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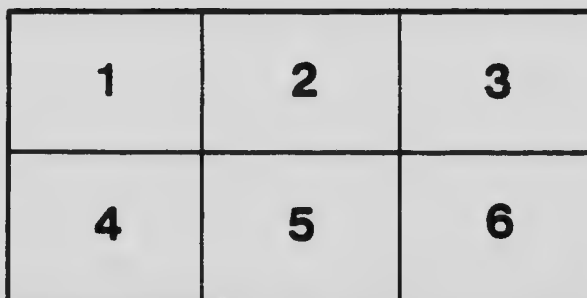
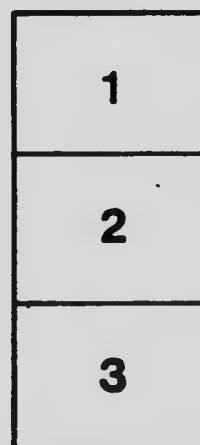
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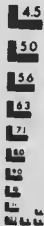
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MORANG'S
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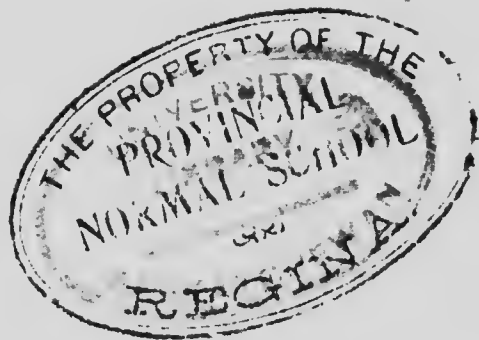
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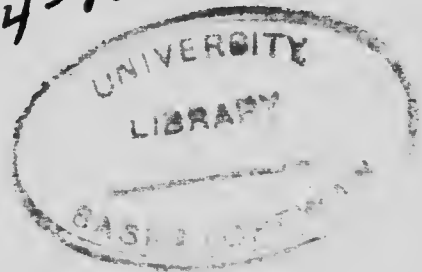


MORANG'S MODERN TEXT-BOOKS

A HAND-BOOK
TO
MORANG'S MODERN ARITHMETICS
BOOKS I AND II

BY
ALEXANDER McINTYRE, B.A.
VICE-PRINCIPAL NORMAL SCHOOL, WINNIPEG

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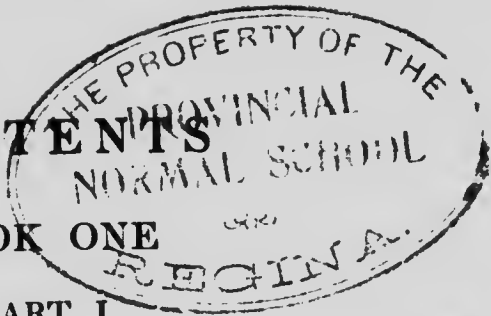
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PREFACE

IF arithmetic is ever to become a thought study—if pupils are ever to form the desirable habit of studying arithmetical problems carefully and independently before attempting their solutions, all such mental crutches as answers and hints must be removed from the backs of text-books. On the other hand, there seems to be a legitimate place for a book embodying answers to such questions as are of a mechanical nature, or are given for the purpose of testing previous progress. The answer to an arithmetical problem, though correct, should not be viewed by the teacher as the most important part of the question. For the teacher, the character of the solution is the main thing; a pupil's method should show a gradual improvement of the reasoning power. It is not to be expected that a child should employ the *best* method of solving a problem from the first, and it is bad teaching to show such a method to him until he has done all he can in an effort to arrive at this himself.

Morang's Modern Arithmetics have been written in the hope of providing books suitable for class and seat work, which shall be at once simple and scientific. An effort has been made to lead, or at least to accompany the pupil, rather than to drive him. It is hoped that the care taken will manifest itself by the absence of all errors except such as can hardly be avoided in collecting and arranging so many disconnected figures. Should any errors or ambiguities of the texts, not noted in the Hand-book, have still escaped notice, the author and the publisher will be grateful for such information as may lead to their correction.

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HANDBOOK TO MORANG'S MODERN ARITHMETICS

BOOK I—PART I

REVIEW OF THE MATHEMATICS OF THE PREVIOUS GRADES

MORANG'S Modern Arithmetics assume that a satisfactory foundation in primary mathematics has already been laid and that this preparation includes:

1. A study of elementary geometry.
2. A practical acquaintance with such measures as the yard, foot, inch; square yard, square foot, square inch; pound, ounce; quire, ream; copper coins and silver coins of Canada, the dollar; pint, quart, gallon, peck, bushel; hour, day, week, month, year.
3. A study of the first hundred numbers.

If the above work has been properly done, pupils should have no difficulty in working the sixteen exercises included in the review of the mathematics of the previous grades.

Exercise 1.—This exercise should test the pupil's knowledge of the elementary geometry already studied. Should the pupils show a ready grasp of the types selected there is a strong probability that the work in form has been faithfully presented. As the subject of geometry is rather an innovation in the primary classes, it is earnestly hoped that teachers may give it its due share of attention.

Exercise 2.—In many respects this exercise is testing for the signs of a habit very much neglected in the past. Do the pupils show a real knowledge of the measuring sticks? Have they made satisfactory progress in determining the heights and lengths of surrounding objects by means of the eye? This exercise should help the teacher as to the progress made.

Exercise 3.—Questions 1 to 7 should be worked quite rapidly. If pupils are a little slow in solving the remaining questions of this exercise, other questions of a similar character should be added. A play-store is also suggested.

Exercise 4.—Find from this exercise whether the pint, quart, etc., mean some reality to the children. If these are only so many sounds the pupils have had insufficient experience in the handling of the measures.

Exercise 5.—Do the pupils use yards, feet, and inches as readily as they use, e.g., sevens and nines in forty-nine?

Exercise 6.—Have the pupils make diagrams illustrating questions 4 and 5.

Exercise 7.—Question 2 may be too difficult. Change it to read: John bought four quires of notepaper at four dollars a ream, and sold it at two cents a sheet. How much did he gain or lose?

Exercise 8.—This exercise is meant to provide a rapid oral review of fractional relations. It should be conducted without any previous preparation on the part of the pupils. Solutions should be asked for.

Exercise 9.—In this exercise pupils are to show that they can add rapidly, that they have made some progress in mastering the endings in addition, and that they understand the value of the decimal notation for numbers up to 100.

Exercise 10.—This exercise should be worked in class orally. Solutions should be asked for, as the habit of accepting answers alone is not a desirable habit to form. Questions 4, 5, 7, 9, 10, 11, 13, and 14 should also be worked in the exercise book and on the blackboard.

Exercise 11.—This exercise is to test what power the pupils have attained in rearranging awkward minuends. The method suggested in the note at the end of the chapter should be employed. Some teachers prefer, however, to treat all subtraction questions as questions in addition. Thus—Take 19 from 31 is

made to read: What do we add to 19 to make 31? It is well to follow the method the children have already acquired, provided this method is a correct one.

Exercise 12.—See hints under Exercise 10.

Exercise 13.—The facts of the multiplication tables must be readily available to the pupil. A pupil who has to think out 9×8 every time he meets this problem is rather badly handicapped for the work of multiplication. This exercise will furnish a sufficient test as to the readiness of the pupil in this particular.

Exercise 14.—Follow the same order as in Exercises 10 and 12.

Exercise 15.—Questions 1 to 3 are given as a test of pupil's readiness in exact divisions. Questions 4 to 6 are mainly for the purpose of ascertaining how pupils deal with the more difficult cases of division. The teacher should therefore make a note of these, as it may be very valuable in connection with the method of formal division later.

Exercise 16.—Follow the same order as in Exercises 10, 12, and 14, and look for a variety of solutions for some of the questions. In question 5, change 36 to 56. Question 21: How often did I purchase 10 turkeys? How often did I sell 5 turkeys? Question 28: How much did each hat cost per month?

NOTATION AND NUMERATION

Much of the difficulty accompanying formal addition, subtraction, etc., is due to a too hasty work in notation. It is therefore advised that teachers proceed rather slowly here until pupils feel sure of their ground. Read the introduction given on pages 22 and 23. Remember that what seems very easy now to the teacher is by no means an easy matter to the young pupil.

Exercise 17.—2. Six tens and seven ones, etc. 10. 345, 354, 453, 435, 534, 543.

Exercise 18.—Read carefully what is said on pages 24 and 25. Place the plan of enumeration on the blackboard and have pupils read the numbers given. 2. The smallest number capable of being represented by four figures is 1000. By four different figures, 1234. The greatest number is 9999. The greatest when the figures are different is 9876.

ADDITION

Exercise 19.—Has the teacher read the introduction to addition, pages 27 and 28? This exercise should be worked in the exercise-book and on the blackboard.

- | | | | | | | | |
|------------|-------------|-------------|-------------|-----------|-----------|-----------|------------|
| 3. 240 | 4. 161 | 5. 243 | 6. 230 | 7. 162 | 8. 140 | 1. 176 | 2. 186 |
| 9. 2004 | 10. 2175 | 11. 2201 | 12. 1572 | 13. 2848 | 14. 3046 | 15. 2123 | 16. 2997 |
| 17. 16220 | 18. 30931 | 19. 29992 | 20. 29942 | 21. 30943 | 22. 31987 | 23. 41668 | 24. 168407 |
| 25. 177833 | 26. 1678269 | 27. 2300029 | 28. 2637598 | | | | |

Exercise 20.—The questions of this exercise should be neatly worked in the exercise-books.

- | | | | | | |
|--------------|----------------|--------------|--------------|----------|----------|
| 1. \$1053.84 | 2. \$12744.11 | 3. \$7047.98 | 4. \$1144905 | | |
| 5. (A) 5630 | (B) 7861 | (C) 8439 | | | |
| (D) 5539 | (E) 6445 | (F) 5720 | | | |
| 1. 3674 | 2. 2719 | 3. 4379 | 4. 1654 | 5. 2796 | 6. 2822 |
| 7. 3509 | 8. 2619 | 9. 2021 | 10. 3569 | 11. 3044 | 12. 3635 |
| 13. 3193 | Totals, 39634. | | | | |

- Exercise 21.**—1. 34430 2. 36897 3. 39001 4. 28773
 5. 33648 6. 39105 7. 35657 8. 23840 9. 34257
 10. \$1901.02 11. Downwards—6307 9219 15386
 4917 and 5908 Across—3294 2428 4210 10396
 11471 3386 and 6552. Totals, 41737
 12. 31 lb.; 14 ft. 4 in. or 4 yd. 2 ft. 4 in.; 26 bu. 1 pk.
 13. 11 gal. 1 qt.; 27 da. 8 hr.; 7 da. 12 hr.
 14. 11, 445, 253.

- Exercise 22.**—1. 779 ft. 2. \$375. 4. \$9192. 5. 4755.
 6. 5415 bu. 7. 38138. 8. The numbers are 9876, 9867,
 9786, 9768 and 9687.

9. Monday totals, 26383. Tuesday totals, 22754. Wednesday totals, 29709. Thursday totals, 25006. Friday totals, 27291. Saturday totals, 33003. Total ordinary letters, 52097. Registered letters, 4500. Postal cards, 18071. Book packets, 2242. Parcels, 1614. Newspapers, 85622. Total matter for the week, 164146 articles.

10. This question will probably be worked as an addition question—295612 lb.

- Exercise 23.**—1. \$629.65 2. \$1816.10 3. \$42718
 4. \$51281.65 5. 5789981 lb. \$542364
 6. (a) 2214422 ac. 43251692 bu.
 (b) 955260 ac. 33726856 bu.
 (c) 109559 ac. 2805766 bu.
7. The answers to *a*, *b*, *c* and *d* are at the top of each column following *Canada*. (e) 53785. (f) 45182. (g) 123710.
 (h) 87939. (i) 4833239. (j) 5371315. 8. 28881700 lb.
 9. 4051495. 10. 45°. 11. 108°. 57°.

SUBTRACTION

Read what is said on pages 36, 37 and 38 before undertaking the exercises on subtraction. The purpose of Exercise 24 is preparatory to Exercise 25. Oral work is required.

Exercise 24.—1. 6 tens and 17 ones. 2. 5 tens and 13 ones.

Exercise 25.—

- | | | | | | | | |
|-----------|--------|-----------|------|--------|-----|------|-----|
| 1. 133 | 171 | 188 | 388 | 89 | 418 | and | 243 |
| 2. 189 | 184 | 169 | 579 | 232 | 147 | and | 195 |
| 3. 168 | 229 | 191 | 395 | 87 | 38 | and | 37 |
| 4. 165 | 368 | 139 | 166 | 299 | 278 | and | 111 |
| 5. 5129 | 1191 | 6427 | 5501 | 1200 | and | 3189 | |
| 6. 4447 | 2061 | 2798 | 3482 | 2999 | and | 4999 | |
| 7. 852556 | 41830 | 261636 | and | 294626 | | | |
| 8. 281939 | 481909 | 174873 | and | 287107 | | | |
| 9. 69989 | and | 99109119. | | | | | |

Exercise 26.—

- | | | | | | |
|----|-----------|-----------|-----------|-----|-----------|
| 1. | \$18.98 | \$50.50 | \$10.95 | and | \$55.80 |
| 2. | \$34.85 | \$69.78 | \$54.32 | and | \$100.25 |
| 3. | \$367.98 | \$88.62 | \$271.00 | and | \$265.79 |
| 4. | \$100.05 | \$24.75 | \$131.18 | and | \$771.95 |
| 5. | \$1486.38 | \$9254.15 | \$111.12 | and | \$3849.02 |
| 6. | \$3573.25 | \$472.85 | \$1092.68 | and | \$5970.83 |
7. 3 yd. 1 ft.; 2 yd. 2 ft.
 8. 14 oz.; 2 lb. 12 oz.
 9. 6 qt. 1 pt.; 2 gal. 2 qt.
 10. 2 wk. 6 da.; 3 wk. 6 da.
 11. 1556.
 12. 12 times.
 13. \$840.
 14. The answer to this question will vary from year to year.

Exercise 27.—1. Total receipts, \$50070.99. Difference between first and second week's receipts, \$7655.38. Between second and third week's, \$5092.93. Between third and fourth week's, \$86.94. Between fourth and fifth week's, \$2570.51.
 2. \$84.25. 3. \$959 loss. 4. 48064. 5. Give the grocer all your money. He would then owe you the difference between \$6.65 and \$10.75, or \$4.10. How could he pay this? 6. \$24770.
 7. 17485. 8. 232. 9. 47 ml., 224 ml., 707 ml., 1349 ml., 1326 ml., 1557 ml.

Exercise 28.—1. \$4960. \$2500. 2. \$10156.25.
 3. 3602. 4. 19089. 5. 8735 bu. 6. 18153. 7. \$2566.
 8. \$744.95. 9. \$72345.
 10. (a) 251. (b) 6690. (c) 65941. (d) 61598.

MULTIPLICATION

Read what is said on pages 44 and 45 before taking Exercise 29.

Exercise 29.—

1. 352 1150 1794 1316 1458 1728 1000

2.	2925	2604	2247	1959	1581	1332	2598
3.	3724	3368	3012	2656	2300	1944	1596
4.	4380	3935	3490	2545	2050	1605	1160
5.	3228	3894	4500	5166	5832	2898	2364
6.	5761	6538	5215	4592	3969	3346	2723
7.	7912	7184	56	4928	4200	3472	2744
8.	8991	7992	6216	5994	4995	3636	3600
9.	59744	75573	46053	44094	43780		
10.	467475	491176	747081	160072	277775		

Exercise 30.—1. \$27832. 2. \$3402. 3. 26400 ft. 4. 225 da. 5. How many times as long a time have the family to be kept? \$2880. 6. \$1847. See that the pupils use the sign \times properly. 7. \$14180. 8. How much more land did one get than the other? \$595. 9. \$5.49. Expect good form here. 10. 329 books. 11. 896 desks. 12. 109548.

Exercise 31.—The purpose of this exercise is to help the pupils to multiply numbers by tens. Read the exercise carefully before teaching it.

Exercise 32.—Have the pupils been able to understand the explanatory work leading up to this exercise?

- 884, 1872, 4672, 1550, 7134, 1925, 2926, 5037.
- 25272 45927 74404 32715 18900
- 13566 7182 22200 57950 60840
- 161840 149994 277134 718758 591668
- 4453912 4776171 7269192 9276655 693750
- Multiplier 58, products—14210, 41122, 40484, 42746, 28014, 44022, 28884, 38570, 110084, 404028, 177132, 145290, 2463318, 2782434, 743560, 3192320. Multiplier 89, products—21805, 63101, 62122, 65593, 42987, 67551, 44322, 59185, 168922, 619974, 271806, 222945, 3779919, 4269597, 1140980, 4898560. Multiplier 47, products—11515, 33323, 32806, 34639, 22701, 35673, 23406, 31255, 89206, 327402, 143538, 117735, 1996137, 2254731, 602540, 2586880. Multiplier 63,

products—15435, 44667, 43974, 46431, 30429, 47817, 31374, 41895, 119574, 438858, 192402, 157815, 2675673, 3022299, 807660, 3467520. Multiplier 74, products—18530, 52466, 51652, 54538, 35742, 56166, 36852, 49210, 140452, 515484, 225996, 185370, 3142854, 3550002, 948680, 4072960.

7. 241285, 613536, 416295, 368324, 657822.

8. 313425, 659064, 867411, 414222, 417816.

Exercise 33.—1. \$100, \$700, \$2500. 2. \$1152, \$558. 3. \$15414.60. 4. \$776.53. 5. 108000. 6. \$153.18. 7. 150815 lb. 8. 6912 ml. 9. 34944 letters. 10. 18768 boards. 11. \$352.60. 12. 2277508. 13. \$76.80. 14. (b) \$6.25. 15. (a) \$5.12. (b) \$3.75. (c) \$1.75. (d) \$2.40. (e) \$13.02. (f) \$6.77.

Exercise 34.—Read this exercise before presenting it to the class. Its purpose is to show how hundreds, thousands, etc., may be used as multipliers.

Exercise 35.—

2. 72616, 38988, 198205, 147744, 127182, 559619.

3. 91044, 210469, 253800, 439110, 388800, 443556.

4. 1175328, 3856600, 223000, 2899962, 2453544, 8078625.

5. 1069936, 1757216, 947298, 1549800, 1834542, 4673500.

6. 29802537, 24034300, 54209498, 71796498, 91840610.

7. 7520415, 23065974, 34327414, 15587904, 30906876.

8. 9063866, 26532352, 57889850, 11944636, 9358349.

9. 6480, 76500, 8330000, 580314, 241768, 2636316, 123024000, 3999996.

10. 6060600.

13. 168510, 602982, 352955, 365638, 444978, 432378.

14. 11136, 17892, 109970, 786660, 15228, 14625.

Exercise 36.—1. \$22.23, \$97.75, \$113.40, \$123.50, \$10.80, \$14.25, \$64.80. Total, \$446.73. 2. \$263.67.

- 817, 3. \$1668 ~~40~~ gain. Have the children noticed that the farmer
 815, had to pay altogether \$5.85 per acre? 4. \$564, \$178.40.
 rod- 5. The merchant owes \$136.67. 6. \$336.80. 7. \$10667.40.
 852, 8. \$98175. 9. \$2561.65. 10. \$2250. 11. \$1330. 12.
 854, \$2334. Have the children observed that each head cost \$51,
 and that the cattleman therefore made \$6 per head? 13. \$4000.
 14. \$12720. 245 ac. \$5070. \$6000. 15. \$101.50. \$226.50.
 Have the pupils noticed that he gained 50 cts. on each of the
 97 bbl. sold, and one dollar on each of the 53 bbl. sold? 16.
 2505 bu. 17. Six days constitute a week. \$2543.80 18. \$564.

558.

0815

ards.

5.25.

3.02.

the

etc.,

Exercise 37.—7. 8676, 31347, 25650, 23200, 31344,
 6930, 47040, 10444, 19770, 27972, 180012, 365450, 175806,
 55296, 289160, 417032, 463608, 844800, 50955, 147357. 8.
 128625, 146412, 222144, 120528. Several members of the
 class should work some of the examples under 7 and 8 on
 blackboard.

619.

556.

544,

542,

610.

876.

349.

316,

378.

625.

350,

3.67.

Exercise 38.—1. The answer to this question will depend
 upon the school year. 2. How much was made on one bushel?
 3. No gain or loss. Can the pupils work this question and
 questions 4, 5, 6 and 7 orally? 4. How much was lost on one
 lot and how much gained on the other? What was then the
 gain or loss? 5. 72 cts. gain. 6. How much was gained on
 each dozen? 7. \$5.91. 8. (a) \$2.12. (b) \$7.30. Pupils
 should work these rapidly. 9. How many times the cost of
 3 bbl. is the cost of 12 bbl.? 10. How much was saved per
 week? 11. 25½ ml. 12. 45 P.M. 12. \$901.80. 13. (a) 800.
 (b) 825. (c) 500. (d) 5000. (e) 11500. This question
 should be placed on the board and worked orally. Ask for
 several solutions. 14. Work orally. 15. \$28.50. Work
 orally. 16. \$8.25. 20. This question should be added in at
 least three minutes. 276, 226, 528, 440, 116, 300, 393.
 21. These questions should not take more than two minutes.
 (a) \$273.06, \$116.47. (b) \$78.08, \$122.23. (c) \$50.62,
 \$60.82. (d) \$748.65, \$4280.25. 22. (a) \$402.93. (b) \$157.49.
 (c) \$20.13. (d) \$490.82.

DIVISION

Read the introduction, pages 62, 63, and 64.

Exercise 39.—This exercise requires the teacher's constant supervision of her class. The *reason why* of the process is what dominates at present. On account of the nature of this exercise, no answers are given.

Exercise 40.—Questions 1, 2, and 3 are for oral work.

- | | | |
|--|---|--|
| 4. $70\frac{1}{2}$ months. | 5. $285\frac{1}{4}$ wk. | 6. 64 yd., 73 yd. |
| 7. 932 gal., 466 bu.,
3456 pt. | 8. 208, 200, 16000. | 9. \$455. |
| 12. \$11420. | 10. Oral. | 11. 713 bbl. |
| 13. \$3326. | 14. \$182. | |
| 15. 23125 bu. | 16. 132 da., 11 da. | 17. \$1000.15. |
| 18. $8\frac{1}{2}$ yr. | 19. 444. | 20. One ton is equal in value
to how many sheep? 21. How far do both travel in an hour?
In a day? Do the pupils see how this may now be worked
by a subtraction process? 22. 21. 23. 117. 24. 81 times. |
| 25. \$82.80. | 26. 4673. | 27. \$4.20. |
| 28. Say—"4 bushels of
barley at 35 cts. per bushel."
96 cts. | 29. 8 cts. gain. | 30. 30
in each. |
| 31. $211\frac{1}{4}$ ac. | 32. There is a station at each end of
the line. How many would there be were the line 361 ml.
long? | |

Exercises 41 and 42.—Read these exercises carefully. In question 8, Exercise 41, read as 67000 cts.

Exercise 43.—1. 374-15, 328-20, 55-13, 6008, 115-2, 147-25, 154-3, 7006, 150-34, 109-9, 83-27, 30003.

2. 109-9, 55-35, 129-42, 66-24, 138-30, 64-48, 107-42, 70-21, 116-63.

3. 92-27, 66-8, 110-16, 47-23, 35-18, 128-20, 57-64, 70-78, 83-66.

4. 101-73, 66-69, 52-43, 64-39, 69-78, 38-41, 42-10, 72-88, 90-90.

5. 21-55, 52-14, 12-65, 64-46, 52-16, 15-150, 24, 37, 59.

6. 103-86, 103-138, 200-212, 290-148, 81-177,
126-233, 196-428, 132-371, 141-188.

7. 16-281, 121-301, 2903-107, 6182-127, 1265-79,
1770-451, 25648-13, 4170-80, 7079-5.

8. 23 times. 34 times. 9 times.

9. 83. 10. 596. 11. 12 times.

Exercise 44.—1. \$97. 2. \$8. 3. \$57. 4. 734 da. 5. 71.
6. 79. 7. 405½ doz. 8. 24. 9. \$1.70. 10. \$20. 11. \$2.
12. 92 cts. each, or \$26.68 total. 13. \$2.25. 14. \$5. 15. 29
lb. 16. 45. 17. \$3100. How much money did he spend
in the 10 yrs.? How much of this did he save? 18. \$30.
19. \$3200. 55½ da. Take \$3600 as cost of house. 20. \$71.80.
21. 10 wk. 22. 16 bu. 23. 60 cts. Eighty-seven cts. is
equal to first cost, freight, and gain. 24. 40 ft., 24 ft.
25. \$87.89.

Exercise 45—(Review.)

1. (a) 55457 (b) 65789 (c) 63109 (d) 56906 (e) 54132
(1) 15610 (2) 27232 (3) 24472 (4) 25543 (5) 21945
(6) 36605 (7) 31058 (8) 32019 (9) 29692 (10) 30581
(11) 20636 Totals, 295393.

2. 14788263, 7910088, 161057559, 820834, 7657564,
9400282.

3. Take the product of 768 and 867, 964 and 593, etc.,
665856, 371652, 42531024, 604127265.

4. 428, 458, 987. Questions 5 and 6 should be taken
orally. 7. (a) \$4.37. (b) \$9.93. (c) \$17.13. The teacher
should see to the form in which the pupils work these questions.

8. 81 da., 92 da., 98 da., 99 da., 143 da., 73 da.

9. Take this question to apply to the actual year and tell
the class that May commenced on a particular day of the week.

10. (a) 17 gal., 1 qt., 1 pt. (b) 14 bu., 2 pk., 4 qt. (c) 18
yd., 1 ft., 3 in. 11. (a) 2 bu., 2 pk., 7 qt. (b) 12 yd., 4 ft.,
5 in. (c) 1 lb., 4 oz.

12. 37. How many quarts in 1½ pks.? 13, 14, 15 are in-
tended for oral work in class.

16. How much do I make per pk.? How much then per qt.? 19. 815. 20. 22. 21. 145 times. 22. (a) 60. (b) 672. (c) 225. 23. 90 bbl. 24. 672. 25. How far must the boy travel to go for the first potato and carry it back to the basket? 3600 ft. 26. Cost price, \$3420. Gain, \$180. 27. \$3.60. 28. Gain, \$152. 29. (a) 28428. (b) 4. 30. 276 hr., or $11\frac{1}{2}$ da. 31. \$0.120. 32. \$17.70 if the year is not a leap year. \$18 if the year is a leap year. 33. \$508. 35. \$9.84. 36. \$6.85.

MENSURATION

Exercise 46.—An effort has been made in this and in subsequent exercises to treat the subject of mensuration in as practical a manner as possible. It is therefore expected that teachers will exercise the greatest care in having pupils obtain exact measurements. If mensuration fails to interest the class it is not likely to be the fault of the subject. The rulers used should be accurate.

19. (a) 60 in., 120 in., 60 in., 30 in., 30 in., 30 in. (b) 420. (c) 1800 sq. in., 1800 sq. in., 900 sq. in., 900 sq. in. (d) 5400 sq. in., 1800 sq. in.
20. (a) 78 in. by 48 in. (b) 66 in. by 30 in. (c) 6 in. (d) 3744 sq. in. or 26 sq. ft., 2376 sq. in. or $16\frac{1}{2}$ sq. ft. The difference of the areas of room and rug equals the area of the border, namely $9\frac{1}{2}$ sq. ft. In all such questions this is the most practical way of working. (e) 34. 23. (a) 4 times. (b) 9 times. (c) 4 times. (d) 9 times. (e) 9 times. 24. (a) 6 times. (b) 15 times. (c) 6 times. 26. Fig. F is 2 inches long by half an inch wide. Such questions as these are meant to help the student along to the time when he has ceased to associate *form* with the square inch. 27. Do not let anything interfere with this work. 28. (a) 360. (b) 540. (c) 864. (d) 864. (e) 3528. 29. Class work.

- Exercise 47.**—6. Change the scale to one inch = 64 feet. (a) About 552 ft. (b) 184 yd. (c) 32 ft. (d) By way of B. How much nearer? About 64 feet. (e) In either case 276

paces. (f) 2208 pickets. (g) About 1492 sq. yd. (h) $298\frac{3}{4}$ sq. yd., or 2688 sq. ft.; $554\frac{3}{4}$ sq. yd.; or 4992 sq. ft. (i) $298\frac{3}{4}$ sq. yd.

7. (a) 16 (b) 64 (c) 25 (d) 9 (e) 81

8. (a) 48 (b) 108 (c) 135 (d) 405

9. (a) 12 (b) 20 (c) 70 (d) 72

10. Class work.

11. (a) 5 yd. (b) 7 yd. (c) 15 yd.

12. (a) 24 (b) 25 (c) 56 (d) 90

14. (a) \$2.25 (b) \$7.20

15. (a) 540 (b) 486 (c) 20.

20. (a) 36 ft. 24 ft. (b) 120 in. (d) 1080 sq. ft.
(e) 972 sq. ft. (f) Each 864 sq. ft.

21. Say, 24 ft. wide. 1604 sq. ft. The door takes up a part of the wainscotting.

22. 7776. 23. 155. 24. \$91.20.

Exercise 48.—10. Teachers will find this question more in line with the children's power of measurement if the scale is changed to read $\frac{1}{4}$ inch = 4 rods. (a) 150 rd. (b) $60\frac{1}{2}$ nearly; 88 yd.; slightly over 143 yd. (c) $159\frac{1}{2}$ yd.; 70 rd.; 80 rd. (d) About 825 steps. (e) 413 posts. How far would the last post be from the first? (f) 336 sq. rd. 11. (a) 12800. (b) 800. (c) 12000. (d) 28800. (e) 28672. 12. 480 and 120. 13. 23760 in., 87120 in., 2420 yd., 3960 yd.; 11880 ft., 11616 ft. 15. (a) 2844 sq. rd. (b) \$237. (c) \$249. Take the shorter dimensions for widths. (d) 79 rd. 16. (e) 22 ft. 20 rd. 17. (a) 20. (b) 2. (c) 240. (a) 462. (b) 198. (c) 5478. 18. (a) $\frac{1}{3}$. (b) $\frac{1}{2}$. (c) $\frac{4}{5}$.

Exercise 49.—7. Change, in question 7, to, in question 6. 10. (a) 96. (b) 600. (c) 1800. (d) 3240. (e) 1728. 11. 200, 200. 12. 6912. 15. (a) 15. (b) 84. (c) 40. (d) 108. (e) 400. 16. (a) 36. (b) 60. (c) 120. (d) 280. (e) 540. Change the dimensions at once to yards. 17. (a) 288. (b) 216. (c) 144. 18. (a) 60 ft. (b) 171 sq. ft. (c) 36 sq. ft. (d) 1026 cub. ft. (e) 38 cub. yd. 20. (a) 280. (b) 48. (c) 960.

Exercise 50.—7. \$223.75. 9. $\frac{1}{2}$ a cord. 10. (a) 24. (b) 39. (c) 102. 11. 7 trains. The last train does not carry its full load. 3300 cords.

Exercise 51.—1. Change scale letting one inch equal 32 feet. (a) Length of lot accordingly is 88 ft., and width about 54 ft.; house, 26 ft. by 21 ft.; walk, 37 ft. by 6 ft.; cellar, 11 ft. by 10 ft. (b) 4590 sq. ft. = lot; house is 546 sq. ft.; cellar, 110 sq. ft.; the area of the backyard is the area of MC all but the area of the house = about 2046 sq. ft.; lawn, 964 sq. ft.; garden, 814 sq. ft. 2. (a) Consider the depth of the cellar at 6 ft. Cost \$6.67. (b) \$27.75. (c) \$41.25. (d) \$5.56. (e) \$42.84. (f) \$2.71. 3. How long is the yard-stick? 50 yd. 4. (a) 2178 sq. ft. (b) 242 sq. yd. (c) 8 sq. rd. 5. (b) 412 sq. ft. 6. 500 rd. 7. 9600. 8. 864. 9. 2728320 lb. 10. 630. 12. Change this scale so that an inch equals 32 rods. The exact length is $2\frac{3}{8}$ inches. The width is $1\frac{3}{8}$ inches. These represent in the above scale 76 rods by 52 rods. (a) 1408 yds. (b) Complete the rectangles B D and F H. Ascertain the area of the lot when the dimensions are 76 rods by 52 rods and deduct the areas of B D and F H. 3540 sq. rd. (c) The latter by \$38.60.

Exercise 52.—Review.—1. 29° . 3. \$10.80. 5. $2\frac{1}{4}$ bu. \$6.75. 6. \$320. 7. 1 s. 8. 6 da., 3 da. 9. 90 and 270. 10. \$20. Oral work. 11. \$46.65. 12. \$1.70. 13. \$3.72; \$3.60. 14. \$30.86. 15. \$10960.50. 16. 5 ml. 17. 96 cts. 18. 76 + cts. 19. 99554. 20. 20 hrs. 140 ml. and 160 mi.

BOOK I—PART II

REVIEW

Exercise 1.—This exercise should be conducted orally. Questions 3 and 4 should be worked on the blackboard.

Exercise 2.—

1. (a) \$904.89 (b) \$1,108 (c) \$450.71 (d) \$1663.88

2. \$18723.23 \$14232.40 \$10965.77

3. Have pupils find the addends missing in the four addition questions given. They are 7428, 8011, 4367 and 3283.

4. 59120721 37879920 32257824 929280 563200
248832 412693 547808 and 358992

5. 89, 75, 66, 465, 439 and 200. Have any noticed in the last example that 1934 is just twice 967? Questions 6, 7 and 8 are for oral work. Inquire in each case as to the methods used by the pupils.

Exercise 3.—Questions 1 to 6 are introductory. The answers to these should be given smartly. In working such a question as 3a pupils should translate the dimensions at once into yards, and subsequently find the areas. 7. 726 sq. yd.; 24 sq. rd. 8. 768. Pupils should be almost as familiar with the chain as with the rod. 9. 300. 10. 13^o24 lb. 11. 1728 bricks. 12. 7090. What part of the space is left? This may be readily answered if pupils are trained to look at the data of the questions aright. In this case the height is the only dimension affected. 13. When no width is given, four feet is assumed. 247½ cd. 14. 5184 sq. rd. 3456 sq. rd. Have the pupils observe that $\frac{1}{4}$ of the original field has been sold? 576 sq. rd., 576 sq. rd., 792 fence posts. Which would take the greater number of rods of fencing, the field as it now stands or the

original field? It is this kind of work that helps the pupil to attack his geometry successfully later in his school life.

Exercise 4.—The answers to the questions of this exercise are not so important as the way pupils obtain the answers. See that pupils get a chance to explain their solutions. See, too, that the written work parallels the thought. 1. \$4. 2. \$7.90. 3. Although formal fractions have not yet been presented, it is possible that pupils will sum such simple fractions as halves, fourths, etc. If some of the pupils change the fraction of a dozen into single eggs, do not interfere. It is a sign of individual thinking. \$10.26. 4. \$78. 5. \$9.30. 6. \$20.95. 7. 20. 8. \$2.02. 9. 32 cts. 10. 5 cts. per lb. 11. \$665.10. 12. \$11.29. 13. \$3.20, 44 cts. 14. \$7.50. The man's expenses were \$3 for each day of the year, not for each of the 200 working days. 15. Oral work. \$1.10. How was the answer obtained? 16. 8 hr. 40 min. 17. Test the pupils first orally. 244 oz., 134 pt., 26 qt., 22 yd., 15 qt., 19 ft. 18. 180, 180, 1440, 3240. 19. 300, 840, 300. 20. \$1.60.

WEIGHTS AND MEASURES

Exercise 5.—Some experimental work is supposed to have been made in connection with lb. and oz. in the lower grades. Examine, before proceeding with the problems of this exercise, the pupils' grasp of these weights. Continue the practical work by referring the class to the weight of loads of hay, coal, wheat, etc. 1. An oral problem. \$7.14. \$26.40. (b) will probably be worked as follows: 240 lb. raisins at 10 cts. equal \$24. 240 lb. at 1 ct. equals \$2.40. \$24 and \$2.40 is \$26.40. 2. Oral work: 65 cts., \$2.40. 4. \$10. Oral work. 5. $2\frac{1}{4}$ bu. 6. 1700 lb. 7. %6. 8. 672 loaves.

Exercise 6.—1. 50. 2. 87. 3. 256. 4. $12\frac{1}{2}$ lb. 5. 15. 10. 32490. 11. 38972. 12, 13, and 14 are for oral work. 15. 238480. 16. 784172. 17, 18, 19, 20, 21 and 22 are all for oral work in class. 23. 6 T. 4 cwt. 25 lb. The answer to this problem may be read almost as easily as the notation of the number 12425. 24. $2\frac{1}{2}$ T.

