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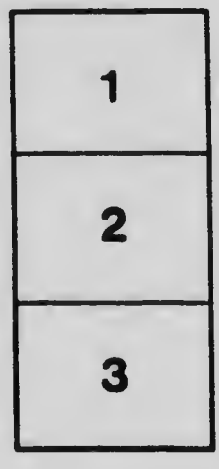

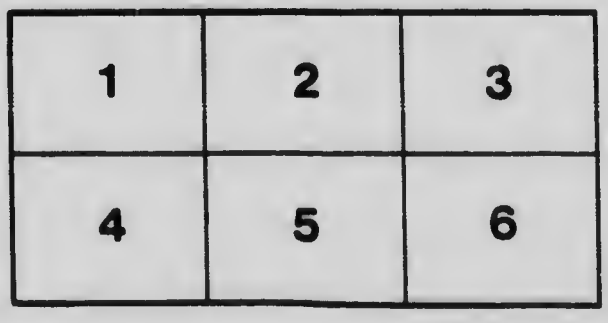

SOLUTIONS OF THE PROBLEMS

IN THE

ONTARIO HIGH SCHOOL

ARITHMETIC

TORONTO
THE HUNTER-ROSE COMPANY, LIMITED
1910

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12-14 Sheppard Street, Toronto

SOLUTIONS OF THE PROBLEMS

IN THE

HIGH SCHOOL ARITHMETIC

Measures and Multiples

Page 15

10. The required number is the G. C. M. of 13949 and 14558.

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13. It must be a mult. of 2, 3, 4 and 5 or of 60, and must therefore be 360, as this is the only multiple of 60 greater than 300 and less than 400.

14. It is the G. C. M. of 34037 and 307007.

15. The other $= 244188 \times 84 \div 1428$ (see pp. 14-15).

16. Since $96 = 2^5.3$ the other may be 2^5 or $2^5.3$.

17. The other must have the factor 17, because the G. C. M. $= 17$, also the factor 7 because the L. C. M. has the factor 7 and neither of the other numbers has it. It may have the factor 5, but cannot have the factor 2. $\therefore$ it must be 7×17 or $5 \times 7 \times 17$.

18. The side of each square is the G. C. M. of 465 and 682, or 31. $\therefore$ there are 15 on one side and 22 on the other, or 330 in all.

19. Length of rail is G. C. M. of 3143 and 2471 = ' ft. Distance around the field = 11228 ft. $\therefore$ number of rails $= 11228 \div 7 \times 8$.

20. Greatest weight = G. C. M. of 7000 and 5760 = 40 gr. Least = L. C. M. of 7000 and 5760 = 1008000 gr. = 144 lb. avoir.

Fractions

Page 63

1. See Arith., pp. 44, 45.

2. Multiply to 4 decimal places and the result lies between 138·280 and 138·281.

3. Reduce to vulgar fractions.

4. $\cdot 142857142\ldots\ldots \div 5 = \cdot 0285714285\ldots\ldots = \cdot 0\dot{2}85714\dot{2}$.

5. The remaining digits may be 0's and ∴ the least value is ·8397; they may be 9's, and ∴ the greatest value is $\cdot 8397\dot{9} = \cdot 8398$.

6. $1769 \div 5 = 353{\cdot}8$; this $\div 3 = 117{\cdot}933\ldots$; this $\div 7 = 16{\cdot}847619047\ldots = 16{\cdot}8476190$.

7. $9{\cdot}9 \div (5280 \times 12) = 9{\cdot}9 \div 10 \div 11 \div 9 \div 8 \div 8 =$ &c.

8. $17 \div 42 = \cdot 40476+$ and ∴ lies between ·4047 and ·4048.

9. See Arith., page 33.

10. $\frac{876}{1159} = \frac{\frac{876}{1159} \times 50}{50} = \frac{37\frac{917}{1159}}{50} = \frac{38}{50}$ most nearly.

11. The sum of these fractions is $2\frac{691}{1170}$, which is less than the next integer, 3 by $\frac{479}{1170}$.

12. Express the vulgar fractions as decimals.

13. $\cdot 834 \times \cdot 623 = \cdot 519582$, which differs from ·52 by ·000418 and from ·519 by ·000582, &c.

Page 64

14. Since one factor of 180 contains a digit in the ten's place, the other factor must be carried to at least the sixth dec. place.

16. $\frac{6\frac{1}{3}}{7} = \frac{19}{21} = \frac{19 \times \frac{17}{19}}{21 \times \frac{17}{19}} = \frac{17}{18\frac{15}{19}}$.

17. Divide 1 by 3·14159 by contracted method.

18. Assuming $\frac{511}{1000}$ as the value of the fraction, its denominator must be $\frac{1000}{511}$ of its numerator, or $\frac{1000}{511}$ of 209 = &c.

19. See Arith., pp. 49-51.

20. A cubic foot of water will make $\frac{11}{10}$ cub. ft. of ice. ∴ $\frac{11}{10}$ cub. ft. of ice weigh 1000 oz., &c.

21. In 45 hours 15 ac. are mown by 4 men, ∴ in 22 hr. 11 ac. are mown by $(4 \times \frac{11}{15} \times \quad)$ men = 6 men.

22. A bought $\frac{3}{4}$ of it, B $\frac{4}{5}$ $\frac{1}{4}$, or $\frac{1}{5}$ of it. ∴ A and B bought $\frac{19}{20}$ of it. ∴ he received \$50 for $\frac{1}{8}$ of $\frac{1}{20}$ of the land. ∴ the value of the land was \$6000.

23. Suppose D gets \$1·00, then A gets \$·30, then C gets \$·09, then B gets \$·39, and the whole sum divided would be \$1·78. But \$12·46 = 7 times \$1·78, &c.

24. Reduce to decimals and find $\frac{1}{8}$ of their sum.

25. 12 men do $\frac{4}{5}$ of the work in 160 hours, or the whole work in 200 hours. ∴ 15 men would do it in 160 hours, or $\frac{7}{8}$ of it in 140 hours, or 14 days.

26. He loses \$10500 × $\frac{1}{5}$ × $\frac{65}{100}$ = \$1365.

27. Suppose the cask holds 6 gal. The value of the mixture will be 90c. × 5 + 50c. = \$5·00, or $83\frac{1}{3}$c. per gal.

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28. B's cost = $\frac{20}{17}$ of \$306 = \$360, ∴ A's cost = $\frac{8}{9}$ of \$360 = \$320.

29. When B runs 200 yd. C runs 190 yd. ∴ when B runs 190 yd. C runs $\frac{190}{200}$ of 190 yd. = $180\frac{1}{2}$ yd. ∴ when A runs 200 yd. C runs $180\frac{1}{2}$ yd., and ∴ A wins by $19\frac{1}{2}$ yd.

30. Whole selling price of 535 lb. = \$52.10 + \$6.75.

31. The usual rate is $21\frac{3}{4}$ ml. per hr., the increased rate is $23\frac{7}{11}$ ml. per hr. The increase is $1\frac{32}{33}$ ml., which is $\frac{1}{11}$ of the usual rate.

32. The value of the house $= \frac{4}{3}$ the val. of the lot. $\therefore$ the val. of both $= \frac{7}{3}$ of val. of lot $=$ \$2100. $\therefore$ val. of lot $= \frac{3}{7}$ of \$2100 $=$ \$900.

33. An increase of $\frac{2}{15}$ in $\frac{3}{4}$ of the price $=$ an inc. of $\frac{2}{15}$ of $\frac{3}{4}$, or $\frac{1}{10}$ in the whole price.

34. Divide the sum into 91 equal parts and give them respectively 17, 20, 24 and 30 of these parts.

35. In 1 day A would rec. $\frac{4}{245}$ and B $\frac{3}{245}$ of the sum. $\therefore$ both would rec. $\frac{1}{35}$ of the sum, or the whole sum in 35 days.

36. Total selling price $=$ \$6133·75; first sale brings \$2027·30. $\therefore$ remaining 3135 bus. must sell for \$4106·45.

37. In one day they can do $\frac{1}{10} + \frac{1}{15} + \frac{1}{20}$, or $\frac{13}{60}$ of the work, $\therefore$ they can do the whole work in $\frac{60}{13}$, or $4\frac{8}{13}$ days.

38. Suppose A gets \$4 and B \$5 for each unit of time they work, then when A earns \$12, B earns \$20. $\therefore$ A will receive $\frac{12}{32}$ of \$60 $=$ \$22·50.

39. 6 yr. $= \frac{1}{3}$ of father's age $- \frac{1}{5}$ of father's age $= \frac{2}{15}$, &c.

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40. \$9000 $\times \frac{23}{20} \times \frac{5}{4} =$ \$12937·50.

41. The selling price of 306 gal. $=$ \$1089·70.

42. If the cost of the first is the unit, the second cost $1\frac{1}{2}$, the third $2\frac{1}{4}$, the fourth $3\frac{1}{4}$ = a total cost of 8, making the unit \$3000.

43. \$4064·55 $\times \frac{26}{7} \times \frac{9}{35} \times \frac{21}{20} =$ \$4076·163.

44. When C receives \$400, B gets \$420 and C \$441. $\therefore$ A receives $\frac{441}{1261}$ of \$3783 $=$ \$1323.

45. $\frac{2}{11}$ of 2607 lb. $=$ 474 lb.

46. The time till midnight $= \frac{5}{7}$ of the time past noon. $\therefore \frac{5}{7}$ of the time past noon is 12 hours. $\therefore$ the time past noon is $4\frac{1}{2}$ hours.

47. After the first drawing $\frac{2}{3}$ of the wine remains;

after the second $\frac{2}{3}$ of $\frac{2}{3}$, &c. After the last drawing there will remain $\frac{2}{3}$ of $\frac{2}{3}$ of $\frac{2}{3}$ of $\frac{2}{3}$ of $\frac{2}{3}$ of 150 gal.

48. See Arith., pp. 36, 37.

49. $\frac{1}{8} = \cdot 125$, $\frac{1}{8^2} = \frac{\cdot 125}{8} = \cdot 015625$, &c.

50. On \$400 of liabilities he can pay \$300 − \$50 = \$250, &c.

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51. The cost of the carriage $= \frac{3}{5}$ of cost of the horse. $\therefore$ $\frac{3}{5}$ of the cost of the horse = \$280, &c.

52. One $= \frac{2}{5}$ of the other. $\therefore$ $\frac{3}{5}$ of the larger = 18, &c.

53. If the charge for a cow for a unit of time is \$2, then the charge for a horse is \$3. Each horse for 3 units of time would cost \$9; each cow for 4 units of time would cost \$8. $\therefore$ 2 cows and 3 horses would cost \$43, and 3 cows and 2 horses would cost \$42. $\therefore$ A should pay $\frac{43}{85}$ of \$42·50 = \$21·50.

54. The vote of the elected candidate $= \frac{140}{175}$ of $\frac{140}{175} = \frac{80}{175}$ of the vote polled. $\therefore$ the other received $\frac{95}{175}$ of the vote polled. $\therefore$ $\frac{1}{175}$ of the vote polled = 50, &c.

55. The total volume of 1 lb. of each $= (\frac{1}{500} + \frac{1}{600} + \frac{1}{480})$, or $\frac{23}{4800}$ of a cub. ft. $\therefore$ $\frac{23}{4800}$ of a cub. ft. of the mixture weighs 3 lb., &c.

56. Sum of the first 5 numbers $= 34 \cdot 5 \times 2 + 19 \cdot 3 \times 3 = 126 \cdot 9$; $\therefore$ the sum of the other two $= 26 \cdot 98 \times 7 - 126 \cdot 9 = 61 \cdot 96$, &c.

57. On every \$16 the customer paid he was cheated \$$\frac{3}{4}$. $\therefore$ on \$9·60 paid he was cheated 45c.

Compound Quantities

Page 71

1. $1000 \div 100$; $1000 \div 10$; $1000 \div 100 \div 10$.

2. $1000 \div 1000$; $1000 \div 10$; 1000×10.

3. 12×100; 15×1000; $21 \times 1000 \times 1000$.

4. $123456789 \div 100$; $123456789 \div 1000$; $123456789 \div 1000 \div 1000$.

5. $8{\cdot}56 \times 1000 \times 100$; $5{\cdot}632 \times 1000$; 12468×1000.

6. Expressed in metres these quantities are 14·6, 2·27, 1623, 1634000, then add.

7. Expressed in cm. these quantities are 567800, 13648·9, then subtract.

8. 12 Km. 5m. 8 cm. = 12·00508 Km., then multiply by 8×12.

9. 103 Km. = 10300000 cm. $= 64 \times 1760$ yd. $\therefore$ 1 yd. $= 10300000$ cm. $\div 64 \div 1760$.

10. 66000 m. in 3600 sec. $= 66000 \div 3600$ m. per sec.

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11. In 1 min. the train goes 1 Km. = 1000 m., which $\therefore = 20$ spaces. $\therefore$ 1 space = 50 m.

12. The man's height = 5 ft. $10\frac{1}{2}$ in. $= 70{\cdot}5$ in. $= 70{\cdot}5 \div 39{\cdot}37$ m. $= 70{\cdot}5 \div 39{\cdot}37 \times 100$ cm.

13. $29{\cdot}5 \div 39{\cdot}37 \times 1000$.

14. 10 m. = 1000 cm. In taking one-half of one part and two-thirds of the other we have taken one-half the whole string and one-sixth of the other part; but one-half the whole string is 500 cm. $\therefore$ one-sixth of the other part is 100 cm. $\therefore$ the other part is 600 cm.

15. No. minutes = 65 Km. ÷ 80 m. = 65000 m. ÷ 80 m. = 812·5 = &c.

16. 1 yd. = 36 in. = $36 \times \frac{5}{2}$ cm. = $36 \times \frac{5}{2} \times 10$ mm.

17. 1 Km. ÷ 1 m. 5 cm. = 1000000 mm. ÷ 1050 mm.

18. 1200 ÷ 100; 1200 × 100; 1200 ÷ 10.

19. These expressed as ares are 12·64, 4·68, 1000, then add.

20. Expressed in dekares those are 10 and ·1.

21. 7·5645 Ha. × 27 = 204·2415 Ha.

22. 100 dm. = 1 Dm.; ∴ 10000 sq. dm. = 1 sq. Dm. = 1 are = 1000 ma. ∴ 1 sq. dm. = ·1 ma.

23. 1 a. 5 da. = 1·5 a. = 1·5 sq. Dm. = 1·5 × 10 × 10 sq. m. = 1·5 × 10 × 10 × 100 × 100 sq. cm.

24. 10000 sq. m. = 1 Ha. = $2\frac{1}{2}$ acres = 12100 × 9 × 144 sq. in. ∴ 100 m. = 110 × 3 × 12 in. or 1 m. = 39·6 in.

25. 1 s. = 1 cu. m. = $(100)^3$ cu. cm. = &c.

26. One million cu. cm. = 1 cu. m. = 1 s.

27. 1 ds. = ·1 s. = ·1 cu. m. = ·1 × $(10)^3$ cu. dm. = 100 cu. dm.

28. 1 s. of earth = $2\frac{1}{2}$ s. of water = $2\frac{1}{2}$ cu. m. water = $2\frac{1}{2}$ $(100)^3$ cu. cm. of water = $2\frac{1}{2}$ $(100)^3$ g. = $2\frac{1}{2}(100)^3 \div 1000$ Kg.

29. 1 s. ice = $\frac{10}{11}$ s. water = $\frac{10}{11}$ of 1000 Kg. = &c.

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30. 1 cu. m. = $(10)^3$ cu. dm. 1 s. = 1 cu. m. = 1000 cu. dm. = 1000 litres.

31. 1 litre = 1000 cu. cm. wh. weigh 1000 g. = 1 Kg.

32. 1000000 g. = wt. of 1000000 cu. cm. = wt. of 1000 cu. dm. = wt. of 1000 litres.

33. The vol. of the solid = vol. of water displaced wh. weighs 1000 g. and ∴ = 1000 cu. cm. = 1 cu. dm.

34. 1 Kl. of water = 1000 l. = 1000 cu. dm. = 1000000 cu.

cm., and ∴ weighs 1000000 g. = 1000 Kg.; ∴ 1 Kl. of air weighs $1000 \div 770$ Kg. = &c.

35. 1 l. = 1 cu. dm. = 1000 cu. cm.

36. 1 Kg. = 1000 g. = 1000×1000 mg.

37. 1 tonneau = 1000 Kg. = 1000×1000 g.

38. 10 cu. m. of water = 10000000 cu. cm., and ∴ weighs 10000000 g. = 10000 Kg.

39. 1 l. of water weighs 1 Kg.; ∴ 1 l. of mercury weighs 13.5 Kg.

40. 1 l. of water weighs 1000 g.; ∴ ratio = 1840 : 1000.

41. 1 ton = 2000 lb. = 32000 oz. = $32000 \times 28{\cdot}35$ g. = $32 \times 28{\cdot}35$ Kg.

42. 5 Km. per hour = 500000 cm. per 3600 sec. = &c.

43. 1 ch. = 66 ft. = $66 \times 12 \div 39{\cdot}37$ m. = &c.

44. 250 ac. = 1568160000 sq. in. = $1568160000 \div (39{\cdot}37)^2$ sq. m. = $156816 \div (39{\cdot}37)^2$ Ha. = &c.

45. 229 miles = $229 \times 5280 \times 12$ in. = $229 \times 5280 \times 12 \div 39{\cdot}37$ m. = $229 \times 5280 \times 12 \div 39{\cdot}37 \div 1000$ Km.

46. 1 mile = 5280 ft. = 5280×12 in. = $5280 \times 12 \div 39{\cdot}37$ m.

47. ∴ 8 Km. = 5 miles; but 8 Km. = 8000 m., and 5 miles = 316800 in. ∴ 1 m. = $316800 \div 8000$ in.

48. 1 tonneau = 1000 Kg. = the wt. of 1000 l.

Roots of Numbers

Page 81

2. $9\frac{67}{121} = \frac{1156}{121}$. $\therefore$ square root $= \frac{34}{11} = 3\frac{1}{11}$.

3. $\cdot 027 = \frac{25}{900}$. $\therefore$ square root $= \frac{5}{30} = \frac{1}{6}$.

8. $12825 = 3^3.5^2.19$. $\therefore$ multiplier $= 3 \times 19$.

9. $90250 = 2.19^2.5^3$. $\therefore$ multiplier $= 2^2 \times 19$.

Page 82

12. The units digit of its square must be the units digit of the square of 7, which is 9, &c.

15. The square root lies between 335 and 336.

16. The cost in cents $= \sqrt{5625} = 75$.

17. Number on each side $= \sqrt{567 \times 7} = 63$.

18. Pop. in 1901 = pop. in $1881 \times \frac{14822500}{13690000}$. Since this fraction is the square of $\frac{12250}{11850}$ or $\frac{77}{74}$, $\therefore$ the pop. in . . = pop. in $1881 \times \frac{77}{74}$.

19. The sum of the numbers in the first row $= (1 + 2 + \ldots . + 12)$. Let this $= N$. Sum of second row $= 2N$, of third $3N$, &c. $\therefore$ total $= (1 + 2 + \ldots . + 12)\ N$, &c

20. If both numbers were the same as the smaller, the product would be $43923 \div 3 = 14641$. $\therefore$ the smaller $= \sqrt{14641} = 121$.

21. If both were equal to the smaller the product would be $1512 \times \frac{9}{7} = 1296$, &c.

22. If all were equal to the smallest, the product would be $3072 \div 6 = 512$. $\therefore$ the smallest = the cube root of $512 = 8$.

Mensuration

Page 111

1. Area of floor = 480 sq. ft.; of carpet = 357 sq. ft. Area painted = 123 sq. ft. = $13\frac{2}{3}$ sq. yd. $\therefore$ cost = \$1·64.

2. Diagonal = $\sqrt{216^2 + 195^2} = 291$ yd. $\therefore$ distance saved = $216 + 195 - 291 = 120$ yd.

3. Width in ft. = $\sqrt{40^2 - 24^2} + \sqrt{40^2 - 32^2} = 56$.

4. Area in acres = $160 \times 50 \div 160 = 50 = 500$ sq. ch.

5. No. = $480 \times 10800 \div 24$.

Page 112

6. The surface is a trapezium. See page 88.

7. Dimensions inside the road are 77 yd. and 48 yd. $\therefore$ area of road in sq. yd. = $85 \times 56 - 77 \times 48 = 1064$.

8. Reduce area to feet and take the square root.

9. No. = $(15 \times 9 \times 144) \div (27 \times 18) = 40$.

10. 2, page 111.

11. Altitude bisects base. The altitude, $\frac{1}{2}$ base, and side form a right-angled triangle.

12. The ladder, in its new position, forms with the wall and ground a right-angled $\triangle$. Ladder 30 ft., wall to the top of ladder 24 ft. $\therefore$ dist. of the bottom of ladder from the foot of the wall = $\sqrt{30^2 - 24^2}$ ft. = 18 ft.

13. Draw the diagram.

14. Half the altitude in yd. = $4840 \div 90\frac{1}{3}$.

15. Area = 11·02 ac. = $11{\cdot}02 \times 4840$ yd. $\therefore$ the side = $\sqrt{11{\cdot}02 \times 4840}$ yd.

16. If length was the same as breadth cost would be £$38 \div 5 = 152$s. Area would then be $152 \div 9\frac{1}{2} = 16$ sq. yd. $\therefore$ width = 4 yd.

17. See No. 7.

18. 12 ac. = 120 sq. ch. $\therefore$ width = 5 ch.

19. Apply formula on page 87.

Page 113

20. Area = 10000 plan, $\therefore$ linear measurement = $\sqrt{10000}$ or 100 plan. . . 24 yd. = $\frac{24}{100}$ yd. in plan = 8·64 in.

21. The diagonal of the end of the stick equals the diameter of the end of the tree. Diameter = $(12 \div \frac{22}{7})$ ft. = $\frac{42}{11}$ ft. Now side of stick : the diagonal : : 1 : $\sqrt{2}$ $\therefore$ side = $(\frac{42}{11} \div \sqrt{2})$ ft. = 2·699 ft.

22. Cost in pence = $21\frac{1}{2} \times 13\frac{1}{3} \times 6$.

23. Length of string = $\sqrt{24^2 + 18^2 + 7^2}$ ft. = 30·505 ft.

24. Apply formula page 87.

25. The diagonal divides the quadrilateral into 2$\triangle$s whose sides are 20, 30, 40 and 25, 32, 40 chains; or into 2$\triangle$s whose sides are 20, 32, 40 and 25, 30, 40 chains. Apply formula.

26. Diameter of $\odot$ = diagonal of square. The dia. of sq. = $\sqrt{8^2 + 8^2}$ ft. = $8\sqrt{2}$ ft. $\therefore$ area of $\odot$ = $\frac{22}{7}$ $(4\sqrt{2})^2$ sq. ft. = $100\frac{4}{7}$ sq. ft.

27. Perimeter of semi-circle = semi-circumference + diameter, circumference = $2 \cdot \frac{22}{7} \cdot 2$ ft. $\therefore$ semi-circumference = $6\frac{2}{7}$ ft.

28. If r is the radius, then $\frac{22}{7}r + r = 80$.

29. Inner radius = $(420 \div \frac{44}{7})$ ft. and the outer radius = $(560 \div \frac{44}{7})$ ft. $\therefore$ breadth of road = $(560 - 420) \div \frac{44}{7}$ ft.

30. 1000 times the circumference of the wheel equals one mile. $\therefore$ the circumference = 5·28 ft. $\therefore$ dia. = $(5{\cdot}28 \div \frac{22}{7})$ ft. = 1·68 ft.

31. Radius of pond = $(220 \div \frac{44}{7})$ yd. = 35 yd. Area of pond = $(\frac{22}{7} \times 35^2)$ sq. yd. = 3850 sq. yd. $\therefore$ area of outer circle, including both path and pond, is (3850 + 120) sq.

yd. = 3970 sq. yd. ∴ radius of this circle = $(\sqrt{3970 \div \frac{22}{7}})$ yd. = 35·541 yd. ∴ width of road = (35·541 − 35) yd.

32. The length contains 3 ft. as many times as the width contains 2 ft. Area of rectangle 3 ft. by 2 ft. = 6 sq. ft. ∴ 240 sq. ft. contains (240 ÷ 6) of these rectangles = 40. ∴ the length = $(\sqrt{40} \times 3)$ ft. = 18·973 ft.

33. Circumference of circular field = $(\frac{22}{7} \times 15)$ rods = $47\frac{1}{7}$ rods, and perimeter of square field = (4 × 14) rods = 56 rods. ∴ square field by $8\frac{6}{7}$ rods.

34. 7, page 112.

Page 114

35. External dimensions are 36 in., 24 in., 18 in. Internal dimensions are 34 in., 22 in., 17 in. No. of cu. in. of material = 36 × 24 × 18 − 34 × 22 × 17 = 2836 cu. in.

36. Side of sq. = $\sqrt{80}$ in. ∴ length = $(\sqrt{80} \div 8)$ in. = 1·118 in.

37. Area field = $(40 \times 5\frac{1}{2} \times 3 \times 30 \times 3)$ sq. ft. ∴ side of sq. = $\sqrt{40 \times 5\frac{1}{2} \times 3 \times 30 \times 3}$ ft. = 243·721 ft.

38. 6, page 112.

39. See page 87.

40. Area = $2\{(9 \times 10) + (10 \times 7\frac{1}{2}) + (9 \times 7\frac{1}{2})\}$ sq. ft. = &c.

41. Rad. = $\frac{7}{44} \times 55$ in. = $\frac{35}{4}$ in. ∴ area of circle = $\frac{22}{7} \cdot (\frac{35}{4})^2$ sq. in. ∴ side of sq. = $\sqrt{\frac{22}{7} \cdot (\frac{35}{4})^2}$ in. = $\frac{35}{4}\sqrt{\frac{22}{7}}$ in. = $\frac{35}{4}\sqrt{3{\cdot}142857}$ in. = 15·512 in.

42. 15, page 112, and 32, page 113.

43. Side of square = 25 yd., sides of rect. = 10 and 40 yd.

44. Side of field = $\sqrt{10 \times 4840}$ yd. = 220 yd. Length of wire = (5 × 4 × 220) yd. = 4400 yd. Cost of wire = \$(4400 × ·03) = \$132. No. of posts to a side = 84. ∴ no. of posts required = 4 × 84 − 4 = 332. Cost of posts = \$(332 × ·08) = \$26·56. ∴ total cost = \$(132 + 26·56) = \$158·56.

45. Cu. ft. = 1728 cu. in. 3 ac. = (3 × 4840 × 9 × 144) sq. in. ∴ thickness = {1728 ÷ (3 × 4840 × 9 × 144)} in. = ·0000918 in.

46. If r is the radius, then $\frac{44}{7}r - 2r = 12$.

47. Side of square = $\sqrt{14}$ in. ∴ dia. = $\sqrt{14} \cdot \sqrt{2}$ in. = $\sqrt{28}$ in. = 5·291 in.

48. Area in sq. ft. = $3 \times 3\frac{5}{8} \times 5\frac{8}{9} = 64\frac{1}{24}$.

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49. Rad. of end in ft. = $\frac{7}{44} \times 22 = 3\frac{1}{2}$. ∴ area of end in sq. ft. = $\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$. ∴ no. of cu. ft. = $\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 40 = 1540$. ∴ no. of cords = 1540 ÷ 128 = $12\frac{1}{32}$.

50. If side of cube be 1 in., when diminished it is $\frac{7}{8}$ in. ∴ new vol. = $(\frac{7}{8})^3$ cu. in. = $\frac{343}{512}$ cu. in. ∴ it is diminished by $\frac{169}{512}$ cu. in., &c.

51. Aisle + row of desks equal at least 44 in. Take one of the outside aisles of the width of the room. ∴ no. of rows = (22 × 12 ÷ 44) = 6.

