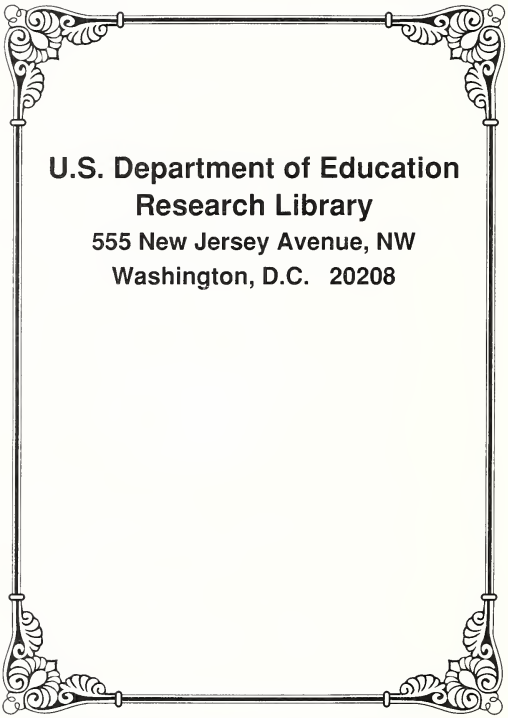
GRADED ARITHMETICS

BOOK FIVE-GRADE VI.

CHANCELLOR



ELEMENTARY SCHOOL MATHEMATICS BY GRADES

GLOBE SERIES

FIFTH BOOK

STANDARD MEASUREMENTS

BY

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GLOBE SCHOOL BOOK COMPANY

NEW YORK AND CHICAGO

"It is a curious fact that we Americans habitually underestimate the capacity of pupils at almost every stage of education from the primary school through the university."

"The right time for advancing a child to the study of a subject is the first moment he is capable of comprehending it."

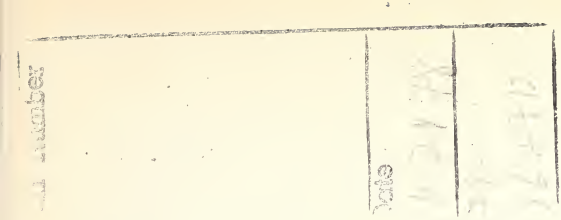
President CHARLES W. ELIOT, LL.D.,
Harvard University.

From "Educational Reform."

A skillful teacher is always reviewing in connection with the advance work. . . . There is one season when a review is essential, a brisk running over of the preceding work that the pupil may take his bearings, and this is at the opening of the school year. Such a refreshing of the mind, such a lubricating of the mental machinery, gets one ready for the year's work. Complaints which teachers generally make of poor work in the preceding grade are not unfrequently due to the one complaining; the effects of the long vacation have been forgotten; the engine is rusty, and it needs oiling before the serious start is made.

DAVID EUGENE SMITH, PH.D.,
Professor of Mathematics, Teachers College, Columbia University.

From "The Teaching of Elementary Mathematics."



PREFACE

We have come to see in the light of our new knowledge of mental and moral growth that what a child enjoys learning he profits by, and that what he profits by develops in him the normal life of the child which is the guarantee of an efficient life as an adult. There is a growing tendency to decrease the range of arithmetical instruction in grammar grades and to introduce early some geometrical instruction. There is also a distinct tendency to rely more and more upon the various forms of "manual training" in the education of boys and girls; and this development along the lines of the industrial arts which afford the materials of manual-mental discipline lends itself notably to the encouragement of the study of geometry early in life.

In the primary and first grammar grades children may easily learn common and decimal fractions, factoring, cancelling, finding least common multiples and greatest common divisors, and how to add, subtract, multiply, and divide accurately and rapidly. They ought to learn to image correctly the facts involved in ratios, percentages, and measurements, and to understand the simplest elements in simple proportion and in the equation involving one unknown quantity.

It appears from the investigations of child-students and of psychologists that unless a boy learns before the age of ten or twelve how to perform the fundamental operations both correctly and quickly he seldom becomes proficient later. Early proficiency, however, can be maintained only by constant exercise. For boys and girls who are prepared in the essential elements of arithmetic this, the Fifth Book of the Series, proposes additional instruction in concrete measurements, percentage, interest, and commercial matters.

Early arithmetical exercises are, in most cases, inevitably oral rather than written. As we go higher in the science of arithmetic the temptation to rely upon writing more than upon speech in the development of the processes of problems greatly increases in strength. Observation and reflection make it entirely clear that the most frequent uses of arithmetic are: simple multiplications, as in retail purchases, additions, and measurements by the eye. Various problems in this book illustrate the common instances in which we need to have arithmetical processes at perfect command. The complicated problems are for the special workers in business and industry, and do not belong in children's text-books.

It is possible that all the arithmetic which for its own sake as a useful body of knowledge every boy or girl ought to know is contained in the earlier books of this Series. Certainly very few girls will ever need to know much arithmetic beyond the topics of the Fourth Book. The chief value of advanced arithmetic is not utilitarian, but disciplinary and cultural. I have aimed to make the oral recitations reviews of practical matters, involving the fundamental operations and essential principles of arithmetic, but to make the written exercises such as involve careful, continued, and progressive reasoning.

This Series is not a scientific topical manual for teachers of arithmetic, published in parts. It purports to be only a systematic arrangement of lessons for children studying the subject. It is a series of handbooks for pupils. It consists of graded lessons arranged in the spiral order, partly of topical, partly of intentionally miscellaneous problems. Adults' minds sometimes grow; children's brains inevitably do grow. Adults often forget; children necessarily must forget. The developed cells of children's brains are constantly increasing in number and changing in their connections. Any moment with a child may mean a physical re-arrangement of the registering bases of the processes of memory and reasoning. To expect a child not to forget is to be ignorant of the anatomy and physiology of brain-growth. The review-drill, by keeping all knowledge

active, preserves for future use essential truths and principles, and maintains and increases proficiency in methods and processes.

In mathematics we have our traditions as to what ought and what ought not to be taught in the different grades. These traditions had their origins long before either courses of study were scientifically ordered or men questioned themselves as to the stages in the growth of the mind. In consequence there are many easy processes in mathematics which are postponed until after much more difficult processes have been mastered, at needlessly great costs in time and energy. It too often happens that the attack upon these more difficult processes results in such discouragement that the student never completes even the elementary school courses. It is not the purpose of this Series to overturn the accepted order of mathematical topics; but certain changes have been made in the direction suggested. The utilitarian value of the simplest geometrical exercises is not less than that of many arithmetical exercises; and their cultural value is greater because they fit more closely the powers and needs of the minds of boys and girls. It is unquestionably good pedagogy and sound common sense to develop for boys and girls fundamental geometric principles, of angles and areas, of forms and of volumes, even at the expense of an encyclopedic knowledge of the rules and methods of interest, discount, partial payments, and cube root at an age when the student is still living the natural life of the boy or girl and has years yet ahead before needing or caring to know all the conventions of the world of finance. We are not all destined for bank clerkships. There are more mechanics than merchants in the world. Boys and girls without knowledge of geometry cannot use tools or examine the construction of things made with tools.

A great amount of material has been presented in these pages so as to give the teacher an unusually large and free range of selection. No class in one year is expected even to try to solve every problem in any book. Classes in the same

grade vary radically in power. The first principle of each book, that it is a text-book for the students in their personal study rather than a handbook for teachers, necessitates the introduction of a considerable amount of explanatory instruction. Too much dependence upon oral teaching makes the pupil weak. To develop the self-activity of the boys and girls is the most important aim of education; and to secure such original effort is to establish the foundation of self-reliance, which is the substance of true character.

The familiar scientific topical epitome of arithmetic and the text-book of arithmetical methodology are both out of place in the children's hands. Mere separation of the topics and problems into books graded, or supposed to be graded, to fit the different years of the present conventional school curriculum is not enough. This Series is an effort to advance positively in the direction of the elementary mathematical handbook for boys and girls which modern psychology demands.

Author and publishers desire to acknowledge with thanks the helpful and valuable suggestions of Dr. F. E. Spaulding, Superintendent of Schools, Passaic, New Jersey, and of Mr. G. I. Aldrich, Superintendent of Schools, Brookline, Massachusetts, in revising the proofs of this book. We are indebted also for criticisms of methods and problems to several teachers, among whom Mr. Edgar S. Pitkin, Center Grammar School, Bloomfield, has given important assistance. No effort has been spared to make the text at once modern and practical.

W. E. C.

Bloomfield, N.J.,
April 15, 1902.

SUGGESTIONS TO TEACHERS

1. The preface explains the general purpose of this book.

2. Read also the prefaces and suggestions to teachers in each of the earlier books of this Series. It may be desirable to review some of their exercises before taking up this book systematically. The value of these exercises in awakening the pupils' interest and activity is speedily evident upon trial.

3. Read this book itself. The purposes of certain features appear only when considered in relation to other features.

4. This book deals with eminently practical matters. When discussing any special topic and at any time after having discussed it, welcome suggestions and information from the pupils regarding the way business men, artisans, mechanics deal with the same subject. Encourage the boys and girls to get into touch with the world of affairs. If the time of the recitation is being unduly encroached upon, postpone lengthy discussions to private talks, or, if the matter is important to all, to some suitable time "between periods," or at the beginning or end of the session. It is worth very much to boys and girls, especially to those who will not continue in school long, to be encouraged to observe and to think for themselves.

5. Remember that in our American schools, during or just after each of the fourth, fifth, sixth, seventh, eighth, and ninth years in school, from ten to twenty-five per cent of a class drop out of school. In a sixth or seventh year class of forty-five boys and girls using this book, a half dozen, more or less, will remember throughout life this instruction as the highest stage of their formal education. Some of these may be among the most promising students, sifted out from their

class by economic or social forces. For these the cultural quality of their instruction and association in school is even more important than the utilitarian. Even more than the other students those who drop out early need to know not only the processes and the methods of arithmetic, but the reasons involved. We are too apt to judge the ability of students in comparison with our own experienced skill or in comparison with the rapid work of the most forward students, who are by no means always the most thorough, the most retentive, and the most accurate. There is danger in teaching too rapidly just as there is in overdeveloping a lesson.

6. The nature of the human mind is such that when in a student's effort upon a problem he shows that he is radically deficient in the fundamental operations, it becomes the teacher's duty to give to him individual exercises. The dropped stitch in knitting is a trifle compared with an omitted process in an art. And further, if anything has been thoroughly demonstrated by the study of the psychology of children and youth, it is this, that we become proficient in addition, subtraction, multiplication, and division most easily when from eight to twelve years of age. To postpone to later years the boy's acquirement of rapidity and of accuracy is to make that acquirement yet harder for him. When we find our students compelled to add columns over and over again, because of getting different results, we know that the time when they could learn addition most quickly and surely has already passed. With every later added year the difficulty becomes greater. This book, however, does not devote very much space to the fundamental operations. Individuals who need special drill in the elements may be trained in the earlier books of this Series.

7. As all measurements involve ratio, and as measurement is the chief topic of this book, it is desirable to cultivate the habit of observation in the children. Various passages in the text suggest the sort of questions we may ask from time to time in order to lead the student to make comparisons. The

habit of noticing sizes and weights is as valuable as that of noticing forms, colors, and textures, which is developed by drawing and manual training.

8. All arithmetic must be mental; but oral recitations, passing immediately from one kind of problem to another and using small numbers, insure the student's reasoning upon the problems. Reasoning is the soul of arithmetic.

9. Neatness tends to accuracy in all the written work. But it is easy to cause much unprofitable time to be spent in copying correct solutions, carelessly written. As far as possible our pupils should be induced to write neatly the first time. Even permission to copy encourages in some natures the habits of carelessness and of slovenliness. It becomes extremely important for this reason, as well as for others even greater, to study and to know the characters, needs, and powers of each individual in a class.

10. From a half to a whole page will be found usually a sufficient lesson. One hundred pages of problems make a reasonable year's work. Topics and problems are offered here in sufficient variety to permit a considerable range of choice in planning a grade's assignment. Whether problems should be given out for home-study is a question not entirely settled; but the reasons for having all problems done in school hours by pupils of this grade rather outweigh the convenience and the apparent saving of time in school resultant from giving problems to be done at home.

11. Never refuse to accept a correct solution of a problem, which can be explained by the student, even if the solution is extremely indirect and inconvenient. But if there is a better method, make its excellence plain.

12. Many problems at first to be solved only in writing may later be solved orally. In reviews of problems on earlier pages oral explanations should be encouraged.

13. Use concrete materials and illustrative drawings as much as time permits. Arithmetic cannot be too clear.

14. One good mode of solution well understood is worth any number of solutions but partly comprehended. On the other hand, one method of solution often throws much light upon another method.

15. Pupils who have thoroughly mastered the fundamental operations need not perform the work of all problems; let them rather indicate what must be done, giving reasons.

16. The five principles of the recitation carried out systematically insure success in the arithmetic lesson. Let the *preparation* of the class for recitation be oral, with easy review exercises and questions. Make the *presentation* definite, with the written test-exercise after it for the *generalization.* Question here closely. Secure brief oral explanations of problems for *recapitulation.* And by further questioning bring the *application* home to the children's lives.

17. The fact that a problem is hard is not necessarily a reason for not requiring its solution. Effort is the mountain air of the soul. Difficulty lends interest. Arithmetic is the main reliance of modern education to develop carefulness of mind and power of attack and persistence. Only those boys and girls know the meaning and get the benefit of arithmetic who study and master its difficulties.

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INTRODUCTORY REVIEW — ORAL

1. What is $\frac{1}{10}$ of $\$7\frac{1}{2}$? of $\$25$? of $\$33$?

2. How many yards of velvet, at $\$5\frac{1}{2}$ per yard, can be bought for $\$66$?

3. At $\$\frac{3}{4}$ a bushel, how many bushels of wheat can be bought for $\$12$?

4. When A gave $40\,¢$ for $6\frac{2}{3}$ qt. of milk, what was the cost of 1 qt.?

5. At $2\frac{1}{2}\,¢$ per mile, what is the cost of a railroad ticket from Boston to Worcester, 44 mi.? from Worcester to Springfield, 56 mi.? from A to B, 200 mi.? from C to D, 500 mi.? from E to F, 1000 mi.? from G to H, 1300 mi.? from I to J, 1800 mi.?

6. A farmer who had nine hundred sixty bushels of potatoes sold five hundred seventy-six bushels. How many bushels had he remaining?

7. B sold a boat for $\$87\frac{1}{2}$, which was $\frac{7}{8}$ of its cost. What was its cost?

8. Find $\frac{1}{12}$ of $\$96$.

9. Multiply 625 by $\frac{4}{25}$.

10. A man worked 6 hours at $\$\frac{3}{4}$ an hour. After receiving his pay he spent $\$2\frac{1}{2}$. How much had he then?

11. Divide :

a.	8,	10,	18,	11,	23,	by 2.
b.	9,	15,	27,	33,	17,	by 3.
c.	20,	28,	44,	36,	19,	by 4.
d.	35,	10,	50,	25,	28,	by 5.
e.	18,	42,	54,	36,	40,	by 6.
f.	35,	7,	21,	63,	25,	by 7.
g.	24,	72,	96,	40,	57,	by 8.
h.	81,	45,	18,	72,	60,	by 9.
i.	10,	40,	100,	120,	97,	by 10.
j.	33,	77,	121,	88,	100,	by 11.
k.	60,	32,	36,	96,	117,	by 12.
l.	17,	23,	38,	62,	29,	by 7.
m.	53,	67,	71,	90,	121,	by 8.
n.	23,	100,	48,	80,	10,	by 9.
o.	16,	37,	140,	101,	92,	by 12.

12. How many coats can be made from 34 yards of cloth, allowing 4.25 yards for each coat?

13. A man borrowed $150, and paid 7% for the use of the money. How much did he pay?

14. Review together such facts of weights and measures as are known by any members of the class.

15. Review the multiplication tables.

16. Drill upon additions, subtractions, multiplications, and divisions of small numbers.

17. At $1\frac{1}{8}$ per bu., what is the cost of 40 bu. of apples?

18. When a laborer's wages are $1\frac{5}{8}$ per day, how much does he earn in a week?

19. A boy worked two hours on each school day and five hours on Saturday for 6¢ per hour. How much did he earn per week?

20. John bought a bicycle for $35, paying $10 down and the balance at the rate of 50¢ per week. How long did it take him to pay for the wheel?

21. What is the ratio of $7 to $98?

22. When 2 pencils can be bought for 5¢, how many can be bought for 95¢?

23. A horseshoer charges 15¢ per shoe for shoeing horses. How much must Mr. Brown pay for having his pair of horses shod all around?

24. A man borrowed $250 for one year and paid 6% for the use of it. What amount did he have to pay at the end of the year?

25. A farmer having 400 sheep sold $\frac{1}{8}$ of them. How many had he left?

26. $12 is what per cent of $100? of $200?

27. $15 is what per cent of $45? of $300?

28. When a man can make $\frac{3}{7}$ of a door in a day, how many doors can he make in 14 days?

29. To the difference between 27 and 11 add 20.

30. When 9 bu. of potatoes cost $7.20, what do 8 bu. cost? 12 bu.? 15 bu.?

31. $\frac{2}{3}$ of $\frac{3}{4}$ of a dollar are how many cents?

32. A boy bought a pair of guinea-pigs for 1\frac{3}{4}$ and sold them for 2\frac{1}{4}$. What was his gain?

33. A N.Y. Central R. R. mileage book for 1000 miles costs $20.00. How much is this per mile?

34. A boy bought a pig for $2.50; paid $6.30 for corn-meal to feed it; and sold it for $11.00. What was his profit?

35. An old sailor sold toy boats for 50¢ each. When he made 3 boats per day, how much did he earn per week?

36. What part of one-tenth is one-hundredth?

37. A man bought $2\frac{3}{4}$ lb. of sausage at 16¢ per lb. Find the cost.

38. How many clams at 10¢ per doz. can be bought for $2.50?

39. A bookkeeper whose salary is $860 per year spends $100 for clothes and $20 per mo. for house rent. How much has he left for other purposes?

40. A school teacher receives a salary of $80 per mo. for 10 mo. in a year. How much can she save in a year when her expenses are $650?

41. Find $\frac{7}{11}$ of 132.

42. What is the sum of $\frac{1}{2}$ of $\frac{3}{4}$, and $\frac{1}{3}$ of $\frac{5}{8}$?

43. A boy paid $1.10 for a history, and 15¢ for a note book. How much change should he receive from a two-dollar bill?

44. When silver is worth $\$\frac{7}{10}$ per oz., how many ounces can be bought for $\$6\frac{3}{10}$?

45. How many pounds of cheese at 15¢ per pound can be purchased for $3.30?

46. If 4 men can do a piece of work in 12 da., in what time can 6 men do the work?

47. What is the cost of $3\frac{2}{3}$ lb. of butter at 21¢ per pound?

48. Name the two equal factors of 81.

49. John and Henry have $2.40. John has 3 times as much as Henry. How much has each?

50. How many cubic feet are there in a pile of wood 8 ft. long, 3 ft. high, and 2 ft. thick?

51. If soft coal is $3\frac{1}{4}$ per T., how many tons can be bought for $39?

52. Find the value of x when $6x + 9x - 2x = 65$.

53. Add

a.	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*	*h.*	*i.*	*j.*	*k.*
1	2	3	4	5	6	7	8	9	6	3
3	2	9	5	6	8	7	1	2	4	7
7	1	8	6	9	3	2	4	5	3	3
2	9	7	1	3	4	6	5	8	7	5
8	6	4	2	1	9	5	7	3	2	8
5	3	6	7	8	2	1	9	4	1	8
4	3	1	3	2	5	9	6	7	3	2
9	4	5	8	7	5	3	2	6	4	1
6	5	2	9	4	1	8	3	1	9	1

54. Find:

a. 6% of $200. *b.* $12\frac{1}{2}$% of 16 pounds. *c.* 50% of $31.18. *d.* 40% of 20¢. *e.* 9% of 300 desks. *f.* $33\frac{1}{3}$% of $72.

55. A silver watch cost $8. A gold watch, with the same movement, or works, cost $22. If the movement is worth $6, what is the ratio of the value of the silver case to the gold case?

56. At $1.50 per inch what is the cost of a 40 in. advertisement in a daily newspaper?

57. What does it cost to carpet a room 4 yd. by 5 yd. when the carpet, made, laid, and lined, costs $1.25 per yard?

INTRODUCTORY REVIEW — WRITTEN

1. In one year Mr. King bought 274 books for his library at a total cost of $582.25. What was the average cost of the books per volume?

2. At 93¢ per gallon, what was the cost per child in a school of 558 children that used 12 gal. of ink in a year?

3. Find the cost of 15 bbl. of oil at 7.62\frac{1}{2}$ per bbl.

4. A certain treatise consists of four volumes. The first volume contains xxxvii + 498 pages; the second, xlix + 795 pages; the third, cix + 688 pages; and the fourth, xciv + 873 pages. How many pages are there in the whole treatise?

5. $\frac{9}{10} \times 2\frac{1}{2}$ of $\frac{5}{9} \times 1\frac{1}{3} = ?$

6. Add: $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, $\frac{11}{12}$, $\frac{15}{16}$, and $\frac{23}{24}$.

7. From a tank holding 3465 gallons there were drawn out 75.25 barrels, of 31.5 gallons each. How many gallons were left in the tank?

8. 925682143 + 832563297 + 4327568 + 98526342 − 753291484 + 643263 − 71952875 + 2147397 = ?

9.

a.	*b.*	*c.*
7596741 ÷ 48 = ?	301147 ÷ 63 = ?	108750 ÷ 25 = ?
d.	*e.*	*f.*
7590000 ÷ 84 = ?	765431 ÷ 96 = ?	1276704 ÷ 42 = ?

10. A dealer bought two rolls of carpet, one roll containing 37.5 yards, at $2.75 a yard, and the other roll containing 27.35 yards, at $3.125 a yard. He sold both rolls at $2.94 a yard. Did he gain or lose, and how much?

11. Add together: thirteen thousand thirteen; eighty-three thousand ninety-seven; eighty-nine; seven; three million three thousand thirty; seventy-six million seventy-six thousand seventy-six; nineteen million nineteen; seven hundred eighty thousand seventy-eight.

In each of the next four problems draw to scale the figures indicated before trying to solve the problem.

12. What is the area of a rectangular house lot 45 ft. by 160 ft.? What length of fence is required to enclose it?

13. What is the area of a building lot with parallel sides, which has a 190 ft. front and is 70 ft. deep?

14. A circular pond was 392 ft. in diameter. What was its circumference?

15. A building stands on a plot that forms a right-angled triangle, base 100 ft. and altitude 48 ft. What is the area of the land?

16. Find the difference between:

a. $3\frac{1}{3}$ and $\frac{5}{6}$. *b.* $8\frac{4}{9}$ and $9\frac{1}{9}$. *c.* $11\frac{13}{15}$ and $10\frac{24}{30}$.

d. $11\frac{11}{12}$ and $7\frac{23}{24}$. *e.* $2\frac{3}{11}$ and 3. *f.* $14\frac{7}{8}$ and $3\frac{11}{16}$.

g. $14\frac{9}{10}$ and $3\frac{17}{20}$. *h.* $4\frac{13}{21}$ and $4\frac{13}{28}$. *i.* $1\frac{1}{8}$ and $\frac{11}{16}$.

j. $10\frac{17}{40}$ and $5\frac{71}{80}$. *k.* $1\frac{1}{4}$ and $\frac{7}{8}$. *l.* $2\frac{1}{2}$ and $\frac{7}{8}$.

17. The earnings of three persons amount to \$3660 a year, and their expenses to \$1590; if the balance be divided equally, what sum will each person receive?

18. A speculator bought 15 shares of mining stock at \$40 a share and sold at 10% less than he gave. He was charged $\frac{1}{2}$ per cent brokerage on each transaction. What was his total loss?

Suggestion. — Brokerage is always reckoned on the par value of the stock. Thus the brokerage on 1 share at $\frac{1}{2}$% is \$.50, whatever the market value of the share.

19. Reduce to lowest terms:

a. $\frac{9 \times 8 \times 90}{27 \times 4 \times 30}$. *b.* $\frac{44 \times 6 \times 120}{60 \times 8 \times 11}$.

20. Add:

I	II	III	IV
64738	328695	916738	67891
28674	847598	892654	34567
35978	473876	491673	102368
67536	873569	389265	89123
93625	695724	549167	45678
28967	958293	738926	91234

21. If 18 men in 24 days earn \$864, how many can earn the same sum in 36 days, working at the same rate of pay?

22. *a.* $4685.5 + .065 + 79.8064 + .0974 + 6000.04 + 5.895 + 8.3954 + 42.7261 = ?$

b. $45.685 + 725.025 + 68.125 + 48.068 + 79.065 + 45.008 + 94.336 + 8.002 = ?$

c. $79 + .0079 + 79.79 + .6895 + .0085 + 204 = ?$

23. *a.* $\frac{1}{2} - \frac{1}{3} + \frac{7}{8} - \frac{5}{12} = ?$ *b.* $11\frac{3}{8} - \frac{1}{6} - \frac{5}{18} - 2\frac{1}{12} = ?$

c. $\frac{1}{2} + \frac{3}{4} - \frac{5}{6} + \frac{7}{9} = ?$ *d.* $\frac{2}{27} + 11\frac{5}{54} - 2\frac{7}{45} - \frac{1}{10} = ?$

24. What distance will a wheel 16 feet 8 inches in circumference pass over in making 84 revolutions?

25. 127 lambs were sold at \$3.75 each. What was the amount of the sale?

26. Find the least common multiple of:

a. 10, 20, and 24. *b.* 18, 12, 39, 216, and 234.

c. 14, 21, 3, 2, and 63. *d.* 8, 18, 15, 20, and 70.

27. Reduce to decimals: $\frac{1}{7}$; $\frac{9}{16}$; $\frac{69}{22}$.

28. Find the cost of 458 yd. of sheeting at $5\frac{3}{4}$¢ per yd.

29. $3 \times 5 + [16 \div 4] - [12 + 9] + 15 - [30 - 14] = ?$

30. Divide:

a. $6 \times 7 \times 9 \times 11$ by $2 \times 3 \times 7 \times 3 \times 21$.

b. $4 \times 14 \times 16 \times 24$ by $7 \times 8 \times 32 \times 12$.

c. $5 \times 11 \times 9 \times 7 \times 15 \times 6$ by $30 \times 3 \times 21 \times 3 \times 5$.

31. A merchant sold $\frac{5}{8}$ of a bolt of cloth containing $126\frac{5}{12}$ yd. for $\$2\frac{1}{5}$ a yard, and the rest for $\$1\frac{3}{4}$ a yard. How much did he get for the cloth?

32. If $3\frac{1}{2}$ yards of cloth make a suit of clothes, how many suits of clothes can be made out of $38\frac{1}{2}$ yards?

33. In a school of 580 pupils, 90 per cent attend every day; how many pupils are in daily attendance?

34. What is the difference between $7\frac{1}{2}$ per cent of $\$8000$ and $8\frac{1}{2}$ per cent of $\$7000$?

35. The population of a town in 1890 was 3750, and in ten years it increased 30 per cent; what was the population in 1900?

36. Find the products:

a. 342×364.	*b.* 2187×215.	*c.* 8432×635.
d. 476×536.	*e.* 3489×276.	*f.* 9763×582.
g. 225×475.	*h.* 7654×989.	*i.* 1354×114.

37. If $9\frac{5}{6}$ tons of coal cost $\$39.53$, how much must be paid for 7 tons?

38. A farm sells for $\$3687$. What sum represents $\frac{7}{8}$ of the value of the farm?

39. If $\$12000$ be paid for 160 horses, how many dollars does one horse cost?

40. *a.* $26\frac{3}{7} - 19\frac{7}{9} = ?$ *b.* $36\frac{3}{5} - 27\frac{8}{11} = ?$

c. $178\frac{2}{40} - 56\frac{8}{9} = ?$ *d.* $400\frac{5}{12} - 327\frac{5}{8} = ?$

e. $25\frac{5}{7} - 13\frac{2}{3} = ?$ *f.* $761\frac{25}{75} - 482\frac{60}{1000} = ?$

41. How many yards of silk at $\$1\frac{1}{8}$ a yard can be obtained for $\$13\frac{1}{2}$?

42. A man bought $37\frac{3}{5}$ yards of gingham for $\$5.64$. How much did it cost a yard?

43. I had $\$14{,}725$ and paid one debt of $\$3560$, and another of $\$7015.87$. How much money had I left?

44. A lady bought a jacket for $\$13\frac{3}{4}$, a hat for $\$5\frac{1}{4}$, a pair of gloves for $\$1\frac{3}{8}$, and a scarf for $\$\frac{7}{8}$. She gave to the clerk three ten-dollar bills. How much was due her in change?

45. A merchant made in one week $\$480$; in the next week $\$80.50$, and in the third week $\$200$ less than he had made in the two previous weeks. How much did he make in the third week?

46. The shortest route of travel around the globe is 27,000 miles. How long would it take a man to make the trip when he could go on the average 225 miles a day?

47. A traveler made the trip around the world in 69 da. How many miles on the average did he travel each day?

48. If 600 pounds of raisins cost $\$48$, what will 2172 pounds cost?

49. From seventy-six million eight take eleven million nine hundred seventy-eight thousand five hundred twenty-nine.

50. Subtract, proving each answer:

a.	8167140 914067	*b.*	1910042 191008	*c.*	80000007 9149136
d.	8043007 3429168	*e.*	960007008 9989986	*f.*	600400070 19140607

51. A man gave \$1200 to a hospital, \$300 to a free library, and five equal sums of money to as many relatives. Since all the money he disposed of amounted to \$8562, how much did each relative get?

52. What will $9\frac{3}{5}$ T. of cannel coal cost at \$12 per T.?

53. What will $7\frac{2}{3}$ yd. of braid cost at $9\frac{3}{4}$¢ a yard?

54. The salary of the President of the United States is \$50,000 a year. How much is this each day?

55. In the town of X, C's property, worth \$10,000, is assessed at \$4500. The tax rate is \$.025 per dollar. In the town of Y, D's property, worth \$10,000, is assessed at \$8000. The tax rate is \$.016 per dollar. Which man, C or D, pays the higher sum of money as his tax?