Exercise 7.—

- | | | |
|----------------------------------|-----------------------------------|-----------------------------------|
| 1. 41 lb. 12 oz. | 2. 48 lb. 7 oz. | 3. 62 lb. 9 oz. |
| 4. 23 cwt. 25 lb.
9 oz. | 5. 29 cwt. 13 lb.
3 oz. | 6. 21 cwt. 3 lb. 11
oz. |
| 7. 23 T. 12 cwt. 81
lb. 6 oz. | 8. 41 T. 12 cwt.
36 lb. 4 oz. | 9. 13 oz. |
| 11. 7 lb. 11 oz. | 12. 1 cwt. 91 lb. 5
oz. | 13. 5 cwt. 54 lb. 10
oz. |
| 14. 3 cwt. 93 lb. 5
oz. | 15. 6 T. 18 cwt. 97
lb. 13 oz. | 16. 5 T. 7 cwt. 31
lb. 12 oz. |
| 17. 20 lb. 15 oz. | 19. 158 lb. | 20. 32 cwt. 42 lb.
13 oz. |
| 18. 37 lb. 14 oz. | 22. 231 cwt. 87 lb.
3 oz. | 23. 87 T. 11 cwt.
86 lb. 6 oz. |
| 21. 98 cwt. 7 lb. 8
oz. | 24. 175 T. 8 cwt. 65
lb. | 25. 343 T. 18 lb. 12
oz. |
| 24. 175 T. 8 cwt. 65
lb. | 26. 2 lb. 5 oz. | 29. 1 T. 5 cwt. 84
lb. 11 oz. |
| 27. 1 lb. 5 oz. | 28. 1 cwt. 45 lb. 3
oz. | |

Exercise 8.—1. 25. 2. 25920 lb. 3. \$13.12½. 4. \$96.25.
5. The latter by \$30.60. 6. (a) \$5.00. (b) \$8.25. (c) \$80.40.
7. Change "per bushel (cleaned)" to per hundred lb. (cleaned)
59 + lb., \$294. Frame a second question by changing 4000 lb.
of each load to 3350 lb., and 75 cts. per hundred lb. to \$1.50
per 120 lb. (cleaned). The answers of this are 50 lb. to the
bushel, and a total selling price of \$410.37½. 8. 6400 bu. 9.
\$3490. 10. \$4.80. 11. (a) 200. (b) 240. (c) 61. *a* and *b*
may be worked orally. 12. 265 cars. 13. \$3289.92. 14. Work
a, *b* and *d* orally. (e) \$13.80. 15. Change 49 lb. 12 oz. to
49 lb. 11 oz. 15 boxes. 16. \$2.10. 17. 19 men. 18. \$25,
\$22.50 and \$17.50. 19. 11 cts.

Exercise 9.—Questions 1 to 7 are to be taken orally. So
also are questions 9 and 10. 8. (a) 40 gal. (b) 11 gal. 1 pt.
(c) 15 gal. 3 qt. (d) 177 gal. 3 qt. 11. 12 gal. 3 qt. \$12.75.
Have the pupils been able to change the 12¾ gal. at once into
12¾ dollars? 12. 2 bu. 2 pk. 7 qt. Have the pupils note
the difference between the measures used in Dry and Liquid

measures. 13. 4 bu. Give this as oral work. 14. 3 bu. 1 pk. 6 qt. 15. Oral. 60 cts. 16. \$12.20. 17. 4 gal. 18. 45 cts.

Exercise 10.—1. (a) 9 gal. (b) 12 pk. 1 qt. 1 pt. (c) 2 gal. 1 qt. 3 gi. (d) 9 bu. 3 pk. 5 qt. 2. (a) 84 cts. (b) \$39.60. (c) \$1.90. (d) \$4.56 taking the reading of the text. \$3.66 if the question read 3 pk. 6 qt. 1 pt. 3. (a) 10 gal. 1 qt. 1 pt. (b) 43 bu. 1 qt. (c) 13 bu. 1 pk. 6 qt. (d) 24 gal. 2 qt. 1 pt. 4. 3 bu. 1 pk. \$31.20. 5. 5 bu. 3 pk. 5 qt. 6. 6 gal. 1 qt. 1 pt. 7. 3 pk. 6 qt. 8. \$10. 9. Work as much as possible orally. (a) 19 gal. 2 qt. (b) 38 gal. 2 qt. 1 pt. (c) 84 bu. 1 pk. 4 qt. (d) 197 bu. (e) 55 pk. 4 qt., or 13 bu. 3 pk. 4 qt. 10. \$60.90. 11. 7 gal. 12. (a) 6 gal. 2 qt. 1 pt. (b) 8 bu. 6 qt. $1\frac{1}{4}$ pt. (c) 1 gal. $\frac{1}{8}$ qt. (d) 3 qt. $\frac{3}{8}$ pt. Do we say—4 pt. 5 pt.? 13. (a) 20. (b) 25. (c) 20. There is some barley remaining. 14. $42\frac{3}{4}$ da. 15. Take as much as possible of this orally. 280 pt., 18 pk., 148 pt., 528 qt., 57 gal., 320 gal.

Exercise 11.—1. \$1.44. 2. 80. 3. One quarter. 4. \$13.14. 5. 16 bu. 3 pk. 4 qt. 36 bu. 2 pk. 7 qt. 6. \$14.20. 7. \$5.84 per lamp. 8. 60 cts. What has the number of chickens to do with the question? 9. \$3040. 10. The horse cost me in the first place \$120. He used 483 qts. of oats, worth 1 ct. a quart in the 42 days. He therefore cost me $\$120 + \4.83 , or \$124.83. I sold him to gain \$90. I have already made \$72 out of his work. I may therefore sell him for \$124.83, plus the difference between \$90 and \$72, or $\$18 + \124.83 , or \$142.83. 11. 7 bu. 1 qt. is 225 quarts. Oats are therefore worth 2 cts. per qt. 3 bu. 2 pk. 7 qt. 1 pt. are $119\frac{1}{2}$ qt. The cost is \$2.39. 12. \$1.20. I must get for each $\frac{3}{4}$ of a gal. the cost price of a gal.

Exercise 12.—Pupils should be able to work these problems with considerable rapidity. Much of the value of this exercise is lost if the teacher is content with the getting of answers only. See that an opportunity is given for solutions. Have the pupils criticise the various solutions.

Exercise 13.—Questions 1 to 8, questions 10 and 11, questions 13, 14 and the leading work in question 15 are for the purpose of a rapid review in class. 9. 184 days from the vernal to the autumnal equinox. How many days are there from the autumnal to the vernal equinox? 12. The present century began January 1st, 1901. It will end December 31st, 2000. 15. (a) Saturday. (b) The 6th, 13th, 20th and 27th.

Exercise 14.—2. 43, 193, 248. 3. Introduce the additional fact that October 3d was a Monday. \$140. 4. (a) 339. (b) 1511. (c) 786. 5. (a) 10 da. (b) 49 da. 6. August 21st. 7. 64 da. 8 and 9 are for oral work. 10. (a) 83 da. 8 hr. (b) 36 da. 5 hr. (c) 4 da. 4 hr. (d) 2 da. 12 hr. 11. 301 da. of 11 hr. each, or 3311 hr. 12. 6 hr. 5 min. 13. (a) 3 mo. 3 da. (b) 5 mo. 8 da. (c) 1 mo. 20 da. (d) 5 mo. 8 da. All Saints' Day is November 1st. 14. \$1087.80. 15. (a) Sunday. (b) Saturday. (c) Saturday. (d) Thursday.

Exercise 15.—1. $13\frac{1}{2}$, $6\frac{1}{2}$, $12\frac{1}{2}$, $33\frac{1}{2}$. 2. 1390, 2118, 2725. 3. Oral. 4. 12, 15, 50. 5. 10800, 7800, 13520. 6. $11\frac{2}{3}$ da., $12\frac{1}{2}$ da., 1 da. 7. $10\frac{2}{7}$ or 10 wk. 2 da., $142\frac{6}{7}$ or 142 wk. 6 da., $5\frac{3}{7}$, 2, $3\frac{2}{3}\frac{1}{4}\frac{0}{8}$. 8. 2, $15\frac{2}{3}$, 2, $7\frac{2}{3}\frac{4}{8}$, 2. 9. (a) Nov. 6. (b) Sept. 25. (c) Take the present year, 1904, as a basis of work. Dec. 6th. 10. 67 yrs. 185 da. From June 3d, 1837, to June 3d, 1904, is 67 years. From June 3d to December 5th is 185 da. 11. 18 hours. 12. 60 ml. 15 hr. Will the teacher see that the rate of 4 miles per hour back is understood? 13. Buying-price of cow, \$45.00. 11 quarts of milk per day for 14 days, at 12 cts. per quart, is \$18.48. The cost of the food is 35×14 cts., or \$4.90. The selling price is \$48. The cow cost him $\$45 + \4.90 , or \$49.90. He received $\$48 + \18.48 , or \$66.48. His gain is \$66.48 less \$49.90, or \$16.58. 14. Saturday, June 14th. 15. 8 o'clock P. M. 240 miles from Truro. 16. 15 cts. 17. 4950 paces. $2\frac{1}{2}$ ml. Have the pupils seen that the boy will take $\frac{3}{4}$ of 6600 paces because he walks for $\frac{3}{4}$ of an hour? 18. (a) \$58.65. (b) \$4. (c) \$1.20. \$4.35. (d) 29 da. + .

Exercise 16.—The work asked in questions 4 and 5 is very valuable. Nothing should tempt the teacher to set it aside. 16. $\frac{2}{3}$ of a yard is 2 ft. 17. To go a mile one would have to walk about the lot ten times. 19. 440. 20. (a) 11 yd. 1 ft. 5 in. (b) 38 yd. 2 ft. 2 in. 21. (a) 6 yd. 11 in. (b) 7 yd. 1 ft. 9 in. 22. \$234. 23. \$15.24. 24. 1320 and 3960.

Exercise 17.—1. (a) 16 mi. 29 rd. 2 yd. (b) 18 rd. $4\frac{1}{2}$ yd. 2 ft. 10 in., or 18 rd. 4 yd. 3 ft. 16 in., or 18 rd. 5 yd. 1 ft. 4 in. All are correct, but it is better to remove the fraction (if at all convenient) from the body of the answer. 2. (a) 2 mi. 317 rd. $3\frac{1}{2}$ yd. 2 ft. 10 in., or 2 mi. 317 rd. 4 yd. 1 ft. 4 in. (b) 2 rd. $3\frac{1}{2}$ yd. 1 ft. 8 in., or 2 rd. 4 yd. 2 in. 3. (a) 12 mi. 95 rd. $1\frac{1}{2}$ yd. 0 ft. 6 in., or 12 mi. 95 rd. 1 yd. 2 ft. (b) 40 mi. 147 rd. $2\frac{1}{2}$ yd. 1 ft. 4 in., or 40 mi. 147 rd. 2 yd. 2 ft. 10 in. 4. (a) 1 mi. 66 rd. 2 yd. 2 ft. 8 in. (b) 1 mi. 244 rd. 3 yd. 1 ft. 5 in. 5. (a) 990 rd. (b) 3630 yd. (c) 273 ft. (d) 533 in. 6. (a) 2 mi. 8 rd. (b) 2 mi. 5 ch. (c) 1280 rd. (d) 40 ch. 7. 260. Look out for the cents at the corners of the table. Have the class make a diagram for a surface, e. g., 5 in. by 4 in., that the reason may be noted. 8. 6 ft. 3 in. oral. 9. 180 ft. oral. 10. 616 yd. 112 rd. 1848 ft. Note—11 yd. = 2 rd.; 33 ft. = 2 rd. These relations are useful. 11. 1 hour. 12. \$1035. 13. 594 ml. 14. 36 days. \$259.20. 15. (a) 116 ft. (b) 230 ft. (c) 302 ft. 16. (a) 188 ft. (b) 274 ft. (c) 288 ft. 17. 60 cts. 18. How many furrows will the farmer have to draw since each is half a foot wide? 135 miles. 19. The train goes 20 yards per second, or nearly 41 miles per hour.

Solution.—20 yards per second is
 20×3600 yds. per hour = 72000 yds.
 $= 72000 \div 1760$ ml.
 $= 40\frac{1600}{1760}$ ml., or nearly 41 ml.

In such a question and at this stage of development an exact answer like $40\frac{16}{11}$ should not be expected.

Another solution may be given thus:

20 yds. per sec. is the same as
 1760 yds. in 88 secs., or 1 ml. in 88 secs.,
 or $3600 \div 88$ ml. in 1 hr.,
 or $40\frac{5}{8}$ ml. per hour.

Exercise 18.—This exercise is given for the purpose of reviewing the various surface measures obtained from the practice of preceding grades. Should the pupils show that they have but an inferior grasp, the teacher of this grade should proceed to give the necessary experimental work leading to a conception of the units used. 11. (a) \$6.48. (b) \$6. (c) \$10. Parts (b) and (c) are for oral work. 12. (a) 40. (b) 6. (c) 700. Question 12 is for oral work.

Exercise 19.—2. $\frac{1}{4}$. $\frac{3}{4}$. How was the second found? Did the pupils make use of the first result? 5. A 3-inch square contains 5 square inches more than does a 2-inch square. A 6-inch square is greater than a 5-inch square by 11 square inches. 6. 30 square inches. 90 square inches. 56 square yards. It is suggested that this question be added to as pupils are readily bewildered by the similarity of the language used. 7. Many pupils think an acre has a particular shape. 8. 480, 800, 1600, 1520, 80, 120. Have any pupils obtained the fourth result by taking $\frac{1}{2}$ an acre or 80 square rods from 10 acres or 1600 square rods? 9. (a) 60. (b) 54. Oral work. 10. 2178, 3267. 11. 121, $181\frac{1}{2}$. 12. (a) 726. (b) 2420. See that the pupils work this from the square rods. If any work by changing the linear rods into yards, attempt to get them to see another method of reaching the result. 13. (a) $544\frac{1}{2}$. (b) 3267. In questions where the pupils must multiply by a half or a fourth, permit the meaning "one-half of" or "one-fourth of" to be used. 14. (a) \$254.10. (b) \$544.50. 15. 30. Have the pupils make the plan in their exercise books. 16. Oral. (a) 16 rd. (b) 4 rd. Pupils should remember that one acre is the same as 160 square rods. Have any noticed the peculiar use of the width and length in this question? 17. Oral. (a) $\frac{1}{2}$. (b) $\frac{1}{4}$. (c) $\frac{5}{8}$. 18. (a) 8. (b) 10. (c) 6. (d) 20 acres.

As it is easier to find acres from dimensions given in rods, 440 yards may be readily changed to rods provided the pupil knows that 11 yards is the same as 2 rods. 19. (a) 640. (b) 160. (c) 40. (d) 10. 20. 1200 acres. How many rods long is the strip?

Exercise 20.—1. Have the pupils make the plan of the land divided. 2. \$150. 3. 320 ac. 4. 40 ac. 5. Oral work. Ask for solutions. 6. 7680, 13440, 16440. 7. (a) 36. (b) 23040. (c) 1280. (d) 640. (e) 25600. (f) N. E. $\frac{1}{2}$ 19; N. W. $\frac{1}{4}$ 28; S. W. $\frac{1}{4}$ 15; S. E. $\frac{1}{4}$ 23. (g) \$256. \$512. \$3072. Have any of the pupils taken the perimeter of the quarter-section as a standard? 8. \$13680. How many sections were bought? 9. (a) 803. (b) 48400. The number of square yards in an acre is worth keeping in mind. (c) 61105 sq. yd. 10. (a) 484. (b) 605. 11. (a) 320. (b) 160. (c) 1920. 12. (a) 9072. (b) 20304. 13. (a) 6 ac. (b) $11\frac{6}{17}$ ac. 14. (a) 3872 sq. yd. (b) 52272 sq. ft. (c) 320 sq. rd.

Solution:—

10 square chains = one acre = 4840 square yds.

8 square chains = 484×8 square yds.
= 3872 square yds.

15. (a) 120. (b) 16. 16. (a) 30. (b) 24. 17. 72 acres.
18. \$13280. 19. 632 acres.

Exercise 21.—4. (a) 27. (b) 343. (c) 27. 5. (a) 1000. (b) 3375. 6. (a) 720. (b) 864. (c) 4320. 7. (a) 360. (b) 5832. 8. (a) 36. (b) 144. (c) 324. 9. 6, 12, 18. 10. 8, 27, 125. Can you verify these results? 11. (a) 2880. (b) 8640. (c) 3888. (d) 4500. 12. (a) 201. (b) 351. (c) 314496. (d) 2 cub. yd.

Exercise 22.—1. (a) \$140. (b) \$216. 2. (a) 4320. (b) 1440. (c) 2592. (d) 5760. 3. (a) 30×26 . (b) 68×56 . (c) 78×69 . 4. (a) 300. (b) 928. (c) 846. See Fig. E, page 85. 5. (a) 32. (b) 48. (c) $182\frac{1}{2}$. 6. 33. 7. 448 ft. If the sawyer put 3 cuts in each stick he would have 4 pieces. The pile as it stood before cutting began is 56 ft. long and 8 ft. high. This means a pile 56×2 ft. long and 4 ft. high. After

the cutting the pile would be 4 times this length. 8. \$1.60.
The man has to do twice the work. 9. 6912, 216. 10. 6 to
1; 27 to 1; 1 to 12.

Exercise 23.—2. 12, 33, 72, 240. 3. 8, 24, 160,
12. 4. 6, 8, 18. 5. 100, 300, 225, 4 cts. 6. \$2.40.
7. 64 cts. 8. \$2.40 gain. 9. Say—"Find the gain on the
sale of 42 score eggs." \$2.46. 10. Change 100 to 120. \$8.91.
11. \$3.31. 12. 28.

Exercise 24.—The teacher should see that each pupil knows
how to make a protractor by using the diagram in Appendix B.
She should also see that this is mounted on a suitable card-
board and that each pupil understands how to use it. This
exercise is considered as one of the most valuable in the book.
Every problem then should be worked as patiently and as care-
fully as possible.

Exercise 26.—3. 240d. 4. 64s., 106s., 209s. 5. 40d.,
93d., 282d. 6. £10 7s. 9d. 7. (a) £26 1s. 10d. (b) £16
16s. 11d. (c) £49 9s. 10d. (d) £55 8s. 5d. 8. (a) 8s. 3d.
(b) £4 15s. 5d. (c) £4 16s. 10d. (d) £7 6s. 3d. 9. (a)
£3 15s. (b) £59 1s. 3d. (c) £372 16s. (d) £440 17s. 6d.
10. (a) £1 7s. (b) £1 3s. 4d. (c) £1 6s. 8d. 11. (a) 125d.
(b) 3201d. (c) 333d. 12. (a) 9s. 8d. (b) £12 8s. 10d.
(c) £93 8s. 13. 13 caps. 2d. change. 14. £7 12s. 15. (a)
\$18.69. (b) \$38.61. (c) \$120.67. 16. (a) £5 12s. 4d.
(b) £7 11s. 8½d. (c) £11 11½d. It is not intended that pupils
should obtain exact answers to these problems. All that is
intended is to direct the attention of the children to the fact
that our money may be expressed in £ s. d., and *vice versa*. The
examples under question 16 may be worked as follows:

$$2 \text{ cts.} = 1d.$$

$$\$26.96 = 1348d.$$

$$= £5 \text{ 12s. 4d.}$$

$$\begin{aligned} 18. \text{ £} &= \$4.86\frac{2}{3}. \quad 720 \text{ yds. at } 7\text{s. per yd.} = 5040\text{s.} \\ &= £252 \\ &= \$4.86\frac{2}{3} \times 252 \\ &= \$1226.40 \end{aligned}$$

Total cost is \$1226 + freight of \$72.

= \$1298.40

Selling price is \$1298.40 + \$28.40 or

\$1326.80

720 yds. sell for \$1326.80

= \$1.84 per yd. +.

Exercise 27.—3. \$1.86. 4. The latter by \$60. 5. \$18. What did the potatoes sell for per bushel? How much was then gained per bushel? 6. 101° . 8. (a) 10560. (b) 1980. (c) 2400. (d) 990. (e) 2. (f) 105. 9. (a) 5280. (b) 440. What part of a ml. is 55 rds.? (c) 440. (d) 324. (e) 201. 10. (a) $2\frac{1}{4}$ T. (b) 3 T. (c) 2 T. 11. (a) 406. (b) 1100. Do the pupils interpret 23 cwt. at once as 2300 lbs.? (c) 44000. 12. (a) 1200. (b) 640. (c) 80. 13. (a) 88. (b) 42. (c) 29. 14. The dimensions of a cord must be $8 \times 4 \times 4$ ft. and the shape must be rectangular. A diagram will show the difficulty.

Exercise 28.—1. (a) \$158.75. (b) \$2.34. (c) \$3.75. Question (b) may be taken orally. 2. (a) 621. (b) 4820. (c) 43. (d) 916. The teacher may take the greater part of 2 orally. 3. If the pupils hesitate over this, the fundamental exercises must be repeated. Pupils should be able to recognize leap years almost as soon as the number of the year catches the eye. 4. 180° , 90° , 144° . 5. 3° , 15° , 90° . 6. 2070. 7. \$1442.88. 8. (a) The corner cubes. 8. (b) The centre cubes of each edge. 12. (c) The centre cube on each face. 6. (d) The small cube at the centre of the larger. 9. \$862.50. 10. The six sides are equal. Their total area is 216 square inches or 36 square inches to a side. 36 square inches means a six-inch square.

Exercise 29.—1. (a) \$7. (b) \$50. 2. \$9.45. A bbl. is $31\frac{1}{2}$ gallons. 3. \$170. \$136. What we wish the pupils to see in this question is that two surfaces of equal area do not necessarily have the same perimeter. 4. 3000 apples. Solution:

6 apples cost 5 cts.
 An apple costs $\frac{5}{6}$ ct.
 5 apples sell for 5 cts.
 An apple sells for 1 ct.
 On each apple $\frac{1}{6}$ of a ct. is gained.
 On 6 apples a whole cent is gained.
 On 6×500 apples \$5 is gained.

= 3000 apples.

5. (a) The last day of July. (b) July 20th. 6. 126 lb.
 7. 45000 ft. or 15000 yd. or 8 ml. 920 yd. 8. Friday,
 Sunday, Sunday, Tuesday. 9. 160. 10. 11 ml. 11. \$2160.
 Data 180 cd. tamarack at \$6.50; 120 cd. jack pine at \$5.75; 60
 cd. poplar at \$5. 12. \$1013.04. Solution: 36 horses for 24
 weeks would be the same as $36 \times 24 \times 7$ horses for a day.

= 6048 horses for a day.

These horses would eat 20×6048 lb. of hay and 6048 pk. of
 oats.

2000 lbs. of hay cost 800 cts.

20 lbs. cost 8 cts.

20×6048 lbs. cost 8×6048 cts. = \$483.84

6048 pks. = 1512 bushels.

1512 bu. cost 35×1512 cts. = \$529.20

The total cost is therefore $\$483.84 + \$529.20 = \$1013.04$

13. They dug for 61 days. They have still 760 rods to dig.

14. \$361.67. Note that 11 yds. = 2 rds. If the width be
 changed to 80 rods the result is easier handled. \$280.

15. 1925 times.

MENSURATION

Exercise 30.—1. 1344 rd., $4\frac{1}{2}$ ml. 2. 5 rd. 3. 15 rd.
 4. $102\frac{1}{2}$ acres. 5. $115\frac{1}{2}$ acres. 6. $51\frac{1}{2}$ acres. 7. $76\frac{1}{2}$ acres.
 8. 384 ac. 9. 86. Dimensions of field 192 rods by 192 rods.
 Area 192 $92 \div 160$ acres = 230 + acres. The question now
 is: How often can 8 acres be set apart to 3 cows? The answer
 lies between 2 and 29 times. As an approximate is all we can

expect of the pupils, take 29 times. This means 87 cows, an answer near enough to a correct result in such experimental questions. 10. 128 sheep. 11. 2688 fence posts. 12. \$1083.60. 13. 1024 square rods. 278784 square feet. 14. 2787840 cubic feet.

Exercise 31.—In these and other mensuration problems the teacher should insist upon neat diagrams being made. In other words, the pupils should get into the habit of picturing the data. If this is followed carpeting questions will be a delight to the pupil and a great assistance to arithmetic generally. 1. 12, 18, 24, 16, 27. 2. 24 yds. 3. 288, 432, 384, 576. 4. \$441.60. 5. \$576. \$367.20. 7. 32, 36, 48. 8. (a) 288. (b) 384. (c) 432. (d) 576. 9. (a) \$576. (b) \$441. (c) \$367.20. 10. 18 strips. 11. 29 strips, 6 in. 12. (a) From end to end, or from side to side of room. (b) From end to end. (c) From side to side. (d) From side to side.

Exercise 32.—1. 12, 14, 10, 12. 2. 27, 10, 11, 23. 4. 12, 120 yd., 10 yd., 4 yd. 5. (a) 296. From side to side. (b) 256 yd. From end to end. (c) 144 yd. Either way. (d) 96. From side to side. 6. (a) 135. (b) 231. (c) $163\frac{1}{2}$ if laid from end to end. $158\frac{1}{2}$ if laid from side to side. 7. (a) \$100.80. (b) \$97.20. 8. 90 ft. 9. A practical question, depending upon the particular room. 10. (a) 240. (b) 3456 sq. ft. or 384 sq. yd. (c) 144 sq. yd. (d) \$960. (e) \$12.96. 11. In this question count the first 10 inches of the landing as the *tread* of the 20th step, and add the extra yard besides. \$9.90.

Exercise 33.—Plan Fig. A. $AF = 24$ ft.; $AE = 120$ ft. The dimensions of floor and ceiling are each 36×24 ft. 1. (a) 528 sq. ft. (b) 270 sq. ft. (c) 270 sq. ft. 2. 33 strips. Perimeter is twice $(18 + 15)$. Perimeter divided by 2 gives number of strips = 33. 3. 9 strips. 4. 8 ft. 15 ft. 133 yds. 19 single rolls. 10 double. Why 10? 5. 184 yds. Note—46 strips, each $\frac{1}{4}$ yds. long. 6. 305 yd.; 39 rolls. \$5.85. 7. (a) 64. (b) 168. 8. (a) \$12.25. (b) \$15.40. (c) \$27.30. 9. (a) \$277.20.

(b) \$10.50. (c) \$19.60. The first long strip would be placed along the lower edge. The last long strip would be turned under for part of its length only. A part of it would help to cover the angle at the right-hand corner top. The plan will make all this clear. 10. \$35.80.

Exercise 34.—1. (a) 60. (b) 112. 2. (a) 42. (b) 315. 3. Consider the height of a as 15 ft., and of b as 18 ft. (a) \$50.40. (b) \$95.04. 4. Take a as 12 ft. in height and b as 21 ft. (a) \$138.84. (b) \$294.84. 5. (a) \$189. (b) \$2916. 6. 388 sq. yd. 7. (a) \$52.80. (b) \$364.80. 8. (a) 18. (b) 270. 9. 45 ft.; 120 ft. The teacher should add the following as other examples of the same character: 1. The wall surface of a room 18 ft. wide and 10 ft. high is 120 yds. Find the length of the room. 2. The walls of a room, 45 ft. by 30 ft., have an area of 400 sq. yd. Find its height.

Exercise 35.—1. 12 board ft. (b) 32. (c) 4. 2. (a) 12. (b) 6. (c) 9. 3. (a) 30. (b) 108. (c) 48. 4. (a) 24 M. (b) 180 M. (c) 24 M. 5. (a) 9000. No allowance is made for thicknesses less than one inch. Boards 12 ft. long, a foot wide and an inch thick, and boards the same length and width, but a half inch thick, count the same, namely, 12 board feet. (b) 24000. (c) 36000. 6. Inch lumber considered when no thickness is given. (a) 60. (b) 40. (c) 15. 7. (a) 328. (b) 485. (c) 645. 8. (a) 880. (b) 1056. (c) 1560. 9. (a) \$21. (b) \$40. (c) \$35. (d) \$18. (e) \$9. Find the cost of flooring the library with maple boards 10 ft. long, three inches wide, and one inch thick; the boards to be placed on edge, and maple worth \$72.50 per M used, \$108.75. 10. \$600. Library not included. 11. (a) 11250. (b) 12000. (c) 13333 $\frac{1}{3}$. 12. (a) 4320. (b) 3150. (c) 2592. 13. (a) 18200. (b) 50160. (c) 712800. 14. (a) 3600. (b) 6400. (c) 9000. 16. (a) 125. (b) 75.

Exercise 36.—This exercise is conducted orally. Its purpose is to reach methods of finding the areas of parallelograms and other right-lined figures. If this exercise is read over until the

author's plan of procedure is thoroughly grasped, we think that very excellent results will obtain. 18. (a) 100 sq. ft. (b) 225 sq. ft. (c) 1500 sq. yd. 19. (a) 18 ft. (b) 18 ft. (c) 18 ft. 20. (a) 16 ft. (b) 20 ft. (c) 6 yd. 21. (a) 2 acres. (b) 10 acres. 22. 280 acres. Join B D. 23. (a) 144 sq. ft. (b) 576 sq. ft. 24. (a) 1440. (b) 3432. (c) 15120.

Exercise 37.—3. 10 sq. in. 10 sq. in. 5. 288 sq. in. 336 sq. in. 6. 48 cub. in. 7. 48 sq. in. 720 cub. in. 8. 18000 cub. ft. Note that the roof of barn is prismatic in shape. 9. (a) 20 sq. in. (b) 6 sq. in. (c) 28 sq. in.

Exercise 38.—1. (a) 12416. (b) 31104. (c) 11340. 2. 69120. 3. 224 loads. \$1083.60. 4. \$124.80. 5. This question is out of place. Have pupils work it orally. Answer, 10 ml. 6. 1792. Refer to Fig. E, page 85. 7. \$27.30. 8. In this take the height as being 13 ft. 6 in. \$38.52. How much paper was wasted? 9. \$140.40. 10. 54000. 11. Work this question as it stands; the answer is \$9600. Add a second question by changing "\$20 per rod" to \$20 per M. \$792. 12. This question will now apply to the second under question 11. 13. \$864.

BILLS, ACCOUNTS AND AVERAGES

Exercise 39.—1. \$217.95. 2. \$26.01, \$18.15. 3. \$1523.45. The teacher will have to explain what is meant by interest. A very brief explanation is all that is required. 4. \$49.90. 6. (a) \$26.75. (b) \$103.75. 5 and 7. Examine these with class. 8. (a) \$13.02. (b) \$8.73. Carry out the hint given at end of this exercise.

Exercise 40.—1. (a) \$4.80. (b) 6. (c) 80. 2. (a) 12. (b) 32. (c) $341\frac{2}{3}$. (d) \$9. 3. (a) 45. (b) 75. (c) 80. (d) \$75. 4. 33. 5. \$32. 6. (a) 5 ft. (b) 7 ft. 6 in. (c) 5 ft. 2 in. 7. 36 ml. at an average speed of 9 ml. per hr. 8. 160. 32. 9. 4 in. 11. 5 ft. 12. (a) 6.5 ft. (b) 2160 ft. 13. (a) 540 ft. (b) 2000 yd. 14. 14 acres. 15. \$38 $\frac{2}{3}$. 16. \$1.95 gain. 17. 5438. 18. (a) About 2954 lb. (b) 25 $\frac{1}{2}$ bu. 19. 62 cts.

FACTORS, MEASURES AND MULTIPLES

Exercise 41.—As this and the following exercises are largely for the object of obtaining correct ideas and methods, extra supervision on the part of the teacher is desirable. 4. (a) 16840. (b) 20020. 5. We should expect children to get the following pairs of factors from 72, viz: 8 and 9, 3 and 24, 6 and 12, 18 and 4, 2 and 36. Lest pupils get the idea that there must always be two factors before the name factor can be used, it is desirable that teachers obtain as many numbers as possible which give as final products the numbers mentioned in question 5. 10. Questions 10, 11, 12 and 15 are an attempt to introduce a device which we think the pupils are now ready to appreciate. The whole spirit of the series, however, is opposed to the introduction of any short method before the standard method has become settled and before the pupil has felt any need of a short cut. This we believe is good pedagogy. 17. 63972 is divisible by 3, 4 and 9, 213231 by 3, 70024 by 4 and 8, 1132 by 4, 7205 by 5, 4264 by 4 and 8, and 80001 by 3 and 9. 19. (a) 11 and 13; 5. 7 and 11; 2^3 . 3. 7; 2^2 . 3^3 . 7. (b) 3^2 . 5. 11; 2. 3^3 . 13; 2^3 . 11^2 ; 5^4 . (c) 2^9 ; 3^6 ; 2^{12} ; 2^4 . 5^3 . (d) 2^6 . 3^3 ; 2^5 . 3. 5. 11; 2^5 . 5. 11; 3^2 . 11^2 . (e) 2. 3^2 . 5^2 . 7; 2^7 . 3^2 . 7; 2. 3^4 . 11; 2. 3. 5. 7. 13. 20. 15, 40; 34, 15; 60 and 72.

Exercise 42.—2. Have the pupils obtain as many common factors as possible. For example, the factors common to 72 and 162 are 2, 3, 6, 9, 18, factors made up of all the common prime factors and all possible combinations of these. 3. 5; 3 and 9; 7; 7; 3, 9 and 27; 2, 3, 4 and 12. 6. 9, 33, 9; 18, 24, 6; 240, 6, 22; 9, 7, 12. Read 7, 8, 9 and 10 closely, and add to them if necessary. The result has much to do with the understanding of the work following. 12. 19, 23, 31 and 37. 16. 4, 2 and 74. The pupils will not likely get the last of these, but their want of success will prepare for the acceptance of the general method which follows. 17. Note in this question that the first difference is factorable. 18. 47, 227, 47, 307, 97, 221, 389, 29.

Exercise 43.—1. 13 ft. 2. 6 ft. 3. 182 bu. 4. 70 acres.
5. \$1533. 6. 82 posts. 7. 7 lb. 8. Boards 11 ft. long.
2532 boards needed. The only difficulty in this exercise lies
in the similarity of the wording of the problems. The teacher
can prevent mere form by calling for reasons why such and
such steps were taken.

Exercise 44.—10. Find a number of common multiples.
16. 180, 336, 1260, 480, 6800, 8800, 840, 756, 1120.
18. 252, 450, 4200, 12600, 13728, 6600, 1620, 576
5040, 3360, 420, 3780. 20. 1330732, 1103941, 170085,
527711.

Exercise 45.—1. 3605401800. 2. (a) 60. (b) 72. (c) 280.
(d) 180. 3. \$20. 4. 2160 ml. 5. 60 times. 6. 388. 7. 188123.
8. $2^3 \times 3^2 \times 5 \times 7$. 9. 4400 times. Counting the first step.
4401 times. 10. 1200 ac. 12. 12, 13 and 14. 13. \$840.
14. 432 in. 15. 78 yr. 16. 19833. 17. $18\frac{2}{3}$ ml. 18. \$5.72 -
19. \$6. 20. \$6.40. 21. \$88.05.

FRACTIONS

Exercise 46.—Pupils have been considering fractional rela-
tions from the time of the beginning of their second school
year. This exercise is for the purpose of a review and as a
preparation for the more formal work of fractions.

Exercise 47.—The important feature of this exercise is the
development of the principle that *the value of a fraction is not
changed by multiplying its terms or dividing its terms by the
same number.* If this principle is understood by referring it
to numbers, surfaces, lines, etc., the subsequent work in formal
fractions will be materially simplified. Questions 6 and 7 are
given because we think that the children have already found
out how to read and to write fractions. 16. The teacher may
show how to apply the principle of cancellation. For example

$$\frac{15}{15} \times \frac{2}{2} \times \frac{2}{2} \times \frac{2}{2} \times \frac{2}{2} \times \frac{2}{2} \times \frac{2}{2} \times \frac{8}{8}$$

Answers (a) $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{10}$, (b) $\frac{1}{2}$, $\frac{1}{11}$, $\frac{1}{7}$, (c) $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{4}$
(d) $\frac{1}{15}$, $\frac{1}{3}$, $\frac{1}{3}$, (e) $\frac{1}{10}$, $\frac{1}{3}$, $\frac{1}{3}$, (f) $\frac{3}{11}$, $\frac{1}{3}$, $\frac{1}{7}$, (g) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{4}$

17. Read in columns: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{7}$; $\frac{1}{3}$, $\frac{2}{3}$, $\frac{4}{5}$; $\frac{2}{5}$, $\frac{3}{4}$, $\frac{3}{8}$; $\frac{4}{7}$; $\frac{5}{7}$, $\frac{3}{7}$, $\frac{2}{7}$, $\frac{1}{3}$; $\frac{3}{8}$, $\frac{7}{8}$, $\frac{3}{8}$; $\frac{8}{9}$, $\frac{7}{10}$, $\frac{8}{29}$.

Exercise 48.—1. (a) $\frac{3}{8}$. (b) $\frac{5}{28}$. (c) $\frac{9}{32}$. 3. (a) $46\frac{7}{8}$. (b) 120. (c) 24. 4. 30. 5. \$100. 6. 8100. 7. \$30. 8. (a) $6\frac{2}{3}$ T. (b) 20 horses. (c) $4\frac{2}{3}$ tubs. (d) 135 bu. 9. (a) \$2.68. (b) \$175. (c) 15 cts. (d) 60 cts.

ADDITION OF FRACTIONS

Exercise 49.—2. (a) 133 in. (b) 29 pt. (c) 67 oz. 3. (b) $\frac{6}{18}$, $\frac{15}{18}$, $\frac{8}{18}$. (c) $\frac{2}{24}$, $\frac{20}{24}$, $\frac{2}{24}$. (d) $\frac{1}{20}$, $\frac{8}{20}$, $\frac{15}{20}$. (e) $\frac{2}{60}$, $\frac{15}{60}$, $\frac{12}{60}$. (f) $\frac{16}{40}$, $\frac{4}{40}$, $\frac{5}{40}$. (g) $\frac{7}{42}$, $\frac{4}{42}$, $\frac{14}{42}$. (h) $\frac{12}{120}$, $\frac{48}{120}$, $\frac{12}{120}$. (i) $\frac{6}{12}$, $\frac{4}{12}$, $\frac{3}{12}$. 4. (a) $\frac{9}{10}$. (b) $\frac{11}{10}$ or $1\frac{1}{10}$. (c) $\frac{7}{6}$ or $1\frac{1}{6}$. (d) $\frac{23}{18}$ or $1\frac{5}{18}$. (e) $\frac{31}{30}$ or $1\frac{1}{30}$. (f) $1\frac{7}{2}$ or $1\frac{5}{2}$. (g) $\frac{8}{6}$ or $1\frac{1}{3}$. (h) $\frac{26}{24}$ or $1\frac{1}{2}$. (i) $\frac{33}{40}$. (j) $\frac{13}{10}$ or $1\frac{3}{10}$. (k) $\frac{11}{2}$. (l) $\frac{14}{2}$ or $1\frac{1}{2}$. 5. (a) $\frac{5}{6}$. (b) $\frac{3}{4}$. (c) $\frac{5}{6}$. (d) $\frac{4}{5}$. (e) $\frac{2}{3}$. 6. (a) $2\frac{7}{2}$ or $2\frac{1}{2}$. (b) $\frac{23}{12}$ or $1\frac{11}{12}$. (c) $\frac{31}{18}$ or $1\frac{13}{18}$. (d) $\frac{12}{10}$ or $1\frac{1}{5}$. (e) $\frac{23}{12}$ or $1\frac{11}{12}$. (f) $\frac{13}{120}$ or $1\frac{13}{120}$. 8. In the solution given under a, change the 14 to 9 and the $15\frac{7}{2}$ to $10\frac{7}{2}$. (b) $11\frac{31}{40}$. (c) $9\frac{1}{2}$. (d) $14\frac{1}{6}$. 9. (a) $1495\frac{3}{8}$. (b) $2088\frac{5}{2}$. (c) $2007\frac{1}{8}$. (d) $2490\frac{1}{2}$. 10. $4\frac{1}{6}$. 11. $1\frac{4}{15}$. 12. $\frac{5}{8}$. 13. $\$6\frac{1}{8}$. 14. $\$1\frac{27}{40}$. 15. $8\frac{5}{8}$ ml. 16. $\frac{5}{12}$. 17. $2\frac{1}{4}$. 18. 102 rd. 19. 47 bu.