52. Space = sq. + ¼ circle (rad. in.) + ¼ circle (rad. 6 in.) + ¼ circle (rad. 9 in.) + ¼ circle (rad. 12 in.) = &c. Peri. = ¼ circumference (rad. 3 in.) + &c.

53. No. of sq. ft. = (90 × 15 × 8 × 12 + 60 × 12 × 7 × 14) ÷ 144 = 1450, &c.

54. Dia. stick = $\frac{7}{22} \times 120$ in. = $38\frac{2}{11}$ in. If we deduct 10 in. for slabs and ¼ in. for cut, there will be left as many planks as cuts. ∴ every plank will require $2\frac{1}{4}$ in. ∴ no. planks equals the greatest whole no. in $(38\frac{2}{11} - 10\frac{1}{4}) \div 2\frac{1}{4}$ = 12.

55. Circumference = $\frac{44}{7} \times 12$ in. ∴ length of arc = $\frac{75}{360} \times \frac{44}{7} \times 12$ in. = $15\frac{5}{7}$ in.

56. Area of △s in sq. ch. = 40 × 23 + 40 × 29 = 2080 = 208 ac.

57. Area in sq. yd. $=\frac{1}{2}\times 60\times 280$. Formula page 111.

58. Sector $=\frac{5}{360}$ of the area of $\odot$. $\therefore \pi r^2=\frac{360}{5}\times 230$ sq. ft. $\therefore r=22{\cdot}9545$ ft. and peri. $=2r+\frac{5}{8}\cdot 2\pi.r$.

59. Vol. by first pipe : vol. by second pipe : : 3^2 : $(4\frac{1}{2})^2$ $\therefore$ time $=2\times \frac{3^2}{(4\frac{1}{2})^2}$ hr. $=\frac{8}{9}$ hr.

60. Sector $=\frac{1}{2}\frac{1}{7}\frac{5}{5}$ circle, and arc of sector $=\frac{1}{2}\frac{1}{7}\frac{5}{5}$ circumference $\odot$, but $\pi r^2=275$ sq. in. $\therefore r=5\sqrt{\frac{7}{2}}$ in. $\therefore$ sector $=2\cdot\frac{22}{7}\cdot 5\sqrt{\frac{7}{2}}\times\frac{1}{2}\frac{1}{7}\frac{5}{5}$ in. $=24{\cdot}589$ in.

61. No. of cu. ft. $=\frac{22}{7}\times\frac{3}{2}\times\frac{3}{2}\times 30=212\frac{1}{7}$.

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62. In 1 hr. it travels $2\times\frac{22}{7}\times 11$ ft. $\therefore$ in 1 day it travels $2\times\frac{22}{7}\times 11\times 24$ ft. $=553\frac{1}{7}$ yd.

63. No of cu. in. of lead $=(208\times 160\times\frac{1}{16})=2080$. $\therefore$ cost $=\$(2080\times 6{\cdot}5\div 16\times{\cdot}07)=\$59{\cdot}15$.

64. Let x be the distance. Then from similar triangles (page 90), $\frac{11}{5\frac{5}{8}}=\frac{x+7}{x}$. $\therefore x=6{\cdot}2$ ft.

65. Formula 4, page 110. Area $=(\frac{1}{2}\times 4{\cdot}7\times 1\frac{1}{3})$ sq. ml. $=(\frac{1}{2}\times 4{\cdot}7\times 1\frac{1}{3}\times 640)$ acres.

66. Length of pole : 29 ft. 8 in. $=5$ ft. 10 in. : 7 ft. 5 in., &c.

67. Apply formula page 107.

68. Radius of base of circular cistern $=(20\div\frac{44}{7})$ ft. $=\frac{35}{11}$ ft. Volume of water $=7\times\frac{22}{7}\times(\frac{35}{11})^2$ cu. ft. $=\frac{2450}{11}$ cu. ft. The side of the square base $=(20\div 4)$ ft. $\therefore$ the area of the base $=25$ sq. ft. $\therefore$ the depth of water $=\frac{2450}{11}$ cu. ft. $\div 25$ sq. ft. $=8{\cdot}90$ ft.

69. Apply formula pages 107-8.

70. Slant height $=\sqrt{4^2+9^2}$ ft. $=\sqrt{97}$ ft. and circumference of base $=\frac{44}{7}\times 4$ ft. $=\frac{176}{7}$ ft. $\therefore$ no. of sq. yd. $=(\frac{1}{2}\sqrt{97}\times\frac{176}{7}\div 9)=13{\cdot}75$.

71. The height and radius of base of cone cut off are half of the height and radius of the original cone. ∴ area of base of large cone is 4 times area of base of small one. ∴ the volume of large cone is 8 times that of the small one.

72. Side $\triangle = 12$ in. ∴ area $= 6 \times 6\sqrt{3}$ sq. in In $\odot$ $2\pi r = 36$ in. ∴ $r = \frac{1}{2} \cdot \frac{7}{22} \cdot 36$ in. $= \frac{63}{11}$ in. ∴ area $= \frac{22}{7} \cdot (\frac{63}{11})^2$ sq. in. Diff. in area $= \{\frac{22}{7} \cdot (\frac{63}{11})^2 - 36\sqrt{3}\}$ sq. in. $= 40{\cdot}737$ sq. in.

73. Let r = rad. $4\pi r^2 = 616$ sq. in. ∴ $r^2 = \frac{7}{88} \times 616$ sq. in. $= 49$ sq. in. ∴ $r = 7$ in. Vol. of sphere $= \frac{4}{3} \cdot \frac{22}{7} \cdot 7^3$ cu. in. $= 1437\frac{1}{3}$ cu. in.

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74. Area of $\triangle = 84$ sq. in. Whole area $= 13^2 + 14^2 + 15^2 + 84 = 674$ sq. in. Per. $= 3(13 + 14 + 15)$, or 126 in.

75. Dif. of two spheres whose radii are 2 in. and 1 in.

76. Dia. of sphere = edge of cube, &c.

77. Circumference of wheel $= \frac{22}{7} \times 14$ ft. $= 44$ ft. Distance traversed in 1 hr. $= (44 \times 50 \times 60 \div 5280)$ miles.

78. Dist. trav. in 1 rev. $= 2 \cdot \frac{22}{7} \cdot \frac{7}{2}$ ft. $= 22$ ft., and in $1\frac{1}{2}$ rev. $= 33$ ft. Train goes in 1 sec. 33 ft. ∴ in 1 hr. it goes $(\frac{33}{5280} \times 60 \times 60)$ miles $= 22\frac{1}{2}$ miles.

79. Vol. of cube $= 27$ cu. in. Vol. of one coin $\frac{22}{7} \times \frac{3}{8} \times \frac{3}{8} \times \frac{1}{8}$ cu. in. $= 27 \div (\frac{22}{7} \times \frac{3}{8} \times \frac{3}{8} \times \frac{1}{8}) = 488+$.

80. Vol. of [illegible]re $= \frac{4}{3} \times \frac{22}{7} \times (\frac{9}{2})^3$ cu. in. ∴ wt. $= \frac{4}{3} \times \frac{22}{7} \times (\frac{9}{2})^3 \div 30$ lb. $= 12{\cdot}728$ lb.

81. Let r = rad. of sphere. ∴ $4 \cdot \frac{22}{7} \cdot r^2$ = surface of cylinder $= \{\frac{44}{7} \cdot 4 \cdot 12 + 2 \cdot \frac{22}{7} \cdot 4^2\}$ sq. in. $= \frac{44}{7} \cdot 64$ sq. in. ∴ $r = 4\sqrt{2}$ in. ∴ vol. sphere $= \frac{3}{4} \cdot \frac{22}{7} \cdot (4\sqrt{2})^3 = 758{\cdot}556$ cu. in.

82. Length of cylinder $= (42 - 2 \times 2\frac{1}{2})$ in. $= 37$ in. Vol. of cylinder $= \frac{22}{7}(\frac{5}{2})^2 \cdot 37$ cu. in. Vol. of ends $= \frac{4}{3} \cdot \frac{22}{7}(\frac{5}{2})^3$ cu. in.

83. Let r = rad. of base. Then area of base = $\frac{22}{7}r^2$. Slant height = $\sqrt{r^2+49}$. $\therefore$ curved surface = $\frac{22}{7}r\sqrt{r^2+49}$ = $3\times\frac{22}{7}r^2$. $\therefore$ $r^2=\frac{49}{8}$. $\therefore$ vol. = $\frac{7}{8}\times\frac{22}{7}r^2 = 44\frac{11}{12}$ cu. in.

84. Area of zone = areas of 2 sectors (angle 105°) + area of equilateral $\triangle$ (side 12 ft.) + area of right-angled $\triangle$ (equal sides 12 ft.) = $\frac{105}{180}\times\frac{22}{7}\times144+36\sqrt{3}+72$.

85. 3 (side of cube)^2 = 1 sq. in. $\therefore$ side = $\sqrt{\frac{1}{3}}$ in. = ·577 in.

86. Area of rim = $\frac{22}{7}(3^2-2^2)$ sq. in. = $\frac{22}{7}\cdot5$ sq. in. Area of outer surface = $2\cdot\frac{22}{7}\cdot3^2$ sq. in. Area of inner surface = $2\cdot\frac{22}{7}\cdot2^2$ sq. in. = $\frac{22}{7}\cdot8$ sq. in. $\therefore$ whole surface = $\frac{22}{7}$ (5+18+8) sq. in. = $97\frac{3}{7}$ sq. in.

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87. If radii are 2 in. and 3 in. the vols. are $\frac{4}{3}\times\frac{22}{7}\times2^3$ and $\frac{4}{3}\times\frac{22}{7}\times3^3$ and are $\therefore$ in the ratio of 2^3 to 3^3.

88. Vol. = $(12\times1760\times7\times\frac{5}{3})$ cu. yd. $\therefore$ time = $\{12\times1760\times7\times\frac{5}{3}\div(20\times400)\}$ days = $30\frac{4}{5}$ days.

89. Inner rad. = $\frac{3}{4}$ in., and outer rad. = $1\frac{1}{4}$ in. Area of end = $\frac{22}{7}\{(1\frac{1}{4})^2-(\frac{3}{4})^2\}$ sq. in. = $\frac{22}{7}$ sq. in. No. cu. ft. = $(\frac{22}{7}\div144\times20)$; $\therefore$ weight = $(\frac{22}{7}\times\frac{20}{144}\times\frac{11500}{16})$ lb. $\therefore$ cost = $\$\{\frac{22}{7}\times\frac{20}{144}\times\frac{11500}{16}\times\cdot08\}$ = \$25·099.

90. External vol. = (40×30×20) cu. in., and the internal vol. = (37×27×17) cu. in. $\therefore$ plank contains $\{(40\times30\times20)-(37\times27\times17)\}$ cu. in. = 7017 cu. in. But a sq. ft. of plank contains $(12\times12\times1\frac{1}{2})$ cu. in. = 216 cu. in. $\therefore$ no. sq. ft. = $(7017\div216)=32\frac{35}{72}$.

91. Perp. bisects chord. The $\perp$, $\frac{1}{2}$ chord and radius form a right-angled $\triangle$. $\therefore$ $\frac{1}{2}$ chord = $\sqrt{26^2-10^2}=24$ in.

92. The line joining pt. to centre, the tangent and the radius to the point of contact of tangent and circle, form a right-angled $\triangle$. $\therefore$ tangent = $\sqrt{7^2-4^2}$ ft. = 5·744 ft.

93. The diagonals bisect each other at right angles.

94. Let x = perp. on chord 12 units in length, then $14-x$ = length of other perp. $\therefore\ x^2+6^2=\text{rad.}^2=(14-x)^2+8^2$. $\therefore\ x=8$. $\therefore$ rad. $=\sqrt{8^2+6^2}=10$.

95. Let x = length of corner cut off. $\therefore\ x\sqrt{2}$ = side octagon. $\therefore\ 2x+x\sqrt{2}=40$ yd. $\therefore\ x=\dfrac{40}{2+\sqrt{2}}$ yd. $=20(2-\sqrt{2})$ yd., and $2x^2$ = area of corners cut off $=800(6-4\sqrt{2})$ sq. yd. $=1600(3-2\sqrt{2})$ sq. yd., but area of sq. $=1600$ sq. yd. $\therefore$ area of octagon = diff.

96. Area of zone = areas of 2 sectors (angle 120°) and of 2 equilateral $\triangle$'s (side 8 in.).

97. No. of gal. $=8\times10\times9\times62\frac{1}{2}\div10=4500$.

98. Vol. in cu. ft. $=\frac{22}{7}\times4^2\times4$.

99. Wt. of sphere of water $=(\frac{4}{3}\cdot\frac{22}{7}\cdot3^3\div1728\times62\frac{1}{2})$ lb. $\therefore$ wt. of iron $=8\times(\frac{4}{3}\cdot\frac{22}{7}\cdot3^3\div1728\times62\frac{1}{2})$ lb. $=32\frac{3}{4}\frac{1}{2}$ lb.

100. No. of cu. ft. of ice $=4\times4840\times9\times\frac{1}{2}$. $\therefore$ no. of cu. ft. of water in it $=4\times4840\times9\times\frac{1}{2}\times\frac{10}{11}$. Weight in tons $=4\times4840\times9\times\frac{1}{2}\times\frac{10}{11}\times62\frac{1}{2}\div2000=2475$ tons.

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101. Vol. of earth $=40\times32\times8$ cu. ft. $\therefore$ wt. in tons $=40\times32\times8\times2\times62\frac{1}{2}\div2000=640$ tons.

102. 98, page 118.

103. Vol. of pail $=60\times1728\div62\frac{1}{2}$ cu. in. Area of base $=\frac{22}{7}\times6^2$ sq. in. $\therefore$ depth in in. $=(60\div62\frac{1}{2}\times1728)\div(\frac{22}{7}\times6^2)=14{\cdot}661$.

104. Height cone $=\sqrt{12^2-8^2}$ ft. $=\sqrt{80}$ ft. Vol. $=\frac{1}{3}\cdot\frac{22}{7}\cdot8^2\cdot\sqrt{80}$ cu. ft. = &c.

105. Vol. of water replaced by stone $=\frac{22}{7}\cdot14^2\cdot4$ cu. in. $\therefore$ wt. of stone $=(8\cdot\frac{22}{7}\cdot14^2\cdot4\div1728\times1000)$ oz. = &c.

106. Wt. of water $=449$ lb. $\therefore$ no. gal. $=44{\cdot}9$.

107. No. of cu. ft. emptied per hr $= \frac{1}{4} \times 2000 \div 62\frac{1}{2} = 8$. Area of base $= \frac{22}{7} \times (\frac{7}{2})^2$, or $38\frac{1}{2}$ sq. ft. $\therefore$ height that water rises per hr. $= 8 \div 38\frac{1}{2}$, or $\frac{16}{77}$ ft.

108. Vol. $= 862\frac{5}{7}$ cu. ft. (page 107) $= 5391\frac{27}{28}$ gal.

109. No. revolutions = distance ÷ circumference of wheel $= 55000$ m. $\div (1{\cdot}4 \times 2 \times \frac{22}{7})$ m. $= 6250$.

110. No. sq. metres $= 6{\cdot}175 \times 4{\cdot}12$.

111. Sq. root of $15227{\cdot}56 = 123{\cdot}4$.

112. 18·49 Ha. = 1849 ares = 1849 sq. decametres. $\therefore$ one side is 43 Dm. = 430 m. $\therefore$ perimeter = 1720 m.

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113. Since the cube is a 3-metre cube the area of each face is 9 sq. m. $\therefore$ whole surface is 54 sq. m. = ·54 sq. Dm. = ·54 ares = 54 ca.

114. If the dimensions are 2, 3, 4, linear units, the volume is 24 cubic units. $\therefore$ 8 cubic units = 1 cubic m. $\therefore$ linear unit = a half metre. $\therefore$ whole surface = 52 sq. half m. = 13 sq. m. = ·13 sq. Dm. = ·13 a. = 13 ca.

115. If the block is a metre thick it will cover 4·5 sq. m. $\therefore$ if cut into 100 sections it will cover 450 sq. m. = 4·5 Dm. = 4·5 a.

116. The surface measures 20 Ha. = 2000 a. = 2000 sq. Dm. = 200000 sq. m.; and the thickness is ·03 m. $\therefore$ vol. $= 200000 \times {\cdot}03$ sq. m.

117. A side of the field measures 10 m. $\therefore$ area of field = 100 sq. m. = 1 a.

118. If the length and breadth are 3 and 2 units respectively the area is 6 sq. units. $\therefore$ 1 sq. unit = 4 Ha. = 40000 sq. m. $= (200)^2$ sq. m. $\therefore$ 1 linear unit = 200 m. $\therefore$ length of field is 600 m., and width 400 m. $\therefore$ diag. is $100\sqrt{52}$ m. = &c.

119. The path is 60 m. long and 1·5 m. wide, and $\therefore$ has an area of 90 sq. m. = 90 ca.

120. Area $= 7 \times 7 \times \frac{22}{7}$ sq. m. $= 154$ ca. $= 1{\cdot}54$ a.; smaller portion $= \frac{3}{7}$ of this area $= {\cdot}66$ a.

121. The vol. $= 3 \times 3 \times 3$ cu. m. $= 27$ s.

122. 1 Ks. $= 1000$ cu. m. $\therefore$ edge $= 10$ m. $= 1000$ cm.

123. Vol. $= 40 \times 30 \times \frac{1}{50}$ cu. m. $= 24$ s.

124. 20 cu. units cost \$54. $\therefore$ 1 cu. unit cost \$2·70 = cost of 27 s. $\therefore$ 1 cu. unit $= 27$ s. $= 27$ cu. m. $\therefore$ linear unit $= 3$ m.

125. A vol. of 1 cu. m. has a surface of $\frac{5}{2}$ sq. m. $\therefore$ its depth must be $\frac{2}{5}$ m.

126. The vol. when the water is 1 dm. deep $= 4 \times 2{\cdot}5 \times {\cdot}1$ cu. m. $= 1$ s, which requires 1 min.

127. First tap pours in 10 l. in 6 sec.; the second 50 l. in 20 sec. $= 15$ l. in 6 sec., or 25 l. in 6 sec. for both. Vol. to be filled $= 9$ cu. m. $= 9000$ l. $\therefore$ no. sec. required $=$ 9000 l. $\div$ 25 l. $\times 6 =$ &c.

128. If a piece 1 m. long be cut off its vol. will be $\frac{22}{7} \times (1{\cdot}4)^2$ cu. m. $= 6{\cdot}16$ cu. m. $= 6{\cdot}16$ s. $\therefore$ no. of m. in the length of the log $= 61{\cdot}6$s. $\div 6{\cdot}16$ s.

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129. Length of an edge of the box $= 1$ m. $+ 2 \times 5$ cm. $=$ 1·1 m. $\therefore$ total vol. $= (1{\cdot}1)^3$ cu. m. $= 1{\cdot}331$ s. $\therefore$ vol. of box $= {\cdot}331$ s.

130. The cistern $= 4$ cubes each containing a million litres $=$ one million cu. dm. $= 1000$ cu. m. $\therefore$ an edge of the cube $= 10$ m. $=$ depth of cistern.

131. Sides of the triangle, in dm., are 13, 14, 15, $\therefore$ area $= 84$ sq. dm. $= {\cdot}84$ sq. m. $= {\cdot}84$ ca.

132. The trapezium $=$ a rectangle of the same width and 2 m. long. $\therefore$ width $= {\cdot}375$ m.

133. The height is 10 cm. $\therefore$ vol. $= (\frac{21}{2})^2 \times \frac{22}{7} \times \frac{10}{3}$ cu. cm. $= 1155$ cu. cm. $= 1{\cdot}155$ cu. dm. $= 1{\cdot}155$ l.

134. The height is 60 cm. $\therefore$ vol. $= (40)^2 \times \frac{60}{3}$ cu. cm. $= 32000$ cu. cm., and $\therefore$ its wt. $= 32000 \times 11{\cdot}4$ g. $= 364.8$ Kg.

Miscellaneous Theorems and Applications

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2. Take any number, say, 53768. This number = 53000 + 768. Since 1000 is divisible by 8, any number of thousands must also be divisible by 8. Therefore, any remainder obtained on dividing the number by 8 must result from dividing 768 by 8. Since 768 is divisible by 8, the number must be divisible by 8. The same argument will apply to any number.

5. Since the sum of the digits is the same for both numbers, the remainder must be the same when each is divided by 9. The fractional parts of the quotients obtained by dividing the numbers by 9 are therefore the same, and therefore the difference between the quotients is an integer; but this difference is the same as the quotient obtained by dividing the difference between the numbers by 9.

6. Such a number is evidently divisible by 21.

10. See No. 5.

11. Since it is 3 hours later, the place must be $15° \times 3$, or 45° east of London.

12. The ship must be $15° \times 3\frac{52}{60}$ west of Greenwich, $\therefore$ its longitude is 53° W.

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13. The dif. in long. is 59° 29′. Each degre of long. corresponds to 4 min. in time, and each min. of long. to 4 sec. in time. $\therefore$ the dif. in time is 3 hr. 57 min. 56 sec.

14. The dif. in time corresponds to 17° 43′ in long.

15. The dif. in time is 5 min. ∴ the second steamer must be 1° 15′ w. of the first.

16. The dif. is 8 hr. in time, or 120° in long.

17. The time meridian of Hamilton is 75° W., and of Dawson 135° W., ∴ the dif. is 60° in long., or 4 hours in time.

18. It would be 8 hr. 20 min. after 5 a.m.

19. The time meridian of Kingston is 75° W., ∴ the dif. is 1° 29′ in long., or 5 min. 56 sec. in time. Since Kingston takes the time of a place 1° 29′ east of it, the standard time is faster than the true time.

22. The required number $\div 154 = 45 \div 126$, &c.

25. The first should have paid $\frac{8}{13}$ of \$104 = \$64, &c.

26. If there was but one 50 cent piece the total value would have been \$1·50. But the total sum is 7 times this. ∴ there were 7 50 cent pieces, &c.

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27. When the first gets \$21, the second gets \$27 and the third \$28. ∴ the first receives $\frac{21}{76}$ of \$3648.

28. The sum of their ages 18 years ago was 39 years, ∴ A was then 26 and B 13, &c.

29. It will be divided in the ratio of 33 to 13.

30. If one gal. be taken from each, the mixture would contain $\frac{6}{7} + \frac{5}{6}$, or $\frac{71}{42}$ gal. of wine and ∴ $1\frac{13}{42}$ gal. of water.

31. The cost of 6 lb. of the mixture is \$1.80, or 30c. a lb., &c.

32. Since there is a loss of 3c. per lb. on the coffee and a gain of 15c. per lb. on the chicory, they must be mixed in the ratio of 15 to 3.

33. The mixture is worth \$100, and ∴ must contain $83\frac{1}{3}$ gal. of wine and $16\frac{2}{3}$ of water.

34 The given mixture contains $\frac{96}{100}$ of 75, or 72 pints of alcohol. $\therefore$ $\frac{84}{100}$ of the second mixture = 72 pints. $\therefore$ the second mixture = $72 \times \frac{100}{84}$, or $85\frac{5}{7}$ pints. $\therefore$ $10\frac{5}{7}$ pints of water must be added.

35. B's share = $\frac{3}{4}$ of A's share + \$31·75. $\therefore$ $\frac{7}{4}$ of A's share + \$31.75 = \$338. $\therefore$ A's share = \$175.

36. If they had all been men the amount paid would have been \$270. When a boy is substituted for a man it reduces the amount paid by \$4.50, $\therefore$ the no. of boys = $\frac{\$270 - \$162}{\$4{\cdot}50} = 24$.

37. When B runs 390 yd. C runs 360 yd. $\therefore$ when B runs a mile, C runs $\frac{360}{390}$ of 1760 yd., &c.

38. If A's step is 13 units in length, B's is 11 units. $\therefore$ when A goes 91 units, B goes 99 units. $\therefore$ when B has gone 100 yd., A has gone only $\frac{91}{99}$ of 100 yd., &c.

39. When the first has gone 11 rounds the second has gone 14, and $\therefore$ the second has gained 3 rounds when he has gone 14 rounds, and $\therefore$ he has gained 1 round when he has gone $4\frac{2}{3}$ rounds, &c.

40. When the first has gone 12 rounds, the second has gone 14 and the third 15. They will then be first together.

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41. The faster train travels 20 miles farther each hour than the slower, $\therefore$ they must have met $\frac{135}{20}$, or $6\frac{3}{4}$ hours after starting, and $\therefore$ the distance was $80 \times 6\frac{3}{4}$ miles.

42. To pass the man the train must gain 110 yards. It gains 27 ml. per hr. $\therefore$ it gains 110 yd. in $8\frac{1}{3}$ sec. In the opp. direction it would pass him at the rate of 33 ml. per hr., &c.

43. The train gained 88 yd. on the first person in 10 sec., or 18 ml. per hr. ∴ the rate of the train was 22 ml. per hr. It gained 88 yd. on the second in 9 sec., or 20 ml. per hr. ∴ the rate of the second person was 2 ml. per hr.

44. His rate down stream is 8 ml. per hr. and rate up is 2 ml. per hr. If he goes down 1 ml. and back again, it would take $\frac{1}{8}+\frac{1}{2}$, or $\frac{5}{8}$ hr. ∴ if he takes $2\frac{2}{3}$ hr. he may go down $2\frac{2}{3}\div\frac{5}{8}$, or $4\frac{4}{15}$ ml.

45-7. See Arith., page 131.

48. In $53\frac{1}{2}$ hr. the clock loses 15 min. ∴ in $26\frac{1}{3}$ hr. it will lose $15\times26\frac{1}{3}\div53\frac{1}{2}=7\frac{41}{107}$ min.

49. The work which A does in the 12 days could be done by B in 6 days, and the work that C does in the 12 days could be done by B in 24 days, ∴ B could do the whole work in 42 days, &c.

50. The additional 10 men will work only half the time that the 5 men remained away, &c.

51. The 3 taps would empty $\frac{1}{80}+\frac{1}{100}+\frac{1}{200}$, or $\frac{1}{40}$ of the vessel in 1 min., &c.

52. If the wages of a boy be the unit, then the wages of a woman is $3\frac{1}{3}$, and of a man 5. ∴ the wages of 15 men, 18 women and 26 boys would be 161 units, which is equal to \$64·40. ∴ the unit is 40c., &c.

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53. A man can do $\frac{1}{168}$ and a boy $\frac{1}{294}$ of the work in 1 day. ∴ 7 men and 4 boys can do $\frac{7}{168}+\frac{4}{294}$, or $\frac{65}{1176}$ in 1 day. ∴ they can do the work in $1176\div65$, or $18\frac{6}{65}$ days.

54. There are 40 days' work to do. ∴ one man does $16\frac{1}{2}$ and the other $23\frac{1}{2}$ days' work, and the \$120 is divided in this ratio.

55. The whole work consists of 40 days' work for a man and 100 days' work for a boy, or of 18 days' work for a man and 144 for a boy. ∴ 22 days' work for a man = 44 days' work for a boy. ∴ a man does twice as much as a boy, &c. ∴ 9 boys would do the work in 20 days, or 1 boy would do it in 180 days.

56. If A had worked at the same rate as B he would have earned $\$29.70 \times \frac{10}{11}$, or \$27. ∴ the times they worked are in the ratio of 27 : 30.

57. Suppose A's wages per hour to be the unit, then B's wages per hour would be $\frac{11}{15}$ of the unit. A works $11\frac{3}{4}$ hr. and would earn $11\frac{3}{4}$ units. B works $15\frac{3}{4}$ hr. and would earn $15\frac{3}{4} \times \frac{11}{15} = 11\frac{11}{20}$ units. ∴ they would both earn $23\frac{3}{10}$ units = \$13·98. ∴ the unit = 60c., &c.

