NEW AND COMPLETE

SYSTEM

OF

ARITHMETIC:

INTENDED FOR THE USE OF

SCHOOLS AND ACADEMIES.

BY CALEB ALEXANDER, A. M. AND

Author of "Virgil's Works translated into literal English prose," "The Columbian Dictionary," An English, Latin, and Greek Grammar, "The Young Gentlemen and Ladies' Instructor," and a Spelling Book on an improved plan—late principal of Fairfield Academy, (N. Y.) now Preceptor of Onondaga Academy.

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District of Massachusetts District, to wit:

(*L. S.*) BE IT REMEMBERED, That on the twenty-eighth day of January, in the twenty-sixth year of the Independence of the United States of America, CALEB ALEXANDER, of the said District, hath deposited in this Office, the Title of a Book, the right whereof he claims as Author, in the words following, to wit:

"*A new and complete System of ARITHMETIC: intended for the use of Schools and Academies.*

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N. GOODALE, *Clerk of the District of Massachusetts District.*

A true copy of Record,

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PREFACE.

TO render the following *system* plain and easy, no pains have been spared. Treatises of this kind have often abounded with abstruse and intricate questions, more puzzling than beneficial to the learner. And some authors have dwelt too much on trifling questions, which, when understood, afford no useful knowledge. To shun these extremes, to feed the mind, and form our *youth* for active life, has been the principal aim, in this work. As the Federal mode of reckoning is well adapted to business, and is rapidly growing into use, particular attention has been given to this mode, in the rules under ***Decimal Fractions.*** To the patronage of a generous public, this work is humbly dedicated, by

THE AUTHOR.

ARITHMETIC.

SECTION I.

Explanation of Characters.

+	Signifies Addition; as 4+5 make 9,
—	Subtraction; as, 6—4 leaves 2.
×	Multiplication; as, 7×3 makes 21.
÷	Division; as, 12÷6 quotes 2.
::::	Proportion; as, 4:8: :5: 10. Read thus as 4 is to 8, so is 5 to 10.
=	Equality; as, 4 and 7=11.

Arithmetic is the art of computing by numbers, and is comprised in the five following rules, Numeration, Addition, Subtraction, Multiplication, and Division.

NUMERATION

Shows the different value of figures, as they may be differently arranged, and teaches how to read and write, by the following ten characters 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The first is called a cypher; the rest, figures.

The last nine are called significant figures, to distinguish them from the *cypher*, which of itself has no value. As it is placed, it may serve to increase or decrease the value of the figure or figures, with which it is connected. Thus, 4 is but four. If the *cypher* be placed after it thus, 40, it becomes forty. When the *cypher* is placed before any figure, as in decimal arithmetic, it decreases the value of the figure. Thus, 4 in decimals, is only the 4 tenths of any thing. But when the *cypher* is placed before it thus, 04, it becomes 4 hundredths of any thing.

The nine figures have a *certain*, or an *uncertain* value. When they stand singly, or alone, their value is *certain*. Thus, 4, 5, 6, are but four, five, and six. If another figure be added, they are increased, in value, ten times. Thus 4, with 3 added, becomes 43 forty-three; and 5, with 7 added, becomes 57 fifty-seven. This is called their *uncertain* value.

Every figure, at the left hand, increases the value tenfold, in proportion to its distance from the right hand figure, or the place of *units*. Thus, 6 is six; 66 are sixty and six; 666 are six hundred, sixty, and six; 6666 are six thousand, six hun-

dred, sixty, and six; 66666 are sixty-six thousand, six hundred, sixty, and six.

9 Quadrillions,
8 Hundreds of thousands of trillions,
7 Tens of thousands of trillions,
6 Thousands of trillions,
5 Hundreds of trillions,
4 Tens of trillions,
3 Trillions,
2 Hundreds of thousands of billions,
1 Tens of thousands of billions,
9 Thousands of billions,
8 Hundreds of billions,
7 Tens of billions,
6 Billions,
5 Hundreds of thousands of millions,
4 Tens of thousands of millions,
3 Thousands of millions,
2 Hundreds of millions,
1 Tens of millions,
9 Millions,
8 Hundreds of thousands,
7 Tens of thousands,
6 Thousands,
5 Hundreds,
4 Tens,
3 Units,

To exercise the pupil, let him write, in figures, the following numbers:

Seventy-seven; eighty-nine; ninety-four; one hundred and six; nine thousand, four hundred and twenty-three; four millions, six hundred, and forty-six thousand, seven hundred, and twenty-five; two billions; one million, seven hundred, eighty-seven thousand, four hundred, and thirty-two; six trillions, three thousand, four hundred, and fifty-seven billions, nine hundred, and sixty-five millions, and twenty-nine.

To facilitate enumeration, accomptants often distinguish their figures thus:

423,678,943,278,742,684,927,867,423.

Let the following numbers be written in words;

9	748	648	42
74	6329	7329	786
239	87243	98654	2849
847	98476	841265	69487
982	347632	3649872	267432

ADDITION

IS the putting together of two or more numbers, so as their total value may be known by one sum.

SIMPLE ADDITION

Is the putting together of several whole numbers of one denomination.

In placing your numbers, observe to set units exactly under units, tens under tens, hundreds under hundreds, &c. and then observe the following

RULE.

Having drawn a line under the numbers to be added, begin with the row of units; add the figures together; consider how many tens there are in the row; set down the excess, if any, directly under the place of units, and for every ten carry one to the next row or place of tens. Proceed in the same manner with each row; and your work, having set down the whole sum of the last row, will be done.

EXAMPLES.

472	8472	94826	47836427
364	3674	78324	92342874
43678	742689		9236847234
24736	723746		6248736429
94238	634287		8426738724
162652			

TO PROVE Addition, begin at the top, in the place of units, and compute the figures downwards, in the same manner you did upwards; if your work be right, the aggregate sum will be the same as the former.

4367423	4236742
2467836	3468273
4238204	4967426
6237420	8423678
3746348	4628742

426347	734264	7236423
238742	873072	8246374
634267	637493	2371694
9742367	4236742	8463742367
2346724	8647893	2367423674
8962347	2786374	1072073042
2746374	7634276	6342674672
5236742	6237427	8964236746
4626342	8426378	7423642
9437876	9345629	6342674
3785210	7465546	9267846
7426784	2140367	3427643
3642792	2467896	6426789
6342187	6784263	7236402
6342678	7423642	9423678
2369289	6020304	2030406
1478356	6708420	0267087
4167265	3670842	6958423
3146789	6468403	3678942
6234267	4263426	6374367
8463426	7423678	0426789
		6342687
6342678	63784236	23467842
2074023	42874236	37426346
6742378	78942367	28674342
9236787	23462364	37862463
2030607	28976342	42367426
4263789	59623426	34020768
5678742	78923426	67423678
6402074	47234628	42378462

SUBTRACTION

IS the taking of a less number from a greater, to show the difference. And, like addition, it is simple and compound.

SIMPLE SUBTRACTION

Is the finding of the difference of two numbers of the like kind, by taking the less from the greater.

Rule.

Place the less number under the greater, and observe to set, exactly, units under units, tens under tens, hundreds under hundreds, &c. Draw a line underneath; and, beginning at the right hand, or place of units, take the lower line from the upper, or the less number from the greater. If the figure, in the lower line, in the place of units, be greater than the one in the upper line, you must borrow ten from the place of tens, and add them to the figure in the upper line; then take the figure in the lower line from this sum; set down the excess, above ten, in the place of units, and carry one, for the ten you borrowed, to the row of figures, in the place of tens, in the lower line. In this manner, proceed carefully with every row, and your work will be complete.

To prove Subtraction, you may add the remainder to the less number: If your work be right, the aggregate will be like the greater number.

Examples.

From	467	893	746238	9236842784
Take	324	742	635127	8125731673
Rem.	143			
From	276	924	427842	7234263487
Take	187	867	346974	6349297649

From 43672342	From 97236423	From 4362497423
Take 37496274	Take 78427964	Take 2487238674
From 9423674	From 4236742	From 6237426
Take 8647289	Take 3787964	Take 3749627
From 6234897	From 4236742	From 742367429
Take 4367489	Take 3674964	Take 463749736

From 423674	From 7423674	From 8423674
Take 346785	Take 4632789	Take 3687496
From 8462374	From 30794067	From 704060809
Take 3987429	Take 17040609	Take 670403079
From 7423674	From 406070804	From 63742674
Take 6374896	Take 030708070	Take 38763698

The distance of any time, since any remarkable event, may be found, by subtracting the date from the date of the present year.

In the year 59, Nero put his mother and brethren to death. How many years between that and the present year, 1801?

Christianity was introduced into England by Paul, as is supposed, in 63. How long since?

In 306, Constantine the Great began to reign.—How long since?

In 516, the computing of time, by the christian æra, was introduced by Dionysius the Monk. How long since?

In 622, Mahomet, the false prophet, fled to Mecca. How long since?

In 1180, glass windows began to be used in private houses, in England. How long since?

In 1340, gun-powder and guns were first invented by Swartz, a Monk of Cologne. How long since?

In 1492, America was first discovered by Columbus. How long since?

King Charles I. was born in 1600, and beheaded in 1649. How long since he was born, and since he was beheaded, and how old was he when beheaded?

In 1759, General Wolfe was killed in the battle before Quebec. How long since?

In 1793, Louis XVI. King of France, was gulliotined. How long since?

American Independence was declared in 1776.—The present year is 1801. How long since the declaration?

The Spanish Invasion was in 1588; the present year is 1801. How long since?

The fire of London was in 1666; the present year is 1801. How long since?

1801	1801	1801
1776 Am. In.	1666 Fire Lon.	1588 Sp. In.
25 Answer.	135 Answer.	213 Answer.

MULTIPLICATION.

Of all the rules in *Arithmetic*, Multiplication is the most useful. By two given numbers, it teaches us to find out a third, which shall contain, or increase, the greater as many times as there are units in the less.

By this rule, many sums, in addition, may be wrought, in the most compendious manner.

By this rule, greater denominations are brought into smaller; as pounds into shillings; shillings into pence; and pence into farthings.

Knowing the length and breadth of a plain surface, we may learn, by this rule, its superficial contents, or square measure.

And by knowing the value of one thing, or the wages of one person, we are taught, by this rule, the value of many such things, or the wages of many such persons.

The number to be multiplied, is called the *multiplicand*; that by which the number is multiplied is called the *multiplier*; which is, commonly, the less number: The *product* is the result of the work, or the answer. The *multiplicand* and *multiplier*, taken together, are called the *factors*.

SIMPLE MULTIPLICATION,

Means the multiplying of any two numbers together which are of one denomination.

Before the learner proceeds in this useful rule, he ought to commit perfectly to his memory, the following table.

MULTIPLICATION TABLE.

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

To PROVE multiplication, division is the most sure and expeditious mode. Or you may invert your *factors*, and if the product be like the former, the work is right. As the pupil is supposed not to have learned division, he may prove multiplication, by the excess of nines.

RULE.

Reject all the *nines* out of the multiplicand, multiplier, and product, and place the excess of each directly opposite their respective terms. You must then multiply the excess of *nines* in the multiplicand, by the excess of *nines* in the multiplier; reject all the *nines* from this last product, and if the *excess* be equal to the *excess* in the first product, the work is right.

CASE 1.

When the multiplier does not exceed 12.

RULE.

Having placed units under units, and tens under tens, proceed, in the work, as the table directs, being careful to carry one for every ten, to the place of tens, or to the next superior row, as in simple addition.

EXAMPLES.

	1.	2.	3.	4.	5.
Multiplicand	4	36	87	4236	4623
Multiplier	2	4	5	6	7
Product	8	144	435	25416	32361

6.	7.	8.	9.
87423	9423	4237	84567
8	9	11	12
699384	84807		1014804

CASE 2.

When the multiplier is more than 12.

RULE.

Multiply separately each figure, in the multiplicand, by each figure in the multiplier, beginning with the place of units, and placing the first figure of each product directly under its multiplier; then add the several products together, in the same order, as they stand, and their sum will be the total product.

EXAMPLES.

Multiplicand	42367	42367
Multiplier	13	24
		169468
		84734
		1016808

97237	8273562	73237872864
34	142	4362

723642	842367	742364	682367
16	18	27	86
465374	742264	842674	23678423
92	57	175	7632
46789	347896	426989	7423679
3478	6457	34278	426347
845236	634278	4256784	3674236
57897	96786	3678974	4236789

Case 3.

When either the multiplicand, or multiplier, or both, have cyphers at the right hand.

Rule.

Set the first figure of the multiplier under the first figure of the multiplicand. And then, not regarding the cyphers, proceed as in Case 1. or 2. as the operation may require. Lastly, to the product annex all the cyphers in the multiplier and multiplicand.

Examples.

46700	43000	7800000	567000000
300	9000	700000	97000000
13710000			
63426000	8723600000	782360000000	
463000	84200000	8420000000	
236400000	7426000000	962300000000	
634200000	4634000000	645700000000	

23450000000	236784200000	5623000000000
74630000000	742365700000	7436000000000

Case 4.

To multiply by 10, 100, 1000, 10000, &c.

Rule.

Add as many cyphers to your multiplicand, as there are in the multiplier; and your work will be done.

Examples.

46	7423	96234	842367	7423678992
10	100	1000	10000	10000000
460	742300			

Case 5.

When cyphers are intermixed with the multiplier.

Rule.

Omit to multiply by the cyphers, and place the first figure of each product directly under the figure, by which you multiply. Then add the products together, and their sum will be the total product.

Examples.

423	24393	742267	89236782
306	402	4023	403064
2538	48786		
1269	97572		
129438	9805986		
702036	6080403	4236702	703040206
40672	406077	3040605	340207093

40206007	400020007	6000036702074
62004802	702030604	3070806040307

We shall now teach how to apply this rule, in the real business of life.

What are the superficial contents, in feet, of a garden, 80 feet in length, and 70 in breadth?

80 length.
70 breadth.

5600 Answer.

2. If the wages of one man, for a year, be 112 dollars, What are the wages of 24 men?

112 dollars.
24 men.

448
224

2688 dollars, the answer.

3. If one yard of broadcloth cost 5 dollars, What is the cost of 63 yards, at the same rate?

63 yards.
5 dollars.

315 dollars, the answer.

4. If one dozen of eggs cost 10 cents, what is the cost of 13 dozen? Answer, 130 cents, or 1 dollar and 30 cents.

5. If one pound of flax cost 17 cents, What is the cost of 245 pounds? Answer, 4165 cents, or 41 dollars and 65 cents.

6. If one gallon of rum cost 133 cents, What is the cost of 6 gallons? Answer, 7 dollars and 98 cents.

7. If I give 6 cents a mile for the hire of a horse, What will a journey of 146 miles cost me? Answer, 876 cents, or 8 dollars and 76 cents.

8. If I give 14 cents a mile for the hire of a horse and chaise, What will a journey of 237 miles cost me? Answer, 3318 cents, or 33 dollars and 18 cents.

9. If one pound of butter cost 20 cents, What is the cost of a firkin of butter containing 86 pounds? Answer, 1720 cents, or 17 dollars and 20 cents.

10. If one pound of live geese feathers cost 75 cents, What is the cost of feathers for a bed, containing 44 pounds? Answer, 3300 cents, or 33 dollars.

11. If one piece of nankeen cost 116 cents, What is the cost of 4 dozen pieces? Answer, 5568 cents, or 55 dollars and 68 cents.

DIVISION.

TO know how many times one number is contained in another, is the use of Division. It teaches also, to separate any number, or quantity, into any number of parts assigned; and shows how, from any two numbers given, you may find a third, which shall consist of so many units, as the one of those given numbers is contained in the other.

In Division there are *four* principal parts to be understood. The *dividend*, or number to be divided; the *divisor*, or number by which you divide; the *quotient*, or answer to the question, which shows how many times the *divisor* is contained in the *dividend*; and the *remainder*, which is always less than the divisor; and of the same denomination with the *dividend*. The *remainder* is uncertain: for there is sometimes a remainder, and sometimes none.

Division is either *simple* or *compound*. Simple, when the divisor consists of but one figure; and the dividend, of two, or more. Compound, when the divisor consists of two, or more, figures.

To PROVE Division, you may multiply together the quotient and divisor, taking heed to add the remainder, if any there be. If the *product* be like the *dividend*, your work is right; if otherwise, it is wrong.

CASE I. and RULE.

Inquire, first, how many times you can have your divisor in the first figure of the dividend.* When known, place it in the quotient; then multiply the divisor by this quotient figure, and set the product under the left hand figure, or figures, of the dividend, as the case may be; then subtract this product from the figure or figures, of the dividend, under which it is placed, and bring down the next figure of the dividend to the right hand of the remainder; then proceed as in the first instance. If the figure, brought down, be less than the divisor, you must place a cypher in the quotient, and bring down another figure to make a second dividend. You must proceed carefully, in this manner, with all the figures of the dividend, till your work is finished.

EXAMPLES.

7)365(52
35

15
14
---
(1)

* *If you cannot have your divisor in the first figure of the dividend, you must take two, three, or four figures, as the case may require.*

4)9236(3)6969(4)862468(

6)7436(8)74236(9)723642(

Multiplying the quotient by the divisor, is a sure way of proving *division*, as already mentioned. But long division, may be proved by addition.

1 *Proof by Addition.*

RULE.

Add together the remainder and all the bottom lines, and if their sum be like the dividend, the work is right.

1.	2.	3.
23)44(1	26)742(28	37)8236(222

N. B. The asterisms show the bottom lines and the remainder, which are to be added together, as proof.

4.	5.
462)742364(1606	634)2674236(4218
* 462	* 2536
2803	1382
* 2772	* 1268
316	1143
* 000	* 634
3164	5096
* 2772	* 5072
* 392	* 24
Proof 742364	2674236 proof.

EXAMPLES.

23)42674(46)2367423(72)936742367(324(6324674(

Examples, in which only the remainder, and the proof by the excess of nines, are set down.

4)63426742(6)72314267(5)4236742(3)14674236(

14)6234674(18)67423674(28)62347742(54)62342674(

Case 2.

When the divisor does not exceed 12, the operation is called *short* division.

Rule.

Inquire how often you can have the divisor, in the first figure, or figures, of the dividend. Then multiply, in your mind, the divisor by the quotient figure, and subtract the product from a like number of figures, at the left hand of your dividend. The unit, or units, which remain, if there be any, must be reckoned as so many tens, which you must consider as standing at the left hand of the next figure of the dividend, and to be reckoned with it; then inquire how often you can have your divisor in these two figures. If nothing remain, you must inquire how often you can have the divisor in the next figure, and thus proceed, till the work is done.

Examples.

Divisor 2)6482648 dividend.
3241324 quotient.

2

6482648 proof.

6)7423	4)8637	8)9367	3)874
10)9423	11)6345	12)9436	6)7423

5)942367423674 7)842364936423

Case 3.

In dividing by 110, 120, 1100, or 12000, &c. the learner has nothing to do, but to cut off, or separate the cyphers, in the divisor, 110, 120, &c. and cutting off, or separating a like number of figures from the right hand of the dividend.

Examples.

110)9423678	1100)634278	1100)2367423
120)637426	120)7863478	130)9023674
140)23674923	150)6342786	150)72367425
1600)9423674237	1700)823674236	18000)236742634
12000)2367426378	19000)634267894	19000)7236423655
11)72646206	12)76677240	11)47627000
		12)42007400

By fully understanding the above examples, you may expeditiously divide, by 110, 120, 1100, or 1200, &c. For, in the operation you have nothing to do, except cutting off, or separating the cyphers from 11, and 12, (when these numbers happen to be the divisors) and separating, or cutting off, the like number of figures, or cyphers, from the right hand of your dividend. And then proceed, as in the above examples.

Divisor 11)0)3456(7

314

Case 4.

To divide by 10, 100, 1000, 10000, 100000, &c.

Rule.

Cut off, or separate, as many figures or cyphers, from the right hand of your dividend as you have cyphers in the divisor, and your work is done; for the remaining figures of your dividend will be the quotient, and those cut off, the remainder.

10)123456789	100)123456789	1000)123456789
10000)123456789	100000)123456789	1000000)123456789
1000)462346	1000)72364236	10000)7236742
10000)634267423	100000)36423674	1000000)6236742643

To exercise the pupil, we shall add some promiscuous examples and questions, under addition, subtraction, multiplication, and division.

1. Add together 42, 602, 7046, 47823, 460766, and 74. Ans. 516373.

2. What is the number, being added to 24978792879, that will produce 46324674236? Ans. 21345881357.

3. John owes Peter 6342 dollars, and has paid 5986, what sum is still due to Peter? Ans. 356.

4. The amount due from A. B. C. and D. to F. is 63427 dollars; A. has paid 279; B. 3784; C. 742, and D. 46. What is still due to F? Ans. 58576 dols.

5. Six men in partnership, have, in stock, 74628 dollars, of which M. put in 436; L. 792; S. 4623; N. 6742; and Q. 2763; what did H. put in? Ans. 59272.

6. How many pence are there in one dollar, a half dollar, a quarter of a dollar, a shilling, and six pence, estimating a dol. at 8 shillings? Ans. 186 pence.

7. A vessel, containing 422 pieces of nankeen; 456 chests of Hyson tea; 397 pieces muzlin; 4276 yards silk; 674 yards cassimer, and 7496 yards of chintzes, was taken by 86 men, and equally divided among them. How much of each kind fell to each man's share? Ans. 4 pieces nankeen, and 78 remaining; 5 chests of Hyson, and 26 remaining; 4 pieces muzlin, and 53 remaining; 49 yards of silk, and 62 remaining; 7 yards cassimer, and 72 remaining; 87 yards chintzes, and 14 remaining.

8. The undivided remainders of the above cargo were sold for 5276 dollars. How many dollars fell to each man's share? Ans. 61 dollars, 34 cents, 8 mills, and $\frac{72}{86}$ of a mill.

9. Socrates, the famous Grecian philosopher, was put to death 400 years before the birth of Christ.—General Washington died 1799 after the birth of Christ. What is the difference of time? And how old would Socrates be, if he had lived to this year 1806? 1 Ans. 2199, 2 Ans. 2206. The last answer makes no allowance for Socrates' age.

10. The world was created 4004 years before the birth of Christ. Gen. Washington was born 1732 years after the birth of Christ. How old was the world when Washington was born? Ans. 5736.

COMPOUND ADDITION.

Compound Addition is the adding of several numbers together, having divers denominations.

Rule.

1. Place the numbers of a similar denomination under each other, and separate each denomination, by a comma. The lowest denomination should, ever, be in the right hand column.

2. Begin with the right hand column first; add it up, and see how many of the next denomination are contained in the first column, carry the ones, or the sum to the second column, set the overplus directly under the first column. Then begin with the second column, and proceed in the above manner, till the operation be finished.

Of Money.*

4 Farthings (*qrs.*) make one penny *d.*
12 Pence —— one shilling *s.*
20 Shillings —— one pound *l.*
£. *l.*=20*s.*=240*d.*=960*qrs.*

$\frac{1}{4}d.=1$ *qr.*
$\frac{1}{2}d.=2$ *qrs.*
$\frac{3}{4}d.=3$ *qrs.*

Pence Table.

d.		*s.* *d.*	*s.*		*d.*	*s.*		*l.* *s.*
20	=	1 8	2	=	24	30	=	1 10
30	=	2 6	3	=	36	40	=	2 0
40	=	3 4	4	=	48	50	=	2 10
50	=	4 2	5	=	60	60	=	3 0
60	=	5 0	6	=	72	70	=	3 10
70	=	5 10	7	=	84	80	=	4 0
80	=	6 8	8	=	96	90	=	4 10
90	=	7 6	9	=	108	100	=	5 0
100	=	8 4	10	=	120	110	=	5 10
110	=	9 2	11	=	132	120	=	6 0
120	=	10 0	12	=	144	130	=	6 10

Examples.

l.	*s.*	*d.*	*qr.*	*l.*	*s.*	*d.*	*qr.*	*l.*	*s.*	*d.*
42,	16,	8,	2	567,	14,	6,	3	37,	14,	$8\frac{1}{4}$
68,	17,	7,	3	48,	17,	4,	2	26,	15,	$9\frac{1}{2}$
76,	9,	10,	2	467,	18,	6,	3	48,	19,	7
48,	12,	8,	1	384,	14,	9,	2	68,	13,	$10\frac{3}{4}$
67,	13,	11,	2	146,	17,	10,	1	46,	17,	9
304,	10,	10,	2							

l.	*s.*	*d.*	*qr.*	*l.*	*s.*	*d.*	*qr.*	*l.*	*s.*	*d.*	*qr.*
93,	14,	6,	2	146,	12,	7,	2	4126,	13,	7,	2
74,	10,	7,	3	793,	14,	5,	3	6729,	17,	4,	3
87,	16,	9,	2	296,	15,	6,	2	8274,	16,	7,	2
46,	12,	11,	1	472,	18,	4,	1	7423,	18,	9,	1
79,	18,	10,	3	629,	13,	7,	2	2346,	14,	6,	3

* *Sterling money was, formerly, of the same value in all the Colonies of North-America. By reason, however, of a paper currency, a dollar was reckoned, in*

New-England, Virginia and Kentucky, - - 6*s.*
Pennsylvania, New-Jersey, Delaware and Maryland, 7*s.* 6*d.*
New-York and North-Carolina, - - - 8*s.*
South-Carolina and Georgia, - - - 4*s.* 8*d.*
In all the Colonies, one pound was the integer.

l.	s.	d.	qr.	l.	s.	d.	qr.	l.	s.	d.	qr.
89723,	14,	7,	2	7823,	14,	2,	3	123,	14,	7,	3
63742,	19,	6,	2	4267,	18,	9,	2	763,	17,	9,	2
27469,	17,	2,	3	3462,	14,	8,	3	406,	10,	10,	0
42674,	13,	6,	2	4263,	17,	7,	2	802,	4,	4,	3
93672,	18,	7,	1	6342,	18,	9,	2	960,	00,	4,	2
40620,	15,	11,	3	7464,	11,	10,	3	874,	16,	0,	2
67082,	15,	6,	2	9467,	10,	11,	2	786,	14,	7,	3
37492,	10	3,	1	7402,	13,	4,	2	947,	16,	6,	1

Troy Weight.*

24 Grains *(gr.)* make 1 penny weight, pwt.
20 Penny Weights — 1 ounce, oz.
12 Ounces — 1 pound, lb.

Examples.

lb.	oz.	pwt.	gr.	lb.	oz.	pwt.	gr.	lb.	oz.	pwt.	gr.
24,	8,	18,	20	74,	10,	13,	20	55,	6,	14,	18
28,	9,	17,	22	84,	9,	16,	22	84,	7,	16,	19
69,	7,	16,	23	49,	6,	17,	18	37,	10,	17,	18
74,	6,	19,	18	68,	8,	13,	17	28,	6,	14,	23

Avoirdupois Weight.†

16 Drams *(dr.)* make 1 ounce, oz.
16 Ounces —— 1 pound, lb.
28 Pounds —— 1 quarter of a hundred, qr.
4 Quarters —— 1 hundred weight, cwt.
20 Hund. Weight —— 1 ton T.

Examples.

T.	cwt.	qr.	lb.	oz.	dr.	lb.	oz.	dr.
78,	18,	2,	22,	13,	14	17,	14,	15
28,	19,	3,	26,	12,	15	14,	12,	13
76,	18,	1,	37,	14,	12	16,	15,	15
87,	17,	2,	22,	15,	13	20,	10,	12

* *By this weight are weighed all jewels, gold, silver, plate, pearl, medicines, and liquors.*

† *All coarse and drossy goods are weighed by this weight.*

Apothecaries' Weight.

20 Grains (*gr.*)	make 1 scruple,	℈.
3 Scruples	—— 1 dram,	ʒ.
8 Drams	—— 1 ounce,	℥.
12 Ounces	—— 1 pound	℔.

Examples.

℔.	℥.	ʒ.	℈.	gr.
84,	9,	5,	2,	18
67,	10,	6,	1,	16
54,	8,	5,	2,	17
46,	6,	7,	2.	16

℔.	℥.	ʒ.	℈.	gr.
84,	10,	7,	1,	17
67,	11,	6,	2,	16
47,	10,	4,	1,	18
46,	8,	6,	2,	19

Cloth Measure.

4 Nails, (*na.*)	make 1 quarter,	qr.
4 Quarters	—— 1 yard,	yd.
5 Quarters	—— 1 ell English,	E. E.
3 Quarters	—— 1 ell Flemish,	E. Fl.
6 Quarters	—— 1 ell French,	E. Fr.

Examples.

yd.	qr.	na.
468,	3,	2
384,	2,	3
767,	3,	2
846,	2,	3

E.E.	qr.	na.
786,	4,	3
643,	3,	3
486,	4,	2
764,	3,	1

E.Fl.	qr.	na.
78,	2,	2
86,	2,	3
87,	1,	2
96,	2,	3

Dry Measure.

2 Pints (*Pt.*)	make 1 quart,	qt.
8 Quarts	—— 1 peck,	pk.
4 Pecks	—— 1 bushel,	bu.*

* *Grain, Salt, &c. are measured by struck measure: but Pears, Apples, Potatoes, Turnips, &c. are heaped to a handsome rounding measure.*

Examples.

bu.	pk.	qt.	pt.
384,	2,	6,	1
476,	3,	7,	1
286,	2,	6,	1
185,	3,	4,	1

bu.	pk.	qt.	pt.
78,	3,	5,	1
19,	2,	6,	0
28,	3,	5,	1
86,	2,	7,	1

Liquid Measure.*

4 gills	(*gl.*) make	1 pint,	pt.
2 pints	——	1 quart,	qt.
4 quarts	——	1 gallon,	gal.
31½ gallons	——	1 barrel,	bl.
42 gallons	——	1 tierce,	tier.
63 gallons	——	1 hogshead,	hhd.
2 hogsheads	——	1 pipe,	p.
4 hogsheads	——	1 ton,	T.

Examples.

T.	hhds.	gal.	qt.	pt.
48,	3,	60,	2,	1
69,	2,	58,	2,	1
87,	3,	62,	2,	1
19,	2,	46,	3,	1

hhd.	gal.	qt.	pt.	gl.
2,	48,	2,	1,	3
3,	46,	3,	1,	2
3,	28,	2,	1,	3
2,	56,	2,	1,	2

Measure of Time.

60 seconds	(*sec.*) make	1 minute,	min.
60 minutes	——	1 hour,	h.
24 hours	——	1 day,	d.
7 days	——	1 week	w.
4 weeks	——	1 month,	mon.
13 months, or 365 days and 6 hours.†	——	1 year,	y.

* *Brandy, Spirits, Perry, Cider, Vinegar, Mead, Honey, Oil, and Milk, are measured by this measure.*

† *According to the best computation, a solar year consists of 365 days, 5 hours, 48 minutes, and 55 seconds. But by the calendar, it is divided in the following manner.*

Nо more days than 30, hath the month of September,
The same may be said of June, April, November:
The rest of the months have just 30 and one,
Except that short month, February, alone,
Which to itself claimeth just 8 and a score,
But in every leap year we give it one more.

Examples.

y.	mon.	w.	d.	h.	min.	sec.
78,	11,	2,	4,	20,	28,	40
67,	10,	2,	3,	17,	46,	25
84,	9,	3,	6,	22,	40,	56,
69	7,	2,	5,	18,	56,	39

y.	d.	h.
78,	285,	16
29,	176,	22
87,	317,	23
96,	284,	19

Long Measure.*

3 barley corns (*b.c.*)	make 1 inch,	in.
12 inches	—— 1 foot,	ft.
3 feet	—— 1 yard,	yd.
5½ yards or 16½ feet	—— 1 rod or pole,	rd *or* p.
40 rods	—— 1 furlong,	fur.
8 furlongs	—— 1 mile,	m.
3 miles	—— 1 league,	lea.
69½ miles	—— 1 deg. on the earth,	°
360 degrees	—— circum. of the earth.	

Examples.

m.	fur.	rd.	yd.	ft.	in.	b.c.
9723,	7,	28,	3,	1,	7,	2
7864,	4,	35,	4,	2,	9,	1
3074,	5,	27,	3,	2,	5,	2
7402,	6,	29,	2,	1,	8,	2

m.	fur.	rd.	yd.	ft.	in.	b.c.
786,	6,	30,	5,	2,	10,	1
643,	7,	28,	4,	1,	9,	2
487,	6,	36,	3,	1,	8,	1
678,	5,	38,	2,	2,	10,	2

Solid, or Cubic Measure.

1728 inches make	1 foot,	ft.
40 feet of timber make	1 ton, or load,	T.
128 feet, or 8 feet long, 4 feet high, and 4 feet wide, make	1 cord of wood,	C.

Example.