SUBTRACTION OF FRACTIONS

Exercise 50.—1. (a) $\frac{1}{10}$. (b) $\frac{1}{8}$. (c) $\frac{1}{30}$. (d) $\frac{3}{40}$. (e) $\frac{13}{40}$. (f) $\frac{1}{8}$. (g) $\frac{7}{24}$. (h) $\frac{1}{12}$. (i) $\frac{1}{10}$. 2. (a) $11\frac{1}{6}$. (b) $5\frac{5}{6}$. (c) $62\frac{1}{2}$. (d) $72\frac{1}{2}$. 4. (b) $7\frac{1}{4}$. (c) $17\frac{3}{20}$. (d) $62\frac{3}{4}$. 5. $\frac{2}{5}$. 6. (a) $\frac{1}{6}$ of my age. (b) $\frac{1}{5}$ of my property. 7. (a) $\frac{1}{20}$ of a dollar or 5 cts. (b) $\$3\frac{7}{10}$. 8. $\frac{2}{3}$. 9. (a) $4\frac{1}{6}$. (b) $4\frac{1}{2}$. (c) $5\frac{1}{8}$. 10. $\$12\frac{1}{2}$. 11. (a) $\frac{37}{80}$. (b) $\frac{4}{5}$. (c) $2\frac{3}{4}$.

Exercise 51.—4. $\frac{2}{4}$, $\frac{18}{4}$, $\frac{36}{4}$. The important feature here is to assist the pupils towards the principle that a fraction is multiplied by a whole number by multiplying the numerator by the whole number and setting the denominator underneath. The simplification of the result will come when this is understood. 7. (a) 75, 100, 125. (b) 100, 150, 200. (c)

- 100, 200. (d) 103, 206, 412. (e) 26, 52, 130. (f) 59, 118, 295. 8. (a) \$4.92. (b) \$50.25. (c) \$14.44. 9. (a) \$56. (b) 90 cts. (c) 10 cts. 10. (a) 18, 20, 21. (b) 18, 25, 8. (c) 35, 36. (d) 36, 40, 30, 50, 54, 35. (e) 36, 48, 54, 60, 63, 64, 42. (f) 50, 80, 75, 70, 40, 36. 11. (a) 45. (b) 138. (c) 140. (d) 95. (e) 69. (f) 228. (g) 115. (h) 168. (i) 130. 13. (a) 4. (b) $\frac{3}{8}$ or $5\frac{3}{8}$. (c) $\frac{2}{3}$ or $3\frac{2}{3}$. (d) $\frac{2}{3}$ or $7\frac{2}{3}$. (e) $\frac{4}{7}$ or $6\frac{4}{7}$. (f) $\frac{4}{7}$ or $9\frac{4}{7}$. (g) $\frac{1}{2}$ or $4\frac{1}{2}$. (h) $\frac{2}{3}$ or $2\frac{2}{3}$. (i) $\frac{2}{7}$ or $6\frac{2}{7}$. (j) $6\frac{2}{7}$ or $7\frac{2}{7}$. (k) $24\frac{2}{7}$ or $27\frac{2}{7}$. (l) $36\frac{2}{7}$ or $43\frac{2}{7}$. 14. Oral $\frac{2}{3}$. 15. $\frac{1}{4}$. \$5. \$12. \$30. 16. (a) 45. (b) \$58. (c) 40 cts. 17. (a) $\frac{1}{4}$. (b) $\frac{1}{2}$. (c) $\frac{1}{2}$. (d) $\frac{1}{2}$. (e) $\frac{1}{2}$. (f) $\frac{1}{2}$. 18. (a) 9, 4, 8, 10. (b) $\frac{1}{2}$, 1, $\frac{1}{3}$, $\frac{1}{3}$. (c) $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{3}$. 19. (a) $\frac{1}{2}$. (b) $\frac{1}{12}$. (c) $\frac{1}{2}$. (d) $\frac{1}{2}$. (e) $\frac{1}{2}$. (f) $\frac{1}{2}$. (g) $\frac{1}{15}$. (h) $\frac{1}{2}$. (i) $\frac{1}{20}$. (j) $\frac{1}{12}$. (k) $\frac{1}{12}$. (l) $\frac{1}{2}$. 21. (a) $\frac{1}{2}$. (b) $\frac{1}{2}$. (c) $\frac{1}{12}$. (d) $\frac{1}{2}$. (e) $\frac{1}{12}$. (f) $\frac{1}{2}$. (g) $\frac{1}{12}$. (h) $\frac{1}{12}$. (i) $\frac{1}{12}$. 22. (a) \$1.50. (b) \$1.44. 23. (a) $\frac{1}{10}$. (b) $\frac{1}{2}$. (c) $\frac{2}{12}$. (d) $\frac{1}{12}$. (e) $\frac{1}{12}$. (f) $\frac{1}{12}$. (g) $\frac{1}{12}$. (h) $\frac{1}{10}$. (i) $\frac{2}{12}$. 24. (a) $\frac{1}{2}$ of a dollar or 60 cts. (b) $\frac{1}{4}$ of a dollar. (c) $\frac{1}{2}$ of a dollar. (d) $\frac{1}{2}$ of a dollar. 26. (a) 93 cts. (b) \$120. (c) \$106. 27. (b) $61\frac{1}{2}$. (c) $513\frac{1}{2}$. 28. (a) \$3.08 $\frac{1}{2}$. (b) \$2.63 $\frac{1}{2}$. (c) \$3.18 $\frac{1}{2}$.

DIVISION OF FRACTIONS

- Exercise 52.**—9. (a) 9, 8, $7\frac{1}{2}$. (b) $13\frac{1}{2}$. 12. $10\frac{1}{2}$. 16. $14\frac{1}{2}$. $13\frac{1}{2}$. 10. (a) 3. (b) $\frac{1}{12}$. (c) $\frac{1}{3}$ or $1\frac{1}{3}$. (d) $\frac{1}{2}$ or $1\frac{1}{2}$. (e) $\frac{1}{3}$. (f) $\frac{1}{3}$. (g) $\frac{1}{3}$ or $2\frac{1}{3}$. 11. (a) $\frac{1}{2}$. (b) $\frac{1}{2}$. (c) $\frac{1}{2}$. (d) $\frac{1}{2}$ or $1\frac{1}{2}$. (e) $\frac{1}{2}$ or $10\frac{1}{2}$. (f) $\frac{1}{2}$ or $11\frac{1}{2}$. (g) $\frac{1}{2}$ or $1\frac{1}{2}$. (h) $\frac{1}{2}$. (i) $\frac{1}{2}$ or $1\frac{1}{2}$. 12. (a) 8 times. (b) 15 times. (c) 18 times. (d) 27 times. 13. $1\frac{1}{2}$. 14. 9 pairs. 15. 12 wk. 16. (a) $\frac{1}{2}$. (b) $\frac{1}{2}$. 17. (a) $\frac{1}{2}$. (b) $\frac{1}{2}$. (c) $\frac{1}{2}$. (d) $\frac{1}{2}$. (e) $0\frac{1}{2}$. (f) $7\frac{1}{2}$. (g) $\frac{1}{2}$. (h) $\frac{1}{2}$. (i) $\frac{1}{2}$. (j) $\frac{1}{2}$. (k) $\frac{1}{2}$. (l) $\frac{1}{2}$. (m) $\frac{1}{2}$. (n) $\frac{1}{2}$. (o) $\frac{1}{2}$. (p) $\frac{1}{2}$. (q) $\frac{1}{2}$. (r) $\frac{1}{2}$. (s) $\frac{1}{2}$. (t) $\frac{1}{2}$. (u) $\frac{1}{2}$. (v) $\frac{1}{2}$. (w) $\frac{1}{2}$. (x) $\frac{1}{2}$. (y) $\frac{1}{2}$. (z) $\frac{1}{2}$. 18. (a) 10. (b) $10\frac{1}{2}$. (c) $13\frac{1}{2}$. (d) $16\frac{1}{2}$. (e) $24\frac{1}{2}$. (f) $31\frac{1}{2}$.

- Exercise 53.** 1. 4, 5, 3, 5, 5, 11, 13, 1, 3 $\frac{1}{2}$. 2. (a) 11, 11, 11, 11, 11, 11. (b) 11, 11, 11, 11

- (c) $\frac{175}{210}$, $\frac{180}{210}$, $\frac{160}{210}$, $\frac{140}{210}$. 3. (a) $\frac{24}{36}$, $\frac{20}{36}$, $\frac{27}{36}$. (b) $\frac{32}{36}$ and $\frac{24}{36}$. (c) $\frac{20}{60}$, $\frac{15}{60}$ and $\frac{12}{60}$. 4. (a) $1\frac{5}{10}$. (b) $2\frac{7}{10}$. (c) $11\frac{1}{10}$.
 5. (a) $\frac{1}{8}$. (b) $\frac{1}{36}$. (c) $\frac{1}{18}$. 6. (a) $\frac{5}{21}$. (b) $\frac{5}{18}$. (c) 1. 7. (a) $\frac{180}{112}$. (b) $1\frac{1}{2}$. (c) $1\frac{2}{5}$. 8. (a) $\frac{1}{3}$, $\frac{3}{4}$, $\frac{5}{7}$. (b) 42, 105, 375. (c) $84\frac{1}{2}$, $123\frac{1}{2}$, $164\frac{8}{5}$. 9. (a) $\frac{2}{15}$. (b) $\frac{1}{4}$. (c) $\frac{9}{40}$.
 (d) 16. (e) $22\frac{1}{2}$. (f) 20. (g) $1\frac{7}{8}$. (h) $\frac{6}{35}$. (i) $\frac{8}{45}$. 10. $\$23\frac{7}{10}$.
 11. $22\frac{3}{4}$ yd. 12. 8 families. 13. $\$353.60$.

DECIMAL FRACTIONS

A great many pupils find decimal fractions rather meaningless. This is not due to any difficulty in the conception of these fractions. It is due, though, to a too rapid and too hazy introduction. It is not too much to say that considerable practice had to be resorted to in order to make the writing of whole numbers a habit. A similar amount of practice is required to enable one to grasp the notation of decimals. We would suggest that the teacher exercise a good deal of patience in the preliminary decimal work, for we are sure that here, as in vulgar fractions, the subsequent work will be easy or difficult in proportion as the introduction has been made complete or incomplete. Children should not leave Exercise 54 until they can read and write simple decimal numbers almost as readily as whole numbers.

Exercise 54.—25. .8, .75, .056, .9, .07, .008, 7.5, 2.13, .204, 1.9, 24.68, 4.287, 300.042, .342. Have the pupils place the decimal point in its correct place as 3.7 and not as 3·7. In reading numbers do not permit such reading of 3.216 as 3-point-2-1-6. Insist on reading it as three and two hundred and sixteen thousandths.

ADDITION OF DECIMALS

Exercise 55.—1. 7.1, 5.6, 1.6, 2.4, 2.9, 7.46, 8, 7.268, 40.002, 4, 203.7, 312.03, 279.5, 272.82, 269.684, 21.948. 5. (a) 815.667. (b) 1803.29. (c) 607.377. (d)

- 674.65. (e) 178.125. (f) 126.401. (g) 169.59 yd. (h)
 235.866 lb. 6. (a) 1034.373. (b) 117.041. (c) 215.456.
 7. 506.17 lb. 8. 122.56 ml. Ninety-seven hundredths of my
 money.

SUBTRACTION OF DECIMALS

- Exercise 56.**—2. 12.74, 27.6, 12.89, 24.65, 21.909,
 55.228. 3. (a) 2.075, 59.071, 13.16. (b) 40.899, 7.54,
 17.711. (c) 4.889, 55.1, 6.565. 4. (a) 129.689. (b)
 118.045. (c) 130.666. 5. 16.531. 6. 3.595. 7. \$4501.86.
 8. 184 529. 9. 150.052, 112.762, 129.992. Have the
 third question solved by subtraction. 10. 999.644, 7199.28.
 11. Three hundred and fifty-six thousandths, .356. 12.
 27.913. 13. 116.577 ml.

MULTIPLICATION OF DECIMALS

Exercise 57.—

7. (a) 23.5 39.2 4.68 12.639
 (b) 22.8 41.5 10.23 21.256
 (c) 67.2 75.2 30.48 32.075
 (d) 99.2 130.5 38.36 45.096
8. (a) 59.99 cts. (b) 194.4 cts. (c) 411.48 cts. (d)
 \$350.80. 9. 4867, 7246.3 and 8211.56. 10. Oral work.
 8463, 7289.3, 4262.46, 7, 7.6, 4.76. 11. 327.8, 46397,
 7280. 12. (a) 42863.9, 4286, 480. (b) 726439, 62730,
 8900. 13. (a) 6, 16, 40.8, 147. (b) 12.9, 16.28,
 164.84, 375.2. (c) 2.952, 5.472, 7.704, .144. (d)
 36.189, 66.599, 129.744, and 216.12. 14. (a) \$270.
 (b) \$40.80. (c) \$1102.72.

- Exercise 58.**—6. (a) 288, 28.8, 2.88, 2⁹.68. Com-
 pare the last of these results with the sum of the three previous
 results. (b) 584, 58.4, 5.84, 648.24. Have the pupils
 inferred the second and the third of the above results from the
 first result? 8. (a) 74.7, 77.19, 77.522. (b) 63.2, 66.36,
 66.755. (c) 67.2, 72.96, 73.248. 10. (a) 576, 1118,

2368, 35109. (b) 767, 1008, 2115, 30132. (c) 539, 1485, 3528, 12875. 11. (a) 57.6, 111.8, 23.68, 351.09. (b) 56.7, 100.8, 21.15, 301.32. (c) 53.9, 148.5, 35.28, 128.75. 12. (a) 34.4, 21.39, 258.4. (b) 56.4, 45.36, 354.27. (c) 256.8, 304.56, 8175.81. (d) 549.9, 371.91, 4024.58.

14. (a) 72 7.2 .72 15.2
 (b) 7.2 .72 .072 3.42
 (c) .72 .0072 .000072 1.1772

15. (a) 5968 6142 135648
 (b) 7488 6912 331248
 (c) 5075 1036 592325
 (d) 3756 3627 199368

16. (a) 59.68 6.142 135.648
 (b) 74.88 6.912 3312.48
 (c) 50.75 1.036 592.325
 (d) 37.74 3.627 199.368

The first result in (d) may be obtained if the multiplicand 62.9 be changed to 62.6. 17. (a) 1686.6, 305.27, 35.476, 3.999. (b) 87.97, 428.04, 198.968, 3.999. (c) 2.172, 448.23, 34.188, 3.999. 18. (a) \$1816.51. (b) 1627.392 cts. (c) \$764.925. What does the 5 to the right mean?

19. (a) 5674.5 18926.4 987
 (b) 567.45 1820.64 98.7
 (c) .56745 182.064 9.87
 (d) 7.2 21.6 32.4
 (e) 8.16 22.95 32.93
 (f) 8.328 23.112 42.864
 (g) .72 2.892 4.1725
 (h) 1.296 2.4582 4.6732
 (i) 10.3768 21.62184 31.737745

DIVISION OF DECIMALS

Exercise 59.—1. Eighty-nine and seventy-six hundredths dollars, etc. 3. 16.24. 15.17, 144.16. 4. (a) 3.21, 4.56, 7.34, 13.45. (b) .73, .84, 1.21, 4.56, 43.21. (c) .45,

.86. 4.62. 4.44. 3.29. 7. 3456. 7349. 7638. 8. 3.456. 734.9. 76.38. Notice the number of decimal places in the dividend and in the quotient. 9. 9.269, 21.747 +, 107.606. 10. (a) \$90.08. (b) \$9.391. 11. 22.12 sq. yd. 12. 1.586. 158.5. 90.15. 7.75. 86.53. 46.8. 5.166. 3. 1.41. 13.374. .99. 1.021. 103.081. 9.318. .091. .001.

Exercise 60.—4. 10.5. 1.05. .105. 105. 1050. 10.5. 1.05. 16. 16. 16. 160. 1600. 4.5. 45. 25. 250. 2500. 250. 25. 2.5. .25. 8. 10. 10. 100. 100. 10. 100. 1000. 100. 100. 10. 100. 100. 9. 72.5 -. 92.6. 47.59 -. 231. 672. 724. 126. 741.3. 10. 32.7 lb. Notice that one sum is given in dollars and the other in cts. Both must be brought to the same denomination—thus—45.8 cts. is \$.458. When this is arranged the division process may proceed. 11. 238.14 cts. or \$2.3814. 12. 100 bins. Have any of the pupils seen that 725 bushels is just 100 times 7.25 bushels. 13. 1864. \$13.98 is 1398 cts. This change must be made before division can be effected.

REVIEW

Exercise 61.—1. (a) \$2.67. (b) \$1.02. oral. (c) 27 cts. 2. (a) \$25.38. (b) \$126. Note that 5 yd. 1 ft. 6 in. is $5\frac{1}{4}$ yd. or 1 rod. This makes 21 rods. (c) \$836. 3. (a) \$74.40. (b) \$15.36. (c) \$24. 4. (a) 9.6 acres or $9\frac{3}{4}$ acres. (b) 32 acres. (c) 400 ac. 5. (a) 8640 cu. ft. (b) 1980 cu. ft. (c) 720 cu. ft. 6. (a) 1350 cords. (b) 360 cords. (c) 24 cords. 7. (a) 192 cu. yd. (b) $2\frac{1}{4}$ cu. yd. (c) 720 cu. yd. 8. (a) \$33.75. (b) \$38.70. Solution: 5375 lb. = 53.75 cwt., which costs 53.75×33.75 = above result.

It is well henceforward to count on the pupils employing any method previously grasped. The decimal method is in this particular case the best. (c) \$101.25. 9. The carper is supposed to be put on the floor in the most economical manner. (a) 12 widths, each 13 ft. long (b) 20 widths, each 36 ft. long, or 18 widths, each 40 ft. long. 10. This means that the

strips run from end to end of the room. (a) 648 yd. (b) 960 yd.
 11. A. \$393.21. B. \$426.07. C. \$410.10. D. \$447.04.
 E. \$552.70. F. \$196.26. 1. \$342.59. 2. \$304.16. 3.
 \$354.37. 4. \$271.33. 5. \$270.40. 6. \$351.55. 7. \$259.77.
 8. \$271.21. Total \$2425.38.

Exercise 62.—1. \$18. 2. \$10.26. 3. A loss of \$1331.
 4. \$2129. 5. $5.14\frac{1}{4}$ or \$5.15. 6. 72 lbs., $40\frac{1}{2}$ lbs. 7. 18 da.
 8. (a) \$188. (b) \$17. (c) \$144. (d) \$88.074. (e) \$3.24.
 9. \$1.80. 10. 201. 11. \$4434. 12. The horse cost \$300 and
 the buggy \$60. 13. \$380. 14. 270 ml. 30 hr. 15. Lost
 \$13.44.

Exercise 63.—1. 80 cts., 48 cts. 2. $\frac{9}{10}$, $\frac{5}{7}$, $\frac{13}{16}$, $\frac{2}{3}$, $\frac{8}{27}$.
 3. $1\frac{1}{6}$, $1\frac{5}{12}$, $1\frac{1}{4}$, $\frac{3}{4}$, $1\frac{1}{2}$. 4. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{5}{24}$, $\frac{23}{24}$. 5. $\frac{1}{3}$, $\frac{1}{3}$,
 $\frac{1}{6}$. 6. 6. 6. $38\frac{3}{4}$ yd. 7. \$6.33. 8. $6\frac{1}{4}$ ml. 9. \$32 $\frac{5}{8}$.
 10. (a) \$2.56 $\frac{1}{4}$. (b) \$15.25. 11. \$4.57. 12. $1\frac{1}{2}$, $1\frac{5}{16}$, $\frac{21}{4}$.
 13. 12 da., 16 da., 20 da. 14. 3 hr., 6 hr. 15. $\frac{2}{3}$.
 16. \$10069.24. 17. \$14.10. 18. 197 lots. 19. £466 15s.
 6d. 20. £92 9s. 8d. 21. 11 T. 10 cwt. 33 lb. 2 oz. 22. 89
 boxes. 48 oz. 23. $5\frac{1}{2}$ hr. 3.43 o'clock p. m. 24. (a) 135.
 (b) $86\frac{1}{8}$ bu. (c) $197\frac{3}{8}$ gal. 25. \$7. 26. 2304. 27.
 4500 doz.

Exercise 64.—1. Four tenths; forty-nine hundredths;
 four hundred and ninety-five thousandths; one hundredth; one
 tenth; one thousandth; twelve and eight tenths; one and
 twenty-eight hundredths; one hundred and twenty-eight thou-
 sandths; sixty-seven and three hundred and forty-six thou-
 sandths; seventy-eight and thirty-five hundredths; nineteen
 and six tenths. 2. 700.054, 17.63, 209.9, 3000.25. 3.
 (a) 465.612. (b) 466.693. 4. 8168. 5. \$72130. 6. (a)
 9.572 ml. (b) 19.73 gal. 7. 341.6. 86.67, 65.86, 4627.692.
 8. (a) \$61.5285 or \$61.53. (b) \$8.6025 or \$8.604. 9. $2^3 \times 3^4$
 $\times 5 \times 7$. 10. 12600. 11. (a) 120. (b) 30. 12. 216.
 13. 729. 14. The numbers are 37, 48 and 64. Their L.C.M.
 is 7104. 15. 864. 16. 54 sq. ft. 17. (a) 108 sq. ft. (b)

11616 sq. yd. 18. \$11.16. 21 rolls for walls. 15 rolls for ceiling. 19. \$28.80. 20. 3300. 21. 79200 ft. 22. \$259.20. 23. (a) 10368 cu. in. (b) 7552 cu. in. Outside dimensions are 40 in., 28 in., 16 in., while the inside dimensions are 36 in., 24 in., 12 in. 24. 466560 bricks. \$3382.56.

HANDBOOK TO MORANG'S MODERN ARITHMETICS

BOOK II—PART I

REVIEW

Exercise 1.—

- | | | |
|--------------|-----------|-----------|
| 1. A. 561675 | B. 481147 | C. 246767 |
| D. 532767 | 1—231590 | 2—241380 |
| 3—215023 | 4—181290 | 5—170295 |
| 6—247364 | 7—182667 | 8—352731 |
2. Footings and totals each 1822340. 3. 91802, 5295481, 35543. 4. (a) 1175. (b) 575. 5. 19750800, 19958670, 24602400, 40439583. 6. 20, 11, 32, 13, 1001. 7. 5, 7 and 11. $2^2 \times 3^2 \times 5 \times 7$. $3^2 \times 11^2$. 2^{12} . 8. Can the pupils do these without actual division? 9. 384. 10. 6, 8. 11. 118, 118. 12. 13, 67. 13. 1680, 288. 14. 360, 2016. 15. (a) 24. (b) 15. 16. 19897. 17. 720, 3375, 7686, 9720. 18. 480 acres. 19. 210 cords. 20. 11 ft.

- Exercise 2.—**1. (a) 45 bu. (b) 2100 bu. 2. How many books were really paid for? \$290.85. 3. 132 times. 4. \$14.17 gain. 5. $55\frac{1}{4}$ ct. per lb. 6. $5866\frac{2}{3}$ bu. 7. \$1289 gain. 8. $36\frac{5}{8}$ yd. 9. Make a plan of the room. 50 yd. long by 40 yd. wide. 10. $\$7.52\frac{1}{2}$. 11. 43 lb. 12. (a) 40 lb. (b) 80 lb. 13. Ask for solutions in these questions. 14. \$4702.75. 15. \$396. 16. 1350. 17. \$28. 18. 48 apples. 19. 270 tons. 20. A loss of \$18. 21. 816256, 759966, 799767.

- Exercise 3.—**1. 7s. 6d. 2. 12. 3. Total cost = \$350 + oats + hay = \$350 + \$12.60 + \$25.20 = \$387.80. Total amount received = \$370 + work = \$370 + \$414 = \$784. The gain is

therefore $\$784 - \$387.80 = \$396.20$. 4. $\$360$. The second room is 30 ft. wide = $\frac{3}{4}$ as wide as the first. The cost would have to be in the same proportion. $\frac{3}{4}$ of $\$288 = \360 . Cost of carpet $\$3$ per yd. 5. $\$1600$. 6. $\$158.25$. 7. 3, 5, 17, 15, 51, 85. 8. $\pounds 12$ 14s. 9. 252 gal. 10. 156 lb. 11. 18s. 12. 5 times. 13. 108. 14. 36 cts. 15. 168, 60. 16. $2\frac{1}{2}$ da. The man would lose $\$2$ per day. 17. $\$9371.43$. 18. What difference in width makes a difference of $\$10$? 18 ft. 19. 15 ft. 20. $\$21.90$. 21. As to the eating, the second group may just as well be doubled. 8 men have provisions for 15 days. 20 men have provisions for 8 days. The provisions would last one man 120 days + 160 days, or 280 days. The provisions would last 28 men 10 days. 22. 168. 23. 5 lb. to the bushel. He bought 60 bu. and sold 65 bu. 24. 15 ml. The wagon gains 3 miles per hour.

Exercise 4.—1. 7000. 2. 10800. 3. 8800. 4. 18048. 6. Consider the scale in this question as $\frac{1}{4}$ inch = 40 rods. (a) About 751 acres 90 sq. rds. (b) Northwest corner—contained 80 acres; the southwest corner—109 ac. 110 sq. rd. nearly; the southeast corner—a little over 72 acres. (c) Have the pupils look at the field as it stands in the plan. Have them picture what it looked like before the lands mentioned were sold. Does it require more to fence it now? $\$1651.32$. 7. A B C is $\frac{7}{8}$ in. wide by $1\frac{5}{8}$ in. long. Number of acres in A B C = $(140 \times 210 \div 160) \div 2$. Cost = $\$6890.62$. 8. A B C has an area of 1215 sq. yd. and A C D an area of 1620 sq. yd. The total area is therefore 2835 sq. yd. 9. 1320 yd. long by 330 yd. wide. 90 ac. 10. 281600, $\$3328$. 96 lots. 11. (a) A 24-inch cube. (b) 5824 cub. in. 12. 1408 cub. ft. 13. (a) 192 ft. (b) 162 ft. 14. (a) $\$3584$. (b) If laid so that the strips run from end to end of the room. $\$1086.75$. If the reverse, $\$1076.25$. 15. (a) Find the total length of paper used on walls and ceiling before converting it into rolls. $\$25.11$. (b) $\$45.15$. 16. (a) $\$390$. (b) $\$574.40$. 17. (a) $\$3.60$. (b) $\$7.20$. 18. (a) 48 ft. (b) 60 ft. 19. (a) 9 ft. (b) 12 ft. 20. (a) 18 yd. (b) 12 yd. 21. (a) 36000. (b) 21600.

Exercise 5.—1. (a) \$11.70. (b) \$2.90. 2. (a) \$51220. (b) \$16.50. 3. (a) Use multiplication of decimals. 4635 lbs. = 46.35 cwt. \$55.62. (b) 9.68 thousands at \$18 per M. \$174.24. 4. (a) 12 gal. 2 qt. 1 pt. 1 gi. (b) 13 bu. 1 pk. 4 qt. 1 pt. 5. (a) 4 bu. 3 pk. 1 pt. (b) 2 gal. 5 qt. 1 pt. 1 gi. 6. (a) \$4.20. (b) \$41.44. (c) \$76.80. 7. (a) 504 gi. (b) 798 qt. (c) 620 in. 8. (a) 16 gal. 3 qt. (b) 4 bu. 2 pk. 6 qt. (c) 11 yd. 1 ft. 6 in. 9. (a) 127 gal. (b) 911 bu. 2 qt. (c) 932 yd. 10. (a) 6 gal. 1 qt. $1\frac{1}{2}$ gi. (b) 3 bu. $\frac{1}{2}$ pk. 4 qt. (c) 12 yd. $2\frac{1}{2}$ in. 11. \$1087.80. 12. Change \$132 to \$92. As it stands it is unworkable. Wood is worth \$5 a cord. 13. Take the gain on each and have nothing to do with finding the total cost or total selling price. \$134.40. 14. He made $\frac{1}{2}$ of \$120 and lost $\frac{1}{2}$ of \$120. His gain is therefore \$14. 15. 133 times. This includes the maple tree and the poplar beginning the road. 16. 8100 yd. The total length of the roadway if the parts were placed end to end is 400 yd. The corner squares take 40 yd. of this, leaving 360 yd. as the perimeter of the inner square, or 90 yd. to a side. 17. The stone occupies 16 cu. ft. The water in the well occupies 96 cu. ft. When the stone is placed in the well the water will rise so that there will apparently be $96 + 16$ cu. ft. of water in the well. This would mean that the water was $112 \div 16$ ft. deep, or 7 ft. deep. 18. \$372.26.

Exercise 6.—1. $\frac{5}{7}$, $\frac{3}{4}$, $\frac{3}{4}$, $\frac{7}{8}$, $\frac{3}{3}\frac{1}{2}$ and $1\frac{1}{2}$. 2. $\frac{5}{12}$, $\frac{1}{2}$ and $1\frac{10}{12}$; $\frac{2}{3}\frac{1}{4}$ and $\frac{2}{3}\frac{0}{2}$. 3. $1\frac{5}{12}$, $1\frac{1}{2}\frac{1}{4}$, $1\frac{1}{10}$, $1\frac{1}{2}$ and $1\frac{1}{2}$. 4. $36\frac{5}{8}$, $32\frac{5}{12}$ and $37\frac{1}{2}$. 5. $\frac{1}{8}$, $\frac{1}{8}$ and $\frac{1}{4}$. 6. $1\frac{3}{4}$. 7. $98\frac{1}{2}$. 8. \$6.80. 9. $5\frac{1}{2}$, $6\frac{2}{3}$, $12\frac{1}{2}$. 10. 6, 6 and 12. 11. $\frac{1}{2}$, $\frac{3}{8}$ and $\frac{3}{4}$. 12. (a) $\frac{3}{20}$, $\frac{5}{8}$ and $\frac{4}{3}$. (b) 9, $14\frac{3}{4}$ and $18\frac{1}{4}$. (c) $\frac{8}{9}$, $1\frac{1}{4}$ and $1\frac{1}{8}$. 13. (a) One third. (b) $\frac{5}{4}$ of a yd. 14. \$144. 16. 813483.3; 780.78 and 1.8. 17. (a) 348.265. (b) 66.901. 18. (a) 374.875; 3.251. (b) 89.536; .614. 19. (a) 343.371; 21.55; 36516. (b) .15; 640.475; 3019.016. 20. (a) 3.27; 117.09; 25.144. (b) 8.6; 4.56; 8.5. 21. 73.6 rd. 22. 2.7 in. 23. $\frac{3}{4}$, $1\frac{3}{4}$ and $1\frac{1}{2}$; $1\frac{3}{4}$, $1\frac{1}{4}$ and $3\frac{0}{4}$; $1\frac{3}{8}$, $1\frac{1}{8}$ and $5\frac{1}{8}$. 24. $2\frac{3}{4}$, $4\frac{1}{4}$ and $4\frac{1}{4}$.

VULGAR FRACTIONS

The exercises forming the previous review will serve as a guide to the character of the fractional work already attempted. Nothing more than a beginning however has been made. The work now will assume a more formal and complete character.

Exercise 7.—Questions 1, 2 and 3 are for oral work. They will show to what extent the fractional idea has been grasped. 4. The division of 2 by 3 may be indicated as $2 \div 3$; as 2 to 3 and as $\frac{2}{3}$. 7. It is well always to refer the fraction to a number of different things. Do not neglect this review. 10. (a) $\frac{3}{7}$ is $\frac{27}{84}$, $\frac{54}{112}$ and $\frac{270}{300}$; $\frac{5}{9}$ is $\frac{35}{63}$, $\frac{70}{126}$ and $\frac{350}{630}$. (b) $\frac{70}{105}$, $\frac{63}{105}$, $\frac{60}{105}$, $\frac{49}{105}$, $\frac{80}{105}$ and $\frac{24}{105}$. (c) $\frac{90}{30}$, $\frac{18}{30}$, $\frac{4}{30}$ and $\frac{18}{30}$. 11. $\frac{8}{12}$, $\frac{45}{12}$ and $\frac{10}{12}$. 12. $\frac{30}{60}$, $\frac{40}{60}$, $\frac{50}{60}$, $\frac{35}{60}$ and $\frac{44}{60}$. 13. (a) $\frac{15}{45}$, $\frac{9}{45}$ and $\frac{10}{45}$. (b) $\frac{40}{140}$, $\frac{84}{140}$ and $\frac{56}{140}$. (c) $\frac{400}{300}$, $\frac{300}{300}$ and $\frac{21}{300}$. (d) $\frac{297}{603}$, $\frac{296}{603}$ and $\frac{385}{603}$. (e) $\frac{252}{36}$, $\frac{4}{36}$ and $\frac{5}{36}$. 14. (a) $\frac{5}{6}$ and $\frac{7}{4}$. (b) $\frac{8}{9}$ and $\frac{5}{8}$. (c) $\frac{4}{7}$ and $\frac{4}{9}$. (d) $\frac{2}{3}$ and $\frac{7}{12}$.

Exercise 8.—1. $\frac{4}{7}$, $\frac{3}{8}$, $\frac{2}{3}$, $\frac{1}{3}$, $\frac{2}{7}$, $\frac{6}{7}$, $\frac{3}{4}$, $\frac{8}{9}$ and $\frac{2}{3}$.

2. $\frac{13}{13}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{11}$, $\frac{7}{10}$, $\frac{3}{13}$, $\frac{3}{5}$, $\frac{5}{7}$ and $\frac{19}{11}$.

3. $\frac{8}{9}$, $\frac{3}{4}$, $\frac{2}{7}$, $\frac{7}{8}$, $\frac{30}{20}$, $\frac{4}{7}$, $\frac{2}{4}$, $\frac{3}{4}$ and $\frac{5}{6}$.

4. $\frac{9}{17}$, $\frac{2}{7}$, $\frac{70}{30}$, $\frac{1}{3}$, $\frac{203}{64}$, $\frac{10}{20}$, $\frac{13}{20}$, $\frac{1}{4}$ and $\frac{3}{8}$.

5. $\frac{9}{10}$, $\frac{12}{13}$, $\frac{904}{104}$, $\frac{1}{4}$, $\frac{1}{4}$, $\frac{2}{4}$, $\frac{1}{13}$, $\frac{38}{81}$ and $\frac{3}{8}$.

6. $\frac{17}{18}$, $\frac{188}{200}$, $\frac{15}{44}$, $\frac{8}{27}$, $\frac{1}{4}$, $\frac{140}{103}$, $\frac{16}{20}$ and $\frac{5}{6}$.

7. $\frac{27}{46}$, $\frac{7}{9}$, $\frac{12}{19}$, $\frac{33}{28}$, $\frac{14}{15}$, $\frac{107}{101}$, $\frac{7}{11}$ and $\frac{11}{14}$.

8. $\frac{26}{25}$, $\frac{2}{3}$, $\frac{70}{111}$, $\frac{420}{500}$, $\frac{8}{9}$, $\frac{181}{20}$, $\frac{3}{4}$ and $\frac{29}{39}$.

9. $\frac{1}{11}$, $\frac{8}{27}$, $\frac{12}{19}$, $\frac{4}{16}$, $\frac{103}{307}$, $\frac{19}{67}$, $\frac{15}{17}$ and $\frac{65}{43}$.

Exercise 9.—1. $1\frac{1}{2}$, $1\frac{1}{6}$, $4\frac{1}{2}$, $3\frac{1}{3}$, $1\frac{7}{8}$, $4\frac{1}{2}$, $3\frac{2}{3}$, $4\frac{1}{4}$ and $7\frac{3}{4}$.

2. $6\frac{1}{2}$, $3\frac{6}{11}$, $1\frac{7}{8}$, $7\frac{1}{2}$, $2\frac{2}{3}$, $1\frac{5}{6}$, $1\frac{1}{2}$, $4\frac{1}{3}$ and 3.

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

4. $4\frac{5}{12}$, $3\frac{10}{13}$, $4\frac{7}{12}$, $1\frac{11}{18}$, $1\frac{1}{2}$, $1\frac{1}{2}$, $1\frac{13}{24}$, 9 and $5\frac{3}{4}$.

5. 5, $8\frac{2}{3}$, $4\frac{1}{2}$, 5, $25\frac{5}{8}$, $3\frac{3}{8}$, $3\frac{1}{4}$, $2\frac{37}{11}$ and 5.

6. $7\frac{4}{11}$, $3\frac{1}{2}$, $18\frac{27}{19}$, $16\frac{1}{2}$, $15\frac{1}{6}$, $12\frac{1}{11}$ and $5\frac{2}{11}$.

Exercise 10.—1. $\frac{3}{8}$, $\frac{4}{3}$, $\frac{5}{4}$, $\frac{6}{5}$, $\frac{7}{6}$, $\frac{8}{7}$, $\frac{8}{8}$, $\frac{10}{9}$ and $1\frac{1}{10}$.