58. Suppose A and B had worked as long as C, then the whole work would have been done, and $\frac{3}{10} + \frac{2\frac{1}{4}}{12}$, or $\frac{39}{80}$ of the work a second time. They can all do $\frac{1}{10} + \frac{1}{12} + \frac{1}{15}$, or $\frac{1}{4}$ of the work in 1 day. ∴ they can do $1\frac{39}{80}$ of the work in $1\frac{39}{80} \times 4$, or $5\frac{19}{20}$ days.

59. $20 \times 1\frac{1}{2} \times 18 = 540$.

60. Each contains $18 \times \frac{1}{6} \times 4$, or 12 board feet; 480 feet would cost $\$18 \times \frac{480}{1000} = \$8·64$.

61. Cost = $\$25 \times 28 \times 32 \div 1000 = \$22·40$.

62. Number of feet of lumber = $80 \times 20 \times 2\frac{1}{2}$, &c.

63. Length of the four walls = 120 feet. ∴ amount of lumber = $120 \times 18 \times \frac{5}{4}$, or 2700 feet.

64. Whole length of fence = 2310 ft. and the whole width of the boards = 39 in. ∴ number of feet of lumber = $2310 \times \frac{39}{12}$, &c.

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65. Amount of lumber in planks $= 1320 \times 8 \times 2$ feet. Amount of lumber in scantling $= 1320 \times \frac{3}{12} \times 4 \times 3$ feet. Total $= 25080$ feet, &c.

66. Number of strips required $= 9$, each 21 ft. 9 in. long. $\therefore$ amount of carpet $= 195\frac{3}{4}$ feet, or $65\frac{1}{4}$ yd.

67. 7 strips each, 18 ft. 4 in. long, &c.

68. 8 strips are required, the first being 15 ft. 5 in. long and the others 16 ft. long, &c.

69. It will require 5 strips of carpet each 18 ft. long, or 30 yd. of carpet, costing \$36. Also 74 feet of border costing \$18·50. If the border is cut without waste 4 feet less are required.

70. Each step requires 18 in. of carpet, or 10 yd. in all.

71. Whole length of walls to be papered $= 108 - 18$, or 90 ft., &c.

72. 48 strips each 9 feet long $= 144$ yd. of paper, or 18 single rolls, &c.

73. No. of yd. in walls $= 72 \times 9 \div 9 = 72$, and in ceiling $= 20 \times 16 \div 9 = 35\frac{5}{9}$. Total $= 107\frac{5}{9}$, &c.

74. Area of walls $= 114 \times 12$, or 1368 sq. ft. Area of ceiling $= 30 \times 27$, or 810 sq. ft. Amount deducted $= 51$ sq. ft., &c.

Commercial Arithmetic

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13. 10% of the no. = 13. ∴ 100% of no. = 130.

14. No. of boys = 60% of 60 = 36. ∴ total no. = 96.

15. Weight of oxygen = $11\frac{1}{9}$% of 10 lb. = $1\frac{1}{9}$ lb.

16. $112\frac{1}{2}$% of average last term = 225. ∴ average last term = 200.

17. 114% of no. = 285. ∴ no. = $\frac{100}{114}$ of 285 = 250.

18. $88\frac{3}{4}$% of no. = 710. ∴ no. = $\frac{100}{88\frac{3}{4}}$ of 710 = 800.

19. Weight of water = 1·804 gr. = $\frac{1804}{5000}$ of the whole, or 36·08%.

20. A loaf will now cost 125% of 10c., or $12\frac{1}{2}$c.

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21. 90% of remainder after battle = 360 men. ∴ remainder after battle = 400 men. ∴ 80% of original regiment = 400 men. ∴ original regiment = 500 men.

22. No. = $25400 \times \frac{100}{26 \cdot 3} = 96578$ (to nearest integer).

23. 2nd year's earnings = 105% of 1st year's earnings. ∴ 205% of 1st year's earnings = \$6560. ∴ 105% of 1st year's earnings = $\$6560 \times \frac{105}{205} = \$3360$.

24. $62\frac{1}{2}$ lb. = weight of 1 cu. ft. of water. ∴ 2000 lb. = weight of 32 cu. ft. of water. 32 cu. ft. of water become (110% of 32) cu. ft. of ice, or $35\frac{1}{5}$ cu. ft. of ice.

25. A creditor receives 30% of the debt. He loses 70% of the debt. ∴ he receives $\frac{3}{7}$ of amount of loss; *i.e.*, he receives $42\frac{6}{7}$% of amount of loss.

26. The increased value = 220% of \$4000 = \$8800.

27. He saves $7\frac{1}{2}\%$ of a year's salary in 1 year. $\therefore$ he saves 100% of a year's salary in $\frac{100}{7\frac{1}{2}}$ years, or $13\frac{1}{3}$ years.

28. 10% of greater number $= 20\%$ of smaller number. $\therefore$ $32\frac{1}{2}\%$ of smaller number $= 39$. $\therefore$ smaller number $= 39 \times \frac{100}{32\frac{1}{2}} = 120$. $\therefore$ greater number $= 240$.

29. Moisture $= \frac{29{\cdot}07}{100}$ of 2000 lb. $= 581{\cdot}4$ lb.

30. Imports from Canada $= \frac{38{,}720{,}000}{149{,}459{,}655}$, or $25{\cdot}9\%$.

31. $33\frac{1}{3}\% = \frac{1}{3}$. A's money $= \frac{4}{3}$ of B's money. $\therefore$ B's money $= \frac{3}{4}$ of A's money $= 75\%$ of A's money.

32. 50% of the silver money $= \$1{\cdot}50$. $\therefore$ the silver money was \$3. $\therefore$ the paper money was \$9.

33. The number of girls is $62\frac{1}{2}\%$ of whole number. $\therefore$ 25% of whole number $= 50$. $\therefore$ whole number $= 200$. $\therefore$ no. of girls $= 125$.

34. A does 20% of work in two days, and B does $37\frac{1}{2}\%$ of work in three days. Whole amount done is $57\frac{1}{2}\%$ of work. $\therefore$ $42\frac{1}{2}\%$ of work remains to be done.

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35. $33\frac{1}{3}\%$ of the man's share was worth \$12000. $\therefore$ the man's share was worth \$36000. $\therefore$ 30% of value of mine was \$36000. $\therefore$ value of mine was \$120000.

36. 60% of \$4000 $=$ \$2400. 40% of 3 times the value of the house $=$ \$2400. $\therefore$ 3 times the value of the house $=$ \$6000, or value of the house $=$ \$2000.

37. Suppose the 1st is 10, then the 2nd is 8 and the 3rd 6. $\therefore$ 1440 is divided in the proportion of 10, 8, 6.

38. $\frac{1}{2}$ is 100% of $\frac{1}{2}$. $\therefore$ 1 is 200% of $\frac{1}{2}$. $\therefore$ $\frac{1}{5}$ is 40% of $\frac{1}{2}$.

39. C receives 4% of selling price. $\therefore$ A and B receive 96% of selling price. $\therefore$ A receives 80% of 96% of selling price, or $76{\cdot}8\%$ of selling price.

40. 126 gal. = 504 qts. 2 gal. $1\frac{3}{5}$ qt. = $9\frac{3}{5}$ qt. $\frac{9\frac{3}{5}}{504} = 1\frac{19}{31}\%$.

41. 1 lb. Av. = 7000 grs.; 1 lb. Troy = 5760 grs. He sells 5760 grs. for the cost of 7000 grs. ∴ on 5760 grs. he gains the cost of 1240 grs. ∴ on 1 gr. he gains $\frac{1240}{5760}$ of cost of 1 gr. ∴ he gains $21\frac{19}{36}\%$ of cost.

42. 90% of cost = \$15840. ∴ cost = \$17600. ∴ 110% of actual value = \$17600. ∴ value = \$16000.

43. 3% of half of the number is $1\frac{1}{2}\%$ of the number. ∴ $3\frac{1}{2}\%$ of the number = 21. ∴ the number = 600.

44. 6% of twice the number = 12% of the number. ∴ 17% of the number = 175. ∴ the number = $1029\frac{7}{17}$.

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2. 85% of bill = \$850. ∴ 15% = \$150 = discount.

3. Original amount of bill was \$200; discount was \$30. ∴ rate of discount was 15%.

4. Marked price was \$5 per ream. ∴ price, after discount, was $87\frac{1}{2}\%$ of \$5 per ream. ∴ cash price was 98% of $87\frac{1}{2}\%$ of \$5, or $\$4.28\frac{3}{4}$ per ream.

5. To make a gain of \$3, the article must sell for \$15. ∴ 90% of marked price = \$15. ∴ m.p. = $\$16.66\frac{2}{3}$.

6. $87\frac{1}{2}\%$ of marked price = \$4. ∴ m.p. = $\$4.57\frac{1}{7}$.

7. 80% of marked price = \$3. ∴ marked price = \$3.75.

8. Reduced price = 90% of marked price. Customer pays 90% of reduced price, or 81% of m.p.

9. By previous result 10 and 10% off leaves 81% of original price. But 20% off leaves 80% of original price. Hence difference is 1% of original price, or 12 cents.

10. 95% of marked price = \$7.60. ∴ m.p. = \$8.00. $133\frac{1}{3}\%$ of cost = \$8. ∴ cost = \$6.

 trade discount

11. Marked price = 140% of cost. ∴ selling price = 90% of 140%, or 126% of cost. ∴ 26% of cost = \$2·60.

12. Cost of 150 axes at \$2·50 per dozen is \$31·25. ∴ net cost is 90% of \$31·25, or \$28·12½.

13. 66⅔% of marked price = 30c. ∴ m.p. = 45c.

14. Marked price = 140% of cost. Cash price = 70% of 140% of cost = 98% of cost. ∴ loss was 2% of cost.

15. Giving 16½ oz. for price of 16 oz. equals a discount of ½ on 16½. This is $3\frac{1}{33}$%.

16. See solution of 15.

17. 95% of usual cash price = \$3·42. ∴ usual cash price = \$3·60. ∴ 90% of m.p. = \$3·60. ∴ m.p. = \$4.

18. Nine gallons of mixture contain 1 gallon of water. ∴ he can throw off $\frac{1}{9}$, or $11\frac{1}{9}$%.

19. 45% would reduce the price to \$550; 30% and 20% to \$560.

20. The selling price of one article is $1\frac{2}{5}$, or $\frac{4}{5}$ of the list price of one article. ∴ discount is $\frac{1}{5}$, or 20%.

21. 90% of marked price = 110% of cost. ∴ m.p. = $122\frac{2}{9}$% of cost. ∴ 95% of m.p. = $116\frac{1}{9}$% of cost. ∴ gain is $16\frac{1}{9}$%.

22. 80% of 90% = 72%. ∴ 20 and 10% off = 28%.

23. 90% of 1st reduced price = 85% of original price. ∴ 1st reduced price = $94\frac{4}{9}$% or original price. ∴ discount = $5\frac{5}{9}$%.

24. 90% of reduced price = \$3·60. ∴ reduced price = \$4. ∴ marked price was reduced by \$1, or 20%.

25. Goods sell for 95% of 105% of cost; that is, for $99\frac{3}{4}$% of cost. ∴ loss = ¼%.

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26. 5c. was the discount off 50c., or the rate was 10%. ∴ original price was \$5 and the selling price \$4·05.

27. The article must sell for \$1·75. ∴ 75% of the marked price = \$1·75. ∴ m.p. = \$2·33⅓.

28. 5% of selling price = 4% of list price. ∴ s.p. = 80% of l.p. ∴ 20% of l.p. = 10c. ∴ l.p. = 50c.

29. On Jan. 1st there is no discount; on Nov. 20th the discount is 5%; on Oct. 27th it is 10%.

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5. Gain 1st year = 12½% of \$6000 = \$750. 75% of \$750 = \$562·50. ∴ capital 2nd year = \$6562·50. 20% of \$6562·50 = \$1312·50. ½ of \$1312·50 = \$656·25. ∴ capital 3rd year = \$7218·75. ∴ gain = 40% of \$7218·75 = \$2887·50.

6. The sheep cost \$1920. ∴ they are sold for 120% of \$1920, or \$2304. 5% of 240 = 12. ∴ 228 sheep were sold by the drover for \$2304, or each sheep sold for \$10·10$\frac{10}{19}$.

7. Paper must be sold for 112½% of \$1000, or \$1125. 1200 reams = 24000 quires. 24000 quires sell for \$1125, or 1 quire sells for 4$\frac{11}{16}$c.

8. He loses ⅛ of each gallon bought. ∴ he must sell ⅞ gal. for 20c., or 1 gal. for 22$\frac{9}{7}$c.

9. A gain of 20% on ⅓ of the goods is equivalent to a gain of 6⅔% on the whole amount. A loss of 10% on ⅔ of the goods is equivalent to a loss of 6⅔ on whole amount. ∴ he neither gains nor loses.

10. That which costs 7 cents, is sold for 12 cents. ∴ he gains 5 cents on 7 cents, that is, $\frac{5}{7}$, or 71$\frac{3}{7}$%.

11. ⅔ of the goods sell for cost of the goods. ∴ the goods sell for ⅔ of cost of the goods. ∴ the gain is ½ of the cost, or 50% of the cost.

12. He must sell 80% of a gal. for 120% of cost of a gal. ∴ he must sell one gal. for 150% of cost of a gal. ∴ he must increase cost price by 50%.

13. 90% of cost of flour per hundred = $2·70. ∴ cost per hundred = $3·00. Sold at $2·55, the loss would be 45c. per hundred. 45c. is 15% of $3·00.

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14. 85% of cost = $4·25. ∴ 115% of cost = $5·75.

15. 5% of cost = 20c. ∴ cost = $4·00. ∴ $4·25 = $106\frac{1}{4}\%$ of cost, and gain is $6\frac{1}{4}\%$.

16. At first sale received $112\frac{1}{2}\%$ of original sum invested. At second sale received $112\frac{1}{2}\%$ of $112\frac{1}{2}\%$ of original sum invested. At third sale received 75% of $112\frac{1}{2}\%$ of $112\frac{1}{2}\%$, or $94\frac{59}{64}\%$ of original sum invested. ∴ loss = $5\frac{5}{64}\%$.

17. He sells $\frac{9}{10}$ of original number for $\frac{9}{8}$ of total cost. ∴ at same rate he would sell the original number for $\frac{10}{9}$ of $\frac{9}{8}$, or $\frac{5}{4}$ of cost. ∴ he sells each sheep for $\frac{5}{4}$ of $8, or $10.

18. $\frac{9}{10}$ of the cargo must be sold for cost of cargo. ∴ at same rate, the cargo would be sold for $\frac{10}{9}$ of cost. ∴ advance is $\frac{1}{9}$, or $11\frac{1}{9}\%$ of cost.

19. 110% of cost of 1st = $198. ∴ cost of 1st = $180. 90% of cost of 2nd = $198. ∴ cost of 2nd = $220. ∴ total cost = $400 and loss is 1%.

20. The paper cost $6 per ream. ∴ to gain 20% it must sell for 120% of $6, or $7·20 per ream. ∴ 95% of marked price per ream = $7·20. ∴ marked price per ream = $7·20 × $\frac{100}{95}$. ∴ m.p. per quire = $7·20 × $\frac{100}{95}$ × $\frac{1}{20}$ = $37\frac{17}{19}$c.

21. 125% of cost of 16 qt. = $1·00. ∴ cost of 16 qt. = 80c. ∴ cost of 15 qt. = 75c. Hence gain on 15 qt. would be 25c., or $33\frac{1}{3}\%$.

22. $\frac{2}{3}$ of selling price = $\frac{3}{4}$ of cost price. ∴ selling price = $\frac{9}{8}$ of cost price. ∴ gain = $\frac{1}{8}$ = $12\frac{1}{2}\%$.

23. He sells 11 qt. for 18 times cost of 1 qt. ∴ sells 1 qt. $\frac{18}{11}$ of cost of 1 qt. ∴ he gains $\frac{7}{11}$, or $63\frac{7}{11}\%$.

24. $114\frac{2}{7}\%$ of cost of 1 gal. of mixture = \$1·20. ∴ cost of 1 gal. of mixture = \$1·05. ∴ each gal. of mixture contains $\frac{105}{125}$ gal. of whiskey, and $\frac{20}{125}$ gal. of water. ∴ water is $\frac{20}{105}$, or $\frac{4}{21}$ of amount of whiskey.

25. He sells $15\frac{3}{4}$ oz. for the cost of 16 oz. ∴ he sells 1 oz. for the cost of $\frac{64}{63}$ oz., or for $\frac{64}{63}$ cost of 1 oz. ∴ he gains $\frac{1}{63}$ or $1\frac{37}{63}\%$.

26. For 8 papers he pays 5 cents, and sells the same for 16 cents. He gains $\frac{11}{5}$, or 220%.

27. He must receive 125% of \$180, or \$225. ∴ horse must be sold for \$225 + \$10, or \$235.

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28. She buys 100 for 25c. Ten are lost. She sells the remaining 90 for 54c. ∴ on 25c. she gains 29c., or 116%.

29. B paid 115% of what A paid. ∴ C paid 120% of 115%, or 138% of what A paid. ∴ 38% of what A paid = \$190. ∴ A's cost = \$500.

30. B's cost = $\frac{21}{20}$ of A's cost. C's cost = $(\frac{21}{20})^2$ of A's cost. D's cost = $(\frac{21}{20})^3$ of A's cost. ∴ C's gain was $(\frac{21}{20})^3 - (\frac{21}{20})^2$ or $\frac{441}{8000}$ of A's cost. A's gain = $\frac{1}{20}$ of cost. ∴ $\frac{441}{8000}$ of A's cost = \$5. ∴ $(\frac{21}{20})^3$ of A's cost = $1129\frac{16}{21}$.

31. The gain is 20% of cost. ∴ 20% of cost of 1 bush. = 8c. ∴ cost of 1 bush. = 40c. ∴ selling price = 48c.

32. 110% of cost of 1st cow = \$60. ∴ cost of 1st cow = $\$54\frac{6}{11}$. 125% of cost of 2nd and 3rd cows = \$120. ∴ cost of these two = \$96. $66\frac{2}{3}\%$ of cost of 4th and 5th cows = \$120. ∴ cost of these two = \$180. ∴ total cost was $\$330\frac{6}{11}$; the selling price was \$300. ∴ loss was $\$30\frac{6}{11}$ on $\$330\frac{6}{11}$, or $9\frac{7}{9}\frac{3}{0}\%$.

33. 110% of cost of 1 bush. of mixture = 50c. ∴ cost of 1 bush. = $45\frac{5}{11}$c. On 1 bush. of oats the loss would be $4\frac{6}{11}$c. ∴ on 100 bush. of oats the loss would be $\frac{5000}{11}$c. On 1 bush. of corn the gain would be $5\frac{5}{11}$c. ∴ on ($\frac{5000}{11} \div 5\frac{5}{11}$) bush. of corn the gain would be $\frac{5000}{11}$c. ∴ no. bush. of corn = $83\frac{1}{3}$.

34. 3 articles are sold for 4 times cost of 1 article. ∴ 1 article is sold for $\frac{4}{3}$ of cost of 1 article. ∴ gain is $\frac{1}{3}$, or $33\frac{1}{3}$%.

35. A's increased capital = $\frac{6}{5}$ of sum each invested. B's increased capital = sum each invested + $100. ∴ sum each invested + $100 = $\frac{12}{5}$ of sum each invested. ∴ $\frac{7}{5}$ sum each invested = $100. ∴ sum each invested = $71\frac{3}{7}$.

36. 115% of cost = $16·10. ∴ cost = $14·00. Selling at $20, the gain would be $6, or $\frac{6}{14}$ of cost, or $42\frac{6}{7}$%.

37. The total cost was $88·75. He sells 90% of 315 gal., or $283\frac{1}{2}$ gal. He receives payment for 94% of $283\frac{1}{2}$ gal., or $266\frac{49}{100}$ gal. To make a gain of 40%, he must sell $266\frac{49}{100}$ gal. for 140% of $88·75, or 1 gal. for 46·6 + c.

38. The article is sold for 105% of actual cost. If the cost had been 95% of actual cost, to gain 10% the selling price would have been 110% of 95% of actual cost, that is, $104\frac{1}{2}$% of actual cost. This is $1 less than former selling price. ∴ $\frac{1}{2}$% of actual cost = $1. ∴ actual cost = $200.

39. Jones' present cap. = 120% of $9600 = $11520, which is 75% of Smith's original cap.

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2. S.P. = $6000. Com. = $150. Amt. remitted = $5850.

3. $98\frac{1}{2}$% of S. P. = $65\frac{2}{3}$c. ∴ S. P. = $66\frac{2}{3}$c. per bus.

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4. $32 is com. on $1600. ∴ rate = 2%.

5. S. P. = $1500. ∴ rate = 4%.

6. Com. = $104 on a sale of $5200. ∴ rate = 2%.

7. Com. for selling 1 acre was $\frac{1}{2}\%$ of \$125, or $62\frac{1}{2}$c. $\therefore$ no. of acres $= \$50 \div 62\frac{1}{2}\text{c.} = 80$.

8. Com. on \$10000 is \$75, or $\$\frac{3}{4}$ on \$100, or $\frac{3}{4}\%$.

9. Com. is $2\frac{1}{2}\%$ of \$650, or \$16·25.

10. He must receive \$100 the price of the horse and his com. of 2%, or \$102 in all.

11. He keeps \$5 out of \$105 sent him, or \$25 out of \$525.

12. The amount invested is $\frac{100}{102}$ of sum sent to agent. $\therefore$ amount paid by agent for goods $= \frac{100}{102}$ of $\$1750 = \$1715\frac{35}{51}$.

13. The com. was $\frac{2}{102}$ of \$3570, or \$70.

14. The agent invested \$2400 and retained \$80. $\therefore$ on \$100 invested, his com. was $\$3\frac{1}{3}$. $\therefore$ rate of com. $= 3\frac{1}{3}\%$.

15. He collects \$1000. Com. is \$55. $\therefore$ he pays \$945.

16. He invested $\frac{100}{102}$ of \$1224, or \$1200.

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17. Cost = \$9600. Com. = \$120. Amt. remitted \$9720.

19. S. P. of coal = \$5700. Com. = \$28·50. Net proceeds = \$5671·50. Gross cost of 1M of lumber = \$18·18. $\therefore$ no. of feet bought $= \$5671{\cdot}50 \div \$18{\cdot}18 \times 1000$.

20. S. P. of flour = \$16000. Com. = \$240. Net proceeds = \$15112·50. Gross cost of 1 cwt. of cotton = $\$15{\cdot}11\frac{1}{4}$. $\therefore$ no. of cwt. bought $= \$15112{\cdot}50 \div \$15{\cdot}11\frac{1}{4}$.

21. \$150 is com. on \$12500. $\therefore$ rate $= 1\frac{1}{5}\%$.

22. Gross cost of 1 cwt. of sugar = \$5·30, etc.

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23. S. P. = \$3750. Freight = \$75. Com. = \$75. Net proceeds = \$3600. Gross cost of 1 cwt. of tea = $\$45{\cdot}87\frac{1}{2}$.

24. He receives $4\frac{1}{2}\%$ of sales, or \$54.

25. $4\frac{3}{4}\%$ of sales = \$380. $\therefore$ sales = \$8000.

26. $\frac{3}{4}\%$ of sales = \$40. $\therefore$ sales = $\$5333\frac{1}{3}$.

27. Com. for selling cotton $= \frac{4}{100}$ of selling price of cotton. Com. for buying sugar $= \frac{1\frac{1}{2}}{101\frac{1}{2}}$ of $\frac{96}{100}$ of selling price of cotton $= \frac{288}{2030}$ of selling price of cotton. $\therefore$ two coms. amount to $(\frac{4}{100} + \frac{288}{2030})$, or $\frac{113}{203}$ of selling price of cotton. $\therefore \frac{113}{203}$ of selling price of cotton $=$ \$220. $\therefore$ cotton sold for \$4060.

28. Total cost of 1 cwt. of sugar $=$ \$5·07$\frac{1}{8}$, the com. for buying being 7$\frac{1}{8}$c. But com. on sale of wheat is $\frac{2}{100}$ of amount of sale, or $\frac{2}{98}$ of amount left to purchase sugar. $\therefore$ com. on sale of wheat, sufficient to buy 1 cwt. of sugar $= \frac{1}{49}$ of \$5·07$\frac{1}{8}$. $\therefore$ total com. when 1 cwt. of sugar is bought is 7$\frac{1}{8}$c. $+ \frac{1}{49}$ of \$5·07$\frac{1}{8}$, &c.

29. The first com. is calculated on \$4060. The second com. is calculated on \$3940. $\therefore$ \$120 is the com. on \$4060 + \$3940, or \$8000. $\therefore$ rate is 1$\frac{1}{2}$%.

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31. See solution of 30.

32. See solution of 30.

33. Selling com. is calculated on \$1734. Buying com. on \$1649. Selling com. is 1% of \$1734, together with com. on \$1734 at same rate as in buying. 1% of \$1734 $=$ \$17·34. $\therefore$ \$85 $-$ \$17·34, or \$67·66, is the com. on \$1734 + \$1649, or \$3383, at buying rate. $\therefore$ buying rate $= 2\%$.

34. In buying he paid \$81 + \$79, or \$160 less than he received when selling. The com. was \$2 less. $\therefore$ \$2 is com. on \$160. $\therefore$ rate is 1$\frac{1}{4}$%.

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4. Prem. for 1 yr. $= \frac{7}{8}\%$ of \$4000 $=$ \$35.

5. Prem. for 1 yr. $= \frac{9}{8}\%$ of \$1800 $=$ \$11·25.

6. Policy $=$ \$8000. Prem. for 2 yr. $= 2\%$ of \$8000.

7. Prem. on \$4000 for 1 yr. = \$30. ∴ rate is $\frac{3}{4}\%$.

8. The rate is 2% for 3 yr., or $\frac{2}{3}\%$ yea..y.

9. Policy = \$4000. Prem. for 1 yr. = \$21.

10. Policy = \$937·50. Rate = $1\frac{1}{3}\%$.

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11. $\frac{1}{2}\%$ of policy = \$8. ∴ policy = \$1600. ∴ value = \$2133$\frac{1}{3}$.

12. 1% of policy = \$37·50. ∴ policy = \$3750, which is $\frac{5}{8}$ of value.

14. 1st company received the prem. on \$10000 at $\frac{3}{4}\%$, or \$75, and paid the prem. on \$4000 at $\frac{7}{8}\%$, or \$30.

16. Policy = \$7940 + $\frac{3}{4}\%$ of policy ∴ $99\frac{1}{4}\%$ of policy = \$7940. ∴ policy = \$8000.

17. See solution of 15.

18. Policy = \$15800 + $\frac{5}{8}\%$ of policy + \$100. ∴ $99\frac{3}{8}\%$ of policy = \$15900. ∴ policy = \$16000.

19. See solution of 15.

20. The company receives prem. on \$40000 at $1\frac{3}{4}\%$, or \$700. It pays the prem. on \$16000 at 2%, or \$320, and on \$10000 at $2\frac{1}{4}\%$, or \$225. ∴ it carried a risk of \$14000 for \$155, or $1\frac{3}{28}\%$.

21. Let \$10000 be the risk. See No. 20.

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22. Divide loss in proportion to risk carried. When \$100000 is divided in prop. of 5, 8, 20, the first company loses $\frac{5}{33}$ of \$100000, &c.

23. Prem. on furniture = $\frac{3}{4}\%$ of $\frac{3}{5}$, or $\frac{1}{200}$ of value. Prem. on house = $\frac{3}{4}\%$ of $\frac{4}{5}$ of 5 times value of furniture = $\frac{9}{320}$ of val. of furniture. ∴ total prem. = $\frac{53}{1600}$ of val. of furniture = \$13·25. ∴ val. of furniture = \$2000.

