Exercises in Arithmetic

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EXERCISES IN ARITHMETIC.

BY

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It has been the author's intention for some years to publish such a book of Exercises in Arithmetic as this. It is now offered to teachers and scholars in the hope that they may find it helpful to them in acquiring a thorough knowledge of Arithmetic. He takes the liberty of directing the attention of students to the *Analytic Method*, sometimes called the *Unitary Method*, of solving questions, which is fully explained and exemplified in the Advanced Arithmetic, first issued in 1870, and of which a revised edition has just been published. The friends who have assisted in the preparation of this work will please accept the thanks of the author.

TORONTO, *Sept.*, 1877.

FRENCH TABLES.

1. MONEY.

Accounts are kept in France in Francs and Centimes. The unit of value is 1 Franc, a silver coin; it consists of $\frac{9}{10}$ths pure silver, and $\frac{1}{10}$th alloy. The value of 1 Franc = $9\frac{3}{4}d.$ English, nearly.

10 Centimes = 1 Decime.
10 Decimes = 1 Franc.

Note. A Napoleon is a gold coin = 20 Francs; a Sou, a copper coin = 5 Centimes.

The French system of Weights and Measures is constructed in accordance with the decimal scale. The multiples of the unit are denoted by the words (derived from the Greek language) Deca, which signifies 10; Hecto, 100; Kilo, 1000; Myria, 10000, prefixed to the name of the unit. The divisors of the unit are denoted by the words (derived from the Latin language) Deci, which signifies $\frac{1}{10}$th; Centi, $\frac{1}{100}$th; Milli, $\frac{1}{1000}$th, prefixed to the name of the unit.

2. MEASURES OF LENGTH.

The Unit of Length is the ten-millionth part of the distance from the Pole to the Equator in the meridian of

Paris. This length is called a Mètre, and = 39·371 English inches, nearly.

1 Millimètre	= $\frac{1}{1000}$th of 1 Mètre	= ·039371	English in.
1 Centimètre	= $\frac{1}{100}$th of 1 Mètre	= ·39371	"
1 Décimètre	= $\frac{1}{10}$th of 1 Mètre	= 3·9371	"
1 Mètre (unit)		= 39·371	"
1 Décamètre	= 10 Mètres	= 393·71	"
1 Hectomètre	= 100 Mètres	= 3937·1	"
1 Kilomètre	= 1000 Mètres	= 39371	"
1 Myriamètre	= 10000 Mètres	= 393710	"

Note. Long distances are generally quoted in Kilomètres; 1 Kilomètre = $\frac{5}{8}$ English mile, nearly.

3. SUPERFICIAL MEASURE.

The Unit of Area is called an Are, which = 1 square Décamètre = 119·6046 English square yards, nearly.

1 Centiare	= $\frac{1}{100}$th of 1 Are	= 1·196046	English sq. yards.
1 Deciare	= $\frac{1}{10}$th of 1 Are	= 11·96046	" "
1 Are (unit)		= 119·6046	" "
1 Decare	= 10 Ares	= 1196·046	" "
1 Hectare	= 100 Ares	= 11960·46	" "

Note. Large surfaces are generally quoted in Hectares; 1 Hectare = 2$\frac{1}{2}$ English acres, nearly.

4. MEASURES OF SOLIDITY.

The Unity of Solidity is called a Stère, which = 1 Cubic Mètre = 35·317 English cubic feet, nearly.

1 Décistère	= $\frac{1}{10}$th 1 Stère	= 3·5317	English cubic feet.
1 Stère (unit)		= 35·317	" "
1 Décastère	= 10 Stères	= 353·17	" "

5. MEASURES OF CAPACITY.

The Unit of Capacity is called a Litre, which = 1 Cubic Décimètre = 61·028 English cubic inches, nearly.

1 Centilitre	= $\frac{1}{100}$th of 1 Litre	= ·61028	English cubic in.
1 Décilitre	= $\frac{1}{10}$th of 1 Litre	= 6·1028	" "
1 Litre (unit)		= 61·028	" "
1 Décalitre	= 10 Litres	= 610·28	" "
1 Hectolitre	= 100 Litres	= 6102·8	" "

Note. 1 Litre = $1\frac{4}{5}$ English pint, nearly.

6. MEASURES OF WEIGHT.

The Unit of Weight is called a Gramme, which = the weight of a cubic centimètre of distilled water at its greatest density = 15·434 English grains, nearly.

1 Décigramme	= $\frac{1}{10}$th of 1 Gramme	= 1·5434	English grs.
1 Gramme (unit)		= 15·434	"
1 Décagramme	= 10 Grammes	= 154·34	"
1 Hectogramme	= 100 Grammes	= 1543·4	"
1 Kilogramme	= 1000 Grammes	= 15434	"

Note. 1 Kilogramme = $2\frac{1}{5}$ English lbs., Avoirdupois, nearly. 1 Quintal = 100 Kilogrammes = 1·97 English cwt. 1 Millier = 1000 Kilogrammes = 19·7 English cwt.

EXERCISES IN ARITHMETIC.

Ex. I.

1. Explain the meaning of Numeration, Notation, Digit.

2. What are even numbers? What are odd numbers?

3. Find the value of (1) 9087613 + 4079 + 8703476 + 133 + 61304 + 887 + 537189; (2) 890 + 5432100 + 99309 + 169 + 34 + 7102358 + 3211 + 477; (3) 6108 + 2370774 + 900 + 039 + 33851616 + 7401147 + 555 + 5. Prove the truth of each result.

4. Add together (1) seven hundred and ninety-seven thousand five hundred and four; two millions eighty-eight thousand one hundred and fifty-six; twenty-three thousand and twelve; three hundred and seventy thousand nine hundred and eight; sixty thousand one hundred and forty; one million six hundred thousand and fifty-eight: (2) ninety-nine hundred and one; one million forty-four thousand five hundred and eight; six hundred and fifty-nine thousand and seventeen; two thousand two tens and two; twenty-five thousands twenty-five hundreds twenty-five tens and twenty-five.

5. A man bought three estates: for the first he gave $5260; for the second, $3085; for the third, $200 more than he gave for both the others. He sold all of them for $20,000. What sum did he gain?

6. A carriage and a pair of horses cost \$650; the value of one horse was \$275, and the second horse cost \$69 less than the other. What was the cost of the carriage?

7. What must be added to seven thousand one hundred and seven to make half a million?

8. How much does the difference between 7562 and 3876 exceed the sum of 1734 and 305?

9. Find the sum of 7501930856+32908+74693+517 +9963459876+60534+9+46325+550580+100077868. Write in words the meaning of the result, and prove the correctness of it.

10. Find the product of (1) 450520 and 12950; (2) 739087 and 300059; (3) 506079 and 8010035; (4) 89706300 and 4030800; (5) 7140895 and 790302; (6) 17035900 and 7007800. Test each result by casting out the nines.

11. A drover bought 127 bullocks at \$150 each, and 93 others at \$125 each. He lost one of the former and two of the latter by accident in transporting them, but sold the remainder at \$190 a head. Did he gain or lose? and how much?

12. Multiply the difference between 876042 and 834260 by four times the sum of 1200 and 1082.

Ex. II.

1. What are the "Factors" of a number? What is an Integer? Explain the meaning of the terms, Dividend, Divisor, Quotient.

2. By how much does the sum of 193453, 460158, 443387, 606331, 370273, 386052, 184905, 547494, 385291, 483323, 401691, 272128, fall short of five millions?

3. Work this sum by the rules of Simple Multiplication and Division: If 20 men can build a wall in 18 days, how many men can build it in 12 days?

4. If the dividend be 6050034, the quotient 550003, the remainder 1, what is the divisor?

5. A grocer buys 252 pounds of tea, and wishes to pack it in parcels of 1 pound, 3 pounds, and 5 pounds, an equal number of parcels of each kind. How many parcels can he make?

6. What is the divisor if the dividend be one million seven hundred and thirty-two thousand eight hundred, and the quotient four thousand five hundred and sixty?

7. Divide (1) 52847241 by 607; (2) 48288058 by 3094; (3) 746130000 by 9500; (4) 13699840 by 342.

8. A man left his property, $30,000, between his wife, two sons and one daughter; the wife had $12,000, and each of the sons double the portion of the daughter. What did each receive?

9. Divide (1) 671088553800 by 7980; (2) 213777000 by 450; (3) 5030084 by 55, and also by 11 and 5.

10. Divide $25 between Jane, Ellen and Thomas, so that Ellen may have $2 more than Jane, and Thomas as much as Jane and Ellen together.

11. (1) Divide the product of 658302 and 630967 by 701. (2) How often must 706 be added to 116 to make ten thousand?

12. (1) Divide £1870 10*s.* 6½*d.* by 754. (2) If you had to distribute this sum of money equally amongst 377 persons, what would each receive?

Ex. III.

1. How does Simple Division differ from Compound Division? Can you divide \$25 by 5? What is the meaning of the operation? Put it down as a question in Subtraction. Can you divide \$25 by \$5? What is the meaning of the operation? Can you divide 25 by \$5?

2. Explain the method of working this sum: Divide \$30 between *A* and *B* so that *A* may have half as much again as *B*. For half as much again read three times as much. Shew then how to work it.

3. Find the sum, difference, product and quotient of 537152 and 765.

4. A cistern containing 480 gallons can be emptied by one pipe in 24 minutes, and by another in 15 minutes. Supposing the cistern quite full, and the first pipe to be open for 5 minutes and the second for 10 minutes, how many gallons will remain in the cistern?

5. A train travelling at the rate of 41 miles an hour starts from Toronto for Quebec, a distance of 516 miles, and another train starts at the same time from Quebec for Toronto at the rate of 25 miles an hour. Where will they meet?

6. A gun is fired at the same instant in the same direction from two vessels in a direct line from a given point. An interval of 5 seconds takes place before the report of the nearer gun, and of 12 seconds before that of the further one, is heard. What distance are the vessels apart if the sound travels 1130 feet in a second?

7. If fifty-seven thousand five hundred and six be represented by £838 12*s.* 7*d.*, what is the value of a unit?

8. A cistern containing 480 gallons can be filled by one pipe in 32 minutes, by another in 24 minutes, and can be emptied by a third in 16 minutes. If the cistern be empty and all the pipes opened at once, in what time will it be filled?

9. How long will 12 men take to do a piece of work which 8 men can do in 27 days?

10. A grocer buys a chest of tea containing 126 pounds at 68 cents a pound. He retains 18 pounds for his own use, and sells the remainder at 84 cents a pound. How much more money does he receive than he laid out?

11. Can you multiply \$5 by 4? What is the meaning of the operation? Put it down as a question in Addition. Can you multiply 4 by \$5, or \$4 by \$5? Why?

12. A cistern containing 720 gallons is filled by two pipes in 24 and 30 minutes respectively, and it is emptied by a pipe in 20 minutes. If the cistern be empty and all the pipes left open, when will it be half full?

Ex. IV.

1. Work this question by the rules of Simple Multiplication: If 20 men can build a wall in 18 days, in how many days ought 30 men to build it?

2. If 38 men can do a piece of work in 57 days, in what time will 3 men do a piece of work three times as large?

3. How often will a wheel, whose circumference is 7 feet, 4 inches, turn in a distance (1) of $2\frac{1}{2}$ miles, (2) of 3 miles 700 yards?

4. A silversmith melted a silver tray weighing 6 lbs. 9 oz. 18 dwts., and made spoons of it, each weighing 2 oz. 5 dwts. 12 grs. How many dozen spoons did he make?

5. A man buys 10 lbs. coffee at 32 cents per lb., and 4 lbs. chicory at $11\frac{1}{2}$ cents per lb. He mixes them and sells the mixture at 39 cents per lb. Find his profit.

6. How long will a machine take to mow a field of 6 acres 3 rods 19 poles $23\frac{3}{4}$ yards, at the rate of 3 rods 2 poles 6 yards an hour?

7. A gentleman distributed $330 among 12 men, 16 women, and 30 boys; to every man he gave twice as much as to a woman, and to every woman three times as much as to a boy. What did each receive?

8. A truck of coals weighed 9 tons 16 cwt. 1 qr., the weight of the coals being four times that of the truck. Find the weight of the coals. (Cwt. = 112 lbs.)

9. A man took 990 steps in walking half a mile, and his son 1440. How much longer was the father's step than the son's?

10. If wine is bought at $4.50 a pipe, and sold at $10.50 a dozen, a gallon filling 6 bottles, what is lost or gained, the expense of bottles being 55 cents a dozen?

11. How many seconds will there be from noon, January 3rd, 1876, to midnight, March 3rd, 1876?

12. Divide $56.10 between A, B and C, so that for every 10 cents which A receives B may receive 12 cents, and C half as much more as A and B together receive.

Ex. V.

1. An English mile is 1760 yards, a Scotch, 1976 yards, an Irish, 2240 yards. By how much does the difference between 20 Irish and Scotch miles exceed the difference between 20 Scotch and English miles?

2. Among how many persons can you divide £962 5*s.* 0½*d.*, giving each of them £137 9*s.* 3½*d.*?

3. A house and its furniture cost $6272; the house is worth seven times as much as the furniture. Find the value of the house?

4. Divide $11 among *A*, *B* and *C*, so that *A* may have three times, and *B* four times, as much as *C*.

5. A tea merchant mixes 25 pounds of tea worth 42 cents a pound, 40 pounds worth 58 cents a pound, and 27 pounds worth 76 cents a pound. At what rate per pound must he sell the mixture to gain $6.30?

6. Separate 25000 apples into three heaps, the second heap containing three times as many as the first, and the third twice as many as the second.

7. A man has a yearly income of $2433.75; he puts aside $315. What is the greatest average amount he may spend per day without getting into debt? (A year 365 days.)

8. Divide $26.25 among *A*, *B* and *C*, so that *A* and *B* may have equal shares, and *C* twice as much as *A* and *B* together.

9. How many payments each of £190 14*s.* can be made out of a fund amounting to £28065 7*s.* 3½*d.*? What sum would remain after the payments were made?

10. A man mixes two casks of wine each containing 36 gallons, for one of which he gave 12*s.* 6*d.* a gallon, for the other 18*s.* a gallon; he sells the mixture at 15*s.* a gallon. Find his gain or loss.

11. The 365th part of a number is 101001. What is the number?

12. Divide £4387 11*s.* 8*d.* among *A*, *B* and *C*, so that A may have one quarter of the whole sum, and *B* four times as much as *C*.

Ex. VI.

1. At a factory where an equal number of men and boys were employed, the weekly wages amounted to $626.40, the daily wage of each boy being 30 cents, and that of a man three times as much. Find the number of each class.

2. (*a*) Reduce 2 miles 6 furlongs 4 poles 3 yards to inches. (*b*) How many turns will a wheel, whose outside rim is 11 feet 4 inches, make in $8\frac{1}{2}$ miles?

3. A farm of 74 acres was divided equally among a certain number of children, each of whom received 7 acres 1 rood 24 poles. How many children were there, and what was the share of each worth, at £70 an acre?

4. Two sets (each containing an equal number) of parcels of sugar, weighing respectively 1 lb. 4 oz. and $2\frac{1}{2}$ lbs., are made out of a barrel holding 1 cwt. 1 qr. 25 lbs. Find the number of parcels in each set. (Cwt. = 112 lbs.)

5. Two boats start at the same time in a race of two miles, and one gains on the other 9 feet 6 inches in every

55 yards. How much will it have gained at the end of the race?

6. *A* has 6 houses let for \$240 each; *B* has 5 houses let for \$336 each; and *C* has 3 houses let for \$384 each. Divide a tax of \$44.50 fairly between them.

7. The fore wheel of a carriage, whose outside rim is 7 feet, makes 1584 more turns than the hind wheel in a journey of 7 miles. Find the size of the rim of the hind wheel.

8. Two watches are set together; one loses 7″ and the other gains 8″ a day. When will one be a quarter of an hour before the other?

9. A bankrupt owes *A* £515 12*s.* 6*d.*, *B* £407, and *C* £293 6*s.* 8*d.*; his estate is worth £911 19*s.* $4\frac{1}{2}d.$ How much can he pay in the £, and what will *A*, *B* and *C* receive respectively?

10. How many steps does a man take in $1\frac{1}{2}$ mile, the length of each step being 2 ft. 8 in.?

11. Make out the following bill: Loin of mutton, $6\frac{1}{2}$ lbs., at 14 cts. a lb.; fillet of veal, $10\frac{3}{4}$ lbs., at 16 cts. a lb.; ribs of beef, 14 lbs., at 10 cts. a lb.; 6 kidneys, at 10 cts. each: 2 pickled tongues, at 40 cts. each.

12. Find the product of nine hundred and five thousand seven hundred and forty-one, and five hundred thousand two hundred and eighty.

Ex. VII.

1. A man buys sheep at \$4 each and sells them all again at one price; on every \$1200 which he receives he gains \$400. What was the selling price per head?

2. How many bricks, each containing $121\frac{1}{2}$ cubic inches, ought to be packed in 3 cubic yards?

3. Find the cost of making a road 9 mls. 5 fur. 44 yds. long, at $2992 a mile.

4. Which is the more valuable crop, and by how much per acre: wheat, yielding 5 qrs. an acre, and selling at 6*s.* 6*d.* per bush.; or barley, yielding 6 qrs. 6 bush. an acre, and selling at 4*s.* 10*d.* per bush.

5. How many parcels of 3 lbs. and 5 lbs. each can a grocer make out of a cwt. of sugar: 1st, If there be the same number of parcels of each sort; 2nd, If there be three times as many of the smaller parcels as there are of the larger? (Cwt. = 112 lbs.)

6. An estate yields a gross rental of $7250, on which an income tax of 1 cent 4 mills in the $ has to be paid; the expense of collecting the rent amounts to 5 cents in the $, and other charges to 241.58\frac{1}{3}$. Find the net rental.

7. At a game of cricket, *A*, *B* and *C* together score 21 runs, *B* and *C* together, 14, and *A* and *C* together score 17 runs. How many runs did each score?

8. A man distributed $11.25 among 1 man, 2 women, and 3 children; to the man he gave twice as much as to each woman, and to every woman three times as much as to each child. What did each receive?

9. The outside rim of the fore wheel of a carriage is 9 ft. 4 in., and it makes in a journey of 21 miles 4840 more turns than the outside rim of the hind wheel. Find outside rim of hind wheel.

10. The penny loaf weighs 10 oz. when wheat is at 5*s.* a bushel; how much ought it to weigh when wheat is 6*s.* 3*d.* a bushel?

11. Telegraph posts are placed 66 yards apart; a train passes one every 3″ Find at what rate per hour the train is travelling.

12. How many spaces of a yard, a foot, and an inch, an equal number of each, are there in 54 yds. 1 ft. 4 in.?

Ex. VIII.

1. If 19 men can make a railway cutting in 147 days, how long would it take 23 men, supposing each man to do the same amount of work?

2. The total stock of gold coin and bullion in the Bank of England on a certain day being of the value of £16548126, and the value of a pound of gold being £46 14*s.* 6*d.*, find the weight of the stock in ounces.

3. Sound travels at the rate of 1140 feet a second. If a shot be fired from a ship moving at the rate of 10 miles an hour, how far will the ship have moved before the report is heard at a place 14¼ miles off?

4. What is the cost per hour of lighting a room with 3 burners, each consuming 5 cubic inches of gas per second, the price of the gas being $2 per 1000 cubic feet?

5. If 2 horses be worth as much as 5 oxen, and 3 oxen as much as 16 sheep, what will be the value of a horse if the price of a sheep be $12?

6. A bankrupt's debts are $1700; his assets $950.75. After paying the costs of the bankruptcy, his creditors receive 29 cents in the $. What do the costs amount to?

7. At what time are the hands of a clock opposite to each other, (1) between 1 and 2; (2) between 8 and 9 o'clock?

8. If $\frac{17}{30}$ of an estate be left to the elder of two children, and the remainder to the younger, and the difference of their legacies be \$725, what is the value of the whole estate?

9. *A* and *B* can do a piece of work in 3 days, *A* and *C* in $3\frac{1}{2}$ days, *B* and *C* in 4 days. In what time can they do it, all working together?

