\ 2240 \overline{) 7} \\ 2240 \quad 7 \\ \hline 3.5 \text{ Ans} \end{array}$$

Of the screw.

The power is to the weight
which is to be raised, as
the distance between two threads
of the screw &c.

Rule. Find the circum-
ference of the lever, then, as
the circumference is to the
distance between the spiral
threads of the screw, so is
the weight to be raised, to

Let the power be 1188 lbs,
the weight 2240 lb, and the
threads an inch asunder, to
find the length of the lever.

$$\begin{array}{r} \text{lbs.} \quad \text{lbs.} \quad \text{in.} \\ 1188 : 2240 :: 1 \\ \hline 1188 \overline{) 2240} (188, 5 \\ 1188 \\ \hline 10520 \\ 9504 \\ \hline 10160 \\ 9504 \\ \hline 6560 \\ 5940 \\ \hline 620 \end{array}$$

Then, 355 : 113 :: 1885

$$\begin{array}{r} 355 : 113 :: 1885 \\ \hline 355 \overline{) 20900,5} (60)30 \\ 2090 \\ \hline 0 \end{array}$$

Useful And Div- erting exercises

Is
it
Ru
mit
2. Is
is
Pro
age

1. What difference is the dif between between twice 5 and twenty and twice twenty-five!*

* this

5	25
5	25
10	50
20	50
30	20 Answer

yr.	yr.
6:5000::1:833 $\frac{1}{3}$	
7 $\frac{1}{2}$:5000::1:666 $\frac{2}{3}$	

8500 sum.

$$\begin{array}{r} 1666\frac{2}{3} \\ - 1500 \\ \hline 166\frac{2}{3} \end{array}$$

Then, as $166\frac{2}{3} : 1 :: 5000$

$$\begin{array}{r} 166\frac{2}{3} \overline{) 5000} \\ 9 \overline{) 15000} \quad \text{Ans.} \\ 1500 \quad (30 \\ \hline 0 \end{array}$$

2. In an orchard of fruit trees, $\frac{1}{2}$ of them bear apples, one $\frac{1}{4}$ pears, $\frac{1}{6}$ plums, $\frac{1}{8}$ of them peaches, and 40 cherries; how many trees does the orchard contain?

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{1}{8}$	40
2	4	6	8	60
6	2	4	44	40
12	8	24	48	100

$$\begin{array}{r} 1:100::12 \\ 12 \\ \hline 1200 \text{ Ans.} \end{array}$$

3. A merchant begins the world with \$5000 and finds that by his distilling he clears \$5000 in 6 years, by his navigation, \$5000 in 7 $\frac{1}{2}$ years; and that he spends in gambling \$5000 in 3 years; how long will his estate last?

4. I can do a piece of work in 7 days, and B 12. in what time will both, working together, finish it?

D. H.	D.
12:1::7	
7	41 once in 70.
7	80 $\frac{1}{2}$ of it.
12	1 $\frac{1}{2}$

$$\begin{array}{r} 1\frac{1}{2}:7::1 \\ 12 \\ \hline 19:7::12 \\ 12 \\ \hline 19)81(4\frac{3}{19} \text{ Ans.} \\ 76 \\ \hline 5 \end{array}$$

5.

A and B run one on opposite sides of a circular field 268 poles about; they begin to go round it, both the same way at the same time, A goes 22 rods in 2 minutes, and B 34 rods in 3 minutes; how many times will they go round the field before the swiftest will overtake the slower?

1st. $2:22::3:33$, and $34-33=1$

2d. $1:34::134:4556$

3d. $4556 \div 268 = 17$ times for B.

4th $34:17::33:16\frac{1}{2}$ times for A.