56. E insured his house and furniture in the Planet Insurance Company for \$3000 for 3 yr., at a premium of 55¢ per \$100. What did his insurance cost each year?

57. Find the unknown quantity in each of the following proportions, viz.:

a. \$10 : \$1000 = \$$x$: \$5000.

b. 16 qt. : 4 qt. = 100 qt. : x qt.

c. x : $7\frac{1}{2}$ = 8 : 30.

d. 50 yd. : x yd. = 150 yd. : 6 yd.

e. \$$x$: \$25 = 20 sheep : 100 sheep.

58. In a pile of wood 40 feet long, 12 feet wide, and 8 feet high are how many cords?

59. In a certain orchard $\frac{1}{2}$ of the trees bear apples, $\frac{1}{4}$ of them bear peaches, $\frac{1}{6}$ of them plums, 120 of them cherries, and the rest, 80, pears; how many trees are there in the orchard?

60. How many square yards of asphalt are there in a street 2700 ft. long and 40 ft. wide?

61. A novelist, in writing a book, dated it MMCCL. What year does this indicate? He wrote in the year MCMI. What was the year?

62. From an angle of 75° was deducted an angle of 20°. What part of a right angle was the angle then left?

63. What is the fifth power of 10?

64. Write in figures: one hundred fifty-nine thousand eight hundred and forty-three millionths.

65. I bought 48 barrels of apples, each barrel containing 3 bushels, worth $1.20 a bushel, and paid for them with 60 barrels of vinegar worth 16¢ a gallon. How many gallons were there in each barrel of vinegar?

66. The cloth and materials for a suit of clothes cost a tailor $9.34. He sold the suit for $16. What were his earnings per day for 3 days' labor?

67. Write a bill of goods consisting of six items.

68. A's total income from two million dollars of property is at the average rate of four per cent a year. What is the amount of his income?

69. The total assessed value of a town is five million dollars. At two per cent tax rate, what is the town's annual revenue?

70. A railroad company bought in one order nine locomotives at a cost of $27,750 each. What was their total cost?

71. A city library bought four thousand sixty-one books at a total cost of four thousand two hundred sixty-four dollars and five cents. What was the average cost of the books?

DENOMINATE NUMBERS

A **denominate number** is a concrete number whose unit of measure has been established by law or by custom: 6 yards; 2 quarts.

Denominate numbers are either **simple** or **compound**.

A **simple** *denominate number* is composed of units of the same kind or denomination: 3 pounds; 7 dollars.

A **compound** *denominate number* consists of units of two or more denominate numbers of the same kind: 8 miles 2 yards; 5 dollars 11 cents.

The reduction of denominate numbers to lower denominations of equivalent value is called **reduction descending**.

15 bu. = 60 pk. = 480 qt. = 960 pt.

The reduction of denominate numbers to higher denominations of equivalent value is called **reduction ascending**.

LINEAR MEASURE

Linear measure, sometimes called **long measure**, is used in measuring lines, dimensions, and distances.

TABLE

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
$5\frac{1}{2}$ yd., or $16\frac{1}{2}$ ft., = 1 rod (rd.)
320 rods = 1 mile (mi.)

				ft.		in.	
		yd.		1	=	12	
	rd.	1	=	3	=	36	Prove these items.
mi.	1	=	$5\frac{1}{2}$	=	$16\frac{1}{2}$	=	198
1	= 320	=	1760	=	5280	=	63360

REDUCTION DESCENDING

1. Reduce 2 mi. 141 rd. 3 yd. 2 ft. 9 in. to inches.

In 1 mi. there are 320 rd., hence in 2 mi. there are

320 rd.
2
640 rd.
141 rd.
781 rd.
$5\frac{1}{2}$ (yd.) = 1 rd.
$390\frac{1}{2}$
3905
$4295\frac{1}{2}$ yd.
3 yd.
$4298\frac{1}{2}$ yd.
3 (ft.) = 1 yd.
$12895\frac{1}{2}$ ft.
2 ft.
$12897\frac{1}{2}$ ft.
12 (in.) = 1 ft.
6
25794
12897
154770 in.
9
154779 in.

320 rd. multiplied by 2 = 640 rd. 640 rd. + 141 rd. = 781 rd. In 1 rd. there are $5\frac{1}{2}$ yd., hence in 781 rd. there are 781 multiplied by $5\frac{1}{2}$ (yd.) or $4295\frac{1}{2}$ yd. In 1 yd. there are 3 ft. In $4298\frac{1}{2}$ yd. there are $4298\frac{1}{2}$ multiplied by 3(ft.) or $12895\frac{1}{2}$ ft. In 1 ft. there are 12 in. In $12897\frac{1}{2}$ ft. there are $12897\frac{1}{2}$ multiplied by 12 (in.) or 154770 in. 154770 in. + 9 in. = 154779 in.

2. Reduce .7825 of a yard to units of lower denominations.

.7825 yd.
3
2.3475 ft.

.3475 ft.
12
4.1700 in.

Therefore .7825 yd. = 2 ft. 4.17 in.

3. Reduce $\frac{11}{13}$ of a mile to units of lower denominations.

320 rd. $\times \frac{11}{13} = 270\frac{10}{13}$ rd.

$\frac{10}{13}$ rd. $= \frac{11}{2}$ yd. $\times \frac{\overset{5}{\cancel{10}}}{13} = \frac{55}{13}$ yd. $= 4\frac{3}{13}$ yd.

$\frac{3}{13}$ yd. $= 3$ ft. $\times \frac{3}{13} = \frac{9}{13}$ ft.

$\frac{9}{13}$ ft. $= 12$ in. $\times \frac{9}{13} = \frac{108}{13}$ in. $= 8\frac{4}{13}$ in.

Therefore $\frac{11}{13}$ mi. $= 270$ rd. 4 yd. $8\frac{4}{13}$ in.

4. Reduce 6 yd. 2 ft. 9 in. to inches.

5. Reduce 5 mi. to rd.; to yd.; to ft.; and to in.

6. How many feet are there in 27 mi.?

7. How many yards are there in 3000 mi.?

8. In 15 mi. 231 rd., are how many rods?

9. In 59 mi. 318 rd., are how many feet?

10. In 719 mi. 16 rd. 6 yd., are how many feet?

11. Reduce 17 mi. 314 rd. 11 ft. 9 in. to inches.

12. Reduce 69 mi. 53 rd. 5 ft. 6 in. to inches.

13. Reduce 18 mi. 19 rd. to feet.

14. In 248 mi., are how many inches?

15. Reduce $\frac{1}{3}$ of a mile to feet.

16. What is the value of 0.2525 of a mile in units of lower denominations?

17. What part of a foot is $\frac{320}{1980}$ of a rod?

18. Reduce $\frac{4}{5}$ of a mile to rods.

19. In 2 mi., are how many feet?

20. In 1 mi. 192 rd. 4 yd. 2 ft. 8 in., how many inches?

REDUCTION ASCENDING

1. Change 397024 yd. to units of higher denominations.

$5\frac{1}{2}$ yd.	397024 yd.	
	2	
11	794048	[1 yd.]
320 rd.	72186 rd., 2 half yd. =	
	225 mi., 186 rd.	

Since $5\frac{1}{2}$ yd. $= \frac{11}{2}$ yd. $= 1$ rd., 397024 yd. equal as many rods as $5\frac{1}{2}$ yd. are contained times in 397024 yd. or 72186 rd. and $\frac{2}{2}$ yd. or 1 yd. over. Since 320 rd. $= 1$ mi., 72186 rd. equal as many miles as 320 rd. are contained times in 72186 rd.; or 225 mi. and 186 rd. Therefore 397024 yd. $= 225$ mi. 186 rd. 1 yd.

Hence 397024 yd. $= 225$ mi. 186 rd. 1 yd.

2. Change 3 yd. 2 ft. 1 in. to the decimal of a mile.

12	1.000000 in.
	.083333
	2.
3	2.083333 ft.
	.694444
	3.
	3.694444 yd.
	2
11	7.388888
320	.671717 rd.
	.002099 mi.

1 in. $= \frac{1}{12}$ as many feet $= .083333$ ft. We add the 2 ft.

2.083333 ft. $= \frac{1}{3}$ as many yards $= .694444$ yd. We add the 3 yd.

3.694444 yd. $= \frac{1}{5\frac{1}{2}} = \frac{2}{11}$ as many rods $= .671717$ rd.

.671717 rd. $= \frac{1}{320}$ as many miles $= .002099$ mi.

3. Change to units of higher denominations:

17110 ft. 39250 rd. 54954 in. 14640 ft. 37841673 in. 87844 in. 374186 yd. 565810 rd.

4. How many inches are there in .9 ft.?

5. 1 in. $\times$ 1000 = how many yards, feet, and inches?

6. Express 1 mi. 200 yd. as a decimal of 10 mi.

7. Change 218 rd. 3 yd. 2 ft. to the decimal of a mile.

8. Change 527.3994 yd. to a decimal of a mile.

9. Change $\frac{487}{1056}$ of a mile to rods.

10. Change 149 rd. 4 yd. 9 in. to the decimal of a mile.

11. 17.0625 rd. are how many inches?

12. Reduce 8 rd. $1\frac{1}{2}$ ft. to inches.

13. Reduce $\frac{5}{48}$ mi. to units of lower denominations.

14. Reduce 18.9142 mi. to rods, yards, feet, and inches.

15. Reduce 11 yd. 11 in. to inches.

16. Reduce 7 yd. 1 ft. to inches.

17. Reduce 47 mi. 3 rd. to rods.

18. Reduce 6 yd. 2 ft. 3 in. to inches.

19. Reduce $\frac{7}{8}$ mi. to units of lower denominations.

20. Reduce $\frac{5}{8}$ of a mile to inches.

21. Express $\frac{1}{4}$ in. as the decimal of a yard.

22. Express .75 ft. as the fraction of a rod.

23. How many inches in length is a wire rope that stretches across a river 2 rd. 2 yd. 1 ft. 7 in. in width?

24. A boy had a kite string 56 yd. in length and added to it 24 ft. How many inches long was the string then?

25. A modern 13-in. gun throws a projectile 13 mi. How many feet is that?

26. What is the length in feet of a submarine telegraph cable 2500 miles long?

27. Which is longer, 10 miles or 20,000 yards?

TIME BETWEEN DATES

How many years, months, and days were there between July 5, 1898, and Mar. 8, 1901?

From July 5, 1898, to July 5, 1900, are 2 yr. From July 5, 1900, to March 5, 1901, are 8 mo. From March 5, 1901, to March 8, 1901, are 3 da.

yr.	mo.	da.
1901	3	8
1898	7	5
2	8	3

We write the later date as the minuend, giving the number of the month, 7, and that of the day, the 5th. In the earlier date the number of the month is 3, and that of the day is the 8th. We take 1 yr. from 1901 and add 12 mo. to 3 mo.; then from 15 mo. we subtract 7 mo.

The civil day begins and ends at midnight.

Find the number of years from the first date to the corresponding day of the corresponding month next preceding the last date. From that date find the number of months to the corresponding day of the month occurring previous to the last date given. From that date find the number of days to the last date given. The number of years, months, and days taken together is the time between the two dates.

1. Our Revolutionary War began April 19, 1775, and peace was declared Jan. 20, 1783. What was its length?

2. America was discovered by Columbus, Oct. 12, 1492. How many years have elapsed since that date?

3. Supposing that the Declaration of Independence was published at noon on the 4th of July, 1776, find how much time elapsed to Jan. 1, 1901, at noon?

4. Find the difference in time between March 21, 1896, and Jan. 6, 1900.

5. A note was given Nov. 15, 1894, and paid April 25, 1899. What was the length of time between those dates?

6. Andrew Jackson was born March 15, 1767, and died June 8, 1845. At what age did he die?

7. Abraham Lincoln was born Feb. 12, 1809, and died April 15, 1865. How long did he live?

8. George Washington was born Feb. 22, 1732, and died Dec. 14, 1799. At what age did he die?

9. Find the difference between the ages of the last two men at death.

10. The War of Secession began April 14, 1861, and ended April 9, 1865. Vicksburg surrendered July 4, 1863. Find the time that elapsed between these dates.

MEASURE OF TIME

TABLE

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
365 days (or 52 weeks 1 day) .	= 1 common year (yr.)
366 days	= 1 leap year
100 years	= 1 century (cen.)

Names of the months and number of days in each:

1.	January (Jan.) . . 31	7.	July 31
2.	February (Feb.) 28 or 29	8.	August (Aug.) . 31
3.	March 31	9.	September (Sept.) 30
4.	April (Apr.) . . 30	10.	October (Oct.) . 31
5.	May 31	11.	November (Nov.) . 30
6.	June 30	12.	December (Dec.) . 31

The number of days in each month may be remembered by means of the following lines:

Thirty days hath September,
April, June, and November;
All the rest have thirty-one,
Excepting February alone;
Twenty-eight are all its store
Till leap year gives it one day more.

A **solar** year is the time that the earth takes to make one complete revolution around the sun. It is a little less than $365\frac{1}{4}$ days of 24 hours each. Therefore to every fourth year an extra day is added. February of leap years has 29 days instead of 28.

But this is adding a little too much as it takes a little less than $365\frac{1}{4}$ days for the earth to revolve around the sun, and therefore not quite an extra day over 365 days every fourth year. To correct this error, centennial years are not leap years unless divisible by 400.

1. In 2 minutes are how many seconds? in 3 minutes?

2. In 4 hours are how many minutes? in 7 hours?

3. A boy who sleeps 9 hours a day has how many waking hours in a week?

4. In 3 days are how many hours? in 9 days? in 10 days? in a month of 30 days?

5. How many weeks are there in 28 days? in 60 days?

6. How many months are there in 3 years? in 20 years?

7. *Reduce to minutes:*

a. 296 da. 18 hr. 32 min. *b.* 67 wk. 6 da. 9 hr. 52 min.

c. 25 days, 6 hours. *d.* 30 da. 10 hr.

8. *Reduce to seconds:*

a. 6 days. *b.* 30 days. *c.* 25 years.

9. How many times does a clock, ticking once a second, tick in 24 hours?

10. Change to units of higher denominations:

a. 847125 minutes to weeks. *b.* 5623480 seconds to days.

11. How many days are there from:

a. March 17, 1896, to May 16, 1897?

b. Aug. 30, 1899, to June 1, 1900?

c. July 4, 1895, to July 4, 1896?

d. June 5 to Dec. 11, 1900?

e. Dec. 18, 1900, to Jan. 30, 1901?

12. The four grandparents of a boy lived to these ages:

a. 71 yr. 3 mo. 18 da. *b.* 59 yr. 8 mo. 1 da.

c. 88 yr. 4 mo. 19 da. *d.* 29 yr. 9 mo. 8 da.

What was the average age at death of the grandparents?

13. A boy was 14 yr. 8 mo. 7 da. old. His brother was 2 yr. 6 mo. 5 da. younger. What was his age?

14. One of their two sisters was 16 yr. 11 mo. 5 da. old, and the other was 9 yr. 5 mo. 3 da. old. What was their difference in age?

15. What was the average age of the four boys and girls of the family?

16. How many days have passed since Julius Caesar was killed in Rome, 44 B.C.; that is, 44 yr. before the beginning of our counting the years A.D.?

B.C. means *Before Christ.* A.D. means *Anno Domini*, In the year of the Lord.

17. John was born Aug. 17, 1872. His brother was born Feb. 20, 1879. How much older is John?

18. Henry was born Jan. 12, 1873. His sister was born 3 yr. 6 mo. and 11 da. later. Find the date of his sister's birth.

19. The Civil War began Apr. 12, 1861, and ended Apr. 9, 1865. How many days did it last?

CIRCULAR OR ANGULAR MEASURE

TABLE

60 seconds = 1 minute	$60'' = 1'$
60 minutes = 1 degree	$60' = 1°$
360 degrees = 1 circumference	$360° = 1$ circ.

$13° \ 27' \ 49'' = 13$ degrees, 27 minutes, and 49 seconds.

An arc of 90° is called a **quadrant.**

A **sign** is an astronomical measure of 30°, or $\frac{1}{12}$ of a circle. There are twelve signs in the Zodiac or great circle of the sky.

Circular or **angular measure** is used principally in surveying, navigation, astronomy, geography, and for computing differences of time.

All circles, large or small, may be divided into the same number of equal parts: as quarters, called quadrants; twelfths, called signs; 360ths, called degrees; etc. Therefore the length of a degree depends on the size of the circle. Show this by drawings.

Minutes at the earth's equator are called geographical or nautical miles. A geographical mile = 1.16 common miles. Prove this, considering the equator 24,902 miles in length.

1. How many seconds are there in 5 minutes? in 6?
2. How many minutes are there in 6 degrees? in 30?
3. How many degrees are there in 240 minutes? in 720?
4. In $36° \ 16' \ 20''$ are how many seconds?
5. In 180° are how many seconds?
6. *a.* In $275° \ 39' \ 48''$ are how many seconds?
   b. In $56° \ 17'$? *c.* In $98° \ 27'$?

ORAL REVIEW

1. From a suburban town to a nearby city round-trip railroad tickets are sold for 45¢. A 10-trip ticket is sold for $1.75. How much does a man save in a week by buying 10-trip tickets when he makes the trip daily?

2. How many years, months, and days are there from June 16, 1888 to Nov. 25, 1900?

3. One of the big dictionaries now published is said to contain 300,000 words. If 150 words can be defined on a page, how many pages are there in each volume of a two-volume edition?

4. A girl bought two yards of gingham for an apron for 13¢ per yd., two spools of thread a 5¢ each, and a paper of needles for 10¢. How much change should she receive from a $1 bill?

5. When $2\frac{3}{5}$ lb. of meat can be bought for 39¢, how many lb. can be bought for $2\frac{6}{10}$?

6. A farmer sold 15 sheep at $4 each, and a cow for $30. The buyer gave him a wagon valued at $65, and and the remainder due in $5 bills. How many $5 bills did the farmer receive?

7. When 6 sheep are sold for $36, how many sheep will bring $144?

8. When a train runs 40 miles per hour, what part of a mile does it run per minute?

9. When a typewriter can write 50 words per min., how many words can she write in $1\frac{1}{2}$ hr.?

10. A boy bought apples at 2 for 5¢ and sold them at 3 for 10¢. What did he gain on 3 dozen?

11. How many rods are there in 3 miles? in $1\frac{1}{2}$ miles?

12. How many strips of paper $\frac{1}{2}$ yd. wide are required for the sides of a room 15 ft. square?

13. A horse traveling at the rate of 32 rd. per min. goes how far in an hour?

14. What must be paid for 8 rakes when 5 rakes are sold for $\$\frac{3}{4}$?

15. Mary has in the savings bank \$13.15, John \$15.35, and Anne \$21.25. How much have they in all?

16. A house lot 80 ft. wide in front was sold for \$30 per foot. What was the selling price?

17. A boy paid \$8 for a camera, 80¢ for two dozen plates, and \$1.65 for other photographic supplies. What was his total outlay?

18. Two boys shoveled the snow from a sidewalk 240 ft. long. *a*. They received 60¢ for their work. How much was this per foot? *b*. They agreed to divide the money in proportion to the number of feet each cleared. The bigger boy cleared $\frac{3}{5}$ of the walk, the smaller boy the rest. What was the amount that belonged to each?

19. Several boys hired a rowboat at 20¢ an hour or \$1.50 a day of 10 hr. They used the boat $8\frac{1}{2}$ hr. What amount did they save by paying at the rate by the day?

20. Long ago a king, captured in war, was ransomed by the payment of a hundred pounds in gold. To get the money, the queen sold the king's cattle at the rate of two pounds of gold for a hundred head. How many head of cattle were sold?

WRITTEN REVIEW

1. Since the earth revolves on its axis 15° in 1 hour, how far does it revolve in 1 minute?

2. When a steamer goes 224 mi. in a day, how long does it take to go 12,000 mi.?

3. 2500 bbl. of flour weigh 245 tons. How much is this per barrel?

4. *a.* At $\$3\frac{1}{4}$ a pair, how many pairs of shoes will \$104 buy? *b.* At $\$2\frac{3}{5}$? *c.* At \$24 a dozen pair?

5. Reduce 12° 3′ 14″ to seconds.

6. Reduce 110° 20′ to seconds.

7. Reduce 30 days to seconds.

8. Reduce 25 years 6 months to days.

9. In building a house the cost was as follows: Bricks, \$148.75; lime, \$38.50; sand, \$8.40; lumber, \$374.98; cartage, \$94.65; wages, \$974.57; and extras, \$173.48. The land cost \$325, and fencing and draining it, \$49.64. What was the total cost of house and lot?

10. A man traveled 38 mi. 429 yd. one day, 24 mi. 785 yd. the next day, and still had 46 mi. 376 yd. to go to finish his journey. What was the length of that journey?

11. How long will it be from Dec. 4th of this year to the 4th of the next August?

12. Multiply 2.4327 by 4.23.

13. Will the year 2000 be a leap year?

14. Why was not 1900 a leap year?

15. How many months and days elapsed from Dec. 3, 1899, to Sept. 1, 1900?

16. The wool sheared from 630 sheep, each yielding 8 pounds of wool, worth 24¢ a pound, was exchanged for 32 bolts of cloth, each bolt containing 18 yards. How much was the cloth worth a yard?

17. Four loads of oats, each load containing 35 bushels, worth 50¢ a bushel, were exchanged for 7 sacks of grass seed, each sack containing 2 bushels. What was the cost of the grass seed a bushel?

18. Subtract:

a.	*b.*	*c.*	*d.*	*e.*
676643	816427	16134	291860	810006
12571	13518	5317	119137	79867

19. What will 7640 bricks cost at $4.75 per M?

20. Express as a simple decimal, $\frac{1.875}{2.1} \times \frac{3.5}{3.75}$.

21. Change 30 da. 23 hr. 59 sec. to seconds.

22. Change 36 wk. 5 da. 17 hr. to seconds.

23. Change 40.000 sec. to days, minutes, and seconds.

24. Change 1,000,000 sec. to days.

25. How long will it take a railroad train, traveling 26.18 miles an hour, to travel 366.52 miles?

26. How much will $10\frac{3}{5}$ lb. of cheese cost at $16\frac{1}{2}$¢ a pound?

27. A grocer bought $12\frac{3}{4}$ bushels of pears at 75¢ a bushel. What was the total cost?

28. When 18 books cost $\$13\frac{1}{2}$, what does 1 book cost?

29. There are $18\frac{1}{4}$ gallons of mineral water in 6 jugs of equal size. How many gallons are there in 2 such jugs?

30. When $14\frac{4}{5}$ T. of coal are worth \$76.96, what is 1 T. worth?

31. What must I pay for 75 rolls of wall paper at $38\frac{2}{3}$¢ a roll?

32. Divide:

7583261 by 28.	27005126 by 48.	23001281 by 72.
23581271 by 31.	38174265 by 59.	3766 by 25.

33. Reduce to common fractions:

.025; .5; .25; .005; .15625; .01875; 5.128; 6.075; .078125; 7.512; .015625; .34; .375; .078; .03125; 3.24.

34. A certain Park Row office building in New York City is 380 ft. in height. What fraction of a mile high is it? Express the answer both as a common and as a decimal fraction.

35. The Park Row building has 29 stories. What is the average height of each story?

36. Reduce $\frac{1}{4\,8\,0}$ mi. to inches.

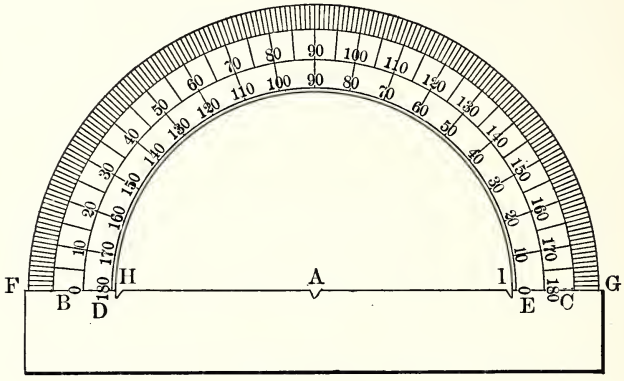
37. The ridge-pole of a house is 26.5 ft. from the ground. How many inches is this?

38. A steamer going at the rate of 516 mi. per day made a certain voyage in 6 da. 1 hr. How great was the distance traveled?

39. A man deposited in bank \$360, and drew checks as follows: viz. \$36.15, \$81.95, \$34, \$18.49, \$72. He then deposited \$140; and drew checks for \$19.50 and \$100. Find his balances after each check and deposit.

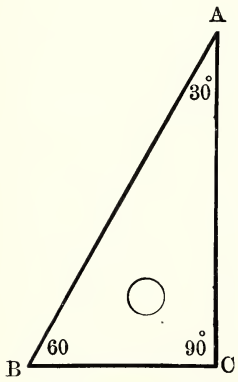
40. In a certain county of 600 sq. mi. are 145 farms. What is the average number of acres in these farms? At \$90 an acre, what is the value of all the land in the county?

INSTRUMENTS FOR DRAWING FORMS

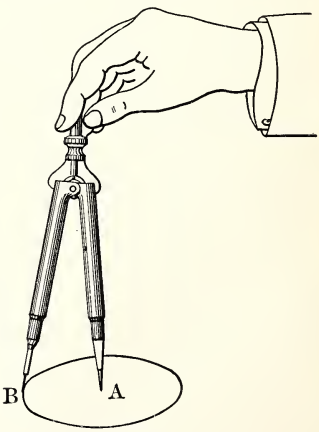


PROTRACTOR

By the *protractor* we measure angles. Set *A* at the vertex of an angle, and let the line *FA* or *AG* exactly follow one side of the angle, which should appear at *H* or *I*. Then the arc *BC* or *DE* marked in degrees gives the measure of the angle.



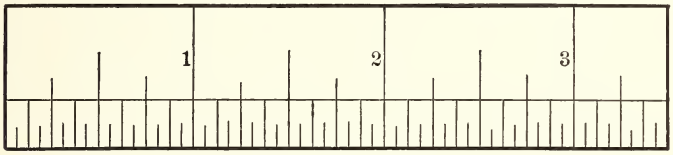
TRIANGLE



COMPASSES

By the *compasses* we can draw a circumference of any radius and from any center. At B we may attach a pencil instead of the steel point. Often a drawing pen is attached.

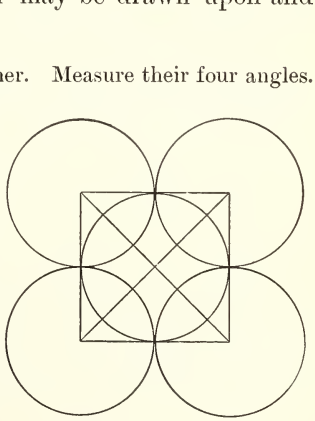
By the *triangle* used with or without a ruler we can draw perpendicular lines readily. The angle BCA in the triangle on the opposite page is a right angle. We may draw angles of 30° and 60° also by using the triangle.



RULER — 3½ INCHES

Protractor, triangle, and ruler may be drawn upon and cut out of cardboard.

1. Draw two lines crossing each other. Measure their four angles. What do you notice about the sizes of the opposite angles? To what is the sum of each pair of adjacent angles equal?

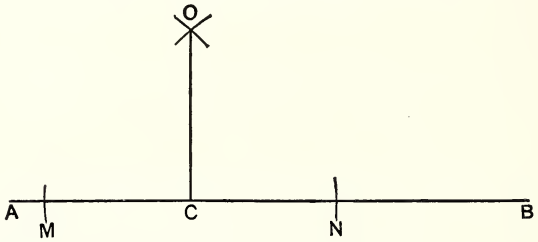


2. Draw a square. Bisect each of its sides. From each corner draw a circumference with a radius of one half the side of the square. Draw diagonals in the square, and from their point of intersection as a center draw a circumference with a radius equal to half the side of the square.

3. Draw with unequal radii two circumferences, just touching each other. Connect the centers of the circles by a straight line. Is the point of contact in that straight line?

To erect a perpendicular at any given point in a straight line.

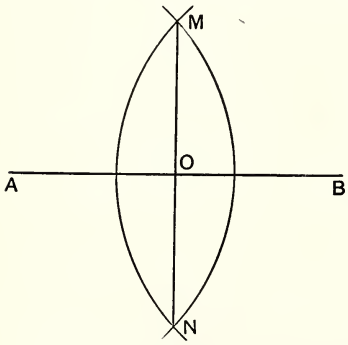
Let AB be the line and C the given point. From C as a center, with equal radii, describe arcs cutting AB at M and N. From M and N as centers, with radii greater



than CM or CN, describe arcs intersecting at O. Draw the line OC. Then OC is perpendicular to AB at point C. Measure the angles ACO and BCO with the protractor.

To draw a line parallel to a given line.

Let AB be the line. Proceed as in 1. Then at any point in OC erect a perpendicular. This perpendicular will be parallel to line AB.



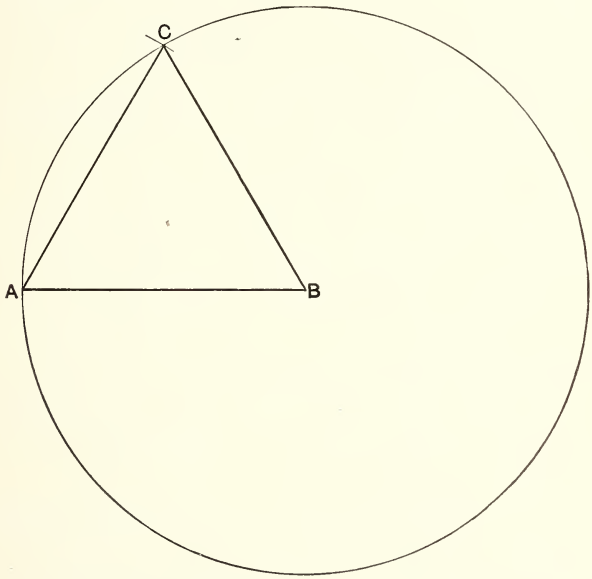
To bisect a straight line.

Let AB be the line. From A and B as centers, with radii greater than one-half AB, describe arcs intersecting at M and N. Draw a straight line connecting MN. The point O in the line MN is equally distant from A and B, and divides AB into two equal parts.

1. Draw any line. Divide it into halves, quarters, eighths, and sixteenths.

2. Draw any triangle. Bisect each of its sides. Connect the bisecting points by straight lines. What new figure is inscribed in the first figure?