C.	ft.	in.
678,	112,	1600
776,	114,	1560
489,	76,	860
376,	118,	1187

* 66 *Feet, or 4 rods, make a Gunter's chain.*
60 *Geometrical miles make a degree.*
6 *Feet make one fathom—4 inches one hand.*

Land, or Square Measure.

144 inches (*in.*)	make 1 foot,	ft.
9 feet	—— 1 yard,	yd.
30¼ yards or 272¼ feet	1 rod,	rd.
40 rods	—— 1 rood,	r.
4 roods	—— 1 acre,	a.
640 acres	—— 1 mile,	m.

Examples.

a.	r.	rd.
789,	3,	28
678,	2,	36
437,	3,	29
267,	2,	38

a.	r.	rd.	ft.	in.
78,	2,	20,	212,	120
69,	3,	36,	182,	116
78,	2,	30,	196,	134
67,	3,	38,	107,	140

COMPOUND SUBTRACTION

Teaches how to find the difference, or inequality, of any two sums of divers denominations.

Subtraction of Money.

Rule.

Place those numbers under each other which are of the same denomination; the less being placed below the greater, begin with the least denomination, and if it exceed that in the upper, you must borrow as many units as make one of the next greater; and then proceed as you were directed in *simple subtraction*, remembering always to add one to the next superior denomination towards the left hand, for that which you borrowed. *Proof*, same as *simple subtraction*.

Examples.

	£.	s.	d.	qr.
From	96,	12,	8,	1
Take	74,	18,	9,	2
Remains	21,	13,	10,	3
Proof	96,	12,	8,	1

	£.	s.	d.	£.	s.	d.	qr.	£.	s.	d.
From	14,	12,	7	77,	11,	6,	1	84,	10,	7½
Take	9,	18,	9	46,	18,	8,	2	46,	8,	8¼
Rem.										
Proof										

£.	s.	d.	qr.	£.	s.	d.	qr.	£.	s.	d.	qr.
97,	15,	6,	2	842,	16,	4,	1	742,	7,	9,	2
56,	19,	7,	3	497,	18,	11,	3	657,	5,	11,	3

£	s.	d.	qr.	£.	s.	d.	qr.	£.	s.	d.	qr.
942,	14,	4,	1	274,	7,	3,	2	7623,	15,	9,	1
296,	17,	5,	3	197,	18,	7,	3	6746,	18,	11,	3

£.	s.	d.	qr.	£.	s.	d.	qr.	£.	s.	d.	qr.
497,	12,	4,	1	874,	10,	2,	2	974,	17,	10,	2
278,	16,	10,	3	495,	16,	8,	3	796,	18,	11,	3

	£.	s.	d.		£.	s.	d.
Borrowed	580,	16,	8	Lent	620,	17,	8
Paid at several times.	124,	14,	6	Received at several times.	140,	13	6
	68,	12,	7		67,	14,	7
	132,	14,	6		84,	15,	9
	76,	18,	7		184,	17,	6
Paid in all				Rec'd in all			
Rem. unp'd				Rem. due			
Proof				Proof			

Troy Weight.

lb.	oz.	pwt.	gr.	lb.	oz.	pwt.	gr.
36,	4,	13,	14	87,	6,	12,	18
27,	9,	10,	16	69,	9,	18,	20

Avoirdupois Weight.

cwt.	qr.	lb.	oz.	T.	cwt.	qr.	lb.	oz.	dr.
78,	2,	19,	14	78,	18,	2,	20,	14,	12
49,	3,	22,	16	39,	19,	1,	26,	12,	13

APOTHECARIES' WEIGHT.

lb.	℥	ʒ	℈	gr.	lb.	℥	ʒ	℈	gr.
86,	4,	4,	1,	14	98,	4,	3,	0,	16
38,	7,	6,	2,	18	69,	2,	6,	2,	17

CLOTH MEASURE.

yd.	qr.	na.	E.E.	qr.	na.	E.Fl	qr.	na.
78,	2,	2	61,	2,	1	98,	1,	2
49,	3.	6	46,	3,	3	19,	2,	3

LIQUID MEASURE.

T.	hhd.	gal.	qr.	pt.	T.	hhd.	gal.	qr.	pt.
367,	2,	48,	2,	1	67,	1,	20,	1,	0
848,	3,	59,	3,	1	69.	2,	38,	2,	1

MEASURE OF TIME.

y.	mon.	w.	d.	h.	min.	sec.	y.	d.	h.	min.
79,	10,	1,	4,	20,	36,	40	48,	112,	18,	22
69,	12,	3,	6,	19,	38,	54	29,	226,	22,	23

LONG MEASURE.

m.	fur.	rd.	yd.	ft.	in.	bc.	fur.	rd.	yd.	ft.
764,	4,	15,	4,	1,	8,	1	28,	20,	3,	1
387,	6,	24,	5,	2,	10,	2	19,	28,	4,	2

COMPOUND MULTIPLICATION

Is the multiplying of divers denominations by one, or more integers, or by a multiplier of divers denominations.

CASE 1.

When the multiplier does not exceed 12: or, when the price is multiplied by the quantity.

RULE.

Multiply separately each denomination in the multiplicand,

beginning at the lowest denomination and carry to the next superior denomination, as in Compound Addition.

EXAMPLES.

	£.	s.	d.
Multiply	7,	12,	6
by			6
Ans.	£.45,	15,	0

In this example, I say, 6 times 6 make 36 pennies, which are 3*s*. Set down 0, in the place of pence and carry 3. to the place of shillings. Then say, 6 times 12 make 72, and 3, that were carried, make 75*s*. or 3*l*. 15*s*. Set down 15 in the place of shillings, and carry 3 to the pounds; and then say, 6 times 7 are 42, and 3, that were carried, make 45*l*.

	£.	s.	d.	£,	s.	d.	qr.	£.	s.	d.
Multiply	38,	10,	6	28,	17,	4,	2	38,	16,	7½
by			5				7			8

	lb.	oz.	pwt.	gr.	cwt.	qr.	lb.	oz.	dr.
Multiply	76,	6,	14,	20	18,	2,	14,	13,	12
by				4					5

	£.	s.	d.	qr.	£.	s.	d.	qr.	£	s.	d.
Multiply	68,	7,	7,	3	93,	14,	6,	2	146,	14.	4½
by				9				8			5

T.	cwt	qr.	lb.	oz.	dr.	T.	cwt.	qr.	lb.	oz.	dr.
76,	19,	3,	26,	12,	13	794,	18,	2.	24	10,	12
					7						5

bu.	pk.	qt.	pt.	bu.	pk.	qt.	pt.	hu.	pk	qt.	pt.
286,	2,	6,	1	79,	3,	5,	1	1472,	3,	6,	1
			7				9				8

T.	bhds.	gal.	qt.	pt.	hhd.	gal	qt.	pt.	gil.	a.	r.	rd.
37,	3,	62,	2,	1	3,	28,	2,	1,	3	687	3,	28
				6					8			9

QUESTIONS.

What is the amount of 6 pieces of ribbon, at 2*s*. 6*d*. per piece?

6

Ans. 15*s*. 0*d*.

What is the amount of 7 lbs. of tea, at 4*s*. 6$d\frac{1}{2}$. per lb.?

What is the amount of 8 days labor, at 5*s*. 9$d\frac{1}{2}$, per day?

What is the amount of 5cwt. of sugar, at 3*l*. 14*s*. 6*d*. per cwt.?

If 1 yard of cloth cost 14*s*. 6*d*. what will 9 yards cost?

9

£.6, 10, 6 *Ans*.

What is the weight of 4 hhds. of sugar, each weighing 6cwt. 2qr. 20lb.?

What is the weight of 6 silver spoons, each weighing 1oz. 12pwt. 14gr.?

How many acres in 6 lots, each containing 75a. 3r. 28rd.?

What is the amount of 15 firkins of butter, each containing 68lb. at 1*s*. 4*d*. per lb.?

What is the amount of 25hhds. of rum, each containing 115gals. at 7*s*. 9*d*. 3*qr*. per gal.?

A husbandman wishing to stock his farm, bought 4 horses at 45$\frac{1}{2}$ dols. each; 7 cows at 15$\frac{1}{4}$ dols. each; 35 sheep at one dol. $\frac{1}{2}$ each; 12 yearlings at 4$\frac{3}{4}$ dols. each; 4 colts at 19$\frac{1}{4}$ dols. each; and 16 swine at 6$\frac{1}{2}$dols. each. What is the amount of the whole stock; and the separate amount of each?

What is the amount of 56 cases of gin, each case containing 8 bottles, at 6*s*. 11*d*. 3*qr*. per bottle?

What is the amount of 642 bushels of wheat, at 1 dol. and a quarter per bushel?

What is the weight of 25 loads of hay, each weighing 16cwt. 3 qr. 25lb. 7oz.?

What is the weight of 125 fat oxen, each ox weighing 895wt. 14 oz.?

What is the weight of 376 fat sheep, each quarter weighing 22lb. 13oz.?

What is the amount of 649 pieces of callico, each piece containing 50yds. at 3*s*. 7*d*. 3*qr*. per yd.?

What is the amount of 1249 pieces of tape, each piece containing 75yds. at 1*d*. 3*qr*. per yd.?

What is the amount of 96 bales of cotton, each bale containing 235lb. at 3*s*. 7*d*. 3*qr*. per lb.

What is the amount of 84hhds. of sugar, each hhd. containing the wt. of 3 barrels, and each barrel containing 263lb. at 14*d*. 3*qr*. per lb.?

What is the amount of 94 hhds. of molasses, each hhd. containing 127 gals. at 5*s*. 9*d*. 3*qr*. per gal.?

What is the amount of 44 barrels of linseed oil, each barrel containing 31 gals. at a dol. and a quarter per gal.?

What is the cost of 89 dozen penknives, each knife costing 1*s.* 8*d.* 2*qr.*?

What is the amount of 23 days labor, at 4*s.* 6*d.* 2*qr.* per day?

What is the amount of 749yds. of broadcloth at 1*l.* 12*s.* 6*d.* 3*qr.* per yd.?

If 1 gal. of brandy cost 7*s.* 4*d.* 2*qr.* what is the cost of 347hhds. each containing 127 gals.?

CASE 2.

When the multiplier is any number, produced by multiplying together any two numbers found in the table of multiplication.

RULE.

Multiply the given price by two such numbers as, when multiplied together, will produce the given quantity; as, suppose it to be 42; by the multiplication table you will find that 6 times 7 make 42.—Multiply the given price by the 6, or 7, first, and that product by the other: The last product will be the answer.

What is the amount of 42 bushels of corn, at

4*s.* 6*d.* per bushel?

$6 \times 7 = 42$

6

1, 7, 0

7

£.9, 9, 0 *Ans.*

What is the amount of 72lbs. of flax, at 1*s.* 2½*d.* per lb.?

What is the amount of 24 bushels of potatoes, at 2*s.* 6*d.* per bushel? *Ans.* 3*l.*

What is the amount of 96 acres of land, at 4*l.* 16*s.* 8*d.* per acre? *Ans.* 464*l.*

What is the amount of 144 sheep, at 6*s.* 8½*d.* per head? *Ans.* 48*l.* 6*s.*

What is the amount of 49 yds. of cloth, at 18*s.* 4*d.* per yard? *Ans,* 44*l.* 18*s.* 4*d.*

What is the amount of 81 days labor, at 5*s.* 6*d.* 2*qr.* per day?

What is the amount of 54 gals. of spirits, at 8*s.* 7*d.* 2*qr.* per gal.?

What is the amount of 72 bushels of wheat at 8*s.* 4*d.* 2*qr.* per bushel?

What is the amount of 24 horses at 16*l.* 14*s.* 6*d.* per horse?

What is the amount of 63lb. of butter, at 1*s.* 4*d.* per lb.?

What is the amount of 56 cases of knives, at 10*s.* 9*d.* 3*qr.* per case?

What is the amount of 45 yds. of chintz, at 4*s.* 9*d.* 3*qr.* per yd.?

What is the amount of 79lb. 7oz. at 13*s.* per lb.?

Case 3.

When the multiplier cannot be produced by multiplying together any two, or more numbers, found in the *Table*.

Rule.

Multiply by the numbers that come the nearest to the multiplier, and then multiply the multiplicand by that number, which makes up the defioiency ;—add the two products together, and you will have your answer.

Examples.

£.	s.	d.	
At 3,	4,	6	the bag, what will 38 bags of cotton cost ?
		6	
19,	7,	0	
		6	
116,	2,	0	price of 36.
6,	9,	0	price of 2 added.
£.122,	11,	0	*Ans.*

At 4*s*. 6*d*. per bushel, what will 74 bushels of corn cost ? Ans. 16*l*. 13*s*. 0*d*.

At 9*s*. 6*d*. 2*qr*. per bushel, what is the amount of 61 bushels of wheat ?

At 6*d*. 3*qr*. per dozen, what is the amount of 65 dozen of quills ?

At 5*s*. 6*d*. per day what is the amount of 73 days labor ?

At 8*s*. 6*d*. 2*qr*. per gal. what is the cost of 43 gals. of brandy ?

At 12*s*. 7*d*. 2*qr*. per yd. what is the amount of 84 yds of silk ?

To multiply by *fractional* parts, observe the following rule:

Rule.

Multiply the price by the numerator, or upper figure of the fraction, and divide the product, by the denominator, or lower figure of the fraction.

N. B. If the upper figure be 1 only, you may divide the sum by the lower figure, and you will have the answer.

N. B. By fractional parts are meant these, $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{7}$ $\frac{4}{5}$ $\frac{5}{8}$ $\frac{8}{9}$, &c.

Examples.

What is the amount of $\frac{7}{8}$ of a yd. of callico, at 2*s*. 6*d*. per yd.?

2, 6
7

8)17, 6

Ans. 2*s*. 2*d*. 1*qr*.

What is $\frac{3}{4}$ of 35*s*.? Or the amount of $\frac{3}{4}$ of a barrel of rice, at 35*s*. per barrel?

35
3

4)105

26*s*. 3*d*.

What is the amount of $\frac{1}{2}$ of a yd. of sattin, at 1*l*. 7*s*. 6*d*. per yard?

At 3*s*. 4*d*. 2*qr*. per yd. what is the amount of $\frac{5}{8}$ of 1 yd. of durant?

At 9*s*. 4*d*. per bushel, what is the amount of $\frac{3}{5}$ of a bushel of wheat?

At 6*s*. 4*d*. per gal. what is the price of $\frac{2}{4}$ of a gal. of brandy?

At 14*s*. 7*d*. 3*qr*. per yd. what is the price of $\frac{4}{7}$ of a yd. of cloth?

At 28*s*. 9*d*. 2*qr*. per yd. what is the amount of $\frac{5}{9}$ of a yard of broadcloth?

At 1*l*. 4*s*. 6*d*. per yard,* what will 99 yards come to? *Ans.* 121*l*. 5*s*. 6*d*.

Case 4.

When the multiplicand and multiplier are of unlike denominations, but of the same kind, as pounds, shillings, pence, and farthings, multiplied by pounds, shillings, pence and farthings.

To work examples under this case, observe the following directions:

1. Pounds multiplied by pounds, produce pounds.
2. Pounds multiplied by shillings, every 20 is one pound, the rest shillings.
3. Pounds multiplied by pence, every 12 is one shilling, the rest pence.
4. Shillings multiplied by shillings, every 20 is one shilling, every 5 is 3 pence, and each one is 2 farthings, and four tenths of a farthing.
5. Shillings multiplied by pence, every 5 is a farthing, and each one 2 tenth parts of a farthing.

* *Case* 2.

6. Pence multiplied by pence, every 60 is a farthing, and every 6, one tenth part.

EXAMPLES.

l.	*s.*	*d.*		*l.*	*s.*	*d.*			*l.*	*s.*	*d.*		*l.*	*s.*	*d.*
6,	4,	6	×	4,	8,	4			8,	10,	7	×	9,	14,	3

l.	*s.*	*d.*		*l.*	*s.*	*d.*
3,	5,	6	×	2,	12,	9

The Work.

£.	*s.*	*d.*		
3,	5,	6		
2,	12,	9		
6				
2,	6			
	3	3		
	3	0	*qr.*	
		5	3,	4
				9
£.8,	12,	9,	0,	3

CASE 5.

When a shilling, or a foot, &c. are the integer.

To work examples under this case, observe the following directions:

1. Shillings multiplied by shillings, produce shillings.
2. Shillings by pence, every 12 is a shilling, and the rest pence.
3. Shillings by farthings, each one is a farthing.
4. Pence by pence, every 12 is a penny, and each 3 a farthing.
5. Pence by farthings, every 12 is a farthing, and every 3 is a quarter of a farthing.
6. Farthings by farthings, each 12 is a quarter of a farthing.

EXAMPLES.

s.	*d.*		*s.*	*d.*		*s.*	*d.*		*s.*	*d.*		*s.*	*d.*		*s.*	*d.*
8,	4	×	6,	3		14,	9	×	13,	7		2,	6	×	2,	6

The last example is thus wrought:

1. 2×2 make 4; which, according to direction 1, are 4 shillings.
2. 2×6 make 12, and 2×6 make 12, whose sum is 24; which, by direction 2, is 2 shillings.
3. 6×6 make 36; which, by direction 4, make 3 pence.

s.	*d.*
2,	6
2,	6
4,	0
2,	0
	3
6,	3

l.	*s.*	*d.*		*l.*	*s.*	*d.*		*l.*	*s.*	*d.*
44,	6,	7	×	37,	16,	4		74,	14,	6	×	44,	15,	9

842, 14, 9, 2 × 637, 18, 4, 3

As a complete knowledge of this case is of great use in the mensuration of boards, glass, plasterings, &c. I shall state a few questions for the exercise of the learner. He will please to observe, that every foot is divided into 12 inches, and every inch into 4 quarters; and of course he can work according to the directions, as if the statement were shillings, pence, and farthings.

1. What are the contents of a piece of wainscot 8 feet, 6 inches, and 2 quarters long, and 2 feet, 9 inches and 3 quarters broad?

The Work.

	ft.	*in.*	*qr.*
	8,	6,	2
	2,	9,	3
1st direction, 8×2 make 16=	16,	0,	0
2d do 6×2=12, 9×8=72+12=84=	7,	0,	0
3d do. 2×2=4, 8×3=24+4=28=		7,	0
4th do. 9×6=54=		4,	2
5th do. 6×3=18, 9×2=18+18=36=			3
6th do. 3×2=6=			0¾
	24,	0,	1¼

2. What are the contents of a board 16 feet, 10 inches, and 3 quarters long; 2 feet, 7 inches and 2 quarters broad?

3. What are the contents of a plastered wall 34 feet, 8 inches, and 1 quarter long, and 25 feet, 10 inches, and 2 quarters broad?

What are the contents of a board 18 feet, 9 inches, 2 quarters long, and 1 foot, 11 inches and 3 quarters wide?

What are the contents of a floor 16 feet, 9 inches, 3 quarters long, and 15 feet, 7 inches, and 2 quarters wide?

What are the contents of the front of a house, 44 feet, 8 inches, 2 quarters long, and 18 feet, 10 inches, 1 quarter high?

What are the contents of a wainscot 22 feet, 11 inches, 3 quarters long, and 9 feet, 7 inches, 2 quarters high?

What are the contents of a garden, 267 feet, 8 inches 1 quarter long, and 196 feet, 5 inches, and 3 quarters broad?

COMPOUND DIVISION.

Is the dividing of numbers of different denominations.

Case 1.

When different denominations are divided, by any number not exceeding 12.

Rule.

Divide the highest denomination first. The remainder, if any, must be brought to the next lower denomination; and, after adding it to the next lower denomination, divide the sum by your divisor; and proceed thus, with all the denominations, till the work is finished.

Examples.

£.	s.	d.	qr.
3)7,	16,	10,	2
£.2,	12,	3,	2

£.	s.	d.	qr.
4)22,	12,	6,	0
£.5,	13,	1,	2

£.	s.	d.	qr.
5)21,	16,	4,	1

£.	s.	d.	qr.
6)78,	14,	4,	2

4 Men spent at a tavern, £. 2, s. 16, d. 4; what must each pay? *Ans.* 14*s.* 1*d.*

If 5 bushels of corn cost £. 1, s. 2, d. 8, qr. 2; what is that per bushel? *Ans.* 4*s.* 6*d.* 2*qr.*

lb.	oz.	pwt.	gr.
4)22,	9,	18,	16

cwt.	qr.	lb.	oz.	dr.
5)18,	2,	13,	14,	10

T.	hhds.	gal.	qt.	pt.
7)69,	3,	60,	2,	1

hhd.	gal.	qt.	pt.	gil.
8)3,	46,	3,	1,	3

bu.	pk.	qt.	pt.
9)384,	2,	6,	1

bu.	pk.	qt.	pt.
6)78,	3,	7,	1

T.	cwt.	qr.	lb.	oz.	dr.
7)78,	18,	3,	27,	15,	14

T.	cwt.	qr.	lb.	oz.	dr.
9)47,	7,	2,	24,	11,	10

Case 2.

When the divisor is the product of two, or more numbers multiplied together, as they are found in the table.

Rule.

Divide, first, by one of those numbers, and the quotient by the other. The last quotient will be the answer.

Examples.

£.	s.	d.	qr.	
36)12,	16,	7,	2	In this example, as 6 times
6)12,	16	7,	2	6 are 36, so 6 and 6 are the two divisors.
6)2,	2,	9,	1	
£.0,	7,	1,	2½ *Ans.*	

£.	s.	d.
20)18,	16,	4

£.	s.	d.
72)84,	13,	9

£.	s.	d.
144)986,	16,	8

£.	s.	d.	qr.
72)973,	15,	6,	3

£.	s.	d.	qr.
96)5246,	19,	8,	2

lb.	oz.	pwt.	gr.
54)69,	7,	16,	23

lb.	oz.	pwt.	gr.
63)84,	7,	16,	19

T.	cwt.	qr.	lb.	oz.	dr.
45)84,	17,	2,	3,	14,	13

T.	cwt.	qr.	lb.	oz.	gr.
81)94,	18,	3,	5,	12,	10

℔.	℥.	ʒ.	℈.	gr.
49)67,	9,	5,	1,	18

℔.	℥.	ʒ.	℈.	gr.
93)97,	11,	5,	2,	16

bu.	pk.	qt.	pt.
48)384,	2,	6,	1

bu.	pk.	qt.	pt.
132)674,	3,	5,	2

a.	r.	rd.
120)6723,	3,	37

a.	r.	rd.
108)579,	2,	25

y.	m.	w.	d.	h.	min.	sec.
99)23,	7,	2,	5,	18,	56,	34

y.	d.	h.	min.
96)146,	234,	23,	59

Multiplication and division mutually prove each other.

Questions resulting from the preceding Rules.

1. What is the sum of 47+29+76+34+98?
2. What is the sum of 24789—19867?
3. There is an orchard, in which grow 40 trees, and each tree hath ten limbs, and each limb has 20 branches, and on each branch there are 30 apples; how many apples are there in all?
Ans. 240,000 apples.
4. 436 men take a prize worth £1569 what must each receive?
5. What is the sum of 24*l.* 13*s.* 6*d.* 2*qr.*+98*l.* 18*s.* 7*d.*+36*l.* 14*s.* 6*d.* 1 *qr.*+100*l.* 17*s.*?
6. What is the product of 4*s.* 7*d.* 3*qr.*×6?
7. What is the quotient of 9*l.* 6*s.* 8*d.* 3*qr.*÷8?
8. A feast for 36 men cost 19*l.* 17*s.* 9*d.* 3*qr.* what must each man pay?
9. 18 men took a prize worth 463*l.* 18*s.* 6*d.* what is each man's share?
10. What are the contents of a floor 18 feet, 10 inches and 3 quarters long, and 12 feet 8 inches and 2 quarters broad?
11. What is the product of 4*s.* 6*d.*×2*s.* 8*d.*?

12.

		£.	s.	d.	qr.		£.	s.	d.	qr.
+	467	+ 426,	7,	6,	2		276,	14,	8,	2
	238	536,	14,	9,	3		198,	19,	11,	3

13.

	£.	s.	d.	qr.		£.	s.	d.		£.	s.	d.	qr.
×	147,	15,	6,	2	÷	237,	18,	2	+	678,	15,	7,	3
by				7	by	74			by	72			

14.

	£.	s.	d.	qr.		lb.	oz.	pwt.	grs.
×	346,	14,	7,	3	÷	379,	6,	9,	16
by	48				by	81			

15. 163 men took a prize worth 723*l.* 16*s.* 9*d.* of which the captain had four shares; the first lieutenant, three; the second lieutenant, two; what was the share of each officer, and each private?
16. A tract of land, containing 14378a. 3r. 37rd. 9ft. 137in. is to be equally divided among 236 men, what is each man's share?
17. A West India cargo of 69T. 2hhds. 57gal. 3qt. 1pt. of molasses, is to be equally divided among 27 men, what is each man's share?

18.

	lb.	℥.	ʒ.	℈.	gr.		lb.	℥.	ʒ.	℈.	gr.
	84,	6,	5,	1,	15	×	47,	8,	6,	2,	19
	67,	8,	7,	2,	18	by	43				

÷ 846, 2, 3

T. cwt. qr. lb. oz. dr.
÷ 76, 18, 3, 25, 14, 13
by 37

REDUCTION.

By *Reduction* we change money, measures, weights, &c. out of one denomination into another, and yet retaining the same value. Of this there are two kinds, viz. Reduction Descending, and Reduction Ascending.

1. Reduction Descending is performed by multiplication.
2. Reduction Ascending is performed by division.

REDUCTION DESCENDING.

Rule.

Multiply the highest denomination, by the number of the next less which makes one of that highest; be careful to add to your product the figures of your next less denomination, and proceed in this manner till you have finished the work.

Of Money.

1. In 86*l.* 14*s.* 6*d.* 2*qr.* How many farthings?

£. *s.* *d.* *qr.*
86, 14, 6, 2
× 20=*shillings in a pound.*

1734=*shillings.*
× 12=*pence in a shilling.*

20814=*pence.*
× 4=*farthings in a penny.*

83258=*farthings*; the Answer.

In multiplying by 20, I added the 14*s.* In ×12, I added the 6*d.* In ×4, I added 2*qr.* Which must always be done in similar cases.

To prove questions in this rule, change the order of them. The foregoing question will become—In 83258 farthings, How many pounds?

4)83258

12)20814*d.* 2*qr.*

2)0)173(4*s.* 6*d.*

Ans. 86*l.* 14*s.* 6*d.* 2*qr.* proof.

2. In 397*l.* 16*s.* 7*d.* 3*qr.* How many farthings? *Ans.* 381919.
3. In 156 dollars at 6*s.* How many farthings? *Ans* 44928.
4. In 46*l.* 12*s.* 8*d.* How many half pence? *Ans.* 22384.
5. In 48 guineas at 28*s.* How many farthings? *Ans.* 64512.
6. In 68*l.* How many groats, or fourpences? *Ans.* 4080.
7. In 1796lb. Troy Weight, how many grains?
8. In 4678 oz. Troy Weight, how many grains?
9. In 2347 T. 15cwt. 1qr. 18lb. 9oz. 14drs. How many drams?
10. Anaximander, the Grecian philosopher, lived about 600 years prior to the birth of Christ, How many seconds since, to the year 1806?
11. Gen. Washington died, December 14, 1799, How many seconds since, to December 14, 1806?
12. American Independence was declared, July 4, 1776, How many minutes since, to July 4, 1806, and hours, and days, and weeks, and months, and years?
13. In 7296 miles, How many inches?
14. In 3476 acres, How many inches, feet, rods, and roods?
15. In a pile of wood 37 feet long and 14 feet high, How many cords?
16. In 86hhds. brandy, each containing 146 gals. How many gills?

REDUCTION ASCENDING.

By Reduction Ascending, less denominations are brought into higher.

RULE.

First, divide the sum by that number, which it takes to make one in the next higher denomination; secondly, divide the greatest, which it takes in that denomination, to make one in the next higher; and proceed in the same manner, through all the denominations, till the work be done.

EXAMPLES.

1. In 86435 farthings, How many pence, shillings, and pounds?

Farthings in a penny 4)86435

Pence in a shilling 12)21608*d.* 3*qr.*

Shillings in a pound 2)0) 180(0*s.* 8*d.*

£.90, 0*s.* 8*d.* 3*qr.* *Ans.*

By inverting the question it becomes; In 90*l.* 0*s.* 8*d.* 3*qr.* How many farthings?

£.	s.	d.	qr.
90,	0,	8,	3
20			
1800			
12			
21608			
4			

Ans. 86435, proof *of the first question.*

2. In 68160 farthings, How many pounds? *Ans.* 71*l.*
3. In 7864 pence, How many pounds? *Ans.* 32*l.* 15*s.* 4*d.*
4. In 8674 half pence, How many pounds? *Ans.* 18*l.* 1*s.* 5*d.*
5. In 78640 farthings, How many dollars at 6*s.* each?
Ans. 273*D.* and 4*d.*
6. In 3452 sixpences, How many pounds? *Ans.* 86*l.* 6*s.*
7. In 9763*l.* How many farthings?
8. In 52371b. Troy Weight, How many grains?
9. In 7365T. Avoirdupois Weight, How many drams?
10. In 6321b. Apothecaries' Weight, How many grains?
11. In 22T. Liquid Measure, How many gills?
12. In 360 degrees, How many barley corns?

REDUCTION DESCENDING AND ASCENDING.

This is performed by Multiplication and Division.

1. In 276*l.* 12*s.* How many pence?

20	
5532	
12	
66384	*Ans.*

2. In 66384 pence, How many pounds?

12)66384

2)0)553(2

276*l.* 12*s.* *Ans.*

3. In 39*l.* How many farthings and dollars at 6*s.*?

20	
780	6)780=*shillings.*
12	130 dollars, *Ans.*
9360	
4	
37440 farthings, *Ans.*	

4. In 6*l.* 1*s.* How many threepences, fourpences and sixpences? *Ans.* 484 *threepences*, 363 *fourpences*, 242 *sixpences*.

5. In 12180 threepences, How many shillings, pence, and fourpences? *Ans.* 3045*s.*; 36540*d.*; 9135 *fourpences*.

6. In 144 guineas at 28*s.* How many pounds? *Ans.* 201*l.* 12*s.*

7. In 78 dollars how many ninepences? *Ans.* 624.

8. In 841*l.* How many sixpences and crowns, at 6*s.* 8*d.*? *Ans.* 2523 *crowns*; 33640 *sixpences*.

9. In 73920 farthings, How many pounds and guineas at 28*s.* each? *Ans.* 77*l.*; 55 *guineas*.

10. In 28*l.* How many sixpences, fivepences, fourpences, threepences, and twopences, and of each an equal number? 6*d.*+5*d.*+4*d.*+3*d.*+2*d.*=20*d.* and 28*l.*=6720*d.*÷20=336 *of each sort*. *Ans.*

TROY WEIGHT.

lb. oz. pwt. gr.

1. In 86, 10, 19 21, How many grains?

× 12=*ounces in a pound.*

1042

× 20=*penny weights in an ounce.*

20859

× 24=*grains in a penny weight.*

83437
41720

500637=*grains*; *the answer.*

lb. oz. pwt.

2. In 78, 5, 18, How many penny weights? *Ans.* 18838 *pwt.*

3. In 500637 grains, How many pounds? *Ans.* 86lb. 10 oz. 19pwt. 21 gr.

4. In 18838 pwt. How many pounds? *Ans.* 78lb. 5oz. 18pwt.

Avoirdupois Weight.

cwt. qr. lb. oz.

1. In 36, 2, 14, 13 How many ounces?

4

146

28

1172

293

4102

16

24615

4103

65645 oz. *Ans.*

Proof.

16)65645

28)4102, 13 oz.

4)146, 14lb.

36, 2qr. 14lb. 13oz.

2. In 3 tons of hay, How many pounds? *Ans.* 6720lb.

cwt. qr. lb.

3. In 7, 3, 10, How many drams? *Ans.* 224768dr.

4. In 6720lbs. How many tons? *Ans.* 3 tons.

5. In 224768 drams, How many cwt.? *Ans.* 7cwt. 3qr. 10lb.

6. In 5hhds. of sugar, each weighing 9cwt. 12lb. How many pounds? *Ans.* 5100lb.

Apothecaries' Weight.

℔. ℥. ʒ. ℈. gr.

1. In 8, 6, 4, 1, 12, How many grains?

12

102

8

820

3

2461

20

49232 *Ans.*

℔. ℥. ʒ.