10. If either 5 cows *or* 7 horses will eat up the grass of a field in 87 days, how long ought the field to last 2 cows *and* 3 horses?

11. By a reduction of the income tax from 7*d.* to 2*d.* in the £, a person saves £28 13*s.* $1\frac{1}{2}d.$ Find his income.

12. A fixed money rent of £780 is converted into a variable corn rent—one-half of the above sum in wheat at 48*s.* a qr., and the other half in barley at 30*s.* a qr. What will be the rent when wheat is 56*s.* a qr., and barley 32*s.* a qr.?

Ex. IX.

1. Two cogged wheels, of which one has 15 cogs and the other 28, work in each other. If the first turn 16 times in $7\frac{1}{2}$ seconds, how often will the other turn in 21 seconds?

2. Simplify $\dfrac{17\frac{1}{3}+13\frac{2}{5}}{14\frac{1}{3}+13\frac{1}{15}} - \dfrac{12\frac{1}{7}-11\frac{1}{5}}{13\frac{2}{5}-12\frac{2}{7}}$.

3. At what time are the hands of a clock at right angles to each other, (1) between 2 and 3; (2) between 7 and 8 o'clock?

4. A debt of \$22 is paid in half dollars, quarter dollars, and 20 cent pieces, whose numbers are proportional to 3, 2 and 1. Find the number of each coin.

5. A bankrupt can pay 5*s.* 9*d.* in the £; if his assets were £500 more, he could pay 6*s.* 6*d.* in the £. Find his debts and assets.

6. Work by the independent method. If 14 men can do a piece of work in 14 days, working 10 hours a day, how long ought the work to occupy 12 men working 7 hours a day?

7. Out of a cistern six-sevenths full, 63 gallons are drawn off; the cistern is then found to be three-fifths full. Find contents of cistern.

8. Simplify $(3\frac{4}{3}+5\frac{1}{9}-\frac{1}{45})$ of $(4\frac{1}{5}-3\frac{1}{4})$, divided by $1\frac{5}{11}+2\frac{1}{8}-(2\frac{9}{16}-\frac{1}{8}-\frac{1}{22})$.

9. A and B can do a piece of work in 2 days, B and C in $1\frac{2}{3}$ days, and A, B and C in $1\frac{1}{3}$ days. In what time can A and C do it?

10. Eight bells begin tolling together at the same instant, and they toll at intervals of 1, 2, 3, 4, 5, 6, 7, 8 seconds respectively. After what time will they be again tolling at the same interval?

11. A does $\frac{3}{5}$ of a piece of work in 12 days, and then B helps him; they work together for 2 days, when B leaves, and A finishes the work in 3 days more. How many days would B have taken to do the work alone?

12. If 5 men do as much work as 8 boys in a day, how many days will it take 32 boys to finish a piece of work, of which 15 men did one-fourth in 16 days?

Ex. X.

1. 1500 men have provisions for 13 months. How long will they last, if at the end of 4 months 300 more men join them?

2. A stock of provisions will serve 75 men for 30 days. How many men must leave in order that the stock may hold out for those left for 45 days?

3. The price of 2 turkeys and 9 fowls is \$14.40, and the price of 5 turkeys and 3 fowls is \$20.40. Find the price of each.

4. Simplify $\dfrac{\frac{1}{23}\text{ of }6\frac{13}{17}\text{ of }24\frac{11}{13}-4\frac{13}{18}\times 3\frac{3}{84}\div 3\frac{37}{96}}{8\frac{17}{19}\times 5\frac{14}{39}\div 4\frac{15}{32}-7\frac{19}{20}\times 5\frac{11}{65}\div 14\frac{21}{25}}\times 4\frac{8}{23}$.

5. A, B and C can do a piece of work in 2, $2\frac{1}{2}$ and 3 hours respectively. How much of it could be done in 20 minutes if they all worked at it?

6. A person rows a distance of $1\frac{1}{2}$ mile down a stream in 20 minutes; but without aid of stream it would have taken him half an hour. Find rate of stream per hour, and the time it will take him to return against it.

7. A can beat B by 5 yards in a 100-yard race, and B can beat C by 10 yards in a 200-yard race. By how many yards can A beat C in a 400-yard race?

8. A woman buys some apples for 6 a penny, and the same number for 2 a penny. How much does she gain or lose per cent. by selling them all at 5 for 2 pence?

9. One-seventh of a field is planted with carrots, two-fifths with turnips, and the remainder, 3 acres, with potatoes. Find the size of the parts planted respectively with carrots and turnips.

10. In the addition and subtraction of circulating decimals, if the operation is only required to be carried on to a given number of figures, what course should we take with regard to the periods?

11. What is the value of the gold in an ornament weighing $13\frac{3}{4}$ dwts., of which $\frac{9}{10}$ are pure gold, and the rest alloy of no value, if $\frac{11}{12}$ oz. of pure gold is worth \$18.69?

12. If 5 men with 7 women earn \$36.72 in 6 days, and 2 men with 3 women earn \$15.12 in the same time, in what time will 6 men with 12 women earn \$288?

Ex. XI.

1. A railway train goes 408 miles in 18 hours; its speed bears to the speed of a steamer from Liverpool to New York, 2760 miles, the ratio of 15 : 8. How long will the steamer take in its voyage?

2. A train 88 yards long overtook a person walking along the line at the rate of 4 miles an hour, and passed him completely in 10″; it afterwards overtook another person and passed him in 9″. At what rate per hour was the second person walking?

3. Simplify $\dfrac{6\frac{2}{3}+3\frac{19}{39}}{12\frac{19}{26}+2\frac{1}{2}} - \dfrac{2\frac{1}{4}+3\frac{1}{28}}{3\frac{16}{35}+12\frac{2}{5}}$.

4. Two watches are both right at noon on the 26th of October, 1875; one gains $1\frac{1}{2}$′ a day, the other loses 1′.

When will they be together again, and what o'clock will it be by each of them?

5. Simplify $\dfrac{\dfrac{2}{3-\frac{4}{5}}+\dfrac{3}{4-\frac{5}{6}}}{\dfrac{3}{2-\frac{1}{4}}+\dfrac{1}{3-\frac{4}{5}}} \times \dfrac{\dfrac{1}{\frac{2}{3}-\frac{2}{9}}-\dfrac{1}{1\frac{1}{2}-\frac{19}{22}}}{\dfrac{1}{1\frac{1}{7}-\frac{1}{8}}-\dfrac{2}{6\frac{3}{5}-2\frac{5}{11}}}$.

6. How many revolutions will a carriage wheel, which is $3\frac{1}{2}$ feet in diameter, make in a distance of 5·73 miles? Circumference of a circle : diameter :: 3·14159 : 1.

7. In a certain election there were three candidates, *A*, *B* and *C*. *C* obtained $\frac{1}{4}$ of the whole number of votes polled; and the number of votes given for him bears to the number given for *A* the ratio of 4 to 7. *B* obtained 1260 votes. Find the number of votes polled by *A* and *C* respectively.

8. In any year show that the same days of the month in March and November will fall on the same days of the week.

9. $\dfrac{2\frac{1}{6}-3\frac{7}{8}+8\frac{5}{24}-5\frac{2}{3}+\frac{4}{5}}{1-\frac{1}{3}+\frac{1}{30}-\frac{1}{120}}$.

10. A tradesman said, "I sell it for \$100 and make 15 per cent. profit, for it cost me \$85." Was he correct? If not, find the true rate of profit, and also the cost price in order that it might have been 15 per cent.

11. A woman has a certain number of eggs. She sells ·3 of the number and one more to one person, ·2 of the remainder to a second person, and ·5 of what then remained

to a third; she has then 26 eggs left. How many had she at first?

12. A dealer invested \$30450 in the purchase of horses at a certain average price. He sold a part of them for \$12000, at \$400 each, and by so doing lost \$35 per head. At what price must he sell the remainder so as to gain \$750 on the whole?

Ex. XII.

1. A bath is supplied by three taps, A, B and C, which, when all open, fill it in $2\frac{2}{7}\frac{3}{3}$ minutes; when A is closed it is filled in 4′; when B is closed in $3\frac{1}{2}$′. How long will it take to fill it if C is closed?

2. Simplify $\dfrac{\frac{1}{21}\times 5\frac{17}{25}\times 6\frac{3}{11}+6\frac{19}{51}\times 1\frac{23}{49}\div 2\frac{5}{17}+1\frac{10}{49}}{9\frac{19}{57}\times 1\frac{22}{23}\div 5\frac{17}{38}+3\frac{11}{78}\times 6\frac{17}{21}\div 7\frac{21}{52}}\times 12\frac{4}{5}$.

3. A train 88 yards long overtook a person walking along the line at the rate of 2 miles an hour, and passed him completely in 9″; it afterwards overtook another person walking 4 miles an hour. How long will it take to pass him?

4. Simplify $\dfrac{7\frac{1}{2}+1\frac{17}{22}}{8\frac{2}{3}+3\frac{29}{33}}-\dfrac{3\frac{4}{5}+\frac{29}{45}}{3\frac{3}{4}+14\frac{1}{36}}$.

5. A railway proprietor receives one year a dividend of 7 per cent. on his stock, and pays an income tax of 6*d.* in the £. Next year he receives a dividend of $7\frac{1}{2}$ per cent., and pays an income tax of 4*d.* in the £, and finds himself richer £66. How much railway stock does he hold?

6. Find value of $\left(\dfrac{\frac{1}{4}+\frac{1}{5}}{1\frac{3}{4}}-\dfrac{1}{2}+\dfrac{1}{2\frac{4}{5}}-\dfrac{\frac{1}{3}}{2\frac{11}{12}}+7\right)$ of $\dfrac{\frac{1}{3}+\frac{1}{9}}{\frac{1}{9}+\frac{5}{4}}$ of \$210.

7. How is our common decimal system of notation extended to fractions? How do decimals differ from vulgar fractions? Show that fractions which always produce finite decimals must have a denominator composed of particular factors; and also state in the case where they produce decimals which recur, what in any case will be the extreme number of figures in the recurring period?

8. A tank, measuring 12 ft. by 8 ft. 10 in., and 6 ft. 6 in. deep, is filled with a liquid solution. After a deposit has taken place the clear liquid is drawn off and found to measure 4,000 gallons. What is the depth and value of the deposit at $10 per cubic foot? (The gallon = 277.274.)

9. A person does five-eighths of a piece of work in 11 days; he then receives the assistance of another person, and the two finish it in 4 days. In what time could each do the work by himself? and what would each receive, supposing the whole work worth $17.60.

10. Add together one million eighteen thousand two hundred and sixty-nine, twenty thousand nine hundred and seventy-nine, one hundred millions one thousand and fifty, fifty-four billions and three thousand, four hundred millions and six, nine hundred and ninety-nine thousand nine hundred and ninety.

11. Explain the terms Measure, Multiple, Greatest Common Measure, Least Common Multiple. Find the smallest cask which can be exactly filled by any one of the following measures: 1 pint, 3 pints, 1 quart, 3 quarts, 5 gallons.

12. Simplify $\frac{1\frac{2}{5}}{3\frac{1}{2}} - \frac{5\frac{5}{8}}{6\frac{1}{4}}$ of $\left(\frac{1}{5} - \frac{\frac{1}{2}-\frac{1}{3}}{4\frac{3}{4}-3\frac{2}{3}}\right)$.

Ex. XIII.

1. State why it is necessary, in comparing the values of fractions with different denominators, to reduce them to equivalent fractions having a common denominator. Can the values of fractions be compared in any other way?

2. Simplify $\left(\frac{\frac{1}{4}+\frac{1}{5}}{1\frac{3}{4}}-\frac{1}{2}+\frac{1}{2\frac{4}{5}}-\frac{\frac{1}{3}}{2\frac{1}{12}}+7\right)$ of $\frac{\frac{1}{3}+\frac{1}{9}}{\frac{1}{9}+\frac{5}{4}}$ of \$700.

3. After deducting \$1 in \$48 for income tax, and 4 per cent. of the value of the whole rental for collection, the value of the remainder is \$1127. What is the value of the whole?

4. *A* does a piece of work in 3 days, *B* three times as much in 8 days, *C* five times as much in 12 days; find time for all three doing three times as much work? If the amount allowed for doing the work be \$27, what will be each man's share?

5. Simplify $\frac{\frac{1}{3}}{5\frac{3}{4}}+\frac{4}{4\frac{3}{5}}+\frac{1}{5}$ of $\frac{3\frac{1}{4}-8\frac{1}{5}}{\frac{1}{2\frac{1}{2}}+\frac{1}{1\frac{1}{3}}}$.

6. I pay away $\frac{2}{7}$ of my money, then $\frac{2}{5}$ of the remainder, then $\frac{1}{3}$ of what then remains, and then $\frac{1}{8}$ of the original sum; what fractional part of my money have I left after the second, and also after the final payment?

7. Simplify $\frac{1+2\frac{4}{9}(1+2\frac{4}{9})}{1+2\frac{1}{3}(1+2\frac{1}{3})}-\left(\frac{919}{2844}-\frac{1}{4}\right)$.

8. Multiplying the numerator of a fraction by any number is the same in effect as dividing the denominator

by it, and conversely. Prove this. This being the case, why is it that the Rule is, multiply the numerator, instead of, divide the denominator?

9. Simplify. $\left(\frac{11\frac{3}{4}-10\frac{1}{2}}{11\frac{3}{4}+10\frac{1}{2}} \div \frac{10\frac{3}{8}+11\frac{1}{8}}{10\frac{3}{8}-9\frac{1}{8}}\right) \div \frac{\frac{2}{7}+\frac{3}{11}}{\frac{2}{7}-\frac{3}{11}}$

10. By what number must the product of the sum and difference of $3\frac{1}{3}$ and $2\frac{1}{3}$ be divided to give $\frac{7\frac{1}{2}+1\frac{17}{22}}{8\frac{2}{3}+3\frac{23}{33}} - \frac{3\frac{4}{5}+\frac{29}{45}}{3\frac{3}{4}+14\frac{1}{16}}$ as a quotient?

11. Add together £22 12*s.* 6*d.*, \$227.55, and £17 8*s.* $7\frac{1}{2}d.$; (1) by expressing all in the Halifax or old Canadian currency; and (2) by expressing all in the present Canadian currency; and (3) show that your answers are equal in value.

12. Show that $\frac{3}{7}+\frac{5}{9}=\frac{62}{63}$. Why is it necessary, in multiplying or dividing by a mixed number, to reduce it first to an improper fraction?

Ex. XIV.

1. How is our common system of notation extended to fractions? In whole numbers, for every cipher added to the right of the number, its value is increased tenfold; why is not this the case in decimal fractions? Give a method which applies equally to both.

2. Find the value of (1) $2{\cdot}013 \times 15 \times {\cdot}0001 \times 10000 \times 6{\cdot}00006$. 2. $\frac{3{\cdot}25+2\frac{1}{4}}{3\frac{1}{4}-2{\cdot}25}$. 3. $\frac{73{\cdot}8 \times \frac{3}{19} \text{ of } {\cdot}0009747}{{\cdot}0018}$

3. State the rules for converting circulating decimals into their equivalent vulgar fractions. Find the value of

(1) $3\cdot245+2\cdot324$. (2) $\dfrac{\cdot36}{\cdot\dot{6}\dot{3}}$

4. If the port wine contained in a vessel weighs 17 cwt. 3 qrs. 13 lbs., how much weight of pure water, and how much of cow's milk, would the same vessel contain, the weights of equal bulks of the wine, water and milk being as the numbers 997, 1000, 1032?

5. The earth describes its orbit round the sun in 365 days 5 hours 48 minutes 47·6 seconds; through what space does it move each day and hour, at an average, the circumference of the orbit being 584335740?

6. *A* gets \$4 of a prize for \$3 that *B* gets, and *C* \$5 for \$6 that *B* gets, and *A*'s share is \$5000. What is the value of the whole prize?

7. Simplify $\dfrac{5\frac{5}{8}\div\frac{2}{3}}{1\frac{1}{5}\text{ of }\frac{5}{9}\div10\frac{1}{3}}\times\dfrac{2}{5}\text{ of }\dfrac{1\frac{1}{2}\text{ of }4\frac{1}{9}}{13\frac{7}{8}\text{ of }5\frac{1}{3}}$

8. Reduce $\dfrac{2\cdot375}{3\cdot1\dot{6}}$ of $\dfrac{4\cdot4}{\cdot0625}\div\dfrac{8\cdot8}{7}$ of $\dfrac{4}{5\cdot625}$ to a simple quantity.

9. In the centigrade thermometer the freezing point is zero, and the boiling point is 100°; in Fahrenheit's, the freezing point is 32°, and the boiling point is 212°. What degree centigrade corresponds to 86° Fahrenheit.

10. Reduce to a decimal, correct to seven places,

$$1+\frac{1}{1}+\frac{1}{1.2}+\frac{1}{1.2.3}+\frac{1}{1.2.3.4}+\text{\&c.}$$

11. Being desirous of ascertaining the height of the steeple of St. James' Cathedral, Toronto, I measured the shadow thereof and that of my walking stick, and found them to be 636 feet and 70 inches respectively. The length of my stick is 2 feet 11 inches: what is the height of the steeple?

12. One company guarantees to pay 5 per cent. on shares of \$100 each, another guarantees at the rate of $4\frac{4}{5}$ per cent. on shares of \$7.50; the price of the former is $124\frac{1}{3}$, and of the latter \$8.50. Compare the rates of interest which they return to the purchaser?

Ex. XV.

1. Reduce $\dfrac{2\cdot8 \text{ of } 2\cdot\dot{2}\dot{7}}{1\cdot1\dot{3}\dot{6}} + \dfrac{4\cdot\dot{4} - 2\cdot8\dot{3}}{1\cdot\dot{6} + 2\cdot6\dot{2}\dot{9}} \text{ of } \dfrac{6\cdot8 \text{ of } 3}{2\cdot25}$.

2. What weight of water may be contained in a canal whose depth is 8 feet, width 25 feet, and length 12 miles? (Cubic foot of water = 1000 oz.)

3. A Jewish shekel weighed 219 grains Troy, and was worth 2*s.* $3\frac{1}{2}$*d.* sterling. What was the weight of a talent, containing 3000 shekels? and the value of 10000 talents? Express the last result in our present currency. (£ = \$4.87.)

4. Name and give an example of the different kinds of vulgar fractions. Give the reason for the rule for expressing any number as a fraction with a given denominator. (See Advanced Arithmetic, p. 91.)

5. If 150 apples cost \$2.25, how many of them must be sold at the rate of 8 for 13 cents, and how many at the rate of 3 for 5 cents, that the gain on the whole may be 10 per cent.?

6. Three gentlemen contribute $821.25 towards building a church at the distance of 2 miles from the first, $2\frac{7}{8}$ miles from the second, and $3\frac{1}{2}$ miles from the third; and they agree that their shares shall be reciprocally proportional to their distances from the church. How much must they severally contribute?

7. If a gallon of water were resolved into the oxygen and hydrogen of which it is composed, it is required to determine the bulk into which it would thus be expanded; water being 741 times heavier than an equal bulk of oxygen, and 9699 times heavier than an equal bulk of hydrogen. (These gases to form water combine by weight in the ratio of 16 to 2.)

8. The *City of Brussels* sailed with a cargo which, valued at an advance of one-fourth more than the original cost, would have produced $4000000 in the European market; but on account of being overdue, &c., a profit of only one-fortieth of original cost was realized. For how much was cargo sold?

9. A person who has $10000 of the $7\frac{1}{5}$ per cent. at 175, sells out, and with the proceeds buys Bank of Commerce stock at 125, which pays half-yearly dividends of $3\frac{3}{8}$ per cent. Find alteration in his income.

10. A man walking at the rate of $3\frac{5}{9}$ miles per hour, performs a journey in 12 days of $7\frac{1}{2}$ hours each. At what rate must he walk to accomplish the same journey in 9 days of $10\frac{1}{2}$ hours each?

11. A man buys 200 yards of cloth at 75 cents a yard, and sells it, using a yard stick $\frac{1}{8}$ inch short. How much per yard must he charge to gain $33\frac{1}{3}$ per cent. on his outlay?