To construct an equilateral triangle.



An *equilateral triangle* has three equal sides.

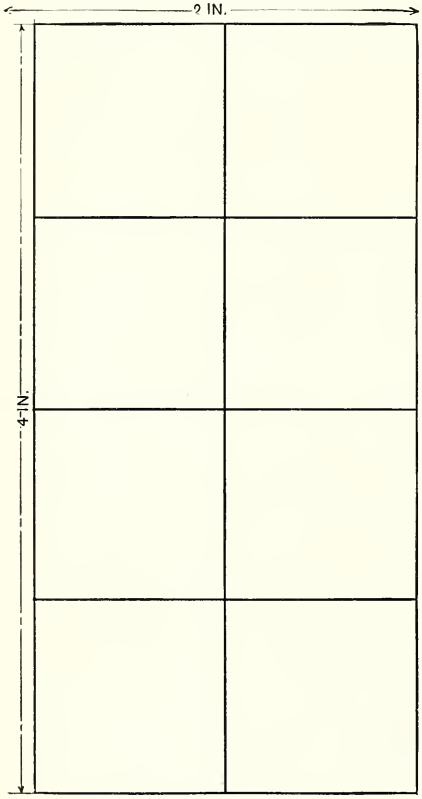
Let AB be any given side of the triangle.

From B as a center, with a radius equal to AB, describe a circle. From A as a center, with a radius equal to AB, describe an arc cutting the circle at C. Draw AC and BC. The triangle ABC is equilateral.

By drawing six equilateral triangles within a circumference a hexagon is formed. Upon AB and CB as given sides, draw other equilateral triangles. Then draw three more within the circle.

SQUARE MEASURE

Square measure is used in computing areas or surfaces, as of land, boards, painting, plastering, paving, carpeting.



RECTANGLE — 2 IN. × 4 IN.

Measure to the nearest inch and express in figures the dimensions of:

A page of this book.

A page of your copy-book.

The top of your desk.

The blackboard.

The floor of the room.

The *perimeter* of any surface figure is the sum or total length of the lines which bound the figure.

1. Draw a rectangle whose length is 4 in. and whose width is 2 in. Mark off the sides into inch lengths and connect opposite points by straight lines.

2. Draw on the blackboard a rectangle 16 in. by 9 in. Divide it into 144 sq. in.

3. Draw to scale a rectangle 20 ft. by 15 ft. 9 in.

In a strip of squares whose length is the length of the rectangle and whose width is 1 in. there are 4 sq. in. In 2 such strips there are 4×2 sq. in. $= 8$ sq. in. $=$ area. But the number of squares in one strip is equal to the number of inches in the length of the rectangle, and the number of strips is equal to the number of inches in the breadth of the rectangle. Therefore, **the number of square units in the area of any rectangle is equal to the product of the numbers expressing the length and breadth in the linear units corresponding to the square units.**

TABLE

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 or 1 section = 1 square mile (sq. mi.)

						sq. ft.		sq. in.	
				sq. yd.		1	=	144	
		sq. rd.		1	=	9	=	1296	Prove
		1	=	$30\frac{1}{4}$	=	$272\frac{1}{4}$	=	39204	these
	A.	40	=	1210	=	10890	=	1568160	items.
sq. mi.	1	160	=	4840	=	43560	=	6272640	
1	640	102400	=	3097600	=	27878400	=	4014489600	

1. What are the dimensions in inches of a square foot?
2. How many square inches are there in a square foot?
3. What are the dimensions in inches of a square yard?
4. How many square inches are there in a square yard?
5. How many square yards are there in a square mile?
6. What are the dimensions in inches of 10 ft. square? How many square inches are there in 10 ft. square? How many square inches are there in 10 sq. ft.?

Surfaces

I. Find the surface of a floor 17 ft. 8 in. long by 3 yd. wide.

17 ft. 8 in. $= 17\frac{2}{3}$ ft. 3 yd. $= 9$ ft.

$17\frac{2}{3}$ sq. ft. $\times 9 = 159$ sq. ft. $= 17\frac{2}{3}$ sq. yd.

Find the surface measure of floors:

1. 37 ft. 2 in. $\times$ 2 ft. 9 in.
2. 23 ft. $\times$ 3 ft. 5 in.
3. 3 yd. 2 in. $\times$ 3 ft.
4. 1 yd. 2 ft. $\times$ 1 yd. 1 in.
5. 15 ft. 7 in. $\times$ 11 ft. 11 in.
6. 22 ft. 5 in. $\times$ 3 yd.

7. What is the area of a court 10 yd. 2 ft. long and 5 yd. 1 ft. broad?

8. How many square yards of plastering will it take for a ceiling 26 ft. by 32 ft.?

9. What is the surface of a marble slab whose length is 5 ft. 7 in. and breadth 1 ft. 10 in.?

10. Find the area of a square building lot whose side is 46 ft. 8 in.

11. How many square yards of paper are required for a room 17 ft. long, 12 ft. 7 in. wide, and 8 ft. 5 in. high?

12. How many square yards of paper are required for the walls of a room:

a. $14' \times 15'6'' \times 10'$?
b. $9' \times 12'' \times 9'4''$?
c. $20' \times 22'3'' \times 12'8'$?
d. $40' \times 55' \times 16'9''$?

13. How many square yards are required for the ceiling of each of the rooms in the problem above?

14. How many square yards of plastering are required for a room $13' \times 17'.8'' \times 24'$?

II. What lengths of wall paper, 2 ft. wide, are required for a room 14 ft. square and 10 ft. 4 in. high?

56 ft. = length of 4 sides

56 ft. ÷ 2 ft. = 28 strips

10 ft. 4 in. = $10\frac{1}{3}$ ft.

$10\frac{1}{3}$ ft. × 28 = $289\frac{1}{3}$ ft. = 96 yd. 1 ft. 4 in.

1. What length of wall paper 18 in. wide is required for a room:

a. 15 ft. × 16 ft.? *b.* 9 ft. × 13 ft.?

c. 20′ × 22′ 3″ × 12′ 18″? *d.* 40′ × 55′ × 16′ 9″?

2. What length of wall paper 18 in. wide is required for the ceiling of each of the rooms in the problem above?

3. What number of rolls of wall paper 18 in. wide, 24 ft. long, is required for these rooms, both walls and ceilings:

a. 15′ × 16′ × 10′? *b.* 9′ 6″ × 14″ × 10′ 3″?

c. 12′ × 14′ × 10′ 6″? *d.* 12′ 4″ × 19′ × 13″?

Since the product of the numbers expressing the length and the breadth equals the area of any rectangular surface, it follows that, by dividing the number expressing the area by the number expressing the length, we get the number expressing the breadth, or, dividing it by the breadth, we get the length. Care must be taken to have divisor and dividend expressed in units of corresponding denominations. We must divide a number of square feet not by a number of inches in length but by a number of feet in length.

When the number of square units in the area of a rectangle is divided by the number of the corresponding linear units in one side, the quotient is the number of linear units in the other side.

1. How many square yards are there in 46 A. 132 sq. rd.?

$$(46 \times 160 + 132) \times 30\tfrac{1}{4} = 226{,}633 \text{ sq. yd.}$$

2. If one side of the above plot is 4657 yd. long, and the plot forms a rectangle, what is the length of the other side?

$$226.663 \div 4657 = ?$$

Reduce to square feet:

3. *a.* 1728 sq. rd. 23 sq. yd. 5 sq. ft. *b.* 18 A. 16 sq. yd.

4. Reduce 832,590 sq. rd. to square inches.

5. Find the cost of 3 A. 150 sq. rd. at $\$1\frac{1}{4}$ per sq. yd.

6. What is the value of 365 A. 137 sq. rd. at \$1.75 per square rod?

7. In a tract of land 12 mi. square, how many acres?

8. I bought 48 A. 134 sq. rd. of land for \$2.25 a square rod, and sold the land for \$3.15 a square rod. How much did I gain?

Reduce to square rods:

9. *a.* 3 sq. mi. *b.* 1,118,448 sq. in.

10. In 56 sq. ft. are how many square yards?

11. Reduce 37,444,325 sq. in. to higher denominations.

12. What will 28 sq. rd. 129 sq. ft. of land cost at \$12 a square foot?

13. Reduce 262,683 sq. ft. to higher denominations.

14. How many yards of carpet 1 yd. wide will be needed to carpet a room 27 ft. long and 16 ft. wide?

15. A lot is 80 rods square. How much will it cost at $45.50 an acre?

16. A garden was $7\frac{1}{2}$ rd. long and 6 rd. wide. What part of an A. did it contain?

17. How many sq. mi. are there in 1,003,622,400 sq. ft.?

18. How many square rods are there in a tract of land 10 miles square?

19. How many sq. mi. are there in 10,240,000 sq. rd.?

20. How many square feet are there in a piece of land 8 rods long and 5 rods wide?

21. A rectangular farm containing 180 A. is 80 rd. wide. How long is it?

22. A screen door requires a piece of wire netting $4\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. How much is the netting worth at 12 ¢ per sq. ft.?

23. How many sq. ft. are there in a rectangular mirror 30 in. by 6 ft.?

24. A farm is 40 rd. square. How many acres does it contain?

25. Work an original problem showing which is greater, the perimeter of a square or that of a rectangle of equal area but twice as long as the square.

26. Mr. Brown's cornfield had an area of $\frac{3}{4}$ A. If he allowed 9 sq. ft. for each hill of corn, how many hills were there in the field?

The hills were three feet apart each way.

27. One side of a rectangular plot, with an area of 1150 A., was 15,560 ft. long. What was the length of the other side? Reduce both dimensions to fractions of a mile.

MEASURES OF EXTENSION

Extension or **space** has three dimensions: *length*, *breadth*, and *thickness*.

A **line** has one dimension only, *length*.

A **surface** has two dimensions, *length* and *breadth*.

A **solid** has three dimensions, *length*, *breadth*, and *thickness*.

CUBIC MEASURE

TABLE

1728	cubic inches (cu. in.)	= 1 cubic foot	(cu. ft.)
27	cubic feet	= 1 cubic yard	(cu. yd.)
16	cubic feet	= 1 cord foot	(cd. ft.)
8 cord feet, or 128	cubic feet . . .	= 1 cord of wood	(cd.)
$24\frac{3}{4}$	cubic feet	= 1 perch of stone or masonry	(pch.)

Work out the scale as on pages 25 and 45.

A **solid** is a magnitude having length, breadth, and thickness.

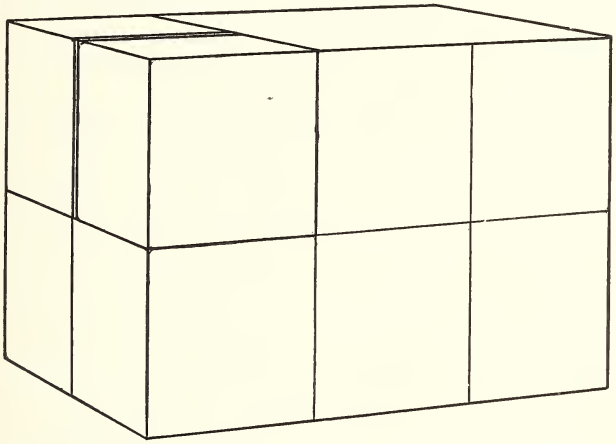
A **cube** is a rectangular solid, whose length, breadth, and height are equal. It may also be defined as a solid which is bounded by six equal squares.

A cube 1 foot long, 1 foot wide, and 1 foot high is a cubic foot. A cube 1 yard long, 1 yard wide, and 1 yard high is a cubic yard. A cubic unit, then, is any solid equivalent to a cube 1 unit long, 1 unit wide, and 1 unit high.

The contents of solids are measured by cubic measure; that is, by finding the number of cubes of a given size which the solids contain, or to which they are equivalent. A solid, or body, may have the three dimensions all different. A body 6 ft. long, 4 ft. wide, and 5 ft. thick contains 6 cu. ft. $\times 4 \times 5 = 120$ cubic or solid feet.

A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high contains 1 **cord**; and a cord foot is 1 ft. in length of such a pile.

A **perch** of stone or of masonry is $16\frac{1}{2}$ ft. long, $1\frac{1}{2}$ ft. wide, and 1 ft. high.



The solid represented is 2 in. high, 2 in. wide, and 3 in. long. It is divided into cubes which are each one cubic inch. In one row of cubes there are 3 cu. in. In one layer of cubes there are two rows or 6 cu. in. In the solid there are 2 layers of cubes or 6 cu. in. $\times$ 2 = 12 cu. in. in the solid.

$$3 \text{ cu. in.} \times 2 \times 2 = 12 \text{ cu. in.}$$

The number of cubic units in any rectangular solid is equal to the product of the numbers expressing the dimensions in the corresponding linear units all of the same denomination.

1. How many cubic inches are there in 1 cu. ft.? in 3 cu. ft.? in 25 cu. ft.?

2. In 1 cubic yard how many cubic feet?

3. How many cord feet are there in 3 cd. of wood? in 6 cd.? in 200 cd.?

4. How many cubic feet are there in 2 cd.? In half a cord how many? How many in a quarter of a cord?

5. How many cubic yards are there in 54 cubic feet?

6. How many cords of wood are there in 64 cd. ft.? in 96? in 128?

7. How many cubic feet are there in a stone 8 ft. long, 3 ft. wide, and 2 ft. thick?

8. In 17 cd. of wood, there are how many cubic feet?

9. In 1000 cd. ft. of wood are how many cords?

10. In 19 cu. ft. are how many cubic inches?

11. How many cords of wood can be piled in a shed 40 ft. long, 22 ft. wide, and 10 ft. high?

12. How many cubic feet are there in a pile of wood 15 ft. long, 4 ft. wide, and $6\frac{1}{2}$ ft. high? How many cords?

13. How many cubic inches are there in a block of marble 4 ft. long, $3\frac{1}{4}$ ft. wide, and 2 ft. thick?

14. A room 14 ft. long, 12 ft. wide, and 8 ft. high, contains how many cubic feet of air?

15. How many cubic feet are there in a block of granite 65 in. long, 42 in. wide, and 36 in. thick?

16. How many cubic feet are there in a load of wood 8 ft. long, $4\frac{1}{2}$ ft. high, and $3\frac{1}{2}$ ft. wide?

17. How many cords of wood are there in a pile 46 ft. long, 16 ft. high, and 15 ft. wide?

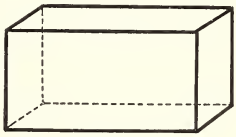
18. How many cubic feet are there in a vat 12 ft. long, $8\frac{1}{2}$ ft. wide, and $7\frac{1}{3}$ ft. deep?

19. How many cubic feet are there in a bin 12 ft. long, 9 ft. deep, and 7 ft. wide?

20. How many cubic yards are there in an excavation 18 ft. long, 12 ft. wide, and 9 ft. deep?

21. How many cubic feet are there in a stick of timber 2 ft. sq., and 40 ft. long?

22. How many cubic feet are there in a silo 15 ft. long, 12 ft. wide, and 10 ft. deep?



SCALE 1:4

23. Draw a rectangular prism of the full size indicated by the scale.

24. Draw a rectangular prism of any form to any scale containing 24 sq. in.

MARKING GOODS

In some retail and in most wholesale stores the selling price is marked on the goods with letters, not figures. Cost prices are always marked with letters. A word of 9 letters, no one repeated, is taken; *e.g. marveling*, and each letter has the value of its place in the word.

1 2 3 4 5 6 7 8 9

0 is represented by any letter not in the regular word.

$2.45 *ave* $10.90 *mxgz* $4.00 *vfh*

1. Write: 25¢; $1.30; $2.75; $100: $13.67.

2. Read: *alh*; *mrjy*; *enbb*; *vri*.

3. Write: 95¢; $8.50; $7.67; 18¢; $6.33.

"Bargain" prices are always in figures; and in retail business the use of letters for figures is going out of fashion.

MAKING PRICES

A firm that always marked its goods for retail sale at 20¢ above wholesale cost bought silk at $1.75 per yard, worsted cloths at 75¢ per yard, and carpets at $1.10 per yard. What was the retail price in each case?

LIQUID MEASURE

The standard unit of liquid measure is the gallon, which contains 231 cu. in.

TABLE

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)

In measuring the capacity of cisterns, reservoirs, tanks, etc., $31\frac{1}{2}$ gal. make a barrel (bbl.) and 63 gal. a hogshead (hhd.); but in commerce the barrel and the hogshead vary in capacity. A gallon of water weighs $8\frac{1}{3}$ lb.

1. In 3 pints there are how many gills? in 9 pints?
2. In 4 quarts there are how many pints? in 6 quarts?
3. In 5 gallons there are how many quarts?
4. How many gallons are there in 12 quarts?
5. How many pints are there in 2 gallons?
6. How many barrels are there in 1 hogshead? How many are there in 4 hogsheads?
7. How many quarts are there in 3 gallons? in 5 gallons? in 20? in a barrel? in a hogshead?
8. What will be the cost of 3 hogsheads, 1 barrel, 8 gallons, and 2 quarts of molasses, at 10¢ a quart?
9. Reduce 27 gal. 3 qt. 1 pt. 3 gi. to gills.
10. Find the weight of a barrel of water.
11. Reduce 895 pt. to gallons.
12. Reduce 292 gi. to gallons.
13. A grocer bought 5 barrels of mineral water at $4 a barrel, and sold it at 5¢ a quart. How much did he gain?
14. At 6¢ a quart, how much milk can be bought for $3.84?
15. How many quart, pint, or half-pint bottles can be filled out of a cask containing 44 gal. 2 qt. 1 pt.?

DRY MEASURE

TABLE

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)

The standard unit of dry measure is the bushel, which is $18\frac{1}{2}$ in. in diameter and 8 in. deep; it contains 2,150.42 cu. in.

The liquid quart contains $57\frac{3}{4}$ cu. in. and the dry quart $67\frac{1}{5}$ cu. in.

1. How many quarts are there in 2 pecks? in 5?

2. How many pecks are there in 24 quarts? in 64?

3. How many pecks in 6 bushels? in 8? in 12?

4. Compare the number of cubic inches in 2688 liquid quarts and 2310 dry quarts.

5. In 372 bushels are how many cubic inches?

6. In 17,408 pints are how many bushels?

7. Reduce 56 bu. 2 pk. 3 qt. to quarts.

8. Reduce 8256 pt. to bushels.

9. Reduce 1597 qt. to cubic inches.

10. If a bushel of potatoes is bought for 80¢, and sold at 14¢ a half-peck, what is the profit on the bushel?

11. Reduce:

a. 25 bu. 3 pk. 7 qt. 1 pt. to pints. *b.* 2 pk. 1 pt. to pints.

c. 7 bu. 4 qt. to pints. *d.* 12 bu. to quarts.

12. Change:

a. 1663 pt. to bushels. *b.* 33 pt. to pecks.

c. 456 pt. to bushels. *d.* 384 qt. to bushels.

AVOIRDUPOIS WEIGHT

TABLE

16 ounces (oz.)	= 1 pound	(lb.)
100 pounds	= 1 hundred weight	(cwt.)
20 hundred weight, or 2000 pounds	= 1 ton	(T.)

	lb.	oz.
	cwt. 1 =	16
T. 1 =	100 =	1600
1 = 20 =	2000 =	32000

Prove these items.

The long or gross ton, the hundred weight, and the quarter, formerly in common use, are now used only in the United States custom-houses, and in weighing coal and iron at the mines.

28 pounds	= 1 quarter	(qr.)
4 quarters = 112 lb . . .	= 1 hundred weight	(cwt.)
20 hundred weight = 2240 lb.	= 1 ton	(T.)

TABLE OF MISCELLANEOUS WEIGHTS

56 pounds of butter	= 1 firkin
100 pounds of nails	= 1 keg
196 pounds of flour	= 1 barrel
200 pounds of pork	= 1 barrel
280 pounds of salt	= 1 barrel

1. How much will 48 T. 17 cwt. of zinc cost at 8¢ a pound?
2. How many ounces in 10 lb.? in 12 lb.? in 100 lb.?
3. How many tons are in 80 cwt.? in 600 cwt.?
4. In 4 lb., how many ounces? in 3 how many? in 2?
5. In 60 hundred weight, how many tons? in 80?
6. Reduce 5 cwt. 21 lb. 4 oz. to ounces.
7. How many tons are there in 60,000 lb. of copper?
8. Reduce 602,000 oz. to tons.

9. What is the cost of $23\frac{3}{4}$ cwt. of pork, at 12¢ a pound?

10. How many tons and hundred weight are there in 13 bales of cotton, each bale weighing 550 lb.?

11. A dealer bought 370 long tons of coal, and sold 370 ordinary tons. How much was the coal he had left worth at 25¢ per cwt.?

12. Bought 7 T. 18 cwt. of iron. What did it cost, at 2¢ a pound?

13. Reduce 47,520 lb. to tons.

14. Reduce 8000 T. to pounds.

15. Reduce 3 T. 17 cwt. 16 lb. to ounces.

16. Reduce 14 T. 5 cwt. 98 lb. to pounds.

17. Reduce 196 T. 21 lb. to ounces.

18. Reduce 28,598 lb. to tons.

19. Reduce 6,272,336 oz. to tons.

20. How much was a consignment of 25 firkins of butter worth @ 18¢ per pound?

21. What is the cost of 150 kegs of nails @ $4\frac{1}{2}$¢ per lb.?

22. What is the price a $\frac{1}{2}$ bbl. of pork @ 9¢ per lb.?

23. What is the difference in weight between 20 bbl. of flour and 10 bbl. of salt?

24. Which is the cheaper price for coal, — $5.50 per T. or 35¢ per cwt.? Find the cost of 1000 lb. at each price.

25. A wagon loaded with hay weighed 4285 lb. Tare weighed 1368 lbs. What was the value of the hay at $20 per T.?

Tare is weight of wagon, box, or barrel holding merchandise.

ORAL REVIEW

1. A grocer buys oil for 10¢ per gal. and sells it for 3¢ per qt. What is his gain on a bbl. of 40 gal.?

2. Find the number of cu. in. in a box 6 in. by 7 in. by 10 in.

3. How many cubic feet are there in a rectangular solid 4 ft. sq. and 30 in. deep?

4. How many qt. bottles can be filled from a bbl. of molasses holding 32 gal.?

5. When a horse eats 16 qt. of grain per day, how long will 15 bu. last him?

6. When a coal carrier can carry 150 lb. in his basket, how many trips will he have to make to empty a wagon load of coal weighing $1\frac{1}{2}$ T.?

7. Dewey entered Manila Bay, May 1, 1898. How many years, months, and days have elapsed since then?

8. How many cubic feet are there in a beam 40 ft. long and 18 in. square?

9. How many rods in length is a 3-acre field whose width is 16 rd.?

10. Find the cost of fencing a base ball ground 30 rd. long by 20 rd. wide, at $\$.62\frac{1}{2}$ per rod.

11. A hay dealer bought hay at $13 per T. and retailed it at 80¢ per cwt. What was his gain per ton?

12. When gold is worth $21 per oz., how many ounces will pay for 15 horses at $105 each?

13. How many sq. in. are there in the surface of a rectangular solid 2 in. by 3 in. by 4 in.?

14. $\frac{7}{10}$ of an inch is what fractional part of a foot?

15. Reduce to in. $\frac{3}{4}$ yd.; $\frac{1}{4}$ yd.; $\frac{1}{8}$ yd.

16. How many cubic ft. of space are there in a cellar 12 ft. square and 10 ft. deep?

17. A boy went fishing and threw back $\frac{2}{7}$ as many fish as he saved. If he saved 35 fish, how many did he catch in all?

18. A cabbage patch is 40 ft. square. If the cabbages are 2 ft. apart each way, how many cabbages can be grown on the patch?

19. What would the crop be worth at 3¢ per head?

20. What number multiplied by 8 and increased by 10 equals 106?

21. What number divided by 16 and diminished by 6 equals 4?

22. Corn meal at $25 per T. is how much per cwt.?

23. How much will 2 bu. 3 pk. of wheat weigh if the weight of 1 bu. is 60 lb.?

24. What is the ratio of a square whose side is $\frac{1}{2}$ in. to one whose side is 3 in.?

25. What is the difference between 9 ft. square and 9 sq. ft.?

26. A rectangle containing 20 sq. ft. is 30 in. wide. What is its length?

27. How many cu. ft. are there in a half cord of wood?

28. What part of a cu. in. does a rectangular solid contain that is $\frac{1}{2}$ in. square and $1\frac{1}{2}$ in. long?

29. A train going a mile in 90 sec. will go how many miles in $\frac{1}{2}$ hr.?

30. How many gi. in 2 qt. 1 pt. 3 gi.?

31. Find the area of rectangles with the following dimensions: —

Length,	3 ft.	Width,	16 in.
"	6 ft.	"	28 in.
"	10 ft.	"	30 in.
"	14 ft.	"	18 in.
"	16 ft.	"	$2\frac{1}{4}$ ft.

32. What is the circumference of a wheel whose radius is 14 in.? whose diameter is 21 in.?

33. Mr. Watson bought 9 lb. of nails at 4¢ per lb. and two small pulleys at 6¢ each. How much change should he receive from a $1 bill?

34. Four sacks are equal to a bbl. of flour. What is the cost per sack when flour is selling at $5.00 per bbl.?

35. What number has the same ratio to 108 that 6 has to 24?

36. $\frac{1}{4}$ of what number is equal to $\frac{1}{5}$ of 80?

37. $\frac{3}{7}$ is equal to how many 84ths?

38. What is the cost of 2250 cu. ft. of gas at $1.10 per M., less a discount of 10¢ per M. for cash?

39. Add:

a.	*b.*	*c.*	*d.*
$39.17	$58.63	$37.69	$84.26
82.49	17.27	58.32	16.78

40. Subtract in each of the above cases.

41. Multiply 19, 28, 37, 46 by 2, 3, 4, 5, 6, 7, 8, 9.

42. Divide in each of the above cases.

WRITTEN REVIEW

1. How much coal can be bought for $142.375, when a ton costs $3.35?

2. If 2.5 acres produce 34.75 bushels of wheat, how much is the yield per acre?

3. If 1.7 of a yard of cloth will make a jacket, how many jackets will 10.2 yards make?

4. If a man earns $3.75 in one day, how many days will it take him to earn $200?

5. If a train travels 35.4 miles an hour, how many hours will it take to travel 244.26 miles?

6. A grocer has 187.5 pounds of lard, which he wishes to put into pails containing 12.5 pounds each. How many pails will he need?

7. Divide:

756.4 by 100. 1268.2 by 1000. 5 by .000001.

8. Reduce to decimals:

$\frac{3}{7}$ $\frac{15}{17}$ $\frac{3}{35}$ $\frac{1}{4}$ $\frac{4}{5}$ $\frac{4}{25}$

$\frac{12}{480}$ $\frac{29}{39}$ $\frac{1}{2}$ $\frac{8}{6}$ $\frac{8}{49}$ $\frac{15}{16}$

$\frac{17}{20}$ $\frac{3}{40}$ $\frac{17}{125}$ $\frac{7}{125}$ $\frac{9}{400}$ $\frac{1}{256}$

9. Find $\frac{7}{9}$ of 1206. 10. Find $\frac{3}{16}$ of 21,600.

11. From four million seventy thousand ninety take six hundred eighty thousand seven hundred four.

12. From twenty-seven million forty-three thousand six take twenty million seven hundred thousand eighty.

13. Divide:

841267 by 90. 46700137 by 30. 45678 by 500.
4725111 by 1000. 4632195 by 100. 147000 by 8000.

14. How many dozen cans of condensed milk, each can containing $1\frac{3}{4}$ pints, can be filled from 63 gallons?

15. During the twelve months of 1898 the United States exported breadstuffs valued as follows:

In January	$25642434
In February	22633253
In March	25249717
In April	28148811
In May	38882373
In June	29649222
In July	17296631
In August	20673029
In September	23410536
In October	25434402
In November	28014323
In December	32845015

What was the total value?

16. If a cask of syrup containing 75 gallons costs $\$67\frac{1}{2}$, what is the cost of 1 gallon?

17. When a dozen spoons cost $\$4\frac{1}{2}$, what is the cost of 1 spoon?

18. Divide by 3, 4, 5, 6, 7, 8, 9, 10, 11, 12: 70609; 908764; 750018.

19. It takes, on an average, $10\frac{3}{4}$ lbs. of milk to make 1 lb. of cheese. What is the season's output of a factory receiving 2073288 lbs. of milk?

20. 931,324 pounds of cheese were made in a cheese factory in 1 year. What was the value of the cheese at $12\not{¢}$ a pound?

21. How many cubic yards are there in a rectangular embankment 198 ft. $\times$ 12 ft. $\times$ 10 ft.?

22. The circumference of the forward wheels of a wagon is 15.5 feet each; the circumference of the hind wheels is 16.8 feet each. How many more times will the forward wheels revolve than the rear wheels in traveling $4\frac{1}{1}\frac{2}{3}\frac{3}{2}$ miles.

23. How much water is contained in 96 hhd., each containing 62 gal. 1 qt. 1 pt. 1 gi.?

24. Since the earth revolves through 15′ of space in a minute of time, how far does it revolve in $\frac{1}{8}$ of a day?

25. The combined ages of A, B, and C are 14 times 2 yr. 5 mo. 3 wk. 6 da. What is the sum of their ages?

26. When a vessel sails 211 mi. 192 rd. a day on the average, how far does she sail in 15 da.?

27. How much molasses is contained in 25 hhd., each hogshead containing 61 gal. 1 qt. 1 pt.?

28. What is the weight of 653 cu. ft. of water, when 1 cu. ft. weighs 62 lb. 8 oz.?

29. Sound travels at the rate of 1142 ft. per second. How far does it travel in 43 seconds?

30. If each of 11 bags of corn contain 2 bu. 1 pk. 3 qt., how much corn in all the bags?

31. In 7 loads of wood, each load containing 1 cord and 2 cord feet, how many cords?

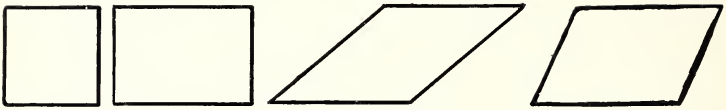
32. Find the products:

141884×45098.	102548×45672.
861070×79369.	443520×82799.

