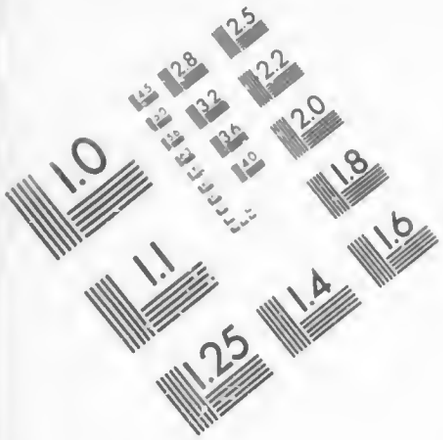

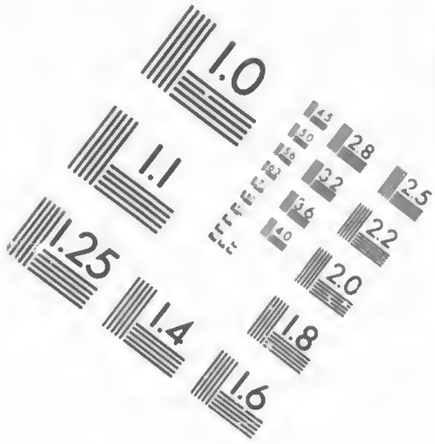

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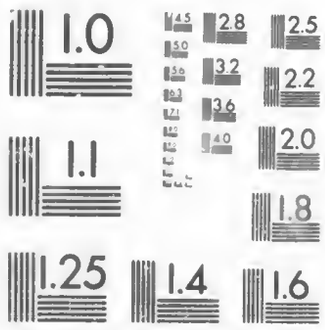

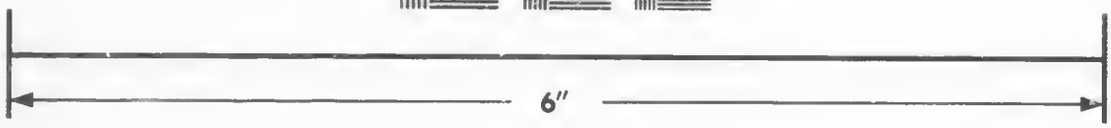

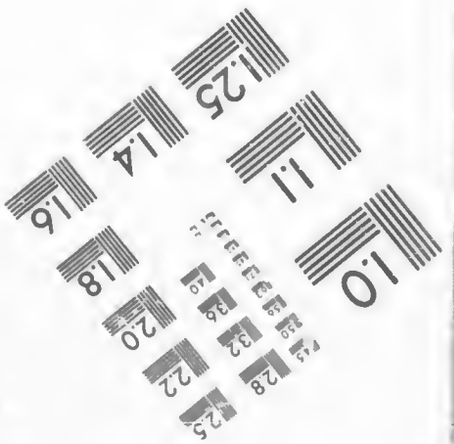

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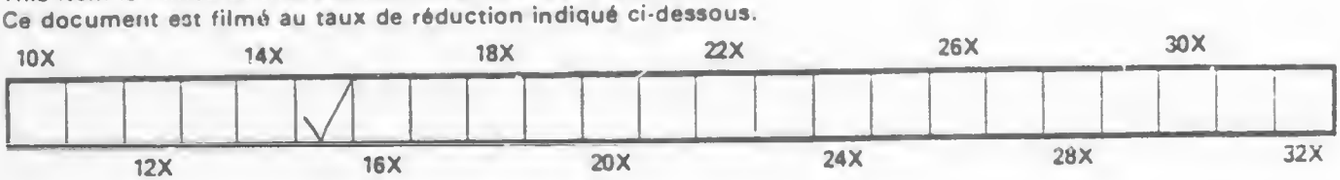

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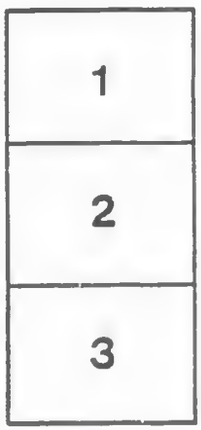

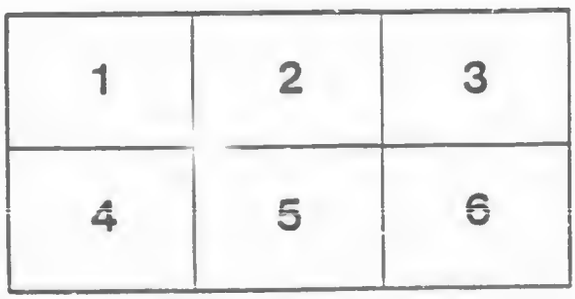

ANSWERS AND SOLUTIONS

TO

PRIZE PROBLEMS IN ARITHMETIC

BY

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TORONTO:

W. J. GAGE & COMPANY.

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HINTS AND ANSWERS.

I.

1. (1) 1760, (2) 7000, (3) 5760, (4) 480, (5)437½, (6) 1840, (7) 640, (8) 128, (9) 10, (10) 1000.

2. A number is divisible by 2 if the last digit to the right is divisible by 2; by 3 if the sum of its digits is divisible by 3; by 4 if the last two digits are divisible by 4; by 5 if the last digit is 0 or 5; by 6 if divisible by 2 and by 3; by 8 if the last three digits are divisible by 8; by 9 if the sum of its digits is divisible by 9; by 10 if the last digit is 0; by 11 if the difference between the sum of the digits in the even places, and the sum of the digits in the odd places, leaves no remainder when divided by 11; by 12 if divisible by 3 and by 4; by 15 if divisible by 3 and by 5; by 25 if the last two digits are divisible by 25.

3. To square a number ending with 5: remove the 5, multiply the number left by the next greater number, then place 25 after this product. Thus, to square 125: multiply 12 by 13, their product is 156, and hence their square is 15625. Similarly, we find the square of 9995 by multiplying 999 by 1000 and placing 25 after their product, giving 99900025.

4. The factors are 3, 7, 11.

5. $2000. 6. $3\frac{31}{198}$ m. 7. 177 lbs. 8. 6000.

9. 48 rods. 10. 10.

II.

1. 1750. 2. 21. 3. 21 cents. 4. $1.05.

5. $36.50.

6. In every 400 consecutive years there are 97 leap years; the years, such as 1900, ending in 00 and not being divisible by 400, not being leap years.

7. 124, omitting 1st July.

8. 63 cents. 9. $9.60. 10. 31 in.

III.

1. $14\frac{7}{16}$. 2. 7200. 3. 33 and 21. 4. 999 at least. 5. Not necessarily. 6. 10. 7. 13. 8. $22. 9. 88 10. 3448.

IV.

1. 56. 2. 4 days. 3. $18.06. 4. $42\frac{1}{2}$. 5. 10. 6. $6\frac{1}{4}$. 7. 400. 8. $1.20. 9. 494. 10. $125.

V

1. $19.20. 2. The latter. 3. $3.75. 4. $2545\frac{4}{11}$.

5. 3800.

6. Horse, $99 ; buggy, $42 ; harness, $18.

7. $38.40. 8. 29 in. 9. $3.15. 10. The second.

VI.

1. 12. 2. Butter, 18 cents ; eggs, 9 cents.

3. $6.80 in this question should be $4.80. Answer, 15 times.

4. More. 5. 22. 6. 13 miles, 260 yards. 7. $259. 8. The second. $5.55. 9. $2.85. 10. $5\frac{5}{6}$ lbs.

VII.

1. 4 feet. 2. $78.29\frac{1}{3}$. 3. $7.04.

4. 103 and 51 yards over.

5. $7.20. 6. $36\frac{1}{2}$ cents. 7. 2520 rods. 8. 20.

9. $3\frac{24}{35}$ lbs. avoirdupois. 10. $110.

VIII.

1. 74 ft., 11 in. 2. 149 ft., 10 in. 3. £300.
4. 5 o'clock p.m. 24 miles.
5. $543\frac{1}{4}$. 6. Christmas Day. 7. 5356800.
8. 33 feet. 9. 237660. 10. 1188 tons.

IX.

1. 1785. 2. $17.50. 3. 19. 4. $33. 5. $198.90.
6. Between 61 and 62.
7. 20 cents. 8. 32 ; 36 ; 40.
9. A, $16 ; B, $18 ; C, $20.
10. A should pay $16, B $18, and C $20.

X.

1. 10. 2. 1 inch. 3. $9012\frac{1}{2}$.
5. Cow, $25.20 ; sheep, $3.60.
6. 110 miles. 7. 103 tons, 250 lbs.
$1.54. 9. $9. 10. 33300.

XI.

1. £16. 19s. $0\frac{103}{114}\frac{82}{71}$d.
2. $\frac{12}{55}$ of a half-crown.
3. $\frac{1}{9}$ of $\frac{7}{8}$ of $\frac{2}{11}$ of the vessel$=\frac{7}{396}$ of vessel is worth £350 $\therefore$ vessel is worth $\frac{396}{7}$ of £350$=$£19800. $\frac{1}{11}$ of $\frac{1}{12}$ of vessel is worth $\frac{1}{11}$ of $\frac{1}{12}$ of 19800$=$£150.
4. No. is : $18-\frac{8}{15}$ of $\frac{5}{16}+\frac{2}{7}$ of $\frac{3}{8}=17\frac{79}{84}$.
5. 8s. 9d. 6. £281. 3s. 6d. 7. $\frac{23}{24}$. 8. 2s. $11\frac{1}{2}$d. ; 65740. 9. $286\frac{1}{2}$ seconds. 10. 4994 yards.

XII.

1. 99.75$\dot{1}$.

2. First obtained $\frac{1}{4}$ runs, each of three others $\frac{1}{10}$ runs, each of two others $\frac{1}{16}$ ∴ first 6 obtain $\frac{27}{40}$; remainder $\frac{13}{40}$ — 39 runs. Whole number=120 runs.

3. Rent paid in barley, £180; in wheat, £180; in cash, £180. Number of quarters wheat=£180÷48s. 75 quarters=600 bushels. Number of quarters barley=£180÷30s.=120 quarters=960 bushels.

4. $2\frac{1}{40}$ of half-a-crown.

5. Master owns $\frac{3}{8}$ of $\frac{1}{5}$ of $\frac{2}{3}=\frac{1}{5}$ of ship ∴ his share will be $\frac{1}{5}$ of $\frac{5}{8}$ of £25000=$4166\frac{2}{3}$.

6. C is to have $2-(\frac{1}{5}+\frac{5}{6})=\frac{11}{30}$ of a chest. A buys $\frac{8}{11}$ of $\frac{11}{30}=\frac{4}{15}$ of a chest from C ∴ A now has $\frac{4}{5}+\frac{4}{15}=\frac{16}{15}$ of a chest. B purchased from C $\frac{2}{11}$ of $\frac{11}{30}=\frac{1}{15}$ ∴ he has now $\frac{5}{6}+\frac{1}{15}=\frac{27}{30}=\frac{9}{10}$ of chest. C has still $\frac{1}{11}$ of $\frac{11}{30}=\frac{1}{30}$ of a chest.

7. $2\frac{1}{2}$ bbls. beer=$36\times2\frac{1}{2}$=90 gals.=720 pints. He put $\frac{2}{3}$ of a pint in one to the pint in the other ∴ for every $1\frac{2}{3}$ pints contained in the $2\frac{1}{2}$ bbls., 1 pint was placed in the larger division, *i. e.*, $\frac{1}{1\frac{2}{3}}$ of 720=$\frac{3}{5}$ of 720=432 pints; in the smaller, $\frac{2}{3}$ of 432=288 pints.

8. $\frac{2\frac{1}{5}\frac{2}{3}}{13\frac{5}{13}}$ of A's=3s.; of B's=2s.; difference, 1s. $\frac{2\frac{3}{8}}{4\frac{3}{4}}$ of 1s.=$\frac{1}{2}$s. A has now 17s. 6d.; B has 12s. 6d. $\frac{1}{35}$ of $\frac{5}{2}$ of 17s. 6d.=$1\frac{1}{4}$s. $\frac{11}{5}$ of $\frac{1}{2}$ of 13s. 6d.=$14\frac{17}{20}$s. $14\frac{17}{20}$s.+$1\frac{1}{4}$s.=$16\frac{1}{10}$s., and $\frac{3}{4}$ of $\frac{2}{3}$ of $16\frac{1}{10}$s.=$8\frac{1}{20}$s.=$\frac{3}{4}$ of [illegible]'s.

9. The first can do $\frac{5}{8}$ of the work in 15 days ∴ he can do the whole work in $\frac{8}{5}$ of 11=$17\frac{3}{5}$ days. He does in 1 day $\frac{5}{88}$ of work, and in 15 days $\frac{75}{88}$ of work. The second man does remainder $\frac{13}{88}$ of work in 4 days ∴ he can do the whole work in $\frac{88}{13}$ of 4=$27\frac{1}{13}$ days.

10. Selling price is $\frac{11}{10}$ of 50s.=55s. Throw off $\frac{1}{20}$ of 55s.=$2\frac{3}{4}$s., so receive $52\frac{1}{4}$s. ∴ gain is $2\frac{1}{4}$s. per watch. On 50s. gain $2\frac{1}{4}$s. ∴ on £100 gain is £$4\frac{1}{2}$.

XIII.

1. $19200. 2. $12. 3. $8.02\frac{1}{12}$. 4. $3.28\frac{1}{8}$.

5. $\$13.78\frac{1}{8}$.

6. $\frac{5}{32}$ left, worth \$15000.

7. $5561\frac{97}{425}$ lbs.

8. Wheat, $1681\frac{3}{7}$ bus.; rye, $627\frac{1}{15}$ bus.; oats, $565\frac{1}{25}$ bus.

9. 4 of each.

10. $\frac{7}{10}$ of $\frac{1}{4}$ of stock$=\frac{7}{40}$ of stock injured. $\frac{3}{10}$ of $\frac{1}{4}$ of stock$=\frac{3}{40}$ of stock uninjured. $\frac{3}{40}$ of stock cost \$5400 $\therefore$ $\frac{1}{40}$ cost \$1800, and $\frac{40}{40}$ of stock cost \$7200. Received for injured goods $\frac{1}{2}$ of \$12600=\$6300. Total receipts= \$5400+\$6300=\$11700. Loss=\$72000 − \$11700=\$60300. Merchant's loss$=\frac{9}{10}$ of \$60300=\$53918.75.

XIV.

1. $13\frac{1}{2}$ francs.

2. A can do $\frac{1}{2}$ work in 1 hour. B can do $\frac{3}{4}$ of $\frac{1}{2}=\frac{3}{8}$ in 1 hour. C can do $\frac{1}{8}$ of work in 20 minutes$=\frac{3}{8}$ in 1 hour. A, B and C can do $\frac{1}{2}+\frac{3}{8}+\frac{3}{8}=\frac{5}{4}$ of work in 1 hour, or whole work in $\frac{4}{5}$ of an hour.

3. $\frac{507}{896}$. 4. $3\frac{1}{3}$ days.

5. 15 men can reap field in 9 days $\therefore$ 10 men can reap it in $\frac{15\times 9}{10}=13\frac{1}{2}$ days, and $\frac{1}{2}$ the field in $\frac{1}{2}$ of $13\frac{1}{2}=6\frac{3}{4}$ days.

6. 15 pence.

7. Simplify fraction. A's income is $\frac{321}{700}$ of B's, *i.e.*, as 321 : 700. B spends ·455 of income=£364. Whole income$=\frac{364\times 1000}{455}$=£800. A's income is $\frac{321}{700}$ of 800= $£366\frac{6}{7}$.

8. $\cdot 08\dot{3}$

9. A gets $\frac{2}{5}$ marks. B's $=2$ (A's−C's). C's$=3$ (B's− D's). D's$=\frac{1}{2}$(A's+B's+C's). E$=\frac{4}{5}$(A's+B's+C's−D's). C's$=3$ (B's−D's)$=3$ {B's−$\frac{1}{2}$ (A's+B's+C's)}$=3$ B's− $\frac{3}{2}$ A's−$\frac{3}{2}$ B's−$\frac{3}{2}$ C's $\therefore \frac{5}{2}$ C's$=\frac{3}{2}$ A's−$\frac{3}{2}$ B's. C's$=\frac{3}{5}$ B's− $\frac{3}{5}$ A's. Again. B's$=2$ A's−2 C's$=2$ A's−2 ($\frac{3}{5}$ B's−$\frac{3}{5}$ A's) $\therefore$ 11 B's$=16$ A's. 11 B's$=16$ times $\frac{2}{5}$ of marks $\therefore$ B's$=\frac{32}{55}$ of marks. Substituting values of A's and B's in C's equa-

tion, we have C's $=\frac{6}{55}$. Substituting in D's we get $\frac{30}{55}$, and in E's $\frac{40}{55}$, therefore E is first and B second.

10. See Arithmetic.

XV

1. £44. 17s. $8\frac{2}{20}\frac{4}{5}$d.

2. A's wages for $38\frac{4}{7}-22\frac{1}{2}$ days=B's wages for $22\frac{1}{2}$ days ∴ A's wages for $38\frac{4}{7}$ days=B's for $\frac{22\frac{1}{2}}{16\frac{1}{4}}\times 38\frac{4}{7}=59\frac{11}{14}$ days.

3. 6 times.

4. A in 2 days does as much as B in 3 ∴ A in 9 days does as much as B in $\frac{3}{2}\times 9=13\frac{1}{2}$ days. B in 5 days does as much as C in 4 days ∴ B in $13\frac{1}{2}$ days does as much as C in $\frac{4}{5}$ of $13\frac{1}{2}=10\frac{4}{5}$ days.

5. First number in 3 hours mow 4 acres, or $1\frac{1}{3}$ acres in 1 hour. Second number in 5 hours mow 8 acres, or $1\frac{3}{5}$ acres in 1 hour. Together they mow $1\frac{1}{3}+1\frac{3}{5}=2\frac{14}{15}$ acres in 1 hour ∴ they mow 11 acres in $(1\div 2\frac{14}{15})\times 11=3\frac{3}{4}$ hours.

6. Together A and B have 4 times as much as B has. B wins $\frac{3}{8}$ of $3=1\frac{1}{8}$ times what he had at first, and now has $2\frac{1}{8}$ times what he had. A must win back $\frac{1}{8}$ of what B had at first, or $\frac{1}{8}\div 2\frac{1}{8}=\frac{1}{17}$ of what B now has.

7. $\$462\frac{8}{9}$.

8. A does $\frac{2}{3}$ in 4 hours, or $\frac{1}{6}$ in 1 hour. B does $\frac{3}{4}$ of $\frac{1}{3}$ $=\frac{1}{4}$ in 1 hour. C does remaining $\frac{1}{12}$ in 20 min., or $\frac{1}{4}$ in 1 hour. Together they do $\frac{1}{6}+\frac{1}{4}+\frac{1}{4}=\frac{8}{12}=\frac{2}{3}$ of work in 1 hour ∴ do all in $1\frac{1}{2}$ hours.

9. £504.

10. Part left in each hour is $\frac{1}{3}-\frac{1}{17}=\frac{14}{51}$ of cistern ∴ whole cistern will be filled in $3\frac{9}{14}$ hours.

XVI.

1. £5. 0s. $11\frac{3}{7}$d.

2. B $5\frac{41}{45}$d. ; C $29\frac{5}{9}$d.

3. $\frac{481}{850}$.

4. $\frac{17}{40}$ lost in washing. $\frac{11}{20}$ of remainder lost in smelting $\therefore \frac{9}{20}$ of remainder is pure. $\frac{9}{20}$ of $\frac{23}{40}$ of ore is pure $= \frac{207}{800}$ pure metal. $\frac{207}{800}$ of ore $= 506$ tons $\therefore$ ore $= \frac{800 \times 506}{207} = 1968\frac{124}{207}$ tons.

5. $8\frac{8}{11}$d. 6. 684.

7. Number of female adults $= \frac{5}{16}$ of population. Males $\frac{12}{17}$ of $\frac{5}{16} = \frac{5}{17}$ of population. Adults $= \frac{5}{16} + \frac{5}{17} = \frac{165}{272}$ of population $= 22815210$. Population is $22815210 \times \frac{272}{165} = 37,710,528$.

8. 12s. 9. £86.

10. $254,500,885\frac{1}{3}$ square miles.

XVII.

1. $12\frac{1}{2}$ thalers. 2. £90. 3. 132.

4. A receives $\frac{1}{7}$ of £897. 15s. $=$ £128. 5s. B receives $\frac{2}{3}$ of £897. 15s. $=$ £598. 10s. C receives $1-(\frac{1}{7}+\frac{2}{3}) = 1-\frac{17}{21} = \frac{4}{21}$ of sum.

5. £4. 16s. 6. 22. 7. 4s. $4\frac{1}{2}$d.

8. Difference between shares of two sons $= \frac{7}{18} - \frac{7}{18}$ of $\frac{11}{18} = \frac{7}{18} - \frac{77}{324} = \frac{126}{324} - \frac{77}{324} = \frac{49}{324} \therefore \frac{49}{324}$ of property is £514. 6s. 8d. Whole property $= \frac{324}{49}$ times £514. 6s. 8d. Widow receives $\frac{11}{18}$ of $\frac{11}{18} = \frac{121}{324}$ of property $= \frac{121}{324}$ of $\frac{324}{49}$ of £514. 6s. 8d. $=$ £1270. 1s. $9\frac{11}{49}$d.

9. Loses $\frac{7}{8}$ of property, retains $\frac{1}{8}$, recovers $\frac{1}{5}$ of $\frac{1}{8}$, so has now $\frac{6}{5}$ of $\frac{1}{8} = \frac{3}{20}$ of original property. Again loses $\frac{1}{2}$, and retains $\frac{1}{2}$ of his present property $= \frac{1}{2}$ of $\frac{3}{20}$ of original property $= \frac{3}{40}$. As his debts are $\frac{1}{14}$, he can still pay them and have $\frac{1}{280}$ of original property left.

10. £4. 15s. $2\frac{458}{817}$d.

XVIII.

1. 40. 2. 120.

3. $\frac{1}{29}$ lb. avoirdupois $= \frac{7000}{29}$ grs. $= \frac{7000}{29} \times \frac{1}{5760}$ lb. $= \frac{175}{4176}$ lb. troy. $\frac{1}{29}$ lb. troy $+ \frac{175}{4176}$ lb. troy $= \frac{1}{144}$ lb. troy. Also similarly $\frac{11}{144}$ lb. troy $= \frac{11}{144} \times 5760$ grs. $= \frac{11}{144} \times \frac{5760}{7000}$ lb. avoirdupois $= \frac{11}{175}$ lb. avoirdupois.

4. $108. 5. 992 bushels. 6. 32 scholars.

7. 48 pupils.

8. A should receive $\frac{7}{9}$ of $\frac{3}{5}$ of $45000 = $21000. B should receive $\frac{15}{14}$ of $\frac{3}{9}$ of $21000 = $15000. C should receive $9000.

9. Amounts bequeathed to A, B, C and D $= \frac{5}{12} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8} = \frac{23}{24}$ of property $\therefore \frac{1}{24}$ amount bequeathed to E = $550, and whole property is 24 times $550 = $13200.

10. 9.33\frac{3}{5}$.

XIX.

1. $1\frac{26}{119}$ pints per hour.

2. $1040\frac{20}{359}$ miles.

3. 24 miles. 1 hour, 44 minutes, 10 seconds.

4. A can mow $\frac{1}{4}$ of the meadow in 1 day. B can mow $\frac{1}{3}$ of the meadow in 1 day. Together they can mow $\frac{1}{4} + \frac{1}{3} = \frac{7}{12}$ of the meadow in 1 day. They can mow the whole meadow in $\frac{12}{7}$ days $= 1\frac{5}{7}$ days.

5. $1\frac{7}{36}$ days.

6. The waste-pipe will remove $\frac{1}{20}$ of cistern in 1 hour, while $\frac{1}{30}$ of cistern flows in per hour $\therefore \frac{1}{20} - \frac{1}{30} = \frac{1}{60}$ of cistern is emptied per hour; whole cistern in 60 hours.

7. A can mow $\frac{5}{27}$ in 1 day; B $\frac{1}{6}$ in 1 day. Together, mow $\frac{5}{27} + \frac{1}{6} = \frac{19}{54}$ in 1 day $\therefore$ mow whole field in $\frac{54}{19} = 2\frac{16}{19}$ days.