2. In 12, 8, 3, How many drams? *Ans.* 1219dr.

3. In 49232 grains, How many pounds? *Ans.* 8lb. 6℥. 4ʒ. 1℈. 12gr.

4. In 73140 grains, How many pounds? *Ans.* 12lb. 8℥. 3ʒ.

Cloth Measure.

yds. qr. na.
1. In 47, 3, 2, How many nails?
4,

191
4

766 *Ans.*

2. In 766 nails, How many yards? *Ans.* 47yds. 3qr. 2na.
3. In 748 ells French, How many ells English, ells Flemish, yards, quarters, and nails? *Ans.* 897E.E. 3qr.—1496E.Fl.—1122ds.—4488qrs.—17952na.
4. In 4 pieces of cloth, each 14 yards, How many nails? *Ans.* 896na.

Dry Measure.

bu. pk. qt. pt.
1. In 36, 2, 6 1 How many pints? *Ans.* 2349 pts.
2. In 2349 pints, How many bushels? *Ans.* 36bu. 2pk. 6qt. 1pt.

Liquid Measure.

1. In 6048 gills, How many hogsheads? *Ans.* 3hhds.
2. In 67892 pints, How many barrels? *Ans.* 269bls. 13gal.
3. If a person drink 3 quarts of cider a day, How much would that amount to in a year? *Ans.* 8bls. 21gal. 3qts.
4. If a person be desirous to draw off 4bls. of cider into bottles, containing pints, quarts, and two quarts, and of each an equal number, How many must he have? *Ans.* 144 of each sort.

Time.

y. m. w. d. h. min. sec.
1. In 46, 10, 3, 4, 18, 53, 29 How many seconds?
Ans. 1361818409 seconds.
2. In 1361818409 seconds, How many years.
Ans. 46y. 10m. 3w. 4d. 18h. 53m. 29sec.
3. Since Christ, have elapsed 1799 years; in which how many hours, minutes, and seconds, allowing the year to contain 365 days, and 6 hours? *Ans.* 15770034h. 946202040min. 56772122400 sec.

Long Measure.

1. In 5 miles, How many barley corns? *Ans.* 950400b.c.
2. In 570240 barley corns, How many miles? *Ans.* 3 miles.
3. The circumference of the earth is 360 degrees, and each

degree 69½ miles; How many barley corns will reach round it? *Ans.* 4755801600 b.c.

4. How many more times will the forward wheels of a coach turn round, than the hind wheels, in running from Mendon to Boston, which is 37 miles, supposing the circumference of the hind wheels is 15½ feet, and the forward wheels 14 feet? *Ans.* 1351.

Solid, or Cubic Measure.

1. In 6 cords of wood, How many solid inches? 6×128×1728 =1327104 in. *Ans.*

2. In 3 solid feet, How many solid inches? 3×3×3×1728= 46656in. *Ans.*

3. How many feet in a stick of timber 35 feet long, and 2 feet square? 2×2×35=140 feet, *Ans.*

Here observe, if you multiply the length, breadth, and depth, of any regular solid, together, it will give the contents.

If two dimensions, (either length, breadth, or depth,) are multiplied in feet, and the other in inches, and you divide by 12, the quotient will be feet, if one is multiplied in feet, and the other two in inches, divide by 144, and the quotient will be feet.

4. How many feet in a stick of timber 30 feet long, 2 feet wide, and 13 inches thick? 30×2×13=780÷12=65 feet, *Ans.*

5. If a stick of timber be 28 feet long, 8 inches wide, and 6 inches thick, how many feet? 28×8×6=1344÷144=9⅓ feet, *Ans.*

Land, or Square Measure.

1. In

a.	r.	rd.
24,	2,	36,
4		
98		
40		
3956		

How many rods? *Ans.*

2. If a room be 14 feet long, and 13 feet wide, how many feet of boards will it take to lay the floor? 14×13=182 feet, *Ans.*

3. If a field be 60 rods long, and 45 rods wide, How many acres does it contain? 60×45=2700÷160=16 *acres*, 140 *rods*, *Ans.*

4. If a house be 36 feet long, and the rafters 28 feet; How many shingles will it take to cover it, allowing each shingle to be 4 inches wide, and each course to be laid out 5 inches? *Ans.* 14515⅓.

RULE OF THREE.

For its usefulness, in *Arithmetic* and other parts of *Mathematical* learning, this *rule* is sometimes, called the *Golden Rule.* And as the *terms*, of which it is composed, bear a certain proportion to each other, it has obtained the name of *the Rule of Proportion.*

In this *Rule*, *three terms* are always given, to find a *fourth.* The *fourth term* bears such a proportion to the *third*, as the *second* doth to the *first.*

Of this *Proportion* there are two kinds; one is called *direct*; and the other *indirect*, or *reverse.*

If the *third term* be greater than the *first*, and require the *fourth term* to be greater than the *second*; or, if the *third* be less than the *first*, and require the *fourth term* to be less than the *second*, the question is in *Direct Proportion.*

But if the *third term* be greater than the *first*, and require the *fourth* to be less than the *second*; or, if the *third* be less than the *first*, and require the *fourth* to be greater than the *second*, the question belongs to *Reverse Proportion.*

To *state the question*, or to place the *three* terms properly, is the chief difficulty attending the *Rule of Three*: To remove which, observe the following *rules*:

Rule 1.

Place that number, that asks the question, for your *third* number; which generally has such words as these before it, *How far? What cost? What will? How many? How much?* &c. That number which is of the same name, or quality, of your *third* number, place for your *first* number. That number, which is of the same name, or quality, of the *fourth* term, or answer required, place for your *second* number, or term.

2. Reduce the first and third numbers to the lowest denomination, mentioned in either of the two numbers; and reduce your second number to its lowest denomination; that is, if they consist of pounds, shillings and pence, &c. you must reduce them to pence, because pence is the lowest denomination mentioned.

3. In *Direct Proportion*, having stated your question and reduced the numbers, multiply your *second* and *third* numbers together for a dividend, divide their product by the first number, and the quotient will be the *fourth* number, or answer to the question.

Note. The quotient, *or* answer, *and* remainder, *are always of the same kind, or denomination, the second number was reduced to.*

RULE OF THREE DIRECT.

EXAMPLES.

1. If 5 cwt. of sugar cost 20*l.* what will 18 cwt. cost?
Ans. 72*l.*

	cwt.	£.	cwt.	
Stated	5	: 20	: : 18	According to Rule 1, I find that
			20	18 cwt. asks the question which
				I place in the third place; and 5
			5)360	cwt. being of the same name, I
				place in the first; and 20*l.* being
			£.72	of the name of answer required,

I place in the second place; and proceeding, according to Rule 3, I find the answer to be 72*l.*

2. If 72*l.* buy 18cwt. of sugar, What will 20*l.* buy? *Ans.* 5cwt.

	£.		cwt.		£.
As	72	:	18	: :	20

3. If 12 yards of cloth cost 6*l.* What will 36 yards cost?
Ans. 18*l.*

	yds.		£.		yds.
As	12	:	6	: :	36

4. If 12 gallons of brandy cost 4*l.* What will 134 gallons cost?
Ans. 44*l.* 13*s.* 4*d.*

	gal.		£.		gal.
As	12	:	4	: :	134

5. If 6*l.* 10*s.* 6*d.* will buy 29 bushels of wheat, How many bushels will 18*l.* 15*s.* 9*d.* buy? *Ans.* 83bu. 2pks.

6. If 6 yards of holland cost 3*l.* 12*s* 6*d.* What will 64 yards and 1 quarter cost? *Ans.* 38*l.* 16*s.* 4*d.* 1*qr.*

7. How many yards of velvet, at 13*s.* 4*d.* a yard, will 136*l.* 12*s.* buy? *Ans.* 204*yds.* 3*qrs.* 2$\frac{2}{5}$*na.*

8. At 10*d.* 2*qr.* a lb. How much sugar can you buy for 22*l.* 11*s.* 6*d.*? *Ans.* 4*cwt.* 2*qr.* 12*lb.*

9. How many days work can you hire for 4*l.* 4*s.* at 3*s.* 6*d.* per day? *Ans.* 24 *days.*

10. If a man expend 1*s.* 6*d.* a day, What does it amount to for a year? Ans. 27*l.* 7*s.* 6*d.*

11. The salary, of the President of the United States, is 7,500*l.*; supposing his daily expence is 20*l.* What has he remaining at the year's end? Ans. 200*l.*

12. What must you give for 28 acres, 34 rods of land, at 4*l.* 10*s.* an acre? Ans. 126*l.* 19*s.* 1½*d.*

13. Bought 6 pieces of calico, each piece contained 28 yards, for which I gave 29*l.* 15*s.* What is that per yard? Ans. 3*s.* 6$\frac{1}{2}$*d.*

14. A drover buys 64 fat oxen, at 15*l.* for an ox; the expence of driving to market, is 6*l.* for butchering, 10*l.* of salt, 8*l.* of barrels and storage, 15*l.* and he would gain 200*l.* by the bargain: What will be the price of 24 of said oxen, after they are killed and barreled? Ans. 449*l.* 12*s.* 6*d.*

15. If 1 dozen of eggs cost 9*d*. What will 150 eggs cost?
Ans. 9*s*. 4½*d*.

16. John Bankrupt owes Peter Commerce, 296*l*. 17*s*. and compounds at 7*s* 6*d*. in the pound. How much must Peter receive for his debt? *Ans.* 111*l*. 6*s*. 4*d*. 2*qr*.

17. What is the worth of three fifths of a vessel, which is valued at 1160*l*.? *Ans* 696*l*.

18. If 100*l* gain 6*l*. interest in a year, What will 17*l*. 10*s*. gain in the same time? *Ans*. 1*l*. 1*s*.

19. A marketer gave 26*l* 15*s*. 4*d*. for a load of fowls: For turkies he gave 3*s*. for geese 2*s* 8*d*. for ducks 2*s*. 4*d*. for hens 1*s* 6*d*. and for partridges 1*s*. 2*d*. and he had of each sort a like number; I demand the number. *Ans*. 50 *of each sort*.

20. If 13*s* be the value of 1*l*. of deferred stock, What is the value of 360*l*. 10*s*? *Ans*. 234*l*. 6*s*. 6*d*.

21. If I give 1*s*. 4*d*. for keeping a cow a week, What must I give for a year? *Ans*. 3*l*. 9*s* 4*d*.

22. If three week's diet cost 11*s*. 3*d*. What will be the cost of a years'? *Ans*. 9*l*. 15*s*.

23. A gentleman has an estate of 242*l*. 10*s*. How much may he spend a day, and lay up 60*l*. at the years' end?
Ans. 10*s*. *per day*.

24 As I was walking on the forest ground,
Up starts a hare, before my old grey hound;
My dog, being light of foot, did fairly run,
Unto her 15 rods, just 2*l*.
Now, the distance, that she started up before,
Was four score and sixteen rods, just, and no more:
Now this I'd have you unto me declare,
How far he ran before he caught the hare.
Ans. 336 *rods*.

25. If a tax be laid on a town, of 273*l*. 3*s*. 9*d* of which the polls pay 36*l*. and the inventory of all the estates in the town amounts to 12,650*l*. What is it on the pound?
Ans. 4*d*. *on the pound*.

26. If a tax be granted of 4½*d* on the pound, What must A. pay, whose estate is valued at 360*l*. 10*s*.? *Ans*. 6*l*. 15*s*. 2¼*d*.

27. What will a barrel of rum come to at 1*s* 8*d*. a quart?
Ans. 10*l*. 10*s*.

28. What is the price of 1lb. of beef, if 112lbs cost 18*s*. 8*d*.?
Ans. 2*d*.

29. If 891 gals. of gin cost 176*l*. 6*s*. 10*d*. 2*qr*. What is the cost of 1 gal.?

30. A merchant, failing in trade, owes 2119*l*. 17*s*. 6*d*. he possesses an interest of 1324*l*. 18*s*. 5*d*. 1*qr*. How much will his creditors receive on the pound? *Ans* 12*s*. 6*d*.

31. What is the price of 1lb. of butter, when 4 cwt. 1qr. 19lb. cost 18*l*. 11*s*. 3*d*.? *Ans*. 9*d*.

32. A merchant gave at the rate of 6*s*. 9*d*. per gal for 377 gals brandy; what did the whole cost? *Ans*. 127*l*. 4*s*. 9*d*.

33. If 1 ton of beeswax cost 22*l.* 8*s.* what will 203T. 9cwt. 3qr. 3lb. cost? *Ans.* 4558*l.* 3*s.*

34. What is the interest of 2364 dols. per year, at 7 per cent? *Ans.* 165 dols. 48 cents.

35. What is the worth of 1 qr of sugar if a merchant give 182*l.* 4*s.* 11*d.* for 47cwt. 3qrs.? *Ans.* 19*s.* 1*d.*

36. A frigate, having 150 hands, is furnished with 18000lb. of bread, of which each man eats 4lb. per week, How long will the bread last? *Ans.* 30w.

37. A carpenter gives 4 cents per foot for boards, What is the cost of 98 feet? *Ans.* 3*d.* 92*c.*

38. What is the weight of a silver tankard, costing 10*l.* 12*s.* at the rate of 5*s.* 4*d* per ounce? *Ans.* 39oz. 15pwt.

39. What sum of money will gain 35*l.* 15*s.* at 10 per cent.? *Ans.* 157*l.* 10*s.*

40 What is the height of a tree, casting a shadow of 37 feet; and a perpendicular staff of 3 feet, casting a shadow of 2ft 7in.? *Ans.* 30ft 6in. 2 bar. corn, $\frac{28}{37}$.

RULE OF THREE REVERSE.

In the *Rule of Three Direct*, the product of the *first* and *fourth* numbers is equal to the product of the *second* and *third*.

But in the *Rule of Three Reverse*, the product of the *third* and *fourth* numbers is equal to the product of the *first* and *second*.

The method of stating any question, in the *Rule of Three Reverse*, is the same with that in the *Rule of Three Direct*.

All questions, in which *less* requires *more*, or *more* requires *less*, belong to this *rule*.

RULE.

Having prepared and stated your question, as you would in the *Rule of Three Direct*, multiply the *first* and *second* terms together, divide the product by the *third*, and the quotient will be the answer, of the same name, or denomination, with the *second* term.

EXAMPLES.

1. If 40 men do a piece of work in 50 days, In how many days can 80 men do the same?

	m.	*da.*		*m.*
Stated, if	40	: 50	: :	80
		40		

80)2000(25 *days, the Answer.*
160

400
400

In this question the *second* term is days; and of course the *fourth* term, or *quotient*, or *answer*, is days.

It is also evident that *more* requires *less*. For 80 are *more* than 40; and it is plain, that 80 men can do the work in a *less* time than 40 men. And consequently, this truth is evident, that, in the *Rule of Three Reverse*, the *fourth* term, or answer, bears the same proportion to the *second*, as the *third* does to the *first*. Or as 50 is twice as great as 25, so 80 is twice as great as 40.

2. If 4 men plane 250 boards, in 6 days, How many men will plane them in 2 days? *Ans.* 12.

3. If 4 men can make 80 rods of wall in 20 days, How many men can make the same number, in 10 days? *Ans.* 8.

4. If a board be 9 inches in width, How much in length will make a square foot? *Ans.* 16 *inches*.

5. How many yards of paper, 3 quarters wide, will paper a room that is 24 yards round, and 4 yards high? *Ans.* 128 *yards*.

6. If a traveller go 160 miles in 7 days, when the day is 16 hours long, In how many days will he go the same, when the day is 12 hours long? *Ans.* 9 *days*, 8 *hours*.

7. How many yards of shalloon, 3 quarters wide, will line 9 yards of cloth 8 quarters wide? *Ans.* 24 *yards*.

8. If 100*l*. gain 5*l*. interest in 12 months, What principal will gain the same interest in 5 months? *Ans.* 240*l*.

9. If A. lends B. 66 dollars for a year; to balance this loan, How much ought B. to lend A. for 7 calender months? *Ans.* 113$\frac{1}{7}$ *dols*.

10. A regiment of soldiers, consisting of 1000 men, are to have new coats, and each coat is to contain 2 yards and 1 quarter of cloth that is 5 quarters wide; How much shalloon, that is 3 quarters wide, will line them? *Ans.* 3750 *yards*.

11. What number of dollars will gain, in 1m. the sum, that 127 dols. will gain in a year, at 6 per cent? *Ans.* 1524.

12. If 16 boarders drink a barrel of strong beer in 24 days, how long will it last if 8 more boarders be added? *Ans.* 16 *days*.

13. If 200 carpenters can finish a building in 24 days, how many are sufficient to finish the same, in 6 days? *Ans.* 800.

14. A garrison, containing 800 soldiers, has provision for 60 days only; how many must be sent off, that the provision may last 100 days? *Ans.* 320.

15. If A. lend B. 200 dollars for 360 days, how long ought B. to lend A. 2000 dollars, to compensate the kindness? *Ans.* 36 *days*.

16. Required the length of a board 1 foot wide, to make 3 feet square. *Ans.* 144.

17. If the carriage of 300wt. 450 miles, cost 4*l*. 4*s*. how far may 1800 be carried for the same money? *Ans.* 75 *miles*.

FEDERAL MONEY AND DECIMAL FRACTIONS.

FEDERAL MONEY is, simply, Decimal Arithmetic. It is added, subtracted, multiplied and divided in the same manner; and proceeds, like decimals, in a tenfold proportion, as may be observed in the following Tables:

TABLE OF DECIMAL FRACTIONS.

Thousands.
Hundreds.
Tens.
Units.
Tenth parts.
Hundredth parts.
Thousandth parts.
X Thousandth parts.
C Thousandth parts.

TABLE OF FEDERAL MONEY.

Thousands of dollars.
Hundreds of dollars.
Tens of dollars.
Dollars.
Dimes, or tenths of a dollar.
Cents, or hundredths of a dollar.
Mills, or thousandths of a dollar.
Tenth parts of a mill.
Hundredth parts of a mill.

In both these tables, it may be observed, that the numbers increase to the left hand of the comma, or separatrix, and decrease to the right hand, in a ten-fold proportion: that is, the figure at the left hand of the comma is ten times greater than the figure at the right hand of the comma; and the second figure at the right hand is ten times less than the first: and so of the rest.

Those figures at the right hand of the comma, are called decimals, or parts of a dollar; those at the left hand are called whole numbers, or dollars; when there are figures on both sides of the comma, they are called mixed numbers, or dollars and cents.

A Decimal Fraction is an unit, supposed to be divided into ten equal parts, and each of those parts into ten other equal parts; and so on, by decimal division, without end.

In Decimal Fractions the denominator is not expressed, but it is understood, which is always an unit, with as many cyphers annexed as there are places of decimals; as, ,5 ,25 ,006 which are read $\frac{5}{10}$ five tenths, (that is, five tenths of an unit, or dollar, which is five dimes;) $\frac{25}{100}$ twenty-five hundredths, (of a dollar, or 25 cents;) $\frac{6}{1000}$ six thousandths, (of a dollar, or six mills.)

A dollar is the Unit Money; dimes, cents, and mills, are valued according to their place from the place of the dollar. One dime is the one tenth part of a dollar; one cent is the one tenth part of a dime, and one mill is the one tenth part of a cent.

These several denominations, being placed in one line, without any comma, or separatrix, between them, thus, 46378, may be read as whole numbers, and called so many mills; that is, 46 thousand, 3 hundred and 78 mills. If you separate them by commas, thus, 46,3,7,8, they must be read, 46 dollars, 3 dimes, 7 cents, and 8 mills, which have the same value as the above number of mills.

Such is the nature of Federal Money, that you may read it differently, and yet retain the same value; accordingly as you may separate it differently by commas. Thus you may call 53.96, 53 dollars and 96 cents. If you point the same thus, 5,3,9,6, you must call them 5 eagles, 3 dollars, 9 dimes and 6 cents, which have the same value as the above.

In the following work, the comma will be used only to separate the dollars from the cents and mills, which is the customary way for keeping book accounts, and is the least liable to error.

A cypher at the right hand of a figure, after the comma, alters not the value of the figure immediately preceding it; thus, 54,70 are $54\frac{7}{10}$ or fifty-four dollars and 70 cents. But a cypher at the left hand of decimals, or cents, diminishes the value of the figure; thus, 54,07 are only fifty-four dollars and seven cents. Of which the reason is plain, as the cypher removes the 7 one place of tens farther from the units or dollars.

ADDITION OF FEDERAL MONEY AND DECIMALS.

Note.	10 mills (*m.*)	make	one cent,	c.
	10 cents	——	one dime,	d.
	10 dimes	——	one dollar,	D. *or* $.
	10 dollars	——	one eagle,	E.

RULE 1.

Whether your numbers be mixed, or only decimals, place them according to their value; that is, place units under units, in whole numbers, and tenths under tenths, in decimals.

2. Add the whole together, as in simple addition, and point off so many places for decimals, as are equal to the greatest number of places in any one line of the sum.

Examples.

1. Add 46*d.* 26*c.* 4*m.* +30*d.* 06*c.* 7*m.* +4*d.* 09*c.* +120*d.* 70*c.* 3*m.* +20*c.* 4*m.* into one sum.

d.	*c.*	*m.*
46,	26	4
30,	06	7*
4,	09	
120,	70	3
	20	4
201,	32	8 *the sum.*

d.	*c.*	*m.*	*d.*	*c.*	*m.*	*d.*	*c.*	*m.*
78,	28	4	416,	06	4	78,	28	3
987,	06		23,	50	7	7,	03	4
40,	70	5	784,	37		84,	70	6
7,	12	3	127,	40	6	7,	26	
876,	95		346,	75		50,	84	
106,	70	3	56,	98		67,	90	9
Sum 2096,	82	5						

5. What is the sum of 70*d.* 70*c.* +6*d.* 06*c.* 5*m.* +48*d.* 86*c.* +74*c.* 5*m.* +73*d.* 63*c.* *Ans.* 200 *doll.*

SUBTRACTION OF FEDERAL MONEY AND DECIMALS.

Rule.

Place units under units, and tenths under tenths, and proceed as in Simple Subtraction. Separate the decimals from the whole numbers, by a comma, as in Addition.

Examples.

	d.	*c.*	*m.*	*d.*	*c.*	*m.*
Borrowed	745,	28	3	896,	84	
Paid	403,	09	5	98,	98	5
Due	342,	18	8			

3. Borrowed 170*d.* 06*c.* paid 98*d.* 20*c.* 4*m.* What remains due?

	d.	*c.*	*m.*
	170,	06	
	98,	20	4
Due	71,	85	6

* *If the number of cents be under* 10, *you must always annex a cipher, to the left hand, in the place of tenths or dimes.*

4. Borrowed 800*d.* 56*c.* paid at one time 76*d.* 44*c.* at another time 186*d.* 28*c.* 5*m.* at another time, 408*d.* 06*c.* 5*m.* What is now due?

	d.	*c.*	*m.*
Borrowed	800,	56	
	76,	44	
	186,	28	5
	408,	06	5
Paid in all	670,	79	
Due	129,	77	*Answer.*

5. Borrowed 560*d.* 28*c.* paid at one time 48*d.* 54*c.* 5*m.* at another time 150*d.* 84*c.* at another time 128*d.* 74*c.* 5*m.* What remains due? *Ans.* 232*d.* 15*c.*

MULTIPLICATION OF FEDERAL MONEY AND DECIMALS.

RULE 1.

Place the numbers according to their value, and multiply them as whole numbers.

2. Separate as many figures, to the right hand for decimals, in your product, as there are decimals in the multiplier and multiplicand counted together.

3. If decimal places be wanting, annex cyphers to the left hand to supply the deficiency.

EXAMPLES.

Multiply	7,643		,00367
by	,007		,073
	,053501		1101
			2569
			,00026791

Note. When any number is multiplied by a fraction, the product is always less than the multiplicand, in the same proportion as the multiplying fraction is less than 1, or an unit. That is, dollars, or units, multiplied by dollars, produce dollars; dollars multiplied by dimes, or tenths, produce dimes, or tenths; and dimes, or tenths, multiplied by dimes produce cents or hundredths: dimes, multiplied by cents, or hundredths, produce mills, or thousandths; cents multiplied by cents, produce tenths of mills, or ten thousandths, &c.

The same is observable in pounds, shillings and pence; Shillings, multiplied by pence, produce twentieths of a penny, &c.

d. m.	*d. c.*	*c.*	*m.*
43,20	4,36	,55	,008
28,	,28	,08	,007
34560	3488	,0440	,000056
8640	872		
1209,60	1,2208		

	d. c. m.		*d. c.*	
	64,345		52,94	
	28,604		43,62	
Prod.	1840,524380		2309,2428	Prod.
	d. c. m.		*d. c. m.*	
	76,435		84,067	
	6,073		,784	

What will 36 bushels of corn come to at ,56*c.* per bushel?
Ans. $20 16*c.*

What will 3 dozen of lemons come to at, 03*c.* 5*m.* per lemon?
Ans. $1 26*c.*

What will 40lbs. flax come to at 12*c.* 5*m.* per lb.?
Ans. 5 *dollars.*

What will 12 days labor amount to at ,66*c.* 4*m.* per day?
Ans. $7 96*c.* 8*m.*

What is the amount of 327 bushels of wheat, at $1 24*c.* 5*m.* per bushel?

What is the amount of 16½ yds. calico, at 4*c.* 6*m.* per yd.?

What is the price of a chaise 275 miles, at 5*c.* 7*m.* per mile?

A merchant bought 50 pieces of calico, each piece containing 36 yds. at 30*c.* 7*m.* per yd. What did the whole cost?

A schoolmaster indented to instruct 40 pupils, divided into 4 classes, for six lunar months, on the following terms: 1 class at 3*c.* 5*m.* per day; 2 class at 2*c.* 7*m.* per day; 3 class at 1*c.* 2*m.* per day; 4 class at 7 *mills* per day: Each class containing 10 scholars, and each scholar paying, per week, the sum above stated; What are the weekly, the monthly, and semiannual expenses of each pupil, and the whole wages of the master?

A shoemaker sold 36 dozen of shoes, at $1 45*c.* for each pair; What sum did he receive for the whole?

DIVISION OF FEDERAL MONEY AND DECIMALS.

Rule 1.

If there be more decimals in the divisor than there are in the dividend, annex cyphers to the dividend to make it equal to the divisor.

2. The decimal places of the divisor and quotient, counted together, must always be equal to those in the dividend; and if the number of places of decimals in the divisor and dividend be equal, the quotient will be whole numbers.

3. If decimal places be wanting in the quotient, they must be supplied by annexing cyphers to the left hand.

Note. If the dividend be greater than the divisor, the quotient will be greater than the dividend: but when the dividend is less than the divisor, then the quotient will be less than the dividend, and in the same proportion as an unit is greater or less than the dividing fraction.

Examples.

72),196416(,002723
144

524
504

201
144

576
576

In this example, there being no decimals in the divisor, I annexed two cyphers to the quotient, to make it equal to the dividend.

2. It is required to divide 45, by ,5365.

,5365)45,0000(83,8769

d. c.	*d. c. m.*	*d. c. m.*
4)624,83	6)78,674	9)796,869
156,207*	13,112	88,541

c. d. c. d. c. m.
,46)82,26(178,826

* *By annexing a cypher to the 3 remaining, you get 7 mills. The other is of no account.*

d. c. d c. d. c. m.	*d. d. c. m. d. c. m.*
5,44)86,00(15,080 $\frac{8}{10}$	41,)742,651(18,113
46,72)786,74(16,839	42,5)5,29125(,1245
36,5),0076345(209†	29,)153,598(5296†
,684),76432(1117†	,0125),7500(60†

If 78lb. of flax cost $10 53*c.* What is that per lb.?
Ans. ,13*c.* 5*m.*

If I have $16 50*c.* for 30 days labor, What is that per day?
Ans. ,55*c.*

If 36 yards of cloth cost $86 48*c.* What is that per yard?
Ans. $2 40*c.* 2*m.*

If 84 bushels of corn cost $46 62*c.* What is that per bushel?
Ans. ,55*c.* 5*m.*

If 20 hundred of hay cost $18 10*c.* What is that per hundred?
Ans. ,90*c.* 5*m.*

If 32 gallons of rum cost $37 28*c.* 4*m.* What is that per gallon?
Ans. $,1 16*c.* 5*m.*

If 205 yds. of calico cost $107 62*c.* 5*m.* What was the price of 1 yd.?
Ans. 52*c.* 5*m.*

If 125 bushels of wheat cost $95, What did the purchaser give per bushel?
Ans. 76*c.*

If 493 yds. of tape cost $4 43*c.* 7*m.* What was given per yd.?
Ans. 9*m.*

By operating carefully the following sums, the learner will perfect himself in all the various cases of decimal division.

÷,803 by ,22. *Ans.* 3,65÷,803 by 2,2. *Ans.* ,365.÷,803 by 22. *Ans.* ,0365.÷80,3 by ,22. *Ans.* 365.÷80,3 by 2,2. *Ans.* 36,5.÷803 by 22. *Ans.* 3,65÷222 by ,365. *Ans.* 608,21.÷222 by 3,65. *Ans.* 60,821.÷222 by 365. *Ans.* ,60821.

N. B. In dividing by 10, 100, 1000, 10000, &c. the learner has nothing to do, but to remove the comma, or separatrix, as many figures to the left hand, as there are cyphers in the divisor.

Examples.

10)462,3(46,23	100)7342,6(73,426
1000)96742,67(96,74267	10000)42367,4(4,23674

† *The questions with this mark are to exercise the learner, the quotient being unpointed.*

REDUCTION OF FEDERAL MONEY AND DECIMALS.

CASE 1.

To reduce a Vulgar Fraction to a decimal of equal value.

Note.—A fraction is called *vulgar* or *decimal*, according to the division of an unit.

A *Vulgar Fraction* is represented by two numbers, one above the other, with a line drawn between them, thus, $\frac{1}{4}$. The upper figure is called the *Numerator*, and the lower figure the *Denominator*, as, $\frac{3}{4}$, $\frac{5}{8}$, which signfy three fourths, five eights, that is, of an unit.

The *denominator* shews the number of parts an unit is divided into; thus, $\frac{3}{4}$ signifies that an unit is divided into four parts, and the *numerator*, 3, shews that three of those parts are signified by the fraction.

RULE 1.

Both terms are to be esteemed whole numbers. Annex cyphers to the upper term, or *numerator*, and divide it by the lower term, or *denominator*.

2. Point off as many places for decimals, in your quotient, as you annex cyphers to the *numerator*, and if the decimal places, in the quotient, be not so many as in the dividend, annex cyphers, to the left hand of the quotient, to make them equal.

EXAMPLES.

1. Reduce $\frac{1}{4}$ of a dollar to decimals, or into cents. *Ans.* ,25c.

4)1,00(,25
8
—
20
20
—

2 Reduce $\frac{1}{2}$ of a dollar to decimals, or to cents. *Ans.* ,50c.

2)1,0(5
10
—

In this example the decimal ,5, *occupies the place of tenths, or dimes, which makes it* ,50 *cents.*

3. Reduce $\frac{3}{4}$ of a dollar to decimals, or to cents. *Ans.* ,75c.
4. Reduce $\frac{1}{8}$ of a dollar to decimals, or to cents. *Ans.* ,12c. 5m.
5. Reduce $\frac{1}{16}$ of a dollar to decimals, or to cents.

Ans. ,06c. $2\frac{5}{10}$ m.

6. Reduce $\frac{9}{240}$ to decimals. *Ans.* ,0375.
7. Reduce $\frac{39}{278}$ to decimals. *Ans.* ,14028.

Case 2.

To reduce the different currencies, of the several states, in pounds, shillings and pence, to Federal Money.

1. *To reduce New-England, Virginia, and Kentucky currency to Federal Money.*

Rule 1.

Add a cypher to the pounds, and divide by half the number of shillings in the dollar and the quotient will be dollars.

Rule 2.

To the whole sum of the pence, contained in the shillings and pence, add two cyphers, and divide by the number of pence contained in the dollar, and the quotient will be cents.

Note 1. Farthings are so inconsiderable as not to deserve any notice.

Note 2, If the shillings and pence remain one, two, or three dollars, you may add them to the dollars already found, and then reduce the remaining shillings and pence into cents, according to the *second rule*.

Note 3. A dollar, in New-England, Virginia and Kentucky, is 6 shillings.

Examples.

1. Reduce 48*l.* 13*s.* 6*d.* to Federal Money.

Half shillings=3)480

160=*dolls.* 13*s.* 6*d.*=162 *pence.*
2,25.

Ans. $162,25

$	c.	$ c.
dol.=72)16200(	225	=2,25
144		
180		
144		
360		
360		

2. Reduce 246*l.* 17*s.* 9*d.* to Federal Money.

Half shillings=3)2460

820=*dol.* 17*s.* 9*d.*=2*dol.* 69*d.*
2,978

Ans. $822,958

dol.=72)6900(95*c.*
648

420
360

After having obtained the 97 cents, I found 60 remained; to which I added a cypher, and divided by 27, which produced 8 mills. with a remainder of 24.