{ A. $16\frac{1}{2}$ times. } Ans.
{ B. 17 times. }

6. A wooden tub holds 79 gallons; the pipe, which conveys the water to it usually admits 7 gallons in 5 minutes, and the spout discharges 20 gallons in 13 minutes. Now supposing both these to be wholly left open, and the water to be turned on at 4 o'clock in the morning: a servant at 6, finding the water run-

ning, puts in the stop: in what time, after this accident, will the tub be filled?

$$\begin{array}{r} \text{m.} \quad \text{gal.} \quad \text{m.} \\ 17:20::112=24:141\frac{2}{3} \\ 5:7::192:168 \quad 168\frac{2}{3} \\ \hline 141\frac{2}{3} \\ \text{gal. m.} \quad \text{gal.} \quad \text{m.} \quad \text{m.} \quad \text{m.} \\ 7:5::46\frac{2}{3}:32, 5\frac{1}{2} \quad 11\frac{1}{2} \\ \hline 26\frac{14}{17} \end{array}$$

7. A hare starts 12 rods before a hound, but is not perceived by him till she has been up 45 seconds; she runs away at the rate of 10 miles an hour; and the dog, on view, makes after her at the rate of 16 miles an hour. how long will the course hold, and what space will be run over, from the spot where the dog started?

Solution.

As 1 h.: 10 mls. :: 45 se.: 40 rods,
and $40 + 12 = 52$ rods to end
 $16 - 10 = 6$ miles gain in an hour
And as 6 miles one to one hour,
so are 52 rods to $97\frac{1}{2}$ seconds,
the time required.

And as 1: 16 :: $97\frac{1}{2}: 228\frac{1}{2}$ feet.
Ans.

8. Required the number from which if 7 be subtracted, and the remainder be divided by 8, and the quotient be multiplied by 5 and 4 added to the product, the square root of the sum extracted, and three fourths of that root cubed, the cube be divided by the last quotient may be 24?

Required that number
from which if 7 be subtracted
etc?

Solution. —

Proceed contrarily
wise.

$$\frac{24}{9} = 2 \frac{6}{3} = 6 \text{ and } 6 = \frac{2}{3} \text{ of square of } 9$$

consequently $\frac{8}{3}$

$$\begin{array}{r} 64 \\ -4 \\ \hline 5160 \\ 12 \\ \hline 26 \\ 7 \\ \hline 103 \end{array}$$

Ans. —

2. Suppose a light house
build on the top of a rock, the
distance between the place of
observation and that of the
rock level with 620 yards, the
distance from the top of the rock
to the place of observation, 846
yards, and from the top of the light
house 900 yards, the height of
the light house is required?

Solution. 1st $900 \times 900 = 810000$
and $620 \times 620 = 384400$, and
 $810000 - 384400 = 425600$, and
the square root of 425600 is
652, 38 + yards.

2d, $846 \times 846 = 715716$, and
 $715716 - 384400 = 331316$, the
square root of which is 575, 61 + yds,
and $652, 38 - 575, 61 = 76, 77$

76, 77 yards, Ans.

10. Sound uninterrupted, moves
at the rate of 1142 ft. per
second; if the time between
the time of and therefore in
one minute at what time
was the explosion?

sc. 1142 ft. 68520 feet
which reduced to miles by
dividing by 5280.

11. If the diameter of the earth
be 7911 miles in diameter and
the moon 2180 miles, how
moons will it take to make
one earth?

Method of solution.

Cube the given diameter of
the earth and also that of
the moon, and divide the
cube of the lesser by that of
the greater and the
quotient will be the answer.

12. A father left his estate of
1300 dollars to his son, but
he being only 14 years of age
his guardian was to pay \$100
per annum for board, educa-
tion, &c., and the surplus was to
be put out to interest for his
benefit, and 6 per cent. compd
and interest, now allowing
no loss, what sum had his
guardian to pay him when
he was of age?

13. Hiero, King of Sicily, ordered
 his jeweller to make a crown,
 containing 63 ounces of gold.
 The workman thought that substituting
 pond silver was only a proper pen-
 quiside, which touching
 him in Archimedes was
 appointed to examine it &c.

1st As 8.2245:63::1:7.66+
 ounces in one inch of the crown.

By alligation alternate.

7.66 { 1 lb 36 1.81 prop. bulk of gold.
 5.85 2.70 do. of silver.

Then, $10.36 \times 1.81 = 18.7516$ prop.
 and, $5.85 \times 2.70 = 15.7950$ do. of silver.
 Sum of proportions, 34.5466.

[to 28.2041 oz.]

3d As 34.5466:63::15.795:
 nearly, the quantity of sil-
 ver in the crown, which sub-
 tracted from 63 oz. will leave
 14.205 oz. of gold.

A person having driven his stock
 of cattle to market, received for
 them all \$156 &c.