33. Reduce to the least common denominator:

$\frac{2}{5}$ and $\frac{3}{7}$.	$\frac{3}{11}$ and $\frac{5}{7}$.	$\frac{3}{8}$, $\frac{1}{3}$, and $\frac{2}{5}$.
$\frac{3}{4}$ and $\frac{2}{3}$.	$\frac{1}{2}\frac{2}{1}$ and $\frac{1}{3}\frac{5}{5}$.	$\frac{3}{5}$, $\frac{4}{7}$, and $\frac{2}{3}\frac{0}{5}$.
$\frac{5}{7}$ and $\frac{3}{4}$.	$\frac{8}{27}$ and $\frac{5}{18}$.	$\frac{3}{9}$, $\frac{5}{8}$, and $\frac{2}{3}$.

PARALLELOGRAMS



SQUARE RECTANGLE RHOMBUS RHOMBOID

A *quadrilateral* is a plane figure with four straight sides.

A *parallelogram* is a quadrilateral with parallel sides. The opposite sides and angles of all parallelograms are equal.

A *rhomboid* is any parallelogram whose adjacent sides are unequal and whose angles are oblique.

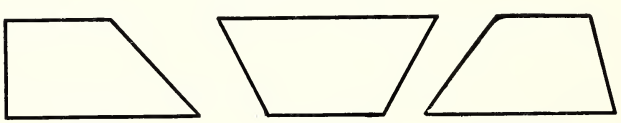
A *rhombus* is a parallelogram with all sides equal and with four oblique angles.

A *rectangle* is a parallelogram with all angles right angles.

A *square* is a rectangle with all sides equal.

Any parallelogram, not a rectangle, has two obtuse and two acute angles.

TRAPEZOIDS



RIGHT ISOSCELES IRREGULAR

A *trapezoid* is a quadrilateral with only two parallel sides.

A *right trapezoid* has one right angle.

An *isosceles trapezoid* has its sides not parallel equal. It always has two adjacent equal obtuse and two adjacent equal acute angles.

An *irregular* or simple *trapezoid* has only two parallel sides, and all of its angles and sides may differ in size from each other.

TRAPEZIUMS

A *trapezium* is a quadrilateral without parallel sides.

A *right trapezium* has one right angle.

RIGHT TRAPEZIUM — TRAPEZIUM

EXERCISES

Every quadrilateral may be divided by a diagonal into two triangles. Draw quadrilaterals and divide each by a diagonal.

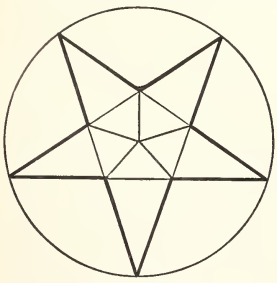
Every parallelogram is divided by its diagonal into two equal triangles. Draw parallelograms on paper and cut them into two equal parts along the diagonals.

1. Find the area of a farm in the shape of a trapezoid, the parallel sides of which are 60 rd. and 80 rd. respectively, and the distance between whose parallel sides is 48 rd.

2. A farm in the form of a trapezoid contains 120 A. The parallel sides are 80 rd. and 48 rd. respectively. Find the perpendicular distance between the parallel sides.

STARS

The beauty of geometric designs is chiefly in their symmetry. By *symmetry* we mean that corresponding parts measure and appear like each other.

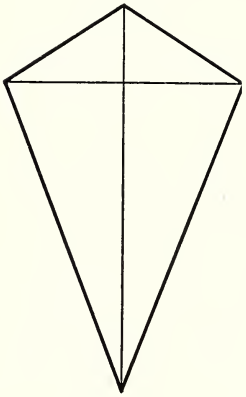


A STAR

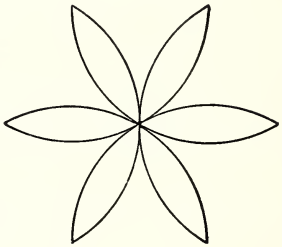
A star has five parts, all alike. Draw a circumference, and with the protractor divide its 360° into five equal arcs. Connect every pair of alternate ends of the arcs with each other. Connect the center of the circle with

the five points where these connecting lines intersect. Many various star figures may be developed from this simple outline. With the protractor measure the different angles in the figure of a star.

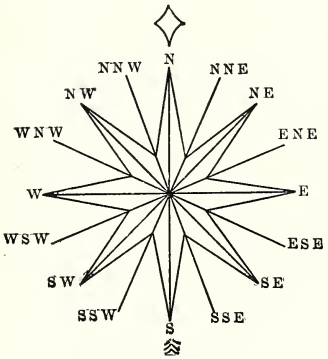
FAMILIAR GEOMETRIC DESIGNS



A Kite



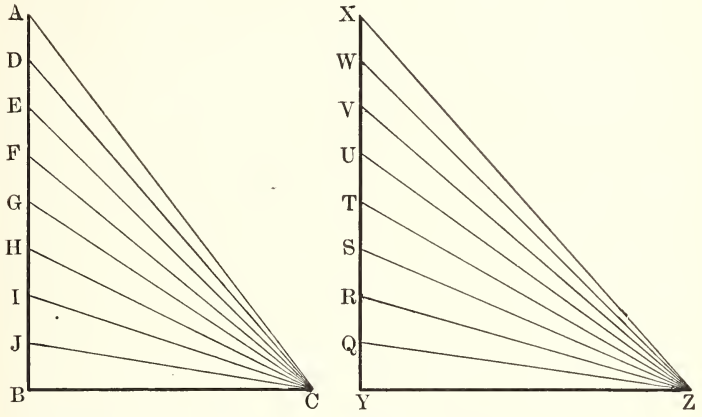
A Flower with Six Rays



The Compass

In "boxing the compass" there are thirty-two points: NORTH, north-by-east, north-northeast, northeast-by-north, NORTHEAST, northeast-by-east, east-northeast, east-by-north, EAST, east-by-south, east-southeast, southeast-by-east, SOUTHEAST, south-east-by-south, south-southeast, south-by-east, SOUTH, south-by-west, south-southwest, southwest-by-south, SOUTHWEST, southwest-by-west, west-southwest, west-by-south, WEST, west-by-north, west-northwest, north-west-by-west, NORTHWEST, north-west-by-north, north-northwest, north-by-west.

TRIANGLES



Scale $\frac{1}{4}$ inch = 1 foot. A **scale** is a ratio.

1. By this scale find the length in inches of: *AC; DC; EC; FC; GC; HC; IC; JC;* and *BC.*

2. Draw on the blackboard full sized triangles, *ABC*, *DBC*, etc.

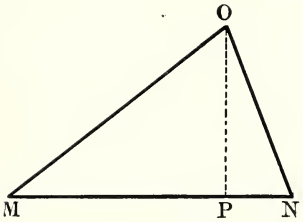
3. Without drawing the squares of each side of each of these triangles, find arithmetically the area of the square of each hypotenuse: *AC*, *DC*, etc.

4. Repeat the operations in 1, 2, and 3, for the triangles *XYZ*, *WYZ*, etc.

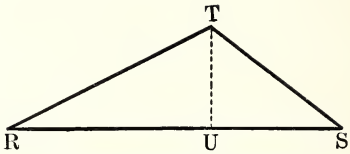
5. In each of these triangles respectively, what letter always marks the vertex of the right angle?

6. Name the base, the perpendicular, and the hypotenuse, in each of these different triangles.

7. Draw other right-angled triangles with bases shorter and longer than these.



ACUTE-ANGLED TRIANGLE



OBTUSE-ANGLED TRIANGLE

1. If *OP* is perpendicular to *MN*, what kind of an angle is: *OPM*; *OPN*?

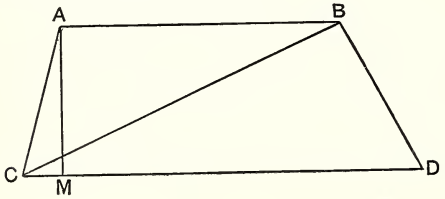
2. Find two right-angled triangles in: *OMN*; *TRS*.

3. Name the hypotenuse in: *OMP*; *OPN*; *TRU*; *TUS*.

To find the areas of triangles and trapezoids.

Since the diagonal of a parallelogram divides it into two equal triangles, and the area of a parallelogram is equal to the product of the numbers expressing the base and altitude, **the area of a triangle is one-half the product of the numbers expressing the base and altitude.** Prove this by cutting two equal triangles and placing them so as to form a parallelogram.

1. Find the area of a triangle whose base is 16 ft. and whose altitude is 10 ft.



2. The diagonal *CB* divides the trapezoid *CABD* into two triangles having the same altitude, *AM*. The area of the

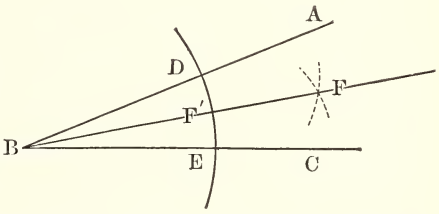
triangle $CAB = \frac{AB \times AM}{2}$ and the area of the triangle $CBD = \frac{CD \times AM}{2}$ and the area of both $= \frac{(AB + CD) \times AM}{2}$.

Therefore, **the area of any trapezoid is equal to one-half the product of the numbers expressing its altitude and the sum of its parallel sides.**

To bisect an angle.

Bisecting the arc that measures an angle bisects the angle.

Open the compasses, and from the vertex of the angle ABC as a center describe an arc DE, cutting both sides of the angle. DE measures the angle ABC. From D, the point where the side AB is cut by the arc DE, describe any arc within the angle ABC with a radius more than half of DE. From E describe an arc of the same radius to intersect the arc from D. The point of intersection, F, is equally distant from D and E. F might be upon the arc DE. Connect F and B, the vertex of the angle. The line BF bisects the angle ABC because it cuts the arc DE into two equal arcs, DF' and EF', which measure equal angles, ABF and CBF.



Exercises

1. Draw an obtuse angle, and divide it into halves, quarters, eighths, and sixteenths. Do you see that the larger the arc is the larger is its angle?

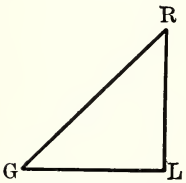
2. Draw on the blackboard a rectangle 15 in. by 24 in. and bisect each of its interior angles.

3. Draw a parallelogram 18 in. by 24 in. with interior angles of 60° and 120°. Bisect each of the angles.

4. Draw an equilateral triangle with 18 in. sides, and bisect each angle.

RIGHT-ANGLED TRIANGLES

A right-angled triangle has one right angle. In a right-angled triangle the side opposite the right angle is called the **hypotenuse.** Here the side GL is the **base,** and the side LR the **perpendicular.**

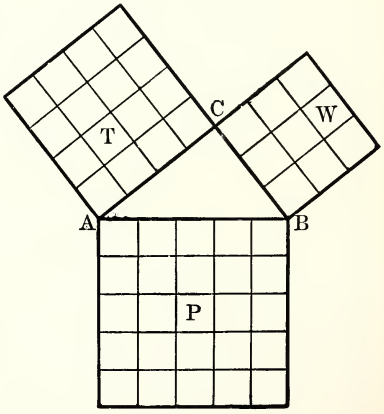


RIGHT-ANGLED TRIANGLE

Find the hypotenuse in the triangle GLR.

In a right-angled triangle the square described on the hypotenuse is equal to the sum of the squares described on the two other sides.

If ABC be a right-angled triangle, right angle at C, then the large square P, described on the hypotenuse AB, will be equal to the sum of the squares T and W, described on the sides AC and CB.



In this triangle the hypotenuse $AB = 5$, $AC = 4$, and $CB = 3$. Any numbers having the same ratios as 5, 4, and 3, such as 15, 12, and 9; 25, 20, 15, will represent the sides of a right-angled triangle.

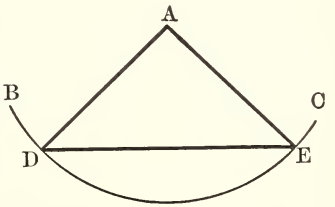
3 linear units squared = 9 sq. units
4 linear units squared = 16 sq. units
Sum = 25 sq. units
5 linear units squared = 25 sq. units

On the blackboard make drawings using larger numbers of linear units than those in this illustration.

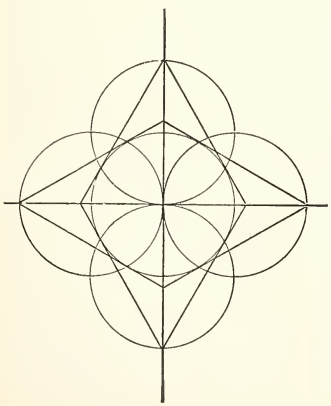
To draw an isosceles triangle.

An *isosceles triangle* has two equal sides.

From any point *A* as a center describe an arc *BC*, with any desired radius. Any two radii, *AD*, *AE*, form the equal sides of the triangle. For the third side connect the points, *D* and *E*, where the radii meet the arc. The line *DE* completes the isosceles triangle *ADE*.



Draw lines crossing at right angles to each other. From the point of intersection mark off upon each line points at equal distances. From these points as centers draw circumferences, using as a radius the equal distance measurement.



Draw another circumference of equal radius from the point of intersection as a center. Draw lines from the points where the circumferences cut the perpendicular lines, passing in contact with the circumference of the circle drawn from the central point where the perpendicular lines intersect each other, and reaching the perpendicular lines.

By emphasis of certain lines such figures as these may develop various appearances. They may also be harmoniously colored in various ways with water colors or colored crayons.

ADDITION OF DENOMINATE NUMBERS

Addition of compound denominate numbers collects into one sum several numbers of the same kind, but containing different denominations of that kind.

Arrange the numbers so that those of the same denomination may be under one another in the same column.

Add the numbers of the lowest denomination together, and find by reduction how many units of the next higher denomination are contained in this sum.

Write the remainder, if any, under the column just added, and carry the quotient to the next column.

Proceed thus with all the columns.

Add:

	yd.	ft.	in.
1.	5	2	10
	8	1	4
	6	0	7
	9	2	5

	gal.	qt.	pt.
2.	27	3	1
	31	2	0
	54	1	1
	37	0	1

	sq. yd.	sq. ft.	sq. in.
3.	20	8	100
	31	7	85
	25	5	34
	37	8	113

	bu.	pk.	qt.	pt.
4.	10	1	1	1
	2	3	6	0
	8	0	0	1
	15	2	4	0

5. Find the sum of 3 cu. yd. 23 cu. ft. 171 cu. in., 17 cu. yd. 17 cu. ft. 31 cu. in., 28 cu. yd. 26 cu. ft. 1000 cu. in., and 34 cu. yd. 23 cu. ft. 1101 cu. in.

6. Add together 39 gal. 3 qt. 1 pt., 48 gal. 2 qt. 1 pt., 56 gal. 1 pt., 74 gal. and 3 qt.

7. Add together $19.28, $27.35, $37.39, $216.16, $152.93, $225.17, and $23.19; also $2795.28, $3878.15,

$737.35, $6797.27, $9689.21, $5293.78, $69256.36, $52768.38, $27812.15.

8. A grocer sold 44 lb. 8 oz. of cheese on Monday, 38 lb. 9 oz. on Tuesday, 64 lb. 11 oz. on Wednesday, 49 lb. 4 oz. on Thursday, 36 lb. 12 oz. on Friday, and 93 lb. on Saturday. What weight of cheese did he sell during the week?

9. Find the total weight of 5 carloads of coal weighing respectively 14 T. 1763 lb., 15 T. 485 lb., 13 T. 1928 lb., 15 T. 1343 lb., and 14 T. 791 lb.

10. What is the entire length of a railway consisting of 5 different lines measuring respectively 167 mi. 1019 yd., 97 mi. 351 yd., 126 mi. 1537 yd., 67 mi. 1094 yd., and 48 mi. 1467 yd.?

11. A merchant sold 47 gal. 3 qt. 1 pt. of kerosene and had 19 gal. 2 qt. 1 pt. left. What quantity had he at first?

12. Find the total quantity of wood in four piles containing respectively 17 cords 98 cu. ft., 49 cords 4 cu. ft., 25 cords 45 cu. ft., and 36 cords 112 cu. ft.

13. A rectangular playground is 38 yd. 2 ft. 6 in. long and 32 yd. 1 ft. 9 in. wide. What is the total distance around it?

14. A schoolroom is 29 ft. 3 in. long by 25 ft. 7 in. wide. Find the total distance around it.

15. The main part of a house was $34' \times 18'6''$ and the ell was $16' \times 12'6''$. Draw an outline of a floor plan with these dimensions to scale $\frac{1}{4}$ in. to foot, and find the distance around it.

16. Three remnants of carpet were $8'\ 3''$, $4\frac{1}{2}$ yd., and 14 yd. 7 in. respectively. What was their total length?

SUBTRACTION OF DENOMINATE NUMBERS

Subtraction of compound denominate numbers finds the difference between two numbers of the same kind, but containing different denominations of that kind.

From 15 rd. 3 yd. 2 ft. 3 in. take 8 rd. 4 yd. 1 ft. 9 in.

rd.	yd.	ft.	in.
15	3	2	3
8	4	1	9
6	$4\frac{1}{2}$	0	6
		1	6
6	4	2	0

We write units of the subtrahend under like units of the minuend, and begin at the lowest denomination to subtract. Since 9 in. cannot be taken from 3 in., we add 1 ft. to the 3 in., making 15 in., and taking 9 in. from 15 in., we write the remainder, 6 in., in the column of inches. Since 1 ft. was taken from 2 ft., only 1 ft. is left in the minuend and 1 ft. from 1 ft. leaves nothing. As 4 yd. cannot be taken from 3 yd., we add 1 rd., or $5\frac{1}{2}$ yd., to the 3 yd., making $8\frac{1}{2}$ yd., and subtracting the 4 yd., we write the remainder, $4\frac{1}{2}$ yd., in the yards column. Since 1 rd. was reduced to yards, there are only 14 rd. left in the minuend. 8 rd. from 14 rd. leaves 6 rd. We reduce the $\frac{1}{2}$ yd. to feet and inches for addition to the feet and inches of the remainder.

Place the lesser compound denominate number below the greater, so that units of the same denomination may be in the same column.

Begin at the right hand, and subtract, if possible, each number of the subtrahend from that number of the minuend which stands above it, and write the remainder underneath.

When the units of any denomination in the minuend are less than the units of corresponding denomination in the subtrahend, take from higher denominations as in subtraction of abstract numbers.

Subtract:

	da.	hr.	min.
1.	147	20	6
	49	16	4

	yr.	wk.	da.
2.	163	42	6
	93	40	2

	gal.	qt.	pt.
3.	729	0	0
	247	1	1

	cu. yd.	cu. ft.	cu. in.
4.	146	7	1200
	91	0	1467

	hr.	min.	sec.
5.	274	52	9
	98	57	14

	sq. rd.	sq. yd.	sq. ft.
6.	167	14	3
	119	27	7

7. I started out for a walk at 2 hr. 37 min. 43 sec. after noon, and got back exactly 5 hr. 9 min. after noon. How long had I been out?

8. How long is it from 24 min. 35 sec. past 8 in the morning to 12 min. 30 sec. past 4 in the afternoon?

9. Take a million inches from a hundred miles.

10. Into a barrel which would hold just 30 gal. there were poured 19 gal. 1 pt. of vinegar and 2 gal. 1 qt. of acetic acid, and the barrel was then filled up with water. How much water was poured in?

11. A farmer had 724 bu. of oats. He sold 429 bu. 1 pk., and fed to his horses 93 bu. 2 pk. 5 qt. What quantity of oats had he left?

12. Three piles of wood contained respectively 12 cords 72 cu. ft., 27 cords 43 cu. ft., and 31 cords 96 cu. ft. 57 cords 100 cu. ft. were sold. How much wood was left?

13. A farm of 110 A. 2319 sq. yd. consists partly of woodland and partly of cleared fields. The cleared fields cover an area of 63 A. 3630 sq. yd. What is the area of the woodland?

14. A merchant's accounts showed for July, receipts, $1746; expenditure, $1423.47. How much more did he receive than expend?

15. I sold goods for $97.48, gaining thereby $19.50. How much did the goods cost me?

MULTIPLICATION OF DENOMINATE NUMBERS

Multiplication of denominate numbers finds the amount of any compound denominate number, when it is repeated a given number of times.

Multiply 22 gal. 3 qt. 1 pt. by 7.

gal.	qt.	pt.
22	3	1
		7
160	0	1

7 times 1 pt. = 7 pt. = 3 qt. and 1 pt. We write 1 under the number multiplied. Then 7 times 3 qt. are 21 qt. and 3 qt. added make 24 qt., equal to 6 gal. We write 0 under the number multiplied as there are no quarts remaining after the reduction of the 24 qt. to gallons. 7 times 22 gal. are 154 gal. and 6 gal. added make 160 gal. We write the 160 gal. under the gallons denomination in the multiplicand.

Multiply the number of the lowest denomination by the multiplier, and find the number of units of the next denomination contained in the product; if there is a remainder, write it under the proper column. For the second product, multiply the number of the next denomination in the multiplicand by the multiplier, and after adding to it the above-mentioned number of units, proceed with the result as with the first product. Proceed in the same manner with the rest of the work.

Multiply 6 hr. 40 min. 17 sec. by 8.

hr.	min.	sec.
6	40	17
		8
53	22	16

17 sec. $\times$ 8 = 136 sec. = 2 min. 16 sec.

40 min. $\times$ 8 = 320 min. 320 min. + 2 min. = 322 min. = 5 hr. 22 min.

6 hr. $\times$ 8 = 48 hr. 48 hr. + 5 hr. = 53 hr.

Find the value of:

1. 5 days 4 hr. 17 min. 4 sec. $\times$ 8.
2. 11 gal. 1 qt. 1 pt. $\times$ 11.
3. 164 years 11 days 17 hours $\times$ 7.
4. 46 cu. feet 319 cu. inches $\times$ 11.
5. 111 rd. 4 yd. 2 ft. 7 in. $\times$ 7.
6. 19 sq. rd. 7 sq. yd. 8 sq. ft. $\times$ 3.
7. 64 weeks 17 hours 38 minutes $\times$ 11.

Multiply :

8. $217.35 separately by 8 and 14.

9. 3 tons 24 lb. 13 oz. separately by 11 and 76.

10. 70 yd. 2 ft. 10 in. by 7.

11. 57 gal. 3 qt. by 10.

12. 1 mi. 100 yd. 2 ft. by 100.

13. 30 sq. yd. 4 sq. ft. 100 sq. in. by 100.

14. 30 gal. 3 qt. 1 pt. by 40.

15. 3 sq. yd. 7 sq. ft. 120 sq. in. by 80.

16. How much wood is there in three piles, each containing 17 cords 56 cu. ft.?

17. A farmer plowed 1 A. 1512 sq. yd. a day for 6 days. How much did he plow during the whole 6 days?

18. A boy gathered 1 pk. 3 qt. of berries each day for 5 days. How many did he gather altogether?

19. A grocer bought 166 lb. of butter at 18¢ a pound. He sold 148 lb. of it at 23¢ a pound, and the rest of it at 12¢ a pound. How much did he gain on the whole?

20. A grocer bought 27 bushels of peaches at $3.65 a bushel, and 36 more bushels at $4.12 a bushel. How much will he gain by selling the peaches at $4.37 a bushel?

21. A merchant bought 24 pieces of cloth measuring 36 yd. each, at $18.72 a piece, and sold the whole at $.67 a yard. How much did he gain on the whole?

22. How much kerosene is contained in 30 barrels, each containing 30 gal. 1 qt. 1 pt.?

23. The fore quarters of a lamb weighed 5 lb. 3 oz. each, and the hind quarters 7 lb. 5 oz. each. How much did the lamb weigh?

24. What is the capacity of a cistern that holds 127 pailfuls of 2 gal. 1 qt. each?

25. A room is 18 ft. 8 in. long and 13 ft. 5 in. wide. What is the distance around it?

26. A box is 3 ft. 4 in. long and 2 ft. 3 in. wide. What length of string would go five times around it?

27. A farmer had 21 bags of wheat, each containing 2 bu. 18 lb. How much wheat had he in all?

28. A watch gains 1 min. 7 sec. per day. How much time will it gain in a fortnight?

29. What is the length of 144 rails, each 16 ft. 6 in. long?

30. In a certain voyage a steamer averaged 14 mi. 513 yd. 1 ft. 6 in. per hour for 9 days. What was the distance run in that time?

ORAL REVIEW

1. At $4\frac{1}{2}¢$ a lb., how much flour can be bought for $90¢$?

2. If a steamer burn $4\frac{1}{8}$ tons of coal a day, how many tons will it burn in 5 days?

3. If the interest on \$1 for one year is $6¢$, what is the interest on \$400?

4. How many inches are there in $\frac{5}{3}$ of a yd.? $\frac{3}{6}$ of a yd.? $\frac{7}{12}$ of a yd., and $\frac{6}{12}$ of a yd.?

5. The cost of 1 dozen of tumblers is $\$1.33\frac{1}{3}$; what will 540 tumblers cost?

6. What will $\frac{1}{6}$ of a bushel of wheat weigh, if 1 bushel weighs 60 pounds?

7. What will $\frac{1}{8}$ of a barrel of flour weigh, if 1 barrel of flour weighs 196 pounds?

8. *a*. What is 25% of \$4.64? *b*. $66\frac{2}{3}\%$ of $12¢$?

9. If 1 pound of meat costs $12\frac{1}{2}¢$, how many pounds can be bought for \$5.50?

10. 45 is $33\frac{1}{3}\%$ of what number?

11. A merchant bought 13 packages of goods, for which he paid \$326; what will 39 packages cost at the same rate?

12. Gunpowder is composed of nitre 15 parts, charcoal 3 parts, and sulphur 2 parts. How many pounds of each of these substances would be required for 100 pounds of powder?

13. A and B, as partners, bought a ship, A paying in twice as much money as B. At the end of one year they sold the ship, and found that they had realized a profit of \$15,000. What was each partner's share?

14. Multiply $\frac{8}{15}$ by 5. Multiply $\frac{16}{27}$ by 3.

WRITTEN REVIEW

1. When 1 bu. of oats weighs 32 lb., how many bushels are there in a carload weighing 56,864 lb.?

2. What are the freight charges on the above load at 6¢ per bushel?

3. The blackboard slates in a certain school building are 5 ft. long and $4\frac{1}{2}$ ft. wide. How many square feet of slate are required for the building, in which are 14 classrooms with 17 slates in each?

4. How many barrels of flour at \$4.90 per barrel may be obtained for 26,755 bu. of wheat at 98¢ per bushel?

5. An Italian fruit vender bought chestnuts for \$2.80 per bushel and sold them for 10¢ per pint. What was his gain per bushel?

6. A dealer bought 86 T. of coal at the mines for \$3.75 per long ton. After paying 7¢ per hundred pounds

for freight, he sold the coal by the ordinary ton for $4.25 per ton. Find his profit.

7. A milk dealer buys milk at 10¢ per gallon and sells it for 6¢ per quart. What is his profit on a can holding 46 gal. 2 qt.?

8. A farmer paid $68.51 for building 403 rd. of patent fence. At the same rate, how many rods can be built for $150.28?

9. How many dozen eggs at 18¢ per dozen must be given in exchange for 3 sacks of flour at $1.17 per sack and 9 cans of corn at 9¢ per can?

10. A farmer bought 17 T. of coal at $5.75 and paid for it in wood at $2.25 per cord. How many cords of wood was he obliged to give?

11. The sum of two numbers is 83,364, and their difference is 4322. What are the numbers?

12. The Empire State Express leaves the Grand Central Station at 8.35 A.M. and arrives in Albany at 11.10 A.M. Albany is 143 miles from New York City. Find the train's rate per hour.

13. A grocer bought 3 bbl. of cider, holding $31\frac{1}{2}$ gal. each, at 25¢ per gallon. He sold it for 5¢ per glass, the glasses averaging $\frac{1}{3}$ of a quart. What was his gain on the 3 bbl.?

14. Find value of the missing term:

$$9 \text{ horses} : 17 \text{ horses} = \$729 : x.$$

15. What will it cost to excavate a cellar 36 ft. long, 28 ft. wide, and 9 ft. deep, at 75¢ per cubic yard?

16. Which is greater, the number of cubic inches in a 5-inch cube, or the number of square inches of its surface?

17. A man rents a house for $600 per year, which is $8\frac{1}{3}\%$ of its value. What is the value of the house?

18. My watch ticks 4 times per second. How many times will it tick in 36 wk. 4 da. 11 hr. 15 min. 21 sec.?

19. What number multiplied by 673 and increased by 347 is 176,000?

20. What number diminished by 84 and divided by 63 is 49,602?

21. 5 sq. yd. 6 ft. 15 in. $\div$ 18 ft. 7 in. = ?

22. How many cubic feet are there in a tower of water 23 ft. in diameter, 52 ft. high?

23. What is the cost of 10 pch. of masonry @ $33\frac{1}{3}¢$ per cubic foot?

24. 11 sq. yd. 3 ft. 129 in. $\div$ 2 ft. 9 in. = ?

25. Compare the number of cubic inches in 10 bu. and 24 gal.

26. 8 sq. yd. 6 ft. 84 in. $\div$ 5 ft. 9 in. = ?

27. How many tons of coal can be sold at retail from a boatload of 100 long tons?

28. Compare the weight of a barrel of water and a barrel of flour, finding the ratio in lowest terms.

29. What is the total surface area of the walls of a room $12' \times 15' \times 10'$?

30. 17 sq. yd. 4 ft. 24 in. $\div$ 23 ft. = ?

31. 42 sq. yd. 1 ft. 50 in. $\div$ 23 ft. 10 in. = ?

32. A lady bought at 25¢ a part a certain work consisting of 77 parts. What was its total cost?

33. What is the cost of 80 sq. ft. of plaster at 40¢ per square yard?

DIVISION OF DENOMINATE NUMBERS

Division of compound denominate numbers separates a compound denominate number into as many equal parts as the divisor contains units; and also finds how many times one compound number is contained in another of the same kind.

