

INTERMEDIATE ARITHMETIC

WATSON *and* WHITE

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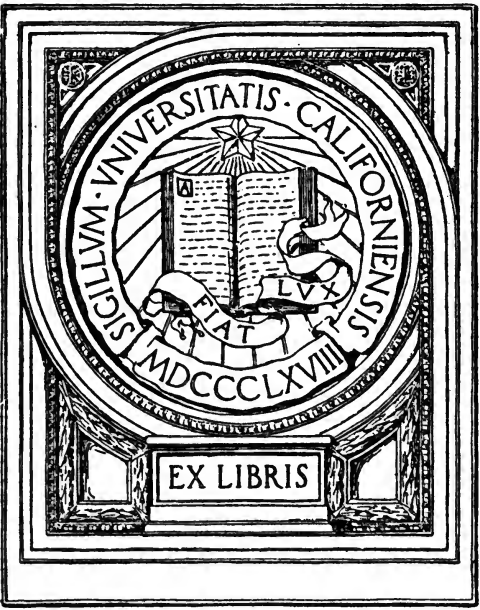


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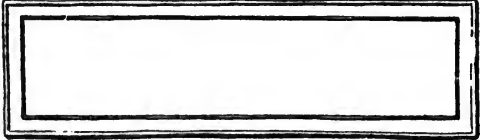
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BOSTON NEW YORK CHICAGO

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INTERMEDIATE ARITHMETIC

BY

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D. C. HEATH & CO., PUBLISHERS

BOSTON NEW YORK CHICAGO

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INTRODUCTION

THE Intermediate Arithmetic is divided into two parts, each containing a full year's work. Throughout the book the pupil is led to see, in each new topic, an extension and application of principles previously learned. Fractions are treated as expressions of division. The work in decimals is presented as an extension of the decimal scale of notation to numbers smaller than one. Percentage is treated as an application of decimals—a familiar topic under a new name. There is no formal division of percentage into "cases," but the pupil is led to apply his knowledge of the relation of product and factors in determining the process to be employed in the solution of each individual problem. All technical commercial terms are reserved for later consideration.

The work in denominate numbers is confined to such problems as people of the present generation are likely to meet in their daily vocations. Extended reductions and intricate measurements are not required. Attention has been given to the development of ideas of proportion, the real purpose of the so-called "ratio exercises" found in some courses of study.

An effort has been made to shorten the course and simplify the work, to a reasonable degree, by reducing each topic to as few cases as possible, and by employing the simplest and most generally applicable processes.

The study of arithmetic should furnish the child a means of interpreting mathematically the world about him. It should

enable him to measure and relate the facts of geography, history, and science. It should bear directly upon the vital interests of the home and family. Care has been taken in the selection of problems to meet these requirements, so far as possible, with due regard to the mathematical content of the exercises, which must always be the first consideration.

INTERMEDIATE ARITHMETIC



INTERMEDIATE ARITHMETIC

PART ONE

NOTATION AND NUMERATION

1. *That which tells how many is number*; e.g. 11, 14 (books), 25 (cents).

2. *One is a unit*; e.g. 1 dollar, 1 house, one.

Every number is made up of units. Three contains 3 units. Twenty contains 20 units.

3. *Expressing numbers in figures or letters is notation*; e.g. 7, 29, VII, XXIX.

4. *Expressing numbers by means of figures is Arabic notation*; e.g. 13, 4728, 23806.

1, 2, 3, 4, 5, 6, 7, 8, and 9 are called significant figures, because each figure has a value.

The figure 0, called *zero*, or *naught*, has no value, but is used to give the significant figures their proper places in a number.

5. *Expressing numbers by means of letters is Roman notation*; e.g. VIII, CD, XCIV.

6.

ARABIC NOTATION

NAMES OF PERIODS.		NAMES OF PLACES.	
Billions	Millions	Hundred-billions	Hundred-thousands
{	{	{	{
Ten-billions	Ten-millions	Ten-thousands	Ten-thousands
Billions	Millions	Thousands	Thousands
Hundred-millions	Hundred-thousands	Hundreds	Hundreds
Tens	Tens	Tens	Tens
Units	Units	Units	Units
4	6	5, 2	0 9, 3
1	5, 0	8	7

This number is read, *four hundred sixty-five billion, two hundred nine million, three hundred fifteen thousand, eighty-seven.*

A comma (,), sometimes called a **separatrix**, is used between periods to aid in reading numbers.

7. *Oral*

1. Name the periods in this number. Name the places.
2. How many periods are there? How many places?
3. How many places are there in each period?
4. How does the name of each period compare with the name of its right-hand place?

8. *Written*

Express in figures:

1. Two hundred thousand, sixteen.
2. Eleven thousand, two.

3. Four million, six hundred eight thousand, three hundred seventy-five.
4. Twenty-five thousand, seven.
5. Nineteen thousand, seventeen.
6. Twenty-seven million, six hundred fifty.
7. Eighty million, six hundred nine thousand, four hundred twenty-eight.
8. Six hundred twenty million, seventeen thousand, four hundred seventy-seven.
9. Four hundred thirty-six thousand, fifty-one.
10. One hundred fifty-seven million, six hundred eight thousand, four hundred seventy-seven.
11. Three billion, fifty-seven million, four hundred seventeen thousand, sixty.
12. Write a number containing five places.
13. Write a number containing three periods. How many places does it contain?
14. Write a number containing three periods in which the thousands' period has no value.

NUMERATION

9. *Naming the places of figures and reading numbers is numeration.* Thus, to numerate 43,008,160, we should say "Units, tens, hundreds, thousands, ten-thousands, hundred-thousands, millions, ten-millions — forty-three million eight thousand one hundred sixty."

10. *Numerate the numbers below :*

- | | | |
|-----------|---------------|------------------|
| 1. 385 | 4. 315,129 | 7. 8,460,000 |
| 2. 1,421 | 5. 6,785,342 | 8. 423,000,501 |
| 3. 25,678 | 6. 35,000,730 | 9. 8,003,040,631 |

ROMAN NOTATION

11. The Roman notation uses seven capital letters to express numbers, as follows :

I (1), V (5), X (10), L (50), C (100), D (500), M (1000).

12. These letters are combined according to the following principles of Roman notation:

1. *Placing a letter after one of greater value adds its value to that of the greater.*

2. *Placing a letter before one of greater value subtracts its value from that of the greater.*

3. *Placing a letter between two letters of greater value subtracts its value from their sum.*

4. *Repeating a letter repeats its value.*

5. *Placing a bar over a letter multiplies the value of the letter by 1000.*

ILLUSTRATIONS

13. 1. $X = 10$, $V = 5$, $XV = 10 + 5 = 15$. Which principle does this illustrate?

2. $V = 5$, $I = 1$, $IV = 5 - 1 = 4$. Which principle does this illustrate?

3. $C = 100$, $L = 50$, $X = 10$, $CXL = 100 + 50 - 10 = 140$. Which principle does this illustrate?

4. $X = 10$, $XXX = 10 + 10 + 10 = 30$. Which principle does this illustrate?

5. $D = 500$. $\bar{D} = 500000$. Which principle?

6. $CCCLX = 360$. Which principle?

7. $MCM = 1900$. Which principle?

8. $MDCLXVI = 1666$. Which principle?

9. Write a number to illustrate each principle.

10. Express in Roman notation all numbers from 1 to 100.

NOTE. — For many years the Roman notation was the one chiefly used in Europe. The ancient Greeks also had a system of notation that employed the letters of the Greek alphabet. Both of these systems were awkward and were not easily used in making computations. The Arabic system of notation, now employed by all the great nations of the world, was used first in India, and afterward brought to Europe by the Arabs.

ADDITION

14. Addition is the process of uniting two or more numbers into one number; e.g. $2 + 5 = 7$.

15. The numbers added are addends; e.g. $3 + 10 = 13$; 3 and 10 are the addends.

16. The result of addition is the sum; e.g. 8 books and 7 books are 15 books; 15 is the sum.

17. The addends and the sum are called the terms of addition.

18. Oral

Add:

1.	3	}	71
	5		
	7		63
	2	}	
	8		56
	6	}	
	6		46
	8		34
	7		26
	5	}	
	5		19
	9		9
	71		

NOTE. — In adding a column, always look for combinations of two or three figures whose sum may be taken as an addend. Thus, in finding the sum in Example 1, say 9, 19, 26, 34, 46, 56, 63, 71.

Read the column downward, making similar combinations.

Add:

2.	4	3.	9	4.	5	5.	6	6.	8	7.	8	8.	5	9.	8
	5		4		9		6		7		6		7		2
	5		6		6		7		9		5		6		4
	5		2		4		6		2		2		4		6
	2		7		3		8		9		3		3		7
	3		5		5		2		1		7		2		3
	4		8		2		7		6		9		4		8
	3		4		4		5		7		1		6		4
	9		3		5		6		3		8		9		7
	8		1		4		7		8		7		3		6
	<u> </u>		<u> </u>		<u> </u>		<u> </u>		<u> </u>		<u> </u>		<u> </u>		<u> </u>

10. *Add 25 and 47.*

$25 + 40 = 65.$

Say 25, 65, 72.

$65 + 7 = 72.$ *Ans.*

In a similar way find the sums indicated in exercises 11–25:

11. $28 + 26$

16. $62 + 28$

21. $62 + 24$

12. $42 + 75$

17. $57 + 36$

22. $65 + 34$

13. $63 + 29$

18. $72 + 29$

23. $53 + 46$

14. $27 + 38$

19. $35 + 26$

24. $64 + 44$

15. $45 + 34$

20. $44 + 38$

25. $73 + 27$

26. A drover bought 8 cows, 5 horses, and 10 sheep. How many animals did he buy?

27. Fred paid 10 dollars for a goat, and 12 dollars for a cart. How much did both cost him?

28. In a certain class 28 pupils were present, 5 were absent on account of sickness, and 4 were absent for other reasons. How many pupils belong to the class?

29. A farmer sold 25 bushels of apples to one man, 10 to another, and 8 to another. How many bushels did he sell?

30. John had 40 cents in his bank. He added 8 cents on Monday, and 10 cents on Wednesday. How much money had he then in his bank?

31. A man paid 6 dollars for paint, and 10 dollars for labor. How much did he pay for both?

32. Bought sheep for 50 dollars, turkeys for 12 dollars, and chickens for 8 dollars. How much did they cost?

33. A man in repairing his house paid 65 dollars for lumber, 8 dollars for paint, 1 dollar for nails, and 30 dollars for labor. What was the cost of his repairs?

34. How many fish did Mr. A catch in four days if he caught 12 the first day, 8 the second, 9 the third, and 7 the fourth?

35. A girl spent 5 cents for car fare, 4 cents for pencils, 8 cents for paper, 10 cents for ribbon, 15 cents for lunch, and had 9 cents left. How much money had she at first?

19. *Written*

Add, and test your work by adding downward:

1.	28	2.	639	3.	1050	4.	126	5.	\$115.85
	39		874		394		149		327.15
	76		596		769		1260		495.27
	42		421		564		1004		160.03
	89		397		285		986		598.09
	<u>73</u>		<u>269</u>		<u>784</u>		<u>24</u>		<u>784.06</u>
6.	97	7.	857	8.	283	9.	\$208.40	10.	\$356.24
	98		943		2075		32.03		35.09
	79		268		298		26.07		2.15
	68		207		963		18.94		30.05
	40		976		859		236.29		5.16
	<u>87</u>		<u>888</u>		<u>876</u>		<u>28.15</u>		<u>304.29</u>

11. 2673	12. 837	13. 628	14. 8063
846	2964	4307	259
1025	418	526	8264
92	3825	8279	1287
837	842	428	428
642	29	4273	3064
4983	561	746	42379
8698	29	394	6507
<u>2789</u>	<u>387</u>	<u>786</u>	<u>93289</u>

15. Three boys went fishing, and caught 16 perch, 19 pickerel, and 8 black bass. How many fish did they catch in all?

16. Two trains starting from the same place ran two days in opposite directions. One ran 530 miles the first day and 525 miles the second, while the other ran 492 miles the first day and 510 miles the second. How far apart were they at the end of the two days? (Illustrate by a picture.)

17. A man bought coal for \$5.60, wood for \$3.45, and a stove for \$45. What was the whole cost?

18. There are 112 bushels of wheat in one bin, 175 in another, and 234 in the third. How many bushels in all?

19. There are 218 pages in my reader, 245 in my arithmetic, 195 in my geography, and 189 in my language book. How many pages in the four books?

20. *The sum of all the sides of a figure is its perimeter.*

1. Find the perimeter of a figure whose sides are 39 inches, 45 inches, 28 inches, 56 inches, 75 inches, and 17 inches.

2. What is the perimeter of a seven-sided piece of land whose sides are 209 feet, 683 feet, 129 feet, 463 feet, 928 feet, 93 feet, and 290 feet? (Illustrate.)

SUBTRACTION

21. *Subtraction is the process of finding the difference between two numbers; e.g. $21 - 7 = 14$; 13 cents - 5 cents = 8 cents.*

22. *The number from which we subtract is the **minuend**. The number subtracted is the **subtrahend**. The result of subtraction is the **difference** or **remainder**.*

The difference is always the number that must be added to the subtrahend to obtain the minuend; e.g. $17 - 9 = 8$. 17 is the minuend, 9 is the subtrahend, and 8 is the difference or remainder.

23. *The minuend, subtrahend, and remainder are called the terms of subtraction.*

24. *Oral*

From 83 take 57.

$83 - 50 = 33$. Say 83, 33, 26.

$33 - 7 = 26$. Ans.

In a similar way find the differences indicated in exercises 1-15.

1. $38 - 19$

6. $72 - 26$

11. $63 - 25$

2. $27 - 18$

7. $66 - 37$

12. $48 - 19$

3. $42 - 15$

8. $92 - 48$

13. $51 - 27$

4. $61 - 22$

9. $87 - 39$

14. $84 - 47$

5. $81 - 36$

10. $42 - 29$

15. $75 - 39$

16. Frank lives 12 blocks from school, and Henry 5 blocks in the same direction. Their homes are how many blocks apart? How many blocks apart would they be if Henry lived 5 blocks from school in the opposite direction? (Illustrate.)

17. Mary added two numbers, and the sum was 28. One of the numbers was 16. What was the other?

18. 20 is how much more than 11?

19. Tom has 20 marbles, and Edward 11. Tom has how many more than Edward?

20. If you pay 15 cents toward the purchase of a slate costing 20 cents, how much do you still owe?

21. Nell had 21 chickens, but a dog killed 10 of them. How many were left?

22. Lucy is 20 years old, and her sister is 6 years younger. How old is her sister?

23. John had \$20. He spent \$10 for a coat and \$3 for a hat. How much had he left?

24. A pole was 19 feet long. I cut off 4 feet at one time and 6 feet at another. How many feet were left?

25. What number must be subtracted from 43 to leave 25?

26. John's heart beat 78 times a minute when he was well, but 130 times a minute during a severe illness. How much faster did the heart beat during illness than in health?

25. *Written*

From 58500 take 26937.

$$58500 = 50000 + 7000 + 1400 + 90 + 10$$

$$\underline{26937 = 20000 + 6000 + 900 + 30 + 7}$$

$$31563 = 30000 + 1000 + 500 + 60 + 3$$

In finding the difference, we write only this:

$$58500$$

$$\underline{26937}$$

31563 and say, 7 from 10 = 3, 3 from 9 = 6, 9 from 14 = 5, 6 from 7 = 1, 2 from 5 = 3.

To test the work, add the subtrahend and remainder. If the minuend is obtained, the work is correct. Do not write the numbers again, but make the test with the numbers as they stand.

In what other way may we test subtraction?

Subtract and test results:

1.	2819 <u>674</u>	2.	8203 <u>1276</u>	3.	4295 <u>597</u>	4.	7306 <u>1807</u>
5.	2763 <u>1289</u>	6.	37284 <u>9287</u>	7.	36801 <u>18463</u>	8.	18003 <u>921</u>
9.	92874 <u>11392</u>	10.	94210 <u>8206</u>	11.	42840 <u>38706</u>	12.	98301 <u>26942</u>
13.	38264 <u>29842</u>	14.	19327 <u>8291</u>	15.	92593 <u>87246</u>	16.	27075 <u>18092</u>
17.	\$2.15 <u>1.12</u>	18.	\$35.28 <u>17.05</u>	19.	\$25.18 <u>1.15</u>	20.	\$36.51 <u>16.82</u>
21.	\$34.28 <u>24.28</u>	22.	\$39.21 <u>27.13</u>	23.	\$17.80 <u>16.75</u>	24.	\$75.00 <u>24.32</u>

25. From seventeen thousand sixteen, take nine thousand four hundred eighty-seven.

26. From seventy-two thousand three hundred eleven, take forty-six thousand nine hundred sixty-one.

27. Take eight thousand four, from thirty thousand.

REVIEW AND PRACTICE

26. *Oral*

1. Read 359,016,007,138 ; \$3,894,760.15 ; 1,010,101.

2. Read CLIX ; DCCXXXVI ; MCMXIII.

3. Numerate 3,057,608.

4. Jennie bought a skein of Shetland floss for 10 cents, 3 skeins of embroidery silk for 12 cents, and a pair of knitting needles for 10 cents. How much change should she receive from a 50-cent piece?

5. The sum of 3 numbers is 100. Two of them are 29 and 37. What is the other?

6. Albert has earned 15 cents, 25 cents, and 17 cents toward a pair of gloves that cost \$1. How much more money must he obtain in order to pay for the gloves?

7. Helen, Howard, and Henry wanted a canoe that cost \$47. They obtained \$19 by renting their row-boat, their mother contributed \$12, and their father the remainder of the price. How much did their father give?

8. Edith made some purchases, gave the clerk a dollar, and received in change three cents, one nickel, two dimes, and a quarter. What was the amount of her purchases?

27. *Written*

1. A farmer having 456 bushels of corn sold 84 bushels to one man and 135 bushels to another. How many bushels did he have left?

2. A man started to walk 112 miles in three days. He walked 32 miles the first day, and 41 miles the second. How far must he walk the third day to complete the journey?

3. I bought a cow for \$42, another for \$48, and a third for \$56. For how much should I sell them to gain \$28?

4. A lady bought sugar for 65 cents, tea for 55 cents, molasses for 72 cents, butter for 84 cents, starch for 25 cents, and gave in payment a five-dollar bill. How much change should she receive?

5. The distance by rail from Galveston to San Antonio is 572 miles, from San Antonio to Tucson 932 miles, and from Tucson to Los Angeles 501 miles. What is the distance by rail from Galveston to Los Angeles?

6. Two vessels start from points 850 miles apart and sail toward each other. How far apart are they when one has sailed 246 miles and the other 352 miles? (Illustrate.)

7. A man sold one horse for \$145 and another for \$182. On the first he gained \$23, and on the second \$36. What was the cost of both?

8. A boy bought apples for \$.45 and pears for \$.62, and sold them all for \$1.50. What was his profit?

9. John sold 62 newspapers, Frank 48, and Henry 27 less than both of them. How many did Henry sell?

10. A grocer sold butter for \$45 and cheese for \$62. On the butter he lost \$6 and on the cheese he gained \$14. What was the cost of both?

11. A farmer bought a barrel of flour for \$6.35, sugar for \$2.15, coffee for \$1.46, tea for \$1.20, and gave in payment \$3.15 worth of butter and the remainder in cash. What did he pay in money?

12. The sum of 52 and 64 is how much greater than the difference between 124 and 69?

13. From a flock of 320 sheep 76 were sold at one time and 112 at another. How many remained?

14. A man bought 148 bushels of potatoes from A, 216 bushels from B, 183 bushels from C, and afterwards sold all but 137 bushels. How many bushels did he sell?

15. The sum of three numbers is 342. Two of the numbers are 84 and 96. What is the third number?

16. John's father gave him \$2.25, and his uncle gave him \$1.40. He earned enough besides so that he bought, with the whole, a suit of clothes for \$8. How much did he earn?

17. Claude took 987 steps in coming to school, Francis 865, and Alice 398 less than the number taken by both the boys. How many steps did all three take?

18. A ship loaded with iron sailed from Cleveland to a port 332 miles west of that city. A car loaded with machinery at Cleveland was taken to a city 619 miles east of Cleveland. How far apart were the ship and the car when each had reached the end of its trip? (Illustrate.)

19. The first Thanksgiving was in 1621 and the day has been observed every year since. How many times has the day been observed?

20. A father and his three sons earned \$2461 in a year. The first son earned \$676, the second \$456, and the father \$1080. How much did the third son earn?

21. A train started from Chicago with 324 passengers. On the way to St. Paul 185 passengers left the train, and 149 came aboard. How many passengers were on the train when it reached St. Paul?

22. A retail grocer bought at a wholesale grocery three barrels of apples for \$4.50, a box of lemons for \$2.70, and three barrels of flour for \$12.30. He handed the wholesale grocer one gold piece and received 50 cents in change. What was the value of the gold piece?

23. During one week, a man put into the bank \$687, drew out \$489, put in \$348, drew out \$298, and then had \$1386 left in the bank. How much had he in the bank at first?

24. A farmer having 215 acres of land, used 21 acres for corn, 36 for oats, 29 for barley, 18 for potatoes, 52 for meadow, and the rest for pasture. How many acres were used for pasture?

MULTIPLICATION

28. **Multiplication** is taking one number as many times as there are units in another; e.g. 6 times 9 are 54.

29. The number multiplied is the **multiplicand**; the number by which we multiply is the **multiplier**; the result of multiplication is the **product**; e.g. 12 times 20 are 240. 20 is the *multiplicand*, 12 is the *multiplier*, and 240 is the *product*. 20 and 12 are factors of 240.

30. The *multiplier*, *multiplicand*, and *product* are called the terms of multiplication.

31. The *multiplier* and *multiplicand* are **factors** of the *product*. The product is the same in whatever order the factors are taken; e.g. 6 times 7 are 42, and 7 times 6 are 42; $3 \times 5 \times 4$ are 60 and $4 \times 3 \times 5$ are 60.

32.

ORAL EXERCISES

(Reviewing work of primary arithmetic)

3	4	5	2	6	1	8	0	7	12	10	11	9
7	12	9	0	11	5	10	4	1	3	6	2	8

1. Multiply every number in the upper line by each number in the lower line.

2. How do we multiply a number by 10? By 100? By 1000?

3. Multiply 7 by 10; by 100; by 1000.

4. Multiply 34 by 10; by 100; by 1000.

5. Multiply 11 by 3; by 30; by 300.

6. Multiply 12 by 7; by 70; by 7000.

7. The product is a multiple of the multiplicand. Of what other number is it a multiple?
8. Of what number is 33 a multiple?
9. Name 5 divisors of 24.
10. Multiply 23 by 12.
11. Multiply 23 by 10, also by 2. Add the two products. How does this result compare with the answer to question 10?
12. Multiply 30 by 5, then by 20. Add the two products. The sum is how many times 30?
13. 90 times 48, added to 6 times 48, are how many times 48?
14. 7 times 786, 40 times 786, and 3 times 786, added, make how many times 786?

Give the products at sight:

- | | | | | |
|---|--|--|--|---|
| 15. $\begin{array}{r} 86 \\ \underline{7} \end{array}$ | 16. $\begin{array}{r} 307 \\ \underline{5} \end{array}$ | 17. $\begin{array}{r} 315 \\ \underline{10} \end{array}$ | 18. $\begin{array}{r} 73 \\ \underline{100} \end{array}$ | 19. $\begin{array}{r} 32 \\ \underline{20} \end{array}$ |
| 20. $\begin{array}{r} 14 \\ \underline{30} \end{array}$ | 21. $\begin{array}{r} 28 \\ \underline{200} \end{array}$ | 22. $\begin{array}{r} 25 \\ \underline{300} \end{array}$ | 23. $\begin{array}{r} 16 \\ \underline{700} \end{array}$ | 24. $\begin{array}{r} 28 \\ \underline{1000} \end{array}$ |
| 25. $\begin{array}{r} 75 \\ \underline{2000} \end{array}$ | 26. $\begin{array}{r} 103 \\ \underline{40} \end{array}$ | 27. $\begin{array}{r} 212 \\ \underline{50} \end{array}$ | 28. $\begin{array}{r} 31 \\ \underline{400} \end{array}$ | 29. $\begin{array}{r} 205 \\ \underline{600} \end{array}$ |

30. Edward feeds his horse 11 quarts of grain per day and his chickens 3 quarts. He feeds his horse how much more in 30 days than he feeds his chickens in the same time?
31. Find the cost of 50 five-cent postage stamps.
32. 11 and 11 are the factors of what number?
33. Of what number are 3, 7, and 5 the factors?
34. What must be paid for a dozen junior baseballs at 70 cents apiece?

33. *Written*

Multiply 1283 by 967.

$$\begin{array}{r}
 1283 \\
 \underline{967} \\
 8981 \\
 7698 \\
 \underline{11547} \\
 1240661
 \end{array}$$

We multiply 1283 by 7, 60, and 900, and then add the results, which are called partial products. The sum of the partial products is the product required. We omit ciphers at the right of the partial products after the first.

Read each partial product as if the ciphers were expressed.

Multiply \$34.79 by 806.

$$\begin{array}{r}
 \$34.79 \\
 \underline{806} \\
 20874 \\
 27832 \\
 \underline{\hspace{1em}} \\
 \$28040.74
 \end{array}$$

Observe that the right-hand figure of each partial product is written directly under the figure by which we multiply to obtain it. Cents in either factor give cents in the product.

- | | | |
|---------------------|--------------------------|---------------------------|
| 1. 324×24 | 15. 296×28 | 29. $\$280.52 \times 236$ |
| 2. 296×39 | 16. 694×39 | 30. $\$356.04 \times 328$ |
| 3. 387×45 | 17. 206×54 | 31. $\$987.62 \times 475$ |
| 4. 263×56 | 18. $\$28.15 \times 28$ | 32. $\$396.41 \times 641$ |
| 5. 892×63 | 19. $\$34.98 \times 27$ | 33. $\$806.04 \times 879$ |
| 6. 728×75 | 20. $\$19.84 \times 46$ | 34. 238×307 |
| 7. 398×84 | 21. $\$7.85 \times 124$ | 35. 5126×208 |
| 8. 987×98 | 22. $\$28.75 \times 15$ | 36. 934×9000 |
| 9. 516×31 | 23. $\$36.91 \times 45$ | 37. 1027×2005 |
| 10. 798×43 | 24. $\$126.93 \times 87$ | 38. 386×1080 |
| 11. 896×79 | 25. $\$17.85 \times 48$ | 39. 527×2300 |
| 12. 598×36 | 26. $\$19.63 \times 49$ | 40. 4008×7003 |
| 13. 287×49 | 27. $\$75.10 \times 97$ | 41. $\$29.05 \times 108$ |
| 14. 799×99 | 28. $\$16.35 \times 764$ | 42. 4040×8356 |

34.

PROBLEMS

1. *a.* What is the perimeter of a square farm whose side is 309 rods? *b.* What is its area?

2. *a.* If it costs \$4.78 a day to support a certain family, how much does it cost for a month of 31 days? *b.* How much does it cost for a month of 28 days? *c.* How much does it cost for a year?

3. There are 2000 pounds in one ton. How many pounds are there in 496 tons? (Solve it in the shortest way.)

4. There are 24 hours in a day, 60 minutes in an hour, and 60 seconds in a minute. *a.* What is the number of seconds in a day? *b.* In a week?

5. *a.* How many minutes are there in the month of May? *b.* In the month of February? *c.* In the month of September?

6. Alice hemmed 4 dozen handkerchiefs, each 12 inches square. How many inches of hem did she make?

7. A manufacturer put up 13 tons of cereal in sample packages, each containing 1 ounce. How many packages did he make?

8. 25,079 crates of strawberries, each containing 36 quarts, were shipped from the city of Oswego in one season. What were they worth at 8 cents a quart?

9. There are 12 things in a dozen, 12 dozen in a gross, and 12 gross in a great gross. How many pens in a case containing 307 great gross?

10. What is the value of 347 barrels of shredded cocoanut, each containing 105 pounds, at 15 cents a pound?

DIVISION

35. Division is the *process of finding one of two factors when the other factor and the product are given*; e.g. 35 is the product of 5 and 7. When 35 and 5 are given, we divide 35 by 5 to obtain 7; when 35 and 7 are given, we divide 35 by 7 to obtain 5.

36. The *number divided* is the **dividend**; the *number by which we divide* is the **divisor**, and the *result of division* is the **quotient**; e.g. $42 \div 7 = 6$. 42 is the dividend, 7 is the divisor, and 6 is the quotient.

When the divisor is not exactly contained in the dividend, the *part of the dividend that is left* is called the **remainder**; e.g. $59 \div 8 = 7$ quotient and 3 remainder.

37. The *dividend*, *divisor*, and *quotient* are called the **terms of division**.

38. *Oral*

1. 6 oranges at 3 cents apiece cost 18 cents. Which of these numbers is a product? Which are factors? When 18 and 6 are given, how can 3 be found? When 18 and 3 are given, how can 6 be found? When 3 and 6 are given, by what operation can 18 be found?

2. The area of a page of Henry's book is 35 square inches. If the length is 7 inches, what must be the width? If the width is 5 inches, what must be the length? 35 is which term in division? 35 is what of 5 and 7?

3. There are 9 square feet in 1 square yard. How many square yards are there in 108 square feet? 108 is the product of 9 and what other number? 108 is which term in division? 108 is what of 9 and 12?

4. Fred paid 54 cents for some sugar. The number of cents that a pound cost is one factor of 54. What is the other factor? What, besides 54 cents, must be given in order that we may find the cost of one pound? What, besides 54 cents, must be given in order that we may find the number of pounds that Fred bought?

5. What is

a. The number of feet in 132 inches?

b. The number of pecks in 72 quarts?

c. The cost of a month's rent at \$120 a year?

d. The number of weeks in 77 days?

e. The price of a lawn mower, when 15 lawn mowers cost \$150?

6. The first number in each line below is a factor of every other number in the line. Find the factor not given of each number:

a. 5: 15; 75; 355; 525; 405

b. 7: 84; 217; 280; 763; 497

c. 11: 110; 44; 121; 880; 2211

d. 9: 819; 945; 189; 360; 963

e. 8: 64; 328; 176; 728; 960

7. In the following statements tell which numbers are factors and which are products:

a. There are — peaches in 7 baskets if each basket contains 12 peaches.

b. 12 quarts of berries cost 96 cents.

c. Jerome's wages for 9 weeks at \$—— a week amounted to 27 dollars.

d. 6 fountain pens at \$3 apiece cost \$——.

e. \$1 will pay 20 car fares at —— apiece.

f. 72 cents will buy 12 pounds of sugar at —— cents a pound.

39. *Written*

1. Divide 990625 by 317.

$$\begin{array}{r}
 3175 \\
 317 \overline{)990625} \\
 \underline{951} \\
 396 \\
 \underline{317} \\
 792 \\
 \underline{634} \\
 1585 \\
 \underline{1585}
 \end{array}$$

317 is not contained in 9 or 99, but it is contained in 990 three times. This is 3 thousand because 990 is thousands. The remainder is 39 thousand. Put 600 with it, and 317 is contained in 396 hundred 1 hundred times, with a remainder of 79 hundred. The remaining figures of the quotient are obtained in a similar manner. When the second figure (from the left) of the divisor is 1, 2, or 3, it is well to use the first figure for a "guide figure" in obtaining each quotient figure. Thus, in this example, we say, 3 in 9 = ? 3 in 3 = ? 3 in 7 = ? 3 in 15 = ?

NOTE.— Be careful to write the first figure in the quotient directly above the right-hand figure of the part of the dividend used in obtaining the first quotient figure.

2. Divide 10192 by 49.

$$\begin{array}{r}
 208 \\
 49 \overline{)10192} \\
 \underline{98} \\
 392 \\
 \underline{392}
 \end{array}$$

In finding the second quotient figure, we see that 49 is not contained in 39; so we place 0 in tens' place in the quotient and bring down 2 units. 49 is almost 50. We may therefore take 5 for a guide figure.

3. Divide 8531 by 672.

$$\begin{array}{r}
 12\frac{467}{672} \text{ Quotient} \\
 672 \overline{)8531} \\
 \underline{672} \\
 1811 \\
 \underline{1344} \\
 467 \text{ Remainder}
 \end{array}$$

In this example the dividend does not contain the divisor an exact number of times, hence there is a remainder. The remainder may be written over the divisor as a part of the quotient; thus, $12\frac{467}{672}$ quotient.

NOTE.— In dividing by any number not larger than 12, short division should be used. That is, no work should be written except the dividend, divisor, and quotient. In such examples the quotient may be written either above or below the dividend according to convenience. If the dividend contains cents, and the divisor is a whole number, the quotient also contains cents.

Solve examples 4-68, and test your work by multiplying the quotient by the divisor and adding the remainder, if there is one, to obtain the dividend:

- | | | | | | |
|-----|-------------------|-----|-------------------|-----|--------------------------|
| 4. | $4503 \div 3$ | 26. | $28,692 \div 9$ | 48. | $130,052 \div 2$ |
| 5. | $2045 \div 5$ | 27. | $333,333 \div 11$ | 49. | $168,754 \div 9$ |
| 6. | $2835 \div 7$ | 28. | $35,621 \div 7$ | 50. | $385,980 \div 5$ |
| 7. | $4986 \div 9$ | 29. | $42,963 \div 6$ | 51. | $769,520 \div 7$ |
| 8. | $2009 \div 7$ | 30. | $50,725 \div 3$ | 52. | $387,052 \div 10$ |
| 9. | $3504 \div 8$ | 31. | $82,956 \div 10$ | 53. | $943,769 \div 12$ |
| 10. | $\frac{61938}{9}$ | 32. | $93,043 \div 7$ | 54. | $748,136 \div 4$ |
| 11. | $\frac{28343}{7}$ | 33. | $65,407 \div 5$ | 55. | $7,688 \div 31$ |
| 12. | $\frac{59840}{4}$ | 34. | $39,842 \div 9$ | 56. | $12,978 \div 42$ |
| 13. | $\frac{12358}{2}$ | 35. | $27,392 \div 8$ | 57. | $31,509 \div 81$ |
| 14. | $\frac{58345}{5}$ | 36. | $63,594 \div 9$ | 58. | $40,948 \div 58$ |
| 15. | $\frac{11007}{9}$ | 37. | $31,493 \div 6$ | 59. | $68,476 \div 68$ |
| 16. | $\frac{13696}{4}$ | 38. | $25,324 \div 5$ | 60. | $168,665 \div 427$ |
| 17. | $\frac{29365}{7}$ | 39. | $28,764 \div 4$ | 61. | $190,855 \div 931$ |
| 18. | $\frac{98346}{6}$ | 40. | $36,099 \div 9$ | 62. | $293,004 \div 801$ |
| 19. | $30,005 \div 5$ | 41. | $14,412 \div 12$ | 63. | $129,324 \div 756$ |
| 20. | $288,012 \div 12$ | 42. | $36,930 \div 11$ | 64. | $3,247,654 \div 79$ |
| 21. | $300,010 \div 10$ | 43. | $24,003 \div 6$ | 65. | $294,490 = 98 \times ?$ |
| 22. | $99,011 \div 11$ | 44. | $30,502 \div 8$ | 66. | $503 \times ? = 637,804$ |
| 23. | $33,264 \div 11$ | 45. | $29,333 \div 11$ | 67. | 58,487 has what |
| 24. | $29,280 \div 12$ | 46. | $675,262 \div 5$ | | factor besides 143? |
| 25. | $36,550 \div 10$ | 47. | $349,872 \div 8$ | 68. | $? \times 215 = 66,220$ |

REVIEW AND PRACTICE

40. *Oral*

1. A farmer exchanged 12 barrels of apples at \$3 a barrel for coal at \$4 a ton. How many tons of coal did he receive?

2. In what time will a boy earn as much at \$3 a week, as a man earns in 6 weeks at \$8 a week?

3. Nell is 3 years old and Will 5. Their sister's age is twice the sum of their ages. What is the sister's age?

4. How many gallons of milk will a family use in the month of June if they use 2 quarts a day?

5. Frank rides 6 miles an hour and Albert 9. *a.* How far apart will they be in 6 hours if they start at the same time and place and ride in the same direction? *b.* If they ride in opposite directions?

6. Grace bought 2 dozen lemons. She used $\frac{3}{8}$ of them for lemonade and gave away 6. How many remained?

7. Helen bought $\frac{7}{8}$ of a yard of cambric. She used half a yard in her dress and wasted $\frac{1}{8}$ of a yard in cutting. How much was left?

8. A man owed \$96. He made 5 payments of \$12 each. How much did he then owe?

9. Luther has \$6 and Leon 3 times as much. How much have both?

10. \$18 plus \$12 is how much less than 4 times \$12?

11. The product is 125 and one of the factors is 5. What is the other factor?

12. The divisor is 11, the quotient 12, and the remainder 9. What is the dividend?

13. The dividend is 85, the quotient 9, and the remainder 4. What is the divisor?

14. How many days will a 12-gallon keg of water last 24 shipwrecked men if each man drinks a pint a day?

15. If Frances can knit 21 stitches a minute, how many stitches can she knit in half an hour?

16. The product of 20 and 16 is how much less than 20 times 20?

41. *Written*

1. How many tons of coal at \$5 a ton will pay for 15 tons of hay at \$11 a ton?

2. A man started on a journey of 724 miles. After he had traveled 12 hours at the rate of 32 miles an hour, how far was he from his journey's end?

3. A farmer bought six sacks of flour at \$1.25 a sack, 25 pounds of sugar at 6 cents a pound, and two pounds of coffee at 30 cents a pound. He paid for it in butter at 24 cents a pound. How many pounds of butter were there?

4. A man having \$738.58 in a bank drew out \$132.75 at one time, \$175.50 at another, and \$216 at another. How much money then remained in the bank?

5. If the divisor is 38, the quotient 209, and the remainder 23, what is the dividend?

6. The product of three numbers is 1260 and two of them are 12 and 7. What is the third?

7. A grocer buys 88 gallons of molasses at \$.56 a gallon. For what price per gallon must he sell it in order to gain \$12.32?

8. The dividend is 1821, the quotient 32, and the remainder 29. What is the divisor?

9. Two trains start at the same time from points 1216 miles apart and travel toward each other, one at the rate of 35 miles

an hour, the other at the rate of 41 miles an hour. In how many hours will they meet?

10. A lady bought 12 yards of dress goods at \$1.75 a yard, 8 yards of silesia at \$.25 a yard, 2 pairs of gloves at \$1.45 a pair, 6 handkerchiefs at \$.25 apiece, and 3 yards of table linen at \$.95 a yard. She paid \$18.75. What did she still owe?

11. How many pounds of cheese at 14 cents a pound will pay for 3 barrels of flour at \$4.20 a barrel?

12. At what rate per hour must a train run to go as far in 9 hours as another train running 27 miles an hour can go in 12 hours?

13. A farmer paid \$1125 for cows, horses, and farming tools, and 8 times as much for a farm of 125 acres. What was the price per acre?

14. A farmer had 46 acres of alfalfa. He cut three crops a year. The first crop yielded $1\frac{3}{4}$ tons per acre, the second $1\frac{1}{4}$ tons, and the third 1 ton.

a. How much was it worth at \$8 a ton?

b. How many pounds of alfalfa did he obtain?

15. At a certain post office there were sold in one year 12,400 twenty-five-cent stamp books; 4600 forty-nine-cent stamp books; 2250 ninety-seven-cent stamp books. How much was received for all of them?

16. A merchant owed a debt amounting to \$9892. He made four payments of \$1980 each. How much did he then owe?

17. A river is 2174 miles long. A steamboat started at the mouth of the river and traveled up stream for 6 days at the rate of 149 miles a day. The boat was then how far from the source of the river? (Illustrate.)

18. *a.* A rural free-delivery mail carrier on a certain route is on duty 298 days in a year and rides 24 miles each day. How far does he ride in a year?

b. He starts at 8.15 A.M. and returns home at 3.15 P.M. every day. How many hours does he spend on the road in a year?

The number of pieces of mail delivered and collected by him in one month was as follows:

	DELIVERED	COLLECTED
Registered Letters	5	3
Common Letters	1764	877
Postal Cards	436	297
Newspapers	4368	27
Circulars	507	0
Packages	105	26

c. The total number of pieces delivered was how much greater than the number collected?



d. If there were 189 families on this route, what was the average number of pieces delivered to each family?

e. If this carrier's salary is \$900 a year, and it costs him \$13 a month to keep his horse, how much of

the salary is left to pay him for his year's work?

f. The Post-office Department of the United States pays the carrier's salary. He sells stamps to the amount of \$31.50 per

month, and sends the money to the Post-office Department. The amount received from this mail route is how much less per month than the cost of delivering the mail?

19. *a.* In the year 1905 the Syracuse post-office received \$411,630.95 for stamps, registering letters, writing money orders, and other postal business. The expense of carrying on the post-office was $\frac{2}{5}$ of this amount. What was the expense of carrying on the post-office?

b. How much did the Post-office Department gain on account of this post-office?

c. In this office 722 sacks and pouches of mail were handled in one day, each sack and pouch containing an average of 154 pieces of mail. How many pieces of mail were handled?

d. At the same rate, how many pieces were handled in a year?

20. *a.* Willis has 15 hens. They laid at the rate of 120 eggs apiece in one year. How many eggs were laid by all of them?

b. The food for the hens cost \$21. Willis sold the eggs at an average price of 22 cents a dozen. How much more did he receive for the eggs than he paid for the food for the hens?

c. What was the profit from one hen?

d. What would be the profit from 75 hens at the same rate?

e. Willis has a rectangular hen park 30 ft. long and 15 ft. wide. How many feet of wire netting will inclose it?

21. From one hundred twenty-two thousand take eighty-seven thousand ninety-four.



INDICATED WORK

42. In problems requiring several operations, or steps, it is well first to indicate the operations by means of signs; *e.g.* $5208 \div 3 \times 8$ means that we are to divide 5208 by 3 and multiply the quotient by 8.

The parenthesis () is sometimes used to inclose certain numbers or expressions which are to be taken together as one thing; *e.g.* $18 \times (15 + 10)$ means that 18 is to be multiplied by the sum of 15 and 10.

Operations indicated within a parenthesis should always be performed first; *e.g.* $5208 \div (3 \times 8)$ means that we are to multiply 3 by 8 and divide 5208 by the product.

When the parenthesis is not used, indicated multiplication and division should be performed before indicated addition and subtraction; *e.g.* $125 + 3 \times 18 - 46 \div 23$ means that we must multiply 3 by 18, then divide 46 by 23, then add and subtract results as indicated; thus, $125 + 3 \times 18 - 46 \div 23 = 125 + 54 - 2 = 177$.

43. *Perform the operations indicated:*

1. $5208 \div 3 \times 8$
2. $5208 \div (3 \times 8)$
3. $203 \times 607015 - 596034$
4. $203 \times (607015 - 596034)$
5. $487 + 598 + 645 - (2030 - 1435)$
6. $9346 - (6342 + 347 + 89) + 2349$
7. $9346 - 6342 + 347 + 89 + 2349$
8. $41983 - 87 \times 103 + 47$
9. $(41983 - 87) \times (103 + 47)$
10. $2310 \div 10 \times 7 + 604 \times 35$
11. $2310 \div (10 \times 7) + 604 \times 35$

12. $3056 + 9821 \div 7 \times 48 - 29$

13. $3056 + (9821 \div 7) \times (48 - 29)$

14. $(\$1.25 \times 6 + 25 \times \$.06 + 2 \times \$.30) \div 24$. See example 3, page 26.

15. $\$738.58 - (\$132.75 + \$175.50 + \$216)$. See example 4, page 26.

16. $1216 \div (35 + 41)$. See example 9, page 26.

44. *Indicate and find results:*

1. \$.75 less the sum of \$.32 and \$.18.

2. \$500 less \$275, and the result added to \$132.

3. \$18 more than the difference between \$27 and \$425.

4. The product of 1125 and 8, divided by 125.

5. The sum of 18 yards and 41 yards taken away from 4 times 69 yards.

6. The sum of 498 and 747 divided by the difference between 2342 and 2425.

7. George earns 55 cents a day and Harry 79 cents. How much do they both earn in the month of October, allowing for 4 Sundays?

8. The product of 162 and 39 divided by the difference of 87 and 61.

9. Frank's earnings for the 6 days of the week were \$.43, \$.59, \$.62, \$.79, \$.38, \$.48. How much more must he earn before he can buy a \$5 set of books?

10. The quotient of $12,848 \div 16$ is how much less than the number of hours in 1 year?

11. A lady bought 10 yd. of silk at \$1.10 a yard and 2 yd. of silesia at 25¢ a yard. How much change should she receive from a 20-dollar bill?

SPECIAL CASES IN MULTIPLICATION AND DIVISION

PRINCIPLES

45. 1. *Each removal of a figure one place to the left increases its value tenfold; e.g. $5 = 5$; $50 = 5 \times 10$; $500 = 50 \times 10$.*

2. *Each removal of a figure one place to the right diminishes its value tenfold; e.g. $500 \div 10 = 50$; $50 \div 10 = 5$.*

46. *Oral*

1. What is the shortest way to multiply by 10? By 100? By 1000? By 10000? By 1 with any number of ciphers annexed?

2. $8 \times 10 = ?$ $8 \times 100 = ?$ $8 \times 1000 = ?$ $8 \times 10000 = ?$

3. Cutting off a cipher from the right of a number is the same as moving all the figures one place to the right. How does it affect the value of the number?

4. How many ciphers must be cut from the right of a number to divide the number exactly by 100? By 1000? By 10000?

5. Divide each of these numbers by 10:

50; 600; 5290; 36000; 4500; 321560.

6. Divide each of these numbers by 100:

300; 4500; 6000; 78000; 70000; 831000.

7. Divide 9600000 by 10000.

8. Multiply each of these numbers by 10, 100, and 1000:

7; 61; 20; 310; 402; 910; 653; 1020.

47. *Written*

1. Multiply 287 by 3700.

$$\begin{array}{r}
 287 \\
 \times 3700 \\
 \hline
 2009 \\
 861 \\
 \hline
 1061900 \text{ Product}
 \end{array}$$

2. Divide 435600 by 1800.

$$\begin{array}{r} 242 \text{ Quotient} \\ 1800 \overline{)435600} \\ \underline{36} \\ 75 \\ \underline{72} \\ 36 \\ \underline{36} \\ 0 \end{array}$$

$$1800 = 18 \times 100.$$

Therefore we divide by 100 and then by 18.

How do we divide by 100?

3. Divide 83,645 by 13,000.

$$\begin{array}{r} 6 \frac{5648}{13000} \text{ Quotient} \\ 13000 \overline{)83648} \\ \underline{78} \\ 5 \end{array}$$

When we divide by 1000, there is a remainder of 648. When we divide by 13, there is a remainder of 5 in thousands' place. $5000 + 648 = 5648$, whole remainder.

Multiply and test by dividing the product by the multiplier:

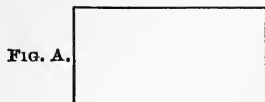
- | | |
|------------------|-----------------------|
| 4. 432 by 20,100 | 9. 208 by 6500 |
| 5. 69 by 38,000 | 10. 320 by 420 |
| 6. 420 by 80,000 | 11. 86 by 12,000 |
| 7. 1242 by 3020 | 12. 409 by 30,800 |
| 8. 5003 by 960 | 13. 6900 \times 413 |

Divide and test results:

- | | |
|-----------------------|-------------------------|
| 14. 257,830 by 590 | 22. 8,205,900 by 4200 |
| 15. 4410 by 70 | 23. 367,298 by 1600 |
| 16. 34,376 by 100 | 24. 368,700 by 3600 |
| 17. 1,333,800 by 1900 | 25. 496,789 by 420 |
| 18. 1,308,580 by 260 | 26. 805,060 by 3090 |
| 19. 572,400 by 3600 | 27. 367,059 by 7800 |
| 20. 42,978 by 300 | 28. 8,079,600 by 71,000 |
| 21. 642,359 by 470 | 29. 4,380,700 by 3210 |

48. *Oral*

IDEAS OF PROPORTION



1. Figure B is how many times as large as figure A?
2. If figure A is 1 inch long, how long is figure B?
3. If A and B are pieces of cloth, and A is worth \$5, what is B worth?
4. If A is a piece of land containing 10 acres, what is B?
5. If A is a piece of land worth \$12, what is B worth?
6. If B is worth \$60, what is A worth?
7. If A and B are blocks of wood and A weighs 9 pounds, what does B weigh?
8. If B weighs 39 ounces, what does A weigh?
9. If A and B are fields, and A can be plowed in 4 days, how long will it take to plow B?



10. *a.* 10 pears are how many times 2 pears?
- b.* 2 pears are what part of 10 pears?
- c.* If 2 pears cost 3 cents, 10 pears cost — cents.
- d.* Two pears are worth — cents, when 10 pears are worth 25 cents.



11. *a.* One dollar is how many times one dime ?
b. One dime is what part of one dollar ?
c. If one dollar will buy 30 pencils, one dime will buy — pencils.
d. If one dollar will pay for 70 apples, one dime will pay for — apples.
e. Frank can earn one dollar in — hours if he can earn one dime in two hours.
f. If one silver dollar weighs one ounce, one silver dime weighs — ounce.

12. If John rides 9 miles in 2 hours, in what time can he ride 27 miles at the same rate ?

Analysis: 27 miles are 3 times 9 miles. Therefore, if John rides 9 miles in two hours, he can ride 27 miles in 3 times two hours, or — hours.

Solve and analyze each of the following problems :

13. If a man's wages for 12 hours are 5 dollars, in how many hours will he earn \$20 ?
14. If 20 men can do a piece of work in 5 days, how long will it take 10 men to do the same ?
15. When 75¢ will buy 6 pineapples, how much should be paid for 2 pineapples ?

FACTORS AND MULTIPLES

49. *One of the numbers that are multiplied to produce a number is a factor of that number ; e.g. 2, 3, and 5 are factors of 30 because $2 \times 3 \times 5 = 30$.*

50. *A number that exactly contains another number is a multiple of that number ; e.g. 21 is a multiple of 7. It is also a multiple of 3.*

51. *A number that is composed entirely of whole units is an integer ; e.g. 7, 13, 200. Can you name a number that is not an integer ?*

52. *A factor that is an integer is called an integral factor ; e.g. 8 is an integral factor of 56.*

53. *A number that is not the product of integral factors other than itself and 1 is a prime number ; e.g. 2, 3, 5, 7, 11, and 13.*

54. *A number that is the product of integral factors other than itself and 1 is a composite number ; e.g. 16, 24, 35, 1000.*

55. *A factor that is a prime number is a prime factor ; e.g. 13 is a prime factor of 26.*

A number that is exactly divisible by 2 is an even number ; e.g. 2, 4, 6, 8, 10.

A number that is not exactly divisible by 2 is an odd number ; e.g. 1, 3, 5, 7, 11.

NOTE.— In finding the factors of a number it is customary to consider only integral factors.

56. *Oral*

1. Give the factors of 21 ; 35 ; 49 ; 77 ; 26 ; 39 ; 34 ; 15 ; 91.
2. Name three factors of 30.
3. Name as many factors of 24 as you can.

4. Of what numbers are 7, 2, and 13 the prime factors?
5. Name four multiples of 9.
6. 132 is the product of 12 and what other factor?
7. Name all the prime numbers smaller than 50.
8. 84 is the product of three factors. Two of them are 2 and 6. What is the other?
9. Of what number are 2, 3, 5, and 7 the prime factors?
10. Give the prime factors of 15; 25; 21; 33; 77; 30; 42; 51.
11. 5, 2, and what other number are the prime factors of 70?
12. Give two factors of 30 that are not prime.
13. What even number is prime?

57. Rule for finding whether a Number is Prime or Composite.

1. *If the given number is odd, divide it by 3.*
2. *If 3 gives a remainder, divide the given number by 5.*
3. *Continue this process, using each prime number in order as a divisor, until an exact divisor is found, or until the divisor equals or exceeds the quotient. If no exact divisor is found until the divisor used equals or exceeds the quotient, the number is prime. Otherwise it is composite.*

e.g. To find whether 71 is prime or composite,

$$\begin{array}{r} 3 \overline{)71} \\ 23 \text{—} 2 \text{ rem.} \end{array} \quad \begin{array}{r} 5 \overline{)71} \\ 14 \text{—} 1 \text{ rem.} \end{array} \quad \begin{array}{r} 7 \overline{)71} \\ 10 \text{—} 1 \text{ rem.} \end{array} \quad \begin{array}{r} 11 \overline{)71} \\ 6 \text{—} 5 \text{ rem.} \end{array}$$

Since the divisor 11, is greater than the quotient 6, and no exact divisor has been found, 71 must be prime.

Even numbers need not be tested; for no even number, except 2, is prime. Why?

58. In finding the factors of a number, it is useful to remember that

a. A number is divisible by 2 if the figure in units' place is even.

b. A number is divisible by 5 if the figure in units' place is 0 or 5.

59. Find whether each of these numbers is prime or composite :

- | | | | | |
|--------|--------|---------|---------|---------|
| 1. 143 | 5. 211 | 9. 121 | 13. 231 | 17. 437 |
| 2. 123 | 6. 221 | 10. 97 | 14. 161 | 18. 401 |
| 3. 324 | 7. 119 | 11. 213 | 15. 87 | 19. 593 |
| 4. 163 | 8. 208 | 12. 215 | 16. 78 | 20. 395 |

60. *Written*

1. Find the prime factors of 7020.

2	7020
2	3510
3	1755
3	585
3	195
5	65
	13

By what kind of numbers do we divide? Why?