12. The value of an oz. of gold, which was £3 14*s.* 6*d.*, falls to £3 12*s.*; what is the decrease in the value of a bar of gold from which 1000 sovereigns might have been coined?

Ex. XVI.

1. Which is the greater and by how much, the 12th part of one billion sixty-two millions six thousand six hundred and twelve, or the 29th part of two billions six hundred and ten millions two hundred and ninety thousand eight hundred and seventy?

2. How many ounces in the sum of ·04 tons, 4·416 lbs., 1·024 ounces, and $\frac{1}{2}$ of ·0604 cwt.?

3. *A* met two beggars, *B* and *C*, and having $\frac{11}{7}$ of $\frac{3\frac{7}{11}}{4\frac{2}{7}}$ of $\frac{10\frac{5}{7}}{7\frac{1}{2}}$ of $\frac{77}{540}$ of \$4.86 in his pocket, gave $\frac{2}{11}$ of $\frac{3}{4}$ of it to *B*, and $\frac{1}{4}$ of $\frac{3}{5}$ of the remainder to *C*. What sum had *A* remaining, and how much did *B* and *C* each receive?

4. Simplify $\left(1+\frac{1+\frac{1}{3}}{3}\right)\div\left(1+\frac{1}{3+\frac{1}{3}}\right)\div\left(1-\frac{1-\frac{1}{3}}{3}\right)$.

5. If 5 horses or 7 cows eat 13 tons of hay in 78 days, in what time will 2 horses and 3 cows eat a similar quantity?

6. Find the cost of $9\frac{5}{12}$ of $\frac{15}{113}$ of 1 ton 11 cwt. 2 qrs. 14 lbs. of sugar at \$9 per cwt.

7. *A*, *B* and *C* together can do a work in 12 days. *C* alone can do it in 24 days, *A* alone in 34 days. In what time can *B* do it alone?

8. An account was paid as follows: \$30 in five dollar bills, as many \$4 bills as fives, half as many \$1 bills as fours, eight half dollar pieces, three quarters, two ten cent pieces, and six five cent pieces. Find amount of account.

9. If 6 lbs. tea be worth 114 oranges, and 96 oranges worth 128 lemons, what is the price of 5 lbs. tea when a lemon is worth 4 cents.

10. *A* owes *B* \$460.88; he gives in payment 174½ yards of cloth at 96 cents per yard; 5 cwt. 2 qrs. sugar at \$11 per cwt.; and the remainder in coffee at 30 cents per lb. How many pounds does he give?

11. A cistern has four pipes, two supply pipes and two discharge pipes. One of the pipes fills the cistern in 30′ and the other in 45′; one-half the cistern can be emptied by one of the pipes in 25′, and one-fourth by the other in 15′. Supposing all the pipes opened at the same time, when would the cistern be filled?

12. The posts of an electric telegraph by the side of a railway are placed at intervals of 60 yards; find the rate per hour of a train which passes over eleven of these intervals in 25″. Also, find the least distance of two posts from each other which are an exact number of miles apart.

Ex. XVII.

1. State what are the advantages and disadvantages of vulgar fractions over decimal fractions?

Simplify $\dfrac{41\frac{1}{7}}{\frac{147}{1000}} \div \dfrac{\cdot 046}{\frac{1000}{441}}$

2. A person gave $429408 \div 59{\cdot}64$ of his estate for charitable purposes, and found that $\frac{25}{2482}$ of the remainder amounted to 26 acres 3 roods 19 yards. Find the size of the estate.

3 Dividend is $\frac{2\frac{1}{2}}{3\frac{1}{4}} + \frac{1\frac{1}{2} - \frac{5}{6}}{1\frac{1}{4} + \frac{5}{6}} - 1\frac{7}{39} + \frac{938}{975}$,

divisor is $\frac{10}{11} + \frac{3}{14}$ of $\frac{4\frac{5}{9}}{6\frac{1}{8}}$ of $\frac{6\frac{8}{11}}{11\frac{5}{7}}$,

remainder is $\frac{1}{3\frac{1}{5}} - \frac{2\frac{1}{4}}{9} + \frac{3\frac{5}{8}}{2} + \frac{\frac{4}{7}}{4\frac{4}{7}} - \frac{1}{2}$ of 4.

Find quotient.

4. Find value of $\frac{7\frac{5}{9} + \frac{2}{3} \text{ of } 3\frac{5}{12}}{3\frac{2}{5} \text{ of } \frac{203}{204}}$ of 18 acres 3 roods 17 perches × 29.

5. I spent $\cdot 007 \times 40$ of my money, and found that $\frac{1}{32}$ of the remainder was \$90; find original sum.

6. What fraction of 1 lb. Troy, when added to 1 oz. Troy, will give 1 lb. Avoirdupois together with 1 oz. Avoirdupois?

7. Find the value of $\frac{\cdot 001 \times \cdot 897}{11{\cdot}96 \times \cdot 0001}$ of 888 miles.

8. If a 40 horse-power engine cost £1000 to run for 40 days of 10 hours each, consuming 10 tons of coal every 5 hours; what will be the cost of running a 100 horse-power engine for 60 days of 5 hours each, consuming 15 tons of coal in 12 hours, 3 tons of the former being as effective as 7 of the latter?

9. By selling my goods at a profit of 15 per cent., I find that I can make \$500 more than by selling at 10 per cent. profit. What amount shall I realize by selling them at $12\frac{1}{2}$ per cent. profit?

10. A bankrupt has book debts equal in amount to his liabilities, but on \$30000 he only realizes 75 cents on the \$, and the expenses of bankruptcy are 4 per cent. on the book debts; he pays 80 cents on the \$. Find amount of his liabilities.

11. What number added to $\frac{7}{8} + \frac{5}{12}$ will give that number which, when subtracted from $3\frac{3}{8}$, leaves $1\frac{3}{4}$ for a remainder?

12. If one ship, with a cargo of 300 tons fresh Canadian beef, has to pay at the Custom House in Liverpool the value of 4 tons, less £12; and another ship, with 480 tons at the same rate, pays the value of 4 tons and £36; find the cost price of the beef per ton and gain in Canadian money, if the beef is sold at a gain of 25 per cent. Sterling exchange being at the ordinary rate of $9\frac{1}{2}$ per cent. premium.

Ex. XVIII.

1. Show that every decimal must either terminate or recur. In the latter case state the limit which the number of decimal places cannot exceed.

Find value of $\dfrac{\dot{3}07692\dot{}\times 2\cdot\dot{7}\dot{8}5714\dot{2}}{\dfrac{1}{8\cdot 02\dot{0}8\dot{3}}}$ to 3 places of decimals.

2. A father divides 100 acres of land between his two sons, so that the younger gets one-half as much again as

the elder; but for every twentieth part of a rood in the excess of his share over his brother's he has to pay the latter 10 cents. The land was worth $100 per acre. What is the value of their respective shares?

3. Find difference between $\frac{1}{13}$ of $(1+5\frac{1}{2})+\frac{5}{6}$ of $\frac{1}{27}$ of $(7-2\frac{2}{5})-\frac{1}{3}$, and $\frac{\frac{10}{3}+\frac{5}{6}-\frac{20}{21}}{\frac{5}{6}-\frac{4}{7}}$.

4. If 400 rooms can be heated with coal for $500 during 40 days of 20 hours each, 4 stoves being required for 9 rooms; for how many days of 11 hours each can 500 rooms be heated for $990, requiring 8 stoves for every 7 rooms; 5 tons of the former being as effective as 4 of the latter?

5. The divisor is one-third the G. C. M. of 5544 and 6552; the quotient is the difference between one-third L. C. M. of 7568 and 9504, and one-half L. C. M. of 4662 and 5476; the remainder is 50 times G. C. M. of 779 and 1800. Find the dividend.

6. A, B and C can do a piece of work in 10 days, A working as much as B. They all work at it for 5 days, when C stops, and A and B finish the work in 15 days. Find time in which A and C can do the whole work.

7. Find the largest integer which will divide the numbers 42698 and 75688, leaving for remainders 461 and 106 respectively.

8. A person insures 90 per cent. of the value of his house. After paying $135 for premiums, the house is burnt. Upon receiving his money from the Insurance Company, he finds that the sum amounts, clear of all charges, to 97 per cent. of the value of his house. Find the value of the house and the rate on the part insured.

9. A sum of money was invested by a broker for his principal in the undermentioned bank stocks, viz.: the Dominion Bank, at $124\frac{5}{8}$, the Standard at $72\frac{1}{8}$, Toronto at $153\frac{7}{8}$; the stocks yield dividends of 5 per cent., 4 per cent. and 6 per cent. respectively; commission on each kind of stock $\frac{1}{8}$ per cent. An equal amount of stock in each bank is thus obtained, and the income arising from them is $150. Find the amount the broker received to invest.

10. There is a certain island of which the northern part is sandy, the central marshy, and the southern arable land. It being known that the sandy part is 4 miles and one-third the arable, the marshy 14 miles and one-third the sandy, and the arable 18 miles and one-third the marshy, find whole length of the island.

11. A merchant in Toronto owes another in Hamburg $5357; he is asked to remit by way of London, Paris, Berlin and Hamburg. What does the merchant in Hamburg receive at the following exchanges: Toronto to London, $9\frac{1}{2}$ per cent. premium; London and Paris, £1 = 25.5 francs; Paris and Berlin, $4\frac{1}{2}$ francs = 1 thaler; Berlin and Hamburg, 18 marcs for 4 thalers. Did the merchant in Hamburg act wisely in so doing? gaining or losing, and how much, by the indirect course of exchange, the marc being worth 30 cents?

12. A person has $25500, which he wishes to invest. The 6 per cent. consols are at 81, and certain guaranteed railway shares, which pay a half-yearly dividend of $1 on each original share of $25, are at 24. Find how many shares he must buy that he may obtain the same income from the railway shares as from the rest of his money invested in the consols.

Ex. XIX.

1. A man bought a house, which cost him 4 per cent. of the purchase money to put it in repair. It stood empty for a year, during which he reckoned he was losing 8 per cent. on his total outlay. He then sold it for $1223.20, by which means he gained a sum equal to 10 per cent. of his original purchase money. Find what he gave for the house.

2. A man bought 200 lbs. Porto Rico sugar at $9\frac{1}{4}$ cent. per lb., and 100 lbs. Scotch at $9\frac{3}{4}$ cents He takes 100 lbs. of the Porto Rico and mixes 10 lbs. of sand with it to supply a deficiency of 10 lbs. which he took for household use; he then sells this sugar at a gain of $18\frac{4}{37}$ per cent., and the remaining sugars at a price equal to 14 per cent. of the selling price of the adulterated sugar. Find his gain per cent. on what he sold.

3. In a debating society, a certain resolution being brought forward, it was carried by a majority which was equal to one-third the number of votes given on the losing side. If, with the same number of voters, 10 more had been given to the losing side, the resolution had been carried but by a majority of 1. Find the number of votes on either side.

4. The road from a place A to a place B part ascends for 5 miles, then it is level for 4 miles, and then it descends for 6 miles, the rest of the distance. A man walks from A to B in 3 hours and 52 minutes. On the day following he walks back to A in 4 hours; he then walks half way to B, but having left his purse behind he travels back to A, which he reaches after an absence of 3 hours and 35 minutes. Find his rates of walking uphill, on level ground, and downhill, supposing his rate remained unchanged.

5. **The present** income of a railway permits a dividend of 6 per cent., if there were no preference shares; but as \$40000 of the stock consists of such shares, which are guaranteed to yield $7\frac{1}{2}$ per cent., the ordinary shareholders receive only 5 per cent. Find the whole amount of stock?

6. Simplify $816\ \dfrac{\frac{14}{17}\ \text{of}\ 2\frac{1}{8}}{13\frac{1}{3}} - \dfrac{\frac{3}{8}\ \text{of}\ \frac{6}{7}\ \text{of}\ 80\frac{1}{6}\ \text{of}\ 9}{\frac{3}{7}\ \text{of}\ \frac{2}{5}\ \text{of}\ \frac{4}{5}\ \text{of}\ 8\frac{3}{4}}$.

7. Divisor is $\frac{3}{4}$ of $5\frac{1}{2} + \frac{3}{5}$ of $4\frac{1}{3} - \frac{7}{20}$ of $\frac{5}{6}$, quotient is $(\frac{3}{8} + \frac{5}{12}) \div \frac{25}{24}$, remainder is $\frac{4}{17}$ of $\frac{119}{120} + \frac{2}{3}$ of $\frac{5}{20}$. Find dividend.

8. By selling one-fifth of a certain amount of goods at a profit of 20 per cent., one-tenth at a gain of 40 per cent., and the remainder at a loss of 4 per cent., \$2600 less is gained than if they had been sold at a gain of $10\frac{2}{5}$ per cent. What did the goods cost?

9. Two men drive round an oval course in the same direction at the rate of 13 miles and 17 miles respectively an hour. When and where will they first be together, supposing the course to be 60 miles round?

10. Divide \$166.80 between A, B and C, giving A two-thirds as much again as B and \$50 besides, or seven-eighths as much again as C and \$100 besides.

11. Find the value of $2\frac{1}{2} \times \dfrac{1}{3\frac{1}{3} + \dfrac{1}{4\frac{1}{4}}}$ of 13 acres.

12. Mint gold has 22 parts pure gold to 2 parts copper, and is worth £3 17*s.* 10½*d.* per oz. Find value of 1 oz. pure gold, supposing the copper to be worth ½*d.*; also find value of an oz. of copper.

Ex. XX.

1. Define the following terms: Quotient, Divisor, Remainder.

2. If 40 times the remainder be added to the quotient, the result is 5525; but if 20 times remainder be added to quotient, the result is 3145. The dividend is 514795033379: find divisor.

3. Reduce 4 lbs. 2 oz. 6 drs. Avoirdupois to the decimal of 2 lbs. 4 dwts. Troy.

4. Divide \$610 between A, B and C, giving A two-thirds as much again as B and \$100 besides, and giving C four-fifths as much again as A and B together and \$50 more.

5. Reduce $\frac{\dot{1}42857\dot{}}{3\cdot6\dot{4}28571\dot{}}$ to 6 places of decimals.

6. If the multiplicand had been 35 more, it would want 200 of 1000; if the difference between the product and multiplicand were increased by 505, it would amount to 514795033000. Find multiplier.

7. Reduce $(\frac{4}{5}$ of $\frac{1}{2}-\frac{2}{3}$ of $\frac{9}{17}+\frac{3}{5}$ of $1\frac{19}{17})$ of 75 French Ells to fraction of $\left(\frac{2\frac{3}{4}+3\frac{2}{5}}{4\frac{1}{5}+5\frac{1}{4}}+\frac{3\frac{2}{5}}{10\frac{1}{2}}\right)$ of English Ells.

8. A farmer's wife knows neither the weight nor prime cost of a tub of butter which she sold. She recollects that she sold it for 30 cents per lb. she would have gained $1, and if she sold it for 22 cents per lb. she would have lost 3 times as much as she gained before. What was the weight and prime cost of the butter per lb.?

9. The rent of a merchant's warehouse is $200. His expenditure (of which one-sixth was taxes) the first year was such that he could only pay his landlord $120; the second year the rent was lowered 20 per cent., taxes were reduced one-half, and his business increased one-third; and now, after paying his rent and former debt, he has $20 over. Find his expenditure.

10. There is an island 90 miles in circumference. Three men start together to travel round it, *P* goes 5 miles a day, *Q*, 8, and *R*, 10; in how many days will they be together again?

11. A merchant sends his agent wheat, barley and cash to a certain amount; the cash is 40 per cent. of the whole and barley 25 per cent. He directs his agent to sell the product and invest the proceeds in bank stock. The agent charges 3 per cent. for buying bank stock, 5 per cent. for selling wheat, and 3 per cent. for barley; his commission amounts to $542.50. Find how much wheat and barley were worth.

12. A yacht and a row-boat start from Toronto for the Port of Niagara, a distance of 32 miles, at the same time. The yacht goes out into the Lake 10 miles, tacks and cuts the row-boat's straight course for Niagara at right angles, 6 miles from her tacking point. After crossing the yacht continues her course for three-fourths the distance she

was from Niagara at point of crossing, and then 4 hours after her first tack, tacks for Niagara, sailing at the rate of 10 miles per hour. The row-boat took 2 hours to reach the point where her course was crossed by the yacht. Find the average rates of motion of the two boats, and which got into Niagara first.

Ex. XXI.

1. Show that to divide a fraction by a whole number, you divide either the numerator or multiply the denominator by it. Why is the rule given in the latter form?

2. From what number must we take, $3\frac{1}{2}+1\frac{1}{3}+2\frac{1}{4}+4\frac{5}{12}$, to leave $7\frac{5}{8}+\frac{11}{12}+6+\frac{17}{16}$?

3. Find the value of $7\frac{3}{13}$ of $\cfrac{1}{10+\cfrac{1}{3+\frac{1}{3}}}$ of \$210.10.

4. Divide 14 acres 3 roods 17 perches between A, B and C, giving A 75 yards more than B, and C 100 yards more than A.

5. A grocer mixes coffee at 40 cents per lb., and chicory at 10 cents per lb. in the proportion of 15 lbs. of coffee to 3 lbs. of chicory, and sells mixture at 60 cents per lb.; what part of his outlay does he gain?

6. When the remainder is 491 and dividend is 26742938, if the quotient exceed the remainder by 14292, by how much does it exceed the divisor?

7. The paid up capital of a railway company is \$1000000, of which 50 per cent. is on a mortgage at 6 per cent.; 20 per cent. are preference shares paying 7 per cent.; 10 per

cent. have been obtained as bonuses; and the remainder, ordinary stock at 5 per cent. The working expenses average 80 per cent. of the receipts. Find the weekly receipts.

8. A company sells gas at \$2 per 1000 cubic feet, which cost the company \$1.80. 400000000 cubic feet of gas are sold in the year; the annual salaries and other expenses amount to 40 per cent. of the net profits; and the paid up capital is \$5000000, on which a dividend of $7\frac{1}{2}$ per cent. annually is paid. Find the reserve fund.

9. If A can do as much work in 5 hours as B in 6, and as much in 5 hours as C in 9: how long will it take C to complete a piece of work, one-half of which has been done by A working 12 hours and B 24 hours?

10. A person has stock in the 3 per cent. consols that will yield an income of \$240 per annum. He sells out one-fourth of the stock at $87\frac{1}{4}$, and invests the proceeds in Bank of Montreal stock at $174\frac{1}{2}$. What dividend per cent. per annum does the Bank of Montreal stock pay so that by the transaction he may increase his income \$40 a year?

11. A merchant, A, has goods worth \$960 in cash, which he sells to another merchant, B, at 6 months' credit, for \$1592.50. If A and B give mutual credit at the same rate of interest, find the cash value of B's goods.

12. A body of soldiers being brought out to drill, were ordered to form a solid square; but in so doing 56 men were left out of the square. The commanding officer then took 4 ranks from the rear of the square, and with these and the 56 additional men added 6 ranks to the flank, thus forming a rectangle whose longest side now contained 6 men more than the original square. Find number of soldiers.

Ex. XXII.

1. Show that $\frac{2}{3} \times \frac{2}{7} = \frac{4}{21}$; also do this by expressing the given fractions as integers, and prove the proposition by the simple rules.

2. A sailing vessel and a steamer start from the same place to go a distance of 48 miles; the sailing vessel is 120 feet long, leaves an hour before the steamer, and takes $10\frac{5}{22}$ seconds to pass a fixed point. The steamer has to call at three intermediate ports, at each of which she stops 10 minutes, and goes out of her way the distance she would go in 10, 20 and 15 minutes respectively. The rate of the steamer is to that of the sailing vessel as $1 : 1\frac{7}{8}$. Find by how much the steamer was before or behind at the finish.

3. I obtain a certain number of eggs each week, and find that the number of eggs varies inversely as the selling price of each egg in cents. When eggs are 3 cents each I get 10 per week; how many will I get per week when eggs are 6 cents per dozen?