2. $\frac{5}{8}$, $\frac{7}{3}$, $\frac{8}{3}$, $\frac{9}{4}$, $1\frac{1}{4}$, $1\frac{1}{6}$, $1\frac{3}{8}$, $1\frac{4}{6}$, $1\frac{3}{8}$, $1\frac{7}{8}$ and $1\frac{5}{7}$.

3. $\frac{17}{7}$, $\frac{19}{7}$, $\frac{20}{7}$, $\frac{11}{3}$, $\frac{15}{4}$, $\frac{23}{6}$, $\frac{14}{3}$, $\frac{19}{4}$, $\frac{31}{7}$.
 4. $\frac{25}{5}$, $\frac{17}{3}$, $\frac{23}{4}$, $\frac{29}{6}$, $\frac{35}{8}$, $\frac{47}{8}$, $\frac{13}{2}$, $\frac{20}{3}$, $\frac{27}{4}$, $\frac{55}{8}$.
 5. $\frac{23}{3}$, $\frac{39}{5}$, $\frac{31}{4}$, $\frac{17}{2}$, $\frac{35}{4}$, $\frac{26}{3}$, $\frac{44}{5}$, $\frac{19}{2}$ and $\frac{29}{3}$.
 6. $\frac{39}{4}$, $\frac{49}{5}$, $\frac{59}{6}$, $\frac{79}{8}$, $\frac{89}{9}$, $\frac{21}{2}$, $\frac{31}{3}$, $\frac{32}{3}$, $\frac{43}{4}$ and $\frac{54}{8}$.

Exercise 11.—1. $\frac{5}{8}$, $\frac{5}{12}$, $\frac{5}{15}$. 2. $\frac{2}{3}$, $\frac{4}{9}$ and $\frac{7}{18}$. 3. $\frac{7}{12}$, $\frac{11}{20}$, $\frac{4}{9}$. 4. $\frac{9}{16}$, $\frac{5}{12}$, $\frac{3}{8}$. 5. $\frac{9}{10}$, $\frac{7}{8}$, $\frac{5}{6}$. 6. $\frac{7}{10}$ is the greater, the remaining fractions are equal to each other. 7. $\frac{8}{12}$ and $\frac{12}{18}$ are equal to each other and greater than $\frac{5}{4}$. 8. $\frac{9}{18}$, $\frac{7}{15}$, $\frac{5}{12}$. 9. $\frac{4}{8}$, $\frac{2}{3}$ and $\frac{9}{15}$. 10. $\frac{8}{15}$, $\frac{5}{12}$, $\frac{8}{24}$.

Exercise 12.—1. 1, $\frac{5}{8}$, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{11}{15}$. 2. $\frac{5}{6}$, $\frac{7}{10}$, $\frac{1}{2}$, $\frac{9}{20}$, $\frac{15}{20}$, $\frac{17}{20}$, $\frac{19}{20}$. 3. 1, $\frac{3}{4}$, $\frac{27}{40}$, $\frac{107}{40}$, $\frac{13}{40}$. 4. $\frac{7}{8}$, $\frac{7}{12}$, $\frac{11}{30}$, $\frac{1}{4}$. 5. $1\frac{1}{6}$, $\frac{5}{6}$, $1\frac{3}{8}$. 6. $1\frac{5}{12}$, $1\frac{7}{12}$, $1\frac{5}{12}$, $1\frac{5}{8}$, $1\frac{9}{30}$, $1\frac{1}{8}$. 7. $1\frac{11}{12}$, $2\frac{1}{8}$, $1\frac{14}{15}$, $1\frac{7}{10}$, $1\frac{13}{20}$. 8. $2\frac{3}{4}$, $2\frac{1}{4}$, $2\frac{1}{2}$. 9. $2\frac{1}{24}$, $1\frac{1}{6}$, $2\frac{31}{66}$, 3. 10. $3\frac{1}{8}$, $3\frac{1}{8}$, $3\frac{17}{8}$.

Exercise 13.—1. $443\frac{2}{3}$ bu. 2. $\$266\frac{1}{2}$ or $\$266.65$. 3. $7642\frac{77}{120}$ bu. 4. $82\frac{61}{120}$ yd. 5. $74\frac{7}{36}$ cwt. 6. $76\frac{1}{12}$. It is sometimes a good feature to introduce into a problem data not intended to be used. In this question not a few pupils will hesitate over leaving out of account the 3 pieces and the 56 yds. 7. $\frac{8}{9}$ oral work. 8. $197\frac{5}{8}$ bu. 9. $242\frac{5}{8}$ rd. 10. $24\frac{1}{20}$ in.

Exercise 14.—6. $\frac{1}{4}$, $\frac{1}{12}$, $\frac{1}{20}$, $\frac{1}{30}$, $\frac{1}{4}$. 7. $\frac{3}{8}$, $\frac{1}{10}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{3}$. 8. $\frac{1}{8}$, $\frac{1}{12}$, $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{6}$. 9. The first question of this group cannot be solved. Draw the attention of the class to this form. $\frac{7}{20}$, $\frac{7}{30}$, $\frac{1}{6}$, $\frac{3}{4}$. 10. $\frac{5}{36}$. The second example cannot be worked, $\frac{13}{60}$, $\frac{3}{8}$, $\frac{13}{14}$. 11. $\frac{3}{4}$, $\frac{7}{9}$, $\frac{5}{6}$, $\frac{3}{8}$, $15\frac{3}{4}$. 12. $2\frac{1}{2}$, $\frac{7}{8}$, $\frac{8}{11}$, $4\frac{5}{8}$. 13. $\frac{11}{18}$, $11\frac{3}{10}$, $3\frac{1}{8}$. 14. 1, $3\frac{1}{30}$, $6\frac{7}{8}$. 15. $2\frac{7}{4}$, $2\frac{7}{2}$, $1\frac{7}{16}$. 16. $1\frac{7}{20}$, $4\frac{7}{20}$, $\frac{3}{8}$.

Exercise 15.—1. $\frac{5}{8}$, $\$1493\frac{1}{2}$ = B's share; $\$266\frac{2}{3}$ = C's share. 2. $\frac{2}{7}$ of a guinea or 6s. to B; $\frac{4}{21}$ of a guinea or 4s. to C, and $\frac{2}{21}$ of a guinea or 2s. to D. 3. $\frac{19}{3}$ of farm. 126 acres. 4. $29\frac{1}{7}$ ml. 5. $\$1680$. 6. $111\frac{1}{2}$ A. 7. He could not make this division with less than 120 apples. 75 apples left. 8. $263\frac{1}{2}$ A. 9. $78\frac{1}{2}$. 10. 3 T. 19 cwt. $68\frac{1}{6}$ lb.

Exercise 16.—1. $\$8$; $\$7$; $\$12$; $\$45.35$. 2. 12 gal.; 18 qt.; 25 pt.; 42 pk. 3. 9; 27; 42; 36; 35. 4. 1; $\frac{2}{3}$; 1; $1\frac{1}{2}$; $\frac{3}{4}$;

- $\frac{3}{44}$. 5. 2s.; $1\frac{1}{2}$ ac. 6. 26 horses; 4 sq. ft. 7. $\frac{8}{21}$; $\frac{22}{31}$; $\frac{8}{32}$.
8. $\frac{1}{9}$; $\frac{4}{21}$; $\frac{70}{81}$. 9. (a) 114 ac. (b) 97 gal. 1 qt. 1 pt. 10. $\frac{5}{16}$.
12. $\frac{4}{21}$. The method given under question 11 is worthy of a fair trial.

- Exercise 17.**—8. $\frac{6}{33}$, $\frac{3}{14}$, $\frac{9}{28}$, $\frac{12}{35}$, $\frac{12}{49}$, $\frac{15}{56}$. 9. $\frac{5}{11}$, $\frac{21}{44}$,
 $\frac{22}{45}$, $\frac{24}{77}$, $\frac{16}{33}$, $\frac{60}{143}$, $\frac{36}{121}$, $\frac{24}{55}$. 10. $\frac{22}{45}$, $\frac{2}{3}$, $\frac{16}{21}$, $\frac{32}{81}$, $\frac{6}{9}$, $\frac{16}{33}$,
 $\frac{28}{45}$, $\frac{16}{27}$. 11. $\frac{6}{7}$, $\frac{2}{3}$, $\frac{2}{3}$, $\frac{2}{7}$ and $\frac{2}{9}$. 12. $1\frac{1}{8}$, $1\frac{2}{3}$, $\frac{60}{77}$.
13. $\frac{10}{39}$, $\frac{32}{117}$, $\frac{27}{200}$. 14. $\frac{8}{45}$, $\frac{5}{27}$, $\frac{3}{5}$. 15. 1, $1\frac{1}{2}$, $25\frac{1}{2}$.
16. $4\frac{1}{2}$, $1\frac{10}{108}$, $10\frac{1}{2}$. 17. (a) $1\frac{7}{13}$, $1\frac{27}{8}$. (b) $13\frac{6}{7}$, $5\frac{3}{8}$.
18. (a) $\frac{1}{2}$, $1\frac{1}{10}$, $13\frac{1}{2}$. (b) $1\frac{2}{75}$, $\frac{21}{64}$. 19. (a) $\frac{23}{40}$, $\frac{187}{120}$ or
 $1\frac{67}{120}$. (b) $1\frac{7}{2}$, $\frac{31}{40}$. 20. (a) 1536. (b) $\frac{1}{20}$. (c) $\frac{6}{35}$. (d)
 $\frac{245}{443}$. (e) $\frac{10}{17}$. (f) $141\frac{3}{7}$. (g) 81.

- Exercise 18.**—1. (a) \$1.06 $\frac{1}{2}$. (b) \$3.41. (c) \$4.72. (d)
 $56\frac{7}{8}$ cts. (e) \$2.29 $\frac{1}{8}$. Total \$12.06. 2. (a) 96 cts. (b)
 $52\frac{5}{16}$ cts. (c) \$1.50. (d) \$1.14. (e) \$4.38. Total \$8.50.
3. (a) \$2.20 $\frac{1}{2}$. (b) \$1.36. (c) 88 cts. (d) 50 cts. Total
\$4.94. 4. 20 cts. 5. \$853 $\frac{1}{2}$.

Exercise 19.—

12. (a) $1\frac{1}{8}$ (f) $\frac{1}{2}$ (k) $7\frac{14}{25}$
(b) $\frac{24}{34}$ or $1\frac{4}{17}$ (g) $\frac{5}{8}$ (l) $5\frac{25}{33}$
(c) $\frac{4}{7}$ (h) $1\frac{7}{110}$ (m) $4\frac{1}{11}$
(d) $\frac{21}{25}$ (i) $1\frac{8}{9}$ (n) 325
(e) $\frac{18}{45}$ (j) $5\frac{1}{4}$ (o) $66\frac{2}{3}$
14. (a) $\frac{8}{9}$, $2\frac{2}{7}$, $1\frac{1}{8}$, $1\frac{3}{17}$, $\frac{8}{9}$ and $2\frac{1}{2}$.
(b) $\frac{3}{4}$, $1\frac{7}{10}$, 1, 1, $1\frac{1}{7}$ and $\frac{3}{4}$.
(c) 1, $1\frac{1}{2}$, $\frac{7}{9}$, $1\frac{7}{8}$, $\frac{24}{25}$ and $2\frac{7}{9}$.
(d) $12\frac{1}{4}$, $5\frac{29}{71}$, $11\frac{3}{14}$, 6, 10 and 16.
(e) $17\frac{1}{9}$, $2\frac{1}{10}$, $\frac{87}{288}$, 64 and $41\frac{17}{25}$.

- Exercise 20.**—1. $\frac{5}{8}$. 2. $3\frac{3}{8}$. 3. $\frac{54}{11}$. 4. $1\frac{1}{2}$ ft. 5. $62\frac{2}{3}$ wk.
6. $\frac{7}{15}$. 7. Oral. 8. $8\frac{1}{8}$ hr. 9. 80 cts. 10. \$1536.

Exercise 21.—

1. $\frac{5}{24}$, $\frac{3}{32}$, $\frac{2}{25}$, $\frac{1}{21}$, $\frac{2}{81}$, $\frac{5}{288}$, $\frac{1}{27}$, $\frac{5}{48}$.
2. $10\frac{1}{2}$, $13\frac{1}{2}$, $14\frac{2}{3}$, $18\frac{1}{4}$, 20, 28, 56, 84.
3. $\frac{8}{9}$, $1\frac{1}{6}$, $1\frac{5}{7}$, 1, $\frac{8}{9}$, $1\frac{2}{3}$, $1\frac{2}{3}$, $1\frac{1}{3}$.
4. $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{7}{8}$, $\frac{1}{4}$, $\frac{1}{2}$.

5. $1\frac{2}{3}$, $\frac{310}{343}$, $1\frac{1}{3}$, $\frac{11}{70}$, $\frac{5}{6}$, $1\frac{9}{10}$, $\frac{41}{6}$.

6. $14\frac{2}{3}$, $\frac{2}{3}$, $4\frac{8}{11}$, $4\frac{4}{75}$, $\frac{2}{3}$.

7. $1\frac{1}{6}$, $\frac{112}{243}$, $\frac{7}{9}$, $2\frac{55}{56}$, $\frac{79}{210}$.

8. $1\frac{13}{11}$, $2\frac{3}{2}$, $\frac{7}{13}$, $1\frac{4}{15}$.

9. $1\frac{1}{2}$, $1\frac{11}{14}$, $1\frac{5}{12}$, $1\frac{10}{13}$.

10. $1\frac{1}{2}$. 11. $1\frac{2}{5}$. 12. $1\frac{10}{18}$. 13. $\frac{107}{120}$. 14. $\frac{5}{6}$. 15. $\frac{4}{11}$.

16. $14\frac{1}{8}$. 17. $1\frac{1}{2}$. 18. 14. 19. $12\frac{2}{3}$. 20. $11\frac{5}{8}$. 21. $11\frac{1}{2}$.

22. $8\frac{3}{16}$. 23. $8\frac{3}{16}$. 24. $2\frac{7}{10}$. 25. 17. 26. $3\frac{2}{5}$.

Exercise 22.—1. $\frac{2}{3}$. 2. 1. 3. $\frac{7}{8}$. 4. $3\frac{17}{144}$. 5. 6. 6. $1\frac{557}{604}$.

7. $1\frac{2}{4}$. 8. $2\frac{1}{6}$. 9. $\frac{55}{23}$. 10. $1\frac{2}{8}$. 11. $1\frac{5}{8}$. 12. $\frac{3}{25}$.

Exercise 23.—1. $\frac{6}{7}$. 2. $\frac{5}{7}$. 3. $\frac{2}{5}$. 4. (a) $\frac{1}{20}$. (b) $\frac{1}{12}$. (c) $\frac{5}{24}$.

(d) $\frac{1}{10}$. 5. (a) $1\frac{1}{5}$. (b) $\frac{6}{7}$. (c) $1\frac{1}{3}$. 6. $\frac{1}{4}$. 7. $\frac{1}{8}$. 8. $\frac{1}{5}$. 9. $\frac{1}{12}$.

10. $4\frac{9}{2}$. 11. $\frac{6}{1}$. 12. $\frac{3}{5}$. 13. 6 times. 14. $7\frac{1}{2}$.

Exercise 24.—2. $6\frac{2}{3}$ days. 3. $3\frac{2}{3}$. 4. $10\frac{2}{7}$ hr. 5. $4\frac{1}{2}$ hr.
 6. 72 days. 7. Two men can finish the work in 14 days. One man does half the work in 12 days. He can do the whole work in 24 days. Answer $16\frac{1}{2}$ days. 8. $1\frac{1}{2}$. 9. The inflowing taps can fill $\frac{1}{6}$ of the cistern in 1 minute. All three can fill it in 15 minutes, or $\frac{1}{4}$ in 1 minute. The waste pipe can therefore empty $\frac{1}{6} - \frac{1}{6}$ in 1 minute or $\frac{2}{6}$ in 1 minute. The waste pipe can empty the cistern in $\frac{6}{2}$ or $3\frac{1}{2}$ minutes. 10. In 6 days B will have done $\frac{6}{15}$ of the work. As A can do the whole work in $30\frac{1}{2}$ days, he would do $\frac{1}{3}$ of it in $\frac{1}{3}$ of $30\frac{1}{2}$ days or $23\frac{1}{2}$ days. 11. A does $\frac{1}{2}$ the work and B does $\frac{2}{3}$ of it. There remains $\frac{1}{4}$ to be done. The boy would then get $\frac{1}{4}$ of the price paid, or 80 cts. 12. $\frac{1}{3}$ day. 13. A in $3\frac{2}{3}$ days, B in $4\frac{1}{2}$ days, and C in 24 days. 14. Change the word "four" of this question to *five*. Three men worked 7 days beyond the time 5 would have taken. This means 21 days' work for 1 man or $10\frac{1}{2}$ days' work for 2 men. Five men would, therefore, have taken $10\frac{1}{2}$ days to do the work. 15. $51\frac{1}{2}$ days. 16. $4\frac{1}{2}$ days. 17. 40 hrs. 28 men. 7 men. 5 days. 18. 20 men would do double the work in 480 hrs. 10 men would do this in 960 hrs., or 80 days of 12 hr. each. 19. Notice the ratio of 6 men and 8 women to 3 men and 4 women. 3 days. 20. Three men do

the same work as 5 women. 12 men and 20 women will do the same as 24 men or as 40 women. $6\frac{3}{8}$ days.

REVIEW

- Exercise 25.**—1. (a) $1\frac{11}{13}$, $2\frac{1}{80}$, $1\frac{603}{840}$. (b) $1\frac{29}{48}$, 2, $3\frac{27}{140}$. (c) $2\frac{3}{10}$, 2, $4\frac{9}{70}$. 2. (a) The first cannot be worked, $7\frac{1}{15}$, $100\frac{1}{6}$. (b) $\frac{5}{98}$, $4\frac{7}{60}$, $345\frac{1}{4}$. (c) $\frac{65}{336}$, $1\frac{7}{12}$, $212\frac{1}{2}$. 3. (a) $53\frac{2}{3}$, 6250, 8000. (b) 63, 4000, 56000. (c) $\frac{1}{4}$, 2700, 27000. 4. (a) $\frac{3}{40}$, 16, $5\frac{9}{13}$. (b) $13\frac{1}{3}$, 27, $10\frac{1}{8}$. (c) $1\frac{5}{16}$, $20, 8\frac{7}{10}$. 5. (a) $\frac{7}{15}$, $\frac{13}{17}$, $\frac{41}{51}$. (b) $\frac{4}{9}$, $\frac{5}{11}$, $\frac{1}{2}$. (c) $\frac{25}{88}$, $1\frac{27}{14}$, $\frac{1}{11}$. 6. (a) $\frac{1}{3}$. (b) $290\frac{1}{2}$. 7. (a) \$3.85. (b) 93 lb. 4 oz. 8. $9\frac{1}{7}$ da. 9. See note under Exercise 21. $\frac{1029}{4160}$. 10. \$7.58 $\frac{1}{3}$. 11. \$36000. 12. $2\frac{1}{3}$ da. 13. How much bread could A provide C? How much could B provide? 9 cts. to B and 63 cts. to A. 14. 56 ft. and 84 ft. 15. 48 lb. 17. $\frac{1}{3}$. 18. \$222.06 $\frac{7}{8}$. 19. \$333. 20. 25 times. 21. \$312.50. 22. $\frac{1}{9}$, $\frac{9}{19}$, $\frac{2}{9}$. Have the children doubled the terms in the second of these fractions and quadrupled them in the case of the third? 23. Change "took" to *lost*, and "but has still" to *and has now*. Harry had 100, James 150, and Tom 50 marbles. 24. A difference of 3 cts. per bu. makes a difference of 12 dollars. Number of bushels sold 400. 25. (a) $\frac{3}{16}$. (b) $\frac{1}{3}$. (c) $\frac{4}{5}$. 27. (a) \$131.20. The method of working this question is the important thing. (b) $35\frac{7}{8}$. 28. (a) 36. (b) 20. (c) \$24. (d) 15 cts. per doz. (c) 40 cts. All for oral work. 29. 70 doz. 30. \$6.50. 31. $58\frac{2}{8}$. 32. \$261.

DECIMAL FRACTIONS

Exercise 26.—The questions of this exercise are for the purpose of reviewing and enlarging the pupils' grasp of decimals. Exercise 26 should be taken in class that perfect supervision may be given.

Exercise 27.—

- | | | |
|-----------------|----------------|----------------|
| 1. 28071.752606 | 2. 75479.61588 | 3. 11692.33564 |
| 4. 1596.86266 | 5. 1211.6368 | 6. 1703.31679 |

7.	923.314	8.	1034.99047	9.	504.9732
10.	92.003183	11.	1131.21311	12.	392.056321
13.	4370.698373	14.	111.253	15.	76.9614875
16.	1382.773 acres	17.	192321.50926	18.	243.126

Exercise 28.—

1.	2.539832	2.	60.42356	3.	36.60133	4.	.0073
5.	3.76439	6.	3.525	7.	7.5531	8.	2.783
9.	77.28931	10.	34.1332	11.	863.9984	12.	.10133
13.	1.822	14.	.6729	15.	6.2115	16.	1.9303
17.	46.8112	18.	82.68395	19.	59.24	20.	6.1833
21.	5.291	22.	59.4879	23.	37.6878	24.	819.1085
25.	\$312.9434	26.	\$55	27.	\$6747.7991	28.	49.99195

Exercise 29.—

- 47.44, 53.37, 71.16, 142.32, 59.3 and 593.
- 183.75, 330.75, 551.25, 367.5, 3675.
- 250, 375, 500, 750, 625, 6250.
- 1.59, 2.65, 6.36, 7.95, 5.3, 53.
- .228, .304, .57, .684, .38, 3.8.
- .0414, .0552, .069, .0966, .046, .46.
- 48, 76.8, 86.4, 172.8.
- 170.8, 256.2, 341.6, 640.5.
- 2.1, 3.5, 4.9, 6.3, 16.8.
- 360, 720, 1080, 2160.
- 620.5, 744.6, 868.7, 4467.6.
- 4.15, 12.45, 29.88, 205.84.
- 16.56, 44.16, 154.56, 706.56.
- 74.43, 239.83, 653.33, 3134.33.
- 25.92, 123.12, 771.12, 10523.52.
- 3.48, 2.088, 6.438, 76.038.
- 8.604, 3.7284, 8.5084, 75.4284.
- 2.9022, 3.09568, 1.276968, 39.972968.
- 66.075525.
- 6010.7480972.
- 78.37967708.
- .075075. Have the pupils examine the first product closely. .1042041, .00012012.

29. .13984.

30. .00050272.

Exercise 30.—

1. (a) 4651.455 sq. ft. (b) 7249.169883 sq. yd.
2. (a) Say, 7.296 thousand ft. \$180.576. (b) \$9.729.
3. (a) 115.6375 cub. ft. (b) 18.3396 cub. ft.
4. (a) 28.5525 ml. (b) 32.07425 ml.
5. (a) 246.807 ml. (b) 424.293 ml.
6. (a) 817.612 sq. ft. (b) 4634.28 sq. ft.
7. (a) 2873.3049 cub. ft. (b) 861.42276 cub. ft.
8. (a) \$18.375. (b) \$33.7225. (c) \$1.968. (d) \$8.0752.

Exercise 31.—

1. 14 1.4 .14 and .014
2. 121 12.1 1.21 and .121
3. 43 4.3 .43 and .043
4. 143 14.3 1.43 and .143
5. 32 3.2 .32 and .032
6. 4.16 .318 21.3 .0806
10. 70.448 + , 8.16, 7240.
11. 965, 82.3. 13. (a) .875, .5875, 1.20625 and 2.265625. (b) 3.65, 2.425, 1.78 and 1.3185. 14. 18.3, 25.609375, 112.78703125. 15. 1.50125, 28.67578125, 2.634375. 16. .00003, 10.005, 51.002. 17. .12, 240, 180. 19. 12, 14400, .013, 1270, 1000, 43000, 250000, .0763, 1470, 847.6, 35.9, 45.761, 2665.4875, .0926, 00000505, 42.3.

- Exercise 32.—**
1. 3.6125 ft. 2. 4.3 ft. 3. \$40.66 +
 4. \$391.38. 5. 9.61 hr. 6. (a) 6.35 cts. (b) \$.45093.
 7. (a) \$1.15344. (b) 6.207022. 8. (a) \$24.76. (b) \$35.55.
 9. (a) 406.075 ft. (b) 237.96 yd. (c) 15.01107 + ml. (d) 41.205 gal.
 10. (a) 2496 rd. (b) 38 qt. (c) 963 in. (d) 14.4 qt.
 11. (a) 720 ac. (b) 16s. 2d. (c) 8750 lb. 12. (a) 1.5 lb. (b) .6996 cwt. (c) 9.202 gal. or 36.808 qt.

- Exercise 33.—**
5. (a) .5, .25, .375, .625, .875, .75, .8. (b) .375, .95, .4, .625, .5, .5, .75. (c) .25, .203125, 1.75, .5625, .4, .2.

6. (a) .25 and .333333

(b) .4 and .66666

(c) .83333 and .5.

7. (a) $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$ and $6\frac{1}{4}$. (b) $\frac{5}{16}$, $\frac{9}{16}$, $1\frac{1}{4}$ and $\frac{1}{2}$.

Exercise 34.—1. 9. Although the former of these quantities is smaller than the latter, the two may be subtracted. Were they written with a minus sign separating them the operation would be an impossible one.

2. $34\frac{43}{100}$. 3. \$43.43.

4. $\frac{1}{2}$. 5. .875. 6. (a) \$24.86875. (b) \$155.529. (c) \$29.53125. (d) \$8.1396.

7. (a) \$49.728. (b) \$25.6562. (c) \$76.08125. (d) \$5.62275. (e) \$14.592. 8. 3.

PERCENTAGE

Exercise 35.—1. (a) $\frac{50}{100}$, $\frac{25}{100}$, $\frac{75}{100}$ and $\frac{20}{100}$. (b) $\frac{40}{100}$, $\frac{35}{100}$, $\frac{45}{100}$ and $\frac{10}{100}$. (c) $\frac{30}{100}$, $\frac{90}{100}$, $\frac{5}{100}$ and $\frac{100}{100}$. (d) $\frac{15}{100}$, $\frac{12}{100}$, $\frac{36}{100}$ and $\frac{55}{100}$. (e) $\frac{65}{100}$, $\frac{70}{100}$, $\frac{85}{100}$ and $\frac{100}{100}$. (f) $\frac{4}{100}$, $\frac{12}{100}$, $\frac{36}{100}$ and $\frac{42}{100}$.

2. (a) $\frac{33\frac{1}{3}}{100}$, $\frac{66\frac{2}{3}}{100}$, $\frac{16\frac{2}{3}}{100}$ and $\frac{83\frac{1}{3}}{100}$. (b) $\frac{14\frac{2}{7}}{100}$, $\frac{42\frac{6}{7}}{100}$, $\frac{71\frac{3}{7}}{100}$ and $\frac{22\frac{2}{3}}{100}$.

(c) $\frac{36\frac{4}{11}}{100}$, $\frac{45\frac{5}{11}}{100}$, $\frac{63\frac{7}{11}}{100}$ and $\frac{69\frac{3}{11}}{100}$. (d) $\frac{84\frac{8}{13}}{100}$, $\frac{71}{100}$, $\frac{35\frac{5}{7}}{100}$.

(e) $\frac{26\frac{2}{3}}{100}$, $\frac{66\frac{2}{3}}{100}$, $\frac{66\frac{2}{3}}{100}$ and $\frac{95\frac{5}{11}}{100}$.

3. (a) 75% 62½% 90% 20% 20%

(b) 80% 33⅓% 70% 80% 75%

(c) 75% 68% 38% 55% 80%

(d) 60% 40% 40% 20% 86%

4. (a) $\frac{1}{10}$, $\frac{3}{10}$, $\frac{2}{5}$, $\frac{1}{10}$, $\frac{1}{2}$. (b) $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{10}$, $\frac{3}{10}$, $\frac{3}{4}$.

(c) $\frac{1}{4}$, $\frac{3}{20}$, $\frac{7}{20}$, $\frac{9}{20}$. (d) $\frac{11}{20}$, $\frac{13}{20}$, $\frac{23}{25}$, $\frac{1}{3}$.

(e) $\frac{2}{3}$, $\frac{1}{8}$, $\frac{1}{8}$, $\frac{17}{100}$.

5. \$2.10. 6. \$4.32. 7. \$16. 8. \$8.32. 9. 10 cts. 10. 304.8.

Exercise 36.—1. (a) 40. (b) 300. (c) 400. (d) 500. (e) 80. (f) 140. (g) 230. (h) 200. (i) 20. (j) 35. (k) 95.

(l) 120. (m) 24. (n) 28. (o) 80. (p) 140. 2. (a) 40.

(b) 80. (c) 160. (d) 200. (e) 42. (f) 54. (g) 36. (h) 21.
 (i) 35. (j) 50. (k) 60. (l) 120. (m) 30. (n) 50. (o) 40.
 (p) 80. 3. (a) 2. (b) 1. (c) $\frac{1}{2}$. (d) $\frac{1}{3}$. (e) 3. (f) $1\frac{1}{2}$.
 (g) $\frac{3}{10}$. (h) 15. (i) 10. (j) 5. (k) 1. (l) $\frac{1}{2}$. 4. (a) 10.
 (b) 5. (c) $2\frac{1}{2}$. (d) 40. (e) 20. (f) 40. (g) $12\frac{1}{2}$. (h) 5.
 (i) 30. (j) 60. (k) 150. (l) 6. 5. (a) 1250. (b) 325.
 (c) $237\frac{1}{2}$. (d) 80. (e) 300. (f) 160. (g) 125. (h) 500. (i)
 250. (j) 300. (k) 80. (l) 400. 6. (a) 4. (b) 10. (c) 32.
 (d) 3. (e) $4\frac{1}{2}$. (f) 36. (g) $10\frac{1}{2}$. (h) 21. (i) 28. 7. (a)
 8000. (b) 2400. (c) 1000. (d) 800. (e) 250. (f) 500. (g)
 3200. (h) 3200. (i) 8200. 8. \$900 = salary for each half.
 \$630. What is my average per cent. saved each year? 9. 480
 maple, 720 oak, 1200 poplar. 10. \$2.05. 11. \$212. 12. $33\frac{1}{3}\%$,
 75% , $83\frac{1}{3}\%$ and $66\frac{2}{3}\%$.

Exercise 37.—1. $\frac{1}{3}$, $12\frac{1}{2}\%$. 2. $\frac{1}{2}$, 20%. 3. 15%. 4. 5%
 of \$60 or \$3. 5. \$380. 6. 30 acres. 7. (a) 25%. (b)
 75%. (c) 20%. (d) 10%. (e) $11\frac{1}{3}\%$. (f) 36 lb. bears to
 200 lb. the same ratio as 18 lb. to 100 lbs. or 18%. 8. (a) 50%.
 (b) $66\frac{2}{3}\%$. (c) 50%. (d) 80%. (e) $83\frac{1}{3}\%$. (f) $87\frac{1}{2}\%$. (g)
 75%. (h) $33\frac{1}{3}\%$. (i) $11\frac{1}{3}\%$. 9. (a) $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{16}$, $\frac{1}{8}$.
 (b) $\frac{1}{15}$, $\frac{1}{3}$, $\frac{1}{7}$, $\frac{1}{2}$, $\frac{3}{5}$, $\frac{1}{10}$. 10. (a) 400%. (b) 50%. (c)
 75%. (d) 250%. (e) 520%. (f) 5%. (g) 310%. 11.
 (a) 16, 48, 42. (b) 30, 40, 3. 12. (a) \$3.84. (b)
 \$2.52.

Exercise 38.—1. (a) 50. (b) 180. (c) 270. (d) 225.
 (e) 310. (f) 941. (g) 3310. (h) 2640. 2. (a) 1428.
 (b) 1456. (c) 3136. (d) 1590. (e) 3720. (f) 1150. (g)
 1075. (h) 360. (i) 3280. (j) 20100. (k) 6100. (l) 2000.
 3. 85% of cost. 51 cts. 4. \$31.20. 5. 90 bbl. 6. 28,500
 lb. 7. He lost \$207.60 by holding the wheat. 8. 1320,
 1452, 1597. 9. \$5828. 10. Have the pupils found the
 man's savings on each 24 dollars, or have they found how much
 was earned in the year or in the three years and then taken the
 savings? The former is certainly the more economic method.
 \$842.40. 11. \$1899. 12. \$3000.

Exercise 39.—Make this an exercise in what is usually called mental arithmetic. Ask for the solutions of the more important problems. 1. 40. 2. 256. 3. 27. 4. 2. 5. 120. 6. 200. 7. 200. Ask the pupils to state this question in two more ways. 8. 600. 9. 20. 10. 11. 11. 74. 12. 104. 13. 175. 14. 42. 15. 16. 16. 140. 17. 35%. 18. 72. 19. \$3. 20. $\frac{1}{4}$, 25%. 21. $\frac{1}{4}$, 25%. 22. $1\frac{1}{8}$, 7%. 23. 10%, \$6.50. 24. \$1200. 25. 26.4 lb., 6.6 lb., 3.52 lb. 26. 7500 lb.

Exercise 40.—2. 25%. 3. (a) 18%, 36%, 72%. (b) 16%, 8%, 32%. (c) 24%, 6%, 12%. (d) 7%, 14%, 28%. 4. (a) 65%, 25%. This should have been 16 of 96, or $16\frac{2}{3}$ %. As it stands $17\frac{1}{3}$ % is the answer. (b) $33\frac{1}{3}$ %, 25%, 10%. (c) 16%, 12%, 12%. 5. (a) 50%, $33\frac{1}{3}$ %, $66\frac{2}{3}$ %. (b) 60%, 6%, 20%. (c) 50%, 25%, $33\frac{1}{3}$ %. 6. (a) $62\frac{1}{2}$ %, $44\frac{1}{3}$ %, $42\frac{2}{3}$ %. (b) $24\frac{2}{3}$ %, 20%, $66\frac{2}{3}$ %. (c) 50%, 25%, $16\frac{2}{3}$ %. 7. (a) 50%, 50%, $33\frac{1}{3}$ %. (b) $43\frac{1}{3}$ %, 28%, 60%. (c) 75%, $62\frac{1}{2}$ %.

Exercise 41.—1. (a) 110. (b) 90. (c) 110. (d) 90. 2. (a) 110%. (b) 4, 400. (c) 80%. (d) 300. 3. (a) 50. (b) $62\frac{1}{2}$ cts. 4. (a) 20%. (b) $16\frac{2}{3}$ %. 5. (a) 20%. (b) 20%. 6. (a) 90%. (b) 80%. 7. (a) 110%. (b) 125%. 8. (a) 30%. (b) 20%. (c) 20%. (d) 60%. (e) 30%. (f) $33\frac{1}{3}$ %. 9. (a) 80 cts. (b) \$1.20. 10. (a) \$2. (b) \$3. 11. (a) 25%, 75%, $12\frac{1}{2}$ %, $37\frac{1}{2}$ %. (b) $33\frac{1}{3}$ %, $66\frac{2}{3}$ %, $16\frac{2}{3}$ %, $83\frac{1}{3}$ %. (c) 75%, 50%, $62\frac{1}{2}$ %, 150%. 12. (a) 25%. (b) 20%. (c) $12\frac{1}{2}$ %. (d) $16\frac{2}{3}$. 13. (a) 50 cts. (b) \$1.40. (e) \$2.40. 14. (a) \$30. (b) \$100. 15. (a) \$648. (b) \$798. 16. 8.75 or $8\frac{3}{4}$, 96.82, \$4.206 and \$9. 17. 7.44, 6.45, 22.05, 47.4 81.6 and 199.36. 18. 700, 400, 800, 2100, \$42, \$20 \$20, \$420, 800, 300, 1000, 1000. 19. (a) $1\frac{1}{2}$, 2, $4\frac{1}{2}$, 6. (b) 3, 6, 9, $10\frac{1}{2}$. (c) 2, 4, 6, $6\frac{2}{3}$. 20. (a) 2000. (b) 3000. (c) 4000. (d) 800. 21. (a) $133\frac{1}{3}$ %. (b) 75%. (c) $57\frac{1}{3}$ %. (d) $66\frac{2}{3}$ %. (e) $41\frac{2}{3}$ %. (f) $8\frac{1}{3}$ %. (g) $8\frac{1}{3}$ %, $83\frac{1}{3}$ %.

- Exercise 42.**—1. $37\frac{1}{2}\%$. 2. \$67.50. 3. \$17.10. 4. 100.
 5. 100. 6. 250. 7. 280 ml. 8. (a) 5% . (b) 25% . (c)
 75% . (d) 15% . (e) $16\frac{2}{3}\%$. (f) $41\frac{1}{6}\%$. 9. \$4000. 10. The
 note preceding this question applies to the question. (a) $\frac{1}{100}$,
 $\frac{1}{80}$, $\frac{1}{60}$, $\frac{1}{40}$, $\frac{1}{20}$, $\frac{1}{10}$. (b) $\frac{3}{10}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$.
 (c) $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$. (d) 1, $1\frac{1}{2}$, $\frac{3}{2}$, 2 , $2\frac{1}{2}$, 3 , $3\frac{1}{2}$, 4 .
 11. (a) 15% , 16% , 26% , $37\frac{1}{2}\%$, $91\frac{1}{11}\%$ and $\frac{1}{2}\%$.
 (b) $8\frac{1}{3}\%$, 70% , $62\frac{1}{2}\%$, 60% , $16\frac{2}{3}\%$ and $14\frac{2}{3}\%$. 12. \$7245.
 13. (a) The agent gets 5% on \$1000 and $2\frac{1}{2}\%$ on \$600, a
 total of \$65. (b) \$153. (c) \$40. 14. Lost \$10. 15. 3000 lb.
 saltpetre, 600 lb. charcoal, 400 lb. sulphur. 16. \$2736.
 17. $33\frac{1}{3}\%$. 18. $66\frac{2}{3}\%$. 19. \$1.99 $\frac{1}{2}$. 20. $6\frac{2}{3}\%$.