Which divisors do we use first?

What besides the divisors is a prime factor?

- 2 · 2 · 3 · 3 · 3 · 5 · 13 Prime factors, *Ans.*

Find the prime factors of:

- | | | | |
|--------|---------|----------|----------|
| 2. 120 | 8. 45 | 14. 3381 | 20. 169 |
| 3. 42 | 9. 189 | 15. 667 | 21. 561 |
| 4. 66 | 10. 665 | 16. 310 | 22. 1001 |
| 5. 110 | 11. 429 | 17. 399 | 23. 1265 |
| 6. 105 | 12. 425 | 18. 1287 | 24. 682 |
| 7. 462 | 13. 414 | 19. 253 | 25. 729 |

CANCELLATION

61. Dividing both dividend and divisor by the same number affects the quotient how ?

$$\frac{462}{66} = \frac{\cancel{2} \times \cancel{3} \times 7 \times \cancel{11}}{\cancel{2} \times \cancel{3} \times \cancel{11}} = 7 \text{ Quotient}$$

We might express this work as follows: dividing both dividend and divisor by 2, then by 3, then by 11:

$$\begin{array}{r} 7 \\ \cancel{77} \\ \cancel{231} \\ \hline \cancel{462} \\ \cancel{66} \\ \cancel{33} \\ \cancel{11} \\ 1 \end{array} = 7 \text{ Quotient}$$

Taking out the same factor from both dividend and divisor is cancellation.

62. *Solve by cancellation:*

1. Divide $36 \times 27 \times 49 \times 38 \times 50$ by $70 \times 18 \times 15$.
2. $(28 \times 38 \times 48) \div (14 \times 19 \times 24 \times 2 \times 2) = ?$
3. $(26 \times 5 \times 54) \div (13 \times 5 \times 6) = ?$
4. What is the quotient of $36 \times 48 \times 16$ divided by $27 \times 24 \times 8$?
5. Divide $5 \times 45 \times 7 \times 20$ by $49 \times 5 \times 4 \times 9$.
6. Divide $5 \times 51 \times 7 \times 9 \times 4$ by $17 \times 20 \times 12 \times 7 \times 2$.
7. Divide $25 \times 2 \times 72 \times 14$ by $6 \times 9 \times 120$.
8. How many bushels of potatoes at 50 cents a bushel must be given in exchange for 15 pounds of tea at 40 cents a pound?

63. *Oral*

REVIEW AND PRACTICE

1. Name the letters used in Roman notation and give the value of each.

In finding the sums and differences below, add or subtract the tens' figures first, thus:

$$36 + 46 = ?$$

$$36 + 40 = 76$$

$$76 + 6 = 82 \text{ Ans.}$$

Say 36, 76, 82.

$$93 - 27 = ?$$

$$93 - 20 = 73$$

$$73 - 7 = 66 \text{ Ans.}$$

Say 93, 73, 66.

2. *Find the sums:*

$$36 + 47$$

$$89 + 27$$

$$82 + 69$$

$$78 + 36$$

$$81 + 29$$

$$62 + 38$$

$$38 + 78$$

$$29 + 92$$

$$76 + 39$$

$$48 + 24$$

$$29 + 33$$

$$26 + 35$$

$$48 + 53$$

$$36 + 17$$

$$42 + 71$$

$$42 + 99$$

3. *Find the differences:*

$$28 - 19$$

$$41 - 14$$

$$31 - 14$$

$$45 - 36$$

$$31 - 13$$

$$62 - 28$$

$$75 - 37$$

$$109 - 87$$

$$43 - 16$$

$$97 - 58$$

$$62 - 19$$

$$203 - 174$$

$$81 - 45$$

$$76 - 59$$

$$58 - 29$$

$$311 - 82$$

4. *Give products at sight:*

$$403 \times 10$$

$$86 \times 200$$

$$19 \times 40$$

$$86 \times 100$$

$$15 \times 40$$

$$16 \times 500$$

$$22 \times 10,000$$

$$18 \times 300$$

$$200 \times 190$$

$$14 \times 20$$

$$12 \times 6000$$

$$403 \times 8$$

5. *Find results:*

$$27,000 + 13,000$$

$$345,000 \div 100$$

$$8324 \div 100$$

$$218 - 38$$

$$6250 \div 10$$

$$2800 \div 400$$

$$550 \times 100$$

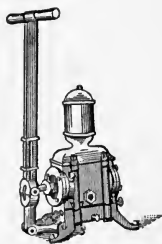
$$435 \div 10$$

$$1635 \div 200$$

6. Henry can row a boat 20 rods in a minute, and Eva can row 15 rods in a minute. If Eva is 60 rods ahead of Henry, in how many minutes can he overtake her?

7. a. How many strokes of a force pump are required to fill $\frac{1}{8}$ of a tank that holds 200 gallons of water, if a pint is pumped at each stroke?

b. How long would it take at 20 strokes per minute?



A Force Pump

64. *Written*

1. *Find sums and test your work.* Can you do it in four minutes? Do not copy addends.

a. 49	b. 235	c. 8749	d. \$346.25
392	419	3254	29.48
48	786	286	934.29
6759	592	39	98.65
24	839	458	813.78
864	496	3476	92.48
9837	318	239	9.62
481	745	8375	46.78
28	932	468	932.86
<u>938</u>	<u>467</u>	<u>9628</u>	<u>48.93</u>

2. *Subtract and test:*

a. 4352	b. 38290	c. 4001	d. 603040
<u>1987</u>	<u>8199</u>	<u>102</u>	<u>13048</u>

3. *Divide and test:*

a. 153825 by 25. b. 49386 by 78. c. 12634 by 500.
 d. 983,700 by 1500. e. 863,426 by 19,000. f. 163,801 by 690.

4. 2, 3, 5, 7, 11, 13, and 17 are the prime factors of what number?

5. What prime factor beside 19 and 11 has 8987?

6. *Indicate the work and solve:*

a. Divide by 37 the result obtained by adding 111 to the product of 148 and 6090.

b. A merchant bought 345 pounds of wool of one man, 3067 pounds of another, 468 pounds of another, and 384 pounds of another; and sold $\frac{1}{2}$ of it at 27 cents a pound. What did he receive for the part sold?

7. Make and solve a problem that might be indicated thus: $\$10.00 - (\$.35 + \$2.20 + \$6.19 + \$.18)$.

8. Solve by cancellation,

$$(48 \times 36 \times 55 \times 26) \div (12 \times 22 \times 13).$$

LEAST COMMON MULTIPLE

65. *Oral*

1. $3 \times 4 = ?$ 12 is what of 3? Of 4?

2. $2 \times 6 = ?$ 12 is what of 2? Of 6?

3. Name all the numbers of which 12 is a multiple.

4. Define multiple.

66. *A number that exactly contains two or more numbers is a common multiple of those numbers; e.g. 12 is a common multiple of 2, 3, 4, and 6. 36 is also a common multiple of 2, 3, 4, and 6.*

Can you name any other common multiple of 2, 3, 4, and 6?

67. *The smallest number that exactly contains two or more numbers is their least common multiple (L. C. M.); e.g. 18 is the least common multiple of 3, 6, and 9. 36 is a common multiple of 3, 6, and 9. Why is it not the least common multiple?*

68. *Oral*

Find the L. C. M. of:

- | | |
|-------------------|---------------------|
| 1. 2 and 3 | 10. 5, 4, and 2 |
| 2. 2, 3, and 4 | 11. 7, 4, and 2 |
| 3. 4 and 6 | 12. 10, 5, and 4 |
| 4. 9 and 6 | 13. 2, 4, 8, and 12 |
| 5. 10 and 6 | 14. 4, 5, and 12 |
| 6. 8 and 6 | 15. 7 and 8 |
| 7. 5, 3, and 2 | 16. 16 and 32 |
| 8. 1, 2, 6, and 4 | 17. 2, 3, 6, and 5 |
| 9. 2, 3, and 9 | 18. 4, 9, 3, and 12 |

69. When the least common multiple is a large number, the following direct method is employed in finding it.

Let it be required to find the L. C. M. of 12, 15, and 18.

$$12 = 2 \times 2 \times 3$$

$$15 = 3 \times 5$$

$$18 = 2 \times 3 \times 3$$

What kind of factors have we found? A number, in order to contain 12, must have what prime factors? What prime factors must it have in order to contain 15? 18?

A number that contains 12, 15, and 18 must have how many factors 2? How many factors 3? How many factors 5?

What is the smallest number that has the factors 2, 2, 3, 3, and 5? What, then, is the L. C. M. of 12, 15, and 18?

The prime factors may be easily found in this way:

2		12	15	18
3		6	15	9
		2	5	3

By what kind of numbers do we divide?

$$2 \times 3 \times 2 \times 5 \times 3 = 180 \text{ L. C. M.}$$

70. Find the L. C. M.:

- | | | |
|-------------------|---------------------|-----------------------|
| 1. 18, 27, 30 | 8. 15, 60, 140, 210 | 15. 10, 15, 6, 14 |
| 2. 9, 12, 18 | 9. 24, 42, 54, 360 | 16. 48, 20, 21 |
| 3. 16, 48, 60 | 10. 25, 20, 35, 40 | 17. 9, 36, 45, 63, 42 |
| 4. 21, 27, 36 | 11. 14, 21, 35, 45 | 18. 25, 15, 30, 50 |
| 5. 36, 40, 48 | 12. 24, 48, 96, 192 | 19. 13, 19 |
| 6. 18, 24, 36 | 13. 15, 18, 20, 60 | 20. 2, 3, 4, 5, 6 |
| 7. 15, 30, 21, 28 | 14. 16, 24, 40 | 21. 7, 8, 9, 10 |

GREATEST COMMON DIVISOR

71. A number that will exactly divide two or more numbers is a **common divisor** of those numbers; e.g. 5 is a common divisor of 30, 40, and 60.

72. The largest number that will exactly divide two or more numbers is their **greatest common divisor** (G. C. D.); e.g. 10 is the greatest common divisor of 30, 40, and 60.

NOTE.—A common divisor is sometimes called a *common factor*, and the greatest common divisor is sometimes called the *highest common factor*.

73. Numbers that have no common divisor are **prime to each other**; e.g. 13 and 15.

74. Oral

1. Find the G. C. D. of:

- | | | |
|---------------|---------------|-------------------|
| a. 6, 9, 12 | e. 8, 24, 40 | i. 30, 45, 60 |
| b. 10, 30, 35 | f. 14, 28, 42 | j. 18, 27, 36 |
| c. 2, 10, 16 | g. 33, 22, 77 | k. 12, 24, 36, 48 |
| d. 12, 30, 18 | h. 21, 27, 39 | l. 24, 32, 48 |

2. Name two numbers of which 7 is a common divisor.

3. Name three numbers of which 9 is a common divisor.

4. Name two numbers which are prime to each other.

5. What is the greatest number that will exactly divide 12, 30, and 36?

6. Name two numbers of which 11 is the G. C. D.

7. Tell which of these pairs of numbers are prime to each other:

a. 12 and 7 b. 16 and 20 c. 19 and 21 d. 8 and 15

75. *Written*

1. Find the greatest common divisor of 336, 504, and 924.

$$\begin{array}{r} 336 = 2 \times 2 \times 2 \times 2 \times 3 \times 7 \\ 504 = 2 \times 2 \times 2 \times 3 \times 3 \times 7 \\ 924 = 2 \times 2 \times 3 \times 7 \times 11 \end{array}$$

$$2 \times 2 \times 3 \times 7 = 84 \text{ G. C. D.}$$

Factoring the numbers and selecting the common prime factors, we find them to be 2, 2, 3, and 7. Since all of them are factors of each of the given numbers, their product, 84, is the greatest common divisor required.

The common prime factors may easily be found in this way:

2	336	504	924
2	168	252	462
3	84	126	231
7	28	42	77
	4	6	11

$2 \cdot 2 \cdot 3 \cdot 7$ Common prime factors.

Find the G. C. D.:

2. 63, 42

8. 36, 48, 24

14. 63, 126, 189

3. 90, 105

9. 40, 56, 72

15. 36, 81, 135

4. 112, 168

10. 18, 54, 32

16. 91, 143, 156

5. 132, 156

11. 45, 60, 90

17. 192, 400, 240

6. 40, 60, 80

12. 36, 72, 81

18. 168, 210, 308, 350

7. 64, 144, 560

13. 44, 121, 33

19. 1980, 945

20. Find the greatest number that will exactly divide 189, 378, and 504.

21. Find all the common prime factors of 360, 540, and 450.

22. Find the product of all the common prime factors of 108, 144 and 360.

23. Find a number that is prime to 210.

24. Name three numbers of which 11 is the greatest common divisor.

REVIEW OF INTEGERS

76. Oral

1. $(15 - 4) \times (3 + 2) = ?$

2. $15 - 4 \times 3 + 2 = ?$

3. Numerate 137,640,507,239.

4. Name the periods in the above number.

5. Read DCXLIV.

6. What is the value of $\frac{236}{4}$?

7. $35 + 48 = ?$ ($35 + 40 = 75$; $75 + 8 = 83$. Say 35, 75, 83.)

In the same way add :

a. 63 and 29; b. 58 and 15; c. 49 and 33; d. 67 and 24.

8. The product of two factors is 45. If one factor is 9, what is the other? If one factor is 15, what is the other? If one factor is 6, what is the other?

Which of the factors given in your answer is not an integral factor?

9. The product of three factors is 108. Two of them are 4 and 3. What is the other?

10. Find the difference by subtracting the tens first:

a. $64 - 25$; *b.* $81 - 32$; *c.* $\$.76 - \$.28$; *d.* $\$.127 - \$.79$.

11. $24 \times 20 = ?$ $30,700 \div 100 = ?$ $1200 \div 200 = ?$

12. $235 \times 1000 = ?$ $208 \times 10 = ?$ $4000 \div 400 = ?$

13. $1,500,000 \div 1500 = ?$

14. Edward earned $\$3$ one week and $\$6$ the next. How much was left after he had spent $\frac{2}{3}$ of it?

15. The change for $\$.24$ from $\$1.00$ is $\$.06 + \$.70 = \$.76$. Say 6, 76.

Find the change from $\$1.00$ for:

a. $\$.28$ *c.* $\$.18$ *e.* $\$.69$ *g.* $\$.52$ *i.* $\$.79$ *k.* $\$.72$

b. $\$.10$ *d.* $\$.42$ *f.* $\$.37$ *h.* $\$.39$ *j.* $\$.83$ *l.* $\$.35$

16. *a.* One day is what part of a week? If a man pays $\$84$ for a week's travelling expenses, they average how much per day? *b.* At the same rate, what would they be for 11 days?

17. What part of $\$5$ is $\$2\frac{1}{2}$? If $\$5$ will buy 20 splint baskets, how many such baskets will $\$2\frac{1}{2}$ buy?

18. How many times is $\$20$ contained in $\$400$?

19. What part of $\$400$ is $\$20$?

20. A cent is what part of a dime? 7 cents are what part of a dime?

21. If a dime will pay for 20 steel hooks, how many such hooks will 7 cents buy?

22. 6 is what part of 12?

23. When a hardware merchant makes a profit of $\$1.44$ on 12 window screens, what does he make on 6 of them?

77. *Written*

Test and time yourself on the first eight examples.

- | | | | |
|------------|-------------|-------------------------------|----------------|
| 1. Add: | 2. Add: | 3. Subtract: | 4. Subtract: |
| 287 | 627 | 807,204 | 230,007 |
| 965 | 438 | <u>99,197</u> | <u>150,008</u> |
| 473 | 796 | | |
| 287 | 342 | 5. 2059×78 | |
| 69 | 109 | | |
| 218 | 781 | 6. $786 \times 205 \div 210$ | |
| 246 | 627 | | |
| 968 | 280 | 7. $302 \times (4780 - 3874)$ | |
| 749 | 3578 | | |
| 421 | 642 | 8. $346793 \div 5700$ | |
| 372 | 7986 | | |
| <u>568</u> | <u>8144</u> | | |

9. A park in the shape of a rectangle, 135 rods long and 48 rods wide, contains how many square rods of land? How many acres?

10. A certain street is 6 rods wide. How long must it be to contain 77 acres of land?

11. A farmer has 20 cows and feeds each of them two quarts of corn meal a day. How long will 100 bushels of corn meal last them? (Solve by cancellation.)

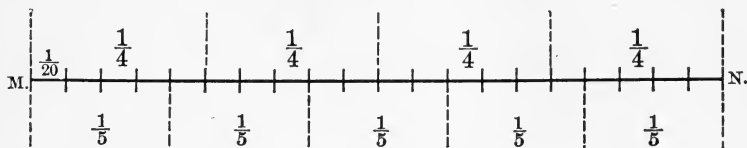
12. A man owed his grocer \$135. He paid $\frac{2}{3}$ of the debt in labor and the rest in cash. *a.* How much cash did he pay? *b.* How many days did he work, if he received \$2 a day?

13. In the year 1905, 1,027,421 immigrants came to this country; 317,000 of them settled in New York State, 222,300 in Pennsylvania, 20,000 west of the Mississippi River, and the rest

in other parts of the country. *a.* How many settled in other parts of the country? *b.* The entire number was how many times the number that settled west of the Mississippi?

REVIEW OF FRACTIONS

(Studied in the Primary Arithmetic)



78. Oral

- This figure shows that $\frac{1}{4} = \frac{5}{20}$. What else does it show?
 - Make a figure to show that $\frac{2}{4} = \frac{1}{2}$.
 - Make a figure to show that $\frac{2}{8} = \frac{1}{4}$.
 - Make a figure to show that $\frac{1}{3} = \frac{2}{6}$ and $\frac{1}{2} = \frac{3}{6}$.
 - What is the value of $\frac{4}{8}$? $\frac{12}{24}$? $\frac{20}{5}$? $\frac{8}{3}$? $\frac{17}{4}$? $\frac{9}{6}$? $\frac{25}{8}$?
 - Express in lowest terms:
 $\frac{2}{4}$; $\frac{3}{6}$; $\frac{5}{10}$; $\frac{6}{8}$; $\frac{9}{18}$; $\frac{8}{12}$; $\frac{5}{15}$; $\frac{16}{20}$.
- | | | |
|--|--------------------------------------|--------------------------------------|
| 7. $\frac{1}{2} + \frac{1}{4} = ?$ | 16. $\frac{2}{3} + \frac{2}{3} = ?$ | 25. $\frac{5}{12} - \frac{1}{6} = ?$ |
| 8. $\frac{1}{2} + \frac{1}{4} + \frac{1}{4} = ?$ | 17. $\frac{1}{6} + \frac{1}{3} = ?$ | 26. $\frac{5}{12} + \frac{1}{2} = ?$ |
| 9. $\frac{3}{8} + \frac{1}{8} = ?$ | 18. $\frac{5}{6} - \frac{1}{3} = ?$ | 27. $\frac{1}{12} + \frac{2}{3} = ?$ |
| 10. $\frac{3}{4} - \frac{1}{8} = ?$ | 19. $\frac{5}{6} + \frac{2}{3} = ?$ | 28. $\frac{1}{12} + \frac{1}{4} = ?$ |
| 11. $\frac{3}{8} + \frac{1}{4} = ?$ | 20. $\frac{1}{2} - \frac{1}{6} = ?$ | 29. $\frac{1}{3} - \frac{1}{4} = ?$ |
| 12. $\frac{3}{4} - \frac{1}{2} = ?$ | 21. $\frac{1}{2} + \frac{5}{6} = ?$ | 30. $\frac{1}{9} + \frac{1}{2} = ?$ |
| 13. $\frac{5}{8} + \frac{1}{2} = ?$ | 22. $\frac{1}{2} + \frac{1}{3} = ?$ | 31. $\frac{1}{8} + \frac{1}{3} = ?$ |
| 14. $\frac{7}{8} - \frac{1}{4} = ?$ | 23. $\frac{3}{10} + \frac{1}{5} = ?$ | 32. $\frac{3}{8} - \frac{1}{12} = ?$ |
| 15. $\frac{2}{3} + \frac{1}{3} = ?$ | 24. $\frac{7}{10} - \frac{1}{5} = ?$ | 33. $\frac{5}{9} - \frac{1}{2} = ?$ |

34. Harold bought a melon. He gave $\frac{1}{3}$ of it to Clarence and $\frac{1}{4}$ of it to Howard. What part of the melon did he keep?

35. A blotter is $7\frac{1}{2}$ inches long and $3\frac{3}{8}$ inches wide. What is the sum of the two sides? Of the two ends? What is the perimeter? Draw the blotter, full size.

79. *Written*

Add:

$$\begin{array}{r} 1. \quad 12\frac{1}{2} \\ 13\frac{1}{4} \\ \underline{25\frac{3}{4}} \end{array}$$

$$\begin{array}{r} 2. \quad 58\frac{1}{3} \\ 17\frac{1}{2} \\ \underline{28\frac{2}{3}} \end{array}$$

$$\begin{array}{r} 3. \quad 41\frac{7}{10} \\ 5\frac{1}{2} \\ \underline{268\frac{2}{5}} \end{array}$$

$$\begin{array}{r} 4. \quad 25\frac{5}{12} \\ 17\frac{5}{6} \\ \underline{8\frac{1}{2}} \end{array}$$

$$\begin{array}{r} 5. \quad 18\frac{1}{2} \\ 2\frac{1}{9} \\ 3\frac{1}{6} \\ \underline{5\frac{2}{3}} \end{array}$$

$$\begin{array}{r} 6. \quad 325\frac{1}{2} \\ 27\frac{2}{3} \\ 41\frac{5}{6} \\ \underline{17\frac{1}{3}} \end{array}$$

$$\begin{array}{r} 7. \quad 84\frac{7}{8} \\ 56\frac{5}{16} \\ 91\frac{1}{2} \\ \underline{3\frac{5}{8}} \end{array}$$

$$\begin{array}{r} 8. \quad 152\frac{1}{7} \\ 59\frac{5}{14} \\ 301\frac{1}{2} \\ \underline{20\frac{2}{7}} \end{array}$$

Subtract and test your work:

$$\begin{array}{r} 9. \quad 43\frac{3}{4} \\ \underline{29\frac{1}{2}} \end{array}$$

$$\begin{array}{r} 10. \quad 85\frac{9}{10} \\ \underline{37\frac{1}{2}} \end{array}$$

$$\begin{array}{r} 11. \quad 401\frac{7}{8} \\ \underline{123\frac{1}{3}} \end{array}$$

$$\begin{array}{r} 12. \quad 204\frac{7}{16} \\ \underline{13\frac{3}{8}} \end{array}$$

$$\begin{array}{r} 13. \quad 132\frac{2}{5} \\ \underline{24\frac{3}{15}} \end{array}$$

$$\begin{array}{r} 14. \quad 203 \\ \underline{16\frac{7}{9}} \end{array}$$

$$\begin{array}{r} 15. \quad 83 \\ \underline{14\frac{3}{11}} \end{array}$$

$$\begin{array}{r} 16. \quad 401\frac{3}{10} \\ \underline{85\frac{2}{5}} \end{array}$$

17. What must be added to $5\frac{1}{3}$ to make $16\frac{2}{7}$?

18. What must be taken from $18\frac{9}{10}$ to leave $6\frac{2}{3}$?

19. Laurence bought a pencil $6\frac{1}{16}$ inches long and cut it into 3 pieces, two of which were $3\frac{3}{8}$ and $2\frac{1}{16}$ inches long. How long was the third piece? Prove the correctness of your answer by drawing a line $6\frac{1}{16}$ inches long and cutting off pieces $3\frac{3}{8}$ and $2\frac{1}{16}$ inches long.

20. Indicate by signs the work required for example 19.

FRACTIONS

80. *One or more of the equal parts of a unit is a fraction; e.g.*
 $\frac{1}{8}$; $\frac{2}{5}$; $\frac{2}{7}$; $\$ \frac{5}{10}$.

81. *A fraction is always an expression of division.* For example, if 1 inch is divided into 8 equal parts, each part is $\frac{1}{8}$ of an inch. If a line 7 inches long is divided into 8 equal parts, one part is $\frac{7}{8}$ of an inch long. That is, $1 \text{ in.} \div 8 = \frac{1}{8} \text{ in.}$, and $7 \text{ inches} \div 8 = \frac{7}{8} \text{ inch}$.

Take your rule and draw a line 1 inch long. Divide it into 4 equal parts. How long is one part? Draw a line 3 inches long. Divide it into 4 equal parts. Measure one of the parts. $3 \text{ inches} \div 4 = ?$

Draw a line 5 inches long. Divide it into 8 equal parts. Measure one of the parts. $5 \text{ inches} \div 8 = ?$ $3 \div 7 = ?$
 $9 \div 11 = ?$

82. *The number above the line in a fraction is the numerator.* It is always a dividend. In the fractions $\frac{1}{3}$, $\frac{7}{9}$, $\frac{15}{5}$, $\frac{23}{12}$, the numerators are 1, 7, 15, and 23.

83. *The number below the line in a fraction is the denominator.* It is always a divisor. In the fractions $\frac{1}{3}$, $\frac{7}{9}$, $\frac{15}{5}$, $\frac{23}{12}$, the denominators are 3, 9, 5, and 12.

84. *The numerator and denominator are the terms of a fraction; e.g. the terms of $\frac{7}{11}$ are 7 and 11.*

85. *The value of a fraction is the quotient obtained by dividing the numerator by the denominator.*

REDUCTION OF FRACTIONS

86. *Changing the form of a number without changing its value is reduction; e.g. 8 pt. = 4 qt.; \$7 = 700 ct.; 7 ft. = $2\frac{1}{3}$ yd.; $\frac{12}{4} = 3$; $\frac{18}{24} = \frac{3}{4}$; $\frac{2}{5} = \frac{6}{15}$.*

REDUCTION TO LOWEST TERMS

87. A fraction is in its lowest terms when the numerator and denominator are prime to each other; e.g. $\frac{5}{7}$, $\frac{3}{11}$, $\frac{19}{20}$.

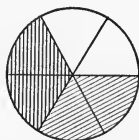
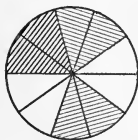
88. Oral

1. Dividing both dividend and divisor by the same number affects the quotient how?

2. $\frac{48}{20}$ compares how with $\frac{12}{5}$?

3. $\frac{6}{21}$ compares how with $\frac{2}{7}$? What did we do with the terms of $\frac{6}{21}$ to obtain $\frac{2}{7}$?

4. Show by these circles that



$$\frac{2}{6} = \frac{1}{3}.$$

$$\frac{4}{6} = \frac{2}{3}.$$

$$\frac{2}{10} = \frac{1}{5}.$$

$$\frac{4}{10} = \frac{2}{5}.$$

$$\frac{6}{10} = \frac{3}{5}.$$

$$\frac{8}{10} = \frac{4}{5}.$$

$$\frac{5}{10} = \frac{1}{2}.$$

5. How are these fractions reduced to lowest terms?

6. Reduce to lowest terms: $\frac{2}{4}$; $\frac{3}{6}$; $\frac{6}{8}$; $\frac{3}{9}$; $\frac{2}{6}$; $\frac{5}{10}$; $\frac{4}{8}$; $\frac{6}{9}$; $\frac{9}{12}$; $\frac{2}{8}$; $\frac{2}{10}$; $\frac{7}{14}$; $\frac{3}{12}$; $\frac{5}{15}$; $\frac{6}{12}$; $\frac{9}{18}$; $\frac{4}{12}$; $\frac{2}{14}$; $\frac{14}{18}$; $\frac{15}{20}$; $\frac{16}{24}$; $\frac{12}{15}$; $\frac{18}{24}$; $\frac{8}{10}$; $\frac{10}{12}$; $\frac{8}{12}$; $\frac{8}{14}$.

89. Written

Reduce $\frac{42}{8}$ to lowest terms. $\frac{42}{8} = \frac{21}{4} = \frac{7}{1}$ Ans. We divide both terms by 2 and then by 3.

If we use the greatest common divisor (6), we shall need to divide only once, thus $\frac{42}{8} = \frac{7}{1}$.

NOTE. — We may often save time by remembering that an even number will never exactly divide an odd number. Can you tell why?

90. *Reduce to lowest terms :*

- | | | | |
|---------------------|------------------------|------------------------|------------------------|
| 1. $\frac{36}{54}$ | 8. $\frac{72}{128}$ | 15. $\frac{112}{1888}$ | 22. $\frac{647}{1294}$ |
| 2. $\frac{72}{108}$ | 9. $\frac{214}{316}$ | 16. $\frac{121}{154}$ | 23. $\frac{441}{945}$ |
| 3. $\frac{27}{81}$ | 10. $\frac{75}{225}$ | 17. $\frac{130}{260}$ | 24. $\frac{97}{873}$ |
| 4. $\frac{45}{95}$ | 11. $\frac{80}{236}$ | 18. $\frac{77}{165}$ | 25. $\frac{83}{581}$ |
| 5. $\frac{38}{86}$ | 12. $\frac{124}{224}$ | 19. $\frac{96}{544}$ | 26. $\frac{198}{612}$ |
| 6. $\frac{55}{99}$ | 13. $\frac{470}{2350}$ | 20. $\frac{114}{285}$ | 27. $\frac{105}{525}$ |
| 7. $\frac{60}{360}$ | 14. $\frac{150}{6000}$ | 21. $\frac{384}{1152}$ | 28. $\frac{121}{143}$ |

29. Express in lowest terms $230 \div 345$.

30. Express in lowest terms 98 divided by 392.

31. Express in lowest terms $437 \div 2484$.

32. Express in lowest terms the quotient of 288 divided by 504.

33. What are the lowest terms of $\frac{138}{153}$?

REDUCTION OF IMPROPER FRACTIONS TO INTEGERS OR MIXED NUMBERS

91. *A fraction whose numerator is smaller than its denominator is a proper fraction ; e.g. $\frac{2}{9}$, $\frac{1}{15}$, $\frac{16}{17}$. The value of a proper fraction is always less than 1.*

92. *A fraction whose numerator equals or exceeds its denominator is an improper fraction, e.g. $\frac{5}{5}$, $\frac{9}{8}$, $\frac{24}{12}$. The value of an improper fraction compares how with 1?*

93. *A number that is composed of an integer and a fraction is a mixed number ; e.g. $5\frac{2}{7}$, $10\frac{1}{3}$, $201\frac{6}{11}$.*

94. *Oral*

1. A boy has two half dollars. That is the same as how many whole dollars? Six half dollars equal how many whole dollars? How do you find it?

2. Eleven half dollars make how many dollars and how many halves over? How do you find it? Write it.

3. How many quarters make a dollar?

4. How many dollars are there in 8 quarters? 40 quarters?

5. Fifteen quarters make how many dollars and how many quarters over? Write it. What do you do to find it?

6. $\frac{2}{2} =$ how many whole ones? $\frac{8}{2}$? $\frac{16}{2}$? $\frac{9}{2}$?

7. $\frac{4}{4} = ?$ $\frac{8}{4} = ?$ $\frac{12}{4} = ?$ $\frac{14}{4} = ?$

8. A fraction is an expression of what operation?

9. How may we find the value of a fraction?

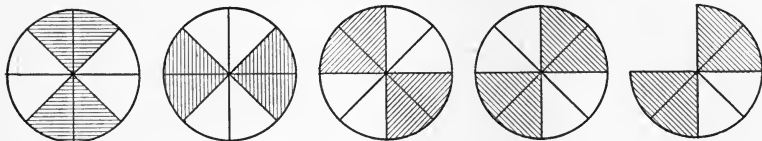
10. Define the value of a fraction.

Find the values of:

11. $\frac{4}{2}$	15. $\frac{10}{4}$	19. $\frac{25}{6}$	23. $\frac{73}{7}$	27. $\frac{245}{5}$	31. $\frac{42}{13}$
12. $\frac{5}{4}$	16. $\frac{7}{3}$	20. $\frac{39}{7}$	24. $\frac{80}{11}$	28. $\frac{77}{12}$	32. $\frac{63}{15}$
13. $\frac{6}{3}$	17. $\frac{13}{3}$	21. $\frac{40}{8}$	25. $\frac{91}{9}$	29. $\frac{46}{11}$	33. $\frac{56}{15}$
14. $\frac{7}{2}$	18. $\frac{17}{4}$	22. $\frac{51}{3}$	26. $\frac{124}{2}$	30. $\frac{74}{12}$	34. $\frac{111}{11}$

95. *Written*

1. $\frac{191}{4}$	3. $\frac{292}{14}$	5. $\frac{967}{32}$	7. $\frac{1216}{20}$	9. $\frac{930}{57}$
2. $\frac{376}{25}$	4. $\frac{817}{27}$	6. $\frac{785}{37}$	8. $\frac{989}{45}$	10. $\frac{3900}{29}$
11. $\frac{943}{18}$	14. $\frac{9603}{39}$	17. $\frac{893}{46}$	20. $\frac{4973}{67}$	
12. $\frac{3467}{14}$	15. $\frac{979}{37}$	18. $\frac{912}{89}$	21. $\frac{7234}{79}$	
13. $\frac{879}{37}$	16. $\frac{348}{18}$	19. $\frac{3522}{171}$	22. $\frac{28501}{104}$	

REDUCTION OF INTEGERS AND MIXED NUMBERS TO
 IMPROPER FRACTIONS


96. Oral

- How many fourths in 1 circle? In 2 circles? In 3 circles? In 4 circles?
- How many fourths in $4\frac{3}{4}$ circles? In $2\frac{3}{4}$ circles? In $3\frac{1}{4}$ circles?
- How many eighths in 1 circle? In 3 circles? In 2 circles? In $4\frac{6}{8}$ circles? In $2\frac{3}{8}$ circles?
- How do you reduce an integer or a mixed number to a fraction?

Reduce to improper fractions:

- | | | | |
|-------------------|--------------------|--------------------|---------------------|
| 5. $1\frac{1}{3}$ | 9. $3\frac{4}{5}$ | 13. $3\frac{4}{7}$ | 17. $8\frac{1}{9}$ |
| 6. $4\frac{1}{2}$ | 10. $2\frac{3}{4}$ | 14. $4\frac{7}{9}$ | 18. $7\frac{5}{11}$ |
| 7. $3\frac{2}{3}$ | 11. $4\frac{3}{5}$ | 15. $5\frac{2}{5}$ | 19. $8\frac{9}{10}$ |
| 8. $5\frac{1}{4}$ | 12. $2\frac{5}{6}$ | 16. $6\frac{3}{7}$ | 20. $9\frac{1}{6}$ |

97. Written

- Reduce $38\frac{7}{9}$ to a fraction.

$$38 = 38 \times 9 \text{ ninths} = 342 \text{ ninths.}$$

$$342 \text{ ninths plus } 7 \text{ ninths} = 349 \text{ ninths.}$$

The work may be expressed thus: $38\frac{7}{9} = \frac{349}{9}$ Ans.

$$\begin{array}{r} 9 \\ \hline 342 \\ 7 \\ \hline 349 \end{array}$$

Reduce to fractions:

2. $9\frac{3}{14}$	9. $49\frac{7}{15}$	16. $19\frac{7}{12}$	23. $35\frac{1}{31}$
3. $17\frac{1}{9}$	10. $25\frac{1}{30}$	17. $29\frac{4}{11}$	24. $191\frac{5}{12}$
4. $25\frac{6}{7}$	11. $59\frac{3}{14}$	18. $149\frac{6}{7}$	25. $203\frac{8}{19}$
5. $15\frac{5}{11}$	12. $67\frac{5}{16}$	19. $128\frac{4}{5}$	26. $98\frac{11}{13}$
6. $23\frac{2}{15}$	13. $89\frac{20}{9}$	20. $137\frac{7}{18}$	27. $87\frac{17}{19}$
7. $40\frac{7}{9}$	14. $131\frac{7}{9}$	21. $238\frac{11}{8}$	28. $138\frac{20}{29}$
8. $37\frac{4}{13}$	15. $270\frac{23}{5}$	22. $491\frac{7}{5}$	29. $351\frac{13}{17}$

LEAST COMMON DENOMINATOR

98. *Fractions whose denominators are alike have a common denominator; e.g. 60 is a common denominator of $\frac{3}{60}$, $\frac{18}{60}$, and $\frac{27}{60}$.*

99. *Fractions having the smallest possible common denominator have their least common denominator; e.g. $\frac{1}{20}$, $\frac{6}{20}$, $\frac{9}{20}$.*

100. Oral

1. We have found that when we add fractions having different denominators, we must first change them to fractions having the same denominator. What shall we call that denominator?

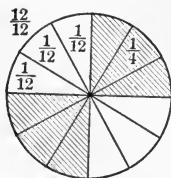
2. Since the common denominator must contain all the given denominators, it must be what of those denominators? (A number that exactly contains two or more other numbers is what?)

3. The least common denominator, then, must be which multiple of the given denominators?

4. Reduce $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{2}{3}$ to fractions having the least common denominator.

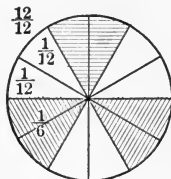
How many 12ths in $\frac{1}{4}$? ($12 \div 4 = 3$.)

How many 12ths in $\frac{3}{4}$? ($\frac{3 \times 3}{4 \times 3} = \frac{9}{12}$.)



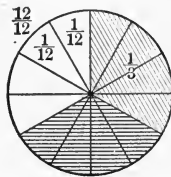
How many 12ths in $\frac{1}{6}$? ($12 \div 6 = 2$.)

How many 12ths in $\frac{5}{6}$? ($\frac{5 \times 2}{6 \times 2} = \frac{10}{12}$.)



How many 12ths in $\frac{1}{3}$? ($12 \div 3 = 4$.)

How many 12ths in $\frac{2}{3}$? ($\frac{2 \times 4}{3 \times 4} = \frac{8}{12}$.)



Change the following to fractions having the least common denominator:

5. $\frac{1}{2}, \frac{3}{4}$

14. $\frac{7}{9}, \frac{2}{3}, \frac{3}{2}$

23. $\frac{7}{9}, \frac{5}{6}, \frac{1}{2}, \frac{1}{3}$

6. $\frac{2}{3}, \frac{5}{6}$

15. $\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{12}$

24. $\frac{1}{4}, \frac{2}{3}, \frac{1}{12}, \frac{7}{8}$

7. $\frac{1}{2}, \frac{7}{9}$

16. $\frac{1}{3}, \frac{2}{5}, \frac{2}{3}, \frac{7}{15}$

25. $\frac{1}{7}, \frac{1}{14}, \frac{1}{4}, \frac{1}{2}$

8. $\frac{5}{7}, \frac{1}{14}, \frac{1}{2}$

17. $\frac{5}{24}, \frac{1}{8}, \frac{1}{3}$

26. $\frac{5}{7}, \frac{3}{14}, \frac{3}{4}, \frac{1}{28}$

9. $\frac{1}{5}, \frac{1}{3}, \frac{7}{15}$

18. $\frac{3}{8}, \frac{7}{12}, \frac{5}{6}$

27. $\frac{1}{7}, \frac{1}{8}, \frac{1}{4}, \frac{1}{2}$

10. $\frac{1}{2}, \frac{2}{7}, \frac{1}{21}$

19. $\frac{5}{9}, \frac{1}{2}, \frac{1}{6}$

28. $\frac{3}{7}, \frac{5}{8}, \frac{3}{4}, \frac{1}{28}$

11. $\frac{2}{3}, \frac{5}{9}, \frac{7}{18}$

20. $\frac{7}{8}, \frac{2}{3}, \frac{5}{12}$

29. $\frac{1}{9}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{12}$

12. $\frac{5}{6}, \frac{3}{4}, \frac{2}{3}$

21. $\frac{5}{7}, \frac{2}{3}, \frac{1}{21}$

30. $\frac{7}{9}, \frac{2}{3}, \frac{5}{6}, \frac{7}{12}, \frac{1}{18}$

13. $\frac{6}{5}, \frac{5}{6}, \frac{1}{2}$

22. $\frac{1}{2}, \frac{7}{15}, \frac{3}{10}$

31. $\frac{3}{4}, \frac{7}{8}, \frac{1}{16}, \frac{1}{32}, \frac{1}{2}$

101. *Written*

Change $\frac{7}{10}$, $\frac{8}{15}$, $\frac{16}{33}$ and $\frac{17}{30}$ to fractions having the least common denominator.

	7	8	16	17
2	10	15	33	30
3	5	15	33	15
5	5	5	11	5
	1	1	11	1

$$330 \div 10 = 33 \quad \frac{7 \times 33}{10 \times 33} = \frac{231}{330}$$

$$330 \div 15 = 22 \quad \frac{8 \times 22}{15 \times 22} = \frac{176}{330}$$

$$330 \div 33 = 10 \quad \frac{16 \times 10}{33 \times 10} = \frac{160}{330}$$

$$2 \times 3 \times 5 \times 11 = 330 \text{ L. C. M.} \quad 330 \div 30 = 11 \quad \frac{17 \times 11}{30 \times 11} = \frac{187}{330}$$

$$\frac{231}{330}, \frac{176}{330}, \frac{160}{330}, \frac{187}{330} \text{ Ans.}$$

Change to fractions having the least common denominator:

1. $\frac{1}{4}, \frac{3}{5}, \frac{5}{6}$

6. $\frac{1}{4}, \frac{3}{5}, \frac{5}{6}, \frac{7}{8}$

11. $\frac{14}{35}, \frac{5}{91}, \frac{27}{65}$

2. $\frac{2}{3}, \frac{4}{5}, \frac{4}{9}$

7. $9, \frac{5}{8}, \frac{9}{10}, \frac{4}{5}$

12. $\frac{2}{5}, \frac{3}{8}, \frac{1}{4}, \frac{11}{12}$

3. $\frac{5}{8}, \frac{9}{10}, \frac{1}{2}$

8. $\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{12}$

13. $\frac{15}{34}, \frac{5}{12}, \frac{3}{17}$

4. $\frac{5}{7}, \frac{12}{13}$

9. $\frac{3}{4}, \frac{3}{5}, \frac{4}{9}, \frac{9}{10}$

14. $\frac{21}{28}, \frac{7}{18}, \frac{5}{13}$

5. $\frac{3}{7}, \frac{5}{12}, \frac{13}{28}$

10. $\frac{5}{8}, \frac{7}{10}, \frac{3}{4}, \frac{4}{5}$

15. $\frac{8}{21}, \frac{5}{18}, \frac{1}{63}, \frac{8}{11}$

REVIEW AND PRACTICE

102. *Oral*

1. What change should I receive out of \$2 for a purchase of \$.50? \$.75? \$.85? \$.45? \$1.25? \$1.79? \$.69?

2. Henry bought a top for 3 cents, some candy for 11 cents, and a pencil for 7 cents. What change should he receive from a quarter?

3. \$240 will buy how many typewriters at \$60 apiece? At \$80 apiece?

4. 8 cows at \$40 a head cost how much?

5. What is the cost of 2 bushels of potatoes at 20¢ a peck?

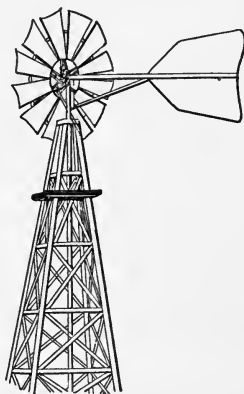
6. $800 + 500 + 700 + 1500 = ?$
7. Name the prime factors of 90.
8. Tell the value of $1\frac{2}{3}$; $1\frac{6}{8}$; $2\frac{1}{5}$; $3\frac{2}{7}$; $1\frac{200}{600}$.
9. Change to improper fractions $8\frac{1}{4}$; $2\frac{5}{9}$; $17\frac{2}{3}$; $5\frac{11}{12}$; $24\frac{1}{2}$; $12\frac{3}{7}$; $9\frac{7}{12}$.
10. What is a fraction? If you change $\frac{3}{4}$ to eighths, how will its value be affected? How will the number of parts be changed? How will the size of the parts be changed?
11. How does $\frac{1}{2}$ compare with $\frac{1}{4}$? Show this by a drawing.
12. Which is larger, $\frac{1}{3}$ of an apple or $\frac{1}{2}$ of an apple? $\frac{6}{12}$ or $\frac{1}{2}$? $\frac{2}{3}$ or $\frac{6}{9}$?
13. Which is greater, $\frac{2}{3}$ or $\frac{3}{5}$?
14. 29 pounds are how many times 5 pounds? Compare \$250 with \$50; 1 qt. with 1 pt.; 80¢ with 20¢.
15. Compare 2 cents with 50 cents; 2 gal. with 3 gal.; 8 lb. with 64 lb.; \$.25 with \$1.50.
16. Find the cost of 24 souvenir cards at the rate of 3 for 5 cents.

17. A windmill turned 20 times a minute with a certain wind. The owner oiled the bearings of the mill and then it turned 24 times a minute with the same wind.

a. How many turns per hour were gained by oiling the bearings?

b. How many times as much work did the mill do after oiling as before oiling?

c. What part as much work did the mill perform before oiling as after oiling?



103. Written

Land Surfaces in Square Miles

New York	47620	Rhode Island	1080
Texas	262290	Pennsylvania	44980
Nebraska	76840	Connecticut	4850
Delaware	1960	Illinois	56000
California	155980	Montana	145310
Kentucky	40000	Massachusetts	8040
New Jersey	7450	New Hampshire	9000
District of Columbia	60	Alaska . . . (nearly)	570390

NOTE 1. — Water surfaces are not included in the above figures.

NOTE 2. — While answering questions 1–5, keep your geography before you, open at the map of the United States. By referring to the map, estimate each answer before computing it, and then compare your estimate with the result obtained by computation.

1. *a.* Texas contains how many times as much land as New York? *b.* It contains how many more square miles of land than New York?

2. Alaska would make how many states the size of New Hampshire?

3. Compare, by division, the land areas of:

- a.* Alaska and Illinois.
- b.* Illinois and New Hampshire.
- c.* New Jersey and Pennsylvania.
- d.* Rhode Island and Texas.
- e.* Massachusetts and New York.
- f.* Connecticut and California.
- g.* Montana and Delaware.
- h.* Rhode Island and District of Columbia.

4. Compare, by subtraction, the land areas of:

- a.* Nebraska and Pennsylvania.

- b. Delaware and New Hampshire.
 c. Kentucky and Rhode Island.
 d. Illinois and Massachusetts.
 e. Texas and Alaska.

5. *a.* Find which of the columns of land surfaces (top of page 60) indicates the greater number of square miles.

b. What is the difference?

Make other problems from the above table.

6. Find the prime factors of 1232.

7. Reduce $365\frac{1}{4}$ and $66\frac{2}{3}$ to improper fractions.

8. Reduce $\frac{72}{144}$ to lowest terms.

9. How many 15ths are there in 39?

10. Find the value of $\frac{500}{29}$; $\frac{625}{37}$; $\frac{481}{19}$.

11. How many 40ths are there in $7\frac{5}{8}$?

12. 7 is equal to what fraction having 7 for a denominator?

13. *Reduce to lowest terms:*

a. $\frac{728}{784}$ *b.* $\frac{120}{216}$ *c.* $\frac{245}{385}$ *d.* $\frac{42}{140}$ *e.* $\frac{150}{900}$ *f.* $\frac{28}{154}$ *g.* $\frac{112}{480}$

14. *Reduce to fractions having the least common denominator:*

a. $\frac{7}{9}$, $\frac{13}{18}$, $\frac{3}{10}$ *b.* $\frac{5}{14}$, $\frac{16}{21}$, $\frac{31}{35}$ *c.* $\frac{8}{11}$, $\frac{2}{3}$, $\frac{3}{8}$

ADDITION OF FRACTIONS AND MIXED NUMBERS

104. *A number is in its simplest form when it is in the form of an integer, or a proper fraction in its lowest terms, or a mixed number whose fractional part is in its lowest terms; e.g. $18, \frac{3}{7}$ and $5\frac{1}{9}$ are in their simplest forms; $\frac{26}{2}, \frac{21}{4}, \frac{46}{9}$ and $8\frac{3}{6}$ are not in their simplest forms. Why?*

Answers should always be expressed in simplest form, unless the question requires a different form.

105. *Oral**Add:*

1. $\frac{1}{2}, \frac{1}{3}$

5. $\frac{1}{4}, \frac{1}{5}$

9. $\frac{2}{7}, \frac{1}{3}, 3$

13. $1\frac{1}{4}, 2\frac{1}{2}, \frac{1}{3}$

2. $\frac{2}{3}, \frac{1}{2}$

6. $\frac{3}{5}, \frac{1}{3}$

10. $\frac{1}{4}, \frac{1}{2}, 1\frac{1}{2}$

14. $3\frac{1}{3}, 1\frac{2}{5}, 5$

3. $\frac{2}{3}, \frac{1}{4}$

7. $\frac{1}{7}, \frac{1}{2}$

11. $2\frac{1}{3}, 4\frac{1}{2}, 1$

15. $\frac{6}{7}, 3\frac{1}{2}, 4$

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

8. $\frac{1}{3}, \frac{1}{6}$

12. $\frac{1}{7}, \frac{1}{2}, \frac{1}{14}$

16. $2\frac{1}{8}, 3\frac{1}{4}, 2\frac{1}{2}$

17. A man paid $\$ \frac{3}{4}$ for a book, $\$ \frac{4}{5}$ for an inkstand, and $\$ \frac{1}{4}$ for writing paper. How much did he spend?

18. Mary had $\$ \frac{3}{4}$; her mother gave her $\$ 3\frac{1}{2}$. How much had she then?

19. The addends are $7\frac{2}{3}, 16\frac{1}{3}, 10\frac{1}{2}\frac{3}{4}$. What is the sum?

20. Mary walked $5\frac{3}{8}$ miles on Monday, 4 miles on Tuesday, $5\frac{5}{8}$ miles on Wednesday, and as far during the next three days as during these days. How far did she walk in all?

106. *Written*

$$\begin{array}{r} 2 \left| \begin{array}{r} 7 \\ 9 \end{array} + \frac{9}{16} + \frac{11}{12} = ? \\ \hline 2 \left| \begin{array}{r} 9 \\ 9 \end{array} \quad \begin{array}{r} 8 \\ 4 \end{array} \quad \begin{array}{r} 6 \\ 3 \end{array} \\ \hline 3 \left| \begin{array}{r} 9 \\ 3 \end{array} \quad \begin{array}{r} 4 \\ 4 \end{array} \quad \begin{array}{r} 3 \\ 1 \end{array} \end{array}$$

$$\begin{array}{r} \frac{7}{9} = \frac{112}{144} \\ \frac{9}{16} = \frac{81}{144} \\ \frac{11}{12} = \frac{132}{144} \end{array}$$

$$\frac{325}{144} = 2\frac{37}{144} \text{ Sum.}$$

$$2 \times 2 \times 3 \times 3 \times 4 = 144, \text{ L. C. D.}$$

Add $10\frac{3}{5}, 7\frac{5}{8},$ and $6\frac{3}{4}$.

$$10\frac{3}{5} = 10\frac{24}{40}$$

$$7\frac{5}{8} = 7\frac{25}{40}$$

$$6\frac{3}{4} = 6\frac{30}{40}$$

$$\frac{2370}{40} = 24\frac{30}{40} \text{ Sum.}$$

We add the whole numbers and fractions separately, and then unite the sums.

Add:

- | | | |
|---|--|--|
| 1. $\frac{5}{7}, \frac{1}{14}, \frac{1}{2}$ | 9. $\frac{1}{4}, \frac{3}{5}, \frac{5}{6}, \frac{7}{8}$ | 17. $6\frac{3}{4}, 8\frac{2}{3}, \frac{6}{7}, \frac{1}{8}$ |
| 2. $\frac{1}{5}, \frac{1}{3}, \frac{7}{15}$ | 10. $\frac{3}{4}, \frac{4}{5}, 6, \frac{4}{9}$ | 18. $3, \frac{2}{3}, \frac{1}{7}, \frac{3}{6}$ |
| 3. $\frac{2}{3}, \frac{5}{9}, \frac{7}{18}$ | 11. $\frac{3}{4}, \frac{4}{9}, \frac{7}{11}, \frac{3}{5}$ | 19. $\frac{5}{6}, 4, \frac{2}{3}, 1\frac{4}{5}$ |
| 4. $\frac{5}{6}, \frac{3}{4}, \frac{2}{3}$ | 12. $\frac{3}{8}, \frac{9}{10}, \frac{3}{4}, \frac{4}{5}$ | 20. $\frac{3}{5}, \frac{7}{6}, \frac{7}{10}, \frac{8}{15}$ |
| 5. $\frac{5}{12}, \frac{1}{2}, \frac{5}{4}$ | 13. $\frac{1}{2}, 2\frac{2}{5}, \frac{2}{3}, 6$ | 21. $6\frac{2}{3}, 8\frac{1}{2}, 5\frac{3}{4}, 7\frac{5}{8}$ |
| 6. $\frac{1}{8}, \frac{3}{4}, \frac{1}{2}, \frac{3}{16}$ | 14. $\frac{4}{5}, \frac{3}{8}, 2\frac{1}{4}, \frac{7}{10}$ | 22. $9\frac{1}{5}, 5\frac{2}{7}, 9, \frac{1}{3}\frac{2}{5}$ |
| 7. $\frac{2}{5}, \frac{3}{10}, \frac{7}{20}, \frac{1}{2}$ | 15. $4\frac{5}{9}, \frac{2}{7}, \frac{1}{3}, \frac{8}{21}$ | 23. $\frac{5}{3}, \frac{5}{6}, \frac{6}{8}, \frac{2}{4}$ |
| 8. $\frac{2}{3}, \frac{1}{8}, \frac{5}{12}, \frac{7}{24}$ | 16. $\frac{3}{5}, \frac{1}{2}, \frac{9}{10}, 4$ | 24. $5\frac{1}{4}, 7\frac{3}{8}, 9\frac{1}{6}, 45$ |

25. What is the sum of $14\frac{3}{7}, 9\frac{5}{8}, 10\frac{1}{2}$, and $12\frac{13}{14}$?

26. A man travels $25\frac{2}{3}$ miles on Monday, $37\frac{2}{5}$ miles on Tuesday, and on Wednesday as many miles as on Monday and Tuesday. How many miles does he travel in three days?