4. In the construction of a railway 8000 cubic yards are to be excavated, and the earth carried by means of waggons to a distance of 4 miles; these travel at the rate of 4 miles an hour loaded, and return empty at the rate of 5 miles per hour; there are 720 cubic feet conveyed each journey, and the nature of the material is such as to require 3 pickmen to 4 shovellers. Required to find the time when the excavation will be completed, the number of men of each sort necessary to keep the waggons going, and the cost of the work exclusive of the waggons; allowing \$1.20 per day of 10 hours to each workman, and supposing each shoveller to lift 300 cubic feet of earth per day.

5. The capital of a railway company is \$11400000; besides this there are \$3420000 preference shares, paying $5\frac{1}{4}$ per cent., and \$2800000 debentures, paying on an average $4\frac{1}{2}$ per cent. per annum. The half-yearly receipts are \$725000, and the current expenses are 59 per cent. of the receipts. Find the half-yearly rate per cent. for the shareholders, laying by for contingencies each half-year \$1200.

6. If the price of pure whiskey be \$2.52 per gallon, and its specific gravity be 75, what should be the price of a mixture of whiskey and water, which in gauging is found to be of sp. gr. 8; sp. gr. of water being unity?

7. A schooner leaves Buffalo for Toledo, and after sailing one-fourth of the distance, springs a leak which lets in 10 tons of water per hour; the pumps can throw off $1\frac{1}{2}$ tons in 10 minutes, and 80 tons will sink her. If the distance from Buffalo to Toledo be 240 miles, at what rate per hour does she sail after springing the leak, if she sinks 5 miles from Toledo?

8. The distance from a certain house to a school-house along a sidewalk is 1200 yards. Telegraph poles are erected at intervals of 60 yards; shade trees of 3 kinds, viz., horse chestnut, maple and lime, are planted by the sidewalk, at distances of 6 feet, 9 feet and 12 feet respectively. If I take a step a yard long each time, how many times will my step coincide with a telegraph pole and a shade tree?

9. *A* can mow a field in 15 days by getting 7 days' help from *B*, and *B* can do it in 24 days by getting $2\frac{2}{7}$ days' help from *A*; in what time will the two working together do it?

10. At a certain examination two candidates, L and M, presented themselves. L got 600 marks and failed; M gets 20 per cent. more than L, and if he had got 130 marks more, he would have had a number of marks equal to $\frac{17}{15}$ of the minimum for Pass. Find the minimum for Pass. Solve this question in two ways; 1st, understanding the 20 per cent. to refer to the number of marks L obtained, and 2nd, to the number of marks necessary for Pass.

11. A invested £5600, and B £4200 in a joint business, on condition that each should receive for management 5 per cent. on the profits, and that the remainder should be divided between them, according to the capital. After 9 months A retired from the management and B invested £2800 more in the business, and thenceforth received 10 per cent. on the profits for management. What share ought each to receive of the gross profits, which amounted to £2565 8*s.* 4*d.* at the end of 12 months?

12. A and B ride a race of 50 miles on bicycles. The wheel of A's bicycle makes 3 revolutions in 2 seconds. A accomplishes the distance in 3 hours 20 minutes, and B in $\frac{11}{10}$ of this time. Find the difference between the circumferences of the wheels of the bicycles.

Ex. XXIII.

1. Define Interest, both Simple and Compound. Find the difference between the simple and compound interest of $800 for two years at 8 per cent. per annum, payable half-yearly.

2. I own $\frac{177}{438862}$ of a ship, and sell $\frac{1156815}{1594477}$ of my share, and find that I am still worth in the vessel $50. What was she worth?

3. A cistern can be filled by three pipes in 8, 10 and 12 minutes respectively, and emptied by a fourth in 5 minutes. Supposing that all four taps were turned on at the same time, how much per cent. of the cistern would be filled in 6 minutes?

4. Required to make an alloy containing by weight 8 parts bismuth, 5 lead and 3 tin. The only bismuth I can get is $1\frac{1}{2}$ cwt. of an alloy containing 11 parts bismuth, 3 tin and 2 lead. What weight of tin and lead must I add to this? (Cwt. = 112 lbs.)

5. A builder signs a contract, estimating two-thirds of the whole cost for materials and one-third for labour. When one-third of the time has expired, 30 per cent. of the materials rise 10 per cent.; and on the expiration of half the time, 60 per cent. of the labour rises from 24 cents to 27 cents per hour. Supposing an original profit of 5 per cent. to have been charged, what is the final gain or loss per cent.?

6. *A* invests \$2000 in bank stock at par and receives a dividend of 4 per cent. half-yearly for two years, when dividends cease for two payments. The stock is then reduced 25 per cent., and a half-yearly dividend of 3 per cent. is declared on the reduced stock, on receiving which he sells out at $80\frac{1}{8}$, paying $\frac{1}{8}$ per cent. for commission. *B* at the same time invests \$2000 in a mortgage at 9 per cent. for $3\frac{1}{2}$ years. Expense of mortgage, &c., was \$4, which he had to pay. Which is the more profitable investment and by how much, allowing *A* compound interest at 9 per cent. on all dividends received?

7. Simplify $\frac{\frac{3}{4}}{1\frac{7}{8}} + \frac{2\frac{11}{12}}{\frac{5}{9}} - \frac{\frac{1}{27}}{2\frac{1}{3}}$.

8. I wish to cash a note, made on July 30th and ne November 5th, for $850, interest at 9 per cent., days of grace being allowed. What will the bankers allow me ?

9. Simplify $\frac{33{\cdot}07949}{{\cdot}745 \times {\cdot}00298}$.

10. An ounce of gold is worth £3 17*s.* 10½*d.* In making sovereigns two parts out of every twenty-three consist of an alloy worth 1½*d.* per oz. How much gold and how much alloy will be respectively needed for 5230 sovereigns.

11. An accommodation train on the Grand Trunk Railway is 4 hours in travelling from *P* to *Q*, and the mail train takes 1½ hours less. A mail train leaves Toronto at 5 a.m., and arrives in Whitby just when the accommodation is leaving, which arrives in Toronto at 10.30 a.m. Find how long the mail is in going to Whitby.

12. A proprietor of railway stock received last year a dividend of 8 per cent. on his stock, and paid an income tax of 1½ cents in the dollar. This year the dividends have fallen off to 7 per cent., and income tax raised ½ cent, and his net income is reduced by $510. Find the amount of stock which he holds.

Ex. XXIV.

1. Define Discount—Present Worth. Distinguish between True Discount and Bankers' Discount.

2. A man has three notes: one for $300 at 6 months, another for $400 at 9 months, and a third for $60 at 5 months. He gets for these one note for $700 at 6 months, and another for $800 at 5 months. For what sum should a third note for 4 months be given?

3. If for 4 sovereigns I can buy 44 gulden 48 krutsers, or 102 francs; and for one 20-franc piece I can buy 9 gulden 20 krutsers; how much per cent. do I gain by buying French gold with my English gold before buying German money?

4. A merchant in Oporto, Spain, owes another in Constantinople 5200 reals. He has two ways of exchange open to him: first, by draft, the expenses of which are 20 per cent.; second, by Marseilles, Rome, Athens and Constantinople, at the following rates: 52 reals = 25 francs, 24 francs = $4\frac{1}{2}$ scudi, 4 scudi = 30 drachmas, 25 drachmas = 110 piastres. Given that 125 piastres = 52 reals, which way is most advantageous to the Turk, and by how much?

5. At the review of an army, the troops were drawn up in a solid mass 60 deep, when there were just one-fourth as many men in the front rank as there were spectators. Had the depth, however, been increased by 5, and the spectators drawn up with the army, there would have been 10 fewer men in the front rank than before. Find strength of army.

6. The trustees of a certain church insure 75 per cent. of its value in an insurance company at $3\frac{2}{15}$ per cent.; the company immediately re-insured 40 per cent. of their risk in another company, and 50 per cent. of it in a third. The first company loses, on the church being burnt down, $4390. Find the value of the church; the rates for second and third companies being $2\frac{9}{10}$ and $3\frac{1}{8}$ per cent. respectively.

7. The Russian government determines to transport 1000 horses to the seat of war. When two-thirds of the voyage has been accomplished, a storm overtakes the transports in which 30 of the horses die. The whole cost of

transportation was 198 roubles. If each horse cost 1 kopeck per day, what was the length of the voyage? (A rouble = 100 kopecks).

8. A certain iceberg, one-third above water, floating in the Gulf Stream, is melted by the combined action of the water and sun. In the day time the part above water is diminished one-tenth, while at night it is diminished five per cent.; the part below water during the day is reduced in bulk twenty per cent., while the same portion during the night loses one-tenth. At 6 o'clock on the 5th May the iceberg enters the stream; on the following morning at 6 its displacement is 30000 cubic feet less than before. Water expands ten per cent. in freezing; cubic foot of sea water = 1036 oz. Find the number of tons of sea water which the ocean receives on the iceberg being melted.

9. A man invests a certain sum through a broker in debentures, paying 5 per cent. per annum, and finds that he has $5\frac{1}{2}$ per cent. on his money after paying an income tax of 2 cents 5 mills on the dollar. The broker charges one-eighth per cent. commission. What was the price of the debentures?

10. A young man inherited an estate of $40000; after spending one-fifth of it, he invested the remainder in a joint stock company, which failed, paying $66\frac{2}{3}$ cents in the dollar; with the remaining money he purchased 5-20 United States bonds at par, bearing 6 per cent. interest payable in gold. How much was his yearly income in currency, gold being 175 per cent.?

11. A Collingwood merchant bought a quantity of pork for $6000, and forwarded it to Toronto, paying 9 per

cent. of the cost for freight and other charges; it was then sold by an agent at an advance of 30 per cent. on the prime cost, commission 5 per cent. How much was the net gain?

XXV.

1. Define Ratio, Proportion. What is a Mean Proportional?

2. *A* had at first 5*s.*, and *B*, after paying $\frac{2\frac{4}{5}}{7}$ of $\frac{7\frac{1}{2}}{4}$ of $\frac{6\frac{2}{3}}{2}$ of 3*s.* to *A*, found that he had just $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of what *A* then had. What was *B*'s money?

3. What number must be added to 51 to produce the excess of 10 times the L. C. M. over $\frac{1}{11}$ of the G. C. M. of 264, 418?

4. Multiply $2\frac{3}{7} - 8\frac{1}{14} + \frac{2}{3} + \frac{4}{5} + 1\frac{1}{3}$ of $\frac{2\frac{1}{2}}{11}$ by $\frac{11}{15}$ of $1\frac{3}{2\frac{1}{2}}$ of $\frac{1}{7\frac{1}{0}}$ of $\frac{7}{12}$ of $37\frac{14}{35}$ of $3\frac{1}{8}$ of $\frac{1}{11}$.

5. What part of $\frac{5}{9}$ of £2 6*s.* $8\frac{1}{4}d.$ is $\frac{\frac{3}{4}\text{ of }4\frac{2}{7}}{5\frac{1}{7}-\frac{1}{14}}$ of 4*s.* $5\frac{1}{4}d.$

6. Divide 4 acres 3 roods 17 perches × 19 between *A* and *B*, giving *A* five-sevenths as much again as *B*.

7. A fortress is victualled for 360 days; at the end of 60 days, it is found that 25 per cent. of the stores then remaining is unfit for use; at the end of 40 days more a reinforcement arrives of 3000 men, and then the stores are made to last 74 days longer by putting the men on half rations. Find the strength of the original garrison.

8. A man can hoe four-fifths of an acre in five-sixths of a day, and a boy can hoe five-sixths of an acre in $1\frac{1}{2}$

days. How long will it take 4 men and 5 boys to hoe 20 acres, after 3 men had been working one-half day each, and 4 boys one-third day each?

9. In computing the custom's duties on a cargo of wine the officer used by mistake the beer or imperial measure. The duty at $1.20 per gallon was $48000; required the number of wine gallons, and also the sum lost by using the wrong measure.

10. *A*, *B* and *C* can do four-fifths of a piece of work together in 24 days. *A* does the same amount of work as *B* in the same time. Had either *A* or *B* been absent, then the two others would have accomplished five-ninths of the work in 28 days. In what time can each separately do the work?

11. A person who held bonds in the Toronto, Grey and Bruce Railway to the amount of $54000, exchanged them at a market price of 96 per cent. for capital stock in the same company selling at 81 per cent. The bonds produced 8 per cent. annually; the stockholders received two dividends a year—one of $3\frac{1}{2}$ per cent., the other of 4 per cent. Find the amount the person gained or lost annually by the exchange.

12. A southern merchant shipped to his agent in New York a quantity of sugar, consisting of 200 barrels of New Orleans, each containing 216 lbs., purchased at 5 cents per lb.; and 560 barrels of West India, each containing 200 lbs., purchased at $5\frac{3}{4}$ cents per lb.; freight on this shipment amounts to $\frac{2}{5}$ per cent. The agent's account of the sales shows a loss of 1 per cent. on the New Orleans, and a profit of $\frac{29}{33}$ per cent. on the West India sugar. How much did the merchant gain or lose?

Ex. XXVI.

1. Explain how you express one concrete number as the fraction of another concrete number. Of what nature is your answer?

2. What part of $\frac{2\frac{1}{4} - \frac{2}{3} \times 1\frac{5}{6}}{\frac{1}{5} \times 3\frac{1}{3} + \frac{13}{36}}$ of $\frac{6}{7}$ of 1 inch is $\frac{11\frac{5}{7} - 7\frac{5}{11}}{3\frac{1}{2} + 5\frac{5}{22}}$ of 1 Flemish ell?

3. What decimal is 5 mls. 5 fur. 11 per. 4 yds. 2 ft. of 372032 French ells, 5 qrs. 1 nl. $\frac{3}{4}$ in.? Give answer correct to four decimal places.

4. A speculator in Toronto sends \$9835$\frac{30}{107}$ gold to a broker in New York to be invested in the following railway stocks (the first two of which pay 4 per cent. per annum, while the third only pays $2\frac{11}{20}$ per cent.). In the New York Central at $92\frac{1}{2}$, \$2778$\frac{3}{4}$ was invested; in the Rock Island at $94\frac{3}{4}$, \$3795.00 was invested; and in the Delaware and Hudson at $39\frac{3}{8}$, the remainder was invested. The quotations in the above stocks, as well as the interest, are in United States currency. If the agent charge $\frac{1}{8}$ per cent. commission on each transaction, and turn the Canadian money into American currency before investing, find the income of the speculator in Canadian money, gold being 107.

5. The multiplier exceeds the multiplicand as much as it wants of 148891, and if it be increased by 21153, it would equal 100000. Find the product.

6. Divisor is three-fifths of dividend, which is 916 acres 2 roods 17 perches. What is the quotient?

7. A snail trying to reach the top of a pole 20 ft. 4 in. high, climbs 14 inches during the day and falls back 6 inches during the night. How long will it take to get there?

8. A hare pursued by a dog has one-eighth of a mile the start: but the dog can run 15 inches while the hare runs 12 inches. How long will the dog take to catch the hare if he runs at the rate of 10 miles an hour?

9. Height of a room is $4\frac{2}{3}$ yards; the cost of painting the shorter wall at 1*s.* 6*d.* a foot is £12 12*s.*, and the cost of painting all the walls at 1*s.* 3*d.* a foot amounts to £73 10*s.* Find the length and breadth of the room.

10. How much is paid to the booksellers when \$1.36 is charged to them for a \$1.92 book, 25 copies are given for 24, 10 per cent. deducted for commission from the amount, and the money is paid 5 months after the expiration of the year, the interest on money due being reckoned at 5 per cent. for the last 5 months?

11. If 19 lbs. of gold weigh 18 lbs. in water, and 10 lbs. of silver weigh 9 lbs. in water, find the quantity of gold and silver in a mass of gold and silver weighing 106 lbs. in air and 99 lbs. in water?

Ex. XXVII.

1. What is Multiplication? Show by an example that it is a particular case of Addition.

2. The remainder is 542962567, quotient 5771, divisor 687637943. Find dividend.

3. From what number must one-twelfth of the G. C. M. of 3444 and 2268 be taken to produce the same number as, added to one-seventh the L. C. M., makes it 1000000?

4. Reduce $1\frac{1}{2}$ acres $- 1\frac{1}{2}$ rods to the fraction of $37\frac{1}{2}$ rods $- 7\frac{1}{2}$ feet.

5. Two houses, a barn and lot, cost together $2337.40; the barn cost one-twelfth as much as a house, and cost of house was three times as much as that of the lot. Find value of each.

6. I own $\frac{19}{125}$ of a vessel, and find, after selling $\frac{730}{855}$ of my share, that I have still left a part of the vessel worth $100. What was the value of the vessel?

7. 500 sovereigns weigh 10 lbs. 8 oz. 18 dwt. 3 grs. Find the weight of $62\frac{1}{2}$ sovereigns.

8. The rent of a fishery is £350. The tenant employs 12 men at 11*d.* per day, and an overseer at treble wages. The fishermen get one-ninth of the fish caught. The fishing season extends to 219 working days, and they catch on an average 290 fish in 5 days, weighing on an average $4\frac{1}{2}$ lbs. each. The expense of boats, nets, &c., is £69 5*s.* 9*d.* The fish are packed in barrels, each containing 292 lbs.; price of each barrel, 3*s.* 9*d.*; salt for each barrel, 1*s.* 3*d.* Required, price at which they must be sold, that the tenant's gain may be $12\frac{1}{2}$ per cent.

9. The sides of a triangle are 36, 45 and 54. Find the segments into which the line bisecting the greatest angle divides the opposite side.

10. Two merchants, *A* and *B*, trade together, *A*'s share in the business being three-fourths. At the dissolution of the co-partnership the stock in hand amounted to £2564 10s., and the debts due to £3658 6*s.* 8*d.* *A* has the debts assigned to him at 17*s.* 6*d.* per £, and *B* takes the goods at five per cent. discount. How will accounts stand between them?

11. The shares of a certain undertaking pay $87\frac{1}{2}$ cents each, being at the rate of 5 per cent. What interest per

cent. will a person make on his money who buys them at $\frac{7}{8}$ premium?

12. If 12 oxen eat $3\frac{1}{3}$ acres of grass in 4 weeks, and 21 oxen eat 10 acres in 9 weeks, how many oxen will eat 24 acres in 18 weeks?

Ex. XXVIII.

1. Show that if a proportion exist among four numbers taken in a certain order, it will exist also among the numbers taken in the contrary order.

2. If 9 oxen can be kept for the same money as 7 horses for any given time, and assuming that a team of oxen takes one-fifth as long again to plough 97 acres as the same number of horses takes in ploughing 90 acres; and that the cost of ploughing a field with oxen or horses is the same, viz., £7 5*s.* 6*d.*, the same number of men being employed in both cases, and paid by time: find the respective wages due to them.

3. The distance from New York to San Francisco is 3500 miles by the Pacific Railway. Three trains leave New York each day at 12.05 midnight, 8 a.m. and 4 p.m. respectively; and in like manner, at like times, three trains leave San Francisco daily for New York. Now, supposing that each train takes exactly 7 days to perform the journey, how many trains coming from San Francisco should I meet in case I were to leave New York at 12.05 midnight, on Monday, 27th September, making allowance for the difference of time between the two places—longitude of San Francisco being 122° 08′ west, and that of New York 73° 59′ west?

4. *A* and *B* run a race of 150 yards. *A*'s rate is 1 mile in $3\frac{1}{2}$ minutes; *B*'s, 21 yards in $2\frac{1}{2}$ seconds. After running

two-thirds of the distance, *A* increases his speed to the rate of a mile in 3 minutes 12 seconds, and *B* to 9 yards per second. Which wins the race, and by how much?

5. Two trains start at the same time from Toronto and another station east of it. If they run towards each other they will meet in 4 hours; if they both run east the Toronto train will overtake the other in 8 hours 48 minutes. Supposing the faster to run 40 miles an hour, how far is the station east of Toronto?

6. The diameter of the hind wheel of a pony chaise is double that of the fore wheel. After travelling $\frac{2}{5}$ of a mile, it is found that the hind wheel has made 256 revolutions. Find the number of revolutions that the fore wheel will make in a mile, and state its diameter.

7. A broker in England advises a broker in Toronto to credit a loaning company with £3600 sterling. The bank credits the company with $17430. What was the rate of exchange?