MENSURATION

Exercise 43.—There is no reason why children should be compelled to accept on the authority of the teacher that the circumference is $3\frac{1}{2}$ times the length of the diameter, or that the area of a circle is $3\frac{1}{2}$ times the square of the radius. This exercise outlines a method of procedure that will place the children in a measure in the attitude of discoverers.

- Exercise 44.**—3. (a) 7 in., $3\frac{1}{2}$ in. (b) 28 ft., 14 ft. (c) 140 yd., 70 yd. 4. (a) 22 in., $3\frac{1}{2}$ in. (b) 66 in., $10\frac{1}{2}$ in. (c) $245\frac{1}{4}$ ft., 39 ft. (d) 462 yd., $73\frac{1}{2}$ yd. 5. (a) 88 in. (b) 440 ft. (c) 880 yd. (d) 4400 rd. 6. (a) Circumference of this circle double that of b , four times that of c , and six times that of d . This kind of work is invaluable to a proper understanding of the properties of a circle. 7. (a) *Circumferences are to each other as their radii, viz., as* (a) 2:3. (b) 1:3. (c) 1:4. (d) 1:7. 8. (a) 44 ft. (b) 66 ft. (c) 88 ft. (d) 110 ft. 9. (a) 2:3. (b) 1:2. (c) 1:4. 11. 330 rd. 12. \$1749. 13. \$476.25. 14. (a) 2508 ft. (b) 234 yd. (c) $112\frac{1}{2}$ in. 16. 1728 times, 2880 times. 17. 990 times. 18. $5\frac{1}{2}$ ml. 19. 36000 times. 20. 22 ft. 21. 88, 176, 220. 22. 1155 ft. 23. $3\frac{1}{4}$ ml. 24. (a) One wheel has 12 times as great a circumference as the other. (b) 35 times, 84 times.

Exercise 45.—2. (a) 24 sq. in. (b) 27 sq. ft. (c) 14 sq. ft. (d) 5670 sq. in. or $4\frac{3}{8}$ sq. yd. 3. (a) 72 sq. in., 144 sq. in., 108 sq. in., 54 sq. in. (b) 378 sq. in. Have the pupils reach this result by two methods. (c) 378 sq. in. 4. 1440 sq. in. 6. 360 sq. in. 7. 96 sq. yd. 9. Do not attempt to hurry this work.

Exercise 46.—2. (a) 1386 sq. in. (b) 3850 sq. yd. (c) 5544 sq. ft. (d) 18634 sq. rd. (e) 61,600 sq. ml. 3. (a) 1386 sq. in. (b) 154 sq. ft. (c) 7546 sq. yd. (d) 61600 sq. rd. 4. (a) $38\frac{1}{2}$ sq. ft. (b) $346\frac{1}{2}$ sq. in. (c) $779\frac{5}{8}$ sq. yd. (d) $1886\frac{1}{2}$ sq. rd. 5. (a) 9856 sq. ft. (b) 2464 sq. yd. or 22176 sq. ft. (c) 8217594 sq. ft. 6. (a) 77. (b) 308. (c) 12276. 7. (a) $50\frac{3}{4}$ sq. in. (b) $38\frac{1}{2}$ sq. in. (c) $38\frac{1}{2}$ sq. ft. (d) $12\frac{1}{4}$ sq. in. 8. (a) 3850 sq. rd. or $24\frac{3}{8}$ acres. (b) 34650 sq. rd. or $216\frac{3}{8}$ acres. (c) $502\frac{3}{4}$ acres. 9. (a) A square mile: $\frac{1}{4}$ of a square mile or 640 acres to $502\frac{3}{4}$ acres. (b) 160 acre. $125\frac{1}{2}$ acres. 10. 42 sq. ml. 11. Practical work. 12. 56 in., 48 in., 2464 sq. in., 672 sq. in. $1\frac{1}{4}$. 13. 9 in. The pupils have not studied square root. An approximate answer is all that is required. About $11\frac{1}{2}$ ft., 12 yds. 14. 400 sq. in., 80 in. 15. 56 rd., 196 sq. yd. 16. (a) 1:4. (b) 1:9. (c) 1:16. 17. (a) 1:4. (b) 1:9. (c) 1:16. 19. (a) All are as 3:4. (b) All are as 5:6. (c) All are as 8:9. 20. (a) \$180, because the second field has just twice the radius—diameter—circumference of the first field. (b) \$225. *Similar surfaces are to each other as the squares of their like dimensions.* 21. (a) How does the second field compare in area with the first field? 480 bu. (b) 8192 bu.

Exercise 47.—3. (a) 44 in. (b) 396 in. (c) 88 ft. (d) 132 yd. 4. This does not include the ends of the cylinder. (a) 324 sq. in. (b) 1848 sq. ft. (c) 4158 sq. ft. (d) $471\frac{3}{4}$. (e) 480 sq. yd. 5. (a) 77 in. (b) 91 ft. (c) 126 yd. (d) $66\frac{1}{4}$. 6. (a) 240 times. (b) 1440 times. 7. 7040 sq. yd. 8. 21120 sq. yd. 9. (a) 132 times. (b) 82 double journeys and 1 single journey. 10. $59\frac{3}{4}$ acres. 11. (a) 154 sq. ft. (b) 308

sq. ft. (c) 880 sq. ft. (d) 1188 sq. ft. 12. (a) \$106.40.
(b) \$28.61 $\frac{1}{4}$.

Exercise 48.—1. (a) 150 cub. ft. (b) 90 cub. in. 2. (a) 64 cub. in., 88 cub. in. (b) 84 cub. in. 4. (a) 144 cub. in. (b) 180 cub. in. (c) 156 cub. ft. 5. (a) Area of end 154 sq. in. = $\frac{2}{7}$ times the radius times the radius. Radius \times radius = $\frac{7}{2}$ of 154 sq. in. = 49 sq. in. Therefore the radius = 7 in. Diameter = 14 in. (b) As the question stands the operation is too difficult. Change as follows: Volume 4400 cub. ft., length 14 ft. Solution: $4400 \div 14 = 220$ = area of end of cylinder. $\frac{7}{2}$ of $220 =$ radius squared = 100. Radius = 10 ft. Diameter = 20 ft. (c) $149688 \div 108 =$ area of end = 1386 sq. in. $1386 \div \frac{2}{7} =$ square of radius = 441. The factors of 441 are $3 \times 3 \times 7 \times 7$, or $3 \times 7 \times 3 \times 7$, or 21×21 . The radius is 21 in. and the diameter 42 in. 6. (a) 1386 sq. in. (b) 5544 sq. in. (c) $346\frac{1}{2}$ sq. in. 7. (a) 462 cub. ft. (b) 1155 cub. ft. (c) 4158 cub. in. 8. (a) 770 cub. ft. (b) 2772 cub. ft. (c) $5197\frac{1}{2}$ cub. ft. 9. (a) 144 lb. 6 oz. (b) 721 lbs. 14 oz. 10. (a) 15 T. 12 cwt. 81 lbs. 4 oz. (b) 57 T. 15 cwt. 11. (a) $125\frac{1}{2}$ cub. ft. (b) $173\frac{1}{4}$ cub. ft. 12. (a) 88 in. or 7 ft. 4 in. (b) 1386 sq. in. (c) $9051\frac{3}{4}$ cub. in. (d) $346\frac{1}{2}$ sq. in. 13. This question supposes that the stone can be fully covered by the water. Volume of stone 308 cub. ft. Problem now is to find the length of a cylinder 14 ft. in diameter, having a volume of 308 cub. ft. Area of a 14-ft. circle is 154 sq. ft. Length of cylinder = 2 ft. = height which the water has risen. 14. 3080 cub. ft. 15. (a) 8 times. (b) 864 times. Volume of second pail $12 \times \frac{2}{7} \times 7 \times 7$ cub. in. Volume of tank = $72 \times \frac{2}{7} \times 84 \times 84$ cub. in.

Exercise 49.—1. (a) 616 sq. in. (b) 154 sq. in. 2. Area of annulus 462 sq. in. 3. (a) 462 sq. in. (b) 2464 sq. in. 4. (a) 2464 sq. yd. (b) 176 yd. 5. 1386 sq. yd. 6. 7392 sq. rd. 7. (a) 18480 cub. in. (b) 97020 cub. ft. 8. Solidity of cylinder previous to the removal of the piece, 1848 cub. in. Solidity of the rectangular piece removed, 192 cub. in. Solidity of the remaining portion $1848 - 192$ cub. in. = 1656 cub. in. 9. (a) \$110.88. (b) \$43.12.

Exercise 50.—4. The faces are triangles. 192 sq. ft., 240 sq. ft., 304 sq. ft., and 384 sq. ft. 5. Take the perimeter of the base and multiply this by half the slant-height = 432 sq. ft., or 48 sq. yd. At 19 cts. per sq. yd. this would cost \$9.12. 6. (a) 216 sq. in. (b) 552 sq. in. (c) 160 sq. ft. 7. Perimeter of plan $4\frac{1}{8}$ inches. This represents a perimeter of $97\frac{1}{2}$ ft. The lateral surface is therefore $10 \times 97\frac{1}{2}$ sq. ft. or 975 sq. ft. The altitude of the triangle is one inch. The area is $24 \times 36 \div 2$, or 432 sq. ft. 8. Have the apparatus described under this experimental work procured. A solution found experimentally will do the pupils more good than one taken on authority. 9. 3 in. 10. The solidity or volume of the cup is 2×25 cub. in. That of the box is 150 cub. in. 3 times. 13. (a) 360 cub. ft. (b) 168 cub. ft. (c) 864 cub. ft. 14. 132 cub. ft. 15. Solidity of lead pyramid 24 cub. in. Length of rectangle = $24 \div 36$, or $\frac{2}{3}$ in.

Exercise 51.—5. (a) 264 sq. in. (b) 660 sq. in. (c) 198 sq. ft. (d) 528 sq. ft. 6. 14 in., 44 in., 14 in., 308 sq. in. Have the pupils verify these results by experimentation. 9. (a) 1078 cub. in. (b) 6160 cub. in. Have this reduced to cub. ft. (c) 33264 cub. in. Solution: Area of base of cone $\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 144$ sq. in. Solidity is then multiplied by $\frac{1}{3}$ of the altitude. = 13 cub. ft. 800 cub. in. 10. (a) 616 cub. in. (b) 3080 cub. in. 11. Pupils should know by this time the weight of a cub. ft. of water. If they do not, refer them to question 10, Exercise 48, page 72. 11. (a) 44 T. 2 cwt. 99 lb. $2\frac{3}{4}$ oz. (b) 123 T. 10 cwt. 41 lb. $10\frac{3}{4}$ oz.

REVIEW

Exercise 52.—2. 7515.0061, 476.0000084, .020406. 3. Nine hundred and fifty-eight thousand and ninety-eight. 4. (a) 35094029. (b) 31455513. The teacher may develop a short method of obtaining this product, viz., by taking advantage of the nearness of 999 to 1000: thus— $31487 \times 999 = 31487 \times 1000 - 31487$. We have not, for pedagogical and other reasons, brought the matter of devices before the pupil. We think,

however, that from now onward the best of these may be gradually presented. 5. (a) 10233 and a remainder of 15. The teacher should examine the class as to how the accompanying operation has been done and why such steps were taken. (b) 1047 and a rem. of 135. 6. $2^3 \times 3^4$, $2^2 \times 3^2 \times 5^2$ and $2 \times 5^2 \times 7^2$. 7. (a) 21. (b) 2310. 8. (a) 37. (b) 7293. 9. (a) $2\frac{1}{3}$, $1\frac{7}{10}$, $1\frac{11}{8}$. (b) $1\frac{2}{3}$, $1\frac{3}{4}$ and $1\frac{1}{2}$. (c) $25\frac{1}{2}$, $23\frac{1}{2}$ and $31\frac{3}{8}$. 10. (a) $\frac{2}{5}$, $\frac{1}{4}$ and $\frac{1}{4}$. (b) $\frac{7}{2}$, $\frac{11}{30}$ and $\frac{2}{3}$. (c) $2\frac{9}{4}$, $3\frac{1}{2}$ and $7\frac{3}{8}$. 11. (a) $4\frac{2}{7}$, $12\frac{1}{4}$, 12. (b) 6, 9, $11\frac{1}{2}$. (c) $\frac{21}{4}$, $\frac{6}{7}$, $\frac{27}{8}$. 12. (a) $\frac{3}{2}$, $\frac{5}{4}$ and $\frac{1}{2}$. (b) $13\frac{1}{2}$, 32 and 24. (c) $1\frac{5}{8}$, $1\frac{1}{2}$ and $1\frac{7}{8}$.

Exercise 53.—1. 3104292. 2. See that actual multiplication and division are made in this question. 2038. 3. (a) 81130875. (b) Solution:

$$\begin{array}{r}
 14169 \\
 175357 \\
 \hline
 99183 = 14169 \times 7 \\
 495915 = 99183 \times 5 \text{ or } 14169 \times 35 \\
 \hline
 2479575 = 495915 \times 5 \text{ or } 14169 \times 175 \\
 \hline
 248463333
 \end{array}$$

4. (a) 208438. (b) 92167. 5. No one can find the greatest number. Have the pupils discovered this at once? Ask for the least number that will contain the given numbers exactly. It is 73718. 6. 1025. The numbers are 71, 73, 79, 83, 89, 97, 101, 103, 107, 109 and 113. 7. $6\frac{1}{2}$. 8. 3s., 1s. 8d. 9. 56322. 10. (a) £2 15s. (b) £7 11s. 3d. 11. (a) $1\frac{1}{8}$. (b) $3\frac{2}{3}$. 12. 10s.

Exercise 54.—1. (a) .4, .375, .3125, .35. (b) .8, .7, .4, .68. (c) .38, .48, .21875 and .97. 2. (a) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ and $\frac{1}{10}$. (b) $\frac{9}{10}$, $\frac{2}{5}$, $\frac{1}{10}$ and $\frac{3}{5}$. (c) $3\frac{1}{2}$, $7\frac{1}{4}$, $8\frac{1}{8}$ and $15\frac{1}{10}$. 3. (a) .285714, .4, .583, .73. (b) .83, .6, .83 and .3. 4. (a) 236.96825. (b) 188.777165. (c) 301.1241. 5. (a) 229.0892. (b) 14.61359. (c) 107.55875. 6. (a) .1716, .478 and 1469.7. (b) 58099.2, 792 and 3512.016. (c)

22.6188, .24735 and 1.940969. 7. (a) 1.105, 9.0408 and .001143. (b) 7.223974358, .7606779+. Have the pupils continue this decimal. .278169. (c) .00091348, 7.2184 and 8000000. 8. (a) 4%, 75%, 1%, 8%, 46%, 9%, 12% and 60%. (b) $12\frac{1}{2}\%$, 50%, 75%, 80% and $62\frac{1}{2}\%$. (c) 250%, 510%, 1040%, 1280% and 875%. 9. 50%, 20%, 25%, 40%, $37\frac{1}{2}\%$, $33\frac{1}{3}\%$, $83\frac{1}{3}\%$, $66\frac{2}{3}\%$, 80%, $11\frac{1}{3}\%$, $9\frac{1}{11}\%$ and $87\frac{1}{2}\%$. 10. (a) $\frac{1}{4}$, $\frac{3}{4}$, $\frac{2}{5}$, $\frac{7}{10}$, $\frac{4}{5}$ and $\frac{2}{5}$. (b) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{10}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{7}{8}$. 11. (a) .4, .6, .8, .25, .2. (b) .1, .05, .15, 1.25 and .37. 12. (a) 7.2, 7.2, 7.5. (b) 12, 36, 36.

Exercise 55.—1. Mon. \$66145.92. Tues. \$28768.57. Wed. \$83597.30. Thurs. \$73079.04. Fri. \$38344.24. Sat. \$7821.44. 1st, \$21474.03. 2d, \$13060.43. 3d, \$23361.06. 4th, \$20757.86. 5th, \$20757.18. 6th, \$18045.29. 7th, 18748.23. 8th, \$17330.13. 9th, \$19244.23. 10th, \$13727.23. 11th, \$31306.59. 12th, \$25390.13. 13th, \$27273.41. 14th, \$27280.71. Total, \$297756.51. 2. (a) \$5.53. (b) \$1.98. (c) \$3.90. (d) \$2.43. (e) \$4.35. Total cost, \$18.19. 3. (a) 20 gal. 2 qt. 1 pt. 1 gi. (b) 16 cwt. 13 lb. 5 oz. (c) 52 rd. 3 yd. 9 in. 4. (a) 6 bu. 1 pk. 6 qt. (b) 94 lb. 4 oz. (c) 5 yd. 1 ft. 6 in. = 1 rd. Question is therefore—from 1 ml. take 65 rd. = 320 - 65 rd. = 255 rd. 5. (a) 16 lb. 2 oz. (b) 18 yd. 7 in. (c) 5 bu. 3 pk. 4 qt. 6. (a) £3 8s. $11\frac{1}{2}d$. (b) 86 packages—61 oz. of tea remaining. 7. \$1200. 8. $146359\frac{1}{2}$ lb. or 73 T. 3 cwt. 59 lb. 8 oz. 9. 396208 oz. 10. 27. 11. .04452875 and 251.25. 12. $\frac{251}{1000}$.

Exercise 56.—1. (a) 280 sq. yd. (b) The average width is 42 ft., 3360 sq. ft. (c) How many feet must be taken away from the length of each side to have a square-shaped room? The solution is: $(288 - 32) \div 4 = \text{width} = 64 \text{ ft.}$, length = 80 ft. = $568\frac{3}{4}$ sq. yd. 2. (a) 448 sq. yd. (b) 144 sq. yd. 3. (a) 11 strips each 12 yd. in length, or 132 yd. (b) 32 strips, each 12 yd. long, or 384 yd. (c) Place the strips from end to end of room. 6 strips each 80 ft. or $26\frac{2}{3}$ yd. long, or 160 yd. *Note.*—Change *stripe* to strips in this question. 4. (a) 64 yd.

(b) Strips run the same as in *a*. 15 strips, each 11 yd. long or 165 yd. 5. (a) \$1433.60. (b) \$708.75. 6. (a) \$89.28. (b) \$42.30. 7. (a) \$425.25. (b) \$190. 8. (a) Each scantling is equal to a board a foot wide, or the three are equal to half the walk. 47520 ft. (b) 1944 ft. 9. 3816. 10. (a) This room will require 83 strips for the walls. Consider the height as 12 ft. The ceiling will take 18 strips, each 35 ft. long. Both ceiling and walls will require 542 yd. of paper, or 68 rolls. They will cost \$21.76. (b) Take the height of this room at 15 ft. \$31.45. 11. (a) 48 A. (b) $\frac{1}{4}$ A. (c) 80 A. (d) 40 A. 12. 810. 13. \$50.40. 14. \$360 for the walls and \$172.80 for the ceiling. Total, \$532.80. 15. 800 sq. ft.

Exercise 57.—1. $\frac{1}{3}$, $11\frac{1}{3}\%$. 2. 967680. 3. How long does the person take to take 1800 steps? This is the time he takes to go 1 ml. How far can he go in 3600 seconds? 4 ml. 4. 10 ml. 5. $3\frac{3}{4}$ da. 6. $\frac{3}{70}$. 7. $35\frac{3}{17}$ da. 8. \$51.60. 9. 13. Oral work. 10. A's money is equal to $\frac{3}{4}$ of $\frac{1}{4}$ of B's money = $\frac{3}{16}$ of B's money. Their money must therefore be taken as 9 to 8. A has $\frac{9}{17}$ of \$136, or \$72, and B has \$64. 11. 228 rd. 12. (a) Change 8425 ft. to thousands of feet, thus 8.425 thousand ft. and employ decimals. $\$27 \times 8.425 = \227.475 . What does 5 mean in \$227.475? (b) 9.267 thousands of brick at \$8.40 = $\$8.40 \times 9.267 = \77.8428 . 13. 39600 ft. 14. Each board will make 3 planks. These will cover 30 inches, or $2\frac{1}{2}$ ft. of the walk. To cover the whole walk there will be needed $1800 \div 2\frac{1}{2}$ planks or 720 planks. 15. 1152 persons. 16. 160 rods is equal to 40 chains. The area of the farm is therefore 1600 square chains. 9 trees to a square chain means 9×1600 trees, or 14400 trees. 17. Change *leave* to *lower*. $80 \times 40 \times \frac{1}{4}$ cub. ft. or 2400 cub. ft. 1600 cub. ft., $2133\frac{1}{3}$ cub. ft. 18. $48 \times 36 =$ area on which house stands. $45\frac{1}{2} \times 33\frac{1}{2} =$ area enclosed by wall. The difference, $216\frac{2}{3}$ sq. ft. equals cross-section of wall. Solidity of wall therefore is equal to $12 \times 216\frac{2}{3}$ cub. ft. = $2602\frac{2}{3}$ cub. ft. Number of bricks = solidity of wall \div solidity of each brick = 70272 bricks. 19. Find outside measurements and proceed as in 18. 11664 cub. ft. 20. \$105.408. 21. Area of

board = $18 \times 1\frac{1}{4} \div 9$, or $2\frac{1}{2}$ sq. yd. The remainder has an area of $1\frac{1}{2}$ sq. yd. Its length is therefore $13\frac{1}{2} \div 1\frac{1}{4}$ ft. = $10\frac{1}{2}$ ft.

22. The fence was painted on the outside only. \$157.50.

23. 6800, 12000. 24. 96 men. Ask for solutions here. There may be some who have thought away from the old lines of working such questions. 25. Add "in 45 min." He will row back in 2 hr. 15 min. How far did he go down stream? At what rate did he return?

Exercise 58.—1. 35 wk. The food would have lasted in all 30 wk. In 15 wk. a sale is made, leaving $\frac{3}{4}$ of the number of hogs, and half the food. This will now last $\frac{1}{2}$ of 15 wk., or 20 wk. In all, the food will therefore last 35 wk. 2. \$24.75. The laborer earned each month \$23 and $\frac{1}{12}$ of the amount. In 8 mo. he earned \$184 and $\frac{2}{3}$ of the amount. The difference between \$184 and \$175.75 must balance the price of $\frac{1}{3}$ of the amount. 3. \$110. 4. 400 doz. 5. The pasture will feed only 30 cows. If 12 cows are now in, $\frac{1}{10}$ of the pasture is in use. $\frac{1}{10}$ of 40 horses may now be added, or 24 horses. 6. 40 ac. = 6400 sq. rd. Field must be 80 rd. to a side. The diameter of the circle is the same as a side of the square or 80 rd. There are $1371\frac{1}{2}$ sq. rd. outside of circle. 7. Say "tents," not "huts." (a) 1056 sq. yd. (b) 1584 sq. yd. 8. Have the word *slant* removed. Read as height of 24 ft. and of 25 ft. (a) $2514\frac{1}{2}$ cub. ft. (b) $1283\frac{1}{2}$ cub. ft. 9. (a) Do not consider the ends of the cylinder. 14080 stamps. (b) 2592 stamps. 10. $\frac{1}{4}$, 25%. 11. $\frac{1}{4}$, 20%. 12. (a) 3.2. (b) 12. These questions may also be answered as: (a) 2% of 160. (b) $1\frac{1}{2}$ % of 800. 13. \$672. 14. $\frac{1}{2}$, 44%. 15. 20% or $\frac{1}{5}$. 16. \$14.04. 17. I lost \$72 on the two transactions.

Exercise 59.—1. $\frac{9}{11}$. 2. 6 ft. 3. 7.7. 4. $\frac{5}{8}$, $4\frac{3}{8}$. 5. $\frac{7}{8}$, $\frac{4}{7}$, $\frac{4}{3}$ and $\frac{2}{3}$. 6. $22\frac{1}{4}$. 7. (a) 74.9892. (b) .00742095. 8. 817. Work the question without changing the decimals to vulgar fractions. 9. 42240. 10. This question assumes that none of the carpet was turned under. Number of strips = $483 \div 26\frac{1}{2} = 18\frac{1}{2}$. Width of room = $\frac{1}{4} \times 18\frac{1}{2} = 23$ yd. or 69 ft. 11. 200 men. 12. $\frac{1}{10}$ pt. 13. 98 lb. 7 oz., 45 packages,

25 packages and 105 packages. 14. (a) $66\frac{2}{3}\%$. (b) 75% .
 (c) 80% . (d) 4% . (e) $7\frac{1}{2}\%$. (f) 25% . (g) $5\frac{3}{11}\%$. (h)
 $6\frac{1}{3}\%$. (i) $2\frac{1}{11}\%$. 15. (a) 225. (b) 160. (c) 2160. 16. \$720.

Exercise 60.—1. 77 sq. ft. 2. 77 sq. ft. 3. (a) $96\frac{1}{2}$ cub.
 ft. (b) 462 cub. ft. 4. 2332 cub. in. 5. (a) 210 sq. ft.
 (b) 204 sq. ft. 6. (a) 24 cub. ft. (b) 480 cub. ft. 7. (a) 64
 cub. ft. (b) $38\frac{1}{2}$ cub. ft. (c) 77 cub. ft. (d) 60 cub. ft. The
 above is all the comparison required. It gives a summing up
 of certain important operations. 8. (a) 217 da. (b) 1021
 da. 9. (a) June 2d. (b) Sept. 27th. 10. (a) 498 da.
 (b) 307 da. 11. (a) \$46.5575. (b) \$180.096. 12. (a) 145.
 (b) 444.2. 13. (a) 204 lb. (b) 21.2 lb. 14. About 33600
 sq. yd. As this is a question depending entirely on the
 exactness of the plan, the teacher will have to allow for a
 good deal of latitude. 15. About 87 ft. 16. (a) 1 T. 17 cwt.
 38 lb. 12 oz. (b) $373\frac{1}{2}$ gal.

BOOK II—PART II

REVIEW

Exercise 1.—(a) 10397. (b) 2223. (c) 205179. 2. (a) 118999. (b) 482790. (c) 21661. 3. (a) 14525, 72625, 127575 and 1435525. (b) Have many of the students seen the relation of the multiplier to 100? 522225, 41877, 866448, 591129 and 8147799. 4. (a) 207, remainder 30; 92, remainder 33. (b) 1584, remainder 35; 14650, remainder 57. 5. 798664 is divisible by 2, 4 and 8; 5498775 is divisible by 3, 9, and 5; 428972 is divisible by 2 and 4; 44181000 is divisible by 2, 3, 4, 5, 6, 8 and 9; 33696072 is divisible by 2, 3, 4, 6, 8 and 9. 6. $2^2 \times 3^3 \times 11$, $2^3 \times 3^2 \times 5^2 \times 7$, $2^3 \times 5^3 \times 19$, $7 \times 11 \times 71$ and $2 \times 11 \times 47$. 7. (a) 15. (b) 5. 8. (a) 209. (b) 37. 9. (a) 6720. (b) 609840. 10. (a) 3360. (b) 136136.

Exercise 2.—1. (a) 60144 oz. (b) 358 pt. 2. (a) 2 T. 5 cwt. 19 lb. 10 oz. (b) 871 rd. 2 yd. 2 ft. 6 in. 3. (a) 23522400 sq. ft. (b) 64 sq. yd. 13 sq. in. 4. (a) £13 10s. 5d. (b) 32 cwt. 71 lbs. 5 oz. 5. (a) £10900 9s. 9½d. (b) 410 yd. 1 ft. 6 in. 6. (a) 7 pk. 6 qt. (d) 49 yd. 2 ft. 2 in. 7. (a) 528 lb. 8 oz. (b) 2136 yd. 6 in. 8. (a) £10 12s. 0½½d. (b) 53 gal. 3 qt. 3½½ gi. 9. (a) 2 cwt. 75 lb. 2¾ oz. (b) £166 10s. 10. (a) \$42.31½. (b) \$98.46. Have the pupils observed the equality of the price per bu. and the number of lb. in the bu.?

Exercise 3.—1. $\frac{1}{10}$, $\frac{1}{5}$. 2. $\frac{2}{5}$, $\frac{3}{10}$ and $\frac{5}{10}$; $\frac{1}{10}$, $\frac{1}{5}$ and $\frac{1}{10}$. 3. $17\frac{1}{2}$, $9\frac{1}{4}$ and $36\frac{1}{2}$. 4. $\frac{4}{8}$, $\frac{1}{11}$ and $\frac{1}{34}$. 5. (a) $3\frac{1}{2}$. (b) $8\frac{1}{4}$. 6. (a) $1\frac{1}{2}$. (b) $\frac{1}{2}$. 7. (a) $7\frac{1}{10}$. (b) 0. 8. (a) 6, 9, 15. (b) 28, 15, 15. (c) $\frac{1}{2}$. 9. (a) $\frac{1}{2}$. (b) $1\frac{1}{2}$. 10. (a) $\frac{3}{10}$, $\frac{1}{10}$, $\frac{1}{10}$. (b) 8, 7, 3½. (c) $\frac{1}{2}$. 11. \$1280.

Exercise 4.—1. $37\frac{1}{4}$. 2. \$8294.40. 3. 710. 4. This question is on the same principle as the following. What number divided by 5 gives 20? $6\frac{2}{3}$. 5. \$1200 equals the value of the house and \$200 the value of the lot. 6. \$30. 7. \$37.68. The total cost is \$16.50. 8. 10. 9. 126. 10. \$125.

Exercise 5.—1. .171, 3.20016, 20.03, 3.1 and 7.432. 2. $\frac{3}{10}$, $\frac{3}{1000}$, $\frac{3}{25}$, $\frac{11}{100}$, $4\frac{1}{2}$ and $\frac{2\frac{1}{2}0^3}{10^3}$ or $50\frac{3}{10}$. 3. (a) 1408 yd. (b) 174. Are gallons and bushels of the same series of measures? 4. 387.3534. Get the pupils to read this result. 5. 1.9992606. 6. .02602053. 7. 33 pieces. $\frac{2}{3}$ of a yd. or .036 yd. 8. (a) 58.6 rd. (b) 210 sq. rd. or $1\frac{5}{8}$ A. 9. $34\frac{3}{4}$ cub. in. 10. 32 T.

Exercise 6.—1. \$5.40. 2. The farmer has $\frac{2}{3}$ of his money left. The difference between what he spent and what he has left is $\frac{1}{3}$ of his money, or \$75. He had, therefore, at first \$300. The horse cost him \$112.50. 3. 4 da. 4. $\frac{2}{3}$ da. 5. \$2.50. 6. \$5 per head. 7. 27 cts.; 9 cts. as an average. In reality he made 30 cts. on the first kind of tea, 3 cts. on the second, and lost 6 cts. on the third. His gain per cent. is $11\frac{1}{2}$. 8. Gain \$60, 15 cts., $\frac{5}{8}$, $15\frac{5}{8}\%$. 9. $\frac{1}{2}$, 20%.

Exercise 7.—1. 165 trees. 2. Train must go its own length and the length of the bridge before it is said to have crossed. $\frac{2}{3}$ minutes. 3. He has left \$6.40 less than $\frac{2}{3}$ of his money. $\frac{2}{3}$ of his money is therefore \$6.40 + \$8, and his money \$23.04. 4. 1680 times. 5. \$112. 6. 20 ml. per hr. 7. $1985\frac{5}{8}$ lb. or 33 bu. +. 8. $26\frac{2}{3}$ ft. 9. $17\frac{1}{2}$ ml. 10. 648 gal.

Exercise 8.—1. 800 bbl. 2. \$17280. 3. He can cut a cord in $3\frac{1}{2}$ hr. He can cut 144 cd. in 480 hr. or 60 da. of 8 hr. each. 4. \$1200, \$400, \$300, \$240 and \$260. 5. 14789. 6. \$31.20. 7. Change *length* to *height*. 11 ft. 3 in. 8. $3\frac{1}{2}$ ft. 9. \$22.05. 10. 144 sq. ml.

Exercise 9.—1. 184 bu. 2. \$6.063 +. 3. 7 cts., $\frac{7}{8}$, $9\frac{1}{2}\%$. 4. 41 cts., \$184.50. 5. 80 ft. 6. Half the land cost him \$540. He therefore gains on this \$810 - \$540 or \$270. At \$15 per ac. gain, this would mean 18 acres for half the land,

or a total of 36 acres. 7. Had he worked the whole time he would have received \$93.75. He must have lost by idleness \$24.60. Every day he was idle he lost \$2.05. He was 12 da. idle. 8. \$30. 9. 2640 pickets. \$72.60. 10. 7724 and 1926.

Exercise 10.—1. 75% , 70% , $93\frac{1}{3}\%$, 64% , 65% , 44% , 54% and 15% . 2. (a) 9, 8, 36, 72. (b) 5, 2, 12, 66. 3. (a) 400, 900, 576, 375. (b) 2400, 600, 850, 1500. 4. (a) 20% , $8\frac{1}{2}\%$, 75% , $83\frac{1}{3}\%$. (b) $31\frac{1}{4}\%$, $59\frac{1}{8}\%$, 30% , $11\frac{1}{5}\%$. 5. (a) \$264, \$137.28, \$324.90, \$645.76. 6. 2% , $12\frac{1}{2}\%$, 2% , 20% , 12% and $12\frac{1}{2}\%$. 7. 12% . 8. 49% .

Exercise 11.—(a) 5544 sq. ft. (b) $962\frac{1}{2}$ sq. ft. (c) 616 sq. in. 2. (a) 1848 cub. ft. (b) 1386 cub. ft. 3. (a) $146\frac{2}{3}$ sq. ft. (b) 165 sq. ft. 4. (a) 168 sq. ft. (b) 42 sq. ft. 5. Circle a is 4 times the area of circle b. 6. Cube a is 8 times as large as cube b. 7. Four times as large a piece of land. 8. 124416 blocks. 9. \$12.10. 10. (a) \$357. (b) 5831 sq. ft. + $1041\frac{1}{4}$ sq. ft. = $6872\frac{1}{4}$ sq. ft. (c) 42 ft. by $29\frac{1}{2}$ ft. (d) 308 cub. ft. (e) About 200 sq. ft. (f) 61° . Pupils will find a plan of tractor at the end of Book I.

Exercise 12.—1. (a) $\frac{3}{100}$, $\frac{1}{10}$, $\frac{1}{18}$, $\frac{1}{12}$, $\frac{1}{10}$, $\frac{1}{8}$, $\frac{3}{10}$. (b) $\frac{4}{5}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{5}$, $\frac{3}{10}$, $\frac{1}{5}$. (c) $\frac{2}{5}$, $\frac{9}{10}$, $\frac{1}{2}$, $\frac{3}{5}$, $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{1}{5}$. 2. (a) 75% , $16\frac{2}{3}\%$, 20% , $12\frac{1}{2}\%$, 10% , 5% , $33\frac{1}{3}\%$, 15% , 16% , 45% and $3\frac{1}{3}\%$. (b) $83\frac{1}{3}\%$, $37\frac{1}{2}\%$, $62\frac{1}{2}\%$, $9\frac{1}{11}\%$, $8\frac{1}{3}\%$, $11\frac{1}{3}\%$, $66\frac{2}{3}\%$, $87\frac{1}{2}\%$, 70% , $46\frac{2}{3}\%$ and $14\frac{2}{3}\%$. (c) 18% , 95% , 68% , 60% , 110% , $114\frac{2}{3}\%$, 200% , 250% , $233\frac{1}{3}\%$, 103% and 206% . 3. $71\frac{3}{4}\%$. 4. 124 acres. $77\frac{3}{4}\%$. 5. (a) 20% gain. (b) $16\frac{2}{3}\%$ loss. (c) $11\frac{1}{3}\%$ gain. (d) 20% loss. (e) 25% loss. (f) $12\frac{1}{2}\%$ gain. (g) $16\frac{2}{3}\%$ gain. (h) $14\frac{2}{3}\%$ gain. (i) 50% gain. 6. \$120, $55\frac{5}{8}\%$. 7. \$2800, \$4500. 8. (a) \$69.60. (b) \$23.40. (c) \$25.80. 9. (a) $276\frac{2}{3}\%$. (b) $36\frac{4}{11}\%$. 10. (a) 100% gain. (b) 60% gain. (c) 20% loss. (d) $33\frac{1}{3}\%$ gain. (e) 25% loss.

Exercise 13.—1. 400 bu. of oats and 1300 bu. of wheat. 15%. 2. 72. 3. \$92, \$68. 4. (a) $11\frac{1}{3}\%$ gain. (b) 20% gain. (c) $16\frac{2}{3}\%$ gain. (d) $16\frac{2}{3}\%$ loss. 5. (a) $\$1.20\frac{3}{10}$. (b) \$2.10. (c) $\$3.26\frac{11}{100}$. 6. \$4740. 7. 15%. 8. (a) 25%. (b) $6\frac{2}{3}\%$. (c) \$1120. (d) \$1950. 9. The cattle actually cost him \$46.75 per head. His gain is \$15811 $\frac{1}{3}$. 10. (a) 72 cts., 70 cts., 75 cts. (b) 90 cts., \$1.25, 78 cts. (c) \$1, \$1.26, \$1.08.

LOSS AND GAIN

Exercise 14.—1. (a) $\frac{1}{4}$, 25%. (b) $\frac{1}{5}$, 20%. (c) $\frac{1}{4}$, 80%. (d) $\frac{1}{4}$, 125%. 2. (a) $12\frac{1}{2}\%$. (b) 75%. (c) 30%. (d) $83\frac{1}{3}\%$. 3. (a) 50%. (b) $33\frac{1}{3}\%$. (c) 20%. (d) $14\frac{2}{3}\%$. 4. (a) $33\frac{1}{3}\%$. (b) 25%. (c) $16\frac{2}{3}\%$. (d) $12\frac{1}{2}\%$. 5. (a) \$162. (b) \$504, \$336. (c) \$126, \$18. (d) $12\frac{1}{2}\%$. 6. (a) $28\frac{1}{3}\%$. (b) \$2100. $\frac{3}{4}$ here means—at a gain of $\frac{3}{4}$ of the cost price. (c) \$427.50, \$47.50. (d) \$716.80, \$76.80. 7. (a) \$2000. (b) \$3750. (c) $33\frac{1}{3}\%$. 8. \$2640. 9. 96 cts. 10. 15%. 11. (a) \$4 loss. (b) \$1.20 loss. 12. \$4 loss. 13. 25% advance, $62\frac{1}{2}\%$, 50%, $87\frac{1}{2}\%$. Pupils at this stage may be gradually introduced to the use of representative numbers. In the latter part of question 13, if we suppose the cost price of the article to be \$1, we must have sold it at 80 cts. To gain 30% on the cost means to sell the article at \$1.30. The difference between \$1.30 and 80 cts. is 50 cts. and 50 cts. is $\frac{5}{8}$ of the initial selling price, or a gain of $62\frac{1}{2}\%$. This is perhaps the most desirable solution of such questions at the present stage of the work. 15. He gained or lost nothing.