27. A farmer has $27\frac{1}{2}$ bushels of potatoes in one bin, $133\frac{3}{8}$ bushels in another, $47\frac{5}{18}$ bushels in another. How many bushels has he?

28. How many yards of cloth will I have, if I buy $123\frac{7}{8}$ yards, $76\frac{3}{4}$ yards, and $58\frac{2}{3}$ yards?

29. $2\frac{1}{8}$ yards of cloth are required for a coat, $1\frac{1}{3}$ yards for trousers, and $\frac{3}{8}$ of a yard for a vest. How many yards are required for the whole suit?

SUBTRACTION OF FRACTIONS AND MIXED NUMBERS

107. *Oral*

- | | | |
|---------------------------------|----------------------------------|-----------------------------------|
| 1. $\frac{3}{4} - \frac{1}{4}$ | 6. $\frac{3}{4} - \frac{5}{8}$ | 11. $12 - 1\frac{1}{2}$ |
| 2. $\frac{3}{5} - \frac{1}{2}$ | 7. $\frac{9}{10} - \frac{3}{5}$ | 12. $22 - 1\frac{1}{5}$ |
| 3. $\frac{5}{6} - \frac{1}{3}$ | 8. $1\frac{9}{24} - \frac{3}{4}$ | 13. $4 - 1\frac{1}{2}$ |
| 4. $\frac{1}{2} - \frac{1}{6}$ | 9. $7 - \frac{1}{2}$ | 14. $6\frac{1}{3} - 4\frac{2}{3}$ |
| 5. $\frac{9}{14} - \frac{2}{7}$ | 10. $8 - \frac{3}{8}$ | 15. $11 - 8\frac{2}{3}$ |

64 SUBTRACTION OF FRACTIONS AND MIXED NUMBERS

16. $19\frac{1}{7} - 9\frac{5}{7}$

20. $6 - \frac{1}{3}$

24. $12\frac{1}{4} - 5\frac{1}{2}$

17. $\frac{2}{3} - \frac{1}{4}$

21. $3\frac{1}{4} - \frac{3}{4}$

25. $8\frac{1}{2} - 4\frac{1}{4}$

18. $\frac{1}{2} - \frac{1}{3}$

22. $15 - 2\frac{1}{2}$

26. $\frac{1}{18} - \frac{2}{9}$

19. $\frac{7}{8} - \frac{1}{2}$

23. $10 - \frac{5}{7}$

27. $\frac{3}{4} - \frac{1}{3}$

108. *Written*From $\frac{11}{15}$ take $\frac{4}{9}$.

$$\frac{11}{15} = \frac{33}{45}$$

$$\frac{4}{9} = \frac{20}{45}$$

$$\frac{13}{45} \text{ Difference}$$

How is 45 obtained?

From $29\frac{1}{6}$ take $13\frac{7}{10}$.

$$29\frac{1}{6} = 29\frac{5}{30} = 28\frac{35}{30}$$

How do we obtain $\frac{35}{30}$?

$$13\frac{7}{10} =$$

$$\frac{133}{10}$$

$$15\frac{14}{30} = 15\frac{7}{15} \text{ Difference}$$

1. Take $\frac{1}{6}$ from $\frac{5}{6}$.
2. From $\frac{19}{20}$ take $\frac{9}{11}$.
3. Find the difference between $\frac{15}{17}$ and $\frac{17}{34}$.
4. Take $91\frac{4}{5}$ from $178\frac{1}{3}$.
5. $3\frac{1}{3} - \frac{3}{5}$
6. $6\frac{1}{2} - 4\frac{2}{3}$
7. $42\frac{3}{5} - 33\frac{5}{7}$
8. $198\frac{3}{6} - 49\frac{3}{3}$
9. $3\frac{7}{8} - 2\frac{8}{9}$
10. $16\frac{2}{3} - 8\frac{5}{6}$
11. $\frac{1}{7} - \frac{1}{8}$
12. $\frac{7}{8} - \frac{7}{12}$
13. $\frac{27}{40} - \frac{3}{8}$
14. $8\frac{1}{7} - 5\frac{1}{2}$
15. $210\frac{1}{2} - 109\frac{5}{9}$
16. $12\frac{1}{5} - 5\frac{1}{3}$
17. $7\frac{2}{3} - 5\frac{4}{5}$
18. $46\frac{3}{5} - 27\frac{7}{9}$
19. $1867\frac{2}{3} - 976\frac{3}{4}$
20. $32\frac{1}{3} - 26\frac{5}{7}$
21. $13\frac{7}{10} - 3\frac{7}{10}$
22. $481\frac{3}{15} - 232\frac{7}{10}$
23. $862\frac{5}{9} - 46\frac{5}{7}$
24. $230\frac{1}{2} - 140\frac{3}{11}$
25. $89\frac{7}{9} - 43\frac{1}{2}$
26. $807\frac{1}{17} - 298\frac{1}{3}$
27. $190\frac{2}{3} - 28\frac{4}{7}$
28. $281\frac{4}{11} - 37\frac{1}{2}$

29. A piece of silk contains $18\frac{1}{4}$ yd. How many yards will be left after $13\frac{1}{8}$ yd. are used?

30. Mrs. Brown bought $4\frac{7}{8}$ yd. of broadcloth and used all but $1\frac{5}{8}$ yd. How much did she use?

31. Find the difference between $256\frac{1}{3}$ and $149\frac{1}{2}$.

32. A man bought a lot at auction for $\$92\frac{2}{5}$ and sold it the next day for $\$105\frac{3}{4}$. What did he gain?

ADDITION AND SUBTRACTION OF FRACTIONS

109. *Written*

1. From a piece of cloth containing $47\frac{1}{2}$ yd., $22\frac{2}{3}$ yd. were sold to one lady and $5\frac{3}{4}$ yd. to another. How many yards remained unsold?

2. A farmer sold a load of hay for $\$13\frac{7}{10}$ and another for $\$16\frac{3}{4}$. He was paid $\$25$. How much was still due?

3. A lady paid $\$1\frac{3}{10}$ for a pair of gloves, $\$3\frac{1}{5}$ for an umbrella, and $\$29\frac{7}{10}$ for dress materials. How much should she have left from four ten-dollar bills?

4. What must be added to the sum of $\frac{5}{8}$ and $10\frac{3}{8}$ to make 20?

5. From the sum of $109\frac{1}{2}$ and $87\frac{2}{9}$ take their difference.

6. A grocer drew at one time $9\frac{1}{8}$ gallons and at another time $15\frac{3}{4}$ gallons from a tank containing $44\frac{3}{16}$ gallons of oil. How many gallons were left?

7. Mary and Alice live on Bryant Avenue, and their school is on the same street, between their homes. Mary walks $40\frac{2}{11}$ rods to school, and Alice $25\frac{1}{3}$ rods. *a.* How much farther does Mary walk than Alice? *b.* How far apart are their homes?

8. It took Mr. Farmer $8\frac{7}{15}$ hours to plow a field, and $13\frac{1}{4}$ hours to plant it. *a.* How much more time was required for planting than for plowing? *b.* How much time was required for both?

9. $13\frac{5}{21} - 2\frac{3}{4} + 7\frac{6}{7} - 4\frac{15}{8} = ?$ Can you find the result in two ways?

10. *a.* $\frac{1}{24} + (\frac{11}{16} - \frac{1}{3}) = ?$ *b.* $8\frac{1}{4} - (\frac{11}{16} + \frac{1}{3}) = ?$

11. Roscoe gave $\frac{1}{3}$ of his new writing pad to his sister and $\frac{1}{5}$ to his brother. What part did he keep?

12. From $16\frac{2}{3} + 12\frac{1}{2} + 5\frac{1}{4}$ take $18\frac{3}{4} + 6\frac{1}{5}$.

13. Add $\frac{5}{6}$, $\frac{5}{8}$, $\frac{5}{12}$, and $\frac{5}{24}$; then subtract $1\frac{1}{2}$ from the sum.

14. After reading $\frac{5}{21}$, $\frac{2}{7}$, and $\frac{1}{3}$ of a book, what part have you yet to read?

15. A owns $79\frac{5}{16}$ acres of land, B $9\frac{7}{8}$ acres less than A, and C $25\frac{3}{4}$ acres less than B. *a.* How many acres has B? *b.* How many acres has C? *c.* How many acres have all three together?

16. From $4223\frac{1}{10}$ take $826\frac{5}{8}$.

17. Take $8\frac{9}{2}$ from $17\frac{3}{11}$.

18. A has $\$64\frac{1}{2}$. B has $\$37\frac{4}{5}$ less than A. How much money have both?

19. $19\frac{7}{16}$ yards of twine were cut from a ball containing $59\frac{7}{12}$ yards. The piece that was left was how much longer than the piece cut off?

20. Add $\frac{7}{8}$, $\frac{8}{9}$, and $\frac{11}{36}$, and subtract the sum from 5.

21. Find the sum of $\frac{3}{8}$, $\frac{4}{5}$, $\frac{9}{10}$, and $\frac{31}{100}$.

22. Find the difference between $\frac{3}{4}$ and $\frac{83}{100}$.

23. A boy walked to his grandfather's in three hours, walking $\frac{39}{100}$ of the distance the first hour and $\frac{7}{25}$ the second hour. What part of the distance did he walk the third hour?

QUICK TEST

110. 1. 39 cents is how much less than one dollar ?
 2. $25 \times 20 = 1000 \div ?$
 3. Which is greater, $\frac{5}{7}$ or $\frac{3}{4}$?
 4. 3400 is the product of 100 and what other number ?
 5. Express $\frac{86}{10}$ in simplest form.
 6. Express $\frac{3}{4}$ as 28ths.
 7. How far will a motor car run in 12 hours if it runs at the rate of 50 miles in 4 hours ?
 8. What is the L. C. M. of 2, 3, 4, and 5 ?
 9. What is the G. C. D. of 21, 35, and 49 ?
 10. 16 is the sum of $10\frac{5}{7}$ and what other number ?

MULTIPLICATION AND DIVISION COMBINED

111. *Written*

$$(20 \div 4) \times (21 \div 7) = ?$$

$$20 \div 4 = 5 \quad 21 \div 7 = 3 \quad 5 \times 3 = 15 \quad \text{Ans.}$$

or,

$$\frac{20}{4} \times \frac{21}{7} = \frac{20 \times 21}{4 \times 7} = 15 \quad \text{Ans.}$$

20 and 21 are dividends and 4 and 7 are divisors. The result is the same whether we make each division separately and then multiply the quotients, or divide the product of the dividends by the product of the divisors. In many cases the latter way is easier, because we may use cancellation; *e.g.*

$$a. (20 \div 4) \times (21 \div 7) = \left(\frac{20}{4} \times \frac{21}{7} \right) = \frac{\overset{5}{\cancel{20}} \times \overset{3}{\cancel{21}}}{\underset{4}{\cancel{4}} \times \underset{7}{\cancel{7}}} = 15 \quad \text{Ans.};$$

$$b. (18 \div 7) \times (28 \div 24) \times (210 \div 15) = \frac{\overset{3}{\cancel{18}} \times \overset{7}{\cancel{28}} \times \overset{42}{\cancel{210}}}{\underset{7}{\cancel{7}} \times \underset{6}{\cancel{24}} \times \underset{5}{\cancel{15}}} = 42 \quad \text{Ans.}$$

Find results :

1. $(12 \div 11) \times (22 \div 5) \times (35 \div 6) \times (15 \div 2)$
2. $(20 \div 6) \times (55 \div 10) \times (42 \div 11)$
3. $(39 \div 13) \times (35 \div 21) \times (12 \div 7) \times (21 \div 3)$
4. $\frac{42}{4} \times \frac{36}{7} \times \frac{63}{14}$
5. $(27 \div 18) \times (35 \div 75) \times (25 \div 12) \times (12 \div 7)$
6. $(68 \div 7) \times (14 \div 8) \times (35 \div 17)$
7. $(52 \div 10) \times (34 \div 13) \times (125 \div 10)$
8. $(26 \div 20) \times (68 \div 13) \times (125 \div 35)$
9. $(70 \div 17) \times (68 \div 24) \times (35 \div 7)$
10. $\frac{75}{42} \times \frac{108}{26} \times \frac{98}{15}$
11. $\frac{49}{56} \times \frac{24}{34} \times \frac{17}{5} \times \frac{20}{3}$
12. Multiply the quotient of 29 divided by 12 by the quotient of 84 divided by 29.

MULTIPLICATION OF FRACTIONS

112. Any integer may be expressed as a fraction by writing it as a numerator with 1 for a denominator, e.g. ; 5 is the same as $\frac{5}{1}$; 19 is the same as $\frac{19}{1}$; $\frac{2}{3} \times 7 \times \frac{15}{2}$ is the same as $\frac{2}{3} \times \frac{7}{1} \times \frac{15}{2}$.

113. The word *of*, between fractions, means the same as the sign of multiplication ; e.g. $\frac{2}{3}$ of $\frac{8}{9} = \frac{2}{3} \times \frac{8}{9}$; $\frac{2}{3}$ of $4 \times \frac{7}{16} = \frac{2}{3} \times 4 \times \frac{7}{16}$.

114. An indicated multiplication of two or more fractions is called a **compound fraction** ; e.g. $\frac{2}{7} \times \frac{8}{9}$; $\frac{3}{16} \times \frac{12}{21} \times \frac{24}{25}$; $\frac{5}{7}$ of $\frac{3}{8}$.

115. *Written*

1. Find the product of $\frac{2}{3}$, $\frac{5}{7}$, and $\frac{9}{16}$.

Each of these fractions indicates what operation ?

Since all the numerators are dividends and all the denominators are divisors, we may find the result by dividing the product of the numerators by the product of the denominators, as in Article 111, using cancellation :

$$\frac{2}{3} \times \frac{5}{7} \times \frac{9}{16} = \frac{15}{56} \text{ Ans.}$$

Find the products :

- | | | |
|--|---|---|
| 2. $\frac{3}{4} \times \frac{4}{5}$ | 8. $\frac{5}{6}$ of $\frac{9}{10}$ of $\frac{4}{5}$ | 14. $\frac{2}{3} \times 7 \times \frac{15}{42}$ |
| 3. $\frac{9}{10} \times \frac{5}{8}$ | 9. $\frac{4}{9} \times \frac{3}{12} \times \frac{6}{7}$ | 15. $\frac{2}{3}$ of $\frac{8}{9} \times 14$ |
| 4. $\frac{7}{9}$ of $\frac{9}{14}$ | 10. $\frac{5}{16} \times \frac{8}{9} \times \frac{3}{4}$ | 16. $\frac{5}{11} \times \frac{16}{15} \times 22$ |
| 5. $\frac{5}{6}$ of $\frac{12}{20}$ | 11. $\frac{9}{25} \times \frac{10}{7} \times \frac{8}{9}$ | 17. $2 \times \frac{3}{8}$ of $\frac{7}{12}$ |
| 6. $\frac{7}{19} \times \frac{9}{14}$ | 12. $\frac{12}{17} \times 34 \times \frac{5}{8}$ | 18. $\frac{3}{17}$ of $34 \times \frac{5}{16}$ |
| 7. $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{2}{3}$ | 13. $\frac{2}{9}$ of 15 | |

Find the value :

- | | | |
|-------------------------|--------------------------|----------------------------|
| 19. $\frac{4}{5}$ of 40 | 22. $\frac{5}{8}$ of 328 | 25. $\frac{17}{18}$ of 342 |
| 20. $\frac{6}{7}$ of 42 | 23. $\frac{3}{7}$ of 721 | 26. $\frac{15}{16}$ of 800 |
| 21. $\frac{3}{5}$ of 16 | 24. $\frac{4}{5}$ of 90 | 27. $\frac{9}{11}$ of 2222 |

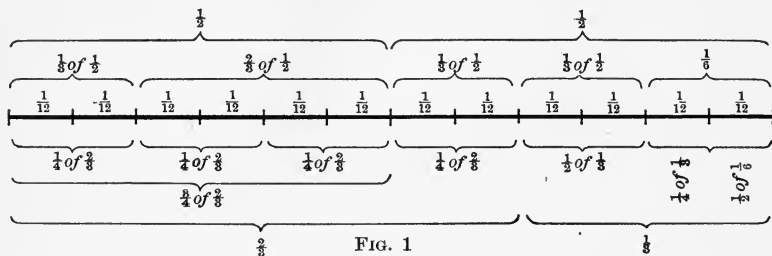
28. Find the areas of rectangles having these dimensions :

- | | |
|--|---|
| a. $\frac{7}{8}$ in. by $\frac{5}{8}$ in. | e. $\frac{63}{80}$ mi. by $\frac{56}{99}$ mi. |
| b. $\frac{2}{3}$ yd. by $\frac{3}{4}$ yd. | f. $\frac{5}{11}$ mi. by $\frac{44}{5}$ mi. |
| c. $\frac{5}{11}$ rd. by $\frac{2}{3}$ rd. | g. $\frac{7}{8}$ mi. by $\frac{40}{99}$ mi. |
| d. $\frac{3}{4}$ ft. by $\frac{8}{9}$ ft. | h. $\frac{11}{15}$ mi. by $\frac{45}{8}$ mi. |

29. What is the cost of $\frac{2}{3}$ of 24 quarts of milk at $5\frac{1}{2}$ cents a quart ?

30. A grocer bought 27 barrels of apples and sold $\frac{5}{9}$ of them at $\$2\frac{1}{5}$ a barrel. How much money did he receive ?

MULTIPLICATION OF FRACTIONS ILLUSTRATED
GRAPHICALLY



116. Look at Fig. 1 and answer :

1. How many 12ths are there in $\frac{1}{3}$?
2. How many 12ths are there in $\frac{1}{2}$ of $\frac{1}{3}$? How many 6ths?
3. How many 12ths are there in $\frac{2}{3}$?
4. How many 12ths are there in $\frac{1}{4}$ of $\frac{2}{3}$?
5. How many 12ths are there in $\frac{3}{4}$ of $\frac{2}{3}$?
6. How many halves are there in $\frac{3}{4}$ of $\frac{2}{3}$? $\frac{3}{4}$ of $\frac{2}{3} = \frac{6}{12} = \frac{1}{2}$.
7. What else is shown in this figure?

Look at Fig. 2 and answer :

A	B	C	D
E			

FIG. 2

1. $A, B, C,$ and D together are what part of Fig. 2?
2. A is what part of $\frac{1}{2}$?
3. A is what part of Fig. 2?
4. A and E together are what part of Fig. 2?
5. A is what part of $\frac{1}{4}$? $\frac{1}{2}$ of $\frac{1}{4} = ?$
6. $A + B + C =$ what part of $\frac{1}{2}$? $A + B + C =$ what part of Fig. 2? $\frac{3}{4}$ of $\frac{1}{2} = ?$

NOTE.—Feet and inches are sometimes indicated by marks, thus: 7' stands for 7 feet; 6'' stands for 6 inches. What does $7\frac{1}{2}''$ stand for? $\frac{7}{8}'$?

From Fig. 3 answer the following questions:

1. How many parts like K are there in the square inch?

2. What part of a square inch is K ?

3. What is the length of K ? The breadth? The area?

4. The top row of oblongs is what part of the square inch? K is what part of that row? $\frac{1}{4}$ of $\frac{1}{8} = ?$

5. The left-hand column of oblongs is what part of the square inch? K is what part of the column? $\frac{1}{8}$ of $\frac{1}{4} = ?$

In Figure 4:

1. M (the unshaded part) is how long? How wide? What is its area?

2. K is what part of the square inch? M contains how many parts like K ? M is what part of the square inch?

What does Fig. 5 show?

Draw on the blackboard a square foot.

Divide two opposite sides into fourths and the other two sides into thirds. Connect the opposite division points. Show that: $a. \frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$. $b. \frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$.

Show as many other facts as you can by that figure.

TO THE TEACHER.— Many exercises similar to the preceding may be given to interest children and make the topic real to them. We must remember, however, that these are mere *graphic verifications* of the rule for multiplication of fractions. They neither prove nor derive the principle. The authority for every operation in fractions is found in the principles of division and the relation of dividend, divisor, and quotient.

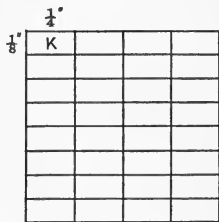


FIG. 3

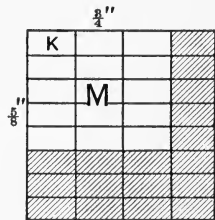


FIG. 4

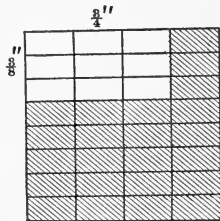


FIG. 5

117. *Oral*

- How much is $\frac{1}{2}$ of $\frac{1}{4}$ of an inch?
- Illustrate that $\frac{1}{4}$ of $\frac{1}{2}$ of an apple is $\frac{1}{8}$ of an apple.
- Multiply $\frac{3}{5}$ by $\frac{1}{4}$; $\frac{4}{5}$ by $\frac{1}{2}$; $\frac{1}{2}$ by $\frac{1}{3}$; $\frac{1}{6}$ by $\frac{1}{2}$.
- How much is $\frac{1}{4}$ of $\frac{4}{7}$? $\frac{3}{5}$ of $\frac{5}{7}$? $\frac{1}{4}$ of $\frac{4}{5}$? $\frac{1}{6}$ of $\frac{6}{11} = ?$
- A man owned $\frac{3}{4}$ of a farm and sold $\frac{1}{2}$ of his share. What part of the farm did he sell?
- James had $\$ \frac{3}{4}$, and John $\frac{2}{3}$ as much. How much had both?
- If a pound of tea costs $\$ \frac{3}{5}$, what will $\frac{1}{4}$ pound cost?
- $\frac{1}{3}$ of $\frac{1}{3}$ of a square yard is what part of a square yard? Show it by a drawing.
- Frank gave Harry $\frac{1}{2}$ of his apple and Harry gave away $\frac{2}{3}$ of his piece. What part of the apple did Harry give away?
- Mr. Greeley, having an acre of ground, took $\frac{1}{4}$ of it for a garden. He planted $\frac{1}{3}$ of the garden to potatoes and $\frac{1}{2}$ as much to corn. What part of an acre of corn did he have?

118. *Mixed numbers may be reduced to improper fractions and then multiplied; thus,*

$$1\frac{2}{3} \times 8\frac{1}{2} \times \frac{5}{17} \times 4 =$$

$$\frac{5}{3} \times \frac{17}{2} \times \frac{5}{17} \times \frac{4}{1} = \frac{50}{3} = 16\frac{2}{3} \text{ Ans.}$$

Written

- | | |
|---|--|
| 1. $4\frac{3}{4} \times 5\frac{1}{2}$ | 4. $35\frac{1}{5} \times 27\frac{8}{9}$ |
| 2. $11\frac{9}{11} \times 7\frac{1}{3}$ | 5. $28\frac{1}{2} \times 17\frac{3}{5}$ |
| 3. $177\frac{2}{3} \times 3$ | 6. Find $\frac{3}{11}$ of $\frac{5}{8}$ of $\frac{11}{12}$ of $8\frac{1}{5}$ |

7. $4\frac{1}{2} \times 7\frac{2}{3}$ 9. $\frac{3}{11} \times 25\frac{2}{3} \times \frac{5}{8}$
8. $5\frac{2}{3} \times 8\frac{6}{7} \times \frac{5}{17}$ 10. $3\frac{1}{2} \times 9\frac{1}{7} \times 6\frac{5}{8}$
11. Multiply $10\frac{1}{2}$ by $\frac{2}{3}$ by $\frac{3}{7}$ by $6\frac{2}{3}$.
12. Multiply : a. $15\frac{7}{9}$ by $14\frac{2}{7}$. b. 16 by $\frac{7}{12}$.
13. $5\frac{3}{4} \times 2\frac{4}{5} \times 20$ 15. $9\frac{1}{4} \times \frac{4}{37} \times 2\frac{1}{5}$ 17. $\frac{7}{16} \times 4 \times 5\frac{1}{2}$
14. $7\frac{1}{2} \times 5\frac{4}{9} \times \frac{3}{7}$ 16. $6\frac{1}{4} \times \frac{11}{25} \times \frac{5}{11}$ 18. $\frac{9}{10} \times 80 \times 5\frac{1}{2}$
19. If a man earns \$2 $\frac{7}{8}$ a day, how much does he earn in 35 days?
20. Multiply $\frac{2}{9}$ by $\frac{5}{6}$ by $\frac{27}{36}$ by $\frac{81}{90}$ by $\frac{9}{21}$.
21. Find the cost of 16 bushels of oats at 37 $\frac{1}{2}$ ¢ a bushel.
22. Mrs. A buys 3 $\frac{1}{2}$ qt. of milk a day. What does she pay for it at 5 $\frac{1}{2}$ ¢ a quart?
23. Show by a diagram that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$.
24. How far can Joe ride in 3 $\frac{3}{8}$ hours if he rides 9 $\frac{1}{3}$ miles an hour?
25. How many square feet of floor are there in a room 12 $\frac{1}{3}$ ft. by 7 $\frac{1}{2}$ ft?
26. Find the cost of 86 cords of wood at \$4 $\frac{3}{4}$ a cord.
27. Find the value of $\frac{2}{3}$ of a chest of tea weighing 57 $\frac{1}{2}$ lb. at \$ $\frac{3}{5}$ per pound.
28. a. $\frac{7}{8}$ of $\frac{5}{9}$ of $\frac{6}{7}$ of $\frac{2}{3}$ of $\frac{4}{5} = ?$ b. $\frac{9}{10}$ of $\frac{6}{7}$ of $\frac{1}{2}$ of $\frac{6}{11} = ?$
29. a. $\frac{6}{11}$ of $\frac{3}{12}$ of $\frac{9}{10}$ of $\frac{15}{20}$ of $\frac{2}{3} = ?$ b. $\frac{7}{8}$ of $\frac{16}{21}$ of $\frac{4}{5}$ of $\frac{25}{8} = ?$
30. Mr. Brown earns \$60 $\frac{3}{4}$ a month, and his son $\frac{2}{3}$ as much. How much does the son earn?
31. At \$12 $\frac{1}{2}$ a ton, how much will 9 $\frac{3}{10}$ tons of hay cost?
32. What will be the cost of 48 $\frac{3}{4}$ yards of cloth at \$ $\frac{4}{5}$ a yard?

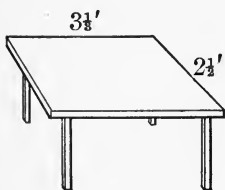
33. A man gave $124\frac{5}{16}$ acres of land to his two sons, giving $\frac{3}{5}$ of it to the elder and $\frac{2}{5}$ to the younger. How many acres did each receive?

34. If it requires $21\frac{3}{4}$ days for a man to dig a ditch, in what time can he dig $\frac{5}{6}$ of it?

REVIEW AND PRACTICE

119. *Oral*

1. Read 305,027,503,060.
2. Read XLVI; CXII; CCIV; XCIII.
3. If 2 sheep are worth \$7, what are 8 such sheep worth?
4. If 12 books, worth \$8 apiece, will pay for a typewriter, how many books at \$6 apiece would pay for it?
5. If I make a purchase for \$9.15, what change should I receive for a \$10 bill?
6. Express in simplest form: $\frac{6}{10}$; $\frac{15}{3}$; $\frac{25}{8}$; $\frac{25}{50}$; $6\frac{5}{10}$; $2\frac{1}{8}$; $42\frac{21}{49}$.



7. What is the area of the top of this table?

8. $280 \div 70 = ?$ $640 \div 40 = ?$

9. Find the product of 32 and 20.

10. $? \div \frac{5}{8} = \frac{4}{5}$ $\frac{1}{9} + \frac{1}{7} = ?$ $\frac{3}{8} \div ? = \frac{4}{5}$.

11. Name two numbers that are prime to each other.

120. *Written*

1. Express in figures one hundred twenty-five million, ten thousand, seven.
2. Find the G. C. D. of 126, 210, and 294.
3. Find the L. C. M. of 720 and 216.

4. Divide the product of 144, 25, and 56 by the product of 48, 120, and 105, using cancellation.

5. When potatoes are worth 55¢ a bushel, how many bushels must be given in exchange for 3 jars of butter, each containing 33 lb. at 25¢ a pound? Indicate the work, and solve by cancellation.

6. When \$150 will buy 189 bushels of wheat, how many bushels will \$50 buy? (\$50 is what part of \$150?)

7. Express in simplest form: a. $\frac{232}{376}$ b. $\frac{588}{37}$ c. $\frac{240}{312}$ d. $17\frac{169}{195}$.

8. Change 18 to ninths.

9. Reduce $\frac{216}{240}$ to a fraction whose terms are prime to each other.

10. How many 40ths are there in $7\frac{5}{8}$?

11. How many 99ths are there in $89\frac{65}{99}$?

12. A certain block in our city is $\frac{11}{40}$ of a mile long and $\frac{18}{33}$ of a mile wide. What part of a square mile of land does it contain?

13. Find the area of both sides of a square piece of cardboard whose edge is $15\frac{3}{8}$ inches.

DIVISION OF FRACTIONS

121. Divide $\frac{35}{72}$ by $\frac{5}{8}$.

Since $\frac{35}{72}$ is a product and $\frac{5}{8}$ is one of its factors, we may state the question thus:

$$\frac{35}{72} = \frac{5}{8} \times ? \quad \text{or} \quad \frac{35}{72} = \frac{5 \times ?}{8 \times ?}$$

In order to find the required factor we must divide the numerator 35 by 5, and the denominator 72 by 8, thus:

$$\frac{35 \div 5}{72 \div 8} = \frac{7}{9}$$

That is exactly what we should do if the question were:

$$\frac{35}{72} \times \frac{8}{5} = ? \quad \frac{\overset{7}{\cancel{35}}}{\underset{9}{\cancel{72}}} \times \frac{\overset{7}{\cancel{8}}}{\cancel{5}} = \frac{7}{9}$$

The latter method is the more convenient, especially when the numerator of the divisor is not exactly contained in the numerator of the dividend or the denominator of the divisor in the denominator of the dividend.

Therefore, *to divide by a fraction we interchange the terms of the divisor and multiply.*

122. Written

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

$$\text{Solution: } 4\frac{2}{3} \div 5\frac{3}{5} = \frac{14}{3} \div \frac{28}{5} = \frac{14}{3} \times \frac{5}{28} = \frac{5}{6} \quad \text{Ans.}$$

(How do we treat mixed numbers?)

2. Divide 47 by $6\frac{1}{2}$.

$$\text{Solution: } 47 \div 6\frac{1}{2} = \frac{47}{1} \div \frac{12}{2} = \frac{47}{1} \times \frac{2}{12} = \frac{94}{12} = 7\frac{3}{12} \quad \text{Ans.}$$

(How do we treat integers?)

3. $\frac{8}{11} \div \frac{4}{33}$

9. $3\frac{1}{2} \div \frac{14}{15}$

15. $8 \div \frac{7}{10}$

21. $2\frac{3}{4} \div \frac{11}{12}$

4. $\frac{7}{8} \div \frac{3}{4}$

10. $5\frac{1}{4} \div \frac{9}{20}$

16. $10 \div \frac{5}{6}$

22. $2\frac{1}{3} \div 3\frac{1}{2}$

5. $\frac{11}{12} \div \frac{5}{6}$

11. $\frac{3}{11} \div 5\frac{3}{4}$

17. $\frac{7}{8} \div 14$

23. $8\frac{1}{9} \div 9\frac{1}{7}$

6. $\frac{5}{18} \div \frac{3}{4}$

12. $\frac{7}{10} \div 4\frac{1}{5}$

18. $\frac{16}{21} \div 8$

24. $\frac{49}{72} \div \frac{14}{27}$

7. $\frac{16}{27} \div \frac{2}{3}$

13. $\frac{13}{15} \div 5\frac{1}{2}$

19. $2\frac{3}{4} \div 5\frac{1}{2}$

25. $\frac{42}{55} \div \frac{7}{11}$

8. $\frac{14}{15} \div \frac{7}{10}$

14. $2 \div \frac{4}{5}$

20. $7\frac{1}{8} \div 1\frac{1}{2}$

26. $10\frac{2}{9} \div 4\frac{10}{27}$

27. By what must $\frac{24}{35}$ be multiplied to make $\frac{36}{7}$?

28. One factor of $\frac{34}{9}$ is $\frac{17}{84}$. What is the other?

29. How many pieces $\frac{7}{8}$ of an inch long can be cut from a wire that is $10\frac{1}{2}$ inches long?

30. When $3\frac{3}{8}$ lb. of beef steak are worth $57\frac{3}{8}$ cents, what is the value of one pound?

123. *Division of fractions is sometimes indicated by writing the dividend above and the divisor below a line. Such an expression is called a complex fraction; e.g.*

$$\frac{\frac{3}{8\frac{2}{5}}}{\frac{2}{16}}, \frac{\frac{5\frac{1}{2}}{25}}{\frac{3\frac{2}{3}}{7\frac{4}{9}}}, \text{ and } \frac{\frac{2}{3} \div 9}{1\frac{3}{8} - \frac{2}{5}}$$

are complex fractions. Read each fraction.

A fraction whose terms are integers is a simple fraction; e.g. $\frac{1}{12}$ is a simple fraction.

1. Reduce $\frac{7}{8\frac{2}{3}}$ to a simple fraction.

$$\frac{7}{8\frac{2}{3}} = 7 \div 8\frac{2}{3} = \frac{7}{1} \div \frac{26}{3} = \frac{7}{1} \times \frac{3}{26} = \frac{21}{26}. \text{ Ans.}$$

2. Reduce $\frac{5}{17\frac{7}{40}}$ to a simple fraction.

$$\frac{5}{17\frac{7}{40}} = \frac{5}{17} \div 40 = \frac{5}{17} \times \frac{1}{40} = \frac{1}{136}. \text{ Ans.}$$

3. Reduce $\frac{7\frac{5}{8}}{21\frac{3}{20}}$ to its simplest form.

$$\frac{7\frac{5}{8}}{21\frac{3}{20}} = 7\frac{5}{8} \div 21\frac{3}{20} = \frac{61}{8} \div \frac{53}{20} = \frac{61}{8} \times \frac{20}{53} = \frac{305}{106} = 2\frac{93}{106}. \text{ Ans.}$$

In examples 4–13 change the given complex fractions to simple fractions by performing the indicated divisions :

4. $\frac{7\frac{1}{9}}{\frac{16}{27}}$

6. $\frac{15\frac{3}{4}}{4}$

8. $\frac{19}{16\frac{4}{5}}$

10. $\frac{3\frac{1}{2}}{\frac{7}{10}}$

12. $\frac{\frac{1}{4} \text{ of } \frac{7}{8}}{\frac{2}{3} \text{ of } \frac{5}{6}}$

5. $\frac{18\frac{1}{2}}{\frac{4}{5}}$

7. $\frac{17}{\frac{18}{16}}$

9. $\frac{\frac{7}{8}}{\frac{9}{16}}$

11. $\frac{18}{\frac{9}{16}}$

13. $\frac{\frac{2}{3} \text{ of } 5\frac{1}{2}}{\frac{7}{8}}$

14. If $\frac{3}{5}$ of an acre of land is worth \$72 $\frac{3}{10}$, what is the value of an acre at the same rate ?

15. There are 5 $\frac{1}{2}$ yards in a rod. How many rods in 70 $\frac{1}{8}$ yards ?

16. At \$6 $\frac{1}{4}$ a ton, how many tons of coal can be bought for \$73 $\frac{1}{2}$?

EXAMPLES FOR PRACTICE

124. 1. $2\frac{1}{7} \times \frac{7}{8} \div 1\frac{1}{2} = ?$

2. Multiply $\frac{12}{17}$ by $\frac{13}{16}$ and divide the product by $1\frac{3}{17}$.

3. a. $14\frac{2}{3} \div 7\frac{1}{3} = ?$ b. $7\frac{1}{3} \div 14\frac{2}{3} = ?$

4. Change to a simple fraction $\frac{7\frac{1}{2}}{\frac{3}{4} \times 12\frac{1}{2}}$.

5. $45\frac{1}{2} \div 6\frac{1}{2} - \frac{3}{8} + \frac{1}{16} = ?$

6. What is one third of one hundred seventy-five and one half ?

7. The multiplicand is $1\frac{5}{18}$ and the product is $2\frac{5}{4}$. Find the multiplier.

8. Simplify $\frac{2\frac{1}{4} \div \frac{3}{5}}{4\frac{1}{12} - \frac{5}{6}}$.

9. How many pounds of sugar at $6\frac{1}{4}$ cents a pound will pay for $12\frac{1}{2}$ dozen eggs at 16 cents a dozen?

10. When 15 yards of silk cost $\$16\frac{7}{8}$, what is the price per yard?

11. Divide $75\frac{3}{5}$ by $14\frac{3}{7}$.

12. Find the value of $\frac{5\frac{3}{10}}{1\frac{1}{2}} - \frac{1\frac{3}{5}}{1\frac{5}{16}}$.

13. In one month Mr. Finlay earned $\$46\frac{3}{4}$, his wages being $\$2\frac{3}{4}$ a day. How many days did he work?

14. Divide $\frac{3}{4}$ of $\frac{2}{3}$ of $2\frac{3}{5}$ by $\frac{7}{9}$ of $\frac{2}{5}$ of 7.

15. $\$75$ will pay for how much corn at $\$\frac{2}{5}$ a bushel?

16. Divide the sum of $4\frac{7}{8}$ and $5\frac{2}{3}$ by their difference.

17. If $\frac{7}{8}$ of a mile of telephone wire was divided into 14 equal pieces, how long was each piece?

18. By what must $2\frac{1}{8}$ be multiplied to obtain $2\frac{3}{7}$?

19. By what must $3\frac{8}{9}$ be divided to obtain $1\frac{4}{11}$?

20. How many aprons can be made from $10\frac{1}{2}$ yards of cloth, if $1\frac{3}{4}$ yards are enough for one apron?

21. Divide $85\frac{1}{7}$ by $14\frac{2}{3}$.

AVERAGES

SOLUTION

125. 1. Jacob weighed six of his chickens, and found their weights to be 68 oz., 40 oz., 63 oz., 47 oz., 55 oz., and 70 oz. What was the average weight of the chickens?

68 oz.	
40 oz.	
63 oz.	
47 oz.	
55 oz.	
70 oz.	
6)343	oz. Total weight.
57 $\frac{1}{3}$	oz. Average weight, Ans.

2. Harry's marks in spelling for a month were as follows:

	1ST WEEK	2D WEEK	3D WEEK	4TH WEEK
Monday	80	75	78	80
Tuesday	86	90	84	88
Wednesday	83	82	90	92
Thursday	88	80	86	96
Friday	92	76	90	100

a-d. Find Harry's average for each week.

e-i. Find his average for all the Mondays, all the Tuesdays, etc.

j. How much higher was his fourth week's average than his average for all the Mondays?

k. On which day of the week did he spell best?

l. What was Harry's general average for the month?

3. Here are the standings of seven girls in three examinations:

	MARION	FRANCES	DOROTHY	HELEN	JESSIE	HAZEL	RUTH
Arithmetic,	70	93	98	92	70	83	95
Geography,	93	90	76	98	90	84	80
Language,	95	88	95	79	96	85	76

a. Which girl has the highest average?

b. What is the average of the class in language? *c.* In arithmetic? *d.* In geography?

e. Find the difference between Marion's average and Hazel's.

f. Between Ruth's and Jessie's.

g. Find the general average of the class.

h. Find the difference between Helen's average and the average of the class.

4. Our outdoor thermometer indicated the following temperatures for the mornings of last week: 76°, 82°, 80°, 67°, 60°,

70°, 81°. The week before the record was 60°, 63°, 58°, 57°, 70°, 68°, 72°. For which week was the average temperature higher, and how much higher was it?

IDEAS OF PROPORTION

126. *Oral*

1. 2 is what part of 6? If 6 quarts of beans cost 45 cents, what will 2 quarts cost?
2. 14 is how many times 2? What will 14 pears cost at the rate of 2 for 5 cents?
3. 18 is how many times 3? If a boy is paid 20 cents for 3 hours' work, what should he receive for 18 hours' work?
4. If a boy works 6 days to earn \$4, how long should he work to earn \$10?
5. What should I receive for 5 weeks' work when I earn \$16 in 5 days?
6. One gallon is how many times 1 quart? 10 gallons are how many times 10 quarts? When 10 quarts of milk cost 60 cents, what should be paid for 10 gallons of milk?
7. If 14 five-pound jars of butter will last a family a certain time, how many ten-pound jars would last the same time?

127. *Written*

1. 3 is what part of 4? What should a man pay for three acres of land when 4 acres are worth \$189?
2. How many bushels of wheat can be raised on 42 acres of land when 159 bushels are raised on 7 acres?
3. How many tons of hay can be bought for \$3600 when 17 tons cost \$300?

4. How many 10-gallon cans may be filled from a tank of oil that will fill 155 two-gallon cans ?

5. Five is how many times three ? How far can a man walk in 5 days if he walks at the rate of 67 miles in 3 days ?

6. Find the amount of cloth needed for 36 suits when $17\frac{2}{3}$ yd. will make 3 suits.

7. How many 8-quart baskets of peaches would it take to equal in value 5346 bushel baskets of peaches ?

REVIEW AND PRACTICE

128. *Oral*

1. What is the L. C. M. of 8 and 12 ?

2. Name two other common multiples of 8 and 12.

3. Which of these numbers are composite : 15, 13, 29, 36, 71, 83, 87, 91, 97, 99 ?

4. Name two numbers that are prime to each other.

5. Name a number that will exactly contain 13.

6. What is the smallest number that will exactly contain 3, 4, and 6 ?

7. $\frac{1}{2}$ of $\frac{1}{3} = ?$ $\frac{1}{2}$ and $\frac{1}{3} = ?$ $\frac{1}{2}$ less $\frac{1}{3} = ?$ $\frac{1}{2}$ times $\frac{1}{3} = ?$
 $\frac{1}{2} \div \frac{1}{3} = ?$

8. From $\frac{3}{4}$ take $\frac{2}{3}$.

9. A farmer having 60 sheep sold $\frac{1}{4}$ of them at one time and $\frac{1}{5}$ at another. How many had he left ?

10. A field of $3\frac{7}{8}$ acres was planted to corn and potatoes. There were $1\frac{3}{4}$ acres of potatoes. How many acres of corn were there ?

11. A lady went shopping with \$10. After spending $\$3\frac{3}{4}$ in one store and $\$5\frac{1}{2}$ in another, how much money had she?

12. Change $\frac{1}{18}$ to a fraction whose terms are prime to each other.

13. Change $4\frac{1}{5}$ to an improper fraction.

14. Find the value of $2\frac{1}{5}$.

15. My mother paid 8 cents for one melon, 7 cents for another, and 10 cents for another. What was the average cost?

16. Show by means of a circle that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$.

129. *Written*

1. Draw a clock face, using Roman numerals. Let the hands indicate a quarter past 9.

2. Find the wages of 8 men for $5\frac{3}{4}$ days at $\$3\frac{1}{2}$ a day.

3. 15 sheep at $\$2\frac{5}{8}$ apiece will pay for how many yards of cloth at $\$3\frac{3}{8}$ per yard?

4. A watch gains $1\frac{1}{2}$ seconds every day. How many minutes does it gain in the months of June and July?

5. There are 609 pupils in a school, $\frac{4}{7}$ of whom are girls. How many boys are there?

6. Divide $\frac{1\frac{1}{2}}{\frac{2}{3}}$ by $\frac{2\frac{2}{5}}{\frac{1}{6}}$.

7. A man spent $\frac{2}{3}$ of his money and had \$60 left. How much had he at first?

8. a. $15\frac{3}{8} \times 16\frac{7}{8} = ?$ b. $16\frac{2}{3} \div 33\frac{1}{8} = ?$ c. $5\frac{3}{8} \div 1\frac{1}{3} = ?$

9. $(2\frac{1}{2} + \frac{6}{7} + 3) \div \frac{3}{5} = ?$

10. If $6\frac{1}{4}$ bushels of rye cost $\$5\frac{3}{4}$, what is the cost of 1 bushel?

11. Change to a simple fraction $\frac{1}{2}$ of $\frac{2}{3}$.
12. \$78 $\frac{5}{8}$ will buy how many barrels of flour at \$4 $\frac{5}{8}$ a barrel?
13. Find the value of $\frac{5\frac{3}{4}}{6\frac{1}{2}}$.
14. The area of a wall map is 976 $\frac{7}{8}$ square inches. Its length is 42 $\frac{1}{2}$ inches. Find its width.
15. An alley between two houses is $\frac{3}{8}$ of a rod wide and 7 $\frac{1}{2}$ rods long. How many square rods of land does it contain?



16. *a.* The bunches of bananas hanging in this fruit stand contain respectively 98, 124, 62, and 140 bananas. What is the average number of bananas per bunch?
- b.* The two smaller bunches are red, and sell at the rate of 2 for 5 cents. What are they all worth?
- c.* What will the others bring at 15 cents a dozen?
- d.* If the four bunches were bought at \$1.09 per bunch, what will be the entire profit on the sales?

17. Mr. Scotese, the fruit dealer, bought 5 bushels of apples for \$3.25. They average 136 apples per bushel. He sells them all at the rate of 4 for 5 cents.

- a. What is the cost per bushel?
- b. What is received for a bushel?
- c. What is the profit on 5 bushels?

18. a. He sold a dollar's worth of pears at the rate of 3 for 5 cents. How many pears did he sell?

b. If he should put the pears in baskets, 12 in each basket, and offer them to you at 14 cents a basket, or at the rate of 4 for 5 cents, which offer would you take?

19. a. He bought peaches at \$1 a basket and sold them at 15 cents a quart. There were 10 quarts in a basket. What was his profit on 5 baskets of peaches?

b. If 9 of these peaches would make a quart, and they were sold at 2 cents apiece, what would be the profit on a basket of peaches?

20. What was his profit on 50 baskets of Delaware grapes bought at $12\frac{1}{2}$ ¢ a basket and sold at 18¢ a basket?

21. He bought chestnuts at \$4.00 a bushel and sold them at 20 cents a quart. What did he gain on a quart?

22. Spanish shelled peanuts cost him \$9.80 a sack, each sack containing 140 pounds. He sold them at 12 cents a pound. What was the profit on a sack?

23. He bought 50 watermelons at 23 cents apiece and sold them at 40 cents each. What was his profit?

24. He paid \$8 a hundred for cantaloupes and sold them for 12 cents apiece. How much did he gain on a hundred?

25. John earned \$6 $\frac{3}{4}$ one week, \$8 $\frac{3}{8}$ the second, and \$7 $\frac{1}{2}$ the third. What were his average earnings per week?

26. How many pounds of sugar, at 5 $\frac{1}{2}$ cents a pound, are equal in value to 6 $\frac{1}{3}$ dozen eggs, at 15 cents a dozen?

27. Divide $\frac{1\frac{3}{5}}$ of $\frac{9}{11}$ by $3\frac{2}{3}$ times $1\frac{7}{11}$.
28. Divide $\frac{3}{5}$ of $\frac{5}{7}$ of $\frac{4}{9} \times 3\frac{1}{4}$ by $\frac{5}{8}$ of $\frac{1\frac{2}{5}}$ of $\frac{4}{9}$.
29. Solve in the easiest way :
- a. If 6 acres of land cost \$438, what will 42 acres cost ?
- b. How many loads of earth can be bought for \$80 when \$400 will buy 1135 loads ?
30. $\frac{7}{9}$ is how many times $\frac{2}{1}$?

ALIQOT PARTS

130. *One of the equal parts of a number is an aliquot part of that number; e.g. 8 oz. is an aliquot part of 16 oz. because 8 oz. is $\frac{1}{2}$ of 16 oz. ; $16\frac{2}{3}$ cents is an aliquot part of 100 cents because $16\frac{2}{3}$ cents = $\frac{1}{6}$ of 100 cents.*

Find the number of cents in $\$ \frac{1}{2}$; $\$ \frac{1}{3}$; $\$ \frac{1}{4}$; $\$ \frac{1}{5}$; $\$ \frac{1}{6}$; $\$ \frac{1}{7}$; $\$ \frac{1}{8}$; $\$ \frac{1}{10}$; $\$ \frac{1}{12}$; $\$ \frac{1}{20}$.

The answers you have given are all what kind of parts of a dollar?

Prove the correctness of the following table :

PARTS OF A DOLLAR

5 cents = $\$ \frac{1}{20}$	$33\frac{1}{3}$ cents = $\$ \frac{1}{3}$
$6\frac{1}{4}$ cents = $\$ \frac{1}{16}$	$37\frac{1}{2}$ cents = $\$ \frac{2}{8}$
$8\frac{1}{3}$ cents = $\$ \frac{1}{12}$	50 cents = $\$ \frac{1}{2}$
10 cents = $\$ \frac{1}{10}$	$62\frac{1}{2}$ cents = $\$ \frac{5}{8}$
$12\frac{1}{2}$ cents = $\$ \frac{1}{8}$	$66\frac{2}{3}$ cents = $\$ \frac{2}{3}$
$16\frac{2}{3}$ cents = $\$ \frac{1}{6}$	75 cents = $\$ \frac{3}{4}$
25 cents = $\$ \frac{1}{4}$	$87\frac{1}{2}$ cents = $\$ \frac{7}{8}$

Which column in the table gives aliquot parts? This table should be committed to memory like the multiplication table, because its use will shorten many problems, e.g. 33 books, at $\$.16\frac{2}{3}$ each, will cost $33 \times \$ \frac{1}{6} = \$ 5\frac{1}{2}$.

131. *Oral**Multiply:*

- | | |
|--------------------------------|--------------------------------|
| 1. $12\frac{1}{2}$ cents by 16 | 7. $37\frac{1}{2}$ cents by 8 |
| 2. $16\frac{2}{3}$ cents by 12 | 8. 50 cents by 15 |
| 3. 25 cents by 20 | 9. $62\frac{1}{2}$ cents by 8 |
| 4. $33\frac{1}{3}$ cents by 27 | 10. $66\frac{2}{3}$ cents by 9 |
| 5. $6\frac{1}{4}$ cents by 16 | 11. 75 cents by 4 |
| 6. $8\frac{1}{3}$ cents by 24 | 12. $87\frac{1}{2}$ cents by 8 |

13. What is the cost of:

16 pounds of bacon at $12\frac{1}{2}$ ¢ a pound?

16 balls at 50¢ each?

36 yards of ribbon at $33\frac{1}{3}$ ¢ a yard?

36 pounds of candy at 25¢ a pound?

8 pounds of tea at $62\frac{1}{2}$ ¢ a pound?

14. When 4 geographies cost \$3, what is the cost of one? Of 9? Of 11? Of 15? (There is an easier way to find the cost of 20 geographies. What is that way?)

15. At \$.75 apiece, what must be paid for 3 chairs? 4 chairs? 6 chairs? 16 chairs? 40 chairs?

132. *Written*

What is the cost of:

166 pounds of pork at $12\frac{1}{2}$ cents a pound?348 pounds of veal at $16\frac{2}{3}$ cents a pound?

265 boxes of strawberries at 25 cents a box?

1215 yards of flannel at $33\frac{1}{3}$ cents a yard?

3580 pounds of honey at 20 cents a pound?

748 pounds of tea at 50 cents a pound?

Oral

1. At 25¢ a pound, how many pounds of butter can be bought for \$8? (How many pounds can be bought for \$1? For \$8?)

Divide:

2. \$3 by $33\frac{1}{3}$ ¢

5. \$9 by $12\frac{1}{2}$ ¢

8. \$6 by $33\frac{1}{3}$ ¢

3. \$5 by 25¢

6. \$1 by $6\frac{1}{4}$ ¢

9. \$4 by $12\frac{1}{2}$ ¢

4. \$2 by $8\frac{1}{3}$ ¢

7. \$10 by 50¢

10. \$2 by 25¢

11. \$3 divided by $8\frac{1}{3}$ ¢ = ?

12. At 25 cents apiece, how many hats can be bought for \$6?

13. At 25 cents a pound, how many pounds of cheese can be bought for \$5?

14. At $16\frac{2}{3}$ cents a dozen, how many dozen eggs can be bought for \$4?

15. How many pounds of beef can be bought for \$4 at $16\frac{2}{3}$ ¢ a pound?

16. At $33\frac{1}{3}$ ¢ a yard, how many yards of linen can be bought for \$10?

17. How many penknives can be bought for \$6 at $33\frac{1}{3}$ cents apiece?

18. $24 \times 12\frac{1}{2}$ ¢ = ?

19. $\$24 \div 12\frac{1}{2}$ ¢ = ?