8. First fills $\frac{1}{2}$ in $\frac{3}{4}$ hour, or whole cistern in $1\frac{1}{2}$ hours $\therefore \frac{2}{3}$ in 1 hour. Second fills $\frac{3}{4}$ in $\frac{1}{2}$ hour $\therefore \frac{1}{4}$ in $\frac{1}{6}$ hour, and whole cistern in $\frac{2}{3}$ hour, *i. e.*, $\frac{3}{2}$ cistern in 1 hour. Both together fill $\frac{3}{2} + \frac{2}{3} = \frac{9}{6} + \frac{4}{6} = \frac{13}{6}$ in hour, or whole cistern in $\frac{6}{13}$ of hour.

9. First fills $\frac{4}{3}$ of cistern in 1 hour. Second lets out $\frac{3}{4}$ of cistern in 1 hour. Part left in at end of 1 hour $= \frac{4}{3} - \frac{3}{4} = \frac{16}{12} - \frac{9}{12} = \frac{7}{12}$ cistern; whole filled in $1\frac{5}{7}$ hours.

10. A and B can do $\frac{2}{5}$ of work in 1 day. A and C do $\frac{3}{10}$ in 1 day. B and C do $\frac{2}{9}$. Together they do $\frac{2}{5} + \frac{3}{10} + \frac{2}{9} = \frac{83}{90}$ of work in 2 days $\therefore$ whole work in $2\frac{14}{83}$ days. A in $4\frac{8}{43}$ days; B in $6\frac{6}{29}$ days; C in $16\frac{4}{11}$ days.

XX.

1. 9 feet. 2. 330 yards.

3. Width is $\frac{400}{24}=16$ yards 2 feet $=50$ feet $\therefore \frac{50}{3\frac{1}{3}}=15$ widths of roller.

4. Each sod will cover $27\frac{1}{2}\times 8\frac{1}{4}=226\frac{7}{8}$ square inches. Number of square inches in an acre $=6272640$ sq. in. Number of sods $=6272640\div 226\frac{7}{8}=27641$ sods.

5. \$15.20.

6. Room is $\frac{26}{3}=8\frac{2}{3}$ yards long, so will require strips 9 yards long. Number of strips $=15\frac{3}{4}$ feet $\div\frac{3}{4}$ yard $=7$ strips, so will require $9\times 7=63$ yards, with $\frac{1}{3}\times 7=2\frac{1}{3}$ yards turned under. In second case, 6 yards in length and 12 strips, or 72 yards, with $11\frac{1}{3}$ yards turned under.

7. $17\frac{1}{2}$ square yards.

8. Including ceiling, $121\frac{3}{8}$ yards.

9. Area of four walls=681 square feet. Area of doors and windows $=42+53\frac{5}{9}=95\frac{5}{9}$ square feet. Remainder $=585\frac{4}{9}$ square feet. Area covered by roll of paper $=24\times\frac{3}{2}$ $=36$ square feet. Number of rolls $=585\frac{4}{9}\div 36$. Value at 75c. $=\$12.19\frac{83}{108}$.

10. Cubic contents of wood $=60\times 12\times 9=6480$ cubic inches. Cubic contents of match $=\cdot 1\times\cdot 1\times 2\frac{1}{2}=\frac{1}{40}$ cubic inch. Number of matches $=6480$ cubic inches $\div\frac{1}{40}$ cubic inches $=259200$ matches.

XXI.

1. \$27. 2. \$126. 3. \$26. 4. \$15. 5. \$48.
6. 50 cents. 7. \$5. 8. \$3. 9. \$3. 10. \$18.

XXII.

1. \$446.40.

2. \$1 in 4 years at 4 per cent. will amount to \$1.16 $\therefore$ \$40 will amount to \$46.40.

3. \$22.40. 4. \$209.97½. 5. \$742.

6. The first loan runs for $1\frac{7}{12}$ years; the second for 1 year; the third for $\frac{7}{12}$ year. Answer \$1399.17½.

7. \$107.80.

8. Rate, 6 per cent.; time, $\frac{1}{4}$ year; answer \$1015.

9. Rate, 8 per cent. Answer \$1.10.

10. \$2 in each case.

XXIII.

1. The rate is 6 per cent. Answer \$440.88.

2. The time is $\frac{1}{5}$ year ∴ interest will be 2 per cent., or \$56.

3. \$1.03. 4. \$1.02.

5. Rate, 6 per cent.; time, 73 days; interest, \$39.42.

6. Reckoning 20 days as $\frac{2}{3}$ of a month or $\frac{2}{36}$ of a year, the time is $3\frac{20}{36}$ years. Answer $\$1\frac{16}{45}$.

7. \$81.36.

8. At the end of the first year he will owe \$1060; he pays \$300 and still owes \$760. At the end of the second year this will amount to \$805.60; he pays \$300 and still owes \$505.60, which at the end of the third year will amount to \$535.94 nearly.

9. 20 years.

10. At 1 per cent. the interest on \$100 for $12\frac{1}{2}$ years will be \$12.50, therefore, in order that the interest may be \$100, 8 per cent. must be charged.

XXIV.

1. 10 per cent. is $\frac{10}{100}$ or $\frac{1}{10}$; 5 per cent. is $\frac{1}{20}$; $12\frac{1}{2}$ per cent. $\frac{1}{8}$; 7 per cent. $\frac{7}{100}$.

2. $12\frac{1}{2}$; 6; 10; $11\frac{1}{9}$. 3. $\frac{3}{20}$. 4. $\frac{217}{1200}$.

5. The time is $3\frac{8\frac{1}{2}}{12}$ years, and the rate $\frac{8}{100}$; multiplying these together we have $\frac{89}{300}$.

6. $1\frac{1}{5}$. 7. $1\frac{17}{50}$ G. 8. $1\frac{39}{500}$.

9. The time is $4\frac{47}{60}$ years. Multiply by $\frac{6}{100}$ and we have $\frac{287}{1000}$; add 1 to this and the required fraction is $1\frac{287}{1000}$. The amount will be $1287.

10. $10.39.

XXV.

1. March 21, 1886. 2. April 6, 1886.

3. (1) March 5. (2) March 3. (3) March 3.

4. (1) March 3. (2) December 24. (3) May 25.

5. May 29 or May 30.

6. One month, 30 days or 31 days. The first two would make the note fall due on December 25, but as this is a legal holiday, the note would be payable on the 26th.

7. February 22, 1886. $433.53.

8. The note is payable in 90 days, and in that time the $1825 will amount to $1861.

9. Draw the note for 143 days, and make the other necessary changes in the form given in question 7.

10. $396.84.

XXVI.

1. $\frac{6}{5}$. 2. $\frac{5}{7}$. 3. $\frac{13}{10}$, $\frac{10}{13}$. 4. $\frac{2}{3}$. $100.

5. The amount is $\frac{140}{100}$ of the principal, therefore the principal is $\frac{100}{140}$ or $\frac{5}{7}$ of the amount, and $\frac{5}{7}$ of $70=$50.

6. $1000. 7. $10. 8. $1.09. $\frac{100}{109}$ of $1.

9. £$\frac{100}{113}$. 10. $500.

XXVII.

1. $250. 2. Read "24th of July." $730.

3. $500. 4. $625.

5. Altogether 21 per cent., so that $100 will amount to $121, or the principal is $\frac{100}{121}$ of the amount. Answer $10.

6. $\frac{51}{40}$. 7. \$160.

8. The amount will be $\frac{361}{300}$ of the principal ; that is, the principal is $\frac{300}{361}$ of the amount, or \$30.

9. 900 guineas. 10. $\frac{7202}{9671}$ of \$1.

XXVIII.

1. \$2.50. 2. 4 per cent. 3. 5 per cent.

4. The interest for 45 days is \$9.90, hence the interest for 365 days is \$80.30. Therefore \$80.30 is the interest for 1 year on \$730, hence the interest on \$100 is \$11 ; hence the answer is 11 per cent.

5. 10 per cent.

6. The interest for the whole time is \$196 ; the interest for 1 year is \$39.20, hence the number of years is 5.

7. The interest for a year would be \$21.90, or 6 cents a day ; hence the interest will be \$19.14 in 319 days.

8. $16\frac{2}{3}$ years ; 12 years ; 8 years.

9. The amount is \$1.05 in 1 year ; \$1.10 in 2 years, and \$1.13 in $2\frac{2}{5}$ years, or 949 days.

10. 50 years.

XXIX.

1. \$90 : \$1800. 2. \$1000. 3. \$2190. 4. $6\frac{1}{2}$ per ct.

5. The interest for a year would be \$36.50, hence the required time is $\frac{8.20}{36.50}$ of a year, or 82 days. Answer July 31.

6. $\frac{17771}{12000}$. 7. 5 per cent. 8. $\frac{9125}{9398}$.

9. $\frac{2}{3}$ of a month is $\frac{1}{18}$ of a year, whereas 20 days $=\frac{4}{73}$ of a year, and as $\frac{1}{18}$ is greater than $\frac{4}{73}$, the result would be too great. $\frac{1}{219}$ of \$1.

10. The interest is \$6 for 12 months, or \$1 for every 2 months.

XXX.

1. The first is equivalent to a cash offer of $1744 ; the second to one of $1629, and the third is $1600. The first offer is consequently the best.

2. $1331. 3. $12.46. 4. $400. 5. 20 years.

6. 5 per cent. 7. $6\frac{1}{2}$ cents. 8. 8 per cent.

9. 15 per cent.

10. The interest on $1000 for a year is $60, or $1 for every 6 days, if we call 360 days a year. This method is, therefore, not strictly correct, but is sufficiently accurate when the number of days is small.

XXXI.

1. Increase is $\frac{2}{25}$ of population of 1870 $\therefore$ population of 1880 is $\frac{27}{25}$ of population of 1870 $= \frac{27}{25}$ of $12275 = 13257$.

2. 24 tons, 1840 lbs.

3. 1500 lbs., 200 lbs., 300 lbs. respectively.

4. 12 per cent.

5. 1 lb. of each would cost $2.42. The three sell for $2.70. Gain on $2.42 = 28c. Gain on $1.00 is $\frac{28}{242} \times 100 = 11\frac{69}{121} = 11\frac{69}{121}\%$.

6. 15 per cent.

7. $17\frac{1}{2}\% = \frac{7}{40} \therefore \frac{47}{40}$ of cost is the selling price. $\frac{47}{40}$ of cost $= \$253.80 \therefore$ cost $= \frac{40}{47}$ of $\$253.80 = \$216.00$.

8. Cost of 42 gals. is $258.00. Received for it $\$42 \times 7 = \$294.00$. Gained $36. Gain on $258 is $36 \therefore$ Gain $\% = \frac{36}{258} \times 100 = 13\frac{41}{43}\%$.

9. Loss is $12\% = \frac{3}{25}$ of cost. S.-P. is $\frac{22}{25}$ of cost $\therefore$ cost is $\frac{25}{22}$ of $\$200 = \$227\frac{3}{11}$. Gain by selling for $250 is $\$22\frac{8}{11}$. Gain per cent. $= (22\frac{8}{11} \div 227\frac{3}{11}) \times 100 = 10\%$.

10. $7200 amount for which sold : $6400 cost.

XXXII.

1. Cost of spirits $= \$3.25 \times 75 = \$243.75$. Gain $= 5\% =$

$\frac{21}{20}$ of cost ∴ selling price $=\frac{21}{20}$ of cost $=\frac{21}{20}$ of \$243.75 $=$ \$255.93¾. Selling price per gal. $=$ \$255.93¾ ÷ 65 $=$ \$3.93¾.

2. Throws off 50% $=\frac{1}{2}$ of marked price ∴ selling price is $\frac{1}{2}$ of \$5 $=$ \$2.50. Gain is 14% $=\frac{7}{5}$ of cost ∴ selling price is $\frac{57}{50}$ of cost. Cost is $\frac{50}{57}$ of \$2.50 $=$ \$2.19$\frac{17}{57}$.

3. 6⅔%.

4. Deduct 5% $=\frac{1}{20}$ of marked price ∴ $\frac{19}{20}$ of marked price $=$ selling price $=$ \$7.12½. Marked price $=\frac{20}{19}$ of \$7.12½ $=$ \$7.50.

5. Gain by false weight $=\frac{3}{25}$ of cost. Received $\frac{28}{25}$ of cost ∴ $\frac{28}{25}$ of weight is 1 lb., *i.e.*, lb. weight is $\frac{25}{28}$ of 1 lb. $=$ 14$\frac{2}{7}$ oz.

6. 5 tons, 8 cwt.

7. To make 20% he must receive $\frac{6}{5}$ of cost, as he throws off 20%; $\frac{6}{5}$ of cost is $\frac{4}{5}$ of marked price ∴ marked price is $\frac{5}{4}$ of $\frac{6}{5}=\frac{3}{2}$ of cost, or an advance of 50%.

8. 35$\frac{5}{7}$ per cent. advance.

9. $\frac{9}{10}$ of cost $=$ \$117 ∴ cost $=$ \$130. Selling price to gain 10% $=$ \$143.

10. 2$\frac{19}{28}$%.

XXXIII.

1. Cost of fish is 20% $=\frac{1}{5}$ cost of clams and oysters ∴ $\frac{6}{5}$ cost of fish and oysters $=$ \$59.40. Cost of clams and oysters $=\frac{5}{6}$ of \$59.40 $=$ \$49.50, and cost of fish is \$9.90. Cost of clams $=\frac{65}{100}$ cost of oysters ∴ $\frac{165}{100}$ cost of oysters $=$ \$49.50, and cost of oysters $=\frac{100}{165}$ of \$49.50 $=$ \$30. Cost of clams $=$ \$19.50.

2. 180. 3. \$3000.

4. Paid for jewelry $\frac{6}{5}$ of cost of clothes ∴ $\frac{11}{5}$ of cost of clothes $=$ \$280. Cost of clothes, \$127$\frac{3}{11}$; of jewelry, \$152$\frac{8}{11}$.

5. Deducting the excess 30%, each could have 35%, *i.e.*, the defeated 35%, the elected 65% ∴ successful candidate received 65 per cent of 120 $=$ 78 votes.

6. 200 lbs. cotton, 480 lbs. wool.

7. $16.00.

8. Profit is $\frac{3}{4}$ of cost $= \frac{3}{4}$ of 3s. 4d. $=$ 2s. 6d. $\therefore$ profit on 360 yards $=$ 360 times 2s. 6d. $=$ £45.

9. Cost of 60 gals. @ $7\frac{1}{2}$c. $=$ $4.50. Received for 40 gals. @ $9\frac{3}{8}$c., $3.75 ; for 20 gals. @ $8\frac{1}{4}$c., $1.65. Gain is $5.40 - $4.50 $=$ 90c. $\therefore$ gain per cent. is $\frac{90}{450} = 20\%$.

10. 20%.

XXXIV.

1. Freight is 5% of $300 $=$ $15. Cost $=$ $315. Gain on $\frac{2}{5}$ of goods $= 27\%$ $\therefore$ selling price is $\frac{127}{100}$ of $\frac{2}{5}$ of cost $= \frac{127}{250}$ of cost. Gain on remaining $\frac{3}{5}$ of cost is 25% $\therefore$ selling price is $\frac{125}{100}$ of $\frac{3}{5} = \frac{3}{4}$ of cost. Total receipts $= \frac{127}{250} + \frac{3}{4}$ of cost $= \frac{1258}{1000}$ of cost $= \frac{1258}{1000}$ of $315 $=$ $396.27 $\therefore$ gain is $396.27 - $315.00 $=$ $81.27.

2. For $\frac{3}{4}$ of goods received $\frac{2}{3}$ of $340 $=$ 226\frac{2}{3}$. For remaining $\frac{1}{4}$ of $340 received $\frac{155}{100}$ of $\frac{1}{4}$ of $340 $=$ 106\frac{1}{4}$. Total receipts $=$ 226\frac{2}{3}$ + 106\frac{1}{4}$ $=$ 332\frac{11}{12}$ $\therefore$ Loss is 7\frac{1}{12}$.

3. $66\frac{2}{3}\%$.

4. Gain is 6 cents on 24 cents.

5. Loss on $1.14 was $1.14 - $ .99$\frac{3}{4}$ $=$ 14$\frac{1}{4}$c. $= \frac{1}{8} = 12\frac{1}{2}$ per cent.

6. $31374. 7. 65$\frac{485}{691}$ per cent. 8. 16$\frac{2}{3}$c. on the $.

9. Loss $= \frac{3}{4}$ of $\frac{16}{100} = \frac{12}{100} = \frac{3}{25}$ of sheep. Remainder $\frac{22}{25}$ of sheep $=$ 264. Whole number $=$ 300 sheep.

10. Decrease in 1876 $= \frac{1}{10}$ of population, leaving $\frac{9}{10}$ of population. Decrease in 1877 $= 6\% = \frac{3}{50}$, leaving $\frac{47}{50}$ of $\frac{9}{10} = \frac{423}{500}$ of population $\therefore$ population in 1876 was $\frac{500}{423}$ of 55413 $=$ 65,500.

XXXV.

1. $12\frac{1}{2}$ per cent. or $\frac{1}{8}$ of cost $=$ $5 $\therefore$ cost $=$ $40. By selling for $9 more I gain $3, *i. e.*, $\frac{3}{40}$ of cost $= 7\frac{1}{2}$ per ct.

2. Marked price $= \frac{7}{5}$ of cost. Selling price $= 85$ per ct.

of $\frac{7}{5}$ of cost $= \frac{119}{100}$ of cost $\therefore$ gain is $\frac{19}{100}$ of cost $= \$38$. $\frac{1}{100}$ of cost $= \$2$, and $\frac{119}{100}$ of cost $= \$238$, amount of bill.

3. Vinegar is $\frac{3}{4}$ of $\frac{2}{3}$ of keg $= \frac{1}{2}$ keg. $\frac{1}{10}$ of $\frac{1}{2}$ of vinegar in keg is drawn out, leaving $\frac{9}{10}$ of $\frac{1}{2} = \frac{9}{20}$ of keg of vinegar $= 45$ per cent. vinegar.

4. \$100,000. 5. 35 per cent. 6. 20 per cent.

7. Loss = 2 lbs. butter on every 10 lbs. = 20 per cent.

8. 125 gals. wine, 25 of water.

9. Gain on one dozen papers is 36 cents − 25 cents = 9 cents = $\frac{9}{25}$ of cost = 36 per cent.

10. $\$6\frac{2}{3}$.

XXXVI.

1. 139500 cords.

2. Expected to receive $\frac{11}{10}$ of cost; did receive $\frac{85}{100} = \frac{17}{20}$ of cost. Difference $\frac{1}{4}$ of cost = \$50. Cost = \$200.

3. $\frac{11}{10}$ of cost of mixture = 15 cents per lb. $\therefore$ cost is $\frac{10}{11}$ of 15 cents $= 13\frac{7}{11}$ cents per lb. On one pound of coffee costing 25 cents he would lose $25\text{c.} - 13\frac{7}{11}\text{c.} = 11\frac{4}{11}$ cents. On one lb. chicory would gain $13\frac{7}{11}\text{c.} - 10\text{c.} = 3\frac{7}{11}$ cents. Would gain one cent on $\frac{1}{3\frac{7}{11}}$ lbs. $\therefore$ gain $11\frac{4}{11}$ cents on $11\frac{4}{11} \times \frac{1}{3\frac{7}{11}} = 3\frac{1}{8}$ lbs. $\therefore$ proportions are 1 lb. coffee to $3\frac{1}{8}$ of chicory, or 8 lbs. coffee to 25 lbs. chicory.

4. Spends, saves, and pays as interest $\frac{1}{3} + \frac{1}{4} + \frac{1}{20} = \frac{12}{30}$ $\therefore$ has left $\frac{11}{30}$ of income which equals \$150. Income $= \$409\frac{1}{11}$. Amount paid as interest $= \frac{1}{20}$ of $\$409\frac{1}{11} = \$20\frac{5}{11}$

$\therefore 7\frac{1}{2}$ per cent. of debts is $\$20\frac{5}{11}$; debts are $\frac{20\frac{5}{11} \times 100}{7\frac{1}{2}} = \$572\frac{8}{11}$.

5. Gain = 2 per cent. $= \frac{2}{100}$ of cost $\therefore \frac{102}{100}$ of cost = selling price. Cost $= \frac{100}{102}$ of $\$1.08\frac{1}{3} = \$1.06\frac{35}{153}$ per yard. Loss on 1 yard of dearer silk $= \$1.12\frac{1}{2} - \$1.06\frac{35}{153} = 6\frac{89}{306}$ cents. Gain on 1 yard of cheaper silk $= 6\frac{32}{153}$ cents $\therefore$ gain 1c. on

$\frac{1}{6\frac{32}{153}}$. Gain $6\frac{89}{306}$ on $\frac{1}{6\frac{32}{153}} \times 6\frac{89}{306} = 1\frac{1}{76}$ yards. Proportions are 76 to 77. Number of yards of first is $\frac{76}{153}$ of $\frac{\$2500}{\$1.06\frac{32}{153}}$ $= 11\frac{9}{13}$ yards. Number of yards of second $= \frac{77}{153}$ of $\frac{\$2500}{\$\ .06\frac{32}{153}} = 11\frac{11}{13}$ yards.

6. $71\frac{3}{7}$ per cent.

7. Gain from goods $= \frac{1}{5}$ of cost. Selling price $= \frac{6}{5}$ of cost. Loss from bad eggs $= \frac{1}{6}$ of value of eggs. Real value of eggs $= \frac{5}{6}$ of supposed value $= \frac{5}{6}$ of $\frac{6}{5}$ of cost of goods = cost. Neither gains nor loses.

8. B has 50 per cent. more than A.

9. Goods marked at \$18000, and costing \$15000.

10. In buying, he receives $\frac{11}{10}$ of amount paid for. In selling, he gives $\frac{9}{10}$ of amount paid for $\therefore$ for $\frac{1}{10}$ of amount paid for, he gives $\frac{1}{9}$, and for $\frac{11}{10}$ he gives $\frac{11}{9} = 122\frac{2}{9}$ per ct. He gains $22\frac{2}{9}$ per cent.

XXXVII.

1. $18\frac{3}{4}$ per cent.

2. Loss is 5 per cent. $\therefore$ selling price is $\frac{19}{20}$ of cost = 3s. 9d. Cost is $47\frac{7}{19}$ pence. $4\frac{1}{2}$ per cent. $= \frac{9}{200}$. To gain $\frac{9}{200}$ must be sold for $\frac{209}{200}$ of $47\frac{7}{19} = 4$s. $1\frac{1}{2}$d.

3. Realize 10 per cent. $= \frac{1}{10}$ of £25 = £2 10s. Wine must be sold for £27 10s., at 18s. 4d. per gallon.

4. 25 per cent.

5. Cost = 10s. 3d. − 4s. $10\frac{1}{2}$d. = 5s. $4\frac{1}{2}$d. $\therefore$ gain per cent. is $90\frac{39}{41}$ per cent.

6. Profit per lb. on tea = 4d. On 100 lbs. = 400d. Profit per lb. on sugar 1d. On 100 lbs. = 100d. Total profit = 500 pence. Total cost = 3059 pence. Gain $= \frac{500}{3059} = \frac{10}{71} = 14\frac{6}{71}\%$.

7. Cleared $\frac{3}{8}$ of cost $\therefore \frac{1}{8}$ of cost = 11s. Cost = 8s. Gain by selling at 13s. 6d. = $5\frac{1}{2}$s. = $68\frac{3}{4}\%$.

8. Ordinary trade price = $\frac{120}{100}$ of cost. $\frac{83}{100}$ of cost = £520 10s. $\frac{1}{100}$ of cost = £520 10s. $\div$ 83. $\frac{120}{100}$ of cost = $\frac{120}{83}$ of £520 10s. = £752 10s. $7\frac{10}{83}$d.

9. Loss on 250 bush. = $7\frac{1}{2}\%$ of 280 bush. = $18\frac{3}{4}$ bush. Gain on 150 bush = $12\frac{1}{2}\%$ of 150 bush. = $18\frac{3}{4}$ bush. $\therefore$ there was neither loss nor gain.