72)600(8
576

$\frac{24}{72}$ *parts of a mill.*

3. Reduce 82*l* 14*s.* 8*d.* to Federal Money.

Half shillings=3)820

273 $\frac{1}{3}$ of a dollar remains=2*s.* which I take and add to the 14*s.* 8*d.*=16*s* 8*d.*=2 *dol.*=56*d.*

d. c. m. *dol.*=72)5600(77*c.*
273, 504
2,777

560
504

Ans. $275,777$\frac{56}{72}$=2*qr.*

72)560(7*m.*
504

$\frac{56}{72}$ *parts of a mill.*

Pounds and shillings, in this currency, may be more readily brought into dollars and cents, as follows:

RULE.

Annex the figure, that represents half the even number of shillings, to the right hand of the pounds; or, if there be only one shilling, add a cypher; and if the number of shillings be odd, place 5 as a decimal, for the odd shilling; divide by 3, the quotient will be the answer.

Reduce 7*l.* 18*s.* to Federal Money.

3)79

Ans. $26,33$\frac{1}{3}$*

* *By adding cyphers to the remainders, produces the cents and mills.*

Reduce 22*l.* 1*s.* to Federal Money.

3)220,5

Ans. $. 73,50

Reduce 17*l.* 13*s.* to Federal Money.

3)176,5

Ans. $. 58,833⅓

2. *To reduce New-York and North-Carolina currency to Federal Money.*

Note. In this currency 8*s.* make a dollar.

RULE.

Proceed according to the foregoing rules, with observing, that 8*s.*=a *dol.* and 96*d.*=a *dol.*

1. Reduce 64*l.* 8*s.* 10*d.* to Federal Money.

Half shillings=4)640

160

1,104 *dol.*=96*d.*)1000(10*c.*

96

Ans. $. 161,104

40

8s. 10d.— 1 *dol.*=10*d.*

96)400(4*m.*

384

16/96 *pts. m.*

2. Reduce 74*l.* 3*s.* 4*d.* to Federal Money.

Half Shill.=4)740

185

0,416 *dol.*=96)4000(41=*cents.*

Ans. $. 185,416

384

160

96

640(6=*mills.*

576

64/96 *parts of a mill.*

3. *To reduce Pennsylvania, New-Jersey, Delaware, and Maryland currency to Federal Money.*

Rule.

Multiply the pounds by 8, and divide the product by 3; the quotient will be the dollars. For the shillings and pence, you must proceed as before.

Note. A dollar in the currency of these States, is 7*s.* 6*d.*=90*d.*

1. Reduce 24*l.* 18*s.* 4*d.* to Federal Money.

24
×8
192
÷3)

18*s.* 4*d.*—2=40*d.*

$=90)4000(44*=*cents.*
360
400
360
)400(4=*mills.*
360

$\frac{40}{90}$ *parts of a mill.*

2. Reduce 47*l.* 6*s.* 4*d.* to Federal Money.

×8
376
÷3)
c. m.
125,333
,844
Ans. $. 126,177

6*s.* 4*d.*=76

$.=90)7600(84=*cents.*
720
400
360
)400(4=*mills.*
360

$\frac{40}{90}$ *pts. of a mill.*

4. *To reduce Federal Money to New-England, Virginia, New-York, &c. currency.*

Rule 1.

Multiply the dollars, by half the number of shillings in a dollar, and double the right hand figure for shillngs, the rest are pounds.

Rule 2.

Multiply the cents, by the number of pence, in a dollar, and divide by 100; the quotient will be pence.

* *When the divisor is greater than the number of pence, in the dividend, with one cypher added, you must place a cypher in the place of tenths, or dimes, in the quotient.*

1. Reduce $.162 25c. to New-England currency.

×3

48)6=12, *doubled.* 25

48,12 72=*pence in a dol.*

1,6

50

Ans. 48*l.* 13*s.* 6*d.* 175

1)00)18(00=1*s.* 6*d.*

2. Reduce $.646 74c. to New-England currency.

Ans. 194*l.* 0*s.* 5*d.* 1*q.*

3. Reduce $.161 10c. to New-York, &c. currency.

4

64)4=8, *doubled.* $ =96

10

1)00)9(50=9½*d.*

The remainder being equal to ½ the divisor, produces the ½*d.*

Ans. 64*l.* 8*s.* 9½*d.*

5. To reduce Federal Money to Pennsylvania, &c. currency.

RULE.

Multiply the dollar by 3, and divide the product by 8; the quotient will be pounds. Then multiply the cents, by the number of pence, in a dollar, and divide that product by 100; it will give the answer in pence.

1. Reduce $.476 20c. to Pennsylvania currency.

3

8)1428

178 4/8=10*s.*

90=*pence in a dol.*

20

1)00)18(00=1*s.* 6*d.*

l.	*s.*	*d.*
178	10	0
	1	6
Ans. £.178	11	6

The 4 eights, reduced to their lowest term, make ½, that is, one half of 20*s.*=10*s.* or, the 4 multiplied by 20, =the shillings in a pound, and divided by 8, will give the shillings.

2. Reduce $.74 28c. to Pennsylvania currency.

3

8)222

27 15*s.*

2 1

Ans. £.27 17 1

90=*pence in a dollar.*

28

720

180

1)00)25(20=2*s.* 1*d.*

3. What number of dollars is equivalent to 1500*l.* Maryland currency? *Ans.* 4000.

4. What is the sum of 846*l.* 13*s.* 10*d.* Delaware currency, in Georgia currency? *Ans.* 526, 16, 7, $\frac{13}{45}$.

5. Reduce 1556, 13, 9$\frac{1}{2}$ New-Hampshire currency to Pennsylvania currency. *Ans* 1945, 17, 3.

6. Reduce 9000*l.* New-Jersey currency to New-York currency. *Ans.* 9600.

7. What number of dollars is contained in 8007*l.* North-Carolina currency? *Ans.* 2112,50.

8. Reduce 845*l.* 10*s.* New-York money into Federal currency. *Ans.* 2113,75.

9. In New-England currency, what is the amount of 547, 13, 6 New-York money? *Ans.* 410, 15, 1, 1.

10. Reduce 1903, 16, 3 New-York money, into Virginia money. *Ans.* 1427, 17, 2, 1.

11. What is the sum of 5913, 8, 9, 3 Maryland currency in New-York money? *Ans.* 6307, 18, 5.

12. Reduce 643, 15, 7 New-York currency into New-Jersey currency. *Ans.* 603, 10, 10, 3$\frac{3}{4}$.

CASE 3.

To reduce numbers of different denominations to decimals.

RULE 1.

Place the number, you are to reduce, for a numerator; and the integer, you are required to reduce your number to the decimal of, for a denominator.

2. Reduce the numerator and denominator to the lowest term mentioned in your numerator; add cyphers to the numerator, and divide it by the denominator, and it will give the decimal required.

1. Reduce 9 pence to the decimal of a pound.

1*l.*=240 *pence. Therefore,* 9 *pence*=$\frac{9}{240}$.

240)9,00(,0375=*Answer.*
720
1800
1680
1200
1200

In this example I added 4 cyphers to the numerator, consequently my quotient must consist of 4 places, agreeable to rule 2d, under case 1.

2. Reduce 6 pence to the decimal of a pound.

6*d.*=$\frac{6}{240}$.

240)6,00(,025 *Answer.*
480
1200
1200

3. Reduce 3 pence to the decimal of a shilling.

3 pence $= \frac{3}{12}$ *of a shill.* 12)3,00(,25 *Answer.*

24

60

60

4. Reduce 1 shilling to the decimal of a pound.

1 shill. $= \frac{1}{20}$ *of a pound.* 20)1,00(,05 *Answer.*

100

5. Reduce 2, 3, 4, 5 and 6 shillings to the decimal of a pound.

Shillings. 2 3 4 5 6

Answers. ,1 ,15 ,2 ,25 ,3

6. Reduce 15*s.* 8*d.* 3*q.* to the decimal of a pound. *Ans.* ,7864

15*s.* 8*d.* 3*q.* = 755*q.* $\frac{755}{960}$

1*l.* = 960*q.*

7. Reduce 8*oz.* 12*pwt.* 6*gr.* to the decimal of a pound Troy. *Ans.* ,7177.

8*oz.* 12*pwt.* 6*gr.* = 4134*gr.* $\frac{4134}{5760}$

1*l. Troy* = 5760*gr.*

8. Reduce 3qrs. 12lb. 8oz. 6dr. to the decimal of a cwt. *Ans.* ,8618.

9. Reduce 3qrs. 2na. to the decimal of a yard. *Ans.* ,875.

Different denominations may be reduced to decimals by the following rules:

Rule I.

Set the numbers under each other, for dividends, having the lowest denomination at the top.

2. At the left hand, opposite to each dividend, set that number that will bring it to the next superior denomination.

3. Begin with the uppermost dividend, supposing cyphers to be annexed to it, and divide it, setting the quotient, as decimal parts, at the right hand of the dividend next below it, and so proceed with each dividend, and the last quotient will be the decimals required.

Examples.

1. Reduce 18*s.* 6*d.* 3*qr.* to the decimal of a pound.

4 | 3,
12 | 6,75
20 | 18,5625

,928125 *Answer.*

2. Reduce *4cwt. 2qrs.* to the decimal of a ton.

4 | 2,
20 | 4,5

,225 *Answer.*

3. Reduce 1 pint to the decimal of a gallon. *Ans.* ,125.

CASE 4.

To find the proper quantity, or value of a decimal in the known parts of an integer.

RULE 1.

Multiply the given decimal by the number of parts in the next inferior denomination, cut off as many figures to the right hand, as there are places in the decimal given.

2. The remaining figures, at the right hand, multiply by the next inferior denomination, cut off as before, and so proceed till you have reduced it to its lowest denomination, and the figures, at the left hand, will be the answer required.

EXAMPLES.

1. What is the proper quantity of ,5396 of a pound?

,5396
× 20=*shillings in a pound.*

10,7920
× 12=*pence in a shilling.*

9,5040
× 4=*farthings in a penny.*

2,0160

Ans. 10*s.* 9*d.* 2*qr.*

2. What is the proper quantity of ,56 of a pound?

Ans. 11*s.* 2*d.* 1*qr.*

3. What is the proper quantity of ,786 of a shilling?

Ans. 9*d.* 1,7*qrs.*

,786
12=*pence in a shilling.*

9,432
4=*farthings in a penny.*

1,728

4. What is the proper quantity of ,861 of a cwt.?

Ans. 3*qrs.* 12*lb.* 6*oz.* 14*dr.*

5. What is the proper quantity of ,4895 of a lb. Troy?

Ans. 5*oz.* 17*pwt.* 12*gr.*

6. What is the proper quantity of ,78 of an acre of land ?
Ans. 3*r.* 4*p.* 217*ft.* 115*in* 15 *c.*
7. What is the proper quantity of ,45 of a day ? *Ans.* 10*h.* 48*m.*
8. What is the proper quantity of ,61 of a ton of wine ?
Ans. 2*hhds.* 27*gal.* 2*qts* $1\frac{7}{10}$ *pt.*
9. What is the proper quantity of ,3 of a year ?
Ans. 109*days.* 12*hrs.*

CASE 5.

TO REDUCE FEDERAL MONEY.

Speaking properly, this is not reduction, either by multiplication or division; for it is performed either by removing or adding the commas, as the case may require.

RULE 1.

To reduce dollars to cents.—Remove the comma, and add two cyphers to the dollars, and the product will be cents.
Reduce 78 dol. to cents. *Ans.* 7800 *cents.*
2 *To reduce dollars to mills.*—Remove the comma, and add three cyphers to the dollars.
Reduce 64 dol. to mills. *Ans.* 64000 *mills.*
3. *To reduce dollars and cents to mills.* Remove the comma, and add one cypher to the cents.
Reduce $98 24*c.* to mills. *Ans.* 98240 *mills.*
4 *To bring mills into dollars.*—Separate three figures to the right hand, by a comma, the left hand figures will be dollars, and those at the right hand; cents and mills.
In 68973 mills, How many dollars, cents and mills ?
Ans. $68 97*c.* 3*m.*
5. *To bring cents into dollars.*—Separate two figures, to the right hand, by a comma.
In 7896 cents, How many dollars and cents ? *Ans.* $78 96*c.*

RULE OF THREE DIRECT, IN FEDERAL MONEY AND DECIMALS.

RULE.

Reduce your fractions to decimals, according to the foregoing rules; state your question as in the *Rule of Three Direct* in whole numbers. Multiply the second and third terms together; divide that product by the first term, and the quotient will be the answer.

EXAMPLES.

1. If 6lbs. of butter cost ,96*c.* What will 56lbs. cost at the same rate ?
Ans. $8 ,96.

lb. c. lb.
If 6 : ,96 : : 56
56

576
480

6)53,76

8,96

2. If 96c. buy 6lb. of butter, What will $8 96c. buy at that rate? *Ans.* 56lb.

3. If $3 36c. buy 4 bushels of corn, What will $89 24c. buy? *Ans.* 36 *bushels.*

4. If 14 yards of cloth cost $56 What will 28 yards cost at the same rate? *Ans.* $112.

5 If 20 yards of cloth cost $44 56c. How much will 40 yards cost? *Ans.* $89 12c.

6. If 1,5 yards of cloth cost $3 84c. What will 24,6 yards cost? *Ans.* $62 97c. 6m.

7. If ,24c. 5m. buy 8 lemons, How many can I have for $15? *Ans.* 499,7 *lem.*

8. If 84c. buy 2 bushels of potatoes, How many bushels will $,12 buy? *Ans.* 28,57 *bushels.*

9. What is the price of a pint of wine, at $1 75c. a gallon? *Ans.* 21c. 8m.

10. The weekly pay of a journeyman, at ,57c. a week, is postponed for 3 years, 9 months and 10 days, What is his due? *Ans.* $,119 49c. 8m.

11. What is the cost of 17cwt. 3qr. 14lb. at ,10c a lb.? *Ans.* $,200 20c.

12. At ,55c. a day, How many days work can you hire for $,18? *Ans.* 32,7 *days.*

13. A. owes B. $,1753 58c. but B. compounds with him for ,65c. on the dollar, What must B. receive for his debt? *Ans.* $,1139 82c. 7m.

14. If 1,37cwt. of sugar be worth $,15 43c. What is 1,6lb. worth at that rate? *Ans.* ,16c. $0\frac{8}{10}$.

15. If my income, yearly, be $730 How much may I expend daily, and have $91 25c. left at the years end? *Ans.* $1 75c.

16. A merchant shipt for the West-Indies 39000 feet of boards, at $8 20c. per thousand; 300 quintals of fish, at $2 60c. per quintal; 15000 of shingles, at $,2 20c. per thousand; 34200 of hoops, at $1 60c. per thousand; and 1000 dollars: and in return, he had 3000 gallons of rum, at 55c. per gallon; 2000 gallons of molasses, at ,20c. per gallon: 1000lb. of coffee, at 16c. per lb. and 10cwt. of sugar, at $4 50c. per cwt.: and his charges on the voyage were $153 80c.: Did he gain or lose, by the voyage, and how much?

Ans. he neither gained nor lost.

17. What is the value of 6 gross of buttons, at ,12c. 5m. per. dozen? *Ans.* 9 *doll.*

18. If a tax of $574 24c. be laid on a town, of which the polls pay 100 dollars, and the valuation of all the estates in the town amounts to $18240, What will it be on the dollar?

Ans. ,02c. 6m.

19. If a tax be laid on a town, which amounts to ,02c. 6m. on a dollar, What must A. pay, whose real and personal estate is valued at $450 28c? *Ans.* $11 70c. 7m.

20. A merchant bought 6 pieces of calico, each piece containing 28 yards, for which he gave $100 80c. and he would sell it so as to gain 20*d. per cent.* How must he sell it per yard?

Ans. 72c.

21. What does the insurance of $2650 60c. amount to, at $4 50c. *per cent?* *Ans.* $119 27c. 7m.

22. If 30 pence and 40 groats buy 50 pints of wine, What is the cost of 60 quarts, in *Columbia's* Federal coin?

Ans. $6 33c. 3m.

23. The salary of the President of the United States is 25000 dollars a year; What is his pay for a solar month, a week, a day, an hour, and a minute?

Answers.				*Answers.*		
d.	*c.*	*m.*		*d.*	*c.*	*m.*
2082,	33	$3\frac{3}{10}$	a month.	2,	85	$3\frac{3}{10}$ an hour.
480,	76	$9\frac{3}{10}$	a week.	0,	04	$7\frac{3}{10}$ a minute.
68,	49	$3\frac{3}{10}$	a day.			

INTEREST.

INTEREST is both *Simple* and *Compound.*

SIMPLE Interest is a certain sum agreed on between the lender and borrower, to be paid for every 100*l.* or dollars, which is called the rate *per cent.* for a year.

Principal is any sum of money, lent, for which interest is to be received.

The *principal* and *interest*, added together, is called the *amount.*

Note. Simple Interest is applied to Commission, Insurance, Brokerage, Duties, &c. or any thing else estimated at a certain rate *per cent.*

CASE 1.

To estimate interest for pounds, shillings and pence.

RULE 1.

Multiply the principal by the rate, cut off the two right hand

figures of the pounds; multiply the two figures at the right hand by 20, and add the shillings of the principal, cut off the two right hand figures, and so proceed till you have reduced it to its lowest denomination; and the figures at the left hand will be the interest sought, for one year.

2. When the rate *per cent.* is 6, multiply the principal by half the number of months, cutting off and multiplying as before directed, it will give the interest for the given time.

To estimate the interest for days, work by the aliquot parts of a month, or by the *Rule of Three Direct.*

Examples.

1. What is the interest of 330*l.* 14*s.* 7*d.* 3*qr.* for one year, at 6*l. per cent?*

l.	*s.*	*d.*	*qr.*
330	14	7	3
			6
19)84	7	10	2
20			
16)87			
12			
10)54			
4			
2)18			

Ans. 19*l.* 16*s.* 10*d.* 2*qr.*

2. What is the interest of 25*l.* 12*s.* 6*d.* for 10 months, at 6*l. per cent?* *Ans.* 1, 5, 7, 2.

3. What is the interest of 136*l.* 14*s.* 8½*d.* for 11 months, at 6*l. per cent?* *Ans.* 7, 10, 4, 3.

4. What is the interest of 70*l.* 16*s.* 8*d.* for 7 months and 10 days, at 6*l. per cent?* *Ans.* 2, 11, 11, 1.

5. What is the interest of 138*l.* 12*s.* 8*d.* for 18 months, at 5*l. per cent?* *Ans.* 10, 7, 11, 1.

6. What is the interest of 84*l.* 12*s.* 9*d.* for 17 months, at 6*l. per cent?* *Ans.* 7*l.* 3*s.* 10½*d.*

7. What is the interest of 128*l.* 13*s.* 6*d.* from Jan. 10, 1797, to July 20, 1799, at 6*l. per cent?* *Ans.* 19*l.* 10*s.* 3¾*d.*

8. What is the interest of 230*l.* 14*s.* 7*d.* from the 9th of May, 1797, to the 4th of April, 1799, at 6*l. per cent?* *Ans.* 26*l.* 8*s.*

Case 2.

To estimate the Interest of Federal Money.

Rule.

When the rate *per cent.* is 6*d.* multiply the principal by half the even number of months, and a sixth part of the remaining days, placing the sixth part of the days as decimals; cut off the two right hand figures of the dollars, or integers, and the left hand figures will be dollars, and the right hand figures, parts of a dollar; the interest required.

Note. If there be an odd month, reduce it to days.

Examples.

1. What is the interest of 267*d.* 27*c.* for 6 months and 24 days, at 6*d. per cent.* ?

	d. *c.*
	267,27
Half of the months=3	3,4
Sixth part of the days=,4	
	1069 08
3,4	8018 1
	Answer.
	9)08,718*=9*d.* 08*c.* 7*m.*

2. What is the interest of 136*d.* 84*c.* for 15 months and 21 days, at 6*d. per cent* ?

	d. *c.*
Half the months=7,	136,84
Sixth of 51 days=,85	7 85
7,85	684 20
	10947 2
	95788
	Answer.
	10)74,19 40=10*d.* 74*c.* $1\frac{9}{10}$*m.*

3. What is the interest of $760 28*c.* for 19 months and 27 days, at $6 *per cent* ? *Ans.* $75 64*c.* 7*m.*

4. A note was given Nov. 15, 1796, of $282 56*c.* May 9, 1797, $96 34*c.* were endorsed; and Dec. 20, 1797, there were $174 28*c.* more endorsed; and June 10, 1799, the note was taken up. What was the last payment, interest at $6 *per cent.* ?

Ans. $29 71*c.* 3*m.*

* *Point off as many decimals as there are in the multiplicand and multiplier.*

$	c.	
282,56		*Note.*
×2,9		=3 *mo.* 24 *days.*
8,19	4	*interest.*
282,56		*principal added.*
290,75	4	*amount.*
96,34		*endorsement subtracted.*
194,41	4	*due May* 9, 1797.
×3,68	5	=7 *mo.* 11 *days.*
7,16	4	*interest.*
194,41	4	*principal added.*
201,57	8	*amount.*
174,28		*endorsement subtracted.*
27,29	8	*due December* 20, 1797.
×3,85		=17 *mo.* 21 *days.*
2,41	5	*interest.*
27,29	8	*principal added.*
29,71	3	*due June* 10, 1799. *Answer.*

Note. It is customary with some, to cast the interest of the whole principal, for the whole time, and find their amount; then to cast the interest on the several endorsements, and find their amount, and deduct it from the amount of the principal.

To cast the interest of the above sum, according to this method, the sum due would be only $.28 7c.; which would be $.1 64c. 3*m.* less than the former method.

5. A note was given January 20th, 1797, of $.360 50c.; September 10th, there were $.280 paid, and December 20th, 1798, it was taken up; What was the last payment, interest at 6 *per cent.*? *Ans.* $.137 74c.

6. What is the interest of $.786 28c. for 24 days, at 6 *per cent*? *Ans.* $.3 14c. 5*m.*

7. What is the interest of $.80 96c. from April 1st, 1795, to July 7th, 1798, interest at 6 *per cent*? *Ans.* $.15 86c. 3*m.*

Case 3.

To find the interest when the rate is, or is not 6d.

Rule.

Multiply the principal by the rate *per cent.* cut off the two right hand integers, as before, and it will give the interest for

one year; and if there be parts of a year, you must take parts of the sum; as, for 6 months, you must take $\frac{1}{2}$ of the product for one year; for 6 months $\frac{1}{2}$; for 4 months $\frac{1}{3}$ &c. For 20 days take $\frac{1}{3}$ of the product for one month; for 15 days $\frac{1}{2}$; for 10 days $\frac{1}{3}$, &c.

Examples.

1. What is the interest of $270 for 1 year and 3 months at 5 *per cent?*

	d.
	270
	5=*rate per cent.*
3 *months*=$\frac{1}{4}$)	13,50=*interest for* 1 *year.*
	3,365=*interest for* 3 *months.*
	$ 16,875=*the Answer.*

2. What commission must you pay on $890 84c. at 3½ *per cent.?* *Ans.* $31 17c. 9m.

3. What does the insurance of $ 2230 amount to, at 12½ *per cent.?* *Ans.* $ 278 75c.

4. What is the interest of $987 27c. for 11 months and 10 days, at 4 *per cent.?* *Ans.* $ 37 29c. 7m.

	d.	c.
	987,	27
		4
months=12)	39,	49, 08=*interest for* 1 *year.*
20 *days*=$\frac{1}{3}$)	3,	2909=*interest for* 1 *month.*
	2,	1938—*from one year's interest.*
	37,	297=*int. for* 11 *months,* 10 *days.*

Case 4.

To calculate interest for days, at any rate per cent.

Rule.

Multiply the given principal by the given number of days, and that product, by the interest of one dollar for one year, at the given rate *per cent.* (which, if 6 *per cent.* is ,06c. if 5 *per cent.* is ,05c. if 4½ *per cent.* is ,04c. 5m. &c.) divide the last product by 365, (the days in a year,) and it will give the interest, in dollars and parts of a dollar.

Examples.

1. What is the interest of $175 58c. for 85 days, at 6 *per cent.?*

	d. c.	
	175,58	*given principal.*
	× 85	*number of days.*
	87790	
	140464	
	14924,30	
	× ,06	*interest of a dollar.*
÷ 365)	895,4580(2,4533	
	730	
	1654	*Ans.* 2,45 $\frac{3}{10}$.
	1460	
	1945	
	1825	
	1208	
	1095	
	1130	
	1095	
	35	

2. What is the interest of $785 28c. for 220 days, at 5 *per cent.?* *Ans.* $23 66c. $5\frac{9}{10}m$.

3. What is the interest of $.987 75c. for 136 days, at 4½ *per cent.?*

	d c.	
	987,75	
	136	
	592650	
	296325	
	98775	
	134334,00	
	,045	
	67167000	
	53733600	
÷ 365)	6045,03000(16	*d.* 56c. 1$\frac{5}{10}m$. *Answer.*

4. What is the interest of 586*d.* 25*c.* for 84 days, at 3 *per cent.?* *Ans.* 4*d.* 04*c.* 7$\frac{1}{2}m$.

5. What is the interest of 689*d.* 80*c.* for 20 days, at 3½ *per cent?*
Ans. 1*d.* 34*c.* 2*m.*

6. What is the interest of 1000*d.* for 150 days, at 8½ *per cent?*
Ans. 34*d.* 93*c.* 1*m.*

7. An obligation was given May 9, 1796, for 467*d.*; November 20th, there were 295*d.* paid, and January 18th, 1797, it was taken up; What was the last payment, interest 5 *per cent?*
Ans. 185*d.* 96*c.*

Case 5.

Compound Interest is that which arises from the interest's being added to the principal; and being continued in the hands of the borrower, it becomes a part of the principal at the end of each stated time of payment.

Rule.

Find the interest of the given principal for one year, and add it to the principal; next find the interest of that amount, and add it as before; and thus proceed for any number of years. The given principal being subtracted from the last amount, the remainder will be the compound interest.

Examples.

1. What is the compound interest of 855*d.* for 3 years, at 6 *per cent.?*

d.		*d.* c.	
855	*prin.*	960,678	2*d amount.*
6		6	
51,30	*int.*	57,64,068	*interest.*
+855	*prin.*	960,678	
906,30	*amt.*	1018,318	3*d amount.*
6		855	—*first principal.*
54,37,80	*int.d*	163,31c. 8m.	=*compound int. the Answer.*
906,30			
960,678			

2. What is the compound interest of 768*d.* for 4 years, at 6 *per cent?*
Ans. 201*d.* 58*c.*

3. What is the compound interest of 560*d.* for 3⅓ years, at 6 *per cent?*
Ans 126*d.* 97*c.* 7*m.*

Note. After you have gotten the amount for 3 years, multiply by 3,=half the number of months.

4. What is the compound interest of 720*d.* for 3 years, at 5 *per cent?*
Ans. 113*d.* 49*c.*

ANOTHER RULE TO CAST INTEREST.

RULE.

Multiply the principal by half the months and half the decimal of the days annexed to the months.

Or, Multiply by the whole sum of the months and whole decimal of the days, and the product will be just double the interest. In either case, strike off as many figures from the right hand of the product, as there are decimal places in the multiplicand and multiplier. The figures on the left hand, will be the answer in cents.

EXAMPLES.

1. What is the interest of 102*d.* 50*c.* for 2 years, 2 months and 17 days, at 6 *per cent?*

		Second mode.	
102,50	*principal.*		102,50
13,28	*half.*		26,56
82000			61500
20500			51250
30750			61500
10250			20500
1361,2000		½)2722,4000	
		1361,2 *half.*	
Ans. 1361 *cents*, or		*Ans.* 1361 *cents* 2 *mills*, or	
13*d.* 61*c.* 2*m.*		13*d.* 61*c.* 2*m.*	

Promiscuous examples, in Interest, to be cast up by each preceding rule, in separate operations.—To be well versed, in casting interest, is highly useful to all persons. Instructors ought, therefore, to take special pains with their pupils, in this part of arithmetic. The answer to some of the questions, is, intentionally omitted.

EXAMPLES.

1. What is the interest of £80, 12, 9 for 1 year and 11 months, at 6 *per. cent?* *Ans:* £9, 5, 5, 1.

2. What is the interest of £18, 7, 4, 2 from 19th May to 25th October, at 6 *per cent?* *Ans.* 9*s.* 6*d.* 2*q.*

3. At 6 *per cent*, What is the interest of £19, 13, 7 from 3d January, 1806, to 18th May, 1807. *Ans.* £1, 12, 5, 1.

4. What is the interest of 8276 *dol.* 75*c.* for 7 years, 8 months, at 7 *per cent?* *Ans.* 4441, 84.

5. What is the interest of 8796 *dols.* 57 *cents*, for 7 years, 2 months, at 7 *per cent?*

6. What is the interest of 2369 *dol.* 25, at 7 *per cent.* for 2*y.* 7*m.* 4*d.*?

7. At 3 *per cent.* What is the interest of £547, 16*s.* for 6 years? *Ans.* £164, 6, 6.

8. At 6 *per cent.* What is the interest of £325, 7, 6, for 3 years and a half? *Ans.* £68, 6, 6, 1.

9. At $4\frac{1}{2}$ *per cent.* What is the interest of £576, 2, 7, for $7\frac{1}{4}$ years? *Ans.* 187, 19, 1, 2.

10. At $2\frac{1}{2}$ *per cent.* What is the interest of £256, 5, 3, for $2\frac{1}{12}$ years?

11. At $4\frac{1}{2}$ *per cent.* What is the interest of £375, 6, 1, for 2 months?

12. At 5 *per cent.* What is the interest of £259, 13, 5, for $1\frac{8}{12}$ year?

13. What is the interest of £347, 5, 9, for $\frac{1}{4}$ year, at 6 *per cent?* *Ans.* £5, 4, 2.

14. What is the interest of 124 *dolls.* for 5 months, at 6 *per cent?* *Ans.* 3, 10.

15. At 10 *per cent.* What is the amount of 694 *dol.* 84 *cents.* for $1\frac{1}{2}$ year? *Ans.* 104 *dol.* 22*c.* 6*m.*

16. At 6 *per cent.* What must I give for the use of 126 *dol.* 46*c.* for $2\frac{3}{12}$ years? *Ans.* 17*d.* 97*c.*

17. At 6 *per cent.* What is the amount of 268 *dol.* 44*c.* for 3 years, 5m. 26d.? *Ans.* 56, 19, 3.

18. On compound interest, What is the amount of £.259, 10, for 3y. 9m. 10d. at 9 *per cent.*? *Ans.* £.94, 0, 8, 2.

19. On compound interest, What must B. pay A. for the use of £.409, for 7 years, at 6 *per cent.*? *Ans.* £.981, 7, 10 2.

DOUBLE RULE OF THREE.

IN this rule, there are five numbers given to find out a sixth, which is to be in the same proportion to the product of the fourth and fifth numbers, as the third number is to the product of the first and second numbers, in the *Direct Rule.*

When the question belongs to the *Double Rule of Three Reverse*, the sixth number bears such proportion to the fourth and fifth, as the first bears to the second and third.

The three conditional terms must be placed in the following manner, *viz.* that number, which is the principal cause of gain, loss, or action, must be set in the first place; that number, which denotes the space of time, or distance of place, must be in the second place; and that, which is the gain, loss, or action, in the third place. Having done this, place the other two numbers, which move the question, directly under those of the same name; and if the blank place, or term sought, fall under the third number, then the question belongs to the *Direct Rule.*

Rule.

Multiply the three last terms, for a dividend; and the two first for a divisor. Divide the dividend by the divisor, the quotient will be the answer.

But if the blank fall under the first or second term, the question belongs to the *Reverse Rule*.

Rule.

Multiply the first, second, and last terms together for a dividend, and the other two for a divisor; divide, and the quotient will be the sixth term, or answer.

Examples.

1. If 100*l.* principal, in 12 months, gain 5*l.* What will 246*l.* principal gain in 7 months?

l. *m.* *l.*

Stated, If 100 : 12 : : 5 *the three conditional terms.*

246 : 7 *the terms moving the question.*

As the blank falls under the third term, the question belongs to the *direct rule*. And of course, the three last terms must be multiplied together for a dividend, viz. $7 \times 246 \times 5 = 8610$. The two first terms must be multiplied together for a divisor, viz. $100 \times 12 = 1200$.