8. A shilling weighs 3 dwts. 15 grs., of which three parts out of forty are alloy. What is the value, according to this rate, of an ounce of *pure* silver?

9. At what rate (Compound Interest) must $100 be invested for two years, so that the second year's interest shall exceed the first year's by $1.

10. The atmospheric pressure which a man generally supports is reckoned at 30000 lbs. How many square feet of surface does this suppose, if the pressure be 14·76 lbs. to the square inch?

11. An Attic talent was worth $62\frac{3}{8}\frac{7}{2}\frac{4}{3}$ pounds of English standard gold; 60 minæ make a talent, and 100 drachms

a mina. If the par of exchange between England and France be £1 for 25·9459̇ francs, and English standard gold be worth £46·725 per pound: compare the respective values of a French franc and an Attic drachm.

12. Find the value of

$$\frac{3\frac{1}{2} \text{ of } \frac{27}{28} \text{ of } 1\frac{1}{81} - \frac{1}{8} \text{ of } \frac{4}{7} \text{ of } 5\frac{1}{4} + 3\frac{3}{4} \text{ of } \frac{1}{55} \text{ of } \frac{121}{9} + \frac{1}{24}}{2\frac{5}{8} + 3\frac{7}{16} + \frac{25}{4} + 1\frac{2}{3} + \frac{27}{16} + \frac{10}{3}}.$$

Ex. XXIX.

1. Water expands one-tenth in freezing. Find the weight of water in a block of ice containing 550 cubic feet. (A cubic foot of water weighs 1000 ounces.)

2. A grocer mixes coffee at 40 cents per lb. with chicory at 10 cents a lb., at the rate of 15 lbs. of coffee to 3 lbs. of chicory, and sells the mixture at 60 cents per lb. What part of his outlay does he gain?

3. At what rate per cent. will $760 amount to $1000 in 4 years?

4. Find the difference between true and banker's discount on a note paid on the 18th of June, due on the 27th of August of the same year, for $560, interest at 8 per cent., and days of grace allowed.

5. On the 27th July I receive $845 for a note of $860. When is the note legally due, interest at 8 per cent. per annum.

6. I wish to exchange £800 sterling from the 3 per cent. consols at 93⅛ to Bank of Commerce stock at 154. How much will I receive? (£ sterling = $4.86.)

7. I put $270 out for 2 years at 8 per cent. compound interest, and then invest the amount in Government 8 per cents. at 104. Find annual income.

8. I purchase on 3rd January $1800 B. N. A. 10 per cent. stock at 112½, with a note of $5000, due 24th March of the same year, bearing interest at 8 per cent. Find derivable income.

9. At what rate per cent. will $270 produce $44·928 in two years at compound interest?

10. On the 30th December, 1799, a bill for $350 was discounted at bank for $343. When was it nominally due, interest at 10 per cent. per annum?

11. To pay for a house for 3 years, I can either pay $450 cash, or $150 at the end of each year. By how much is one method better than another at 10 per cent.?

12. Goods are marked at $2.40 per yard, being 20 per cent. advance on the selling price. At what figure were they bought so that the merchant may still gain 40 per cent.?

Ex. XXX.

1. Explain what is meant by the "Funds" in England. Have we anything corresponding to these in Canada?

2. I invest $230 for 3 years at 7 per cent., and then purchase Bank of Commerce 12 per cents. at 114½. How much stock can I obtain?

3. Two pounds of tea, three pounds of coffee and half pound sugar cost together $2.45. If tea rose 20 per cent., coffee 25 per cent., sugar 10 per cent., the same would

cost \$2.99½; but if tea fell 10 per cent. and coffee 40 per cent., and sugar rose 20 per cent., the same would cost \$1.86. Find price of each per lb.

4. Divide \$464 between *A*, *B*, *C* and *D*, giving *B* five-sixths as much again as *C*; *A* eight-elevenths as much again as *B* and *C* together; while *D* gets as much as all the rest, and \$200 besides.

5. What sum, put out at compound interest for three years at 7 per cent., will produce, as interest, \$180.03$\frac{11}{25}$?

6. To pay for a farm in 4 years, I may pay \$120 at the end of each year. If money is worth 5 per cent. per annum, what sum should I be allowed to pay at once to purchase the farm?

7. A person has \$10000 7$\frac{1}{5}$ per cents. at 175, but sells out and buys Bank of Commerce stock at 125, paying 3$\frac{3}{8}$ per cent. half-yearly. Find alteration in his income.

8. A vessel, with an insurance of 4 per cent. for one week on the three-fourths value of cargo, is reported an entire loss. The owner of cargo, *A*, sells out to *B* for one-fourth the *cost value of cargo and premium of insurance*. *B* effects an insurance for one week longer at 50 per cent. on old *policy value* of cargo, at expiration of which time the vessel arrives and the cargo is sold for \$202400, a profit of 33$\frac{1}{3}$ per cent. on amount paid to *A* and the insurance by *B*. Find the value of goods when shipped by *A*.

9. A solid iron ball, 7 inches in diameter, weighs 64 pounds; a shell the same size, with a hollow space in the centre in the form of a sphere, weighs 37 pounds. If the weight varies as the cubes of the radii, find the diameter of the hollow part.

10. Milwaukee grain dealers had wheat on hand on May 1st, purchased at an average of \$1.08 currency per bushel. *A* sold in Milwaukee at \$1.44 currency per bushel; *B* shipped to Montreal by rail, and on its arrival realized a price which paid freight at 41⅔ cents per 100 pounds, and an advance of 11⅔ cents gold per bushel on *A*'s selling price. *C* shipped to Montreal by vessel, and effected a saving of 5 cents gold per bushel in freight (as compared with *B*). Ground it into flour, 10 bushels wheat producing 2 barrels flour and middlings, bran, &c., enough to pay freight on 37½ bushels from Milwaukee. £2 5*s*. per barrel is realized in Liverpool. Insurance, freight, &c., amounts to 30 cents per barrel. Exchange between Liverpool and Montreal 111. Gold 108. How much more does *C* make on 10000 bushels than *B*? All freights payable in gold. Answer in currency or gold.

11. (*a*) If the commission on purchasing stock is ⅛ per cent. on the stock purchased, what ought to be the price of the 3 per cents. when the 3½ per cents. are at 89⅞, in order that an equal income may arise from investing the same sum of money in either? (*b*) What ought to be the price if the commission were ⅛ per cent. on the money invested?

12. A store valued at \$12000 and stock at \$24000 are insured at a premium of 2 per cent., that in case of fire $\frac{47}{60}$ of the former, ⅝ value of latter and the premium of insurance may be recovered. Find the premium.

Ex. XXXI. (ADMISSION HIGH SCHOOLS. 1877.)

1. What is the least number that must be added to five millions to make the sum exactly divisible by seven thousand and nineteen?

2. Simplify $\frac{20}{21} - \left(\frac{48\frac{1}{2} + 7\frac{2}{3} - 16\frac{3}{4}}{16\frac{1}{2} \times 14\frac{1}{3} \times 12\frac{1}{4}} \div \frac{5\frac{2}{7}}{7\frac{2}{5}}\right)$.

3. Simplify $\frac{£14\ 12s.\ 11d.}{10\frac{4}{5} - 3\frac{5}{8}} \times \frac{£10\ 10s.\ 10d.}{10s.\ 9\frac{1}{2}d.}$

4. A man bought a quantity of hay at $15 for 20 cwt. He sold it at 85 cents. per cwt., gaining $22.25. How many cwt. did he buy?

5. $3\frac{1}{8}$ yards of cloth cost $12.50; what will $23\frac{7}{16}$ yards cost?

6. A person having an annual income of $1400, spends a sum equal to $625.50 more than he saves. Find his daily expenditure. (Year = 365 days).

7. A lady had in her purse just money enough to buy a certain quantity of silk; but she spent $\frac{3}{10}$ of the money in flannel, $\frac{3}{5}$ of the remainder in calico, and had then only enough money left to buy $10\frac{1}{2}$ yards of silk. How many yards of silk could she have bought at first?

8. A room 15 feet wide and 18 feet long is covered with matting at a cost of $25; what would be the expense of covering, with the same quality of matting, a room a yard longer and a yard wider?

9. The average of four quantities is $18\frac{35}{297}$; the first is 26·207, the second 3·592, and the third is 38·06̇. Find the fourth.

10. A bankrupt owes to *A* \$1039.84, and to *B* \$612.80; if *A* receives \$357.44$\frac{1}{2}$, what will *B* receive?

Ex. XXXII. (III. CLASS. 1877.)

1. If 69 German thalers, of which 9 parts in 10 are fine silver, weigh 41 ounces, what is the value of a thaler in English money when standard silver, of which 37 parts in 40 are fine, is worth 5*s*. 1$\frac{1}{2}$*d*. per ounce?

2. *A*, *B* and *C* can do a piece of work in 2 days, *A* and *C* in

$$6\left(\frac{7\frac{2}{9}\text{ of }12\frac{2}{3}}{2\frac{2}{9}\text{ of }15\frac{5}{6}}\right)-3\left(\frac{2\frac{1}{7}\text{ of }4\frac{1}{3}}{2\frac{11}{14}\text{ of }2\frac{1}{2}}\right)\text{ days};$$

in what time can *B* do it alone?

3. A certain kind of brass is made by fusing together old brass, refined copper and zinc, in the proportion of 33, 55 and 24; how much of each must be taken to produce 170 lbs. of brass, after allowing 2$\frac{2}{7}$ per cent. for waste?

4. March 21st, 1877, sterling exchange is quoted at 9$\frac{3}{4}$ for demand bills; what must be paid for a demand bill for £18 5*s*.?

5. What will be the cost of insuring a ship worth \$4836281$\frac{1}{8}$, at 3$\frac{1}{3}$ per cent., so that in case of loss the owner may recover the value of the ship, and the amount paid for insurance?

6. The numerator of a certain fraction is a fifth as much again as its denominator, and the sum of the numerator and denominator is 352. Find the fraction.

7. A room whose height is 12 feet, and length $1\frac{1}{8}$ times its width, takes $178\frac{2}{7}$ yards of paper 1 foot 9 inches wide to cover its walls. What will it cost to cover the floor with carpet 27 inches wide, and costing \$1.75 a yard?

8. The G. C. M. of two numbers is 634938944494, and their L. C. M. is 9187 : one of the numbers is 85044059. Find the other.

9. The difference between the interest and discount of a sum of money for 1 year and 9 months at 8 per cent. is \$9.80. Find the sum.

10. A rectangular field, whose length is three times its breadth, contains 6 acres 900 yards. Find its length and breadth.

Ex. XXXIII. (II. CLASS AND INTERMEDIATE. 1877.)

1. Prove the rule for reducing a mixed circulating decimal to an equivalent vulgar fraction.

Find *accurately* what fraction $\frac{5}{8}$ of $(\frac{7}{9} - \cdot 512)$ of 3.6_{12}^{77} ac., is of $2.66\dot{2}60\dot{1}$ acres.

2. Show how to find the L. C. M. of two or more numbers.

Find the L. C. M. of 483 bushels, 472 bushels 2 pecks; 258 bushels 3 pecks.

3. A merchant buys flannel at 32 cents per yard; at what profit per cent. must he sell it in order that the money he receives for 220 yards may be equal to his gain on \$480 of outlay?

4. Three watches hang side by side, and all show 12 o'clock at the time of observation; the first is known to gain 10 minutes, and the second to lose 10 minutes in 12 hours, while the third keeps accurate time. When will all the *minute* hands be next at 12 o'clock together?

5. How many ounces of coinage gold are equal in value to 112 ounces of coinage silver, 1869 sovereigns weighing 40 lbs. Troy, and 66 shillings weighing 1 lb. Troy?

6. Distinguish between bank discount and true discount. If the simple interest on a sum of money for a given time and rate is $\frac{1}{n}$ of the sum itself, show that the true discount is $\frac{1}{n+1}$ of that sum.

7. Reckoning commercial discount at 5 per cent., a person would receive $44.52 less than the nominal value of a note which has a year to run; what should he receive for the note if true discount only were deducted?

8. What must a person have invested in Bank of Commerce Stock at 120, and paying 4 per cent. half-yearly dividends, if a transfer of 65 per cent. of his capital to Dominion Bank Stock at 130, and paying $4\frac{1}{2}$ per cent. half-yearly dividends, makes a difference of $5 in his semi-annual income?

9. A merchant in Montreal drew on Hamburg for 6000 guilders, at $ 415; how much more would he have received if he had ordered remittance through London to Montreal, exchange at Hamburg on London being $11\frac{1}{4}$ guilders for £1, and at London on Montreal, $9\frac{1}{4}$ per cent., brokerage being $1\frac{1}{4}$ per cent. for remitting from London?

10. The length of an iron cylindrical vessel with closed ends is 3 feet, and its outside circumference is 36 inches, the metal being 1 inch in thickness. Find its weight when filled with water, iron being $7\frac{1}{9}$ times heavier than water, and water $62\frac{1}{2}$ lbs. per cubic foot.

Ex. XXXIV. (MATRICULATION, TORONTO UNIVERSITY. 1877.)

1. Perform the following operations by short methods: 479×125; $873294 \div 99$; 34687×320648.

2. Prove that $\frac{2}{7} \times \frac{3}{5} = \frac{6}{35}$.

3. Prove in a particular case the rule for reducing a mixed recurring decimal to a vulgar fraction.

Find the value of

$$\frac{\cdot 2\dot{3} - \left(\frac{1}{3} - \frac{2\frac{2}{3}}{10}\right)}{\cdot\dot{4}\dot{5} - \cdot 1\dot{3}\dot{6} - \frac{1}{11}} \text{ of } £1 + \frac{\cdot\dot{5}71428\dot{5} - \frac{3}{21}}{2\frac{2}{7} - 1\frac{1}{28} - 1\frac{1}{8}} \text{ of 1 guinea.}$$

4. Without making a "proportion statement," determine the interest on \$750 for 9 months, if the interest on \$500 for $6\frac{2}{3}$ months be \$26.

5. Bank of Commerce stock is worth 120, and pays a dividend of 8 per cent. per annum. Find the income from 100 shares, and the amount obtained by the sale of them, allowing the broker a commission of $\frac{1}{8}$ per cent.

6. A man has real estate from which he receives an income at the rate of 10 per cent., without allowing for taxes. On both income and property he is taxed at the rate of $19\frac{1}{2}$ mills on the dollar. At what rate is his property taxed altogether?

7. A grocer mixes 40 gallons of whiskey at 75 cents, 40 at \$1.50, and a certain number of gallons at \$1. After keeping the mixture a year, by selling it at \$1.35 a gallon, he would have gained 20 per cent. profit, and 6 per cent. interest on his capital; but owing to a leakage, he gains his interest and $16\frac{1}{2}$ per cent. profit. Find the number of gallons that leaked out.

8. A metre equals 39·37 inches; a cubic inch of distilled water weighs 252·458 grains, and a gallon of such water weighs 10 lbs. Avoirdupois: determine the number of bushels, &c., in a hectolitre.

9. \$1200 is to be distributed among *A*, *B* and *C*. From part of it they receive equal amounts, and of the rest *B*'s share is 10 per cent. more than *A*'s, and *C*'s is 10 per cent. more than *B*'s. Altogether *B*'s share is $8\frac{16}{123}$ per cent. more than *A*'s, and $7\frac{23}{68}$ per cent. less than *C*'s. Find the part of the \$1200 that was divided equally.

10. A certain amount of 6 per cent. stock at 95 is sold out, and being invested in the $7\frac{1}{2}$ per cents. at a certain price, it is found that the resulting income, after deducting an income tax of 1 per cent., is 2 per cent. more than the previous one, after deducting an income tax of 2 per cent. Find at what the second stock is quoted.

Ex. XXXV. (I. CLASS. 1877.)

1. Define and investigate methods of finding the G. C. M. and the L. C. M. of two or more fractional numbers.

Three watches hang side by side, and all show 12 o'clock at the time of observation. The first is known to gain 10 minutes, and the second to lose 10 minutes, in 12 hours,

while the third keeps accurate time. In what time will *all* the hands first be at 12 together?

2. A grocer bought a quantity of tea at 40 cents per lb., and fixed a price on it to gain $23\frac{17}{21}$ per cent.; but in selling it he inadvertently used a pound weight which was $\frac{3}{4}$ oz. too light, thus gaining $31.20 more than he would have gained if the weight had been true. How much did he buy?

3. Show that if the true discount of a sum of money for a given time and rate be $\frac{a}{b}$ of that sum, then the interest will be $\left(\frac{a}{b-a}\right)$.

(1) The interest on a certain sum for 6 years is $261, and the discount for the same time is $180. Find the sum and the rate per cent.

(2) The interest on a certain sum is $180, and the discount for the same time and rate is $150. Find the sum.

4. How much U. S. currency will be required to purchase U. S. 6 per cent. bonds, interest payable in gold, to give an income of $1113 in currency, gold being at 106, and the broker's commission $\frac{3}{8}$ per cent. on the par value of the bonds?

5. I bought a quantity of tea from Thwaite, Eby & Co., Toronto, who allowed me a discount of 4 per cent. on the price charged for the tea, and accepted for the reduced amount my note, payable in 6 months. I sold the tea at once for a note of $510.51 payable in 3 months; and allowing money to be worth 8 per cent. per annum, I found I had made a profit of $18\frac{2}{11}$ per cent. Find the price first charged for the tea.

6. From 2 lbs. of standard gold are coined 89 guineas, and from 1 lb. standard silver 66 shillings—$8\frac{1}{3}$ per cent. of standard gold being alloy, and $7\frac{1}{2}$ per cent. of standard silver. If 24 pennies are coined from 1 lb. Avoirdupois, calculate the ratio of the values of gold and copper.

7. Find the compound interest on \$4000 at 10 per cent. for $3\frac{1}{2}$ years (payable yearly).

8. A man invested a certain sum in Bank of Commerce stock at 125, and paying $4\frac{1}{4}$ per cent. half-yearly dividends; 44 per cent. *more* than that sum in Dominion Bank stock at 135, and paying $4\frac{1}{2}$ per cent. half-yearly dividends; and $39\frac{1}{3}$ per cent. *less* than that sum in Consolidated Bank stock at 95, and paying $3\frac{1}{4}$ per cent. half-yearly dividends; his half-yearly income from the second investment was \$12.75 less than from the other two together. Find the amount invested in each kind of stock.

9. To do a certain piece of work, for which \$120 is paid, B would take $2\frac{2}{3}$ times as long as A and C together, C $4\frac{1}{2}$ times as long as A and B together, and all three working together actually do the work in $2\frac{2}{3}$ days. Divide fairly among them the money paid for the work.

10. (1) The base of an equilateral triangle falls on the diameter of a semicircular arc, and its vertex is in the middle point of the arc; the length of a side of the triangle being 8 feet, find the diameter of the circle.

(2) The town A is 30 miles from B, B 25 miles from C, and C 20 miles from A. Find where a house must be erected to be equally distant from A, B and C.

Ex. XXXVI.

1. Assuming only the definition of a vulgar fraction, prove that the numerator and denominator of any vulgar fraction can be multiplied or divided without altering its value.

2. Simplify $\frac{\frac{6}{11}}{\frac{10}{99}} + \frac{56}{1\frac{5}{9}} - \frac{13\frac{1}{3}}{20}$.

3. Shares in a certain railway pay, when at par, £3 5*s*. dividend per annum. How much must I give for them to get 5 per cent. for my money?

A person having bought 20 shares at this price, sells them when they have risen £7 each, and buys $3\frac{1}{2}$ per cent. stock at 90. Find the change in his income.

4. In 5 months, at 4 per cent., a man pays a certain sum for interest. Had he borrowed \$400 more, and paid 5 per cent. on the whole sum, his interest would have been $\$20\frac{10}{12}$. What interest did he pay?

5. A sum amounts to \$746.75 in 9 months; at the same rate it would double in 25 years. In what time would it amount to \$783?

6. A course is 75 miles round. *A*, going at the rate of 12 miles an hour, gives *B*, who goes at the rate of 30 miles an hour, a start of 600 yards. When will *B* be again $\frac{1}{4}$ mile ahead of *A*?