DECIMALS

133. Each removal of a figure one place to the right affects its value how?

We have used this principle thus far in dealing with integers only; but it holds true also for numbers smaller than one. Thus,

$$\text{Moving 5 to the right} \left\{ \begin{array}{l} 5000. \\ 500. = 5000. \quad \div 10 \\ 50. = 500. \quad \div 10 \\ 5. = 50. \quad \div 10 \\ .5 = 5. \quad \div 10 = \frac{5}{10} \\ .05 = .5 \quad \div 10 = \frac{5}{100} \\ .005 = .05 \quad \div 10 = \frac{5}{1000} \\ .0005 = .005 \quad \div 10 = \frac{5}{10000} \end{array} \right.$$

$$\text{Moving all the figures to the right} \left\{ \begin{array}{l} 734. = 7340. \quad \div 10 \\ 73.4 = 734. \quad \div 10 = 73\frac{4}{10} \\ 7.34 = 73.4 \quad \div 10 = 7\frac{34}{100} \\ .734 = 7.34 \quad \div 10 = \frac{734}{1000} \end{array} \right.$$

Notice that we place the decimal point (.) at the right of units' place. This shows where the integer ends and the fraction begins. The places at the right of the decimal point are called decimal places and are named much like those at the left, thus :

Thousands	Hundreds	Tens	Units	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
4	6	3	8	. 7	5	4	9	6	5

.7 is read *seven tenths*.

.75 is read *seventy-five hundredths*.

.754 is read *seven hundred fifty-four thousandths*.

.7549 is read *seven thousand five hundred forty-nine ten-thousandths*.

Oral

1. Read .8; .49; .786; .4923; .56249; .387654.
2. Read 500; 50; 5; .5; .05; .005; .0005; .00005.
3. Read .25; .36; .39; .47; .365; .3; .7; .403; .07; .009.
4. How many cents make one dollar? What part of a dollar is one cent? 7 cents? 19 cents? 41 cents? 97 cents?
5. We write 25 cents, \$.25, because it is 25 hundredths of a dollar. One dime is 1 tenth of a dollar. How would you write it? Write on the blackboard: 5 dimes; 7 dimes; 8 dimes; 3 dimes.
6. 4321.648 is read 4321 *and* 648 *thousandths*.

Notice that *and* is used between the integer and the fraction. Read: 6.42; 17.5; 4.23; 583.97; .640; 7.640; 439.018; 9341.215; 68.43; 70.9; 893.047; 903.03; 642.008; 95.249.

Read: 3.4; .0034; .987; 2048.017; .00315; 200.02.

Write in words on the blackboard: 35.08; 6.5; .084; .6082; 235.235; 64.105; 308.02; 56.081; 30.130.

134. The product of equal factors is a power:

e.g. 4 is a power of 2 because $2 \times 2 = 4$

8 is a power of 2 because $2 \times 2 \times 2 = 8$

81 is a power of 3 because $3 \times 3 \times 3 \times 3 = 81$

100 is a power of 10 because $10 \times 10 = 100$

Name 3 other powers of 10.

135. A fraction whose denominator is 10 or a power of 10 is a decimal fraction; e.g. $\frac{6}{10}$, $\frac{59}{1000}$, .25, .3421. Only decimal fractions can be expressed by use of the decimal point as in the

last exercise. When a decimal fraction is thus expressed, how may we tell what the denominator is? Name some decimal fractions not given here.

136. A number that is composed of an integer and a decimal fraction is called a **mixed decimal**; e.g. 2.5; 130.35; 21.007.

137. A fraction that is expressed by writing the numerator above and the denominator below a line is a **common fraction**; e.g. $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{9}$, $\frac{13}{16}$, $\frac{8}{10}$.

138. Change to the decimal form:

1. $\frac{25}{100}$

6. $\frac{384}{1000}$

11. $\frac{25}{1000}$

16. $\frac{9}{10}$

2. $\frac{85}{100}$

7. $\frac{49}{100}$

12. $\frac{11}{100}$

17. $\frac{1}{10}$

3. $\frac{326}{1000}$

8. $\frac{5}{10}$

13. $\frac{9}{100}$

18. $5\frac{40}{100}$

4. $\frac{6}{10}$

9. $\frac{6}{100}$

14. $\frac{500}{1000}$

19. $8\frac{2}{10}$

5. $\frac{16}{100}$

10. $\frac{15}{1000}$

15. $\frac{50}{100}$

20. $64\frac{683}{1000}$

Change to common fractions and read:

21. .36

26. .485

31. 5.6

22. .7

27. .016

32. 5.06

23. .125

28. .16

33. 5.006

24. 12.2

29. .06

34. 5.600

25. 6.25

30. .6

35. 5.060

Write, first as common fractions, or mixed numbers, then as decimals:

36. Four tenths.

37. Seventy-five hundredths.

38. One hundred twenty-five thousandths.

39. Sixteen, and forty-eight hundredths.
40. Twelve, and four tenths.
41. Six tenths.
42. Six hundredths.
43. Six thousandths.
44. How many decimal figures are required to express thousandths? Hundredths? Tenths?
45. Read the numerators only in examples 36 to 43.

Write the following as decimals, and read the numerator and denominator of each :

46. Two hundred eighty-two thousandths.
47. Fifty-six hundredths.
48. Seven tenths.
49. Six hundred thousandths.

139. *Oral*

1. What part of 10 units is 1 unit?
2. What part of 1 ten is 1 unit?
3. What part of 2 hundreds is 2 tens?
4. In the number 555, what is the value of the first 5 at the right? The second 5? The third 5?
5. Upon what does the value of any figure depend?
6. In the number 555, the value of the first 5 is what part of the value of the second 5?
7. $\frac{2}{10}$ is what part of 2 units?
8. In the number 5.5, the value of the right-hand 5 is what part of the value of the left-hand 5?

9. In the decimal .555, what is the value of the first 5 at the right? The second 5? The third 5?

10. Name the denominator of .6; .17; .105; .006; .05; .225; .3478; .06; .049; .207; .3007.

11. Read the numbers in question 10.

12. *Read:*

a. .368

j. 37.005

s. $.42\frac{1}{2}$

b. .894

k. 25.2036

t. $.69\frac{1}{6}$

c. .5328

l. 38.000006

u. $.8\frac{1}{3}$

d. .2053

m. .498369

v. $.637\frac{3}{4}$

e. 25.623

n. 4.9836

w. $.4378\frac{1}{8}$

f. 7.0063

o. 49.836

x. $.809\frac{7}{11}$

g. 28.3005

p. 498.36

y. $.430\frac{7}{10}$

h. .28962

q. .000400

z. $.6842\frac{1}{3}$

i. 15.605

r. .0004

Write decimally:

1. Eight tenths.
2. 29 hundredths.
3. Sixteen, and 284 thousandths.
4. 4584 ten-thousandths.
5. Twenty-five hundredths.
6. Twenty-five thousandths.
7. Twenty-five ten-thousandths.
8. Twenty-five hundred-thousandths.
9. Twenty-five millionths.
10. 1650, and 464 thousandths.

11. One thousand one, and 36 hundred-thousandths.
12. Sixteen, and six thousandths.
13. Seven hundred eighty-four millionths.
14. Twelve hundred-thousandths.
15. Seventy-five ten-thousandths.
16. Seven hundred five thousandths.
17. Seven hundred, and five thousandths.
18. Four thousand three ten-thousandths.
19. Four thousand, and three ten-thousandths.
20. Twenty-four, and five hundred-thousandths.
21. Seventy-one, and seven hundred-thousandths.
22. Four hundred thirty-five, and four thousandths.
23. Eight thousand three hundred forty-one ten-thousandths.
24. Ninety-nine, and eighty-six thousandths.
25. Seventy-eight, and four thousandths.
26. Nine thousand seven, and two hundred seven ten-thousandths.
27. One, and one hundred thousandths.
28. One thousand one, and one hundred one thousandths.
29. Ten, and ten ten-thousandths.
30. One hundred, and one hundred ten thousandths.
31. One hundred one, and one hundred ten-thousandths.
32. One thousand one ten-thousandths.
33. One thousand, and one ten-thousandth.
34. Two hundred seven thousand, and two hundred seven thousandths.
35. Six, and six thousand ten-thousandths.

ADDITION AND SUBTRACTION OF DECIMALS

140. Since decimal figures increase in value from right to left, like the figures in whole numbers, we may add and subtract decimals as we add and subtract whole numbers, taking care to write them so that the decimal points are all in a column, thus :

4.375	391.42
.35	165.70316
28.3065	225.71684
351.294	<i>Difference</i>
384.3255	

Sum

The vacant places in the addends and in the minuend are treated as if they were occupied by ciphers.

Add:

1. 2.2	2. 3.25	3. 4.5	4. .004
34.5	7.163	.168	4.1
79.89	15.0032	2.12	16.1563

5. $.175 + 1.75 + 17.5 + 175.$
6. $145 + 14.5 + 1.45 + .145 + .0145.$
7. $3.2 + 14.0063 + .006 + 25.384 + .1.$
8. $.8 + .446 + 59.3 + 2.575 + 1.0056 + .3.$
9. $1.45 + 2.365 + 96 + .96 + 15.863 + 4.3 + .0004.$
10. $446 + 44.6 + 37562 + 9 + .8 + .321 + .16.$
11. $21.0005 + .3842 + .1 + .005 + 3.6 + .158.$
12. $1.0006 + 2001.1 + .003 + 5.5 + 11.1111.$
13. $205.07 + 301.2 + 687.9124 + 83.045 + 200.$
14. $.308 + 308. + 8.09 + 9.0786 + 859.$
15. $2378. + 23.50 + .890 + .089 + 1.0886.$

141. 1. *Subtract:*

<i>a.</i> 24.3	<i>b.</i> 2.86	<i>c.</i> 4.	<i>d.</i> 2.46
<u>4.5</u>	<u>1.325</u>	<u>1.15</u>	<u>.005</u>

2. $7 - .15$

7. $29.325 - 15.14$

3. $1 - .004$

8. $3.852 - .125$

4. $13 - 2.1$

9. $1.1111 - .0011$

5. $3.256 - 1.05$

10. $500 - .05$

6. $256.1 - 1.256$

11. $25.3894 - 15.005$

12. From twenty-eight, and twenty-five thousandths take fourteen, and twenty-five hundredths.

13. From one tenth take one thousandth.

14. *a.* Which is the greater, fifty thousandths or five hundredths? *b.* Three tenths or three hundred thousandths?

15. Take one thousandth from one thousand.

16. From 5 hundred take 5 hundredths.

142. *Find results:*

1. $175 - 30.23$.

2. $.015 + 1.05 + .57 + 5.7 + 1.04 + .0045 + 75.36$.

3. $50.4 - .504$.

4. $25.006 + 200.00008 + 6.00005 + 49.005 + 300.059$.

5. $2.005 + 5.5 + 25.010 - 3.2045$.

6. Find the sum of two hundred forty, and four hundred fifty thousandths; thirty-four, and three hundredths; six hundred four, and six hundred four ten-thousandths; fifty, and five tenths.

7. A boy had two balls of kite string. One contained 145.3025 yards and the other 84.3502 yards. He made a kite string 200.02 yards long. How much string had he left?

8. *Subtract:*

$$\begin{array}{r} a. \ 32.854 \\ \underline{9.378} \end{array}$$

$$\begin{array}{r} c. \ 86.2 \\ \underline{43.948} \end{array}$$

$$\begin{array}{r} e. \ 21.101 \\ \underline{7.999} \end{array}$$

$$\begin{array}{r} b. \ 19.042 \\ \underline{16.854} \end{array}$$

$$\begin{array}{r} d. \ 36.015 \\ \underline{24.008} \end{array}$$

$$\begin{array}{r} f. \ 28.78 \\ \underline{21.987} \end{array}$$

9. There are four villages on the same road. From the first to the second is 8.46 miles; from the second to the third, 10.5 miles; from the first to the fourth, 25 miles. Make a picture of the road and find the distance from the third to the fourth village.

MULTIPLYING AND DIVIDING BY MULTIPLES OF TEN

143. *Oral*

1. How can we multiply decimals by 10? By 100? By 1000?

2. *Multiply by 10:*

5.25; .06; 3.7; 593.207; 6.800; 9.16; 82; 420; .035; .0061.

3. *Multiply by 100:*

61.843; 3.215; 75.16; 3.18; .65; 2.3; 5; 520.

4. Multiply .0612 by 10; by 100; by 1000; by 10,000; by 100,000; by 1,000,000.

5. By what must .0503 be multiplied to obtain .503? 503? 50.3? 5030.?

6. Moving the decimal point one place to the left is the same as moving all the figures of the number one place to the right. For example, moving the decimal point one place to the left in the number 42.3, it becomes 4.23. How does this affect the value of the number?

7. What, then, is the easiest way to divide a decimal by 10?

8. *Divide by 10:*

35.; 247.; 385.; 16.; 24.3; 2.59; 347.69; 8.137; 42.69;
394.68; .725; .042.

9. How may we divide decimals by 100? By 1000? By 10,000?

10. *Divide by 100:*

3567.8; 937.; 635.25; 42304.; 687.96; 485.03.

11. *Divide by 1000:*

986; 5321; 63,485; 983.7; 4284.25.

12. *Divide by 10,000:*

389,076; 42,831; 68,379.5; 425.

13. By what must 8193 be divided to obtain 819.3? 8.193?
81.93? .8193? .08193? .008193?

14. How must the decimal point be moved to change tenths to hundredths? Thousandths to tenths? Thousandths to millionths?

15. *Divide as follows:*

64.2 by 10; 83.75 by 10; 63.59 by 100; 4251 by 10,000;
33 by 1000; 5 by 100.

16. What is the effect of moving the decimal point three places to the left? One place? Two places? Four places? Six places?

17. *Find results:*

3.5×10 ; $6.5 \div 10$; $83 \div 1000$; $.987 \div 10,000$; $.8432 \times 100,000$.

18. What is the effect of moving the decimal point to the left one place? To the right two places? To the left four places? To the right six places?

19. How may we multiply a decimal by 10,000? Divide a decimal by 1000? Multiply a decimal by 100,000?

MULTIPLICATION OF DECIMALS

144. Multiply 6.41 by 3.2.

$$6.41 = 641 \div 100$$

$$3.2 = 32 \div 10$$

$$6.41 \times 3.2 = \frac{641 \times 32}{100 \div 10}$$

$$\begin{array}{r} 641 \\ \times 32 \\ \hline 1282 \\ 1923 \\ \hline 20512 \end{array}$$

$$\begin{array}{r} 6.41 \\ \times 3.2 \\ \hline 1282 \\ 1923 \\ \hline 20.512 \end{array}$$

$$20512 = 641 \times 32$$

$$20.512 = \frac{641 \times 32}{100 \div 10}$$

How did we divide by 100 and by 10?

From this we see that *to multiply decimals we multiply the factors as whole numbers and point off in the product as many decimal places as there are in both factors*;

e.g.
$$\begin{array}{r} 2.8 \\ \times 8 \\ \hline 22.4 \end{array}$$

$$\begin{array}{r} 1.25 \\ \times .6 \\ \hline .750 \end{array}$$

$$\begin{array}{r} .005 \\ \times .03 \\ \hline .00015 \end{array}$$

$$\begin{array}{r} 25 \\ \times .06 \\ \hline 1.50 \end{array}$$

Find the products:

1. $.18 \times .15$

8. 13.3×1.3

2. $1.0005 \times .2$

9. $100 \times .01$

3. $2.5 \times .06$

10. $100.56 \times .0005$

4. $56 \times .005$

11. 25.32×1.05

5. $.005 \times 1.6$

12. $2.84 \times .25$

6. 25.05×1.15

13. 3.28×1.125

7. 2.863×100

14. 1.111×1000

145. *Oral*

1. One of the factors has two decimal places and the other has five. How many decimal places has the product?
2. When there are five decimal places in one factor and one in the other, how many are there in the product?
3. When there are eight decimal places in the product and five in one factor, how many are there in the other factor? When there are six in the product and four in one factor? Five in the product and three in one factor?

DIVISION OF DECIMALS

146. Divide 10.96516 by 4.67.

$$\begin{array}{r}
 2.348 \text{ Quotient} \\
 \hline
 4.67 \overline{)10.96516} \\
 \underline{934} \\
 1625 \\
 \underline{1401} \\
 2241 \\
 \underline{1868} \\
 3736 \\
 \underline{3736}
 \end{array}$$

We first divide as in whole numbers. Since the dividend is a product and the divisor one of its factors, the other factor, or quotient, contains as many decimal places as the number of decimal places in the dividend, less the number of decimal places in the divisor.

Mistakes may be avoided by observing the following

RULE FOR PLACING THE DECIMAL POINT

When the divisor is an integer, place the decimal point in the quotient directly over the decimal point in the dividend (or under in short division).

When the divisor contains decimal places, make a dot on a line with the tops of the figures as many places at the right of the decimal point in the dividend as there are decimal places in the divisor. Place the decimal point in the quotient directly above this dot (or below in short division).

NOTE 1. If there is a remainder after all the figures of the dividend have been used, we annex ciphers to the dividend, and continue the division until there is no remainder, or until a sufficient number of decimal places have been obtained in the quotient.

NOTE 2. When the dividend contains fewer decimal places than the divisor, we annex ciphers to the dividend until it has as many decimal places as the divisor.

Written

Find the quotients and test by multiplication :

- | | |
|------------------------|---------------------------|
| 1. $60.8 \div 1.6$ | 19. $18.65 \div 100$ |
| 2. $.00075 \div .05$ | 20. $266.4 \div .036$ |
| 3. $25.50 \div .34$ | 21. $2.107 \div .35$ |
| 4. $15.2 \div 3.04$ | 22. $.100854 \div 3.879$ |
| 5. $.27560 \div 265$ | 23. $125874. \div .486$ |
| 6. $90.978 \div 3.54$ | 24. $9801. \div .99$ |
| 7. $38.4444 \div 177$ | 25. $2976. \div 4.96$ |
| 8. $14.4 \div .0018$ | 26. $164.32 \div .208$ |
| 9. $1.127 \div 4.9$ | 27. $347.76 \div .368$ |
| 10. $.9156 \div 12$ | 28. $.0006478 \div .079$ |
| 11. $315.432 \div .48$ | 29. $2.5826 \div 69.8$ |
| 12. $1.5906 \div .6$ | 30. $98.07 \div .210$ |
| 13. $375 \div .125$ | 31. $20.852 \div .52$ |
| 14. $125 \div .125$ | 32. $.0023322 \div .0026$ |
| 15. $1000 \div .001$ | 33. $676.8 \div .08$ |
| 16. $.001 \div 1000$ | 34. $1273.998 \div .199$ |
| 17. $25 \div .25$ | 35. $357.6 \div 2.98$ |
| 18. $.25 \div 25$ | 36. $.75897 \div 810$ |

147. Find the products and test by division :

- | | |
|--------------------------|---------------------------|
| 1. 3.2×3.6 | 16. $7.0001 \times .0603$ |
| 2. $86 \times .09$ | 17. $43.55 \times .06$ |
| 3. $9.8 \times .005$ | 18. $2354 \times .008$ |
| 4. $.039 \times 57$ | 19. 39.04×2.08 |
| 5. $.00356 \times 6.8$ | 20. 6.80×86732 |
| 6. $6394. \times .029$ | 21. $2400. \times .387$ |
| 7. $864. \times .278$ | 22. $.0406 \times 3080$ |
| 8. $.00967 \times 240$ | 23. 920×63.7 |
| 9. $839.42 \times .0015$ | 24. $.992 \times 3001$ |
| 10. 208.7×30.9 | 25. $2460 \times .0039$ |
| 11. 930×6.80 | 26. $1234. \times .56$ |
| 12. $4203 \times .0076$ | 27. $9.924 \times .0106$ |
| 13. $69 \times .00035$ | 28. $.0204 \times 20.40$ |
| 14. $406 \times .000039$ | 29. $78.08 \times .025$ |
| 15. 7.92×1.002 | 30. $.8060 \times 300$ |

148. Oral

$$.7 = \frac{7}{10}, \text{ or } 7 \text{ divided by } 10.$$

$$.305 = \frac{305}{1000}, \text{ or } 305 \text{ divided by } 1000.$$

$$.58\frac{1}{3} = \frac{58\frac{1}{3}}{100}, \text{ or } 58\frac{1}{3} \text{ divided by } 100.$$

In like manner tell the meanings of the following decimals :

- | | | | |
|----------|-----------------------|------------------------|-------------------------|
| 1. .8 | 6. $.89\frac{1}{2}$ | 11. $.029\frac{1}{3}$ | 16. $.05\frac{1}{2}$ |
| 2. .416 | 7. $.6\frac{5}{9}$ | 12. $.007\frac{2}{3}$ | 17. .034 |
| 3. .21 | 8. $.39\frac{2}{3}$ | 13. $.103\frac{2}{3}$ | 18. .0165 |
| 4. .3879 | 9. $.48\frac{6}{11}$ | 14. $.2134\frac{5}{8}$ | 19. $.00017\frac{1}{2}$ |
| 5. .200 | 10. $.873\frac{1}{2}$ | 15. $.4070\frac{1}{8}$ | 20. $.000\frac{3}{7}$ |

CHANGING DECIMALS TO COMMON FRACTIONS OR MIXED NUMBERS

$$149. \quad .072 = \frac{72}{1000} = \frac{9}{125}$$

$$18.25 = 18\frac{25}{100} = 18\frac{1}{4}$$

Reduce to common fractions or mixed numbers in simplest form:

- | | | |
|--------|----------|----------------------|
| 1. .8 | 8. .125 | 15. 16.75 |
| 2. .25 | 9. .875 | 16. .00125 |
| 3. .35 | 10. .375 | 17. .054 |
| 4. .75 | 11. .455 | 18. .0250 |
| 5. .64 | 12. .025 | 19. .01375 |
| 6. .52 | 13. .561 | 20. $.34\frac{2}{7}$ |
| 7. .38 | 14. .368 | |

$$\text{Solution: } .34\frac{2}{7} = 34\frac{2}{7} \div 100 = \frac{240}{7} \times \frac{1}{100} = \frac{12}{35} \text{ Ans.}$$

- | | | |
|----------------------|-------------------------|---------------------------|
| 21. $.12\frac{1}{2}$ | 31. $2.33\frac{1}{3}$ | 41. $.166\frac{2}{3}$ |
| 22. $.62\frac{1}{2}$ | 32. $.3\frac{1}{7}$ | 42. $.19\frac{7}{12}$ |
| 23. $.06\frac{1}{4}$ | 33. $42.62\frac{1}{2}$ | 43. $.562\frac{1}{2}$ |
| 24. $.18\frac{1}{3}$ | 34. $97.087\frac{1}{2}$ | 44. $400.40\frac{5}{7}$ |
| 25. $.03\frac{3}{4}$ | 35. $56.13\frac{1}{3}$ | 45. $361.41\frac{1}{9}$ |
| 26. $.25\frac{4}{5}$ | 36. $158.06\frac{1}{4}$ | 46. $2042.1\frac{5}{6}$ |
| 27. $.87\frac{1}{2}$ | 37. $409.6\frac{7}{8}$ | 47. $79.00\frac{5}{9}$ |
| 28. $.66\frac{2}{3}$ | 38. $.07\frac{3}{11}$ | 48. $308.00\frac{25}{36}$ |
| 29. $.36\frac{7}{8}$ | 39. $.26\frac{2}{3}$ | 49. $2890.90\frac{4}{9}$ |
| 30. 16.25 | 40. $.012\frac{6}{7}$ | 50. $98.000\frac{40}{41}$ |

150. *Oral*

Using aliquot parts, reduce the following to mixed numbers :

- | | | |
|-----------------------|-----------------------|-------------------------|
| 1. \$58.50 | 6. \$6.05 | 11. $15.08\frac{1}{3}$ |
| 2. \$39.33\frac{1}{3} | 7. \$32.12\frac{1}{2} | 12. $422.33\frac{1}{3}$ |
| 3. \$5.16\frac{2}{3} | 8. \$19.10 | 13. $100.14\frac{2}{7}$ |
| 4. \$7.25 | 9. \$18.14\frac{2}{7} | 14. $603.16\frac{2}{3}$ |
| 5. \$19.20 | 10. 16.02 | 15. 99.02 |

151. *At sight*, reduce the following to common fractions or mixed numbers :

- | | | | |
|---------------------|------------|-----------------------|------------------------|
| 1. $.62\frac{1}{2}$ | 4. 12.875 | 7. $29.87\frac{1}{2}$ | 10. 43.4 |
| 2. $.66\frac{2}{3}$ | 5. 13.02 | 8. 3.6 | 11. $12.37\frac{1}{2}$ |
| 3. $.75$ | 6. 430.625 | 9. 7.8 | 12. 54.375 |

REDUCTION OF COMMON FRACTIONS AND MIXED NUMBERS TO DECIMALS

152. *Written*

Change $\frac{5}{16}$ to a decimal.

$$\begin{array}{r}
 .3125 \\
 16 \overline{)5.0000} \\
 \underline{48} \\
 20 \\
 \underline{16} \\
 40 \\
 \underline{32} \\
 80 \\
 \underline{80} \\
 \hline
 \end{array}$$

$$\frac{5}{16} = 5 \div 16 = .3125 \text{ Ans.}$$

Write $9\frac{5}{16}$ as a mixed decimal.

Reduce to decimals:

1. $\frac{4}{5}$	11. $\frac{12}{40}$	21. $\frac{47}{64}$	31. $19\frac{19}{125}$
2. $\frac{3}{4}$	12. $\frac{9}{16}$	22. $\frac{38}{64}$	32. $\frac{1}{625}$
3. $\frac{4}{25}$	13. $\frac{1}{8}$	23. $\frac{43}{80}$	33. $\frac{7}{125}$
4. $\frac{7}{8}$	14. $\frac{56}{85}$	24. $\frac{17}{20}$	34. $12\frac{6}{25}$
5. $\frac{3}{20}$	15. $3\frac{1}{16}$	25. $13\frac{7}{20}$	35. $14\frac{29}{80}$
6. $\frac{2}{5}$	16. $\frac{3}{8}$	26. $19\frac{7}{16}$	36. $9\frac{9}{125}$
7. $\frac{3}{5}$	17. $\frac{3}{80}$	27. $12\frac{9}{25}$	37. $13\frac{1}{40}$
8. $\frac{5}{32}$	18. $\frac{8}{25}$	28. $\frac{11}{50}$	38. $2\frac{21}{50}$
9. $\frac{7}{16}$	19. $\frac{15}{20}$	29. $\frac{23}{40}$	39. $5\frac{8}{32}$
10. $\frac{54}{36}$	20. $2\frac{3}{32}$	30. $\frac{87}{125}$	40. $\frac{23}{320}$

153. A fraction in lowest terms whose denominator contains other prime factors than 2 and 5 cannot be reduced to an exact entire decimal; e.g. $\frac{2}{3}$, $\frac{5}{9}$, $\frac{15}{22}$, $\frac{8}{11}$, $\frac{19}{26}$, $\frac{41}{35}$.

Such a fraction may be reduced to a decimal of nearly the same value by carrying the division to a certain number of decimal places, thus:

Reduce $\frac{19}{26}$ to a decimal of four places.

$.7307\frac{9}{13}$ Ans.

26.)19.0000

182

80

78

200

182

18

$$\frac{18}{26} = \frac{9}{13}$$

.7307 is almost equal to $\frac{9}{13}$.

The exact value of $\frac{19}{26}$ is $.7307\frac{9}{13}$.

The result may be expressed, $.7307 +$

154. *Written**Reduce to decimals of three places:*

- | | | | |
|-------------------|--------------------------------|-----------------------|-----------------------|
| 1. $\frac{1}{3}$ | 7. $\frac{1}{3}\frac{1}{4}$ | 13. $8\frac{7}{15}$ | 19. $42\frac{10}{20}$ |
| 2. $\frac{5}{7}$ | 8. $\frac{5}{4}\frac{8}{8}$ | 14. $23\frac{1}{9}$ | 20. $\frac{236}{388}$ |
| 3. $\frac{2}{11}$ | 9. $\frac{12}{17}$ | 15. $681\frac{4}{11}$ | 21. $\frac{85}{275}$ |
| 4. $\frac{5}{6}$ | 10. $\frac{143}{19}$ | 16. $3\frac{8}{17}$ | 22. $43\frac{5}{42}$ |
| 5. $\frac{4}{7}$ | 11. $\frac{1}{2}\frac{10}{40}$ | 17. $\frac{22}{23}$ | 23. $16\frac{9}{71}$ |
| 6. $\frac{8}{13}$ | 12. $15\frac{2}{9}$ | 18. $\frac{50}{61}$ | 24. $\frac{256}{301}$ |

A COMMON FRACTION AT THE END OF A DECIMAL

155. $.2\frac{1}{2} = .2 + (\frac{1}{2} \text{ of } \frac{1}{10}, \text{ or } \frac{1}{20}, \text{ or } .05).$

$.2 + .05 = .25.$

In a similar manner, we may show that,

$.27\frac{1}{2} = .275, .384\frac{1}{2} = .3845, \text{ etc.}$

Also, that $.2\frac{1}{4} = .225, .34\frac{1}{4} = .3425, \text{ etc.}$

Also, that $.8\frac{3}{4} = .875, .06\frac{3}{4} = .0675, \text{ etc.}$

Also, that $.9\frac{1}{8} = .9125, .07\frac{3}{8} = .07375, \text{ etc.}$

*Oral**Express as entire decimals:*

- | | | | | |
|-------------------------|-----------------------|--------------------------|-----------------------|-----------------------|
| 1. a. $.2\frac{1}{2}$ | b. $\$.17\frac{1}{2}$ | c. $.360\frac{1}{2}$ | d. $7\frac{1}{2}$ | e. $.004\frac{1}{2}$ |
| 2. a. $.8\frac{1}{4}$ | b. $3.7\frac{1}{4}$ | c. $\$.9.20\frac{1}{4}$ | d. $\$.39\frac{1}{4}$ | e. $.145\frac{1}{4}$ |
| 3. a. $.05\frac{3}{4}$ | b. $1.1\frac{3}{4}$ | c. $\$.21.46\frac{3}{4}$ | d. $.033\frac{3}{4}$ | e. $.090\frac{3}{4}$ |
| 4. a. $.7\frac{1}{4}$ | b. $6.8\frac{1}{2}$ | c. $80.3\frac{1}{2}$ | d. $12\frac{3}{4}$ | e. $1.9\frac{1}{4}$ |
| 5. a. $42\frac{1}{2}$ | b. $3.97\frac{1}{2}$ | c. $150\frac{3}{4}$ | d. $24.0\frac{1}{2}$ | e. $29.0\frac{1}{4}$ |
| 6. a. $1.30\frac{3}{4}$ | b. $2.45\frac{3}{4}$ | c. $100\frac{1}{2}$ | d. $20\frac{3}{4}$ | e. $40.00\frac{1}{2}$ |

REVIEW AND PRACTICE

156. *Oral*1. *Read:*

.0305; 42.0042; 4.0004; 6.395; .0600; 639.500; 639.00005;
10.10; $36\frac{2}{3}$; $50.00\frac{5}{9}$.

2. *Express as common fractions in lowest terms:*

.5; .25; .75; $.12\frac{1}{2}$; $.37\frac{1}{2}$; $.87\frac{1}{2}$; $.16\frac{2}{3}$; $.33\frac{1}{3}$; $.62\frac{1}{2}$; $.66\frac{2}{3}$;
 $.08\frac{1}{3}$; .02.

3. *Divide by 10:*

62; 93.5; 3.44; .25; .0081; .0384; 1.027.

4. *Multiply by 1000:*

8.934; .0245; .612356; 48; 63.05.

5. *Give results:*

436×100 ; $436 \div 1000$; 436×10 ; $5 \div 100$; $8314 \div 10,000$;
 $6.183 \times 10,000$.

6. *Express as common fractions in lowest terms:*

.4; .60; .8; .500; .70; .200; .600.

7. How many decimals be divided by 10? by 100? by 10,000?
by 1,000,000? by 1000?

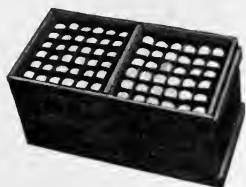
8. A stamp clerk received \$4085 for special delivery stamps
at 10 cents apiece. How many such stamps did he sell?

9. Compare $\$ \frac{1}{4}$ with $\$ \frac{1}{8}$; $\$ \frac{3}{4}$ with $\$ \frac{3}{8}$.

10. Compare 1 bushel with $\frac{1}{9}$ of a bushel; 5 bushels with $\frac{5}{9}$
of a bushel.

11. What will 3 months' rent cost at \$240 a year?

12. What will a dozen cabbages cost at the rate of 3 for 25¢?



13. *a.* Count the eggs in the top layer of this crate. How many dozen are there?

b. How many such layers are there if the crate contains 30 dozen?

c. $\frac{4}{5}$ of them are how many dozen? How many eggs?

d. $\frac{1}{2}$ of one layer is what fraction of the entire number?

e. How many pounds will a dozen eggs weigh if their average weight is 2 oz. apiece?

f. What is the entire weight of the eggs in the crate?

14. If $\frac{3}{4}$ of a yard of cloth costs 50 cents, what will 3 yards cost? (3 yd. are how many times $\frac{3}{4}$ yd.?)

15. If I borrow one dollar, and agree to pay it back in one year, with 6 cents more to pay for the use of it, how much must I pay in all, at the end of the year?

16. If you lend me \$8 for a year, and I agree to pay five cents for the use of each dollar, how much will I owe you at the end of the year?

How much will I owe if I agree to pay $5\frac{1}{2}$ cents for the use of each dollar? 7 cents? 8 cents? $4\frac{1}{2}$ cents? $6\frac{1}{2}$ cents? 9 cents?

17. What must I pay for the use of \$20 for one year, if I pay 5 cents for the use of each dollar?

If I keep the money three years, paying each year for the use of it, and then pay back the \$20 which I borrowed, how much will I have paid in all?

18. Mr. A borrowed 9 dollars from Mr. B. After four years he paid it back and also paid 5 cents a year for the use of each dollar. How much did Mr. A pay to Mr. B?

19. A man borrowed \$10 from me and agreed to pay me for the use of it at the rate of 6 cents a year for each dollar. He kept the money only half a year. How much should he pay me for the use of the money?

How much should he pay me in all?

20. How much should be paid for the use of twenty dollars for one and one half years at the rate of 5 cents a year for every dollar?

21. A man paid \$5 a year for the use of \$100. How much a year would he pay for the use of \$500 at the same rate?

22. If \$7 is paid for the use of a sum of money for 2 years, what should be paid for the use of the same sum for 6 years?

23. A woman who lives near the grocery takes her lamp to the grocery to be filled and pays 5 cents every time. The lamp holds a pint of oil.

a. How much per gallon does the oil cost her?

b. If the lamp burns one pint of oil in two days, in how many days will it consume one gallon of oil?

c. In how many days will it consume four gallons?

d. How much would she save by buying four gallons of oil at $12\frac{1}{2}\text{¢}$ a gallon?

24. Margaret's mother buys $\frac{1}{2}$ lb. of sliced bacon twice a week at 23¢ per pound.

a. How much does she pay each time?

b. How much does she pay for bacon in six weeks?

c. How much would a 6-pound piece of bacon cost at 20¢ a pound?

d. How much would Margaret's mother save by buying such a piece at that price?

25. What will 20 quarts of berries cost at the rate of 2 quarts for 25¢ ?

157. *Written*

1. Express as common fractions in simplest form: *a.* .125; *b.* .625; *c.* .025; *d.* .5625; *e.* .087500; *f.* Five hundred five thousandths.

2. Express as exact decimals:

$$a. \frac{7}{8}; b. 1\frac{19}{20}; c. \frac{7}{16}; d. \frac{3}{250}; e. 6\frac{5}{4}; f. \frac{18}{125}.$$

3. Reduce to decimals of four places:

$$\frac{1}{3}; \frac{37}{111}; \frac{115}{120}; \frac{24}{175}; \frac{65}{91}; \frac{14}{20}.$$

4. *Express in figures and add:* Six and forty-five thousandths; forty-nine and seven hundred seventy-nine thousandths; twenty-four thousand nine hundred, and five hundredths; six hundred five thousandths; three hundred forty-three hundred-thousandths; seventy-nine and five tenths; eleven and thirty-nine hundredths; eight hundred twenty-five, and forty-five hundredths; nine hundred fifteen, and six tenths.

5. From fifteen and twenty-five thousandths take five and six hundred twenty-five millionths. Express the result in words.

6. Find the sum of 3.7; 36.05; .085; 35.25.

7. From .8 take eight thousandths.

8. Find the sum of .0375, $24\frac{1}{6}$, 43.8, and $7\frac{1}{2}$.

9. Find the cost of 6.5 barrels of flour at \$5.75 a barrel.

10. What number divided by $17\frac{3}{8}$ will give 5.05?

11. Add 36.048, 25.13, $13\frac{5}{8}$, and $25\frac{3}{4}$.

12. Find the sum of $\frac{5}{8}$ and .375.

13. A liveryman bought 10.5 tons of hay at \$10.375 a ton. What did it cost?

14. At \$60.75 an acre, what is the cost of 40.25 acres of land?

15. A lady purchased 4.5 yd. of silk at \$1.25 per yard and 7.25 yd. of broadcloth at \$3.50 per yard. What change should she receive from a \$20 bill and two \$10 bills?

16. A farmer divided his farm of 168.8 acres into 16 equal fields. How much land was there in each field?

17. Divide 53.66523 by .941.

18. $28.8 \div .0072 = ?$

19. Divide .305996 by .337.

20. Divide 990 by .11.

21. \$87.50 will pay for how many piano lessons at \$1.25 a lesson?

22. $207.09 \div .015 = ?$

23. A boy's height increased 1.4 inches in his 12th year, 1.5 inches in his 13th year, and 1.6 inches in his 14th year. What was his average growth per year for the three years?

24. A farmer received \$146 $\frac{1}{4}$ for pigs at \$3 $\frac{1}{4}$ apiece. How many pigs did he sell?

25. The smaller of two numbers is 9346.05. Their difference is 412.08. What is the greater?

26. $9.2 \times 5.37 - (1.785 + .1318) = ?$

27. The following quantities of stamps were sold during a year at a city post office. Find what was received for all of them :

1-cent . . .	4,832,500	6-cent . . .	40,000
2-cent . . .	10,550,000	8-cent . . .	47,100
3-cent . . .	117,500	10-cent . . .	70,200
4-cent . . .	161,000	13-cent . . .	3400
5-cent . . .	198,000	15-cent . . .	8800

PART OF AN AMERICAN WAR FLEET

BATTLESHIPS

NAME	LENGTH	TONNAGE	NO. OF GUNS	SPEED IN KNOTS PER HOUR	MEN
Maine	388 ft.	13500	44	18	648
Missouri	388 ft.	14278	44	18.2	652
Kentucky	368 ft.	12905	60	16.9	613
Kearsarge	368 ft.	12905	56	16.8	650
Louisiana	450 ft.	17666	74	18.8	803
Rhode Island	435 ft.	16125	66	19.5	812
New Jersey	435 ft.	16125	66	19.5	812
Virginia	435 ft.	16125	66	19.5	812
Alabama	368 ft.	12170	48	17	592
Illinois	368 ft.	12170	46	17.5	660
Indiana	348 ft.	11403	45	15.5	491
Iowa	360 ft.	12445	48	17.1	520

ARMORED CRUISERS

West Virginia.	502 ft.	13680	60	22.2	648
Pennsylvania .	502 ft.	13780	60	22.9	750
Colorado	502 ft.	13780	60	22.2	750
Maryland	502 ft.	13680	60	22.4	648

28. *a.* If all these ships were formed in a single unbroken line, how many feet long would the line be?

b. How many miles long would it be?

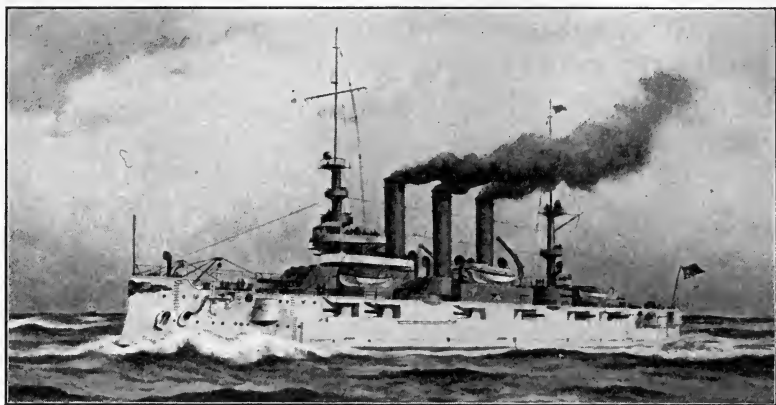
c. What is the average tonnage?

d. How many guns do they all carry?

e. How many men are there on all the ships?

f. How many knots greater is the average speed of the cruisers than of the battleships?

g. What is the average number of men on a ship?



THE BATTLESHIP LOUISIANA

29. A knot, or nautical mile, is used in measuring the speed of vessels. It is equal to about 1.15 common or statute miles.

a. The *Missouri's* speed is how many common miles per hour?

b. The *Maryland's* speed per hour is how many common miles greater than the *Missouri's*?

30. a. A knot is 6080.27 ft. How many feet farther can the cruiser *Maryland* sail in an hour than the battleship *Alabama*?

b. If the *Alabama* is 9.9 knots ahead of the *Louisiana*, and both are moving at highest speed, in how many hours can the *Louisiana* overtake the *Alabama*?

31. How many common miles can the *Kentucky* go in 24 hours, if she goes 16.9 knots per hour all the time?

32. How many feet can the *Rhode Island* go in 1 minute?

Make other problems about these warships, using the numbers given in the table.

33. What is the cost of 8.2 bales of cotton, each bale weighing 412.6 lb. at $\$ \frac{1}{8}$ a pound?

34. Two motor cars start from the same place at the same time and go in opposite directions, one at the rate of 12.325 miles an hour, and the other at the rate of 14.875 miles an hour. How far apart are they at the end of $10\frac{1}{4}$ hours?

35. *a.* What must be paid for the use of \$225 for one year at the rate of 6 cents a year for the use of one dollar? *b.* For two years? *c.* For $3\frac{1}{2}$ years?

36. Mr. Scott borrowed \$1500 from Mr. Moore and agreed to pay it back in two years, and also to pay Mr. Moore for the use of it at the rate of 5 cents a year for every dollar. *a.* How much did Mr. Scott have to pay for the use of the money?

b. How much did he have to pay in all?

37. If I pay 42 dollars for the use of \$600 for a year, how much do I pay for the use of one dollar?

38. Find how much I will pay in $2\frac{1}{2}$ years for the use of \$2000 if I pay $4\frac{1}{2}$ cents each year for the use of every dollar.

39. Mr. Marvin borrowed \$3500 and paid it five years afterward. He also paid 4 cents each year on every dollar he owed. How much did he pay in all?

40. If I pay at the rate of 7 cents a year for the use of one dollar, how much must I pay for the use of \$2800 for six months? (Six months are what part of a year?)

41. *a.* If 5 cents will pay for the use of one dollar for a year, \$24 will pay for the use of how many dollars for a year?

b. At the rate of 6 cents a year for the use of a dollar, \$24 will pay for the use of how many dollars for a year?

42. These loaves of bread are $11\frac{1}{4}$ inches long. The blade of the bread cutter revolves so as to cut off a slice of bread at every turn of the wheel.

a. If the slices are $\frac{5}{16}$ in. thick, how many inches of the loaf will be cut off by 18 turns of the wheel?

b. How many inches will be left?

c. How many turns are made in cutting an entire loaf?



d. How many slices are made from one loaf?

43. A loaf of this bread is made into sandwiches. The slices are $\frac{5}{16}$ in. thick. The crusts are not used for this purpose. Each sandwich is made of two slices of bread and one ounce of meat that costs 16¢ a pound. The bread costs 5¢ a loaf.

a. How many sandwiches are made?

b. What is their entire cost?

c. If they are sold at 5¢ apiece, what is the profit on all of them?

44. There are 90 loaves of bread in the picture.

a. If they are $11\frac{1}{4}$ in. long and cut into slices $\frac{5}{8}$ in. thick, how many slices are there?

b. If the bread costs 5¢ a loaf and all except the crusts is served at a lunch counter at 1¢ a slice, what is the profit on all of it?

c. The 90 loaves would make how many slices $\frac{3}{8}$ in. thick?

45. A barrel of flour weighs 196 lb. Flour costing \$5 a barrel is made into bread containing $11\frac{1}{8}$ oz. of flour to a loaf. Some of the bread is bought by Mrs. X at 5¢ a loaf.

a. How many loaves of bread are made from a barrel of flour?

b. How much does it bring at 5¢ a loaf?

c. How much would Mrs. X save by buying a barrel of flour and making her bread, supposing that the yeast costs 50¢ and the extra coal 80¢?

MULTIPLYING AND DIVIDING BY TWENTY-FIVE

158. $25 = 100 \div 4$. Therefore we may multiply a number by 25 by multiplying it by 100 and dividing the product by 4, thus: $36 \times 25 = 3600 \div 4 = 900$.

How did we multiply 36 by 100?

159. Oral

Multiply the following numbers by 25:

12, 24, 16, 20, 48, 36, 44, 32, 8, 28, 40.

Written

1. Multiply by 25:

a. 63	e. 76.347	i. \$124	m. 2.463
b. 7428	f. 14.231	j. 9.370	n. 2468 tons
c. 231	g. 2.31	k. 21.3	o. .0934
d. \$55	h. .2835	l. 84.8	p. .00080

2. Find the cost of:

a. 97 stoves at \$25 apiece.

b. 25 yd. of silk at \$1.39 a yard.

c. 130 acres of land at \$25 an acre.

d. A 12-pound turkey at 25 cents a pound.

160. To divide a number by 25 we may point off two decimal places in the number and multiply the result by 4, thus:

$$452 \div 25 = 4.52 \times 4 = 18.08$$

$$\text{Explanation: } 452 \div 25 = \frac{452}{1} \div \frac{100}{4} = \frac{452}{1} \times \frac{4}{100} = 18.08$$

$$37.5 \div 25 = .375 \times 4 = 1.500$$

$$\text{Explanation: } 37.5 \div 25 = 37.5 \div \frac{100}{4} = \frac{37.5}{1} \times \frac{4}{100} = 1.500$$

161. Written

1. Divide by 25:

a. 425	e. 6934	i. 63,940	m. \$348.5
b. 37.8	f. 5876	j. 6234	n. \$2964
c. 239	g. 93.6	k. \$934	o. 832 pk.
d. 87.64	h. 98,301	l. \$50.25	p. .637

2. a. $831 \div 25 = ?$ b. $6.934 \times 25 = ?$ c. $25 \times ? = .21$

3. a. $428 = 25 \times ?$ b. $389 \div ? = 25.$ c. $? \times 25 = 12.6$

ACCOUNTS AND BILLS

162. When your mother sends you to the store where she is accustomed to buy groceries, giving you no money to take with you, and tells you to buy certain articles and have them charged, what does she mean?

The merchant has a book in which he keeps the names of persons to whom he sells things not paid for at the time of the sale, together with a list of the articles sold, their value, and the date of sale. This list is called an **account**.

The person who sells the goods is the **creditor**, and the person who buys the goods is the **debtor**. The debtor and creditor are called **parties** to the account.

A doctor keeps a record of the calls which he makes or receives in treating his patients, when the calls are not paid for at the time. This record is called the patient's account. Who is the creditor? Who is the debtor?

If your father works for some one, he keeps an account of his time and wages. Which party is your father?

Whenever something is paid toward a debt of this kind, a record of the payment is put in the account and is called a **credit**. The difference between the amount of the debit (or *owing*) items and the amount of the credit items is called the **balance** of the account.

At certain times, the creditor copies on a piece of paper a statement of the debtor's account and sends it to the debtor. This statement is called a **bill**. Some merchants always send a bill with the goods at the time of purchase.

163. There are various ways of writing a bill, but it should always contain these things:

1. The time and place of making out the bill. This is called the date of the bill.

2. The debtor's name and address.

3. The creditor's name and address.

4. A list of the items—that is, the goods sold, money paid or services rendered, with the amount of each item.

5. The date of each transaction, if any of them occur at any other time than that of making out the bill.

6. The amount, or footing, of the bill.

164.

FORMS OF BILLS

(Form 1)

SYRACUSE, N. Y., June 20, 1907.

MR. JOHN P. SMITH,
713 McBride St.,

Bought of ANDREWS BROTHERS,
cor. James and Warren Sts.

2 bu. Apples	\$ 1.10	\$ 2	20		
10 lb. Granulated Sugar	.05½		55		
½ lb. Tea	.50		25	\$ 3	00

What is the date of this bill?

Who is the creditor? The debtor?

Read the items.

What is the amount of the bill?

Who ought to pay the bill?

Who should receive the money?

When a bill is paid, the creditor "receipts" the bill by writing at the bottom, "Received Payment," followed by the date and his own name. This shows that the bill has been paid. The debtor keeps the receipted bill to show that the debt has been paid.

When the above bill is paid, who should receipt it?

Make a bill similar to the one given above, but using different items. Find its amount, and receipt it.

(Form 2)

SPOKANE, WASH.,

April 1, 1907.

MR. W. C. FLINT,
1213 Maxwell Ave.,

To JOHN M. SEMPLE, M.D., *Dr.*
207-208-209 Jamieson Building.

To professional services rendered, Feb. 25 to March
18, 1907,

	\$ 37 50
--	----------

Received Payment,
April 16, 1907.

JOHN M. SEMPLE.

Name each of the parties in this bill. Has the bill been paid? How do you know?

Sometimes a clerk, an agent, or a bookkeeper of the creditor receives the money for payment of a bill. He should then write the creditor's name under the words "Received Payment," and under the creditor's name, his own name or initials, thus :

Received Payment,

JOHN M. SEMPLE,

Per KATE L. BUNN.

3. Receipt the bill in Form 1 as though you were a clerk for the creditor.

4. Make out bills of the following items, the teacher being the debtor in each one, and yourself the creditor. Let the teacher examine each bill, and mark it O.K. if correctly made. Receipt the bill and return it to the teacher.

- a. 3 bu. potatoes at 75¢ per bushel.
8 lb. lard at 15¢ per pound.
5 gal. kerosene oil at 12¢ per gallon.
- b. 4 lb. coffee at 25¢ per pound.
18 lb. sugar at 5½¢ per pound.
5 gal. molasses at 60¢ per gallon.
- c. 6 bbl. potatoes at \$1.80 per barrel.
2 tons hay at \$16 per ton.
3 cords wood at \$4 per cord.
- d. 16 yd. silk at \$1.50 per yard.
4 pairs hose at 50¢ per pair.
9 yd. lace at 60¢ per yard.
- e. 1 chocolate pot, 75¢.
6 salad plates at \$1.10 each.
15 Haviland bouillon cups at \$12 per doz.
1 bread plate, 98¢.

VOLUME MEASURE

165. *Anything that has length, breadth, and thickness is a solid;* as wood, stone, earth.

166. *A solid bounded by six square faces is a cube.*

167. *A solid bounded by six rectangles is a rectangular prism.* Name as many objects as you can that are rectangular prisms.

168. *The length, breadth, and thickness of a solid are its dimensions.*

169. *A cube whose edge is 1 inch is a cubic inch.*

Show with your hands how long, wide, and high a cubic inch is.

170. *A cube whose edge is 1 foot is a cubic foot.*

Show with your hands the length, breadth, and height of a cubic foot.

Show how high a cubic foot would be if it were lying on your desk.

Can you think of some object about as large as a cubic foot?

171. *A cube whose edge is 1 yard is a cubic yard.*

Show with your hands how wide and high a cubic yard is. Show how high it would reach if it stood on the floor by your side.

Could a cubic yard be put through the open door or window of your school-room? Measure and see.

172. *The number of cubic yards, cubic feet, or cubic inches that a solid contains is its contents or volume.*

Name some object whose volume is about 1 cubic yard.

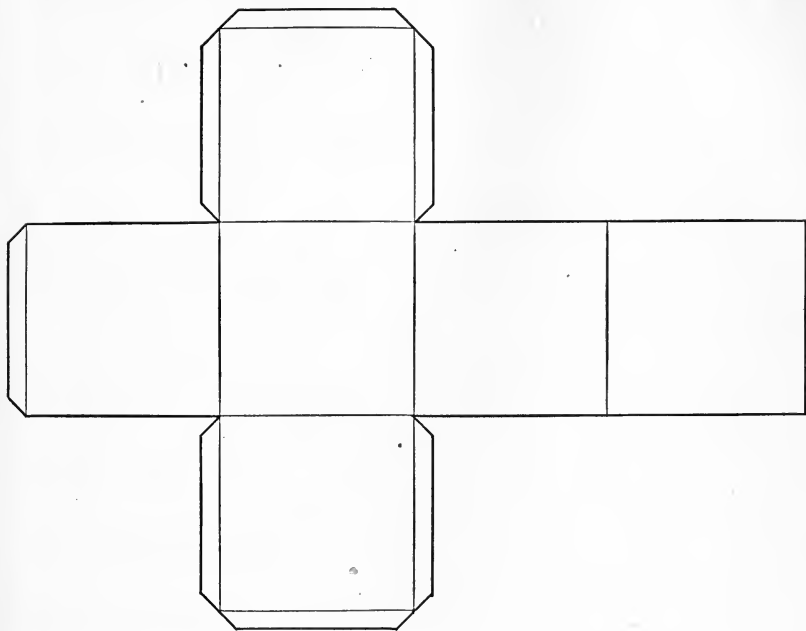
The measure by which the contents of a solid are measured is called volume measure.