24. See No. 23.

25. Sum of policies = \$45000. Total prem. = \$316⅔. ∴ rate = $\frac{19}{27}$%.

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27. 2½% of policy = \$75. ∴ policy = \$3000. ∴ value = \$4000. ∴ he must sell 500 bbl. for \$4000 + \$1000 + \$75.

28. ⅗% of ¾ of value = \$21. ∴ value = \$4666⅔.

29. He paid out \$2500 + \$9 + \$500 = \$3009. He received \$750 + ⅗ of \$2500 = \$2250. ∴ he lost \$759.

30. Suppose he insures for \$1000. Then the value = \$1000 − 1¼% of \$1000 = \$987·50. He receives ⅘ of \$1000, or \$800, which is \$187·50 less than value. But this is ¼ of the sum given; ∴ the value is \$987·50 × 4 = \$3950.

31. \$3000 = ½ of \$5935 + prem. ∴ prem. = \$32·50.

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32. \$4000 = ⅘ of \$4925 + prem. ∴ prem. = \$60.

33. \$15000 = \$14750 + prem. + \$100. ∴ prem. = \$150.

34. Suppose value = \$12000. 1st Co. received prem. on \$8000 at 1¾%, or \$140, and paid to the 2nd prem. on \$2000 at 1½%, or \$30. ∴ net prem. of 1st Co. = \$110. Loss of 1st Co. = \$6000 − \$110 = \$5890. Loss of 2nd = \$2000 − \$30 = \$1970. Loss of owners = \$4000 + \$140 = \$4140. ∴ 2nd Co. lost \$3920 less than 1st when the owners lost \$4140. ∴ \$49000 less when the owners lost \$4140 × 49000 ÷ 3920 = \$51750.

35. Suppose my brother's is worth \$4800 and mine \$7200. Prem. on mine = \$33·75, and on his \$20. The dif. is \$13·75 when val. of mine is \$7200. ∴ the dif. is \$12 if the val. of mine is \$6283$\frac{7}{11}$.

36. ¼% of policy = \$15. ∴ policy = \$6000. ∴ ½ of val. = \$5985.

37. Policy = \$18000 + 1¼% of policy + \$84. ∴ 98¾% of policy = \$18084. ∴ policy = \$18312·91.

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1. 2% of $5000 = $100.

2. On $1 the tax is 1½c. ∴ on $2500 the tax is $37·50.

3. On $1 the tax is 2c. ∴ on $12000 the tax is $240.

4. On $1000 the tax is $15. ∴ on $2000 the tax is $30.

5. On $1000 the tax is $12·50. ∴ on $750000 the tax is $9375.

6. On $135,000,000 the tax is $1,500,000. ∴ on $1000 the tax is $1,500,000 ÷ 135000 = $11⅑. ∴ rate is 11⅑ mills on the dollar.

7. Tax on $1000 = $18. ∴ tax on $800000 = $14400. Cost of collection = 2% of $14400 = $288. ∴ net taxes = $14112.

8. 98% of tax = $19600. ∴ tax = $20000 on $1,200,000. ∴ tax on $1000 = $20000 ÷ 1200 = $16⅔.

9. His tax will be 1⅘% of $800 = $14·40.

10. His tax is $16, since his assessment is $1000.

11. Tax on $1400 = $21. ∴ net income = $1979.

12. Tax on $1100 is $17·60. ∴ tax on $1000 is $16.

13. 1¾% of his inc. = $28. ∴ his inc. = $1600, which is 25% of his capital. ∴ his cap. = $6400.

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14. On $1400 the tax is $21. ∴ tax on $1000 is $15.

15. Total taxes = $10150, which is 2% of the assessment. ∴ the assessment = $507500.

16. A man whose gross income is $1000 pays tax on $600, which is $9. ∴ his net inc. = $991. The man whose inc. is $995 pays no tax and is ∴ $4 better off.

17. On $255000 tax is $4250. ∴ on $1800 tax is $30.

18. On $930000 tax is $15000. ∴ on $900 tax is $14⅙.

19. $16 is tax on $1000. ∴ $24 is tax on $1500. ∴ inc. = $1900.

20. He pays \$66 taxes, \$22·50 insurance, and loses \$300 interest. ∴ house costs \$388·50 yearly, or \$32·37½ per month.

21. See 18.

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2. Duty on \$290 = \$46½. ∴ duty on \$100 = \$16·03. ∴ rate = 16·03%.

3. Total cost = \$2·96. ∴ he sells for 125% of \$2·96.

4. The cost would be \$2·60. To make the same rate of gain he would sell for 125% of \$2·60 = \$3·25. The amount of gain in (3) is 74c. To make the same amount of gain he would sell for \$2·60 + 74c. = \$3·34.

5. The invoice price and the ad valorem duty = \$360. ∴ 120% of inv. = \$360. ∴ inv. = \$300.

6. Invoice price is \$·40 × 63 = \$25·20. ∴ duty of 15% = \$3·78.

7. With duty the cost per gal. is 46c. ∴ selling price would be 125% of 46c., or 57½c. Selling price, without duty, would be 50c. ∴ reduction = 7½c.

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8. The area of the section is $(\frac{35}{12} \times \frac{1}{2})^2 \times \frac{22}{7}$ sq. ft. ∴ no. of cords in log = $(\frac{35}{12} \times \frac{1}{2})^2 \times \frac{22}{7} \times 30 \times \frac{1}{128}$. ∴ export duty = \$1·50 × $(\frac{35}{12} \times \frac{1}{2})^2 \times \frac{22}{7} \times 30 \times \frac{1}{128}$ = \$2·34+.

9. 1 sq. ft., board measure (*i.e.*, 1 in. in thickness) contains $\frac{1}{12}$ cu. ft., or 1 cu. ft. contains 12 feet, board measure. ∴ the stick contains (20 × 3 × 2 × 12) feet, board measure. ∴ export duty = $\frac{\$2 \times 20 \times 3 \times 2 \times 12}{1000}$ = \$2.88.

10. The specific duty on the tobacco was 30c. × 50, or \$15. ∴ the ad valorem duty was \$2·50. ∴ 12½% of value (invoice) = \$2·50. ∴ value = \$20.

11. 140% of total cost to dealer = \$304. ∴ cost to dealer = \$217$\frac{1}{7}$. The specific duty was \$30. ∴ 115% of invoice price = \$187$\frac{1}{7}$. ∴ invoice price = \$162·73+.

12. If there were no duty, the dealer would sell for 140% of \$162·73+, or \$227·82+. ∴ price would be reduced by \$304 − \$227·82+, or \$76·17+.

13. The whole cost was \$4384, and cartage expenses \$100. ∴ invoice price and ad valorem duty = \$4284. But duty was 20% of 95% of invoice price, or 19% of invoice price. ∴ 119% of invoice price = \$4284. ∴ invoice price = \$3600. ∴ price of 3600 bottles was \$3600.

14. The duty was \$1800 − \$1200 − \$75, or \$525. On \$1200, invoice, the duty was \$525. ∴ rate = 43$\frac{3}{4}$%.

15. If the duty on cases had been also 20%, the total duty would have been 20% of \$30, or \$6. But the duty on cases was 35%. ∴ 15% of invoice price of case was \$7·50 − \$6, or \$1·50. ∴ invoice price of case was \$10.

16. The number of pounds of raisins was 15000. ∴ the specific duty was \$150, and ∴ the ad valorem was \$120. The invoice price was \$1200. ∴ rate of ad valorem duty was 10%.

17. Twice the ad valorem duty, together with \$24 = \$56. ∴ twice the ad valorem duty = \$32. ∴ ad valorem duty = \$16, and specific duty = \$40. \$2 = specific duty on 1 doz. ∴ \$40 = specific duty on 20 doz.

18. The invoice price was \$20. ∴ the ad valorem duty was \$3.00; and hence the specific duty was 75c. ∴ the bale contained 75 sq. yd. ∴ the width was $\frac{3}{4}$ yd.

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19. Cost of a roller is \$1 and of a shade \$2. The ad val. duty on a roller = 30c., and on a shade 30c. The total duty on a shade and roller = \$9·90 ÷ 12 = 82$\frac{1}{2}$c. ∴ specific

duty on a shade is 22½c. ∴ each shade contains 4½ sq. yd. The width is 1½ yd. ∴ the length is 3 yd.

20. Inv. price = $20. ∴ ad val. duty = $3. ∴ specific duty = $12·50, or 12½c. per ft. ∴ wt. per ft. = 2½ lb.

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3. A received ⅓ of the gain and must have supplied ⅓ of the capital, or $4000.

4. Smith received ¾ of the remaining $2000 and ∴ his cap. was ¾ of $8000, or $6000.

5. $1000 is the gain on $4000 cap. ∴ $5000 is the gain on $20000. ∴ D invested $20000.

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7. Page 168.

8. The net gain after paying manager and bookkeeper was $8640 − $1200 − $1050 = $6390. This sum is divided in proportion to each man's investment for 1 month; that is, in prop. to 14400, 12000, 48000, or 6, 5, 20. ∴ C will receive $\frac{20}{31}$ of $6390. C will also receive $600 as manager and $700 as bookkeeper.

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9. A contributes $4000 for 4 mo. and $2000 for 8 mo. = $32000 for 1 mo. B contributes $4000 for 6 mo. and $1000 for 6 mo. = $30000 for 1 mo. C contributes $4000 for 12 mo. = $48000 for 1 mo. Divide the gain in prop. to their investments for 1 mo.

10. A's gain on $100 capital = $32, B's = 40, C's = $48. ∴ gain on $100 in 2 mo. = $8, or $4 per mo. ∴ A's cap. was invested for 8 mo.

11. In 1 month A's gain was $300, B's $200, C's $200. If $300 is gain on $3000, then $200 is gain on $2000.

12. The cap. for the first 4 mo. was \$27000, for the fifth and sixth mo. \$24000, and for the last 6 mo. \$20000. Hardy received, as manager, \$800 for first 4 mo., $\$200 \times \frac{24}{27} \times 2$, or $\$355\frac{5}{9}$, for the fifth and sixth mo., and $\$200 \times \frac{20}{27} \times 6$, or $\$888\frac{8}{9}$ for the last 6 mo. In all, he received $\$2044\frac{4}{9}$ as manager. The balance, $\$3955\frac{5}{9}$, is divided in prop. to investments for 1 mo.

13. Their capitals are in the prop. of 1, 2, 3, 6.

14. B's men did 4000 days' work, C's 3600. ∴ the \$12000 should be divided in the ratio of 10 to 9.

15. A owned $\frac{1}{4}$ of the vessel and lost $\frac{1}{4}$ of his share. ∴ $\frac{1}{16}$ of value of vessel = \$1000. ∴ val. = \$16000. B lost $\frac{1}{4}$ of $\frac{1}{3}$ of \$16000, and C lost $\frac{1}{4}$ of $\frac{5}{12}$ of \$16000.

16. The net cap. is now \$40000, the original cap. was \$20000. ∴ there is a gain equal to cap. ∴ Smith's gain is \$8000.

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17. Suppose the cost of pasturing 1 sheep for a week to be 8 units, then cost of 1 cow is 14 units, and of 1 horse 21 units. Total cost of 3 horses for 9 weeks is 567 units; of 7 cows for 6 weeks is 588, and of 30 sheep for 4 weeks is 960. ∴ total cost = 2115 units = \$176·25. ∴ 567 units = \$47·25.

18. The rent is \$40 a month. Terry paid the first three months' rent, \$120. Terry and Tucker paid the next four months' rent, that is, \$80 each. Terry, Tucker and Taylor paid the next four months' rent, that is, $\$53\frac{1}{3}$ each. Terry and Taylor paid the last month's rent, that is, \$20 each. ∴ Terry paid $\$120 + \$80 + \$53\frac{1}{3} + \$20$, or $\$273\frac{1}{3}$. Tucker paid $\$80 + \$53\frac{1}{3}$, or $\$133\frac{1}{3}$. Taylor paid $\$53\frac{1}{3} + \$20$, or $\$73\frac{1}{3}$.

Stocks

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9. $\$117\frac{3}{4}$ is the selling price of 1 share. $\therefore$ \$4710 is the selling price of $4710 \div 117\frac{3}{4}$, or 40 shares.

10. Net selling price of each share is $\$117\frac{3}{4}$.

11. \$8 is the income on each share.

12. 1 share costs \$91. $\therefore$ no. of shares $= 100$. 1 share sells for $\$91\frac{7}{8}$. $\therefore$ gain is $\$\frac{7}{8}$ per share.

13. Each share cost $\$96\frac{1}{4}$, and sold for $\$94\frac{7}{8}$. $\therefore$ I lost $\$1\frac{3}{8}$ on each share, or \$118·25 on 86 shares.

14. On \$95 I make a gain of \$5, or $5\frac{5}{19}\%$.

15. Same as the preceding.

16. On 1 share I receive \$8. $\therefore$ rate $= 8\%$.

17. \$6 is the inc. from 1 share, or \$240 from 40 sh. Each share costs $\$75\frac{1}{4}$. $\therefore$ 40 shares cost \$3010.

18. 1 share pays \$7 dividend. $\therefore$ 5% of the cost of 1 share $=$ \$7. $\therefore$ 1 share costs \$140.

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19. $4\frac{1}{2}\%$ of the price $=$ \$5. . . price of 1 share is $\$111\frac{1}{9}$. $\therefore$ stock is quoted at $\$111\frac{1}{9} - \$\frac{1}{8} = \$110\frac{7}{72}$.

20. Inc. on 500 shares $=$ \$3000. S.P. $= \$104\frac{3}{4} \times 500$. $\therefore$ no. of shares bought $= 104\frac{3}{4} \times 500 \div 125 = 419$. $\therefore$ income $= \$8 \times 419 = \$3352$, or a gain of \$352.

21. If he had 100 sh. of 3% stock his dividend would be \$300. The 100 sh. sell for \$6700, which will buy 67 shares at par, and will pay \$268 div. His div. is thus reduced \$32 when he has 67 shares of 4%'s, or \$480 when he has 1005 sh.

22. Similar to the preceding.

23. To gain \$150 on 48 sh. I must gain $\$3\frac{1}{8}$ per sh.

24. His dividend is \$4 per sh., or $\frac{1}{30}$ of the cost of the sh. $\therefore$ the second div. $= \frac{31}{30}$ of the first. But the second is \$496. $\therefore$ the first is \$480.

25. 1 sh. pays \$3 div. ∴ net inc. after paying tax is \$2·94, which is $3\frac{1}{2}\%$ of cost of sh.

26. Int. on mortgage = 6% of \$1,600,000 = \$96000. Dividend = \$5 × 24000 = \$120000. ∴ net income = \$216000. ∴ 35% of yearly gross receipts = \$216000, &c.

27. The amount of preference stock is 5000 sh. and the div. on it is \$40000. The balance, \$15000, will pay \$3 per sh. on the 5000 ordinary sh.

28. In the former \$1 is the inc. from $\$128\frac{1}{8} \div 6$, or $\$21\frac{17}{48}$ invested, and in the latter from $\$99\frac{1}{8} \div 5$, or $\$19\frac{33}{40}$. ∴ the latter is better.

29. The net gain is \$60000. 3% on the whole stock would require \$30000. ∴ the additional 5% on the pref. shares requires \$30000. ∴ no. of pref. shares = 6000.

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30. The div. = 8% of \$200000 = \$16000, which is 5% of the increased cap., which is ∴ \$320000.

31. No. of shares = 80. ∴ selling price = \$7200. \$2400 invested at 96 buys 25 shares and pays \$87·50 div. \$4800 invested in 5% stock at par pays \$240 div. ∴ total div. = \$327·50.

32. The stock sold at \$90. ∴ $112\frac{1}{2}\%$ of cost = \$90. ∴ cost = \$80 per sh., or 20% discount.

33. If \$4 is the inc. from \$100, \$3 is the inc. from \$75.

34. He gets 500 sh. of $5\frac{1}{2}\%$ stock, the div. on which is \$2750. He gets 500 sh. of $7\frac{1}{2}\%$ stock, the div. on which is \$3750. The brokerage on 1000 sh. is $\$\frac{1}{4} \times 1000 = \$250$.

35. 150 sh. pay \$750 div. ∴ div. from 2nd stock = \$810. ∴ no. of sh. of 2nd stock = 810 ÷ 6 = 135, which cost \$120 × 135 = \$16200. ∴ selling price per sh. of 1st stock = \$16200 ÷ 150 = 108.

36. 15 mills on the $\$ = 1\frac{1}{2}\%$. $98\frac{1}{2}\%$ of taxable inc. = \$1379. ∴ taxable inc. = \$1400, and whole inc. = \$1800. \$5 is the inc. from \$115 invested, ∴ \$1800 is the inc. from \$41400.

37. On 1 sh. bought at $\$88\frac{1}{8}$ and sold at $\$91\frac{7}{8}$ the gain is $\$3\frac{3}{4}$, or \$300 is the gain on 80 sh.

38. If he invested \$1200 in 6% stock at 120 his inc. would be \$60, and from \$1800 in 5% stock at 100, the inc. would be \$90. Total income would be \$150, which is $\frac{1}{6}$ of the given total. ∴ he invested \$7200 in 1st stock.

39. Inc. from stock = \$48. Inc. from interest = $4\frac{1}{2}\%$ of \$1080 = \$48·60. Loss = 60c.

interest

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4. From May 1st to Nov. 14th is 197 days. ∴ the interest is $\$1400 \times \frac{8}{100} \times \frac{197}{365}$, or \$60·449.

5. The time is 1 year and 300 days, or 666 days. ∴ the interest is $\$1650 \times \frac{6}{100} \times \frac{666}{365}$, or \$180·64.

6. The time is 1 year and 195 days, or 560 days. ∴ the interest is $\$1275 \times \frac{8}{100} \times \frac{560}{365}$, or \$156·493. ∴ the amount is \$1275 + \$156·493 or \$1431·493.

7. The interest is $\$5500 \times \frac{4}{100} \times \frac{1}{2}$, or \$110. ∴ the amount of the payment is \$5610.

8. The interest on \$550 for 2 years is \$44. ∴ on \$550 for 1 year is \$22. ∴ on \$100 for 1 year is $\$22 \times \frac{100}{550}$, or \$4.

9. 146 days = $\frac{2}{5}$ of 1 year. The interest on \$840 for $\frac{7}{5}$ year is \$58·80. ∴ the interest on \$650 for 2 years is $\$58{\cdot}80 \times \frac{5}{7} \times \frac{1}{840} \times 2 \times 650$, or \$65.

10. The interest on \$1440 for $1\frac{2}{3}$ years is \$72. ∴ on \$100 for 1 year is $\$72 \times \frac{3}{5} \times \frac{100}{1440}$, or \$3. ∴ the rate is 3%.

11. The interest on \$400 for 3 years is \$448 − \$400, or \$48. ∴ on \$100 for 1 year is $\$48 \times \frac{1}{4} \times \frac{1}{3}$, or \$4.

12. See solution of 11.

13. The time is 73 days. The interest on \$1500 for 73 days is \$15. ∴ on \$100 for 365 days is \$5.

14. The interest is \$600 − \$500, or \$100. The int. for 1 year is \$500 × ·04, or \$20. ∴ the no. of years is $\frac{100}{20}$, or 5.

15. See solution of 14.

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16. The interest is \$100. ∴ the time is 100 ÷ 6, or $16\frac{2}{3}$ years. The amount is double the principal. ∴ \$579·89 amounts to \$1159·78 in the same time.

17. 4% of the principal is the interest for 1 year. ∴ 100% of the principal is the interest for 25 years. ∴ any sum of money will double itself in 25 years.

18. $\frac{3}{100}$ of the principal is the interest for 1 year. ∴ the principal is the interest for $\frac{100}{3}$, of $33\frac{1}{3}$ years.

19. The interest for 1 year is $\frac{4}{100}$ or $\frac{1}{25}$, of the sum loaned. ∴ the interest for 3 years is $\frac{3}{25}$ of the sum loaned.

20. The interest for 1 year is ·05 of the principal. ∴ the interest for 4 years is ·2, or $\frac{1}{5}$, of the principal.

21. (*a*) For 1 year the fraction is $\frac{7\frac{1}{2}}{100}$, or $\frac{15}{200}$. ∴ for 4 years the fraction is $\frac{3}{10}$. (*e*) For 1 year the fraction is $\frac{8}{100}$, or $\frac{2}{25}$. ∴ for $\frac{1}{2}$ year the fraction is $\frac{1}{25}$. (*g*) For 1 year the fraction is $\frac{1}{10}$. ∴ for 292 days, or $\frac{4}{5}$ year, it is $\frac{2}{25}$.

22. $\frac{1}{12}$ of the sum loaned is the interest for 1 year. ∴ the sum loaned is the interest for 12 years.

23. $\frac{5}{100}$ of the sum loaned is the interest for 1 year. ∴ the sum loaned is the interest for 20 years.

24. $6\frac{1}{4}$% of the sum loaned is the interest for 1 year. ∴ the sum loaned is the int. for $100 \div 6\frac{1}{4}$, or 16 years.

25. 4% of the sum loaned is the interest for 1 year. ∴ the sum loaned is the interest for 25 years. ∴ twice the sum loaned is the interest for 50 years.

26. The rent for a year amounts to \$240. The rent amounts to $6\frac{1}{4}\%$ and $1\frac{1}{4}\%$ of the value; that is, to $7\frac{1}{2}\%$ of the value. $\therefore$ $7\frac{1}{2}\%$ of value = \$240. $\therefore$ value = \$3200.

27. The taxes and the interest = 9% of the value = \$720. $\therefore$ rent for 12 months = \$720. $\therefore$ rent for 1 month = \$60.

28. The interest on \$511000 for 365 days, or 1 year = \$280 × 73. $\therefore$ the int. on \$100 for 1 year $= \frac{\$280 \times 73}{5110} = \$4$.

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29. If the 1st rate was 1%, the total int. would be \$4 + \$10, or \$14. $\therefore$ 1st rate is 2%.

30. If the 1st rate was 1%, the total int. would be \$6 + \$36 = \$42. $\therefore$ 1st rate is $\frac{1}{4}\frac{0}{2}\frac{5}{}$, or $2\frac{1}{2}\%$.

31. If the 1st rate was 1%, the total int. would be \$1.25 + \$5·06¼ = \$6·31¼. $\therefore$ 1st rate is 25·25 ÷ 6·31¼, or 4%.

32. Interest = \$2. $\therefore$ amount = \$102.

33. Interest for 9 mo. at 4% = 3% of principal. $\therefore$ 103% of principal = \$540·75. $\therefore$ principal = \$525.

34. $102\frac{1}{2}\%$ of principal = \$820. $\therefore$ principal = \$800.

35. 103% of principal = \$1339. $\therefore$ principal = \$1300.

36. The amount of taxes = \$750. Interest for 219 days at 6% = $\frac{3}{3}\frac{1}{6}\frac{9}{5}$ of 6% of principal = $3\frac{3}{5}\%$ of principal. $\therefore$ $103\frac{3}{5}\%$ of sum deposited = \$750. $\therefore$ sum = \$723·93+.

37. \$1500 in 9 months at 8% amounts to 106% of \$1500, or \$1590. $\therefore$ \$1650 in 9 months is the better offer.

38. The interest on \$250 in the time = \$25. $\therefore$ the interest on \$250 for half the time = $\$12\frac{1}{2}$. $\therefore$ $\$262\frac{1}{2}$ is the amount of \$250 for half the time. $\therefore$ \$275 is the amount of $\$261\frac{1}{2}\frac{9}{1}$ for half the time.

39. Int. for 4 mo. at 8% = $2\frac{2}{3}\%$ of principal. $\therefore$ $102\frac{2}{3}\%$ of principal = \$462. $\therefore$ principal = \$450.

40. The int. = 11% of prin. $\therefore$ 111% of prin. = \$506·16.

41. A offers \$2180, payable at end of 3 years. B offers \$455 now, \$455 at end of 1 year, \$455 at end of 2 years, and \$455 at end of 3 years. These sums at end of 3 years amount to \$568¾, \$530⅚, \$492½, and \$455: in all \$2047½, at end of 3 years. C offers \$1600 cash, this amounts to \$2000 in 3 years. ∴ A's offer is the best.

42. Amount of \$1200 for 1 year at 5% = \$1260. Amount of \$1260 for 1 year = \$1323. Amount of \$1323 for 1 year = \$1389·15. ∴ at end of 3 years I must pay \$1389·15.

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43. The yearly income from the business was 15% of \$15000, or \$2250. He loaned 90% of \$15000, or \$13500. ∴ yearly interest was 8% of \$13500, or \$1080. ∴ loss in yearly income was \$2250 − \$1080, or \$1170.

44. At the end of 6 months he must pay [illegible]. In 6 months, at 6%, \$2800 amounts to \$2884. [illegible] gain, at end of 6 months, is \$384.

45. The interest for 7½ years is $\frac{5}{16}$ of the sum loaned. ∴ the interest for 1 year is $\frac{5}{16} \div 7\frac{1}{2}$, or $\frac{1}{24}$ of sum loaned. ∴ interest for 2 years is 4⅙% of sum loaned. ∴ rate is 4⅙%.

46. The interest on \$100000 for 1 month = the interest on \$1000 for 100 months = the interest on \$5000 for 20 months. ∴ ⅔ of the interest on \$100000 for 1 month = the interest on \$5000 for ⅔ of 20 months = the interest on \$5000 for 1⅓ years.

47. The interest on \$1·33⅓ for the time is \$·33⅓, or \$⅓. The interest on \$1·33⅓ for 1 year at 5% is \$$\frac{1}{15}$. ∴ \$⅓ is interest for 5 years.

48. He sold the flour for 112½% of \$2000, or \$2250. The interest for 6 months at 5% is equal to 2½% of the sum. ∴ 102½% of sum deposited = \$2250. ∴ sum = \$1951·21. ∴ he had left \$2250 − \$1951·21, or \$298·78.

49. The interest for 12 months = 6% of principal. ∴ the interest for 2 months = 1% of principal. ∴ the interest for any number of months is equal to 1% of the principal multiplied by or ½ of the number of months.

Bank Discount

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1. Six months after Mar. 1st is Sept. 1st. ∴ day of maturity is Sept. 4th. From June 4th to Sept. 4th is 92 days. ∴ discount is $\$1000 \times \frac{5}{100} \times \frac{92}{365}$, or \$12·60. ∴ proceeds = \$1000 − \$12·60 = \$987·40.

2. Three months after Jan. 15th is April 15th. ∴ day of maturity is Apr. 18th. From Feb. 1st to Apr. 18th is 76 days. ∴ discount is $\$1250 \times \frac{6\frac{1}{2}}{100} \times \frac{76}{365} = \$16·92$. ∴ proceeds = \$1233·08.

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8. Sixty days after Feb. 14th, 1909, is April 15th. ∴ day of maturity is April 18th. The note is discounted 63 days before it is due. ∴ discount = \$2356·50 × $\frac{6}{100} \times \frac{63}{365} = \$24·40$. ∴ proceeds = \$2332·10.

11. The date of maturity is May 9th. The interest on \$480 for 92 days at 5% = $\$480 \times \frac{5}{100} \times \frac{92}{365} = \$6·05$. ∴ the amount of the note is \$486·05. The time from Feb. 18th to May 9th is 80 days. ∴ discount = \$486·05 × $\frac{6}{100} \times \frac{80}{365} = \$6·39$. ∴ proceeds = \$486·05 − \$6·39 = \$479·66.

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14. See Arith., page 184.

15. The interest for 1 year is $\frac{5}{100}$ of sum loaned. ∴ the int. for 73 days is $\frac{1}{100}$ of sum.

16. For 95 days the int. is $\frac{95}{365}$ of $\frac{6}{100}$, or $\frac{57}{3650}$ of face of note.

17. The note is due in 95 days. ∴ the discount is $\frac{95}{365}$ of $\frac{6}{100}$, or $\frac{57}{3650}$, of face value of note.