10. Profit = $\frac{1}{8}$ of cost $\therefore$ sell 21 for $\frac{9}{8}$ of a shilling. Sell for 1s. $\frac{8}{9}$ of 21, and for 1 guinea $21 \times \frac{8}{9}$ of 21 = 362 eggs.

XXXVIII.

1. B pays $\frac{115}{100}$ of first cost. C pays $\frac{85}{100}$ of what B paid. C pays $\frac{85}{100}$ of $\frac{115}{100}$ of £345 15s. = £337 19s. $4\frac{10}{20}$d.

2. B pays $\frac{122\frac{1}{2}}{100}$ of cost. C pays $\frac{107\frac{1}{2}}{100}$ of what B pays, *i. e.*, $\frac{107\frac{1}{2}}{100}$ of $\frac{122\frac{1}{2}}{100}$ of first cost = $\frac{2107}{1600}$ of what A paid $\therefore$ A paid $\frac{1600}{2107}$ of £263 7s. 6d. = £200.

3. $4\frac{3}{4}$ per cent.

4. He sells 1 lb. $-$ 13 drams as 1 lb., *i. e.*, sells $15\frac{3}{16}$ oz. for 1 lb. Gain on $15\frac{3}{16}$ oz. is $\frac{13}{16}$ oz. Gain per cent. is $5\frac{85}{243}$ per cent.

5. $\frac{97}{100}$ of debt is £210 3s. 4d. $\frac{1}{100}$ is £210 3s. 4d. $\div$ 97. $\frac{96}{100}$ is $\frac{96}{97}$ of £210 3s. 4d. = £208.

6. Rent of 150 acres @ 30s. = £225. Return is $4\frac{1}{2}$ per cent. = $\frac{9}{200}$ of investment $\therefore \frac{9}{200}$ of investment = £225. Investment = $\frac{200}{9}$ of £225 = £5000. Amount spent in repairs = £5000 $-$ £4624 = £376.

7. Cost of $\frac{1}{2}$ acre @ 15s. 9d. per square yard = £1905 15s. Total cost = £4000. Rent 9 per cent. of £4000 = £360 per annum.

8. Deduct $\frac{1}{10}$ and $\frac{9}{10}$ of original sum remain. Deduct charge of $12\frac{1}{2}$ per cent. of remainder and $\frac{7}{8}$ of $\frac{9}{10}$ of original sum remain. $\frac{7}{8}$ of $\frac{9}{10}$ of original sum = £787 10s. $\therefore$ original sum is £1000.

9. Income tax, $\frac{1}{50}$ of rental. Remainder, $\frac{49}{50}$. Cost of

collection, 4 per cent. of $\frac{49}{50}$ of rental. Remainder, $\frac{26}{100}$ of $\frac{49}{50}$ of rental = £490 ∴ rental is £520 16s. 8d.

10. Cost is as 1 to 3. On the 1 he gained $\frac{1}{10}$. On the 3 he gained $\frac{1}{5}$ of $3 = \frac{3}{5}$. Total gain $= \frac{1}{10} + \frac{3}{5} = \frac{7}{10}$. On 4 he gained $\frac{7}{10}$ ∴ gain per cent. $= 17\frac{1}{2}$ per cent.

XXXIX.

1. $15\frac{15}{29}$ per cent.

2. Sells $\frac{2}{3}$ of $\frac{5}{6} = \frac{5}{9}$ of property for £160 ∴ property is worth £288. It had risen $\frac{1}{5}$ in value, therefore $\frac{6}{5}$ of original value = £288 ∴ original value was $\frac{5}{8}$ of £288 = £240.

3. Purchaser pays $\frac{125}{100}$ of $\frac{110}{100} = \frac{11}{8}$ of first cost, or an advance of $37\frac{1}{2}$ per cent. on prime cost.

4. Sells 1 for $\frac{1}{3}$ of a penny. Gain = 5 per cent. $= \frac{1}{20}$ ∴ $\frac{21}{20}$ of cost of 1 apple $= \frac{1}{3}$ of a penny ∴ cost is $\frac{20}{21}$ of $\frac{1}{3} = \frac{20}{63}$d. per apple. Loss by selling 25 for 6d. $= \frac{20}{63}$d. $- \frac{6}{25} = \frac{122}{1575}$d. Loss on $\frac{20}{63}$d. $= \frac{122}{1575}$ ∴ Loss per cent. $= 24\frac{2}{5}$ per cent. = £24 8s. on £100.

5. Pay for 100 lbs., 756 pence. Receive for (100—4) lbs., $96 \times 10\frac{1}{2} = 1008$ pence. Gain per cent. = 252 pence $= 33\frac{1}{3}$ per cent.

6. Pipe $= 126 \times 8 = 1008$ pints. One dozen bottles hold 18 pints ∴ number of dozen $= 1008 \div 18 = 56$ dozen. Sold for $56 \times 3 =$ £168. Gain = £78 $= 86\frac{2}{3}$ per cent.

7. See Paper XXXVII, Problem 8. £708.

8. Loss of 5 per cent. on prime cost = loss of $\frac{1}{20}$ of cost. Selling price $= \frac{21}{20}$ of cost ∴ cost is $\frac{20}{21}$ of selling price, and loss $= \frac{1}{21}$ of selling price $= \frac{1}{21}$ of £50 = £2 7s. $7\frac{3}{7}$d. 5 per cent. of selling price $= \frac{1}{20}$ of £50 = £2 10s. Difference = 2s. $4\frac{4}{7}$d.

9. Cost of tea = 74s. Received for it 6s. $9\frac{1}{4}$d. $\times 12 = 81$s. 3d. Gain is 81s. 3d. − 74s. = 7s. 3d. Gain per cent. =

$$\frac{\text{7s. 3d.}}{\text{74s.}} \times 100 = 9\frac{52}{74} \text{ per cent.}$$

10. $\frac{9}{10}$ of cost of goods = £75 ∴ cost = £83$\frac{1}{3}$. Value = $\frac{130}{100}$ of cost = $\frac{130}{100}$ of 83$\frac{1}{3}$ = £108 6s. 8d.

XL.

1. Railroad receiv $\frac{4}{5}$ of 60c. = 48c. per cwt. ∴ charges = $\frac{48}{100}$ of 26000 = $124.80.

2. 58·43 per cent.

3. 35 per cent. more. 4. 3 per cent.

5. $\frac{1}{5}$ of his share was worth $650 ∴ share was worth $3250. He owned 32$\frac{1}{2}$ per cent. of right, so 32$\frac{1}{2}$ per cent. of right was worth $3250 ∴ whole right was worth $\frac{100}{32\frac{1}{2}}$ of $3250 = $10000.

6. $\frac{4}{5}$ of first cost = $840 ∴ cost = $\frac{5}{4}$ of $840 = $1050. Freight and insurance = 5 per cent. of cost = $\frac{1}{20}$ of $1050 = $52.50.

7. Wife received 40 per cent. ; son, 35 per cent. ; daughter, 25 per cent. 60 per cent. = $18600 ∴ 100 per cent. = $31000. Wife received $12,400 ; son, $10,850 ; daughter, $7,750.

8. 40 per cent. of $\frac{3}{5}$ of interest = $\frac{6}{25}$ of his interest sold for $4800 ∴ $\frac{1}{25}$ is worth $800. Remainder of his interest, $\frac{19}{25}$ of interest, is worth $800 × 19 = $15200, which is face of note.

9. $\frac{60}{100}$ of $\frac{2}{5}$ of invoice = $50 ∴ invoice = 208\frac{1}{3}$. Part due still will be 60 per cent. of 60 per cent. = $\frac{9}{25}$ of invoice = $\frac{9}{25}$ of 208\frac{1}{3}$ = $75.

10. $\frac{3}{8}$ of 20 per cent. of his capital = $1500 ∴ 20 per cent. of capital = $\frac{8}{3}$ of $1500 = $4000. Capital = $20,000.

XLI.

1. 144 lbs. avoirdupois = 175 lbs. Troy, difference 31 ; so that for difference 62 we shall have 288 lbs. avoir.

2. $100.

3. A $44 ; B $45 ; C $22.

4. 10 cubic feet of water make 11 of ice. Therefore 11

of ice make 10 of water, or ice loses $\frac{1}{11}$, which is $9\frac{1}{11}$ per cent.

5. $140.

6. Question should read $\frac{3}{13}$. Answer 272, 170.

7. The boats are shortening the distance between them at the rate of 26 miles an hour, and as they meet in $1\frac{1}{2}$ hours, that distance must have been 39 miles.

8. $\frac{48 \times 16 \times 6}{12 \times 4 \times 4} = 24$.

9. 80 years. 10. $6.50.

XLII.

1. $3.60. 2. 18 feet. 3. $1045.44. 4. $47.38\frac{1}{3}$.

5. 14 days. 6. $63.75. 7. $14.62\frac{1}{2}$. 8. $48.

9. $201.60. 10. 45 miles an hour.

XLIII.

1. George's, $25; Charles', $37.50.

2. 25 per cent. 3. The second; $1\frac{1}{9}$ per cent.

4. Out of each $102.50 that he receives, he invests $100 in tea. 5000 lbs.

5. $14,400. 6. $9775. 7. $10093.75. 8. $157.50.

9. Eldest, $8100; each of the others, $5400.

10. 80 feet; 63 feet.

XLIV.

1. $20.

2. Wheat is worth $\frac{5}{4}$ as much as barley, or $\$\frac{5}{6}$ per bushel. Therefore, 27 bushels of wheat can be bought for $22.50.

3. $27/15. 4. $36.

5. "A has \$320" should read "A has \$310." Then the G. C. M. of the three numbers is \$62, the price of a horse. A can buy 5; B 9, and C 12.

6. Find L. C. M. \$1800.

7. \$44.37. 8. 76250 men. 9. 16 per ct. 10. 35c.

XLV.

1. ·1553237297.

2. If for 40 weeks' work he is entitled to \$40 and the suit, then for 24 weeks' work he should receive \$24 and $\frac{3}{5}$ of the value of the suit; hence $\frac{2}{5}$ of the suit must be worth \$6, or the whole suit \$15.

3. \$17.06$\frac{1}{4}$. 4. 195.

5. $\frac{3}{5}$ of remainder cost \$1656; therefore whole remainder cost \$2760; therefore 40 bbls. cost \$240, or \$6 each; hence whole number was 500 bbl.

6. Assume that he began business with \$100; at the end of the first year he would be worth \$140; at the end of the second, \$120; at the end of the third, \$160. Thus his gain is \$60 on the \$160, or \$6000 on the \$16000.

7. \$3553.12$\frac{1}{2}$.

8 $\frac{2}{13}$ of cost is $\frac{2}{15}$ of selling price; hence the cost is $\frac{13}{15}$ of selling price, or 13 cents a dozen.

9. Simple interest, \$144. Compound interest, \$154.01; difference, \$10.01.

10. In 60 days A can do the work 6 times; B 4 times, and C 3 times. So that the three can do the work 13 times in 60 days, or $\frac{13}{60}$ in one day. When C begins there is $\frac{9}{20}$ of the work still to be done, which will therefore require $2\frac{1}{13}$ days.

XLVI.

1. 20 per cent. discount off leaves \$2.08, which is one-third more than the buying price, hence the cost is three-fourths of \$2.08, or \$1.56.

2. $1800. 3. 25.

4. 14 cents, 9 cents, and 19 cents.

5. (*a*) 53885 lbs. (*b*) 205 yds. (*c*) 127 days.

6. $335\frac{5}{17}$ rods, etc. 7. 121095 times. 8. $56.

9. Every 12 feet of the fence contains 34 feet of lumber and 2 posts, and therefore costs 42 cents. Multiply this by $71\frac{1}{2}$, and add $20 for labor, and we have $50.03.

10. 4841 m. 200 rds. 10 ft.

XLVII.

1. 181 ac., 34 per. ; 203 ac., 2 roods, 14 per.

2. A cubic foot of ice will weigh $\frac{10}{11}$ of 1000 ounces. Answer, 750 tons.

3. $137.81\frac{1}{4}$.

4. The numbers 4, 6, 9, will represent the shares, so that the first will receive $\frac{4}{19}$, the second $\frac{6}{19}$, and the third $\frac{9}{19}$.

5. Loss $400. 6. $22000.

7. All open will fill $\frac{13}{36}$ in 12 minutes, leaving $\frac{23}{36}$ to be filled by B and C. These two can fill the cistern in 432 minutes, and will fill $\frac{23}{36}$ in 276 minutes. So that the whole time required is 288 minutes.

8. $217.60. 9. 3267. 10. $74 ; $59.

XLVIII.

1. $751. 2. 675 days. 3. $11.04. 4. $1140.25.

5. $165.72.

6. When the ice melts there will be room for 21 cubic feet of water, that is 21 times $6\frac{1}{4}$ gallons.

7. 5. 8. $\frac{5}{22}$. 9. 80. 10. $31.20.

XLIX.

1. 3 feet ; 38 trees. 2. $2533. 3. 21216 ft.

4. $\$9\frac{1}{6}$ gain. 5. $1\frac{1}{7}$ hours. 6. 40 bushels.

7. 938 strips; ·02268 inches.

8. John, 63 cents; James, $1.12.

9. $280. 10. 45.

L.

1. 9 cents. 2. Lost $1.40. 3. $2\frac{2}{7}$ cents.

4 The pupils may be divided into groups of 6, each group consisting of 5 girls and 1 boy. The boys are, therefore, $\frac{1}{6}$ of the whole number, or 91; the answer required is 364.

5. Annie, 55 cents; Jane, 80 cents.

6. 4 yds., 2 ft., 9 ins. = 177 in. $= \frac{177}{5280 \times 12}$ m. $= \frac{59}{5280 \times 4}$

$= \cdot 002793560\dot{}$ m.

7. The fraction $= \frac{\frac{30}{31} \times \frac{3}{7}}{56 \times \frac{5}{360}}$ of $\frac{1}{2} \times \frac{245}{87} = \frac{750}{1421}$.

8. $229.50. 9. $\$21.72\frac{1}{2}$. 10. 7 o'clock.

LI.

1. 48. 56.

2. Number of square feet in fence = $360 \times 4 = 1440$ square feet. Area of first kind of board = 12 square feet. Number required = $1440 \div 12 = 120$. Value = $12. Number of second kind required = $1440 \div 16 = 90$. Value at 12c. = $10.80. Second are cheaper by $1.20.

3. 75 miles = 396000 feet. Wheel turns $396000 \div 10 = 39600$ times. Burns 2000 lbs. in turning 39600 times $\therefore$ burns 1 lb. in turning $39600 \div 2000 = 19\frac{4}{5}$ times.

4. One three-inch volume, two two-inch volumes, and two one-inch volumes take 9 inches. Length of shelf = 36 inches $\therefore$ we can have $36 \div 9 = 4$ sets, *i. e.*, 4 three-inch, 8 two-inch, and 8 one-inch volumes.

5. Number of coins=L. C. M. of 4, 5, 6=60 coins. Value=$450.

6. Diameter=$\frac{4\frac{2}{3}}{14\frac{2}{3}}=\frac{7}{22}$ of circumference. $\frac{22}{22}$ of circumference$-\frac{7}{22}$ of circumference$=\frac{15}{22}$ of circumference=difference=60 yards. $\frac{1}{22}$ circumference=4 yards. Circumference=88 yards. Cost of fence=$8.80.

7. Amount realized from stock=$\frac{6}{8}$ of $3500=$2187.50. Amount realized from book debts=$\frac{55}{100}$ of $1750=$962.50. Amount realized from notes, etc.=$\frac{4}{5}$ of $680=$544.00. Total receipts=$3694.00. Deduct 2 per cent.=$73.88. Net assets=$3620.12. Liabilities, $6464.50. Creditors receive on $6464.50, $3620.12. On $1, receive 56 cents.

8. 3 oxen eat as much as five horses ∴ 6 oxen eat as much as 10 horses. 7 sheep eat as much as 2 horses ∴ 56 eat as much as 16 horses. 6 oxen, 5 horses, and 56 sheep eat as much as 31 horses. 31 horses in 5 weeks eat 5 tons hay. 31 horses in 3 weeks eat 3 tons hay. Sheep must be put in to eat as much as 31−7=24 horses, *i. e.*, 84 sheep.

9. Total cost of apples and barrel=$2.50. Value of apples=$2.50−$ .15=$2.35. A received value, $2.35 ÷2=$1.17½. He paid $1.50 ∴ B owes him 32½ cents.

10. Value of one 25 cent piece, four 10 cent pieces, and twelve 5 cent pieces=25+40+60=$1.25. Value of same number 17 of 25 cent pieces=$4.25. Difference in value =$3. Number of coins=(36÷3)×17=204, divided in proportions 1, 4, 12. There were 12 of first, 48 of second, and 144 of third.

LII.

1. $17\frac{511}{2500}$. 2. $94\frac{2}{3}$ cents.

3. When 1st receives £1, 2nd receives £1⅔ ∴ 1st receives $\frac{1}{2\frac{2}{3}}=\frac{3}{8}$ of £12 16s. 8d.=£4 16s. 3d. 2nd receives $\frac{5}{8}$ of £12 16s. 8d.=£8 0s. 5d.

4. Number of acres in each is G. C. M. of numbers =91 acres. Number of farms=27, 32, 43.

5. Divide total capital and gains in proportions 6, 5, 4. Capital, \$2400, \$2000, and \$1600; profits, \$300, \$250, \$200. Rate per cent.$=12\frac{1}{2}$ per cent.

6. Gain$=50$ per cent.$=\frac{1}{2}$ cost $\therefore$ selling price$=\frac{3}{2}$ of cost $=\frac{3}{2}$ of \$75.00$=$\$112$\frac{1}{2}$. 30 gal. @ \$2 per gal.$=$\$60. Amount to be received for remainder$=$\$112.50$-$\$60$=$ \$52.50. Price per gal.$=$\$52.50$\div 25=$\$2.10.

7. 70 per cent of cost is \$140 $\therefore$ cost$=$\$200. Selling price to gain 5 per cent.$=$\$210.00.

8 Loss on one is 25 per ct.$=\frac{1}{4}$ of cost $\therefore$ selling price$=\frac{3}{4}$ cost. $\frac{3}{4}$ cost$=$\$800 $\therefore$ cost$=$\$1066$\frac{2}{3}$. Gain on the other $\frac{1}{4}$ cost $\therefore \frac{5}{4}$ cost$=$\$800. Cost$=\frac{4}{5}$ of \$800$=$\$640. Cost of two$=$\$1706$\frac{2}{3}$. Realized, \$1600 $\therefore$ Loss$=$\$106$\frac{2}{3}$.

9. \$200.

10. Receives for goods $\frac{5}{4}$ of cost$=\frac{5}{4}$ of \$6.00$=$\$7.50. Threw off 20 per cent. of marked price $\therefore \frac{4}{5}$ of marked price $=$\$7.50. Marked price, \$9.37$\frac{1}{2}$.

LIII.

1. Cost of 8 lbs. of 50 cent tea and 5 lbs. of 37 cent tea is \$5.85 $\therefore$ cost of mixed tea is 45 cents per lb. Sells 15·75 oz. for 45 cents $\therefore$ sells 1 lb. for $\frac{45}{15 \cdot 75} \times 16 = 45\frac{5}{7}$c.

Gain per lb.$=\frac{5}{7}$ cents $\therefore$ gain per cent.$=1\frac{37}{63}$ per cent.

2. Amount of gold$=\frac{18}{24}$ of 6 oz.$=4\frac{1}{2}$ oz. Value$=4\frac{1}{2} \times$ 84$=$378s.$=$£18 18s. Amount of alloy$=\frac{1}{4}$ of 6 oz.$=1\frac{1}{2}$ oz. Value, $1\frac{1}{2} \times 3 = 4$s. 6d. Value of metal$=$£19 2s. 6d. Value of ornament$=\frac{4}{5}$ of £19 2s. 6d.$=$£25 10s.

3. Area of field$=$150 chains, width 10 chains $\therefore$ length is 15 chains. Perimeter is 50 chains$=50 \times 22 \times 3=3300$ ft. Number of trees$=3300 \div 11=300$ trees.

4. 4 men can do $\frac{1}{47}$ in 1 day $\therefore$ 2 men can do $\frac{1}{94}$ in 1 day. 5 women can do $\frac{1}{47}$ in 1 day $\therefore$ 1 can do $\frac{1}{235}$ and 4 can do $\frac{4}{235}$ in 1 day. 6 boys can do $\frac{1}{47}$ in 1 day $\therefore$ 1 can do $\frac{1}{282}$ and 5 can do $\frac{5}{282}$ in 1 day. 8 girls can do $\frac{1}{47}$ in day. 2 men, 4 women, 5 boys and 8 girls can do $\frac{1}{94} + \frac{4}{235} + \frac{5}{282} + \frac{1}{47}$ in 1 day$=\frac{1}{15}$ in 1 day $\therefore$ whole work in 15 days.

5. A, B and C can earn \$240 in 6 days, or \$40 in 1 day. A and B can earn \$240 in 8 days, or \$30 in 1 day ∴ C earns \$10 per day. B and C earn \$240 in 10 days or \$24 in 1 day ∴ B earns \$12 per day. A earns \$18 per day.

6. Length of road $=18\times1760$. Number of square yards $=18\times1760\times33$ ∴ number of acres $=\frac{18\times1760\times33}{30\frac{1}{4}\times40\times4}$ $=216$ acres. Value $=\$5.67\times216$. Value in £ sterling $=\frac{\$5.67\times216}{\$4.86\frac{2}{3}}=\left(\frac{\$5.67\times216}{\$4.86\frac{2}{3}}\times240\right)$d. ∴ number of acres in field $=\frac{\$5.67\times216}{\$4.76\frac{2}{3}}\times\frac{240}{7}\times\frac{1}{40}\times\frac{1}{4}=53\frac{38}{365}$ acres.

7. Length of ditch around plot $=580$ feet. Length of ditches crossing $=275$ ft. Total length $=855$ ft. Cubic contents $=855\times5\times\frac{11}{5}=9405$ cubic feet $=348\frac{1}{3}$ cubic yards which at 54c. $=\$183.10$.

8. 15 miles $=79200$ feet. Number of revolutions of front wheel $=79200\div12=6600$. Hind wheel makes $6600-2200=4400$ turns in 15 miles ∴ makes 1 turn in $79200\div4400=18$ feet. Circumference of hind wheel is 18 feet.

9. Cubic contents of block $=4\times3\times2\frac{1}{12}=25$ cubic feet. Cubic feet of water $=\frac{9}{10}$ of $25=22\frac{1}{2}$ cubic feet. Number of gals. $=(22\frac{1}{2}\times1728)\div277\frac{3}{7}=140$ gals.

10. Duty on 120 gals. $=50$ per cent. of value $+75$c. $\times120$ $=50$ per cent. and \$90. He pays \$225 ∴ 50 per cent. of value is $\$225-\$90=\$135$. Value is \$270, or \$2.25 per gal.

LIV.

1. 103 lots, and a remainder of 51 square yards.

2. Room is 10 yards long, 9 yards wide. $\frac{3}{4}$ is contained in 9, 12 times ∴ there will be 12 strips 10 yards long, or 120 yards. Cost per yard $=\$100\div120=83\frac{1}{3}$c. per yard.

3. 1 hhd. wine $=63$ gals. $=504$ pints ∴ there will be $504\div3=168$ bottles of wine in 1 hhd, or in 2, 336 bottles.

4. Cost of syrup $= \$3 \times 40 + \$3.50 \times 30 = \$225$. Sells 90 gals. for $\$225 + \$45 = \$270 = \$3$ per gal. Gain on $\$225 = \$45$ ∴ gain per cent. $= \frac{45}{225} \times 100 = 20$ per cent.

5. 1 furlong, 15 poles, 1 yard, 1 foot.

6. $13\frac{13}{8720}$. 7. $\frac{101}{6250}$ of \$1000.

8. Amount of \$100 for 4 years @ 6 per cent. $= \$124$ ∴ \$1 is amount of $\frac{\$100}{\$124}$ and \$496 is amount of $\frac{\$496 \times 100}{\$124} = \$400$. Amount of \$100 of second sum for 4 years at 8 per cent. $= \$132$ ∴ \$1 is amount of $\frac{\$100}{\$132}$ and $\$1288 - \$496$ is amount of $\frac{\$792 \times 100}{132} = \$600$.