The operation at large.

l. *m.* *l.*

If 100 : 12 : : 5

246 : 7

100 × 12 = 1200

246 × 7 = 1722

1722 × 5 = 8610

1200)8610(7*l.*
8400
210
20
)4200(3*s.*
3600
600
12
)7200(6*d.*
7200

2. If 20 men spend 18*l.* in 24 weeks, How much will 40 men spend in 48 weeks? *Ans.* 72*l.*

3. If 10 bushels of oats be sufficient for 18 horses 20 days, How many bushels will serve 60 horses 36 days? *Ans.* 60 *bushels.*

4. A man lent $350 to receive interest, and when it had continued 9 months, he received, principal and interest together, 360 *dol.* 50 *cents*; at what rate *per cent.* did he lend his money? *Ans.* 4 *dol. per cent.*

5. If the carriage of 20cwt. from Mendon to Boston, which is 37 miles, cost 16 *dol.* What will the carriage of 12cwt. be from Boston to Worcester, which is 50 miles? *Ans.* 12*d.* 97*c.* 2*m.*

6. If 700 *dol.* in half a year, gain 14 *dol.* interest; How much will 400 *dol.* gain in 5 years? *Ans.* 80 *dol.*

7. If 100 *dol.* gain 6 *dol.* in a year; In what time will 600 *dol.* gain 24 *dol.*? *Ans.* 8 *months.*

Here the blank falling under the 2d place, the question belongs to *reverse proportion*, and the answer must be sought by the 2d rule.

8. If 305 polls pay 28 cents, each, to a state tax of 415 *dol.* What must 112 polls pay, each, to a parish tax of 300 *dollars*? *Ans.* 55 *cents.*

9. If 20 cows for 80 *dolls.* go 40 weeks to grass; How many cows for 30 *dolls.* may winter in that place? *Ans.* 25 *cows.*

TABLE I.

In which the different CURRENCIES, throughout the United States, from *One Farthing* to a *Thousand Pounds*, are reduced to an equivalent value in *Dollars, Cents* and *Mills*.

N. Ham.	*N. York.*	*N. Jer.*	*S. Caro.*
Mass. R.	*N. Caro.*	*Penn.*	*Georgia.*
Isl. Conn.		*Dela.*	
Vir. Ken.		*Maryl.*	
Vermont.			

	Dol.	*C.*	*M.*	*D.*	*C.*	*M.*	*D.*	*C.*	*M.*	*D.*	*C.*	*M.*
Qrs.	1	0	0	3	0	0	3	0	0	3	0	0	4
	2	0	0	7	0	0	5	0	0	6	0	0	9
	3	0	1	0	0	0	8	0	0	8	0	1	4
Pence.	1	0	1	4	0	1	0	0	1	1	0	1	8
	2	0	2	8	0	2	1	0	2	2	0	3	6
	3	0	4	2	0	3	1	0	3	3	0	5	4
	4	0	5	6	0	4	2	0	4	4	0	7	1
	5	0	6	9	0	5	2	0	5	6	0	8	9
	6	0	8	3	0	6	2	0	6	7	0	10	7
	7	0	9	7	0	7	3	0	7	8	0	12	2
	8	0	11	1	0	8	3	0	8	9	0	14	3
	9	0	12	5	0	9	4	0	10	0	0	16	1
	10	0	13	9	0	10	4	0	11	1	0	17	9
	11	0	15	3	0	11	4	0	12	2	0	19	6
Shillings.	1	0	16	7	0	12	5	0	13	3	0	21	4
	2	0	33	3	0	25	0	0	26	7	0	42	9
	3	0	50	0	0	37	5	0	40	0	0	64	3
	4	0	66	7	0	50	0	0	53	3	0	85	7
	5	0	83	3	0	62	5	0	66	7	1	7	1
	6	1	0	0	0	75	0	0	80	0	1	28	6
	7	1	16	7	0	87	5	0	93	3	1	50	0
	8	1	33	3	1	0	0	1	6	7	1	71	4
	9	1	50	0	1	12	5	1	20	0	1	92	9
	10	1	66	7	1	25	0	1	33	3	2	14	3
	20	3	33	3	2	50	0	2	66	7	4	28	6

N. Hampshire, &c. &c.		*N. York, &c.*	*N. Jersey, &c. &c.*		*S. Carolina, &c.*	
£.	*d. c. m.*	*d. c.*	*d. c. m.*		*d. c. m.*	
1	3,33,3	2,50	2,66,7		4,28,6	
2	6,66,7	5,00	5,33,3		8,57,1	
3	10,00,0	7,50	8, 0,0		12,85,7	
4	13,33,3	10,00	10,66,7		17,14,3	
5	16,66,7	12,50	13,33,3		21,42,9	
6	20,00,0	15,00	16, 0,0		25,71,4	
7	23,33,3	17,50	18,66,7		30,00,0	
8	26,66,7	20,00	21,33,3		34,28,6	
9	30,00,0	22,50	24, 0,0		38,57,1	
10	33,33,3	25,00	26,66,7		42,85,7	
11	36,66,7	27,50	29,33,3		47,14,3	
12	40,00,0	30,00	32,00,0		51,42,9	
13	43,33,3	32,50	34,66,7		55,71,4	
14	46,66,7	35,00	37,33,3		60.00,0	
15	50,00,0	37,50	40,00,0		64,28,6	
16	53,33,3	40,00	42,66,7		68,57,1	
17	56,66,7	42,50	45,33,3		72.85,7	
18	60,00,0	45,00	48,00,0		77,14,3	
19	63.33,3	47,50	50,66,7		81,42,9	
20	66,66,7	50,00	53,33,3		85,71,4	
30	100,00,0	75,00	80,00,0		128,57,1	
40	133,33,3	100,00	106,66,7		171,42.9	
50	166,66,7	125,00	133,33,3		214,28,6	
100	333.33,3	250,00	266,66 7		428,57,1	
200	666,66,7	500,00	533.33,3		857,14,3	
500	1666,66.7	1250,00	1333,33,3		2142,85,7	
1000	3333,33,3	2500,00	2666,66,7		4285,71,4	

To find the amount, in *Pounds, Shillings, Pence* and *Farthings*, in the Currency of any one of the States, in *Dollars, Cents* and *Mills*, look for the several sums in their respective columns, and in the angles of meeting, in the columns, at the tops of which the States are placed, you will find the amount; add all the sums together, and the sum total will be the answer. Thus, 10*l.* (New England currency) make 33*dol.* 33*c.* 3*m*; 4*s.* make 66*c.* 7*m.*; 5*d.* make 6*c.* 9*m.*; 2*q.* make 7*m.* Now, 33*dol* 33*c* 3*m*; + 66*c.* 7*m.* + 6*c.* 9*m* + 7*m* = 34*dol.* 7*c.* 6*ms* = 10*l.* 4*s.* 5*d* 2*q*.—What is the amount, in Federal Money, of 14*l.* 7*s.* 9*d.* 3*q.* N. Jersey currency?

Ans. 38*d.* 37*c.* 4*m.*

TABLE II.

Showing the value of any number of cents, in other currencies, from one to an hundred.

N. Hampshire,	*Mass. R. Island,*	*Conn. Vermont,*	*Virginia, Ken.*
C. s. d q.	*C. s. d.q.*	*C. s. d.q.*	*C. s. d.q.*
1 0, 0,3	26 1, 6,3	51 3, 0,3	76 4, 6,3
2 0, 1,2	27 1, 7,2	52 3, 1,2	77 4, 7,2
3 0, 2,1	28 1, 8,1	53 3, 2,1	78 4, 8,1
4 0, 3,0	29 1, 9,0	54 3, 3,0	79 4, 9,0
5 0, 3,2	30 1, 9,2	55 3, 3,2	80 4, 9,3
6 0, 4,1	31 1,10,1	56 3, 4,1	81 4,10,2
7 0, 5,0	32 1,11,0	57 3, 5,0	82 4,11,0
8 0, 5,3	33 1,11,3	58 3, 5,3	83 4,11,3
9 0, 6,2	34 2, 0,2	59 3, 6,2	84 5, 0,2
10 0, 7,1	35 2, 1,1	60 3, 7,1	85 5, 1,1
11 0, 8,0	36 2, 2,0	61 3, 8,0	86 5, 2,0
12 0, 8,3	37 2, 2,3	62 3, 8,3	87 5, 2,3
13 0, 9,1	38 2, 3,1	63 3, 9,1	88 5, 3,1
14 0,10,0	39 2, 4,0	64 3,10,0	89 5, 4,0
15 0,10,3	40 2, 4,3	65 3,10,3	90 5, 4,3
16 0,11,2	41 2, 5,2	66 3,11,2	91 5, 5,2
17 1, 0,1	42 2, 6,1	67 4, 0,1	92 5, 6,1
18 1, 1,0	43 2, 7,0	68 4, 1,0	93 5, 7,0
19 1, 1,3	44 2, 7,3	69 4, 1,3	94 5, 7,3
20 1, 2,2	45 2, 8,2	70 4, 2,2	95 5, 8,2
21 1, 3,0	46 2, 9,0	71 4, 3,0	96 5, 9,0
22 1, 3,3	47 2, 9,3	72 4, 3,3	97 5, 9,3
23 1, 4,2	48 2,10,2	73 4, 4,2	98 5,10,2
24 1, 5,1	49 2,11,1	74 4, 5,1	99 5,11,1
25 1, 6,0	50 3, 0,0	75 4, 6,0	100 6, 0,0

N. York, N. Carol.				N. Jer. Penn. Dela. Maryland.				S. Carol. Georgia.			
Cts.	s.	d.	q.	Cts.	s.	d.	q.	Cts.	s.	d.	q.
1	0,	1,	0	1	0,	1,	0	1	0,	0,	2
2	0,	2,	0	2	0,	1,	3	2	0,	1,	0
3	0,	3,	1	3	0,	2,	3	3	0,	1,	3
4	0,	3,	2	4	0,	3,	2	4	0,	2,	1
5	0,	4,	3	5	0,	4,	2	5	0,	2,	3
6	0,	5,	2	6	0,	5,	2	6	0,	3,	1
7	0,	6,	3	7	0,	6,	1	7	0,	4,	0
8	0,	7,	1	8	0,	7,	1	8	0,	4,	2
9	0,	8,	3	9	0,	8,	0	9	0,	5,	0
10	0,	9,	2	10	0,	9,	0	10	0,	5,	2
11	0,	10,	2	11	0,	10,	0	11	0,	6,	1
12	0,	11,	3	12	0,	10,	3	12	0,	6,	3
13	1,	0,	1	13	0,	11,	3	13	0,	7,	1
14	1,	1,	2	14	1,	0,	2	14	0,	7,	3
15	1,	2,	2	15	1,	1,	2	15	0,	8,	2
16	1,	3,	1	16	1,	2,	2	16	0,	9,	0
17	1,	4,	1	17	1,	3,	3	17	0,	9,	2
18	1,	5,	2	18	1,	4,	1	18	0,	10,	0
19	1,	6,	3	19	1,	5,	1	19	0,	10,	3
20	1,	7,	2	20	1,	6,	0	20	0,	11,	1
30	2,	4,	2	30	2,	3,	0	30	1,	4,	3
40	3,	2,	2	40	3,	0,	0	40	1,	10,	2
50	4,	0,	0	50	3,	9,	0	50	2,	4,	0
60	4,	9,	2	60	4,	6,	0	60	2,	9,	2
70	5,	7,	1	70	5,	3,	0	70	3,	3,	1
80	6,	4,	3	80	6,	0,	0	80	3,	8,	3
90	7,	2,	2	90	6,	9,	0	90	4,	2,	2
100	8,	0,	0	100	7,	6,	0	100	4,	8,	0

TABLE III.

The value of English and Portuguese gold, in dollars, cents *and* mills, *in the United States.*

Gr.	Cts.	M.	Pwt.	D.	Cts.
1	3	7	1	0	89
2	7	4	2	1	77 3/4
3	11	1	3	2	66 2/3
4	14	8	4	3	55 1/2
5	18	5	5	4	44 1/2
6	22	2	6	5	33 1/3
7	25	9	7	6	22
8	29	6	8	7	11
9	33	3	9	8	0
10	37	0	10	8	89
11	40	7	11	9	77 3/4
12	44	4	12	10	66 1/3
13	48	1	13	11	55 1/2
14	51	8	14	12	44 1/2
15	55	5	15	13	33 1/3
16	59	2	16	14	22
17	63	0	17	15	11
18	66	6	18	16	0
19	70	4	19	16	89
20	74	0	1oz	17	77 3/4
21	77	6	*Note.* 89cents		
22	81	5	is the value of		
23	85	2	one pwt.Eng. & Port. gold.		

TABLE IV.

The value of French and Spanish gold, in dollars, cents *and* mills, *in the United States.*

Gr.	Cts.	M.	Pwt.	D.	C.	M.
1	3	6	1	0	89	6
2	7	3	2	1	75	2
3	11	0	3	2	64	6
4	14	6	4	3	50	3
5	18	2	5	4	38	0
6	21	9	6	5	25	5
7	25	5	7	6	13	1
8	29	2	8	7	00	1
9	32	8	9	7	88	3
10	36	5	10	8	76	0
11	40	1	11	9	63	5
12	43	7	12	10	51	1
13	47	4	13	11	38	7
14	51	1	14	12	26	3
15	54	6	15	13	13	9
16	58	4	16	14	1	5
17	62	0	17	14	89	0
18	65	7	18	15	76	6
19	69	3	19	16	64	2
20	73	0	1oz	17	51	8
21	76	9	*Note.* 89 cts. 6			
22	80	3	m. the value of			
23	83	9	1pwt. of Frenc. & Span. gold.			

TABLE V.

The value of the several pieces of Silver Coin *now in circulation in the United States, in Federal Money.*

	Cts.	M.
One fourth of a pistareen, or half a dime,	5	0
Four pence half penny,	6	2
Half a pistareen, or dime,	10	0
Nine pence piece, or $\frac{1}{8}$ of a dollar,	12	5
Pistareen, or two dimes,	20	0
Quarter of a dollar,	25	0
Half a dollar,	50	0
Dollar,	100	0
Half a French crown,	55	0
Half an English crown,	55	5
French crown,	110	0
English crown,	111	0

TABLE VI.

Containing the value of Foreign Coins, in Federal Money, as estimated by Act of Congress.

	D.	D.	C.	M.
Pound sterling of Great-Britain,	4	4	4	0
Pound sterling of Ireland,	4	1	0	0
Pagoda of India,	1	9	4	0
Tale of China,	1	4	8	0
Millree of Portugal,	1	2	4	0
Ruble of Russia,	0	6	6	0
Rupee of Bengal,	0	5	5	5
Fiorin, or Guilder of the United Netherlands,	0	3	9	0
Marco Banco of Hamburgh,	0	3	3	5
Livre Tournois of France,	0	1	8	5
Rial Plate of Spain,	0	1	0	0
Rix Dollar of Denmark,	1	0	0	0

TABLE VII.

Shewing the weight *and* value *of* Foreign Coins, *as they pass in the U. S. with their* Sterling *and* Federal *value.*

DOUBLE RULE OF THREE.

Names of Coins.	*Old Standard weight.*		*Sterling money of G. Britain.*	*N. Hamp. Massa. Con. Rh. Island.*	*New-York. N. Carolina.*	*New-Jersey, Pennsylvania Del. Mary.*	*S Carolina, Georgia.*	Federal Value.				
	Pt.	*Gr.*	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d	E.	D.	d.	C.	M.
(Gold)												
A Johannes,	18	0	3 12 0	4 16 0	6 8 0	6 0 0	3 4 8	1	6	0	0	0
A Half Johannes,	9	0	1 16 0	2 8 0	3 4 0	3 0 0	1 17 4	1	8	0	0	0
A Doubloon,	16	12	3 6 0	4 8 0	5 16 0	5 12 0	3 10 0	1	4	6	6	7
A Moidore,	6	18	1 7 0	1 16 0	2 8 0	2 5 0	1 8 0	0	6	0	0	0
An English Guinea,	5	6	1 1 0	1 8 0	1 17 0	1 15 0	1 1 9	0	4	6	6	7
A French Guinea,	5	5	1 0 6	1 7 4	1 16 5	1 14 3	1 1 3	0	4	5	6	2
A Spanish Pistole,	4	3	0 16 3	1 1 8	1 8 11	1 7 11	0 17 3	0	3	6	1	0
A French Pistole,	4	4	0 16 3	1 1 8	1 8 11	1 7 11	0 17 3	0	3	6	1	0
(Silver)												
A French Crown,	19	0	0 5 0	0 6 7	0 8 9¾	0 8 5	0 5 1	0	1	1	0	0
An English Crown,	19	0	0 5 0	0 6 8	0 9 0	0 8 4	0 5 2	0	1	1	1	1
Dollar of Spain, Denmark and Sweden,	17	6	0 4 6	0 6 0	0 8 0	0 7 6	0 4 8	0	1	0	0	0
A Pistareen,	3	11	0 0 10½	0 1 2½	0 1 7	0 1 6	0 0 11	0	0	2	0	0

H

PRACTICE.

PRACTICE is a contraction of the Rule of Three Direct, when the first term happens to be an unit, or 1; and is a short way of finding the price of any quantity of goods, &c. in sterling money; But, whenever the reckoning in *Federal Money* becomes general, this rule will become almost useless; for the price of any quantity of goods, in this money may be much easier found by Multiplication.

Previous to working the questions, hereafter given, it is necessary to have the following tables by heart.

TABLES OF EVEN PARTS.

Parts of a Shill. of a £.					*Parts of a £.*				*Parts of a cwt.*			
d.		*s.*		*£.*	*s.*	*d.*		*£.*	*qrs.*	*lb.*		*cwt.*
6	=	$\frac{1}{2}$	=	$\frac{1}{40}$	10	0	=	$\frac{1}{2}$	2	0	=	$\frac{1}{2}$
4	=	$\frac{1}{3}$	=	$\frac{1}{60}$	6	8	=	$\frac{1}{3}$	1	0	=	$\frac{1}{4}$
3	=	$\frac{1}{4}$	=	$\frac{1}{80}$	5	0	=	$\frac{1}{4}$	0	16	=	$\frac{1}{7}$
2	=	$\frac{1}{6}$	=	$\frac{1}{120}$	4	0	=	$\frac{1}{5}$	0	14	=	$\frac{1}{8}$
$1\frac{1}{2}$	=	$\frac{1}{8}$	=	$\frac{1}{160}$	3	4	=	$\frac{1}{6}$	0	8	=	$\frac{1}{14}$
1	=	$\frac{1}{12}$	=	$\frac{1}{240}$	2	6	=	$\frac{1}{8}$	0	7	=	$\frac{1}{16}$
$\frac{3}{4}$	=	$\frac{1}{16}$	=	$\frac{1}{320}$	1	8	=	$\frac{1}{12}$	0	4	=	$\frac{1}{28}$
$\frac{1}{2}$	=	$\frac{1}{24}$	=	$\frac{1}{480}$	1	0	=	$\frac{1}{20}$				
$\frac{1}{4}$	=	$\frac{1}{48}$	=	$\frac{1}{960}$								

RULE.

If the given price be an even part of the next higher denomination, divide the quantity by the even part, and the answer will be in the next higher denomination; but if it be not an even part, divide, by the greatest number that is an even part, and take parts of the quotient, for the remainder of the price and the sum of these several quotients will be the whole price, in the next higher denomination.

EXAMPLES.

6*d*=$\frac{1}{2}$*s*.	$\frac{1}{2}$.	468*lbs*. at 6*d*. per *lb*.	Here 6*d*. being the price of each *lb*. and the half of a shilling: therefore the half of 468 is taken, and gives 234*s*. or 11*l*. 14*s*.
1*s*.=$\frac{1}{20}$*l*.	$\frac{1}{20}$	23)4=*number of s*.	
		£11 14*s*. *Ans*.	
4*d*.=$\frac{1}{3}$	$\frac{1}{3}$.	784 yds. at 4*d*.	Here, taking the third part, there is $\frac{1}{3}$ of a shilling, or 4*d*. remains. *The remainder is always of the same name with the dividend, which here is four pence.*
	$\frac{1}{20}$	26(1 4*d*.	
		£13 1*s*. 4*d*. *Ans*.	

3d.=¼s. ¼ | 960lbs. at 3d.

1/20 | 24(0

12l. *Answer.*

4d=⅓s. ⅓ | 435lb. at 4½d.

½d.=⅛ of 4d. ⅛ | 145

18 1½d.

1/20 | 16(3 1½

8l. 3s. 1½l. *Ans*

Here, after taking the third part, I consider that a half penny is the eighth of four pence, therefore I take the 8th part of 145s. and that produces 18s and ⅛ of a shilling, or, 1½d. Then I add the two lines together, and they give the answer.

6d.=½s. ½ | 920 yds. at 7½d.

1½d.=⅛s. ⅛ | 460

115

1/20 | 57(5

28l. 15s.

6s. 8d.=⅓l. ⅓ | 426 gal. at 6s. 8d.

142l. *Answer.*

4s.=⅕l. ⅕ | 395lb. at 4s. 6d.

6d.=⅛ of 4s. ⅛ | 79

9 17 6

£.88 17 6 *Ans.*

Here, after taking ⅕ for the 4s. I consider that 6d. is the eighth of 4s. therefore I take the 8th of 79l. and ⅛ of a £. or 17s. 6d. remains.

6d.=½s. ½ | 426 yds. at 4s. 9d.

3d.=¼s. ¼ | 4

1704

213

106 6d.

2/0 | 202(3 6

101l. 3s. 6d. *Ans.*

When the price is shillings and pence, or shillings, pence and farthings, and not an even part of a pound, multiply the given number by the shillings, and take even parts for the pence, or pence and farthings, and add the several lines together, and they will be shillings, which bring into pounds, as before.

$6d = \frac{1}{2}s.$ $\frac{1}{2}$ | 339 gal. at 7*s.* 8*d.*
$2a = \frac{1}{6}s.$ $\frac{1}{6}$ | 7

2373
169 6
56 6

2(0 | 259(9

129*l.* 19*s.* *Answer.*

436 *lbs.* butter, at 10*d.*

$\frac{1}{12}$ | 4360

$\frac{1}{20}$ | 363 4*d.*

18*l.* 3*s.* 4*d.* *Ans.*

When the price is 10*d.* annex a cypher to the right hand of the given number, which divide by 12 and 20.

426 *lbs.* at 11*d.*
426

12 | 4686

2(0 | 39(0 6

19*l.* 10*s.* 6*d.* *Ans.*

When the price is 11*d.* set down the quantity twice in the form of Multiplication; add the two lines together; then divide by 12 and 20.

378 yds. at 2*s.*

37*l.* 16*s.* *Ans.*

When the price is 2*s.* double the right hand figure for shillings, and the figures at the left hand are pounds.

What is the price of 3cwt.1qr.14lbs. at 2*l.* 10*s.* 8*d.* a cwt.?

1qr. = $\frac{1}{4}$ | 2*l.* 10*s.* 8*d.*
3 = *integer.*

7 12 0
14lb. = $\frac{1}{2}$ a qr. | 12 8
6 4

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

When the quantity is of different denominations, multiply the price by the integers of the highest denomination, and take parts for the inferior denominations.

Questions.		Prices.			Answers.		
yds.					£.	s.	d.
204.	at	1s.	1d.	=	11	1	0
142		2s.	8d.	=	18	18	8
104		16s.	7d.	=	86	4	8
391		3s.	2½d.	=	62	14	5½
6000		0s.	8½d.	=	218	15	0
86		6s.	10d.	=	29	7.	8
9cwt. 2qr. 26lb.		4l.	10s.	4¼d. =	43	19	6

TARE AND TRETT.

GROSS WEIGHT is the whole weight of any sort of goods, together with the box, barrel, or bag, &c. which contains them.

Tare is an allowance made in the weight of goods, for the box, barrel, firkin, &c. in which they are packed.

Trett is an allowance of 4lb. in every 104lb. for waste, dust, &c.

Cloff is an allowance of 2lb. upon every 3cwt.

Suttle is when part of the allowance is deducted.

Neat weight is what remains after all allowances are made.

CASE 1.

When Tare is at so much per box, barrel, &c.

Multiply the number of boxes, &c. by the tare, subtract it from the gross, and the remainder will be the neat weight.

EXAMPLES.

1. In 5 hogsheads of sugar, each weighing 8cwt. 1qr. 9lb. gross, tare 24lb per hogshead; How much neat weight?

cwt.	qr.	lb.		cwt.	qr.	lb.
24×5=	1	0	8	8	1	9
						5
				41	2	17 *gross.*
				1	0	8—*tare.*
			Ans.	40	2	9 *neat.*

2. In 12 casks, of indigo, containing 45cwt. 1qr. 14lb. gross, tare 30lb. per cask; How much neat weight?

Ans. 42cwt. 1qr. 18lb.

CASE 2.

When the Tare is at so much per cwt.

Divide the gross, by the even parts of a cwt. to find the tare; subtract the quotient from the gross, and it will give the neat weight.

EXAMPLES.

1. What is the neat weight of 33cwt. 2qr. 18lb. gross, tare 16lb. per cwt.?

	cwt.	qr.	lb.
16lb. $=\frac{1}{7}$)	33	2	18
	4	3	$6\frac{4}{7}$
Ans.	28	3	$11\frac{3}{7}$ *neat.*

2. What is the neat weight of 84cwt. 2qrs. 14lb. gross, tare 14lb. per cwt? *Ans. 74cwt. 0qrs. $5\frac{1}{7}$lb. neat.*

CASE 3.

When Trett is allowed with Tare.

Divide the suttle by 26, and the quotient will be the trett, which subtract, and the remainder will be the neat.

EXAMPLES.

1. In 342cwt. 2qrs. 14lb. gross, tare 16lb. per cwt. and trett 4lb. per 104lb. What neat weight?

	cwt.	qrs.	lb.
16lb. $=\frac{1}{7}$)	342	2	14 *gross.*
	48	3	22—*tare.*
$\frac{1}{26}$)	293	2	20 *suttle.*
	11	1	$5\frac{1}{13}$—*trett.*
Ans.	282	1	$14\frac{12}{13}$ *neat.*

2. In 247cwt. 2qrs. 15lb. gross, tare 28lb. per cwt. and trett 4lb. per 104lb. What neat weight?

Ans. 178cwt. 2qrs. 9lb. 4oz. neat.

DISCOUNT.

DISCOUNT is when a sum of money, due at any time to come, is satisfied by paying so much present money as being put out to interest, would amount to the given sum in the same space of time.

The present value of 53 *dol.* due 12 months hence calculated at 6 *per cent. per annum*, is only 50 *dol.*, because, if 50 *dol.* were to be placed out at interest for 12 months, at 6 *per cent.* its amount would then be 53 *dollars.*

RULE.

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

Subtract the discount from the given sum, and the remainder will be the present worth.

EXAMPLES.

1. What is the present value of 360 *dol.* due 2 years hence, discount at 6 *per cent. per annum?*

Int. of 100 *dol.* 2 *years*=12 *dol.*+100=112 *dol.*

d. d. d.
If 112 : 12 : : 360
12

d. c. m.
112)4320(38,571=*discount*
336

960
896
640
560
800
784
160
112
48

d. c. m.
360,000
38,571
321,429=*present worth, Ans.*

2. What ready money will discharge a debt of 74*l.* 15*s.* due 2 years and 6 months hence, discount at 6 *per cent?* *Ans.* £.65.

3. What is the present value of 376*d.* 26*c.* due 18 months hence, discount at 5 *per cent.?* *Ans.* 350 *dollars.*

4. A certain parish settled a Minister, and agreed to give him a salary of $.300 a year; but afterwards he wishing to build a house, proposed to the parish to pay him, in ready money, 4 years' salary, to which they agreed; How much ready money must the parish pay, discount at 6 *per cent. per annum?*

Ans. $.1047 04*c.* 9*m.*

5. What is the discount of $.675, the one half payable in 8 months, the other half in a year, at 7 *per cent.?*

Ans. $.37 12*c.* 4*m.*

6. A. owes B. 450 *dol.* to be paid in 6 months, What discount, at 6 *per cent.* must be made for ready pay? *Ans.* 436,89.

7. Allowing 1 *per cent.* for ready pay, What is the discount, at 8 *per cent.* for 5150 *dol.* due in $4\frac{15}{36}$ months? *Ans.* 4950 *dols.*

8. What is the discount of 275*l.* 10*s.* for 7 months at 5 *per cent.?*

Ans. 7, 16, 1, 1.

9. What is the discount, at 5 *per cent.* of 75*l.* payable in $1\frac{3}{12}$ year? *Ans.* 70, 11, 9, 1.

10. A. owes B. 150 *dol.* payable in 60 days. For prompt payment, what is the discount at 6 *per cent?*

Ans. 148 *dol.* 50 *cents.*

11. What is the discount of 853 *dol.* at 4 *per cent.?*

Ans. 34 *dol.* 12*c.*

EQUATION OF PAYMENTS.

EQUATION OF PAYMENTS is when several sums of money, due at different times, are reduced to one proportional payment, so that no loss may be sustained by either party.

RULE.

Multiply each payment by the time at which it is due, and divide the sum of the products by the sum of the payments; the quotient will be the equated time for the payment of the whole.

EXAMPLES.

1. A. owes B. 600 *dol.* of which 200 *dol.* are due in 2 months, 150 *dol.* in 4 months, and the remainder in 8 months; but they agree to make one payment of the whole; What is the equated time for said payment?

$200 \times 2 = 400$
$150 \times 4 = 600$
$250 \times 8 = 2000$

600)3000(5 *months, Answer.*
3000

2. B. owes C. 750*l.* to be paid as follows, *viz.* 500*l.* at 2 months, 150*l.* at 3 months, and 100*l.* at 4½ months; When must the whole be paid together? *Ans.* 2½ *months.*

3. D. owes E. a certain sum of money, which is to be paid one half in two months, one third in 4 months, and the remainder in 10 months; What is the equated time for the whole? *Ans.* 4 *months.*

4. L. is indebted to Z. 120*l.* of which ⅓ is payable in 3 months, ¼ in 6 months, and the other ⅓ in 9 months, What is the mean time for paying the whole? *Ans.* 7*m.* 3*d.*

5. At what time must a note of £.500 be paid, which stipulates, that £.100 shall be paid in 3 months, 150, in 6 months, and the remainder in one year? *Ans.* 8*m.* 12*d.*

6. What is the equated time of paying a note of 4253 *dol.* 75*c.* stipulating to be paid, at 6 different times, *viz.* ⅓ in 60 days, ⅙ in 90 days, ⅙ in 120 days, ⅙ in 150 days, ⅙ in 180 days, and ⅙ in 210 days? *Ans.* 127½ *days.*

7. What is the mean time of paying 120 *dol.* ⅓ to be paid in 90 days, ¼ in 180 days, and ¼ in 270 days? *Ans.* 157 *days.*

8. A note of 1400 *dol.* payable in 90 days, has at the expiration of 60 days, an endorsement of 1000 *dol.* How much longer, than the stipulated time of payment, should the possessor, in equity, wait for the remaining 400 *dol.*? *Ans.* 75 *days.*

BARTER.

BARTER is the exchanging of one commodity for another, and informs merchants how to proportion their quantities, that neither may sustain loss.

RULE.

Find the value of the commodity, whose price is given, then find how much of the other commodity, at its given price, can be had for that money.

EXAMPLES.

1. How much rye at 84 *cents* a bushel, must be given in barter for 60 bushels of corn, at 50 *cents* a bushel?

Ans. 35*bu.* 2*pks.* 6$\frac{6}{7}$*qts.*

60
×.50
,84)30,00(35 *bushels.*
252
480
420
60
×4=*pecks in a bushel.*
)240(2 *pecks.*
168
72
×8=*quarts in a peck.*
)576(6 *quarts.*
504
$\frac{72}{84}=\frac{6}{7}$

2. B. bartered 3hhds. of rum, at 6*s.* 8*d* a gallon, with C. for 126 yards of cloth. What was the cloth a yard?

Ans. 10*s. a yard.*

3. A. bartered 340lbs. of pork, at ,07 *cents* a lb. and 80lbs. of butter at 17 *cents* a lb. with C. for 16 bushels of salt at 1*d.* 20*c.* a bushel, and the remainder he received in sugar at 18 *cents* a lb.; How much sugar did he receive? *Ans.* 101$\frac{1}{9}$*lbs.*

4. B. delivered 15cwt. 3qrs. of sugar, at 7 *pence* a lb. to C. for 343 yards of cloth; What did the cloth cost per yard?

Ans. 3*s. a yard.*

5. A. gives B. 50lbs. of wool, at 30 *cents* a lb. for 125lbs. of flax; What is the flax a lb.? *Ans.* 12 *cents a lb*

6. A. bartered 380 yards of calico, at 2*s.* 3*d.* a yard, and 15 yds. of broadcloth at 1*l.* 10*s.* a yard, with C. for 3cwt. 2qrs.

of sugar at 4*d.* 10*s.* a cwt. and the remainder in molasses at 3*s.* 6*d.* a gallon; How many gallons did he receive?