18. The discount is $\frac{73}{365}$ of $\frac{10}{100}$, or $\frac{1}{50}$, of face value.

19. The discount is $\frac{90}{365}$ of $\frac{6}{100}$, or $\frac{27}{1825}$, of face value of note. ∴ seller of note receives $\frac{1789}{1825}$ of face value.

20. The discount is $\frac{60}{365}$ of $\frac{8}{100}$, or $\frac{24}{1825}$, of face value. ∴ $\frac{1821}{1825}$ of face value = \$360·20. ∴ face value = \$365.

21. The note is due Sept. 4th. ∴ it is discounted 95 days before due. The discount is $\frac{95}{365}$ of $\frac{8}{100}$, or $\frac{38}{1825}$, of face value. ∴ $\frac{1787}{1825}$ of face value = \$870. ∴ face value = \$888.50.

22. The note is due Sept. 28th. ∴ it is discounted 117 days before it is due. The discount is $\frac{117}{365}$ of $\frac{6}{100}$, or $\frac{351}{18250}$, of the face value. ∴ $\frac{17899}{18250}$ of face value = \$357·98. ∴ face value = \$365.

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23. The discount was \$730 − \$724·60 = \$5·40. ∴ the discount for 365 days would be \$5·40 × $\frac{365}{45}$, or \$43·80. ∴ the discount from \$730 for 1 year is \$43·80. ∴ the discount from \$100 for 1 year is \$6. ∴ rate is 6%.

24. The discount from \$1000 for 73 days is \$10. ∴ the discount from \$1000 for 365 days is \$50. ∴ the discount from \$100 for 1 year is \$5. ∴ rate is 5%.

25. The discount for 58 days was \$20·30. ∴ discount for 365 days would be \$127·75. ∴ discount from \$100 for 1 year would be \$127·75 × $\frac{100}{1825}$, or \$7. ∴ rate is 7%.

26. The discount was $\frac{20}{1460}$, or $\frac{1}{73}$ of the face value of the note. ∴ the discount for 1 year would be $\frac{1}{73} \times \frac{365}{40}$, or $\frac{1}{8}$ of face value. ∴ rate of discount = 12½%.

27. The note is due Sept. 2nd. ∴ it is discounted 80 days before due. ∴ discount is $\frac{80}{365}$ of $\frac{8}{100}$, or $\frac{32}{1825}$, of face value. ∴ $\frac{1793}{1825}$ of face value = \$358·60. ∴ face value = \$365.

28. The discount from \$1460 for 1 year would be \$87·60. The discount was \$1460 − \$1448·48, or \$11·52. \$87·60 is discount for 365 days. ∴ \$11·52 is discount for $365 \times \frac{1152}{8760}$, or 48 days. ∴ note was due 48 days after May 23rd.

29. The discount from \$292 for 1 year would be \$23·36. The discount was \$2·88. ∴ the discount was calculated for $365 \times \frac{288}{2336}$, or 45 days. ∴ note was legally due 45 days after Dec. 20th, that is on Feb. 3rd. ∴ the note was made 93 days before Feb. 3rd, or on Nov. 2nd.

30. The interest on the note = $\$1200 \times \frac{6}{100} \times \frac{63}{365}$ = \$12·43. ∴ amount of note = \$1212·43. ∴ discount = $\$1212{\cdot}43 \times \frac{6}{100} \times \frac{63}{365}$ = \$12·56. ∴ proceeds = \$1212·43 − \$12·56 = \$1199·87.

31. Suppose the face of the note is \$365. Then the discount for 93 days is \$6·51. ∴ the bank pays \$358·49 for the note. ∴ on \$358·49 the bank receives \$6·51 interest in 93 days. ∴ on \$100 in 1 year they would receive \$7·127 +.

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13. From Jan. 1st to Mar. 15th is 73 days. The interest is $\$400 \times \frac{6}{100} \times \frac{73}{365}$, or \$4·80. ∴ the note at this date amounts to \$404·80. The payment is \$20. ∴ the balance of the note on Mar. 15th is \$384·80. From Mar. 15th to July 10th is 117 days. The interest on \$384·80 for 117 days is \$7·40, which is more than the payment made. From Mar. 15th to Sept. 20th is 189 days. The interest is $\$384{\cdot}80 \times \frac{6}{100} \times \frac{189}{365}$, or \$11·96. The amount

of the note is \$384·80+\$11·96, or \$396·76. The two payments amount to \$156. ∴ the balance of the note on Sept. 20th is \$240·76. From Sept. 20th to Dec. 24th is 95 days. The interest is $\$240{\cdot}76 \times \frac{6}{100} \times \frac{95}{365}$, or \$3·76. ∴ the balance on Dec. 24th is \$240·76+\$3·76, or \$244·52.

16. The interest on \$950, from Jan. 25th to March 2nd, 1908, 37 days, is \$6·74. Principal and interest amount to \$956·74. The payment is \$225. ∴ the balance is \$731·74. The interest on \$731·74, from Mar. 2nd to May 5th, 64 days, is \$8·98. ∴ the amount on May 5th is \$740·72. The payment is \$174·19. ∴ the balance on May 5th is \$566·53. The interest on \$566·53, from May 5th to June 29th, 55 days, is \$5·98. ∴ the amount on June 29th is \$572·51. The payment is \$187·50. ∴ the balance on June 29th is \$385·01. The interest on \$385·01, from June 29th, 1908, to Jan. 1st, 1909, 186 days, is \$13·73. ∴ the amount due on Jan. 1st, 1909, is \$398·74.

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1-8. See solutions on pages 192-3.

9. He is entitled to the use of \$2400 for 6 mo., or \$14400 for 1 mo. He has had the use of \$800 for 3 mo., and \$600 for 5 mo., or \$5400 for 1 mo. ∴ he should still have the use of \$9000 for 1 mo. ∴ he should keep the balance, \$1000, for 9 mo.

10-11. See page 193.

12. See No. 9.

13. I am entitled to the use of \$2400 for 30 days, and \$800 for 60 days, or \$120000 for 1 day. ∴ I should keep the balance, \$1000, for 120 days.

14. I owe him the use of \$16000 for 1 day. He must allow me the use of \$30000 for 1 day. ∴ I ought to have

the use of \$14000 for 1 day, or the whole debt, \$2000, for 7 days.

15. Suppose the debt is \$1000 and see No. 14.

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16. Count time from June 20th. \$500 is due in 30 days; \$600 in 29 days; \$450 in 102 days; \$800 in 141 days. The equated time is 82 days; that is, Sept. 10th.

17. The equated time of the debit side is $63\frac{2}{3}$ days, counting from May 1st. The equated time of the credit side is $27\frac{2}{3}$ days, counting from May 1st. Jones should pay \$2400 in $63\frac{2}{3}$ days; the payments made are equal to \$1500 paid in $27\frac{2}{3}$ days. The interest on \$2400 for $63\frac{2}{3}$ days = interest on \$153000 for 1 day. The interest on \$1500 for $27\frac{2}{3}$ days = interest on \$41500 for 1 day. Jones should have the interest on \$111500 for 1 day, or the interest on the balance, \$900, for 124 days. ∴ balance should be paid 124 days after May 1st; that is, Sept. 2nd.

18. The amount of \$900 at 8% per annum, from Sept. 2nd to Jan. 1st, is \$923·87.

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7. The balance to his credit on each succeeding Jan. 1st will be: \$204, \$312·16, \$424·646, \$541·632, \$663·297, \$689·83.

8. The amount of \$1 is $\$(1{\cdot}04)^3 = \$1{\cdot}124864$. ∴ \$·124864 is the int. on \$1. ∴ \$150 is the int. on \$150 ÷ ·124864 = \$1201·31.

9. The amount of \$1 is $(1{\cdot}04)^4 + (1{\cdot}04)^3 + (1{\cdot}04)^2 + (1{\cdot}04)$ dollars, that is, \$4·4163. ∴ the amount of \$150 is \$4·4163 × 150, or \$662·45.

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10. The amount at simple interest is 1·15 of the principal. The amount at compound interest is 1·157625 of the principal. ∴ the difference is ·007625 of the principal. ∴ difference on \$1275 is \$1275 × ·007625, or \$9·72.

11. The amount at simple interest is 1·24 of the principal. The amount at compound interest is 1·26247696 of the principal. ∴ the difference of interest is ·02247696 of the principal. This difference is \$100. ∴ the principal = \$100 ÷ ·02247696 = \$4449.

12. In 4 years, at 4% per annum, the amount is $(1·04)^4$ of the principal. ∴ the principal = \$1200 ÷ $(1·04)^4$ = \$1025·72.

13. The amount of \$1200 = \$1200 × $(1·03)^4$ = \$1350·61.

14. The amount = \$1450 × $(1·025)^3$ = \$1561·49. ∴ the interest = \$1561·49 − \$1450 = \$111·49.

15. Interest for 73 days, or $\frac{1}{5}$ of a year, is ·01 of the principal. ∴ amount of \$1 in 2 years and 73 days is \$1 × $(1·05)^2$ × (1·01), or \$1·113525. ∴ int. = 11·3525 cents.

16. In 2 years and 3 months, at 4% per annum, the amount is $(1·04)^2$ × (1·01) of the principal; that is, 1·092416 of the principal. ∴ the interest is ·092416 of the principal. ∴ the principal = \$400 ÷ ·092416 = \$4328·25.

17. The population at the end of 4 years is $(1·1)^4$ of that at the beginning; that is, 1·4641 of that at the beginning. The increase is ·4641 of original population. ∴ the original population was 13923 ÷ ·4641, or 30000. ∴ present population is 43923.

18. Amount = \$1789·25 × $(1·04)^6$ = \$1789·25 × 1·26532. (See page 265).

19. Amount = \$1 × $(1·06)^8$(1·04).

21. The amount in $2\frac{1}{2}$ years, at 4%, is $(1{\cdot}04)^2 \times (1{\cdot}02)$, or 1·103232 of the principal. ∴ the principal = \$16989·7728 ÷ 1·103232 = \$15400.

22. The amount in 4 half-years, at 2% each half-year, is $(1{\cdot}02)^4$, or 1·08243216, of the principal. ∴ the principal = \$10824·3216 ÷ 1·08243216 = \$10000.

23. The amount is $(1{\cdot}05)^2 \times (1{\cdot}01)$, or 1·113525, of the principal. ∴ the interest is ·113525 of the principal. ∴ the principal = \$82·82 ÷ ·113525 = \$729·53.

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24. In 7 years the amount is $(1{\cdot}1)^7$, or 1·9487+, of the principal. In 8 years the amount is $(1{\cdot}1)^8$, or 2·1435+, of the principal. ∴ the sum of money will double itself in a little more than 7 years.

25. The difference between the interest for the second year and that for the third year is the interest on the second year's interest; that is, is the interest on the first year's interest and the interest on \$1. ∴ \$·05 is the interest on \$1 for 1 year. ∴ the rate is 5%.

26. At 3% per half-year, the amount in 1 year is $(1{\cdot}03)^2$, or 1·0609 of the principal. ∴ 6·09% compounded yearly equals 3% per half-year.

27. The amount at the end of a half-year is obtained by multiplying the principal by a certain fraction. ∴ the square of this fraction = 1·06. ∴ the fraction = $\sqrt{1{\cdot}06} = 1{\cdot}029+$. ∴ rate per half-year is 2·9+%.

28. The interest = ·21550625 of the principal. ∴ the amount = 1·21550625 of the prin. ∴ the amount in 1 year is found by multiplying the principal by the fourth root of 1·21550625, which is 1·05. ∴ rate = 5%.

29. The amount in 2 years, at 10% yearly, is $(1{\cdot}1)^2$, or 1·21, of the principal. The amount in 2 years, at 5%

half-yearly, is $(1{\cdot}05)^4$, or 1·21550625. ∴ the difference, or ·00550625 of prin. = \$55·0625. ∴ the prin. = \$10000.

30. The table on page 264 shows that \$1 amounts to \$2 at $2\frac{1}{2}\%$ in 28+ years, and at 7% half-yearly in 20+ half-years, or in 10+ years.

31. See table page 265.

32. \$1 amounts to \$2·40622 in 18 yr. ∴ rate is 5%.

33. \$1 would amount to \$2·0122. ∴ time = 12 yr.

34. Amount of \$1 is \$1·2 in 4 years. ∴ in 8 yr. the amount of \$1 is $\$1 \times (1{\cdot}2)^2 = \$1{\cdot}44$, and in 2 yr. the amount is $\$1 \times \sqrt{1{\cdot}2} = \$1{\cdot}0955$. ∴ the amount of \$100 in 8 yr. is \$144, and in 2 yr. is \$109·55

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11. The P. W. of \$100, due in 2 years $= \$100 \div (1{\cdot}05)^2 = \$90{\cdot}702$; of \$150, due in 3 years $= \$150 \div (1{\cdot}05)^3 = \$129{\cdot}575$; of \$200, due in 4 years $= \$200 \div (1{\cdot}05)^4 = \$164{\cdot}540$. ∴ the debt would be paid now by \$384·82.

12. The P. W. of the 1st quarter's rent $= \$25 \div 1{\cdot}01$, of the 2nd $\$25 \div 1{\cdot}02$, of the 3rd $\$25 \div 1{\cdot}03$, and of the 4th $\$25 \div 1{\cdot}04$. Total P. W. = \$97·572.

13. The amount of \$100 in 3 mo. at 6% = \$101·50. ∴ the discount off \$101·50 is \$1·50. ∴ \$7·75 is the discount off $\$101{\cdot}50 \times 7{\cdot}75 \div 1{\cdot}50 = \$524{\cdot}42$.

14. P. W. of \$3140 due in 8 mo. = \$3000. Cash price = 95% of \$3140 = \$2983. ∴ latter is better by \$17.

15. P. W. of \$133·65 due in 3 mo. = \$132.

16. Cash cost = P. W. of \$255 due in 3 mo. = \$250. ∴ gain on \$250 is \$5. ∴ rate of gain is 2%.

17. P. W. of \$4·18 due in 9 mo. = \$4. ∴ cash price is 5c. better.

18. Cash value of A's offer = \$7·21; of B's = \$7·14.

19. Cash cost = \$405. Cash selling price = \$427·09. ∴ gain on \$405 is \$22·09, or 5·45%.

20. Cash value of goods at time of sale = \$1545 ÷ 1·02 = \$1514·706. Cash selling price = \$1600.

21. I pay now \$5000, and \$5300 at the end of a year. The P. W. of \$5300, due in 1 year, is \$5300 ÷ 1·05, or \$5047·62. ∴ the present cost of the farm is \$10047·62. I receive at the end of 3 months \$12120. The present worth of \$12120 due in 3 months, is \$12120 ÷ 1·0125, or \$11970·37. ∴ my present gain is \$1922·75.

22. The int. on \$100 in 9 mo. = \$6. ∴ the bank discount = 6% of \$530 = \$31·80. The true discount on \$106 is \$6. ∴ on \$530 it is \$30. ∴ diff. = \$1·80.

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23. On \$103 the true discount = \$3 and the bank discount is \$3·09. ∴ 9c. is the dif. on \$103, or 90c. on \$1030.

24. The P. W. = \$200. ∴ the int. on \$200 is \$10 in 6 mo. and would be \$20 in 12 mo. ∴ the amount of \$200 is \$220 in 12 mo. ∴ the true discount off \$220 is \$20. ∴ the true discount off \$210 = \$20 × 210 ÷ 220 = \$19 $\frac{1}{11}$.

25. See solution on page 202.

26. There are three interest payments each of \$180. ∴ present value $= \frac{\$180}{1{\cdot}025} + \frac{\$180}{(1{\cdot}025)^2} + \frac{\$180}{(1{\cdot}025)^3} + \frac{\$4000}{(1{\cdot}025)^3}$.

27. See solution on page 202.

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1. 20s. = \$4·86$\frac{2}{3}$. ∴ 21$\frac{1}{2}$s. = \$5·23.

2. (a). The premium is $\frac{1}{4}$% of \$3560 = \$8·90. ∴ cost = \$3568·90.

3. Prem. on \$3750 = \$1·50. ∴ cost = \$3751·50.

4. \$100$\frac{1}{4}$ buys a draft for \$100. ∴ \$7500 will buy a draft for \$7481·30.

5. A draft for \$100 would cost \$99. ∴ rate is 1% discount.

6. Net proceeds = \$850 − $\frac{1}{10}$% of \$850 = \$849·15.

7. Cost will be \$465 + 1% of \$465 + 50c. = \$470·15.

12. If \$1100 = 5742 fr. ∴ \$1 = 5·22 fr.

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13. Cost = $1\frac{7}{8}$d. × 12000 = 17250d. = \$4·86$\frac{2}{3}$ × 17250 ÷ 240 = \$349·79.

14. Cost = \$1 × 1500 ÷ 5·16 = \$290·70.

15. £1200 = \$4·80$\frac{2}{3}$ × 1200 = \$5764·50.

16. £1 = \$$\frac{40}{9}$ × $\frac{109\frac{1}{8}}{100}$. ∴ £1500 = \$7275.

17. $\frac{108}{100}$ of \$$\frac{40}{9}$, or \$4·80 = £1. ∴ \$2400 = £500.

18. If £1500 = \$7300, ∴ £1 = \$4·86$\frac{2}{3}$, which is 109$\frac{1}{2}$% of \$$\frac{40}{9}$. ∴ exchange is quoted at 9$\frac{1}{2}$

19. £1 = \$$\frac{49}{9}$ × $\frac{109\frac{3}{8}}{100}$ = \$$\frac{175}{36}$. 294000 fr. = \$$\frac{175}{36}$ × $\frac{100}{2530}$ × 294000 = \$56510·76, the interest on which is \$2920, which is 5·16%.

20. By the circuitous exchange, \$10000 = 10000 × 5·4 × $\frac{100}{185}$ × $\frac{35}{2}$ × $\frac{1}{220}$ pounds = £2321 17s. 4d. By direct exchange £1 = \$$\frac{44}{9}$. ∴ \$10000 = £2045 9s. 1d. ∴ £276 8s. 3d.

21. The agent's com. = \$12·50. ∴ proceeds = \$12187·50. \$99$\frac{1}{4}$ pays for a draft for \$100. ∴ \$12187·50 pays for a draft for \$12275.00.

22. 1800 fr. = £$\frac{1800}{25·2}$ = \$$\frac{1800}{25·2}$ = 342·857.

23. \$1 = $\frac{1}{4·866564}$ pound = $\frac{971}{564}$ florins = 2·487 fl.

General Problems

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1. Cost of keep = \$1·75 × 11 × 17. ∴ total cost = \$327·25 + \$253 = \$580·25. Selling price = \$52[illegible]

2. Interest = $\$1022 \times \frac{93}{365} \times \frac{5\frac{1}{2}}{100}$

3. A should receive $\frac{1000}{6750}$ of \$9[illegible]·25.

4. The third gets $1 - \frac{2}{5} - \frac{1}{3}$, or $\frac{4}{15}$ the farm. If $\frac{4}{15}$ of the farm cost \$1884, then [illegible] will cost 2826.

5. Cost of 10 apples = 12c. [illegible] ∴ gain = 25%.

6. Duty = ½c. × 7200 + ½ of ½c. × 720 = \$36 + \$108.

7. Area in acres = 1200 [illegible] = 7[illegible]. ∴ cost = 70c. × 7½.

8. Com. = 85c × 3500 × $\frac{7\frac{1}{2}}{100}$ = \$133·87½.

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9. Simple interest [illegible] Compound int. = \$400 $(1·07)^3$ − \$400.

10. 40 shares will cost \$87½ × 40 = \$3485.

11. 85% of cost \$[illegible]. ∴ cost = $\frac{100}{85}$ of \$153 = \$180.

12. Total cost = [illegible] + \$21 = \$45. S.P. = \$50.

13. Side in rods [illegible] = 20. ∴ cost = 50c. × 20 × 4.

14. First should get [illegible] of \$720 = \$180.

15. Cost = 4½s. × 4000 = £900 = \$4·87 × 900.

16. Premium = ⅞% of \$18000 = \$157·50.

17. No. of shares = 5100 ÷ 85 = 60. ∴ inc. = \$4½ × 60.

18. Apply formula, page 87.

19. Total S.I. [illegible] 5.11. Cash discount = \$5·11 ÷ 20.

20. The maj. is 2 on every 12 votes polled. ∴ the number of votes polled was 240 × 12 ÷ 2 = 1440.

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21. Int. = \$15.07 on \$137 in 2 years, ∴ int. on \$100 in 1 yr. = \$15·07 × $\frac{100}{137}$ × $\frac{1}{2}$ = \$5½.

22. Specific duty = 12c. × 450 × 110 = \$5940. Ad valorem duty = 21c. × 450 × 110 × $\frac{1}{10}$ = \$1039·50.

23. No. of strips = 9, each 21 ft. long. ∴ no. of yd. = 60.

24. Goods costing \$100 are marked at \$120 and sold for \$120 − 40% of \$120 = \$72. ∴ loss is 28%.

25. 3% of liabilities = \$480. ∴ liabilities = \$16000.

26. No. of shares bought = 5176·50 ÷ 76⅛ = 68. ∴ brokerage = \$⅛ × 68 = \$8·50.

27. They will receive $\frac{5}{7}$, $\frac{7}{24}$ and $\frac{1}{24}$, respectively, of \$4669.

28. If they worked the same time, A would do $\frac{6}{5}$ as much as B. ∴ the \$22 is divided in the ratio of 6 : 5.

29. If the goods cost \$100, he first asked \$75 and afterwards sold them for $\frac{5}{4}$ of \$75, or \$93¾, thus losing 6¼%.

30. The taxes on \$500 at \$18 per \$1000 = \$9. ∴ net inc. = \$891.

31. Side of field = 110 yd. ∴ length of walk in yd. = 440 − 4 = 436. Area of walk = 436 sq. yd. ∴ cost = 15c. × 436.

32. Int. for 1 yr. = \$11·84. ∴ no. of yr. = 33·39 ÷ 14·84.

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34. On every \$72 invested he makes \$3, &c.

35. Asking price = $\frac{5}{4}$ of cost, and S. price = $\frac{86}{100}$ of asking price = $\frac{86}{100}$ of $\frac{5}{4}$ of cost = $\frac{43}{40}$ of cost. ∴ $\frac{3}{40}$ of cost = \$170. ∴ $\frac{43}{40}$ of cost = $\frac{43}{3}$ of \$170 = \$2436⅔.

36. The net taxes on \$1000 = \$18·62, &c.

37. If \$12 be deducted, the balance may be divided between A and B in the ratio of 1 to 2, &c.

38. Cost of 7 lb. tea $=7\times\frac{3}{2}$ of coffee $=7\times\frac{3}{2}\times\frac{6}{14}$ of cocoa, &c.

39. 22% on 80% of the goods $=17{\cdot}6\%$ on all. $\therefore$ $17{\cdot}6\%$ of the invoice $=\$633{\cdot}60$.

40. 97% of debt $=\$1008{\cdot}80$. $\therefore$ $96\%=\frac{96}{97}$ of $\$1008{\cdot}80$.

41. Cost of goods $=\$53{\cdot}60\times\frac{100}{2}=\$2680$. $\therefore$ the amount remitted $=\$2680+\$53{\cdot}60$.

42. Cost of 8 lb. of the mixture $=\$3{\cdot}60$. $\therefore$ the selling price of 8 lb. $=\$3.60\times\frac{108}{100}$.

43. A supplies $\frac{32}{117}$ of the cap. and $\therefore$ receives $\frac{32}{117}$ of the gain.

44. Cost $=18\text{c.}\times16\times12\frac{1}{4}\div9$.

45. Loss $=\frac{3}{8}$ of $\$3200-\frac{1\frac{3}{4}}{100}$ of $\frac{3}{8}$ of $\$3200=\$1179$.

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46. Interest $=\$39(1{\cdot}04)^{16}-\$39=\$39\times1{\cdot}87298-\$39=\$34{\cdot}046$. See table, page 265.

47. Wholesale price $=115\%$ of cost. $\therefore$ retail price $=110\%$ of 115% of cost $=126\frac{1}{2}\%$ of cost. $\therefore$ gain $=26\frac{1}{2}\%$.

48. $\frac{3}{4}\div\frac{1}{2}$ of $\frac{5}{6}=\frac{3}{4}\times\frac{3}{1}\times\frac{6}{5}=\frac{9}{5}$, $\frac{3}{4}\div\frac{1}{2}\times\frac{5}{6}=\frac{3}{4}\times\frac{2}{1}\times\frac{5}{6}=\frac{5}{4}$.

49. In $22\frac{1}{2}$ sec. the train goes $18\times1760\times22\frac{1}{2}\div3600$, or 198 yd. $\therefore$ length of bridge $=198$ yd. -90 yd.

50. The weight of each will be $\frac{33}{48}$, $\frac{7}{48}$, $\frac{5}{48}$, respectively, of 60 lb.

51. Rad. of base $=\frac{7}{44}$ of 9 ft. $=\frac{63}{44}$ ft. $\therefore$ vol. $=\frac{1}{3}\cdot4\cdot\frac{22}{7}\cdot\left(\frac{63}{44}\right)^2$ cu. ft.

52. If cost $=\$100$, gain $=\$20$, $\therefore$ selling price $=\$120$. $\therefore$ gain $=\frac{1}{6}$, or $16\frac{2}{3}\%$ of selling price.

53. Amount of \$100 in 9 mo. at $7\frac{1}{2}\%=\$105\frac{5}{8}$. $\therefore$ the true discount on $\$105\frac{5}{8}=\$5\frac{5}{8}$, $\therefore$ disct. on $\$422{\cdot}50=\$22{\cdot}50$.

54. Decimal $=\frac{714285}{999999}=\frac{142857\times5}{142857\times7}=\frac{5}{7}$. See page 52.

55. 115% of prin. = \$373.75. ∴ prin. = \$373·75 × $\frac{100}{115}$.

56. Prem. rec'd = $\frac{7}{400}$ of risk. Prem paid. = $\frac{9}{400}$ of $\frac{3}{5}$ of risk = $\frac{6}{400}$ of risk. ∴ net prem. = $\frac{1}{400}$ of risk = \$4.30. ∴ risk = \$1720.

57. Had he worked 40 days he would have received \$16. By being idle he lost \$8.40. Each day he was idle he lost 56c. ∴ he was idle $\frac{840}{56}$, or 15 days.

58. Balance after 1st payment = \$15000 + \$750 − \$2500 = \$13250. Balance after 2nd payment = \$13250 + \$662·50 − \$2500 = \$11412·50. Balance after 3rd payment = \$11412·50 + \$570·625 − \$2500 = \$9483·125.

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59. 3 lengths require 2 cuts and 4 lengths 3. For 2 cuts the cost is \$2 per cord. ∴ for 3 cuts the cost is \$3.

60. \$14 = tax on \$1000. ∴ \$7 = tax on \$500. ∴ salary = \$900.

61. Square of the greater = 35643 × 3. ∴ greater = 327.

62. Assets = \$3000 × $\frac{65}{1000}$ + \$50 = \$2000.

63. Let \$500 be the face of the note. Then the discount = \$500 × $\frac{73}{365}$ × $\frac{8}{100}$ = \$8. ∴ the banker pays \$492 for the note. ∴ the int. on \$492 in 73 days is \$8.

64. Cost = \$22.50. Selling price = \$22·50 × $\frac{114}{100}$ = \$25·65. No. of lb. sold = 375 × $\frac{9}{10}$ = 337½.

65. When the discount is 40% the selling price is 60% of list price. When the discounts are 20, 10, 10, the selling price = $\frac{80}{100}$ × $\frac{90}{100}$ × $\frac{90}{100}$, or $\frac{81}{125}$, or 64·8% of list price.