9. Cost of 30 lbs. of tea $= 50c \times 20 + 30c. \times 10 = \$13.00 = 43\frac{1}{3}$c. per lb. Gain when sold at 60c. $= 16\frac{2}{3}$c. $= \frac{16\frac{2}{3}}{43\frac{1}{3}} = \frac{50}{130} = 38\frac{6}{13}\%$. Loss when sold at 35c. $= 8\frac{1}{3}$c. $= \frac{8\frac{1}{3}}{43\frac{1}{3}} = \frac{25}{130} = 19\frac{3}{13}$ per cent.

10. $\frac{7}{9}$ of a lemon is worth $\frac{7}{10}$ of an orange : $\frac{1}{9}$ lemon is worth $\frac{1}{10}$ orange ∴ lemon is worth $\frac{9}{10}$ orange, and 27 lemons worth $24\frac{3}{10}$ oranges.

LV.

1. At 9 o'clock the minute-hand is 45 min. spaces behind hour-hand. It must gain $45 - 7 = 38$ spaces, or $45 + 7 = 52$ spaces. Minute-hand goes 12 spaces in 12 minutes, while hour-hand goes 1 min. space in 12 minutes. Minute-hand gains 11 min. spaces in 12 minutes ∴ gains 38 spaces in $\frac{38 \times 12}{11} = 41\frac{5}{11}$ minutes ; gains 52 minutes in $56\frac{8}{11}$. Answers are : (1) $41\frac{5}{11}$ and $56\frac{8}{11}$ minutes after 9 o'clock (2) $48\frac{4}{11}$ and $49\frac{9}{11}$ minutes after 9 o'clock.

2. £18 0s. $10\frac{2}{7}\frac{6}{3}$d.

3. A, B and C can cut 100 rails in 2 days, or 50 in 1 day. A and B can cut 100 in 4 days, or 25 in 1 day ∴ C

can cut 25 per day, or 350 in 14 days. B and C can cut 100 in 5 days, or 20 in 1 day. A can cut 30 in 1 day, or 350 in $11\frac{2}{3}$ days. A and C can cut $30+25=55$ in 1 day $\therefore$ B is a hindrance.

4. On 1st gain $\frac{1}{2}$ cost $\therefore$ cost $=\frac{2}{3}$ of selling price $=\frac{2}{3}$ of $\$2000=\$1333\frac{1}{3}$. On 2nd lose $20\%=\frac{1}{5}$ of cost $\therefore$ cost $=\frac{5}{4}$ of $\$2000=\$2500$. Cost of 3rd $=\$2000-\$50=\$1950$. Total cost $=\$5783\frac{1}{3}$ $\therefore$ gain $=\$6000-\$5783\frac{1}{3}=\$216\frac{2}{3}$. Gain per cent. $=3\frac{2}{3}\frac{5}{4}\frac{9}{7}$ per cent.

5. 2nd builds $12\frac{1}{2}$ rods. Length is $32\frac{1}{2}$ rods.

6. L. C. M. $+6=366$.

7. Gain $=\frac{2}{5}$ of cost $\therefore$ selling price $=\frac{7}{5}$ of $2=2\frac{4}{5}$ cents for 5 eggs $\therefore$ 1 cent for $\frac{5}{2\frac{4}{5}}$ and 14 cents for $14\times5\div2\frac{4}{5}=25$ eggs.

8. Cubic contents of tank $=8\times5\frac{1}{3}\times4\frac{1}{2}=192$ cubic feet. Weight of water $=192\times1000=192000$ oz. $=12000$ lbs. Gallon of water $=8$ pints $=10$ lbs. $\therefore$ number of gallons $=1200$.

9. Train must go length of bridge and length of itself $=35$ rods. Runs 15 miles $=4800$ rods in 60 minutes. Runs 1 rod in $\frac{60}{4800}$ min. $\therefore$ runs 35 rods in $\frac{35\times60}{4800}=\frac{7}{16}$ mins. $=26\frac{1}{4}$ seconds.

10. Cost of cow $=£21$ 6s. 6d. $=£21\frac{1}{40}=\$4.86\frac{2}{3}\times£21\frac{13}{40}=\$103.78\frac{1}{6}$ $\therefore$ gain is $\$36.21\frac{5}{6}$.

LVI.

1. A can do 3 times, B 5 times, and C 6 times the work in 1 day. Together 14 times the work in 1 day, or whole in $\frac{1}{14}$ of day.

2. Cost of first $=\frac{5}{6}$ of $\$150=\$125$. Cost of second $=\frac{5}{4}$ of $\$150=\$187.50$. Total cost $=\$312.50$ $\therefore$ Loss of $\$12.50$.

Loss per cent. $=\dfrac{12\frac{1}{2}}{312\frac{1}{2}}\times100=4$ per cent.

3. Dealer pays $200 for coal. Cost is $4.50 + .50 = $5.00 per ton ∴ he gets 40 tons = 40 × 2240 lbs. Sells 2000 lbs. for $6.50 ∴ sells 40 × 2240 lbs. for $\frac{\$6.50 \times 40 \times 2240}{2000}$ = $291.20 ∴ gain is $91.20.

4. 46 per cent.

5. On the $1 tea I lose 20 cents per lb. ∴ on 50 lbs. I lose $10. On the 70 cent tea I gain 10 cents per lb. gain $10 on 100 lbs. Must mix in 100 lbs.

6. B has as much as C and $40. A has as much as C and $140 ∴ A, B and C have three times as much as C and $180 ∴ three times what C gets = $840 - $180 = 660. C gets $220 ; B, $260 ; A, $360.

7. 2 miles = 10560 feet. Circumference of wheel = $\frac{22}{7}$ of 7 feet = 22 feet. Number of revolutions = 10560 ÷ 22 = 480 times.

8. In $4\frac{1}{2}$ seconds goes 8 rods ∴ goes 20 miles per hour.

9. For 100 receives $104 ∴ average price = $1.04. On one turkey loss would be $1.25 − $1.04 = 21 cents. On one goose gain 29 cents ∴ gain 21 cents on $\frac{21}{29}$ of goose. Therefore proportions are as 1 to $\frac{21}{29}$, or 29 to 21. Number of geese = $\frac{21}{50}$ of 100 = 42 geese. Number of turkeys = $\frac{29}{50}$ of 100 = 58 turkeys.

10. Number of pages = 336 × 1000 = 336000 pages = 168000 leaves = 84000 sheets = 84000 ÷ 24 quires = 35000 quires = 175 reams. Waste is 175 quires = 8 reams and 15 quires ∴ total number of reams = 183 reams, 15 quires.

LVII.

1. Mortar will add $\frac{1}{4}$ inch to length, width and thickness ∴ cubic contents of brick = $8\frac{3}{4} \times 4\frac{3}{4} \times 2\frac{3}{4} = \frac{25725}{256}$ cub. ins.

Number of bricks in 1 cubic foot = $\frac{1728 \times 256}{2575}$ = 17.

2. Number of days in 40 years $=365\times40=14600+10=14610$ days. Gain $=50$ min. $\times 14610=730500$ min. $=1$ yr., 142 days, 35 min.

3. Cubic contents of space to be filled $=650\times12\times4{\cdot}5=35100$ cubic feet. $=35100\div27$ cubic yards $=1300$ cubic yards. Cost $=1300\times42=\$546.00$.

4. Profit $=16\frac{2}{3}\%=\frac{1}{6}$ of cost $\therefore$ selling price $=\frac{7}{6}$ of $\$3.60=\$4.20$ per yard. Amount abated $=12\frac{1}{2}\%=\frac{1}{8}$ of marked price $\therefore\frac{7}{8}$ of marked price $=\$4.20$. Marked price $=\frac{8}{7}$ of $\$4.20=\$4.80$.

5. Width of both ends $=34$ inches $\therefore$ average width $=17$ inches. Area of board $=18\times1\frac{7}{12}=25$ sq. feet, 6 sq. inches.

6. Received per bbl. $\$32.50\div7=\$4.64\frac{2}{7}$. $\frac{5}{8}$ of price of remaining bbls. is $\$4.64\frac{2}{7}\therefore$ price is $\$7.42\frac{6}{7}$. Number of bbls. is $\$84\times\$7.42\frac{6}{7}=11\frac{4}{13}$ bbls. Number of bbls. is $18\frac{4}{13}$ bbls.

7. Silver should be $\frac{2}{5}\times\frac{1}{10}=\frac{1}{25}$ of gold. 6 oz. is $\frac{1}{25}$ of 150 oz. $\therefore$ there must be 150 oz. of gold and 6 oz. of silver. Amount of gold to be added $=156-98\frac{1}{2}=57\frac{1}{2}$ oz.

8. $\frac{1}{6}\times\frac{1}{10}=\frac{1}{60}$ of new mixture is salt. $\frac{1}{60}$ of mixture $=2$ lbs $\therefore$ mixture $=120$ lbs. Amount to be added $=120-80=40$ lbs. of fresh water.

9. Proportions, 3 bush. of barley, 6 of wheat, 1 of oats. Cost $=62\frac{1}{2}$c. $\times3+\$1.87\frac{1}{2}\times6+37\frac{1}{2}$c. $\times1=\$13.50$. Every time $\$13.50$ is contained in $\$121.50$, we have 3 bush. barley, 6 bush. wheat, and 1 bush. oats $=27$ bush. barley, 54 bush. wheat, 9 bush. oats $=90$ bush.

10. Number of pages $=20{,}000\times400=8{,}000{,}000$ pages $\therefore$ number of reams used to make books $=\dfrac{20000\times400}{20\times24}\times\dfrac{22}{20}=18{,}333\frac{1}{3}$ reams.

LVIII.

1. $487\frac{1}{2}$ reams.

2. Area of satin $=24\times\frac{3}{4}=18$ sq. yards $\therefore$ number of yards of silk received $=18\div\frac{5}{8}=28\frac{4}{5}$ yards.

3. Length of fence in 1st = 400 rods. Length in 2nd = 500 rods ∴ extra cost is 100 rods @ \$3.25 per rod = \$325.

4. Area of field = 8100 sq. rods. In wheat, 5 acres = 800 sq. rods. In vegetables, 100 sq. rods ∴ remainder = 7200 sq. rods = $\frac{7200}{8100} = \frac{8}{9}$ of field in meadow.

5. Solid contents of joist = 1000 ÷ 200 = 5 cubic feet. Area of end of joist = $\frac{10}{12} \times \frac{3}{12}$ cubic feet = $\frac{5}{24}$ cubic feet ∴ length = $5 \div \frac{5}{24} = 24$ feet.

6. Length of walls without corners is 127 ft. Cubic ft. in walls = $127 \times 2 \times 9 = 2286$ cubic feet. Allowance for corners is $\frac{1}{2}$ foot. ∴ cubic contents of corners is 4 times $\frac{1}{2}$ foot $\times 9 = 18$ cubic feet. Total cubic contents is 2304 cubic feet. $24\frac{3}{4}$ cubic feet costs \$3.85. ∴ 2304 cubic feet costs

$$\frac{2304 \times 385}{24\frac{3}{4}} = \$358.40.$$

7. Cost of drugs is $\$12.50 \times 8 = \$100$. Number of lbs. Apothecaries = $\frac{8 \times 1000}{5160} = 9\frac{13}{18}$ lbs. Value at \$16.25 per lb. = $\$157\frac{1}{2}$. ∴ gain is $\$57\frac{1}{2}$.

8. Time walking 1 mile = 16, 24, 32, 36 minutes respectively. Time occupied = L. C. M. of 16, 24, 35, 36 = 288 minutes. ∴ distances are 9, 6, $4\frac{1}{2}$, and 4 miles, respectively.

9. $\frac{3}{4}$ of selling price = $\frac{2}{3}$ of cost. ∴ selling price = $\frac{8}{9}$ of cost. Loss = $\frac{1}{9}$ of cost = $11\frac{1}{9}\%$.

10. 1st boy has $\frac{1}{3}$ of $\frac{9}{10} = \frac{3}{10}$ bush. 2nd has $\frac{9}{10} + \frac{2}{3}$ of $\frac{9}{10} = \frac{15}{10}$ of a bush. 3 is $\frac{1}{5}$ of 15, therefore $\frac{1}{5}$ of what 2nd has equals what 1st has.

LIX.

1. 19.

2. Area of roof = 20×15 ft. = 300 sq. ft. Area of 4 walls = 70×9 sq. ft. = 630 sq. ft. Deduct doorway = 21 sq. ft. Number of sq. ft. required = $630 + 300 - 21$ sq. ft. = 909 sq. ft.

3. 80 lbs. of fish are worth $\frac{80 \times .350}{112} = \$2.50$. \$6 will buy 100 sq. ft. of lumber. ∴ \$2.50 will buy $\frac{\$2\frac{1}{2} \times 100}{\$6} = 41\frac{2}{3}$ sq. ft.

4. Number of cubic feet in room $= 20 \times 10 \times 9$. Number of cords $= \frac{20 \times 10 \times 9}{128} = 14\frac{1}{16}$ cords.

5. Number of furrows = (300 ft.) 3600 in. ÷ 15 in. = 240 Distance $= 240 \times 500 = 120000$ ft. $= 22\frac{8}{11}$ miles.

6. See LV. I. and (5). $28\frac{3}{4}$ ft.

7. The former by .01 of a rod.

8. Interest on \$100 for 1 year @ $3\frac{1}{2}$ per cent. per 6 months = \$7: for $2\frac{3}{4}$ years = $\$19\frac{1}{4}$ ∴ amount of \$100 = $\$119\frac{1}{4}$. Amount of \$40.60 = $\$40.60 \times \frac{119\frac{1}{4}}{100} = \$48.41\frac{1}{20}$.

9. \$ .50 per barrel. 10. $195\frac{5}{9}$ ft. per minute.

LX.

1. Man can do $\frac{1}{4}$ work in 1 day. Boy can do $\frac{1}{10}$ of $\frac{1}{4} \times \frac{2}{1}$ in 1 day $= \frac{1}{20}$ of work in 1 day. Together can do $\frac{1}{4} + \frac{1}{20} = \frac{6}{20}$ in 1 day. ∴ whole work in $3\frac{1}{3}$ days.

2. $2\frac{1}{2}$ days.

3. On \$20 gain is $\$2\frac{1}{2}$. ∴ gain per cent. is $12\frac{1}{2}$ per cent.

4. 2nd boy runs 130 ft. while 1st runs 150 ft. ∴ 2nd runs 1 ft. while 1st runs $\frac{150}{130}$ and 10000 ft. while 1st runs $10000 \times \frac{150}{130} = 11546\frac{2}{13}$ ft. 1st runs 11 rounds and $546\frac{2}{13}$ feet.

5. Gain at 30% profit $= \frac{3}{10}$ of cost. Gain at second rate $= \frac{55}{100}$ of $\frac{3}{5}$ of cost $= \frac{33}{100}$ of cost. ∴ second gives greater gain by $\frac{3}{100}$ of cost.

6. Number of sq. yards carpet=$25.00÷$1.25=20 sq. yards. Width of floor=20×9÷15=12 ft.

7. Sold to A 50×20=1000 sq. rods; to B (484×600) sq. ft.=1066⅔ sq. rods. Sold in all, 2066⅔ rods. Has left, 640 acres−2066⅔ rods=100333⅓ square rods. ∴ has still 100333⅓ rods. $\frac{100333\frac{1}{3}}{640 \text{ acr.}} = \frac{1505}{1536}$. ∴ $\frac{1505}{1536}$ square mile is left.

8. 196 lbs. of flour are worth $5.60. ∴ 7 lbs. are worth $\frac{7\times 560\text{c.}}{196}$ =20 cents=value of 10 lbs. herring.

9. By selling flour, gain is 20 cents on $5.50. Interest on $5.50 for 6 months @ 7%=19½ cents. ∴ the former is the better.

10. Interest on $50 for 1 year @ 6%=$30. ∴ $25 is interest for $\frac{25}{30}$ of 365 days=304¼ days.

LXI.

1. C=E−5. D=C+E−45=E−5+E−45=2 E−50. B=C+D−35=E−5+2 E−50−35=3 E−90. A=B+10=3 E+80. ∴ A+B+C+D+E=E+E−5+3 E−50+3 E−90+3 E−80=10 E−225 *i.e.*, 875=10 E−225, or 10 E=1100, E=110, C=105, D=170, B=240, A=250.

2. 63 cents=84%. 3 cents=4%. 75 cents=100%. 83 cents=110⅔%=a gain of 10⅔%.

3. In one day A can do the work 2¾ times; B 2⅙ times; C 2⅔ times, and D 2$\frac{5}{12}$ times. Therefore, all together can do the work 10 times in a day, or the work in $\frac{1}{10}$ of a day.

4. $1.80.

5. 29 cents in the dollar on $1700=$493: hence expenses must be $457.75.

6. Total expense is 5½ cents in the dollar, hence the net rental is 94½ cents in the dollar on $8,000, or $7560.

7. For each dollar of cost he formerly received $1.25, but now receives $\frac{8}{7}$ of $1.25, or 1.42\frac{6}{7}$, so that his profit at the advanced rate is $42\frac{6}{7}$ per cent.

8. $1125.

9. $1400 in Dominion Bank. $420 in Bank of Montreal. Total half-yearly interest, $63.70.

10. Asks 130 per cent.; accepts $113\frac{3}{4}$ per cent.; gains $13\frac{3}{4}$ per cent., which=$317.50; therefore 100 per cent. or cost of the farm=2309\frac{1}{11}$.

LXII.

1. 14 days, 18 hours, 36 minutes, 12 seconds.

2. The pure gold in the ornament weighs $\frac{9}{10}$ of $13\frac{3}{4}$ dwt. $=\frac{99}{130}$ oz., and is therefore worth $12 $31\frac{23}{40}$.

3. 1 ac., 0 r., 17 per., 23 yds., 4 ft., 108 in.

4. 10 lbs., 4 dr.

5. 36 lbs. avoirdupois=$43\frac{3}{4}$ lbs. Troy, which are to sell for $39.50, or 1.13\frac{1}{7}$ per lb.

6. Loss on $14000 is $5250 ∴ loss on $3581 is 1342.87\frac{1}{2}$.

7. $385. 8. 120.

9. A received 32 months' pasture for 1 cow; B 48; and C 36, hence A should pay $\frac{4}{13}$, B$\frac{6}{13}$, and C $\frac{3}{13}$ of the cost, or $8, $12, and $6 respectively.

10. A has $600 for 3 months, which=$1800 for 1 month; and also $450 for 9 months; which=$4050 for 1 month, or altogether $5850 for 1 month. B has $11250 and C $9000 for 1 month, therefore A should receive $\frac{13}{58}$; B $\frac{25}{58}$; C $\frac{20}{58}$.

LXIII.

1. In the first case $\frac{180}{7}$ lbs. cost $1.80, or 1 lb. costs 7 cents; in the second, $\frac{200}{8}$ lbs. cost $1.50, or 1 lb. costs 6 cents.

2. (1) The minute hand is 20 minute spaces behind the hour hand, and [illegible] to be at right angles will require to gain 5 spaces. [illegible] as the minute hand gains 11 spaces in 12 minutes, th[illegible] for $\frac{12}{11}$ of 5, or $5\frac{5}{11}$ minutes past four o'clock is the required result. (2) Minute hand has to gain 20 spaces, hence $\frac{12}{11}$ of 20 is the answer. (3) $\frac{12}{11}$ of 35. (4) $\frac{12}{11}$ of 50.

3. 81. 4. $19\frac{5}{363}$ yards.

5. A gets \$20 for B's \$25 or for C's \$24, hence A gets $\frac{20}{49}$ or \$100; B \$125, and C \$120.

6. I am entitled to the use of \$960 for 6 months, or \$5760 for 1 month, or \$576 for 10 months.

7. If 16 men=20 boys, 32 men=40 boys, so that 32 men and 16 boys=56 boys; and if 20 boys do the work in 42 days, 56 boys can do it in 15 days.

8. Of any two numbers the G. C. M. × L. C. M.= product of the numbers, hence $\frac{12 \times 72}{24}=36$, number required.

9. $\frac{56}{300}$.

10. $\frac{2}{3}$ cargo=$\frac{1}{3}$ ship; cargo=$\frac{3}{10}$ ship; *i. e.*, the value is divided between the cargo and the ship in the ratio of 3 to 10, hence cargo=$\frac{3}{13}$ of 260,000=\$60,000.

LXIV.

1. The cash and credit prices may be represented by 140 per cent. and 150 per cent., or by 14 and 15, or by 42 and 45, hence 42 cents is the cash price.

2. 32 − 4 = 28 = sum of ages now. Therefore, Mary's age is 8 and Jane's 20 years.

3. If the water is 50 quarts less than half the mixture the wine must be 50 quarts more; but the wine is also 125 quarts more than one-fifth the mixture. Therefore the difference between $\frac{1}{2}$ and $\frac{1}{5}$ the mixture is 75 quarts, making 250 altogether, 75 water and 175 wine.

4. \$2400 − \$600 = \$1800 = cost of 30 per cent. ∴ \$6000 = cost of 100 per cent. ∴ 200 = number bought.

5. Cost and selling prices may be represented by 100 and 140, or by 5 and 7 ∴ cost is $\frac{5}{7}$ of \$1.92 = 80 cents.

6. The top, bottom and sides are each 30×15, and the ends 15×15. Answer, $15\frac{5}{8}$ square feet.

7. \$450 + \$40 = \$490 = 3 times cost of carriage. Answer, carriage $\$163\frac{1}{3}$; horse $\$286\frac{2}{3}$.

8. \$65 = 92% − 40% = 52% ∴ \$5 = 4% ∴ \$125 = 100%.

9. The whole interest is \$15000 and the interest each year \$1600; hence the number of years is $9\frac{3}{8}$.

10. For second horse: \$124.80 = 80%. ∴ \$156 = 100%. For first horse: \$156 = 130%. ∴ \$120 = 100%.

LXV.

1. She had $\frac{11}{12}$ left; *i. e.*, $\frac{10}{12}$ more than she spent ∴ $\frac{10}{12}$ her money = \$99.40 ∴ her money = \$119.28.

2. In 20 lbs. std. gold there are $\frac{22}{24}$ of 20 lbs. of pure gold, worth $\frac{22}{24}$ of 20×240 or \$4400, leaving the alloy worth \$100.

3. The second stick is only $\frac{4}{15}$ as large as the first, and therefore 36 feet of it would weigh $\frac{4}{15}$ of 3600 = 960 lbs., but it must weigh 1200 lbs., therefore its length must be $\frac{1200}{960}$ of 36 = 45 feet.

4. $\frac{4}{9}$ longer = 2 shorter piece. Longer = $4\frac{1}{2}$ shorter piece. Longer + shorter = $5\frac{1}{2}$ shorter piece. 1 yard = $5\frac{1}{2}$ shorter piece. $\frac{2}{11}$ of 1 yard = shorter piece ∴ $\frac{9}{11}$ of 1 yard = longer piece.

5. At the end of 6 months the amount due will be \$615. He pays \$215, leaving \$400 still due. At the end of the year this will amount to \$410.

6. 90 per cent. = \$6000 ∴ 110 per cent. = $\$7333\frac{1}{3}$.

7. 6 times the number = 864 ∴ the number = 144.

8. Loss on \$550 = \$200 ∴ loss on \$90 = $\$32\frac{8}{11}$.

9. Weight of copper $=6\times3\frac{1}{2}=21$ tons : 1 part $=7$ tons ; 2 parts $=14$ tons $=$ tin ; 7 parts $=49=$ iron.

10. Distance round the field is $218\frac{1}{2}$ rods, to fence which at \$2.40 a rod will cost \$524.40.

LXVI.

1. 24 lbs. avoirdupois $=24\times7000$ grains $=\frac{24\times7000}{480}$ ozs. apothecary $=350$ ounces, which at 80 cents an ounce will sell for \$280 ; and the 24 lbs. cost \$224, hence the gain is \$56.

2. Weight $=\frac{450.000\times3\frac{1}{2}}{2000}$ tons ; cost $=450\times\$5\frac{1}{3}$.

3. I own $\frac{2}{5}$ and sell $\frac{1}{6}$ of it, therefore I have left $\frac{5}{6}$ of $\frac{2}{5}$, or $\frac{1}{3}$ of the ship, hence my share is worth \$10,000.