Ans. 218 *gal.* 2 *qts.*

7. How many pounds of cotton wool, at 4*s.* per lb. must be given, in barter, for 2cwt. of Hyson, at 9*s.* per lb.?

Ans. 504*lb.*

8. How much cash must A. pay B. in B's bartering with him 8 pieces of cloth, at £.3, 14*s.* per piece for 2cwt. of cheese, at £.1, 1, 6 per cwt.?

Ans. £.8, 2.

9. For 320 dozen of candles, at 4*s.* 6*d.* per doz. B. gave A. £ 30; and the remaining sum he paid in raisins, at 8*d.* per lb. How many pounds of raisins did B. deliver to A.

Ans. 11*cwt.* 1*qr.*

10. What is the price of tallow per cwt. when 85cwt. 2*qr.* 24lb. with the addition of £.125, 12*s.* in cash, pay for 608 bushels of wheat, at 1 *dol.* 75*c.* per bushel?

Ans. £.3, 10.

11. A's. young Hyson sells at 7*s.* 6*d.* per lb. in cash; in barter A. demands 8*s.* The worth of D's. tobacco is 9*d.* per lb. in cash; In bartering, what must he ask per lb. that he may have an equal profit with A.?

Ans. 9$\frac{3}{5}$*d.*

12. In bartering, M. estimates his cloth at 2*s.* 4*d.* per yd. N's. cloth cost him 1*s.* 10*d.* per yd.; and he estimates it at 2*s.* 1*d.* To gain 10 *per cent.* more than N. what must M. demand for his cloth?

Ans. 2*s.* 11*d.* *per yd.*

LOSS AND GAIN.

LOSS AND GAIN is a rule which teacheth merchants what they shall gain or lose, in the sale of their goods, having the price that they bought and sold them for both known; and is generally performed by the *Rule of Three.*

EXAMPLES.

1. Bought 18cwt. of cheese, at 4*d.* 67*c.* a cwt. which I sell out again at ,05*c.* a lb.: What is the whole gain? *Ans.* 16*d.* 74*c.*

d. *c.*	*cwt.*
4,67	18
18	4
3736	72
467	28
The whole cost 84,06	576
	144
	2016
	,05
	100,80 *sold for.*
	84,06 *prime cost.*
	16,74 *gain.*

2. At what price must I sell my cloth a yard, which cost me 3*s*. 8*d*. to gain 12½*l*. *per cent*. ? *Ans*. 4*s*. 1½*d*. *a yd*.

3. At what price must I sell my cloth a yard, which cost me 3*s*. 8*d*. to lose 12½*l*. *per cent* ? *Ans* 3*s* 2½*d*.

4. If by selling cloth at 4*s*. 1½*d*. a yard, I gain 12½*l per cent*. What did it stand me in per yard ? *Ans*. 3*s*. 8*d*.

5. If by selling cloth at 3*s* 2½*d*. *per* yard I lose 12½*l*. *per cent*. What is the prime cost ? *Ans*. 3*s*. 8*d*.

6. Bought salt for 84 *cents* a bushel, and sold it again for 1*d*. 12*c*. a bushel; What did I gain *per cent*. or in laying out 100 *dol*.?

7. At 1½*d*. a shilling profit, How much *per cent*. ?

Ans. 12*l*. 10*s*.

8. If 4cwt. 3qrs. 14lb. of sugar be bought for 15*l* 18*s*. 6*d*. and sold for 18*l*. 15*s*. 4½*d*. What is the rate of gain *per cwt*. ?

Ans. 11*s*. 8*d*. *per cwt*.

9. What is the gain *per cent*. on wheat, bought at 11*s*. and sold at 12*s*. 6*d*. per bushel ? *Ans*. £.13, 12, $8\frac{8}{10}$.

10. What is the price per yd. for cloth, if 375 yds. be sold for £.490, at 20 *per cent*. profit ? *Ans*. £1, 1, 9, 1.

11. What is the profit on 249 gals. of molasses, at 3*s*. 4*d*. per gal. and sold at 4*s*. 2*d* ? *Ans*. £.10, 7, 6.

12. To gain 15 *per cent*. What must be the price of 1 yd. of linen, when 124 yds. cost £.32 ? *Ans*. 5*s*. $11\frac{7}{31}d$.

13. Does a man lose, or gain, in buying wheat at 17*s*. per bushel, 4 months credit, on interest, or paying ready cash ?

Ans.

14. L. bought poor brandy, at 1*dol* 25 *cents* per gal. In selling he was compelled to suffer a discount of 18 *per cent*. What did he receive per gal. ? *Ans*. 1*d*. 2*c*. 5*m*.

15. A corn merchant wishes to purchase 10,000 bushels of corn. By paying the money, he can purchase at 48 cents per bushel. At 2 months credit, he must give 50 cents. Question, will it be profitable to borrow the money at 8 *per cent*. ?

Ans. By borrowing he will lose 136 *dols*.

ALLIGATION MEDIAL

IS when the quantities and price of several things are given, to find the mean price of the mixture compounded of those things.

RULE.

As the whole composition is to its total value, so is any part of the composition to its mean price.

EXAMPLES.

1. A farmer mixed 12 bushels of rye at 70 *cents* a bushel, 15 bushels of Indian corn at 54 *cents* a bushel, and 20 bushels of barley at 40 *cents* a bushel; What is a bushel of this mixture worth ? *Ans*. 52.8 *cents*.

bu.	c.	d.	c.
12 at	70	=	8.40
15	54	=	8,10
20	40	=	8. 0
47			24,50

If 47 : 24,50 :: 1
1

47)24,50(52
235
100
94
6

2. A grocer mixed 2cwt. of sugar at 56*s*. a cwt. and 1cwt. at 43*s*. a cwt. and 2cwt. at 50*s*. a cwt.; What is the price of 3cwt. of this mixture? *Ans.* 7*l*. 13*s*.

3. A vintner mixed 6 gal. of wine, at 4*s* 10*d*. a gallon with 12 gallons, at 5*s*. 6*d*. and 8 gallons at 6*s*. 3½*d*. a gallon; What is a gallon of this mixture worth? *Ans.* 5*s*. 7*d*.

4 What is the value of a bushel of oats and corn equally mixed? The oats cost 2*s* 6*d*. per bushel; and the corn, 4*s*. 6*d*. *Ans.* 3*s*. 6*d*.

5. Three sorts of sugar are mixed together; of which 3 cwt. were bought at £.2, 16 per cwt.; 6cwt. at £.1, 17, 4 per cwt. and 3 cwt. at £.3, 14, 8 per cwt. What is the true value of 1 cwt.? *Ans.* £.2, 11, 4.

6. A vintner compounds 4 sorts of wine, 20 gals. of port, at 5*s*. 4*d* per gal. 12 gal. of white wine, at 3*s*. per gal. 30 gal. of Lisbon, at 6*s*. per gal. and 20 gal. of Mountain, at 4*s*. 6*d*. per gal. What is the value of 1 gal. of this composition? *Ans.* 5*s*. 3*d*. $3\frac{5}{12}qrs.$

7. A goldsmith united, by fusion, 3 sorts of silver; of which, 12lb. were 6oz. fine; 8lb. 7oz. fine; and 10lb. 8oz. fine. Required the fineness of 1lb. *Ans.* 6oz. 18pwt. 16grs.

8. A dealer, in tobacco, heaps together four sorts of tobacco Of the first sort, 50lb. at 11*d* per lb. second, 30lb. at 1*s*. 2*d* per lb. third, 25lb. at 1*s*. 10*d*. per lb. and fourth, at 2*s*. per lb; What is the worth of 1 lb.? *Ans.* 16*d*. $3\frac{9}{71}qrs.$

ALLIGATION ALTERNATE.

IS the method of finding what quantity of each of the ingredients, whose rates are given, will compose a mixture of a given rate.

RULE.

Place the rates of the simples in a column under each other, and the propounded price of the composition against them; link the several rates together, in such a sort, that one greater than the mean rate may be coupled to another which is less; take the differences between the mean rate and the several prices, and place them each against his yoke-fellow.

Examples.

1. How many bushels of oats at 2*s* 6*d*. a bushel, barley at 3*s*. 8*d*. a bushel, corn at 4*s*. a bushel, and rye at 4*s*. 8*d*. a bushel. must be mixed together, that the compound may be worth 3*s*. 10*d*. a bushel?

	d.	*bu.*			*d.*	*bu.*	
Mean rate 46 *d.*	30	10	*of oats.*	Or, 46	30	2	*oats.*
	44	2	*barley.*		44	10	*barley.*
	48	2	*corn.*		48	16	*corn.*
	56	16	*rye*		56	2	*rye.*

2. A merchant would mix three sorts of sugar together, viz. one sort at 10*d*. another at 7*d* and another at 6*d*. a lb.; How much of each sort must he take, that the mixture may be sold at 8*d*. a lb.?

	d.	*lb.*	*lb.*
8	6	2	2 *at* 6*d.*
	7	2	2 *at* 8*d.*
	10	1+2	3 *at* 10*d.*

3. A farmer has a heap of corn, consisting of 4 sorts. First sort at 2*s*. 6*d*. second, at 3*s*. 8*d*. third, at 4*s*. and fourth, at 4*s*. 8*d*. The number of bushels of each sort is required. *Ans.* First sort, 12 bushels; second sort, 12; third sort, 18; fourth sort, 13.

4. A cask contains a mixture of brandy, wine, cider and water, which is worth 5*s*. per gal. Required the number of gals. of each kind, allowing the brandy worth, 8*s*. per gal. wine 7*s*. per gal. cider 1*s*. per gal. and water 0.

Ans. Brandy, 9; wine, 9; cider, 5; water, 5.

5. How much rum at 6*s*. per gal. and 4*s*. per gal. must be mixed, so that the composition may be worth 5*s*. per gal?

Ans. 1 *gal.*

SINGLE FELLOWSHIP.

SINGLE FELLOWSHIP teaches to divide any number into any assigned number of parts, in the same proportion as these parts are to each other.

Rule.

As the whole sum of the several stocks is to the total gain or loss, so is each man's share in stock, to his share of the gain or loss.

Proof.

Add all the shares together, and the sum will be equal to the given gain or loss.

Examples.

1. A. B. and C. trading together, gained $120 which is to be shared according to each man's stock; A. put in $140 B. $300 and C. $160 What is each man's share?

	$.
A. put in	140
B.	300
C.	160
	600

If 600 : 120 : : $\begin{cases} 140 : 28 \text{ A's share.} \\ 300 : 60 \text{ B's share.} \\ 160 : 32 \text{ C's share.} \end{cases}$

120 *proof.*

2. A gentleman died, leaving three children, to whom he bequeathed his estate in the following manner: to his eldest son he gave $560 to his second son $500 and to the third $450 but when his debts were paid, there were but $950 left; What must each have in proportion to his legacy?

3. A gentleman left an estate of $720 to his three children, to be divided as follows, *viz.* as often as the eldest took up $7 the second should take $5 and the third $3 What did each receive?

4. A. B. and C. trading together, gained 1010*l.* which is to be shared according to their stock; A. put in 480*l.*; B. 680*l.*; C. 840*l.*; What is each man's share?

Ans. A. 242*l.* 8*s.*; B. 343*l.* 8*s.*; C. 424*l.* 4*s.*

5. Three merchants, in company, have a stock, of which A. put in £.20; B. 30; and C. 40. They gain £.360. What is each man's dividend? *Ans.* A. £.80; B. 120; C. 160.

6. Three men, trading on a capital of £.100, gain in the following manner: A. gains £.3; B. £.5; and C. £.8. What sum did each put into the stock?

Ans. A. put in £.18, 15; B. £.31, 5; and C. £.50.

7. A merchant, failing in business, is found with £.675 in his possession. To L. he owes £.275, 14; to M. £.304, 7; to R. £.152, and to T. £.104, 6. On dividing this property proportionally, What will fall to each man's share? *Ans.* L. will have £.222, 15, 2; M. £.245, 18, 1, 2; R. £.122, 16, 2, 3; T. £.84, 5, 5.

8. A. B. C. and D. gain £.100, by trading in company. Into the stock, A. put $\frac{1}{3}$; B. $\frac{1}{4}$; C. $\frac{1}{5}$; and D. $\frac{1}{6}$. What is each man's part of the gain? *Ans.* A's part is £.35, 1, 9; B's £.26, 6, 3, 3; C's £.21, 1, 0, 2; D's £.17, 10, 10, 2.

DOUBLE FELLOWSHIP.

DOUBLE FELLOWSHIP, or fellowship with Time, is when the stocks continue in an unequal term of time.

RULE.

Multiply each man's stock and time together; add the several products thence arising together; then, as the sum of those products, is to the whole gain or loss; so is each product, to its share of the gain or loss. *Proof*, the same as in *Single Fellowship.*

Examples.

1. Three merchants traded in company; A. put in 600 *dol.* capital for 9 months, B. 700 *dol.* for 12 months, and C. 800 *dol.* for 15 months, and they gained by trade 212*d.* 10*c.*; What is each man's share in the gain?

d.	*m.*	
600 ×	9 =	5400
700 ×	12 =	8400
800 ×	15 =	12000
		25800

	d.	*c.*			*d.*	*c.*	*m.*	
If	25800	: 212,10	: :	5400	:	44,393	=	A's.
				8400	:	69,055	=	B's.
				12000	:	98,651	=	C's.
						212,099		*proof.*

2. Two merchants trade in company; A. put in 60*l.* for 3 months, and B. 50*l.* for 4 months; but by misfortune they lose 30*l.*; How must they share the loss?

Ans. A. 14*l.* 4*s.* 2½*d.*; B. 15*l.* 15*s.* 9½*d.*

3. Three persons hired a pasture for 100 *dol.*; A. put in 40 oxen for 20 days, B. 30 oxen for 40 days, and C. 50 oxen for 10 days; How much, of the 100 *dol.* must each pay?

Ans. A. 32 *dol.*; B. 48 *dol.*; C. 20 *dol.*

4. Two men hired a pasture for 18 months, for 262 *dol.* A. at first, put in 100 sheep, and at the end of 8 months he put in 50 more; B. at first, put in 275 sheep, and at the end of 4 months he took out 70 sheep; What must each man pay?

Ans. A. 96*d.* 10*c.* 8*m.*; B. 165*d.* 89*c.* 1*m.*

5. Three persons, in company, trade in the following manner, A. deposits in the stock £.195, 14 for 90 days; B. £.179, 18, 3 for 150 days; C. 59, 14, 10 for 330 days. At the expiration of the last term, they settle and find a gain of £.364, 18. and make a dividend; What does each man receive?

Ans. A. receives £.102, 6; B. £.148, 1, 1, 2; C. £.114, 10, 6, 1.

6. By trading in partnership, Peter and John gain £.70. Into the stock, Peter put £.40, for 90 days, John put £.75 for 120 days; What is each man's share?

Ans. John has £.50 and Peter £.20.

7. Three farmers rent pasturage, at £.36, 10, 6 the season. W. put in 23 horses for 27 days; Z. 21, for 35 days; and X. 16, for 23 days; What is the proportionate part of each man's debt?

Ans W. owes £.13, 3, 1, 2; Z. £.15, 11, 5, and X. £.7, 15, 11.

EXTRACTION OF THE SQUARE ROOT.

A SQUARE number ariseth from the multiplication of a number into itself; the number, so multiplied, is called the root; thus, 4 multiplied by 4, produces 16; so 16 is a square number, and 4 is the root.

To extract the square root of any number, is to find another number; which, multiplied by (or into) itself, produces the given number; and after the root is found, such a multiplication is a proof of the work.

All the single square numbers, with their respective roots, are contained in the following *Table*.

Roots.	1	2	3	4	5	6	7	8	9
Squares.	1	4	9	16	25	36	49	64	81

RULE.

1. When the square root of any number, not expressed in the table, is required, set a point over the place of units, another over the place of hundreds, and so on, over every second figure towards the left hand, which points shew the number of figures the root will consist of.

2. Find the nearest square number in the first, or left hand period, and subtract it therefrom, and place the root of the square on the right of the given number, in the manner of a quotient in division, for the first figure of the root.

3. To the remainder annex the second period for a dividend; and on the left thereof write the double of the root, already found, for a divisor.

4. Seek how often the divisor is contained in the dividend (reserving, always, the unit's place) and place the said figure in the root, and likewise on the right hand of the divisor: multiply the divisor by the figure last found in the root, and subtract the product from the dividend; to the remainder join the next period for a new dividend.

5. Find a new divisor, by doubling the right hand figure of the last divisor, and bring it down; and from these find the next figure in the root, as directed last; continue the operation in the same manner, till you have brought down all the periods.

Note 1. If there be decimals in the given number, it must be pointed both ways from the place of units.

2. When the divisor cannot be had in the dividend, place a cypher in the root, and also on the right hand of the divisor.

3. If there be a remainder after extraction, add two cyphers and proceed as before, and the root, arising therefrom, will be a decimal.

EXAMPLES.

1. What is the square root of 18496?

```
18496(136 the root. Answer.
  1
 ---
23)84
  69
 ---
266)1596
  1596
 ----
```

2. What is the square root of 234,09?

234,09(15,3 *the Answer.*
1

25)134
125

303)909
909

3. What is the square root of 6

6(2,449, *&c. the root.*
4

44)200
176

484)2400
1936

4889)46400
44001

2399

4. What is the square root of 292,41? *Ans.* 17,1.
5. What is the square root of ,002809? *Ans.* ,053.
6. What is the square root of 30138696025? *Ans.* 173605.
7. What is the square root of 213858? *Ans.* 654.
8. What is the square root of 72745922? *Ans.* 12062.
9. What is the square root of 22071204? *Ans.* 4693.
10. What is the square root of 2268741? *Ans.* 1506,23.
11. What is the square root of 7596796? *Ans.* 2756,228.
12. What is the square root of ,00032754? *Ans.* ,01809.

APPLICATION AND USE OF THE SQUARE ROOT.

To find a mean proportional between two numbers.

RULE.

Multiply the given numbers together, and extract the square root of the product, which root will be the mean proportional sought.

EXAMPLES.

1. What is the mean proportional between 49 and 64?

49
64

196
294

3136

3136(56 *Ans.*
25

106)636
636

2. What is the mean proportional between 144 and 121 ?
Ans. 132.
3. What is the mean proportional between 6 and 24 ? *Ans.* 12.
4. What is the mean proportional between 4276 and 842 ?
Ans. 1897,4.

To find the side of a Square equal in Area, *to any given* Superficies *whatever.*

RULE.

Find the content of the given Area, and the root is the side of the square sought.

EXAMPLES.

1. An acre of land contains 160 square rods; What is the side of a square equal in area thereto ?

160)12,649, *&c. Answer.*
1
—
22)60
44
—
246)1600
1476
—
2524)12400
10096
—
25289)230400
227601
—
2799

2. Suppose a general had an army of 567009 men, and he would form them into a square; How many men must be in rank and file ? *Ans.* 753.

3. Let 8192 men be formed into an oblong, so that the number in rank may be double the file.

Ans $8192\sqrt{2}=4096$ r.$=64$ *in file.* $64\times2=128$ *in rank.*

4. Suppose a gentleman would set out an orchard of 864 trees, so that the length shall be to the breadth as 3 to 2; How many trees must there be in length, and how many in breadth ?

To resolve any question of this nature; say, as the ratio in length is to the ratio in breadth, so is the number of trees to a fourth number, whose square root is the number in breadth; then, as the ratio in breadth, is to the ratio in length, so is the number of trees, to a fourth number, whose root is the number in length.

As 3 : 2 : : 864 : : 576 *and* $\sqrt{576}=24$ *number in breadth.*
As 2 : 3 : : 864 : :1296 *and* $\sqrt{1296}=36$ *number in length.*

Note. The square of the hypothenuse or the longest side of a right angled triangle, is equal to the sum of the squares of the other two sides; and consequently, the difference of the

squares of the hypothenuse and either of the other sides, is the square of the remaining side.

5. A line 81 feet long, will exactly reach from the top of a fort, on the opposite bank of a river, known to be 69 feet broad: The height of the wall is required?

81×81=6561; *and* 69×69=4761: *then* 6561—4761=1800, *and* $\sqrt{1800}$=42,426 *feet, the Ans.*

6. Two ships sail from the same port, one goes due east 150 miles; the other due north 252 miles; How far are they asunder?

150×150=22500. 252×252=63504, *then* 63504+22500=86004 *and* $\sqrt{86004}$=293,26 *miles the Ans.*

7. A ladder, 40 feet long, may be so planted, as to reach a window 33 feet from the ground, on one side the street; and without moving it at the foot, will do the same by a window 21 feet high on the other side; How wide is the street?

40×40=1600. 33×33=1089. 21×21=441: *then* 1600—1089=511, *and* $\sqrt{511}$=22,6, *and* 1600—441=1159, *and* $\sqrt{1159}$=34,04: *then* 22,6+34,04=56,64 *feet, the Ans.*

8. If a man travel 40 miles due north, and then turn and travel 30 miles due west; How far is he from the place where he first started? *Ans.* 50 *miles.*

The area of a circle given to find the diameter.

RULE.

Multiply the square root of the area, by 1,12837. The product is the answer.

Required the length of a rope, having one end fastened in the ground, and the other tied to a horse's tail, so that he may eat an acre of grass, allowing the horse and his tail to be 5½ yds. *Ans.* 6,136.

The area of a circle given to find the circumference.

RULE.

Multiply the square root of the area by 3,5449. The product is the circumference.

1. What is the circumference of a circle, whose area is 12 rods? *Ans.* 24,5596.

2. What is the circumference of a circle, whose area is 320 rods? *Ans.* 89,1678.

EXTRACTION OF THE CUBE ROOT.

TO extract the *Cube Root* of any number, is to find another, which multiplied by itself, and that product by the number found, produces the number given for extraction.

All single cube numbers, with their respective roots are contained in the following *Table.*

Roots.	1	2	3	5	6	7	8	9
Cubes.	1	8	27	125	216	343	512	729

RULE.

1. Separate the given number into periods of three figures each, by placing a point over the unit's place, and every third figure to the left hand of the unit.

2. Seek the nearest cube in the left hand period, and place its 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.*

4. Multiply the square of the quotient by 300, and call it the *triple square*, and the quotient by 30, and call it the *triple quotient*, and the sum of all these call the *divisor*.

5. Seek how often the *divisor* may be had in the *dividend*, and place the result in the *quotient*.

6. Multiply the *triple square* by the last quotient figure, and write the product under the *dividend*; multiply the square of the last quotient figure by the *triple* quotient, and set this product under the last; under all set the cube of the last quotient figure, and call their sum the *subtrahend*.

7. Subtract the *subtrahend* from the *dividend*, and to the remainder bring down the next period for a new *dividend*, with which proceed as before, and so continue till the whole is finished.

Note.—Observe the same rules for pointing, when there are decimals, and continuing the operation, as in the square root.

EXAMPLES.

1. What is the cube root of 444194947? *Ans.* 763.

444194947(763 *the root.*
7×7×7=343
1*st. divis.*=14910)101194=1*st. dividend.*
95976=1*st. subtrahend.*
2*d. divis.* 1735080)5218947=2*d. dividend.*
5218947=2*d. subtrahend.*

7×7×300=14700=1*st. triple square.*
7× 30= 210=1*st. triple quotient.*

14910=1*st. divisor.*

14700×6=88200
6×6×210= 7560
6×6×6= 216

95976=1*st. subtrahend.*

76×76×300=1732800=2*d. triple square.*
76×30 = 2280=2*d. triple quotient.*

1735080=2*d. divisor.*
1732800×3=5198400
2280×3×3= 20520
3×3×3= 27

5218947=2*d. subtrahend.*

2. What is the cube root of 3034644483 ? *Ans.* 672.
3. What is the cube root of 436036824287 ? *Ans.* 7583.
4. What is the cube root of 41,063625 ? *Ans.* 3,45.
5. What is the cube root of ,002197 ? *Ans* ,13.
6. What is the cube root of 389017. *Ans.* 73.
7. What is the cube root of 5735339 ? *Ans.* 179.
8. What is the cube root of 32461759 ? *Ans.* 319.
9. What is the cube root of 122613327232 ? *Ans* 4968.
10. What is the cube root of 219365327791 ? *Ans.* 6031.
11. What is the cube root of 36155,027576 ? *Ans.* 33,06.
12. What is the cube root of 15926,972504 ? *Ans* 25,16.

APPLICATION AND USE OF THE CUBE ROOT.

The use of the Cube Root is to find out the dimensions of like solids, as globes, cylenders, cubes, &c.

RULE.

As the content, or weight, of a given solid, is to the content, or weight of another like solid; so is the cube of the side or diameter of the one, to the cube of the side or diameter of the other. Then the cube root of the quotient will be the length of the side, or diameter required.

EXAMPLES.

1. If a bullet that weighs 72lb. be eight inches in diameter, What will be the diameter of that bullet that weighs 9lb. ?

The cube of 8 *is* 512;
then as 72 : 9 : : 512
9

)4608(64 ; The cube root of 64
432 is 4, the diameter
288 required.
288

2. If a ship of 100 tons be 44 feet long at the keel, of what length must the keel of a ship be that carries 220 tons ?

Say, as 100 : 220 : : *so is the cube of* 44, *viz* 85184, *to* 187404,8; *whose cube root is* 57,226 *feet, the length of the keel sought.*

To find the length of the Masts of a Ship.

RULE.

Two thirds the length of the keel, and the breadth of the beam is the length of the mainmast; therefore multiply the length of the keel by 2, and divide the product by three, then add the breadth of the beam to the quotient, and the total will be the length of the mainmast.

EXAMPLES.

1. Suppose a ship to be 108 feet by the keel, and 40 feet by the beam, What is the length of her mainmast?

108 *keel.*
2
3)216
72=⅔ *of the keel.*
40=*the breadth of the beam.*
112=*length of the mainmast.* *Ans.*

2. If a ship be 84 feet by the keel, and 31 feet by the beam, What is the length of her mainmast? *Ans.* 87 *feet.*

To find the length and thickness of Masts and Yards.

RULE.

Add the breadth of the beam, and the depth of the hold, in feet, together, divide the product by 1,5, and the quotient will be the length of the mainmast in yards.

EXAMPLES.

1. If the keel of a ship be 73 feet in length, and the breadth of the beam 28,5 feet, and the depth of the hold 12 feet; What is the length of the mainmast?

ft.
28,5 *breadth of the beam.*
12, *depth of the hold.*

1,5)40,5(27 *yards, Answer.*
30
105
105

To find the thickness of the mast, having the length given, say, *f l. in. thick. f l.*

If 84 : 28 : : 81
81
28
224
84)2268(27
168
588
588

To find a Ship's Burthen.

The forms of ships are so various that no general rule can be applied to answer all varieties; however, the following rules are practised.

RULE.

1. Multiply the breadth, and half the breadth, at the main beam, together, and that product by the length; divide the last product by 94, and the quotient is the tons.

2. Divide the continued product of the length, breadth and depth, in feet, by 100, for ships of war, and 95 for merchant-ships, in which nothing is allowed for guns, &c. and the quotient is the tons.

3. Take the length, from the sternpost to the upper part of the stem; subtract two thirds of her breadth from that length; multiply the remainder by the whole breadth, and that product by half the breadth, in feet, and divide by 100 for war, 94 for merchant-ships.

4. The weight of a ship's burthen is half the weight of water she can hold.

EXAMPLES.

1. What is the tonage of a ship, whose length is 97 feet, breadth 31 feet, and depth 15½ feet?

By Rule 1st.

breadth 31
½ *breadth* 15,5

155
155
31

480,5
length 97

33635
43245

94)46608,5(495,83 *tons.*

100)46608,5(466 *tons.*

By Rule 2d.

length 97
breadth 31

97
291

3007
½ *breadth*, × 15,5

95)46608,5(490,61 *tons.*

By Rule 3d.

length = 97
⅔ *of breadth* = 20,66 *sub.*

76,33
mult. by breadth 31

2366,23
½ *breadth* × 15,5

94)36676,565(390,175 *tons.*

The proportions of NOAH'S ARK were as follow, viz. length of the keel 300 feet, breadth by the midship-beam 50 feet, depth

in the hold 30 feet; What was its burthen as a man of war, and merchant ship.

$300 \times 50 \times 30 = 450000 \div 100 = 4500$ *tons as a man of war.*

$450000 \div 95 = 4736\frac{80}{95}$ *tons as a merchant ship.*

Extraction of the Biquadrate Root.

By discovering a number, which, being involved 4 times into itself, produces another number, is the extraction of the Biquadrate Root.

Rule.

First extract the square root of the given number, and then extract the square root of that square root, and it will give the biquadrate root.

Examples.

1. What is the biquadrate root of 27? *Ans.* 531441.
2. What is the biquadrate root of 76? *Ans.* 33362176.
3. What is the biquadrate root of 275? *Ans.* 5719140625.
4. What is the biquadrate root of 531441? *Ans.* 27.
5. What is the biquadrate root of 33362176? *Ans.* 76.
6. What is the biquadrate root of 5719140625? *Ans.* 275.

SUPERFICIAL, OR BOARD MEASURE.

THE dimensions of boards, glass, &c. are generally taken in feet, inches and parts.

Rule.

If the board be regular, multiply the length in inches by the breadth in inches, and divide the product by 144, it will give the answer in feet: Or, if you multiply the length in feet by the breadth in inches, and divide by 12, it will give the answer in feet.

Examples.

1 How many square feet in a board, 18 feet long, and 13 inches wide? *Ans.* 19*ft.* $\frac{6}{12}$ *or,* $19\frac{1}{2}$ *feet.*

Length	18	*feet.*
Breadth	13	*inches.*
	54	
	18	
12)	234	
	19	6

2. How many square feet in a board 15 feet 4 inches in length, and 9 inches in breadth?

ft.	*in.*		
15	4	*Length* = 184 *inches.*	
12		*Breadth* 9	
184		144)1656(11½ *feet, the Answer.*	
		144	
		216	
		144	
		72 = ½ *of* 144.	

If the board be wider at one end than the other, then take the breadth in the middle, or add the measure of both ends together, and take half the product for a mean breadth, which multiply by the length.

3. How many square feet in a board 10 feet long, and 13 inches wide at one end, and 9 inches wide at the other?

Ans. 9 *feet* $\frac{2}{12}$ *or,* $\frac{1}{6}$

13	10 *feet.*	
9	11 *inches.*	
½)22	12)110	
11 = *mean breadth.*	9*ft.* $\frac{2}{12}$ *or,* $\frac{1}{6}$.	

4. How many square feet in a board, 14 feet long, and 15 inches broad at one end, and 12 inches at the other?

Ans. 15 *feet* $\frac{75}{100}$ *or* $\frac{3}{4}$.

15	13.5
12	14 *feet.*
½)27	540
13½ = 13,5	135
	12)189,0(15,75
	12
	69
	60
	90
	84
	60
	60

CROSS MULTIPLICATION.

THIS Rule is made use of by Workmen and artificers, in casting up the contents of their works.

Dimensions are generally taken in feet, inches, &c. as follow, viz.

1 foot contains 12 inches or primes, (′)
1 inch, or prime, contains 12 seconds, (″)
1 second contains 12 thirds, (‴) &c.

RULE.

1. Write the corresponding denominations of the multiplier under the multiplicand.

2. Multiply each term in the multiplicand, beginning with the lowest, by the highest denomination in the multiplier, and write the result of each under its respective term, observing to carry an unit for every 12, from each lower denomination to its next superior, and so for other numbers.

3. Multiply, in the same manner, all the multiplicand, by the primes, or second denomination, and set the result of each term one place removed to the right hand of those in the multiplicand.

4. Proceed in the same manner with the seconds in the multiplier, setting the result of each term two places to the right hand of the multiplicand; and so of others.

EXAMPLES.

	ft.	′	*or in.*	
Multiply	7	3		Here I begin with the 4, and say 4
By	4	7		times 3 are 12; set down 0 and carry
	29	0	″	1; then 4 times 7 are 28, and 1 I carry make 29, which I set down.
	4	2	9	Next I begin with 7, and say 7
Product.	33	2	9	times 3 are 21, set down 9 in the place of seconds and carry 1 prime, or inch; then 7 times 7 are 49, and

1 make 50 inches, or 4 feet 2 inches, which set down; then add them together, and the product is 33*ft.* 2*in.* 9*sec.*

2. If a board be 17 feet 7 inches long and 1 foot 5 inches wide, How many square feet does it contain?

Ans. 24*ft.* 10*in.* 11*sec.*

ft.	′	
17	7	
1	5	
17	7	″
7	3	11
24	10	11

3. How many square feet in 10 boards, each 13 feet 8 inches in length, and 1 foot 3 inches in breadth?

Ans. 170 *feet* 10 *inches.*

ft.	′	
13	8	
1	3	
13	8	″
3	5	0
17	1	*in one board.*
	10	
170	10	*in ten boards.*

GLAZIERS' WORK BY THE FOOT.