7. Find value of $\frac{4\frac{1}{4} - 3\frac{3}{8}}{4\frac{1}{4} + 3\frac{3}{8}} + \frac{3 - 2\frac{1}{3}}{4 - 3\frac{1}{4}}$ of 1 fur. 26 per. 3 yds.

8. Reduce 7560 grains Troy to pounds, &c., Avoirdupois.

9. A man gave away $\cdot 9 \times \cdot 846$ of his money, and found that $\frac{250}{1193}$ of the remainder was £4 8*s*. 6*d*. Find his money.

10. Reduce $3\frac{2}{5}$ of $5\frac{1}{2}$ of $\frac{7}{9} - \frac{1}{3}$ of $\frac{5}{12}$ of $1\frac{1}{2}$ lbs. Troy to the fraction of $\frac{3}{14}$ of $\frac{4\frac{5}{9}}{6\frac{1}{8}}$ of $\frac{6\frac{8}{11}}{11\frac{5}{7}}$ of $1\frac{1}{2}$ lbs. Avoirdupois.

11. A merchant buys from a wholesale house goods to the amount of $5600, for which he gives a note payable in 6 months at 8 per cent. A bank discounts the note for the same time at 7 per cent. and $\frac{1}{4}$ per cent. commission. Find value of the note to the wholesale merchant, and also its present value at the time of discounting it. Days of grace not allowed.

12. In 1874 the annual revenue of Great Britain was £76608770. The specific gravity of gold is 19·2, that of water being taken as 1. A cubic foot of water weighs 1000 oz. Find the edge of the solid cube made by the above sum.

Ex. XXXVII.

1. *A* can do a piece of work in 12 hours, *B* in 4 hours, and *C* in 3. *A*, *B* and *C* work together for half an hour, when *A* leaves off. How long will it take *B* and *C* to finish the work?

2. If a cubic foot of marble weigh 2·716 times as much as a cubic foot of water, find the weight of a block of marble 9 feet 6 inches long, 2 feet 3 inches broad, 2 feet thick. (Cubic foot of water weighs 1000 oz.)

3. What interest will a man obtain in three years by compounding $500 at 4 per cent. the first year, 5 per cent. the second year, and 6 per cent. the third?

4. A man contracts to perform a piece of work in 60 days, and immediately employs upon it 30 men; at the

end of 48 days the work is only half done; required the additional number of men necessary to fulfil the contract.

5. A publisher wishes to net $1.50 for each copy of a work. What price should he put upon it so as to be able to allow the trade 30 per cent. discount?

6. A merchant sells 576 quarters of corn at a profit of 8 per cent., and 296 quarters at a profit of 12 per cent. If he had sold the whole at a uniform profit of 10 per cent. he would have received $8.40 more than he actually did. What was the price he paid for the corn per bushel?

7. A fixed rent of £1170 per annum is converted into a corn rent of one half wheat at the average price of 48*s.* per quarter, and the other half barley at the average price of 30*s.* per quarter. What will be the rent when wheat has advanced to 56*s.* and barley to 32*s.* per quarter?

8. A man, buying goods, by means of false scales defrauds to the extent of 15 per cent., and gains by selling 15 per cent. Find his whole gain.

9. A person bought four railway tickets to go 60 miles. Two were for first class, one for second class, and the fourth was a half first class ticket for a child. The cost of a second class ticket was two-thirds that of a first class, and the whole sum was £1 11*s.* 8*d.* Find the price of each ticket, and the rate per mile for the first class.

10. The value of money increases from 4 to 5 per cent. Supposing this to have a corresponding influence on the funds, how much ought the 3 per cent. consols to sink?

11. A merchant's profits are each year 20 per cent. on the capital at the beginning of the year. The first year he takes for personal expenses 20 per cent. of his profits,

the second year 40 per cent., and the third year 50 per cent. His capital now amounts to \$14291.20. With what sum did he begin?

12. The net rental of an estate, after deducting $2\frac{1}{2}$ cents in the dollar for income tax, and 5 per cent. on the remainder for the expenses of collecting, is \$4604.08. Find the gross rental.

Ex. XXXVIII.

1. A merchant buys flour at \$3.50 per bag. At what advance per cent. on cost must he sell it so that the money he receives for 100 bags may be equal to his gain on \$1400 of his outlay?

2. (*a*) The interest on a sum of money for two years is \$116.48, and the discount is $\$99.99\frac{23}{27}$. Find rate per cent. and sum of money.

(*b*) Calculating banker's discount at 8 per cent., a person would receive \$60 less than the face value of a note made for one year. What would he receive for the note if true discount only were deducted?

3. The last half-yearly dividends of the Montreal, Toronto and Consolidated Banks were 6 per cent., 4 per cent. and 3 per cent. respectively. A man invests a certain sum in Bank of Montreal stock at \$160; $53\frac{1}{8}$ per cent. of that sum in the Consolidated Bank stock at 85; $176\frac{8}{17}$ per cent. of the last mentioned sum in Bank of Toronto stock at 150. His income from the Bank of Montreal is \$10 less than from the other two banks. Find amount of stock held in each.

4. A merchant in Toronto drew on Rotterdam for 5000 florins at \$·419. How much more or less would he have

received if he had ordered remittance through Rotterdam to Paris at 1 florin for 2·4 francs; from Paris to London at 25·5 francs = £1; and from London to Toronto, $9\frac{1}{4}$ per cent. premium, brokerage being 1 per cent. for remitting from London?

5. A land owner allows his agent $4\frac{1}{6}$ per cent. for collecting his rents; he spends $14\frac{2}{7}$ per cent. of net income for insurance and repairs (which portion is exempt from income tax). If his income tax at 4 cents $1\frac{2}{3}$ mills amounts to $194.75, find his gross income.

6. A farmer insures his house and barn for $2037.50. His property being burned, he finds that his premium of $1\frac{7}{8}$ per cent., together with the actual value of his house and barn, is recovered. If 300 per cent. of the value of his house is equal to 200 per cent. of the value of his barn, find the value of the house and barn.

7. Incomes below £350 a year being subject to 5*d.* in the £ income tax, and incomes above £350 to 8*d.* in the £, what income above £350 a year must a man have so that he may be 10*s.* 11*d.* poorer than a man with a yearly income of £348?

8. A merchant buys sugar at 10 cents per pound; he sells at a profit of 20 per cent., and by a mistake uses a pound weight $\cdot\dot{0}\dot{3}$ too heavy. Having sold all his sugar, he finds that he has lost $60 of his profit by overweight. Find how many pounds he bought.

9. Four watches hang side by side, and all show 12 o'clock at time of observation. The first is known to gain 10 minutes, the second to lose 20 minutes, the third to gain 30 minutes, and the fourth to gain 5 minutes, in 12

hours. After how many days will all the clocks show 12 o'clock at the same time?

10. How much U. S. currency will be required to purchase U. S. Treasury notes bearing interest at $7\frac{3}{10}$ per cent. (payable in currency), to give an income in currency of \$2190, gold being at $105\frac{5}{8}$? Find also the broker's commission at $\frac{1}{8}$ per cent. in gold.

11. The population of a country would increase every year by 5 per cent. were it not for emigration, which annually carries off 5 per cent. of the people. What will be the population of a country from which at the above rate 1227000 persons emigrate in two years?

12. Two merchants, X and Y, sell wheat. X sells some at \$1.50 per bushel, thereby gaining 20 per cent.; Y sells his at the same figure, and gains 20 per cent. of the *proceeds*. X and Y again sell some more of the same wheat each for \$91; X now sells at a profit of 4 per cent. on the *proceeds*, and Y sells at a gain of $8\frac{1}{3}$ per cent. How many bushels did each sell?

Ex. XXXIX.

1. Find the value of the following:

$$\$34\tfrac{11}{14} \div \left(\frac{\cdot\dot{7}14285\dot{} - \cdot\dot{4}28571\dot{}}{\cdot\dot{8}57142\dot{} - \cdot\dot{2}85714\dot{}} + \frac{\frac{4}{15} \text{ of } \frac{\frac{5}{6}}{\frac{5}{18}} (3\tfrac{9}{10} \times 15\tfrac{5}{13})}{(\frac{6}{7} \times \frac{35}{48} \times \frac{24}{30}) + \frac{27}{36} \div \frac{45}{54}} \right).$$

2. A fish swims from P to Q in 2 hours, and from Q to P in 3 hours. If the rate of the stream per hour be equal to $\frac{1}{3}$ per cent. of the distance travelled in miles, find the distance from P to Q.

3. A grocer intending to gain 10 per cent. on a stock of tea, fixed his prices accordingly. When he had sold three-fourths of his stock he was compelled to reduce his price 15 cents per pound, and so gained only one-half as much as he intended. What was the original price per pound of his tea?

4. A commission merchant in Toronto sells for his principal 500 barrels of flour at $8.60 per barrel, on a commission of $3\frac{1}{2}$ per cent., and buys groceries required by his principal on a commission of 2 per cent. on the price paid for the groceries. Find the whole amount of his commission.

5. Two farms are bought whose united area is 500 acres. One farm is bought for $75 per acre, and the other for $85 per acre. Had both farms been bought for $80 per acre, the total sum paid would have been $500 more. Find the area of each farm.

6. A wholesale dealer imports goods worth a certain sum, on which he pays an *ad valorem* duty of $17\frac{1}{2}$ per cent. He then sells them to a retail dealer, making a profit of 14 per cent. The retail dealer in selling them charges the same rate of profit as the wholesale dealer, but he makes $23.03 more than the wholesale merchant. Find the prime cost of the goods.

7. A merchant starts in business with a certain capital; 75 per cent. of his gains are added each year to his capital. The first year he gains 40 per cent., the second, 25 per cent., and the third, 60 per cent. On balancing his books at the end of the third year he finds that his capital is 225 per cent. of what it originally was all but $462.50. Find his original capital.

8. A man invests a certain sum, through a broker, in Bank of Montreal stock at $163\frac{1}{2}$, and $13\frac{1}{4}\frac{2}{3}\frac{3}{0}\frac{8}{5}$ per cent. of that amount in Bank of Toronto at 152. At the end of 6 months his income from the two banks is $330. If brokerage be $\frac{1}{8}$ per cent., and the half-yearly dividends of the Banks of Montreal and Toronto be 6 per cent. and 4 per cent. respectively, find the amount invested in each of the kinds of stock.

9. On account of a war the debt of a country is increased 40 per cent. During the seven years following peace, £2300000 of the principal, in addition to the interest, is annually paid off; at the expiration of this period the rate of interest on the national debt is reduced 5 per cent. If, notwithstanding these diminutions, the interest on the public debt is still 10 per cent. more than before, find the cost of the war.

10. A merchant bought a quantity of American cloth, and marked it at an advance of 30 per cent. on cost, and in selling it used a yard-stick $\frac{3}{8}$ of an inch too short, his total gain being $57.60. Find the cost price of the cloth, and the amount he gained by using the short yard-stick.

11. Given, that if the number of days were constant, the number of horses would vary as that of acres directly, and if the number of acres were constant, the number of horses would vary as that of days inversely. Find how many horses would plough 33 acres in 18 days, if 12 horses plough 11 acres in 5 days.

12. (*a*) A ladder, 20 feet long, reaches the top of a wall when the foot is 13 feet from the bottom of the wall. How much does the ladder project when its foot is 5 feet from the wall?

(*b*) The length of a road in which the ascent is 1 foot in 5, is $1\frac{2}{3}$ miles from the foot of the hill to the top. What will be the length of a road up the same hill in which the ascent shall be 1 foot in 12?

Ex. XL.

1. Simplify $\dfrac{3\frac{3}{41} + \frac{1}{4} + \frac{2}{3} + \frac{5}{6} \times \frac{7}{5} \text{ sq. ft.}}{\frac{24}{41} \text{ of 2 yds. } 3\frac{1}{2} \text{ ft. 6 in.}}$ of

$\dfrac{4 \text{ lbs. 8 oz. Avoir.}}{5 \text{ lbs. 10 oz. Troy}}$ of $\dfrac{4s.\ 8d.}{3s.\ 3d.}$ of 1 ft. 4 in.

2. *A*, *B*, *C* and *D*, working together, can do a piece of work in 26 days. They work together 7 days, when *C* and *D* leave for 6 days, in consequence of which *A* and *B* are obliged to increase their work by $\frac{1}{2}$ and $\frac{1}{3}$ respectively. If *A* does as much in $1\frac{1}{2}$ minutes as *B* does in 3 minutes, find the time in which *C* and *D*, working together, can finish the piece of work.

3. A person invests £5127 10*s.* in Canadian railway shares and bank stock. The railway shares, which pay a half-yearly dividend of 10*s.* 6*d.* on each original share of £30, are at 28. The bank stock, which is at 83, yields a yearly dividend of $3\frac{3}{4}$ per cent. Find how many railway shares he must buy in order that he may obtain an equal income from each source, taking brokerage, $\frac{1}{8}$ per cent., into account on the latter investment.

4. A grocer forms a mixture of 51 lbs. of tea, consisting of equal quantities of three different qualities. He sells the whole so as to gain $5\frac{15}{17}$ per cent., which is \$2.55. If

the ratio of the number of pounds of the first kind had been to the number of pounds of the second as 5 : 12, he would have gained 35 cents less on the whole; but if the ratio of the number of pounds of the second kind had been to the number of pounds of the third as 5 : 12, his gain on the whole would have been reduced by $\frac{28}{51}$ of the expected gains. Find the price of each kind of tea.

5. Money is worth 8 per cent. compound interest. What are debentures (redeemable in 4 years, and paying 6 per cent. dividends) worth?

6. A buyer bought a horse and a cow. The cow cost two-thirds as much as the horse. He gained 5 per cent. on the total cost of both, and 20 per cent. on the cost of the horse. What rate per cent. did he gain or lose on the cow?

7. A merchant sends to an agent 200 barrels of flour, with instructions to sell and deduct his commission of 2 per cent. for selling, and 3 per cent. for buying tea at 60 cents per pound with the proceeds. The agent shipped the tea, which was sold at an advance of 10 per cent. on cost, and realized $2000. Find the selling price of the flour per barrel, and also the quantity of tea bought.

8. A person invests $3000 in Montreal Bank stock at 180, which pays a dividend of 6 per cent. half yearly; and he sells out at 170, and invests the proceeds in Bank of Toronto stock, which pays a half-yearly dividend of 5 per cent., thus losing $20 on his half-yearly income. Find the price of the Toronto stock.

9. Supposing that cloth, $\frac{3}{4}$ yard wide, shrinks 8 per cent. in length and 2 per cent. in breadth in washing, but

increases 10 per cent. in price. What rate per cent. does a person gain or lose, if the washing cost 2 per cent. of the value of the cloth after it is washed?

10. A person has £20000 in sterling bonds at 90, yielding 4 per cent. yearly dividend, and exchanges for Dominion 6 per cents., losing £200 in income by so doing. Find the price of Dominion 6 per cents., and how much he received. (Exchange, $109\frac{1}{2}$.)

11. A garret is 16 feet wide. The ceiling on one side is 12 feet high; on the other, 9 feet. The length of the level portion of the ceiling is the same as the length of the floor, 18 feet; the width, 12 feet. Find the number of square yards in walls and ceiling.

12. A pile of inch lumber, 14 feet wide, contains 10822 feet, and consists of three different lengths, viz., 12 feet, 14 feet, and 16 feet—the first tier being 12 feet, the second, 14 feet, and the third, 16 feet, &c. Between each tier are placed two cross boards, each 9 inches wide. Find the length of the top tier.

Ex. XLI.

1. Write down the tables for Troy and Apothecaries' weight. To what uses is Troy weight applied? How are diamonds and precious stones weighed? Find the relation between 1 lb. Avoirdupois and 1 lb. Troy. Express 576 lbs. Avoirdupois in lbs. Troy, and 58 lbs. 4 oz. Troy in lbs. Avoirdupois.

2. If the matter in the earth be denoted by $2\frac{1}{2}$, and the matter in the moon by ·031293, show that the matter in the earth equals the matter in the moon × 79·89 nearly.

3. A reservoir is 57 feet 8 inches long by 46 feet 3 inches wide. How many cubic feet of water must be drawn off to make the surface sink 1 foot?

4. *A* gives *B* a bill for $2000, due at the end of 12 years, in discharge of a bill of $1200, due at the end of 8 years. For what sum should *B* give *A* a bill, due at the end of 10 years, to balance the account at 7 per cent. compound interest?

5. How many years purchase, that is, how many years rental should be paid for freehold property to clear 6 per cent. per annum?

6. A cubic foot of water weighs 1000 oz., and the weight of a given volume of air equals weight of same volume of water × ·00125. What weight of air is contained in a room measuring 30 feet in length, 24 feet 6 inches in width, and 16 feet in height?

7. The inscription on the Congius of Vespasian, preserved at Dresden, states that it contains 10 Roman pounds. When this measure was filled with water and carefully weighed, the weight of the water was found to be 63460·6 French grains. Find how many grains Troy are contained in one Roman pound, if the French grain is equal to ·8202 of the English grain.

8. Building Societies, &c., were lending money in May, 1877, at the nominal rate of 8 per cent., payable half-yearly in advance. What is the real rate of interest per annum?

9. On the roof of a building there was a tank holding 18 tons of water. Supposing it cubical, what would have been its dimensions? (Cubic ft. of water = 1000 oz.)

10. When \$350 stock can be bought in the 4 per cents. for $\$180\frac{3}{4}$, what amount should be given for \$200 stock in $3\frac{1}{2}$ per cents. with equal advantage?

11. Eight men contribute equally to a fund, (to be invested at 5 per cent. compound interest,) in the following manner: All at the beginning of the first year, three at the beginning of the second, and one at the beginning of the third. Each withdraws \$1000 in the following order: Five at the end of the first year, two at the end of the second, and one at the end of the third. Find each man's contribution.

12. Three debentures of \$2000 each, without interest, the first payable in one year, the second in two years, and the third in three years, were sold at a discount of 8 per cent. compound interest. How much did these realize?

Ex. XLII.

1. Define a Product, a Factor. Show that the product is not affected by changing the order of its factors.

2. A gentleman has a croquet lawn 300 feet long by 200 feet broad, which he would raise one foot higher by means of the earth to be dug out of a ditch that goes round it; to what depth must the ditch be dug, supposing the breadth everywhere to be 8 feet?

3. A man allows his agent 5 per cent. on his gross income for collecting his rents. He spends 6 per cent. of his net income in assuring his life, and this part of his income is exempt from income tax. The income tax being 2 per cent., and his income tax amounting to \$71.44: find his gross income.

4. I buy a set of watches for \$10 each. I sell them again at a profit of one-tenth the prime cost, but in consequence of cash payment I throw off one-twentieth of the purchase money. What gain do I make on the prime cost of each watch, and also on each \$400 of my outlay?

5. A certain sum amounts, at 4 per cent., to \$535.60 in 9 months. What is the present value of the same sum, due 1 year hence?

6. An agent's commission is \$25, being $1\frac{1}{4}$ per cent. of the rent, which is 10 per cent. of the value of the buildings. Find that value.

7. The Anglo-American Company has five cables, which are worked 300 days in the year of 12 hours each. The average time for the transmission of a message is 5 minutes. What must be paid for each message, so that after paying \$100000 expenses, the receipts may give 5 per cent. on the capital (\$35000000), supposing the cables to be constantly employed?

8. In the above question, if money be worth 8 per cent., at how much per cent. should shares in the Anglo-American be quoted?

9. The owner of an estate has an annual income of 15 per cent. of the value of his estate. His property is assessed at 70 per cent. of its value, and his taxes, at 2 cents 9 mills on the \$ (reckoned on his estate and the income derivable therefrom), amounts to \$186.76. Find the value of his estate.

10. An estate is bought at twenty years' purchase for \$20000, three-quarters of the purchase money remaining

on mortgage at 4 per cent. The cost of repairs averages $150 per annum. What interest does the buyer make on his investment?

11. Simplify

(1) $\frac{1}{2} + \frac{1}{6} + \frac{1}{7} + \frac{1}{3}$.

(2) $\frac{2}{25} - 5\frac{2}{3}$ of $\frac{1}{15} \div 6\frac{1}{5}$.