4. He loses 1 ft. in 66 ft., or 80 ft. in the mile.

5. He owned $\frac{3}{16}$ and sold $\frac{16}{90}$ of his share, keeping $\frac{74}{90}$ of his share, and $\frac{74}{90}$ of $\frac{3}{16}=\frac{37}{240}$.

6. One dozen cost \$10.32. ∴ number dozen $=\frac{\$415.20}{\$10.32}$ $=40\frac{10}{43}$.

7. $\frac{8}{9}$ of \$32324.58.

8. $\frac{5}{2}$ of $\frac{7}{3\frac{4}{5}}=\frac{175}{38}$; $\frac{175}{38}\div1\frac{77}{228}=\frac{210}{61}$; $2\frac{3}{4}+\frac{210}{61}=6\frac{47}{244}$.

9. $62\frac{3}{4}$ cents.

10. \$33.60 + \$3.36 = \$36.96 = selling price of 1 cwt. ∴ selling price per lb. $=36\cdot96$ cents.

LXVII.

1. $\frac{9}{1000}$ of \$1560.50 = \$14.04.

2. Silk, \$26.25 ; tweed, \$24.75 ; [illegible], \$164.00 ; oats, \$16.54 , lumber, \$4.80.

3. The time is 1 year, 122 days. The interest for 1 year is $12, and for 122 days, $4.01; total interest, $16.01.

4. $\frac{5}{24}$ in the air = 12 ft. ∴ length of pole = $57\frac{3}{5}$ ft.

5. Area of walls = 1176 ft.; area of doors, etc. = 294 sq. ft.; area of ceiling = 432 sq. ft. = 146 sq. yards. Cost = $36.50.

6. The smaller wheel makes one revolution more than the larger one in every 30 ft., and as this distance is contained 220 times in $1\frac{1}{4}$ miles, the required answer is 220.

7. $\frac{40}{36} = 1\frac{1}{9} = 1.\dot{1}$.

8. On $8500 he pays $4750; on $1 he pays $\frac{4750}{8500}$ = $55\frac{13}{17}$ cents. ∴ loss on $1 = $44\frac{4}{17}$ cents; loss on $1475 = $650.74.

9. Cash price = $\frac{11}{10}$ of cost price. ∴ cost = $\frac{10}{11}$ of cash price = $\frac{10}{11}$ of $8.80 = $8.00. To find the credit price, add 5 per cent. to $8.80 and we have $9.24.

10. $130 in 9 months at 6 per cent. will amount to $135.85, hence the cash sale is the more profitable.

LXVIII.

1. Their sum is 11,169; their difference is 7,689 11169 + 7689 = 18858 = $\overline{X}$VIIIDCCCLVIII.

2. Remainder = 576; divisor = 1728 − 576 = 1152; dividend = 1728 × 1152 + 576 = 1,991,232.

3. (1) $1\frac{1}{4} \times 1\frac{1}{4} \times 640 = 1000$ ac. = 10 farms. (2) $\frac{600 \times 320}{160}$ = 1200 acres. (3) 200, 80; 160, 100.

4. The hoop turns once in $5\frac{1}{2}$ ft. ∴ $\frac{7\frac{1}{2} \times 5280}{5\frac{1}{2}}$ = 7200.

5. The detective is 504 miles behind the prisoner and gains 84 miles a day; he will therefore overtake him in 6 days, or 10 days after the prisoner escaped.

6. A post every 6 seconds is ten posts a minute, or 30 in 3 minutes, *i. e.*, 30 in a mile, or 3000 in 100 miles.

7. G. C. M. of $8.60 and $6.80 is 20 cents. ∴ 43 boys and 34 girls altogether, allowing 42 boys and 33 girls to be invited.

8. If 100 bush. fill 125 cubic ft., 750 bush. will require $937\frac{1}{2}$ cubic ft., and as a bin $12\frac{1}{2}$ ft. sq. and 1 ft. high would contain $156\frac{1}{4}$ cubic ft. ∴ the required height would be $\frac{937\frac{1}{2}}{156\frac{1}{4}}$, or 6 ft.

9. Possible aggregate $= 50 \times 220 = 11000$; days lost $=$ 1250; actual aggregate $= 11000 - 1250 = 9750$. Average $= \frac{9750}{220} = 44\frac{7}{22}$.

10. Taking 4 for each son's share, the mother's share will be 6 and each daughter's share 3, so that the sons will get 12, the daughters 12, and the mother 6 ∴ each daughter gets one-tenth of the property (after deducting expenses), which would thus be $18,000, and $\frac{25}{24}$ of this $=$ $18,750.

LXIX.

1. The son does $\frac{1}{3}$ of the work, and would therefore do it all in 24 days or 216 hours, and 5 times as much in 1080 hours, or 90 days of 12 hours.

2. $2.50 $= 1\frac{1}{8}$ of cost ∴ cost $= \frac{8}{9}$ of $2.50 $= 2\frac{2}{9}$. If sold for $3, the gain would be $\frac{7}{9}$, which is $\frac{7}{20}$ of cost.

3. John's share $= \frac{3}{5}$ of James'; Tom's $= \frac{3}{5}$ John's $= \frac{15}{25}$ James'; Alex.'s $= \frac{7}{5}$ Tom's $= \frac{105}{25}$ James'. If, then, James has 8, John will have 12, Tom 30, and Alex. 105, out of each 155 or 32, 48, 120 and 420 respectively.

4. A does $\frac{1}{4}$ and B $\frac{7}{18}$, leaving $\frac{13}{36}$ for C, which he can do in $\frac{13}{36}$ of 8 hours $= 2\frac{8}{9}$ hours.

5. One man for 1 week cost $2.40; 1 woman, $1.80; 1 child, $1.44 ∴ total cost $=$ $129.48.

6. $\frac{1}{17} = 42\frac{1}{2}$ bush. B's share $= \frac{10}{17} = 425$ bush.

7. He has 9 acres and sells $\frac{1}{3}$ acre for 3650 guineas ∴ remaining $\frac{26}{3}$ are worth 26×3650 guineas, or $484,939.00.

8. The hall is 35 by 21 ft. Cost of carpet, \$122.50 and \$105 ; difference required, \$17.50.

9. He still has $\frac{15}{49} = .306122+$. 10. 264.

LXX.

1. Groceries sold for \$7275, and cost $\frac{4}{5}$ of \$7275 = \$5820. Boots sold for \$5820, and cost $\frac{10}{13}$ of \$5820 = \$4476$\frac{12}{13}$. Dry-goods sold for \$16005, and cost $\frac{3}{4}$ of \$16005 = \$12003$\frac{3}{4}$. Total cost = \$22300.67 ∴ gain = \$6799.33.

2. $83\frac{37}{61}$ per cent.

3. The time = 422 days. Interest = $\$204.40 \times \frac{422 \times 4}{365 \times 100}$

= \$9.45 ∴ answer = \$213.85.

4. The first gets 30 weeks pasture for one cow ; the second, 28 ; the third, 24 ; and the fourth, 18. Hence the first pays $\frac{30}{100}$ of \$45, or \$13.50 ; the second, \$12.60 ; the third, \$10.80 ; the fourth, \$8.10.

5. $\frac{1}{4}$ mile = 1320 ft. $1320 \times 4 \times 2 \times 3$ = number ft. lumber ∴ cost = \$253.44.

6. Width of zone = 43 degrees ∴ $\frac{43}{360}$ = answer.

7. \$27.97.

8. The watch shows 14 hours 90 seconds for every 14 hours true time, or 561 for every 560 true time ∴ when the watch shows the end of the week, only $\frac{560}{561}$ of the week will have passed, or $\frac{1}{561}$ of the week will still be left, that is, the time will be $17\frac{543}{561}$ minutes to 12 o'clock Saturday night.

9. At the end of the week the watch will show $\frac{561}{560}$ of a week, or $\frac{1}{560}$ on the next week ; that is, 18 minutes past 12 Sunday morning.

10. $\frac{\$93.75}{\$7.50} = 12\frac{1}{2}$ long tons $= 12\frac{1}{2} \times 2240$ lbs. = 28000 lbs.

= 14 short tons ∴ price = \$105.

LXXI.

1. Area of 10 acre field is 1600 sq. rods. Length of side is sq. root of 1600 sq. rods = 40 rods. Length of 4 sides = $4 \times 40 = 160$ rods. Cost at 15 cents = \$24. Length of side of second field = $\frac{1600}{30} = 53\frac{1}{3}$. ∴ length of 4 sides = $166\frac{2}{3}$ rods. Cost is $166\frac{2}{3} \times 15 = \$25$. Difference = \$1.

2. Block 3 ft. long, $\frac{2}{3}$ ft. thick, contains 10 cubic ft. − 8 cubic ft. = 2 cubic ft. ∴ breadth $= 2 \div 2 = 1$ ft. Length of stick $= 10 \div (\frac{8}{12} \times 1) = 15$ ft.

3. Marked price = 140% of cost. Selling price to friend $= \frac{4}{5}$ of 140% of cost = 112% of cost. ∴ gain = 12% = \$1.08. Cost = \$900.

4. Income $= 5\frac{1}{2}\%$ of \$18000 = \$990. Tax = \$990 − \$975 = \$15. Tax on \$990 is \$15 ∴ tax on \$100 $= \frac{100 \times 15}{990} =$ $\$1\frac{17}{33} = 1\frac{17}{33}$ per cent.

5. Merchant pays $\frac{6}{5}$ of cost. Last purchaser pays $\frac{5}{4}$ of $\frac{6}{5}$ of cost $= \frac{6}{4}$ of cost. ∴ $\frac{6}{4}$ of cost = \$30. Cost = \$20.

6. On 36 in. gain 39·371 in. − 36 in. = 3·371 in. ∴ gain per cent. $= \frac{100}{36}$ of $3{\cdot}371 = 9\frac{131}{136}$ per cent.

7. The slower train has a start of 50 miles. Faster train gains this and 25 miles more, *i. e.*, gains 75 miles. Gains 5 miles per hour ∴ runs 15 hours. Distance = 450 miles.

8. 60 degrees is $\frac{2}{3}$ of right angle $= \frac{2}{3}$ of $\frac{1}{4}$ of circle = 10 minute spaces. At 1 o'clock the minute hand is 5 minute spaces behind. It must gain 15 minute spaces. Gains 11 spaces in 12 minutes. ∴ gains 15 minute spaces in $16\frac{4}{11}$ minutes. Answer, $16\frac{4}{11}$ minutes after 1 o'clock.

9. $\frac{1}{6}$ of circumference is between them. ∴ $\frac{1}{6}$ of circumference $= 7\frac{1}{3}$ inches. ∴ circumference = 44 inches $3\frac{1}{7}$ times the diameter = 44 inches. ∴ diameter is $44 \div 3\frac{1}{7} = 14$ inches. Length of minute hand = 14 in. ÷ 2 = 7 inches. Distance travelled in 24 hours = 44 in. × 24 = 88 ft.

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

LXXII.

1. Gain $=\frac{1}{6}$ of \$60 $=$ \$10 per acre $\therefore$ gains \$400 on 400 $\div$ 10 $=$40 acres. $\frac{1}{6}$ of farm is 40 acres $\therefore$ whole farm was 240 acres. Kept 200 acres.

2. $\frac{1}{5}$ of his money is \$2000 more than $\frac{1}{8}$ of his money and \$1000 $\therefore$ $\frac{1}{5}$ of money $=\frac{1}{8}$ of money $+$ \$3000. $\frac{1}{5}$ of money $-\frac{1}{8}$ of money $=$ \$3000 $\therefore$ $\frac{3}{40}$ of money $=$ \$3000; money $=$ \$40000. Gave his son \$6000.

3. 155 yards.

4. B spends $\frac{11}{8}$ of $\frac{4}{5}=\frac{11}{10}$ of income $\therefore$ $\frac{1}{10}$ of income is \$55. Income is \$550.

5. 7 bbls. of first are worth \$17.50 more than 7 of second, but 7 bbls. of first are worth 9 bbls. of second $\therefore$ 2 bbls. of second are worth \$17.50, and 1 bbl. worth \$8.75. First is worth \$11.25 per bbl.

6. Selling price $=\frac{7}{5}$ of 85 cents $=$ \$1.19 per gal. Number of gallons sold $=$ \$675.32$\frac{1}{2}$ $\div$ \$1.19 $=567\frac{1}{2}$. Number of gals. bought $=$ \$675.32$\frac{1}{2}$ $\div$ 85 cents $=794\frac{1}{2}$. Number gals. leaked out $=794\frac{1}{2}$ gals. $-567\frac{1}{2}$ gals. $=227$ gals.

7. Elected candidate gets $\frac{19}{40}$ of whole votes. Defeated gets $\frac{80}{80}-(\frac{38}{80}+\frac{5}{80})=\frac{37}{80}$ of whole votes. Difference $=\frac{1}{80}$ of votes $=5$ $\therefore$ whole vote $=400$.

8. In 18 seconds train goes 264 yards. In 18 seconds man goes 44 yards. Train goes its own length $+$ the distance man goes $\therefore$ length of train is 264 yards -44 yards $=220$ yards.

9. Length of ditch $=209$ ft. $+209$ ft. $+152\frac{5}{8}+152\frac{5}{8}+14$ $=737\frac{1}{4}$ ft. Cubic contents $=737\frac{1}{4}\times3\frac{1}{2}\times4=10321\frac{1}{2}$ cubic ft. Cost at $2\frac{1}{2}$c. per ft. $=$ \$258.03$\frac{3}{4}$.

10. Received $\frac{6}{5}$ cost of horse, $\frac{7}{6}$ cost of cows, $\frac{3}{4}$ cost of sheep $=$ together $\frac{187}{60}$ of cost of each kind of animals $=$ \$4675 $\therefore$ cost of each $=$ \$1500.

LXXIII.

1. Difference between shares $=\frac{1}{8}$ of whole capital $\therefore$ $\frac{1}{8}$ of capital $=$ \$379$\frac{3}{7}$ $\therefore$ whole capital $=$ \$3035$\frac{3}{7}$. A's share, \$1328; B's, \$1707$\frac{3}{7}$.

2. C receives \$100. ∴ A and B receive \$130. If \$130 be gained from \$390, \$100 will be gained from $\frac{390 \times 100}{130}$ =\$300, which is then the value of 120 yards of cloth. ∴ 1 yard is worth \$2.50.

3. Second man is worth $\frac{23}{20}$ of \$9000=\$10350. $\frac{3}{4}$ of first man's capital=\$10350. ∴ capital was=\$13800.

4. Cost of wheat: 3000 bush. @ \$1.50=\$4500. Selling price=$\frac{29}{25}$ of \$4500=\$5220. Allowing $\frac{1}{10}$ for bad debts must sell for $\frac{10}{9}$ of \$5220=\$5800. Allowed $\frac{1}{5}$ discount on asking price. ∴ $\frac{4}{5}$ of asking price=\$5800. Asking price is $\frac{5}{4}$ of \$5800=\$7250.

5. $\frac{4}{7}$ of fortune=\$6800. ∴ fortune=\$11900. Laid in speculation, $\frac{3}{7}$ of \$11900=\$5100. Gain in speculation, $\frac{5}{17}$ of \$5100=\$1500. Interest, $\frac{1}{8}$ of \$6800=\$850. Total gain=\$2350.

6. Area of end=4 sq. ft. Length=16×27÷4=108 ft. Value=108×55=\$59.46

7. Received for wine $\frac{24}{25}$ of \$149.00=\$143.04. Number of gals. sold=\$143.04÷\$2.98=48 gals. Number of gals. leaked out=63−48=15 gals.

8. Value of wheat=20×2½ times \$1.05=\$52.50. Gain =$\frac{1}{5}$ of cost. ∴ \$52.50=$\frac{6}{5}$ of cost. $\frac{1}{5}$ of cost=\$8.75. Merchant's gain=$\frac{1}{4}$ of cost. ∴ \$50=$\frac{5}{4}$ of cost. Gain=\$10. Merchant gained the more.

9. $\frac{14}{100}$ of $\frac{6}{7}$ sells for \$2760. ∴ ship would be worth \$23000. Ship had decreased in value $\frac{8}{100}$. ∴ $\frac{92}{100}$ of former value=\$23000. Former value=$\frac{100}{92}$ of \$23000=\$25000.

10. Interest on \$100 for 1 year at 8%=\$8; at 6%=\$6. Difference=\$2 per year. Difference between interests at 8 and 6 per cent.=\$57.60 for same time. ∴ \$28.80 is the interest at 1%, and \$28 80×8=\$230.40=interest at 8% ∴ principal=\$710.40−\$230.40=\$480.00. Interest on \$480.00 for 1 year=\$28.80 ∴ rate=6%.

LXXIV.

1. \$1.36. 2. \$114.50. 3. 8 years.

4. 1 gal. milk cost 16 cents, and is sold for 24 cents. 1 quart of watered milk is sold for 5 cents. $\therefore 4\frac{4}{5}$ quarts are sold for 24 cents. $\frac{4}{5}$ quarts of water is added to every gal. of milk.

5. From 15th October to 15th May is 212 days. $\therefore 10\frac{2}{21}$ tons will be used. Cost at \$6.50 = \$65.61$\frac{19}{21}$.

6. Gain on one = $\frac{1}{5}$ of cost. $\therefore$ selling price = $\frac{6}{5}$ of cost. $\frac{6}{5}$ of cost = \$1500. $\therefore$ cost = \$1250. Loss on second = $\frac{1}{6}$ of cost. $\therefore \frac{5}{6}$ of cost = selling price. $\therefore \frac{6}{5}$ of \$1500 = \$1800. Cost of two = \$3050. Loss is \$50.

7. Each of first three rides twice as far as the fourth $\therefore$ fourth pays $\frac{1}{7}$ of cost = $\frac{1}{7}$ of \$5 = $71\frac{3}{7}$ cents.

8. 1600 yards. 9. \$38.40.

10. Number of cubic yards in room = $\frac{36 \times 30 \times 15}{27} = 600$ cubic yards. Number of cubic yards per pupil = 600 cubic yards $\div 40 = 15$ cubic yards.

LXXV.

1. 1290994. 2. £480. 3. $\frac{13}{162}$.

4. Paid 2d. in the £1 $\therefore$ has 238d. in the £1 left = $\frac{238}{240}$ of money. $\frac{238}{240}$ of income = £178 10s. $\therefore$ income = $\frac{240}{238}$ of £178 10s. = £180.

5. If saddle cost $\frac{1}{3}$ of whole, the horse cost $\frac{2}{3}$ of whole $\therefore \frac{2}{3}$ of whole = £60. Whole cost = $\frac{3}{2}$ of £60 = £90.

6. 13s. $7\frac{33}{37}$d. 7. $9\frac{1}{7}$ men.

8. Interest on £100 for 4 years @ $2\frac{1}{2}$ per cent = £10. If £10 is the interest on £100, interest is $\frac{1}{10}$ of principal. $\therefore$ principal is 10 times £591 12s. 4d. = £5916 3s. 4d.

9. Length of walls = 30 + 30 + 24 + 24 ft. = 108 ft. Area = $108 \times 12\frac{1}{2} = 1350$ sq. ft. = 150 sq. yards. Number of yards of paper = $150 \div \frac{3}{4} = 200$ yards.

10. $\frac{3}{5}$ of cost = 1s. 6d. ∴ cost = 1s. per 24, or 6d. per doz. $66\frac{2}{3}\% = \frac{2}{3}$. Therefore, to gain $66\frac{2}{3}\%$ I must sell for $\frac{5}{3}$ of 6d. = 10d. per doz.

LXXVI.

1. Area of one side of cube $= 3\frac{1}{2} \times 3\frac{1}{2}$ sq. ft. $= 12\frac{1}{4}$ sq. ft. Area of six sides $= 73\frac{1}{2}$ sq. ft. = 10584 sq. in. 56 sq. in. are covered by one grain. ∴ 10584 sq. in. are covered by $10584 \div 56$ grs. = 189 grs.

2. Loss $= 8\% = \frac{2}{25}$ of cost. ∴ $\frac{23}{25}$ of cost = 60 cents. Cost = $\frac{25 \times 60}{23} = \frac{1500}{23}$ cents. Gain $15\% = \frac{3}{20}$ of cost. ∴ selling price $= \frac{23}{20}$ of cost $= \frac{23}{20}$ of $\frac{1500}{23} = 75$ cents per lb.

3. While 3rd receives \$1, 2nd receives \$2, and 1st receives \$5 more than 2nd. Deduct \$5 and divide remainder, \$22.12½. 3rd gets $\frac{1}{5}$ of \$22.12½ = \$4.42½; 2nd receives \$3.85; 1st, \$13.85.

4. $27\frac{3}{11}$ minutes after 5 o'clock.

5. Average cost per bbl. = \$650 ÷ 120 = \$5.41$\frac{2}{3}$ per bbl. On bbl. of first quality he loses $33\frac{1}{3}$ cents, or 1c. on $\frac{3}{100}$ bbls. On bbl. of second quality gains $41\frac{2}{3}$ cents, or 1c. on $\frac{3}{125}$. ∴ he gets $\frac{3}{100}$ bbls. of first to $\frac{3}{125}$ of second = 5 or first to 4 of second = $66\frac{2}{3}$ bbls. of first quality, and $53\frac{1}{3}$ bbls. of second quality.

6. \$1.20 is value of 1 gal. wine. ∴ \$1.00 is value of $\frac{100}{120} = \frac{5}{6}$ gal. of wine. Remainder, $\frac{1}{6}$ gal. = $\frac{2}{3}$ quart, is water.

7. Cost of 4 pipes = 504 × \$2.15 = \$1083.60. Freight, \$57.60. Duty, $\frac{6}{25}$ of \$1083.60 = \$260.06$\frac{2}{5}$. Total cost = \$1401.26$\frac{2}{5}$. Gain = \$1980 − \$1401.26$\frac{2}{5}$ = \$578.73$\frac{3}{5}$. ∴ gains

$$\text{per cent.} = \frac{100 \times \$578.73\frac{3}{5}}{\$1401.25\frac{2}{5}} = 14 + \text{per cent.}$$

8. Extra value of 56 bush. of barley = 35 × 56 = \$19.60. 34 bush. corn and 56 bush. barley, at same price as corn, are worth \$63.10 − \$19.60 = \$43.50. ∴ 1 bush. corn is worth \$43.50 ÷ 90 = 48⅓ cents; barley is worth 48⅓c. + 35c. = 83⅓ cents per bush.

9. Buys peaches at $\frac{3}{5}$c. each; sells at $\frac{3}{4}$c. each ∴ profit is $\frac{3}{4}$c. $-\frac{3}{5}$c. $=\frac{3}{20}$c. per peach. Must buy and sell \$4.20 ÷ $\frac{3}{20}$ = 1200 peaches.

10. $144\frac{3}{4}$.

LXXVII.

1. Area of hall $=21\times10$ ft. $=210$ sq. ft. $=\frac{210}{9}$ sq. yards ∴ expense of carpet will be \$1.25 $\times\frac{210}{9}$ = \$29.16$\frac{2}{3}$.

2. 20 gallons.

3. Distance two trains pass over in 8 seconds equals their combined lengths. In 60 seconds, first train moves 880 yards; in 8 seconds, moves $\frac{8}{60}$ of 880 yards = 352 ft. Second train passes over 320 ft. ∴ lengths are $352+320=672$ ft. $=224$ yards. Second train is 114 yards long.

4. In 42 hours it would lose $\frac{42}{24}$ of $5=8\frac{3}{4}$ minutes. It will show 6, 1′, 15″.

5. Interest on \$100 for $2\frac{1}{2}$ years @ 7% is \$17$\frac{1}{2}$. \$1 is interest on $\frac{100}{17\frac{1}{2}}$ ∴ \$5.87$\frac{1}{2}$ is interest on $\frac{\$5.87\frac{1}{2}\times100}{\$17\frac{1}{2}}=\$33\frac{4}{7}$.

6. Sold $\frac{3}{5}$ of article for $\frac{2}{3}$ of cost ∴ sold whole article for $\frac{5}{3}$ of $\frac{2}{3}=1\frac{1}{9}$ of cost. Gain is $\frac{1}{9}$ of cost $=11\frac{1}{9}$ per cent.