IF the windows be square, multiply the length by the breadth, the same as in board measure;

Note.—If the windows are arched, or have a curved form, no allowance is made on account of the extraordinary trouble, waste, &c. The length is taken from the highest part of the arch down to the bottom.

EXAMPLES.

1. If a window be 4 feet 5 inches in length, or height, and 2 feet 9 inches in breadth, How many square feet does it contain? *Ans.* 12 *feet*, 1 *in.* 9 *sec.*

ft.	′	
4	5	
2	9	
8	10	″
3	3	9
12	1	9

2. There is a house with 3 tiers of windows, and 4 windows in a tier; the height of the first tier is 6ft. 8′: of the second 5ft. 9′; of the third 4ft. 6′; and the breadth of each is 3ft. 5′; How many square feet in the whole? *Ans.* 173 *ft.* 4′ 9″

ft.	′	
6	8	
5	9	
4	6	
16	11	
	3	=*num. of tiers.*
50	9	

ft.	′	
50	9	
3	5	
152	3	″
21	1	9
173	4	9

CARPENTERS' WORK.

To know how many boards it will take to cover a frame.

RULE.

1. *For the body of the frame.* Add the length and breadth of the frame together, and then double the sum, or multiply by 2; then multiply that product by the height, and it will give the content.

2. *For the gable ends.* Multiply the height of one gable end by its breadth, and it will give the content of both.

3. *For the roof.* Multiply the length of both rafters, added together, by the length of the frame, and it will give the content.

EXAMPLE.

How many boards will cover a barn that is 50 feet long, and 30 feet wide; and the height of the gable ends 13 feet, and the rafters 20 feet each; and the body of the frame 15 feet in height?

50 *ft. length.*
30 *ft. breadth.*

80
2

160
15

800
160

2400 *ft. for the body.*
390 *ft. gable ends.*
2000 *ft. roof.*

4790

Gable end 13 *ft. height.*
30 *ft. breadth.*

390 *ft. for both.*

20
20

40 *ft. both rafters.*
50 *length of the frame.*

2000 *ft. for the roof.*

Ans. 4790 *feet.*

Note.—The rafters are, generally, two thirds of the breadth of the frame in length.

To know how many shingles it will take to cover a roof.

RULE.

Multiply the length of both rafters, added together, by the length of the building, and that product by 144, and it will give the content of the roof in square inches: Then multiply the width of a shingle by the breadth of the course for a divisor; by which divide the content of the roof, and it will give the number of shingles.

EXAMPLE.

How many shingles will cover a barn 50 feet long, and 20 feet rafters, allowing each shingle to be 4 inches wide, and each course 5 inches?

20 | 5
20 | 4

40 *rafters.* | 20 *sq. in. in a shingle.*
50 *length of building.*

2000
144

2)0)28800(0(
14400

8000
8000
2000

288000 *sq. in. in the roof.*

Ans. 14400 *shingles.*

Note.—In measuring roofs, no deduction is made for sky-lights, chimney-shafts, &c.

In measuring flooring, from the content of the whole floor in feet, take the content of the vacancies for the stairs, hearths, &c. in feet, and the remainder is the content.

To know the contents of the ceiling of a room, multiply the number of feet round the room by the height; from which subtract the doors and windows, and the remainder will be the content.

WOOD AND TIMBER MEASURE.

To measure wood.

128 feet make a cord of wood, or bark; that is, 4 feet high, 4 feet wide, and 8 feet long.

Rule.

Multiply the length by the breadth, and that product by the height, and divide the last product by 128, and it will give the number of cords.

Examples.

1. If a load of wood be 8 feet 4 inches long, 3 feet 8 inches wide, and 4 feet 6 inches high, How many cubic feet does it contain, and how many cords?

ft.	′			
8	4	*length.*	128)137	6(1 *cord* 9*ft.* 6′ *cubic feet.* *Ans.*
3	8	*breadth*	128	
5	0	″	9	
5	6	8		
30	6	8		
4	6	*height.*		
122	2	8 ‴		
15	3	4 0		
137	6	0 0	*cubic feet.*	

Note.—It is customary, in some places, to call $\frac{1}{8}$ of a cord 1 foot, $\frac{2}{8}$ or $\frac{1}{4}$ of a cord 2 feet, $\frac{3}{8}$ 3 feet, &c. To find the contents of a load of wood, or number of feet, as above, divide the whole content, in cubic feet, by 16, and it will give the answer.

2. If a load of wood be 8 feet long, 4 feet wide, and 2 feet 6 inches high, How many cubic feet, and feet representing parts of a cord?

8
4
32
2 6
64
16
80 *cubic feet.*

16)80(*5 feet or,* $\frac{5}{8}$ *of a cord. Ans.*
80

3. How many cubic feet, cords, and feet representing parts of a cord, are there in a load of wood, 9 feet 4 inches long, 3 feet 8 inches wide, and 4 feet 9 inches high?

ft.	′	″	‴
9	4		
3	8		
28	0	″	
6	2	8	
34	2	8	
4	9		
136	10	8	‴
25	8	0	0
162	6	8	*cubic feet.*

ft.	′	″	‴	⁗	″″
128)162	6	8(1 *cord* 34 *ft.*	6	8	
128					
34					

ft.	′	″	′	″
16)162	6	8(10$\frac{1}{8}$ *feet*	6	8
16				

$\frac{2}{16}=\frac{1}{8}$

4. How many cubic feet, cords, and feet representing parts of a cord, are there in a load of wood 9 feet long, 3 feet 5 inches high, and 4 feet 3 inches wide?

Answers. { 130 *ft.* 8′ 3″ *cubic feet,* / 1 *cord,* 2 *ft.* 8′ 3″ / 8$\frac{1}{8}$ *feet,* 8′ 3″

To find the contents of a round stick of timber of equal bigness from end to end.

RULE.

Find the area at one end, by multiplying half the circumference by half the diameter; multiply that by the length, and divide the last product by 144, it will give the contents.

Note.—To find the circumference of a circle, say, as 7 : is to 22 : : so is the given diameter : to the circumference.

EXAMPLES.

1. How many solid feet are there in a round stick of timber of equal bigness from end to end, whose diameter is 14 inches, and length 20 feet?

As 7 : 22 : : 14
14

88
22

7)308
44=*circum.*

22=*half circum.*
7=*half diam.*

154=*area of one end.*
20=*length.*

144)3080(21$\frac{7}{18}$ *feet, Ans.*
288

200
144

56=$\frac{7}{18}$.

2. How many solid feet are there in a round stick of timber, of equal bigness from end to end, whose diameter is 20½ inches, and length 30 feet?

As 7 : 22 : : 20,5 : 64,42=*circum.*

32,21=*half circum.*
10,25=*half diam.*

330,1525
30=*length.*

144)9904,5750(68,781 *feet Ans.*

To find the solid contents of a tapering stick of timber, whether square or round, when one end is a point.

RULE.

Multiply the area of the great end, by one third of the length.

EXAMPLES.

1. How many solid feet in a tapering round stick of timber, 21 feet long, 28 inches diameter at one end, and a point at the other?

As 7 : 22 : : 28 : 88 *cir.*

44=½ *circum.*
14=½ *diam.*

616=*area at one end.*
7=⅓ *of the length.*

144)4312(29,94 *feet. Ans.*

2. How many solid feet are there in a tapering square stick of timber, 30 feet long, 12 inches square at one end, and a point at the other?

12
12

144
10=⅓ *of the length.*

144)1440(10 *feet. Ans.*

To find the contents of a tapering round stick of timber, when the small end is not a point.

RULE.

Multiply each diameter into itself; multiply one diameter by the other; multiply the sum of these products by the length; annex two cyphers to that product, and divide by 382; the quotient will be the solid contents.

EXAMPLE.

How many solid feet are there in a round stick of timber, whose diameter at one end is 18 inches, and at the other end 12 inches, and length 20 feet?

18×18=324
12×12=144
12×18=216

684

684
20=*length*.
---
382)13680(3581÷144=24,8 *feet*.

Ans.

To find the solid contents of a tapering square stick of timber, when the small end is not a point.

RULE.

Multiply each end into itself separately; multiply one end into the other, and then multiply the sum of these products, by one third of the length, and the product will be the solid contents.

EXAMPLE.

How many solid feet are there in a tapering square stick of timber, whose largest end is 15 inches, and least end 9 inches, and length 24 feet?

15×15=225
9× 9= 81
9×15=135

441

441
8=*third of the length*.
---
144)3528(24,5 *feet*. *Answer*.

To find how many solid feet a round stick of timber, equally large from end to end, will contain, when made square.

RULE.

Multiply half its diameter into itself, and that product by twice its length.

EXAMPLE.

If a round stick of timber, were hewn square, which is 20 feet long and 18 inches diameter, How many solid feet would it contain?

9=½ *diameter*.
9

81

81
40=*twice its length*.
---
144)3240(22,5 *feet*. *Answer*.

CASK GAUGING.

AMONG the many different rules for gauging, the following is as exact as any.

Rule.

Take the diameter at the bung and head, and length of the cask: Subtract the head-diameter from the bung-diameter, and note the difference.

If the staves of the cask be much curved or bulging between the bung and the head, multiply the difference by ,7: if not quite so much curved, by ,65; if they bulge yet less, by ,6; and if they are almost or quite strait, by ,55, and add the product to the head-diameter; the sum will be a mean diameter.

Square the mean diameter, thus found, then multiply it by the length; divide the product by 359 for ale or beer gallons, and by 294 for wine gallons.

Note 1.—To measure the length of the cask; measure the length of the stave; then take the depth of the chimes, which, with the thickness of the heads (which are 1 inch, 1½ inch or 2 inches, according to the size of the cask,) being subtracted from the length of the stave, leaves the length within.

Note 2.—In taking the bung-diameter, observe by moving the rod backward and forward, whether the stave, opposite the bung, be thicker or thinner than the rest, and if it be, make allowance accordingly.

Example.

A cask, whose bung-diameter in 30 inches, head-diameter 25 inches, and length 40 inches, How many ale and wine gallons will it contain?

Bung-diameter = 30
Head-diameter = 25

Difference 5
,7

3,5
Add the head-diam. = 25

Mean-diameter = 28,5
28,5
1425
2280
570

Squared 812,25
Square of the diam. = 812,25
Length. = 40

359)32490,00(90,50 *Ale gal.*
294)32490(151,10 *Wine gal.*

By the Sliding Rule.

On D. is 18,94, the gauge-point for ale or beer gallons, marked A. G. and 17,14 the gauge-point for wine gallons, marked W. G. Set the gauge-point to the length of the cask on C. and against the mean diameter, on D. you will have the answer in ale or wine gallons according to which gauge-point you make use of.

By the Scale.

Take the extent from the gauge-point to the mean diameter, set one foot of the dividers in the length, and turning them twice over, they will point out the content.

TO GAUGE ROUND TUBS, &c.

Rule.

Multiply one diameter by the other, and to that product add one third of the square of their difference; multiply this sum by the length, and divide by 359 for beer, and 294 for wine gallons.

Example.

What is the content, in beer and wine gallons, of a round tub, whose diameter at the top, within, is 40 inches, and at the bottom 34 inches, and the perpendicular height 36 inches?

34	40	
40	34	
1360	6 = *their difference.*	
12	6	359)49392(137$\frac{1}{3}$ *ale gal.*
1372	$\frac{1}{3}$)36	
36 = *height*	12 = $\frac{1}{3}$ *of the square.*	
8232		
4116		
294)49392(168 *wine gallons.*		

TO GAUGE A SQUARE VESSEL.

Rule.

Multiply the length by the breadth, and that product by the depth, and then divide by 282 for beer or ale, (the inches in a beer or ale gallon,) and by 231 for wine, brandy, &c. (the inches contained in a wine gallon,) and the quotient will be the answer.

Example.

If a square vessel be 80 inches in length, 60 in breadth, and 40 inches deep, What is the content in beer and wine gallons?

80 *length.*
60 *breadth.*

4800
40 *depth.* 282)192000(680,85 *beer gal.*

231)192000(831,12 *wine gal.*

Note.—The content of any vessel, in feet, gallons, and bushels, may be thus found: Measure the inside of the vessel, according to the rule of the figure, and find the content in cubic inches, then,

Divide by { 1728 / 282 / 231 / 250,425 } *and the quotient will be the content in* { *Cubic feet.* / *Ale or beer gal.* / *Wine gallons.* / *Bushels.* }

To exercise the pupil, we shall exhibit some more examples, under *Superficial Measure, Cross Multiplication,* &c.

EXAMPLES.

1. Required the value of a marble *stratum,* 5ft. 7in. in length, and 1ft. 10in. in breadth, at 1*dol.* per foot. *Ans.* 10*dol.* 23*c.*

2. What will it cost to glaze a house, having three tiers of windows, and three in a tier. Of the first tier, the height is 7ft. 10in.; of the second, 6ft. 8in.; and, of the third, 5ft. 4in. The breadth, 8ft. 11in.? The glazing per foot being 14*d.*
Ans. £.13, 11, 10, 2.

3. What are the solid contents of a stone, 7ft. 6in. long; 3ft. 3in. broad, and 1ft. 10in. in thickness? *Ans.* 44ft. $8\frac{3}{12}$in.

4. The walls of a painted room, are, in length 97ft. 8in., in height, 9ft. 10in. What was the price of painting at 2*s.* 8*d.* 3*qrs.* per yard?
Ans. £.14, 11, 1.

5. In 173ft. 10in. in length, and 16ft. 7in. in breadth, How many squares?
Ans. 18-*squares,* 39*ft.* 8*in.* 10*parts.*

6. A house measures within the walls, 52ft. 8in. in length, and 30ft. 6in. in breadth; the length of the rafters is $\frac{3}{4}$ the breadth of the building. What will it cost, per square, to roof the house?
Ans. £.12, 12, 11, 3.

7. What is the tonage of a single decked vessel, whose length is 60 ft.; breadth, 20ft. and depth, 8ft.?
Ans. 101 $\frac{5}{95}$.

8. What is the tonage of a ship, 74ft. by the keel, and 26ft. 6in. by the beam?
Ans. $273\frac{48}{95}$*tons.*

POSITION.

To discover, by false or supposed numbers, the true one, is the intention of *Position.* It is *single* and *double.*

SINGLE POSITION.

By using one supposed number, and working with it as the true one, the real number is discovered, by the following

RULE.

As the total of the errors is to the given sum, so is the supposed number to the true number.

N. B. To prove the work, add together the several parts of the result, and if it agrees with the given sum, it is right.

EXAMPLES.

1. An apple woman being asked the number of apples in her basket, replied, that if she had as many, half as many, and one fourth as many more, she should have 88, How many apples were there in her basket?

Suppose	40	*As* 110 : 88 : : 40		
As many	40	40	32	
½ *as many*	20		32	
¼ *as many*	10	11)0)352(0(32	16	
		33 *Ans.*	8	
	110			
		22	88 *proof*	
		22		

2. A sharper being asked the number of dollars in his trunk, replied, that if ⅓, ¼ and ⅛ of them were added together, they would make 54. The number of dollars is required. *Ans.* 72.

3. A gentleman bought a sleigh, harness, and span of horses for £.120. For the horses he gave twice the price of the harness, and for the sleigh, twice the price of the horses and harness, How many pounds did he give for each?

Ans. for the horses, £.26, 13, 4; for the harness, £.13, 6, 8; for the sleigh, £.80.

4. A money-lender loaned an unknown sum of money, at 6 *per cent.* At the expiration of 10 years, he received for principal and interest, £.1200, How many pounds were loaned?

Ans. £.750.

5. A beef seller was asked, whither he was driving his 30 fat oxen; I have not 30, he replied, but if I had as many more, ½ as many more, and 5 more, I should have 30, How many oxen had he in his drove? *Ans.* 10.

DOUBLE POSITION

IS the using of two supposed numbers; and if both prove false, they, with their errors, must be managed according to these *rules*:

RULE 1.

Place each error against its respective position.

2. Multiply them cross-wise.

3. If the crosses are alike; that is, both greater, or both less than the given number, take their difference for a divisor, and the difference of their products for a dividend. But if they be unlike, you must take their sum for a divisor, and the sum of their products for a dividend. The quotient will be the answer.

EXAMPLES.

1. Thompson asked Gregory the price of his chaise. Gregory answered, had it cost me 3 times as much as it did, and 15 dollars more, it would have cost me 300 dollars. What did it cost?

	dol.				
Suppose	90		*Suppose*	96	
	3			3	
	270			288	
	15			15	
	285	*too lit. by* 15.		303	*too much, by* 3.

90 15
×
96 3

	1440	270	
15	270		
3			
Sum of errors 18	18)1710(95 *Ans.*		95
	162		3
	90		285
	90		15
			300 *proof.*

2. A silversmith hath two silver tankards, of unequal weight, and but one lid to both, weighing 10oz. If the lid be placed on the less tankard, it will double the weight of the greater. But if placed on the greater tankard, it will be thrice as heavy as the less. Required the weight of each tankard.

Ans less tankard, 6oz.; greater tankard, 8oz.

3. Three fishermen, in company, caught 196 haddock. Falling into a contention, each seized as many as he could, A. seized on a certain number; B. on as many as A. and 16 more; and C. on the sixth part of both their numbers. On how many did each seize? *Ans.* A. 76; B. 92; and C. 28.

4. Robert, stealing peaches, was apprehended by the owner's son, and to still him, delivered up ½, the son gave him back 20. Meeting with John, he was robbed of half he had left, and John gave him back 8. William soon met him, and forcibly takes away half of what he had, but returns one. Arriving at a safe place, he counted his peaches, and found 26 only, How many did he steal? *Ans.* 120.

GEOMETRICAL DEFINITIONS.

1. A point is that which has no parts, being of itself indivisible. As, A.

2. A line has length; but no breadth. As, ——

3. The extremities of lines are points. As, ——

4. A right line is the shortest, that can be drawn between any two points. As, A——B

5. If it be not the shortest, then it is called a curved line. As, A⌒B

6. Superficies, or surface, is length and breadth, without any thickness.

7. The inclination of two lines, meeting one another, or the opening between them is called an angle. As, ∠

8. If a right line fall upon another, so as to incline to neither side, and making the angles equal; then the angles are called right angles; and the falling line is called the perpendicular. As, ⊥

9. An obtuse angle is greater than a right angle: An acute angle is less.

10. If a right line be fastened at one end, and the other end be carried quite round, then the inclosed space is called a circle, and the curve line, described by the other end of the line is called the circumference, or periphery.

11. The place where the first end is fixed is called the centre; and the describing line, the semi-diameter, or radius.

12. The diameter of a circle is a right line drawn through the centre, and terminates on each side of the circle. And it divides the circumference and circle into two equal parts called the semicircles.

13. The circumference of every circle, is supposed to be divided into 360 equal parts, called degrees; and each degree, into 60 equal parts, called minutes; and each minute, into 60 equal parts, called seconds, and these into thirds, fourths, &c.

14. Parallel lines are equidistant from each other.

15. A figure, having three equal sides, is called an *equilateral* figure: Having two sides equal, *Isoseles:* Having three sides unequal, *scalene.*

16. Any four sided figure is called a *quadrilateral* figure.

17. Quadrilateral figures, having opposite sides parallel, are called *parallelograms.*

18. A parallelogram having its opposite sides equal, and all its angles, right angles, is called a *square.*

19. A parallelogram, having opposite sides equal and angles right, is called an *oblong.*

20. A *rhombus* is a parallelogram of equal sides, and has its angles either obtuse or acute.

21. A rhomboides is a parallelogram whose *opposite* sides are equal and angles obtuse, or acute

22. A quadrilateral figure, that is not a parallelogram, is called a *trapezium.*

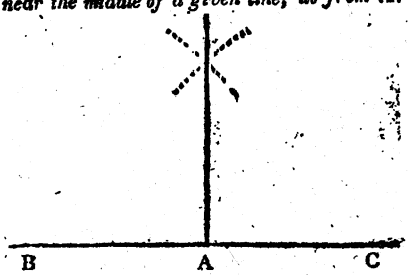
23. Figures, having more than four sides and four angles, are called *polygons;* and they often take their name from the number of angles; as *pentagon,* five angled; *hexagon,* six angled; *septagon,* seven angled; *octagon,* eight angled, &c.

N. B. Let the Instructor illustrate each definition, by examples.

GEOMETRICAL PROBLEMS.

Problem 1.

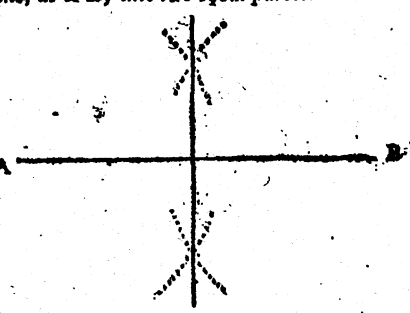
To erect a perpendicular near the middle of a given line, as from A.



Set one foot of the compasses in the given point, A, open them to any distance at pleasure as to B, and with that extent make the marks B and C. Set one foot of the compasses at B at any extent above half the distance from B to C, describe an arch above the line, and with the same extent, and one foot in C, describe an arch crossing the former; draw a line from the insersection of the arches to the given point A, which will be the perpendicular required.

Problem 2.

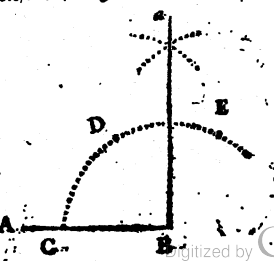
To divide a line, as A B, into two equal parts.



Set one foot of the compasses in the point A, & opening them beyond the middle of the line, describe arches above and below the line; with the same extent, set one foot in the point B, and describe two arches crossing the former: draw a line from the intersection of the arches above the line, to the intersection below the line, and the line A B, will be divided into two equal parts.

Problem 3.

To erect a perpendicular upon the end of a line.

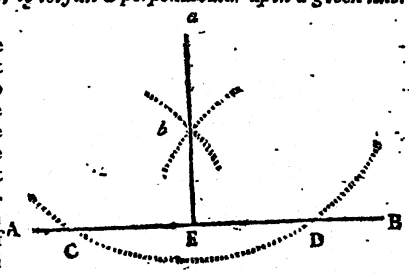


Set one foot of the compasses in the given point B, open them to any convenient distance, and describe the arch C D E; set one foot in C, and with the same extent, cross the arch at D; with the same extent cross the arch again from D to E; then with one foot of the compasses in D, and with any extent above the half of D E, describe an arch *a*, take

the compasses from D, and keeping them at the same extent with one foot in E, intersect the former arch *a*, from thence draw a line to the point B, which will be the perpendicular required.

Problem 4.

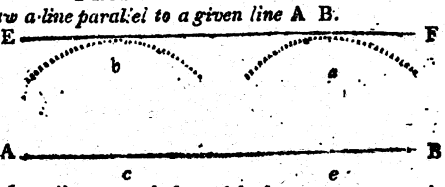
From a point assigned, to let fall a perpendicular upon a given line.



With one foot of the compasses in the point *a*, extend the other so as to reach beyond the line A B, and describe an arch to cut the line A B in C and D; set one foot of the compasses in C, and with any extent above half C D, describe an arch *b*, keeping the compasses at the same extent, set one foot in D, and intersect the arch *b*; through which intersection, and the point *a*, draw a E, which will be the required perpendicular.

Problem 5.

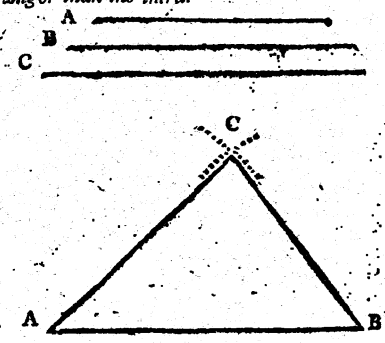
To draw a line parallel to a given line A B.



Set one foot of the compasses in any part of the line, as at *c*; extend the compasses at pleasure, unless a distance be assigned, and describe an arch *b*; with the same extent, in some other part of the line A B, as at *e*, describe the arch *a*; lay a ruler to the extremities of the arches, and draw the line E F, which will be parallel to the line A B.

Problem 6.

To form a triangle with three given lines, provided any two of them be longer than the third.



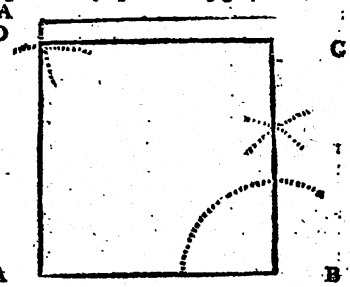
Let A, B, C, be the three given lines; draw a line, A B, at pleasure; take the line C in the compasses, set one foot in A, and with the other make a mark at B; then take the given line B, in the compasses, and setting one foot in A, describe an arch at C; then take the given line A, in your compasses, setting one foot in B, intersect the arch

C in C; lastly, draw the lines A C and B C, and the triangle will be formed.

PROBLEM 7.

To make a square, having equal sides, equal to any given line.

Let A be the given line: draw a line A B, equal to the given line, from B raise a perpendicular to C, equal to A B, with the same extent, set one foot in C and describe the arch at D; also with the same extent, set one foot in A and intersect the arch at D; lastly, draw the lines A D and D C, and the square will be completed.

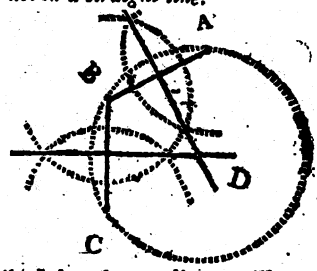


A parallelogram, or long square, may be constructed in like manner, by attending to the difference between the length and breadth.

PROBLEM 8.

To describe a circle, which shall pass through any three given points, which are not in a straight line.

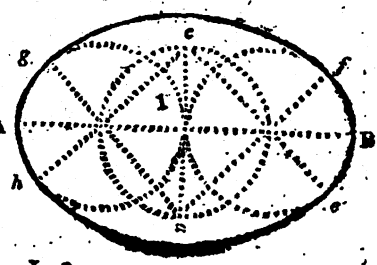
Let A B C be the three given points through which the circle is to pass. Join the points A B and B C with right lines, and bisect these lines; the point D, where the bisecting lines cross each other, will be the centre of the circle required. Place one foot of the compasses in D, extending the other to either of the given points, and the circle described by that radius, will pass through all the points.



PROBLEM 9.

To describe the Carpenter's oval.

Take one fourth of the intended length of the oval, in the compasses, and describe a circle at pleasure, and thro' the centre thereof, at 1, draw a line as A B. On the two points where the circumference of this circle cuts the line A B. as centres, describe circles with the same extent as before;—

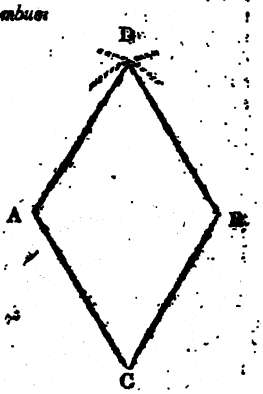


draw $d\,c$ perpendicular to A B, passing through the centre of the middle circle From the points c and d, draw $c\,e$, $c\,h$ and $d\,f$, $d\,g$; set one foot of the compasses in d, and extend the other to g; describe the arch $g\,f$; with the same extent, and one foot in c, describe the arch $h\,e$; these arches, with the circular parts, will form the oval required.

PROBLEM 10.

To describe a rhombus.

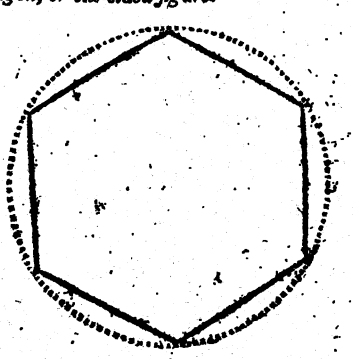
Make the angle, A C B of any magnitude, at pleasure; then taking the length of one of these lines in the compasses, set one foot in A, and describe an arch, as at D; then with the same extent, and one foot in B, describe an arch intersecting the other; lastly, from the intersecting of the arches draw the lines A D and D B, and it will be completed.



PROBLEM 11.

To make a hexagon, or six-sided figure.

Draw a circle at pleasure, then without altering the extent of the compasses, mark out the hexagon required round the circle; for the semidiameter of any circle is the side of the greatest hexagon that can be made within the same circle. By this method coopers find out the bigness of heads for their casks; that is, they take a sixth part of the circumference of the inside of the chime, to describe the circle for the head.



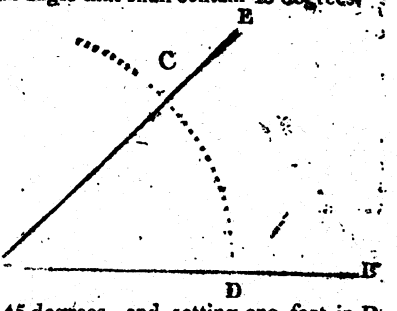
PROBLEM 12.

To make an angle to contain any number of degrees.

Note.—To do this it is necessary to have a scale, of which there are several sorts, both large and small. On one side of the scale there are generally two lines with brass centres, marked at the ends Cho. which are the lines of chords for laying down and measuring angles. At the left hand of the line of chords, and on the

other side of the scale, are lines of equal parts for laying down chains and links, rods, &c.

It is required to make an angle that shall contain 45 degrees.



Draw a line at pleasure, as A B, then setting one foot of the compasses in the brass centre at the beginning of the line of chords, see that the other fall just on 60 degrees, or the other brass centre: With that extent set one foot in A, and describe the arch C D. Then take from your line of chords 45 degrees, and setting one foot in D, make a mark upon the arch at C, through which draw the line A E: So shall the angle A E B be 45 degrees. If you would erect a perpendicular, by the line of chords, upon a given line, it is no more than to make an angle that shall contain 90 degrees.

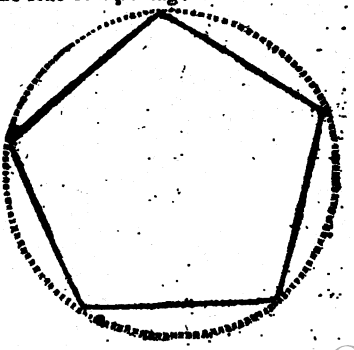
The reason why you are to take 60 from the line of chords to make your arch by, is, because the chord of 60 degrees is the semidiameter of a circle, whose circumference is divided into 360 equal parts.

Problem 13.

To make a regular Polygon or any figure of 5, 6, 7, 8, or more sides, by the line of chords.

Divide 360, the number of degrees contained in a circle, by the number of sides you would have your figure to contain; the quotient taken from the line of chords will be one side of such a figure.

To make a pentagon, or a figure of five sides; divide 360 by 5, the quotient is 72, equal to one side of a pentagon.



Take 60 degrees from the line of chords, and describe a circle; then take 72 from the line of chords, and beginning at any part of the circle, set off that extent round the circle, then draw lines between those marks, and the figure will be completed. And so of any other Polygon, be the number of sides what they will.

LAND MEASURE, OR SURVEYING.

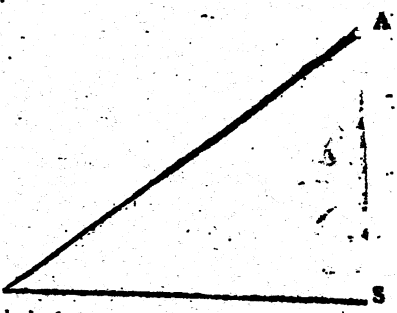
Note.—12 inches make one foot, 3 feet one yard, 5½ yards, or 16½ feet, one rod, 4 rods one chain of *Gunter's*, eighty chains or 320 rods, one mile.

There are but two material things, towards the measuring of a piece of land, to be done in the field; the one is to measure the lines, the other is to take the quantity of the angle each line makes with the meridian; then drawing meridian lines upon paper, which represents the needle of the instrument, and by the help of a protractor, which represents the instrument, we readily lay down the lines and angles in such proportions as they are in the field.

To measure the lines there are several sorts of chains, as Mr. *Rathbrone's* of two rods in length, containing 50 links; others of one rod in length.—But that which is the best to cast up the content of a field by, is Mr. *Gunter's*, which is 4 rods long, and contains 100 links, each link being $7\frac{92}{100}$ inches long. But this chain is too long to be used in uneven ground and thick woods. When this is the case you may measure with a chain two rods in length, remembering when you put down the measure of the lines in your field book, that you set down but half of the chains and odd links, carrying 50 to the odd links for every odd chain; as, if a line measured, by the two rod chain, 9 chains, 30 links, you must set down 4 chains, 80 links; which will be the same as if you had measured by the 4 rod chain.