12. *A* can do a piece of work in 3 days, *B* can do thrice as much in 8 days, and *C* five times as much in 12 days. In what time can they do a piece of work three times as great if they all work together?

Ex. XLIII.

1. State the causes which usually affect the course of exchange between different countries.

2. English standard gold contains $91\frac{2}{3}$ pure gold in 100 parts, while French standard gold contains 90 of pure gold in 100 parts. A kilogramme of French standard gold makes 155 Napoleons, equivalent to 3100 francs. 1 oz. Troy is equal to ·0311 kilogramme, and the value of 1 oz. Troy pure gold is £4 5s. Find the value of an English sovereign in francs, and also that of a dollar.

3. A gentleman left his eldest son $\frac{5}{8}$ of his money, to the younger $\frac{2}{3}$ of the remainder, and the rest to his wife; upon dividing the money, it was found that the eldest son had $750 more than the younger. How much was left to each?

4. A quadrant of the meridian in French metres is 10000565·278, and one metre is 39·37079 English inches: required the length of the quadrant in English feet.

5. The rent is 10 per cent., insurance 1 per cent., agent's commission $1\frac{1}{8}$ per cent. of the rent, taxes $19\frac{1}{2}$ mills on the \$; the owner's income exceeds the agent's by \$5460. Find the value of the buildings.

6. Three months after the half-yearly dividend has been paid, the 10 per cent. stocks are selling at \$145.35$\frac{5}{7}$. What rate will this pay an investor?

7. A mortgage for \$500 is payable as follows: \$100 of principal yearly and 6 per cent. on the unpaid principal only, *i.e.* \$130 at the end of one year, \$124 at the end of two years, and so on. Find its present value to pay 8 per cent. compound interest.

8. A cubical box exactly holds 125 shot, 3 inches in diameter; find how many cubic inches of sand would be required to fill up the interstices.

9. A certain 3 per cent. stock is at $91\frac{1}{2}$, and a 4 per cent. at 123; one person buys £1000 in each, and another invests £1000 in each. Compare the respective rates of interest obtained by the two on their whole investment.

10. A farmer borrows to improve his property \$1000 for 10 years at 8 per cent. interest, payable yearly. What amount must he raise yearly to pay the interest and to furnish a sinking fund at 6 per cent. to pay off the debt, the first investment of the fund being made in one year?

11. A person sets out to walk from A to B at the rate of 4 miles an hour. After he has walked $1\frac{2}{3}$ miles he is overtaken by the coach, which started a quarter of an hour after him. At a distance of 13 miles from A he meets the coach returning from B, where it has stayed for half an hour. Find the distance from A to B.

12. The area of the coal field of South Wales is 1000 square miles, and the average thickness of the coal is 60 feet. If a cubic yard of coal weigh a ton, and the annual consumption of coal in Great Britain be 80000000 tons, find the number of years for which this coal field alone would supply Great Britain with coal at the present rate of consumption.

Ex. XLIV.

1. A farmer has an orchard in which there are four kinds of trees, viz., apple, pear, plum and cherry. He sells his apples by the barrel at $2.50 per barrel, his pears by the basket at $1.75 per basket, his plums by the peck at 80 cents per peck, and his cherries by the quart at 10 cents per quart. On selling all his fruit he receives $1510. The trees yield in the following ratio, each tree by its own measure, 2, 4, 6, 20. The number of cherry trees is $56\frac{1}{4}$ per cent. that of the pears, that of the plums is 75 per cent. that of the apples, that of the pears is $106\frac{2}{3}$ per cent. that of the plums. Find the number of trees of each kind.

2. A merchant bought 300 lbs. sugar and 60 lbs. tea. The cost of the sugar per lb. was 20 per cent. that of the tea. He sold the tea at a loss of $8\frac{1}{3}$ per cent., and the sugar at a gain of 20 per cent., gaining on the whole $15.20. Find his selling prices.

3. If 3 men, 4 women and 6 children can pick 150 quarts of berries in 3 hours, or 3 men, 3 women and 1 child in 5 hours; and if 2 men, 1 woman and 2 children can pick 232 quarts in 8 hours, in how many hours will 4 men, 4 women and 4 children pick 480 quarts?

4. A man builds 10 houses for $8000, a certain number of which were burnt, but in consequence of their having been insured, the loss on each house was only 10 per cent. on its cost price; and it was also found to be at the rate of 3 per cent. on each house built. How many houses were burned?

5. A speculator in Toronto determines to invest in French stock. He gives $\$14713\frac{11}{99}$ to a broker in Toronto, with instructions to remit this sum to New York, after taking out of the money in hand his commission of $\frac{1}{2}$ per cent. The money is then remitted from New York to London, sterling exchange $4.88; and from London to Paris, £1 = 25.5 francs, where it is invested in the French Rentes, paying $5\frac{1}{8}$ per cent. at 120. Find derivable income if one franc = $0·195 Canadian currency.

6. Shew how to find the least whole number which is accurately divisible by each of two given whole numbers.

(*a*) Find the least number of ounces of standard gold that can be coined into an exact number of half sovereigns; standard gold being coined at the rate of £3 17*s.* $10\frac{1}{2}d.$ to an ounce.

(*b*) Find the least number of pounds which can be paid in either half-crowns or guineas.

7. A building society loans $4000 on the following conditions, viz., interest 10 per cent. per annum, one-twelfth of the principal and one-twelfth of the interest to be paid each month; on the twelfth payment, what rate of interest is charged on the principal which is then paid?

8. A man invests a certain sum in Bank of Toronto stock at 150, paying 4 per cent. half yearly, $60\frac{3}{4}$ per cent. of that sum in Ontario Bank stock at 96, paying 4 per

cent. half-yearly; 80 per cent. of the first mentioned sum in Consolidated Bank stock at 80 paying 3 per cent. half-yearly, his income from the last bank is \$70 less than from the other two; find the total sum of money invested, and average rate per cent. obtained on it.

9. Simplify

$$\left(\frac{3\frac{1}{2} \text{ of } 5\frac{5}{8}}{2\frac{5}{8} \text{ of } 3\frac{1}{3}} \div \frac{2\frac{2}{11} \text{ of } 1\frac{1}{12}}{3\frac{1}{9} \text{ of } 7\frac{5}{7}}\right) \text{ of } \frac{1s.\ 5d.}{4s.\ 7d.} \text{ of } \frac{2\text{ ft. } 3\text{ in.}}{5\text{ ft. } 5\text{ in.}}$$

of 24 weeks 4 days 19 hours.

Ex. XLV.

1. The funded debt of Great Britain, January, 1877, was £712349000, interest thereon £28000000; find rate per cent.

2. The Canada 6 per cents., due in 1880, are quoted April, 1877, at $108\frac{1}{4}$; if money be worth at the present time 8 per cent., what should the above be quoted at?

3. The estimated revenue from the income tax in Great Britain for 1877 is £5540000. The rate is 3*d.* in the £; what is the assessable income in Great Britain for the present year?

4. A man borrows a sum to be repaid by equal annual instalments of \$100, or an equivalent half-yearly. What should the half-yearly payment be, allowing 4 per cent. half-yearly?

5. *A* can row from *A* to *B* (a distance of 24 miles) and back in still water in 12 hours; how long will it take him to do the same, when there is a current flowing from *A* to *B* at the rate of 2 miles an hour.

6. *A*, *B* and *C* are sent to empty a cistern by means of two pumps of the same bore. *A* and *B* go to work first, making 37 and 40 strokes respectively a minute; but after 5 minutes they each make 5 strokes less a minute; and after 10 minutes more *A* gives place to *C*, who works at the rate of 30 strokes a minute. The cistern is emptied in 22 minutes altogether, and the men are paid \$6.04 for their labour. What should each receive?

7. In England gunpowder is made of 75 parts nitre, 10 of sulphur and 15 of charcoal; in France of 77 of nitre, 9 of sulphur and 14 of charcoal; if half a ton of each be mixed, what weight of nitre, sulphur and charcoal will there be in the compound?

8. At a certain game of skill *A* can give *B* 10 points out of 50, and *B* can give *C* 10 points out of 50. How many points can *A* afford to give *C* out of 50?

9. A man pays a debt of \$800 due in 12 months in four equal quarterly payments; he is allowed 8 per cent. discount simple interest, *i.e.*, 6 per cent. on the first, 4 per cent. on the second, and 2 per cent. on the third payment; find the amount of each payment.

10. A bill of \$999 is due in such a time that \$80 would in the same time amount to \$83.25. What discount should be allowed for ready payment?

11. A railway train travels 27 miles per hour, including stoppages, and 30 miles per hour when it does not stop; in what distance will it lose 20′ by stopping?

12. A contractor sends in a tender of \$5000 for a certain work; a second sends in a tender for \$4850, but stipulates to be paid \$500 every three months; find the

difference in the tenders, supposing the work in both cases to be finished in two years, and money to be worth 8 per cent. simple interest.

Ex. XLVI.

1. Explain the terms "new style" and "old style." Explain how each arose, and how they differ? Is there any country in which the "old style" is still followed?

2. Capital originally invested so as to yield an annual income of \$4,500 at the rate of 6 per cent., is re-invested at 7 per cent., and then divided among three persons in shares which are as 4, 7 and 9. What is the yearly income of each?

3. The difference between the interest of a certain sum for one year, and the discount on the same sum due a year hence at 8 per cent. is \$1; find the sum.

4. The solid contents of a sphere being $\frac{4}{3}$ of $\frac{355}{113}$ of a cube, the side of which is the radius of sphere, and a cubic foot of iron weighing 450 lbs., find the diameter in inches of a 68 lbs. cannon-ball.

5. A person buys 20,000 bushels of wheat at \$1.05 a bushel; he keeps it 7 months, during which it loses in quantity $1\frac{1}{2}$ per cent.; if money be worth 7 per cent. and his incidental expenses be \$500, what does he gain or lose by selling the wheat at \$1.95 per bushel?

6. *A* can mow $2\frac{1}{2}$ acres in $4\frac{2}{3}$ days, and *B* $2\frac{1}{6}$ acres in $3\frac{1}{2}$ days; they mow together a field of 10 acres. How long will it take them to do it, how many acres will each mow, and what will each receive at 75 cents an acre?

7. A company is formed in which the liability of each partner is limited to the amount of his shares. There are 500 shares of \$10 each. After three calls have been made of \$2 on a share, it is found that the concern is a failure, and its affairs are wound up. At this period its assets amount to \$10217.00$\frac{5}{16}$, and its liabilities to \$15763.87$\frac{1}{2}$. How much will the company be able to pay in the dollar after all the remaining calls are paid up?

8. A man has tea made up in parcels of 6 lbs., 8 lbs., 9 lbs. and 10 lbs. What is the smallest quantity that he could sell by taking any one of the above parcels?

9. What sum compounded half-yearly amounts to \$1.08 in a year? Does a society gain or lose, and how much, on \$10000, by charging its customers 4 per cent. half-yearly, when the rate is 8 per cent. per annum?

10. A person buys tea at 72 cents a lb., and also some at 48 cents a lb. In what proportions must he mix them, so that, selling his tea at 63 cents per lb., he may gain 20 per cent. on each lb. sold?

11. In a certain river the tip of bud of a water lily was seen 9 inches above the surface of the water. Forced by the wind, it gradually advanced, and was submerged at a distance of 3 feet. Find the depth of the water.

12. *A*, *B* and *C* are partners. *A* receives $\frac{1}{5}$ profits, and *B* twice as much as *C*; find the capital of *C*, *A*'s income being diminished \$40 by a fall of $\frac{1}{2}$ per cent. in the rate of profit.

Ex. XLVII.

1. Explain the method of pointing in extracting the square roots of whole numbers and decimals. Find the square roots of 5 and ·5, each to 4 places of decimals.

2. If the wholesale dealer sell to a retailer at 10 per cent. profit, and the retailer sell to the consumer at 50 per cent. profit, what proportion of the price paid by the consumer is profit?

3. Suppose five candidates are examined for two scholarships, and that A obtains two-fifths of the whole number of marks given, B twice as many as A gets more than C, who obtains three times as many as B gets more than D; that D obtains one-half as many as A, B, C together, and E one-third more than the excess of the sum of A, B and C's marks together over D's. Who were the successful candidates?

4. A and B, directly opposite to each other, start to go round an oval race course at the same time in the same direction; A at the rate of 11 miles in 2 hours, and B at the rate of 17 miles in 3 hours. How many rounds will each take before the one will overtake the other, and in what time will this be done?

5. A is twice, and B one and a half times as good a workman as C. The three work together for two days, and then A works alone for half a day and B for one day. How long would it have taken A and C together to complete as much as the three will have thus performed?

6. A merchant purchased 600 bushels of corn, but when he measured it, found that he had only $\frac{39}{40}$ of the

quantity he expected. This he sold, gaining one-eighth the cost of the corn, and in so doing he charged $12\frac{4}{13}$ cents per bushel more than he paid. At what price did he buy?

7. Simplify $\dfrac{\frac{22}{31}+\frac{3}{29}}{\frac{34}{41}+\frac{5}{19}} \div \dfrac{\frac{21}{37}+\frac{8}{23}}{\frac{20}{43}+\frac{13}{17}}$.

8. If the Imperial Government allow land tax to be redeemed for so much stock in the 3 per cent. consols as will produce a yearly income larger by one-tenth part than the yearly tax redeemed, what sum of money sterling must be invested in stock in order to redeem a land tax of £2 6*s.* 8*d.* per annum, consols being at $96\frac{3}{8}$ per cent., inclusive of brokerage?

9. A person invests \$4800 in the 6 per cents. Dominion stock at 106, and at the end of each year invests the dividend which becomes due in the same stock. Supposing the stock to remain at 106 for three years, find his dividend at the end of the third year.

10. *A* and *B* engage in trade. *B* invests \$3000, and at the end of 6 months he puts in \$6000 more. *A* invests \$8000. At the year's end, *B*'s gain is \$1000 and *A*'s \$1125. Find the amount *A* took out at the end of 9 months.

11. A person sells 25 Egyptian £100 bonds at $50\frac{5}{8}$, and invests the proceeds in a railway stock at 125; the brokerage for selling bonds is $\frac{1}{8}$ per cent. on the stock, and the brokerage, &c., for buying railway stock is

1 per cent. on its actual value. What amount of stock did he buy?

12. If I borrow money at 6 per cent. interest payable yearly, and lend it immediately at 8 per cent. payable half-yearly (receiving compound interest for the second half year), and gain thereby at the end of the year $660, what was the sum of money which I borrowed?

Ex. XLVIII.

1. A person subscribes for 300 shares in a certain railway company; the par value of the stock was placed at $50 per share. After paying three instalments, amounting to 75 per cent. of the par value, a dividend of 3 per cent. was declared. How much will he receive, and at what rate per cent. on the actual cost?

2. If a four-oared boat cost $250, what would a six-oared boat cost, supposing the expense of setting up a boat is proportionate to the square of the number of oars? Which would cost the least per head?

3. A tradesman finds that if he asks for his goods 15 per cent. above the wholesale price, he can sell his whole stock in 4 months, whereas, if he asks 20 per cent., he requires 6 months to sell the same amount. Which will he find the more profitable system at the year's end?

4. A field of 7 acres is sown with turnips, beet and cabbages, the areas of the crops being respectively as $1\frac{1}{3} : 1\frac{1}{2} : 1\frac{1}{4}$. If the values of an acre of each be also respectively in the same ratios, and an acre of turnips be worth $14, what is the worth of the whole crop?

5. The driving wheel of a locomotive engine, five feet in diameter, turned 2500 times in going 6 miles; supposing the circumference of a circle to be 3·14159 times the diameter: find what distance was lost owing to the slipping.

6. A person sells 16 Russian bonds of £100 each at $75\frac{7}{8}$, and invests the proceeds in a railway stock at 120: the brokerage for selling bonds is $\frac{1}{8}$ per cent. stock, and the brokerage, &c., on purchasing railway stock is 1 per cent. on the actual value. What amount of stock did he buy?

7. Forty old Spanish dollars are of the same value as £9 sterling; \$100 Spanish = \$109$\frac{1}{2}$ American; 25 francs = £ sterling; \$100 American (in gold) = \$107 in greenbacks. How many francs are equal in value to \$680 in greenbacks?

8. A man pays \$580 for a note, the face value of which was \$600, bearing interest at 5 per cent., and having eight months to run. What is the rate per cent. on the \$580?

9. The value of a life annuity of \$100 immediate entrance at the age of 65 is \$776.38; what is the value of the same annuity at the age of 40, if out of 328802 persons living at the age of 40, 163195 reach 65, allowing 4 per cent. compound interest. (\$1 in 25 years at 4 per cent. amounts to \$2·6658).

10. The Dominion 4 per cents., due 1904, are quoted at present in the English money market at $92\frac{1}{2}$: find the present worth of a note for \$1900 having eight months to run.

11. Multiply and divide 52 ft. 6 in. by 5 ft. 10 in., and explain the results. I have to pack 1200 books in a box

5 ft. 3 in. long, 3 ft. wide, and 2 ft. 9 in. deep; each book is $10\frac{1}{2}$ in. long, $4\frac{1}{2}$ in. wide, and $1\frac{3}{8}$ in. thick. Find how many must be left out.

12. A tradesman marks his goods with two prices, one for ready money and the other for credit of three months. What fixed proportion ought the two prices bear to each other, allowing 10 per cent. per annum simple interest?

Ex. XLIX. (MATRICULATION PAPERS, MEDICAL COUNCIL.)

1. Divide the sum of six millions seventy thousand and nine, and five millions eight hundred and twenty thousand and nine, by their difference. Quotient to be correct to three decimal places.

2. Convert 60004000 grains Troy to pounds, &c., Avoirdupois.

3. Find the value of $\dfrac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\frac{1}{2\frac{1}{2}}+\frac{1}{3\frac{1}{2}}+\frac{1}{4\frac{1}{2}}}$ of \$100.

4. Multiply $1\cdot62\dot{}$ by $\cdot8\dot{7}\dot{5}$, and from the product take 214. Answer to three decimal places.

5. Simplify $\dfrac{8\frac{1}{2}\times2\frac{2}{3}}{8\frac{1}{2}+2\frac{2}{3}}\div\dfrac{8\frac{1}{2}-2\frac{2}{3}}{8\frac{1}{2}\div2\frac{2}{3}}$.

6. A vessel is required to be exactly filled by any one of the following measures: 3 quarts, 5 quarts, 7 quarts or 9 quarts. Find the smallest vessel for the purpose.

7. Find the value of $\frac{7}{6}\frac{3}{2}\frac{}{5}$ of 5 cwts., and express the result as a fraction of half a ton. Answer to four decimal places.

8. Find the value of £·13 + ·12*s.* + ·7*d.*

9. Simplify $1\frac{1}{2} - \frac{2}{3} - (\frac{1}{4} - \frac{2}{7} \times \frac{7}{15})$, and express the result as a fraction of 2 acres.

10 Find the difference between $1\frac{5}{8}$ and $\frac{5\frac{1}{2} \text{ of } 8\frac{3}{4}}{\frac{1}{8} \times 1\frac{1}{5}}$; and express 159·5 as a decimal of the result.

11. A gentleman invests his funds as follows: in real estate, two-fifths; one-sixth of the remainder in a steam vessel; one-third of his fortune in Dominion stocks at 6 per cent.; and the balance, which amounted to $600, he puts out at 8 per cent. interest. What was his entire fortune?

12. Find, in lbs. Avoird., the value of $7\cdot\dot{6}$ oz. Avoird. + $8\cdot\dot{0}\dot{1}\dot{5}$ oz. Troy − $9\cdot\dot{3}$ oz. Apoth. (7000 grains Troy = pound Avoirdupois.)

Ex. L.

1. Two steamers, the first going at the rate of 10 miles an hour, and the second at the rate of 8 miles an hour, are observed to pass a channel-buoy in succession, the first being half as long again as the second. What is the ratio of the time taken by the second to that of the first to pass the buoy, assuming the buoy to be fixed?