7. Discount is $\frac{1}{5}$ of selling price ∴ $\frac{4}{5}$ of selling price is 75 cents. Selling price is $\frac{5}{4}$ of 75 cents $=90\frac{3}{4}$ cents.

8. Gain $=\frac{1}{8}$ of cost ∴ $\frac{9}{8}$ of 10 lbs. $=$ \$1. Cost of 10 lbs. $=\frac{\$8}{9}=88\frac{8}{9}$ cts. $=8\frac{8}{9}$c. per lb. Cost of 11 lbs. $=97\frac{7}{9}$ cts. ∴ gain is $2\frac{2}{9}$ cents. Gain per cent. $=(2\frac{2}{9}\div97\frac{7}{9})\times100=2\frac{3}{11}$ per cent.

9. Interest on \$100 for 5 years @ 4 per cent. is \$20 ∴ amount of \$100 for given time at 4 per cent. is \$120. \$500 is amount of \$500 $\times100\div120=\$416.66\frac{2}{3}$.

10. Loss from false weight $=\$48-\$42=\$6=\frac{6}{48}$ of amt. paid for $=\frac{1}{8}$ of 16 $=2$ oz. ∴ 14 oz. were given as 1 lb.

LXXVIII.

1. Weight of shilling = 87 grs. ∴ weight of silver is $\frac{37}{40}$ of 87 grs. = 3 dwt. $8\frac{19}{47}$ grs. Alloy is $\frac{3}{40}$ of weight = $\frac{3 \times 100}{40}$ per cent. = $7\frac{1}{2}$ per cent.

2. $\frac{1}{8}$.

3. Interest on \$50 for 1 day = 1 cent ∴ interest on \$100 for 1 day = 2 cents. Interest on \$100 for 1 year is 2 cents $\times 365 = \$7.30$ ∴ rate per cent. per annum is $7\frac{3}{10}$ per cent.

4. Number of sq. yards of carpet equals area of floor = £5 12s ÷ 3s. 6d. = 32 sq. yards = 288 sq. ft. Width of room is 288 ÷ 18 = 16 ft, Area of 4 walls = number of sq. yards of paper = £17 ÷ $4\frac{1}{2}$s. = $75\frac{5}{9}$ sq. yards = 680 sq. ft. Length of 4 walls = 68 ft. ∴ height = 680 ÷ 68 = 10 ft.

5. Number of sq. metres = $393{\cdot}7 \times \frac{27}{39{\cdot}37}$ = 270 sq. met.

Value at 4 francs per sq. metre = 1080 francs. Value in English money = (£1080 ÷ 25.15) = £42 18s. $10\frac{82}{503}$d. = $10306\frac{82}{503}$d. Number of sq. feet = $10306\frac{82}{503}$d. ÷ 3d. = $3435\frac{185}{503}$. Length of cotton = $3435\frac{185}{503} \div 4 = 858\frac{847}{10006}$.

6. The use of £91 15s. for £$4\frac{1}{2}$ is the greater rate.

7. 3 men can do $\frac{1}{60}$ of work in 1 day ∴ 1 man can do $\frac{1}{180}$ in 1 day. 4 women can do $\frac{1}{60}$ of work in 1 day ∴ 2 women can do $\frac{1}{120}$ in 1 day. 5 boys can do $\frac{1}{60}$ of work in 1 day ∴ 3 boys can do $\frac{1}{100}$ in 1 day. 6 girls can do $\frac{1}{60}$ of work in 1 day ∴ 4 girls can do $\frac{1}{90}$ in 1 day. 1 man, 2 women, 3 boys and 4 girls can do $\frac{1}{180} + \frac{1}{120} + \frac{1}{100} + \frac{1}{90}$ in 1 day. 1 man, 2 women, 3 boys and 4 girls can do $\frac{7}{200}$ in 1 day ∴ do whole work in $\frac{200}{7} = 28\frac{4}{7}$ days.

8. Spends $\frac{3}{7} + \frac{3}{8}$ of money = $\frac{45}{56}$ of money ∴ has left $\frac{11}{56}$ of his money = $\frac{11}{56}$ of £3 5s. 4d. = 154d. Can give away $5\frac{1}{2}$d. to 154d ÷ $5\frac{1}{2}$d. = 28 persons.

9. Number of sq. yards in room = £6 2s. 6d. ÷ 5s. = $24\frac{1}{2}$ sq. yards. Floor is two squares of $12\frac{1}{4}$ sq. yards each. Width of room is, therefore, square root of $12\frac{1}{4} = \frac{7}{2}$ yards = $3\frac{1}{2}$ yards. Length is 7 yards, *i. e.*, 21 ft. Length of

walls = 63 ft. Number of yards in wall = £1 6s. 3d. ÷ 6 ÷ 9 yds. = 35 sq. yards = 315 sq. ft. Height of walls = 315 = 5 ft.

10. Clock goes $24\frac{1}{60}$ hrs. in 24 hrs. ∴ goes 1 hr. in $\frac{24}{24\frac{1}{60}}$ and goes 24 hrs. in $\frac{24 \times 24}{24\frac{1}{60}} = 23$ hrs. $59\frac{1}{1441}$ min., or $\frac{1440}{1441}$ of a minute to 12 o'clock.

LXXIX.

1. Has $\frac{1}{2}$ money left when leaving first shop. Has $\frac{2}{3}$ of $\frac{1}{3} = \frac{1}{5}$ of money left when leaving second shop. Has $\frac{1}{3}$ of $\frac{1}{3} = \frac{1}{15}$ of money left when leaving third shop ∴ $\frac{1}{15}$ of money = 1s. Whole sum = 15 of 1s. = 3s. 9d.

2. Wages for 30 days at 40d. per day = £5. Loss from idleness = £5 − £3 11s. = £1 9s. Loses each idle day wages and forfeit = 58d. ∴ loses £1 9s. in £1 9s. ÷ 58d. = 6 days ∴ was idle 6 days.

3. $\frac{2}{3}$ of the voters less 85 voters = $\frac{1}{3}$ of voter + 60 voters ∴ $\frac{1}{3}$ of voters = 145. Whole number = 435 voters.

4. 4 hours, 48 minutes.

5. In 24 hrs. gains 4 min. From 6 a.m. to 7:15 p.m. is $13\frac{1}{4}$ hrs. Gains in $13\frac{1}{4}$ hrs. $\frac{13\frac{1}{4} \times 4}{24} = 2\frac{3}{24}$ min. Should be placed back $2\frac{5}{24}$ min., *i. e.*, $5{:}57\frac{19}{24}$ a.m.

6. Rate of stream is 4 mls. per hr. $\frac{8}{\text{Rate of stream} + 8 \text{ mls.}} + \frac{8}{8 \text{ mls.} - \text{rate of stream}} = 2\frac{2}{3}$ ∴ rate of stream is 4 miles per hour.

7. $\frac{5}{9}$ of A's money = B's ∴ A has $£2\frac{1}{2}$ to B's £1. B has £9 to C's £7, or £1 to $£\frac{7}{9}$ ∴ proportions are $2\frac{1}{2}$, 1, $\frac{7}{9}$. A has $\frac{2\frac{1}{2}}{4\frac{5}{18}}$ of £770 = £450. B has $\frac{1}{4\frac{5}{18}}$ of £770 = £180. C has $\frac{\frac{7}{9}}{4\frac{5}{18}}$ of £770 = £140.

8. Cost of 3 apples at 3 a penny=1 penny. Cost of $\frac{5}{6}$ of 3 apples=$2\frac{1}{2}$ apples, at 4 a penny or $\frac{1}{4}$ penny each=$\frac{5}{6} \times 3 \times \frac{1}{4}=\frac{5}{8}$d. ∴ cost of $5\frac{1}{2}$ apples is $1\frac{5}{8}$d. ∴ cost of 1 apple is $1\frac{5}{8} \div 5\frac{1}{2}=1\frac{3}{44}$, and sells 16 for 6d. or $\frac{6}{16}$d.=$\frac{3}{8}$d. each. Gain =$\frac{3}{8}$d. $-1\frac{3}{44}$d.=$\frac{33}{88}$d. $-\frac{26}{88}$d.=$\frac{7}{88}$d. on each apple ∴ gains 1 penny on $\frac{88}{7}$ apple, and gains $3\frac{1}{2}$d. on $\frac{3\frac{1}{2} \times 88}{7}$ apples=44 apples.

9. Interest in second case is at $\frac{1}{2}$ rate for $\frac{1}{4}$ time ∴ interest is $\frac{1}{8}$ of the former. Difference between interests for the two periods is \$525 ∴ interest for time at 6 per cent. is $\frac{8}{7}$ of \$525=\$600. Loan=\$600−\$100=\$500.

10. On 1 lb. of spice at 8s. per lb. loss is 2s. On 1 lb. of spice at 5s. gain is 1s. ∴ 2 lbs. must be taken of 5s. spice to 1 of 8s. spice, or 40 at 5s. to 20 at 8s.

LXXX.

1. First, 21 gals. ; second, 9 gals. ; third, 2 gals.

2. A in 12 days can do $\frac{3}{4}$ of work, or in 1 day do $\frac{1}{16}$ of work. B can do $\frac{1}{20}$ of work in 1 day. C can do $\frac{1}{16}$ of work in 1 day. A, B and C can do $\frac{1}{16}+\frac{1}{20}+\frac{1}{16}$ of work =$\frac{7}{40}$ of work in 1 day ∴ can finish it in $5\frac{5}{7}$ days.

3. 383, 321. 4. 15 per cent. per annum.

5. Interest on \$1280 for 1 year at 7 per cent.=\$89.60. Whole interest is \$220. \$89.60 is interest for 1 year ; \$220 is interest for $\frac{220}{89.60}$ years=$2\frac{51}{112}$ years.

6. Each plank takes space $12\frac{1}{4}$ in wide. Number of planks in 300 yards is 10800 in. ÷$12\frac{1}{4}$ in.=$881\frac{31}{49}$. Number of ft. is $881\frac{31}{49} \times 6=5289\frac{34}{49}$ sq. ft.

7. \$47.25. 8. \$42 worth=1400 stamps.

9. Cubic contents of block=24 cubic ft. Expansion of water is $\frac{1}{10}$ of bulk of water ∴ 24 cubic ft. ice=$\frac{10}{11}$ of 24 cubic ft. water=$21\frac{9}{11}$ cubic ft.

10. Cost of flour without making is $\$5.62\frac{1}{2}$ per bbl. when wheat is \$1.25 ∴ when wheat is 90c. it should cost $\frac{90}{125}$ of $\$5.62\frac{1}{2}=\$4.05$. Cost, including making$=\$4.42\frac{1}{2}$ per bbl.

LXXXI.

1. Length of A's step=32 in. Length of B's step= 22 in.

2. First consider A and B. A goes 4 miles to B's 5 ∴ A will have gone 4 times when B has gone 5 times round the island, but A requires $10\frac{1}{2}$ days to go round the island ∴ A and B are together at the end of 42 days. Next consider A and C. A goes 2 miles to C's 3, or twice round to C's three times ∴ A and C are together at the end of 21 days. A, B and C are together at the end of 42 days.

3. Man's wages=\$60. Number bushels=75 ∴ price per bushel=80 cents.

4. Cost of a horse=\$90.90. Gain on each=\$120−\$90.90=\$29.10 ∴ number of horses$=\frac{\$349.20}{\$29.10}=12$.

5. \$64.

6. Bought 1298 quarts for \$51.92, or 4 cents a quart. Sold 404 quarts for \$20.20, or 5 cents a quart ∴ his gain is 1 cent a quart, or 32 cents a bushel.

7. \$6400. 8. $16\times10\times9=1440$.

9. For "lb." in this question read "bbl." \$1568 − \$224=\$1344=cost of $\frac{4}{5}$ remainder ∴ remainder cost \$1680 ∴ 20 bbls. cost \$120, or \$6 per bbl. ∴ number of bbls. is 300.

10. \$78.21.

LXXXII.

1. Consider 24 miles (a multiple of 8 and 3); this would take him 3 hours going and 8 hours coming back, or 11 hours altogether; but as $5\frac{1}{2}$ hours is all the time he has, he can go 12 miles only.

2. If 2 hens and 3 ducks cost \$1.15, then 8 hens and 12 ducks cost \$4.60, but 8 hens and 5 ducks cost \$2.85 ∴ 7 ducks cost \$1.75, and 1 duck cost 25c. ∴ 1 hen cost 20c.

3. \$19.20.

4. The buggy cost $\frac{2}{3}$ of his money, the harness $\frac{4}{15}$, and had $\frac{1}{15}$ or \$15 left ∴ his money = \$225 ; buggy cost \$150, and harness \$60 ∴ required answer is \$90.

5. Interest for the required time = \$45.09 ; interest for a year = \$20.04 ∴ the required time = \$45.09 ÷ \$20.04 = $2\frac{1}{4}$ years nearly.

6. A does $\frac{2}{5}$ in 4 days, and therefore the whole work in 10 days. A works $5\frac{2}{3}$ days, thus doing $\frac{17}{30}$, leaving $\frac{13}{30}$ for B, which he does in $1\frac{2}{3}$ days ∴ B can do the work in $3\frac{11}{13}$ days.

7. Half an acre = 80 rods ∴ width of lot = 5 rods ∴ distance round the lot is 231 yards = length of inner edge of path ; length of outer edge of path = 247 yards ∴ average length of path = half the sum of these = 239 yards ∴ area of path = 239 × 2 = 478.

8. 1 per cent. on \$300 for 2 years = \$6, leaving \$130 as the interest on both sums at the lower rate ; at 1 per cent. the interest on these will be \$20 ∴ the required rate is \$130 ÷ \$20 = $6\frac{1}{2}$, and the higher rate, $7\frac{1}{2}$ per cent.

9. Withdrawing $\frac{1}{3}$ the mixture does not change the ratio of wine to water, so that the wine is still $\frac{10}{13}$ of the whole, or the water is $\frac{3}{10}$ of the wine. After 8 gals. water are added the water is $\frac{1}{2}$ the wine, so that the water added increases the water from $\frac{3}{10}$ to $\frac{5}{10}$ of the wine, and must, therefore, be = $\frac{2}{10}$ of the wine ∴ $\frac{2}{10}$ wine = 8 gals., or the wine = 40 gals ∴ wine at first = 60 gals., and water = 18 gals.

10. 100 ft. wide and 435·6 ft. or 26·4 rods long make an acre ∴ number of acres = $\frac{400}{26 \cdot 4} = 15 \cdot 185$ nearly.

LXXXIII.

1. One-twelfth to A for management leaves \$3300 to be divided as \$15,000 is to \$18,000, or \$1500 to A and \$1800 to B ∴ A's complete share is \$1800.

2. 3 hours lost in time = 90 miles lost in distance ; then if 10 miles are lost in going 20 miles, 90 miles will be lost in going 180 miles.

3. In 72 days A and B can do the work 12 times ; B and C, 9 times, and C and A, 8 times ∴ the three will do the work 29 times in 144 days, or once $4\frac{28}{29}$ days.

4. B's share is $160 more than A's, and C's $210 more than A's, so that if $160 and $210 be both taken from $760, what is left will be three times A's share ∴ A's share is $130, B's, $290, and C's, $340.

5. Cost of house = $\frac{14}{15}$ of whole cost = £616 14s. 7d. = £$616\frac{35}{48}$ = $\$\frac{73}{15}$ of $616\frac{35}{48}$ = $3001.41.

6. Number of steps, 21 ; 17 in. of carpet for each step ; cost = $6.20 nearly.

7. Length of carpet = 357 inches ∴ number of surface yards = $\frac{357 \times 22}{36 \times 36}$ = 6 yds., 78 in.

8. The 16 in. = 5×3 in. $+ 4 \times \frac{1}{4}$ in ; the $22\frac{1}{2}$ in. = 7×3 in. $+ 6 \times \frac{1}{4}$ in. ; the 23 ft. = 85×3 in. $+ 84 \times \frac{1}{4}$ in. ∴ number of cubes = $85 \times 7 \times 5 = 2975$.

9. Every $3\frac{1}{4}$ in. in length gives 35 cubes ∴ the number of such lengths = $\frac{7000}{35} = 200$, and $200 \times 3\frac{1}{4} = 650$ ∴ required length = $650 - \frac{1}{4} = 54$ ft. $1\frac{3}{4}$ in.

10. $39{\cdot}37079 \times 4 \times 10000000 = 1574831600$ in. = 24855·296 miles.

LXXXIV.

1. 1 egg = 3 oz. beef ; 4 doz. eggs = 9 lbs. beef ; but 4 doz. eggs cost 80 cents, and 9 lbs. beef cost 99 cents.

2. Each tree has 16 sq. yards of ground ∴ the number of trees = $\frac{10 \times 4840}{16} = 3025$. Cost = $399.30.

3. Average cost per basket = 60 cents ; commission on 60 cents = $1\frac{1}{2}$ cents. Number of baskets = $\frac{\$12}{1\frac{1}{2}\text{c.}} = 800$.

4.
$$\begin{array}{r} 81^\circ\ 15' \\ 63^\circ\ 36' \\ \hline 15)\overline{17^\circ\ 39'} \\ \hline 1^\circ\ 10'\ 36'' \end{array} = 1 \text{ hr. } 10 \text{ min. } 36 \text{ sec.}$$

5. $\dfrac{10{,}000 \times 128 \times 1728 \times 55}{50 \times 36} = 67{,}584{,}000$ boxes.

6. $\dfrac{1847 \times 60}{100} \times 13 = \$144.06\frac{3}{5}$.

7. $\dfrac{360 \times 60 \times 10}{60 \times 24} = 150$ days.

8. $\frac{2}{5}$ of $\frac{625}{1000}$ of $\$6000 = \$1500$.

9. $\dfrac{1260}{196} \times \$5.25 = \$33.75 =$ value of the flour, and the note will amount to $\$31.20$ ∴ wagon cost $\$64.95$.

10. Each shingle covers 18 sq. in., or 8 shingles will cover a foot, and there are 1080 sq. ft. to cover ∴ number of shingles $= 8{,}640$ ∴ cost $= \$19.44$.

LXXXV.

1. Out of every 40 bush. (40 is taken because $\frac{3}{8}$ and $\frac{2}{5}$ of it are both whole numbers) there are 15 wheat, 16 oats, 9 peas, and the cost of these is $\$24.50$ ∴ number of bush. $= \dfrac{\$73.50}{\$24.50} \times 40 = 120$.

2. $\dfrac{54 \times 40 \times 56}{277 \cdot 274} \times \frac{1}{8} =$ answer.

3. Each plant has $3\frac{1}{2} \times 1\frac{1}{2} = 5\frac{1}{4}$ sq. ft of ground ∴ the number of plants $= \dfrac{4840 \times 9}{5\frac{1}{4}}$

4. The Canadian oil lasts $\frac{3}{4}$ as long as the American, but does not cost $\frac{3}{4}$ as much, and is therefore cheaper.

5. 2 miles by rail will require $4\frac{1}{5}$ minutes, and 1 mile by stage, 10 minutes $\therefore$ 3 miles so travelled will take $14\frac{1}{5}$ minutes $\therefore \frac{2 \text{ hrs. } 42 \text{ min.}}{14\frac{1}{5} \text{ min.}} \times 3 =$ required distance $= 45$ miles.

6. $2.80 nearly.

7 Each load of gravel makes $13\frac{1}{2}$ ft. of road $\therefore$ 6 loads make 81 ft., at a cost of $2.25, or $45\frac{5}{6}$ cents a rod.

8. $80 \times \frac{120}{100} \times \frac{100}{90} = \$1.06\frac{2}{3}$.

9. $4840 \times 9 \times \frac{1}{2} \times \frac{7}{6} =$ number of cubic ft. $= 18150 \therefore$ weight $= 508\frac{1}{5}$ tons.

10. The son does $\frac{2}{3}$ as much as the father, and therefore earns 50 cents a day or $3 a week.

LXXXVI.

1. Expenses $= \frac{1}{6} + \frac{1}{15} + \frac{1}{12} + \frac{1}{20} = \frac{11}{30} \therefore$ profit $= \frac{19}{30} = \$63\frac{1}{3}$ on every $100 worth sold.

2. Area of two sides $= 2 \times 60 \times 18 = 2160$; average height of end $= \frac{1}{2}(30 + 18) = 24 \therefore$ area of ends $= 2 \times 32 \times 24 = 1536$. From eave to ridge of roof $= 20$ ft. $\therefore$ area of whole roof $= 2 \times 60 \times 20 = 2400$; and floor $= 2 \times 60 \times 32 = 3840$. The sum of these results $= 9936$, the numberof feet lumber required.

3. Cost $= \$2.25 \times 24 = \$54$. 2 lbs. $= 11520$ grs. $\therefore$ sold for $115.20 $\therefore$ gain is $61.20 on $54, or $113\frac{1}{3}$ per cent.

4. Find the number which multiplied by itself will give 1296 Answer, 36.

5. The street being 66 ft. or 4 rods wide occupies $\frac{1}{8}$ of the field, leaving $8\frac{3}{4}$ acres $= \frac{70}{8} = 70$ lots. Each lot contains 605 sq. yards and is 77 yards deep, and therefore has a frontage of $7\frac{6}{7}$ yards.

6. Taking 1 bush. of each, we have 62 cents nearly.

7. L. C. M. of 34, 48, 60, 56 $= 28560$ lbs. $= 840$ bush. oats, or $= 595$ bush. barley, or 476 bush. peas. or 510 bush.

rye. 840 bush. oats cost $357 : 595 bush. barley cost $357 : 476 bush. peas cost $357 ; 510 bush. rye cost $357, making 2421 bush. at a cost of $1428, or nearly 59 cents a bush.

8. 1 lb. of oats, barley, peas, or rye, is worth $1\frac{1}{4}$ cents, or 1 cwt. worth $1.25 ; but toll leaves 90 lbs. at a cost of $1.25, or nearly $1.39 per cwt.

9. 1 ton lasts 40 hours and costs $6.50 ∴ cost per hour is $16\frac{1}{4}$ cents.

10. $\$6.50 \times 6 \times \frac{60}{70} = \$33.43$.

LXXXVII.

1. Return fare = 5 cents a mile ∴ $\$1.80 \div 5c. = 36$ miles.

2. 10 sq. yards of paper will make 540 leaves, each 6 in. by 4 in. Divide 540 by 450 for thickness in inches. Answer, $1\frac{1}{5}$ in.

3. $\$4.86\frac{2}{3} = £1$. $\$1095 = £225$, and $\frac{1}{2}(500 - 225) = 137\frac{1}{2}$.

4. A gains $\frac{1}{2}$ yard in 8 yards, and gains $27\frac{1}{2}$ yards in 440 yards ∴ B requires $27\frac{1}{2}$ yards start.

5. Hay brings $14.70 : wheat, 25 bush., brings $[illegible]0. Interest on $44.70 for $7\frac{1}{2}$ months at 8 per cent. = $\$2.23\frac{1}{2}$ ∴ amount = $\$46.93\frac{1}{2}$.

6. The 75 lbs. are worth $45 ; the 40 lbs. are worth $22.40 ∴ 35 lbs. are worth $22.60, which is $64\frac{4}{7}$ cents a lb.

7. In 10 min. the machine goes 440 yards and $\frac{1}{8}$ acre = 605 sq. yards ∴ required width is $\frac{605}{440}$ yards $= 4\frac{1}{8}$ ft.

8. The sides are 220, 132, and 124, and H. C. F. of these is 4 ∴ boards are 4 yards long, and number to go once round is 119.

9. 5 francs $= 92\frac{1}{2}$ cents ∴ 1 franc $= 18\frac{1}{2}$ cents. £1 $= \$4.86\frac{2}{3}$

1 shilling $= 24\frac{1}{3}$ cents ∴ 1 franc $= \frac{18\frac{1}{2}}{24\frac{1}{3}}$ sh. $= \frac{111}{146}$.

10. Interest on 1st = \$18 ∴ John gets \$18 on \$200, or \$9 on each \$100, or 9 per cent.

LXXXVIII.

1. The man earns \$2.50 a day. The boy in 12 days does what would take the man 3 days ∴ he earns $\frac{1}{4}$ as much as the man, or \$2.50 in 4 days, or \$10 in 16 days.