Divide 175 cu. yd. 10 cu. ft. 784 cu. in. by 4.

	cu. yd.	cu. ft.	cu. in.
4)	175	10	784
	43	22	1492

4 is contained 43 times in 175 cu. yd. with 3 cu. yd. remainder. We write the 43 under the denomination of cubic yards. Reducing the 3 cu. yd. to cubic feet we add the 10 cu. ft., and obtain 91 cu. ft. which divided by 4 gives a quotient of 22 cu. ft. with 3 cu. ft. remainder. We write the 22 cu. ft. under its denomination. Reducing the 3 cu. ft. to cubic inches and adding the 784 cu. in. and dividing by 4 we obtain the last quotient, 1492, which we write under the denomination of cubic inches.

Write the number as in simple division. Find how many times the divisor is contained in the highest denomination of the dividend; write this number in the quotient; multiply as in simple division and subtract.

If there is a remainder, reduce the remainder to the next lower denomination, adding to it the number of that denomination in the dividend, and repeat the division.

1. 6 lb. 12 oz. ÷ 2 =
2. $183 ÷ 4 =
3. 7 lb. 5 oz. ÷ 3 =
4. 19 mi. 1354 yd. ÷ 6 =
5. 15 T. 156 lb. ÷ 4 =
6. 129 mi. 1030 yd. 1 ft. 6 in. ÷ 7 =
7. 19 T. 378 lb. 2 oz. ÷ 5 =
8. 28 gal. 2 qt. ÷ 6 =
9. 193 mi. 1467 yd. ÷ 9 =

10. Divide 17 hhd. 26 gal. 3 qt. 2 gi. by 6.

11. If 6 men can build 18 rd. 3 yd. 2 ft. of wall in 6 da., how much can one man build in the same time?

12. What is the weight of 1 basket of coal if 29 baskets weigh 23.3 cwt. 50 lb.?

13. If a ship sails 79° 32′ 26″ in 27 da., what is her average speed per day?

14. 15 hogs weighed 2 T. 9 cwt. 5 lb. Find the average weight of each hog.

15. How many cans each holding 2 gal. 2 qt. 1 pt. can be filled from 3 bbls. of oil holding $31\frac{1}{2}$ gal. each?

$$2 \text{ gal. } 2 \text{ qt. } 1 \text{ pt.} = 21 \text{ pt.}$$
$$3 \times 31\tfrac{1}{2} \text{ gal.} = 94\tfrac{1}{2} \text{ gal.} = 756 \text{ pt.}$$

$756 \text{ pt.} \div 21 \text{ pt.} = 36$, therefore 36 cans can be filled. When both dividend and divisor are compound denominate numbers, reduce them to simple denominate numbers of the lowest denomination found in either term and divide.

16. How many packages of coffee each holding 2 lb. 4 oz. may be put up from a wholesale shipment of 3 T. 6 cwt. 42 lb.?

17. How many sacks each holding 2 bu. 1 pk. 2 qt. can be filled from a bin holding $2312\frac{1}{2}$ bu.

18. A barrel of vinegar holding $31\frac{1}{2}$ gal. was emptied into bottles holding 1 gi. more than a quart. How many bottles were required?

19. Seven boys went nutting and got 3 bu. 3 pk. 2 qt. 1 pt. of hickory nuts. What was the share of each?

20. In one week a farmer's dairy of 20 cows made 1 cwt. 28 lb. 14 oz. of butter. What was the average of each cow for the week? What was the average per day?

REVIEW OF DENOMINATE NUMBERS

1. How many bags will hold 265 bu. 2 pk. of corn if 1 sack holds 2 bu. 1 pk.?

Reduce to units of next lower denominations:

2. 1000 yds.	**3.** 8 mi.	**4.** 17 ft.
5. 14 yr.	**6.** 8 mo.	**7.** 15 da.
8. 33°.	**9.** 17′.	**10.** 3 sq. mi.
11. 12 sq. rd.	**12.** 5 sq. ft.	**13.** 4 cd.
14. 19 gal.	**15.** 18 bu.	**16.** 82 T.

Reduce to units of next higher denominations:

17. 5000 rd.	**18.** 350 min.	**19.** 500 sq. yd.
20. 10,000 cu. in.	**21.** 260,000 lb.	**22.** 70 qt. (dry).

23. Divide 27 gal. 3 qt. 1 pt. 3 gi. by 7.

24. When five loads of wood measure 8 C. 110 cu. ft. 435 cu. in., what is the average size of each load?

25. How long will 3 T. 7 cwt. 32 lb. of corn meal last a dairy of cattle if they are fed 1 cwt. 53 lb. per day?

26. A watch loses 1 min. 18 sec. per day. What is the loss in a week?

27. A boy skated on a river 8 mi. at the rate of a mile in every 9 min. He left home at 2.12 P.M. At what time did he arrive at his destination?

28. A block of marble was 4 ft. 6 in. by 2 ft. 8 in. by 2 ft. 10 in. What was its cost at $14.75 per cubic yard?

29. Take $7\frac{3}{4}$ cwt. from 9 T.

30. Add 2 A. to 80,000 sq. ft.

THE EQUATION

1. There are three numbers whose sum is 30; the second is equal to twice the first, and the third to three times the first. What are the numbers?

Let x = the first number
then $2x$ = the second number
and $3x$ = the third number
But $x + 2x + 3x = 30$
or $6x = 30$, $\therefore x = 5$, $2x = 10$, $3x = 15$.

2. There are three numbers whose sum is 21; the second is equal to twice the first, and the third is equal to twice the second. If x represents the first, what will represent the second? If $2x$ represents the second, what will represent the third? What is the sum of $x + 2x + 4x$? What are the numbers?

3. There are three numbers whose sum is 100. The first is equal to the sum of the second and third, and the second is three times the third. What are the numbers?

4. John has 40 cents less than three times what James has; how much has each when both have \$1?

5. Divide \$420 among A, B, and C, so that B shall have \$17 more than A, and C \$26 more than B.

6. A man bought a horse and wagon for \$160. If he paid 3 times as much for the horse as for the wagon what was the cost of each?

7. Mr. Brown bought 6 horses, 10 cows, and 24 sheep for \$970. The price of a cow was 5 times the price of a sheep, and the price of a horse was 4 times the price of a cow. Find the value of each.

8. $7x + 6 = 3x + 22$. Find the value of x.

9. A man bought three horses for $380, paying for the second $60 more than for the first, and for the third twice as much as for the second. Find the price paid for each horse.

10. A father left to his eldest son $5000 more than he left to his second son; and he left to his second son $3000 more than to his third son: the total amount left to all three sons was $20,000. What sum did each son receive?

REVIEW

1. 31 gal. 2 qt. ÷ 7 = ?

2. 49 mi. 649 yd. 6 in. ÷ 5 = ?

3. 745 bu. 3 pk. ÷ 8 = ?

4. 47 cu. yd. 11 cu. ft. ÷ 3 = ?

5. 426 bu. 3 pk. 6 qt. ÷ 9 = ?

6. 104 cu. yd. 5 cu. ft. ÷ 9 = ?

7. 29 da. 7 hr. 37 min. ÷ 7 = ?

8. 10 A. 1343 sq. yd. ÷ 3 = ?

9. 42 hr. 56 min. 24 sec. ÷ 9 = ?

10. 497 A. 2714 sq. yd. ÷ 9 = ?

11. Twelve boys gathered 11 bu. 2 qt. of nuts and divided them equally among themselves. How much did each boy receive?

12. There are two numbers in the proportion of 7 to 8 and the larger number is 291. What is the smaller?

Divide:

13. *a.* $6 \times 9 \times 8 \times 11 \times 12 \times 5$ by $27 \times 2 \times 32 \times 3$.

b. $1 \times 6 \times 9 \times 14 \times 15 \times 7 \times 8$ by $36 \times 126 \times 56 \times 20$.

14. From thirty thousand take three millionths.

15. What is the value of a barrel of linseed oil at 72¢ per gallon?

16. In September, 1901, 61 warships were being built for the United States at a total cost of $80,954,116, without armament. What was their average cost?

17. If a farm of 100 acres be divided into 9 equal-sized fields, what will be the area of each?

18. Seven horses eat 13 bu. 3 pk. 1 qt. of oats in a week. What quantity does each horse eat per week?

19. A rectangular cistern is 6 ft. $\times$ 4 ft. $\times$ 4 ft. What will be the weight of the water in it when the cistern is full? (1 cu. ft. of water weighs 1000 oz.) How many gallons will the cistern hold? (1 gallon of water weighs $8\frac{1}{3}$ lb.)

20. How many bricks will be required to build a wall 124 ft. long, 33 ft. high, and 8 in. thick? (1 brick is 8 in. by 4 in. by 2 in. = 8 cu. in. $\times$ 4 $\times$ 2 = 64 cu. in.)

21. How many cubic yards of stone are there in a rectangular pile of stone 15 ft. $\times$ 12 ft. $\times$ 6 ft.?

22. How many cubic yards of masonry are there in a breakwater 1500 ft. $\times$ 25 ft. $\times$ 18 ft.?

23. A man worth \$185,725 is taxed $\frac{3}{10}$ of a mill on a dollar. How much is his tax?

24. If property worth \$275 is taxed $7\frac{5}{10}$ mills on a dollar, what is the amount of the tax?

25. A farmer sold seven loads of wheat, the first load containing 1763 pounds; the second load 1827 pounds; the third load 1329 pounds; the fourth load 1901 pounds; the fifth load 1666 pounds; the sixth load 1879 pounds; and the seventh load 1185 pounds. What was the aggregate weight of the seven loads?

26.

a. $\frac{2}{3}+\frac{1}{6}-\frac{5}{9}+\frac{11}{12}=?$ *b.* $\frac{7}{8}+\frac{8}{12}+\frac{7}{16}-\frac{7}{15}=?$

c. $\frac{3}{10}+\frac{13}{15}-\frac{1}{5}+\frac{4}{9}=?$ *d.* $\frac{11}{70}-\frac{5}{21}+\frac{1}{5}+\frac{17}{42}=?$

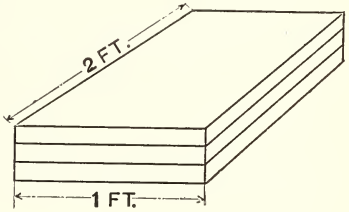
e. $2\frac{1}{2}-3\frac{1}{3}+4\frac{1}{4}+5=?$ *f.* $\frac{138}{15}\frac{7}{}-\frac{322}{48}\frac{34}{}+\frac{161}{10}\frac{72}{}+\frac{155}{3}=?$

27. A circular cistern is 7 ft. in diameter, and holds 20 ft. in depth of water. How many gallons?

BOARD MEASURE

A board foot is 1 ft. long, 1 ft. wide, and 1 in. or less thick. A board 8 ft. long, 1 ft. wide, and 1 in. thick is said to contain 8 ft., board measure. If the board is only $\frac{1}{2}$ an inch thick, it still contains 8 ft., board measure. But if the board is $1\frac{1}{2}$ inches thick, it contains 8 ft. $\times$ 1 $\times$ $1\frac{1}{2}$ = 12 ft., board measure.

A plank 11 ft. long, 2 ft. wide, and 2 in. thick contains 11 ft. $\times$ 2 $\times$ 2 = 44 ft., board measure.



This drawing represents three boards, each $1' \times 2' \times 1''$, or 2 ft. board measure.

$'$ is the sign for foot or feet and $''$ for inch or inches.

1. How many feet are there in a sill 20 ft. long, 1 ft. wide, and 6 in. thick? 20 ft. $\times$ 1 $\times$ 6 = 120 ft., board measure.

How many feet, board measure, are there in:

2. A plank 10 ft. long, 2 ft. wide, 2 in. thick?
3. A board 8 ft. long, 1 ft. wide, $\frac{1}{4}$ in. thick?
4. 2 boards, each 9 ft. long, 2 ft. wide, $1\frac{1}{2}$ in. thick?
5. What will 19,780 feet of timber cost at \$8.50 per M?
6. Find the cost of 986 feet of pine boards at \$30 per M.
7. What must be paid for planing 234 feet of boards, at 35¢ per M?
8. Find the cost of 7200 ft. of pine at \$18.25 per M.
9. How many feet, board measure, are there in a floor of Georgia pine, $16' \times 24' \times 1\frac{1}{2}''$?
10. What is the board measure of a piece of timber $24' \times 14'' \times 12''$?

PERCENTAGE

What is 16% of $674?

$$16\% = .16,$$

$$\$674 \times .16 = \$107.84.$$

Or, $\frac{1}{100}$ of $\$674 = \$6.74$ and $\frac{16}{100} = \$6.74 \times 16$, or $\$107.84$.

What is 7% of 8473 acres?

$$8473 \text{ acres} \times .07 = 593.11 \text{ acres}.$$

1. What is 11% of 947 bu. apples?
2. How much is 23% of $6147.80?
3. How much is 27% of $6090.80?
4. What is $87\frac{1}{2}\%$ of $1234?
5. What is $6\frac{1}{4}\%$ of $89.40?
6. How much is $17\frac{1}{2}\%$ of $2998.40?
7. What is 72% of 429 lb. 11 oz. 6 pwt.?
8. What is 15% of 227 wk. 4 da. 11 hr.?
9. What is 6% of £ 93 14*s*. $7\frac{1}{2}d$.?
10. What is 29% of $2947.40?
11. From 16% of $294 take 29% of $39.17.
12. Add together 7% of $94.80, 11% of $1129, $17\frac{1}{2}\%$ of $1296.42.
13. A regiment went into battle 1147 strong, and after the battle it was found that 23% had been killed or wounded, and 7% taken prisoners. What was the number killed or wounded, and what was the number taken prisoners?

BUSINESS

Business involves the buying and selling of services or of articles of value.

The products of agriculture, of manufacture, and of mining are bought and sold in business.

1. Make on the blackboard a list of all the kinds of business of which any members of the class may know.

Business may be *local*, in one neighborhood or community; *domestic*, within the United States; or *foreign*. Business, when carried on in very large transactions, is often called **Commerce**.

2. Make on the blackboard a list of various articles of local business with prices; *e.g.* milk, vegetables.

3. Make another list of articles of domestic commerce; *e.g.* drugs, lumber, cloth.

4. Make another list of articles of foreign commerce; *e.g.* tea, coffee, sugar, iron, precious stones, wheat.

5. A man in the grocery business sold in one year goods to the gross amount of $20,000. He had the following expenses, viz.: stock of all kinds, $16,000; wages, $900; rent, $400; care and keeping of horse, $180; repairs, $150; lost in bad debts, $450; taxes, $100; sundries, $250. He had $3500 capital invested in the business, and charged this at 6% a year. How much was the interest? Did he make or lose money? How much?

6. A butcher sold $60 worth of meat per day. His total expenses were $56 per day. A rival in business offered him $30 a week in wages, if he would give up his own stand and come to him. What reasons would lead him to accept or to decline the offer?

7. A boy bought a bicycle, second hand, for $8.00. He had new tires put on it, and other repairs were made, at a cost of $7.50. Another boy then offered him $15.00 for the bicycle. Did he lose or gain if he accepted the offer?

8. A department store bought 1000 books at 12¢ each, less 5% for cash. 925 of the books were sold at 15¢ each, at a cost of $16.00 for clerk hire. 50 of the remaining books were sold at 10¢ each, at a cost of $4.00 for clerk hire. The rest of the books were sold out as "damaged," at 3¢ each. What was the gross profit on the transaction? Does this make any allowance for the cost of wrapping and delivering parcels, for bookkeeping and other expenses, and for the use of the capital involved?

9. One year a store sold 200,000 parcels of goods, and delivered them at an average cost per parcel of $\frac{1}{2}$¢. The average selling price of parcels delivered was 8¢. The value of parcels delivered compared with the value of parcels taken away by customers was 300%. In that year the entire expense of operating the store, not including delivery of goods, was $18,000. What was the cost of delivering the goods? What was the total amount of all sales? What was the profit?

10. If a man buys goods at a wholesale cost of $10,000, and sells them for $12,500, upon what conditions will he make money? Upon what will he lose money?

11. A man bought a horse for $125 and a wagon for $100. At the end of ten years the horse died, and he sold the wagon for $15. What was the average loss per year of the capital invested in the horse and wagon?

12. A contractor and builder agreed to build a house for $4000. When it was done he found that he had paid out the following amounts, viz.: materials of all kinds,

$1700; wages of all kinds, $1200; subcontracts for plumbing, etc., $350; and sundry items, $275. Did he make or lose money? How much? If he himself devoted $\frac{1}{3}$ of his time for four months to the work, what wages of superintendence did he earn, counting twenty-five working days to the month?

13. A manufacturer employed 100 men, at the cost of $4200 a month. His materials cost him $5600. He sold the product for $12,000. He charged $500 a month for depreciation of value in machinery and buildings, and for repairs, and $150 a month as interest for the use of the capital. What was his net profit a month? What work did the manufacturer do in return for this profit?

14. A boy made a canvas canoe at a total cost for canvas, wood, paint, nails, screws, and tools of $9.75. The work required 250 hours of his time. He then sold the canoe for $20. What was his profit? How much was this per hour? If he kept the tools, were these part of his profit? Why?

Price measures an article of merchandise by money.

Wages measure services by money.

Salary measures services by money.

Cost is the amount of money the buyer gives or a manufacturer pays for an article of value or for service.

1. Find illustrations of prices, wages, salaries, and costs.

2. When a machine that costs $1800 does the work of 4 men, earning each $15 a week, in how many weeks does it save its own cost?

3. Which is "better pay," $1200 a year as a salary, or wages of $25 a week for 50 weeks a year?

FOREIGN TRADE

The value of the imports into the United States for the fiscal year from July 1, 1900, to June 30, 1901, was $822,756,533, a decrease of $27,184,651 from the imports for the previous year.

1. What was the amount of the imports for the year July 1, 1899, to June 30, 1900?

Exports amounted to $1,487,656,544, an increase of $93,173,462 over the previous year.

2. What was the amount of the exports for the fiscal year 1899–1900?

3. What was the total of the decrease in imports and of the increase in exports, taken together?

4. If the imports were sold here at an average advance of 25% over this total, what was their total cost to us?

5. If the exports were sold in Europe and elsewhere at an average advance of 25% over this total, what was their total cost to the Europeans?

6. What was the difference between the reported values of imports and exports?

7. The "balance of trade" is the difference between exports and imports. What was the balance for the year July 1, 1900—June 30, 1901?

8. If the balance of trade for 1900–1901 was $120,358,-113 more than in 1899–1900, what was it in the earlier year?

9. The principal items of exports from our country are breadstuffs, live animals, provisions, cotton, and mineral

oils. During the year 1900–1901 the total exports of breadstuffs amounted in value to $267,487,239. Cattle and hogs amounted to $36,537,062, provisions to $179,875,250, cotton to $313,283,578, and mineral oils to $69,905,689. What was the total value of these staples?

10. What was the total foreign trade, both imports and exports, for the year 1900–1901?

11. If the total foreign trade for 1900–1901 was 2% of the total domestic trade, what was the amount of the domestic trade?

12. A firm of exporters sold in one year 2500 bicycles at $27.50 each, 8700 sewing machines at $19.75 each, and 170 locomotives at $19,000 each. What was the gross total of all these items?

13. A firm of importers purchased at one time a million yards of carpet at 1.87\frac{1}{2}$ per yd., 600,000 yd. of silk at 1.12\frac{1}{2}$ per yd., and 750,000 yd. of woolen goods at $66\frac{2}{3}$¢ per yd. What was the gross total cost?

14. A European banker bought 20,000 U.S. Government bonds, par value $1000, at $1174.50 each. What was their total cost?

15. A dealer in Swiss watches bought 86 watches at a total cost, including import duties, of $2666, and sold them at the average price of $48. What was his average gain per watch?

16. An American watch-making corporation sold in a year to the foreign trade 16,050 watches at the average price of $6.75. What was the total amount of its sales?

LONGITUDE AND SOLAR TIME

The **equator** of the earth, like other circles, may be divided into 360 degrees. These are called degrees of longitude.

The prime meridian, from which all longitude, east or west, is reckoned, is the meridian of Greenwich (London), England.

The sun apparently goes round the earth once in 24 hours. This means that in 24 hours the sun apparently passes through 360° of longitude. In 1 hour it passes through $360° \div 24 = 15°$. To pass through 1° requires 60 minutes $\div$ 15 = 4 minutes of time; and to pass through 1′ of longitude requires 60 seconds $\div$ 15 = 4 seconds.

15° of longitude correspond to 1 hour of time.
1° of longitude corresponds to 4 minutes of time.
1′ of longitude corresponds to 4 seconds of time.

When the sun is exactly over the meridian of any place, it is 12 o'clock, or noon, at that place, and is past noon at all places east, and before noon at all places west.

When we know the difference of time between two places and the exact time at one of them, the corresponding time at the other is found by adding their difference, if that other place be east, or by subtracting it if west.

1. When A is 62° 35′ 15″ farther west than B, what is the difference in time between the two places?

$$15)62° \quad 35' \quad 15''$$
$$4 \text{ hr. } 10 \text{ min. } 21 \text{ sec.}$$

Every hour of time corresponds to 15° of longitude, every minute of time to 15′ of longitude, and every second of time to 15″ of longitude.

To obtain the difference in time we divide the difference in longitude, expressed in degrees, minutes, and seconds, by 15. The result is the difference in time expressed in hours, minutes, and seconds.

2. The difference of longitude between Albany and Boston is 2° 9′. What is the difference in their time?

3. The difference of longitude between Albany and Detroit is 9° 45′. What is the difference in their time?

4. The difference of longitude between New Haven and New Orleans is 17° 10′. What is their difference in time?

5. The difference of longitude between Charleston, S.C., and Mobile is 8° 27′. What is their difference in time?

6. What time is it at Columbus (long. 83° 3′ W.) when it is 4 P.M. at Baltimore, Md. (long. 76° 37′ W.)?

7. What time is it at Copenhagen, Denmark (long. 12° 34′ 57″ E.), when it is 10 P.M. at Mobile, Ala. (long. 88° 11′ W.)?

8. When it is noon at Louisville, Ky. (long. 85° 30′ W.), what time at Bangor, Maine (long. 68° 47′ W.)?

9. What time is it at Cambridge, England (long. 5′ 21″ E.), when it is 9 P.M. at Cambridge, Mass. (long. 71° 7′ 21″ W.)?

10. The longitude of Paris, France, is 2° 20′ 22″ E., and that of Washington, D.C., is 77° 1′ 30″ W. What time is it at Paris, when it is 11 o'clock 15 min. 11 sec. A.M. at Washington?

11. There are 22° 22′ difference of longitude between *A* and *B*. What time is it in *A* when it is 12 o'clock in *B*?

AMERICAN STANDARD TIME

In 1883 there were so many railroads in our country that differences in time made the connections for trains going east and west very confusing, as every town and city had its own local solar time. If a train conductor set his watch at Albany, New York, at 6 o'clock A.M., and traveled with his train just twelve hours, he would arrive in Cleveland, Ohio, at 5.30 P.M., because the sun rises there half an hour later than at Albany. At Buffalo, on his return trip, his watch, if set at Cleveland, would be a quarter of an hour slow. To remedy this the railroads adopted standard time, dividing the country into four sections, each with an hour's difference in time.

Eastern time	.	based on Philadelphia time.
Central time	.	based on St. Louis time.
Mountain time	.	based on Denver time.
Pacific time	.	based on Sacramento time.

1. Upon a map of the United States measure by the *scale* the distance from Philadelphia to St. Louis, to Denver, to Sacramento.

2. At 12 M. in New York what time is it in Chicago? in New Orleans? in Cheyenne? in San Francisco?

3. At 8 A.M. in Los Angeles what time is it in Salt Lake City? in Omaha? in Charleston?

4. At 4 P.M. in Nashville what time is it in Boston? in Helena? in Seattle?

5. By standard time what is the difference between Portland, Maine, and Portland, Oregon?

THE DIFFERENCE OF LONGITUDE

When it is 15 minutes and 11 seconds past 11 o'clock A.M. at Washington, D.C., it is 32 minutes and 38 seconds past 4 o'clock P.M. at Paris, France. What is the difference in longitude of the two cities?

	hr.	min.	sec.
Paris time past midnight,	16	32	38
Washington time past midnight,	11	15	11
	5	17	27
			15
	79°	21′	45″

Since the number expressing the difference in longitude between two places is 15 times the number expressing their difference in time, to obtain the difference in longitude we multiply by 15 the difference in time.

1. The difference of time between Jersey City and Pittsburg is 19 min. What is the difference of their longitude?

2. When it is 12 M. at New York, it is 11 o'clock 6 minutes and 28 seconds at Cincinnati. What is their difference of longitude?

3. When it is 1 P.M. at Utica, N.Y., whose longitude is 75° 13′ W., it is 11 hr. 52 min. 4 sec. A.M. at Little Rock, Ark. What is the longitude of the latter city?

4. A sea captain observed at noon one day that his watch, set to the time of Greenwich, England, pointed to 4 o'clock 10 min. 21 sec. What was his longitude?

5. A man, traveling from Augusta, Maine, to Little Rock, Arkansas, found his watch pointed to 29 min. 28 sec. past 1 o'clock when it was 12 o'clock. How many degrees of longitude are there between the two places, if his watch was running correctly?

REVIEW

1. What will 75 bolts of muslin cost, each bolt containing 56 yards, at 16¢ a yard?

2. Find the difference in time between two places on the earth's equator 3700 miles apart.

3. A merchant bought 37 pieces of silk, each piece containing 46 yards, worth $4 a yard. How much did the silk cost him?

4. Find the sum of 5 da. 6 hr. 12 sec.; 6 da. 17 hr. 35 min. 46 sec.; 8 da. 9 hr. 24 min. 27 sec.; and 19 hr. 47 min. 32 sec.

5. A man with a family spends 15% of his income for rent, 20% for meat, provisions, and groceries, 18% for clothing, 5% for books and amusements, 3% for medical care, and 12% for sundries, and gives $\frac{1}{3}$ of the balance away, saving all the rest. What does he save from $3600 a year?

6. At $2\frac{3}{8}$ each, how many hats can be bought for $35\frac{5}{8}$?

7. Find the area of a rectangular courtyard, 17 ft. 6 in. long, and 13 ft. 4 in. broad.

8. A bin of corn contains 232 bu. 3 pk. 7 qt. It is to be put into 105 bags. How much must each bag contain?

9. What is the difference of longitude between two places when the difference of time is 2 hr. 20 min. 44 sec.?

10. Since the difference of time between London and San Francisco is 8 hours, what is the difference in longitude?

11. When it is 4 o'clock P.M. in New York, it is 3 hr. 18 min. 28.4 sec. P.M. in Cincinnati. New York is 74° 1′ 6″ W. longitude. What is the longitude of Cincinnati?

12. The length of a rectangular building is 26 yd. 5 in. The area of the floor is 683 sq. yd. 2 sq. ft. 25 sq. in. What is the width of the building?

13. How many yards of carpeting, 2 ft. 4 in. broad, will it take to cover a room whose dimensions are 26 ft. by 35 ft. ?

14. It is found that 288 yd. of paper, 2 ft. 8 in. wide, will cover the walls of a room; how many would be required of paper 2 ft. 3 in. wide ?

15. How many yards of matting, 2 ft. 3 in. wide, will be required for a square room whose side is 18 ft. 9 in. ?

16. If a room 13 ft. sq. is 13 ft. 4 in. high, how many yards of paper 1 ft. 4 in. wide will be required for its walls ?

17. How many blocks of stone, each 2 feet long, 1 foot wide, and 6 inches thick will build a pier 12 yards long, 2 yards high, and $1\frac{1}{3}$ yards thick ?

18. I bought a bicycle for \$30 cash, and sold it for \$35 on a credit of 8 months; reckoning the interest at the rate of 6 per cent a year, how much did I gain ?

19. A person owned $\frac{3}{5}$ of a mine, and sold $\frac{3}{4}$ of his interest for \$1710. What was the value of the mine ?

20. A floor 30 feet long and 18 feet wide is to be covered with carpet $\frac{3}{4}$ of a yard wide; how many yards will be needed ?

21. How many bushels of wheat are there in 71,496 lb.? (60 lb. = 1 bu.)

22. Two partners, A and B, gained in a speculation \$1800. A had invested \$2400 in the speculation and B \$4080. How many dollars should each partner receive as his share of the gain ?

23. A hall is lighted by 10 gas burners, each burner consuming 4 cubic inches of gas a second. What is the cost of lighting the hall per hour, the price of gas being \$1 a thousand cubic feet ?

DRILL IN MULTIPLICATION AND DIVISION

I. Multiply or divide any of the numbers in the first or third columns by any of the numbers in the second or fourth columns.

	A	B	C	D
1.	80126	29	31428	752
2.	100000	56	90829	1528
3.	923831	71	834126	224
4.	235825	15	1432829	435
5.	723899	87	26634	132
6.	13428	16	3135572	873
7.	63976	96	2431869	7829
8.	250000	66	200000000	237
9.	436977	34	1000000000	351
10.	354764	48	91432829625	976

DRILL IN ADDITION AND SUBTRACTION

II. Add together the numbers in each column.

III. Deduct the sum of all the numbers except 10, C, from that number.

IV. Make combinations of multiplication, addition, and subtraction: *e.g.* Multiply 3, A, by 10, D, and add to the product the product of 7, C, by 1, D, and subtract from the sum the product of 9, A, by 7, D.

V. Vary by considering A and C as dollars.

VI. The columns A, C, and D may be used as representing amounts of denominate numbers, to be reduced to higher terms: *e.g.* reduce 1, A, as inches, to yards or to rods.

VII. Make problems using these numbers.

DAILY AFFAIRS — ORAL

1. A boy bought a pair of skates for $2.25 and a hockey stick for 35¢. How much change should he receive if he gave the clerk 2 two-dollar bills?

2. One Fourth of July a boy spent 30¢ for firecrackers, 25¢ for rockets, 40¢ for Roman candles, and 15¢ for pinwheels. How much did he spend in all?

3. At $5 per barrel, how many barrels of flour should a farmer receive in exchange for 50 bushels of potatoes at 60¢ per bushel?

4. Bert sold from his garden 12 qt. of berries at 9¢ per quart, 8 cabbages at 5¢ each, and 2 bunches of celery for 15¢ each. How much did he get in all?

5. John bought a fish pole for 75¢, a line for 15¢, 3 hooks at 5¢ each, and a reel for $1.25. Find the cost of his fishing outfit.

6. Alice bought 4 yd. of gingham for 14¢ per yard. How much change should she receive from a two-dollar bill?

7. Mary's tuition at a boarding school was $120, her board $160, books $30, other expenses $70. Find cost of one year's schooling.