Exercise 15.—1. $22\frac{2}{3}\%$. 2. 25%. 3. $37\frac{1}{2}\%$. 4. 25%. 5. The gain % is most easily obtained from a consideration of the cost price and the selling price of 1 bbl. Here I gained 25 cts. on \$6.75, or $\frac{1}{27}$ of the cost, or $3\frac{1}{3}\%$. The selling price of the whole is $\frac{2}{3}$ of \$9000, or \$9333 $\frac{1}{3}$. My total gain, \$333 $\frac{1}{3}$. 6. How much was gained on the 400 bbl.? \$600 is what part of the cost price of the whole lot? What per cent? 40%. 7. He made $\frac{1}{3}$ of cost or $12\frac{1}{2}\%$. 8. \$300, $66\frac{2}{3}\%$. 9. 50%.

10. \$2.70. 11. 50 cts. 12. \$400. 13. 20%. 14. 120 bbl.
15. 90 cts. 16. $66\frac{2}{3}\%$.

TAXES

Exercise 16.—It is important here to see that the pupils understand the meaning of taxes. Read the introduction carefully and make such additions as you think will help. 1. \$21.60. 2. \$120. 3. \$36. 4. (a) Change the \$6000 to mills = 6000000 mills. On \$500000, 6000000 mills are raised. On one dollar 12 mills are required. (b) \$4200. 5. 14 mills, \$10.08. 6. \$10.80. 7. (a) 25 mills. (b) \$96. 8. 3 mills, 5 mills, 8 mills. 9. (a) \$86.40. (b) \$67.50. (c) \$281.60. (d) \$38.40. 10. The former. The first town pays $\frac{1}{4}$ of 18 mills on each dollar of actual value of property. The second pays $\frac{1}{3}$ of 20 mills on the same, or $\frac{1}{4}$ of a mill less on each dollar of actual value of property. 11. \$17.55, \$15.80.

Exercise 17.—1. \$72. 2. 12 mills. 3. 17 mills. 4. (a) 2 cts. (b) $12\frac{1}{2}$ mills. 5. (a) \$106.80. (b) \$72. (c) \$184.20. (d) \$75.15. 6. (a) 15 mills, \$48. (b) 5 mills, \$22.50. 7. \$432. Taxes are paid at the end of the year. The house cost me \$7200. Five per cent. of this is \$360. \$360 + taxes of \$72 = \$432. 8. (a) \$28.80. (b) \$3.60. (c) \$31.20. (d) \$28.80. Total \$92.40. Can the pupils get the total any other way? 9. (a) \$31.50. (b) \$22.50. (c) \$13.50. (d) \$4.50. (e) \$13.50. Total tax, \$85.50. 10. (a) \$3000. (b) \$10700. (c) \$40000. (d) \$5030. 11. \$1153.40. 12. \$15400, \$22000.

INSURANCE

Exercise 18.—1. (a) \$64. (b) \$37.50. (c) \$45. 2. (a) \$9. (b) \$12. (c) \$3.50. 3. (a) \$26.25. (b) \$38.50. (c) \$52.12 $\frac{1}{2}$. 4. (a) \$3.90. (b) \$6.25. (c) \$6.67 $\frac{1}{2}$. 5. (a) \$7.87 $\frac{1}{2}$. (b) \$54. (c) \$5.12. 6. (a) \$2000. (b) \$1600. (c) \$9750. 7. (a) \$2666 $\frac{2}{3}$. (b) \$36000. (c) \$11250. 8. (a) \$487.50. (b) \$129.60. (c) \$18. 9. (a) \$3750. (b) \$4000.

Note.—No account is to be taken of the premium paid. If the premium paid were \$60, how much insurance received? 10. (a) \$15.50. (b) \$38.75.

Exercise 19.—1. \$31.50. 2. (a) \$6. (b) \$13.33 $\frac{1}{3}$. 3. (a) 3 $\frac{1}{2}$ %. (b) $\frac{3}{8}$ %. 4. (a) This does not mean 3% each year. \$18. (b) \$400. (c) \$200. 5. \$9600. 6. \$13200. 7. Find the premium paid by the man. \$450. 8. (a) 2 $\frac{1}{4}$ %. (b) $\frac{3\frac{1}{2}}{4}$ %. 9. Company lost the difference between \$120000 and \$96000 and the five premiums paid, or \$25500. 10. \$6400 and \$4800.

DUTIES

There is no good reason why pupils should have any difficulty in solving problems on duties provided the meaning of the term is sufficiently understood. It is therefore wisdom for the teacher in this and other exercises of a commercial character to spend some time in assisting the pupils to grasp the nature and purpose of duties.

Exercise 20.—1. \$271.50. 2. (a) \$1140. (b) £40. (c) \$214.50. 3. \$189. 4. \$403.50. 5. (a) \$6996. (b) \$537.60. (c) \$131.34. 6. (a) 4770 francs. (b) 507 $\frac{1}{2}$ francs. (c) 7200 francs. Total duty paid 12477 $\frac{1}{2}$ francs = \$2408.11+. 7. (a) \$1573.59. (b) \$2098.40. Total, \$3671.99. 8. (a) \$240.26 $\frac{1}{3}$. (b) \$1226.40. Total duty, \$1466.66 $\frac{1}{3}$. 9. (a) \$1302.60. (b) \$1418.50. 10. \$362.28. 11. \$3470.75.

Exercise 21.—1. (a) 900 sq. yd., \$297. (b) \$504. 2. \$1860, \$2.06. 3. \$345.60. 4. \$75.60. 5. \$544.32. 6. \$9039.10. 7. Question 7 is a little vague. The importer would pay 75% on cost price. That is, he would have to pay 4 cts. per lb. + 3 cts. per lb. The sugar would cost him 7 cts. per lb. His profit was one cent. If the duty were removed he would charge 5 cts. per lb., thus saving the family 3 cts. a lb., or \$18 on the year's supply. 8. \$1337940.73. 9. \$13824. 10. \$3125. The consumer had to pay $\frac{1}{6} \times \frac{1}{3} \times \frac{32}{100}$ of what the importer paid in the first place.

COMMISSION

Exercise 22.—1. (a) \$6.40. (b) \$14.40. (c) \$35.60. 2. (a) \$18. (b) \$6.72. (c) \$19.11. 3. (a) \$24.01 $\frac{1}{4}$. (b) \$38.63 $\frac{1}{4}$. (c) \$64.02. 4. (a) \$40. (b) \$70. (c) \$73. 5. (a) \$52.32 $\frac{1}{2}$. (b) \$14.11 $\frac{1}{4}$. 6. (a) \$15.83. (b) \$1259.37. 7. (a) \$10.08. (b) \$3.96. (c) \$519.96. 8. (a) \$55. (b) \$1152, \$916. 9. \$78.12 $\frac{1}{2}$. 10. (a) \$354.75. (b) \$600, \$1370.25.

Exercise 23.—1. \$746.87 $\frac{1}{2}$. 2. (a) \$1800. (b) \$10400. 3. (a) \$1200, \$1224. (b) \$10400, \$10439. 4. (a) $\frac{1}{2}\%$. (b) $\frac{7}{8}\%$. 5. (a) \$1.25. (b) \$1300. 6. (a) \$16. (b) 2%. 7. (a) \$3620. (b) 18000 bu. 8. \$1368. 9. (a) \$1920, \$1890. 10. \$111.54. 11. (a) \$170. (b) \$4080. 12. (a) \$1200 in potatoes. (b) \$3650 in wheat. (c) \$960 in butter. 13. 7500 bu. 14. \$1560. The agent had to deduct the freight charge from the amount sent and afterwards invest as much as possible on a basis of 2 $\frac{1}{2}\%$. \$1613 - \$14 = \$1599. The agent could invest $\frac{100}{102\frac{1}{2}}$ of this amount.

STOCKS

Many pupils, and not a few teachers, have found this department of Arithmetic exceedingly perplexing. The difficulty is not due to any complexity of the operations involved, but to an improper conception of the meaning of the stock *terms* and the nature of the stock *business*. An attempt has been made here to present the subject in a manner that should cause no haziness either to the scholar or to the teacher.

Exercise 24.—1. (a) A, \$90; B, \$72; C, \$108; D, \$60; E, \$150; F, \$78; G, \$42; H, \$36; I, \$30; K, \$18; L, \$12; M, \$24. 6% on the money subscribed by each shareholder, and \$6 on each share held, mean the same. (b) \$720. (c) E had 25 shares which he sold at \$120 each. \$3000. (d) \$119 $\frac{1}{4}$ per share; \$21 $\frac{1}{4}$. (e) \$240. A received \$30; C, \$36; F, \$26, and N, \$50. (f) \$92 a share or \$4124. (g) \$92 $\frac{3}{4}$ per share

- or \$4159½. (h) \$1920. (i) \$1800. N, \$375. P, \$705. R, \$720. 2. \$50, \$75, \$15. 3. \$150 per share. 150% of the par value. 4. \$225 or 5% more than the bank gave him. 5. \$300, \$276. Instead of making \$10 per share, he would make but \$9½. 6. (a) \$4200. (b) \$6330. (c) \$8460. 7. \$480. This would be the same, no matter what the stock was worth. 8. \$240. 9. \$11580, \$1380. 10. (a) \$4000 stock means 40 shares of stock. \$3840. (b) \$8190. (c) \$4950. 11. (a) 28 shares. (b) 16 shares. (c) 32 shares.

TRADE OR COMMERCIAL DISCOUNT

- Exercise 25.**—1. (a) \$2.70 per pair. (b) \$2.70. 2. (a) \$2. (b) \$4.50. 3. \$576, \$528. 4. \$45. 5. \$78, 17½%. 6. The second discounts are the better by \$2.50. 7. 25%. 8. (a) \$162. (b) \$535.50. (c) \$662.62½. (d) \$468.35. (e) \$16.12½. 9. (a) Have gained nor lost nothing. (b) Gained \$31.50. (c) Gained \$19.20. (d) Neither gained nor lost. (e) Gained \$204.

- Exercise 26.**—1. \$1800 or \$3 a bbl. 2. \$8.96. 3. \$120. 4. 25%. 5. 44%. 6. \$180, \$225. 7. Suppose the list price is a dollar. The goods cost me 60 cts. and I sell them at 80 cts. I therefore make 20 cts. on an investment of 60 cts., or 33⅓% of my investment. 8. \$3.20, 53⅓%. 9. \$18, \$16.80. 10. \$51. 11. \$561.60. 12. 52⅓%.

INTEREST

- Exercise 27.**—1. (a) 60 cts. (b) \$28.50. (c) \$94.50. (d) \$21, \$49, \$63. (e) \$126. 3. (a) 12 cts. (b) 24 cts. (c) \$1.65. (d) \$1.44. (e) \$1.62. (f) \$1. (g) \$2.40. (h) \$4.80. 4. (a) \$12. (b) \$36. (c) \$48. (d) \$1½. (e) \$18. (f) \$62.40. (g) \$121.80. (h) \$288. (i) \$324. (j) \$525. (k) \$756. 5. (a) \$150. (b) \$434. (c) \$334.80. (d) \$287. (e) \$210. (f) \$936. (g) \$275. (h) \$840. (i) \$1710. (j) \$360. (k) \$2244. 6. (a) The second interest is 1½ times as great as

the first. (b) The second interest is $1\frac{1}{2}$ times as great as the first. (c) The second interest is only $\frac{3}{4}$ of the first. 7. (a) \$1.35, \$2.02 $\frac{1}{2}$. (b) \$1.20, 60 cts. (c) \$3, \$6. Have the pupils used what was found in question 6 to solve these problems? 8. (a) \$16.80. (b) \$5.25. (c) \$19.14. (d) \$26.04. (e) \$27.84. 9. (a) \$5.18 $\frac{2}{3}$. (b) \$10.72 $\frac{1}{2}$. (c) \$27.18. (d) \$17.38 $\frac{1}{4}$. (e) \$27.63 $\frac{2}{3}$. 10. (a) \$19.51 $\frac{1}{2}$. (b) \$32.60 $\frac{1}{4}$. (c) \$81.22 $\frac{1}{2}$. (d) \$123.31 $\frac{1}{5}$. (e) \$256.61 +.

Exercise 28.—

1. (a) \$48.81 (b) \$71.46 + (c) \$39.88 $\frac{1}{2}$

(d) \$29.04 (e) \$129.23 $\frac{1}{4}$ (f) \$79.42 $\frac{1}{2}$

2. (a) \$289.10 (b) \$441.60 (c) \$870

(d) \$843.60 (e) \$1251.60 (f) \$629.20

(g) \$489.60 (h) \$1152.40 (i) \$878.40

(j) \$350.55 (k) \$1273

3. (a) \$9.56 $\frac{1}{3}$ (b) \$13.86 $\frac{1}{3}$ (c) \$5.76 (d) \$9.60

(e) \$9.63 $\frac{1}{3}$ (f) \$27.40

4. (a) \$8.15. (b) \$10.67. (c) \$13.74. (d) \$13.90. *Note.*

—These answers are only correct to the nearest cent. (e)

\$81.04. 5. He will gain \$100. 6. I must pay \$400 per

year together with the interest on the debt. Nov. 1st, 1904.

\$511.60; Nov. 1st, 1905, \$487.60; Nov. 1st, 1906, \$463.60;

Nov. 1st, 1907, \$439.60; Nov. 1st, 1908, \$275.60. 7. \$36.75.

8. \$1701.21 $\frac{1}{2}$. 9. (a) 3 yr. (b) 4 yr. (c) 4 yr. (d) 7 yr.

10. (a) \$800. (b) \$950. (c) \$400. (d) \$500. 11. \$440.

or 7 $\frac{1}{2}$ % . 12. \$16. 13. \$750, 8%. *Solution:*

In 8 mo. the amount is \$790

In 19 mo. the amount is \$845

The interest for 11 mo. is \$55

The interest for 8 mo. is \$40

The principal is . . . \$750

The interest for 12 mo. is \$60

The rate is 8%.

14. What sum in 8 mo. will give us interest \$720? \$18000.

15. (a) $\frac{8}{15}$ or 32% of the principal. (b) $\frac{1}{15}$ or 30% of the principal.

BANK DISCOUNT

Exercise 29.—2. (a) Days of grace are always added in real business. \$4.14. (b) \$6.51. (c) \$9.56. (d) \$18.34.
 3. (a) \$396.55. (b) \$552.82. (c) \$633.60. (d) \$708.55.
 4. (a) \$123.09. (b) \$335.90. 5. (a) \$12.25. (b) \$3.30.
 6. (a) \$724.24. (b) \$316.14. 7. \$734.71. 8. \$16.31, \$1558.69. 9. \$9.81, \$970.94. 10. Find the proceeds of this note it being discounted on January 15th, at 10%. \$1981.92.

Exercise 30.—1. (a) 65 da. (b) 40 da. (c) 76 da. (d) 59 da. 2. (a) 49 da. (b) 16 da. (c) 21 da. 3. (a) April 10th. (b) June 12th. (c) Sept. 20th. (d) June 24th. (e) July 31st.
 4. This note matures August 10th. Its amount is \$863.27. This amount is discounted at 8% for 56 days. The discount is \$10.59 and the proceeds \$852.68. 5. \$1009.84. 6. \$48.08. 7. \$175.43. 8. Since no date is given in this question no days of grace may be added. The discount is at 6%. Proceeds \$842.37. 9. This note matures in 73 days or $\frac{1}{4}$ yr. The discount for this time is at the rate of $1\frac{1}{2}$ %. On \$100 face the bank will give me \$98.80. On what amount then will the bank give me \$1000? \$1012.15. 10. The discount is \$14.50. At 6% per annum the interest on the amount discounted (\$1200) is \$72. The note has therefore run for $14\frac{1}{2}$ yr. or 73 da. 11. \$285.60.

REVIEW

Exercise 31.—1. \$300. 2. \$2430. 3. \$547.20 in flour; \$820.80 in canned goods; \$1368 in sugar, rice and potatoes; \$1824 in teas and tobaccos and \$912 in spices. 4. \$3520. 5. \$2280. If he used 60% of what was taken out he would have used $\frac{3}{4}$ of 40% or 24%, which is equal to \$720. 6. \$10 per T. 7. $81\frac{1}{2}$ cts. per lb. 8. 10 bu.

Exercise 32.—1. He gained 2%. Suppose the merchant owned \$100 stock. He sold this in two sales, one of \$60 and the other of \$40. On the former he made 20%. His selling-

price was \$72, and on the latter he lost 25%, that is, he sold the stock at \$30. He therefore received for all \$102, or 2% more than he paid. 2. \$8000. 3. \$93.88, \$18.78 per annum. 4. \$7000. 5. (a) $9\frac{1}{11}\%$. (b) $5\frac{5}{11}\%$. 6. \$2400. 7. \$512. 8. \$7500.

Exercise 33.—1. (a) 480. (b) 10. 2. (a) 572. (b) 500. 3. Take 12 acres as representing his first farm. Why 12 and not 15? \$8160. 4. 9. 5. 2% of amount of insurance is \$120. Insurance is \$6000. This is $\frac{5}{6}$ of the value of the flour. Flour is therefore worth \$6 per bbl. 6. $12\frac{1}{2}\%$. 7. 3 to 100 is the ratio of the commission to the selling-price of the goods, and 3 to 97 the ratio of the commission to the proceeds. 8. 20 yr., 16 yr., $16\frac{2}{3}$ yr., 12 yr. and 25 yr.

Exercise 34.—1. \$4 per day. 2. 196 lb. one bbl. of flour. 392 lb., 4.59 cts. per lb. \$15.35. 3. No difference. 4. \$192. 5. \$517.76. 6. How many more acres were there in the second and the first fields than in the third field? How many acres must we take away from the whole area (180 A) to have three times the area of the third field? $73\frac{1}{3}$ acres in first field; $63\frac{1}{3}$ in second field, and $43\frac{1}{3}$ in the third field. 7. (a) \$345, \$1200. (b) 57 shares or \$5700; \$2300; \$1955; A made \$300 on his stock and \$300 as his dividend; B made \$255 on his stock and \$255 on his dividend. (c) 25%, D, \$1425; C, \$575. (d) \$2800. (e) \$900, \$1900. (f) \$960; C, \$516. D, \$444. 8. \$5220. 9. \$97.20. 10. $5\frac{1}{2}$ cts. instead of 5 cts. 11. $\$1.10\frac{7}{10}$. 12. \$14790. Without the expenses the proceeds would have been \$14494.20. This is 98% of the price received. 13. The latter by \$2300. 14. \$3. 15. \$1200.

PARTNERSHIP

Exercise 35.—(a) $\frac{2}{3}$; $\frac{2}{3}$ of the rental. (b) $\frac{3}{4}$; $\frac{3}{4}$ of the rental. 2. \$30 and \$15. 3. \$576 and \$288. 4. A, \$2993.87; B, \$2817.76; C, \$2641.65. 5. $\frac{5}{8}$ of a bbl. and $\frac{3}{8}$ of a bbl. 6. (a) \$2979. (b) A, $\frac{9}{11}$; B, $\frac{19}{11}$ and C, $\frac{13}{11}$. (c) A, \$769.50; B, \$850.50, C, \$1061.10. 7. The men who had the horses must

pay the \$96. One pays \$32 and the other \$64. 8. \$1890, \$1260 and \$1050. 9. $\frac{5}{31}$, \$49000. 11. A, \$8.08; B, \$12.12; C, \$26.44; D, \$53.36. 12. A can build $\frac{1}{3}$ of the wall; B, $\frac{1}{4}$ and C, $\frac{1}{7}$ da.; A, \$3; B, \$2.40; C, \$2. The pay is divided according to the actual work done by each.

Exercise 36.—1. \$900, \$1350 and \$1800. 2. B, \$1000; C, \$1500; D, \$2000. 3. A, \$372; B, \$744; C, \$496; D, \$868. 4. A, \$95; B, \$105; C, \$435. 5. A, \$3000; B, \$2800. 6. \$960, \$400. 7. A has made $\frac{4}{11}$ of the total gain. B must have made the balance. A's gain is represented by \$1200 for 1 mo. B's gain must be represented by \$1000 for 1 mo., or \$500 for 2 mo. 8. $\frac{1}{13}$, $\frac{1}{13}$, 33 $\frac{1}{3}$ da. 9. For each horse the man sold, he sold 2 cows and 16 sheep. These would sell at \$214. As he got \$1498 for all, he must have sold 7 horses, 14 cows and 42 sheep. 10. B's gain is \$1771 and his capital \$8855. His capital is therefore 5 times what was gained. This holds true for the remaining members of the company. Hence A's capital was \$6325; C's, \$13915, and D's, \$16445. 11. A's money was in the business 12 mo., B's 10 mo., and C's 9 mo. A made \$4320 B, \$3000 and C, \$2520. 12. A, \$1920; B, \$1150. 13. Each man should receive the half of the difference of receipts and expenses or \$385.50. B has received only \$378. A and C will have to pay B \$7.50 to carry out the agreement. 14. \$8376, \$12300, \$7200. 15. \$6.01 $\frac{1}{3}$. 16. (a) \$12000. (b) $\frac{1}{3}$ or \$3000. (c) \$3000. The manager gets 25% of the whole and also $\frac{1}{3}$ of 75% of the whole.

SQUARE ROOT

Exercise 37.—1. (a) 4, 9, 16, 25, 49, 64, 81, 100, 121, 144, 169, 196. (b) 225, 256, 289, 324, 361, 400, 441, 484, 529, 576, 625. (c) 676, 729, 784, 841, 900, 1600, 2500, 3025, 3600, 4225 and 4900. 2. (a) 1681, 1849, 2209, 2401. (b) 2809, 3249, 3481, 3969. (c) 4624, 5184, 5625 and 6400. 3. (a) 225, 8649, 90000, 1000000. (b) 289, 10000, 160000, 1440000. (c) 529, 20736, 490000 and

2250000. 4. (a) 881, 2525, 5234, 11745. (b) 685, 2989, 4850, 9490. (c) 1402, 1921, 3560, 11450. 5. (a) 225, 656, 3097. (b) 145, 2120, 1995. (c) 520, 2272, 7473. 6. (a) 9, 16, 25, 36 and 49. (b) 64, 81, 100 and 121. (c) 144, 400, 900, 625 and 3600. 7. (a) $\frac{1}{4}$, $\frac{4}{9}$, $\frac{9}{16}$, $\frac{16}{25}$, $\frac{25}{36}$, $\frac{36}{49}$ and $\frac{49}{64}$. (b) $\frac{81}{100}$, $\frac{100}{121}$, $\frac{81}{121}$, $\frac{49}{121}$, $\frac{25}{121}$, $\frac{16}{121}$, $\frac{9}{121}$. (c) $\frac{81}{81}$, $\frac{64}{81}$, $\frac{81}{225}$, $\frac{100}{225}$, $\frac{144}{225}$ and $\frac{1}{64}$. 8. (a) .16, .36, .49, .64, 1.44, 5.29, 20.25 and 243.36. (b) .0441, .1225, .2209, .3969, 2.1904, 15.7609, 52.5625 and 257.5881. (c) .015625, .106276, .169744, .016129, 1.726596, 6.330256 and 6910.098129. 9. (a) 3, 4, 5, 6, 9, 7, 12, 8, 11, 10. (b) 20, 30, 25, 40, 50, 60 and 90. 10. (a) 14, 15, 23. (b) 19, 27, 24. (c) 18, 32, 35. (d) 36, 42, 45. (e) 48, 49, 54. (f) 64, 75 and 72. 11. 80 rods, 24 yd., 96 ft. 12. 408. 13. 75 yd. by 25 yd.

Exercise 38.—1. (a) $\frac{3}{8}$, $\frac{3}{4}$, $\frac{4}{9}$, $\frac{5}{8}$. (b) $\frac{8}{9}$, $\frac{5}{6}$, $\frac{6}{8}$ and $\frac{8}{9}$. 2. 9 in. 3. $2\frac{3}{4}$ ml. 4. (a) .5, .6, .7, .8, .9. (b) 1.2, 1.5, 2.5. The square root of 4.85 lies between 2.2 and 2.3. Its root is too difficult for the children to get exactly. The purpose of interposing such an expression as 4.85 is to place before the pupil a field that has to be thought out by some other method. Have the pupils return to this after finishing Exercise 39. The square root of 12.96 is 3.6. 5. (a) 55, 65, 85. (b) $\frac{12}{13}$, $\frac{6}{13}$, $\frac{3}{7}$. (c) .8, .08 and 1.6. 6. 2000. 7. (a) 84, 105. (b) 132, 52361 is not an exact square. Substitute instead 186624, which has for its square root 432. (c) 252 and 315. 8. 48 ft.

Exercise 39.—An attempt is made in this exercise to develop first the reason for dividing a number whose square root is required into sections of two figures each. This has in too many cases been accepted on faith by the pupil. The second feature of the exercise is for the purpose of reaching a formal method of solving square-root problems. In covering Exercise 39 the teacher should proceed very slowly as the subject matter is not easily grasped. 4. (a) 27, 29, 33, 36 and 37. (b) 38, 41, 43, 46, 49. (c) 51, 53, 55, 57, 58. (d) 59, 63,

65, 66, 82. This question provides an excellent means of arithmetical expression, but this will be largely lost if the teacher does not inquire how each result was reached. For example: How did the pupil conclude that the square root of 3364 is 58 and not 52? 8. Take the work of this question very slowly. If one example is not sufficient, multiply examples. 9. (a) $30^2 + 2 \times 30 \times 8 + 8^2$, $40^2 + 2 \times 40 \times 7 + 7^2$, $50^2 + 2 \times 50 \times 6 + 6^2$. (b) $60^2 + 2 \times 60 \times 3 + 3^2$, $70^2 + 2 \times 70 \times 2 + 2^2$, $80^2 + 2 \times 80 \times 1 + 1^2$. (c) $40^2 + 2 \times 40 \times 9 + 9^2$, $80^2 + 2 \times 80 \times 5 + 5^2$, $90^2 + 2 \times 90 \times 7 + 7^2$. 10. Before beginning to work the examples given under question 10 see that the formal plan of attacking a square root question is understood by the children. If children can appreciate *rearrangement* in the cases of subtraction and division the rearrangement of square root numbers cannot be a difficult matter, provided the teacher makes progress slowly. 11. (a) 27, 32, 42, 63. (b) 93, 69, 75, 41. (c) 51, 95, 84, 47. (d) 59, 76, 83, 93. 12. 40 rd. 13. 240 rd. 14. (a) About 43 in. (b) 42 in. (c) 352 yd. 15. 119, 151, 253, 383, 476, 499, 503, 613 and 739. 16. $\frac{10}{13}$, $\frac{11}{17}$, $\frac{83}{93}$, $\frac{1}{2}$. 17. 1.4, 1.8, 9.3 and 42.8.

Exercise 40.—1. A class exercise. The teacher should take this up so that every member of the class may become familiar with the basis of the problems following. 4. (a) 10 ft. (b) 20 ft. (c) 41 ft. 5. (a) 85 ft. (b) 17 yd. (c) 25 ft. 6. (a) 6 ft. (b) 40 ft. (c) 28 yd. 7. 20 ft. 8. 40 ft. 9. 5 ft. 10. 15 ft. 11. 40 ft. 12. 23.06 ft.

Exercise 41.—1. 40 ft. 2. 100 ml. 3. 180 ml., 420 ml., 720 ml. 4. 60 ft. 5. 17.6 ft., 20.3 ft. 6. A square stick about 17 inches to a side. 7. 49 ft. 8. (a) 72.1 yd. (b) 172.1 yd. (c) 1200 sq. yd. 9. (a) 20 rd. (b) 80 rd. (c) 28.2 rd. 10. 40 rd. 11. Twice the square of a side is 8100. The square of a side is the square of the diagonal. The area is therefore the half of 8100 or 4050 sq. ft. 12. As the triangle given in the text is not true to the description, have the pupils construct a triangle and ascertain from the figure the altitude.

THE SPHERE

Exercise 42.—It is altogether too common to-day to trust to book descriptions of experiments instead of working out the actual experiment before the class. The experiment of this exercise is one easily worked. 1. (a) 616 sq. in. (b) 2464 sq. in. (c) 5544 sq. ft. 2. The two have the same curved surfaces. Have the class compare the dimensions of these two forms. 3. (a) 132 in. (b) 176 in. 4. (a) 55.44 sq. in. (b) 154 sq. in. 5. \$443.52. 6. (a) \$462. (b) \$20124.72. 7. (a) 21:11. (b) 25 to 18. 8. (a) Help the children to see that this is 3 times the area of the surface of the circle. 4158 sq. in. (b) 11550 sq. in. 9. (a) 1386 sq. ft. (b) 2464 sq. ft. 10. (a) 1018 $\frac{1}{2}$. This must be multiplied by 4. (b) 1886 $\frac{1}{2}$ sq. ft., 7546 sq. ft.

Exercise 43.—1. (a) 326 $\frac{2}{3}$ cub. ft. (b) 56 cub. yd. or 1512 cub. ft. 2. 960 cub. ft. 3. 616 sq. in., 616 sq. in., 1437 $\frac{1}{2}$ cub. in. 4. The hemisphere is but half the volume of the sphere. 5. (a) 11498 $\frac{2}{3}$ cub. in. (b) 38808 cub. in. (c) 22458 $\frac{1}{2}$ cub. ft. (d) 179666 $\frac{2}{3}$ cub. yd. 6. \$34650, \$606375. 7. 2744 cub. in., 1437 $\frac{1}{2}$ cub. in., 2156 cub. in. 8. 21 in., 4410 cub. in. 9. (a) 8. (b) 27. (c) 64. (d) 125. (e) 216. 10. 4 lb., 13 $\frac{1}{2}$ lb., 32 lb. 11. (a) 1. (b) 8. (c) 27. (d) 64. (e) 125. 12. 4 lb., 13 $\frac{1}{2}$ lb., 62 $\frac{1}{2}$ lb., 364 $\frac{1}{2}$ lb. 14. 256 lb. 15. (a) 1. (b) 4. (c) 9. (d) 16. (e) 36. 16. \$1260. 17. (a) 1. (b) 4. (c) 9. (d) 16. (e) 25. 18. \$13500. 19. (a) 1. (b) 4. (c) 9. (d) 16. (e) 25. 20. \$54.

Exercise 44.—While the subject of this exercise is comparatively new—the subject matter belongs to the mental furnishing of every intelligent person. The problems of longitude and time—time and longitude, afford excellent means of training as well as valuable information regarding the world we live in. The teacher should consider this exercise as deserving of her time and supervision as any exercise in percentage, interest, etc.

2. (a) At noon-day. Along the meridian line, passing through

M. (b) Midnight. On the meridian, passing through N. (c) P represents the sunrise line. All places on the meridian through P. (d) K is the sunset line. All places on the meridian K have this time. What about the arctic and antarctic regions as to sunrise and sunset? (e) Later. How is this known? Earlier. By how much earlier? (f) The sunrise line appears to be moving westwards and the sunset line the same. (g) 180° ; 12 hours. (h) 1 hour, 1 hour; 1 hour, 3 hours; 1 hour, 3 hours, 4 hours. 8 hours. (i) The equator. (j) The equinoxes.

3. (a) East. (b) The same. 4. (a) 1 o'clock P. M. (b) 11 o'clock A. M. (c) 2 o'clock P. M. (d) 10 o'clock A. M. (e) 3 o'clock P. M. (f) 9 o'clock A. M. 5. (a) 8 minutes to 2 P. M. (b) 2.40 o'clock P. M. (c) 8 o'clock A. M. (d) 8 o'clock P. M. 6. (a) 15° W. (b) 15° E. (c) 60° E. (d) 180° W. or E. (e) $37^\circ 30'$ W. (f) 50° E. 7. (a) 5° . (b) 35° . (c) 25° . (d) 96° . (e) $127^\circ 30'$. (f) 180° . 8. (a) $32'$. (b) One hour. (c) 1 hour, 36 min. (d) 3 hr. (e) 4 hr. 9. (a) 64° . (b) 70° . (c) 62° . (d) 88° . (e) 71° . 10. All that can be done in these questions is to take the school geography—ascertain as nearly as possible the longitude of each place mentioned, and work as in questions 8 and 9. This is practical work. From a geographical point of view it is more important than any of the questions preceding it. 11. This also is for the pupils' own determination. 12. This answer may be readily inferred from the previous work. 13. 10° W. 14. 20° E. 15. (a) West 110° . (b) East 96° . 16. $37^\circ 30'$ West. 17. 15° , 30° , 45° , 105° , 285° and 345° . 18. East 6° . 19. (a) 3 hr. (b) 6 hr. (c) 8 hr. (d) 2 hr. Give additional questions on parallels of length 16000 ml., 12000 ml. and the equator.

REVIEW

Exercise 45.—1. \$99000. 2. \$11552 $\frac{1}{4}$, \$8183 $\frac{1}{2}$, \$14028 $\frac{1}{4}$. 3. \$5000. 4. \$63.90. 5. \$449.67+. 6. \$3118.57 $\frac{1}{2}$. 7. 1350. 8. 5 cts. 9. 33 $\frac{1}{2}$ %, 66 $\frac{1}{2}$ %, 133 $\frac{1}{2}$ %. 10. 33 $\frac{1}{2}$ %, 46 $\frac{1}{2}$ %, 60%, 20%. 11. 40 cts., 32 cts., 27 cts., 42 cts. and 36 cts.

12. \$34500. The lots are now worth $287\frac{1}{2}\%$ of what I paid.
 13. (a) The grocer sold \$6 worth. (a) $85\frac{1}{2}$ cts. (b) $17\frac{1}{2}$ lb.

Exercise 46.—1. (a) $94\frac{1}{4}$ cts. (b) $\$1.37\frac{1}{4}$. 2. Gained \$2490, $12\frac{1}{2}\%$. 3. 30% gain, 30% loss. Received for the two lots the same as I paid. 4. 25% , 50% , $33\frac{1}{3}\%$ and $16\frac{2}{3}\%$. 5. $\$129\frac{1}{2}$ or $41\frac{1}{2}$ cts. per gal. 6. 20% . 7. \$27. Have the pupils found the buying price and then taken $\frac{1}{2}$ of this? Have they found the gain on each cord sold and used this alone? 8. \$1320, \$6600, \$1650, \$17600, \$9900. 9. \$4960, \$1808.33 $\frac{1}{3}$. 10. Total premium paid, \$2475; A, \$3000; B, \$4000; C, \$1500; D, \$2000 and E, \$1500; A, \$60000; B, \$80000; C, \$30000; D, \$40000; E, \$30000. If the building were entirely consumed, or if damaged over \$240000 the companies would pay only the risks each carried, viz.: \$60000, \$80000; \$30000; \$40000, and \$30000. 11. \$93.75. 12. \$13. (a) \$1722. (b) \$978.

Exercise 47.—1. \$144, \$31.20 and \$70.81. 2. \$78.97 $\frac{1}{2}$. 3. \$9375, \$9281.25. 4. 15 mills. 5. \$29.75. 6. 3 cts. on the dollar. 7. On what sum do I pay taxes? What are my taxes? Rate 2 cts. on the dollar. 8. \$7.40. 9. \$6.50, \$6.68. 10. \$240. 11. \$643.50. 12. $43\frac{1}{4}\%$. 13. $3\frac{1}{2}\%$.

Exercise 48.—1. (a) \$225. (b) \$109.01 $\frac{1}{4}$. Total commission, \$334.01 $\frac{1}{4}$. 2. (a) \$92.50. (b) \$328.10. Total commission, \$420.60. 3. 2% . 4. 2% . 5. 300 acres. 6. \$8265.60. 7. \$1260. 8. Gained \$40. 9. \$3500, $71\frac{2}{3}\%$. 10. $56\frac{1}{2}\%$. 11. Have any noticed that $4\frac{1}{2}$ gal. sell for $4\frac{1}{2}$ dollars? 20% . 12. \$245. He does not make anything on the agent's charges. 13. $48\frac{1}{2}$ cts.

Exercise 49.—1. \$480, \$560. 2. 15% . 3. \$72. 4. \$7.40. 5. 60% . 6. \$48. 7. (a) \$5. (b) \$4. 8. (a) \$3400. (b) \$10125. (c) \$13440. 9. (a) 90. (b) 40. 10. \$15 and \$25, \$14415 and \$18025. 11. (a) \$630. (b) \$960. 12. (a) \$960. (b) \$720. 13. \$7200, \$7240.

Exercise 50.—1. (a) \$54. (b) \$16. (c) \$14.60. 2. (a) \$264. (b) \$367.50. (c) \$198. 3. (a) \$840. (b) \$1100.80.



MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc

1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

(c) \$1630.20. 4. (a) \$1388.80. (b) \$1413.60. (c) \$1560. 5. \$6760. 6. (a) \$.99. (b) \$1.58. (c) \$8.37½. 7. (a) 5%. (b) 3%. (c) 4%. 8. 3%. 9. 4 yr. 10. (a) ½. (b) ⅓. (c) ⅔. 11. \$841.20. 12. \$1263.80. 13. This note was discounted June 15th at 10%. Find the proceeds. \$2394.71.