TO THE TEACHER.—Cubes of various sizes should be provided for this lesson. Inch cubes should be put together to make two-inch cubes, three-inch cubes, and so on.

The teacher should gain from children that each block has six equal square faces, and therefore is a cube. Make prisms with the cubes, and gain from the children that each face of the prism is a rectangle; also that the volume of a rectangular prism is the product of its three dimensions.

A piece of board one foot square and one inch thick can be used effectively. Mark it off, to show that it contains 144 cubic inches. Gain from children that 12 such boards, piled one upon another, would make a cubic foot. Have children draw patterns of inch cubes, cut, and paste them. Draw on the blackboard a pattern of a cubic foot.

Work with such exercises as are here outlined until pupils are perfectly familiar with these fundamental ideas of volume measure. Do not take for granted that children have these ideas, but test their knowledge by requiring them to *show* and *construct*.



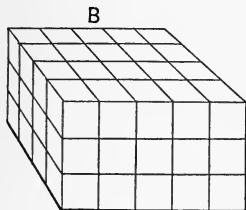
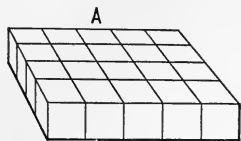
This is a pattern of a cubic inch, or an inch cube. When it is drawn on paper, an inch cube may be made by cutting along the dark lines, folding along the light lines, and pasting the flaps over to hold the edges together.

How many faces has an inch cube? What is the size of each face?

Draw a pattern of a cubic inch. Cut it out and paste it so as to make a cubic inch.

A foot cube has how many faces? What is the size of each face?

On a large sheet of stiff paper, at home, draw a pattern of a cubic foot. Bring it to school and paste it together.

173. *Oral*

1. Using inch cubes, make a rectangular prism, 4 in. by 5 in. by 1 in. How many cubic inches does it contain?
 $5 \times 4 \times 1 = ?$

2. If three such prisms as figure A were piled up, they would make a prism containing how many cubic inches?
 $5 \times 4 \times 3 = ?$

3. How many cubic feet are there in a rectangular prism 5 ft. by 4 ft. by 3 ft.?

4. How many cubic yards are there in a rectangular prism 5 yd. by 4 yd. by 3 yd.?

5. A rectangular prism 6 in. long, 3 in. wide, and 2 in. high contains how many cubic inches?

Make this prism from paper and find the area of each face and all its faces.

6. Find the contents of a 2-inch cube. Find its entire surface.

7. A dry-goods box is 6 ft. long, 3 ft. wide, and 3 ft. deep. How many cubic feet of space will it occupy in a freight car?

8. Find the contents of a 4-inch cube. Find its entire surface.

9. A block 8 inches long, 2 inches wide, and 2 inches high will make how many 2-inch cubes?

10. From a piece of paper 8 in. square, Mabel cut enough to cover a box 2 in. by 4 in. by 1 in. How many square inches of paper were used? How many were left?

11. How many cubic inches in a cube of soap 4 in. by 3 in. by $1\frac{1}{2}$ in.?

12. If a pasteboard box is 4 in. square, how high must it be to contain 32 cu. in.? $4 \times 4 \times ? = 32$. $16 \times ? = 32$.

13. A stick of wood is 3 in. wide and 2 in. thick. How long must it be to contain 60 cu. in.? $3 \times 2 \times ? = 60$. $6 \times ? = 60$.

14. $2 \times 5 \times ? = 70$. $? \times 3 \times 4 = 48$. $7 \times ? \times 2 = 28$.

15. If a cubic foot of ice weighs 60 lb., what is the weight of a cake of ice 2 ft. by 1 ft. by 1 ft.?

16. Will's lunch box is 8 in. long, 4 in. wide, and 3 in. thick. What is its volume?

17. If a common brick is 8 in. by 4 in. by 2 in., how many cubic inches does it contain? What is the area of one of its largest faces? How many such faces has it? What is the area of one of its smallest faces? How many such faces? What is the area of the other faces?

NOTE.—Bring a brick to the class and verify these results.

18. Find the contents of a rectangular prism, 3 in. by 4 in. by $2\frac{1}{2}$ in.

19. A cubic foot is how many inches wide? High? Long? It contains how many cubic inches? Can you show this by a drawing?

20. A cubic yard is how many inches wide, high, and long? It contains how many cubic inches? Show this by a drawing.

21. How many square inches in one face of a cubic foot?

22. How many square feet in one face of a cubic yard? In all its faces?

23. Learn the table of Volume Measure, p. 173.

174. *Written*

1. How many cubic inches are there in one cubic yard?
2. *a.* How many cubic inches are there in $5\frac{2}{3}$ cubic feet?
b. In $10\frac{5}{9}$ cubic feet? *c.* In $25\frac{4}{9}$ cubic feet? *d.* In 307 cubic feet?
3. *a.* How many cubic feet are there in $70\frac{8}{9}$ cubic yards?
b. In $235\frac{1}{2}$ cubic yards? *c.* In $.16\frac{2}{3}$ of a cubic yard? *d.* In $21.33\frac{1}{3}$ cubic yards? *e.* In $4.66\frac{2}{3}$ cubic yards?
4. 9234 cu. ft. = how many cubic yards?
5. How many cubic feet are there in 24,192 cubic inches?
6. How many cubic feet are equal to 84 cu. yd. 17 cu. ft.?
7. Change 38 cu. ft. 347 cu. in. to cubic inches.
8. A cake of ice containing $3\frac{1}{2}$ cu. ft. contains how many cubic inches?
9. How many cubic feet are there in a boulder that contains $7\frac{2}{3}$ cu. yd.?
10. Change 13 cu. yd.; *a.* to cubic feet; *b.* to cubic inches.
11. Change 513,216 cu. in. to cubic feet.
12. A carload of earth containing 19.8 cu. yd. contains how many cubic feet?
13. $7 \times 8 \times ? = 280$. The contents of a rectangular prism are 280 cu. in. Two of its dimensions are 7 in. and 8 in. What is the other dimension?
14. The dimensions of a water tank are 10 ft., 11 ft. and $2\frac{1}{2}$ ft. What is the volume of the tank?
15. A gallon contains 231 cubic inches. Seven gallons are how many cubic inches less than one cubic foot?

16. A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high contains how many cubic feet?

17. A stick of timber 8 in. square and 45 ft. long contains how many cubic inches? (First change 45 ft. to inches.)

18. *a.* A block of granite 16 ft. by $3\frac{3}{4}$ ft. by $2\frac{5}{8}$ ft. contains how many cubic feet? *b.* How many cubic inches?

19. A flagstone 8 ft. long, 5 ft. wide, and 6 in. thick contains how many cubic feet?

HINT: The stone is what part of a foot in thickness?

20. A street 100 rods long must be lowered 3 ft. in order that a pavement 36 ft. wide may be laid. *a.* How many yards long is the street? *b.* The cut is how many yards wide? *c.* How many cubic yards must be cut out?

21. *a.* A box car 30 ft. long, 9 ft. wide, and 7 ft. high contains how many cubic feet of space? *b.* How many cubic yards?

22. A school-room is 39 ft. long, 30 ft. wide, and 12 ft. high.
a. How many cubic feet of air space are there in the room?
b. How many cubic yards? *c.* If there are 40 pupils in the room, how many cubic feet of space are there for each pupil?
d. How many cubic yards are there for each pupil?

175. Oral

1. What three numbers multiplied together equal 12?

2. What dimensions could a cake of maple sugar have to contain 12 cubic inches?

3. $4 \times 3 \times ? = 24$. A block of wood 4 in. long and 3 in. wide must be how thick to contain 24 cubic inches?

4. What dimensions could a box have to hold 36 cu. ft. of coal?

5. What dimensions could a box have to hold :
a. 40 inch-cubes? *b.* 18 inch-cubes? *c.* 32 inch-cubes?
6. A box is 4 in. wide and $1\frac{1}{2}$ in. deep. It contains 72 cubic inches? How long is it?
7. How many inch-cubes are equal to a rectangular prism 3 in. by 2 in. by 5 in.?

176. *Written*

1. A man engaged to dig a cellar 40 ft. long, 25 ft. wide, and 6 ft. deep. How much has he to dig after he has taken out 3246 cu. ft. of earth?

2. How many bricks 4 in. by 8 in. by 2 in. are equal to a cubic foot?

3. Henry gathered 2 boxes full of hickory nuts. The boxes measured 6 in. by 14 in. by 10 in. and 7 in. by 9 in. by 12 in. He emptied the nuts into a box 20 in. long, 18 in. wide. and 1 ft. deep. How much space was left in the large box?

4. *a.* A tank 2 ft. by 3 ft. by 4 ft. contains how many cubic feet? *b.* How many cubic inches? *c.* If there are 100 gallons of water in the tank, how many cubic inches of water are there? *d.* How many more cubic inches of water will fill the tank?

5. If a box of candy $1\frac{1}{4}$ " by 4" by 6" is sold for 19 cents, what should be the price of a box 5" by 3" by 6" filled with the same kind of candy?

6. *a.* How many cubic feet of earth are required to fill an old cellar 30 ft. by 90 ft. and $7\frac{1}{2}$ ft. deep?

b. How many loads of earth are required if one load will fill $1\frac{1}{2}$ cu. yd. of space?

7. Make and solve a problem about the volume of a wagon box.

8. Make and solve a problem about the quantity of air in a room.

PART TWO

TO THE TEACHER.—It will be found worth while to give frequent “quick tests,” specimens of which are given in this and the primary book. Dictate the questions one at a time, and allow a few seconds (more or less time according to the nature of the question) for the pupils to obtain the answer mentally. Then at a given signal let all write the result at the same time. Allow no use of pen or pencil except to write results. This exercise will cultivate power of attention, concentration, and alertness. Let it be short, sharp, and rapid enough to keep pupils doing their best.

REVIEW AND PRACTICE

177. *Oral*

1. \$8 will buy how many pounds of butter at 25¢ a pound?
2. At $33\frac{1}{3}$ ¢ a bushel, \$3 will pay for how many bushels of turnips?
3. \$1 is the cost of how much cheese cloth at $6\frac{1}{4}$ ¢ a yard?
4. Find the cost of 24 yd. of ribbon at $8\frac{1}{3}$ ¢ a yard.
5. When \$4 will buy 24 lb. of beefsteak, how many pounds will \$1 buy? How much does a pound cost?
6. When \$9 will pay for 72 cans of peas, what is the price per can? (How many cans for a dollar?)
7. How long will \$6.00 worth of stamps last a man who uses \$.30 worth every day?
8. Find the cost of 300 yd. of flannel at $33\frac{1}{3}$ ¢ a yard.

9. Give the products:

$$\frac{3}{4} \times 2; \frac{1}{2} \times 3; 2 \times 1\frac{1}{2}; \frac{2}{3} \times 3; \frac{1}{2} \times \frac{1}{2}; \frac{1}{5} \times \frac{2}{3}; \frac{7}{8} \times \frac{1}{2}; \frac{1}{4} \times \frac{3}{4}.$$

10. 2 qt. of beans at $7\frac{1}{2}\text{¢}$ and 3 lb. of maple sugar at $8\frac{1}{3}\text{¢}$ cost how much?

11. How many one-ounce samples can be made from $2\frac{1}{2}$ lb. of cereal?

12. How many yards are there in 4 rd.?

13. What is the area of a floor 12 ft. by $6\frac{1}{2}$ ft.?

14. Express $\frac{2^2}{8}$ in simplest form.

15. $\frac{1}{2}$ of $\frac{1}{4}$ of a gallon is how many gills?

16. When 3 cents will buy $\frac{1}{4}$ lb. of maple sugar, what is the cost of 2 lb.?

17. $\frac{2}{5}$ of 75 ft. are how many yards?

18. $\frac{1}{3}$ of $\frac{1}{4}$ of a yard is how many inches?

19. Frank began at Chapter XVII in his book this morning and has read 12 chapters to-day. Express in Roman notation the number of the last chapter which he read.

20. Multiply 2.04056 by 1000; by 100; by 10,000.

21. Divide 89,345 by 10; by 1000; by 10,000; by 100.

22. $42.86 = 4286 \div ?$

23. $8903.4 = 8.9034 \times ?$

24. $3.984 \times ? = 3984.$

25. $\frac{246}{1000} \times \frac{13}{100} = \frac{246 \times 13}{?}.$

26. $24.63 \times .029 = 2463 \times 29 \div ?$

27. Name and describe the parties to an account.

178. *Written*

1. Express in Arabic notation eight hundred million eighty thousand eight, and seventy thousandths.
2. Write in words 4040.0700.
3. Find the prime factors of 176; 482; 1260; 775; 385; 1920.
4. Divide the product of 36, 45, 20, and 14 by the product of 80, 27, 35, and 72.
5. Find the quotient of $27 \times 28 \times 30$ divided by $18 \times 35 \times 36$.
6. Find the G. C. D. and L. C. M. of 182 and 196.
7. Find the smallest number that will exactly contain 42, 63, and 105.
8. What is the greatest number that will exactly divide 1176 and 1848?
9. Change $7\frac{86}{87}$ to simplest form.
10. How many ninths are there in 18?
11. Change $2\frac{1}{11}$ to 33ds.
12. $8\frac{1}{7} - 2\frac{16}{21} + 3\frac{5}{14} = ?$
13. A man bought $5\frac{7}{2}$ acres, $6\frac{7}{4}$ acres, and $10\frac{1}{4}$ acres of land. He then gave his son $11\frac{7}{9}$ acres. How many acres had he left?
14. The sum of two fractions is $\frac{14}{15}$. One of them is $\frac{3}{10}$. What is the other?
15. The product of two fractions is $\frac{3}{10}$. One of them is $\frac{14}{15}$. What is the other?
16. Yesterday you bought from your grocer 60 lb. of sugar at $5\frac{1}{2}$ ¢ per pound, 60 clothespins at 5¢ per dozen, and $\frac{1}{8}$ of a barrel of flour at \$4.64 per barrel. To-day you paid the bill,

and the grocer receipted it and gave it to you to take home. Write a copy of the bill.

17. $\frac{2}{3}$ of the difference between $\frac{4}{11}$ and $\frac{6}{13}$ is what?
18. Find the cost, at $\$.62\frac{1}{2}$ a bushel, of the seed oats for a field of $7\frac{1}{8}$ acres, if the farmer sows $2\frac{3}{8}$ bu. on an acre.
19. Draw a plan of a rectangular lawn 4 rd. by 2 rd., using $\frac{1}{16}$ of an inch for a foot. That is, draw it to the scale of $1' = \frac{1}{16}''$.
20. Find the cost of $325\frac{1}{8}$ bu. of wheat at $\$1.16\frac{2}{3}$ per bushel. (Express $\$.16\frac{2}{3}$ as a fraction of a dollar.)
21. $8\frac{1}{2}$ sq. rd. = how many square yards?
22. A merchant bought $\frac{2}{3}$ of a piece of cloth containing $59\frac{1}{4}$ yd. at $37\frac{1}{2}$ ¢ a yard. Find the cost.
23. How long will it take a motor car to travel $87\frac{5}{8}$ mi., if it travels $12\frac{3}{8}$ mi. in half an hour?
24. Divide .1024 by the product of .064 and .01.
25. How many cubic yards of earth must be removed to make an excavation 123 ft. by 24 ft. by 12 ft.?
26. Make a problem about 7 tons of coal, $\$43.75$, and 28 tons of coal. Find the answer.
27. A mile is 5280 ft. A rod is $16\frac{1}{2}$ ft. What can you find from these numbers? Find it.
28. The product of .025, .85, and another number is 1.7. Find the other number.
29. Find the number of cubic inches in a cake of ice $1\frac{1}{2}$ ft. by $2\frac{1}{3}$ ft. by $1\frac{1}{4}$ ft.
30. Find the number of cubic feet in a bin $6\frac{1}{4}$ ft. long, $4\frac{1}{2}$ ft. wide, and $3\frac{1}{3}$ ft. deep.
31. A room $16\frac{1}{4}$ ft. long and $10\frac{3}{8}$ ft. wide must be how high to contain $1425\frac{7}{9}$ cubic feet of air?

PRODUCTS AND FACTORS

179. Complete each of the following statements and tell which numbers are products and which are factors.

1. Since 1 rod contains — ft., 4 rods contain — ft.
2. At $3\frac{1}{2}$ ¢ each, 8 cucumbers will cost — cents.
3. At — apiece, \$47.50 will buy 10 baseball suits.
4. \$1.25 is $\frac{1}{10}$ of —.
5. \$8 is $\frac{2}{3}$ of —.
6. $\frac{3}{5}$ of $\frac{7}{8}$ = —.
7. .07 of \$25 = —.
8. When $\frac{3}{5}$ of Paul's earnings for a week are \$1.50, he earns —.
9. $16.35 \div .05 =$ —.
10. .75 of — = 225 bu.
11. $.17\frac{1}{2}$ of the cost of a piano was \$35. The piano cost —.
12. $\frac{3}{8}$ of a farm is worth \$1200. The whole farm is worth —.
13. A city lot 47 ft. wide cost \$1950.50. It cost — per front foot.
14. $54\frac{1}{8}$ is — times $2\frac{4}{5}$.
15. $13\frac{2}{3}$ yd. of broadcloth at — a yard cost \$51 $\frac{1}{4}$.
16. A rectangle 4 ft. 6 in. by 8 ft. 3 in. contains — square inches.
17. $7\frac{7}{8} =$ — $\div 1\frac{5}{8}$.
18. \$9.25 will pay for the use of \$ — when \$.05 will pay for the use of one dollar.

180. STATEMENTS AND QUESTIONS OF RELATION

Question.

$4 \times 7\frac{1}{2} = ?$

$4 \times ? = 30$

$? \times 7\frac{1}{2} = 30$

$\frac{3}{4}$ of $\frac{6}{7} = ?$

$\frac{3}{4}$ of $? = \frac{9}{14}$

$? \text{ of } \frac{6}{7} = \frac{9}{14}$

Solution.

$4 \times 7\frac{1}{2} = 30 \text{ Ans.}$

$30 \div 4 = 7\frac{1}{2} \text{ Ans.}$

$30 \div 7\frac{1}{2} = 4 \text{ Ans.}$

$\frac{\overset{3}{3}}{\underset{2}{4}} \times \frac{\overset{6}{6}}{\underset{7}{7}} = \frac{9}{14} \text{ Ans.}$

$\frac{9}{14} \div \frac{3}{4} = \frac{\overset{3}{9}}{\underset{14}{14}} \times \frac{\overset{2}{4}}{\underset{3}{3}} = \frac{6}{7} \text{ Ans.}$

$\frac{9}{14} \div \frac{6}{7} = \frac{\overset{3}{9}}{\underset{14}{14}} \times \frac{\overset{7}{7}}{\underset{6}{6}} = \frac{3}{4} \text{ Ans.}$

Which term in division is a product?

Which terms in division are factors?

When the factors are given, what must be done to find the product?

When the product and one factor are given, what must be done to find the other factor?

Every problem that depends on the relation of factors and product may be solved by one of these operations; *e.g.*1. *a.* An acre of land costs \$80. What is the cost of 12 acres?

Here we have two factors given, and the product is to be found.

Statement of Relation: $12 \times \$80 = \text{cost of 12 acres.}$

$12 \times \$80 = ?$

Solution: $12 \times \$80 = \960 Ans.

b. When 12 acres of land cost \$960, what is the cost of one acre?

What have we given in this problem?

What is to be found?

Statement of Relation: $12 \times (\text{cost of 1 acre}) = \$960.$

$$12 \times ? = \$960.$$

Solution: $\$960 \div 12 = \80 Ans.

c. If 1 acre of land cost \$80, how many acres can be bought for \$960?

What is given in this problem, and what is to be found?

Statement of Relation: (the number of acres) \times \$80 = \$960.

$$? \times \$80 = \$960.$$

Solution: $\$960 \div \$80 = 12$, the number of acres Ans.

We may make use of the relation of factors and product in solving problems containing fractions; *e.g.*

2. a. At \$80 an acre, what is the cost of $\frac{5}{8}$ of an acre of land?

Statement of Relation: $\frac{5}{8}$ of \$80 = cost of $\frac{5}{8}$ of an acre.

$$\frac{5}{8} \text{ of } \$80 = ?$$

$$\text{Solution: } \frac{5}{8} \times \frac{10}{1} = \$50 \text{ Ans.}$$

b. When $\frac{5}{8}$ of an acre of land cost \$50, what is the cost of one acre?

Statement of Relation: $\frac{5}{8} \times (\text{cost of 1 acre}) = \$50.$

$$\frac{5}{8} \text{ of } ? = \$50.$$

Solution: $\$50 \div \frac{5}{8} = \80 Ans.

c. At \$80 per acre, what part of an acre of land will \$50 buy?

Statement of Relation: (number of acres) \times \$80 = \$50.

$$? \text{ of } \$80 = \$50.$$

Solution: $\$50 \div \$80 = \frac{50}{80} = \frac{5}{8}$, number of acres Ans.

3. a. What is the volume of a box which is $\frac{3}{4}$ ft. by $\frac{7}{12}$ ft. by 2 ft.?

Statement of Relation: $\frac{3}{4} \times \frac{7}{12} \times 2 = \text{volume.}$

$$\frac{3}{4} \times \frac{7}{12} \times 2 = ?$$

Solution: $\frac{3}{4} \times \frac{7}{12} \times \frac{2}{1} = \frac{7}{8}$ (cu. ft.) *Ans.*

$$\frac{2}{4}$$

b. What must be the length of a box $\frac{3}{4}$ ft. wide and $\frac{7}{12}$ ft. deep to contain $\frac{7}{8}$ cu. ft.?

Statement of Relation: $(\frac{3}{4} \times \frac{7}{12}) \times \text{length} = \frac{7}{8}.$

$$\frac{3}{4} \times \frac{7}{12} \times ? = \frac{7}{8}.$$

Solution: $\frac{7}{8} \div (\frac{3}{4} \times \frac{7}{12})$ or $\frac{7}{8} \div \frac{7}{16} = \frac{7}{8} \times \frac{16}{7} = 2$ (ft.) *Ans.*

$$\frac{4}{4}$$

Make the statements for finding the height and width of the box.

In each of the following problems let the steps be taken in this order:

First. — Read the problem and determine what is given (two factors, or product and one factor), and what is to be found (the product, or the missing factor).

Second. — Make the statement and question of relation.

Third. — Give the solution.

181. *Written*

1. 99 is how many times 12?

2. A man sold his farm for \$7200. What did he receive for .125 of the farm?

3. 36.48 is how many times .012?

4. How many feet are there in 15 rd.?
5. Find the cost of $98\frac{3}{4}$ bu. of oats at 40¢ a bushel.
6. How much money have I if $\frac{5}{8}$ of it is \$100?
7. $\frac{2}{3}$ of a man's salary is \$1200. What is his salary?
8. $16\frac{2}{3}$ is the product of $33\frac{1}{3}$ and what other number?
9. A boy spent $\frac{3}{7}$ of his money and had \$2.80 left. How much had he at first?
10. A man owning $\frac{3}{8}$ of a vessel sold $\frac{3}{4}$ of his share for \$4800.
a. What part of the vessel did he sell? *b.* What was the whole vessel worth?
11. Wilfred spent \$2.40, which was $\frac{3}{4}$ of his money. How much money had he?
12. By what must we divide $5\frac{2}{7}$ to obtain $3\frac{2}{5}$?
13. \$75 will pay for how much wheat at $\$ \frac{3}{5}$ per bushel?
14. The multiplier is $4\frac{1}{3}$; the product is $16\frac{1}{4}$; find the multiplicand.
15. William earns \$630 in a year, which is $\frac{5}{7}$ as much as his father earns. What can you find? Find it.
16. $\frac{2}{3}$ of a yard of cloth cost $\$ \frac{3}{4}$. Make the question and answer it.
17. *a.* A farmer bought $13\frac{7}{8}$ acres of land at $\$25\frac{3}{4}$ per acre. Find the cost. *b.* He paid for it in wheat at $\$ \frac{7}{8}$ a bushel. How many bushels of wheat were required?
18. 2.3 acres of land for \$149.50 is how much an acre?
19. Find the price of a yard of cloth when $\frac{5}{8}$ of a yard cost \$1.25.
20. *a.* If $\frac{3}{4}$ of the price of a piece of timber land is \$4200, what is the price? *b.* What is the price of $\frac{5}{7}$ of it?

21. *a.* If $\frac{5}{9}$ of a ton of coal cost \$4, what is the price per ton? *b.* How much coal will $\$151\frac{1}{5}$ buy?
22. A man owning $\frac{3}{7}$ of a store sold $\frac{5}{6}$ of his share for \$1000.
a. What part of the store did he sell? *b.* What was the whole store worth at that rate?
23. *a.* $12\frac{3}{8}$ lb. of sugar is how many times $9\frac{3}{8}$ lb.? *b.* If $9\frac{3}{8}$ lb. cost $46\frac{7}{8}$ cents, what will $12\frac{3}{8}$ lb. cost? *c.* In the same way, find the cost of $16\frac{1}{5}$ tons of coal, when $2\frac{1}{4}$ tons cost \$12.60.
24. $\frac{3}{5}$ of the value of Mr. Blank's house is \$2400. *a.* What is the house worth? *b.* Find $\frac{5}{6}$ of its value.
25. I owned $\frac{2}{3}$ of a farm and sold $\frac{4}{5}$ of my share. *a.* What part of the farm did I sell? *b.* If I received \$1248, what was the farm worth?
26. How many oranges at $7\frac{1}{2}$ cents apiece will cost as much as 60 pears at $2\frac{1}{2}$ ¢ apiece?
27. .025 of \$5600 is how much money?
28. .35 of my money is \$700. How much money have I?
29. A grocer buys flour at \$1.44 a sack. He sells it so as to gain $.12\frac{1}{2}$ of the cost. What does he gain on a sack?
30. A merchant sells cloth so as to gain \$.20 on a yard. This is .40 of the cost. Find the cost of a yard.
31. Joseph earned \$17, and used $.62\frac{1}{2}$ of it to help his mother pay for the rent of her house. How much did he give toward the rent?
32. If Mary earned \$1.60 and gave her mother \$.40, what decimal part of her money did she give her mother?
33. A merchant sold cloth for cloaks at \$3.30 per yard. This was 1.65 times as much as it cost. What did it cost?

34. $.22\frac{2}{11}$ of a rod is how many feet ?
35. Lewis wants a bicycle. In 21 days he can earn .42 of the money with which to buy it. How many days must Lewis work in order to earn the bicycle?
36. Mr. Johnson's store caught fire, and his goods were damaged by smoke and water, so that he sold them for .35 of their cost. *a.* What did he receive for 38 yd. of lace that cost \$.25 a yard? *b.* What was the cost of a coat that sold for \$7? *c.* How much did he lose on a table that cost \$15.00?
37. .49 of a number is 19.6. *a.* Find the number. *b.* Find $.62\frac{1}{2}$ of the number.
38. $\frac{3}{11}$ of a certain number is $6\frac{1}{9}$. Find .37 of the number. (How many statements of relation?)
39. Mr. Byrne bought a house for \$1200 and sold it for \$1800. The gain was what decimal part of the cost?
40. 3 inches are how many hundredths of 3 feet?
41. I borrowed \$250. When I paid it back, I paid my creditor \$250 and .05 as much for the use of the money. How much did I pay in all?
42. The width of my garden is 48 feet. The width is .80 of the length. Find the length.
43. $\$3\frac{3}{4}$ is what part of \$10?
44. Eldred sold his bicycle for \$10.50, which was .35 of its cost. What did it cost?
45. There were 50 words in the spelling lesson and Charlotte missed two. How many hundredths of the words did she spell correctly?
46. Raymond shovels the snow from 80 feet of sidewalk. After shovelling .25 of the walk, how many feet more must he shovel?
47. $\frac{8}{27} \times \frac{63}{56} \times ? = 4\frac{1}{9}$.

PERCENTAGE

182. Decimals in hundredths are used very generally in business calculations. The merchant calculates his gain or loss as a certain number of hundredths of the cost of the goods. Banks compute interest in hundredths. Agents who sell goods sometimes figure their earnings as a certain number of hundredths of the selling price of the goods. The relations of numbers are expressed generally in hundredths.

Per cent is another name for hundredths. Six per cent means six hundredths; ten and one half per cent means ten and one half hundredths.

Instead of writing the words *per cent*, the sign % is used; thus:

$$5\% \text{ of } \$8 = .05 \times \$8 = \$.40.$$

$$12\frac{1}{2}\% \text{ of } 4 \text{ in.} = .12\frac{1}{2} \times 4 \text{ in.} = .50 \text{ in.}$$

$$4\% \text{ of } 80 \text{ yd.} = .04 \times 80 \text{ yd.} = 3.20 \text{ yd.}$$

$$108\% \text{ of } \$12 = 1.08 \times \$12 = \$12.96.$$

Oral

As above, tell the meaning of each of the following expressions and find its value:

- | | |
|-----------------------|---------------------------------|
| 1. 8% of 50 | 9. 1% of \$2100 |
| 2. 50% of 200 | 10. 5% of 100 boys |
| 3. 12% of 100 miles | 11. 80% of 20 horses |
| 4. 10% of 60 sheep | 12. 20% of 400 |
| 5. 50% of 300 men | 13. $33\frac{1}{3}\%$ of 900 |
| 6. 2% of 30 bushels | 14. 10% of 2000 |
| 7. 25% of 64 days | 15. $2\frac{1}{2}\%$ of 30 days |
| 8. 10% of 150 bushels | 16. $7\frac{1}{2}\%$ of \$100 |

17. 25% of 200 minutes 20. 90% of \$60
 18. $33\frac{1}{3}\%$ of \$75 21. 150% of 20 pounds
 19. 5% of 32 22. 300% of \$1

183. The statement and question of relation aid in solving problems in percentage; *e.g.*

1. Donald gave his mother \$3.75, which was 75% of his week's wages. How much a week did he receive?

Read the question, using the word *hundredths* in place of per cent.

Statement of Relation: 75% of (Donald's wages) = \$3.75.
 .75 of ? = \$3.75.

Solution: $\$3.75 \div .75 = \5 Ans.

The statement of relation shows that \$3.75 is a product, .75 one of its factors, and Donald's wages the other factor, which we are to find.

2. What per cent of \$38 is \$24.70?

Reading hundredths instead of per cent, the question is, "How many hundredths of \$38 is \$24.70?"

Statement of Relation: — of \$38 = 24.70.

Solution: $\$24.70 \div \$38. = .65$ or 65% Ans.

Observe that the steps in solving percentage problems are:

- Read the question, using hundredths in place of per cent.
- See which terms of relation are given, and which are to be found.
- Give the statement and question of relation.
- Make the solution.

In finding the per cent, or number of hundredths, how many decimal places must there be in the quotient? Then how must the number of decimal places in the dividend compare with the number of decimal places in the divisor?

Therefore,

Before dividing, to find per cents, arrange the dividend and divisor so that the dividend contains two more decimal places than the divisor. This may be done by annexing ciphers to one or the other of these terms, as may be necessary.

If the quotient is not exact when two decimal places have been reached, express the remainder as a common fraction, in the quotient; thus :

3. 1.65 T. is what per cent of 4.2 T. ?

Statement of Relation: — of 4.2 T. = 1.65 T.

Solution: $1.65 \text{ T.} \div 4.2 \text{ T.} = .39\frac{5}{8}$ or $39\frac{5}{8}\%$.

$$\begin{array}{r} .39\frac{5}{8} = .39\frac{5}{8} \text{ or } 39\frac{5}{8}\% \text{ Ans.} \\ 4.2 \overline{)1.650} \\ \underline{126} \\ 390 \\ \underline{378} \\ 12 \end{array}$$

4. Mr. Moore earns \$140 a month and saves \$84. His earnings are what per cent of his savings ?

Statement of Relation: — of \$84 = \$140.

Solution: $\$140 \div \$84 = 1.66\frac{2}{3}$ or $166\frac{2}{3}\%$ Ans.

$$\begin{array}{r} 1.66\frac{2}{3} = 1.66\frac{2}{3} \text{ or } 166\frac{2}{3}\% \text{ Ans.} \\ \$84 \overline{) \$140.00} \\ \underline{84} \\ 560 \\ \underline{504} \\ 560 \\ \underline{504} \\ 56 \end{array}$$

TO THE TEACHER. — It is well to follow this plan until pupils acquire a considerable degree of skill in the process. After pupils have become well grounded in the fundamental idea that *per cent* and *hundredths* are identical as expressions of ratio, it may be desirable to give practice in expressing fractional parts of 1% as decimal approximations, as 8.33% instead of $8\frac{1}{3}\%$.

Written

Solve the following, using the steps indicated above :

5. *Find :*

- | | |
|---------------------------------|----------------------------------|
| a. 40 % of 120 | h. 35 % of 700 pupils |
| b. $12\frac{1}{2}$ % of 160 lb. | i. $\frac{1}{2}$ % of \$90 |
| c. $18\frac{2}{5}$ % of 365 | j. $16\frac{2}{3}$ % of 66 miles |
| d. 36 % of 250 yd. | k. 48 % of \$8.50 |
| e. $8\frac{1}{3}$ % of 360 | l. 100 % of \$24.70 |
| f. $6\frac{1}{4}$ % of 64 bu. | m. 200 % of \$18.79 |
| g. 37 % of \$16.50 | |

6. a. 6.8 is 17 % of what?

b. \$3.95 is 5 % of what?

c. \$289 is 50 % of what?

d. 75 doz. is $2\frac{1}{2}$ % of how many dozen?

e. 5 is 5 % of what?

7. a. What per cent of \$240 is \$80?

b. 150 is what per cent of 900?

c. What per cent of \$113 is \$39.55?

d. Find what per cent 495 years is of 825 years.

e. Find what per cent 12.96 feet is of 96 feet.

8. 45 bushels are 90 % of what?

9. $3\frac{1}{2}$ miles is 70 % of what distance?

10. What is $8\frac{1}{2}$ % of 690 lb.?

11. What per cent of \$920 is \$230?

12. 15 minutes are what per cent of 25 minutes?

13. a. 1 quart is what per cent of 4 quarts?

b. 1 quart is what per cent of 1 gallon?

14. Find $18\frac{1}{2}$ % of 362.

15. Of what number is 3.71 twenty-five per cent?

16. 15% of a number is 10.50. What is the number?
17. What is $1\frac{7}{8}$ % of 640?
18. $37\frac{1}{2}$ % of what equals 15 lb.?
19. What per cent of 85 lb. is 17 lb.?
20. 35 yd. are what per cent of 105 yd.?
21. Henry raised 80 chickens and sold 75% of them. How many chickens did he sell?
22. Mary has an allowance of \$25 a year. If she puts 12% of it in the bank each year, how much will she put in the bank in 5 years?
23. There were 50 words in the spelling test. Dorothy spelled 98% of them correctly. How many did she have right?
24. In a school of 660 pupils, 55% were girls. How many were girls?
25. 45% of a class of 40 pupils were boys. How many were girls?
26. 60% of a class were boys. *a.* If there were 21 boys, how many pupils were there in the class? *b.* How many were girls?
27. In a class of 50 pupils, there were 27 girls. What per cent of the class were boys?
28. In one day a grocer sold $14\frac{2}{7}$ % of a barrel of sugar, containing 350 lb. How many pounds did he sell?
29. Mr. Williams has 40 acres of timber land. This is 25% of all his land. How many acres has he?
30. .375 is what per cent of .875?
31. A man's house and furniture are insured for \$3600. 40% of this insurance is on the furniture. What is the insurance on the furniture?

32. Mr. French borrowed \$725 of Mr. Rich, and paid him 6% of that sum for the use of it. How much was paid for the use of the \$725?

33. A man borrowed some money and paid \$75 for the use of it. If that was 5% of the sum borrowed, how much was borrowed?

34. A bushel of potatoes weighs 60 lb. If 75% of this is water, how many pounds of water are there in a bushel of potatoes?

35. It costs a man \$1200 to support his family for a year. If this is 80% of his salary, what is his salary?

36. 920 lb. or 23% of a load of grain is wheat. How many pounds does the load weigh?

37. *a.* In a baseball game, Fred's team scored 14 runs. If Fred made 2 runs, what per cent of the 14 runs did he make? *b.* If the other team made 6 runs, what per cent of all the runs did Fred's team make?

38. A bat and ball cost \$1.50. If $33\frac{1}{3}\%$ of this sum was paid for the bat, what did the ball cost?

39. A huckster bought berries at 8¢ a quart and sold them at 12¢. His gain was what per cent of the cost?

40. 35 gallons of Jersey milk contained 8.05 gallons of cream. What per cent of the 35 gallons was cream?

41. A man lost \$127.50 by selling a village lot. If this was 15% of the cost, what did the lot cost?

42. A merchant sold goods for \$25.63 less than the marked price. If this reduction was 10% of the marked price, what was the marked price?

43. A grocer bought a crate of cherries containing 32 quarts for \$2.88. He sold them at 12 cents a quart. His gain was what per cent of the cost?

REVIEW AND PRACTICE

60'						9'
<i>Popcorn</i>						
<i>Sweet Corn</i>						18'
<i>Tomatoes</i>						7'
<i>Cucumbers</i>			<i>Squash</i>			7'
<i>Early Lettuce</i>	<i>Radishes</i>	<i>Late Lettuce</i>	<i>Spinach</i>		<i>Peppers</i>	6'
<i>Cabbages</i>						3'
<i>Cauliflower</i>						3'
<i>Parsley</i>	<i>Parsnips</i>	<i>Salsify</i>	<i>Carrots</i>	<i>Onions</i>	<i>Beets</i>	6'
<i>Flowers</i>						5'

This is the plan of a real garden which Joseph and his father cultivated. All the statements in the exercises are facts.

Oral

1. Take your rule and find out the scale of the plan.
2. Find the number of square feet of land planted to radishes; to late lettuce; to spinach; to onions; to beets.

184. *Written*

1. The corn was planted so that each hill occupied one square yard of ground.

a. How many hills of pop corn were there?

b. How many hills of sweet corn?

2. There were six hills of cucumbers, and the same number of hills of squash. How many square feet of land did each hill occupy?

3. There were 15 tomato plants. How much space did each plant have?

4. The cabbage and cauliflower plants each had $7\frac{1}{2}$ square feet of space. How many plants were there?

5. a. What per cent of the entire garden is planted to flowers? b. To cabbage and cauliflower? c. To spinach?

6. The family table was supplied with vegetables from the garden, a correct account of them being kept. Those not needed at home were sold by Joseph during his spare time, mornings and Saturdays.



Find the value of each of the following productions:

a. Sweet corn	312 ears	\$.13 per dozen.
b. Tomatoes	6 bu.	\$.04 per quart.
c. Pop corn	54 lb.	\$.04 $\frac{1}{2}$ per lb.
d. Cucumbers	219	3 for 10 cents.
e. Squash	88 lb.	3 $\frac{1}{2}$ ¢ per lb.

<i>f.</i>	Cauliflower	20 heads	\$.18 apiece.
<i>g.</i>	Lettuce (early) . . .	100 heads	\$.04 apiece.
<i>h.</i>	Lettuce (late)	70 heads	2 for 5 cents.
<i>i.</i>	Spinach	4 bu.	18¢ per pk.
<i>j.</i>	Radishes	66 bunches	3 for 5 cents.
<i>k.</i>	Parsnips	1 bu.	25¢ per pk.
<i>l.</i>	Salsify	25 bunches	5¢.
<i>m.</i>	Peppers	111	16¢ per doz.
<i>n.</i>	Young onions	40 bunches	2 for 5 cents.
<i>o.</i>	Ripe onions	$\frac{1}{2}$ bu.	4¢ per qt.
<i>p.</i>	Cabbage	22 heads	9¢ apiece.
<i>q.</i>	Carrots	22 bunches	2 for 5 cents.
<i>r.</i>	Beets	30 bunches	2 for 5 cents.
<i>s.</i>	Beets (full grown) . .	3 pk.	60¢ per bu.

7. What was the total value of these productions?

Make other problems using the numbers given above.

8. The first ripe tomatoes were gathered on the 14th day of August and the latest on the 17th day of October. How many days did they last?

9. A crop of peas was grown before the cabbage and cauliflower plants were set out. Peas were raised, also, on either side of the rows of tomatoes, cucumbers, and squash before those vines began to spread. The crop of peas was $2\frac{1}{2}$ bu. and they were worth 33¢ a peck. Find the value of the crop of peas raised here.

10. Beans were planted between the rows of corn and matured before the corn was high enough to shut out the sun. The three bushels of string beans thus raised were worth how much at 5¢ a quart?

11. Some pumpkin seeds were planted with the seed corn, and yielded 27 pumpkins worth 12 cents apiece. What were they all worth?

12. Late sweet corn was planted where the radishes, spinach, lettuce, and part of the peas had grown, and yielded 148 ears worth 12 cents a dozen. What was the crop worth?

13. Adjoining this garden is a space of the same size devoted to fruit, flowers, and perennial vegetables. The flowers were used for the adornment of the home and the pleasure of giving them to others. The extra fruit and vegetables were sold.

Find the total value of the following:

Asparagus, averaging one bunch per day from May 1 to July 1 at 9 cents a bunch.

Twenty bundles of pie-plant at 5 cents per bundle.

Three pounds of sage at 35¢ per pound.

Fifty-three baskets of grapes at 20¢ per basket.

Six and one half bushels of plums at 20¢ per peck.

Four bushels of cherries at 12¢ per quart.

Two bushels of pears at 30¢ per peck.

Two and one half bushels of peaches at 8¢ per quart.

Two bushels of currants at 9¢ per quart.

14. The expenditures were :

For fertilizers	\$ 6.50
For seeds	1.38
For Bordeaux mixture for spraying trees, etc.40
For Paris green for spraying30
For trees, vines, and plants	2.38
For implements worn out65

Joseph received as his share \$25.20, which was 25% of the value of all that was raised, after the expenses were paid.

- What was the value of the produce less expenses?
- What was the total value of the produce?

PER CENTS EQUIVALENT TO COMMON FRACTIONS

185. All percentage problems involving the relation of product and factors may be solved in decimals. But in many cases, as we shall see, the work may be shortened by changing the per cents to common fractions.

Oral

1. The whole of anything is how many hundredths of it? What per cent of it?

2. $\frac{1}{2}$ of anything is how many hundredths of it? $\frac{1}{4}$? $\frac{1}{5}$? $\frac{1}{10}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{3}{5}$? $\frac{4}{5}$? $\frac{1}{8}$? $\frac{3}{8}$? $\frac{5}{8}$? $\frac{7}{8}$? $\frac{1}{3}$? $\frac{2}{3}$? $\frac{1}{6}$? $\frac{5}{6}$? $\frac{1}{12}$? $\frac{1}{20}$?

3. What common fraction is the same as .10? .20? .30? .40? .50? .60? .70? .80? .90? .25? $.33\frac{1}{3}$? $.14\frac{2}{7}$? $.62\frac{1}{2}$? $.37\frac{1}{2}$? $.66\frac{2}{3}$? $.12\frac{1}{2}$? $.87\frac{1}{2}$? .75? $.16\frac{2}{3}$? $.83\frac{1}{3}$? $.08\frac{1}{3}$? .05?

4. What per cent is the same as $\frac{1}{2}$? $\frac{1}{3}$? $\frac{1}{4}$? $\frac{1}{5}$? $\frac{1}{6}$? $\frac{1}{7}$? $\frac{1}{8}$? $\frac{1}{10}$? $\frac{1}{12}$? $\frac{1}{20}$? $\frac{1}{16}$? $\frac{1}{25}$? $\frac{2}{3}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{3}{5}$? $\frac{4}{5}$? $\frac{3}{8}$? $\frac{5}{8}$? $\frac{7}{8}$?

5. *Learn this table:*

$$\frac{1}{2} = 50\%$$

$$\frac{1}{3} = 33\frac{1}{3}\%$$

$$\frac{5}{8} = 62\frac{1}{2}\%$$

$$\frac{1}{4} = 25\%$$

$$\frac{2}{3} = 66\frac{2}{3}\%$$

$$\frac{7}{8} = 87\frac{1}{2}\%$$

$$\frac{3}{4} = 75\%$$

$$\frac{1}{6} = 16\frac{2}{3}\%$$

$$\frac{1}{10} = 10\%$$

$$\frac{1}{5} = 20\%$$

$$\frac{5}{6} = 83\frac{1}{3}\%$$

$$\frac{1}{12} = 8\frac{1}{3}\%$$

$$\frac{2}{5} = 40\%$$

$$\frac{1}{7} = 14\frac{2}{7}\%$$

$$\frac{2}{10} = 5\%$$

$$\frac{3}{5} = 60\%$$

$$\frac{1}{8} = 12\frac{1}{2}\%$$

$$\frac{1}{16} = 6\frac{1}{4}\%$$

$$\frac{4}{5} = 80\%$$

$$\frac{3}{8} = 37\frac{1}{2}\%$$

$$\frac{2}{5} = 4\%$$

Answer the following questions, using common fractions instead of decimals when it is easier to do so.

6. Find:

- | | |
|------------------------------------|------------------------------------|
| a. $33\frac{1}{3}\%$ of 12 | k. $6\frac{1}{4}\%$ of 16 days |
| b. 10% of 200 | l. 60% of 50 ft. |
| c. $16\frac{2}{3}\%$ of 30 da. | m. $37\frac{1}{2}\%$ of 64 |
| d. $8\frac{1}{3}\%$ of 144 sq. in. | n. $87\frac{1}{2}\%$ of 96 |
| e. 75% of 28 gal. | o. $83\frac{1}{3}\%$ of 18 trees |
| f. $66\frac{2}{3}\%$ of 27 cu. ft. | p. $12\frac{1}{2}\%$ of 600 |
| g. 20% of $\frac{5}{9}$ | q. $33\frac{1}{3}\%$ of 60 years |
| h. 40% of \$100 | r. 4% of \$50 |
| i. 90% of \$200 | s. $8\frac{1}{3}\%$ of 3600 people |
| j. $62\frac{1}{2}\%$ of 24¢ | t. 25% of 836 miles |
7. 9 is 25% of what number?
 8. 32 is 50% of what number?
 9. 75 is 10% of what number?
 10. 4 is what per cent of 16? ($\frac{1}{4}$ = what per cent?)
 11. 6 is what per cent of 9? ($\frac{6}{9}$ = $\frac{2}{3}$ = what per cent?)
 12. 1 is what per cent of 16?
 13. 3 months are what per cent of 18 months?
 14. 3 books are what per cent of 15 books?
 15. \$7 are what per cent of \$84?
 16. 9 men are 75% of how many men?
 17. 10 min. are $16\frac{2}{3}\%$ of what?
 18. 2 is what per cent of 40?
 19. 80% of 35¢ is what?
 20. 20% of my money is 16¢. How much money have I?
 21. 8 cents are $66\frac{2}{3}\%$ of what?

22. Frank is 15 years old. Julia's age is $16\frac{2}{3}\%$ of Frank's. How old is Julia?

23. Will is 8 years old and Ethel is 7. Ethel's age is what per cent of Will's?

24. I gained \$7 in selling my watch. If that was $12\frac{1}{2}\%$ of the cost, what did it cost?

25. Out of 25 words, Charlie missed one. What per cent of the words did Charlie miss?

26. Edith had 9 examples right. If there were 10 in the lesson, what per cent of them did she have right?

27. $\frac{100}{100} - \frac{90}{100} =$ how many hundredths?

28. $100\% - 90\% =$ what per cent?

29. If I spend 90% of my money, what per cent do I have left?

30. Having spent 90% of my money, I had \$2 left. How much money had I at first?

31. A grocer sold 90% of a barrel of sugar and had 35 lb. left. How many pounds did the barrel contain at first?

32. Hubert gave away 75% of his apples and had 6 left. How many had he at first?

33. Harry took a silver dollar to the store and bought 2 lb. of cheese at 18ϕ a pound. On the way home he lost $12\frac{1}{2}\%$ of the change. How much change did he lose?

34. A boy sold $66\frac{2}{3}\%$ of his chickens and kept 20. What per cent of them did he keep? How many had he at first? How many did he sell?

35. Sarah answered correctly 80% of the questions that came to her and missed one. How many questions came to her? How many did she answer correctly?

36. Alfred attended school 98 % of the days of the term. If he was absent 2 days, how many days were there in the term ?

37. A boy was sick and stayed out of school 5 days in one month. If there were 20 days of school in that month what per cent of the time did he attend school ?

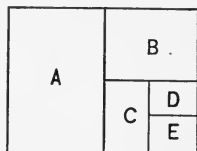
38. $62\frac{1}{2}$ % of a cask of vinegar leaked out. If there were 15 gallons left, how many gallons did the cask hold ?

39. $.20 + .10 =$ how many hundredths ?

40. $20 \% + 10 \% =$ how many per cent ?

41. A butcher bought 200 lb. of beef. He sold 20 % of it to one man and 10 % of it to another. What per cent of the beef did he sell ? What per cent was left ? How many pounds were left ?

42. What per cent of this oblong is *A* ? *B* ? *C* ? *D* ? If *A* is 50 sq. in., what is *B* ? *C* ? *D* ? *E* ? What per cent of the oblong are *A*, *B*, and *C* together ?



43. In a shipwreck, $\frac{1}{3}$ of the crew were lost. What per cent were saved ? If 80 men were saved, how many were lost ?

44. Alice, having read 75 % of a book, has 50 pages yet to read. How many pages does the book contain ?

45. A man has traveled 60 % of the distance from New York to Chicago and has 400 miles yet to travel. What is the whole distance ?

46. When 25 days of the month of November are past, what per cent of the month is yet to come ?

47. If your schoolroom is 40 feet long and 30 feet wide, its width is what per cent of its length ? Its length is what per cent of its width ?

186. *Written*

1. An army of 19,000 men went to the front. $12\frac{1}{2}\%$ of them were killed in battle, and 25% of them died of wounds and sickness. How many were left?

2. A collector for a newspaper started out with bills amounting to \$840. He collected \$756. *a.* What per cent of the bills did he collect? *b.* What per cent did he fail to collect?

3. 35% of the apples in an orchard were unfit for market and could not be sold. If 1300 bushels were sold, what was the entire yield?

4. 39% of the 4700 blossoms on a cherry tree were blasted and the rest became fruit. How many cherries did the tree bear?

5. 98% of the men in a certain city can read and write. If there are 1398 men who cannot read and write, how many men are there in the city?

6. 23% of the men in a certain city work in factories. If there are 9200 men who work in factories, how many men are there in the city?

7. 45% of a jeweler's goods were stolen. *a.* If he had \$16,500 worth of goods left, what was the entire stock of goods worth? *b.* How many dollars' worth were stolen?

8. In an orchard of 3600 trees, 25% were pear trees, 15% peach trees, 10% plum trees, and the rest apple trees. How many apple trees were there?

9. My gas bill for one month was \$1.80. Five per cent of it was deducted for prompt payment. What was saved by paying promptly?

10. A merchant bought a piece of cloth for \$65 and sold it for 130% of its cost. What did he receive for it?



11. This load of hay weighs 2200 lb., the wagon 1200 lb., and the team 2600 lb. *a.* The weight of the hay is what per cent of the entire weight? *b.* The weight of the wagon is what per cent of the entire weight? *c.* The weight of the team is what per cent of the entire weight? *d.* How many tons must the bridge support?

12. *a.* In 1905 the Chicago baseball team won 92 games and lost 60. What per cent of all the games played did they win? *b.* The Boston team won 78 and lost 74. What per cent of all the games did they lose? *c.* The New York team played 149 games and won $47\frac{97}{149}\%$ of them. How many games did they lose?

13. By selling paper at 150 % of its cost, a stationer receives 90 cents a package for it. What is the cost of a package of this paper?

14. Twelve pounds of seed for a lawn contained $2\frac{1}{2}$ lb. of white clover seed. What per cent of the mixture was white clover seed?

15. *a.* If a pine plank weighs 45 lb. and an oak plank of the same size weighs 72 lb., the weight of the pine is what per cent of the weight of the oak? *b.* The weight of the oak wood is what per cent of the weight of the pine?

16. A grocer bought 100 lb. of soda for \$3.50 and sold it for $142\frac{2}{7}\%$ of its cost. What did he receive a pound for it?

A FRACTION IN THE MULTIPLICAND

187. In multiplying a large mixed number by an integer, time may often be saved by multiplying the whole number and the fraction separately, then adding the products, thus:

$$314\frac{7}{9} \times 5 = ?$$

$$\begin{array}{r} 314\frac{7}{9} \\ \underline{\quad 5} \\ 3\frac{8}{9} = \frac{7}{9} \times 5 \\ 1570 = 314 \times 5 \\ \hline 1573\frac{8}{9} = 314\frac{7}{9} \times 5 \end{array}$$

Multiply:

- | | | |
|---------------------------|----------------------------|----------------------------|
| 1. $248\frac{2}{3}$ by 5 | 6. $98\frac{3}{11}$ by 8 | 11. $224\frac{1}{3}$ by 9 |
| 2. $39\frac{7}{11}$ by 3 | 7. $35\frac{2}{7}$ by 7 | 12. $42\frac{3}{17}$ by 12 |
| 3. $42\frac{9}{13}$ by 6 | 8. $49\frac{3}{8}$ by 13 | 13. $65\frac{1}{2}$ by 16 |
| 4. $850\frac{1}{6}$ by 15 | 9. $207\frac{2}{3}$ by 3 | 14. $201\frac{2}{3}$ by 16 |
| 5. $29\frac{2}{7}$ by 11 | 10. $38\frac{5}{16}$ by 16 | 15. $431\frac{1}{3}$ by 72 |

188. In division, if either dividend or divisor contains a common fraction that cannot be easily reduced to a decimal, it is sometimes helpful to multiply both dividend and divisor by the denominator of the fraction, thus making both dividend and divisor integers, or simple decimals; *e.g.*:

$$.05\frac{2}{7} \overline{)148.74}$$

Multiplying both dividend and divisor by 7,

$$\begin{array}{r}
 2814. \quad \text{Quotient} \\
 .37 \overline{)1041.18} \\
 \underline{74} \\
 301 \\
 \underline{296} \\
 51 \\
 \underline{37} \\
 148 \\
 \underline{148} \\
 \hline
 \hline
 \end{array}$$

(Multiplying the dividend and divisor by the same number affects the quotient how?)