To take the quantity of an angle each line makes with the meridian, there are many instruments; as the planetable, semicircle, theodolite, circumferentor or compass, &c. To describe these to you, with their several parts, is needless; as one hour's use of them will better describe them, than the reading of many sheets of paper. The compass is most generally used in America, to take the quantity of an angle, and is generally divided into quadrants, of 90 degrees, proceeding both ways from the north and south points.

Let the line N. S. represent a meridian or north and south line, and you are desirous to know what point A is from N. Place your compass at N. with the *flower-de-luce* towards you; see that the top of the compass be level, and that the needle vibrates freely; as soon as the needle is settled, which is here represented by the line N. S.



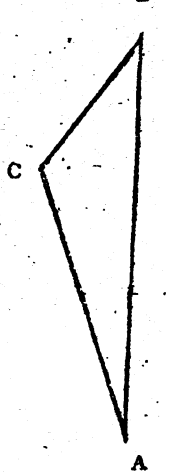
direct your sights to A, and see what degree is cut by the south end of the needle, which let be 40; then is A, south 40 degrees east.

Now to measure the line N. A. or any other line, care must be taken that those who carry the chain do not deviate from a straight line, and that they make no mistake in the number of the chains.

Suppose the line N. A. to be 4 chains, 60 links; and the point, south 40 degrees east, and that the bound at A, be a rock; you must put it down in the following manner in your field book:

Station	*Bearings.*	*Ch.* *Lin.*	*Bounds.*	*Upon whom bounded.*
N.	S. 40° E.	4, 60	A rock.	Joseph Nye.

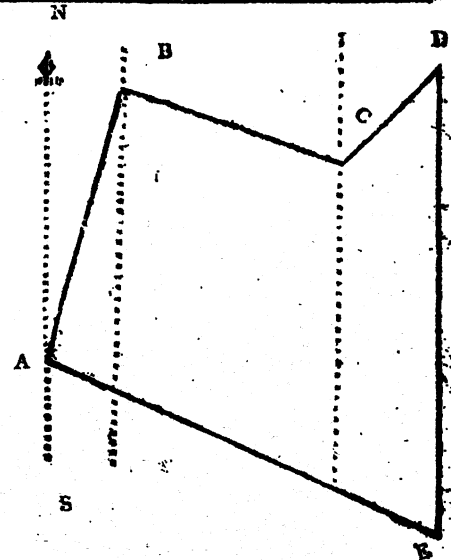
It frequently happens, in surveying, that you cannot see from one bound to the other, by reason of the unevenness of the ground or woods. When this happens, if you can at any place directly between the bounds discover both, you may, by looking through the sights both ways, move your compass until you get it in a direct line, and then take the bearing. Or you may direct your sights to some object which you think is the nearest in course to the bound, observing that those who carry the chain follow in a direct line to that object, and if it be distant as far as the bound, and if you happen to run one rod from the bounds, and the line be 60 rods, you must allow one degree; for one degree will gain a rod in about 60; and so in proportion for a longer or shorter line, or greater or less distance from the bound. But the following method is, by some, preferred to the last; as, suppose it be required to run a line from A to B, but being uncertain whereabouts B is; to find it, I run N. 40° W. 60 rods, to C; from thence I observe B to bear from me N. 13° E. 36 rods; now to find the true course from A to B, I put down the bearings and length of line from A to C, and from C to B, then I draw the line A B; then apply the protractor to the point at A, and find the true course to be N. 20° W. and by taking the line A B, in the compasses, and applying it to the same scale the other lines were taken from, I find the length to be 85 rods. So I find that B is N. 20° W. 85 rods.



The common method to survey a field, is to go round it, and find the bearings of every corner, and length of every line between the corners, which are generally taken in rods and parts, unless the field be large.

To Plot a field from the following field-book.

Stations.	Bearings.	Rods.	Bounds.	On whom bounded.
A.	N 14°. E	60	B.	
B.	S. 72°. E.	50	C.	
C.	N. 45°. E.	30	D.	
D.	S	100	E.	
E.	N. 67°. W	89	*to 1st bounds.*	



First draw a line, as N S. to represent a meridian, or north and south line. Upon any convenient place on the line, make a mark as at A; upon which lay the meridian line of the protractor, (which should be graduated with twice 90 degrees, or in the same manner that the compass is graduated,) to the meridian line on the paper, and against 14° make a mark, through which draw a line; then take 60 from which line you please, of equal parts, on the scale, and set off from A to B; observing to use the same line you begin with thro' the whole plot. Through the mark of B, draw a meridian parallel to the other; turn your protractor the other way, because the line runs south, placing it on the meridian at B, and against 72°. make a mark, and proceed as before, setting off 50 rods from B to C; do the like by the other angles and lines, until you come round to the place where you began.

To find the content of a Plot of land.

In casting up the content of a piece of land measured by the 4 rod chain, multiply the chains and links by chains and links, as whole numbers; and from the product cut off five figures to find the acres; then multiply the 5 figures, cut off, by 4; from that product cut off five figures, and the other will be roods; then multiply by 40, cut off as before, and the remainder will be rods. If the lengths be in rods, multiply them together, and divide by 160; the product will be acres, and the remainder rods.

1. *To measure a square having equal sides.*

RULE.

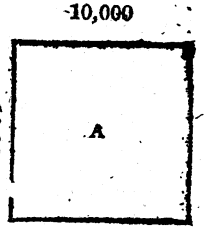
Multiply the side of the square into itself, and the product will be the area.

Let A be a true square, each side measuring 10 chains; multiply 10 chains, 00 links, by 10 chains, 00 links, thus,

10,00
10,00

10)00000

the product is just 10 acres for the square, A,



2. *To measure a Parallelogram, or long square.*

RULE.

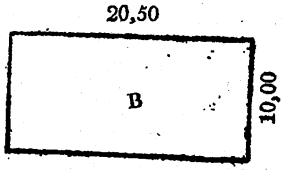
Multiply the length by the breadth.

Let B represent a parallelogram, whose length is 20 chains, 50 links, and breadth 10 chains, 00 links.

20,50
10,00

Acres 20)50000 *Area* 29 *A.* 2 *Roods.*
4

Roods 2)00000



3. *To measure a Triangle.*

RULE.

Multiply half the base by the whole perpendicular; or the whole base by half the perpendicular; or multiply the whole base and whole perpendicular together, and take half that product for the content. Either of these three ways will do.

The longest side of a triangle is usually called the base, except in a right angled triangle, where the longest of the two legs, which include the right angle, is called the base.

In the right-angled triangle, A B C, right angled at B; the base A B 10 chains; the perpendicular B C 13 chains, 70 links.

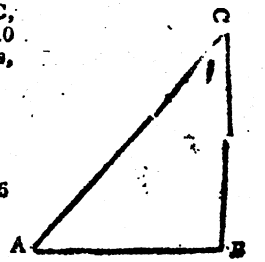
Perpendicular 13 70
½ the base 5 00

6)85000

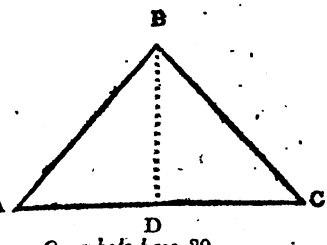
4 *Area* 6 *A.* 3 *R.* 16 *rods.*

3)40000
40

16)00000

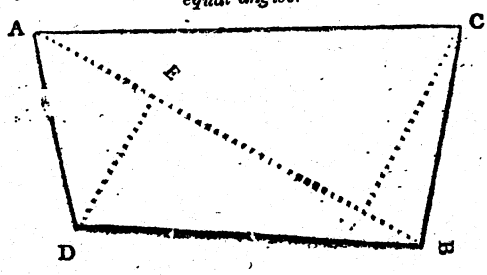


The oblique-angled triangle A B C, being given, let fall a perpendicular from the angle at B on the base A C, and the perpendicular is the height of the triangle. The base A C, being 30 rods, and the perpendicular B D 17 rods.



Half of the base	15	*Or, whole base*	30
Perpendicular	17	½ *Perpendic.*	8,5
	105		150
	15		240
Rods in an acre	160)255(1	*A.*	265,0
	160	*Area* 1 *A.* 2 *R.* 15 *rods.*	
Rods in a rood	40)95(2 *R.*		
	80		
	15 *rods.*		

4. To measure a Trapezium, or figure of four unequal sides, and unequal angles.



RULE.

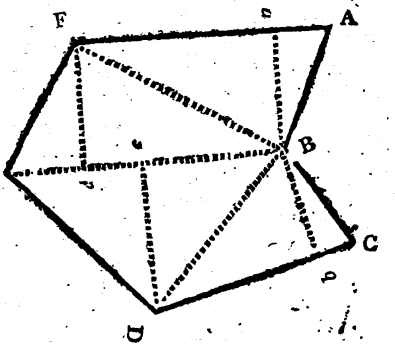
Draw a diagonal line from one of the angles to the opposite angle as A B, and then will the trapezium be divided into two triangles, of which the diagonal is the common base; then letting fall perpendiculars from the other opposite angles, on the diagonal, add those perpendiculars together, and multiply half that sum into the diagonal, or half of the diagonal into the sum of the perpendiculars, and that product will be the area of the Trapezium.—In the Trapezium A C B D, the diagonal A B is 4 chains, 58 links, the perpendicular D E, 1 chain, 55 links, and the perpendicular C F, 2 chains, 23 links.

1,55	*Diagonal* =	4 58
2,23	*½ the sum of the perp.* =	1 89
½ 3 78		41 22
1,89		366 4
		458
		0)865 62
		4
	Area 0 *A.* 3 *R.* 22½ *rods.*	3)56 48
		40
		22)499 20

3. To measure an irregular figure.

RULE.

Divide the figure into triangles, by drawing diagonals from one angle to another; then measure all the triangles, by either of the rules, already taught, and the sum of their several areas will be the area of the given figure



In the triangle A F B, the base F A 26,5 rods, and the perpendicular B *a* 12,5 rods; in the triangle F B E, the base B E 28 rods, and the perpendicular F *d* 13 rods in the triangle E B D, the base B E 28 rods, and the perpendicular D *c* 16; in the triangle D C B, the base D C 22 rods, and the perpendicular B *b* 12 rods. *See the work.*

13,25 = ½ A F.	14 = ½ B E.
12,5 = *per a* B.	13 = *per* F *d*.
6 625	42
26 50	14
132 5	
165,625 = *Area of* A F B.	182 = *Area of* F B E.
14 = ½ B E.	11 = ½ D C.
16 = *per* D *c*.	12 = *per* B *b*.
84	132 = *Area of* D C B.
14	
224 = *Area of* E B D.	

A F B=165.625
F B E=182
E B D=224
D C B=132

The figure contains 4 A. 1 R. 23 6/10 rods.

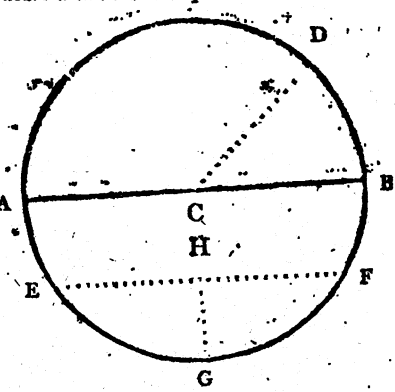
160)703,625(4
640
---
40)63(1
40

23

The number of triangles, in any irregular figure, will be less, by two, and the diagonals less, by three, than the number of the sides of the figure.

To measure a circle and its parts.

In the annexed circle A D B F G E, the arch line A D B F G E is called the *periphery*, the length of which is called the *circumference*: Any line as A B, passing thro' the centre C, cuts the circle into two equal parts, called *semicircles*, or half circles, and such lines are called *diameters*, of the circle.



To find the content of the whole circle, you must first know the length of the diameter, or the circumference; one of which being known, the other is easily found; for as 7 : is to 22 : : so is the diameter: to the circumference; and as 22 : is to 7 : : so is the circumference to the diameter.

In this annexed figure, the diameter A B is 2 chains or 200 links; which, multiplied by 22, and the product divided by 7, gives 6 ch. 28 lin and something more for the circumference. Now, to find the superficial content, multiply half the circumference by half the diameter, the product will be the content; half the circumference is 3 ch. 14 lin.; half the diameter, 1 ch. 00 lin.; which, multiplied together, the product is 3,1400 square links, or 1 rood, 10 rods, the content of the circle.

To find the content by the diameter only.

As 14 : is to 11 : : so is the square of the diameter : to the content.

The square of the diameter is 40000; which multiplied by 11, makes 440000; which, divided by 14, gives 31428, or one rood, 14 rods, and something more.

To find the content of the sector of a circle.

Multiply half the compass thereof by the semidiameter of the circle; the product will be the answer.

"In the foregoing circle I would know the content of that little piece D C B; the arch D B is 78,5 links; the half of it is 39,25 lin.; which, multiplied by the semidiameter, 1 ch. 00 lin. gives 3925 square links, or 6,25 rods.

To find the content of a segment of a circle, without knowing the diameter.

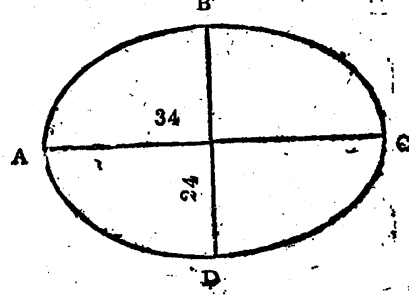
Let E F C, in the foregoing figure be the segment of a circle, the chord E, F is 1 ch. 70 lin. or 170 lin.; the perpendicular G H, 50 links; now multiply $\frac{2}{3}$ of the one by the whole of the other, the product will be the content nearly; the two-thirds of 170 is the nearest 113, which, multiplied by 50, produces 5650 square links, or 9 rods.

7. To measure an Ellipsis or Oval.

RULE.

Multiply the two diameters of the oval together; then, multiplying the product by ,7854, this last product will be the area of the oval.

In the annexed oval, A B C D, the transverse diameter A C, is 34 feet, and the conjugate diameter, B D, is 24, to find the area.



34
24

136
68

816
,7854

3264
4080
6528
5712

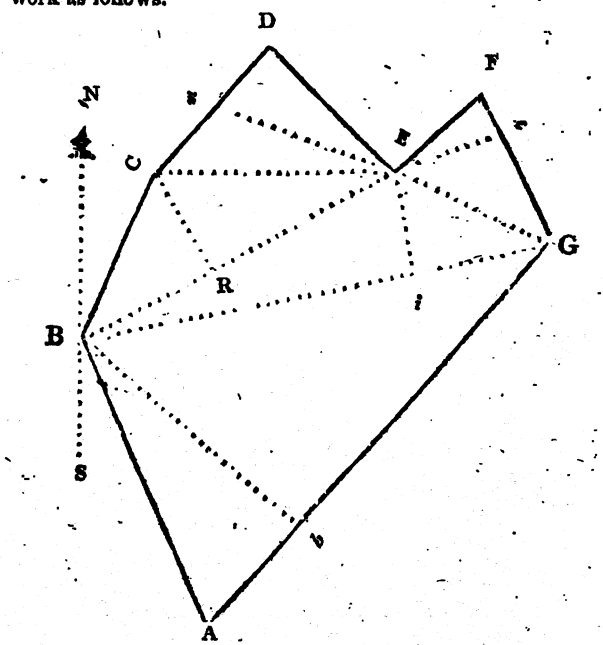
640,8864

Area 640,8864 feet.

To Plot and find the content of a lot of land from the minutes in the field-book.

Stations	*Bearings.*	*Rods.*	*Bounds.*	*On whom bounded.*
B.	N. 21°. E.	19,5	A stake.	Likewise, if there
C.	N. 43°. E.	24	A rock.	be any thing you
D.	S. 25°. E.	19	Stake & stones.	wish to remark, as
E.	N. 48°. E.	12,25	White oak tree.	rivers, roads, buil-
F.	S. 25°. E	18	Apple tree.	dings, &c. you may
G.	S. 41°. W	54	corner of a wall.	set them down in
A.	N. 23°. W.	33,5	Heap of stones.	this column.

First plot the field, by the foregoing rules; then divide it into triangles, and measure their bases and perpendiculars; then work as follows.



Triangle A B G, *Base* A G 54*r*.,
Half perp. B *h* 15

270
54
810

B E G. *Base*, B G 50
Half perp. E *i* 5,75

250
350
250
287,50

B C E. *Base*, B E 36,75
Half perp. C *h* 6

220,50

C D E. *Base* C D 24 — *Half perp.* E *m* 8.75

120
168
192

210.00
810,
287,50
320,50
105.66

E F G. *Base* F G 18 — *Half perp.* E *c* 5 87

126
114
90

105,66

160)1633,66(10 *A.* 0 *R.* 33$\frac{6}{10}$ *rods Area.*
160

33

Note.—You must always use the same line on the scale, to find the content, that you used in plotting.

TO LAY OUT LAND.

To lay out any number of acres in a square figure.

RULE.

Annex to the number of acres given, 5 cyphers, which will turn the acres into links, extract the square root from the number thus increased, which will be the side of the proposed square.

It is required to lay out 100 acres in a square figure. I join to the 100 five cyphers, and then it is 100,00000 square links; the root of which is 3162 nearest, or 31 ch. 62 lin. the length of one side of the square.

To lay out any number of acres in form of a Parallelogram, whereof one side is given.

RULE.

First turn the acres into links by annexing five cyphers; divide that number by the given side, the quotient will be the other side.

It is required to lay out 100 acres in a parallelogram, one side of which shall be 20 chains; to the 100 I annex five cyphers, and it is 100,00000, which divided by 20 chains, or 2000 links, gives 50 chains for the other side of the parallelogram.

To lay out any number of acres in form of a triangle upon a given base.

RULE.

To double the number of acres, annex five cyphers, and divide by the base, the quotient will be the length of the perpendicular required.

It is required to lay out 100 acres in form of a triangle upon a given base, whose length is 40 chains.

To double the 100 acres, I annex five cyphers, which make 200,00000; which, divided by 40, gives 50 chains for the height of the perpendicular.

To find the length of the diameter of a circle, which shall contain any number of acres required.

RULE.

As 11 : is to 14 : : so is the number of acres given : to the square of the diameter, of the circle, required.

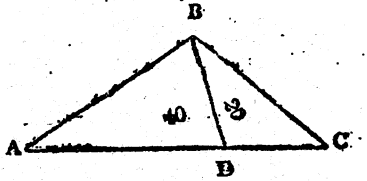
It is required to lay out 100 acres in form of a circle; the length of the diameter is required.

Add five cyphers to the 100, and it makes 100,00000; then, as 11 : 14 : : 100,00000 : 12727272; the root of which is 35 ch. 67 or 68 lin. the diameter of the circle required.

OF DIVIDING LANDS.

To divide a triangle several ways.

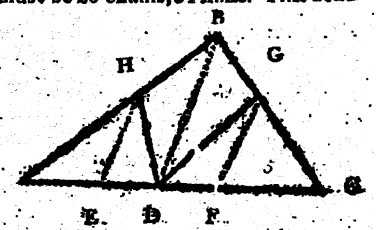
Suppose A B C contain 60 acres, to be divided between two men, one to have 40 acres cut off towards A, and the other 20 acres towards C; and the line of division to proceed from the angle B. First, measure the base A C, viz. 50 chains; then say by the Rule of Three, if the whole content, 60, give 50 chains for its base, What will 40 acres give?



Multiply and divide, the quotient will be 33 ch. 33 lin.; which set off upon the base from A to D, and draw the line B D, which shall divide the triangle as was required.

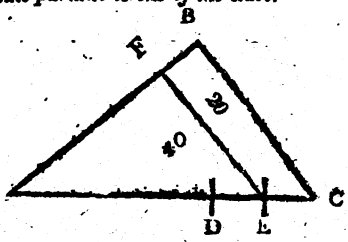
To divide a triangle into any number of unequal parts, by lines proceeding from any assigned point.

The triangle A B C contains 60 acres, to be divided between 3 men; the first to have 15 acres, the second 20, and the third 25 acres; the lines of division to proceed from D. First measure the base, which is 50 chains; then as 60 : 50 : : 15 : 12 ch. 50 lin. to be set off from A to E, for the first man's base; then as 60 : 50 : : 20 : 16 ch. 66 lin. which set off from E to F, for the second man's base; then, consequently, the third man's base via F to C, must be 20 chains, 84 links. This done draw a line from the point assigned, D, to the opposite angle B; and from E and F draw the lines E H, F G parallel to B D. Lastly, from D draw the lines D G, D H which divide the triangle into three such A parts as were required.



To divide a piece of land, in form of a Triangle, according to any proportion given, by a line parallel to one of the sides.

The triangle A B C contains 60 acres, the base A C is 50 chains. It is required to divide it, by a line parallel to B C. into two parts; the one to contain 40 acres, the other 20.



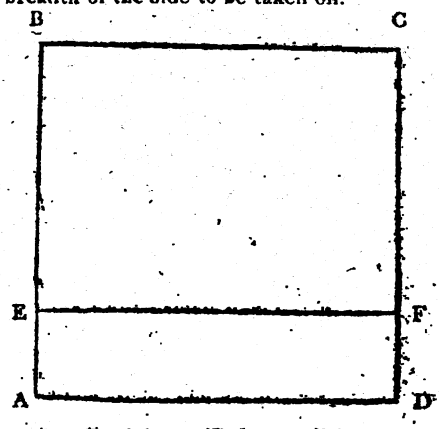
Divide the base as before taught, and at the line of division fall in D; A D being 33 chains, 33 links, and D C 16 chains, 67 links. Multiply the whole base 50 by A D 33 chains, 33 links, the product is 1666,5000; extract the square root, and it gives 40 chains, 82 links; set this off from A to E. From E draw E F parallel to B C, which divides the triangle as required.

To cut off from a square any assigned part, laying in form of a parallelogram.

RULE.

Extract the square root of the number of rods contained in the square; divide the number of rods, to be cut off by the root, the quotient will be the breadth of the side to be taken off.

The square A B C D contains 34 A. 3 R. 20 rods; and it is required to cut off 8 A. 2 R. 35 rods.

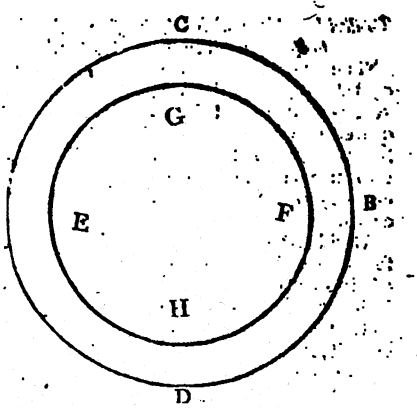


The 34 A. 3 R. 20 rods reduced to rods, are 5380, the square root of which is 74,69 equal to one side of the square. Then the 8 A. 2 R. 35 rods, reduced to rods, are 1395; which divided by 74 69, give 18,6 rods, to be set off from A to E, and from D to F. Then will the parallelogram A E F D contain 8 A. 2 R. 35 rods.

To divide a circle according to any proportion, by a line concentric with the first.

The areas of circles are in proportion to one another as the squares of their semidiameters; therefore if you divide the square of the semidiameter by the proportion given, and extract the square root, you will have your desire.

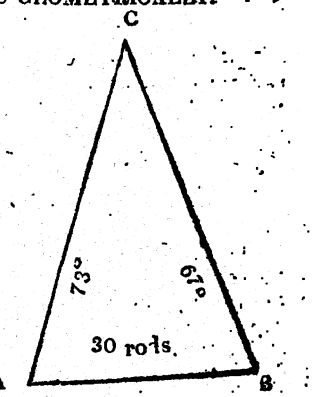
Let A C B D be a circle to be equally divided between two men. The diameter thereof is 2 chains. The semidiameter 1 ch. or 100 links. The square thereof is 10000. Half the square is 5000. The foot of the half is 71 links, nearly; which take from your scale, and upon the same centre describe the circle G E H F, which will divide the circle A B C D into two equal parts.



TO MEASURE DISTANCES GEOMETRICALLY.

If you were at A, and were desirous of knowing the distance from A to C; but by reason of a river or some other obstacle, you could not measure it, you might in the following manner, obtain the true distance.

With a compass, or any other instrument used in taking angles, placed at A, observe what point C bears from you, which let be S. 75° E. then turn your compass towards some other object, as B; note the bearing and distance, which let be S. 30 rods. Then remove your compass to B, and note the bearing to C, which let be N. 67° E.



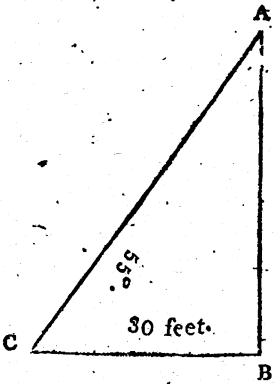
Now to find the distance, draw a line A B, representing a south line, and from any scale of equal parts, lay thereon 30 from A to B; then lay your protractor on the point at A, and set off 73°, drawing a line from A through that point; then lay your protractor on the point at B, and set off 67°, drawing another line intersecting the former; the meeting of these two lines in C completes the triangle; then taking the line A C in your compasses, and applying it to the same line of equal parts, it will give the distance required, 45½ rods.

Note.—The ground between your two stations, as A and B, should be level.

TO MEASURE HEIGHTS GEOMETRICALLY.

Let A B represent a tree or building, standing perpendicu-

larly on level ground. At any convenient distance, as at C place your semicircle or such other instrument as you judge best for taking an angle of altitude, as a quadrant or the like; observe that your semicircle be placed horizontally, by making a plummet-line fixed to the centre fall just upon 90°. Then move the index up and down, till you espy the top of the tree or building, thro' the sights, at A; see then what degree upon the limb is cut by the index, as suppose 55°. Then measure the distance C B, between your instrument and the object, which let be 30 feet.



Draw a line C B at pleasure; at B erect a perpendicular. From B set off 30 feet towards C, taken from any scale. Lay your protractor on the point at C, and against 55° make a mark, through which, and the point C, draw a line intersecting the perpendicular at A; then take the line A B in your compasses and applying them to the same line on the scale, you will find the height of the object A B to be 45 feet, from the level of your instrument; to which add the height of your instrument from the ground, and you will have the height of the object.

To measure heights by a staff or rod.

1. By the aid of a quadrant, a carpenter's, or mason's plumb, erect perpendicularly a staff of a given length, above the surface.

2 Having erected your staff, in a fair day, measure the length of its shadow, and also the length of the shadow of the object, whose height you wish to ascertain; and then you will have all the requisites necessary for operation: Suppose

The length of the shadow of the staff, 15 ft.

The length of the staff, 10 ft.

The length of the shadow of the object, 135 ft.

By the Rule of Three, thus: As 15 : 10 :: 135 : 90 the height of the object.

N. B. In all operations of this description, the person is supposed to stand on an horizontal plane; otherwise his work will be erroneous. On such a plane, the perpendicular height of any object, may be taken, in a clear day.

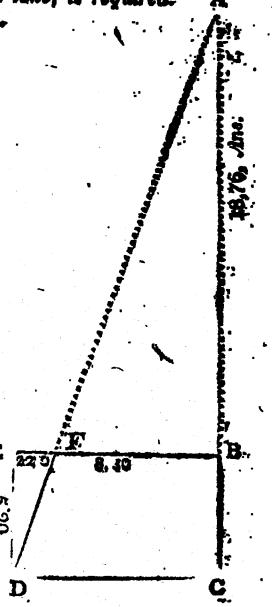
To measure distances by the chain only; or by a cord equally divided into feet and inches.

By either of these instruments, may be measured the distance of an object on the opposite side of a river, pond, lake; or, the distance of any visible, inaccessible object, on the earth.

The breadth of a river, pond, or lake, is required.

OPERATION.

Erect a staff, or any object, at the waters edge, as B. Move directly backwards, two or more rods to C, so that C and B may make a right line with the object A, on the other side of the river. On the brink of the river lay off three, or more rods, to E. Then complete your parallelogram; whether it be a square, or rhombus, or rhomboides, is immaterial. Take your station at D, cause an object to be erected at the water's edge, as at F, in the direction of A, on the opposite side of the river. Measure the distance, in rods, or feet, or inches, from E. to F. Measure also the distance from D to F, and from D. to E. Note your measurements on paper, or slate. The distance from F to B is also known. Then say, as E F : E D : : F B : B A.



Suppose the distance

	ch.	L.
E. F.	2	30
E D.	5	20
F. B.	8	30

ch L.

As 2,30 : 5,20 : : 8,30 : 18 76 the breadth of the river.

N. B. This measurement is founded on the *geometrical theorem*, that, if in two triangles, all the angles of one be each respectively equal to all the angles of the other; then the legs opposite to the equal angles will be proportional.

It is plain, that the sum of all the angles, in the less triangle, D, E, F, is equal to the sum of all the angles in the greater, A, B, F. And of course there must be a proportion between their respective legs. And, consequently, by ascertaining the length of the base and perpendicular of the less triangle, and also the base of the greater triangle, you may easily find the perpendicular of the greater triangle, which is the breadth of the river. This is done by the *Rule of Three Direct*.

The above principles account for the measurement of heights, by a staff and shadows.

Of the line of numbers on Gunter's Scale.

On Gunter's scale there is a line, marked at the right hand, nem. which is divided. The marks of the large division being numbered from left to right, the marks of the smaller division immediately below the preceding, not numbered.

To prove the line by compasses, observe that the distance from 1 to 2, is equal to the distance from 2 to 4; and from 5 to

10 is equal to the distance from 4 to 8; and from 4 to 8 is equal to the distance from 3 to 6.

To find a number on the line, as suppose 134.

For the 1 hundred, account one on the line; and for 3, take 3 of the large divisions; and for 4, take 4 of the smaller divisions, and that is the point. To find 750, for 7, take 7 on the line; for 50, take 5 of the great divisions; and that is the point. To find a small number, as 12; for 10 take one as before, and for 2, take 2 of the large divisions, and that is the point.

Multiplication by Gunter's line.

To multiply 3 by 7, set one foot of the compasses on 1, in the left hand line, and extend the other to 3, towards the right hand, and with the same extent place one foot in 7, and the other foot will fall on 21 in the right hand line, which is the answer.

Division by Gunter's line.

To divide 63 by 3, extend from 3 to 1, towards the left hand, and that extent will reach the same way from 63 to 21, the answer.

Note.—To multiply you must extend your compasses from 1, towards the right hand; and to divide you must extend them to the left hand.

2 Divide 350 by 25; extend from 25 to 1, towards the left hand; and that extent will reach the same way from 350 to 14, the quotient.

Rule of Three Direct.

1. If 4 bushels of oats cost 9 shillings, What will 36 bushels cost?—Extend from 4 to 9, towards the right hand, and that extent will reach the same way from 36 to 81, the answer in shillings.

2. If 5 yards of cloth cost 10*s.* 6*d.* What will 30 yards cost? Extend from 5 to 10½, towards the right hand, and that extent the same way will reach from 30 to 63, the answer.

To Measure Boards.

1. If a board be 9 inches wide, and 18 feet long, What is the content in superficial square feet?—Extend from 12, (the centre of foot measure) to 9, towards the left hand, and that extent the same way will reach from 18 to 13½, the answer.

To Measure Timber by Gunter's Line.

A piece of timber 20 inches square and 9 feet long, What is the content in solid feet?—Extend from 12, the centre, to 20, towards the right hand, and that extent twice the same way will reach from 9 to 25 feet, the content.

TO MEASURE A SPHERE OR GLOBE.

A Sphere or Globe, is a round solid body, in the middle of which is a point, from which all lines drawn from the surface are equal.

Rule.

Multiply the cube of the diameter by ,5236, and the product will be the solid content.

The diameter of a Globe, A B, is 12; to find the solid content.

12
12
—
144
12
—
1728=*the cube of the diameter.*
,5236
—
10368
5184
3456
8640
—
904,7808 *solid content.*

Note.—When the solidity of a Globe is given, the diameter may be found by dividing the solidity by ,5236, and extracting the cube root of the quotient.

To measure the solidity of a Frustrum or Segment of a Globe.

The frustrum of a Globe, is any part cut off by a plane.

RULE.

To three times the square of the semidiameter, of the base, add the square of the height; then multiply that sum by the height, and the product by ,5236, you will have the solid content.

Let A D C represent a coal-pit; the height at the chimney, B D, 9 feet; the diameter, A C, 24 feet; to find how many cords of wood it contains, making no allowance for the chimney.

12=*semidiam.*
12
—
144=*square.*
3
—
432
81=*square of the height.*
—
513
9=*height.*
—
4617
feet in a cord=128)2417,4612(18,886 *cord, Ans.*

4617
,5236
—
27702
13851
9234
23085
—