66. The no. of strips = 11 ft. ÷ ¾ yd. = $4\frac{8}{9}$, *i.e.*, 5 strips. Since the pattern is 8 ft. long each strip will require 24 ft. of carpet with the exception of one, which will only require 20 feet. ∴ 116 feet or 38⅔ yd. of carpet are required. No. of sq. yd. in room = 20 × 11 ÷ 9 = $24\frac{4}{9}$. No.

of sq. yd. of carpet $= 38\frac{2}{3} \times \frac{3}{4} = 29$. $\therefore$ no. of sq. yd. wasted $= 29 - 24\frac{4}{9} = 4\frac{5}{9}$.

67. Bank discount $= \$508 \times \frac{27}{100} = \$137{\cdot}16$. True discount $= \$508 \times \frac{27}{127} = \$108$.

68. 2% of his whole income $= \$18{\cdot}28 + 2\%$ of $\$400 = \$26{\cdot}28$. $\therefore$ his income $= \$1314$. $\therefore$ his capital $= \$1314 \times \frac{100}{8} = \$21900 = £\frac{21900}{4.86\frac{2}{3}} = £4500$.

69. 5 cents will buy $\frac{5}{7}$ of a quart of milk. $\therefore$ each quart contains $\frac{2}{7}$ of a quart of water. $\therefore$ the ratio is 2 to 5.

70. Saving $= \$7950 \times \frac{3}{75} - \$7950 \times \frac{4}{106} = \$18$.

71. Sum $= \$12750 \div (1{\cdot}05)^4$. Divide 4 times by 1·05.

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72. If the value is \$1000, the premium $= 2\%$ of \$600 $= \$12$. Expenses $= 60c.$ $\therefore$ total cost $= \$12{\cdot}60$ when the value is \$1000. $\therefore$ \$75·60 is cost when value is \$6000.

73. A draft for \$347·50 will cost $\$347{\cdot}50 \times \frac{98}{100}$.

74. 120% of cost of one $= 75c.$ $\therefore$ it cost $\frac{100}{120}$ of 75c. $= 62\frac{1}{2}c.$ 80% of cost of the other $= 75c.$ $\therefore$ it cost $\frac{100}{80}$ of 75c. $= 93\frac{3}{4}c.$ $\therefore$ total cost $= \$1{\cdot}56\frac{1}{4}$. $\therefore$ loss $= 6\frac{1}{4}c.$

75. Actual cost is the principal which will amount to \$510 in 3 mo. at 8%, which is \$500.

76. If 4s. 2d. or 50d. $= \$1$, then 1d. $= 2c.$, 1s. $= 24c.$, and £1 $= 4{\cdot}80$. $\therefore$ value $= \$4{\cdot}80 \times 350 + 24c. \times 5 + 2c. \times 7\frac{3}{4}$.

77. Square of no. of bush. $= 1849$. $\therefore$ no. $= 43$.

78. Let the liabilities be \$1200 and assets \$400. But \$100 of assets realize only \$40. $\therefore$ on \$1200 of liability he pays \$340. $\therefore$ on \$1 he pays $28\frac{1}{3}c.$

79. The note is due on Oct. 18th, and is $\therefore$ discounted for 113 days. $\therefore$ discount $= \frac{113}{365} \times \frac{6}{100}$, or $\frac{678}{6125}$ of the face. $\therefore$ the proceeds $= \frac{5809}{6125}$ of the face $= \$560$. $\therefore$ the face $= \$560 \times \frac{6125}{5809}$.

80. If he had sold all at \$4 he would have realized \$540. He makes \$1 more on each bbl. sold for \$5. ∴ he makes \$(615 − 540) more on 75 bbl. sold at \$5.

81. A's capital is \$2400 for 1 mo., and B's is \$2100. ∴ the gain is divided in the ratio of 8 to 7.

82. In 10 years he earns \$400×3 + \$475×3 + \$550×3 + \$625 = \$4900. By the other method he would earn \$400 + \$425 + ... to 10 terms = \$5125.

83. 2% of the risk = \$360·50. ∴ risk = \$18025. ∴ the value = \$18025 × $\frac{5}{2}$ = \$45062·50.

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84. The number must be a multiple of 2, 3, 5, 6, 8 and 12, or 120. It must also be a perfect square, that is, every prime in 120 must be squared. The prime factors of 120 are 2^3, 3, 5. ∴ the least number is 2^4, 3^2, 5^2, or 3600.

85. Assessment = \$3000. ∴ tax on \$1000 = \$17. ∴ rate is 17 mills on the dollar.

86. The selling price = $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{8}{100}$, or $\frac{24}{800}$, or 33$\frac{1}{3}$% of list price.

87. Int. = \$48 $(1{\cdot}04)^{16}$ − \$48. See table, page 265.

88. Pres. value of 68c. due in 3 mos. = $\frac{68c}{1{\cdot}02}$ = 66$\frac{2}{3}$c. ∴ gain = 1$\frac{1}{3}$c. per lb.

89. Consumer's price = \$9875 × $\frac{11}{10}$ × $\frac{8}{5}$ × $\frac{5}{4}$ = \$16293·75.

90. $\frac{97}{100}$ of total taxes = \$33950. ∴ taxes = \$35000 on \$2800000. ∴ tax on \$1000 = \$12$\frac{1}{2}$. ∴ rate = 12$\frac{1}{2}$ mills.

91. L. C. M. = 11154 ÷ 13 = 858. See page 14.

92. Pres. val. of \$5 = $\frac{100}{103\frac{1}{2}}$ of \$5 = \$4·83.

93. Discount = \$52·65, which is 1$\frac{1}{8}$% of \$4680.

94. Int. for 7 mo. = \$11·20. ∴ int. for 9 mo. = \$14·40. ∴ sum = \$334·40 − \$14·40 = \$320. On \$320 the int. is

\$11·20 in 7 mo. ∴ int. on \$100 in 1 yr. $= \$11{\cdot}20 \times \frac{100}{80} \times \frac{12}{7} = \$6$. ∴ rate $= 6\%$.

95. The discount $= \frac{63}{365}$ of $\frac{8}{100}$, or $\frac{126}{9125}$ of the face. ∴ the proceeds $= \frac{8999}{9125}$ of the face $= \$719{\cdot}92$. ∴ the face $= \$719{\cdot}92 \times \frac{9125}{8999} = \$730$.

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96. See solution, page 202.

97. ($\frac{2}{5}$ of $\frac{1}{5} + \frac{7}{20}$ of $\frac{4}{5}$) or $\frac{9}{25}$ of the invoice price $= \$810$. ∴ the invoice price $= \$2250$.

98. No. of shares $= 7140 \div 84 = 85$. Gain on each $= \$11$.

99. 82% of cost $= \$24{\cdot}60$. ∴ cost $= \$30$. ∴ gain $= 20\%$.

100. See page 202.

1. Cost of 4 lb. $= \$2{\cdot}10$. S.P. $= \$3.20$. ∴ gain $= \frac{11}{21}$, or $52\frac{8}{11}\%$.

2. If he had 3 \$10 bills, 4 \$5 bills, 6 \$4 bills, the total value would be \$74. But the value is 7 times \$74. ∴ he had 21 \$10 bills, &c.

3. Page 162.

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4. 32, page 113.

5. The least number divisible by 4, 5, 9, 12, is 180, which $= 2^2 . 3^2 . 5$. To make this a cube the additional factors $2 . 3 . 5^2$ must be introduced, making $(2 . 3 . 5)^3$, or 27000.

6. Divide the sum in the ratio of 17 to 9.

7. If 3780000 is represented by 3, then 6700000 is represented by $3 \times 6700000 \div 3780000 = 5{\cdot}3$, which is nearer 5 than 6, &c.

8. The risks are in the proportion 2 : 3 : 4, ∴ the loss is divided in the same ratio.

9. Simple int. $= \$58{\cdot}50$. Compound int. $= \$57{\cdot}3048$.

10. Length of walls = 60 ft. ∴ no. of strips = 24. 10 ft. ÷ 18 in. = $6\frac{2}{3}$. ∴ each strip is 7 times the length of the pattern, or $3\frac{1}{2}$ yd. ∴ no. of yd. = $3\frac{1}{2} \times 24 = 84$.

11. 65, page 219.

12. No. of shares = $2304 \div 96 = 24$. Net selling price = $\$94\frac{3}{8} \times 24 = \$2265$. Dividend = $\$1\frac{1}{2} \times 24 = \$36$. ∴ loss = $\$2304 - \$2265 - \$36 = \$3$.

13. Out of each \$105 he invests \$100. ∴ amount invested = $\frac{100}{105}$ of \$4200 = \$4000.

14. $\frac{4}{5}$ of the oil is sold at 120% of its cost realizing $\frac{4}{5}$ of 120%, or 96% of the whole cost.

15. 63, page 219.

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16. 128% of cost per M = \$21·12. ∴ cost = $\frac{100}{128}$ of \$21·12 = \$16·50. ∴ gain would be 50c. × 36·84 = \$18·42.

17. 3% of taxes = \$172·80. ∴ taxes = \$5760 on \$320000. ∴ taxes on \$1000 = $\$\frac{5760}{320}$ = \$18.

18. If both rates had been the same as the first the interest would have been \$8·24 less. ∴ interest on \$787 at the rate of the first = \$39·35. ∴ first rate is 5%.

19. A invests \$2 for B's \$3; B invests \$3 for C's $\$1\frac{5}{4}$; C invests $\$1\frac{5}{4}$ for D's $\$\frac{35}{8}$. ∴ the capital is divided in the proportion of 2, 3, $1\frac{5}{4}$ and $\frac{35}{8}$, or 16, 24, 30, and 35.

20. The duty on \$1278 is \$159·75, or $12\frac{1}{2}$%.

21. His wages for the other 3 months would be \$15.

22. The net earnings = \$290056, which will pay \$4 per share on 72514 shares.

23. He has left, after paying board, $\frac{7}{10}$ of \$1200 = \$840; after paying rent $\frac{1}{3}$ of \$840 = \$672; after paying for clothes $\frac{85}{100}$ of \$672 = \$571·20; after paying for books \$500; after paying loan \$300, or 25% of salary.

24. Selling price of 50 oz. $= \frac{50 \times 50}{49}$ or $51\frac{1}{49}$c. $\therefore$ gain on 49c. is $2\frac{1}{49}$c.

25. 36c. more would have given 3c. more to each.

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26. A and B can do $\frac{1}{8}$ of the work in 1 day; B and C $\frac{1}{10}$, and C and A $\frac{1}{12}$. $\therefore$ twice the work done by A, B and C, in 1 day, is $\frac{1}{8}+\frac{1}{10}+\frac{1}{12}$, or $\frac{37}{120}$. $\therefore$ they do $\frac{37}{240}$ of work in 1 day, or the whole work in $\frac{240}{37}$ days.

27. Area of outer circle $= \frac{22}{7} \times 400$ sq. yd. Area of inner $= \frac{22}{7} \times 18^2$. $\therefore$ area of walk $= 238\frac{6}{7}$ sq. yd.

28. Com. for selling $= 3\%$ of \$5100 $=$ \$153. Com. for buying $= 1\frac{2}{102}$ of (\$5100 $-$ \$153) $=$ \$97.

29. 98% of the taxed income $=$ \$465·50. $\therefore$ the taxed income $=$ \$475.

30. Prem. $=$ \$48. $\therefore$ loss $=$ \$48 $+ \frac{2}{5}$ of \$4000.

31. He bought 50 shares and $\therefore$ brokerage was $\$\frac{1}{2}$ per share.

32. Average gain on whole $= 5\%$ of cost $=$ \$63·50.

33. One sq. in. on map $= 64$ sq. miles. $\therefore 1\frac{5}{16} \times 1\frac{1}{8}$ sq. in. $= 64 \times 1\frac{5}{16} \times 1\frac{1}{8} \times 640$ ac. $= 60480$ ac.

34. If the cost is \$100, the selling price $= 130\%$ of \$75 $=$ \$97·50. $\therefore$ loss is \$2·50 on \$100, or $2\frac{1}{2}\%$.

35. Duty $= 24\%$ of $\frac{9}{10}$ of \$1·40 $\times$ 150 $=$ \$45·36.

36. 81, page 220.

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37. Interest for $5\frac{1}{2}$ yr. at the first rate $=$ \$45 $\times \frac{5\frac{1}{2}}{3} =$ \$82·50. $\therefore$ interest for $5\frac{1}{2}$ yr. at $2\% =$ \$27·50.

38. Area $= 6400$ sq. rods. $\therefore$ length of side $= 80$ rods. $\therefore$ length of diagonal $= 80\sqrt{2}$ rods.

39. When B goes 95 yd. C goes 90 yd. ∴ when B goes 100 yd. C goes $\frac{90}{95}$ of 100 yd. $= 94\frac{14}{19}$ yd. ∴ B wins by $\frac{5}{19}$ yd.

40. If the tea cost \$1 per lb., he sells 12 lb. for \$17, or \$1·41⅔ per lb. ∴ he gains 41⅔%.

41. A can do $\frac{1}{5}$ of the work in 1 day, B $\frac{1}{6}$ and C $\frac{1}{7}$. ∴ the money is divided in the proportion of $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, or 42, 35, 30. ∴ A gets $\frac{42}{107}$ of \$21·40.

42. The interest $= \$187(1{\cdot}04)^{13} - \$187$. Use tables.

43. The manager receives $\frac{1}{8} + \frac{1}{3}$ of $\frac{7}{8}$, or $\frac{5}{12}$ of the profit. ∴ $\frac{5}{12}$ of the profits = \$6000.

44. 3% of $\frac{2}{3}$ of value = \$36. ∴ value = \$1800, or \$6 per bbl. ∴ selling price = \$36 + 115% of \$1800 = \$2106.

45. The 6 boys earn 65c. × 6 = \$3·90 below the average. ∴ the men earn \$3·90 above the average. Each man earns 10c. above, ∴ there were 39 men.

46. 16% of the liabilities = \$500.

47. If the farm is divided into 80 equal squares, the area of each is 40 ac., or 6400 sq. rods. ∴ the side of each is 80 rods. ∴ the sides of the farm are 320 and 400 rods. Perimeter = 1440 rods.

48. True discount $= \frac{24}{124}$ of \$558 = \$108. Bank discount $= \frac{24}{100}$ of \$558 = \$133·92.

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49. 125% of cost of one = \$200. ∴ cost = \$160. ∴ gain on it = \$40. ∴ loss on other = \$40, and ∴ its cost = \$240. ∴ loss on it = $\frac{1}{6}$, or 16⅔%.

50. Draft for \$5000 costs \$5075. ∴ draft for \$100 costs \$101·50. ∴ rate is 1½% premium.

51. 15, page 159.

52. If proceeds = \$100, cost = \$70, and gain on \$70 is \$30.

53. $\frac{6}{11}$ cu. ft. of copper weighs $\frac{6}{11}\times 550$ lb. $= 300$ lb. $\frac{5}{11}$ cu. ft. of tin weighs $\frac{5}{11}\times 462$ lb. $= 210$ lb.

54. $\frac{2}{3}$ of S. P. $= 90\%$ of cost, $\therefore$ S. P. $= 135\%$ of cost.

55. A should have paid $\frac{2}{5}$ of \$370 $=$ \$148. $\therefore$ B should pay him \$16.

56. Difference $=$ \$200 $(1{\cdot}035)^{15} -$ \$200 $(1{\cdot}07)^{7}$ $(1{\cdot}035)$.

57. 95% of taxes $=$ \$9690. $\therefore$ taxes $=$ \$10200. \$17 $=$ taxes on \$1000, $\therefore$ \$10200 $=$ taxes on \$10200 $\times \frac{1000}{17}$.

58. 96% of S. P. $=$ \$1872. $\therefore$ 4% of S. P. $=$ \$78.

59. \$1 is the income from \$24 invested in the first, or from \$25 invested in the second.

60. New length $= \frac{11}{10}$ and width $= \frac{8}{7}$ of the original. $\therefore$ area of base of new solid $= \frac{11}{10}\times\frac{8}{7}$, or $\frac{44}{35}$ of the original. $\therefore$ the thickness $= \frac{35}{44}$ of the original, $\therefore$ it is diminished $\frac{9}{44}$.

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61. B's cost $= \frac{106}{100}$ of \$2500. C's cost $= \frac{95}{100}$ of $\frac{106}{100}$ of \$2500.

62. 26880 marks $= 26880\times 2\frac{1}{8}$ francs $= \$\dfrac{26880\times 2\frac{1}{8}}{5{\cdot}16}$.

63. In 10 days, A does the work that B could do in $\frac{10}{9}$ of 10, or $11\frac{1}{9}$ days. $\therefore$ the money is divided in the ratio of $11\frac{1}{9}$ to 11.

64. 90% of cost $=$ \$2925, $\therefore$ cost $=$ \$3250. $\therefore$ 125% of invoice $=$ \$3250, $\therefore$ invoice $=$ \$2600.

65. Suppose A's cap. is \$1500 and B's \$2400. A has \$1500 invested for 4 mo. and \$750 for 8 mo., which is equivalent to \$12000 for 1 mo. B has \$2400 for 4 mo. and \$800 for 8 mo., or \$16000 for 1 mo. $\therefore$ gain is divided in ratio of 12000 to 16000, or 3 to 4.

66. $4.\ \frac{22}{7}r^2 = 120$. $\therefore r = \sqrt{\frac{105}{11}}$. $\therefore$ vol. $= \frac{4}{3}\cdot\frac{22}{7}\cdot\frac{105}{11}\sqrt{\frac{105}{11}}$ $= 123{\cdot}582$ cu. in.

67. Had there been 50 geese the selling price would have been \$25, or \$5 less than it was. Each turkey is worth 25c. more than each goose, ∴ the number of turkeys = \$5 ÷ 25c. = 20.

68. Area = 1·44 Ha. = 144 a. = 144 sq. Dm. ∴ side = 12 Dm., ∴ perimeter = 48 Dm. = 480 m. = ·48 Km. ∴ time in hours = ·48 ÷ 5 = ·096, or 5·76 min.

69. If wholesale price = \$100, cost = \$75, and ∴ net selling price = \$110 × $\frac{94}{100}$ = \$103·40. ∴ gain on \$75 is \$28·40.

70. Page 192.

71. 94¾% of S. P. of wheat = \$3790. ∴ S. P. = \$4000. ∴ com. = \$210.

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72. The int. at 2½% for the given time = \$616·35 − \$558·60 = \$57·75. ∴ int. at 6% = \$138·60. ∴ sum = \$420.

73. Take a risk of \$400. Prem. received = \$16. Prem. paid = 3% of ¾ of \$400 = \$9. ∴ dif. is \$7 on a risk of \$400. ∴ dif. is \$27 on a risk of $\frac{27}{7}$ of \$400.

74. The dif. between 107% of cost and 92% of cost or 15% of cost = \$1·05, ∴ cost = \$7.

75. B's gain = ½ (\$715 − \$275) = \$220. A's = \$495. ∴ the cap. is divided in the ratio of 220 to 495, or 4 to 9.

76. In 2 days A and B can do $\frac{3}{7} + \frac{2}{10}$, or $\frac{17}{35}$ of the work. ∴ C has $\frac{18}{35}$ to do. He does the work in 14 days, ∴ he does $\frac{18}{35}$ in $\frac{18}{35}$ of 14 days.

77. Interest = \$32 $(1{\cdot}02)^{15}$ − \$32.

78. Pop. at the end of 3 years = $(1{\cdot}13)^3$ of pop. at the beginning. ∴ pop. at the beginning = $1442897 \div (1{\cdot}13)^3$.

79. He requires ¾ of 110, or 82½ oz. of gold and 27½ of silver. To get 82½ oz. of gold he must use $\frac{3}{22}$ of 82½ oz., or 90 oz. of his alloy.

80. 23, page 205.

81. 30 shares of the first stock pays \$120 dividend. ∴ the div. from the second stock is \$132, and since it is \$3½ per share, ∴ no. of shares of second stock $= 132 \div 3\frac{1}{2}$. ∴ cost of second stock $= \$75 \times 132 \div 3\frac{1}{2}$. ∴ price of each share of the first stock $= \$75 \times 132 \div 3\frac{1}{2} \div 30 = \$94\frac{2}{7}$.

82. Cost of farm at end of year $= \frac{106}{100}$ of \$4000 = \$4240. Cost of taxes $= \$\left\{\frac{104\frac{1}{2}}{100} \times \frac{18}{1000} \times \frac{3}{5} \times 4000\right\} = \$45{\cdot}144$. Cost of repairs $= \frac{103}{100}$ of \$500 = \$515. Total cost = \$4800·144.

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83. Selling price = 130% of \$40 = \$52, which is $\frac{3}{4}$ of price asked. ∴ price asked = $\frac{4}{3}$ of \$52.

84. For every \$7 invested at 5%, \$5 is invested at 7%. ∴ the part invested at 5% = $\frac{7}{12}$ of \$450.

85. The lots cost \$1000 and \$400. Gain on cheaper = \$200, loss on dearer = \$300. ∴ net loss = \$100.

86. Suppose 100 lb. consumed, ∴ duty = \$6. After reduction in duty consumption = 150 lb. and duty = $\frac{2}{3}$ of \$6 = \$4. On 150 lb. the duty is \$4, or 2⅔c. per lb.

87. Radius = 35 cm., vol. $= \frac{4}{3} \times \frac{22}{7} \times (35)^3$ cu. cm. ∴ weight = 1311·566 Kg.

88. Total area in sq. ft. $= 4\ (30+21) \times 8\frac{1}{2} + 2\ (30+21)$ = 2994. ∴ cost = $\frac{29.94}{9}$ of 12c. = \$39·92.

89. The work requires 36 days' labor. One man works ½ (36 − 5), or 15½ days, and ∴ earns $\$126 \times \frac{15\frac{1}{2}}{36}$.

90. Second man's present cap. = 112% of \$4000 = \$4480. ∴ 80% of first man's cap. was \$4480.

91. If \$3 is the inc. on \$84, \$7 is the inc. on \$196.

92. 10 of A's steps = 11 of B's. ∴ 8 of A's = $8\frac{4}{5}$ of B's. ∴ B goes 9 yd. while A goes $8\frac{4}{5}$ yd. ∴ B goes 100 yd. while A goes $97\frac{7}{9}$ yd. B wins by $2\frac{2}{9}$ yd.

93. 18, page 213.

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94. Prem. received by first = \$120. Prem. received by second = \$48. First loses $\frac{3}{5}$ of \$4800 − \$120 + \$48. Second loses \$1600 − \$48.

95. 2 men and 1 woman earn \$3·25. ∴ no. of women = 45·50 ÷ 3·25 = 14.

96. Gain on 435 bus. = cost of 13% of 435 bus. = 56·55 bus. Gain on 325 bus. = cost of 11% of 325 bus. = 35·75 bus. Total gain = cost of 92·3 bus. Gain on 760 bus. at gain of 12% = cost of 91·2 bus. Dif. = cost of 1·1 bus. = \$1·10. ∴ cost of 1 bus. = \$1.

97. Solution, page 202.

98. 27373 = 101 × 3 × 7 × 13. 101 must be a factor of each number, and the other factor of each must contain 2 digits. ∴ the other factors must be 21 and 13, and the nos. are 101 × 21 and 101 × 13.

99. 37 oz. of gold and 3 of silver are worth \$629 + \$3·30 = \$632·30. ∴ weight of \$632·30 of the alloy is 40 oz. ∴ wt. of \$10 is $\frac{4000}{63\frac{2}{3}}$ oz.

100. 11, page 187, or solution, page 183.

1. S.P. of $\frac{3}{8}$ of $\frac{4}{5}$, or $\frac{3}{10}$ of vessel = \$11700. ∴ S.P. of whole = \$39000, which = 130% of cost. ∴ cost = \$30000.

2. No. of acres = 40 × 35 ÷ 160 = $8\frac{3}{4}$, &c.

3. 15, page 164.

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4. Duty = $2\frac{1}{2}$c. × $\frac{88}{100}$ × 3825 = \$84·15. Total cost = 4c. × 3825 + \$36·25 + \$84·15 = \$273·40.

5. A's share = \$4·20 + 14% of B's share. ∴ 114% of B's share + \$4·20 = \$369. ∴ B's share = $\frac{100}{114}$ of \$364·80.

6. If he rides 8 miles it will take 1 hour to go and $2\frac{2}{3}$ to return, or $3\frac{2}{3}$ hr. for the trip. ∴ he can go 3 times as far, or 24 miles in 8 hours.

7. He buys at \$75 per share and sells at \$81, and ∴ gains \$6 on \$75 invested, or 8%.

8. Suppose the S.P. is 1c. per grain. The druggist receives \$70 for \$57·60 worth of goods. ∴ he gains \$12·40 on \$57·60, or $21\frac{10}{36}\%$. The customer pays \$70 and loses \$12·40. ∴ his loss is $17\frac{5}{7}\%$.

9. If receipts = \$100. Cost = \$60 + \$20 = \$80. ∴ gain = 25% on cost. 2nd outlay = $\frac{7}{10}$ of \$60 + $\frac{11}{10}$ of \$20 = \$64. ∴ S.P. = $\frac{5}{4}$ of \$64 = \$80. ∴ ratio of selling prices is 5 : 4. ∴ the loaf will now sell for $\frac{4}{5}$ of $7\frac{1}{2}$c. = 6c.

10. A and B can do $\frac{1}{5}$ in a day. ∴ in 3 days they do $\frac{3}{5}$ of the work. B can do $\frac{1}{5} - \frac{1}{8}$, or $\frac{5}{40}$ in 1 day. ∴ he can do $\frac{2}{5}$ of it in $\frac{2}{5}$ of $\frac{40}{3}$ days = $5\frac{1}{3}$ days.

11. Total cost = \$43·80. S.P. = $\frac{7}{4}$ of \$43·80 = \$54·75. S.P. of 24 lb. = \$12. ∴ S.P. of the 80 lb. = \$42·75.

12. Net S.P. = \$7900. \$100·25 will buy \$100 draft. ∴ \$7900 will buy draft for $\frac{100 \times 7900}{100{\cdot}25}$ = \$7880·30.

13. Total outlay = \$30 + \$15 + \$47·50 + \$150 = \$242·50. Rent = \$420. ∴ net gain = \$177·50 on \$3000, or $5\frac{11}{12}\%$.

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14. Area = 640 sq. rods. Perimeter of square field = $4\sqrt{640}$ rods. Radius of circle = $\sqrt{640 \times \frac{7}{22}}$ = 14·269. ∴ perimeter = $14{\cdot}269 \times 6\frac{2}{7}$ = 89·7 rods.

15. S.P. = $\frac{8}{6}$ of 100% of cost = $133\frac{1}{3}\%$.

16. When the faster goes 9 rounds he gains 2 rounds on the slower. ∴ he gains 1 round when he goes $4\frac{1}{2}$ rounds, or 1800 yd.

17. If there were no expenses he would have paid 70c. on dollar. Loss on book debts = $8000. ∴ 30% of liab. = $8000.

18. Int. on $100 for $2\frac{1}{4}$ years at 4% = $9. ∴ $62·10 is the int. on $690. ∴ first sum = $230. Int. for 1 yr. = $13·80. ∴ time $= \frac{62·10}{13·80} = 4\frac{1}{2}$ yr.

19. $450 is the int. on $11250 at 4%. Pres. val. of $11250 due in 15 years = $11250 ÷ $(1·04)^{15}$ = $11250 × ·55526 (page 267).

20. 16, page 204.

21. Take half of the 1st quantities and $\frac{1}{3}$ of the second, and take the difference in the results. ∴ $6\frac{2}{3}$ bus. rye sell for $6, or 1 bus. sells for 90c.

22. The inc. from the first = $\frac{4}{87}$ of the investment, and from the second is $\frac{5}{102}$. ∴ $27 = $\frac{5}{102} - \frac{4}{87}$, or $\frac{3}{580}$ of either investment.

23. Expenses = $ (1100 + 400 − 1187 50) = $312·50. Prem. = $20, taxes = $16·50. ∴ $\frac{15}{1000}$ of $\frac{2}{5}$ of val. of farm + $\frac{6}{1000}$ of $\frac{2}{3}$ val. of farm = $276. ∴ $\frac{46}{1000}$ of val. of farm = $276. ∴ value = $6000.