- | | |
|--------------------------------|----------------------------------|
| 1. $2.295 \div .05\frac{2}{3}$ | 6. $.3125 \div .02\frac{3}{11}$ |
| 2. $10.44 \div .04\frac{1}{7}$ | 7. $787.2 \div .93\frac{5}{7}$ |
| 3. $56 \div .13\frac{1}{3}$ | 8. $1.024 \div .005\frac{1}{3}$ |
| 4. $96.9 \div .15\frac{5}{6}$ | 9. $218.24 \div 1.13\frac{2}{3}$ |
| 5. $.0256 \div .07\frac{1}{3}$ | 10. $385.35 \div 5.2\frac{3}{7}$ |

11. Find the number, of which:

- | | |
|--------------------------------|--------------------------------|
| a. 72 is $5\frac{1}{7}\%$ | f. 701.4 is $4\frac{2}{3}\%$ |
| b. 10.5 is $11\frac{0}{11}\%$ | g. 284.4 is $105\frac{1}{3}\%$ |
| c. 24.64 is $39\frac{1}{9}\%$ | h. 5.775 is $116\frac{2}{3}\%$ |
| d. 12.834 is $14\frac{2}{7}\%$ | i. .3155 is $90\frac{1}{7}\%$ |
| e. 1263 is $17\frac{1}{6}\%$ | j. .833 is $108\frac{2}{11}\%$ |

12. Mr. Fitch gained \$4.60 in selling a wagon. This was $6\frac{2}{3}\%$ of its cost. What was the cost of the wagon?

13. The average attendance in a certain school was 640 pupils. If this was $91\frac{3}{7}\%$ of the number registered in the school, how many were registered?

REVIEW AND PRACTICE

189. *Oral*

1. What number is composed of 5 units, 7 tens, and 3 thousands?

2. Read XLIV; CCLXII; DCXCI; MC IVIII; CDLIV.

3. Give results rapidly, adding or subtracting the tens' figures first: $36 + 45$; $29 + 32$; $57 + 76$; $93 + 28$; $93 - 27$; $84 - 45$; $72 + 39$.

4. Give quickly the number of:

a. Quarts in 98 pt.

j. Feet in 2 rd.

b. Pecks in 28 bu.

k. Dollars in 36,000 cents.

c. Hours in a week.

l. Gills in a gallon.

d. Seconds in 1 hour.

m. Days in two common years.

e. Inches in 2 yd.

n. Tons in 1600 lb.

f. Square inches in 2 sq. ft.

o. Square rods in 10 A.

g. Square yards in 450 sq. ft.

p. Yards in 10 rd.

h. Cubic feet in 2 cu. yd.

q. Days in 14 wk.

i. Dimes in \$15.

r. Days in a summer.

s. Cubic inches in a box 5 in. by 2 in. by 1 in.

5. A half dollar, a quarter, 2 dimes, and a nickel are how many cents?

$$6. \frac{1}{2} + \frac{1}{3} + \frac{5}{12} = ?$$

$$10. 15 - \frac{7}{8} = ?$$

$$7. 3 \times 8 \times ? = 48$$

$$11. 18 - 1\frac{3}{8} = ?$$

$$8. 8 \times 9 = 6 \times ?$$

$$12. 5\frac{4}{9} + 13\frac{5}{9} = ?$$

$$9. 88 \div ? = 8$$

$$13. 7\frac{2}{3} - \frac{5}{6} = ?$$

14. When 36 men can earn a sum of money in 15 da., how long will it take 12 men at the same wages to earn the same amount? 9 men? 6 men? 72 men?

15. If 6 men earn 8 dollars in a certain time, how many men can earn \$16 in the same time at the same wages? \$32? \$64? \$4?

16. If 10 men earn \$200 in 8 days, how many dollars will twice as many men earn in that time at the same rate?

17. $\frac{2}{3}$ of 8 bu. = ?

21. 36 is $\frac{9}{10}$ of what?

18. $\frac{7}{8}$ of ? = 14.

22. $\frac{7}{8}$ of $\frac{16}{1}$ = ?

19. 27 is $\frac{9}{11}$ of what?

23. $\frac{5}{8}$ of what = 15 qt.?

20. What part of 18 is 15?

24. $\frac{2}{3}$ of what = $\frac{4}{7}$?

25. What are the prime factors of 84?

26. Name two numbers that are prime to 12.

27. How many 42ds are there in $\frac{3}{4}$?

28. What is the least number that exactly contains 6, 15, and 20?

29. Name three numbers of which 7 is an exact divisor.

30. Give two composite numbers that are prime to each other.

31. How may we tell whether a number is prime or not?

32. What is the greatest number that will exactly divide 26 and 39?

33. What is the smallest number that 6, 8, 12, and 16 will divide?

34. Give results at sight:

a. $362 \div 10$

f. 14×200

k. .06 of 500

b. $4900 \div 1000$

g. $99 \div .1$

l. $\frac{1}{4}$ of — = $7\frac{3}{4}$

c. $29 \times .01$

h. $.224 \text{ T} = \text{— lb.}$

m. 5% of 25

d. $834 \div 10,000$

i. $23,400 \div 200$

n. $12\frac{1}{2}\%$ of — = 7

e. 29×1000

j. $.12 \times 50$

o. $\frac{1}{16} = \text{— \%}$

35. What per cent of a ton is 400 lb.?

36. Compare $.84 \times 25$ with $84 \times .25$.

37. $(16 + 4) \times (43 - 23) = ?$
38. What must we do with $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$ to find out which is greatest?
39. Numerate 23516.00562.
40. Compare the values of $\frac{2}{3}$, $\frac{1}{2}\frac{6}{4}$, and $\frac{1}{15}$.
41. *Find the cost of:*
- a. 64 lb. of pork at $12\frac{1}{2}\phi$
 - b. 600 boxes of berries at $8\frac{1}{3}\phi$
 - c. 96 gal. of molasses at 50ϕ
 - d. 16 doz. oranges at $37\frac{1}{2}\phi$
 - e. 54 yd. of matting at $33\frac{1}{3}\phi$
 - f. 48 lb. butter at 25ϕ
 - g. 16 knives at $62\frac{1}{2}\phi$
 - h. 2 doz. sleds at $87\frac{1}{2}\phi$ apiece
 - i. 80 lb. rice at $6\frac{1}{4}\phi$
42. How many bushels of beets will \$12 buy at $33\frac{1}{3}\phi$ a bushel?
43. \$16 will rent a boat for how many hours at 16ϕ an hour?
44. What change will be left from a \$20 bill after paying for 12 hours' labor at $37\frac{1}{2}\phi$ an hour?
45. At $16\frac{2}{3}\phi$ a dozen, how many ears of corn will \$2 buy?
46. $\frac{1}{2}$ of $\frac{1}{4}$ lb. = — oz.
47. What is the area of a rectangle $5\frac{1}{4}$ inches by 4 inches?
48. What is the cost of a dozen tomato plants at the rate of 4 for 5 cents?
49. At 10ϕ a dozen, how many sheets of sandpaper will 5ϕ buy?

50. A man spent 20% of his salary for rent, 10% for clothing, 5% for fuel and light, 25% for food, and 20% for other things. What per cent of his money did he spend? What per cent did he save? If he saved \$400 a year, what was his salary?

51. What is 120% of 5 miles?

190. *Written*

1. Write in figures forty-two thousand, and two hundred five ten-thousandths.

2. $209 \times 87,000$ (*test*).

3. $235,404 \div 468$ (*test*).

4. $23,945 \div 160$ (*test*).

5. $302,050 - 92,059$.

6. 17 hr. 35 min. = how many minutes?

7. $639,800 \div 700$ (*test*).

8. 4320 square yards = how many square rods?

9. When 60 bu. of oats grow on an acre of ground, how many bushels grow on a square rod?

10. The highest ten batting averages in the National Baseball League in a certain year were .377, .363, .356, .328, .317, .316, .315, .311, .308, .304. What was the average of all these?

11. Using cancellation, divide $48 \times 54 \times 200$ by $18 \times 108 \times 25$.

12. How many pieces of sheeting, 39 yd. in a piece, worth 12¢ a yard, would pay for 52 hours' work for 36 men at 32¢ an hour?

13. Find the L. C. M. of 23, 37, 32, 36, and 56.

14. Find the G. C. D. of 48, 60, and 78.

15. *Change to lowest terms:*

a. $\frac{240}{432}$. b. $\frac{357}{483}$. c. $\frac{54}{135}$. d. $\frac{34}{85}$. e. $\frac{72}{81}$. f. $\frac{48}{84}$.

16. *Reduce to simplest form:*

a. $\frac{728}{894}$. b. $32\frac{24}{40}$. c. $\frac{322}{16}$. d. $\frac{236}{27}$. e. $\frac{136}{23}$. f. $\frac{527}{92}$.
g. $\frac{7108}{84}$.

17. *Change to improper fractions:*

a. $399\frac{87}{90}$. b. $43\frac{27}{32}$. c. $18\frac{3}{15}$. d. $56\frac{7}{15}$.

18. *Change:* a. $7\frac{3}{8}$ to 24ths. b. $\frac{1177}{1284}$ to a fraction whose terms are prime to each other. c. $\frac{3}{8}$, $\frac{5}{6}$, and $\frac{7}{15}$ to fractions having the least common denominator.

19. A wagon which cost $\$52\frac{1}{2}$ was sold for $\$46\frac{3}{4}$. a. What was the loss? b. What per cent of the cost was lost?

20. A salesman cut $19\frac{7}{8}$ yd. of cloth from a piece containing $38\frac{3}{4}$ yd. How many yards remained?

21. The remainder is $632\frac{5}{7}$ and the minuend $965\frac{3}{4}$. What is the subtrahend?

22. a. After John had spent $\frac{1}{3}$ of his money for a book, $\frac{1}{6}$ of it for a knife, and $\frac{1}{4}$ of it for oranges, what per cent of it was left? b. If he had $\$.36$ left, how much had he at first?

23. What can 6 men earn in $4\frac{1}{2}$ wk. at $\$12\frac{3}{4}$ a week?

24. $\frac{9}{10} \times 8 \times \frac{12}{15} \times 6\frac{2}{3} \times \frac{25}{30} = ?$

25. A man sold a horse for $\$160$ and a cow for $\frac{3}{8}$ as much. What did he receive for both?

26. Find the area and the perimeter of a rectangle $12\frac{1}{2}$ inches by $8\frac{7}{8}$ inches.

27. Find $\frac{7}{8}$ of $\frac{5}{6}$ of $\frac{9}{10}$.

28. A man sold $\frac{3}{5}$ of his farm and had 90 acres left. How many acres did the farm contain?

29. Simplify $\frac{16\frac{1}{2}}{87\frac{2}{3}}$.

30. A man put in the bank \$252, which was $\frac{3}{5}$ of what he received for a wood lot. What was the selling price of the wood lot?

31. A merchant lost $\frac{3}{4}$ of his money and has \$123.50 left. How much had he at first?

32. Simplify $\frac{\frac{3}{5} \text{ of } \frac{3}{4}}{\frac{5}{9} \text{ of } 2\frac{1}{3}}$.

33. The sum of two fractions is $1\frac{5}{16}$. One of them is $\frac{1}{4}$. What is the other?

34. Add ten and five thousandths, three and seven tenths, forty-seven millionths, five hundred five thousandths.

35. Find the sum of eight and thirty-five thousandths, seventeen and fifty-three thousandths, fifty and fifty-four millionths, five hundred two and nine ten-thousandths.

36. Find the sum of 6.06; 70.50; 6.0765; .00365; 101.09; 28.56741; 50.005.

37. Express in figures and add: 25 thousandths, 12 hundredths, 26 ten-thousandths, 8 hundred-thousandths, 7 millionths, 2375 hundred-thousandths.

38. Add seventeen thousandths, eighteen ten-thousandths, sixty-four millionths, fifteen ten-millionths, five hundred two hundred-thousandths, and from the sum subtract eighty-four hundred-thousandths.

39. *a.* .0375 is how much greater than $\frac{1}{30}$?

b. $12.5 - 9.0025 = ?$

40. Reduce to common fractions or mixed numbers:

a. .00125. b. .0875. c. 3.625. d. 4.032. e. $.83\frac{1}{8}$.

41. *Multiply and test your work:*

a. .00375 by 400

f. 34.05 by $\frac{1}{8}$

b. 5.275 by 5000

g. .000568 by 1.07

c. 5.64 by .006

h. 4.32 by .15

d. 35.005 by .008

i. .0316 by .58

e. 350.5 by 8.04

j. .375 by 2.05

k. Four and twenty thousandths by twenty-six and nine tenths.

42. How much a ton do I pay for coal when .375 of a ton costs me \$1.875?

43. At what rate per hour is a launch running when it goes 132.3 miles in 13.5 hours?

44. A farmer buys groceries and sells farm produce to the grocer as follows:

Groceries

Farm Produce

10 gal. oil at 25¢

25 lb. cheese at 18¢

50 lb. sugar at $5\frac{1}{2}$ ¢

40 bu. potatoes at 58¢

2 boxes soap at \$3.25

$\frac{1}{2}$ T. hay at \$12

3 dozen oranges at 40¢

20 doz. eggs at 25¢

5 gal. molasses at 40¢

7 bu. pears at \$1.50

20 lb. coffee at 35¢

72 lb. smoked ham at \$.13

In whose favor is the balance of this account, and how much is due him?

45. 10% of a man's income was paid for rent. If his rent was \$15 a month, what was his income per year?

46. After using 70% of his month's wages, Jerry had \$14.40 left. What were his month's wages?

47. *a.* A schoolroom 30 ft. square and 12 ft. high contains how many cubic feet of air?

b. If there are 30 pupils in the room, how many cubic feet of air are there for each pupil?

48. *a.* Supposing a cubic foot of ice to weigh $62\frac{1}{2}$ lb., what is the weight of a pile of ice 12' by 10' by 8'?

b. How many three-ton loads would it make?

c. If $17\frac{1}{2}\%$ of the ice melts in handling, how many pounds can customers receive from this pile of ice?

49. Amos sells vegetables for Mr. Robbins, the gardener, and is allowed to keep $12\frac{1}{2}\%$ of all the money he takes in. *a.* If he earned \$3.41 in a week, what was the amount of his sales for that week? *b.* How much did Mr. Robbins receive?

50. I bought 75% of a carload of sugar and sold $\frac{3}{8}$ of my share. What per cent of the carload did I sell?

51. 97% of the pupils of a certain school are present. If 21 are absent, how many pupils belong to the school?

52. Three days are what per cent of a week?

53. A piano was sold for \$700. This was 140% of what it cost the dealer. *a.* How much did the dealer pay? *b.* How much did he gain?

54. H. J. Howe, jewelry merchant, sold to Mrs. James R. Hazzard $\frac{1}{2}$ doz. silver table-spoons at \$30 a dozen, one dozen silver table-forks at \$25 a dozen, one tea urn \$15.50, one kitchen clock, \$2.00. Who is the debtor? The creditor?

Make out the bill and receipt it.

55. What is the amount of my bill for $4\frac{1}{2}$ lb. of mutton steak at 16¢, $1\frac{1}{4}$ lb. of tea at 48¢, 5 lb. coffee at 34¢, and two lb. raisins at 15¢?

DENOMINATE NUMBERS

191. A number that is composed of units of weight or measure is a **denominate number**; e.g. 10 doz., 215 cu. in., 2 gal. 3 qt. 1 pt.

192. The name of a unit of weight or measure is a **denomination**; e.g. ounce, square foot, minute.

193. A denominate number that is expressed in two or more denominations is a **compound number**; e.g. 1 yd. 2 ft. 7 in.; 2 lb. 14 oz.

194. TABLE OF LIQUID MEASURE

4 gills (gi.) = 1 pint (pt.).

2 pints = 1 quart (qt.).

4 quarts = 1 gallon (gal.).

Oil, vinegar, molasses, and other liquids are shipped in barrels or casks of various sizes. But for the purpose of indicating the capacities of vats, tanks, reservoirs, etc., $31\frac{1}{2}$ gallons are called a *barrel* (bbl.) and 63 gallons a *hogshead* (hhd.).

195. Oral

1. 5 gal. = — pt.

2. 1 hhd. = — bbl.

3. What will 48 pt. of cream cost at \$1.20 per gallon?

4. 1 bbl. is what per cent of 1 hhd.?

5. How many pints in 10 gal.?

6. At 4¢ a pint, what is the cost of 6 qt. of milk?

7. 4 gal. 2 qt. 1 pt. = — pt.

8. A tank contains 10 bbl. of oil. How many gallon cans will it fill?

9. 63 qt. is what part of a hogshead?

10. A gallon contains 231 cu. in. How many cubic inches are there in $\frac{1}{3}$ of a gallon? In $\frac{1}{7}$ of a gallon? In $\frac{1}{11}$ of a gallon? In 1 qt.?

11. How many gallons and quarts are there in 50 quarts?

12. A cistern that holds 10 hhd. of water holds how many barrels? How many gallons?

13. One pint is what per cent of one gallon?

14. 10 % of a barrel is how many gallons?

15. If 1 qt. of sirup can be made from 20 oz. of maple sugar, how many ounces will make a gallon of sirup?

16. $33\frac{1}{3}$ % of a hogshead is how many gallons?

196. TABLE OF DRY MEASURE

2 pints (pt.) = 1 quart (qt.).

8 quarts = 1 peck (pk.).

4 pecks = 1 bushel (bu.).

197. *Oral*

1. 64 qt. = — pk.

2. 1 bu. = — qt.

3. If 2 qt. of cherries fill a jar, how many jars will 2 bu. fill?

4. 1 pk. is what per cent of a bushel?

5. 1 qt. is what per cent of a peck?

6. Elsie, Nina, and Robert gathered 4 bu. of chestnuts and sold them for 10¢ a quart. How much did they receive?

7. 10 bu. = — pt.

8. $\frac{1}{2}$ bu. + $\frac{1}{2}$ pk. = ——— qt.
9. 8 qt. = what part of 2 bu. ?
10. What is gained on a bushel of hickory nuts bought for \$2 and sold at 10¢ a quart ?
11. A barrel of potatoes containing $2\frac{3}{4}$ bushels will sell for how much at 20¢ a peck ?
12. 3 bu. and 3 pk. of apples at \$1 a bushel cost how much ?
13. If a bushel of oats weighs 32 lb., what is the weight of $3\frac{1}{2}$ pk. ?
14. How many bushels of apples at 25¢ a peck can be bought for \$20 ?
15. A bushel of corn and a peck of wheat are ground together. What per cent of the mixture is corn ? What per cent is wheat ?
16. $37\frac{1}{2}\%$ of a bushel is how many quarts ?

198. TABLE OF AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound (lb.).
2000 pounds	= 1 ton (T.).
2240 pounds	= 1 long ton.
100 pounds	= 1 hundredweight (cwt.).

The term *hundredweight* is used less than formerly, although its value (100 lb.) is still taken as a unit in quoting freight rates and prices of various articles, when the quantity used makes this a convenient unit of weight.

The *long ton* is used in wholesaling certain mining products. The ton of 2000 lb. is sometimes called a *short ton*.

199. *Oral*

1. How many ounces are there in 1 ton ?
2. At 48¢ a pound, what must be paid for 4 oz. of tea ?
3. 1% of a ton is how many pounds ?
4. 1 cwt. is what per cent of a ton ?
5. What is the cost of a ton of corn meal at \$1.25 per hundredweight ?
6. How many short tons equal 1 long ton ?
7. What is the cost of 500 lb. of hay at \$12 a ton ?
8. How many pounds of coal at \$6 a short ton can be bought for \$1.50 ?
9. A car was loaded at the mines with 10 long tons of coal. How many pounds of coal did it carry ?
10. One ounce is what per cent of a pound ?
11. 5 lb. of candy will make how many 4-ounce packages ?

200.

TABLE OF LINEAR MEASURE

12 inches (in.)	=	1 foot (ft.).	
3 feet	=	1 yard (yd.).	
$5\frac{1}{2}$ yards	}	= 1 rod (rd.).	
or			
$16\frac{1}{2}$ feet			
320 rods	=	1 mile (mi.).	

201. *Oral*

1. How many inches in 10 yd. ?
2. One foot is what per cent of a yard ?
3. One inch is what per cent of one foot ?

4. How many rods are there in 2 mi.? In 10 mi.? In 100 mi.?

5. 12 yd. 2 ft. = — ft.

6. $33\frac{1}{3}\%$ of 2 rd. = how many feet?

7. 10 rods are how many feet?

8. $12\frac{1}{2}\%$ of a mile is how many rods?

9. $8\frac{1}{3}\%$ of a foot is how many inches? 25% of a foot? 50% ? $16\frac{2}{3}\%$? $33\frac{1}{3}\%$?

10. How many rods are there in the perimeter of a lawn that is 33 feet square?

11. Draw on the blackboard a line 1 yd. long, using no measure. Measure and correct it. On your paper draw a line $3\frac{1}{2}$ in. long, using no measure. Measure and correct it.

12. Estimate the length and breadth of your schoolroom. Test your estimates by measuring.

13. How many feet high do you think your schoolroom is? Can you find a way to measure it without climbing? Measure it, and see how nearly correct your estimate is.

14.

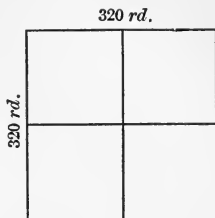
This oblong represents a field. $\frac{1}{8}$ inch stands for 1 rod. Measure the sides, and tell how many rods long and wide the field is.

15. Draw on the blackboard a plan of your schoolroom floor, using $\frac{1}{2}$ inch for 1 foot; that is, draw the floor to the scale of 1' to $\frac{1}{2}$ ".

16. This square represents a square mile. Can you tell what the scale is?

Each small square is what part of a square mile?

How many rods of fence would be needed to inclose a square field containing $\frac{1}{4}$ of a square mile?



17.

The width of this floor is 16 ft.
Can you find the scale of this plan?

What is the length of one long side?
What is the greatest length of the room?

18. If you go 30 inches at a step, how many steps will you take in going 30 feet?

19. If a row of corn contains five hills to a rod, how many hills are there in a row a quarter of a mile long?

202. TABLE OF SURFACE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.).
9 square feet	= 1 square yard (sq. yd.).
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.).
160 square rods	= 1 acre (A.).
640 acres	= 1 square mile (sq. mi.).

203. Oral

1. Without a measure draw a square inch. Measure and correct it.

2. Without a measure draw on the blackboard a square foot and a square yard. Measure and correct them. Divide the square yard into square feet. Divide the square foot into square inches.

3. How many square inches are there in two square feet?

4. Estimate the number of square yards in the floor of your schoolroom. Measure it, and see how nearly right your estimate is. Make an estimate of the area of each wall, and test it by measuring. Measure your school lot, and find what part of an acre it contains.

5. How many square inches are there in $\frac{1}{2}$ sq. ft.?

6. One square yard is $\frac{3}{4}$ of how many square feet?

7. A 5-inch square contains how many square inches? Draw it.

8. A rectangle 6'' by 12'' is what part of a square foot?

9. How many tiles 6'' square will cover a floor 10 ft. by 5 ft.?

10. 8 sq. in. are what part of an 8-inch square?

11. How many square yards are there in 4 sq. rd.?

12. 40 sq. rd. are what per cent of an acre?

13. A room is 15 ft. by 12 ft. and 9 ft. high. How many square yards are there in the floor? Draw a plan of it to the scale of $\frac{1}{2}'' = 1'$.

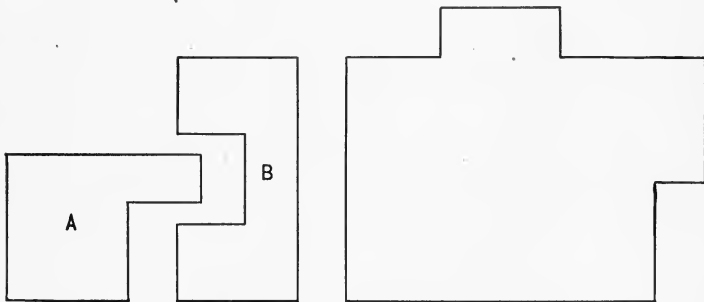
How many square yards are there in one long wall? In one short wall? Draw a plan of each wall.

How many square yards of plastering are needed for the ceiling?

14. How many acres are there in a farm 160 rd. long and 100 rd. wide?

15. How wide must a field be to contain 10 A. if it is 40 rd. long?

16. A 10-acre field is 20 rd. wide. How long is it?



17. The scale of these plans is 16' to 1''. Find the perimeter and area of the surface represented by each.

204. TABLE OF VOLUME MEASURE

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.).

27 cubic feet = 1 cubic yard (cu. yd.).

205. *Oral*

1. Define a cube.
2. How many edges has a cube? How do they compare?
3. How many cubic inches are there in a 6-inch cube?

4. Prove that a tight tin box 7 in. by 11 in. by 3 in. will hold one gallon.
5. A block of wood 4 in. square must be how long to contain 96 cu. in. ?
6. 18 cu. ft. are what part of a cubic yard ?
7. A box 12 ft. long and 3 ft. wide must be how deep to hold 4 cu. yd. of sand ?
8. $8\frac{1}{3}\%$ of a cubic foot is how many cubic inches ?
9. A 2-inch cube is equal to how many 1-inch cubes ?
10. How many 2-inch cubes would make a 4-inch cube ?

206.

TABLE OF TIME

60 seconds (sec.)	= 1 minute (min.).
60 minutes	= 1 hour (hr.).
24 hours	= 1 day (da.).
7 days	= 1 week (wk.).
365 days	= 1 common year (yr.).
366 days	= 1 leap year.

Ten years are called a *decade*, and one hundred years make a *century*, but these terms are not used in arithmetical calculations.

The four thirty-day months may be remembered easily by the following old rhyme :

“Thirty days hath September,
April, June, and November.”

February has 28 days, with 29 in leap year. The other months have 31 days.

207. *Oral*

1. How many minutes are there in a working day of 8 hr.?
2. A man who works for 30 ¢ an hour receives how much a minute?
3. A train that is running at the rate of 2 miles in 3 minutes goes how many miles in an hour? In 10 hours? In 24 hours?
4. A boy who is idle 15 minutes in every hour wastes what per cent of his time?
5. How many hours are there in a week? In the month of June?
6. How many hours have we for work in a morning session of school if it begins at 9 o'clock and closes at 11.45, allowing a quarter of an hour for recess?
7. How many days are there in the fall months?
8. Close your book. Recite the table of time and the names of the months, giving the number of days in each month.

208.

TABLE OF COUNTING

12 = 1 dozen (doz.).

12 doz. = 1 gross.

20 = 1 score.

209. *Oral*

1. How much apiece do oranges cost at 40 ¢ a dozen?
2. One dozen is what per cent of 1 score? Of 1 gross?
3. How many pens are there in a gross?
4. If I buy pens at 72 ¢ a gross and sell them at 1 ¢ apiece, how much do I make on a gross? On a dozen? On a pen? I gain what per cent of the cost?

5. "Fourscore and seven years ago" was how many years ago?

6. A merchant bought fiber pails at \$3 a dozen. How much apiece did he pay? If he sold them at 35¢ apiece, what did he gain on one? On a gross? What per cent of the cost did he gain?

7. A merchant buys shoe brushes at \$1.20 a dozen and sells them at 15¢ apiece. How much does he gain on one? What per cent of the cost does he gain?

8. What is the cost of 6 cans of Alaska salmon at 98¢ a dozen cans?

9. What is the cost of a gross of pencils at 40¢ a dozen?

10. A man's age is threescore and ten years. How many years old is he?

11. Bars of soap at \$9 a gross are how much a dozen?

210. TABLE OF PAPER MEASURE

24 sheets = 1 quire.

20 quires = 1 ream.

The terms *bundle* (2 reams) and *bale* (5 bundles) are seldom used. The denomination *quire* is used mostly in measuring the finer grades of writing paper. Wrapping paper is sold by the pound or by the thousand sheets. Many kinds of paper are sold in packages of five hundred or one thousand sheets. Packages of five hundred sheets are sometimes called *reams*.

211. Oral

1. How many sheets of paper are there in 2 quires? In 4 quires? In $\frac{1}{4}$ of a ream? In 3 quires? In $\frac{1}{2}$ ream? In 10 reams?

2. One quire is what per cent of 1 ream? Of $\frac{1}{2}$ ream? Of $\frac{1}{4}$ ream?

3. What is the profit on 10 quires of paper bought at 14 cents a quire and sold at a cent a sheet?

4. A package of 500 sheets of paper contains how much more than twenty quires?

5. A stationer sold 10 quires out of a package of 1000 sheets of paper. How many sheets were left? What per cent of the package was sold? What per cent was left?

6. A stationer made a dozen tablets, each containing 72 sheets of paper. How many quires were used for each tablet?

The paper cost 40¢ a ream. What was the cost per quire? What was the cost of the paper in one tablet? What was the cost of the paper for a dozen tablets?

If the backs and labor cost 28¢ for a dozen tablets, what was the entire cost of a dozen tablets?

If they were sold for 10¢ a piece, what was the gain on a dozen tablets? The gain was what per cent of the cost? What was the gain on a gross of tablets?

7. One quire of paper will make how many leaves if each sheet is folded into 8 leaves?

8. If 12 sheets of a certain kind of paper weigh one pound, how many pounds will 5 quires weigh?

9. 960 pages in a book would require how many leaves? If one sheet makes 4 leaves, how many sheets are required? How many quires?

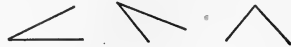
212. TABLE OF ARC AND ANGLE MEASURE

60 seconds ($''$) = 1 minute ($'$).

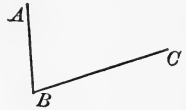
60 minutes = 1 degree ($^{\circ}$).

An arc of 360° = 1 circumference.

213. *The difference in direction of two lines that meet is an angle ; e.g.*



214. *The lines that meet to form an angle are the sides of the angle.*



Lines are read by means of letters placed at their extremities. Angles are read by means of letters placed at the extremities of their sides.

In the angle ABC the lines AB and BC are the sides.

215. *The sum of all the angles that can be formed around a point in a plane is 360° .*

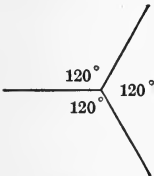


FIG. 1

In figure 1 there are three angles about a point. Add the numbers of degrees.

In figure 2 there are five angles about a point. Add the numbers of degrees.

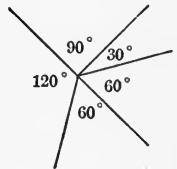


FIG. 2

In figure 3 there are four angles about a point. Add the numbers of degrees.

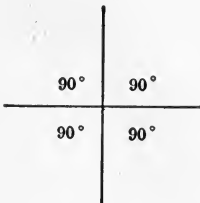


FIG. 3

Draw eight equal angles about a point.
How many degrees are there in each angle?

Make other questions about these angles.

216. *Oral*

1. How many angles are there in Fig. 3, page 178? How do they compare? Each of these angles is a right angle. How many degrees are there in a right angle?

2. When the hour hand of the clock is at 12 and the minute hand is at 9, they form what kind of an angle? At what other number could the minute hand point to make a right angle with the hour hand at 12?

An angle of 90° is a right angle.

An angle that is greater than a right angle is an obtuse angle.

An angle that is less than a right angle is an acute angle.



3. Draw a right angle. How many degrees are there in it? Divide it in the middle by a line. How many degrees are there in each of the angles thus formed?

4. Make a drawing of a wagon wheel with 6 spokes. The spokes form angles of how many degrees? Put in twice as many spokes. How many degrees are there in the angles? Double the number again, and tell the size of the angles. What kind of angles are these?

5. Draw an angle that you think is about an angle of one degree.

6. One minute is what part of a degree? Can you think of something that is like an angle of one minute?

7. The minute hand of a clock passes through how many degrees in 12 hours? In 1 hour?

8. What kind of angle (right, obtuse, or acute) is formed by the hour and minute hands of a clock at two o'clock? At five o'clock? At eleven o'clock?

9. $10^\circ =$ how many minutes? 20° ? 40° ? $\frac{1}{4}^\circ$? $\frac{1}{10}^\circ$?
 10. $1^\circ =$ how many seconds?

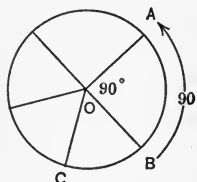
11. Stand facing north. Turn 90° to the left. In what direction are you facing? Turn 90° farther. In what direction are you facing? Turn 180° farther. In what direction are you facing? How many degrees have you turned in all?

217. *A plane figure bounded by a curved line, every point of which is equally distant from a point within, called the center, is a circle.*

218. *The boundary line of a circle is its circumference.*

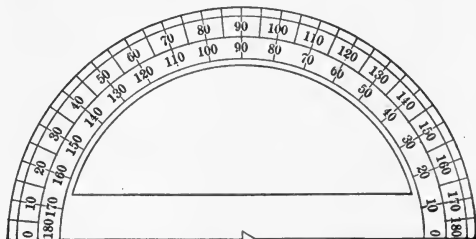
219. *Any part of a circumference is an arc.*

The number of degrees in an arc is always the same as the number of degrees in the angle at the center whose sides meet the extremities of the arc, thus:



The angle AOB is $\frac{1}{4}$ the sum of all the angles at the center, or 90° . The arc AB is $\frac{1}{4}$ of the circumference, or 90° . Can you tell the number of degrees in the arc BC ? In the angle BOC ?

NOTE.—The number of degrees in any angle may be measured by means of a protractor, an instrument with the degrees marked and numbered.



A PROTRACTOR

220. TABLE OF UNITED STATES MONEY

10 mills = 1 cent.

10 cents = 1 dime.

10 dimes = 1 dollar.

The gold coins of the United States are the \$5, \$10, and \$20 pieces, once called the half eagle, eagle, and double eagle. Gold dollars are not in general circulation, although a few of them have been coined.

The silver coins are the dollar, half dollar, quarter dollar, and dime. Silver half-dimes are no longer coined. Most five-cent pieces are made of nickel. Most 1-cent pieces are made of bronze, though some nickel and copper cents are in circulation.

The mill is not coined.

221. Oral

1. One dime is what part of a dollar? What per cent?
2. One cent is what per cent of a dollar?
3. One mill is what part of a dollar? What per cent?
4. 79 cents is what decimal of a dollar? 7 mills is what decimal of a dollar? 19 cents and 7 mills?
5. *Express as decimals of a dollar:*
85 cents 6 mills; 10 cents 8 mills; 4 cents 7 mills; 8 cents; 29 cents 1 mill; 3 mills.
6. 5 mills are what part of a cent? 4 mills? 8 mills?
7. The value of a \$5 gold piece is what per cent of the value of a \$10 gold piece? Of a \$20 gold piece?
8. Make other problems about dollars, mills, and cents.

222. TABLE OF TROY WEIGHT

24 grains (gr.)	=	1 pennyweight (pwt.).
20 pennyweights	=	1 ounce (oz.).
12 ounces	=	1 pound (lb.).

These weights are used in weighing gold, silver, and some jewels. To get an idea of the weight of a grain, think of the weight of a grain of wheat or rice.

223. *Oral*

1. How many grains are there in 1 Troy ounce?
2. A silver dollar weighs about $412\frac{1}{2}$ grains. This is how much less than a Troy ounce?
3. A gold dollar contains 23.2 grains of pure gold, but enough harder metal is put with the gold to make it weigh 25.8 grains. This weight is how much more than 1 pwt.?
4. Calling the weight of a gold dollar 1 pwt., what does a \$20 gold piece weigh? How many dollars in gold would weigh a pound?
5. How many Troy ounces would \$1000 in gold weigh? How many Troy pounds?
6. What must I pay for a watch chain weighing 240 grains at \$1 a pennyweight?

224. TABLE OF APOTHECARIES' WEIGHT

20 grains (gr.)	=	1 scruple (sc. or \mathfrak{D}).
3 scruples	=	1 dram (dr. or \mathfrak{D}).
8 drams	=	1 ounce (oz. or \mathfrak{z}).

This table is used by druggists and physicians in compounding medicines; but medicines are bought and sold by avoirdupois weight, except in quantities smaller than one ounce.

Druggists also use a term *fluid ounce*, which is not a measure of weight, but of capacity, and is equal to $\frac{1}{16}$ of a pint. Thus, a 2-ounce bottle is a bottle that holds $\frac{1}{8}$ of a pint of any liquid regardless of its weight.

225. Oral

1. A druggist buys a pound (avoirdupois) of quinine containing 7000 grains. How many 2-grain tablets can be made from it?

2. How many 2-grain tablets can be made from 1 D ?

3. How many 3-grain tablets can be made from 1 z ?

4. A patient takes 5 gr. of a certain medicine every day. How long will 1 z of it last him?

5. A druggist made 1000 powders, each containing 2 gr. of ipecac, 2 gr. of muriate of ammonia, and 10 gr. of extract of licorice. There are 7000 grains in 1 lb. avoirdupois. How many avoirdupois pounds did all the powders weigh?

REDUCTION OF DENOMINATE NUMBERS

226. *Changing numbers to larger denominations is reduction ascending.*

227. *Changing numbers to smaller denominations is reduction descending.*

228. Oral

1. How many gallons are there in 72 pints? What kind of reduction is this?

2. How many minutes are there in 10° ? What kind of reduction is this?

3. *Reduce:*

- | | |
|---------------------------------------|--|
| <i>a.</i> 2 bu. to quarts. | <i>l.</i> $\frac{3}{4}$ da. to hours. |
| <i>b.</i> 64 pt. to pecks. | <i>m.</i> $\frac{1}{5}$ yr. to days. |
| <i>c.</i> 17 T. to pounds. | <i>n.</i> $\frac{2}{3}$ min. to seconds. |
| <i>d.</i> 96 oz. to pounds. | <i>o.</i> 20 da. to hours. |
| <i>e.</i> 11 yd. to rods. | <i>p.</i> 240 sec. to minutes. |
| <i>f.</i> 33 ft. to rods. | <i>q.</i> 96 doz. to gross. |
| <i>g.</i> 5 A. to square rods. | <i>r.</i> 12 score to units. |
| <i>h.</i> 288 sq. in. to square feet. | <i>s.</i> 100 quires to reams. |
| <i>i.</i> 1728 cu. in. to cubic feet. | <i>t.</i> 50 reams to quires. |
| <i>j.</i> 10 cu. yd. to cubic feet. | <i>u.</i> 7' to seconds. |
| <i>k.</i> 20 wk. to days. | <i>v.</i> 720'' to minutes. |

4. *Reduce:*

- a.* 51 qt. to gallons and quarts.
- b.* 7 gal. 2 qt. to quarts ; to pints.
- c.* 35 qt. to bushels and quarts.
- d.* 1 bu. 3 pk. to pecks ; to quarts ; to pints.
- e.* 1 T. 370 lb. to pounds.
- f.* 40 oz. to pounds and ounces.
- g.* 15 cwt. 50 lb. to pounds.
- h.* 1 A. 40 sq. rd. to square rods.
- i.* 4 sq. yd. to square feet.
- j.* 100 sq. ft. to square yards and square feet.
- k.* 64 fluid oz. to pints.
- l.* 130 min. to hours and minutes.

REDUCTION DESCENDING

229. Compound numbers are seldom expressed in more than two denominations. In measures of time and arcs three denominations are sometimes used.

Long and difficult reductions are seldom necessary.

Reduce 17 da. 10 hr. 40 min. to minutes.

$$\begin{array}{r}
 17 \text{ da.} \\
 \underline{24} \text{ number of hours in 1 da.} \\
 68 \\
 \underline{34} \\
 408 \text{ number of hours in 17 da.} \\
 \underline{10} \\
 418 \text{ number of hours in 17 da. 10 hr.} \\
 \underline{60} \text{ number of minutes in 1 hr.} \\
 25080 \text{ number of minutes in 418 hr.} \\
 \underline{40} \\
 25120 \text{ number of minutes in 418 hr. 40 min.,} \\
 \text{or 17 da. 10 hr. 40 min.}
 \end{array}$$

Reduce 41 A. 20 sq. rd. to square feet.

$$\begin{array}{r}
 41 \text{ A.} \\
 \underline{160} \text{ number of square rods in 1 A.} \\
 2460 \\
 \underline{41} \\
 6560 \text{ number of square rods in 41 A.} \\
 \underline{20} \\
 6580 \text{ number of square rods in 41 A. 20 sq. rd.} \\
 \underline{30\frac{1}{4}} \text{ number of square yards in 1 sq. rd.} \\
 1645 \quad (6580 \times \frac{1}{4}) \\
 \underline{197400} \quad (6580 \times 30) \\
 199045 \text{ number of square yards in 6580 sq. rd.} \\
 \underline{9} \text{ number of square feet in 1 sq. yd.} \\
 1791405 \text{ number of square feet in 41 A. 20 sq. rd.}
 \end{array}$$

230. Written*Reduce :*

1. 49 da. 7 hr. to hours.
2. 79 A. 50 sq. rd. to square rods.
3. 16 yr. 7 mo. 20 da. to days (allow 30 da. for 1 mo.).
4. 9 sq. yd. 6 sq. ft. to square inches.
5. 78 T. 16 cwt. to hundredweight.
6. 59 cwt. 23 lb. to pounds.
7. 48 lb. 15 oz. Troy to ounces.
8. 12 cu. ft. 384 cu. in. to cubic inches.
9. 78 cu. yd. 19 cu. ft. to cubic feet.
10. 48 gal. 2 qt. to pints.
11. 15 bu. 3 pk. to pints.
12. 25° 30' 15'' to seconds.
13. The degrees in 1 right angle to seconds.
14. 158 gross 5 doz. to dozen.
15. 3 mi. to feet.
16. 1 mi. to inches.
17. 1 sq. mi. to square rods.
18. 21 T. 362 lb. to pounds.
19. 4 cu. yd. to cubic inches.
20. 121 yr. 11 mo. to months.
21. 8 mo. 28 da. to days.
22. 42 wk. 3 da. to hours.
23. 17 cwt. to ounces.
24. 12 yd. 19 in. to inches.
25. 2 yr. 4 mo. 3 da. to days.

26. 3 yr. 6 mo. 15 da. to days.
27. $17^{\circ} 3'$ to minutes.
28. 7 yr. 14 da. to days.
29. 15 mo. 29 da. to days.
30. $42^{\circ} 12'$ to seconds.

REDUCTION ASCENDING

231. Reduce 3876 sec. to hours, minutes, and seconds.

$$\begin{array}{r|l} 6\cancel{0} & 387\cancel{6} \text{ sec.} \\ 6\cancel{0} & \underline{64 \text{ min.} + 36 \text{ sec.}} \\ & \underline{1 \text{ hr.} + 4 \text{ min.}} \end{array}$$

1 hr. 4 min. 36 sec. *Ans.*

How many seconds = 1 min. ?

3876 sec. = how many minutes and seconds ?

How many minutes = 1 hr. ?

64 min. = how many hours and minutes ?

Written

Reduce :

1. 42,876 sec. to hours, minutes, and seconds.
2. 16,307'' to degrees, minutes, and seconds.
3. 8370 da. to years and days.
4. 983 pk. to bushels and pecks.
5. 5834 lb. to tons and pounds.
6. 4376 oz. Troy to pounds and ounces.
7. 892 pt. to gallons and quarts.
8. 508 pt. to gallons and quarts.
9. 8376' to degrees and minutes.
10. 45,360'' to degrees and minutes.
11. 4416 sheets to quires.
12. 685 sq. ft. to square yards and square feet.
13. 28,347 cu. ft. to cubic yards and cubic feet.

14. 38,627 sec. to hours, minutes, and seconds.
15. 497' to degrees and minutes.
16. 89,764 lb. to tons and pounds.
17. 49,763 ft. to miles and feet.
18. 42,374 da. to years and days.
19. 94,276 min. to days, hours, and minutes.
20. 13,794 ft. to rods.

VARIOUS FORMS OF REDUCTION

232. *Written*

1. How many inches are there in $\frac{2}{3}$ rd.? (Indicate the work thus: $\frac{2}{3} \times \frac{3\cancel{3}}{2} \times \frac{1\cancel{2}}{1}$; then cancel.)

2. *Find the number of:*

- | | |
|--|--|
| <p>a. Inches in $\frac{5}{8}$ mi.</p> <p>b. Pints in $\frac{7}{16}$ bu.</p> <p>c. Pints in $\frac{5}{9}$ bbl.</p> <p>d. Seconds in $\frac{11^\circ}{24}$.</p> <p>e. Ounces in $\frac{14}{125}$ T.</p> | <p>f. Coat-hooks in $\frac{17}{2}$ gross.</p> <p>g. Sheets in $\frac{9}{96}$ ream.</p> <p>h. Cubic inches in $\frac{5}{576}$ cu. yd.</p> <p>i. Minutes in $\frac{13}{840}$ wk.</p> <p>j. Square feet in $\frac{9}{55}$ A.</p> |
|--|--|

3. What part of 5 gal. is 1 gal. 1 pt.?

NOTE. — Find the number of pints in 5 gal.; then in 1 gal. 1 pt.

Statement of Relation: — of 40 pt. = 9 pt.

4. *What part:*

- | | |
|--|--|
| <p>a. Of 1 T. is 324 lb.?</p> <p>b. Of 2 T. is 7 cwt. 40 lb.?</p> <p>c. Of 3 gal. is 2 qt. 1 pt.?</p> <p>d. Of 5 da. is 12 hr. 30 min.?</p> <p>e. Of a circumference is $36^\circ 45'$?</p> | <p>f. Of 7 cu. yd. is 5 cu. yd. 9 cu. ft.?</p> <p>g. Of 2 yr. is 1 yr. 3 mo.?</p> <p>h. Of a square mile is 200 A. 40 sq. rd.?</p> <p>i. Of 20 gal. is 5 gal. 2 qt.?</p> <p>j. Of a week is 18 hr. 8 min.?</p> |
|--|--|

5. 3 bu. 2 pk. of potatoes are sold out of a load of 28 bu.
a. What part of the load is left? *b.* What per cent of the load is sold?
6. 2 bbl. of cranberries, each containing 3 bu., are worth how much at $12\frac{1}{2}$ ¢ per quart?
7. The speed limit for automobiles in a certain town is 8 miles per hour. That is how many rods per minute?
8. What is the cost of 5 T. 500 lb. of coal at \$5.40 per ton?
9. $\frac{1}{4}$ T. is equal to how many ounces?
10. How long will 16 bu. of corn last Fred's chickens if he feeds them 1 qt. a day?
11. *a.* What is the profit on a bushel of chestnuts bought for \$2 $\frac{1}{2}$ and sold at 10 cents a pint? *b.* The gain is what per cent of the cost?
12. How many minutes are there in April, May, and June?
13. What is the cost of the milk supply for September of a housekeeper who buys $\frac{3}{4}$ gal. per day and pays 6 $\frac{1}{2}$ ¢ per quart?
14. What are the yearly wages of a man who earns a cent in 2 minutes and works 8 hours a day and 26 days in a month throughout the year?
15. If a horse eats 12 lb. of hay per day, how many tons and pounds will he eat in a year?
16. A box 6'' \times 4'' \times 2'' contains what fraction of a cubic foot?
17. $\frac{5}{8}$ of an acre of land contains how many square feet?
18. 16 sq. rd. 11 sq. yd. are what part of an acre?

ADDITION AND SUBTRACTION OF COMPOUND NUMBERS

233. *Written*

Add 7 lb. 8 oz., 15 lb. 14 oz., 23 lb. 15 oz.

Lb.	Oz.	
7	8	15 oz. + 14 oz. + 8 oz. = 37 oz. = 2 lb. 5 oz.
15	14	2 lb. + 23 lb. + 15 lb. + 7 lb. = 47 lb.
23	15	47 lb. 5 oz. <i>Ans.</i>
<u>47</u>	<u>5</u>	

Add:

- 19 ft. 6 in., 17 ft. 10 in., 9 ft. 6 in.
- 13 A. 17 sq. rd., 19 A. 153 sq. rd.
- 2 hr. 5 min. 30 sec., 8 hr. 53 min. 47 sec.
- 8 gal. 3 qt., 15 gal. 1 qt., 16 gal. 2 qt.
- $81^{\circ} 19' 35''$, $2^{\circ} 50' 29''$, $3^{\circ} 4' 50''$.
- 6 T. 480 lb., 7 T. 730 lb., 19 T. 900 lb.
- 5 yd. 2 ft., 16 yd. 1 ft., 18 yd. 2 ft.
- 6 pk. 7 qt., 3 pk. 5 qt., 2 pk. 6 qt.
- 7 cu. yd. 18 cu. ft., 12 cu. yd. 19 cu. ft.
- 6 yr. 7 mo. 3 da., 7 yr. 8 mo. 29 da.
- 8 lb. 7 oz., 16 lb. 14 oz., 19 lb. 10 oz.
- 21 bu. 3 pk., 9 bu. 2 pk., 35 bu. 1 pk.
- 2 wk. 3 da., 19 wk. 1 da., 20 wk. 6 da.
- 7 hr. 38 min. 21 sec., 5 hr. 47 min. 29 sec.
- 5 yr. 200 da., 7 yr. 321 da., 8 yr. 179 da.

234. *Written*

$$\begin{array}{r}
 \text{From } 18 \text{ yr. } 7 \text{ mo. } 14 \text{ da.} \\
 \text{take } \quad 6 \text{ yr. } 8 \text{ mo. } 26 \text{ da.} \\
 \hline
 11 \text{ yr. } 10 \text{ mo. } 18 \text{ da.} \quad \textit{Difference}
 \end{array}$$

$$7 \text{ mo. } 14 \text{ da.} = 6 \text{ mo. } 44 \text{ da.}$$

$$18 \text{ yr. } 6 \text{ mo.} = 17 \text{ yr. } 18 \text{ mo.}$$

(Why do we make these reductions?)

$$18 \text{ yr. } 7 \text{ mo. } 14 \text{ da.} = 17 \text{ yr. } 18 \text{ mo. } 44 \text{ da.}$$

$$17 \text{ yr. } 18 \text{ mo. } 44 \text{ da.} - 6 \text{ yr. } 8 \text{ mo. } 26 \text{ da.} = 11 \text{ yr. } 10 \text{ mo. } 18 \text{ da.}$$

Subtract:

$$\begin{array}{r}
 1. \quad 12 \text{ yr. } 3 \text{ mo. } 15 \text{ da.} \\
 \quad 10 \text{ yr. } 1 \text{ mo. } 19 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 5. \quad 4 \text{ yr. } 2 \text{ mo. } 18 \text{ da.} \\
 \quad 1 \text{ yr. } 7 \text{ mo. } 12 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 2. \quad 9 \text{ yr. } 2 \text{ mo. } 1 \text{ da.} \\
 \quad 3 \text{ yr. } 5 \text{ mo. } 29 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 6. \quad 7 \text{ yr. } 5 \text{ mo. } 18 \text{ da.} \\
 \quad 3 \text{ yr. } 6 \text{ mo. } 7 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 3. \quad 9 \text{ yr. } 2 \text{ mo. } 5 \text{ da.} \\
 \quad 4 \text{ yr. } 8 \text{ mo. } 5 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 7. \quad 9 \text{ yr. } 6 \text{ mo. } 13 \text{ da.} \\
 \quad 8 \text{ yr. } 5 \text{ mo. } 15 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 4. \quad 12 \text{ yr.} \quad \quad 16 \text{ da.} \\
 \quad 8 \text{ yr. } 2 \text{ mo. } 12 \text{ da.} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 8. \quad 1 \text{ yr. } 3 \text{ mo.} \\
 \quad \quad \quad 7 \text{ mo. } 15 \text{ da.} \\
 \hline
 \end{array}$$

9. How many years, months, and days are there from May 30, 1907, to Dec. 5, 1909?

$$1909 \text{ yr. } 12 \text{ mo. } 5 \text{ da.}$$

$$\underline{1907 \text{ yr. } 5 \text{ mo. } 30 \text{ da.}}$$

NOTE.—December is the twelfth month and May the fifth. Count 30 da. for a month.

Find the time from:

10. July 19, 1827, to Mar. 26, 1878.

11. Sept. 20, 1831, to Nov. 15, 1909.

12. Jan. 7, 1840, to Feb. 8, 1896.
13. May 4, 1850, to Jan. 12, 1861.
14. Oct. 19, 1760, to Aug. 20, 1860.
15. Dec. 12, 1880, to June 5, 1903.
16. July 10, 1809, to Oct. 2, 1893.
17. May 8, 1899, to Feb. 12, 1908.
18. Feb. 12, 1901, to Jan. 30, 1906.