2. It ticks 3 times in 2 seconds, or 720 times in 480 seconds = 8 minutes. In 8 minutes the minute-hand makes $\frac{8}{60}$ of the circuit, or goes 4 inches.

3. \$23.10 ÷ $3\frac{1}{2}$c. = 660 = number yards round the field ∴ one side is 165 yards ∴ area is $165 \times 165 \div 4840 = 5\frac{5}{8}$ acres.

4. $\frac{3}{5}$ chain = $\frac{1}{4}$ watch ; chain = $\frac{3}{8}$ watch ∴ \$50 = $\frac{5}{8}$ watch ; \$80 = watch ; \$30 = chain.

5. He now saves 70 per cent. ; by spending half as much he would save 85 per cent. If 70 per cent. = \$1330, 1 per cent. = \$19 : 85 per cent. = \$1615.

6. $\frac{13}{12}$ cloth is worth \$65 ∴ cloth is worth \$60 ∴ there are 48 yards.

7. 315.

8. $\cdot 379 = \cdot 379\dot{9}$. $\cdot 379\dot{9} - \cdot 069\dot{0} = \cdot 310\dot{9} = \frac{171}{550}$. $\frac{171}{550}$ of farm = 61·56 acres ∴ farm = 198 acres.

9. He earns \$140 a month ; he spends \$98 a month ; he saves \$42 a month, or \$504 a year.

10. Interest on \$1460 is \$146 per annum, or 40 cents a day ∴ number days = \$16 ÷ 40c. = 40 ∴ money was paid 13th August.

LXXXIX.

1. $\frac{5}{8} - \frac{1}{3} = \frac{7}{24} = 70$ acres ∴ farm = 240 acres.

2. $\frac{4}{7} - \frac{4}{9} = \frac{8}{63}$, which = \$8 ∴ oats sold for \$63, or $37\frac{1}{2}$c. a bushel.

3. $\frac{1}{3}$ boys = $\frac{1}{5}$ class ∴ boys = $\frac{3}{5}$ class ∴ girls = $\frac{2}{5}$ class ∴ $40 = \frac{2}{5}$ class ∴ $60 = \frac{3}{5}$ class = number boys.

4. He had at first 120 acres, then 175 acres $\therefore$ bought 55 acres.

5. $\$57.20 \times \frac{10}{11} = \$52 =$ cost of what was sold $\therefore$ $\$72 - \$52 =$ cost of 25 yards, or 80 cents a yard.

6. $84 \times 12 \times 14 = 14112$ cubic in. $= 8\frac{1}{6}$ cubic ft. in 1 sec. $= 352{,}800$ cubic ft. in 12 hours.

7. Divide the previous result by $15 \times 20 \times 30$, and we have $39\frac{1}{5}$ times.

8. $4840 \times 9 \times 144 \times 2\frac{1}{2} =$ number of cubic in. of ice; this multiplied by $\frac{10}{11}$ will give the number of cubic in. of water or cubic ft. of steam; then divide by 27 to get the cubic yards of steam. The result is 528,000.

9. Number lines $= 27 \times 9 \times 12 = 2916$; and $\frac{3}{5}$ of 8c. is the profit on each line; hence the total profit is $\$139.96\frac{4}{5}$.

10. $363 \times \frac{5}{2} \times \frac{3}{4} \times \frac{1}{66} \times 5760 \div \frac{1}{2}$ of $\frac{9}{10}$ of $412\frac{1}{2} = 320$.

XC.

1. $\$9000 \times \frac{125}{100} \times \frac{9}{10} =$ price asked $= \$12{,}500$.

2. A 10 acre field contains 1600 rods, and since this field is square, each side will be 40 rods, making 320 rods of fence at \$4.50, or \$1440 for the fence.

3. $22 \times 18 \times 7 \times 1728 =$ number of cubic inches; this result divided by 277·2 will give the number of gals., and 10 times that the number of lbs., or 172,800.

4. The farm consists of 12 square 10-acre lots, 3 in width and 4 in length, and as the side of a square 10-acre lot is 40 rods or 220 yards, the length of the field must be $220 \times 4 = 880$ yards.

5. 90 half-inches, or $1\frac{1}{4}$ yards.

6. 208,920 = distance in ft., and in 1 minute they march 290 ft. $\therefore$ $\frac{208920}{290} =$ number of minutes $= 12$ hrs., $\frac{12}{29}$ min.

7. 2218·192 cubic in. in a bush. $\therefore$ 221819·2 cubic in. in 100 bush. The bin contains 216000 cubic in., and therefore does not contain 100 bush. by 5819·2 cubic in.

8. $\frac{2}{1000}$ of $\frac{3}{4}$ of \$10,000=\$15.

9. 90 articles would cost 81 cents and would sell for \$1, a gain of 19 cents on 81 cents, or $23\frac{7}{81}$ per cent. He gains 19 cents on $7\frac{1}{2}$ dozen ∴ \$19 on 750 dozen.

10. Goods which cost manufacturer 100% are sold to merchant at 150%, but only $112\frac{1}{2}$% is received for them ∴ there is a gain of $12\frac{1}{2}$%.

XCI.

1. 1 cwt., 3 qrs., 17 lbs. avoirdupois.

2. Amount of water in well at 6 a.m. Tuesday=360 gals. Number of hours from 6 a.m. Tuesday to time well is emptied=198 hours. Amount flows in=30 gals. × 198 =5940 gals. Amount emptied by pump=5940 gals. + 360 gals.=6300 gals. Pump works 10 hours a day for 5 days and 4 hours=54 hours. Number of gals. emptied per hour=6300 ÷ 54=$116\frac{2}{3}$ gals.

3. 1430 feet.

4. Water expands in freezing $\frac{1}{10}$ of bulk ∴ 1 cubic ft. water makes $1\frac{1}{10}$ cubic ft. ice ∴ water=$\frac{10}{11}$ of 143 cubic ft. =130 cubic ft. Weight=130 × $62\frac{1}{2}$=8125 lbs.

5. \$250.

6. A makes $\frac{1}{5}$ of sales ∴ cost is $\frac{4}{5}$ of sales. Gain is $\frac{1}{5}$ on $\frac{4}{5}=\frac{1}{4}$ of cost. Difference in profit=$\frac{1}{4}$ of cost−$\frac{1}{5}$ of cost= $\frac{1}{20}$ of cost ∴ $\frac{1}{20}$ of cost=6c. Cost=\$1.20 per yard.

7. Selling price per false yard is $\frac{5}{4}$ of \$1.68=\$2.10 per yard. Sells $34\frac{4}{11}$ in. for \$2.10 ∴ sells 36 in. for $\frac{210 \times 36}{34\frac{4}{11}}=$ \$2.20. Gain on \$1.68 is 52c. ∴ gain per cent. is $\frac{52 \times 100}{168}$ $=30\frac{20}{21}$ per cent.

8. As $\frac{1}{10}$ is lost in matching, we have but $\frac{9}{10}$ left ∴ require $\frac{10}{9}$ of 60 yards=$66\frac{2}{3}$ yards. Again $\frac{1}{7}$ overlaps, leaving but $\frac{6}{7}$ of width available ∴ $\frac{7}{6}$ of amount is required =$\frac{7}{6}$ of $66\frac{2}{3}$ yards=$77\frac{7}{9}$ yards.

9. The hands will be 5 minute-spaces apart in 1 hour *i. e.*, one will be 5 minute-spaces ahead of the other in 1 hour. ∴ 60 minute-spaces ahead in 12 hours. They will be together again in 12 hours. One will have gained in 12 hours $3\frac{1}{3}$ min. $\times 12 = 40$ min. Time is, therefor 12 40′ o'clock.

10. Receives as 1 yard $\frac{17}{16}$ of yard. Sells $\frac{15}{16}$ of yard as 1 yard. ∴ $\frac{17}{16}$ of yard as $\frac{17}{16}$ of $\frac{16}{15} = \frac{17}{15}$ yard. Receives for 1 yard $\frac{6}{5}$ of cost of yard. ∴ receives for $\frac{17}{15}$ yard $\frac{17}{15}$ of $\frac{6}{5}$ of cost of yard $= \frac{34}{25}$ of cost $= 136$ per cent. of cost. ∴ gain is 36 per cent.

XCII.

1. Length of field, 80 rods ; width, 20 rods. 9 rounds will cut a strip $5\frac{1}{2} \times 9 = 49\frac{1}{2}$ ft. wide along each side and each end. ∴ length of part still standing $= 80$ rods $- 99$ ft. Width, 20 rods $- 99$ ft. Length is 74 rods ; width, 14 rods. Number of acres $= 6\frac{19}{160}$ acres.

2. $\frac{5}{160}$ of inmates in $1883 = 140$. ∴ inmates $= 2800$. Increase and decrease are $\frac{1}{4}$ and $\frac{1}{16}$; average increase $= \frac{1}{20}$. ∴ proportions are 15 males to 20 females. $\frac{15}{35}$ of $2800 =$ 1200 males. $\frac{20}{35}$ of $2800 = 1600$ females.

3. By laying out the rectangle, it will be seen that the difference between areas of sidewalks is equal to 8 corners each in form of a square. 160 ft. of lumber cover 8 squares, but 160 ft. $1\frac{1}{4}$ in. lumber cover only 128 sq. ft., therefore each square is 16 sq. ft., and side is 4 ft., which is width of walk.

4. Received for 175 yards @ \$1.50 = \$262.50. Value of 175 yards @ \$1.20 = \$210. \$210 + loss = cost price. Add to this twice the loss and \$10.50, we have selling price = \$262.50. ∴ difference = \$52.50 = three times the loss and \$10.50, that is, three times loss is \$42. Loss is \$14. Gain by selling for \$262.50 is \$38.50. ∴ cost is \$262.50 − \$38.50 = \$224. Cost per yard is \$1.28.

5. It is evident there is more clay than sand. A digs in 17 days 51 rods of clay. B digs 69 rods in 17 days = $4\frac{1}{17}$ rods per day. B digs 5 of sand or 2 of clay per day

$\therefore$ 69 rods must be divided in proportions 16 of clay to 35 of sand. Amount of clay in 69 rods $=\frac{16}{51}$ of $69=21\frac{11}{17}$ rods $\therefore$ clay is $51+21\frac{11}{17}=72\frac{11}{17}$ rods. Sand $=120-72\frac{11}{17}=47\frac{6}{17}$ rods.

6. If gain be 20%, cost is $\$2.08\frac{1}{3}$ per gal. Proportions are $8\frac{1}{3}$ to $91\frac{2}{3}=1$ to $11\therefore$ 110 gals. of \$2 wine will be required.

7. In 60 min. stream would carry him $\frac{1}{2}$ mile. In 64 min. stream would carry him $\frac{64}{60}$ of $\frac{1}{2}$ mile $=\frac{8}{15}$ mile. In going down, he rows a certain distance and stream carries him $\frac{1}{2}$ mile. In coming back, he rows the same distance, the $\frac{1}{2}$ mile the stream carried him down and the $\frac{8}{15}$ mile the stream retarded him, in all $\frac{1}{2}+\frac{8}{15}$ miles more than going down. Rows in 4 min. $\frac{31}{15}$ miles $\therefore$ rows in 1 hour $15\frac{1}{2}$ miles. Length of course is $15\frac{1}{2}+\frac{1}{2}=16$ miles.

8. If B had borrowed no seed he would have drawn away 150 bush. $\frac{2}{3}$ of crop is 150 bush $\therefore$ crop is 225 bush. A is entitled to $\frac{1}{3}$ of 225 bush. $=75$ bush. and to the 30 bush. lent, in all 105 bush.

9. 5 men and 3 boys complete $\frac{1}{15}$ of work in 1 day. 12 men and 6 boys complete $\frac{1}{6}$ of work in 1 day. Multiply 1st by 12 and 2nd by $5\therefore$ 60 men and 36 boys complete $\frac{12}{15}$ of work in 1 day. 60 men and 30 boys complete $\frac{5}{6}$ of work in 1 day. Subtract, and 6 boys do $\frac{12}{15}-\frac{5}{6}=\frac{1}{30}$ in 1 day $\therefore$ the boys are a hindrance.

10. B gains on A 5 miles per hour $\therefore$ gains 1 round in $\frac{73}{5}$ hours. C gains on B 5 miles per hour $\therefore$ gains 1 round in $\frac{73}{5}$ hours. A, B and C will be together every $\frac{73}{5}$ hours $=14\frac{3}{5}$ hours. Will be together at point of starting in L. C. M. of $\frac{73}{7}$, $\frac{73}{12}$ and $\frac{73}{17}=73$ hours.

XCIII.

1. $\frac{5}{9}$ of cask is wine, $\frac{4}{9}$ is water, difference $\frac{1}{9}\therefore 4\frac{4}{5}$ gals. is difference in $43\frac{1}{5}$ gals. Amount of wine drawn off is $\frac{5}{9}$ of $43\frac{1}{5}$ gals. $=24$ gals $\therefore$ amount of wine still in $120-24=96$ gals.

2. $3\frac{3}{4}$ minute-spaces.

3. A runs 8 yards while B runs 7 yards. ∴ A runs 1760 yards while B runs 1540 yards. A can give B a start of 1760 yards − 44 yards − 1540 yards = 176 yards.

4. Interest for 5 months at $3\frac{2}{3}$ per cent. is $\frac{5}{12}$ of $\frac{1}{15}$ of sum $= \frac{1}{36}$ of sum. Interest on sum for $4\frac{3}{4}$ months at $7\frac{1}{2}$ per cent. is $\frac{19}{48}$ of $\frac{15}{200}$ of sum $= \frac{19}{640}$ of sum. Difference $= \frac{1}{36} - \frac{19}{640} = \frac{11}{5760}$ of sum ∴ sum is $\frac{5760}{11} \times \frac{17}{8} = \$1112\frac{8}{11}$.

5. A can do $\frac{2}{15}$ of work in 1 day. B can do $\frac{4}{15}$ in 1 day ∴ both can do $\frac{6}{15}$ of work in 1 day. In $1\frac{1}{3}$ days can do $\frac{4}{3}$ of $\frac{6}{15} = \frac{8}{15}$ of work.

6. 110.

7. Interest on \$80 for 8 months is $3\frac{1}{3}$ per cent. ∴ interest for 1 year is $\frac{12}{8}$ of $3\frac{1}{3}$ per cent. $= 5$ per cent.

8. Cost of wheat is $\$1.08 \times 240 = \$259.20$. Receives for 80 bush. at $\$1.12\frac{1}{2}$, \$90; for 96 bush. at \$1.20, \$115.20. Receives for remainder, 64 bush., \$259.20 + \$12.80 − (\$90 + \$115.20) = \$66.80 ∴ receives for 1 bush., $\$1.04\frac{3}{8}$.

9. 1 man can do $\frac{1}{240}$ of work in 1 day ∴ 16 men do $\frac{16 \times 13\frac{1}{2}}{240}$ in $13\frac{1}{2}$ days $= \frac{216}{240}$ of work. The 4 men do remainder $\frac{24}{240}$ of work. They can do $\frac{4}{240}$ in 1 day ∴ they do $\frac{24}{240}$ in 6 days.

10. Worked 6 hrs. 15 min. = 375 min. Made 5 articles in 12 min. ∴ made $\frac{5}{12}$ of 375 articles $= 156\frac{1}{4}$ articles. Receives for them $\frac{10}{12}$c. each. $\frac{10}{12}$ of $156\frac{1}{4} = \$1.30\frac{5}{24}$.

XCIV.

1. 2 sq. yards. 122 sq. in.

2. In 70 ft. driving wheels make 5 revolutions and front wheels 7 revolutions ∴ front wheels make 2 revolutions more in 70 ft.; 88 ft. more in 3080 ft. Train goes 3080 ft. per min. = 35 miles per hour.

3. Cost of land, $\$75 \times 150 = \$11250$. Sold for \$12250. Receives for 2 acres, 3 roods, 20 poles, at \$80 per acre,

$230, and for lot 25 by 20, $250. Receives for remaining 144 acres, $12250 − ($230 + $250) = $11770 ; for 1 acre, 81.73\frac{11}{18}$.

4. Walks 16 miles at $3\frac{1}{2}$ miles per hour, *i. e.*, in $4\frac{4}{7}$ hours. Walks 16 miles at $4\frac{1}{2}$ miles per hour, *i. e.*, in $3\frac{5}{9}$ hours ∴ walks whole distance in $8\frac{8}{63}$ hours ; is therefore $\frac{8}{63}$ hours late.

5. Earned in 5 months $\frac{5}{12}$ of $215 and $\frac{5}{12}$ of watch = 89\frac{7}{12}$ and $\frac{5}{12}$ of watch. Receives watch and $75 ∴ $\frac{7}{12}$ of watch is worth 89\frac{7}{12}$ − $75 = 14\frac{7}{12}$ ∴ watch is worth $25.

6. Cubic contents of earth of cellar is $30 \times 20 \times 6 = 3600$ cubic ft. Depth on field is $3600 \div \frac{1}{11}$ acre $= \frac{10}{11}$ ft.

7. Cost of sugar = $125. Sells it for 167\frac{3}{11}$. Sells $\frac{1}{3}$ of 2000 lbs. = $666\frac{2}{3}$ lbs. at 11 lbs. for $1, which gives 60\frac{2}{33}$ ∴ receives for remaining $1333\frac{1}{3}$ lbs., 106\frac{2}{33}$ = 8c. per lb. ∴ gives $12\frac{1}{2}$ lbs. for $1.

8. Dick has 75 ; Harry, 100.

9. Length of sides and ends of box = 10 ft. 10 in. + 10 ft. 10 in. + 18 in. + 18 in. = $24\frac{2}{3}$ ft. Cubic contents = $24\frac{2}{3} \times \frac{3}{2} \times \frac{1}{6} = 6\frac{1}{6}$ cubic ft. Cubic contents of bottom is $10\frac{5}{6}$ ft. × $\frac{22}{12} \times \frac{1}{6} = 3_{2}^{67}{}_{16}$. Number of cubic ft. in box is $6\frac{1}{6} + 3_{2}^{67}{}_{16} = 9\frac{10}{2}\frac{3}{16}$ cubic ft.

10. 6 sq. in. in surface of each block ∴ number of sq. yards $= \frac{1728 \times 6}{144 \times 9} = 8$ sq. yards. Number of edges in each is 12 ∴ number of yards is $\frac{12 \times 1728}{12 \times 3} = 576$ yards.

XCV.

1. 10 suits ; 72·5 yards.

2. 227272 miles, 5 fur., 32 per., 4 yds. 18 years, 47 days, $8\frac{6}{11}$ hours.

3. Value of each kind is $12.50 ∴ there are 25 half-dollar coins, 50 quarter-dollar coins, 125 ten-cent coins, and 250 five-cent coins ; in all, 450 coins.

4. Weight of gold $= \frac{250 \text{ grs.} \times 200000000}{10} = 5000000000$ grs. Number of tons $= \frac{5000000000}{7000 \times 2000} = 357\frac{1}{7}$ tons.

5. Proportions are 3, 2, 1. Value of wheat $\frac{3}{6}$ of \$2280 = \$1140. Number of bush. = \$1140 ÷ 95c. = 1200 bush. Value of barley = $\frac{2}{6}$ of \$2280 = \$760. Number of bush. = \$760 ÷ 60c. = $1266\frac{2}{3}$ bush. Value of oats = $\frac{1}{6}$ of \$2280 = \$380. Number of bush. = \$380 ÷ 40c. = 950 bush.

6. 5 sq. ft., 29 sq. in.

7. 30 lbs. flour are worth $37\frac{1}{2}$c. $\times 2\frac{2}{3} =$ \$1.00. 196 lbs. flour are worth $\frac{\$1.00}{30} \times 196 = \$6.53\frac{1}{3}$. ∴ 100 lbs. beef are worth $\frac{6}{7}$ of $\$6.53\frac{1}{3} = \$5.60$, and 775 lbs. are worth $\frac{\$5.60}{100} \times 775 = \$43.40$.

8. Number of cars $= \frac{5000000 \times 2\frac{1}{2}}{2000 \times 20} = 312\frac{1}{2}$ cars. Length of train $= \frac{625 \times 30}{2} = 9375$ ft. Number of engines required to draw it $= \frac{312\frac{1}{2} \times 20}{200} = 31\frac{1}{4}$, *i. e.*, 32.

9. $\frac{2}{4}$ of whole + \$250 + $\frac{3}{5}$ of whole − \$500 + $\frac{6}{35}$ of whole − \$150 = whole property. $\frac{37}{35}$ of whole − \$400 = whole. ∴ $\frac{2}{35}$ of whole property is \$400. Whole investments is \$7000. Cash, \$2250. Stock, \$3700. Notes, \$1050.

10. Length of side of square field is 40 rods = 220 yards. Length of streets = 220 + 220 + 180 + 180 = 800 yards. Area = 800 × 20 = 16000 sq. yards. Cost at 75c. per yard = \$12000. Area of whole piece = 10 acres = 48400 sq. yards. Area of 9 squares = 48400 sq. yards − 16000 sq. yards = 32400 square yards. Area of 1 square = 32400 ÷ 9 = 3600 sq. yards. ∴ length of side = 60 yards. Length of four sides = 240 yards. Cost of fencing 9 squares = $\frac{240 \times 40}{5}$ ×

$\frac{9}{1}$=\$157.09$\frac{1}{11}$. Value of each square=$\frac{3}{4840} \times 15$=\$111$\frac{69}{121}$.

XCVI.

1. He receives only 14 oz. in the lb ; is therefore cheated out of 2 oz. in 16, *i. e.*, $\frac{1}{8}$ of goods $\frac{1}{8}$ of money =1$\frac{9}{16}$c. in the $12\frac{1}{2}$ or $12\frac{1}{2}$%.

2. Proportions are 6, 4, 2. Men get 60, while women get 48 and children get 40. Each man gets $\frac{6}{148}$ of \$740 =\$30 ; each woman, $\frac{4}{148}$ of \$740=\$20 ; each child, $\frac{2}{148}$ of \$740=\$10.

3. Solid contents of pile is $\frac{2}{3}$ of 43560×6 cubic ft.= 174240 cubic ft. Number of cords=$174240 \div 128$=$1361\frac{1}{4}$ cords.

4. 585540 min.

5. 3 r., 39 po., 29 sq. yds., 6 sq. ft., 108 sq. in.

6. Weight of butter=$\frac{15}{16}$ of 12 lbs.=$11\frac{1}{4}$ lbs. Received for it value of tea=\$1.50+30c.=\$1.80. Value of butter per lb.=$\$1.80 \div 11\frac{1}{4}$=16c. per lb.

7. Cost of 10 lbs. tea=cost of 10 lbs. coffee and \$4. ∴ cost of 22 lbs. of coffee=\$8.40 – \$4=\$4.40. Cost of coffee per lb.=20c. ; tea=60c.

8. Length of sides of box=$6+6+4\frac{3}{4}+4\frac{3}{4}$=$21\frac{1}{2}$ ft. Area of sides=$21\frac{1}{2} \times 4\frac{1}{2}$=$96\frac{3}{4}$ sq. ft. Area of bottom and top= $6 \times \frac{19}{4} \times \frac{2}{1}$=57 sq. ft. Total surface=$153\frac{3}{4}$ sq. ft. Cost= $153\frac{3}{4} \times \frac{10}{9}$=\$1.70$\frac{5}{6}$.

9. $\frac{1}{2}$ lb. avoirdupois=3500 grs.=$3500 \div 480$ ozs. Troy. Value is $\frac{3569}{480}$ of £3 17s. 9d.=£28 6s. $11\frac{1}{8}$d.

10. Interest on \$100 for 1 year at 5 per cent. is \$5. Interest on \$100 for $\frac{6}{5}$ year or 438 days is \$6. Interest on \$2400 for $\frac{6}{5}$ year at 5 per cent. is \$144.

XCVII.

1. 4 men do as much as 8 women ; 10 boys do as much as 5 women ∴ 4 men, 6 women and 10 boys do as much

as 19 women. 10 men do as much as 20 women. 22 women can do the work in 4 days ∴ 19 women do it in $\frac{22}{19}$ of $4 = \frac{88}{19}$ days $= 4\frac{12}{19}$ days.