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24. If A earned 70c. per hour, B would earn 60c. A works 13 hours and B 15 hours. ∴ the pay is divided in the ratio of 91 to 90.

25. Wt. of water in oz. = $\frac{10}{11} \times 30 \times 5 \times 1\frac{9}{2} \times 1000$.

26. Duty = 20% of 95%, or 19% of invoice. ∴ 119% of inv. + $80 = $3773·60. ∴ inv. = $\frac{100}{119}$ of $3693·60.

27. $480 will buy 1500 yd. ∴ S.P. of 220 yd. = gain on 1500 yd. But S.P. of 220 yd. = cost of 220 yd., or $70·40 + gain on 220 yd. ∴ gain on 1280 yd. = $70·40, or $5\frac{1}{2}$c. per yd. ∴ gain $= \frac{5\frac{1}{2}}{32}$, or $17\frac{3}{16}$%.

28. Pres. val. = \$500 (·71068 + ·67684 + ·64461).

29. If the amount of insurance is \$1500, the total premium is \$34·25, &c.

30. Cash val. = $\frac{100}{103}$ of \$2100 + $\frac{100}{104\frac{1}{2}}$ of \$2100 = \$4048·40.

31. Net earnings = $\frac{14}{100}$ of $\frac{9}{10}$ of sale − $\frac{1}{10}$ of sale = $\frac{26}{1000}$ of \$56250.

32. When the first goes 5 rounds he gains $\frac{3}{4}$ of a round. ∴ he gains a whole round when he goes $6\frac{2}{3}$ rounds.

33. Page 168.

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34. Other = 924 × 12 ÷ 84. See page 14.

35. £460 = \$4·86$\frac{2}{3}$ × 460 = \$2238·667. 10s. = \$2·433. 8$\frac{3}{4}$d. = \$·175. Total = \$2241·28.

36. $\frac{12}{100}$ of the 1st = $\frac{15}{100}$ of 2nd = $\frac{16}{100}$ of 3rd. If the third = \$3000, the 1st = \$4000, and the 2nd = \$3200. ∴ \$612 is divided in the proportion of 4000, 3200, 3000, or 20, 16, 15. ∴ 1st = $\frac{20}{51}$ of \$612 = \$240.

37. \$5·62$\frac{1}{2}$ = 75% of cost, ∴ \$7·00 is $\frac{700}{562\frac{1}{2}}$ of 75%, or 93$\frac{1}{3}$% of cost.

38. 19, page 136.

39. Suppose he sold the 1st for \$200 and the 2nd for \$300. Cost of 1st = $\frac{100}{92}$ of \$200 and of the 2nd $\frac{100}{108}$ of \$300. ∴ gain = \$$(500 - \frac{5000}{23} - \frac{2500}{9})$ = \$$\frac{1000}{207}$ when the proceeds = \$500. ∴ gain is \$16 when the proceeds = \$1656.

40. They must be mixed in the ratio of $1\frac{1}{2}$ to $3\frac{1}{2}$ (page 128). ∴ no. of lb. of 1st = $\frac{1\frac{1}{2}}{5}$ of 80 = 24.

41. Consider a sale of goods that cost \$1 and sold for \$1·40. No. of lb. of butter received = $\frac{140}{25}$ = 5$\frac{3}{5}$. Value of butter = $\frac{28}{5}$ × $\frac{9}{10}$ × 15c. = 75$\frac{3}{5}$c. ∴ loss = 24$\frac{2}{5}$%.

42. Sells $35\frac{3}{4}$ in. as 36 in., or $\$35\frac{3}{4}$ worth as \$36. Sells $\$35\frac{3}{4}$ worth for 120% of \$36, or \$43·20. ∴ gain = \$7·45 when cost = \$35·75. ∴ gain is \$134·10 when cost = \$643·50.

43. 105% of prem. = \$63. ∴ \$60 is prem. on \$9000.

44. Sup. the 3rd can do $\frac{1}{12}$ of work in 1 day, then 2nd can do $\frac{1}{15}$, and 3rd $\frac{1}{20}$, and all can do $\frac{1}{12}+\frac{1}{15}+\frac{1}{20}$, or $\frac{1}{5}$ in 1 day. ∴ they could do all the work in 5 days. But it really takes 45 days, ∴ the third would do it alone in 12×9, or 108 days.

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45. Dif. in taxes paid = \$21·40. If salaries of each had been same as 2nd, the dif. in taxes would have been $2\frac{1}{2}$% of \$20, or 50c. less. Dif. would then have been \$20·90. ∴ $\frac{19}{1000}$ of 2nd salary = \$20·90.

46. 57, page 67.

47. 19, page 136.

48. 89, page 118.

49. C's S. P. = 1·191016 of A's cost. ∴ A's S. P. = $\sqrt[3]{1{\cdot}191016}$, or 1·06 of A's cost. ∴ each gained 6%.

50. Let \$1 = cost per lb. Sold 5 lb. for 112% of \$5, or \$5·60. If $4\frac{1}{2}$ lb. is sold for \$5·60, or 1 lb. for $\$1{\cdot}24\frac{4}{9}$, the gain is $24\frac{4}{9}$%.

51. Sum of rates = 39 miles in 4 hours, or $9\frac{3}{4}$ m. per hr. Dif. = $5\frac{1}{4}$ miles in 7 hours, or $\frac{3}{4}$ m. per hour. ∴ twice faster rate = $10\frac{1}{2}$ m. per hr.

52. 9, page 194.

53. Gain = 14% of \$600 = \$84. Cost = \$516. ∴ 114% of cost = \$588·24.

54. 47, page 66.

55. Amt. = $\$100\ (1{\cdot}04^5+1{\cdot}04^4+1{\cdot}04^3+1{\cdot}04^2+1{\cdot}04)$.

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56. Prime cost = \$18·75. Freight = \$43·75. Specific duty = \$3.75. Ad val. duty = \$3·75. ∴ total cost = \$70. S. P. = \$87.50. ∴ gain = \$17·50.

57. 110% of 3 times amt. paid for labor + 94% of amt. paid for labor = \$3637·92. ∴ 424% of cost of labor = \$3637·92, &c.

58. Net proceeds = $96\frac{1}{2}\%$ of \$9800 − 25c. × 1400 = \$9107.

59. $18\frac{3}{4}\% = \frac{8}{16}$. Cap. at end = $(\frac{16}{16})^4$ of cap. at beg. ∴ cap. at beg. = \$1303·21 × $(\frac{16}{16})^4$ = \$655·36.

60. 15, page 159.

61. Sum of rates in yd. per sec. = (99 + 132) ÷ $6\frac{3}{4} = \frac{308}{9}$. Diff. = (99 + 132) ÷ $47\frac{1}{4} = \frac{44}{9}$. ∴ twice the faster rate = $\frac{352}{9}$ yd. per sec. = 80 ml. per hr.

62. Cost = \$3450. S. P. = $\frac{11}{10}$ of \$1·04 × 3000 = \$3432.

63. No. of shares of 4%'s = 84. S. P. = \$98 × 84. ∴ no. of shares bot. = 98.

64. 10, page 170.

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65. Total sales = \$11600. Storage = \$125 + \$120 = \$245. Com. for selling = \$120 + \$80 = \$200. Total expenses = \$512·48. Bal. = \$11087·52.

66. \$1 at the end of each year would repay $\$\frac{1}{1{\cdot}07} + \$\frac{1}{(1{\cdot}07)^2} = \$1{\cdot}80802$ (page 267). ∴ yearly payment = \$1500 ÷ 1·80802.

67. Sup. he buys 7000 grains for \$1, then he sells 5760 gr. for \$1·30, or 7000 gr. for $\$1{\cdot}57\frac{1}{7}$. ∴ gain = $57\frac{1}{7}\frac{1}{2}\%$.

68. Total vol. = 176·785 cu. in. ∴ surface of single plate = 353·57 sq. in. ∴ rad. = $\sqrt{353{\cdot}57 \times \frac{7}{22}}$.

69. As assignee, A receives $3\frac{1}{2}\%$ of \$7290 = \$255·15, and as creditor, $\frac{1}{5}$ of \$(7290 − 255·15), or \$3126·60.

70. 108% of cost per lb. = 30c. ∴ cost = $27\frac{7}{9}$c. Total cost = $\$77\frac{7}{9}$. S. P. = $\$85\frac{5}{9}$. ∴ $\$61\frac{5}{9}$ = S.P. of 200 lb.

71. Sup. A earns 56c. per hr., then B earns 48c. and C 42c. A works 33 hours, B 38, C 43. ∴ their wages are in proportion of 56×33, 48×38, 42×43, or 308, 304, 301.

72. No. of bbl. $= \frac{100}{102\frac{1}{2}}$ of $\$6150 \div \$6 = 1000$. Total cost = $6400. S. P. = $7360, or $7·36 per bbl.

73. Present val. of debt $= \frac{100}{103\frac{3}{4}}$ of $7470 = $7200. ∴ 100 shares must be sold.

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74. $\frac{5}{4}$ of $\frac{5}{6}$ of cost + $\frac{85}{100}$ of $\frac{4}{9}$ of cost = $\frac{193}{180}$ of cost, and $1\frac{85}{100}$ of $\frac{5}{9}$ of cost + $\frac{3}{4}$ of $\frac{4}{9}$ of cost = $\frac{35}{36}$ of cost. If $\frac{13}{180}$ of cost = $260 ∴ $\frac{1}{36}$ of cost = $100.

75. They must be mixed in ratio of $2\frac{3}{5}$ to $3\frac{2}{5}$, or 13 to 17 (page 128). ∴ no. of lb. of 54c. tea = $\frac{13}{17}$ of 34 = 26.

76. Brown receives $\frac{3}{8}$ and Stuart $\frac{5}{8}$ of the balance. But Stuart received $50 more of this bal. than Brown. ∴ $\frac{1}{4}$ of balance = $50. ∴ bal. = $700 ∴ total profits = $1100.

77. $\frac{49}{50}$ of total rate on investment = $5\frac{1}{4}$%. ∴ total rate = $\frac{75}{14}$%. $\$\frac{75}{14}$ = income on $100 invested. ∴ $3 is the income on $56. ∴ market price = $\$55\frac{1}{2}$ per share.

78. By accepting the latter he should gain $3\frac{1}{2}$% of $2700, or $94·50. ∴ worthless sales = $94·50 + $21·50.

79. S. P. per acre = $210. ∴ no. of acres sold = 140×75 ÷ 210 = 50.

80. 20, page 213.

81. The share of 1st will amount to 142% of the sum willed to him, and of the 2nd 124%. ∴ their shares must be in ratio of 124 to 142.

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82. Page 130.

83. The \$165 is divided in the prop. of 32, 55 and 45.

84. Prem. I paid = \$80 + \$135 = \$215. ∴ prem. received = \$241·50, which is $1\frac{3}{4}\%$ of amount insured.

85. $\frac{93}{100}$ of $\frac{4}{5}$ of selling price per lb. = $\frac{124}{100}$ of 5c. ∴ selling price per lb. = $8\frac{1}{3}$c.

86. The int. on \$120 is \$5, and ∴ \$10 for twice the time. ∴ the discount off \$130 is \$10, and ∴ off \$125 is $\$9\frac{8}{13}$.

87. Vol. = 7025 cu. in. ∴ area of base = (7025 ÷ 14) sq. in. = 501·78 sq. in. ∴ side = $\sqrt{501{\cdot}78}$ in. = 22·4 in.

88. If A is paid \$2 a day, B is paid \$3 and C \$3·75. ∴ A would earn \$12, B \$21, C \$30. ∴ the \$42 is divided in prop. of 12, 21, 30.

89. On the 276 yd. he gains the cost of 41·4 yd., and on the 398 yd. the cost of 27·86 yd. ∴ total gain = cost of 69·26 yd. If he had sold the 674 yd. at gain of 11%, he would have gained the cost of 74·14 yd. ∴ cost of 4·88 yd. = \$4·88. ∴ the cloth cost \$1 a yard.

90. 120% of cost = 85% of (cost + \$49). ∴ 35% of cost = 85% of \$49. ∴ cost = \$119.

91. Rent = \$1860. Premium = \$86·80. Taxes = \$186·75. Total outlay = \$620. Net income = \$1240, which is 8% of \$15500.

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92. P. W. of 1st = $\$11000 \div 1{\cdot}02^6 = \$11000 \times {\cdot}88797$ = \$9767·67. P. W. of 2nd = $\$2000\left\{\frac{1}{1{\cdot}02}+\frac{1}{1{\cdot}02^2}+\ldots\frac{1}{1{\cdot}02^5}\right\}$ = \$2000 × 4·71346 = \$9426·92. ∴ diff. = \$340·75. Use table, page 266.

93. 1st inc. = \$630. ∴ 2nd inc. = \$702. ∴ no. of shares of second stock = 702 ÷ $4\frac{1}{2}$ = 156. ∴ 156 shares cost \$210 × 78.

94. Amount of \$250 in 2 yr. = \$300. ∴ amt. of \$1 = \$1·20 in 2 yr. ∴ amt. of \$1 in 1 yr. = $\$\sqrt{1{\cdot}20} = \$1{\cdot}0954$. ∴ rate = 9·54%.

95. Cash value of goods = $\frac{100}{102\frac{1}{2}}$ of \$304·50 = \$300. ∴ cash S. P. = \$375. Amt. of \$375 in 8 mo. = \$390.

96. 74, page 229.

97. If the S. P. of each was \$99, the cost of the 1st is \$90, and of the second \$110, and loss would be \$2.

98. 29, page 155.

99. The dif. between $\frac{1}{87}$ and $\frac{1}{99}$ of the sum invested = 12. ∴ the sum invested = \$(87×99), which buys 99 shares of 4%, or 87 shares of 4½% stock. ∴ the dividends are \$396 and \$391·50.

100. Page 192.

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1. 89, page 240.

2. The int. on \$860 is \$15 in 79 + days = 80 days. ∴ it was due 80 days after Mar. 23rd = June 11th.

3. He sells the barrel as $(\frac{8}{15} + \frac{8}{17})$, or $\frac{256}{255}$ of a barrel, and ∴ gains $\frac{1}{255}$, or $\frac{20}{51}$%.

4. Vol. of each brick with mortar = $(9 \times \frac{9}{2} \times 4 \times 1\frac{7}{8})$ cu. in. Vol. of wall = (45×17×4×1728) cu. in., &c.

5. If each had \$100 at first, they would now together have \$61 + \$145 = \$206. ∴ each had $\$100 \times \frac{164 \cdot 80}{206} = \$80$.

6. $\frac{5}{4}$ of $\frac{7}{5}$ of cost = \$714. ∴ the cost = \$734·40.

7. 30, page 160.

8. (a) Amount of \$1 = \$1·12 ∴ \$728 is amt. of \$728 ÷ 1·12 = \$650. (b) Amt of \$1 = \$1·1236 ∴ \$728 is the amt. of \$728 ÷ 1·1236 = \$647·92.

9. Let r yards be the radius of inner circle. ∴ $\frac{22}{7}(r+22)^2 - \frac{22}{7}r^2 = 12 \times 4840$ ∴ $r = 409$.

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10. \$93 invested at 6% yields \$5·58 inc. If \$9 is to be the inc. on \$100 invested, ∴ \$5·58 is the inc. from \$62.

11. Duty on 1 gal. $= \frac{1}{5}$ of $\frac{8}{9}$ of \$1·75 = \$·31$\frac{1}{9}$. ∴ no. gal. = \$268·80 ÷ \$·31$\frac{1}{9}$ = 864.

12. 21, page 188.

13. Net proceeds of sale \$8500 − \$212·50 − \$240·80 = \$8046·70. It costs \$100$\frac{3}{8}$ to send \$100. ∴ the consignor receives $\frac{800}{803}$ of \$8046·70 = \$8016·64.

14. He gained \$1.05 on each bbl. of 1st, and lost 70c. on each of the 2nd. ∴ the no. of bbl. must have been in the ratio of 70 to 105, or 2 to 3.

15. Cost of the land at the end of the year = \$57·50 × 368 × $\frac{104}{100}$ = \$22006·40. S.P. = \$21988.

16. A's share = $\frac{27}{84}$ of 80% of total profits = \$675. ∴ profits = $\frac{84}{27}$ of $\frac{100}{80}$ of \$675 = \$2000 on \$6400, or 31$\frac{1}{4}$%.

17. Rent = \$360. Int. = \$180. Ins. = \$37·50. Taxes = \$57. Water rates = \$15. Loss on sale = \$60. ∴ Diff. = \$10·50.

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18. 9, page 194.

19. 27, page 155.

20. 32, page 113.

21. The time in days $= 380 \times \frac{2210 \cdot 10}{2596 \cdot 92} \times \frac{24944 \cdot 10}{30441} = 265.$

Int. on \$100 in 365 days = \$2210·10 × $\frac{365}{265}$ × $\frac{100}{11}$ = \$10.

22. Suppose the material was to cost \$600 and the labor \$300. Real cost of material = \$300 + $\frac{105}{100}$ of \$300 = \$615, and of the labor = \$100 + $\frac{98}{100}$ of \$200 = \$284. Total cost = \$899, which is \$1 below the estimate. ∴ the estimate was \$9000.

23. Total cost $= \$4{\cdot}87 \times 7490 \div 25{\cdot}22 \times \frac{11}{100} = \$1663{\cdot}27$. Selling price $= \$4{\cdot}87 \times 420 = \$2045{\cdot}40$.

24. 66, page 238.

25. 16, page 195.

26. If the cash price is \$1, the credit price would be the amt. of \$1 in 6 mo. $= \$1{\cdot}05$. $\therefore$ ratio is 100 to 105.

27. \$21·87 is $\frac{2187}{30000}$, or $\frac{729}{10000}$ of \$30. The first reduced price is the same fraction of the marked price that the second reduced price is of the first, and that the third is of the second. $\therefore$ the selling price is obtained by multiplying the marked price by the cube of this fraction. $\therefore$ the cube of the fraction is $\frac{729}{10000}$. $\therefore$ the fraction is $\frac{9}{10}$. $\therefore$ the rate of discount is 10%.

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28. The duty on the wine, without water, is \$60 ad valorem, and \$37 specific; that is \$97 in all. 30 gal. are spirits, $\therefore$ 26% of the mixture is 30 gal. $\therefore$ the mixture $= 115\frac{5}{13}$ gal. The spec. duty on the mixture $= \${\cdot}25 \times 115\frac{5}{13} = \$28\frac{11}{13}$. The ad val. duty $= 30\%$ of $\frac{9}{10}$ of \$200 $=$ \$54. $\therefore$ total duty $= \$82\frac{11}{13}$. $\therefore$ gain in duty $= \$14\frac{2}{13}$. Loss in value of wine is \$20. $\therefore$ net loss $= \$5\frac{11}{13}$.

29. 18, page 213.

30. 45, page 236.

31. The dif., \$·525, is the int. on \$10·50 for 1 year. $\therefore$ the rate is 5%. $\therefore$ 5% of amt. at end of 1st year $=$ \$10·50. $\therefore$ amt. at end of 1st year $= \$210$. $\therefore$ principal $= \$210 \div 1{\cdot}05 = \$200$.

32. Pref. stock receives $\$2\frac{1}{2} \times 1500$, or \$3750 more than the average. $\therefore$ ordinary receives \$3750 less. But ordinary receives $\$1\frac{1}{2}$ per share less. $\therefore$ no. of shares of ordinary stock $= 3750 \div 1\frac{1}{2}$.

33. S.P. of 60·8 yd. $= \$5{\cdot}70 \times 64 \times \frac{6}{5}$.

34. Let cost = \$3. ∴ cash selling pr. = \$4. ∴ credit S.P. = $\frac{9}{8}$ of \$4 = \$4·50. ∴ gain on \$3 is \$1·50, or 50%.

35. Dishonest gain = $\frac{\frac{3}{4}}{35\frac{1}{4}}$, or $\frac{1}{47}$ of marked price. Actual S.P. = $\frac{48}{47}$ of $\frac{5}{4}$ of cost = $\frac{60}{47}$ of cost. ∴ entire gain = $\frac{13}{47}$ of cost = \$124·80. ∴ cost = \$451·20. ∴ dishonest gain = $\frac{1}{47}$ of \$451·20 × $\frac{5}{4}$ = \$12.

36. Net receipts = $\frac{96}{100}$ of $\frac{75}{100}$ of \$2500 + $\frac{90}{100}$ of $\frac{40}{100}$ of $\frac{25}{100}$ of \$2500 = \$2025. ∴ % obtained = $\frac{2025}{2500}$ = 81%.

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37. One cent is the unit. Int. on \$325 = \$126·75, which is represented by 12675 when one cent is the unit.

38. 11520 m.b. = 11520 × $2\frac{1}{8}$ fr. = \$(11520 × $2\frac{1}{8}$ ÷ 5·16).

39. Total S.P. = \$3500. Com. = \$140. Bal. to be divided = \$3360. Suppose B's was worth 100 units per bbl., then A's is worth 110 and C's 116. Total val. of A's would be 125 × 110, or 13750; B's 15000, C's 26100. A should ∴ receive $\frac{13750}{54850}$ of \$3360 = \$842·30.

40. Surface in sq. ft. = $2\frac{1}{2} \times \frac{22}{7} \times 12$. ∴ cost = \$1·25 × $2\frac{1}{2} \times \frac{22}{7} \times 12$.

41. 16, page 195.

42. 20 and 25% off leaves 60% of cost. ∴ S.P. = ·6 of marked price. ∴ S.P. is $\sqrt{\cdot 6}$, or ·7746 of 1st reduced price. ∴ the reduction in each case is ·2254, or 22·54%.

43. P.W. of \$200 due in 8 mo. = \$200 × $\frac{75}{79}$ = \$189·87341. P.W. of \$200 due in 12 mo. = \$200 × $\frac{37}{41}$ = \$185·18518. Total P.W. = \$375·05859. P.W. of \$400 due in 10 mo. = \$400 × $\frac{75}{76}$ = \$375. ∴ Loss = 5·86 cents.

44. Policy = $\frac{3}{4}$ val. + prem. But prem. = 3% of policy, ∴ 97% of pol. = $\frac{3}{4}$ val. ∴ policy = $\frac{75}{97}$ val.

45. 7, page 198.

46. Outside vol. in cu. ft. $=7\frac{5}{6}\times3\frac{2}{3}\times2\frac{1}{2}=71\frac{2}{3}\frac{3}{6}$. Inside vol. $=7\frac{2}{3}\times3\frac{1}{2}\times2\frac{1}{3}=62\frac{1}{1}\frac{1}{8}$. $\therefore$ vol. of boards $=9\frac{7}{3}\frac{7}{6}$ cu. ft. $\therefore$ surface $=110\frac{1}{3}$ sq. ft. $\therefore$ cost $=2c.\times110\frac{1}{3}$.

47. If the cost of the house is the unit, the cost of the farm $=3\frac{3}{4}$ units. S. P. of house $=\frac{9}{1}\frac{9}{0}$, and of farm $=\frac{5}{1}\frac{5}{4}$ of $3\frac{3}{4}$. $\therefore$ total S. P. $=4\frac{8}{8}\frac{5}{0}\frac{7}{0}$ units $=\$3993{\cdot}30$. $\therefore$ the unit $=\$812$.

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48. \$129600 amounts to \$178506·25 in 2 years. $\therefore$ the amt. in 2 years is obtained by multiplying the principal by $\frac{178506{\cdot}25}{129600}$. $\therefore$ the amt. for 1 yr. is obtained by multiplying by the square root of this fraction, or by $\frac{1}{3}\frac{2}{6}\frac{2}{0}\frac{5}{0}$. $\therefore$ the int. fraction is $\frac{6}{3}\frac{2}{6}\frac{5}{0}\frac{5}{0}$, or $\frac{25}{144}$. $\therefore$ the rate is $17\frac{1}{3}\frac{3}{6}\%$. The original sum $=\$129600\div\frac{178506{\cdot}25}{129600}$.

49. P. W. of \$618 due in 4 mo. $=\frac{1}{1}\frac{0}{0}\frac{0}{3}$ of \$618 $=\$600$. Cash price $=96\%$ of \$618, or \$593·28. $\therefore$ dif. $=\$6{\cdot}72$.

50. If laid lengthwise, it requires 8 strips, 7 being 21 ft. long and one 20 ft., or 167 ft. of carpet. If crosswise it requires 9 strips, 8 being 18 ft. long and one 16 ft., or 160 ft. of carpet. $\therefore$ no. of sq. yd. required when laid crosswise $=\frac{1}{9}\frac{6}{0}\frac{0}{0}\times\frac{3}{4}=40$. But area of the room is $35\frac{5}{9}$ sq. yd. $\therefore$ waste $=4\frac{4}{9}$ sq. yd.

51. P. W. of \$224 due in 2 mo. $=\frac{1}{1}\frac{0}{0}\frac{0}{1}$ of \$224 $=\$221{\cdot}78$. P. W. of \$274 due in 4 mo. $=\frac{1}{1}\frac{0}{0}\frac{0}{2}$ of \$274 $=\$268{\cdot}63$.

52. 29, page 155.

53. Cap. at end of 3 yr. $=(\$18052+\$500)\frac{5}{6}=\$15460$. Cap. at end of 2 yr. $=(\$15460+\$500)\frac{5}{6}=\$13300$. Cap. at end of 1 yr. $=(\$13300+\$500)\frac{5}{6}=\$11500$. $\therefore$ original cap. $=(\$11500+\$500)\frac{5}{6}=\$10000$.

54. Page 202.

55. $82\frac{1}{2}\%$ of $\frac{3}{5}$ of the goods $= 49\frac{1}{2}\%$ of the whole, and $76\frac{1}{4}\%$ of $\frac{2}{5}$ of the goods $= 30\frac{1}{2}\%$ of the whole. $\therefore$ the amt. realized $= 80\%$ of whole value. If the whole val. would realize $81\frac{1}{4}\%$ of claims, then 80% of value would realize 80% of $81\frac{1}{4}\%$, or 65%.

56. Time required to plough 1 strip and to turn $= 4\frac{1}{2}$ min. $\therefore$ in 9 hr. he ploughs 4800 rods. $\therefore$ no. of ac. $= \frac{4800}{160} \times \frac{11}{12 \times 3 \times 5\frac{1}{2}}$.

57. On \$500 the interest is \$10·20 in 73 days, &c.

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58. Suppose he bought 4 lb. Then he sold 1 lb. at a reduction of 10c. $\therefore$ he intended to gain 90c. on the 4 lb., which is 30% of cost. $\therefore$ cost of 4 lb. $=$ \$3.

59. P. W. of \$5·70 $=$ \$5·62½. $\therefore$ cash S. P. $=$ \$5·62½ $\times \frac{106\frac{2}{3}}{100} =$ \$6, which amounts to \$6·12 in 6 mo.

60. Net inc. on each share $=$ \$4·90, which is 7% of cost. $\therefore$ cost of 1 share $=$ \$70. $\therefore$ market value $=$ \$69⅞.

61. Total cost $=$ \$2220. S. P. $=$ \$672 + \$1495 + \$345 $=$ \$2512. Com. $=$ \$75·36. $\therefore$ net S. P. $=$ \$2353·20. $\therefore$ gain $=$ \$133·20, or 6%.

62. The loss $= \frac{1}{16}$. But the loss is equal to the discount on the amount of the marked price above the cost; that is the loss may be obtained by multiplying the cost by the square of the discount fraction. $\therefore$ the discount fraction is $\frac{1}{4}$, or 25%.

63. Taking 7, 6, 5 as the length, breadth and height, area of walls and ceiling $= 172$. $\therefore$ each sq. unit costs \$2 $=$ cost of 4 sq. yd. $\therefore$ 1 sq. unit $= 4$ sq. yd.; but area of floor $= 42$ sq. units $= 168$ sq. yd.