8. At $\$\frac{7}{20}$ per pound, how many pounds of coffee can be bought for $\$3\frac{3}{20}$?

9. Mr. Harris paid 60¢ for $3\frac{3}{4}$ lb. of steak. Find the price per pound.

10. David's hat cost $1.50, his shoes $2.00, and his new suit $12. What was the cost of the entire outfit?

11. Find the cost of 7 cd. of wood at $2.50 per cord.

12. What is a man's income if he pays 10% of it per month as rent at the rate of $15 per month?

13. Mrs. Thorn purchased a piano for $400, paying $100 down and the balance in monthly payments of $10. In how long a time were the payments completed?

14. In going to school Mary paid 23¢ car fare for the round trip. How much was that in a school week?

15. A wagon-load of hay weighed 5698 lb. Tare was 1448. At $24 per T., what was the value of the hay?

16. A wagon-load of coal weighed 3152 lb. Tare was 1052 lb. At $6 per T., what was the value of the coal?

17. The table-supplies for a family of six persons cost in one week $7. What was the average cost of a meal for one person?

18. Mr. Williamson took five children to a concert and paid 75¢ each for seats for the party. What did he pay in all?

19. The population of X was $\frac{2}{3}$ that of Y. The population of the latter town was 6300. What was the population of the former?

20. A man sold for $3500 a property that had cost him $\frac{1}{7}$ less than this amount. How much money did he gain?

21. A man earning $4 a day usually had work 185 days in the year. What was his average income per mo.?

22. At 11¢ per pane, what was the total cost of 300 panes of glass for a house?

DAILY AFFAIRS — WRITTEN

1. Mrs. Weyman bought a dress pattern of $12\frac{1}{2}$ yd. of goods at 69¢ a yd. She gave a ten-dollar bill in payment. What change did she receive?

A. $12\frac{1}{2} = \frac{1}{8}$ of 100. Cost of 100 yd. = \$69. $\frac{1}{8}$ of \$69 = ?

B. $12\frac{1}{2} = 10 + 2\frac{1}{2}$. Cost of 10 yd. = \$6.90. Cost of $2\frac{1}{2}$ yd. = ?

$2\frac{1}{2} = \frac{1}{4}$ of 10. $\frac{1}{4}$ of \$6.90 = \$1.75. \$6.90 + \$1.75 = ?

\$10 − ? = ?

2. A boy bought a hammer for 65¢, a saw for \$1.10, and 6 lb. of nails at 5¢ a lb. What was the amount?

3. A family bought 6 qt. of milk daily for a calendar month of 31 da. at 8¢ a quart. Was the bill of \$14.88 correct?

4. A man bought 6 lb. of beef at 16¢ a pound, 3 lb. of mutton chops at 14¢ a pound, and $2\frac{1}{2}$ lb. of porterhouse steak at 28¢ a pound, and offered \$2.08 in payment. Was this correct?

5. The contract price for an iron fence was 43¢ per foot, and \$15 extra for a gate. The lot was 40 ft. wide. What amount was due?

6. Mr. Sands bought 8 T. of coal for \$5.75 a ton, delivered. What was the total cost?

7. John went on a vacation. His railroad fare was \$6.60 each way. Board for two weeks was \$4.50 a week. He spent extra the following sums: 5¢, 50¢, 12¢, 10¢, \$1, 5¢, \$2.25, 25¢, 30¢, \$1.50. When he reached home again, what had been the total cost of his vacation?

8. Miss Jameson received \$650 a year. How much was that a week?

9. A boy earned 7¢ an hour in a mill. For 2 wk. his time was: 8 hr., 10 hr., 8 hr., 9 hr., 6 hr., 8 hr., 8 hr., 8 hr., 12 hr., 3 hr., 8 hr., 7 hr. For each hour over 10 hr. in one day he received 150% of the regular pay. What was due him in the pay envelope?

10. Which is more, $20 a calendar month or $5 a week?

11. A real estate dealer bought a property for $6000, and sold it at a gain of $16\frac{2}{3}\%$. He afterward bought it again for $6500, but sold it at a loss of 10%. Once more it was in the market for $6800, which he paid for it, only to sell it a few days later at an advance of $12\frac{1}{2}\%$. If his expenses for deeds, etc., were in all $200, did he make or lose in the final result of his operations?

12. Which is the cheaper apartment per room, one of 8 rooms at $900 per year, or one of 6 rooms at $60 per month? By how much per room per year?

13. A boy invested $6.60 in fancy poultry. He sold 3 doz. eggs at $1.25 per doz., raised 14 chickens worth $1 each, spent $4 on feed and $3 on house, etc., and lost by disease one of the four fowls first purchased. How many fowls had he at the end of the season? What was their value? How much had they cost him net in money?

14. The father of three children gave them $10, to be divided in the proportion of their ages, 16, 14, and 10 years. What did each receive?

15. A family moved from one house to another. The cartage of the goods cost $15.75; the amount of damage to goods was $8.25; the father lost $3.50, one day's wages; and the change made it necessary to buy $13.00 worth of new furniture otherwise not required. What was the total expense of the moving?

16. A suit of clothes cost \$6.75, a pair of shoes \$1.75, a hat \$1.25, and all other wearing apparel \$4.10. What was the total cost of the outfit?

17. A machinist with a salary of \$18 per week expends \$21 per month for rent, \$5 per week for groceries, \$200 per year for clothing for himself and family, and \$75 per year for extras. How much does he save per year?

18. How many pounds of coffee at the rate of 3 pounds for a dollar will be received in exchange for 25 doz. eggs at 15¢ per dozen?

19. A man bought a house for \$3200, paying \$500 down and the balance in payments of \$30 per month. In what time were the payments completed?

20. A ball nine purchased the following supplies: 4 infielder's gloves at \$3.50 each, 2 balls at \$1.10 each, 7 bats at 45¢ each, and a catcher's outfit costing \$6. What was each player's share of the expense?

21. If $3\frac{3}{7}$ lb. of coffee cost \$1.20, what will $10\frac{1}{7}$ lb. cost?

22. If sugar is selling at 16 pounds for a dollar, how many pounds can be bought for \$5.85?

23. A Board of Education might have erected a school building for \$6000, but instead they rented a building for \$725. In how many years would the rent paid have been enough to erect the building?

24. A newsboy buys papers at the rate of 4 for 5¢, and sells them for 2¢ each. How many will he have to sell to make \$1.20?

25. A man paid $\$1\frac{3}{4}$ for a hat, $\$2\frac{1}{2}$ for a pair of shoes, $\$1\frac{1}{10}$ for a book, and $\$\frac{3}{5}$ for a necktie. How much was this in all?

26. Mrs. Brown bought 3 qt. of molasses at 10¢ per quart, 5 gal. of kerosene oil at 11¢ per gallon, 1 sack of flour at $1.25, 2 lb. of tea at 50¢ per pound, 2 lb. of coffee at 35¢ per pound, and a can of baking powder costing 35¢. She gave the grocer 7 doz. eggs at 17¢ per dozen, 13 lb. of butter at 23¢ per pound, and the rest in cash. How much cash did the grocer receive?

27. John made the following purchases of clothing in one year: two suits of clothes at $23 each, an overcoat at $18, two hats at $2.50 each, 4 shirts at $1.25, and $12.75 for extras, as collars, cuffs, gloves, etc. Find the total cost of his clothing for one year.

28. Mr. Thompson bought a farm of 90 A. at $110 per A. Ten years later he sold 40 A. for building lots at an average of $600 per acre. He considered the rest of the land then worth $300 per acre. What was his apparent gain in the ten years?

29. Mr. Prince bought a house and lot for $5700. He paid for repairs, to the carpenter $248, to the mason $76, to the plumber $169, to the paper-hanger $83, to the painter $360, and for sundries $90. *a.* What was the total cost of the property? *b.* How much cheaper would another property in good repair have been at its price of $6500?

30. How much cheaper per square yard is a carpet $\frac{3}{4}$ yd. wide costing 90¢ per yard than a carpet 1 yd. wide costing $1.15 per yard? How much is saved in a room containing 30 sq. yd.?

31. One man working at 45¢ per hour for 8 hr. per day 185 days a year earns how much less annually than another man working at $2.75 a day 300 days in the year?

GAIN AND LOSS

A merchant bought articles at the following costs, and sold them at the following gains or losses. Find his selling prices.

	Cost	Gain	Loss		Cost	Gain	Loss
1.	\$100	20%		2.	\$75		$33\frac{1}{3}\%$
3.	6	25%		4.	30	10%	
5.	8	$37\frac{1}{2}\%$		6.	4	75%	
7.	72	$8\frac{1}{3}\%$		8.	800		$87\frac{1}{2}\%$
9.	240	$62\frac{1}{2}\%$		10.	48		$16\frac{2}{3}\%$
11.	10	60%		12.	20	80%	
13.	284		50%	14.	9	$66\frac{2}{3}\%$	
15.	60		$83\frac{1}{3}\%$	16.	200		5%
17.	48	$6\frac{1}{4}\%$		18.	500	8%	
19.	104	$12\frac{1}{2}\%$		20.	100		100%

21. Using the facts as above, make problems involving business transactions, *e.g.*: A man bought a horse for \$100, and finding him entirely worthless, gave him away, losing 100% of his cost. Which question above states the numbers involved in such a transaction?

22. Give the common fractions corresponding with the following per cents, viz.:

$6\frac{1}{4}\%$, $12\frac{1}{2}\%$, $18\frac{3}{4}\%$, 25%, $31\frac{1}{4}\%$, $37\frac{1}{2}\%$, $43\frac{3}{4}\%$, 50%, $56\frac{1}{4}\%$, $62\frac{1}{2}\%$, $68\frac{3}{4}\%$.

$8\frac{1}{3}\%$, $16\frac{2}{3}\%$, 25%, $33\frac{1}{3}\%$, $41\frac{2}{3}\%$, 50%, $58\frac{1}{3}\%$, $66\frac{2}{3}\%$, 75%, $83\frac{1}{3}\%$, $91\frac{2}{3}\%$.

23. Write problems of gain or loss, involving the per cents given above in **22.**

INTEREST

Interest is money paid for the use of money.

The **principal** is the sum of money for which the interest is paid. Interest is computed at a certain rate per cent of the principal.

Six per cent is a common business rate. Four and five per cent are usual rates for loans on real estate or on other very good security. Governments pay two, three, and four per cent for what they borrow.

SIX PER CENT INTEREST

At six per cent the interest of \$1 for 1 yr. is \$.06.

At six per cent the interest of \$1 for 2 mo. is \$.01.

At six per cent the interest of \$1 for 1 mo. is \$.005.

At six per cent the interest of \$1 for 6 da. is \$.001.

At six per cent the interest of \$1 for 1 da. is \$.000$\frac{1}{6}$.

The rate of interest of \$100 at 6% for 1 yr. is 6; for 1 mo. is .50; for 6 da. is .10; and for 1 da. is .01$\frac{2}{3}$.

In finding interest we usually call 30 days 1 month and 360 days 1 year.

1. Find the interest on \$240 for 3 yr. 3 mo. and 24 da. Referring to above table:

Rate of interest on \$1 for 3 yr. = .18

Rate of interest on \$1 for 3 mo. = .015

Rate of interest on \$1 for 24 da. = .004

Rate for the whole time = .199

\$240 × .199 = \$47.76

Find the rate of interest for $1 for the time. Multiply the principal by this rate.

2. Find the interest at 6% on the following sums for the terms given:

A. $150 { 30 da. | 60 da. | 90 da. | 4 mo.

B. $250 { 3 da. | 18 da. | 35 da. | 75 da.

C. $275 { 9 da. | 2 mo. | 5 mo. | 7 mo.

D. $845 { 36 da. | 100 da. | 4 mo. 10 da. | 1 yr. 3 da.

E. $1160 { 1 mo. 10 da. | 8 mo. 9 da. | 10 mo. 20 da. | 2 yr. 4 mo.

3. Find the interest of each of the following sums for 2 mo.:

a. $84	*b.* $327.41	*c.* $838.75	*d.* $1000
e. $678	*f.* $637.86	*g.* $3.86	*h.* $95.60

4. Find the interest for 6 da. of:

a. $586	*b.* $67	*c.* $1473.87
d. $930	*e.* $36.75	*f.* $142

5. If the interest of $1 for 1 yr. is 6¢, what will be the interest of $10 for the same time? what will be the interest of $10 for 2 yr.? for 3 yr.? for 4 yr.?

At 6%:

6. What is the interest of $237.64 for 19 mo. 24 da.?

7. What is the interest of $478.96 for 17 mo. 26 da.?

8. What is the interest of $375.81 for 22 mo. 15 da.?

1. A borrowed of B $240 for 1 year 3 months and 15 days. At simple interest, how much did A owe B at the end of the term?

$240 × .06 = interest on $240 for 1 yr. = ?
$240 × .005 × 3 = interest on $240 for 3 mo. = ?
$240 × .001 × 2 = interest on $240 for 12 da. = ?
$240 × .000166 × 3 = interest on $240 for 3 da. = ?

Or we may consider 3 days $\frac{1}{2}$ of 6 days and write

$240 × .001 × $\frac{1}{2}$ = interest for 3 da. = ?

To find the answer, add the interest to the principal.

Finding the Amount

The **amount** is the *principal* with the *interest* added.

2. What is the amount of $4369.87 for 3 mo. 26 da.?
3. What is the amount of $25.50 for 9 mo. 27 da.?
4. What is the amount of $117.58 for 3 yr. 18 da.?
5. What is the amount of $313.27 for 6 mo. 9 da.?
6. What is the amount of $57.75 for 9 mo. 1 da.?
7. What is the amount of $35.86 for 11 mo. 25 da.?
8. What is the amount of $17.64 for 408 da.?
9. What is the amount of $378.51 for 1 yr. 5 mo. 17 da.?

At 6% what is the amount of:

10. $49.37 for 1 yr. 1 mo.?
11. $608.62 for 1 yr. 9 mo.?
12. $341.13 for 7 yr. 9 da.?
13. $100 for 16 yr. 8 mo.?
14. $591.03 for 4 yr. 3 mo. 7 da.?
15. $0.134 for 4 mo. 3 da.?
16. $371.01 for 4 yr. 15 da.?
17. $57.92 for 3 yr. 7 mo. 9 da.?

DUTIES OR CUSTOMS

All goods coming into the United States from foreign countries are required by law to be landed at certain places, or ports, called **ports of entry.**

A certain charge, called a **duty**, fixed by Congress, is made upon many kinds of goods entering the United States from foreign countries.

At every port of entry in the United States the government has a Custom House.

It is the business of the custom house officers to inspect the cargoes of all the vessels entering at any of these ports, to examine the invoice of goods, and collect the duties.

An **invoice** is a written statement of the goods, showing the quantity of each lot of goods and the value or price.

Besides the duties on merchandise, all vessels engaged in commerce are required to pay certain charges for the privilege of entering the port, etc. These charges are called **harbor dues.**

The duties levied by law on goods imported into the United States are of two kinds: *specific* duties and *ad valorem* duties.

A *specific duty* is a certain sum levied by law on an article, irrespective of its value, *i.e.* on the ton, pound, gallon, square yard, etc., of particular kinds of merchandise: — so much per square yard on cloths, so much per pound on tea, so much per gallon on oil, etc.

An *ad valorem* duty is a certain percentage on the invoiced value of the goods.

1. What is the ad valorem duty, at 20 %, on an invoice of broadcloths which cost $1240 in England?

2. What is the ad valorem duty, at 34 %, on an invoice of silks, which cost $2110 in Italy?

3. At 25 %, what is the duty on a quantity of indigo, the invoice of which is $1968?

4. At 33 %, what is the duty on a bale of Irish linens, which cost $3187?

5. Find the duty, at $3 per T., on 8640 lb. of hay.

6. At $33\frac{1}{3}$ %, what is the duty on an invoice of muslins amounting to $3690?

7. At 35%, what is the duty on an invoice of silks, valued at $45,385?

8. At 20%, what is the duty on an invoice of woolens, amounting to $63,212?

9. At 15%, what is the duty on a quantity of drugs, worth $18,714?

10. At 30%, what is the duty on $37,241 worth of diamonds?

11. At $37\frac{1}{2}$ %, what is the duty on $46,210 worth of tea?

12. At 3¢ per dozen, what is the duty on 26,684 eggs?

LARGE AFFAIRS

1. The deposits of the Morristown Trust Company grew from $28,277 in 1892 to $8,881,099 in 1901. What was the average amount of increase a year?

2. What was the value of the Southern California sugar crop, 1901, of 60,000,000 lb. at $4.50 a ton?

3. The town of Ridgemont had seven churches, whose total cost was $228,000. What was their average cost? An eighth church was built at a cost of $110,000. What was the average cost of the buildings?

PARTNERSHIPS AND CORPORATIONS

A **partnership** is an agreement between two or more men to engage in business together.

1. A had $5000 and B $3000. They agreed to go into business together, each to receive a salary of $1000 a year; but the profits were to be divided in proportion to the capital each invested. In the first year each drew his salary. The net profits were $560. What was A's share of the profits?

2. Messrs. Thompson, Williams, King, and Allen agree to form a partnership with the firm name of Thompson & Co. Thompson invested $12,000, Williams $8,000, King $2,000 and Allen, the "silent partner" who did not give his services, $15,000. Thompson was to draw a salary of $300 per month, Williams, $200, and King, $175 a month. The net profits were to be divided in proportion to the capital invested. The gross profits for one year before these salaries were deducted were $10,500. What amount did the silent partner receive?

A **corporation** is a company organized in accordance with state laws. Its capital is divided into *shares* of *stock*. Its permanent *debts*, usually for money borrowed, are secured by *bonds*.

3. A corporation engaged in manufacture had outstanding $1,500,000 of 6% bonds, 10,000 shares of preferred stock, value $100, entitled to 8% dividend, and 20,000 shares of common stock. In one year its gross profits were $290,000. How much did the company pay as interest on the bonds? How much did it pay as dividend on preferred stock? How much was left to divide among the common shares? How much was this per share?

ROMAN NOTATION

The Roman Notation, a system of notation used by the ancient Romans, is still employed in designating chapters of books, in inscriptions, and for a few other purposes.

This notation uses seven capital letters, I, V, X, L, C, D, M.

Letters,	I	V	X	L	C	D	M
Values,	1	5	10	50	100	500	1000

NOTE. — Small letters are sometimes used, i, 1; ii, 2; c, 100.

PRINCIPLES

Repeating a letter repeats its value: II, 2; XX, 20; CCC, 300.

When a letter is placed before another of greater value, its value is subtracted from that of the greater.

IX, 9; XL, 40; CD, 400.

When a letter is placed after one of greater value, their values are added: XI, 11; LX, 60; DC, 600.

When a letter is placed between two letters, each of greater value, its value is to be taken from the sum of the values of the two other letters: XIV, 14; XIX, 19; MCM, 1900.

A bar, ——, placed over a letter increases its value a thousand times: $\overline{\text{V}}$, 5000; $\overline{\text{M}}$, 1,000,000; $\overline{\text{XV}}$, 15,000.

Repeating the bar again increases the value a thousand times: $\overline{\overline{\text{MM}}}$, 2,000,000,000; but $\overline{\text{MM}}$, 1,001,000,000.

Fractions cannot be expressed in the Roman Notation.

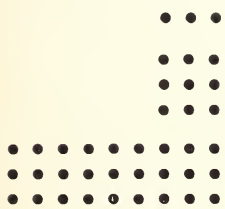
1. Read:

MCMLVI, MMDLXXIXVIII, $\overline{\text{D}}$, $\overline{\overline{\text{MM}}}$, $\overline{\text{L}}$, $\overline{\text{MLV}}$.

2. Write: 3,000,000, 26,000, 1910, 45,000, 25,040, 1899, 1909, 1553, 1776.

INVOLUTION

A **power** of any number is the product of factors each equal to the number itself. The factor thus taken is called the **root** of the power.



First power of three. 3.

Second power of three. $3 \times 3 : 3^2$.

Third power of three. $3 \times 3 \times 3 : 3^3$.

A. Represent by dots on the blackboard the *fourth power* of three.

B. Represent the *first*, *second*, and *third powers* of five.

An **exponent** is a number denoting a power. It is a small figure placed above the root at the right; thus, 5^2 indicates the second power of 5 or $5 \times 5 = 25$.

Involution finds any power of a given number.

$(\frac{3}{4})^3$ or $\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{27}{64}$ = the third power of $\frac{3}{4}$.

Powers are distinguished as *first*, *second*, *third*, *fourth*, etc., according to the times that the given number is taken as a factor.

The *first power* is the number itself. The *second power* is called the *square*, and the *third* the *cube*.

First power of $4 = 4$.

Second power of $4 = 4^2 = 4 \times 4 = 16$.

Third power of $4 = 4^3 = 4 \times 4 \times 4 = 64$.

Fourth power of $4 = 4^4 = 4 \times 4 \times 4 \times 4 = 256$.

I. Find the squares of:

1. 4	2. .5	3. $\frac{3}{4}$	4. 15	5. .05
6. 26	7. 42	8. 63	9. $1\frac{3}{4}$	10. $\frac{6}{7}$
11. $\frac{7}{9}$	12. 4.6	13. $\frac{3}{8}$	14. $2\frac{4}{5}$	
15. $7\frac{5}{8}$	16. $15\frac{9}{12}$	17. $25\frac{9}{10}$	18. 48	

II. Find the cubes of:

1. 2	2. 3	3. 4	4. 5	5. 6
6. 7	7. 8	8. 9	9. 10	10. 11
11. 12	12. 0.13	13. 0.202	14. $\frac{1}{2}$	15. $\frac{1}{4}$
16. $\frac{2}{3}$	17. $3\frac{4}{5}$	18. $5\frac{4}{7}$	19. $9\frac{2}{5}$	20. 8.8

III. What is the fourth power of 16, 24, 127?

IV. What is the fifth power of 1.2, 2.2?

V. What is the fourth power of $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{5}$?

VI. What is the third power of $2\frac{1}{2}$, $3\frac{1}{3}$, $4\frac{2}{3}$, $3\frac{2}{5}$?

VII. Read the following:

6^3; 8^2; 10^3; 5^{10}; 12^4; 7^5; x^5; 1000^2.

VIII. How many factors of its own value has each of the above numbers?

IX. Which is larger: 4^4 or 3^5? 2^{10} or 5^4? 8^3 or 25^2?

X. What is the difference between the fifth power of four and the fourth power of five?

XI. What is the sum of the second power of 100 and the fourth power of 20?

XII. $6^4 - 4^6 = ?$

XIII. $5^5 - 7^4 = ?$

MONEY OF OTHER NATIONS

English Money

We need to know English money for two very good reasons. English money is the standard of the world. We ourselves have a great deal of trade with England and with the British Empire. We read many books and periodicals in which the various English coins are frequently mentioned.

English or Sterling Money is the legal tender currency of the United Kingdom of Great Britain and Ireland.

Table

4 farthings (*far.*)	= 1 penny (*d.*)
12 pence	= 1 shilling (*s.*)
20 shillings	= 1 pound or sovereign (£ or *sov.*)

		d.	*far.*
	s.	1 =	4
£	1 =	12 =	48
1 =	20 =	240 =	960

Farthings are generally expressed as fractions of a penny; thus, 1 far. = $\frac{1}{4}d.$; 3 far. = $\frac{3}{4}d.$

1. How many pence are there in £1?
2. How many shillings are there in £2 8*s.*?
3. How many shillings are there in 48 pence?
4. How many pounds are there in 40 shillings? in 60? in 80?
5. Change to units of higher denomination:

a. 8670*d.* *b.* 16,255*s.* *c.* 15,359 *far.* *d.* 11,186*d.*

The English pound is worth $4.8665 as determined by the United States Treasury.

In the British colony, Canada, decimal money like ours is used.

1. What is the value of an English shilling in our money?

2. A traveler, who took with him to Liverpool $1000, could exchange the money for how many sovereigns?

3. How many farthings are in £1?

4. A traveler, visiting London, paid 3*s.* for lodging, 2*s.* for fire and light, and 4*s.* for meals per day. How many pounds did he spend per week?

5. Which costs less in money, board in London at 25*s.* a week, or board in New York at $8 a week?

6. What is the value of an English penny in our cents?

7. Add together £2 4*s.* $7\frac{1}{2}d.$, £3 5*s.* $10\frac{1}{4}d.$, £15 15*s.*, and £33 12*s.* $11\frac{1}{2}d.$

8. Subtract £88 18*s.* $8\frac{1}{2}d.$ from £146 19*s.* $6\frac{1}{4}d.$

9. Subtract:

£8 10*s.* 2*d.*	£150 17*s.*	£1000
£6 5*s.* 7*d.*	£ 23 15*s.* 6*d.*	£ 816 12*s.* 10*d.*

10. Multiply £56 4*s.* $6\frac{1}{2}d.$ by 5.

11. Multiply:

a. 12*s.* 6*d.* by 4.

b. £1 2*s.* 6*d.* by $7\frac{1}{2}$.

c. £4 8*s.* 4*d.* by 9.

d. £2 15*s.* 2*d.* by 125.

e. £1 17*s.* $11\frac{3}{4}d.$ by 3.

f. £500 10*d.* by 1000.

12. Divide £500 among 15 people as equally as possible.

13. A man left property valued at £7690 to be divided into 18 equal parts. To A he gave 3 parts, to B and C

2 parts each, and to D, E, F, and G 1 part each. The remaining parts he gave to a hospital. Find the amount of each legacy.

14. A man can earn one pound ninepence halfpenny a day; how much is this for a year of 365 days?

15. When one acre of land is worth one hundred thirty-two pounds seventeen shillings ninepence three farthings, what should I pay for three hundred sixty acres?

Values in Exchange

1. Find the value in U. S. money of £ 27 8*s*. 9*d*.

$$9d. = .75s. = £ \quad .0375$$
$$8.\ \ s. = £ \quad .4$$
$$£\,27.$$
$$£\,27.4375$$
$$\$4.8665 \times 27.435 = \$133.524$$

Reduce the English money to pounds and by the number multiply $4.8665, the value of a pound in American money.

2. Find the value in U. S. money of

a. £ 34 16*s*. 6*d*. *b*. £ 56 8*s*. 3*d*.

c. £ 117 3*s*. 10*d*. *d*. £ 48 6*s*. 9*d*.

3. Find the value of $265.77 in English money.

$$265.77 \div 4.8665 = 54.6125 = £\,54\ 12s.\ 3d.$$

Divide the number of American dollars by 4.8665.

4. Find the value in English money of

a. $287.64. *b*. $893.67. *c*. $1000.

d. $764.80. *e*. $425. *f*. $825.75.

g. $100,000,000. *h*. $56,692.81.

Problems

1. Change £25 to U. S. money.

2. Divide £850 among 19 people as equally as possible

3. Nine men had on the average £3 15*s*. 10½*d*. each. How much had they in all?

4. Take £39 17*s*. 4*d*. from £49 16*s*.

Divide:

	£	*s*.	*d*.
5. 2)78	18	10½	

	£	*s*.	*d*.
6. 5)42	12	9	

	£	*s*.	*d*.
7. 3)15	4	7½	

8. When thirty-seven horses cost £434 8*s*. 8½*d*., what is the price of each horse?

9. A man bought 207 sheep for £408 7*s*. 10½*d*. How much is this for each sheep?

10. £500 is to be divided among the crew of a vessel; the captain gets £75 10*s*., and the rest is divided equally among the ten sailors. What does each sailor get?

11. What must be given for a ham weighing 16½ pounds, at 10½*d*. per pound?

12. A traveler bought 8 pr. of hose at 1*s*. 2*d*. per pair. What was the total cost?

13. He bought also 3 suits of clothes at a total cost of £4 8*s*. What was the average cost of each suit?

14. A traveler spent 15 days in England at a cost of £16 8*s*. What was the average cost per day?

Latin Money

The standard coin of value in France, Switzerland, Belgium, and Holland is the **franc**. This is worth $.193.

1. Is a franc more or less than an English shilling?

2. A traveler took with him to Paris $200. How many francs would he receive in exchange?

The small coins of France are measured in centimes, of which there are one hundred in the franc. French newspapers cost usually 5 or 10 centimes.

3. A newsboy in Paris sold 50 papers at an average gain of 4 centimes. How much was this in our cents?

The standard coin of Italy is the **lire**. Its value is one franc.

The standard coin of Spain and Portugal, and of most countries where their language is spoken, is the **pesata**, worth also one franc. The standard coin of Germany is the **mark**, worth about 24 cents in our money. It is worth a half a cent less than the English shilling.

The standard coin of Russia is the **rouble**, worth 50 cents.

4. What is the value of 2 roubles in francs? Of 4 marks in pesatas? Of 1 guinea in lire?

Values in Trade

Though an American dollar is worth more than five francs, it will not buy as much usually in our country as five francs will buy in Europe, because our prices are higher. This is chiefly due to the higher wages paid to laborers in this country.

1. A traveler from Spain brought to New York 1000 pesatas. How many dollars should he receive in exchange for them? In answering omit all fractions.

2. A clock cost an American traveling in Germany 100 marks. If the tax on its importation was 30 % of its value, what was its cost in New York in our money?

3. An Italian came to our country, and after saving $700 returned to Italy. How long could he live there without working for wages, if he spent 700 lire a year?

4. A Russian traveler took with him to Berlin 2500 roubles. For about how many marks could he exchange them? He left there for Paris with 4000 marks. For how many francs could he exchange them? He reached London with 3500 francs. For how many pounds could he exchange this amount? Thence he went to New York with £100. How many dollars was this? Before leaving he exchanged $400 for Spanish pesatas to use in Cuba. How many pesatas did he expect to receive?

5. An American took with him to Europe a letter of credit that cost $973.30. He drew £25 in England; 1000 francs in France; 800 lire in Italy; 200 marks in Germany; and 300 roubles in Russia. He then decided that he needed 1000 pesatas for a visit in Spain, and £20 to pay for his passage from Gibraltar to New York. Would his letter of credit cover these drafts, too?

6. A business man traveling in Italy bought three pearls for 375 lire and sold them for half as many dollars. What was his profit, not considering the import duty?

7. An American family sold their house for $18,000 and bought a property in England for £3200. What was the difference in the values of the properties?