1st	5h.	10	36	20	8	8
50	20	4	50	20	4	12
250	200	120	100	20	4	12
200			80			
120			48			
570			228			
456			456			
114			228			

that from 228
 228
 114
 114
 228
 1968

* 942) 1368 (4 2/3 \$ 200
 828 160
 245 96

228 114 0
 228
 1968

* sum of errors, 942

15. If 1000 bricks lie 6 inches from
 each other in a straight line, and
 a person be employed to gather
 them up one by one, and place
 them on a pile which is one
 foot from the first brick &c.

ft.
 2 = 1st extreme.

1001 = last extreme.

2 + 1009 = sum of extremes. [miles, will give the Ans.]

2) 1009000 ft. 1/2 of which reduced to

3) 504500 = 1/3

5) 167166 = 1/5 ft.

11) 334332

40) 30399 = 9 half yards.

8) 1759 = 33 rods.

Ans, 94m. 7fur. 126 yds. 2 ft.

17. A man dying left his
 wife in expectation that a
 child would be added to his fam-
 ily; and making his will order-
 ed that if it were a son &c.

Suppose the estate \$7.37 1/2

Daugh. 1. 3/7
 Widow 2. 2 1/3 and, lost if only a dau.

1. 3/7

\$7 estate

-2

5 and lost if a son & a daughter

2 1/3

2 2/3 Widow lost move.

Then, As 2 2/3: 7:: 2400: 6300

Now as the estate was \$6300, one

third of it is \$2100, the Ans.

18. When first the marriage knot was tied between my wife and me, &c.

Solution. 1st. suppose the man 19, his wife 11 yrs.

in 15 yrs. he would be 34, she 26, her age should be to his as 6 to 9, or two to 3.

4 9:2::34 yrs.: 22 $\frac{2}{3}$ yrs. but wife should be so that $26 - 22 \frac{2}{3} = 3 \frac{1}{3}$ the error too small.

2d. Suppose man 38 yrs. and his 22, and in 15 yrs. he would be 53, and she 37 yrs. but her age ought to be: and $34 - 35 \frac{1}{2} = 1 \frac{1}{2}$ yrs the error too small

$$\begin{array}{r} 11 \quad 10.3ds. \\ 22 \quad 5.3ds. \\ \hline 220 \\ 55 \\ \hline 5165 \end{array}$$

33 yrs the marriage

and, 11:33::19:57 man's age

19. Answer. 1. Two women went over and one returned again with the boat, and re-passed with the third woman.

2d. One of the two ^{women} men, with his wife went back with the boat, and stopped with her husband, while the one two men went on to their wives.

3d. One of the two men with his wife again returned with the boat, and left his wife again re-

* to question 19

turned with the boat, and left his wife and conveyed the other man over. Then all the men were over and one woman came safe together.

4th. The woman again left her husband with the other two ~~women~~ men, and at two trips brought over the other two women, and then their navigation ended.

20. As I was going to St.ines, &c. Ans only one.

21. A countryman having a fox, a goose, and a perk of corn &c?

The first carried over the goose &c. It need not be explained.

First suppose he had 70, and the

A man driving his geese to market, was met by another who said, &c?

First suppose he had 70,

and the error is $7 \frac{1}{2} +$; second suppose he had 60, and the error is $7 \frac{1}{2} -$; then work with the suppositions as the rule of double position directly, and you will obtain the answer sought, which is 65.

Two men were driving sheep to market, says one to the other, give me one of your and I shall have as many as

you; the other says give me one of
yours and I shall have as many a-
gain as you. How many had
each?

First suppose A had $\frac{2}{3}$ and B $\frac{1}{3}$
then if A gives B one B will have
5 and A one, and as many again as
1 is 2, which subtracted from 5 leaves
an error of 3+.

Secondly suppose A had 4 and
B 6. then if A gives B one, B will
have 7 and A 3, which will give
an error of 1+.

Then,

$$\begin{array}{r} 2 \times 3+ \\ 1 \times 1+ \\ \hline 12 \quad 2 \\ 2 \end{array}$$

$$\begin{array}{r} 2 \overline{) 10} \\ 5 \text{ A's and B's } 7. \end{array}$$

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1/2
1/4
1/8

Feb.
wife age
boat, and
* to question 19