Subtract:

$$\begin{array}{r} 19. \quad 5 \text{ hr. } 54 \text{ min. } 30 \text{ sec.} \\ \quad \underline{1 \text{ hr. } 50 \text{ min. } 50 \text{ sec.}} \end{array}$$

$$\begin{array}{r} 25. \quad 18 \text{ bu. } 1 \text{ pk.} \\ \quad \underline{17 \text{ bu. } 3 \text{ pk.}} \end{array}$$

$$\begin{array}{r} 20. \quad 122^\circ 31' 15'' \\ \quad \underline{60^\circ 20' 45''} \end{array}$$

$$\begin{array}{r} 26. \quad 10 \text{ A. } 56 \text{ sq. rd.} \\ \quad \underline{4 \text{ A. } 106 \text{ sq. rd.}} \end{array}$$

$$\begin{array}{r} 21. \quad 23 \text{ hr. } 54 \text{ min. } 36 \text{ sec.} \\ \quad \underline{20 \text{ hr. } 24 \text{ min. } 48 \text{ sec.}} \end{array}$$

$$\begin{array}{r} 27. \quad 16 \text{ lb. } 4 \text{ oz.} \\ \quad \underline{5 \text{ lb. } 12 \text{ oz.}} \end{array}$$

$$\begin{array}{r} 22. \quad 7 \text{ ft. } 6 \text{ in.} \\ \quad \underline{3 \text{ ft. } 11 \text{ in.}} \end{array}$$

$$\begin{array}{r} 28. \quad 48 \text{ ft. } 3 \text{ in.} \\ \quad \underline{27 \text{ ft. } 9 \text{ in.}} \end{array}$$

$$\begin{array}{r} 23. \quad 27 \text{ gal. } 2 \text{ qt.} \\ \quad \underline{18 \text{ gal. } 3 \text{ qt.}} \end{array}$$

$$\begin{array}{r} 29. \quad 42' 13'' \\ \quad \underline{35' 58''} \end{array}$$

$$\begin{array}{r} 24. \quad 19^\circ 31' \\ \quad \underline{6^\circ 41'} \end{array}$$

$$\begin{array}{r} 30. \quad 5 \text{ min. } 47 \text{ sec.} \\ \quad \underline{2 \text{ min. } 48 \text{ sec.}} \end{array}$$

31. Find the time between Dec. 21, 1620, and July 4, 1776.
32. How much time elapsed from the beginning of the Civil War, April 14, 1861, to the close of the war, April 9, 1865?
33. Washington was born Feb. 22, 1732, and died Dec. 14, 1799. How long did he live?
34. How much time has elapsed from Oct. 12, 1492, to the present time?

EXACT DIFFERENCES BETWEEN DATES

235. *Written*

1. What is the exact number of days between Dec. 16, 1895, and March 12, 1896?

Dec. 15

Jan. 31

Feb. 29

March 12

87 days. *Ans.*

There are 15 days in December after the 16th. January has 31 days, February 29 (leap year), and March 12, making 87 days. Always count the last day.

NOTE. — Every year whose number is divisible by 4 is a leap year, except a centennial year, which is a leap year only when its number is divisible by 400; e.g. the year 1896 was a leap year but the year 1900 was not.

2. Mr. Griffith bought a house, Feb. 25, 1896, and paid for it, July 12, 1896. Find the exact number of days between the buying and paying for the house.

3. Find the exact number of days between June 25, 1900, and Aug. 24, 1900.

Find the exact time between:

4. Sept. 6, 1896, and April 7, 1897.

5. Nov. 11, 1898, and Dec. 4, 1898.

6. Aug. 16, 1907, and Dec. 21, 1907.

7. July 4, 1896, and Aug. 10, 1896.

8. Feb. 23, 1897, and June 4, 1897.

9. Oct. 9, 1899, and Feb. 6, 1900.

10. Nov. 8, 1905, and Oct. 6, 1906.

11. A gardener planted an acre of sweet corn on the tenth day of May. It was ready for market on the third day of August. How many days were required for the corn to grow?

MULTIPLICATION AND DIVISION OF COMPOUND NUMBERS

TO THE TEACHER.—Little time should be spent upon multiplication and division of compound numbers. In solving problems other than those in longitude and time, it is generally better to reduce the compound number to one denomination before multiplying or dividing.

236. *Written*

1. Multiply 8 lb. 3 oz. by 9.

$$\begin{array}{r} 8 \text{ lb. } 3 \text{ oz.} \\ \quad \quad 9 \\ \hline 73 \text{ lb. } 11 \text{ oz.} \end{array} \text{ Product}$$

$9 \times 3 \text{ oz.} = 27 \text{ oz.} = 1 \text{ lb. } 11 \text{ oz.}$

$9 \times 8 \text{ lb.} = 72 \text{ lb.}$

$72 \text{ lb.} + 1 \text{ lb.} = 73 \text{ lb.}$

Multiply:

- | | |
|---|----------------------------------|
| 2. 7 lb. 9 oz. by 5. | 7. 1 hr. 20 min. 20 sec. by 15. |
| 3. 15 gal. 1 qt. by 10. | 8. 2 hr. 40 min. 30 sec. by 15. |
| 4. 14 ft. 11 in. by 3. | 9. 3 hr. 0 min. 30 sec. by 15. |
| 5. 17 A. 40 sq. rd. by 5. | 10. 4 hr. 19 min. 30 sec. by 15. |
| 6. 19 ft. 7 in. by 4. | 11. 0 hr. 58 min. 47 sec. by 15. |
| 12. Divide $32^{\circ} 15' 30''$ by 15. | |

$$\begin{array}{r} 15 \overline{) 32^{\circ} 16' 30''} \\ \underline{2^{\circ} 9' 6''} \\ \text{Quotient} \end{array}$$

$32^{\circ} \div 15 = 2^{\circ} \text{ and } 2^{\circ} \text{ Remainder.}$

$2^{\circ} = 120'. \quad 120' + 16' = 136'.$

$136' \div 15 = 9' \text{ and } 1' \text{ Remainder.}$

$1' = 60''. \quad 60'' + 30'' = 90''.$

$90'' \div 15 = 6''.$

Divide by 15 and test your work:

- | | |
|---------------------------|---------------------------|
| 13. $30^{\circ} 16' 15''$ | 18. $20^{\circ} 0' 30''$ |
| 14. $61^{\circ} 1' 45''$ | 19. $20^{\circ} 5' 45''$ |
| 15. $17^{\circ} 5' 0''$ | 20. $60^{\circ} 35' 15''$ |
| 16. $2^{\circ} 2' 15''$ | 21. $70^{\circ} 30' 45''$ |
| 17. $46^{\circ} 10' 0''$ | 22. $100^{\circ} 1' 30''$ |

REVIEW AND PRACTICE

237. *Oral*

1. At 8¢ a quart, what will a bushel of berries cost?
2. How many oranges will 50 cents buy at the rate of 3 for 10 cents?
3. $\frac{2}{3}$ of 18 is what part of 72? What per cent of 72?
4. From $4\frac{1}{2}$ bu. take 3 pk.
5. What will 15 bu. of potatoes cost if $7\frac{1}{2}$ bu. cost $\$6\frac{1}{2}$?
6. At \$15 a dozen, what will 84 chairs cost?
7. A cube 5 inches long contains what part of a cubic foot?
8. 9 mo. is what part of a year?
9. $\frac{3}{4}$ sq. ft. = ——— sq. in.
10. Bought a peck of chestnuts for 80 cents and sold them at 5 cents a half pint. How much did I gain? What per cent of the cost did I gain?
11. 25 is what part of 75? What per cent of 75?
12. What part of $\frac{5}{6}$ is $\frac{2}{3}$?
13. 15 gal. 3 qt. = ——— pt.
14. Multiply 7.635 by 10; by 1000; by 100.
15. Divide 5.8 by 10; by 100; by 1000.
16. Divide 16.54 by 1654.
17. 36 lb. of coffee for \$9 is at the rate of 12 lb. for how much?
18. A wagon was sold for \$60, which was $\frac{4}{5}$ of the cost. What was the cost? How much was lost? What per cent of the cost was lost?
19. How many square rods are there in $\frac{7}{16}$ of an acre?
20. A ten-acre lot is 20 rods wide. How long is it?

21. $\frac{3}{4}$ of 16 is $\frac{2}{5}$ of what?
22. Andrew spent $\frac{2}{5}$ of his money and had 10 cents left. How much had he at first?
23. What is the entire weight of three chickens if their average weight is 2 lb. 11 oz.?
24. What part of $\frac{1}{2}$ is $\frac{1}{4}$?
25. $\frac{1}{6}$ is what part of $\frac{1}{3}$?
26. Find 20% of 300; $33\frac{1}{3}\%$ of 72; $16\frac{2}{3}\%$ of 60; $62\frac{1}{2}\%$ of 16; 90% of 10.
27. Sugar at \$100 a ton is how much a pound?
28. A house was damaged \$500 by fire. This was 10% of the cost. What was the cost?
29. $87\frac{1}{2}\%$ of the cost of Glen's bicycle was \$28. What was the whole cost?
30. If 9 eggs cost 27 cents, what will 6 doz. cost?

238. *Written*

1. The month of January is how many minutes long?
2. If school closes for the long vacation on June 24 and opens on Sept. 6, how many vacation days are there?
3. If it is now 8.30 A.M., what time will it be in $20\frac{1}{2}$ hours?
4. Find the exact time from March 15, 1906, to Aug. 2, 1906.
5. How many weeks, days, and hours are there in 9785 hours?
6. How many rods of fence are needed to inclose a square field 396 ft. long?
7. What will it cost to paint a ceiling 24 ft. long and $16\frac{1}{2}$ ft. wide, at 25 cents a square yard?
8. What is the length of one side of a square garden whose perimeter is 632 feet?

9. How many square feet of land are there in a field containing $2\frac{1}{4}$ A. ?
10. What will it cost at 65 cents a square yard to cover with matting a floor 21 ft. long and 15 ft. wide ?
11. How many feet of fence will inclose a field 46 rd. by 31 rd. ?
12. Find the perimeter of a room that is $15' 6''$ by $13' 8''$.
13. How many rods are there in 2448 inches ?
14. *a.* If steel rails are 30 ft. long, how many are needed for 8 miles of street railroad track ? *b.* How many tons do they weigh if each foot weighs 90 lb. ?
15. At the rate of 660 feet a minute, how many miles will a street car run in two hours ? (Indicate and cancel.)
16. What is the cost, at \$1.80 per rod, of a fence inclosing a rectangular field 50 rd. by 561 ft. ?
17. Draw a line to represent $1\frac{1}{2}$ miles, letting the scale be 80 rd. to an inch.
18. Draw a rectangular building lot 4 rd. by 8 rd., and put on the lot a house 44 ft. by 33 ft., and a barn 22 ft. square, using as a scale 22 ft. to an inch.
19. Three barrels of extract of witch hazel are put up in pint bottles and sold for 20¢ a bottle. What is received for all of it ?
20. A grocer bought 40 bbl. of cider at \$2.50 a barrel, made it into vinegar, and sold it at 5¢ a quart. *a.* How much did he gain ? *b.* What per cent of the cost did he gain ?
21. Divide in the shortest way the product of 36, 40, 144, 8, and 160 by the product of 18, 272, and 6.
22. Find the least number that will exactly contain 27, 60, and 24.

23. Find the greatest number that will exactly divide 231 and 385.

24. In the corner stone of a church were cut these two dates, MDCCCXXI—MCMVII. How many years apart were they?

25. Mr. C. J. Hogan has laid for Mr. Henry Sumner a piece of Portland cement walk 50 ft. long and 5 ft. wide at $12\frac{1}{2}$ ¢ a square foot. Make out the bill and receipt it.

26. Divide: *a.* 8.8 by .0008; *b.* 20.005 by .005.

27. Divide the sum of two thousand and two thousandths by two hundredths.

28. How many times will a bicycle wheel rotate in going a mile if the wheel is 7.2 ft. in circumference?

29. The product of two numbers is 12.46, and one of them is 24.92. Find the other number.

30. The product of three numbers is .1456. Two of them are 2.6 and .14. What is the third?

31. *Reduce to common fractions in lowest terms:*

<i>a.</i> .025	<i>d.</i> $.06\frac{1}{4}$	<i>g.</i> .625	<i>j.</i> .21
<i>b.</i> .0125	<i>e.</i> $.87\frac{1}{2}$	<i>h.</i> .0875	<i>k.</i> .0495
<i>c.</i> $.37\frac{1}{2}$	<i>f.</i> .375	<i>i.</i> $.012\frac{1}{2}$	<i>l.</i> 4.25

32. *Express as decimals:*

<i>a.</i> $\frac{1}{40}$	<i>e.</i> $\frac{2}{125}$	<i>i.</i> $\frac{11}{125}$	<i>m.</i> $\frac{19}{200}$
<i>b.</i> $\frac{3}{16}$	<i>f.</i> $\frac{19}{20}$	<i>j.</i> $1\frac{3}{8}$	<i>n.</i> $1\frac{53}{500}$
<i>c.</i> $\frac{17}{25}$	<i>g.</i> $\frac{18}{25}$	<i>k.</i> $52\frac{3}{80}$	<i>o.</i> $18\frac{35}{10000}$
<i>d.</i> $\frac{5}{32}$	<i>h.</i> $\frac{63}{64}$	<i>l.</i> $14\frac{51}{60}$	<i>p.</i> $15\frac{7}{9}$

33. *Find the value of:*

a. $2\frac{1}{2} + 3\frac{2}{7} + \frac{1}{4}$ of $\frac{5}{7} + \frac{4}{5}$ of $\frac{1}{3}$ *b.* $314\frac{7}{9} \times 5$

$$c. \frac{\frac{2}{3} + 1\frac{3}{4}}{2\frac{11}{12} - 1\frac{1}{15}}$$

$$d. \frac{3}{4} \times 12 \times \frac{2}{3}$$

$$e. 3\frac{1}{4} \times 2\frac{1}{2} \times \frac{26}{5} \times 8$$

$$f. \frac{\frac{3}{5} \text{ of } 28}{\frac{1}{9} \text{ of } 30} \times 18\frac{3}{4}$$

34. A hardware merchant bought a bill of goods for \$560, and marked them to be sold at a price which was 140 % of the cost. *a.* At what price did he mark the goods? *b.* He sold the goods for 90 % of the marked price. For what did he sell them?

35. A jobber bought 2000 wheelbarrows at \$1.25 apiece, marked them at 115 % of their cost, and sold them for 95 % of the marked price. What did he receive for them?

36. During a storm 1000 bbl. of sugar, or $8\frac{1}{3}$ % of the cargo of a ship, were thrown overboard. How many barrels formed the cargo?

37. Make and solve a problem about \$420 and 35 %.

38. Mr. Fish paid city taxes to the amount of \$280, which was $1\frac{5}{9}$ % of the value of his property. How much was his property worth?

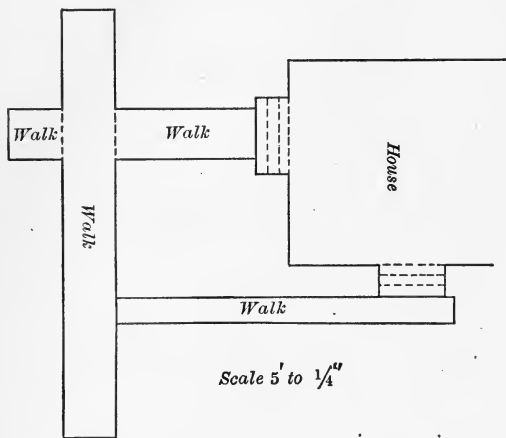
39. A load of boards weighing 3500 lb. were put into a kiln and dried. When taken out they weighed $1\frac{1}{2}$ tons. What per cent of the weight of the boards at first was water?

40. *a.* Write a problem in percentage in which factors are given to find a product. *b.* Write another in which one of the factors is to be found.

41. If a pint of cream is used in making two gallons of ice cream, what per cent of the ice cream consists of other things than cream?

42. $\frac{2}{3}$ of my money is \$1260. What is $\frac{4}{5}$ of my money?

43. This walk is made of sawed Ohio sandstone. Find its cost at $21\frac{1}{2}$ ¢ per square foot.



44. A man owned $\frac{5}{8}$ of a mine and sold $\frac{3}{4}$ of his interest for \$1710. What was the whole mine worth at the same rate?

45. A teamster mixed 600 lb. of wheat bran with a ton of corn meal with which to feed his horses.
a. What per cent

of the mixture was bran? *b.* What per cent was corn meal?

46. The population of a city to-day is 130,000, which is 125% of what it was 10 years ago. What can you find? Find it.

47. Mr. Hunter's ranch in Wyoming contains 3200 acres of land, worth \$25 an acre.

a. How many square miles of land has he?

b. What is its value?

c. One fourth of the land can be irrigated and made worth \$75 an acre. Would it pay to irrigate the land at a cost of \$20,000? Why?

48. *a.* Mr. Hunter has 6000 sheep. They are worth \$5.25 apiece in the fall and \$5.75 apiece in the spring. What is the increase in the value of the entire herd during the winter?

b. The increase is what per cent of the value in the fall? Can you tell why they are worth more in the spring?



THE RANCH

49. *a.* The sheep are separated into two equal flocks and are cared for by two herders, two dogs, and a camp tender. Each herder receives \$40 a month and the camp tender \$50. The supplies cost \$52 per month. What is the cost of tending the sheep for a year?

b. On the twenty-ninth day of June the men started with their flocks for the "summer range" in the mountains 117 miles from the ranch. They traveled an average distance of $6\frac{1}{2}$ miles per day. On what day of the year did they reach the summer range?

c. In the spring the sheep were fed 250 tons of alfalfa, worth \$5 a ton. A ton of salt lasts them 6 months and costs \$60. Add these items to the cost of caring for the sheep, and find the entire cost of keeping these two flocks for a year.



ON THE MOVE

Do you know how much a ton of coarse salt costs where you live?

Why does it cost more at this ranch?

50. *a.* In early summer 5 men sheared the 6000 sheep in 15 days, receiving 8 cents per fleece for their work. What were the average daily wages of the shearers?

b. The wool was bought by a commission man for a jobber in the East at $22\frac{3}{4}$ cents per pound. The fleeces weighed 8 lb. apiece, on the average. What did Mr. Hunter receive for the wool?

c. The commission man charged the jobber $10\frac{1}{2}\%$ of this sum for buying the wool. What did the wool cost the jobber?



A WOOL FREIGHTER

d. The wool was shipped in sacks 8 ft. long and 4 ft. wide, holding 400 lb. apiece. It was taken to the railroad station in loads of 22 sacks each, drawn by ten-horse teams. How many sacks were left after 3 loads had been drawn?

51. It may be found from the foregoing problems that Mr. Hunter received \$7426 more than he expended on account of his sheep business this year. At the same rate, what would be a man's yearly profit from a herd of 48,000 sheep?

52. If a herder kills ten coyotes in a year and receives from the government a bounty of \$3 for each one, how much will he add thereby to his monthly income?

ARTICLES SOLD BY THE THOUSAND, HUNDRED, OR
HUNDREDWEIGHT239. *Written*

1. What is the cost of 8975 bricks at \$7 per M.? (M. stands for 1000.)

$$8975 = 8.975 \text{ M.}$$

Since 1 M. costs \$7, 8.975 M. cost $8.975 \times \$7$, or \$——. *Ans.*

2. What must be paid for 980 soapstone pencils at \$.30 per C.? (C. stands for 100.)

$$980 = 9.80 \text{ C.}$$

Since 1 C. costs \$.30, 9.80 C. will cost $9.80 \times \$.30$, or \$——. *Ans.*

3. Find the cost of 1550 lb. of new buckwheat flour at \$2.50 per cwt.

$$1550 \text{ lb.} = 15.50 \text{ cwt.}$$

Since 1 cwt. costs \$2.50, 15.50 cwt. cost $15.50 \times \$2.50$, or \$——. *Ans.*

NOTE.—In final results, a fraction of a cent, equal to or greater than $\frac{1}{2}$ cent, is counted a whole cent. A fraction which is less than $\frac{1}{2}$ cent is dropped.

4. *Find the cost of each of the following items and the total cost of all of them :*

a. 27,325 bricks at \$5.15 per M.

b. 4900 cu. ft. of gas at \$1.20 per M.

c. 583 lb. sugar at \$4.75 per C.

d. 4900 tomato plants at \$1.50 per M.

e. 1000 laths at 40 ¢ per C.

f. 3125 cu. ft. of city water at \$.14 per C.

g. $\frac{1}{2}$ T. fiber paper at \$2.50 per C.

h. 5600 paper bags at \$2.90 per M.

i. 16 boxes of envelopes, 250 in a box, at \$1 per M.

- j.* 850 Japanese napkins at \$.18 per C.
k. 10 bbl. American lump salsoda, 375 lb. in a barrel, at \$.80 per cwt.
l. 6500 No. 3 butter trays at \$1.60 per M.
m. 8950 7-inch picnic plates at \$1.75 per M.
n. 13,500 cedar shingles at \$4.10 per M.
o. 675 lb. light manila bread paper at \$3.75 per cwt.

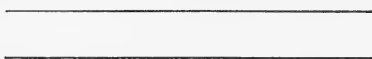
MEASUREMENTS

AREAS OF PARALLELOGRAMS

240. *A plane figure bounded by four straight lines is a quadrilateral; e.g.*



241. *Lines that are the same distance apart throughout their whole length are parallel lines; e.g.*



242. *A quadrilateral whose opposite sides are parallel is a parallelogram. Which of the above figures are parallelograms?*

243. *A parallelogram that has four right angles is a rectangle. Which of the above figures are rectangles?*

244. *Two lines that meet to form a right angle are perpendicular to each other.*



245. *The side on which a figure is supposed to rest is its base.*

246. *The perpendicular distance from the highest point of a figure to the base, or to the base extended, is its altitude; e.g.*

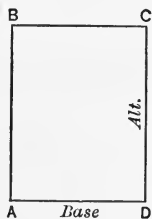


FIG. 1

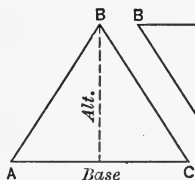


FIG. 2

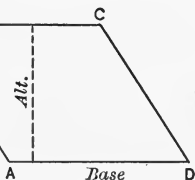


FIG. 3

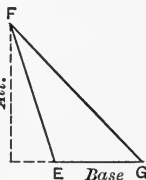


FIG. 4

247. *Figures are read by means of letters placed at their angles.* Thus, Fig. 1 is read, "Oblong $ABCD$." Fig. 2 is read, "Triangle ABC ." Read Figs. 3 and 4. The base of the triangle in Fig. 2 is AC . The altitude of Fig. 1 is DC or AB .

248. *Oral*

1. In Fig. 5 the part K compares how with the part M ?
2. The area of the parallelogram $ABCD$ compares how with the area of the parallelogram $EFCD$?
3. What is the base of each of these parallelograms?

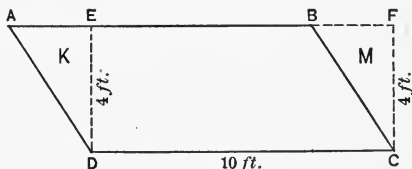


FIG. 5

4. What is the altitude? What is the area?
5. Cut from paper different shaped parallelograms.
6. Change them to rectangular parallelograms by cutting off a part similar to K and placing it like M .
7. How is the area of a rectangle found?
8. If the base of a rectangle is its length, the altitude is what?

9. If we know the base and altitude of a rectangle, how may we find the area?

10. Since any parallelogram may be made into a rectangle of the same base and altitude, how may we find the area of a parallelogram?

249. *The area of a parallelogram is equal to the product of its base and altitude.*

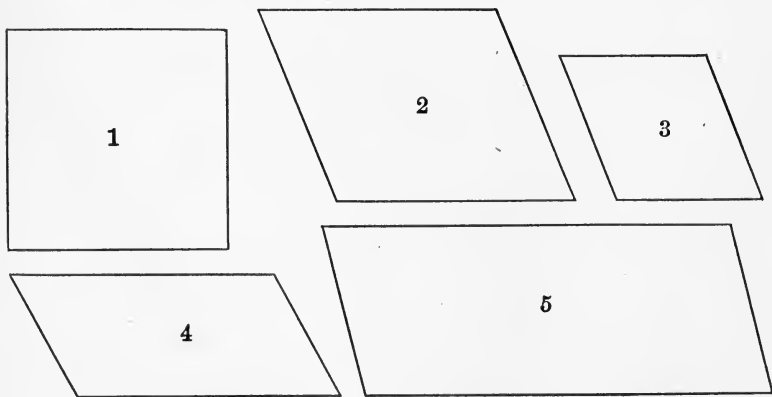
250. *Oral*

The following examples relate to parallelograms.

Fill in the missing number:

	BASE	ALT.	AREA		BASE	ALT.	AREA
1.	8 ft.	6 ft.	—	5.	—	$3\frac{1}{2}$ in.	7 sq. in.
2.	$7\frac{1}{2}$ in.	8 in.	—	6.	2 ft.	6 in.	—
3.	5 mi.	—	4 sq. mi.	7.	$3\frac{3}{4}$ ft.	8 ft.	—
4.	—	6 yd.	96 sq. yd.	8.	—	1 yd.	15 sq. ft.

251. The following parallelograms are drawn to the scale of $1'$ to $\frac{1}{8}''$. Find their areas in square feet.



AREAS OF TRIANGLES

252. *A plane figure bounded by three straight lines is a triangle; e.g.*



253. *Oral*

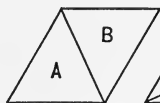


FIG. 1

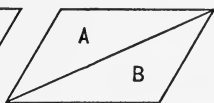


FIG. 2

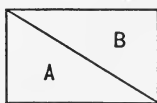


FIG. 3

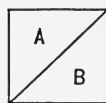


FIG. 4

1. Figures 1, 2, 3, and 4 are what kind of figures? What kind of figures are *A* and *B*?

2. In each of the above figures, how does *A* compare with *B*?

3. In each of the above figures, how do the base of the triangle and the base of the parallelogram compare?

How do the altitude of the parallelogram and of the triangle compare?

4. Fold a paper once. By cutting through both leaves of the paper at the same time, you may cut out two triangles. How do they compare? Put them together so as to make a parallelogram.

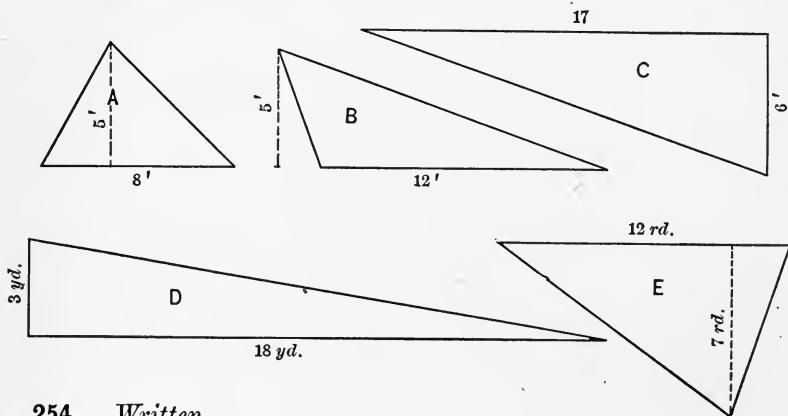
5. Repeat this process, cutting triangles, each pair of which differ in shape from the other pairs.

Each triangle is what part of the parallelogram having the same base and altitude?

6. How is the area of the parallelogram found? Of the triangle?

The area of a triangle is equal to one-half the product of its base and altitude.

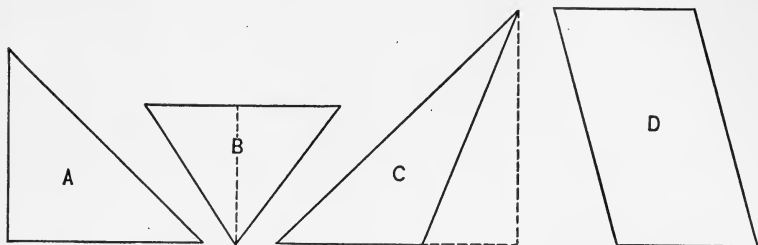
7. The following triangles are drawn to a scale. The bases and altitudes of the triangles which they represent are indicated in the drawings. Find their areas.



254. Written

1. Find the areas of triangles having the following dimensions, using cancellation where possible. When the base and altitude are of different denominations, make them similar before multiplying.

	BASE	ALT.		BASE	ALT.
a.	51 ft.	42 ft.	j.	15 yd.	15 in.
b.	27 in.	15 in.	k.	2 mi.	160 rd.
c.	$6\frac{2}{3}$ ft.	$7\frac{1}{2}$ ft.	l.	$1\frac{1}{2}$ mi.	$120\frac{1}{2}$ rd.
d.	3 ft. 7 in.	2 ft. 9 in.	m.	4 rd.	$3\frac{1}{4}$ rd.
e.	$9\frac{3}{8}$ in.	16 in.	n.	2 yd.	50 in.
f.	18 yd.	27 in.	o.	$\frac{7}{11}$ rd.	12 ft.
g.	12 ft.	$5\frac{1}{8}$ yd.	p.	$10\frac{1}{2}$ yd.	5 ft. 4 in.
h.	14 rd.	7 yd.	q.	7 yd.	7 ft.
i.	1 mi.	80 rd.	r.	$17\frac{3}{4}$ in.	$\frac{2}{11}$ rd.



2. The above figures are drawn to the scale of 10 ft. to $\frac{1}{4}$ in. Find their bases, altitudes, and areas.



THE CORD

255. The pile of wood in the center of this picture is 8 ft. long, 4 ft. wide, and 4 ft. high. How many cubic feet does it contain?

128 cubic feet = 1 cord.

In the forest, fuel wood for market is generally cut in 4-foot lengths like that in the picture, so that a pile 4 ft. high and

8 ft. long contains a cord of 128 cu. ft. The term *cord*, however, is often used to mean any pile of wood that is 8 ft. long and 4 ft. high, whatever may be the length of the sticks.

256. Oral

1. Hold your hand above the floor high enough to show the height of the pile of wood in the picture. Stand as many feet from the side of the room as the pile is long. Show with your hands the length of the sticks.

2. How many cubic feet are there in a pile of wood 8 ft. long and 4 ft. high, if the sticks are 1 ft. long? Show with your hands the height of this pile. Show its width. Walk far enough to show its length.

3. How many cubic feet would there be in the above pile if the sticks were 2 ft. long? Show the width of the pile with your hands.

4. How many cubic feet would there be in the pile if the sticks were 3 ft. long? $1\frac{1}{2}$ ft. long? Show these lengths with your hands.

257. Written

1. Using cancellation, find the number of cords in a pile of 4-foot wood:

- a. 20 ft. long and 8 ft. high.
- b. 64 ft. long and 4 ft. high.
- c. 72 ft. long and 6 ft. high.
- d. 100 ft. long and 7 ft. high.
- e. 26 ft. long and 5 ft. high.
- f. 40 ft. long and 4 ft. high.
- g. 72 ft. long and 7 ft. high.
- h. 18 ft. long and 2 ft. high.

2. If a pile of 4-foot wood is 48 ft. long, how high must it be to contain 9 cd.?

3. What must be paid for enough 4-foot wood to fill a shed 26 ft. long, 16 ft. wide, and 12 ft. high at \$4.50 a cord?

4. In the yard of a certain tannery there is a pile of bark 100 ft. long, 24 ft. wide, and 10 ft. high. How many cords of bark are there in the pile?

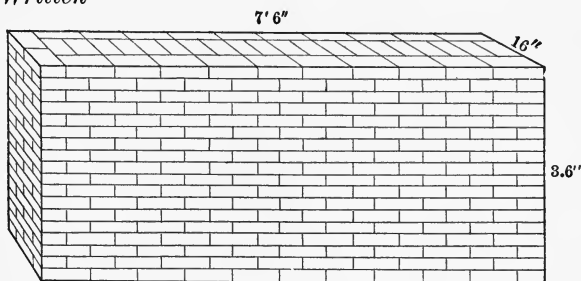
BUILDING WALLS

258. There are no universal rules for the measurement of masonry. Some masons measure around the outside of a cellar wall to determine its dimensions, while others make allowance for the corners. The method of measurement should be specified in the contract in every case.

Quantities of uncut stone are bought by the cord, and usually 99 cu. ft. are taken for a cord.

From 21 to 23 bricks $8'' \times 4'' \times 2''$ are estimated to make a cubic foot of brick wall.

259. *Written*



1. *a.* How many cubic feet does this wall contain?
- b.* If 21 bricks make a cubic foot of wall, how many bricks are used in this wall?

c. What do they cost at \$ 6.30 per M.?

d. At the same rate, what would be the cost of brick for a partition wall 50 ft. long, 11 ft. high, and 12 in. thick?

e. When 22 bricks $2'' \times 4'' \times 8''$ make a cubic foot of wall, how many cubic inches of mortar are used?

2. A house built in the form of a rectangle 36 ft. by 21 ft. has a cellar $8\frac{1}{2}$ ft. deep. The cellar wall is 1 ft. 6 in. thick.

a. Draw a plan of the cellar wall.

b. Find the number of cubic feet to be paid for in the cellar wall, measuring around the outside, and making no allowance for the corners.

c. If the cellar wall extends 3 ft. above the ground, how many cubic yards of earth were removed to make the cellar?

d. What was the cost of the brick at \$ 6.50 per M. for a partition wall 12 in. thick, from end to end through the middle of the cellar, allowing 22 bricks for a cubic foot?

e. What was the cost of a Portland cement floor in one half of this cellar at 10¢ per square foot?

3. Find the cost of the stone for a wall 297 ft. long, 8 ft. high, and $1\frac{1}{2}$ ft. thick at \$ 6.50 a cord (99 cu. ft.).

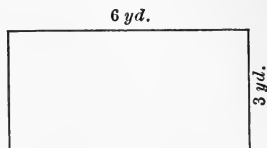
FLOOR COVERING

260. The exact number of yards of carpet, matting, or other covering to be purchased for any given floor is difficult to determine because of the waste in fitting and in matching figures. We may obtain a fairly correct estimate by dividing the number of square yards of surface to be covered, by the width of the strips, in yards, and then adding a certain amount for waste.

A yard of carpet, matting, etc., is a yard of the length of the roll, regardless of its width.

261. Oral

1. A piece of carpet 1 yd. long and $\frac{3}{4}$ yd. wide will cover how much surface? Draw it full size on the blackboard.



2. What is the area of this floor?

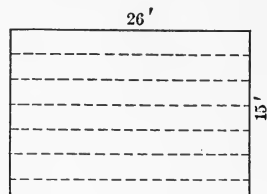
3. If a yard of carpet $\frac{3}{4}$ yd. wide will cover $\frac{3}{4}$ of a square yard of floor, how many yards of such carpet will cover 18 sq. yd. of floor?

4. How many yards of matting 1 yd. wide will cover the same floor?

262. Written

1. If this floor is covered with carpet $\frac{3}{4}$ yd. wide, how many strips, running lengthwise, must be purchased?

NOTE.—When a part of the width of a strip is needed, a whole strip must generally be purchased.



2. How many yards of carpet must be purchased for this floor?

3. Draw a diagram of each of the floors whose dimensions are given below, and compute the number of yards of material to be purchased to cover it, running the strips the longer way of the floor:

DIMENSIONS	WIDTH OF MATERIAL
a. $8\frac{1}{3}$ yd. \times 5 yd.	1 yd.
b. 15 ft. \times 3 yd.	2 ft. 3 in.
c. $10\frac{1}{2}$ ft. \times 18 ft.	$\frac{3}{4}$ yd.
d. 18 ft. \times 24 ft. 6 in.	1 yd.
e. 17 ft. \times 27 ft.	36 in.

<i>f.</i> 9 ft. × 28 ft.	$\frac{3}{4}$ yd.
<i>g.</i> 13 ft. 3 in. × 15 ft.	$\frac{3}{4}$ yd.
<i>h.</i> 12 ft. × 16 ft.	1 yd.
<i>i.</i> $19\frac{1}{4}$ ft. × 29 ft.	$\frac{3}{4}$ yd.
<i>j.</i> 15 ft. 9 in. × 19 ft.	2 ft. 3 in.
<i>k.</i> 11 ft. 3 in. × 14 ft.	27 in.
<i>l.</i> 20 ft. × 10 yd.	1 yd.
<i>m.</i> 16 yd. × 6 yd.	54 in.
<i>n.</i> 20 ft. × 38 ft.	$\frac{3}{4}$ yd.
<i>o.</i> 16 ft. × 22 ft.	1 yd.
<i>p.</i> 15 ft. × 18 ft. 3 in.	27 in.
<i>q.</i> 29 ft. × 16 ft. 6 in.	$\frac{3}{4}$ yd.
<i>r.</i> 14 ft. × 20 ft.	$\frac{3}{4}$ yd.
<i>s.</i> 13 ft. 8 in. × 19 ft. 6 in.	1 yd.
<i>t.</i> 6 yd. × 23 ft.	$1\frac{1}{2}$ yd.
<i>u.</i> 100 ft. × 75 ft.	1 ft. 8 in.
<i>v.</i> 31 yd. 2 in. × 13 yd. 1 ft. 6 in.	$\frac{3}{4}$ yd.

4. What is the expense of covering a kitchen floor 12 ft. × $13\frac{1}{2}$ ft. with inlaid linoleum at \$1.40 per square yard, allowing $1\frac{1}{2}$ sq. yd. for waste in matching the pattern?

5. Find the cost of covering a porch floor 9 ft. by 30 ft. with plain cocoa matting 54 in. wide at 50¢ a square yard.

6. The living room of a summer cottage is 17 ft. × 24 ft., and the floor is covered with plain grass matting 1 yd. wide, laid so as to make no waste. (Which way must the strips run?) Find the cost at 40¢ a yard.

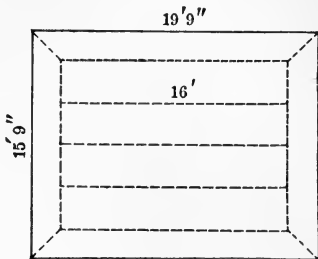
7. Harold's bedroom is $10\frac{1}{2}$ ft. × $13\frac{1}{2}$ ft. It is covered with matting 1 yd. wide, costing 45¢ a yard, pieced so as to make no waste except in turning under at the ends. Carpet paper,

costing 5ϕ a square yard, is laid under the matting. Two 5-yard pieces of braid, costing 2ϕ a yard, are used. Harold does the work, wasting $\frac{1}{4}$ yd. of matting and $\frac{1}{4}$ sq. yd. of paper.

a. What is the entire cost?

b. Draw a diagram of the room showing how the matting is laid and pieced.

8. This rug is made of Royal Wilton carpet costing \$2.60 a yard. The making and sizing cost $12\frac{1}{2}\phi$ a yard. 22 yd. of carpet braid were used at a cost of 5ϕ a yard, sewed on. Find the entire cost of the rug, allowing $\frac{3}{4}$ yd. for waste in matching the pattern.



This is Lucy's room drawn to the scale of $\frac{1}{4}'' = 1'$.

9. a. What would a hard-wood floor in this room cost at $16\frac{2}{3}\phi$ per square foot?

b. Find the cost of carpeting this room with three-ply ingrain carpet 1 yd. wide at 90ϕ per yard, paying 5ϕ per yard for making and laying, and 5ϕ per square yard for carpet paper.

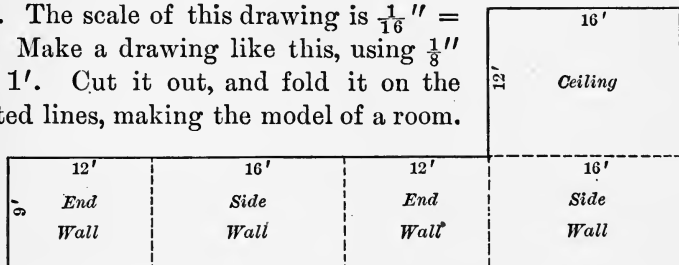
c. Find the cost of cleaning the carpet at 8ϕ per square yard.

PLASTERING

263. There is among builders no universal rule for computing the amount of plastering in the walls and ceilings of a building. Some contractors deduct the entire surface of openings, such as doors, windows, etc., and some only one half of such surface.

264. Written

1. The scale of this drawing is $\frac{1}{16}'' = 1'$. Make a drawing like this, using $\frac{1}{8}''$ for 1'. Cut it out, and fold it on the dotted lines, making the model of a room.



- a. What is the entire length of the end and side walls? What is the height?
- b. How many square feet are there in all the walls?
- c. How many square feet are there in the ceiling?
- d. How many square feet are there in the walls and ceiling together?
- e. How many square yards are there in all?
- f. What will it cost to lath and plaster this room at 35 cents a square yard, taking out $5\frac{5}{8}$ square yards for openings?

2. a. What will it cost to lath and plaster a room 15' by 18' and 9' high at \$.30 a square yard, allowing 10 sq. yd. for doors and windows? b. What will it cost at \$.28 a square yard, making no allowances?

3. Measure your schoolroom to the nearest half, third, or fourth of a foot, and estimate the cost of lathing and plastering it at 40¢ a square yard. Allow 3 sq. yd. for each door and window.

4. Estimate the cost of plastering other rooms in your school building in the same way.

5-6. Measure two rooms in your house. Find the cost of plastering the walls at 30 cents a square yard, allowing 2 sq. yd. for each door and each window. Bring your work to school.

7. Find the cost of lathing and plastering the walls and ceilings of a room 27 ft. by 18 ft. and $9\frac{1}{2}$ ft. high, allowing for 4 windows, each 3 ft. by 6 ft., and 3 doors, each 3 ft. by 8 ft., at 32 cents per square yard.

WALL COVERINGS

265. A roll of figured wall paper is usually 8 yards long and $\frac{1}{2}$ yard wide. How many square yards of paper does it contain? Ingrain paper is 30 inches wide.

Paper hangers generally estimate that a roll of paper will cover from 30 to 34 square feet, after allowing for waste.

Woven wall coverings are sold by the square yard.

266. *Written*

1. Fanny's mother wished to decorate a room in her house, and Fanny estimated the cost. The dimensions were 16 ft. by 21 ft., and 9 ft. 9 in. high. There were 2 doors and 3 windows, each estimated at 2 sq. yd.

a. The paper was estimated to cover 30 sq. ft. per roll. How many rolls were needed for the walls? (You cannot buy a part of a roll.)

b. What would the paper cost at 25¢ a roll?

c. The molding to extend all around the room at the top of the walls was sold only in 12-foot lengths, and cost $4\frac{1}{2}\phi$ a foot. What would it cost?

d. In preparation for tinting, the ceiling was to be lined with paper at 10ϕ a roll of 30 sq. ft. What would this paper cost?

e. They expected to use two packages of tinting material costing 30ϕ a package; the putty, glue, flour, etc., were estimated at 65ϕ ; and the labor at two days' work for two men at \$3.50 per day for each man. What should have been the total of Fanny's estimate?

f. If they decide to add to the ceiling some relief work which costs \$3.81, and the men can put it on in $\frac{1}{4}$ of a day, how much must Fanny add to her estimate?

2. Before being tinted, a ceiling $12' \times 17'$ was covered with sheeting 2 yd. wide. What did the sheeting cost at 25ϕ a lineal yard?

3. a. How much money is needed to buy, at 40ϕ a square yard, enough crash to cover the four walls of a room $18' \times 32'$ and 10 ft. high, allowing 190 sq. ft. for baseboard and openings, and not purchasing a fraction of a square yard?

b. What would it cost to paint the walls and ceiling of this room at \$.23 a square yard?

4. Estimate the cost of painting the walls and ceiling of your schoolroom at \$.25 a square yard.

5. Select a room in your own home; measure it. Find the cost of decorating it as your mother would like to have it done. Ask her to tell you what she would like to have put on the walls; then you make the measurements, compute the amount of material and labor, and the cost.

Make and solve other problems in papering.

LUMBER MEASURE

267. A piece of wood 1 ft. long, 1 ft. wide, and 1 in. thick is a **board foot** (bd. ft.).

TO THE TEACHER.—As material for this lesson, a real board foot—a piece of board exactly 1 ft. long, 1 ft. wide, and 1 in. thick—should be provided. Refer to it in obtaining answers to the oral questions below and whenever pupils seem to answer wide of the mark in this subject. This is very important.

268. *Oral*

1. How many inches long is a board foot? How many inches wide? How many cubic inches does a board foot contain?

2. How many board feet piled one upon another would make a cubic foot? Show with your hands how wide, long, and high this pile would be.

3. A board 1 in. thick, 1 ft. wide, and 6 ft. long contains how many board feet? Draw it full size on the blackboard, and mark off the board feet.

4. If the board in question 3 were twice as thick, how many board feet would it contain? How many inches thick would it be?

5. If it were five times as thick, how many board feet would it contain?

6. How many board feet are there in a piece of board 1 ft. wide, 16 ft. long, and 1 in. thick?

7. If this piece of lumber were 2 in. thick, how many board feet would it contain? 3 in.? 4 in.? 5 in.? 6 in.?

8. A piece of inch board 3 ft. long must be how wide to contain 1 bd. ft.

9. A cubic foot of wood could be sawed into how many board feet if there were no waste in sawing? The number of board feet in any piece of lumber is how many times as great as the number of cubic feet?

269. We may find the number of board feet in a piece of lumber by multiplying the number of cubic feet by 12. The rule commonly used by dealers and mechanics gives the same result, and is stated as follows :

To find the number of board feet in any piece of lumber, multiply together its three dimensions, two of them expressed in feet and the other in inches.

Lumber that is less than 1 in. thick is counted as 1 in. thick in measuring.

270. *Oral*

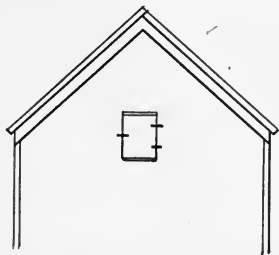
1. About how many feet of lumber (board feet) are there in the top of your desk? The teacher's desk? One end of the bookcase? The cupboard door? All the shelves in the bookcase?

2. How much lumber is used in making this box with cover? (Take outside measurements.)



3. Estimate the amount of lumber in a cubical box, including the cover, made of $\frac{1}{2}$ -inch lumber, the length of the box being three feet.

4. The door in this hayloft is $4\frac{1}{2}' \times 4'$. Two battens across the inside are $4' \times 6''$. How many feet of lumber are used in the door, the lumber being 1" thick?



271. *Written*

1. How many board feet are there in a piece of timber $18' \times 16'' \times 3''$? ($18' \times \frac{16}{12}' \times 3'' = \text{--- bd. ft.}$)

2. The floor of a tent 12 ft. by 16 ft. is made of boards 1 in. thick laid close together. *a.* How many feet of lumber are used? *b.* How much is it worth at \$ 30 per M. (thousand feet)?



a. Find the number of feet of lumber in this stick. Walk as far on the floor as the length of this piece of timber. Show with your hands how high it is. Show how wide it is. How many feet of lumber does it contain?

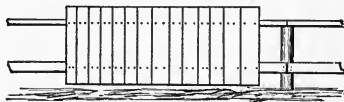
b. What are twenty such sticks worth at \$ 26 per M.?



a. Find the amount of lumber in this plank. *b.* Find the cost of ten such planks at \$ 30 per M.

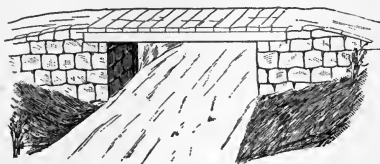
5. The floor of your schoolroom is $\frac{7}{8}$ in. thick. *a.* If no allowance is made for sawing and matching, how many feet of lumber are there in the floor? *b.* If $\frac{1}{5}$ of the lumber was wasted in sawing and matching, the floor contains only $\frac{4}{5}$ of the lumber that was bought. How much lumber was bought? *c.* What did it cost at \$ 42 per M.?

6. A fence like this, 6 ft. high, extends around two sides and one end of a rectangular garden 40



ft. by 55 ft. Draw a diagram of the garden. *a.* How many feet of boards were used? *b.* How much did they cost at \$ 27 per M.?

7. The floor of this bridge is 14 ft. by 8 ft., and made of oak planks 3 in. thick. What did they cost at \$45 per M.?



8. Is there a board fence at the rear or side of your school ground? If so, find the number of feet of boards

in it, as a part of to-morrow's lesson.

9. Find the cost of each of the following quantities of lumber :

	NUMBER OF PIECES	DIMENSIONS	PRICE PER M.
a.	21	3'' × 12'' × 18'	\$ 24
b.	10	4'' × 6'' × 20'	\$ 26
c.	75	2'' × 4'' × 20'	\$ 26
d.	6	10'' × 14'' × 30'	\$ 32
e.	3	11'' × 11'' × 10'	\$ 35
f.	49	1'' × 5'' × 16'	\$ 30
g.	60	2'' × 10'' × 14'	\$ 24
h.	72	2'' × 8'' × 14'	\$ 24
i.	56	2'' × 6'' × 14'	\$ 25
j.	121	7'' × 3'' × 12'	\$ 28
k.	2	6'' × 10'' × 22'	\$ 25
l.	4	6'' × 10'' × 16'	\$ 25
m.	4	2'' × 8'' × 18'	\$ 26
n.	8	2½'' × 8'' × 14'	\$ 27
o.	16	7'' × 10'' × 12'	\$ 40
p.	7	2¼'' × 8'' × 16'	\$ 45
q.	600	¾'' × 5½'' × 10'	\$ 42

REVIEW AND PRACTICE

272. *Oral*

1. Read: 1,003,050; XCIX; MCM; CDIV; CLI; 2,050,205.
2. What is the greatest common divisor of 12, 28, and 56?
3. What is the smallest number that exactly contains 4, 5, and 8?
4. Give five multiples of 11.
5. Name all the composite numbers smaller than 30.
6. Name the prime factors of 42.
7. What common fraction in lowest terms equals $.33\frac{1}{3}$? $.87\frac{1}{2}$? $.625$? $.37\frac{1}{2}$? $.20$? $.80$? $.60$?
8. What decimal is equal to $\frac{3}{4}$? $\frac{1}{6}$? $\frac{2}{3}$? $\frac{3}{5}$?
9. Give results: $.8 \times 7$; $.12 \div 6$; $1.5 \times .6$; 1.03×5 ; $7.01 \times .6$.
10. Give results: $2000 \div 20$; 3.528×100 ; $53 \div 1000$; $950 \div 50$; 2.3×1000 .
11. 10 is how many times $\frac{1}{4}$?
12. What is the cost of 24 oranges, when 8 oranges cost 25 cents?
13. What is the difference between $\frac{1}{4}$ of 10 and $\frac{1}{5}$ of 10?
14. If $2\frac{1}{2}$ yd. of cloth cost $\$7\frac{1}{2}$, what will 5 yd. cost?
15. $\frac{3}{5}$ of 20 are how many times 4?
16. $\frac{1}{3}$ is contained in 7 how many times?
17. Give results: $\frac{1}{2} - \frac{1}{3}$; $\frac{1}{4} - \frac{1}{8}$; $\frac{1}{3} - \frac{1}{6}$; $\frac{1}{8} + \frac{1}{2}$; $\frac{1}{5} + \frac{1}{3}$; $\frac{7}{9} + \frac{1}{3}$; $\frac{5}{14} \times \frac{7}{9}$.
18. What is the cost of three bananas at 20 cents a dozen?

19. What will 4 doz. steel screws cost at 15¢ a gross?
20. If 3 boys can shovel a walk in 15 minutes, how long should it take 1 boy?
21. When 3 eggs cost 5 cents, what is the cost per dozen?
22. A rectangle 18 in. by 2 in. contains what fraction of a square foot of surface?
23. $\frac{4}{5}$ of 25 is what part of 30?
24. Give results: $4\frac{1}{3} - \frac{5}{6}$; $\frac{2}{3}$ of $\frac{3}{8}$; $4 - 1\frac{1}{7}$.
25. A man had a sum of money. He earned $\frac{1}{2}$ as much and then had \$9. How much had he at first?
26. $\frac{1}{3}$ inch is what part of a foot?
27. 40 rd. are what part of a mile?
28. 40 sq. rd. are what part of an acre?
29. How many boys are there in a class of 45 pupils if $\frac{5}{9}$ of the pupils are girls?
30. How many cubic feet of stone are there in a stone wall $8' \times 4' \times 2'$?
31. Ethel cut 20 roses one morning, of which 40% were red. How many red roses did she cut?
32. One dozen is what per cent of one gross?
33. A peddler sold 36 pencils at the rate of 2 for 5 cents. What did he receive?
34. $48 \div 3 + 36 - 50 = ?$
35. 28 days are called a lunar month. One week is what per cent of a lunar month?
36. How many days were there in February, 1906? In February, 1493?

273. Written

1. See how quickly you can obtain correct answers and test them:

a. The addends are 4,798, 6,430, 895, 49,785, 231, 8,942, 700, 98,346, 209, 98,020, 49, 816. Find the sum.

b. The product is 910,386, one factor is 4,398. Find the other factor.

c. 7,695 and 493 are the factors that make what number?

d. 2,983, 4,978, 9,399, and 16,897 are the parts that make what number?

e. 83,469 added to what number will make 103,497?

2. Find the least number that will exactly contain each of these numbers: 28, 35, 20, 42.

3. What is the number whose prime factors are 2, 3, 5, 7, 11 and 17?

4. How many times is the G. C. D. of 48, 36, and 72 contained in their L. C. M.?

5. Reduce to common fractions in simplest form: a. .025; b. .375; c. .3125; d. .8375; e. .1275; f. .30; g. .625.

6. Reduce $\frac{7}{320}$ to a decimal, and write the answer in words.

7. The product of three numbers is $11\frac{9}{10}$. Two of the numbers are $2\frac{1}{7}$ and $1\frac{1}{5}$. Find the other number.