2. Area of leaf $= 36 \times 24 = 864$ sq. in. Thickness is $1 \div 864 = \frac{1}{864}$ in.

3. Makes 4 cuts to cut log into 5 pieces; 9 cuts to cut into 10 pieces. ∴ should receive $\frac{9}{4}$ of $40 \times 2 \times \frac{10}{9} = \$2$.

4. Number of ft. required $= 660 \times 5\frac{1}{2} = 3630$ ft. Value at \$7.50 per 1000 ft. $= \frac{3630 \times 7.50}{1000} = \$27.22\frac{1}{2}$.

5. Profit $= \frac{1}{5}$ of cost. ∴ cost $= \frac{5}{6}$ of 5c. $= 4\frac{1}{6}$c. per oz. $= 50$c. per lb., apothecaries weight.

6. Loss on sugar $= \frac{3}{40}$ of $\$75 = \$5.62\frac{1}{2}$. Gain on tea $= \frac{16}{100}$ of $\$144 = \$23.04$. ∴ gain is $\$23.04 - \$5.62\frac{1}{2} = \$17.41\frac{1}{2}$.

7. Number of bbls. sold $= \$216 \div 6\frac{3}{4} = 32$ bbls. Cost of these $= \frac{10}{9}$ of $\$216 = \$240$. ∴ cost per bbl. $= \$240 \div 32 = \$7.50$. Total number of bbls. $= \$690 \div \$7.50 = 92$ bbls. Receives for it, $\$690 + \$50 = \$740$. Must receive for remaining 60 bbls., $\$740 - \$216 = \$524$. ∴ receives for 1 bbl., $\$524 \div 60 = \$8.73\frac{1}{3}$.

8. Number of cubic ft. in cistern $= 5 \times 4 \times 6 = 120$ cubic ft. Number of gals. $= \frac{120 \times 1000}{16 \times 10} = 750$ gals. 150 gals. $= 1500$ lbs. $= 24000$ ozs. $= 24$ cubic ft. ∴ depth $= 24 \div 20 = 1$ ft. $2\frac{2}{5}$ in.

9. Cost of mixture $= \$2.80 + \$1.80 = \$4.60$. Gain is $\frac{1}{23}$ of $\$4.60 = 20$c. ∴ sell 7 lbs. for \$4.80, or 1 lb. for $68\frac{4}{7}$c.

10. 6250.

XCVIII.

1. See text-book.

2. (*a*) 15 weeks. (*b*) 9491724 sq. ft.

3. 434453 ft.

4. (*a*) 177 bags : 8 lbs. 12 oz. remaining. (*b*) 60 bags : 1 bush. 7 gals. remaining.

5. Cost of $14\frac{3}{4}$ yards silk at \$2.40=\$35.40. Cost of fur cloak, \$70. Groceries, \$14.60. Total cost=\$120.

6. Mrs. F. L. Woodcamp, bought of Messrs. Anderson & Co :—

Sept.	5	To 3 lbs. 2 oz. tea @ 64c.....	\$2	00
"	"	" 5 lbs. 4 oz. lard @ 12c.....		64
"	19	" 3 qts. syrup @ 60c. per gal.....		45
"	"	" 25 lbs. rice @ \$4.50 per 100....	1	$12\frac{1}{2}$
Oct.	3	" 18 herrings @ 25c. per doz.....		$37\frac{1}{2}$
"	"	" $5\frac{1}{2}$ lbs. sugar @ 11 lbs. per \$1..		50
		.....	\$5	09

7. Number of cords is $\frac{4\times 68\times 7}{128}=14\frac{7}{8}$ cords. 9 cords @ \$4.50=\$40.50. $5\frac{7}{8}$ cords @ \$4.40=\$25.85. Total value, \$66.35.

8. If carpet be placed across room, $31\frac{1}{2}\div 2\frac{1}{4}=14$ strips are needed, each 13 ft. 4 in. long. Number of yards= $\frac{14\times 13\frac{1}{3}}{3}=62\frac{2}{9}$ yards. Cost=$62\frac{2}{9}$ times 85c.=\$52.88$\frac{8}{9}$.

If carpet be placed the other way, 6 strips will be needed.

9. \$71.42$\frac{1}{3}$.

XCIX.

1. See text-book. 2. 2. 3. 1600.

4. Breadth of room is $493\frac{1}{2}\div 31\frac{1}{4}=15$ ft. $9\frac{63}{125}$ in.

5. Increase in two years to $\frac{16}{15}$ of $\frac{16}{15}=\frac{256}{225}$ of population $\therefore\frac{225}{256}$ of 34560=population of two years ago=30375. Population one year hence will be $\frac{16}{15}$ of 34560=36864 $\therefore$ difference is 6489.

6. Length=$4840\times 50\div 220=1100$ yards $\therefore$ perimeter is 2640 yards=$1\frac{1}{2}$ miles. Walk 4 miles per hour $\therefore$ walk $1\frac{1}{2}$ miles in $\frac{3}{8}$ hour=$22\frac{1}{2}$ min.

7. C runs 200 yards while A runs 198 yards. A runs 200 while B runs 197. ∴ A runs 198 while B runs $\frac{197 \times 198}{200}$ $= 195\frac{3}{100}$. C can run 200 while B runs $195\frac{3}{100}$. ∴ C can give B $4\frac{97}{100}$ yards start.

8. 48 boys = 20 men. ∴ 72 boys = $\frac{20 \times 72}{48} = 30$ men. If 30 men can do $\frac{1}{3}$ work in 24 days, the 72 boys could finish it in 48 days.

9. Gain = $\frac{1}{20}$. ∴ $\frac{21}{20}$ of cost = \$133. Cost is $\frac{20}{21}$ of \$133. To gain 25 per cent., should be sold for $\frac{5}{4}$ of $\frac{20}{21}$ of \$133 = \$158$\frac{1}{3}$.

10. $1003\frac{236}{541}\frac{6}{9}$.

11. C, for collecting, receives $1\frac{1}{4}$ per cent. $= \frac{1}{80}$ of \$5680 = \$71. Remainder is \$5609. A receives $\frac{35}{100}$ of \$5609 = \$1963.15. B receives $\frac{28}{100}$ of \$5609 = \$1570.52. C receives $\frac{37}{100}$ of \$5609 = \$2075.33, or in all, \$2075.33 + \$71 = \$2146.33.

12. 1st pipe fills $\frac{1}{6}$ of vessel per minute, 2nd fills $\frac{1}{8}$, 3rd empties $\frac{1}{12}$ of it. ∴ 3 pipes fill $\frac{1}{6} + \frac{1}{8} - \frac{1}{12}$ of it in 1 minute = $\frac{5}{24}$ in 1 minute, or whole vessel in $4\frac{4}{5}$ minutes.

C.

1. 128357. 2. \$312.18+. 3. 37 miles per hour.

4. A gets $\frac{3}{15}$ of \$540 = \$108. B gets $\frac{8}{15}$ of \$540 = \$288. C gets $\frac{4}{15}$ of \$540 = \$144.

5. Gain = \$360 − \$270 = \$90. Gain per bbl. is 75c. Number of bbls. = \$90 ÷ 75c. = 120 bbls. Cost per bbl. = \$270 ÷ 120 = \$2.25.

6. Length of walls = 24 + 24 + 20 + 20 ft. = 88 ft. Area = 88 × 14 sq ft. = 1232 sq. ft. Area of floor = 24 × 20 = 480 sq. ft. Cost of painting = $5\frac{1}{2}$c. × 480 = \$26.40.

7. See Arithmetic. L. C. M. of \$5, \$27, \$105 = \$945.

8. Cost per acre = \$7800 ÷ 120 = \$65. Received for 30 acres at \$75 per acre, \$2250. Received for $\frac{1}{2}$ remainder, 45 acres, at \$50 per acre, \$2250. Total receipts must be \$7800 + \$300 = \$8100. ∴ receipts for the 45 acres still on hand must be \$8100 − \$4500 = \$3600. Selling price per acre = \$3600 ÷ 45 = \$80.

CI.

1. See Arithmetic. 2 $46\frac{14}{18}$ yards.

3. 1 ton, 13 cwt., 2 qrs., 10 lbs. ÷ 96 lbs. = 35 boxes.

4. 108 yards. 5. \$9600. 6. 35, 1916.

7. 2 chickens are worth 60c. ∴ 4 chickens or 3 ducks are worth \$1.20. 10 ducks or 3 geese are worth $\frac{10}{3}$ of \$1.20 = \$4. ∴ 1 goose is worth $\$1.33\frac{1}{3}$.

8. Paid for each horse value of 2 wagons. ∴ \$210 is value of 5 wagons. 1 wagon is worth \$42; 1 horse is worth \$84.

9. $11\frac{11}{40}$, $11\frac{17}{60}$.

10. A and B do $\frac{1}{2} + \frac{1}{3}$ of work = $\frac{5}{6}$ of work. ∴ C does $\frac{1}{6}$ of work.

CII.

DECEMBER, 1881.

1. 351526939.2+. 2. 252. 3. $\$356.30\frac{1}{12}$.

4. Platinum weighs $\frac{19}{111}$ of weight of lead. ∴ weight of platinum will be $\frac{19}{111}$ of 56 lbs. = $103\frac{3}{19}$ lbs.

5. Weight of chain cable = 76 lbs × 200 = 15200 lbs. Value at $15\frac{1}{2}$s. per cwt. = $15\frac{1}{2} \times 152$ = £117 16s. Weight of wire rope = 181 lbs. × 600 = 108600 lbs. Value = 1086 × $23\frac{1}{2}$s. = £1276 1s. Difference, £1276 1s. − £117 16s. = £1158 5s.

6. $\frac{13}{8}$ of cost = \$2.60. ∴ cost = \$1.60. ·7 of cost = $\frac{7}{10}$ of \$1.60 = \$1.12. ∴ to gain ·7, must sell for \$1.60 + \$1.12 = \$2.72.

7. Cubic contents of plate $=66\times36\times\frac{3}{4}$ cubic in.; thickness of sheet is $(66\times36\times\frac{3}{4})\div(54\times72)$ in. $=\frac{11}{24}$ in.

8. Cubic contents of brick $=\frac{3}{4}\times\frac{3}{8}\times\frac{1}{3}=\frac{3}{32}$ cubic ft. Cubic contents of wall $=60\times17\times4$ cubic ft. Number of bricks $=\frac{16}{17}(60\times17\times4)\div(\frac{3}{32})=40960$.

9. $\frac{6}{5}$ of cost $=\$1$. $\therefore$ cost $=81\frac{1}{3}$c., or cost per lb. $=8\frac{1}{3}$c. Selling price $=\frac{100}{9}=11\frac{1}{9}$c. per lb. Gain $=11\frac{1}{9}-8\frac{1}{3}$c. $=2\frac{7}{9}$c. Gain per cent. $=(2\frac{7}{9}\div8\frac{1}{3})\times100=33\frac{1}{3}$ per cent.

JUNE, 1882.

1. G. C. M. is 1.

2. Gain $=9$c. per 100 ft. $\therefore$ gain is $\dfrac{9870\times9\times8}{100}=\$71.06\frac{2}{5}$

3. $\frac{33}{182}$.

4. 5462·9911235. 120020 ounces.

5. In $3\frac{5}{6}$ minutes goes 6072 ft. $\therefore$ goes 1584 ft. per minute, or $1584\times60=95040$ ft. per hour $=18$ miles per hour.

6. Cubic contents of pile of brick is $432\times198\times174$ cubic in. $\therefore$ cubic contents of one brick $=\dfrac{432\times198\times174}{122496}$ cubic in. $=121\frac{1}{2}$ cubic in. Thickness $=121\frac{1}{2}\div(9\times4\frac{1}{2})=3$ in.

7. £1 $=24$ francs, and 6 francs $=\$1.14$. $\therefore$ £1 $=\$1.14\times4=\$4.56$. £250 10s. $=\$4.56\times250\frac{1}{2}=\$1142.28$.

8. $\frac{1}{10}$ of inch represents a mile. $\therefore\frac{1}{2}$ inch represents 5 miles. Township contains 25 sq. miles $=640$ ac. $\times25=16000$ acres.

9. 4 men can do work in 8 days. $\therefore$ 1 man can do $\frac{1}{32}$ in 1 day, and 8 men can do $\frac{8}{32}$ or $\frac{1}{4}$ of work in 1 day. 1 boy can do $\frac{1}{48}$ in 1 day. $\therefore$ 4 boys can do $\frac{1}{12}$ of work in 1 day. 8 men and 4 boys can do $\frac{1}{4}+\frac{1}{12}=\frac{1}{3}$ of work in 1 day, or whole work in 3 days.

10. A's votes were $\frac{23}{48}$ of number polled, and B's $\frac{25}{48}$. $\therefore\frac{1}{24}$ or $\frac{2}{24}$ of votes polled $=100$ votes. Number polled $=2400$ votes. Number who did not vote $=300$.

DECEMBER, 1882.

1. $7485\frac{1440}{1567}$.

2.

36 lbs.	8 oz.	beef @ 16c.	$5.84
16 "	10 "	mutton @ 14c.	$2.32\frac{3}{4}$
6 "	12 "	pork @ 12	93
15 "	6 "	turkey @ 18c.	$2.76\frac{3}{4}$
4 "	10 "	suet @ 16c.	74
			$12.60\frac{1}{2}$

3. 49896 ; 1. 4. $\frac{1}{7}$.

5. ·0625 of 112 lbs. = 7 lbs. ∴ cost = 7 times ·0703125 of 16s. = 7s. $10\frac{1}{2}$d.

6. 7 acres, 1 rood, 6 poles, 21 sq. yds., 7 sq. ft., 20 sq. in.

7. Number of cubic ft. in cistern = $3750 \times 16 \div 1000 = 60$ cubic ft. Depth = $60 \div (7\frac{1}{2} \times 3\frac{1}{6}) = 2\frac{10}{19}$ ft.

8. A would have run 1760 yards while B ran $1760 - 22 = 1738$ yards ∴ while B runs 1738, A runs $\frac{3}{4}$ of $1760 = 1320$ yards. Rates are as 1320 : 1738, that is, as 660 : 869.

9. A does $\frac{2}{3}$ of work in 6 hours, or $\frac{1}{9}$ of it in 1 hour. B does $\frac{3}{4}$ of $\frac{1}{3} = \frac{1}{4}$ of work in 2 hours, or $\frac{1}{8}$ in 1 hour. C does remainder $\frac{1}{12}$ of work in 30 min., or $\frac{1}{6}$ in 1 hour. A, B and C can do $\frac{1}{9} + \frac{1}{8} + \frac{1}{6} = \frac{23}{72}$ of work in 1 hour ∴ do whole work in $2\frac{14}{23}$ hours.

10. 90c. per lb.

JUNE, 1883.

1. Quotient, 5783. Remainder, 3086.

2. Weight = 1031 tons, 5 cwt. Value, $3,300,000.

3. $28784.50\frac{5}{6}$. 4. $319.37\frac{1}{2}$. 5. $\frac{3143\,13}{36\,2880}$. $\frac{441}{3760}$.

6. $\frac{3}{20}$ of gunpowder is charcoal ∴ weight of powder is $\frac{20}{3}$ of $20 = 133\frac{1}{3}$ cwt. Weight of nitre is $\frac{15}{20}$ of $133\frac{1}{3}$ cwt. = 100 cwt. Sulphur is $\frac{2}{20}$ of $133\frac{1}{3}$ cwt. = $13\frac{1}{3}$ cwt.

7. Cost of wine = $\$2.60 \times 360 = \$936$. Carriage = $17.20. Duties = $86.50 ∴ total cost = $1039.70. Selling price = $\$1089.70 \div 306 = \$3.39+$.

8. $5.25.

9. 1 metre = 70 yards ÷ 64 = 39·375 in. ∴ difference = 39·375 in. − 39 37079 = ·00421 in.

10. The minute-hand moves 12 minute-spaces while the hour-hand moves 1 minute-space ∴ in 12 minutes the minute-hand will gain 11 minute-spaces on hour-hand. At 4 o'clock the minute-hand is 20 minute-spaces behind. Will gain 11 spaces in 12 minutes, or 20 spaces in $\frac{12 \times 20}{11}$ $= 21\frac{9}{11}$ minutes after 4. (2) In $5\frac{5}{11}$ minutes after 4 o'clock.

DECEMBER, 1883.

1. Quotient, 726390 ; remainder, 1281.

2. 11 boxes = 2640 oranges, which cost $24.20, and sold for $58.08.

3. $\frac{40 \times 25}{160} = 6\frac{1}{4}$ = number acres, and $\$300 \times 6\frac{1}{4} = \$1875$; $\$1.50 \times 130 = \$195$ = cost of fence.

4. A = 2 C, B = 2 C − 70 ∴ A + B + C = 5 C − 70 ∴ C = 254, A = 508, B = 438.

5. 15. 6. ·0014997.

7. $\frac{2875 - 1083}{2000} \times \$16.25 = \$14.56$.

8. B should have a start of 1 minute = $\frac{1}{6}$ of a mile = $293\frac{3}{3}$ yards.

9. When the first man stops, $\frac{3}{8}$ of the work remains to be done, and this is done by the other two men in 5 days, hence they would do it all in $13\frac{1}{3}$ days ; hence in the 10 days that they work they do $\frac{3}{4}$ the work ; hence the first man must have done the other $\frac{1}{4}$ before he quit.

10. $\$275.80 \times \frac{91}{365} \times \frac{7}{100} = \$4.81$.

JUNE, 1884.

1. For "twenty-three" read "forty-three." Answer, 7070.

3. (*a*) Strike out 11, 7, 27, 81, and divide by 2, 2, 3, 7, 3. Answer, 149688. (*b*) 119.

2. 4 min. ÷ 23 hrs. 56 min. $= \frac{1}{359} = \cdot 002785$.

4. (1) $7\frac{21}{352}$. (2) $\frac{1}{7}$.

5. Weight of bags $= 1\frac{3}{4} \times 64 = 112$ lbs. ∴ weight of oats = 3504 lbs. ; gain on 1 bush. $= 8\frac{1}{2}$c. ∴ whole gain $= \frac{3504}{34} \times 8\frac{1}{2}$ $= \$8.76$.

6. Number sq. in. $= \frac{11\text{s. } 6\text{d.}}{2\frac{1}{4}\text{d.}} = 554\frac{4}{9}$. Number cubic in. $= 554\frac{4}{9} \times \frac{1}{2} = 277\frac{7}{9}$. Weight $= 277\frac{7}{9} \times \frac{1000}{1728}$ oz. $= 171\frac{577}{1944}$ oz.

7. A, B and C can do 4 times the work in 48 hours ; A and B can do 3 times the work in 48 hours ; hence C can do the work once in 48 hours, A in $28\frac{4}{5}$ hours, B in 36 hours.

8. After the first engagement there were $\frac{9}{10}$ left, and after the second $\frac{22}{25}$ of $\frac{9}{10}$, or $\frac{99}{125}$ ∴ army $= \frac{125}{99}$ of 3960 = 5000 men.

9. $\frac{84}{100}$ of 9600 times $1\frac{3}{8}$c. = \$110.88.

10. (1) \$24.04. (2) \$312 − \$307.20 = \$4.80 = interest for $\frac{1}{4}$ year ∴ interest for 1 year = \$19.20 ∴ interest for $3\frac{1}{2}$ years = \$67.20 ∴ principal = \$307.20 − \$67.20 = \$240. Interest on \$240 for 1 year is \$19.20 ∴ interest on \$100 for 1 year is \$8 ∴ the rate is 8 per cent.

DECEMBER, 1884.

1. $8967 \times 8967 = 80407089$.

2. $11067 - 17 = 11050$, and $35602 - 21 = 35581$. G. C. M. of 11050 and 35581 is 221.

3. \$126.81 nearly.

4. (*a*) $2\frac{1}{3} \div 11\frac{3}{4} \times 7\frac{1}{2} = \frac{70}{47}$; $\frac{\$18.64}{\$1.16\frac{1}{2}} = 16$; $5\frac{1}{2} + \frac{70}{47} + 16 = 22\frac{93}{94}$. (*b*) $\frac{16}{17}$ of $\frac{2}{3} = \frac{32}{51}$; $\frac{16116}{2750000} \times \frac{51}{52} = \frac{26163}{2750000}$.

5. $\frac{\$22.50}{90c.}$ = 25 yds. or 75 ft. of carpet. This will make 5 strips the length of the room ∴ width of room = 27 in. × 5 = $11\frac{1}{4}$ ft.

6. Boy can do 3 times the work in 14 days and the man 7 times, or both together 10 times ∴ they can do 5 times the work in 7 days.

7. $\frac{\$4.60 \times 92}{\$3.60} - 92 = 25\frac{5}{9}$.

8. The time is 423 days ; $\$275.60 \times \frac{423}{365} \times \frac{6}{100} = \$19.15$.

9. First when the minute-hand has gained 18 minute-spaces on the hour hand, or $\frac{12}{11}$ of 18 minutes past 4 o'clock. Next when it has gained 22 minute-spaces, or $\frac{12}{11}$ of 22 minutes past 4 o'clock.

JUNE, 1885.

1. Seventeen millions eighty-nine thousand six hundred and fifty-three and five thousand nine hundred and four millionths. Seven hundred and five dollars, sixty-three cents and seven mills. One thousand eight hundred and eighty-five.

2. $\frac{7}{47}(3\frac{1}{2} + 9\frac{13}{14}) = 2$; $\frac{4}{13}$ of $\frac{\text{£15 10s. 2d.}}{\text{16s. 2d.}} = \frac{4}{13}$ of $\frac{1861}{97}$; and $2 \times \frac{13}{4} \times \frac{97}{1861} = \frac{1261}{3722}$.

3.
$$\begin{aligned} 17\cdot65\dot{4} &= 17\cdot65454545\dot{} \\ 4\cdot83\dot{5} &= 4\cdot83583583\dot{} \\ 6\cdot40\dot{8} &= 6\cdot40888888\dot{} \\ \text{Sum} &= 27.89927017\dot{} \end{aligned}$$

4. $\$93.39\frac{1}{2}$.

5. $\$7.50 + 10$ per cent. $= \$8.25 = 8\frac{1}{4}$c. a lb.

6. $\$167 \times 3\frac{3}{4} \times \frac{7}{100} = \$37.99\frac{1}{4}$.

7. $\frac{199}{6} = 16\frac{3}{3}$ years.

8. A gets $\frac{2}{9}$=\$266$\frac{2}{3}$. B gets $\frac{7}{9}$=\$933$\frac{1}{3}$.

9. (1) When the hands are on opposite sides of the figure III. The minute-hand will have gone 12 times as far from the figure XII as the hour-hand has from figure III, and is still as far from reaching figure III as the hour-hand is beyond it, or $\frac{1}{13}$ of the distance from XII to III. The minute-hand has, therefore, gone $\frac{12}{13}$ of that distance ∴ the time is $\frac{12}{13}$ of 15 minutes past 3 o'clock. (2) When the minute-hand has caught up to the hour-hand or gained 15 minute-spaces ∴ the time is $\frac{12}{11}$ of 15 minutes past 3 o'clock.

10. Receiving back once as much as he spent would bring his money up to \$720 ∴ the other $6\frac{1}{2}$ times must increase it from \$720 to \$1305, that is by \$585 ∴ $\frac{\$585}{6\frac{1}{2}}$ = \$90=amount spent.

DECEMBER, 1885.

1. 2, 3, 5, 7, 11.

2. (*a*) $\frac{14}{23}$. (*b*) L. C. M. = 28152.

3. Amount left at end of one year=$\frac{2}{3}$; amount left at end of next year=$\frac{5}{7}$ of $\frac{2}{3}$, which=\$900; hence the whole fortune=\$1890.

4. The remainder after dividing $159\frac{1}{7}$ by $12\frac{5}{6}$, which is $5\frac{1}{7}$.

5. $3{\cdot}74976 \div 60 \div 24 \div 7 = {\cdot}000372$.

6. $\$27.50 \times 11\frac{3}{4} = \$323.12\frac{1}{2}$.

7. The unit of length is the yard; of time, the mean solar day; of sterling money, the sovereign or pound sterling.

8. \$132.

9. In 60 hours (L. C. M. of 10, 12, 15) the first could fill it 6 times; the second, 5 times; the third, 4 times ∴ all together would fill it 15 times in 60 hours, or once in 4 hours.