Exercise 51.—1. A, \$400, B, \$450. 2. A, \$1500, B, \$2000. 3. A, \$8000, B, \$4000. 4. A, \$250, B, \$400. 5. Brown pays \$21.60, Smith \$24 and Jones \$48. 6. 21 + ft. 7. 226 28 sq. ft. 8. 480 rd. 9. 245, 387, 623. 10. 30.8 ft. 11. (a) 1½ ml. (b) 120 rd. 12. 600 rd. This question may be readily inferred from question 11. 13. 69.4. 14. 160 persons. 15. 1 hr. 34 min. 40 sec. The time is faster than Greenwich time. 17. \$235.62. 18. 4851 cub. ft.

Exercise 52.—1. How much ground does the larger wheel cover at each revolution? 2256 times. 2. 56 hr. 3. \$12.80. 4. 46656. 5. (a) $601\frac{9}{16}$ gal. (b) 11550 gal. 6. 1801800 sq. ft. or $41\frac{4}{11}$ ac. 7. £174. 8. 7. 9. £15 15s. 10. ¼. 11. 4 min. 12. 567342. 13. 12 min. 14. How will the trimming be cut? $20\frac{1}{4}$ yd. 15. $\frac{213}{88}$. 16. 13 ml. 151 rd. 2 yd. 1 ft. 10 in. 17. 194184 in. 18. 1 pk. 19. 1008. 20. $51\frac{1}{2}$ ft. 21. 588 yd., 45 yd. more. 22. What is the slant-height of this tent? $20\frac{2}{3}$ sq. yd. 23. \$57. 24. 54 double rolls are required. \$19.44. 25. $307\frac{1}{2}$ cords, \$1614.37½. 26. 331776 bricks of value \$2903.04. 27. 7002 ft. costing \$156.49 +. 28. \$620. 29. About 840 acres. B D is $2\frac{3}{4}$ inches; the perpendicular from A is $1\frac{1}{8}$ inches, and the perpendicular from C, $\frac{5}{16}$ inches. 30. 1760 acres. 31. 7 ft. 32. 120 pt. or 60 qt. or 15 gal. or $7\frac{1}{2}$ pk. or $1\frac{1}{2}$ bu. 33. The difference between \$1.26 a yd. and \$1.05 a yd. is 21 cts. How much must we take from 21 so that the loss and the gain will be the same amount? How must we divide the difference so that we may get either the loss or the gain equal to the loss? What does the cloth then cost per yd.? \$1.10 per yd. \$30. 34. 1834 sq. ft. 35. \$3460.

BOOK II—PART III

ADDITION, SUBTRACTION, MULTIPLICATION AND
DIVISION

Exercise 1.—Nine billions, ninety-nine millions, ninety thousand and nine; 102008001. 3. (a) 1019536. (b) 871726. (c) 800803. (d) 940650. 4. (a) 638465. (b) 123456. (c) 987543. (d) 666666. 5. (a) 5742. (b) 4009. (c) 6538. (d) 7042. (e) 5576. (f) 5555. In lines 4164, 3351, 4235, 3871, 3955, 3669, 2882, 4302 and 4033. Totals 34462. 6. (a) 117996. (b) 1140006. (c) 241841. (d) 5700190. (e) 38159. (f) 20092. 7. (a) 798979. (b) 1070707. (c) 372112, 1068047, 1284845 and 749597. 8. (a) 576 and 389. (b) 4001 and 3897. 9. 4382805. 10. The ways are: By casting out the nines and by multiplying 2171 by 398 and 398 by 2171. There is also a third way, viz.—divide the product by either the multiplier or the multiplicand. 11. $476\frac{579}{10514}$. 12. 14789. 13. 815. 14. 7. 15. (a) 1008. (b) 1009. 16. 1861, 2203. 17. 145 times. 18. 794997. 19. Change 9995 to 9998, 563087360, 7040000 and 2543129600. 20. 694596. 21. \$1703.70. 22. 20 T. 23. \$2321.40. 24. \$1186.25. How much at \$3.25 per working day?

Exercise 2.—(a) 81576. (b) 767340. 2. (a) 795. Rem. 45. (b) 16645. Rem. 21. 4. (a) $2^2 \times 3^3 \times 11$, $3^3 \times 7 \times 29$, $3^2 \times 5^3 \times 7$, $2^3 \times 5^3 \times 13$. (b) $2^3 \times 3^2 \times 5^2 \times 7$, $7 \times 11 \times 71$, $2^3 \times 5 \times 7^2 \times 11$, $2^2 \times 3^2 \times 11^2$. 5. (a) 2520. (b) 132000. 7. (a) 18. (b) 102. 8. (a) 401. (b) 311. 9. \$21.11. 10. One second. 14. (a) 1440. (b) 136136. 15. (a) 13860. (b) 10920. 17. 480 times besides the first time. 18. \$10. 19. 12s. 6d. 20. 42. 21. 72. 22. This cannot be found.

Read question as follows: Find the least number of which the given numbers are multiples. The number is 3081540. 1716.

VULGAR FRACTIONS

Exercise 3.—5. (a) $\frac{1}{24}$, $\frac{2}{24}$, $\frac{1}{24}$, $\frac{1}{24}$, $\frac{1}{24}$ and $\frac{1}{24}$. (b) $\frac{4}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{20}{72}$, $\frac{2}{72}$ and $\frac{4}{72}$. **6.** $\frac{7}{3}$ and $\frac{3}{4}$ and $\frac{3}{4}$ and $\frac{9}{16}$, $\frac{3}{4}$ and $\frac{5}{9}$, $\frac{3}{13}$ and $\frac{2}{13}$, $\frac{1}{3}$ and $\frac{1}{2}$, $\frac{2}{5}$ and $\frac{3}{4}$. **7.** $\frac{103}{108}$ and $\frac{53}{72}$, $\frac{6}{13}$ and $\frac{35}{43}$, $\frac{6}{13}$ and $\frac{3}{8}$. **8.** (a) $\frac{2}{5}$, $\frac{8}{15}$, $\frac{4}{5}$. (b) $\frac{2}{30}$, $\frac{11}{12}$, $\frac{7}{8}$ and $\frac{3}{4}$. (c) $\frac{4}{5}$, $\frac{1}{24}$, $\frac{2}{3}$ and $\frac{5}{12}$. *Notc.—In question 8 the greatest fraction is placed first.* **11.** 2, $4\frac{2}{7}$, $1\frac{5}{24}$, $1\frac{17}{8}$, $13\frac{5}{9}$, $1\frac{2}{7}$, $3\frac{3}{10}$, 8, 5 and $9\frac{1}{2}$. **12.** $\frac{4}{12}$, $\frac{3}{10}$, $\frac{8}{7}$, $\frac{9}{9}$, $\frac{10}{4}$ and $\frac{2}{5}$. **13.** (a) $2\frac{2}{3}\frac{3}{10}$. (b) $5\frac{4}{13}\frac{9}{10}$. (c) $3\frac{4}{10}$. (d) $48\frac{5}{12}$. **14.** (a) $\frac{8}{108}$. (b) $\frac{2}{15}$. (c) $1\frac{2}{3}$. (d) $2\frac{4}{10}$. **15.** (a) $4\frac{2}{5}$. (b) $13\frac{3}{5}$. **16.** (a) $\frac{9}{20}$. (b) $\frac{1}{10}$. (c) $\frac{1}{10}$. (d) $\frac{2}{9}$. (e) $\frac{1}{4}$. **18.** (a) $4\frac{1}{2}$, 6, $10\frac{1}{2}$ and $10\frac{1}{2}$. (b) 6, 6, 8 and 9. **19.** (a) $\frac{2}{7}$. (b) $\frac{2}{3}$. **20.** (a) $\frac{4}{15}$, $\frac{1}{10}$, $\frac{4}{15}$, $\frac{1}{15}$, $\frac{4}{15}$. (b) $13\frac{1}{2}$, 12, $10\frac{1}{2}$, $11\frac{1}{2}$. (c) $\frac{3}{4}$, $\frac{2}{12}$, $1\frac{1}{3}$, $\frac{8}{12}$. **23.** Several methods of showing why the divisor in the case of fractional division is inverted have been given. This method connects division of fractions with division of whole numbers. Its consideration will serve to prevent the pupils from falling into mechanical ways of working. **24.** (a) 1. (b) 3. **25.** (a) $\frac{3}{5}$, $\frac{5}{9}$, $\frac{1}{2}$. (b) 2, 2, $\frac{1}{2}$. Have the pupils observed the short method of obtaining the above results?

REVIEW WORK

Exercise 4.—1. \$22.40 $\frac{3}{4}$. **2.** 57114. **3.** 3248208000.
4. Sulphur 225 lb., charcoal 337 $\frac{1}{2}$ lb., saltpetre 1687 $\frac{1}{2}$ lb.
5. 270 women. **6.** 44 ft. **7.** $\frac{2}{100}$. **8.** \$31. The second part of this question is for the purpose of encouraging a close habit of reading a question before attempting to solve it.
9. 669090909 $\frac{1}{11}$ ml. per hr. **10.** 3 revolutions. **11.** 96 cts.
12. 1 $\frac{1}{4}$ da. **13.** 92 boxes of each size. **14.** 12 $\frac{1}{2}$ ml. per hr.
15. Take the square root of 60025. If the pupils hesitate ask them what relation the number of members in the company

bears to the number of dollars subscribed. If we knew the number of members in the company, how could we obtain the total amount subscribed? What is the relation, therefore, of the two factors which give as a product 60025? Answer 245 members. 16. In $51\frac{3}{4}$ da., or on Aug. 21st. 6.17 $\frac{1}{4}$ P. M. One clock points to 25 $\frac{5}{7}$ min. after 5 P. M. and the other to 25 $\frac{5}{7}$ min. after 6 P. M. 17. 2400 ft. 18. 5 ml. an hr. 19. \$609.84. 20. \$2488.32, 36 da. Will the house take longer in the building at the higher price? Why? 21. 30 min. 22. \$5.93. 23. 69 cts. 24. 1 hr. When will the column be said to have marched *through* the street?

Exercise 5.—1. What distance is the same as 41 times the length of the rod? 74 yd. 2 ft. 2. \$51480. 3. \$242.45. 4. Add to this question—if $\frac{17}{10}$ of the farm is valued at \$1377. Ans. \$729. 5. $121\frac{3}{4}$. 6. \$1. 7. 183120 min., or $\frac{763}{210}$ yr. 8. 800 bbl. at \$5.75 per bbl. 9. 2076 $\frac{1}{2}$ ac. 10. 400 bbl. 11. \$45. 12. 55 cts. for the oats and 90 cts. for wheat. What did the wheat cost more than it would have cost were it 19 bu. of oats? 13. 555 acres, \$6. 14. 84 cts. 15. \$1.60 per gal. 16. 98 men. 17. Gained \$325. 18. \$561.92. Av. pr. per lb. 16.88 cts. 19. The first should get \$499.20, the second \$436.80, the third \$388.80, and the fourth \$350. 20. 5 $\frac{3}{4}$ cts. 21. How much would I have gained had I not had to pay \$1.75 extra for their keep? 100 head. 22. 734 acres. 23. Gained \$8000. 24. 70 head of each. 25. \$7.66 $\frac{2}{3}$. 26. \$3.50. 27. 18 yr. 28. The former by $\frac{1}{4}$ of a ton. 29. He will gain \$871. 30. 36 cts. per bu. 31. He gained \$6120. 32. \$5680.

DECIMAL FRACTIONS

Exercise 6.—1. Nine thousand two hundred and seven millionths; twenty-four hundredths of thousandths; one, and three millions one thousand and seventeen tenths of millionths. 2. 203408.0013, 87001.34 and .000925. 3. (a) 45.8841. (b) 1004.45276. (c) 52.5985 ml. 4. (a) 65.0707. (b) 3.78819. (c) 494.66057. 5. (a) .19608. (b) 14530.625. 6. \$5159.47651. 7. (a) \$875. (b) \$275. (c) \$27.60. This question is only a

test of the pupils' ability to move the decimal point when multiplying by tens. 8. .549. 9. (a) .0016. (b) 100.369+. (c) 28920. (d) .00002. 10. (a) $\frac{5}{8}$. (b) $\frac{16}{25}$. (c) $\frac{9}{40}$. 11. (a) .46484375. (b) 9.1875. (c) 4.48. 12. (a) .46. (b) .38. (c) .583. 14. (a) $\frac{1}{3}$, $\frac{2}{3}$, $\frac{4}{11}$, $\frac{7}{11}$, $\frac{9}{11}$ and $\frac{14}{15}$. (b) $\frac{24}{37}$, $\frac{4}{37}$, $\frac{23}{37}$, $\frac{8}{37}$ and $\frac{19}{37}$. 16. (a) $\frac{11}{15}$, $\frac{28}{35}$ and $\frac{1}{30}$. (b) $\frac{5}{4}$, $\frac{1066}{1995}$, $\frac{602}{1995}$ and $\frac{381}{1995}$. 17. 2.65909. 18. (a) \$22.50. (b) \$31. 19. (a) \$31.20. (b) \$43.45. (c) \$113.36. (d) \$94.84. (e) \$93.53. (f) \$2997.82. (g) \$115.31. (h) \$4.51. (i) \$274.52. (j) \$146.73. (k) \$3088.75. (l) \$194.06. (m) \$19.60.

WEIGHTS AND MEASURES

Exercise 7.—1. (a) \$33.48. (b) \$230.23. (c) \$128.32. (d) \$115.92. Total, \$507.95. 2. (a) 495 in., 792 in. (b) 1050 links. (c) 4356 sq. ft. 3. (a) \$6.52 $\frac{1}{2}$. (b) \$3.80. (c) \$14.06 $\frac{1}{4}$. Total, \$24.39. 4. (a) 111 pt. (b) 26 bu. 2 pk. 2 qt. 5. (a) 556800 oz. (b) 1 T. 17 cwt. 50 lb. 6. (a) \$1496.82 $\frac{1}{2}$. (b) \$17.52. 7. (a) 640. (b) 640. (c) 4840. (d) 160. (e) 43560. The purpose of question 7 is to test whether the pupils have these facts in usable form. 8. (a) 128. (b) 153 cub. ft. 9. (a) 8. (b) 36. (c) 54. (d) 27. 11. 2304, 2308, 2312 and each successive fourth year until 2396. Does 2400 belong to the 23d or to the 24th century? 12. (a) 9790 min. (b) 9836 hr. 13. Gained \$33. 14. \$5.18 $\frac{3}{4}$. 15. (a) 55 T. 16 cwt. 92 lb. 4 oz. (b) 30 ml. 57 rd. 5 yd. 9 in. 16. (a) 16 cub. yd., 41 cub. in. (b) 3rd, 2 yd. 1 ft. 8 in. 17. (a) \$1.74. (b) \$11.96. (c) \$1081. 18. 3 $\frac{1}{2}$ d. 19. Note that the question says—"he saves $\frac{1}{3}$ of this"—meaning $\frac{1}{3}$ of his weekly earnings. 300 wk. 20. \$69496.88. 21. 2 $\frac{1}{2}$ acres. 22. 10.09 ml.

MENSURATION OF SURFACES

Exercise 8.—1. (a) 4275 sq. ft. or 475 sq. yd. (b) 5454.9 sq. ft. or 606.1 sq. yd. (c) 1125 sq. ft. or 125 sq. yd. 2. (a) 390 sq. yd. (b) 166 $\frac{2}{3}$ sq. yd. (c) 257.906 sq. yd. 3. (a) Floor 14 $\frac{2}{3}$ sq. yd., walls 259 $\frac{2}{3}$, ceiling 146 $\frac{2}{3}$. (b) Floor and ceiling

each 36.72 sq. yd., walls 87.84 sq. yd. 4. (a) 27 yd. (b) 20 yd. 5. (a) \$603.75. (b) \$3828. 6. 48 ft. 7. (a) \$39.96. (b) \$66.60. (c) \$6.66. 8. Cost of plastering room *a* \$273.60. Cost of plastering room *b* \$364.80. 9. (a) 1728 acres. (b) 691.2 acres. (c) $72\frac{8}{11}$ acres. (d) 200 acres. (e) $\frac{7}{12}$ of a sq. ml. (f) $4\frac{8}{9}$ sq. ml. (g) 6 acres. 10. (a) 432 sq. ft. (b) 372 sq. ft. 11. (a) 54 sq. ft. (b) 102 sq. yd. (c) 486 sq. ft. 12. \$56700. 13. \$1215. 14. 147 sq. ft. 15. (a) $2828\frac{4}{5}$ sq. in. (b) $176\frac{1}{4}$ sq. ft. (c) 2464 sq. yd. 16. (a) 3174 sq. in. (b) 217 sq. ft. (c) End of prism a right-angled triangle. 84 sq. in. 17. (a) 1680 sq. ft. or $186\frac{2}{3}$ sq. yd. (b) 1683 sq. ft. or 187 sq. yd. 18. (a) 4774 sq. ft. or $530\frac{1}{2}$ sq. yd. (b) 7854 sq. yd. 19. (a) 1236 ft. (b) $694\frac{2}{7}$ ft. (c) 660 ft. 20. (a) 168 sq. ft. (b) 165 sq. ft. 21. (a) Take the dimensions of the base as 10 by 10 ft. 460 sq. ft. (b) Take the dimensions of the base of this pyramid as 36 ft. and 18 ft. Area is 198 sq. yd. 22. (a) 198 sq. ft. (b) 1100 sq. rd. or $6\frac{2}{3}$ acres. 23. (a) 352 sq. ft. (b) 31350 sq. ft. (c) 9240 sq. yd. 24. (a) $239\frac{1}{2}$ sq. ft. (b) 2024 sq. ft. 25. This question may, perhaps, be too difficult. It, however, contains no new principle. Solution: (a) The area of the larger circle is to the area of the smaller as 3 is to 2. The circumference of the larger circle is therefore to the circumference of the smaller as $\sqrt{3}$ is to the $\sqrt{2}$, or as 1.732 is to 1.414. The circumference of the larger circle is therefore $\frac{1}{4}\frac{3}{4}\frac{2}{4}\times 2\frac{2}{7}\times 30$ ft., and the circumference of the smaller circle is $\frac{2}{7}\times 30$ ft., a difference of 21 + ft. Solution: (b) Area of larger circle $\frac{3}{2}$ of $\frac{2}{7}\times 15\times 15$, or $14\frac{2}{7}$ sq. ft. Area of any circle is $\frac{2}{7}$ times square of radius. The square root of $\frac{7}{2}\times 14\frac{2}{7}$ is equal to the radius of the larger circle = 18.37 ft. The diameter = 36.74 ft. and the circumference 115.47 ft. Circumference of smaller circle is equal to 94.28 ft. Difference is 21.19 + ft. 26. 10000 tiles, \$20333 $\frac{1}{3}$. 27. \$140. 28. The cover of the cistern is also lined. 483 $\frac{3}{8}$ sq. ft., 3867 lb., \$278.42 $\frac{2}{7}$. 29. 2551 $\frac{3}{4}$ sq. ft., 242 $\frac{3}{4}$ sq. ft. 30. (a) 1:4. (b) 1:9. (c) 1:4. (d) 9:1. 31. \$6000. 32. 1:2, 1:3 and 1:5. 33. \$130. 34. \$380,

\$855, \$71.25. 35. (a) 34650 sq. in. (b) 138600 sq. ft. (c) 138600 sq. yd. 36. (a) A hemisphere has 3 times the area of its circular face. 1848 sq. ft. (b) $1039\frac{1}{2}$ sq. yd. 37. 14 inches. As there is no breaking of tiles the question here is what is the greatest measure that will measure 33 ft. 10 in. and $24\frac{1}{2}$ ft.? 38. \$4500. 39. 660 trees. 40. 6912 sq. ml. 41. $10\frac{1}{2}$ ft. 42. 250 shingles, each 4 inches wide, make a bunch. Four bunches laid 4 inches to the weather cover 100 sq. ft. Will 4 bunches, placed 6 inches to the weather cover 100 sq. ft.? 15840 shingles.

MEASUREMENT OF SOLIDS

Exercise 9.—1. 128 cub. ft., 1 cord. 2. (a) $175\frac{2}{3}$ cd. (b) 66.7 cd. (c) $17\frac{3}{4}$ cd. (d) $390\frac{1}{2}$ cd. 3. (a) \$6612.89. (b) \$6656.25. 4. \$15233.40. 5. \$123.89 $\frac{1}{2}$. 6. 12420 cd. 7. 51192 bricks. 8. (a) \$616. (b) The wall is around the garden. \$87.68. 9. (a) \$54.88. (b) \$20.80. (c) \$469 $\frac{1}{2}$. 10. (a) $9\frac{1}{2}$ ft. (b) 373248. (c) 10 ft. 5 in. 11. 3000 gal. 12. 4 ft. 13. 120 cub. ft. 14. 576 ft. Area of column 13824 $\frac{1}{2}$ sq. in. 15. Solidity of bricks made from a cub. yd. of clay 46575 cub. in. Solidity of a cub. yd. = 46656. Loss, 81 cub. in. Shrinkage $81 \div 46656$ or $\frac{1}{576}$. 16. 21780 tons. 17. 199.42 gal., 1 $\frac{1}{4}$ lbs. 18. $\frac{1}{9}$ of a cub. ft. of ice is the same weight as a cub. ft. of water, or a cub. ft. of ice weighs 900 ozs. 27565312 $\frac{1}{2}$ lb. or 13782 $\frac{3}{4}$ T. 19. 12672000 cub. ft., 396000 T. 20. 30 min. 21. (a) 24. (b) 24. (c) 21 $\frac{1}{2}$. (d) 60. (e) 24. (f) 8. (g) 21 $\frac{1}{2}$. (h) 540. 22. (a) \$118.80. (b) \$334.12 $\frac{1}{2}$. (c) Read instead of 15 ft.—15 in. wide—\$891. (d) \$237.60. 23. (a) Sidewalk is laid on 4 scantlings. 31680 ft. (b) 20790 ft. (c) 4840 ft. 24. 12 ft. 25. (a) $500\frac{1}{2}$ cub. ft. (b) $192\frac{1}{2}$. (c) 11498 $\frac{3}{4}$. 26. $\frac{3}{4}$ of the cylinder, $\frac{1}{11}$ of the cube. 27. 10 lb., 33 $\frac{3}{4}$ lb., 428 $\frac{3}{4}$ lb. 28. \$1.62, \$12.96, \$60. 29. How many sides are lined? What is the area of a side? What are the dimensions of the cistern? 343 cub. ft. 30. 1650 yd. per hr. 31. The spheres are to each other as 3, 5, 6 and 4. Their

volumes are as 3^3 , 5^3 , 6^3 and 4^3 . Now $6^3 = 216$ and $3^3 + 5^3 + 4^3$ equals 216.

AVERAGES

Exercise 10.—1. (a) 145. (b) 22. (c) $6\frac{1}{10}$. (d) 23.9554.
 2. (a) 774.4. (b) 1765.4. (c) 1670.1. (d) 1403.3. 3. (a) $\$104.41\frac{1}{2}$. (b) $\$99.72\frac{1}{2}$. (c) $\$101.28\frac{1}{2}$. (d) $\$107.43\frac{1}{2}$. (e) $\$114.96\frac{1}{2}$. 4. $\$447.79\frac{2}{3}$. 5. 195 lb. $7\frac{1}{2}$ oz. 6. $\$54.63\frac{3}{4}$. 7. 1 T., $51\frac{1}{2}$ lb. 8. (a) $\$499.89$. (b) $\$3.08+$. 9. 229.
 10. 21.2 lb. 11. $69\frac{2}{3}$ cts. 12. $6\frac{6}{13}$ cts. 13. $57\frac{9}{10}$ cts. 14. 145 lb. 15. $35\frac{1}{2}$. 16. $\$5\frac{5}{7}$ per ac. 17. $\$10.80$. 18. 14.583.
 19. $\$7.05$. 20. 51° . 21. (a) 76 ft. (b) 4 ft. (c) 8 ft. $1\frac{1}{2}$ in. (d) 40 ml. an hour. 22. 1669. 23. $\$6$. 24. $\$60$.

WORK

Exercise 11.—1. $11\frac{1}{2}$ da. 2. $14\frac{1}{3}$ da. 3. $3\frac{2}{7}$ da. A, $\$7.91$, B, $\$5.94$, C, $\$4.75$. 4. 10 da. 5. A in 50 da. and B in $21\frac{3}{4}$ da. 6. If the well is emptied in 2 hours it must have held 21600 gal. To empty this the smaller pump would take $21600 \div 80$ min. or 270 min. As the water sinks at the rate of an inch per minute, the well must be 270 inches, or 22 ft. 6 in. deep. 3 hr. 36 min. 7. What part of the work must the men do in the remaining 6 days? What part did 15 men do in the 24 days? How many times 15 men will then be required? 45 more men must be hired. 8. 1 ml. 9. What is the relation of the two speeds? What must be the relation then as to time? 3 hr. 44 min. 10. 7.12 P. M. 11. $\frac{1}{4}$, 2940 gal. (The cistern will hold how many gallons?) 2660 gal. 12. How many minutes should one clock lose while the other is going from 10 o'clock A. M. to 9 o'clock P. M.? $11\frac{1}{3}$ min. 13. Which was moving the faster, the man or the wagon? How far was the wagon ahead when he saw it? How far was he ahead when the wagon was just out of sight? How long did it take him to get to these two points? How far did the wagon go in that time? How far did he go? $3\frac{1}{2}$ ml. per hr. 14. 9.15 A. M. 15. $21\frac{1}{2}$ hr. 16. What start in time have the hares had? How many miles start is this? How long would the hound, who goes 10

ml. an hour, take to gain this distance? Is the course long enough for him to gain it? How many miles has the hound gained when the hares get into cover? In what time did he gain this? Solution: The hares have a start of 20 min. and reach their destination 8 min. before the speediest hound. They have therefore required but 12 minutes' start to get to cover at the same time as the hound. In 12 minutes the hares would have gone $1\frac{1}{2}$ ml. As the hound gains 1 ml. in going 10 he would gain $1\frac{1}{2}$ ml. in going 18 ml., the distance required.

17. 1 ml. 18. At 1.30 P. M. 19. $9\frac{1}{8}$ ml. 20. 3 hr.
 21. While A is going 1760 yd., B can go but 1740 yd. While B is going 1740 yd., C can go but $1702\frac{1}{4}$ yd. A can therefore give C $57\frac{5}{4}$ yd. 22. $1\frac{1}{2}$ ml. in circumference or 2520 ft. in diameter. 23. 36 ml. an hr. $94\frac{1}{2}$ yd. 24. 119 ml. 25. 30 ml.

PROPORTIONAL PARTS AND PARTNERSHIP

Exercise 12.—1. If the balance is paid in the same proportion A should own $\frac{2}{3}$, B $\frac{1}{3}$ and C $\frac{1}{6}$ of the lot. 2. \$540 and \$720. 3. A, \$155, B, \$310, C, \$930. 4. \$5333 $\frac{1}{3}$ and \$6666 $\frac{2}{3}$. 5. 741 bu. wheat and 209 bu. peas or 44460 lb. wheat and 12540 lb. peas. 6. 40 turkeys and 20 geese. 7. 15 lb. for the goose and 9 lb. for the turkey. 8. \$14583.50, \$6869.50, \$1843 and \$1704. 9. A should have paid \$64.40, B \$80.50 and C \$96.60. B must therefore pay A \$11.20 and C \$8.55. 10. £503 8s., £587 6s. and £671 4s. 11. \$1650. 12. A, \$1750, B, \$2250. 13. A, $\$116\frac{7}{8}$, B, $\$153\frac{9}{8}$. 14. A, \$316.27, B, \$1087.95, C, \$695.78. 15. \$900. 16. A, \$1440, B, \$810. 17. A, \$126, B, \$108 and C, \$105. 18. \$1800, \$1620 and \$1400.

REVIEW

Exercise 13.—1. 1s. 6d. 2. \$153.69, \$256.15. 3. £11 1s. 8d. 4. \$5.37, \$12.53. 5. \$2106. 6. 108 men. 7. 15 men, 40 men, 24 men. 8. 6, $10\frac{1}{2}$ persons. Ask class to examine the last of these answers. 9. \$252.50. 10. £26 5s. 11. $\frac{2}{3}$. 12. (a) 12.5 cts. (b) \$33.75 $\frac{1}{4}$. 13. 33 cts. 14. If an ounce is worth \$.5625, a lb. is worth \$2.25, and a cwt. \$225.

The cost of .15625 cwt. is \$35.15625 or \$35.16. 15. \$381.15.
 16. (a) $366\frac{3}{4}$ ml. (b) $366\frac{3}{4}$ ml. 17. $1\frac{2}{3}$ hr. or 1 hr. and $57\frac{1}{2}$ min.
 18. (a) \$2000. (b) \$1000. 19. \$1.20 and 85 cts.
 20. $1\frac{2}{3}$ bu. 21. 8 thieves. 22. 3 doz. 23. 2 da. 24. 20.
 25. He sold the milk for \$11. He got the same rate for the water. He therefore received $\frac{5}{4}$ of \$11 or \$13.75 for his supply. A gain of \$3.75. 26. If the first 10 miles' carriage cost 30 cts., what would the second 10 miles' carriage cost? 15 miles' carriage at the reduced rate is the same as how many miles carriage at the standard rate? If the first ten miles cost as much as the next 15 miles, and the first 25 miles cost 30 cts., what was the carriage of the first 10 mls.? What of the succeeding 15 mls.? What weight was carried 10 miles for 15 ct.? What at the same rate would the carriage of 9 lbs. be? If 12 lbs. can be carried 15 mls. for 15 ct., how far can 12 lb. be carried for $8\frac{3}{4}$ cts. at the same rate? How far can 9 lbs. be carried for $8\frac{3}{4}$ cts.? Total distance which 9 lbs. can be carried for 20 cts. = $21\frac{3}{4}$ ml. 27. 21 wk. Solution: 7 can live on \$700 for 28 wk. 7 can live on \$675 for 27 wk. 9 can live on \$675 for 21 wk.
 28. 38 acres. 29. \$1.80. 30. \$12.87.

BILLS AND ACCOUNTS

Exercise 14.—1. In this and in subsequent questions there are three features at least to be made emphatic—Is the form correct? Are the results accurate? Has the work been done expeditiously? Total amount of bill \$389.44. Balance paid February 2d, \$315.59. 2. Has the teacher done anything to encourage the getting of products mentally by changing the factors to more usable factors? For example: $8\frac{1}{2}$ lb. dried apples at 12 ct. brings the same result as 17 lb. at 6 ct.; $7\frac{3}{4}$ lb. butter at 28 cts., the same result as 31 lb. at 7 ct. The latter forms are more easily worked. Total, \$32.64. 3. Each case contained $1\frac{1}{2}$ doz. cans. Total, \$175.37. Balance paid April 2d, \$160.12. 4. Total, \$155.76. Balance paid May 2d, \$130.75. 5. Total debits, \$39.97. Total credits, \$23.41. Cash, \$16.56. 8. Total

cost, \$1080.88575, or \$1080.89. Balance due after August 19th, \$945.14. Balance due after Sept. 13th, \$917.54. Balance due and paid Oct. 6th, \$917.54. 9. (a) \$1141.72. (b) The cash deposited was taken from the cash received, that is, from what was on hand. \$952.70 on hand and \$805.55 on deposit. (c) \$1253.55 on hand and \$1586.30 on deposit. 10. A gain of \$638.45.

SQUARE ROOT

Exercise 15.—2. 625, 1225, 4225, 5625, 7225, 42025.

Note.—The square of any number ending in 5 may be ascertained quickly by finding the product of the part of the number before the 5, and the number immediately above this number, affixing 25 to the result, *c. g.*, $25 \times 25 = 2 \times 3$ or 625, $95 \times 95 = 9 \times 10$ or 9025, $155 \times 155 = 15 \times 16$ or 24025, etc. This is but a device, but the pupils may now use the best devices for shortening work already rendered mechanical.

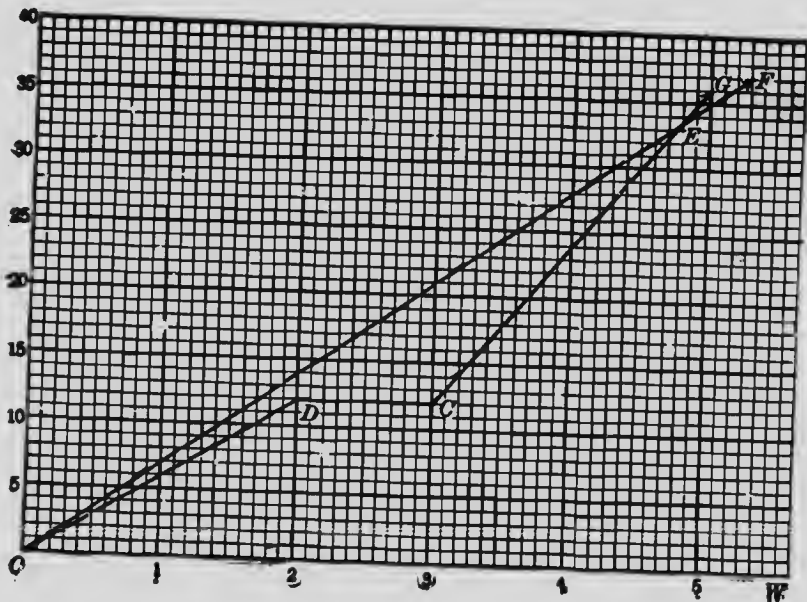
3. $\frac{625}{4}$, $\frac{2209}{9}$, $\frac{8836}{25}$, $\frac{24025}{36}$ and $\frac{370881}{100}$ or 3708.81.

4. 3.24, 58.5225, 9, 7225, 232.654009 and .009025.

5. (a) 96, 105, 110. (b) 84, 120, 127. (c) 72, 77, 102. (d) 99, 91, 225. 6. (a) 91, 143, 180. (b) 99, 153, 240. (c) 77, 228, 493. (d) 72, 156, 547. 7. (a) 3, 3. (b) 4, 4. (c) 5, 7. 9. (a) $\frac{12}{13}$, $\frac{25}{7}$. (b) $\frac{14}{15}$, $\frac{8}{9}$. (c) $\frac{12}{13}$, $\frac{7}{8}$. (d) $\frac{35}{7}$ and $\frac{14}{15}$. 11. (a) 6.8, 7.5. (b) 7.45, 9.23. (c) .9, .29. (d) 73.6, 85.35. 12. 24 and 37, 48 and 51, 56 and 73. 14. (a) 21 ft. (b) 36 ft. (c) 67.8 ft. 15. 47 and \$47. 16. 31 men. 17. 12 in. by 12 in. 18. (a) 44 yd. by 44 yd. (b) 55 yd. by 55 yd. (c) $5\frac{1}{2}$ yd. 19. 72 rods by 96 rods. 20. 33 yd. by 11 yd. 21. 656.04 rods. 22. 1184.16 yd. 23. $137\frac{1}{2}$ yd. 24. 90 rods. 25. 15 ft. 26. (a) 2738 sq. ft. (b) 5832 sq. ft. (c) 62.9 yd. (d) 96 rd. 27. A gal. weighs 10 lb. 1000 gal. weighs 10000 lb. A cub. ft. of water weighs 1000 oz. or $62\frac{1}{2}$ lb. 10000 lb. is equal to $10000 \div 62\frac{1}{2}$ cub. ft. = 160 cub. ft.; $160 \div 3 =$ area of square. Side of square = 7.3 ft. 28. $1\frac{1}{2}$ ft. 29. 142 ft. +. 30. 60 yd.

LONGITUDE AND TIME. THE GRAPH

Exercise 16.—1. 1.20 o'clock P. M., 10.40 o'clock A. M., 7 o'clock A. M., 5 o'clock P. M., 12 o'clock M. 2. (a) 1.12 o'clock P. M. (b) 9 o'clock A. M. (c) 4.12 o'clock A. M. (d) 8.30 o'clock A. M. 3. (a) 45° W. (b) 105° E. 4. (a) 85° . (b) 180° . (c) 120° . 5. (a) 22 min. (b) 4 hr. 3 min. (c) 2 min. 6. (a) Every hour means a difference of 15° . (b) Every 4 minutes means a difference of 1° . 7. (a) 6 hr. 34 min. 24 sec. (b) 4 hr. 13 min. 4 sec. 8. (a) 1 hr. 7 min. 8 sec. (b) 40 min. 8 sec. 9. Edmonton, 12.44 o'clock A. M.; Winnipeg, $1.51\frac{2}{3}$ o'clock A. M., or 51 minutes, 8 seconds after 1 o'clock A. M.; Calgary, 12.42 o'clock A. M.; Regina, $1.22\frac{2}{3}$ o'clock A. M. 10. 42° W. 12. For this and the remaining questions it is well to procure paper ruled in small squares, so that the work may be facilitated. If this cannot be secured, the ruling of proper sheets will be excellent training for the scholars. As this feature of mathematics is of immense importance it cannot be too strongly impressed upon the teacher. Question 18.



PERCENTAGE

Exercise 17.—1. 12, 18, 36, 108, 30%. 2. 120 sheep, $33\frac{1}{3}\%$. 3. \$35, \$66 $\frac{2}{3}$, \$116 $\frac{2}{3}$, $16\frac{2}{3}\%$. 4. (a) 125, 360, 181 $\frac{1}{2}$. (b) 80, 825 and 1.8. 5. 12060 bu., 2412 bu. and 2412 bu. 6. \$185.60. 7. 5856+. 8. 648 and 1072. 9. 40%. 10. (a) $87\frac{1}{2}\%$. (b) $16\frac{2}{3}\%$. (c) $2\frac{1}{2}\%$. (d) $42\frac{1}{4}\%$. 11. (a) 6954. (b) 418. 12. 1240 ml. 13. He will pay for an acre with two weeks' savings. He will pay for 320 acres with 640 weeks' savings, or the savings of $12\frac{4}{13}$ yr. 14. \$44 each, for \$4752 for the lot. 15. \$54 $\frac{1}{2}$. 16. $11\frac{1}{3}\%$, 73 $\frac{1}{2}$ cts. 17. (a) \$97.92. (b) \$57.12. (c) \$1636.25. 18. 21 cts. per yd. 19. (a) 6%. (b) 6%. 20. \$8750. 21. $43\frac{1}{3}\%$. 22. $3.57\frac{1}{4}\%$. 23. $42\frac{1}{4}\%$. 24. \$6400. 25. 24 loaves. 26. $36\frac{2}{3}\%$. 27. $62\frac{1}{2}\%$. 28. \$1900.