8. Which is larger, and how much, $\frac{5}{6}$ of 64 or $\frac{6}{7}$ of 45?

9. Change $\frac{7\frac{2}{3}}{8}$ to its simplest form.

10. $\frac{5}{6}$ of 72 is $1\frac{5}{16}$ of what number?

11. Mrs. Hill's new curtains cost \$85.40. This was $\frac{2}{3}$ as much as her carpets cost. What was the cost of both curtains and carpets?



12. In a certain year 200,000 typewriting machines costing \$12,500,000 were made in the United States by 10,000 men.

a. What was the average cost of the machines?

b. At the average rate, how many men were needed to conduct a factory that turned out 20,000 machines in a year?

c. If the labor was all but 40% of the cost of the machines, what was the expense for labor in making 327 machines?

d. 1440 of these machines were shipped to Mexico. If they were sold in Mexico at an average price of \$95 apiece, how much more did they bring than the cost of manufacture?

e. One of the machines in the picture has 76 keys, and the other two have each 42 keys. If each of the three factories where these machines are made can turn out 50 complete machines in a day, how many key tops are needed to supply the three factories for one week?

13. Find the areas of triangles having the following dimensions:

a. Base 28 rd., alt. 46 rd.

c. Base 16 in., alt. 42 in.

b. Base 19 yd., alt. 23 yd.

d. Base 64 ft., alt. $47\frac{1}{2}$ ft.

14. Find the altitude of a triangle whose base is 18 ft. and whose area is 72 sq. ft.

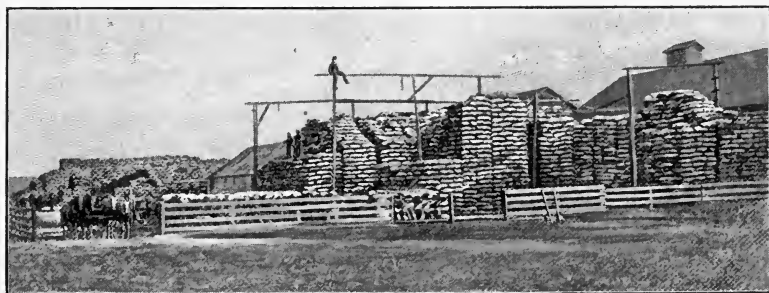
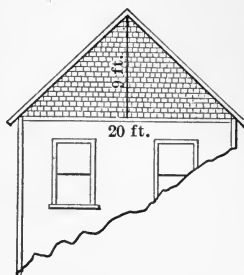
15. Find the base of a triangle whose area is 600 sq. rd. and whose altitude is 30 rd.

16. This gable is covered with shingles that cost \$5.50 per M. If 8 shingles cover a square foot, what did the shingles cost?

17. What are the weekly wages of a girl who finishes 4800 buttonholes a day, if she receives $1\frac{1}{4}$ cents per dozen garments, and each garment contains three buttonholes?

18. John Milton was born Dec. 9, 1608, and died Nov. 8, 1675. What was his age at his death?

19. The battle of Bull Run was fought July 21, 1861. How long ago was that?



WHEAT BLOCKADE IN THE NORTHWEST

20. In two years the United States exported 154 million bu. of wheat.

a. In how many days would 1000 threshing machines thresh this wheat if each machine threshes 1375 bu. per day?

b. How many grain cars would carry this wheat if a car can carry 700 bushels?

c. If a bushel of wheat weighs 60 lb., how many tons would each carload weigh?

d. Allowing 33 ft. for the length of each car, a train must be how long to carry the entire quantity of wheat?



HARVESTING WHEAT

21. 48 % of the yield of wheat in a western township in one year amounted to 73,728 bu.

a. What was the entire yield of this township ?

b. If the average yield was 20 bu. per acre, and 50 % of the land was sown to wheat, how many acres of land were there in the township ?

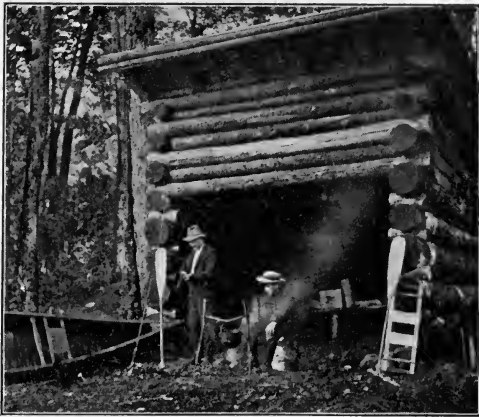
c. If the township was a rectangle 6 mi. long, how wide was it ?

22. How many days elapsed from President McKinley's second inauguration, March 4, 1901, to his death, Sept. 14, 1901 ?

23. The distance from Covington, Ky., to New York is 996 miles. If you leave Covington at 1.30 P.M. (New York time), May 1, and travel toward New York at an average rate of 30 mi. per hour, at what time will you arrive at New York ?

24. How many yards of carpet 32 in. wide must be bought for a room $18' \times 16'$?

25. Find the cost of the paper at 22 ¢ a roll for the four walls of a room that is 9 ft. 6 in. high, 21 ft. long, and 15 ft. wide, making allowance for a baseboard 9 in. wide all around the room, and for two doors and three windows, each 3 ft. by $7\frac{1}{2}$ ft. Estimate a roll of paper to cover 30 sq. ft.



26. Henry was invited to his uncle's camp in the Adirondack Mountains for a two weeks' vacation. He had saved \$20 from his earnings during the year.

a. With a part of this money he purchased the following articles :

- 1 Paragon bait rod, \$2.50.
- 1 multiplying reel, \$1.40.
- 1 enameled silk line, \$.90.
- 3 doz. snelled hooks at \$.35 per dozen.
- 1 canvas hook and tackle book, \$.50.
- 1 willow trout basket, \$1.10.

How much did these articles cost ?

b. He bought a railroad mileage book of 500 miles for \$10. From this he paid his railroad fare for 98 miles each way. How many mile slips were left in the book ?

c. What did Henry's fare cost ?

d. He paid \$.75 for his ride in a buckboard wagon from the station where he left the cars to his uncle's camp, a distance of 6 miles. What was the rate per mile ?



e. He purchased of a St. Regis Indian woman for 60 cents a sweet-grass workbasket for his mother, and for 40 cents a handkerchief box for his sister. His expenses, other than those mentioned, amounted to 65 cents. How much money did Henry have when he returned home?

f. What was the remainder of his mileage book worth, at the same rate per mile at which he bought it?

g. What was the entire cost of his vacation?

h. Henry and his uncle went trout fishing eight times. Their catches for the different trips weighed as follows: 3 lb. 5 oz., 2 lb. 5 oz., 7 lb. 4 oz., 1 lb. 12 oz., 2 lb. 2 oz., 5 lb. 4 oz., 10 oz., 4 lb. 8 oz. What was the total weight?

i. If the weight of the trout averaged 7 oz. apiece, how many did they catch?

27. $\frac{2}{3}$ of a field is planted with corn and $\frac{1}{3}$ is sown with wheat. The corn occupies how many times as much land as the wheat?

28. What is the value of 6 acres of land when 4 acres of the same land are worth \$420?

29. If a ship has water enough to last 25 men 8 months, how long will the water last 8 men?

INTEREST

274. When we have the use of property belonging to another, we pay the owner for the privilege of using it. For instance, if Mr. A lives in a house that belongs to Mr. B, he pays Mr. B a certain sum for the use of the house. That sum is called what? The amount that Mr. A pays depends upon the value of the house and the length of time for which the rent is paid.

When we rent a horse and carriage from a liveryman, we pay for their use. The amount which we pay depends upon the kind of horse and carriage, the length of time we use them, the distance we drive, etc.

When you rent a boat at the boat livery, you pay for it according to the time you use it. Can you give other illustrations of paying for the use of property belonging to others?

Sometimes a man finds it necessary to borrow money from another. Can he return the exact pieces of money which he borrowed? Should he return just as much as he borrowed? Should he return more than he borrowed? Why?

The sum paid for the use of a large quantity of money should compare how with the sum paid for the use of a smaller quantity of money?

The sum paid for the use of some money for a long time should compare how with the sum paid for the use of the same money for a short time?

The price paid for the use of the same quantity of money for the same time varies in different places.

275. *Money paid for the use of money is interest.*

276. *Money for the use of which interest is paid is the principal.*

277. *The sum of the principal and interest is the amount.*

278. *The sum to be paid for the use of money is always determined by taking a certain per cent of the principal.*

279. *The number of hundredths of the principal taken as the interest for one year is the rate of interest.* For instance, if a sum of money is borrowed and 6% of that sum is the interest for one year, the rate of interest is 6%.

280. *The rate of interest which is fixed by law is called the legal rate.* In a majority of the states the legal rate is 6%. In some states it is greater than 6%, and in some states less.

A lower rate than the legal rate is always allowed by law if the debtor and creditor so agree. In a few states a higher rate than the legal rate is allowed if the debtor and creditor so agree; but in most states a higher rate than the legal rate is forbidden by law. What is the legal rate where you live?

281. *Interest at a higher rate than that permitted by law is usury.*

282. *Oral*

1. Mr. Smith borrowed from Mr. Arnold \$100 for 1 yr. At the end of the year Mr. Smith repaid the money which he had borrowed and also paid Mr. Arnold 6% interest. How much was the interest? What was the principal? How much did Mr. Arnold receive in all? What is this sum called? Who was the debtor? Who was the creditor?

2. What is the interest on \$500 at 6% for 1 yr.? On \$800? On \$900? On \$300? On \$1000? On \$250?

3. What is the interest on \$500 for 1 yr. at 5%? At 10%? At 7%? At 4%? At 3%? At 8%?

4. What is the interest on \$1000 at 5% for 1 yr.? For 2 yr.? For 3 yr.? For 8 yr.? For 10 yr.?

5. What is the interest on \$100 for 2 yr. at 6%? At 4%? At 3%? At 9%? At 8%?

6. Six months are what part of a year? 3 mo.? 4 mo.? 8 mo.? 9 mo.? 10 mo.? 1 mo.?

7. What is the interest on \$600 for 1 yr. at 6%? For 6 months? For 3 mo.? For 4 mo.? For 8 mo.? For 9 mo.? For 1 mo.? For 11 mo.?

283. Written

1. What is the interest on \$2000 for 3 yr. at 7%?

$$\frac{\$2000}{1} \times \frac{7}{100} \times \frac{3}{1} = \$420 \text{ Ans.}$$

How do we find the interest for 1 yr.? For 3 yr.?

2. What must be paid for the use of \$700 for 4 mo. at 6% per year?

$$\frac{\$700}{1} \times \frac{6}{100} \times \frac{1}{3} = \$14 \text{ Ans.}$$

3. Find the interest on \$350 for 3 yr. 6 mo. at 4%. 3 yr. 6 mo. = how many years?

$$\frac{\$350}{1} \times \frac{4}{100} \times \frac{7}{2} = \$ \text{---} \text{ Ans.}$$

4. Find the interest on \$800 at 6%:

a. For 7 yr.

b. For $2\frac{1}{3}$ yr.

c. For 9 mo.

- d. For 2 yr. 6 mo. f. For 5 mo. h. For 2 yr. 10 mo.
 e. For 1 yr. 8 mo. g. For 1 yr. 5 mo. i. For 3 yr. 7 mo.

NOTE. — In final results, a part of a cent smaller than $\frac{1}{2}$ cent is dropped; a fraction equal to, or greater than, $\frac{1}{2}$ cent is called one cent.

5. Find the interest on \$1600 at 5%:

- a. For 5 yr. c. For $2\frac{2}{3}$ yr. e. For 1 yr. 3 mo.
 b. For $4\frac{1}{2}$ yr. d. For 3 yr. 8 mo. f. For 2 yr. 3 mo.

6. Find the interest on \$400 for 3 yr. at $3\frac{1}{2}$ %.

$$3\frac{1}{2}\% = \frac{3\frac{1}{2}}{100}, \text{ or } \frac{7}{200}$$

$$\frac{\$400}{1} \times \frac{7}{200} \times \frac{3}{1} = \$42 \quad \text{Ans}$$

7. What is the interest:

- a. On \$200 for 4 yr. at 5%?
 b. On \$1400 for 1 yr. at $4\frac{1}{2}$ %?
 c. On \$1800 for 6 mo. at $6\frac{2}{3}$ %?
 d. On \$1500 for 3 yr. 4 mo. at 4%?
 e. On \$1200 for 2 yr. 8 mo. at $4\frac{1}{2}$ %?

284. It is the custom of business men in computing interest to consider one month as 30 days, and one year as 360 days.

Allowing 360 days for a year, 100 days are what part of a year? 200 da.? 150 da.? 10 da.? 75 da.? 90 da.?

1. What is the interest on \$720 at 6% for 100 da.?

$$\frac{\$720}{1} \times \frac{6}{100} \times \frac{100}{360} = \$12 \quad \text{Ans.}$$

2. Find the interest on \$720 at 6% :

- | | | |
|----------------|---------------|---------------|
| a. For 200 da. | c. For 10 da. | e. For 90 da. |
| b. For 150 da. | d. For 75 da. | f. For 45 da. |

3. Compute the interest on \$1800 at 4% :

- | | | |
|----------------|----------------|----------------|
| a. For 200 da. | e. For 45 da. | i. For 33 da. |
| b. For 150 da. | f. For 75 da. | j. For 93 da. |
| c. For 90 da. | g. For 110 da. | k. For 66 da. |
| d. For 30 da. | h. For 240 da. | l. For 345 da. |

4. Compute the interest on \$75 at 4% for 2 mo. 20 da. 2 mo. 20 da. = how many days? How many years?

$$\frac{\overset{3}{\$75}}{1} \times \frac{\overset{4}{100}}{4} \times \frac{\overset{2}{80}}{\underset{3}{360}} = \overset{2}{\$3} = \underset{3}{\$}.66\frac{2}{3} \text{ Ans.}$$

5. Find the interest on:

- \$280 for 3 mo. 10 da. at 3%.
- \$375 for 7 mo. 9 da. at 8%.
- \$500 for 11 mo. 6 da. at 9%.
- \$450 for 5 $\frac{2}{3}$ mo. at 8%.
- \$300 for 4 mo. 12 da. at 7 $\frac{1}{2}$ %.

6. What is the interest on \$450 at 6% for 1 yr. 1 mo. 10 da.?

1 yr. 1 mo. 10 da. = 360 da. + 30 da. + 10 da., or 400 da.

$$\frac{\overset{5}{\$450}}{1} \times \frac{\overset{6}{100}}{100} \times \frac{\overset{4}{400}}{\underset{4}{360}} = \overset{4}{\$}30 \text{ Ans.}$$

7. Compute the interest on:

- a. \$300 for 1 yr. 5 mo. 12 da. at 5%.
 b. \$900 for 1 yr. 7 mo. 11 da. at 4%.
 c. \$360 for 1 yr. 2 mo. 7 da. at 7%.
 d. \$840 for 2 yr. 15 da. at 6%.

8. Compute the interest on \$660 for 2 yr. 8 mo. at $7\frac{1}{2}\%$.

$$7\frac{1}{2}\% = \frac{7\frac{1}{2}}{100} = \frac{15}{200}$$

$$\frac{\overset{3.30}{\cancel{660}}}{1} \times \frac{\overset{5}{\cancel{15}}}{\underset{100}{\cancel{200}}} \times \frac{\overset{8}{\cancel{32}}}{\underset{4}{\cancel{12}}} = \$132 \text{ Ans.}$$

NOTE.—We cancel 100, then divide 330 by 100 by pointing off two decimal places.

9. Find the interest on \$75.25 at 8% for 20 da.

$$\frac{\overset{3.01}{\cancel{75.25}}}{1} \times \frac{\overset{2}{\cancel{8}}}{\underset{4}{\cancel{100}}} \times \frac{\overset{20}{\cancel{20}}}{\underset{9}{\cancel{360}}} = \$.33\frac{4}{9} \text{ Ans.}$$

10. Compute the interest on:

- a. \$485.50 for 1 yr. 3 mo. at 4%.
 b. \$125.50 for 1 yr. 4 mo. at $4\frac{1}{2}\%$.
 c. \$240 for 8 mo. 15 da. at $5\frac{1}{2}\%$.
 d. \$540 for 1 yr. 4 mo. 10 da. at 5%.

From the foregoing examples we observe that the interest on any sum of money, at any rate, for any time, is always the product of three factors. What are they?

In what denomination is the time expressed before multiplying to find the interest?

285. *Written*

In examples 1-24 compute the interest:

PRINCIPAL	RATE	TIME
1. \$4320	$3\frac{1}{2}\%$	2 yr. 6 mo.
2. \$720	5%	2 yr. 8 mo. 11 da.
3. \$1081.08	7%	6 mo. 20 da.
4. \$5000	$4\frac{1}{2}\%$	2 yr. 8 mo.
5. \$901.80	8%	3 yr. 24 da.
6. \$1236.48	$4\frac{1}{2}\%$	2 yr. 2 mo. 2 da.
7. \$620.40	$5\frac{1}{2}\%$	2 yr. 3 mo. 10 da.
8. \$1275.30	9%	5 yr. 6 mo. 15 da.
9. \$1500	$6\frac{1}{2}\%$	2 yr. 9 mo. 9 da.
10. \$270.27	6%	2 yr. 27 da.
11. \$396	10%	1 yr. 1 mo. 9 da.
12. \$444	4%	5 yr. 6 mo.
13. \$84.50	7%	2 yr. 5 mo. 12 da.
14. \$16.75	7%	7 mo. 17 da.
15. \$336	5%	15 da.
16. \$300.50	3%	1 yr. 2 mo. 15 da.
17. \$42.20	$4\frac{1}{2}\%$	1 yr. 16 da.
18. \$51.17	4%	9 mo. 29 da.
19. \$35.50	7%	3 yr. 5 mo. 20 da.
20. \$691.04	5%	1 mo. 3 da.
21. \$640.50	10%	10 mo. 26 da.
22. \$105.10	12%	48 da.
23. \$92.96	7%	4 mo. 3 da.
24. \$31.40	7%	273 da.

25. Mr. Ward borrowed \$10,000 of Mr. Beach at 5% and lent it to Mr. Waite at 6%. Mr. Waite kept the money 2 yr. 6 mo. 18 da. He then paid Mr. Ward, and Mr. Ward paid Mr. Beach. What was Mr. Ward's gain?

26. What must be paid for the use of \$160 for 11 yr. 11 mo. 11 da. at $7\frac{1}{2}\%$?

27. Required, the interest on \$2000 for 3 yr. 7 mo. 12 da. at 3%.

28. How much will \$358.50 earn in 1 yr. 8 mo. 6 da. when put on interest at 7%?

29. How much interest will \$475.50 earn in 5 yr. 9 mo. 24 da. at 4%?

30. How much interest will \$840.50 yield in 10 mo. 15 da. at $4\frac{1}{2}\%$?

31. At 5% interest, what will \$75 gain in 11 mo. 10 da.?

286. *Oral*

1. The sum of the principal and interest is called what?

2. Mr. Williams borrowed \$100 of Mrs. Johnson, paying 6% interest. What was the principal? The interest? The amount?

3. Name the principal, interest, and amount when \$100 is borrowed for 3 yr. at 6% interest.

4. Find the amount of \$50 for $1\frac{1}{2}$ yr. at 6%.

5. Find the amount of \$1 for 7 yr. at 5%.

6. What is the amount of \$100 for 6 mo. at 5%?

7. If I borrow \$200 at 4% interest, how much do I pay in three years?

8. Frank's uncle gave him a New Year's present of \$100, which he put in a bank that paid 4% interest. How much money did Frank have in the bank at the end of three months?

9. What is the amount of \$ 300 for four years at 5% ?
10. A man bought a span of horses for \$150 apiece and a wagon for \$ 50, agreeing to pay for them in one year with interest at 10%. How much did he have to pay ?
11. Mr. B owes \$1000 on his house and pays the interest every six months at the rate of 5% per year. How much interest does he pay each time ?
12. I owe a debt of \$ 40, due in one year and six months. If I pay interest at the rate of 10% per year, how much will the debt amount to when it is due ?
13. What is the interest on \$ 200 for five years when the rate of interest is $3\frac{1}{2}\%$?
14. What is the amount of \$ 400 for two years at $3\frac{1}{2}\%$?
15. The amount of \$400 for a certain time at 7% interest is \$428. Can you find the time ?
16. The amount of \$100 for 2 years is \$110. Can you find the rate of interest ?
17. The amount of a sum of money for one year at 7% interest is \$214. Can you find the principal ?
18. The interest of \$50 for 2 years is \$6. Can you find the rate of interest ?
19. The amount of \$80 for $1\frac{1}{2}$ years at 5% per year is how much ?
20. When the principal, rate, and time are given, how may the amount be found ?
21. The principal added to the interest gives what ?
22. The difference between the principal and amount is what ?
The difference between the interest and amount ?

287. *Written*

In examples 1-13 find the amount:

	PRINCIPAL	RATE	TIME		
1.	\$450	6%	1 yr.	2 mo.	20 da.
2.	\$150.50	8%			20 da.
3.	\$330	7½%	2 yr.	8 mo.	
4.	\$7500	4%		2 mo.	20 da.
5.	\$1250	4½%	2 yr.	8 mo.	
6.	\$901.80	8%	1 yr.	6 mo.	12 da.
7.	\$620.40	5½%	1 yr.	1 mo.	20 da.
8.	\$444.60	3%	1 yr.	6 mo.	
9.	\$42.25	7%	1 yr.	5 mo.	12 da.
10.	\$960	6%		11 mo.	20 da.
11.	\$173	6%		8 mo.	16 da.
12.	\$1500	8%	2 yr.	5 mo.	13 da.
13.	\$90	6¾%	1 yr.		27 da.

14. What will \$1000 amount to in 1 yr. 7 mo. if put at interest at 4%?

15. What will \$8450 amount to in 90 da. at 10%?

16. A man borrowed \$416 at 5%. If nothing was paid on the debt for 1 yr. 16 da., how much did the man then owe?

17. If you should borrow \$150.25 at the legal rate of interest where you live, how much would you owe 11 mo. 15 da. after borrowing the money?

18. If a man borrows \$146.75 to-day at the legal rate of interest where you live, how much will he owe 9 mo. 15 da. from to-day?

19. Find the amount of \$750.25 for 1 yr. 27 da. at 9%.

PROBLEMS IN WHICH THE TIME MUST BE COMPUTED
BEFORE INTEREST CAN BE FOUND

288. *Written*

1. What is the interest on \$144 from June 12, 1901, to Jan. 2, 1903, at 4%?

1903 yr. 1 mo. 2 da.	$\frac{16}{1}$				
1901 6 12	$\frac{144}{1}$	$\times \frac{4}{100}$	$\times \frac{560}{360}$	$=$	\$8.96
<u>1 6 20</u>	<i>Difference in Time</i>		$\frac{9}{9}$		<i>Ans.</i>

2. *Find the interest on:*

- a. \$500 at 6 % from May 7, 1902, to Sept. 7, 1904
- b. \$72 at $4\frac{1}{2}$ % from Apr. 1, 1904, to Apr. 16, 1907.
- c. \$60 at $5\frac{1}{2}$ % from Sept. 30, 1899, to June 15, 1901.
- d. \$240.60 at 10 % from Oct. 25, 1904, to Dec. 10, 1907.
- e. \$360 at 9 % from Nov. 30, 1903, to May 25, 1905.
- f. \$1000 at $3\frac{2}{3}$ % from Jan. 21, 1904, to June 11, 1906.
- g. \$48.48 at 8 % from Feb. 25, 1906, to Jan. 5, 1908.
- h. \$99 at 6 % from Sept. 21, 1904, to Jan. 1, 1906.
- i. \$36.36 at 10 % from Feb. 2, 1903, to Oct. 22, 1905.
- j. \$900 at $3\frac{1}{2}$ % from Dec. 30, 1904, to Jan. 15, 1905.
- k. \$45.90 at 6 % from Jan. 9, 1900, to Aug. 5, 1903.
- l. \$576 at 4 % from July 4, 1902, to Feb. 3, 1905.
- m. \$960.84 at 3 % from Apr. 3, 1904, to Sept. 6, 1907.
- n. \$162.72 at 5 % from May 12, 1900, to May 4, 1905.

INTEREST FOR SHORT PERIODS

289. When money is on interest for less than a year, it is customary to compute the time in days.

What is the interest on \$1575.25 from Jan. 9, 1904, to March 15, 1904, at 3%?

The money is on interest for $\left\{ \begin{array}{l} 22 \text{ da. left in Jan.} \\ 29 \text{ da. in Feb.} \\ \underline{15} \text{ da. in March} \\ 66 \text{ da. } \textit{Term of Interest} \end{array} \right.$

$$\frac{1575.25}{1} \times \frac{3}{100} \times \frac{66}{10} = \$8.663875, \text{ or } \$8.66 \text{ Ans.}$$

Observe that by keeping (not cancelling) the factors 100 and 10 below the line we may multiply together the factors above the line and then divide by 100 and 10 by pointing off three more decimal places in the product.

290. Written

1. Compute the interest on \$721.44 at 4% from April 3 to July 6.

2. Find the interest on \$9000 at 5% from March 4, 1898, to April 3, 1898.

3. A man borrowed \$576.72, May 12, 1896. How much did he owe Aug. 10, 1896, computing the interest at 5%?

4. A man borrowed \$3500, Jan. 5, 1902, and repaid the money with interest at 6% on April 1, 1902. How much did he pay?

5. Find the amount of \$250 borrowed June 1, 1907, and paid Aug. 21, 1907, with interest at 6%.

6. *Find the interest on:*

- a. \$600 from Aug. 1 to Aug. 21, 1907, at $5\frac{1}{2}\%$.
- b. \$120 from May 6 to May 31, 1905, at 5% .
- c. \$219 at 7% from June 12 to July 30, 1904.
- d. \$638 at 6% from Dec. 15, 1906, to Feb. 8, 1907.
- e. \$1000 at $7\frac{1}{2}\%$ from Nov. 18, 1907, to Feb. 17, 1908.
- f. \$248.50 at 9% from Aug. 15 to Aug. 31, 1901.
- g. \$631.78 at 10% from Jan. 14 to Sept. 8, 1896.
- h. \$48.70 at 10% from May 3 to Oct. 7, 1899.
- i. \$246.42 at 8% from Sept. 30, 1907, to Jan. 1, 1908.
- j. \$401.28 at $4\frac{1}{2}\%$ from July 8, 1906, to Jan. 1, 1907.
- k. \$283.49 at 6% from Dec. 31, 1902, to March 30, 1903.
- l. \$800 at 5% from Dec. 1, 1903, to April 1, 1904.
- m. \$12,000 at $6\frac{1}{2}\%$ from Jan. 30 to June 16, 1896.
- n. \$200,000 at $3\frac{3}{4}\%$ from Aug. 5 to Aug. 23, 1905.
- o. \$150,000 at $4\frac{1}{4}\%$ from March 10 to July 18, 1907.
- p. \$76.47 at 9% from April 1 to April 29, 1901.
- q. \$84.13 at 7% from Feb. 20 to Aug. 1, 1907.
- r. \$43,475 at $4\frac{1}{2}\%$ from May 7, 1899, to Jan. 14, 1900.
- s. \$4376.40 at 6% from May 6, 1900, to March 17, 1901.

7. *Find the amount of:*

- a. \$400 at 7% from Aug. 31 to Dec. 1, 1904.
- b. \$308.12 at 6% from Feb. 1 to March 13, 1906.
- c. \$242.14 at 7% from Jan. 31 to April 3, 1904.
- d. \$800,000 from June 16, 1900, to Jan. 1, 1901, at $3\frac{1}{2}\%$.
- e. \$140,000 from April 14 to May 19, 1904, at $4\frac{3}{4}\%$.
- f. \$131.13 at 8% from Oct. 31, 1905, to Feb. 27, 1906.
- g. \$434.25 at $5\frac{1}{2}\%$ from Feb. 21 to July 3, 1907.

291. Oral REVIEW AND PRACTICE

1. Expressing numbers by means of figures is called what?
2. Name the first six places in integers.
3. Define an integer.
4. Read MCMIX.
5. Numerate 20756.3010.
6. The numbers added are called what?
7. Find the value of $8 + 3 \times 2 - 21 \div 7$.
8. *Give the sums rapidly:*
 $18 + 8$; $27 + 12$; $26 + 19$; $49 + 48$; $53 + 47$.
9. How may we test our work in subtraction?
10. How may we test our work in multiplication?
11. How may we test our work in division?
12. Define division.
13. Which terms in division are factors?
14. Which terms in multiplication are factors?
15. *Give results rapidly:*
 $43 - 12$; $56 - 17$; $93 - 56$; $85 - 59$; $132 - 94$.
16. *Multiply by 100:*
 48 ; 4264 ; 408 ; 37.9 ; 84.729 ; $.0079$.
17. Multiply 48 by 25.
18. *Divide by 1000:*
 2645.3 ; 793 ; 4835 ; 3.9 ; 9638.2 ; 7 ; 82 .
19. When 20 pickles cost 13 cents, how much should be paid for 80 pickles?
20. At the rate of 7 for 3 cents, how many screw hooks can be bought for 15 cents?

21. How much a dozen is paid for bananas when 36 bananas cost 60 cents?
22. Name the odd numbers between 40 and 50.
23. Name the prime numbers from 1 to 47.
24. Name the prime factors of 60.
25. What number will divide every even number?
26. How may we tell whether a number is prime or not?
27. What is cancellation?
28. The smallest number that exactly contains each of two or more numbers is called what?
29. What is the greatest number that will exactly divide 45 and 60?
30. Find the L. C. M. and G. C. D. of 36 and 8.
31. A fraction is always an expression of what operation?
32. Which term of a fraction is the dividend?
33. Which term of a fraction is the divisor?
34. Which is greater, $\frac{1}{2}$ or $\frac{1}{3}$? $\frac{1}{5}$ or $\frac{1}{8}$? $\frac{5}{7}$ or $\frac{5}{9}$? $\frac{3}{11}$ or $\frac{3}{14}$?
35. The "Lincoln Stars" won 5 games of baseball, with the following scores: 7, 8, 2, 9, 4. What was their average score?
36. Name five aliquot parts of one dollar.
37. How many packages of cereal at $\$.12\frac{1}{2}$ each can be bought for \$3?
38. What per cent of anything is $\frac{1}{2}$ of it? $\frac{1}{3}$ of it? $\frac{1}{4}$? $\frac{2}{3}$? $\frac{1}{8}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{7}{8}$? $\frac{5}{8}$?
39. If the interest on \$25 for a certain time is \$3, what is the interest on \$200 for the same time, at the same rate?
40. $62\frac{1}{2}\%$ of \$16 is how much money?
41. Draw a line one yard long without a measure. Measure and correct it.

42. Draw a square foot. Measure and correct it.
43. Draw a square 8 inches on a side. Measure and correct it.
44. How many days are there in the summer months?
45. Each spoke in a certain wheel makes an angle of 60° with the spoke next to it. How many spokes are there in the wheel?
46. When a stationer buys tablets at the rate of \$6 a gross, how much does he pay for each dozen? When he buys them at \$9 a gross, what does he pay for each dozen?
47. I bought a ream of note paper and used 12 quires of it. How many sheets were left?
48. One circumference is equal to how many arcs of ten degrees each?
49. From the Fourth of July to Christmas is how many days?
50. What is the cost of 2500 shingles at \$6 per M.?
51. What is the area of a triangle whose base is 20 inches and altitude is 1 foot?
52. What is the altitude of a triangle whose base is 12 feet and whose area is 48 square feet?
53. How many feet of lumber are there in a board which is 14 ft. long, 6 in. wide, and $\frac{7}{8}$ in. thick?
54. What is the amount of \$300 for $1\frac{1}{2}$ yr. at 3%?
55. The interest on a sum of money for ten months is \$35. What is the interest on the same sum, at the same rate, for two months?
56. $\frac{1}{3}$ of a flag pole 126 ft. high was broken off by the wind. How many feet high was the piece left standing?

292. *Written*

1. Express in Roman numerals the number of the year in which you were born.

2. Write in words 500200.00202.

3. *Add, and test your work:*

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
358	26	98034	12843
47	544	576	798
968	37	934	6347
7684	829	86	999
9235	5444	715	3857
1386	308	8397	92124
428	9176	869	28315
79	283	476	76543
9830	706	59	89412
49	2493	987	6347
15730	819	43	48009
<u>2132</u>	<u>6478</u>	<u>3754</u>	<u>90384</u>

4. The sum of two numbers is 80,305. One of the addends is 79,496. Find the other.

5. One rectangular field is 35 rods by 54 rods; another is 24 rods by 51 rods. How many more feet of fence are required to inclose one of them than to inclose the other?

6. Mr. Walch sold two horses for \$275 each, and a carriage for \$295. He then bought an automobile costing four and three fourths times as much as the horses and carriage brought. He received how much less than he paid out? Indicate the work, and then find the answer.

7. Make and solve a problem that requires the following operations: $16 \times \$.45 + 84 \times \$.70 - \$32.18$.

8. $5.375 \div (1.55 - .3) + 142.34 \times 7 = ?$
9. Find the prime factors of 589.
10. Find the smallest number that will exactly contain each of the numbers 105, 56, 84, 220.
11. Find the largest number that will exactly divide 260, 490, 1078, 364.
12. One factor of $\frac{28}{7}$ is $\frac{18}{7}$. Find the other.
13. Divide $\frac{7}{11}$ of $\frac{5}{8}$ by $\frac{14}{3}$ of $\frac{15}{16}$.
14. Divide $\frac{3}{5}$ of $\frac{5}{8}$ by $\frac{14}{3}$ of $\frac{15}{16}$.
15. Find the value of $\frac{3}{7} \times 4\frac{2}{3}$ divided by $\frac{7}{18}$ of $8\frac{4}{7}$.
16. Change $\frac{9450}{16170}$ to a fraction whose terms are prime to each other.
17. How much greater is $\frac{7}{9}$ of 41 than $51\frac{5}{14} - 42\frac{19}{8}$?
18. What decimal is exactly equal to $\frac{3}{3}\frac{1}{2}$?
19. Mr. Tripp kept a record of the temperature indicated by his thermometer at noon every day for a week as follows: 76° , 80° , 78° , 83° , 87° , 90° , 89° . What was the average noon temperature for the week?
20. Make out a bill of four items, using prices found in the newspaper. Receipt the bill as if you were the creditor's clerk.
21. Multiply $43.76\frac{1}{2}$ by $5.8\frac{3}{4}$.
22. Divide $74.96\frac{3}{4}$ by $.6\frac{1}{4}$.
23. Multiply 3867 by 25, in the shortest way.
24. Divide 3976 by 25, in the shortest way.
25. A contractor agreed to excavate a cellar 180 ft. by 45 ft. and 11 ft. deep. What fraction of the work was left undone when he had removed 175 cu. yd. of earth?
26. What common fraction is the same as $11\frac{7}{8}\%$?

27. 15% of the weight of a certain piece of cloth was wool. If the piece contained $25\frac{1}{2}$ lb. of cotton, how many pounds did the piece weigh?

28. In excavating the side of a hill for a railroad, it was necessary to remove 8500 cubic yards of clay and rock. If $19\frac{3}{4}\%$ of the material removed was rock, how many cubic feet of clay were removed?

29. *a.* A brick wall 41 ft. 6 in. long, 1 ft. 6 in. wide, and 8 ft. high contains how many bricks, if 22 bricks will make 1 cu. ft. of the wall?

b. They cost how much at \$9.50 per M.?

30. 16,200 bricks were required in building a wall 2 ft. thick and 9 ft. high. If it required 24 bricks to make a cubic foot of wall, how long was the wall?

31. *a.* A 20-acre vineyard contains 540 vines to the acre. All the vines in the vineyard are set in 90 equal rows. How many vines are there in each row?



VINEYARD

b. The average yield is 1000 baskets of grapes per acre. An empty basket weighs $1\frac{1}{2}$ lb. A filled basket weighs 8 lb. How many pounds of grapes are raised on an acre?

c. How many tons are raised in the whole vineyard?

d. What are they worth at \$24 per ton?

e. If it costs 1 cent per basket to pick and pack the grapes and $\frac{4}{10}$ of a cent per basket for cartage, what must be paid for picking, packing, and carting an acre's yield of grapes?

32. *a.* Three cents a tray are paid for picking wine grapes. What are the weekly wages of a picker who picks 50 trays of grapes a day?

b. If 64 filled trays weigh a ton, and the yield of an acre is $3\frac{1}{4}$ tons, including the weight of the trays, what is the cost of picking three acres of wine grapes?

c. The weight of an empty tray is 5 lb. What is the weight of the grapes that fill one tray?

d. How many pounds of grapes will fill 64 trays?

e. At 5 cents apiece, what is the cost of the trays for an acre of grapes? (See *b.*)

f. At one cent a pound, what is the value of the grapes from an acre of ground?

33. *a.* A grape grower in California has 40 acres of wine grapes. It costs \$12 an acre to train and cultivate his vines and \$1.35 per ton for picking. If the yield is 6 tons to the acre, and he sells the entire crop for \$15 a ton, what is his net profit per acre?



b. Each ton of these grapes will make 150 gallons of wine. Allowing 32 gallons for a barrel, how many barrels of wine can be made from the entire 40-acre vineyard?

c. How many pounds of grapes are used in making one gallon of wine?

34. The grapevines are supported by wires fastened to posts. If it requires 609 lb. of wire per acre, costing \$42 a ton, what is the cost of the wire for a 15-acre vineyard?

35. What will it cost to carpet a room 20 ft. by 23 ft. with carpet 27 in. wide, costing \$1.75 a yard, with 8¢ per yard added for making and laying, running the strips the longer way of the room, and making no allowance for waste in matching the figure?

36. a. What will it cost to lath and plaster the walls of a room 80 ft. by 30 ft. and 14 ft. high at 40 cents a square yard, making full allowance for 20 windows, each $3\frac{1}{2}$ ft. by 7 ft., and 4 doors, each 3 ft. 3 in. by 8 ft.?

b. The floor of this room is supported by 120 joists, each 16 ft. long, 12 in. wide, and 3 in. thick. What did they cost at \$28 per M. board feet?

37. Find the sum of $35^{\circ} 46' 52''$ and $72^{\circ} 13' 38''$.

38. A game of baseball began at 25 minutes 38 seconds past 2 P.M., and closed at 7 minutes 15 seconds past 4 P.M. How long did the game last?

39. The widths of six city lots, lying side by side, are as follows: 55 ft., 40 ft. 6 in., 72 ft. 9 in., 38 ft. 10 in., 80 ft., and 66 ft. 8 in. Find in feet and inches the entire width of all the lots.

40. What is the amount of \$350 at interest from March 15, to July 11, 1907, the rate of interest being $5\frac{1}{2}\%$?

41. Find in the shortest way the interest on a sum of money for 30 days, when the interest on the same sum, at the same rate, for 120 days, is \$37.16.

TABLES

LIQUID MEASURE

4 gills (gi.)	= 1 pint (pt.).
2 pints	= 1 quart (qt.).
4 quarts	= 1 gallon (gal.).

DRY MEASURE

2 pints (pt.)	= 1 quart (qt.).
8 quarts	= 1 peck (pk.).
4 pecks	= 1 bushel (bu.).

AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound (lb.).
2000 pounds	= 1 ton (T.).
2240 pounds	= 1 long ton.
100 pounds	= 1 hundredweight (cwt.).

LINEAR MEASURE

12 inches (in.)	= 1 foot (ft.).
3 feet	= 1 yard (yd.).
5½ yards or 16½ feet	= 1 rod (rd.).
320 rods	= 1 mile (mi.).

SURFACE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.).
9 square feet	= 1 square yard (sq. yd.).
30¼ square yards	= 1 square rod (sq. rd.).
160 square rods	= 1 acre (A.).
640 acres	= 1 square mile (sq. mi.).

VOLUME MEASURE

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.).
 27 cubic feet = 1 cubic yard (cu. yd.).

TIME

60 seconds (sec.) = 1 minute (min.).
 60 minutes = 1 hour (hr.).
 24 hours = 1 day (da.).
 7 days = 1 week (wk.).
 365 days = 1 common year (yr.).
 366 days = 1 leap year.

COUNTING

12 = 1 dozen (doz.).
 12 dozen = 1 gross.
 20 = 1 score.

PAPER MEASURE

24 sheets = 1 quire.
 20 quires = 1 ream.

ARC AND ANGLE MEASURE

60 seconds (") = 1 minute (').
 60 minutes = 1 degree (°).
 An arc of 360° = 1 circumference.

UNITED STATES MONEY

10 mills = 1 cent.
 10 cents = 1 dime.
 10 dimes = 1 dollar.

TROY WEIGHT

24 grains (gr.) = 1 pennyweight (pwt.).
 20 pennyweights = 1 ounce (oz.).
 12 ounces = 1 pound (lb.).

APOTHECARIES' WEIGHT

20 grains (gr.)	= 1 scruple (sc. or ʒ).
3 scruples	= 1 dram (dr. or ʒ).
8 drams	= 1 ounce (oz. or ʒ).

EQUIVALENTS

1 gallon	= 231 cubic inches.
1 bushel	= 2150.42 cubic inches.
1 quart, dry measure	= $1\frac{1}{3}$ quarts, liquid measure (nearly).
1 lb. Avoirdupois	= 7000 gr.
1 oz. Avoirdupois	= 437.5 gr.
1 lb. Troy or Apoth.	= 5760 gr.
1 oz. Troy or Apoth.	= 480 gr.
1 lb. Avoirdupois	= $1\frac{3}{4}$ lb. Troy or Apoth.
1 oz. Avoirdupois	= $1\frac{1}{2}$ oz. Troy or Apoth.

$2 \times 1 = 2$	$3 \times 1 = 3$	$4 \times 1 = 4$	$5 \times 1 = 5$
$2 \times 2 = 4$	$3 \times 2 = 6$	$4 \times 2 = 8$	$5 \times 2 = 10$
$2 \times 3 = 6$	$3 \times 3 = 9$	$4 \times 3 = 12$	$5 \times 3 = 15$
$2 \times 4 = 8$	$3 \times 4 = 12$	$4 \times 4 = 16$	$5 \times 4 = 20$
$2 \times 5 = 10$	$3 \times 5 = 15$	$4 \times 5 = 20$	$5 \times 5 = 25$
$2 \times 6 = 12$	$3 \times 6 = 18$	$4 \times 6 = 24$	$5 \times 6 = 30$
$2 \times 7 = 14$	$3 \times 7 = 21$	$4 \times 7 = 28$	$5 \times 7 = 35$
$2 \times 8 = 16$	$3 \times 8 = 24$	$4 \times 8 = 32$	$5 \times 8 = 40$
$2 \times 9 = 18$	$3 \times 9 = 27$	$4 \times 9 = 36$	$5 \times 9 = 45$
$2 \times 10 = 20$	$3 \times 10 = 30$	$4 \times 10 = 40$	$5 \times 10 = 50$
$2 \times 11 = 22$	$3 \times 11 = 33$	$4 \times 11 = 44$	$5 \times 11 = 55$
$2 \times 12 = 24$	$3 \times 12 = 36$	$4 \times 12 = 48$	$5 \times 12 = 60$
$6 \times 1 = 6$	$7 \times 1 = 7$	$8 \times 1 = 8$	$9 \times 1 = 9$
$6 \times 2 = 12$	$7 \times 2 = 14$	$8 \times 2 = 16$	$9 \times 2 = 18$
$6 \times 3 = 18$	$7 \times 3 = 21$	$8 \times 3 = 24$	$9 \times 3 = 27$
$6 \times 4 = 24$	$7 \times 4 = 28$	$8 \times 4 = 32$	$9 \times 4 = 36$
$6 \times 5 = 30$	$7 \times 5 = 35$	$8 \times 5 = 40$	$9 \times 5 = 45$
$6 \times 6 = 36$	$7 \times 6 = 42$	$8 \times 6 = 48$	$9 \times 6 = 54$
$6 \times 7 = 42$	$7 \times 7 = 49$	$8 \times 7 = 56$	$9 \times 7 = 63$
$6 \times 8 = 48$	$7 \times 8 = 56$	$8 \times 8 = 64$	$9 \times 8 = 72$
$6 \times 9 = 54$	$7 \times 9 = 63$	$8 \times 9 = 72$	$9 \times 9 = 81$
$6 \times 10 = 60$	$7 \times 10 = 70$	$8 \times 10 = 80$	$9 \times 10 = 90$
$6 \times 11 = 66$	$7 \times 11 = 77$	$8 \times 11 = 88$	$9 \times 11 = 99$
$6 \times 12 = 72$	$7 \times 12 = 84$	$8 \times 12 = 96$	$9 \times 12 = 108$
$10 \times 1 = 10$	$11 \times 1 = 11$	$12 \times 1 = 12$	ROMAN NUMERALS I = 1 V = 5 X = 10 L = 50 C = 100 D = 500 M = 1000 \bar{M} = 1,000,000
$10 \times 2 = 20$	$11 \times 2 = 22$	$12 \times 2 = 24$	
$10 \times 3 = 30$	$11 \times 3 = 33$	$12 \times 3 = 36$	
$10 \times 4 = 40$	$11 \times 4 = 44$	$12 \times 4 = 48$	
$10 \times 5 = 50$	$11 \times 5 = 55$	$12 \times 5 = 60$	
$10 \times 6 = 60$	$11 \times 6 = 66$	$12 \times 6 = 72$	
$10 \times 7 = 70$	$11 \times 7 = 77$	$12 \times 7 = 84$	
$10 \times 8 = 80$	$11 \times 8 = 88$	$12 \times 8 = 96$	
$10 \times 9 = 90$	$11 \times 9 = 99$	$12 \times 9 = 108$	
$10 \times 10 = 100$	$11 \times 10 = 110$	$12 \times 10 = 120$	
$10 \times 11 = 110$	$11 \times 11 = 121$	$12 \times 11 = 132$	
$10 \times 12 = 120$	$11 \times 12 = 132$	$12 \times 12 = 144$	

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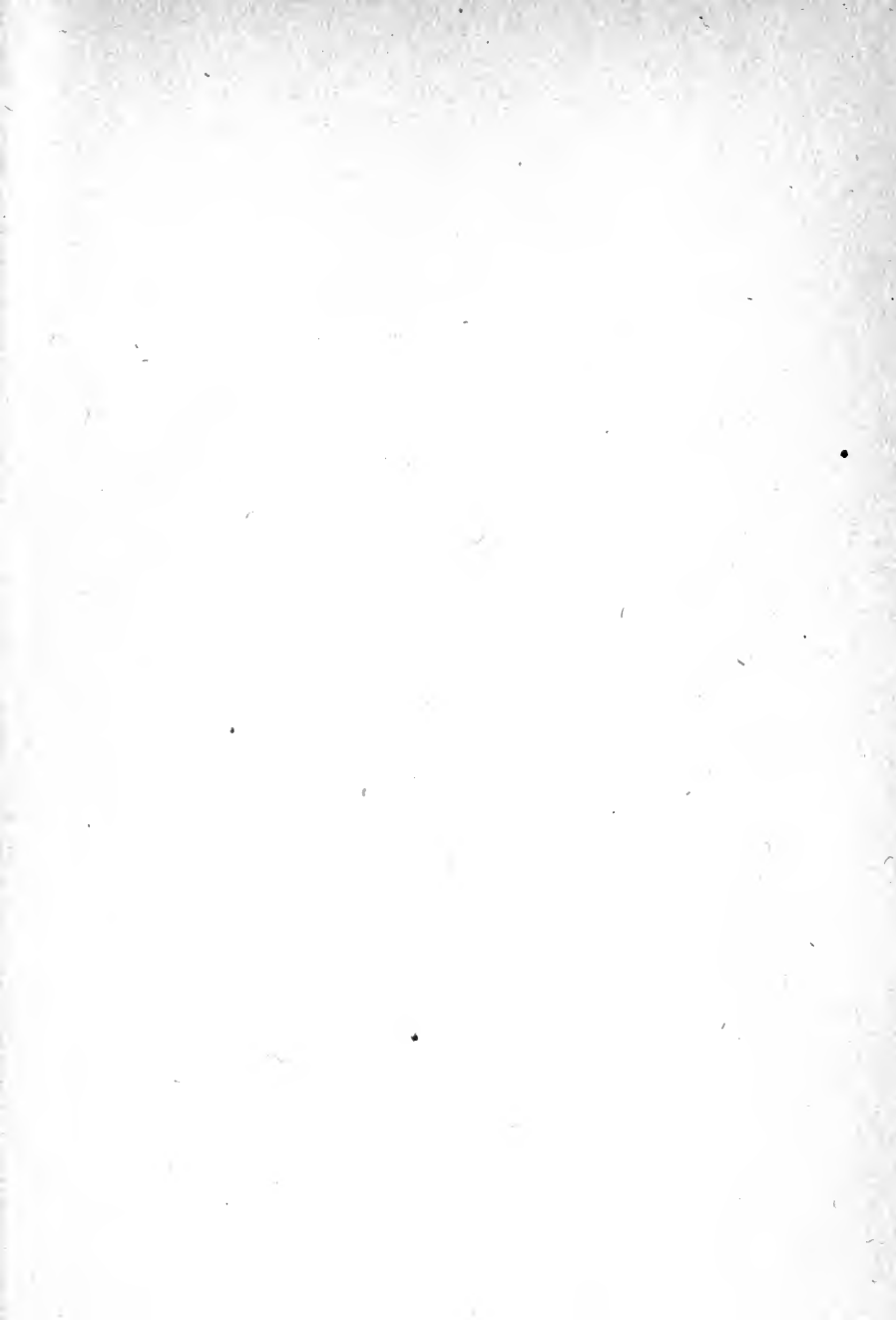
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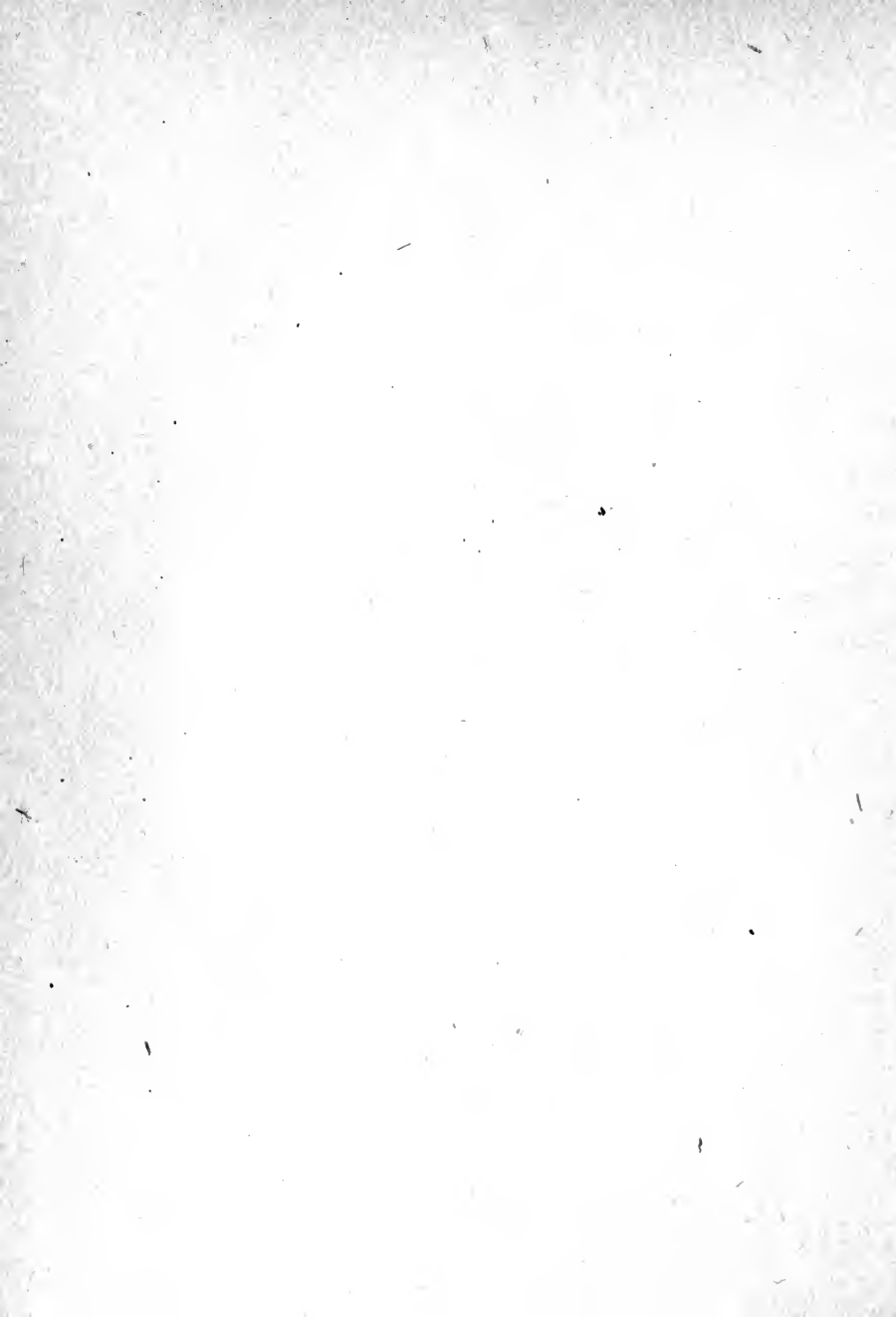
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p. 225 useless term "addendum"

p. 99 what awful notation + +

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