8. A German merchant sold his business for 30,000 marks and his home for 22,000 marks. He invested in the United States $6000 in a home and the rest of his wealth in business. How much did he invest in business?

9. Take from £5000 16,000 marks, 20,000 lire, and $10,000, and give the result in francs.

REVIEW OF DENOMINATE NUMBERS

1. In 65,656 pt., how many bbl. ?

2. In 1000 ounces are how many pounds and ounces ?

3. Change $\frac{1}{8}$ wk. to the fraction of a yr.

4. Reduce 5 cwt. 11 lb. 4 oz. to ounces.

5. In 4355 inches are how many yards ?

6. In 3 acres 27 rods are how many square feet ?

7. In 70,000 square links are how many square chains ?

8. How many square links are there in 5 acres ?

9. In 10,000 gills are how many barrels ?

10. In 100,000 pints are how many hogsheads ?

11. In 10 hogsheads 1 quart 1 pint are how many pints ?

12. In 36 bushels are how many pints ?

13. In 1597 quarts are how many bushels ?

14. $\frac{1}{2} \times \frac{3}{8} \times 1$ mile $= ?$

15. Reduce 1500 sq. mi. to A.

16. $\frac{1}{10}$ of a bushel $= ?$

17. $\frac{1}{2} \times \frac{7}{8} \times \frac{3}{14} \times 1$ hour $= ?$

18. Reduce 1 ft. 4 in. to the decimal of a yard.

19. Reduce 18*s.* $3\frac{3}{4}d.$ to the decimal of a £.

20. Reduce 3 pecks 5 quarts and 1 pint to the decimal of a bushel.

21. Reduce 11 hr. 16 min. 15 sec. to the decimal of a day.

22. Reduce 42 min. 36 sec. to the decimal of an hour.

23. £0.125 = ?

24. £$\frac{2}{3}$ = ?

25. Reduce 0.375 of a hogshead of molasses to units of lower denominations.

26. Reduce $\frac{3}{8}$ A. to sq. ft.

What is the value in next lower denomination of :

27. $\frac{3}{5}$ of a great gross ?

28. $\frac{3}{4}$ of a score ?

29. .4 of a quintal of fish ?

30. .3 of a barrel of flour ?

31. $\frac{1}{3}$ of a barrel of pork ?

32. $\frac{5}{6}$ of a ream of paper ?

33. A dealer sold 8 hhds. of molasses at 43¢ per gallon. What were his total receipts ?

34. How many hours are there in 344 wk. 6 da. 17 hr. ?

35. In 171,360 pence are how many pounds ?

36. £85 8*s.* are worth how much in our money ?

37. In 78640 square rd. are how many acres ?

38. Construct an equilateral triangle each of whose sides shall be 6 in. in length. Find its area.

39. In £15 19*s.* 11*d.* 3 *far.* are how many farthings ?

40. In 445,577 feet are how many miles ?

41. What will be the cost of a pile of wood 36 feet long, 6 feet high, and 4 feet wide, at $1 a cord foot ?

42. A man travels 288 miles in 12 days, traveling 6 hours each day. At what rate does he travel per hour ?

43. How many yards of carpeting 1 yard wide, will carpet a room 18 feet by 20 feet ?

44. A dealer wishes to bottle a cask of olive oil containing 126 gallons, in bottles containing 1 pint each. How many bottles are necessary?

45. A man wishes to ship 285 bu. of grass seed in casks containing 7 bushels 2 pecks each. What number of casks are required?

46. 49 hours are what part of a week?

47. Reduce 1 circumference to seconds.

48. Reduce 192 sq. in. to square yards.

49. Reduce $6\frac{2}{3}$ cu. yd. to cubic inches.

50. Reduce to mills: *a.* \$117.14; *b.* $\$5\frac{3}{8}$.

51. Reduce 1600 mills to dollars.

52. 2 yr. 108 da. 18 hr. 40 min. to seconds.

Reduce:

53. 2800 pt. to bu.

54. 50,000 ft. to miles.

55. 7964 oz. to lb.

56. 19 cwt. to ounces.

57. $\frac{5}{9}$ of a yd. to the fraction of a rod.

58. 35.781 sq. yd. to square inches.

59. 4 sq. rd. 13 sq. yd. 5 sq. ft. 98 sq. in. to sq. in.

60. 7 sq. ft. 120.54 sq. in. to square yards.

61. 63 sq. rd. $10\frac{4}{9}$ sq. yd. to square feet.

62. 1 T. 16 cwt. 27 lb. to oz.

63. 4 gal. $\frac{1}{2}$ pt. to gills.

64. 37 gal. 2 qt. 1 pt. 3 gi. to quarts.

65. 1 gal. 3 qt. $1\frac{1}{2}$ gi. to gallons.

66. 2 pk. 6 qt. 1.8 pt. to bushels.

67. 8 bu. $3\frac{3}{4}$ pk. to quarts. **68.** 2 pk. $7\frac{1}{2}$ qt. to pints.

69. 3 bbl. 16 gal. to pt. **70.** 163° 28′ 7″ to seconds.

71. 27,674 cu. in. to gallons. **72.** \$84, $32\frac{4}{7}¢$ to mills.

73. £304 19*s*. $2\frac{1}{2}d$. to pounds.

74. £58 7*s*. 11*d*. to pence.

COMMERCIAL AFFAIRS

The following table shows the value of imports of the principal tropical productions in the fiscal year 1901:

Articles	1901
Sugar	\$87,551,974
Coffee	62,861,399
Silk, unmanufactured	30,051,365
India rubber	28,586,340
Fibers	22,932,506
Fruits and nuts	19,584,612
Tobacco and manufactures	18,769,463
Tea	11,014,981
Gums	6,639,139
Cocoa	6,761,669
Cotton, unmanufactured	6,787,813
Spices	3,563,046
Rice and rice flour	2,296,337
Cabinet woods	2,993,344
Cork wood and manufactures	2,270,997
Licorice root	1,737,097
Cinchona bark	1,025,546
Indigo	1,402,894
Vanilla beans	875,229
Dye woods	864,986
Sponges	717,550

What per cent of the total value was each item?

PROMISSORY NOTES

A **promissory note** is a written unconditional agreement by one person to pay to another a specified sum at a specified time.

The person making the agreement or signing the note is called the **maker.** The person to whom the sum is payable is called the **payee,** and the owner of the note is called the **holder.**

A joint and several note is one signed by two or more persons, each one being liable as maker or principal.

$ 600.00 Louisville, Ky., October 2, 1900

Three months after date I promise to pay to the order of John J. Audubon

Six hundred ——————————— Dollars

at the National Broadway Bank ———————

with interest at six per cent.

Value received

No. Due Albert Gallatin

If the words "the order of" are omitted, then only the payee can collect the note. But if these words are omitted and the words "or bearer" added after the payee's name, then a person other than the payee can collect the note. When only the payee named in a note can collect it, the note is not negotiable.

A **negotiable note** is one that may be transferred or sold by one person to another.

A **non-negotiable note** is one that may be collected only by the payee.

1. What interest was due on a promissory note for $700 at 6%, dated Oct. 9, 1900, and due Dec. 9?

2. What was due on the note if it ran to March 9?

3. What interest was due on a note for $1200 at 6% at its maturity 90 days after? What was due, if it was renewed to run 108 days more?

4. Draw up various promissory notes and find the interest due on them.

ORAL ANALYSIS

1. When $\frac{3}{8}$ T. of hay cost $6, what do $\frac{7}{8}$ T. cost?

2. If $\frac{2}{3}$ gal. of oil cost 26¢, what will $2\frac{1}{3}$ gal. cost?

3. If 3 apples cost $6\frac{3}{5}$¢, what will 11 apples cost at the same rate?

4. A man gave $60 for lambs at the rate of $15 for 4 lambs. How many lambs did he buy?

5. When 3 pigs cost $7\frac{1}{2}$, how many pigs cost $60?

6. What do 8 shovels cost when 2 shovels cost $\frac{7}{8}$?

7. What do 16 suits cost when 2 suits cost $12\frac{1}{2}$?

8. If a $\frac{3}{8}$ interest in a store is worth $24,000, what is $\frac{7}{8}$ of the same store worth?

9. When a man owning a $\frac{3}{7}$ interest in a ship sells his share for $36,000, what is the whole ship worth at the same rate?

10. John, Henry, and David own a rowboat in company. John paid $\frac{3}{7}$ of the cost, and sold his share to the other boys for $27. At that rate, what was the value of the whole boat? If Henry paid $\frac{2}{3}$ as much as David, and he and David each paid half of the $27, what fractional share did each now own?

11. When a man owning 9 houses is worth $45,000, how much is a man worth who owns 12 similar houses?

12. A workman received for $\frac{3}{8}$ of a day's work $.90. At the same rate what did he earn in $1\frac{1}{8}$ days?

13. One tree 50 ft. high was 125% as high as another tree. What was the height of the second tree?

14. In a man's library in 1898 were 4600 books, which were $\frac{2}{3}$ as many as he owned in 1900. He now owns 200% as many as he owned in 1900. How many does he now own?

15. What number is $\frac{5}{8}$ of another number when $\frac{2}{5}$ of it is 16?

MISCELLANEOUS WRITTEN PROCESSES AND PROBLEMS

The pupils may invent problems of their own, using these as models.

1. Find the solid contents of a beam of timber 30 ft. long, 2 ft. 3 in. wide, and 2 ft. 5 in. thick.

First method of solution:

$$30 \text{ cu. ft.} \times 2\tfrac{3}{12} \times 2\tfrac{5}{12} = 120\tfrac{15}{144} \text{ cu. ft.}$$

Second method of solution:

$$360 \text{ cu. in.} \times 27 \times 29 = 281880 \text{ cu. in.}$$

Reduce results to cubic yards, cubic feet, cubic inches.

2. What is the length of a room whose width is 10 ft. 4 in. and height 10 ft. 6 in., containing 1519 cu. ft.?

SOLUTION.

$124 \text{ sq. in.} \times 126 \text{ sq. in.} = 15624$

$1519 \text{ cu. ft.} = 2624832 \text{ cu. in.}$

$2624832 \text{ cu. in.} \div 15624 \text{ sq. in.} = 168 \text{ in.}$

3. Find the cost of papering a room 18 ft. long, 12 ft. wide, 12 ft. high, with paper 18 in. wide, at $1\frac{1}{2}$¢ per yard.

SOLUTION. — 20 yd. = distance around room. $20 \div \frac{1}{2} = 40$ strips required. 12 ft. = 4 yd. high. $40 \times 4 = 160$ yd. $1\frac{1}{2}¢ \times 160 = \$2.40$.

4. A block of granite, 16 ft. long, 8 ft. broad, 4 ft. deep, stands on one of its broadest faces; the other faces are polished at a total cost of \$16. Find the cost of polishing similarly another block 24 ft. long, 10 ft. broad, 5 ft. deep, similarly placed.

Area of surface to be polished of 1st block

$$= (16 \times 4 \times 2) + (8 \times 4 \times 2) + 16 \times 8$$
$$= (128 + 64 + 128) \text{ sq. ft.} = 320 \text{ sq. ft.}$$

Area of surface to be polished of 2d block

$$= (24 \times 5 \times 2) + (10 \times 5 \times 2) + 24 \times 10$$
$$= (240 + 100 + 240) \text{ sq. ft.} = 580 \text{ sq. ft.}$$

$\therefore$ Cost of polishing second block $= \$\frac{16}{1} \times \frac{580}{320} = \$29$.

5. How many square feet in a floor which is 16 ft. wide and $23\frac{1}{2}$ ft. long? How many yards of carpeting 1 yd. wide will cover the floor?

6. In a table 5 ft. 3 in. long, and 3 ft. 2 in. wide, how many square inches? How many square feet?

7. If 24 horses eat 40 bu. of grain in 10 da., how many bushels will 30 horses eat in 9 da.?

SOLUTION. — Since 24 horses eat 40 bu. in 10 da., one horse eats 40 bu. in 24×10 da. or 240 da., and 30 horses will eat as much in 9 da. as 1 horse will eat in 30×9 da. or 270 da.

In the form of a proportion we have:

$$240 \text{ da.} : 270 \text{ da.} = 40 \text{ bu.} : x \text{ bu.}$$

$$240\,x = 10800 \qquad x = 45$$

This First Method may be explained in the form of a compound proportion with the ratios determined by 'cause and effect.' Thus the cause of 40 bu. being eaten is 24 horses eating 10 da. And the cause of x bu. being eaten is 30 horses eating 9 da. or 1 horse eating 9 da. $\times$ 30. Therefore

$$\begin{aligned} &\text{no. of da.} : \text{no. of da.} = 40 \text{ bu.} : x \text{ bu. or} \\ &10 \times 24 \;\; : 9 \times 30 \;\;\; = 40 \text{ bu.} : x. \end{aligned}$$

Second Method. — In 10 days 1 horse eats $\frac{1}{24}$ of 40 bu.
In 1 day 1 horse eats $\frac{1}{10}$ of $\frac{1}{24}$ of 40 bu.
In 1 day 30 horses eat $30 \times \frac{1}{10}$ of $\frac{1}{24}$ of 40 bu.
In 9 days 30 horses eat $9 \times 30 \times \frac{1}{10}$ of $\frac{1}{24}$ of 40 bu.

8. If 24 horses can be fed for 10 da. on 40 bu. of grain, how many horses can be kept 9 da. on 45 bu.?

9. If 12 horses can be fed for 5 da. on 40 bu. of grain, how many days can 40 horses be fed on 60 bu.?

10. If 30 horses eat 45 bu. of grain in 9 da., how many bushels will 24 horses eat in 10 da.?

11. *a.* When $15 : 4 = 75 : x$, what is x?
b. When $12 : 9 = 40 : x$, what is x?
c. When $x : 18 = 36 : 48$, what is x?
d. When $2 : x = \frac{1}{5} : \frac{2}{5}$, what is x?

12. What is the area of a right angle triangle whose base is 70 ft. and height is 175 ft.?

13. What number is that which, being multiplied by $\frac{2}{3}$, will produce $\frac{1}{4}$?

14. Of a company of soldiers, $\frac{1}{8}$ were on guard, $\frac{1}{6}$ at dinner, and the remainder, 85 men, were drilling. How many men were there in the company?

15. The sum of two numbers is $\frac{6}{7}$ and their difference $\frac{1}{3}$. What are the numbers?

16. I own $\frac{3}{16}$ of a ship worth $1200. What part have I left after selling $\frac{2}{5}$ of $\frac{4}{9}$ of my share, and what is it worth?

17. The slow or parade step is 70 paces per minute; at 28 in. each pace, how far is this per hour?

18. A person bought 160 oranges at 2 for a cent, and 180 more at 3 for a cent. He sold them out at the rate of 5 for 2 cents. Did he make or lose, and how much?

19. Two persons depart from the same place; one travels 32 and the other 36 mi. a day. If they travel in the same direction, how far will they be apart at the end of 19 da., and how far if they travel in contrary directions?

20. When $7 : 11 = 35 : x$, what is x?

21. The second, third, and fourth terms of a proportion are 17, 11, and $93\frac{1}{2}$. What is the first term?

22. The first, third, and fourth terms of a proportion are 21, 63, and 39. Required the second term.

23. The first three terms of a proportion are 2, 3, and 7. What is the fourth term?

24. The last three terms of a proportion are 91, 88, and 104. Required the first term.

25. *a.* 4 yd. : 18 yd. = $96 : x. Find x.

b. 5 lb. : 2 lb. = $3.75 : x. Find x.

26. How long is it from Aug. 21 of this year to the 16th of the next June?

27. Find the profit or the loss and the selling price:

	Cost	Rate of Profit		Cost	Rate of Loss
a.	$150	6%	*d.*	$42.50	10%
b.	$225	5%	*e.*	$250	$1\frac{1}{2}$%
c.	$137.50	36%	*f.*	$900	$16\frac{2}{3}$%

28. Find the value of x:

a. $5 : 7 = 15 : x$.	*b.* $9 : 6 = 6 : x$.
c. $\frac{1}{5} : 3 = 7 : x$.	*d.* $3 : 4 = 9 : x$.
e. $8 : 6 = x : 3$.	*f.* $12 : x = 15 : 3$.
g. $x : 7 = 8 : 9$.	*h.* $27 : 3 = x : 1$.
i. $2 : 100 = 17 : x$.	*j.* $27 : 3 = 54 : x$.
k. $5\frac{1}{2} : x = 16 : 32$.	*l.* $9 : 150 = 105 : x$.
m. $x : 12. = \frac{7}{8} : \frac{3}{4}$.	*n.* $\frac{5}{16} : \frac{1}{4} = 15 : x$.
o. $648 : 243 = 24 : x$.	*p.* 12 yd. : 4 yd. = \$9 : x.
q. x : 4 da. = \$5 : \$15.	*r.* $65 : x = 75 : 850$.
s. $20 : 25 = x : 10$.	*t.* $x : 18 = 15 : 45$.

29. Which is the greatest and which is the least of the following ratios: 3 : 4, 7 : 8, and 9 : 10?

$$3 : 4 = 3 \div 4 = .75.$$
$$7 : 8 = 7 \div 8 = .875.$$
$$9 : 10 = 9 \div 10 = .9.$$

Hence 9 : 10 is the greatest ratio, and 3 : 4 the least.

30. Which is the greatest and which the least of these ratios?

7 : 8, 2 : 3, 11 : 13, and 5 : 6.

31. Find which is the greatest and which the least of the ratios:

7 : 4, 6 : 3, 17 : 8, and 11 : 5.
16 : 9, 10 : 3, 7 : 2, and 8 : 3.
7 : 33, 11 : 49, 16 : 71, and 21 : 106.

32. When three numbers constitute a proportion, one of them is repeated so as to form two terms.

Thus, if 18, 6, and 2 are proportionals, $18 : 6 = 6 : 2$. In this case the 6, that is, the term repeated, is called the

middle term, or a mean proportional between the two other numbers. The 2 is called the third term or a third proportional to the two other numbers.

33. A man traveling 8 hr. a day completed a journey in 32 da. How long would he have taken to go the same distance traveling only 6 hr. a day?

Number of days at 8 hr. a day = 32 da.

Number of days at 1 hr. a day = 8 times 32 da.

Number of days at 6 hr. a day = $\frac{1}{6}$ of 8 times 32 da.

$$\frac{32 \text{ da.} \times 8}{6} = \frac{128}{3} = 42\tfrac{2}{3} \text{ da.}$$

34. Find the product of .12 and .11 expressed as common fractions.

35. Find the product of 4.32 and .00012.

36. Multiply 725.625 by 8.5.

Explain the position of the decimal point in the answer.

$$\begin{array}{r} 725.625 \\ 8.5 \\ \hline 3628125 \\ 5805000 \\ \hline 6167.8125 \end{array}$$

37. A dealer bought at one time 956 bu. 3 pk. of wheat; at another time 759 bu. 2 pk. and 7 qt.; sold 325 bu. 3 pk. and 6 qt. How much wheat had he remaining?

38. If I insure my house and furniture for $7389, at the rate of $1\frac{1}{4}\%$ for five years, what premium must I pay yearly?

$1\frac{1}{4}\%$ is equal to $0.0125 per dollar. The premium therefore will be $\$7389 \times .0125 \div \frac{1}{5} = ?$

39. Find the cost of painting the walls and ceiling of a room whose height, length, and breadth are 17 ft. 6 in., 35 ft. 4 in., and 20 ft., respectively, at 15¢ per sq. yd.

Area of the 2 length walls = 2 (height × length), or 2 (H × L).

Area of the 2 breadth walls = 2 (height × breadth), or 2 (H × B).

Area of the ceiling = (length × breadth), or L × B.

∴ area to be painted

$= 2(H \times L) + 2(H \times B) + L \times B = 2H \times \{L + B\} + L \times B.$

$= (2 + 17\frac{1}{2})$ ft. $\times (35\frac{1}{3} + 20)$ ft. $+ (35\frac{1}{3} \times 20)$ sq. ft.

$= (2 \times 17\frac{1}{2} \times 55\frac{1}{3} + \frac{106}{3} \times 20)$ sq. ft. $= \frac{7930}{3}$ sq. ft.

$= \frac{7930}{3 \times 9}$ sq. yd.

∴ expense of painting $= \left(15 \times \frac{7930}{3 \times 9}\right) = \$44.05\frac{5}{9}$.

40. Find the cost of papering the walls of a room 16′ × 18′ × 9′, with paper costing 50¢ a roll, 18 in. wide, and 24 ft. long.

41. A company with a capital of $600,000 lost $40,000 on its first year's business, and $20,000 on its second year's business. The next year it earned enough to pay 4% on its impaired capital. How much did it earn?

42. Divide thirty-two hundredths by 128, treating the dividend first as a decimal and second as a common fraction.

128).3200(.0025 $= \frac{25}{10000} = \frac{5}{2000} = \frac{1}{400}$.

256

640

640

$.32 = \frac{32}{100}$.

$\frac{32}{100} \div 128 = \frac{32}{100} \times \frac{1}{128} = \frac{1}{400}$.

$\frac{1 \times 25}{400 \times 25} = \frac{25}{10000} = .0025$.

43. If a man walks $9\frac{3}{8}$ miles in $2\frac{3}{4}$ hours, how far can he walk in $6\frac{1}{2}$ hours?

$$(9\tfrac{3}{8} \times 6\tfrac{1}{2}) \div 2\tfrac{3}{4} = \frac{75}{\frac{8}{2}} \times \frac{13}{2} \times \frac{4}{11} = \frac{975}{44} = 22\tfrac{7}{44} \text{ miles.}$$

44. If $\frac{1}{3} + \frac{1}{4} + \frac{1}{12}$ of a number amounts to 36, what is the number?

$$\tfrac{1}{3} + \tfrac{1}{4} + \tfrac{1}{12} = \tfrac{4}{12} + \tfrac{3}{12} + \tfrac{1}{12} = \tfrac{8}{12} = \tfrac{2}{3}.$$

$\frac{2}{3}$ of the number = 36. $\frac{1}{3}$ of the number = $\frac{1}{2}$ of 36; and the whole of the number equals $3 \times \frac{1}{2}$ of 36, or $\frac{3}{2}$ of 36.

$$\frac{3}{\cancel{2}} \times \overset{18}{\cancel{36}} = \frac{54}{1} = 54.$$

45. The amateur running record for 100 yd. is 10 sec. What rate is this per mile?

46. Find the value in U. S. money of £46 8*s.* 8*d.*

47. If A can dig a trench in 3 hours, and B can dig it in 5 hours, and C can dig it in 7 hours, in what time can A, B, and C dig the trench, all working together?

A can dig the trench in 3 hr.; therefore, he can dig $\frac{1}{3}$ of it in 1 hr.

B can dig the trench in 5 hr.; therefore, he can dig $\frac{1}{5}$ of it in 1 hr.

C can dig the trench in 7 hr.: therefore, he can dig $\frac{1}{7}$ of it in 1 hr.

Therefore, the three, A, B, and C, working together, can dig $\frac{1}{3} + \frac{1}{5} + \frac{1}{7}$ in 1 hr.

$$\tfrac{1}{3} + \tfrac{1}{5} + \tfrac{1}{7} = \tfrac{35}{105} + \tfrac{21}{105} + \tfrac{15}{105} = \tfrac{71}{105}.$$

If they can dig $\frac{71}{105}$ in 1 hr., they can dig $\frac{1}{105}$ in $\frac{1}{71}$ hr., and therefore, $\frac{105}{105}$, or the whole trench in $\frac{105}{71}$ hr., or, $1\frac{34}{71}$ hr.

48. A man having \$1000 invested his money in a speculation in wheat and gained 10%. He then invested the amount and lost 10%, again speculated with all his money and gained 10%, and again speculated with the amount and lost 10%. How much was he worth then?

He gained $\frac{1}{10}$ of \$1000 = \$100.

He then was worth \$1000 + \$100 = \$1100.

He speculated again and lost 10%.

Hence he lost $\frac{1}{10}$ of \$1100 = \$110; \$1100 − \$110 = \$990.

In his next investment he gained $\frac{1}{10}$ of \$990 = \$99.

\$990 + \$99 = \$1089 = amount he owned then.

He lost $\frac{1}{10}$ of this amount; $\frac{1}{10} \times \$1089 = \$108.90$.

\$1089 − \$108.90 = \$980.10.

49. A person, owning $\frac{3}{5}$ of a copper mine, sells $\frac{3}{4}$ of his interest in it for \$1800. What, at this rate, is the value of the whole?

50. If $17\frac{1}{2}$ yd. of cloth, 54 in. wide, cost \$78.75, what would be the cost of 30 yd. of cloth of the same quality, but only 40 in. wide?

Cost of $17\frac{1}{2}$ yd. cloth, $\frac{3}{2}$ yd. wide = $\$78\frac{3}{4}$.

Cost of 1 yd. cloth, $\frac{3}{2}$ yd. wide = $\frac{\$78\frac{3}{4}}{17\frac{1}{2}}$.

Cost of 1 yd. cloth, 1 yd. wide = $\frac{\$78\frac{3}{4}}{17\frac{1}{2} \times \frac{3}{2}}$.

Cost of 30 yd. cloth, 1 yd. wide = $\frac{\$78\frac{3}{4} \times 30}{17\frac{1}{2} \times \frac{3}{2}}$.

$$\frac{\$78\frac{3}{4} \times 30 \times \frac{10}{9}}{17\frac{1}{2} \times \frac{3}{2}} = \frac{\$\frac{315}{4} \times \frac{30}{1} \times \frac{10}{9}}{\frac{35}{2} \times \frac{3}{2}} = \frac{\$315}{4} \times \frac{30}{1} \times \frac{10}{9} \times \frac{2}{35} \times \frac{3}{2}.$$

51. Find the cost of building a stone wall 200 rd. long, 3 ft. wide at the bottom, 2 ft. wide at the top, and 5 ft. high, at \$1.65 per perch.

52. What per cent of $\frac{5}{8}$ is $\frac{3}{7}$?

53. Find the volume of a rectangular solid, whose dimensions are 8 ft. 9 in., 3 ft. 4 in., and 8 ft. 4 in.

54. What is the length of a room, whose width is 10 ft. 4 in., and height 10 ft. 6 in., and which contains 1519 cubic feet of air?

55. Find the cost of paving a floor, whose length is 33 ft. 2 in., and whose width is 18 ft., at 60¢ per square yard.

56. How many cubic feet of air are there in a room 32 ft. by 28 ft. by 12 ft.?

57. The ice on a pond 1 mi. in diameter is 1 ft. thick. How many cubic feet of ice are there?

58. What will be the cost of carpeting a room, 17 ft. 9 in. long, and 12 ft. 5 in. wide, with carpet $\frac{3}{4}$ yd. wide, at $1 a yard?

SOLUTION. — Patterns of carpets usually repeat the design with every yard. Each breadth of carpet for this room should be 6 yd. long. 12 ft. 5 in. $\div \frac{3}{4}$ yd. = number of breadths required. 6 yd. $\times$ 6 breadths at $1 a yard are the necessary facts to get the cost.

59. Reduce 5 cu. yd. 5 cu. ft. 255 cu. in. to cubic inches.

60. A room is 34 ft. 8 in. long and 13 ft. 6 in. wide. Find the cost of carpeting it with carpet $\frac{3}{4}$ yd. wide at 75¢ a yard.

61. A tin-lined box is 2 ft. 5 in. long, 1 ft. 10 in. wide, and 1 ft. 3 in. high, inside. What weight of water will it hold? (1 cu. ft. of water weighs 1000 ounces.)

$$1728)9570(5.538\tfrac{7}{36} \text{ (cu. ft.)}$$

$$1000 \text{ oz.} \times 5.538\tfrac{7}{36} = \text{weight of water.}$$

62. If one eighth of a fishing schooner is worth $730.625, what part of the schooner is worth $2505?

63. How many shingles does it take to cover the two sides of the roof of a building 55 ft. long, with rafters $16\frac{1}{2}$ ft. in length, when each shingle is 15 in. long and 4 in. wide, and lies one-third to the weather?

64. How many square yards of plastering are there on the sides of a room 20 ft. long, 14 ft. 6 in. wide, and 10 ft. 4 in. high, which has a fireplace 4 ft. 4 in. by 4 ft., and 2 windows each 6 ft. by 3 ft. 2 in.?

65. A block of stone is 2 yd. 1 ft. 3 in. long, 1 ft. 7 in. broad, and 2 ft. thick. Find its cubic contents and its value at $2\frac{1}{4}¢$ per cu. ft.

66. Find the cubic contents of a log of wood 20 ft. long, 1 ft. 6 in. broad, and 2 ft. 4 in. thick.

67. How many cubic yards of excavation are there in a cellar 8 yd. long, 5 yd. wide, 2 yd. deep?

68. How many cubic yards of excavation are there in a cellar 18 ft. long, 15 ft. wide, 7 ft. deep?

69. The difference between $\frac{12}{14}$ and $\frac{14}{16}$ of a number is 10. What is the number?

70. What is the quotient of $32 \times 10 \times 8$ divided by 16×40?

71. *a.* Multiply 3640 by 10, by 100, by 1000.

b. Multiply 3640.0463 by 10, by 100, by 1000.

c. Divide 3640.0463 by 10, by 100, by 1000.

72. A speculator invested $\$825$ in wheat, and sold it at a gain of $8\frac{1}{2}\%$. What was his selling price?

73. A and B traded in company, and gained $\$348$, of which B's share was $\$261$. If A's stock was $\$175$, what was B's stock? What was A's share of the gain?

74. How many years, months, and days passed from the birth of William Shakespeare, April 23, 1564, to the birth of Milton, Dec. 9, 1608?

75. Change 74237 sq. yd. to square rods.

76. Reduce 308471296 sq. in. to square feet, square yards, etc.

77. A and B traded in company. A put in $200, and B put in $300. A's share of the gain was $84.56. What was B's share?

78. In the Cape Nome district gold dust is valued at $15 an ounce. In the Klondike gold dust is worth 15\frac{3}{4}$ an ounce. What is the difference in value of 1800 oz. in the two places?

79. Last year 19 mi. 400 yd. of water pipe were in use in a city; this year 22 mi. 100 yd. are in use. How much water pipe has been laid during the year?

80. A true year, or the time in which the earth revolves once around the sun, is 365 da. 5 hr. 48 min. 46.15 sec. Reduce this compound number to lower denominations.