REVIEW

Exercise 18.—1. 40%. 2. 60 cts. per lb. 3. 4%. 4. \$35. $41\frac{1}{3}\%$. 5. \$2.72 per bbl. 6. $33\frac{1}{3}\%$. 7. \$1247.64 or $4.07\frac{1}{11}$ per bbl. 8. \$108.24, 164%. 9. A gain of 25% or a gain of \$17.52. 10. $6\frac{1}{2}\%$. 11. 200% is another way of saying, twice the price of eggs. 28 lb. of butter would be the same as 56 dozen eggs. Eggs are worth 9 cts. a dozen, and butter 18 cts. a lb. 12. \$4. 13. \$480. 14. He neither gained nor lost, for 25% added to cost is 20% of marked price. 15. \$2.08. 16. 80 yd. 17. $133\frac{1}{3}$ yd. 18. 20%. 19. 525%. 21. $114\frac{1}{11}$ oz. 22. Suppose an article was sold for \$140. On 95% of this he receives \$133 and on 5% of it he receives \$1.40. He thus receives in all \$134.40 or a gain of $34\frac{2}{3}\%$. 23. Gained £75. 24. 89.07 cts. per lb. 25. 8%, 10%. 26. \$40 +. 27. £120. 28. $12\frac{1}{2}\%$. 29. 16%. 30. $7\frac{3}{16}\%$. 31. \$10.81 $\frac{1}{2}$ per T. 32. 5%. 33. $33\frac{1}{3}\%$. 34. \$131.97. This answer is to the nearest cent. 35. 5%. 36. \$1000. 37. (a) Gain per cent. $16\frac{2}{3}\%$. Gain in dollars \$12. (b) Buying price \$82.90 $\frac{1}{2}$. Gain in dollars \$13.81 $\frac{1}{2}$. (c) Selling price \$132. Gain per cent. $22\frac{1}{3}\%$.

TAXES

Exercise 19.—1. (a) \$36. (b) \$62.30. (c) \$87.37. 2. (a) \$11.90. (b) \$51. (c) \$63, \$32.40, \$56.07 and \$78.63. 3. (a) 7 mills. (b) 14 mills. (c) 1.4 mills. 4. \$59.25. 5. (a) \$10600. (b) \$9860. (c) \$4445. (d) \$33781.25. 6. $1\frac{1}{2}\%$ or 15 mills. 7. \$4668.23, \$95.276 or \$95.28. 8. (a) \$28. (b) \$27. (c) \$27.30. 9. (a) $\frac{3}{4}\%$. (b) $1\frac{1}{7}\%$. (c) 17 mills. 10. \$16000. 11. \$61. 12. (a) \$400. (b) \$1437. (c) \$1017.10. 13. (a) \$40000. (b) \$60000. (c) \$66666 $\frac{2}{3}$. In the first case $98\frac{2}{3}\%$, in the second 98% , and in the third $98\frac{1}{2}\%$. 14. (a) \$20000. (b) \$60000. (c) \$30600. 15. I. by \$12. 16. \$2550000. 17. (a) \$1900. (b) \$4500. 18. How many houses were assessed? What did he receive during the year? What had he to pay out? What is the value of his property? \$3978.50. 19. \$1504.86. 20. \$51.03 and \$32.83. 21. (a) \$4168367.35. (b) \$750.31. 22. \$412500. 23. \$4200. 24. (a) \$4020. (b) 14 mills on dollar. (c) \$190.35.

DUTIES

Exercise 20.—2. (a) \$889. (b) \$1242. 3. \$87.09. 4. \$25222.80. What duty would be paid provided an ad valorem duty of 20% were imposed? 5. \$90. 6. (a) Tea, \$17361. Coffee, \$1522.50. Sugar, \$34000. Tobacco, \$14320.80. Cotton goods, \$9631.20. Canned goods, \$2748. Books, \$8890. Machinery, \$6560. Provisions, \$10080. Coal oil, \$152133. (b) Tea, \$6944.40. Coffee, \$1218. Sugar, \$14450. Tobacco, \$9180. Cotton goods, \$2407.80. Canned goods, \$916. Books, \$3175. Machinery, \$0. Provisions, \$24192. Coal oil, \$104091. (c) \$257246.50. (d) \$166574.20. (e) \$90672.30. 7. (a) 60 cts. per T. (b) $1\frac{1}{4}$ cts. per lb. (c) 15 cts. per gal. 8. (a) 25% . (b) $13\frac{1}{3}\%$. (c) $34\frac{1}{3}\%$. 9. \$20736. 10. \$4194. 11. \$3078. 12. \$3. 13. 30% . 14. \$2876. 15. \$18758.40, \$7.04 $\frac{1}{2}$ per pair, \$9.16 + per suit. 16. What was the ad valorem duty on the goods? What the amount of the specific

duty? 27 inches. 17. Original cost £1600. Duty £320. \$1557½. 18. \$63.60. The last sentence is not needed in this question. 19. (a) \$912. (b) \$5798.16. (c) 25%.

INSURANCE

Exercise 21.—2. (a) \$7.50. (b) \$15.31½. (c) \$37.20. 3. (a) \$40.80. (b) \$90.30. 4. (a) 2¼%. (b) Remove the “1½%”. It has no value in this question. Rate 1½½%. 5. (a) \$32000. (b) \$52500. (c) \$192450¾. 6. \$72800. 7. (a) \$12199.20. (b) \$9079.20, \$2720.64, \$8694.20. The owners would lose the amount of premium paid. 8. \$520. A would pay \$15000 and B \$18000. A would lose \$14750 and B \$17730. The owners would lose \$12520. Were the damage \$6600 A would pay \$3000 and B \$3600. Were the damage more than the amount of insurance carried, each company would pay the total insurance carried. In other words, A would pay \$15000 and B \$18000. 9. (a) \$31.25. (b) \$378. (c) \$296.52. 10. (a) ½%. (b) ¾%. 11. (a) 1¼¾%. (b) ¾%. 12. (a) \$15. (b) ¾%. (c) \$16800. 16. \$200. 17. \$8100. 18. \$6400. 19. \$4500. 20. \$46.50. 21. Lost \$235. 22. \$40000. 23. (a) \$50. (b) \$40. (c) \$10. (d) The first company would lose \$1990. The second company would lose \$5960. The owners would lose \$4050. 24. (a) \$280. (b) \$60. (c) \$11780. (d) \$3940. (e) \$7840. (f) \$4280. 25. \$2105. 26. \$5000, \$955 and \$3920. 27. \$9800 or \$4.90 per bbl. 28. \$96000. 29. (a) \$90, less \$88, or \$2. (b) Without the reinsurance the first company would have lost \$5910. By reinsuring, the first company pays out only \$1998, gaining thereby \$3912. 30. What was the amount of the risk? The house is worth \$3700. 31. The owner lost the premium of insurance but was paid the loss of building and goods in full. Building was worth \$180000 and the goods \$90000. 32. A, \$600. B, \$400. C, \$420. D, \$840. E, \$1000. F, \$1540. G, \$600. A would lose \$2880; B, \$1910; C, \$2046; D, \$3990; E, \$4820; F, \$7574; G, \$2730. The owner would lose \$6450.

COMMISSION

Exercise 22.—1. (a) \$26.29 $\frac{1}{2}$. (b) \$21.76 $\frac{1}{2}$. (c) \$38.68 $\frac{1}{2}$.
 2. (a) \$279.74. (b) \$48.75. (c) \$146.60. (d) \$73.97 $\frac{1}{2}$.
 (e) \$384.60. (f) \$43. Total commission, \$976.66 $\frac{1}{2}$. The remaining question of the problem is perhaps as valuable as the finding of the commissions. It calls attention to the interests of buyer and seller as related to the agent. 3. \$1742.80.
 4. \$575. 5. \$5322.37 $\frac{1}{2}$. 6. \$83.85. 7. \$54000, 60000 bu., \$14335. 9. \$8078.05, \$201.95. 10. 5000 bbl. 11. \$7792.08.
 12. \$1.35 $\frac{5}{12}$. 13. \$833.15. 14. \$460. 15. \$4619.16. 16. \$296.64. The collector gets 3% of what he collects. 17. \$243, \$11931, 2%. 18. 4%, \$3840. 19. 3 $\frac{1}{3}$ %. 20. In this question the agent buys and pays for the house and lot. The wording as the question stands is a little doubtful. The rate is 5%. 21. (a) \$6300. (b) \$315. (c) \$5985. (d) \$5700. (e) \$285. (f) \$600. 22. (a) \$126. (b) \$4074. (c) $\frac{100}{104}$. (d) $\frac{4}{104}$. (e) \$282.69. (f) The first. (g) \$282.69. (h) \$294, 7%. 24. (a) \$20.60. (b) \$1009.40. (c) $\frac{3}{103}$. (d) \$50. (e) \$980. 26. (a) The amount of the commission. (b) The sum representing the sale of the goods. (c) \$180. (d) I must add 5% of \$180 because I received no commission on this amount when purchasing goods. (e) \$2100. (f) \$180.
 27. (a) \$4120. (b) \$3760. 28. \$2058. 29. (a) \$174.82 $\frac{1}{2}$. (d) 1 $\frac{1}{3}$ %. (c) \$826. 30. (a) \$10. (b) \$196. (c) $\frac{5}{103}$, $\frac{5}{13}$.
 31. (a) \$21. (b) $\frac{1}{104}$. 32. (a) \$6180. (b) \$5760. The work of finding a formula for such questions is of great value to the student, and an attempt has been made in questions 21, 22, 23, 24, 25, 26, 27, 28, 30 and 31 to lead up to the discovery of this formula. It may be said that a formula has no place in the earlier part of the work. It is only when the student has passed this stage and has reduced commission questions to mechanics that such comparisons as are made should be attempted.

STOCKS AND SHARES

Exercise 23.—1. (a) \$38000, 380 shares. (b) \$57000, 570 shares. (c) \$77000, 770 shares. (d) \$26000, \$15000, \$7000. (e) 260, 150, 70. (f) \$125000, 1250. 2. (a) \$1000. (b) C and J; H. (c) C and J. (d) \$3200, \$800, \$1000. (e) \$25000. 3. (a) \$550, \$990, \$1650. (b) \$1650, \$1320, \$1100. (c) 11%, \$11. 4. (a) \$10500. (b) \$9333 $\frac{1}{3}$. (c) \$1500. G made in dividends \$2790. (d) \$1333 $\frac{1}{3}$, \$2480, \$3813 $\frac{1}{3}$. 5. (a) A, \$420 and J, \$540. (b) D, E and F together made \$1290 more than did C and H together. (c) \$3 per share. (d) \$3750. 6. (a) \$94 a share or \$39480. (b) C, \$9400, D, \$11280 and E, \$18800. (c) \$100 a share or \$10000, \$12000 and \$20000. (d) C lost \$600, D, \$720 and E, \$1200. (e) C would have made \$1800, D, \$2160 and E, \$3600. At a premium of 25% C would have made \$2500, D, \$3000, and E, \$5000. 7. (a) 21%. (b) \$21. (c) A, \$2940, F, \$7560, H, \$3150, J, \$3780, K, \$8820. (d) This may be obtained from one share as well as from 420 shares. 22 $\frac{1}{7}$ %. (e) K bought his stock at a lower price than the rest. 8. (a) \$130. (b) \$39000. (c) \$275. (d) 1550 shares. 9. (a) \$37200. (b) \$24. (c) \$7200. (d) 18 $\frac{1}{3}$ %. 10. (a) \$81. (b) A should get \$11340, F, \$29160, H, \$12150, J, \$14580, K, \$34020 and M, \$24300. (c) A made \$4110, J made \$6986 $\frac{2}{3}$, F made \$21600, H made \$9000. 11. \$528. 12. \$1272. 13. (a) \$2400. (b) \$2850. (c) \$210, \$300, \$360, \$600. (d) \$1470. (e) 61 $\frac{1}{4}$ %. (f) 15 $\frac{5}{16}$ %. 14. (a) \$612. I lost my interest on \$1800 for one year. (b) 20%. (c) 47 $\frac{1}{2}$ %. (d) 90. 15. 10%. 16. \$16640, \$6060, \$7000, \$6440 and \$4920. (a) \$127.50. (b) 40. (c) 50. (d) 105.

TRADE DISCOUNT

Exercise 24.—1. \$720, \$80. 2. (a) \$208. (b) \$625. (c) \$525. (d) \$1104. 3. (a) \$1000. (b) \$700. (c) \$2142 $\frac{1}{2}$. (d) \$4200. 4. (a) 20%. (b) 27%. (c) 16 $\frac{2}{3}$ %. (d) 15%.

5. 15%. 6. \$72. 7. \$5.60. 8. (a) Have the students found the cost of a set of the books mentioned and then found the cost of two dozen sets? \$154.56. (b) Each must be marked at its list price. (c) \$1.92, \$1.44, \$2.10, \$1.80 and \$2.40. 9. (a) \$7.50. (b) \$2.70. 10. (a) \$2160. (b) \$688. 11. 70%, \$2.40. 12. (a) \$720. (b) \$1521. (c) \$1400. (d) \$648. (e) \$749. (f) 847.22+. 13. (a) 44%. (b) 44%. (c) 33 $\frac{1}{3}$ %. (d) 50%. 14. (a) 58%. (b) 53 $\frac{1}{3}$ %. 15. \$178.50. 16. \$576, 100%. 17. \$340, 35 $\frac{1}{2}$ %. 18. 66 $\frac{2}{3}$ %, 100%. 19. 20%. 20. The worth of a seeder here is the list-price, viz., \$800. There is nothing, however, to prevent a pupil from taking the meaning that \$800 was spent in buying seeders. The answers to the former questions are: \$480 or 100%. The answers to the latter are: \$800 and 100%. Note.—The word *each seeder* should have been *the seeders*. 21. (a) 2% loss. (b) He sold at cost. 22. 16 $\frac{2}{3}$ %, 20% on cost is the same as 16 $\frac{2}{3}$ % on the marked price. 23. $\frac{1}{4}$. 24. (a) 20%. (b) 16 $\frac{2}{3}$ %. (c) 14 $\frac{1}{3}$ %. (d) 28 $\frac{1}{3}$ %. 25. 27 $\frac{1}{11}$ %. 26. 20%. 27. \$16.

SIMPLE INTEREST

Exercise 25.—

- | | | |
|-----------------|-----------------------|-----------------------|
| 1. (a) \$31 | (b) \$66.60 | (c) \$35 |
| 2. (a) \$144 | (b) \$612.50 | (c) \$1010.88 |
| 3. (a) \$525 | (b) \$967.20 | (c) \$327 |
| 4. (a) \$18 | (b) \$59 | (c) \$138 |
| 5. (a) \$14.80 | (b) \$30 | (c) \$210 |
| 6. (a) \$160.53 | (b) \$307.68 | (c) \$129.19 |
| 7. (a) 3% | (b) 6 $\frac{1}{4}$ % | (c) 4 $\frac{1}{2}$ % |
| 8. (a) 6% | (b) 6% | (c) 10% |
| 9. (a) \$520 | (b) \$1554.80 | (c) \$1938 |
10. (a) $\frac{3}{10}$. (b) $\frac{2}{5}$. (c) $\frac{3}{10}$. (d) $\frac{1}{4}$. 11. (a) 5%. (b) 5 $\frac{1}{2}$ %.
 12. (a) 9 yr. (b) 7 yr. 13. (a) $\frac{2}{3}$. (b) $\frac{2}{3}$. (c) $\frac{2}{3}$. (d) $\frac{11}{17}$.
 14. (a) $\frac{1}{2}$. (b) $\frac{5}{4}$. (c) $\frac{1}{4}$. (d) $\frac{1}{4}$. 15. (a) \$100. (b) \$200.
 (c) \$840. (d) \$920. 16. (a) \$300. (b) \$900. (c) \$1750.
 (d) \$2460. 17. Questions of this stamp are the only *real*

questions where the so-called *true discount* has to be considered. To make a special exercise for such questions was not deemed prudent, as the student would find when he entered upon business life that the *true discount* of the books was the *false discount* of the world. (a) \$760. (b) \$560. (c) \$1200. 18. (a) \$1400. (b) \$3500. (c) \$2475. 19. (a) \$300. (b) \$700. 20. (a) \$1800. (b) \$2000. 21. A, \$200, B, \$1600. 22. $16\frac{2}{3}$ yr., 10 yr., 20 yr., 24 yr. and 6 yr. 23. 5 yr. \$400. 24. 4 yr. \$600. 25. $16\frac{2}{3}\%$, 10%, 6%, 5%, 12% and 8%. 26. (a) \$64. (b) \$105.39. (c) \$570.31. 27. (a) \$41.19. (b) \$54.60. (c) \$417.12. 28. June 4th, 1904. 29. 25%. 30. \$1312.50. 31. \$1400. 32. 8 yr. 33. \$23100. 34. 4%. 35. \$1500 @ 8%. 36. \$1500. 37. \$150 $\frac{2}{3}$, \$160.71. 38. To the nearest cent, \$271.52. 39. \$1363 $\frac{1}{3}$. 40. (a) Interest, \$302.40. Amount, \$1742.40. (b) Principal, \$2000. Amount, \$3200. (c) Time, 3 yr. 2 mos. Amount, \$1974. (d) Rate, $5\frac{1}{2}\%$. Amount, \$1908. (e) Principal, \$2400. Interest, \$720.

BANK DISCOUNT

Exercise 26.—1. (a) \$98. (b) 73 days. June 6th. (c) \$1.17+. (d) \$1.20. (e) Questions *c* and *d* are merely for the purpose of leading up to question *e*. In this question the actual rate of discount, viz., 10%, must be taken. Answer, 4 cts. (f) 4 cts. (g) The amounts are the same. (h) The difference between the interest on the proceeds and the amount allowed by the bank is equal to the interest on the discount. The teacher should add several questions testing this feature. 2. (a) \$2.25. (b) \$10. 3. (a) \$750. (b) \$1200. 4. (a) $7\frac{1}{2}\%$. (b) 8%. (c) 6%. (d) Do not omit this, as it emphasizes question 4 and prevents any lapsing to the mere mechanical. 5. (a) Time 4 mo. (b) 8 mo. (c) 73 da. 6. (a) \$1800. (b) \$2100. (c) \$2400. 7. (a) $\frac{1}{3}$. (b) $\frac{9}{100}$. (c) $\frac{3}{50}$. (d) $\frac{3}{100}$. 8. (a) $\frac{1}{6}$. (b) $\frac{9}{100}$. (c) $\frac{1}{6}$. (d) $\frac{1}{6}$. 9. (a) \$800. (b) \$1200. (c) \$1560. 10. (a) \$1.50. (b) The amount of the bank discount is equal to the other discount, together with the interest

on that discount for one year at 5%. 11. (a) \$95.40. (b) \$964.60. (c) The bank loaned \$964.60 and received in 9 mo. \$95.40 as interest, or $13\frac{1}{4}\%$ +. 12. \$2571.43. 13. (a) Nov. 25th. (b) Nov. 28th. (c) \$1264. (d) If no days of grace be taken. \$1162.88. (b) \$1200.80. For the sake of simplicity no days of grace are suggested in this question. In real business this would not be allowed. 14. (a) March 3d. (b) March 3d if a *common* year, otherwise March 2d. (c) As in b. (d) As in b. 15. (a) This note matures June 21st. It is discounted March 18th, not March 13th. Discount, \$35.40. Proceeds, \$1664.60. (b) Discount, \$24.41. Proceeds, \$2097.34.

COMPOUND INTEREST

Exercise 27.—1. \$2205. The difference is \$205. 2. \$30. 3. (a) \$1260. (b) \$1260. (c) \$1323. (d) \$1323. (e) \$1389.15. (f) \$1389.15. (g) \$1458.61. (h) \$258.61. 4. (a) \$123.60. (b) \$249.60. (c) \$401.13. (d) \$649.28. (e) \$1232.40. (f) \$1196.61. (g) \$2003.28. 5. (a) \$5.92. (b) \$4.41. (c) \$5.55. (d) \$4.34. (e) \$21.70. (f) \$11.10; compare *f* and *c*. 6. (a) \$23.21. (b) \$145.64. (c) \$173.89. 7. \$1810.25. 8. \$49.46, provided the returned \$600 and the additional \$600 were not drawing interest. \$0.98, provided the \$1200 were drawing interest for 1904. 9. \$4630.50. 10. (a) \$2000. (b) \$600. 14. (a) \$61.50. (b) \$264.80. (c) \$440. (d) \$2859.37. (e) \$1736. (f) \$1664.

GENERAL REVIEW

Exercise 28.—1. \$98.58. 2. \$121.96 $\frac{1}{4}$. 3. 765625. 4. .0784. 5. \$600. 6. 1200 pickets, \$3300. 7. \$314.90. 8. 8 mills. 9. 792 yd. 10. \$301.96 +. No days of grace considered. 11. $2^3 \times 3^3 \times 7 \times 11^2$. 12. Say \$17.25 per M., \$16394.40. 13. \$336. 14. 100 bbl. @ \$10 and 60 bbl. @ \$8. 15. (1) 212744410875. (2) 63369332. (3) 4.181585. (4) £881 18s. 7d. (5) One inch = 2.54 cm. (6) 41715.62.

16. 24 cts. or 8%. 17. \$181.68. 18. \$206.67. 19. $68\frac{2}{3}$ cts. 20. $\frac{81}{156}$. 21. $1\frac{1}{2}\%$ for the 3 years. 22. 6118. 23. \$6.77. 24. $7\frac{1}{2}$ da. 25. At 20 mills he paid \$232.73. At $14\frac{1}{2}$ mills he paid \$168.73. 26. \$5739.60. 27. \$1000. 28. Perimeter of room is 18 times the height of the room. Area of walls = 162 sq. yd. Question resolves itself into finding the dimensions of a rectangle whose length is 18 times its width and area 162 sq. yd. $\frac{1}{18}$ of 162 sq. yd. = 9 sq. yd. = area of square whose side = the width of the rectangle. Width of rectangle, *i. e.*, height of the wall is equal to 3 yds. Length of room 15 yds. and width 12 yds. Area of ceiling is 180 sq. yds. @ 21 cts. = \$37.80. 29. 121. 30. 142. 31. \$31254.04. \$15166.48 and \$5704.18. 32. 11586575. 33. \$21.45. 34. $44\frac{1}{3}\%$. 35. Consider this at the end of 6 mo. 35 cts. or $6\frac{4}{11}\%$, $6\frac{82}{102}\%$ better. Considered now 34 cts. better or $6\frac{1}{2}\%$ better. 36. $12.10\frac{5}{8}$ P. M. 37. (a) \$4.50. (b) \$24.50. (c) \$3.19. (d) \$17.50. (e) \$255. (f) \$45.54. Total, \$350.23. 38. (a) Interest, \$5.27. Amount, \$625.27. (b) Time, 1 yr. Interest, \$30. (c) Principal, \$200. Amount, \$220.50. 39. A, \$1578.95. B, \$1421.05. 40. 54000 yd. $4\frac{41}{121}$ bu. A loss of \$16.45. 41. (a) \$12069.10. (b) \$522961.56. (c) Total, 637302. (d) 732. 42. 106. 43. \$131.67. 44. $3\frac{1}{2}$ hr. 45. (a) \$3.85. (b) 272 bbl. (c) $27\frac{61}{11}\%$. 46. $8\frac{2}{3}$ min. 47. 15 ml. 48. 144 yd. 49. 80. 50. \$400, 5%. 51. 79958704430. 52. $\frac{8}{15}$. 53. 50.75. 54. \$120. Cost of horse, \$160. 55. The students may not know the weight of a qr., as it is not a weight in general use. \$26.40. 56. 8000 bu. 57. $2\frac{1}{15}$ yr. 58. Include days of grace—\$588. 59. \$3000. 60. Change $\frac{5}{8}$ to $\frac{1}{2}$. Room is 15 yd. wide and 24 yd. long. 61. Columns—4993, 47730, 24056 and 30623. Lines—13761, 3379, 18866, 1726, 17959, 7787, 10587, 11730, 11403, and 10204. Totals, 107402. 62. $16\frac{31}{105}$ ml. per hr. 63. \$8.40. 64. Time $1\frac{4}{11}$ yr. Interest, \$25. Principal, \$600. Interest, \$48. Time, 20 yr. Amount, \$2.25. Amount, \$972.40. Interest, \$132.40. Principal, \$32.92. Interest, \$3.38. 65. \$84.21875. 66. $1\frac{1}{2}$ reams, $88\frac{2}{3}\%$. 67. \$29.39. 68. (a) \$20.97. (b) $1\frac{1}{2}$ ft. 69. He

loses \$5.20. 70. 800 rd. or 4400 yd. 71. (1) \$1147248.24.
 (2) 14734037013. (3) 17276, 58518, 100625, 502536,
 2610. (4) 1043, Rem. 24. 72. $\frac{3}{4}$. 73. 107.0064. 74. 264
 yd. 75. \$100.75. 76. 6%. 77. \$762.30. 78. \$490. 79.
 480 ac. 80. \$25.08. 81. \$726. 82. 8%. 83. 300 ac. 84.
 46 $\frac{3}{4}$ ml. 85. \$28.87 $\frac{1}{2}$. 86. \$16. 87. 3 min. 36 sec. past 3
 o'clock. 88. 4 min. 47 sec. 89. A, \$1312. B, \$574. 90.
 \$20187.50. 91. $\frac{3}{4}$. 92. 42 in. 93. 56. 94. \$16. 95. 8 $\frac{1}{2}$ ft.
 96. \$900. 97. 40%. 98. \$16800. 99. The wood costs me \$12
 per 36 days or \$13.33 $\frac{1}{4}$ per 40 days. The coal costs me \$11.50
 per 40 days. 100. 8716.3 bu. 101. 1. 102. (b) 512. Rem.
 .03. 103. \$4988 $\frac{1}{4}$. 104. Loss 25%. 105. \$27.54. 106. (a) 60
 cts. per \$100. (b) \$20.23. 107. (a) 93.6 da. (b) If the men
 were paid 22 cts. per hour the difficulty in the digging would
 make no difference. The money would be earned in $\frac{5}{8}$ of the
 time. If the men were paid in proportion to the digging they
 would earn but 11 ct. an hour. In this case the men would take
 $\frac{5}{3}$ as long, or 156 da. 108. (a) 13 $\frac{1}{3}$ %. (b) \$4.57 $\frac{1}{2}$ per ac.
 109. \$415400. 110. (a) \$5.76. (b) If paper is placed from
 end to end of the ceiling the cost would be \$4.15. If paper is
 placed from side to side of the ceiling the cost would be \$4.02.
 (Note that the width of the room is 24 ft. 8 in.) 111. Columns
 —\$24178.16, \$21885.65 and \$13281.46. Lines—\$7553.15,
 \$4689.80, \$1857.55, \$473.42, \$2995.76, \$2240.80, \$801.72,
 \$2051.70, \$1536.30, \$2138.10, \$8737.57, \$1718.14, \$593.05,
 \$900.96, \$5467.23, \$8441.68, \$2038.45, \$2567.10,
 \$1058.27, \$1484.52. Totals, \$59345.27. 112. \$62.53.
 113. 11 $\frac{1}{2}$ %. 114. 27.9% of his investment. 115. \$4.94 $\frac{1}{2}$.
 116. At the end of six months \$6 would be worth \$6.18.
 Had I taken the credit price I should have been the loser
 by \$6.40—\$6.18, or 22 cts. Again, the present value of a
 \$6.40 credit is \$6.21, which would be 21 ct. in advance
 of the cash price, \$6. 117. (1) 240115, 220455, 563282.
 (2) 76655, 35561 and 25625. (3) 579.88392, 12869439.
 (4) 756. (5) 15. (6) 125 and 12.1. 118. 123 yd. 119. 539
 sq. ft. 120. 91 cts. 121. (1) 60264. (2) The work of

this part must be seen. $R = 100$. (3) 5689858587. (4) Given number = 9^9 . 122. C, \$4.25 per day. B, \$2.25 and A, \$2. 123. \$2.38 nearly. 124. \$3176.25. 125. \$490.50. 126. The owner lost \$3135. The company \$8865. 127. Lost \$13 $\frac{1}{2}$. 128. 50 cub. yd. 129. (a) \$395.333. (b) \$242.65. 130. \$67.52 $\frac{1}{2}$. 131. Totals, \$111769.10. 132. 1526.5625. 133. $\frac{3}{4}$. 134. \$16381. 135. Take 10 da. as $\frac{1}{3}$ mo. \$2500. 136. (a) 55 $\frac{1}{2}$ secs. (b) 7 $\frac{1}{2}$ secs. 137. 87. 138. 4350 times. 139. A piece of ground, 97 miles long and of a width equal to the width of the roller, has an area of 40 acres. The width of the roller is therefore 1.134 + yd. 140. This is not a puzzle, purely and simply. Such questions have a value if wisely used. 141. Many pupils who would not think of hesitating when asked how many thirds in six, will stop here. 142. Gain 5%. 143. As 9:10. 144. 2.2 da. 145. An average gain of 4 $\frac{3}{4}$ %. 146. \$20. 147. 40 rd., 164.9 rd., 495 ml., \$38.40, 95 $\frac{1}{2}$ cts. per bu. 148. (a) Time 1 $\frac{1}{4}$ yr. Int., \$30. (b) Amount, \$530. Rate, %, 1 $\frac{1}{2}$ %. (c) Principal, \$250. Amount, \$252.50. 149. (a) \$90, \$4410. (b) \$2000, 5 $\frac{1}{4}$ %. 150. \$1.56. 151. 3000 tons. 152. \$214. 153. \$4.32. 154. The strips will run from end to end of the room. 155. 41 ft. 156. 596.65 gal. 157. 10 $\frac{1}{2}$ hr. 158. \$2400. 159. 15%. 160. 57 $\frac{2}{3}$ rd. 161. 5 $\frac{5}{11}$ ml. per hr. 162. 70.244 in. 163. 200. 164. (1) Time, 2 $\frac{2}{3}$ yr. Interest, \$5. (2) Rate, $\frac{1}{4}$ %. Interest, \$10. (3) Principal, \$50. Rate, 8%. (4) Principal, \$240. Amount, \$246. (5) Interest, \$90.53. Amount, \$815.53. 165. \$13.82. 166. 81441 T. 2 cwt. 32 lb. 167. 54000 yd., 4 $\frac{4}{11}$ bu., \$11.45 loss. 168. .00345 in. +. 169. 84 $\frac{2}{3}$ cts. 170. 14 oz. 171. \$100. I lost 10% on the buying-price of the second horse. 172. \$480 and 6 yr. 173. 100 bbl. at \$1.20 and 150 at \$1.50. 174. \$2. 175. 6 $\frac{2}{3}$ %. 176. 520 lb. 177. \$627.85. 178. \$68. 179. \$1.47 +. Is it necessary in this question to find the total cost of the wheat and the total insurance paid? 180. 600. 181. 271.2 min. or 4 hr. 31.2 min. 182. \$3760. 183. $\frac{1}{3}$, $\frac{30}{31}$, $\frac{1}{30}$, $\frac{31}{30}$. 184. \$1000. 185. 351 $\frac{9}{16}$ cub. ft.

186. \$171.32. 187. If $\frac{5}{11}$ of the difference is B's share, then, as the difference is A's share less B's share, $\frac{5}{11}$ of this difference is equal to $\frac{5}{11}$ of A's share $-\frac{5}{11}$ of B's share, which is equal to B's share. In other words $\frac{5}{11}$ of A's share must be equal to $\frac{1}{11}$ of B's share, or the division has been made as 16:5, which would give A $\frac{16}{21}$ and B $\frac{5}{21}$ of the amount divided. 188. In 40 shots one man can kill 24 birds and the other 25 birds, or between them 49 birds. Why was 40 taken? Answer, 160 shots. 189. $3\frac{3}{4}$ hr. 190. 1440. 191. The latter by $3\frac{2}{3}$ cts. per month. 192. 197 yd. by 341 yd. 193. $\frac{5}{6}$ ml. per hr. 194. $8\frac{1}{3}$ hr. A, \$1.38 + B, \$1.24 +. 195. 24 men and 21 men. The first group took but $\frac{1}{7}$ of the time taken by the second group. How is this explained? 196. What per cent. of each cask must be vinegar? $4\frac{1}{2}$ gal. must be transferred from the smaller cask to the larger cask and the same of water from the larger cask to the smaller cask. 197. 24.9 ml. an 198. 14.71 lb. +. 199. The former is to the latter as 36 to 35. 200. 1800 sq. yd., 1600 sq. yd. and 1440 sq. yd. 201. £147825. 202. 56 yd., 56d. per yd. 203. 3 ml. 720 yd. 204. 7 ft. 9 in. 205. 1. 206. 256 sq. rods or 1 ac. 96 sq. rd. 207. 70 yd. 208. $6\frac{3}{4}\%$, \$4000, \$5600 and \$4400. 209. A, \$3528, B, \$3038, C, \$2100. 210. 48.96. 211. \$22.50. 212. 320 acres. 213. July 25th. 214. \$440. 215. \$733.73. 216. 8 ft. 217. \$3137.20. 218. $\frac{3}{14}$. 219. $113\frac{84601}{245623}$. 220. 2904 sq. yd., 3025 sq. yd. and 3850 sq. yd. 221. 15% on his buying price. 222. Do not include days of grace in this case. \$747.94. 223. A's house, \$6000, B's house, \$4000. 224. $\frac{9}{35}$. 225. 864. 226. 277.288, 98.476. 227. 140.45. 228. \$1460. 229. \$692.36. 230. \$1452. 231. \$708, \$1692. 232. 4%.

APPENDIX

The machines referred to in the several exercises of the appendix are common objects in almost every community. Why should they not be studied just as well as a hundred and one other things supposed to provide good arithmetical food?

Is it not true that there are many boys in our classes who would find a study of the simple mechanical powers not only entertaining but of very great value on account of the relation of these to the lives that the boys will live?

THE LEVER

NOTE.—In these problems omit the weight of the plank.

Exercise 1.—6. (a) 4 ft. and 12 ft. (b) 12 ft. and 4 ft. (c) 9 ft. and 7 ft. 8. (a) 2 to 1. (b) 2 to 1. (c) No. 9. (a) 8 ft. and 4 ft. (b) 3 ft. and 9 ft. (c) 7 ft. and 5 ft. 10. (a) 4 to 5. (b) 2 to 1. (c) 13 to 5. (d) 7 to 11. 11. (a) 6 ft. and 9 ft. from ends. (b) 10 ft. from end. (c) 8 ft. from end or 7 ft. from end. (d) 9 ft. from one end. (e) At centre. 12. This is an effort to discover the general law of the lever. 13. $35\frac{1}{2}$ lb. 14. 8 ft. 15. 4 ft. from the 5 lb. wt. 16. 3 ft. from the shoulder of the one carrying the greater load.

Exercise 2.—8. 250 lb. 9. $P = 50$ lb. An advantage of 10. 16. 3 ft. 17. $P = 20$ lb. 18. $122\frac{1}{2}$ lb. 19. 60 lb. 20. 40 lb. 21. $\frac{1}{2}$ of W . 22. (a) $DW = 3\frac{1}{2}$ in. (b) $DP = 24$ ft. (c) $P = 642\frac{1}{2}$ lb. (d) $W = 270$ lb.

THE WHEEL AND AXLE

Exercise 3.—1. (a) $8\frac{1}{2}$ lb. (b) 20 lb. (c) 75 lb. 2. $P = 50$ lb. 3. $62\frac{1}{2}$ lb. 4. 2688 lb. 6. (a) "Relative lengths" here mean lengths of radii. The wheel must have a radius equal to 20 times the radius of the axle. (b) 10 to 1. 7. 8 in. 9. 120 lbs. 10. Friction. 11. $20\frac{1}{2}$ lb. 12. 14400 lb.

WORK

Exercise 4.—1. (a) 120 foot-pounds. (b) 240 foot-pounds. 2. (a) 15 foot-pounds. (b) 600 foot-pounds. 3. (a) 14 ft. (b) 8 ft. 4. (a) 16 lb. (b) 12 lb. 5. (a) 4500 foot-pounds. (b) 4500 foot-pounds. 6. 3600 foot-pounds. 7. 1280000 foot-pounds. 8. In this and in the preceding, very interesting work may be covered in the effort to obtain the average height

to which the materials have to be lifted. 104000 foot-pounds.
 9. 1920 foot-pounds, 2800 foot-pounds, 4720 foot-pounds.
 10. 44,000 foot-pounds.

THE PULLEY

Exercise 5.—1. (a) 30 lb. (b) 20 lb. (c) 70 lb. 2. (a) 15 lb. (b) 34 lb. (c) 120 lb. 3. What wt. can be raised? How high has this to be raised? 1800 foot-pounds. Through 40 ft.
 4. How much of the wt. does he lift? 44 lb. 7. 480 lb., 28 lb.
 8. 50 lb., $55\frac{5}{8}$ lb. 9. (a) $\frac{1}{2}$ in. (b) $1\frac{1}{2}$ ft. 10. He would press nothing on the floor. 80 lb. 11. 20 lb. 12. 260 lb., 200 lb. 13. Practice the pupils in making neat diagrams of these machines.

REVIEW

Exercise 6.—2. 32 lb. 3. 240 lb. 4. 2400 lb. 5. 1500 lb.
 6. 1186 lb. 8. 5120 foot-pounds, 7360 foot-pounds.

THE INCLINED PLANE

Exercise 7.—5. (a) $33\frac{1}{2}$ lb., 1000 foot-pounds, 1000 foot-pounds. (b) $769\frac{3}{13}$ lb., 10000 foot-pounds. 6. 75 lb., 22500 foot-pounds. 7. 200 lb., 160000 foot-pounds. 8. You are asked here to find the pressure of the toboggan and its freight on the slope. 9 lb. 9. $60\frac{2}{3}$ lb.