64. Value of 1 oz. $=934\frac{1}{2}$d. $\therefore$ gold valued at (1869×240)d. weighs 480 oz., or 40 lb. Troy.

65. 66, page 238.

66. The price of the mixture is $37\frac{5}{16}$c. per lb. They must be mixed in ratio of $2\frac{5}{16}$ to $2\frac{1}{16}$ (page 128).

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67. 37, page 151.

68. Let \$100 = cost. $\therefore$ \$70 = new cost. $2\frac{1}{2}$ times the gain on \$70 $=1\frac{3}{4}$ times the gain on \$100. $\therefore$ \$100 + gain on \$100 = \$70 $+ 1\frac{3}{4}$ times the gain on \$100. $\therefore \frac{3}{4}$ of gain on \$100 = \$30. $\therefore$ rate of gain $= 40\%$.

69. It costs \$2·80 + ·20c. + 6·3c. or \$3·063 to buy 1 cwt. of flour. Com. on sale of apples is $\frac{3}{100}$ of amount of sale, or $\frac{3}{97}$ of amount left to buy flour. $\therefore$ com. on sale of apples, sufficient to buy 1 cwt. of flour, is $\frac{3}{97}$ of \$3·063. $\therefore$ total com. when 1 cwt. is bought $= 1\frac{53}{97}$c. Hence no. of cwt. bought $=$ \$63 $+ 1\frac{53}{97}$c.

70. Vol. of plate in cu. in. $= 4\times 4\times \frac{22}{7}\times 2$. Vol. of shot $= \frac{4}{3}\times \frac{22}{7}\times (\cdot 05)^3$.

71. The eagle (\$10) contains $\frac{258}{480}\times\frac{9}{10}$ oz. pure gold. But $\frac{1}{2}$ oz. of pure gold is valued at $\frac{1869}{2}$d. $\therefore$ $\frac{258}{480}\times\frac{9}{10}$ oz. is valued at $(\frac{1869}{2}\times\frac{12}{11}\times\frac{258}{480}\times\frac{9}{10})$d. $\therefore$ 240d., or £1 = \$4·866 +, which is very nearly $109\frac{1}{2}\%$ of \$4·44$\frac{4}{9}$.

72. He gives 35·28 in. for 90% of M. P. per yd. $\therefore$ he gives 36 in. for $91\frac{41}{49}\%$ of M. P. per yd. $\therefore$ he could give a disct. of $8\frac{8}{49}\%$.

73. \$1200 amounts to \$1389·15 in 3 yr., or to $\frac{23061}{20000}$ of the prin. $\therefore$ the amt. in one year is $\frac{21}{20}$, or 1·05 of the prin.

74. Page 129.

75. 27, page 200.

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76. The cube is ·0959... The fourth power is ·0439...

77. The ratio of the prod. of the two smallest to the prod. of the two largest = ratio of the smallest to the largest. ∴ when the smallest is 4 the largest is 6. Similarly the ratio of the intermediate one to the largest is 4 to 5. ∴ when the largest is 6 the intermediate one is $\frac{4}{5}$ of 6, or $4\frac{4}{5}$. ∴ the nos. are in the ratio of 4, $4\frac{4}{5}$, 6, &c.

78. Former rate is $2\frac{1}{2}\%$. ∴ he must pay 3% on \$2500.

79. Suppose A gets \$24, then B gets $\frac{5}{4}$ of \$24, or \$30; C gets $\frac{7}{6}$ of \$30, or \$35; D gets $\frac{9}{8}$ of \$35, or $\$^{39}\frac{15}{8}$. ∴ it is divided in proportion of 24, 30, 35, $^{39}\frac{15}{8}$, or 192, 240, 280, and 315.

80. 11, page 187.

81. The refund = 30% of $7\frac{1}{2}\%$ of \$42134 = \$948·015.

82. The length is $\frac{11}{10}$ and width $\frac{23}{20}$ of original; ∴ area of end is $\frac{11}{10}$ of $\frac{23}{20}$, or $\frac{253}{200}$ of original. ∴ the thickness is $\frac{200}{253}$ of original. ∴ it is diminished $\frac{53}{253}$, or $20\frac{240}{253}\%$.

83. Incomes below + incomes above = £500000. ∴ $\frac{1}{20}$ inc. below + $\frac{1}{20}$ inc. above = £25000. But $\frac{7}{240}$ inc. below + $\frac{1}{20}$ inc. above = £18750. ∴ $\frac{5}{240}$ of inc. below = £6250.

84. 9, page 194.

85. Suppose he invests \$100 in oats, \$125 in barley and \$270 in wheat. The total selling price = \$108 + \$118·75 + \$307·80 = \$534·55, which is $\frac{1}{24}$ of the actual sum. ∴ he invested \$2400 in oats.

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86. $\frac{3}{5}$ of no. of votes cast = 832. ∴ no. cast = 3328. ∴ $\frac{13}{16}$ of no. of electors = 3328. ∴ no. = 4096.

87. They will beat 7, 8, 9 times in $\frac{1}{10}$ of a min., or thus: the time between successive heats is $\frac{6}{7}$, $\frac{6}{8}$, $\frac{6}{9}$ sec., and the l.c.m. of these is 6 sec.

88. $2000 \times 2000 \times 50 \div 360 \div 33000$.

89. $\frac{5}{7}$ of work is done in 20 days. $\therefore \frac{25}{28}$ could be done in 25 days. $\therefore \frac{5}{28}$ is done in 5 days by 3 men. $\therefore \frac{5}{7}$ is done in 20 days by 5 men.

90. Proposed gain $= 8\%$ of $\$600 = \$48$. Actual gain $= \frac{1}{12}$ of $\$600 = \$50$.

91. Page 131.

92. Suppose the two lots are put together then there will be 50 of each coin, and the total value of the two lots is \$22·50. Also the dif. of their values is \$1. $\therefore$ the value of the given lot $= \frac{1}{2}$ of $\$23{\cdot}50 = \$11{\cdot}75$. If they were all 25c. the val. would be \$12·50, or a reduction of 75c. $\therefore$ no. of 20c. pieces is $75 \div 5 = 15$.

93. I want 364 oz. nickel, 336 lead, and 392 tin. The alloy used is $\frac{2}{5}$ nickel. $\therefore$ to get 364 oz. nickel I must use $\frac{5}{2}$ of 364, or 910 oz. of the alloy, which will contain $\frac{9}{55}$ of 910, or 234 oz. lead. $\therefore$ 102 oz. lead must be added.

94. 51, page 247.

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95. If the cask contains 4 gal. wine and 3 water, then after the operation it will contain 3 gal. wine and 4 water. $\therefore$ 1 gal. of wine must be drawn off, or $\frac{1}{4}$ of the mixture.

96. When the first goes 5 rounds, the second goes 7, and the third 9. $\therefore$ when the 1st goes $2\frac{1}{2}$ rounds the 2nd goes $3\frac{1}{2}$ and the third $4\frac{1}{2}$. $\therefore$ they are then all together for the first time.

97. $1 \div 2{\cdot}302585 = {\cdot}43429$.

98. The 3rd gains 100 yd. on 2nd in 6 min., and 200 on the 1st in 8 min. $\therefore$ 3rd gains $16\frac{2}{3}$ yd. per min. on the 2nd and 25 yd. per min. on 1st. $\therefore$ the 2nd gains $8\frac{1}{3}$ yd. per min. on the 1st. $\therefore$ he will gain 100 yd. in 12 min. from starting.

99. The 8 boys receive 27c.$\times$8, or \$2·16 below the average. Each man receives 18c. more than the average. $\therefore$ the no. of men$=2{\cdot}16\div{\cdot}18=12$.

100. The present worth of \$5·10 due in 1 yr. is \$5. $\therefore$ rate is 2%.

1. 150% of cost of mixture=45c. per lb. $\therefore$ cost=30c. Total cost of 47 lb.=\$14·10. Cost of 25 lb. of 32c. tea=\$8·00. $\therefore$ cost of 22 lb. of the first two kinds=\$6·10. If the 22 lb. were all 25c. tea, the cost would be \$5·50, or 60c. less than the actual cost. $\therefore$ no. of lb. of 37c. tea$=60\div12=5$.

2. 1 centimetre$=\cdot3937$ in. $\therefore$ 1 cu. cm.$=(\cdot3937)^3$ cu. in. 277·27 cu. in weigh 70000 grains. $\therefore$ 1 cu. cm. weighs $70000\times(\cdot3937)^3\div277{\cdot}27$.

3. Let r be the rad. of the circle. Then area of square is $4r^2$, and of the circle $\frac{22}{7}r^2$. $\therefore$ the circle is $\frac{11}{14}$ of the square. $\therefore$ the cost is $\frac{11}{14}$ of \$3·20.

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4. 28, page 155.

5. No. of shares of 1st stock=500, $\therefore$ div.=\$2750. No. of shares of 2nd stock=500, $\therefore$ div.=\$3750.

6. 16, page 213.

7. No. of sec.$=5\text{m.}\div1140$ ft.$=23\frac{3}{5}$. In $23\frac{3}{5}$ sec. the train goes $\frac{55}{171}$ mi.

8. The U.S. dollar contains $\frac{9}{10}$ of $412\frac{1}{2}$ grains of pure silver. The Can. dollar contains $\frac{37}{40}$ of 360 grains of pure silver. $\therefore$ the ratio is $\frac{9}{10}$ of $412\frac{1}{2}$ to $\frac{37}{40}$ of 360, or 165 to 148.

9. Vol. of cone in cu. in.$=\frac{22}{7}\times25\times4$. 1 cu. in. of silver weighs $\frac{10500}{17325}$ oz. $\therefore$ wt of cone in oz.$=\frac{10500}{17325}\times\frac{22}{7}\times25\times4$.

10. Average S.P.=\$5·40. $\therefore$ the two kinds were in the ratio of 40 to 60, or 2 to 3, (page 128).

11. 12, page 170.

12. 9, page 194.

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13. Apply formula page 87 to find area.

14. Cost of mixture = 75c. a pint. But 75c. is the cost of only $\frac{5}{8}$ pint of wine. $\therefore$ $\frac{3}{8}$ of the mixture is water.

15. In 1 hr. A does $\frac{1}{80}$ and B $\frac{1}{81}$ of the work. $\therefore$ both do $\frac{161}{6480}$. $\therefore$ they do all the work in $\frac{6480}{161}$, or $40\frac{40}{161}$ hr.

16. $\frac{88}{7}r^2 = 1386$, $\therefore$ $r = 10{\cdot}5$. $\therefore$ vol. of sphere $= \frac{4}{3} \times \frac{22}{7} \times (10{\cdot}5)^3 = 4851$ cu. in. Edge of cube $= 16$ in. $\therefore$ vol. of cube $= 4096$ cu. in.

17. Face of draft = \$400. $\therefore$ no. of shares = 50.

18. Suppose weight of each is 120 grains. The first contains 110 of gold and 10 of alloy, which is the same in value as $110\frac{2}{3}$ grains of gold. Similarly the second is the same in value as $108\frac{4}{5}$ grains of gold. $\therefore$ the ratio is $110\frac{2}{3}$ to $108\frac{4}{5}$, or 415 to 408.

19. The \$12 is 2% of the total com. $\therefore$ the total com. is \$600. $\therefore$ 1st com. was $\frac{1}{2}$(\$600 + \$12), or \$306. $\therefore$ value of goods = $\$306 \times \frac{100}{2} = \$15300$.

20. The diff., \$1·9968, is the int. for 1 year on the second year's int., that is, on \$49·92. $\therefore$ the rate is 4%.

21. Page 202.

22. The diagonals bisect each other at right angles. $\therefore$ the area is $\frac{1}{2}$ of the prod. of the diagonals.

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23. Rent = \$216. Premium = \$19. $\therefore$ net inc. = \$216 − \$66 = \$150, which is $6\frac{6}{19}$% of value.

24. 1 cu. ft. of water weighs $1000 \times \frac{437{\cdot}5}{480}$ oz. Troy. 1 cu. m. $= \left(\frac{5280}{1700}\right)^3$ cu. ft. $\therefore$ 1000 kilo. $= 1000 \times \frac{437{\cdot}5}{480} \times \left(\frac{5280}{1700}\right)^3$ oz. Troy.

25. Measure $= (3\frac{1}{8} \times 5\frac{1}{2}) \div (\frac{3}{4} \times \frac{7}{8}) = 26\frac{4}{21}$.

26. A, B and C do $\frac{1}{4} + \frac{1}{10}$, or $\frac{7}{20}$ in 1 day. $\therefore$ A can do $\frac{7}{20} - \frac{1}{6}$, or $\frac{11}{60}$ in 1 day. $\therefore$ A and C do $\frac{11}{60} + \frac{1}{10}$, or $\frac{17}{60}$ in 1 day.

27. 1 rouble $= 38{\cdot}177$ pence $= 38{\cdot}177 \times \frac{25{\cdot}2215}{240}$ francs.

28. Discount for 100 days $= \$182{\cdot}50 \times \frac{2}{365} \times$ [illegible] $= \$1{\cdot}50$. $\therefore$ on \$179 the bank makes \$3·50 int. in 100 da.

29. Circumference $= 22$ ft. $\therefore$ radius $= 3{\cdot}5$ ft. $\therefore$ area $= 38{\cdot}5$ sq. ft.

30. Suppose it holds 30 pints and $\therefore$ contains 25 of wine and 5 of water. The second mixture contains 18 of wine and 12 of water. $\therefore$ 7 pints of wine were drawn from the 25 pints, or $\frac{7}{25}$ of the mixture.

31. Sup. 30c. the cost of tea and 16c. of coffee. $\therefore$ gain on coffee $= \$44{\cdot}80$. Loss on tea $= \$13{\cdot}50$. Net gain $= \$31{\cdot}30$. $\therefore$ tea cost 60c. per lb.

32. \$2 is the com. on \$100. $\therefore$ rate $= 2\%$.

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33. Cash cost $= \$30$. $\therefore$ cash S. P. $= \$36$. The int. on \$36 is \$1·20 in 10 mo.

34. 462 gal. $= \frac{30 \times 462 \times 8}{1728}$ cu. ft. Surface of base of cistern $= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$ sq. ft. $\therefore$ depth $= \frac{30 \times 462 \times 8}{1728} \div \left\{\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}\right\}$ ft.

35. The sheep at \$5 and \$6 will balance each other. A sheep at \$4 gains \$1½, and one at \$8 loses \$2½. $\therefore$ 5 sheep at \$4 will balance 3 sheep at \$8. $\therefore$ the numbers may be 5, 1, 1, 3, or 5, 2, 2, 3, &c.

36. Cost of cloth = £1500. S. P. = $10000. Com. for selling = $500. Duty = $4·86⅔ × 1500 × ¼ = $1825. ∴ net proceeds = $7350. Each barrel costs (with com.) $2·10. ∴ no. of bbl. = 3500. S. P. of apples = £1750. ∴ gain = £250.

37. If second investment had been equal to the first the dif. in incomes would have been $134 − $125, or $9. Had he invested $3000 in each the incomes would differ by $5. ∴ amt. invested in the first = ⅝ of $3000, or $5400.

38. Vol. of pile = 3000 cu. ft. ∴ 24 cu. units = 3000 cu. ft. ∴ 1 cu. unit = 125 cu. ft. ∴ the linear unit is 5 ft. ∴ dimensions are 20, 15, 10 ft.

39. Sum = $1500 ÷ $(1·0075)^4$.

40. Their areas are 8505 and 8784 sq. yd. $\sqrt{8505} = 92+$ and $\sqrt{8784} = 93+$. ∴ the side of the only square between them in area is 93 yd.

41. Rate with the stream = 4½ ml. per hour. ∴ rate of stream = 1½ m. per hr. ∴ rate up stream = 1½ ml. per hr. ∴ time to return = 2 hr.

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42. 57, page 67.

43. Suppose dist. = 240 miles. Rate of A train is 30 and B train 40 mi. per hr. When B train starts A train has gone 150 mi. ∴ at 11 a.m. they are 90 mi. apart. ∴ they meet at $\frac{90}{70}$ hr. after 11 a.m., or 17⅐ min. past 12.

44. Amount of $1 in a year = $1·08. ∴ amt. in 3 mo. = the fourth root of 1·08 = 1·01942. ∴ quarterly rate = 1·942%.

45. If they can pay 12% on 10% of their capital, they can pay only $\frac{10}{14}$ of 12%, or 8⅝% on 14% of their capital.

46. Page 190.

47. External vol. $= 12 \times 10 \times 8$, or 960 cu. in. Internal vol. $= 10 \times 8 \times 6$, or 480 cu. in. $\therefore$ vol. of metal $= 480$ cu. in., which weighs 89 lb. $\therefore$ wt. of 960 cu. in. $= 178$ lb.

48. Sup. the sum is \$4. $\therefore$ S. P. per yd. $= 10$c. $\therefore$ cost $= 8$c. To gain 50% he must sell at 12c., or $33\frac{1}{3}$ yd. for \$4.

49. It is 5 hr. 20 min. later, or 12.35 a.m.

50. Dif. in dist. travelled by train and man in 8 sec. is 88 yd., or $22\frac{1}{2}$ mi. in 1 hr.

51. Each sold at the same fraction of cost. . the ube of that fraction is $\frac{\$8{\cdot}64}{\$5} = \frac{1728}{1000}$. $\therefore$ the fraction is $\frac{12}{10}$ nd the rate of profit is 20%.

52. \$1 amounts to $\$(1{\cdot}01)^4 = \$1{\cdot}0406+$. $\therefore$ rate $=$ 4·06%.

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53. Cost of wheat $=$ \$7760. Com. for buying $= 2\%$ of \$7760 $=$ \$155·20. Net S. P. of lumber $=$ \$7915·20, which is 97% of gross S. P. of lumber.

54. 18000 fr. $= £\frac{18000}{25{\cdot}2} = \$4{\cdot}86\frac{2}{3} \times \frac{18000}{25{\cdot}2}$.

55. The areas are in the ratio of 4 to 9. $\therefore$ the radii and also the circumferences are in the ratio of 2 to 3. $\therefore$ cost of second fence is $\$30 \times \frac{3}{2} = \$45$.

56. Amt. unpaid at end of 1st yr. $=$ \$2560 + \$128 − \$650 $=$ \$2038. At end of 2nd $=$ \$2038 + \$101·90 − \$650 $=$ \$1489·90. At end of 3rd $=$ \$1489·90 + \$74·495 − \$650 $=$ \$914·395.

57. 80, page 220.

58. 1, page 186; 31, page 189.

59. They are evidently together for the first time at the end of one hour. When the fastest has gone 20 rounds the 4th has gone only $\frac{11}{12}$ of 20, or $18\frac{1}{3}$ rounds. $\therefore$ if the

4th has a start, equal to the time it takes him to go $\frac{3}{4}$ of a round, he would finish with the 5th. ∴ he should have a start of $3\frac{7}{11}$ min. Similarly for the others.

60. They both fill $\frac{1}{30}+\frac{1}{36}$ in 1 min. ∴ in 12 min. they fill $\frac{26}{45}$. The first pipe will fill $\frac{9}{36}$ in $\frac{9}{26}$ of 30 min. $=7\frac{5}{7}$ min.

61. 21, page 188.

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62. 16, page 213.

63. A receives \$200 and pays B \$150 and C \$125. ∴ A loses \$75. B receives \$150 and pays D \$100. ∴ B gains \$50. C receives \$125. D receives \$100.

64. Sup. each cost \$2000. ∴ B's cost = \$1700 for each. ∴ B's S. P. = \$2040 for one and \$1275 for the other. The dif. is \$765, which is 5 times the given dif. ∴ each lot cost A \$400.

65. 121 sq. units $=\frac{1}{10}$ ac. $=484$ sq. yd. ∴ 1 sq. unit $=$ 4 sq. yd. ∴ the linear unit $=2$ yd.

66. Sup. he bought 300 yd. at \$1 a yard. He sells 150 yd. at \$1·20 and 50 yd. at 50c., receiving \$205. To gain 15% he must receive in all \$345. ∴ he sells the remaining 100 yd. for \$140, or \$1·40 a yd., which is $16\frac{2}{3}\%$ above the marked price.

67. The int. on \$93 is \$4 in 1 year, or $\$3\frac{1}{3}$ in 10 mo. ∴ the P. W. of $\$96\frac{1}{3}$ due in 10 mo. is \$93. ∴ the P. W. of \$4335 is \$4185.

68. They approach each other at the rate of $2\frac{3}{4}$ mi. per hr.

69. Total vol. $=18\times18\times3$, or 972 cu. in. Vol. of hole $=\frac{22}{7}\times7\times7\times3$, or 462 cu. in. ∴ vol. of block $=510$ cu. in. Surface of 4 sides $=18\times3\times4$, or 216 sq. in. Surface of top $=18^2-\frac{22}{7}\times7\times7=170$ sq. in. Circular surface $=14\times\frac{22}{7}\times3=132$ sq. in. ∴ total surface $=216+340+132$ $=688$ sq. in.

70. 9842 roubles = £1316 2s. 11·7d. Afterwards 9842 roubles = £1294 6s. 10·3d. ∴ gain = £21 16s. 1·4d.

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71. The discount = \$16. The banker has to pay int. on \$984 for 73d. at $3\frac{1}{2}\%$, which = \$6·888. ∴ his gain is \$16 − \$6·888 = \$9·112.

72. If he sold both at 2% com. he would realize \$16. ∴ he made the extra \$10 by the increased com. on the second lot. Every \$100 at 4% increases the com. by \$2. ∴ the S.P. of the second lot was \$500.

73. The amount in 3 years is \$16872·96. ∴ the int. = \$674·9184.

74. Area of end of wire $= \frac{22}{7} \times \cdot 05^2$ sq. in. ∴ length of wire in in. $= 1728 \div \frac{22}{7} \div (\cdot 05)^2$.

75. If the two lots are mixed there are 14 lb. of each worth \$10·15.

76. Duty = £72. ∴ total cost = £792 = \$3854·40. Net amount of sales = 95% of \$4200 = \$3990.

77. 68 days' wages = sum and int. for 4 days. 72 days' wages = sum and int. for 6 days. ∴ int. for 2 days = 4 days' wages. ∴ int. for 4 days = 8 days' wages, or the wages of 2 men for 4 days.

78. Side of field = 279 yd. Length of walk = 283 × 4, or 1132 yd. ∴ area = 4528 sq. yd.

79. When A goes 34 rounds he has gained 1 round, or $\frac{1}{4}$ mi. on B. ∴ in 40 rounds he gains $\frac{5}{17}$ mi.

80. $59\frac{1}{25}\% = \frac{369}{625}$. ∴ S.P. $= \frac{256}{625}$ of marked pr. This fraction is the fourth power of the fraction by which the first reduced price is obtained from the marked price. ∴ the reduction fraction is $\frac{4}{5}$, or each discount = 20%.

81. Draw the figure. The area = 2 sectors (∠150° and rad. 100 ft.) + 2 sectors (∠30° and rad. 60 ft.) + 2 sectors (∠90° and rad. 20 ft.) + equilateral △ (side 40 ft.).

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82. Circumference = 572 yd. ∴ diameter = 182 yd.

83. Find the equated time and add int. to Oct. 12th.

84. Sup. cost = 20c. per gal. He sells at 25c. per gal. Total S.P. = $2250. ∴ no. of gal. sold = 9000. No. bought = 7500. ∴ each gal. sold was only $\frac{5}{6}$ of a gal.

85. Larger segment = a sector with ∠300° + equilateral △ side r. Smaller segment − sector ∠60° − same equilateral △.

86. Whole gain % = $12\frac{1}{2} + 7 = 19\frac{1}{2}$. $\frac{100}{103}$ of $\frac{95}{100}$ of sales $= \frac{119 \cdot 5}{100}$ of cost. ∴ sales = 1·2956 of cost. ∴ advance = 29·56%.

87. The bullet must travel the 545 yd. in $2\frac{1}{2}$ sec., and ∴ sound travels the 545 yd. in $1\frac{1}{2}$ sec., or 1090 feet per sec.

88. Slant height $= 6\sqrt{2}$. Area of cone $= \frac{22}{7} \times 12 \times 3\sqrt{2}$ = 159·98 sq. ft. Area of cylinder $= \frac{22}{7} \times 12 \times 3 = 113 \cdot 14$ sq. ft. Total area = 273·12 sq. ft. = 30·34 sq. yd. Cost of 1 sq. yd. = 20c. ∴ total cost = $6·07 + 45c. = $6·52.

89. £750 = $3645. Com. = $182·25. ∴ net S.P. = $3645 − $182·25 − $262·75 = $3200, which is $\frac{4}{5}$ of cost. ∴ cost = $2400.

90. Dif. in long. = 214°. ∴ dif. in time = 14 h. 16 m. ∴ it is 14 h. 16 m. later, or 7.26 a.m. of the next day.

91. The base consists of 2 triangles whose sides are 104, 85, 45. ∴ using formula the area of the base is 3744 sq. in. ∴ vol. in cu. ft. = 3744 × 125 ÷ 1728 = $270\frac{5}{6}$.

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92. 5 ac. keep 20 oxen 10 weeks. ∴ 8 ac. keep 32 oxen 10 weeks, and 8 ac. keep 29 oxen 16 weeks, or 320 oxen are kept 1 wk. by the grass on 8 ac. + 10 wks.' growth

of grass, and 464 oxen are kept 1 wk. by the grass on 8 ac. + 16 wks.' growth of grass. ∴ 144 oxen are kept 1 wk. by 6 wks.' growth on 8 ac. ∴ 24 oxen are kept 1 wk. by 1 wks.' growth on 8 ac., and 24 oxen are kept a wks. by a wks.' growth on 8 ac., and 45 oxen are kept a wks. by a wks.' growth on 15 ac. ∴ (32 − 24) or 8 oxen are kept by 8 ac. of grass for 10 wks. ∴ (70 − 45) or 25 oxen are kept by 15 ac. of grass for 6 wks.

93. \$2·40 is the int. for 1 year on the first year's int. \$2·496 is the int. for 1 year on the second year's int. ∴ \$·096 is the interest on \$2·40 for 1 year. ∴ the rate is 4%. \$2·40 is the int. on \$60. ∴ the first year's int. = \$60. ∴ the original sum was \$1500.

94. The sides are 45·5 rods and 58 rods. The diagonal is 72·5 rods.

95. The loss is $\frac{1}{16}$ of cost. ∴ the discount fraction is $\frac{1}{4}$, or 25%. Hence the marked price was \$120.

96. Find its value 6 months ago, as on page 202, and find the amount of that value for 6 months.

97. Cash cost of the goods when sold is the P.W. of \$520·20 due in 3 mo., which is \$510. ∴ cash S.P. = \$561, which amounts to \$575.96 in 4 mo.

98. In 1 min. the no. of cu. ft. of water which flows is $\frac{22}{7}\times 7\times 7\times 880\div 144$. Vol. of reservoir 1 in. in depth = $187\times 96\times 9\div 12$ cu.ft. The 2nd of these divided by the 1st is the required no. of min.

99. He sells $388\frac{1}{2}$ yd. for the cost of $\frac{777}{2}\times\frac{88}{35}\times\frac{5}{4}$ yd. ∴ he must sell the rem. for the cost of $777\times\frac{5}{4}-\frac{777}{2}\times\frac{88}{35}\times\frac{5}{4}$ yd. But he sells the rem. as $\frac{777}{2}\times\frac{88}{37}$ yd. ∴ each yd. of the rem. is sold for the cost of $1\frac{285}{304}$ yd. ∴ he must mark it at $\frac{285}{304}$ of 100% of cost.

100. By (a) the cost will be $100\frac{1}{2}$% of \$5000 = \$5025. By (b) the cost will be $\frac{100}{99\frac{1}{2}}$ of \$5000 = \$5025·1256.