81. Reduce 6 yd. 2 ft. to a fraction of a mile. There are 1760 yd., or 5280 ft., in 1 mi.

6 yd. = 18 ft. 18 ft. + 2 ft. = 20 ft.

$\frac{20}{5280} = \frac{2}{528} = \frac{1}{264}$ of a mile.

82. What per cent of 36 is 6?

83. Of a cargo of 1850 tons of wheat 370 tons were destroyed by fire. What was the per cent of loss?

$\frac{370}{1850} = \frac{37}{185} = \frac{1}{5} = .2 = 20\%$.

84. How many square yards of canvas will be required to make a sail 6 yd. long and 4 ft. wide?

85. A can do a piece of work in 12 days, and B can do the same work in 18 days. How long will it take both, if they work together?

86. What number multiplied by $1\frac{3}{8}$ will produce $14\frac{3}{4}$?

87. What number divided by $1\frac{3}{8}$ will give as a quotient $10\frac{8}{11}$?

88. Subtract:

a.	*b.*	*c.*	*d.*
\$9876.43	\$427.63	\$1234.50	\$671.98
987.49	197.21	999.96	99.67

89. Subtract:

lb.	oz.	dwt.	gr.
554	9	18	4
97	0	16	15

90. Subtract:

£	*s.*	*d.*
1098	12	6
434	15	8

91. Subtract:

yr.	da.	hr.	min.
767	131	6	30
476	110	14	13

92. A can do a piece of work in 5 da., B can do it in 6 da., and C can do it in 7 da. In what time can A, B, and C, all working at it, finish the work? Find also in what time A and B working together, A and C together, and B and C together, can respectively finish the same work.

Representing the work by unity, or 1,

in one day A does $\frac{1}{5}$ part of the work,

in one day B does $\frac{1}{6}$ part of the work,

in one day C does $\frac{1}{7}$ part of the work.

In one day A + B + C do $(\frac{1}{5} + \frac{1}{6} + \frac{1}{7})$, or $\frac{107}{210}$ part; therefore, time in which A + B + C would finish the work $= 1 \div \frac{107}{210}$ da. $= \frac{210}{107}$ da. $= 1\frac{103}{107}$ da.

Again, in one day A + B do $(\frac{1}{5} + \frac{1}{6})$, or $\frac{11}{30}$ of the work; therefore, time in which they would finish it $= 1 \div \frac{11}{30}$ or $2\frac{8}{11}$ da.

93. If A can do a piece of work in 3 da., B in 4 da., and C in 5 da., how many times longer will it take B to do it alone, than it will take A and C together to do the work?

94. Find the premium for fire insurance on buildings for:

a. \$7500, at $1\frac{3}{4}\%$.
b. \$8375, at $\frac{3}{4}\%$.
c. \$6000, at $1\frac{7}{8}\%$.
d. \$5000, at $1\frac{17}{100}\%$.
e. \$6400, at 0.90%.
f. \$4500, at 0.35%.

95. If a load of soft coal, weighing 3650 lb., cost \$4.38, how much is the cost of a ton of 2000 lb.?

96. If $2\frac{2}{4}$ yd. of cloth, $1\frac{4}{10}$ yd. wide, cost $\$3.37\frac{2}{5}$, what will be the cost of $36\frac{1}{2}$ yd., $1\frac{1}{2}$ yd. wide?

97. A is 102 mi. in advance of B, who is in pursuit of him; A travels 32 mi. per hour, and B 38. In how many hours will B overtake A?

98. How many yards of carpet, $1\frac{1}{4}$ yd. wide, will cover a floor 54 ft. long and 30 ft. wide, when there is no pattern requiring matching?

99. If, by working $6\frac{3}{5}$ hr. a day, a man can accomplish a piece of work in $12\frac{1}{2}$ da., how many days are required when he works $8\frac{1}{3}$ hr. per day, working as hard and fast?

100. An open court contains 80 sq. yd. How many stones, 18 in. square, are required to pave it?

101. Divide \$630 among 3 persons, so that the second shall have $\frac{1}{2}$ as much as the first, and the third $\frac{1}{2}$ as much as the other two. What is the share of each?

SUGGESTION. — Let $2x$ = B's share,
then $4x$ = A's share,
and $3x$ = C's share.
$9x = \$630$.

102. Smith and Jones traded as partners. Smith paid in 3 times as much of the capital as Jones, and they gained \$1176. What was each one's share of the gain?

Suggestion. — Since Smith paid in 3 times as much as Jones, both together must have paid in 4 times as much as Jones. Therefore, Jones paid in $\frac{1}{4}$, and Smith $\frac{3}{4}$, of the capital.

103. What is the height of a wall which is $14\frac{1}{2}$ yd. in length and $\frac{7}{10}$ of a yard in thickness, and which has cost \$406, it having been paid for at the rate of \$10 per cu. yd.?

104. How many building lots, each 50 ft. by 100 ft., can be made out of $2\frac{1}{2}$ A. of ground?

105. Add:

I	II	III	IV
73846	8749638	89417675	673673
29873	6859639	714877	968759
48765	6916387	7891466	123456
38214	3878964	815677	567459
47386	8738495	77361648	732567
96786	4856877	58329412	684497
78788	5293750	23798657	732684

106. Multiply:

a. $35.245 \times .035245$.
b. $.0625 \times 6.25$.
c. $47 \times .00047$.
d. $.0045 \times .00045$.
e. $45.25 \times .04525$.
f. $39.12 \times .03912$.
g. $45 \times .075$.
h. $365 \times .00365$.
i. $465.9 \times .04659$.

107. A farmer bought a yoke of oxen, and paid \$40 of their cost in work, which was $\frac{5}{8}$ of the cost. What did they cost?

108. A man having \$1500, paid $\frac{3}{5}$ of it for $112\frac{1}{2}$ acres of land. How much did his land cost per acre?

109. If $\frac{5}{8}$ of a pound of tea cost 40 cents, what will $\frac{7}{8}$ of a pound cost?

110. A bought $\frac{3}{8}$ of a ton of hay for $6.42. How much will $\frac{7}{8}$ of a ton cost?

111. A can build a wall in 6 da., B can build it in 9 da. How long will it take them both together to build it?

112. If A can chop a cord of wood in 4 hr., and B in 6 hr., how long will it take them both to chop a cord?

113. A can dig a cellar in 6 da., B in 9 da., and C in 12 da. How long will it take all of them together to dig it?

114. I employed A and B to dig a trench. A was to receive $87\frac{1}{2}$¢ per rod, and B was to have $\$1.12\frac{1}{2}$ per rod; each man worked until his wages amounted to $50. What was the amount of trench dug by both?

115. After expending $\frac{1}{4}$ of my money, and $\frac{1}{4}$ of the remainder, I had remaining $72. How much had I at first?

116. A father gives to his five sons $1000, which they are to divide according to their ages, so that each elder son shall receive $20 more than his next younger brother. What is the share of the youngest?

117. Two persons, A and B, being on opposite sides of a fish pond, which is 536 ft. in circumference, begin to walk around it at the same time, both in the same way. A goes at the rate of 31 yd. per minute, and B at the rate of 34 yd. per minute. In what time will B overtake A? And how far will A have walked?

SUGGESTION. — How many yards per minute does B gain upon A?

118. How many men must be employed to perform in 26 da. what 60 men could do in 39 da.?

119. If 72 sheep can graze in a field 36 da., how long could 144 sheep graze there?

120. Add

I	II	III	IV
72473683	107485075	5962847	5498
74928	870302861	5196382	672457
5536	73628874	324	766257
674976	668279	648900	35396284
7967450	47538234	8007119	85936428
13207895	267849026	9127644	97894
34827583	486792836	8272491	18769662
27590328	9563748	6378948	91731234
56385517	6473928	4677836	85373948

121. George Washington was born Feb. 22, 1732. How old was he when the battle of Bunker Hill was fought, June 17, 1775?

122. What length of time elapsed between the battle of Bunker Hill and the battle of Waterloo, June 18, 1815?

123. The Spanish fleet under Admiral Cervera was destroyed off the southeastern coast of Cuba, July 3, 1898. How many years, months, and days have passed since then?

124. There are 52 sq. yd. 7 sq. ft. of plastering in the ceiling of a certain room, 30 sq. yd. 5 sq. ft. in each of the two side walls, and 23 sq. yd. 2 sq. ft. in each of the two end walls. Find the total area of plastering in the room.

125. A rectangular solid is 7 ft. high and 6 ft. wide. It contains 966 cu. ft. Find the area of the six faces.

126. A pulp mill turned out $40\frac{3}{4}$ T. of paper pulp per day. Find the yearly output, reckoning 310 working days per year.

127. A is worth $1473.21 more than B, and B is worth just $\frac{3}{4}$ as much as A. How many dollars is each of them worth?

SUGGESTION.—If B is worth only $\frac{3}{4}$ as much as A, the difference between the values of their estates must equal $\frac{1}{4}$ of A's estate.

128. If $8\frac{1}{2}$ yd. of broadcloth can be purchased for $\$29\frac{3}{8}$, how many yards can be purchased for $\$35\frac{1}{4}$?

129. If $10\frac{1}{5}$ yd. of velvet cost $\$35\frac{1}{4}$, how much will $8\frac{1}{2}$ yd. cost?

130. If $\frac{1}{12}$ of a ton of hay costs $\$17.50$, how much will two loads cost, one weighing $\frac{5}{6}$ of a ton, and the other $\frac{3}{24}$ of a ton?

131. I had a field 30 rd. square. I sold 18 sq. rd. to one man, and 82 sq. rd. to another man. What part of the field remained unsold?

132. If 11 men can mow 24 A. 968 sq. yd. of grass in a day, how much can 1 man mow?

133. If a stonemason lays 33 cu. yd. 3 cu. ft. of stone in 6 days, how much does he lay per day?

134. How many bricks 8 in. $\times$ 4 in. $\times$ 2 in. would measure a cubic foot?

135. Find the cubic contents of a stick of square timber 24 ft. $\times$ 15 in. $\times$ 15 in.

136. Find the cost of 9 doz. of knives at $\$10\frac{5}{8}$ per dozen.

137. $441698853 + 37519162 + 599678437 - 4840 + 5128697 + 20304009 + 679821345 - 172564 + 4263721.$

138. $2\frac{2}{3} + \frac{3}{5} + 4 - 5\frac{5}{6} = ?$

139. Find the length of a room 11 ft. 11 in. wide, the floor of which requires 17 sq. yd. 2 sq. ft. 131 sq. in. of drugget to cover.

140. How many bushels of oats at $62\frac{1}{2}$ cents a bushel will pay for 4250 ft. of lumber at $\$7.50$ per thousand?

141. A tailor had a bolt of cloth containing $24\frac{1}{2}$ yd., from which he cuts $6\frac{5}{8}$ yd. How many yards were left?

142. Reduce 742392 sec. to days; 174296 sec. to days.

143. When it is 9 A.M. in Halifax, Nova Scotia, in Chicago it is 7 hr. 24 min. $24\frac{2}{3}$ sec. A.M. The longitude of Halifax being 63° 36′ 40″ W., what must be the longitude of Chicago?

144. A and B can do a piece of work in 6 da.; A and C can do the same work in 8 da.; and B and C can do the work in 10 da. Find the time in which A, B, and C would do the work: working, first, all together; secondly, separately.

145. If a cistern can be filled by a pipe in 2 hr., how long would it take to fill the cistern if it has a leak which would empty it in 10 hr.?

In one hour the pipe fills $\frac{1}{2}$ of the cistern.

In one hour the leak empties $\frac{1}{10}$ of the cistern.

Therefore, in one hour, when the pipe and leak are both open, the part of the cistern filled by what runs in less what runs out

$$= \frac{1}{2} - \frac{1}{10} = \frac{2}{5},$$

Therefore, the time required to fill the cistern $= 2\frac{1}{2}$ hr.

146. How many yards of paper that is 30 in. wide will paper a room that is 20 yd. in circuit, and 9 ft. high?

147. If 12 men reap a field of wheat in 3 da., in what time can the same work be done by 25 men?

148. A man, failing in business, finds that he owes A $424, B $638, C $197, D $338, and E $574, and that his whole available property amounts only to $1173. How much ought he to pay to each creditor?

SUGGESTION.—Since he owes $2171, and has but $1173, he can pay but $\frac{1173}{2171}$ of his debts. Therefore, he ought to pay A $\frac{1173}{2171}$ of $424, B $\frac{1173}{2171}$ of $638, etc.

149. The stock of a bankrupt is valued at $1200, and he owes $4200. How many dollars ought he to pay the person to whom he owes $546? to whom he owes $338.73?

150. Suppose I buy a certain number of apples at 3 for one cent, and as many more at 5 for one cent, and sell them at 4 for one cent; do I gain or lose by the operation?

151. A can do a piece of work in 4 da., and B can do the same in 3 da. How long would it take both together to do the work?

152. How many yards of Brussels carpeting, which is $\frac{3}{4}$ of a yard wide, will it require to cover a floor 18 ft. by 20 ft.?

153. What part of a day is 3 hr. 21 min. 15 sec.?

154. Four men, A, B, C, and D, are in possession of $2000; A has a certain sum, B has twice as much as A, C has $600, and D has $200 more than C; how many dollars has A?

155. At an election, 4800 votes were cast for three candidates, A, B, C; B had 400 more votes than A, and C had 1000 more than B. How many votes were cast for A?

156. A garden, whose breadth is 10 rd., and whose length is $1\frac{3}{5}$ times its breadth, has a wall $3\frac{1}{2}$ ft. thick around it; what was the cost of digging a trench $2\frac{3}{4}$ ft. deep, in which to lay this wall, at $\frac{3}{4}$ of a cent per cubic foot?

157. A and B speculated with equal sums of money; A gained a sum equal to $\frac{2}{10}$ of his stock; B lost \$200, and then he had $\frac{4}{8}$ as much as A. How much was the original stock of each?

158. A house is 24 by 20, with a wing 16 by 18. Find the cost of excavating for an 8-ft. cellar at 25¢ per cubic yard.

159. If a man earn \$75 per month, and spends 65% of it, how much does he save in 9 yr.?

160. A and B can do a piece of work in 14 days; A can do only $\frac{3}{4}$ as much as B. In how many days can each do the work?

161. If $\$7\frac{1}{4}$ will buy $3\frac{1}{4}$ tons of coal, how many tons can be bought for $\$10\frac{1}{2}$?

162. I bought $\frac{6}{7}$ of a yard of silk, and having used $\frac{7}{8}$ of it sold the remainder for $\$2\frac{16}{25}$. How much would a yard cost at the same rate?

163. After losing $\frac{1}{2}$ of a roll of wire, I added 30 ft., the roll then was $\frac{4}{5}$ of its original length. What was its length at first?

164. $48\frac{4}{5}$ is a dividend, and $24\frac{2}{5}$ is the quotient; what is the divisor?

165. $47\frac{3}{5}$ is the product of two factors, and $12\frac{1}{3}$ is one of those factors; what is the other factor?

166. A tub of butter contains $33\frac{1}{2}$ lb. What is the value of the butter at $23\frac{1}{2}$¢ a pound?

167. How many times will a wheel that is $9\frac{1}{3}$ ft. in circumference turn round in running $17\frac{3}{4}$ mi.?

168. A merchant, owning $\frac{3}{8}$ of a vessel, sold $\frac{4}{6}$ of his share for \$3000. What was the value of the vessel?

169. The cargo of a certain ship is worth $48,000, and $\frac{5}{6}$ of the value of the cargo is $\frac{10}{3}$ the value of the ship. What is the ship worth?

170. If a locomotive pass from A to B, a distance of 17 mi., in 45 min., what time will it require, at the same rate, to go from B to C, a distance of 78 mi.?

171. X, Y, and Z traded in company for 1 year. X put in $1000, Y put in $1500, and Z put in $2000. At the end of the year they found that they had gained $1800. What was each man's share of the gain?

172. A certain clerk receives $800 a year; his expenses equal $\frac{5}{3}$ of what he saves. How much of his salary does he save yearly?

173. Add:

I	II	III	IV
896356	823676	896567	968497
729389	767823	269846	732546
674869	476467	673734	123759
643387	696894	893382	567459
869643	568969	324742	732684
323232	467935	742428	684567

174. When $\frac{2}{3}$ of a bolt of cloth cost 5\frac{1}{2}$, what does the whole bolt cost?

175. If 1 yard of dimity is worth $12\frac{1}{2}$¢, what is the value of $12\frac{1}{2}$ yards?

176. A, B, C, and D agree to cut 500 cd. of wood for $300. When the job is finished, they find that A has cut 125 cd., B 100 cd., C 150 cd., and D the rest. How many dollars ought each man to receive?

177.

a. $3001002 - 450678 = ?$	*b*. $7060101 - 879604 = ?$
c. $3100121 - 80976 = ?$	*d*. $2350610 - 708567 = ?$
e. $3001002 - 798607 = ?$	*f*. $4301021 - 908757 = ?$
g. $5001002 - 679807 = ?$	*h*. $2710356 - 706897 = ?$
i. $4987061 - 368509 = ?$	*j*. $9010203 - 768079 = ?$
k. $3001201 - 860859 = ?$	*l*. $2700121 - 768097 = ?$

178. (*a*) Find the length of an 84 A. lot, 48 rd. wide.

(*b*) Find the value of a farm 86 rd. long and 63.5 rd. wide, at $\$ 87\frac{1}{2}$ per acre.

179. How many cubic feet of water can be contained in a vessel with square base, whose side is 3 ft., and height 2 ft. 10 in.?

180. How much timber is there in a beam, whose length is 20 ft., breadth 3 ft., and thickness 2 ft. 6 in.?

181. Find the solid contents of a cube, whose side is 7 ft. 5 in.

182. In making a square pond, whose side was 12 yd., there were taken out 336 cu. yd. of earth. How deep was the pond made?

183. What must be the length of a trench, 5 ft. 6 in. deep, and 10 ft. 8 in. wide, that it may contain 7040 cu. ft.

184. What is the cost of plastering a partition 7 ft. 8 in. long, and 10 ft. 3 in. high, at $45\cent$ a square yard, deducting a door, 6 ft. 3 in. by 2 ft. 10 in.?

185. When it is 2 hr. 36 min. A.M. at the Cape of Good Hope, in longitude 18° 24′ east, what is the time at Cape Horn, in longitude 67° 21′ west?

186. Yesterday my longitude, at noon, was 16° 18′ west; to-day I see by my watch, which has kept correct time, that the sun is on the meridian at 11 hr. 36 min. What is my longitude to-day?

187. From a field containing 3 A. 63 sq. rd. 200 sq. ft., there were sold 1 A. 77 sq. rd. 30 sq. yd. 8 sq. ft. What quantity remained?

188. What part of $\frac{3}{4}$ of an acre is $\frac{5}{9}$ of an acre?

189. How many pounds of raisins, at $15\frac{3}{4}$ cents per pound, can be bought for $6.40?

190. How many square feet in the four walls of a room, $15\frac{1}{3}$ ft. long, $12\frac{3}{4}$ ft. wide, and $8\frac{1}{2}$ ft. high?

191. I bought a cask, containing $94\frac{1}{2}$ gal. of oil, at $1.375 per gallon; $\frac{2}{7}$ of it leaked out, and I sold the remainder at $1.50 per gallon. How much did I lose by the transaction?

192. How many square feet in the floor, ceiling, and four walls of a room that is 18 ft. 6 in. long, 15 ft. 9 in. wide, and 8 ft. 4 in. high?

193. How many yards of carpet, $\frac{3}{4}$ yd. wide, will be required to cover a floor that is 16 ft. 6 in. long, and 15 ft. 8 in. wide, when the pattern must match?

194. Find the cost of roofing a house, 60 ft. long, and 22 ft. 9 in. from the ridge to the eaves, at 36¢ a square yard.

195. Find the cost of a brick wall 150 ft. long, 8 ft. 6 in. high, 1 ft. 4 in. thick, allowing $\frac{1}{10}$ for mortar, at $7 a thousand bricks.

196. Find the cost of painting a wall, 14 ft. by $9\frac{1}{2}$ ft., at 18¢ a square yard, except a chimney, 4 ft. 6 in. by 3 ft. 10 in.

197. How many yards of oilcloth, 27 in. wide, will be required to cover a floor 48 ft. long and 33 ft. wide?

198. How many cubic yards in an embankment 252 ft. long, 22 ft. wide, and 5 yd. high?

199. How many cords in a pile of wood 8 ft. wide, 12 ft. high, and 132 ft. long?

200. How many cubic inches are there in a box, whose length is 30 in., its breadth 18 in., and its depth 15 in.?

201. How many cubic inches in a block of marble 43 in. long, 18 in. broad, and 12 in. thick?

202. How many cubic feet in a room 16 ft. long, 15 ft. wide, and 9 ft. high?

203. How many cubic feet in a pile of wood 16 ft. long, 6 ft. wide, and 5 ft. high? How many cords?

204. How many cords of wood in a pile 140 ft. long, $4\frac{1}{2}$ ft. wide, and $6\frac{1}{2}$ ft. high?

205. How many perches of 25 cu. ft. each in a pile of building stone 18 ft. long, $8\frac{1}{2}$ ft. wide, and 6 ft. 2 in. high?

206. Find the cost of laying a wall 20 ft. long, 7 ft. 9 in. high, and with a breadth of 2 ft., at 75¢ a perch.

207. Find the cost of a foundation wall 1 ft. 10 in. thick and 9 ft. 4 in. high, for a building 36 ft. long, 22 ft. 5 in. wide outside, allowing for 2 doors, each 4 ft. wide, at \$2.75 a perch.

208. Simplify: $\frac{\frac{1}{2}+\frac{1}{4}+\frac{1}{7}+\frac{1}{14}+\frac{1}{28}}{\frac{1}{2}+\frac{3}{4}+\frac{6}{7}+\frac{13}{14}+\frac{27}{28}}$.

$$\frac{(\frac{1}{2}+\frac{1}{4}+\frac{1}{7}+\frac{1}{14}+\frac{1}{28})\times 28}{(\frac{1}{2}+\frac{3}{4}+\frac{6}{7}+\frac{13}{14}+\frac{27}{28})\times 28}=\frac{14+7+4+2+1}{14+21+24+26+27}=\frac{1}{4}.$$

209. Reduce 22 da. 4 hr. 55 min. 42 sec. to the fraction of 34 da. 20 hr. 56 min. 6 sec.

$$\frac{532 \text{ hr. } 35.7 \text{ min.}}{836 \text{ hr. } 56.1 \text{ min.}}=\frac{31955.7}{50216.1}=\frac{106519}{167387}=\frac{15217\times 7}{15217\times 11}=\frac{7}{11}.$$

210. The breadth of a room is half as much again as its height; its length is twice its height; it cost \$87.50 to

decorate its walls at $.125 per square foot. What are the dimensions of the room?

The length, breadth, and height are as 2, $1\frac{1}{2}$, and 1.

Number of linear units around room $= (2 + 1\frac{1}{2}) \times 2 = 7$.

Number of sq. ft. of wall surface $= 87.50 \div \$.125 = 700$.

$700 \div 7 = 100$, number of sq. ft. in a portion of the wall 1 unit long and 1 unit high. $\therefore$ 1 unit $\times$ 1 unit $= 100$.

$\therefore$ the required height is 10 ft., length 20 ft., and breadth 15 ft.

211. A person sold two farms for $1890 each; for one he received $\frac{1}{4}$ more than its true value, and for the other $\frac{1}{4}$ less than its true value. Did he gain or lose by the sale, and how much?

212. What number is that which being increased by its half, its third, and 18 more, will be doubled?

213. A young man inherited a fortune, $\frac{3}{12}$ of which he spent in 3 mo., and $\frac{6}{14}$ of the remainder in 10 mo., when he had $2524 left. How much had he at first?

214. Find the diameter of a circle 10 ft. in circumference.

215. A person owning $\frac{2}{3}$ of a vessel sells $\frac{5}{8}$ of his share for $1736. What was the value of the whole vessel?

216. If a man performs a journey in $7\frac{1}{8}$ da., traveling $14\frac{2}{3}$ hr. a day, in how many days will he perform the same journey by traveling $10\frac{6}{7}$ hr. a day?

217. After spending $\frac{1}{4}$ of my money and $\frac{1}{5}$ of the remainder, I had $1062 left. How much had I at first?

218. A cistern had two pipes. One can fill it in 7 hr., and the other in 5 hr. In what time can both fill it running together?

219. A can mow a certain field of grass in 3 da., B can do the work in 4 da., and C in 5 da. In what time can all three working together mow the field?

220. A reservoir has three pipes; the first can fill it in 10 da., the second in 16 da., and the third can empty it in 20 da. In what time will the cistern be filled if they are all allowed to run at the same time?

221. If 165 lb. of cheese cost $16.50, for how much must one sell 390 lb. in order to gain the cost of 36 lb.?

222. An individual, after spending $\frac{2}{5}$ of all his money, and $\frac{2}{3}$ of the remainder, had $134\frac{1}{2}$ remaining. How much had he at first?

223. A park, 10 rd. square, has a cement walk around it. What was the cost of laying it at 23¢ per square foot?

224. The sum of $8884 is to be divided among a widow, two sons, and two daughters, so that each son shall receive twice as much as each daughter, lacking $120, and the widow as much as all the children, lacking $260. What sum should be given to each person?

225. A rectangular box, 8 ft. long, 3 ft. wide, contains 168 cu. ft. Another box, whose length is the same, and whose height is twice that of the first, contains 1000 cu. ft. Find its width.

226. What number is that, from which if $3\frac{2}{7}$ be taken, the remainder will be $4\frac{1}{4}$?

227. From $\frac{7}{11}$ of a mile take $\frac{7}{9}$ of 40 rd.

228. How many bricks 8 in. long, 4 in. wide, and 2 in. thick, will it take to build a wall 40 ft. long, 20 ft. high, and 2 ft. thick?

229. How many tiles, each 8 in. square, will cover a floor 18 ft. long and 12 ft. wide?

230. A man willed $\frac{1}{3}$ of his estate to his wife, $\frac{1}{4}$ of the remainder to his oldest son, and $\frac{1}{6}$ of the residue, which was $151.33\frac{1}{3}$, to his oldest daughter. Find the value of that part of the estate left to be divided among his other heirs.

231. If $\frac{3}{11}$ of a yard cost \$5, what quantity will \$17.50 purchase?

232. When $\frac{2}{5}$ of a gallon cost \$87, what will $7\frac{1}{4}$ gal. cost?

233. When \$71 are paid for $18\frac{2}{7}$ yd. of broadcloth, what will 5 yd. cost?

234. Since the sun passes over one degree in 4 min., and the longitude of Boston is 71° 4′ west, what is the time at Boston when it is 11 hr. 16 min. A.M. at London?

235. The death rate of a city of 200,000 people in 1890 fell in ten years from 27.4 per thousand to 19.8. It then had 275,000 people. Compare the number of deaths in 1900 with the number in 1890.

236. Add:

I	II	III	IV	V
478	6817	682475	371623	28765
614562	695737	468854	85738	3298
9875	462385	713628	654297	42641
589	752	299	8277	8369
423765	93607	51876	365685	28324
48567	342665	2945	423748	88603

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

a. 108, 126, and 162.

b. 140, 210, and 315.

c. 24, 42, 54, and 60.

d. 56, 84, 140, and 168.

238. Find the L. C. M. of:

a. 9, 15, 20, 35, and 48.

b. 8, 18, 27, 36, and 100.

c. 10, 16, 33, 42, and 66.

d. 15, 36, 48, 64, and 96.

239. The town of X, with 11,000 people, spends \$66,000 a year for public schools. The city of Y, with 280,000

people, spends $2,100,000 a year. The city of Z, with 600,000 people, spends $3,300,000 a year. What is the expense per capita in each community?

240. X has assessed property of $5,500,000. Y has property valued at $210,000,000. Z has property valued at $440,000,000. *a.* What is the wealth of each place per capita? *b.* What is the expense in each community per $1000 worth of property for the schools?

241.

MILWAUKEE, May 25, 1900.

WILLIAM ANHALT,

Bought of WEISTHAL FURNITURE CO.

38 yd. Brussels carpet . .	$1.10
1 doz. Dining room chairs .	1.75
1 Parlor table . . .	18.00
1 Sideboard	200.00
2 Sofas	28.00
4 Rocking chairs . . .	6.50
1 Parlor lamp . . .	12.00
2 doz. Teaspoons . . .	3.00
$\frac{1}{2}$ doz. Tablespoons . .	.75
2 Wedgwood vases . .	8.00

Received payment,

Find the various items and the total of this bill.

242. Divide:

a. $11 \times 26 \times 21$ by 13×14.

b. 56×240 by 28×60.

c. $9 \times 22 \times 12 \times 5$ by $6 \times 3 \times 11 \times 4$.

243. I had $1275 in the bank, but drew out 8 per cent of it; how much money had I left in the bank?

STATIONERS' TABLE

A sheet folded in 2 leaves is called a folio.
A sheet folded in 4 leaves is called a quarto, or 4to.
A sheet folded in 8 leaves is called an octavo, or 8vo.
A sheet folded in 12 leaves is called a 12mo.
A sheet folded in 16 leaves is called a 16mo.
A sheet folded in 24 leaves is called a 24mo.
A sheet folded in 32 leaves is called a 32mo.

The terms folio, quarto, octavo, duodecimo, etc., indicate the number of leaves into which a sheet of paper is folded. 24 inches by 38 inches is a common size for a printer's sheet, but various other sizes are in use.

MISCELLANEOUS TABLE

12 units, or things of the same kind, = 1 dozen.
12 dozen . . . . . = 1 gross.
12 gross, or 144 dozen . . . . . = 1 great gross.
20 things . . . . . = 1 score.
18 inches . . . . . = 1 cubit.
22 inches (nearly) . . . . . = 1 sacred cubit.

SURVEYORS' MEASURES

Surveyors' linear measure is used for land, roads, etc.

TABLE

$7\frac{92}{100}$ inches (in.)	= 1 link (l.)
25 links	= 1 rod (rd.)
100 links, 4 rd., or 66 ft.,	= 1 chain (ch.)
80 chains	= 1 mile (mi.)

Surveyors' square measure is used for area.

TABLE

625 square links (sq. l.)	= 1 square rod (sq. rd.)
16 square rods	= 1 square chain (sq. ch.)
10 square chains	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)
36 square miles (6 miles square)	= 1 township.