2. Goods are sold by a wholesale merchant, (who allows an average credit of 4 months,) of a certain amount to a

retail dealer, who charges a profit of 25 per cent. on the wholesale price, money being worth 8 per cent. The retail dealer's total profit is \$170. What did the goods cost the retail dealer, supposing he paid cash for them?

3. During one year the duty on spirits was $17\frac{1}{2}$ per cent.; the next year the duty is reduced to $12\frac{1}{2}$ per cent., and the consumption is increased thereby 20 per cent. At the end of six months a prohibitory liquor law is passed, which decreases the consumption 25 per cent. At the end of three months more the duty is raised to 15 per cent. At the end of the year the revenue from this branch is \$7625 less than it was the year before. Find the revenue of the first year.

4. The sides of a triangular plot of ground are 4 ft., 6 ft. and 8 ft. respectively. A circular flower bed inside touches each of these sides at their middle points: find distance of centre of flower bed from these points.

5. Simplify the following expression:

$$\frac{(\cdot 05)^3 + (\cdot 05)^2(\cdot 25) - (\cdot 05)(\cdot 25)^2 - (\cdot 25)^3}{(.05)^2 + (\cdot 1)(\cdot 25) + (\cdot 0625).}$$

6. If 11 men, working 10 hours a day, earned $643\frac{1}{2}$ francs in 13 days, how many days would 25 men, working 9 hours a day, be in earning 2673 francs, when the pay for an hour's work has increased 20 per cent.?

7. A cistern has two supply pipes, A, B. If both are left open the cistern would be filled in one hour, were it not for a leak which empties in 3 hours $\frac{1}{3}$ as much water as the pipes fill in 2 hours. There is also a layer of sedi-

ment at the bottom 5 in. deep, and amounting to $\frac{1}{36}$ of the cubic contents of the cistern. If the bottom of the cistern is 9×8 ft., how deep is it, and how long will it take to fill it, if both pipes be left open.

8. A merchant buys teas at 25 cents and 42 cents per pound. He mixes them, and sells a pound of the mixture for $39\frac{1}{16}$ cents, thus gaining 20 per cent. on the cost price of the mixture, as well as allowing 4 per cent. for waste in handling. Find (*a*) the cost price of a pound of the mixture; and (*b*) also the ratio in which the different grades of tea were taken to form the mixture.

9. The steamer *Bavarian* was burned off Bowmanville on Nov. 5th, 1873. At 8 p.m. a party put out from Darlington lighthouse, and on arrival at the steamer could just observe the light (54 ft. high) on the horizon from a point 6 ft. above water. After remaining two hours with the wreck they returned, reaching the lighthouse at 5.20 a.m., the wind having blown them steadily to seaward $\frac{1}{2}$ mile per hour during the entire trip. Find (*a*) the number of miles traversed by the party; and also (*b*) the rate per hour of actual pulling, there being 40 minutes difference between the time occupied in going to and coming from the point whence they returned.

10. A person buys a bill of \$474.60, due 10 months hence, for \$440. He gets it discounted at 6 per cent. per annum interest, and invests the proceeds at 10 per cent. What yearly rate of interest has he made by the transaction?

11. *F* had a certain sum in the 3 per cents. at 90. He sold part of his stock to *G*, and invested the proceeds in the Portuguese 4 per cents. at 60, and now he finds his

income to be \$96 more than *G*'s; but if he had invested in the Turkish 6 per cents. at 72, his income would have been \$114 more than *G*'s. Find (1) the amount of stock he had at first, and (2) how much of it he sold to *G*.

12. *A* employs \$15000, *B* \$9000, in a business. The gross receipts for the first year are \$5600; but of this 5 per cent. is paid for insurance, and one-seventh for other expenses. Of the rest, *B* receives a certain sum for managing the undertaking, and the remainder is divided between them in proportion to the capital engaged. If *A* received $16\frac{2}{3}$ per cent. on his capital, find what *B* should receive for management.

13. In the United States coinage the eagle contains 258 grains of standard gold, standard gold containing 9 parts of pure gold to 1 of alloy. In sterling money, 1 lb. of standard gold is worth £46 14*s.* 6*d.*, and the standard gold contains 11 parts pure gold to 1 alloy. Assuming that the value of pure gold is the same in both currencies, and neglecting the values of the alloys, compare the values of the sovereign and the half eagle; and express the difference between these values in terms of the silver money of both countries.

ANSWERS TO EXERCISES.

Ex. I. (p. 9.)

3. (1) 18394681; (2) 12638548; (3) 43631144.
4. (1) 4939778; (2) 1743223. 5. $3110. 6. $169.
7. 492893. 8. 1647. 9. Seventeen billions five hundred and sixty-six millions two hundred and thirty-four thousand one hundred and sixty-six. 10. (1) 5834234000; (2) 221769706133; (3) 4053710502765; (4) 361588154040000; (5) 5643463600290; (6) 119384180020000. 11. $1125 gain. 12. 753972.

Ex. II. (p. 10.)

2. 265514. 3. 30 men; worked thus:
Wall can be built in 18 days by 20 men.
" " 1 day by 20×18, or 360 men.
" " 12 days by 360 men $\div 12$, or 30 men.
4. 11. 5. 28 of each kind. 6. 380. 7. (1) 87063; (2) 15607; (3) 78540; (4) 40058, rem. 4. 8. Each son received $7200, and the daughter $3600. 9. (1) 84096310; (2) 475060; (3) 91456, rem. 4. 10. Jane gets $5.25, Ellen $7.25, Thomas $12.50. 11. (1) 5924718; (2) 14 times. 12 (1) £2 9*s.* 7½*d.*; (2) £4 19*s.* 2½*d.*

Ex. III. (p. 12.)

2. *A* has $18, *B* $12, thus: If *B* has 2 shares, then *A* will have 2 + 1, or 3 shares; ∴ number of shares = 5, and $30 \div 5 = $6; ∴ *B* has $6 \times 2 = $12; *A* has $6 \times 3 = $18.

In the other case, if B has 1 share A will have 3; $\therefore$ number of shares = 4, &c. 3. 537915; 536389; 409846976; 704. 4. 60 gallons. 5. $320\frac{6}{11}$ mls. from Toronto. 6. 7910 ft. 7. $3\frac{1}{2}d.$ 8. 96 minutes. 9. 18 days. 10. \$5.04. 11. Yes; to last part of question, *No.* 12. 20 minutes.

Ex. IV. (p. 13.)

1. 12 days; worked thus:

20 men can build wall in 18 days.

$\therefore$ 1 man " " 18×20, or 360 days.

$\therefore$ 30 men " " 360 days $\div 30$, or in 12 days.

2. 2166 days. 3. (1) 1800 times; (2) 2446 times, 2 ft. 8 in. 4. 3 dozen. 5. \$1.80. 6. 9 hours. 7. Each man gets \$13.20; each woman, \$6.60; each boy, \$2.20. 8. 7 tons 17 cwt. 9. 10 inches. 10. \$176.06$\frac{1}{4}$. 11. 5227200 seconds. 12. A receives \$11.22; B, \$12.24; C, \$32.64.

Ex. V. (p. 15.)

1. 960 yards. 2. 7 persons. 3. Value of house is \$5488. 4. C, \$1.37$\frac{1}{2}$; B, \$5.50; A, \$4.12$\frac{1}{2}$. 5. 71 cents a pound. 6. 2500 apples in first heap, 7500 apples in second, 15000 in third. 7. \$5.80$\frac{5}{7}$. 8. \$4.37$\frac{1}{2}$. 9. 147; £32 9*s.* $3\frac{1}{2}d.$ 10. Loss = 18*s.* 11. 36865365. 12. A's share is £1096 17*s.* 11*d.*; B's is £2632 11*s.*; C's is £658 2*s.* 9*d.*

Ex. VI. (p. 16.)

1. 522 of each. 2. (*a*) 175140; (*b*) 3960. 3. 10 children; £518. 4. 44. 5. 202 yds. 2 ft. 6. A should pay \$15; B, \$17.50; and C, \$12. 7. 10 feet. 8. 60 days. 9. £$\frac{3}{4}$; A will receive £386 14*s.* $4\frac{1}{2}d.$; B, \$305 5*s.*; and C, £220. 10. 2970 steps. 11. \$5.43. 12. 453124107480.

Ex. VII. (p. 17.)

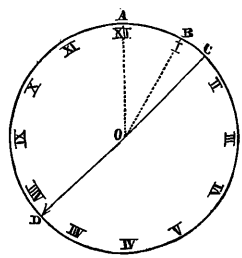
1. \$6. 2. 1152. 3. \$28872.80. 4. Barley, by 1*s.* per acre 5. 1st, 14 parcels; 2nd, 8 parcels of larger and 24 of smaller. 6. \$6544.46⅞. 7. *A*'s score = 7; *B*'s = 4; *C*'s = 10. 8. Each man, \$4.50; each woman, \$2.25; each child, 75 cents. 9. 15 ft. 9 in. 10. 8 oz. 11. 45 miles. 12. 40.

Ex. VIII. (p. 19.)

2. 4249920. 3. 322 yds. 2 ft. 4. 2⅞ cents.

5. \$160, thus: 2 horses are worth as much as 5 oxen (1), and 3 oxen are worth as much as 16 sheep (2). We have 5 oxen and 3 oxen. L. C. M. of 5 and 3 = 15; ∴ multiply each term in (1) by 3, and in (2) by 5. We have then, 6 horses worth 15 oxen, and 15 oxen are worth as much as 80 sheep; ∴ 6 horses are worth as much as 80 sheep, or \$12 × 80 = \$960; ∴ 1 horse = \$960 ÷ 6 = \$160.

6. \$457.75. 7. (1) $38\frac{2}{11}$ minutes past 1 o'clock, thus:



Let OC be the position of the hr. hand.
Let OD be the position of the min. hand.
At 1 o'clock OC overlapped OB, and OD overlapped OA.
Then BC space passed over by hr. hand, and AD space passed over by min. hand.
12 times $BC = AD$ (1)
But $AD = AB + BC + CD$.
$= 5$ min. $+ BC + 30$ min.
$= 35$ min. $+ BC$.

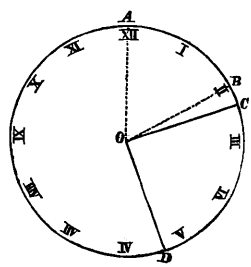
$\therefore$ substituting this value of $A\,D$ for $A\,D$ in (1), we have
12 times $B\,C = 35$ min. + $B\,C$.
$\therefore$ 11 times $B\,C = 35$ min.,
or $B\,C = 35$ min. $\div 11 = 3\frac{2}{11}$ min.
$\therefore$ $A\,D = 35$ min. + $3\frac{2}{11}$ min. = $38\frac{2}{11}$ min.
$\therefore$ time required is $38\frac{2}{11}$ min. past 1 o'clock.

(2) $10\frac{10}{11}$ min. past 8 o'clock.

8. \$5437.50. 9. $2\frac{22}{73}$ days. 10. 105 days.
11. £1375 10*s*. 12. £871.

Ex. IX. (p. 20.)

1. 24 times. 2. $\frac{361}{252}$. 3. (1) $27\frac{3}{11}$ min. past 2 o'clock, thus:



Let $O\,C$ be the position of the hr. hand.
Let $O\,D$ be the position of the min. hand.
When they are at right angles to each other, or have 15 min. between them.
At 2 o'clock $O\,C$ overlapped $O\,B$.
At 2 o'clock $O\,D$ overlapped $O\,A$.
Then $B\,C$ is the space passed over by hr. hand, and $A\,D$ space passed over by min. hand.
12 times $B\,C = A\,D$ (1).
But $A\,D = A\,B + B\,C + C\,D$.
$= 10$ min. + $B\,C$ + 15 min.
$= 25$ min. + $B\,C$.

$\therefore$ 12 times $BC = 25$ min. + BC,
or 11 times $BC = 25$ min.
$\therefore$ $BC = 25$ min. $\div$ 11 $= 2\frac{3}{11}$ min.
$\therefore$ $AD = 25$ min. + $2\frac{3}{11}$ min. $= 27\frac{3}{11}$ min.
$\therefore$ time required $= 27\frac{3}{11}$ min. past 2 o'clock.

Of course they will be at right angles at 3 o'clock, shown thus:

$12\,BC = AD.$
$= AB + BC + CD.$
$= 10$ min. + BC + 45 min.;
since CD will $= 45$ min. in this case.
$= 55$ min. + BC.
$\therefore$ $11\,BC = 55$ min.
$\therefore$ BC 55 min. $\div$ 11 $= 5$ min.
$\therefore$ $AD = 55$ min. + 5 min. $= 60$ min.
$\therefore$ time is 3 o'clock.

(2) $21\frac{9}{11}$ min. and $54\frac{6}{11}$ min. past 7 o'clock.

4. 30 half and 20 quarter dollars, and 10 20 cent pieces. 5. £13333 6*s.* 8*d.* debts, £3833 6*s.* 8*d.* assets. 6. (See Advanced Arithmetic, pp. 185-188.) ~~45~~ 3 days 37. 245 gallons. 8. $7\frac{1}{3}$. 9. $2\frac{1}{2}$ days. 10. 14 minutes. 11. $13\frac{1}{3}$ days. 12. 36 days.

Ex. X. (p. 22.)

...nonths. 2. 25 men. 3. $3.60 and 80 cents, thus: multiply every term in second part by 3, and subtract from the first, and you have the price of turkeys only, from which the answer can easily be obtained. 4. $\frac{75}{77}$. 5. $\frac{83}{210}$. 6. Rate of stream $= 1\frac{1}{2}$ ml. an hour; time in return, 1 hour, thus: distance with stream in $30' = \frac{30}{60} \times 1\frac{1}{2} = 2\frac{1}{4}$. $2\frac{1}{4}$ mls. $- 1\frac{1}{2}$ ml. $= \frac{3}{4}$ ml. = distance in 30'; $\therefore$ rate,

$1\frac{1}{2}$ ml.; in return, 3 mls. − $1\frac{1}{2}$ ml. = $1\frac{1}{2}$ ml. 7. 39 yards, thus: A goes 100 yds., B goes 95 yds.; ∴ A goes $\frac{100 \times 100}{95}$ yds., B goes 100 yds.; A goes $\frac{10000}{95}$ yds., C has gone 95 yds. A goes 1 yd., C has gone $\frac{95 \times 95}{10000}$ yds. A goes 400 yds., C has gone $\frac{95 \times 95 \times 400}{10000}$ yds., = 361 yds.; ∴ A wins by 39 yds. 8. She loses 4 per cent. 9. Carrots, 3 ro. 30 po.; turnips, 2 ac. 2 ro. 20 po. 11. $3.27\frac{3}{40}$. 12. $33\frac{1}{3}$ days.

Ex. XI. (p. 23.)

1. 9 days, 14 hours. 2. 2 miles. 3. $\frac{1}{3}$. 4. August 9th, 1876: 7 hours 12 minutes. 5. 2. 6. 2751·5. 7. A, 1764 votes; C, 1008 votes. 8. In any year there are exactly 35 weeks between the dates; ∴ &c. 9. 1. 10. \$17·467; cost price = \$86·956. 11. 99 eggs. 12. \$480.

Ex. XII. (p. 25.)

1. 3′. 2. 14. 3. 10″. 4. $\frac{1}{2}$. 5. £12000. 6. \$480. 8. $5\frac{647}{1908}$ in.; value, $\$471.62\frac{1}{27}$. 9. $17\frac{3}{5}$ days and $27\frac{1}{18}$ days; \$15 and \$2.60. 10. 54502043294. 11. 15 gallons. 12. $\frac{7}{22}$.

Ex. XIII. (p. 27.)

2. \$1600. 3. \$1200. 4. $2\frac{2}{3}$ days; A's share, \$8; B's share, \$9; C's share, \$10. 5. $\frac{1}{15}$. 6. $\frac{3}{7}$, $\frac{9}{56}$. 7. 1. 9. $\frac{25}{178}$. 10. $\frac{377 \times 71 \times 19}{1027 \times 36}$. 11. $\$387.77\frac{1}{2}$.

Ex. XIV. (p. 28.)

2. (1) 181·1718117; (2) $5\frac{1}{2}$; (3) 6·3099. 3. (1) $5\frac{2341}{4076}$ (2) ·571428. 4. 17 cwt. 3 qrs. $18\frac{3719}{5597}$ lbs. water, 18 cwt. 2 qrs. $\frac{7688}{5597}$ lbs. milk. 5. each day, 1599735·369; each hour, 66647·307. 6. \$11875. 7. $4\frac{23}{64}$. 8. 59·0625. 9. 30. 10. 2·7182818. 11. 318 feet. 12. Rate of first company : that of the second as 6800 : 7221.

Ex. XV. (p. 30.)

1. 9. 2. 396000 tons. 3. 114 lbs., 15 dwts; \$16740625. 5. 90 at 3 for 5 cents, and 60 at 8 for 13 cents. 6. \$362.25. \$252, \$207. 7. The two gases would fill $1736\frac{1}{3}$ gallons, 8. \$3280000. 9. \$225 gain. 10. $34\frac{1}{3}$ days. 11. $99\frac{47}{73}$ cts. 12. £33 11*s.* $1\frac{1023}{1449}$*d.*

Ex. XVI. (p. 32.)

1. 2nd, by 4509479. 2. 1400 oz. 3. $B = 18$ cents, $C = 19$ cents, and $A = 95$ cents. 4. $\frac{10}{7} = 1\frac{3}{7}$. 5. $7\frac{7}{25}$ days. 6. \$355.95. 7. $81\frac{3}{5}$ days. 8. \$62.05. 9. \$6.40. 10. 777 lbs. 11. $52'\ 56\frac{8}{17}''$. 12. 54 miles; 3 miles.

Ex. XVII. (p. 33.)

1. 26832298·1366. 2. 2675 ac. 1 ro. 22 per. 24 yds. 4 ft. 72 in. 3. 1. 4. 1589 ac. 1 ro. 10 per. 5. \$40. 6. $\frac{27833}{28804}$. 7. 666 miles. 8. £2734 7*s.* 6*d.* 9. \$11250. 10. \$46875. 11. $\frac{1}{3}$. 12. £23 per ton; \$21840.35 gain.

Ex. XVIII. (p. 35.)

1. 6·875. 2. Younger, \$5840; elder, \$4160. 3. $11\frac{859}{871}$. 4. 56 days. 5. 6093410. 6. 12 days. 7. 2223. 8. \$5000; 3 per cent. 9. \$3510. 10. 54 miles. 11. 28050 marcs; the Hamburg merchant gains \$3058. 12. 500 shares.

Ex. XIX. (p. 38.)

1. \$1000. 2. 17.8828, nearly. 3. Winning side, 84; losing side, 63. 4. 3 miles uphill, 4 miles on level, and 5 miles downhill. 5. \$640000. 6. $468\frac{138}{185}$. 7. $5\frac{617}{850}$. 8. \$50000. 9. 12 hours; 15 miles from starting place. 10. Shares are, \$117.25, \$40.35, \$9.20. 11. 9 ac. $17\frac{1}{7}$ per. 12. £4 4*s*. $10\frac{10}{11}d$.; 6*d*.

Ex. XX. (p. 40.)

2. 672934684. 3. 2·4999. 4. Shares are, \$140, \$60, \$410. 5. ·039215. 6. 672934684. 7. 1. 8. 50 lbs.; 28 cents. 9. \$240. 10. 90 days. 11. \$6000. 12. 4 miles for row boat and $7\frac{1}{3}$ miles for yacht; row boat was in first.

Ex. XXI. (p. 42.)

2. $27\frac{5}{48}$. 3. \$147.07. 4. *A* gets 4 ac. 3 ro. 32 per. $1\frac{3}{4}$ yds.; *B* gets 4 ac. 3 ro. 29 per. $17\frac{1}{2}$ yds.; *C* gets 4 ac. 3 ro. 35 per. 11 yds. 5. $\frac{5}{7}$. 6. 12974. 7. \$4711.53$\frac{1}{13}$. 8. \$25000. 9. 57 hours 36 minutes. 10. 10 per cent. 11. \$1470. 12. 1656 men.

Ex. XXII. (p. 44.)

2. 1 hr. 33 min. 3. 60. 4. 60 days; 12 shovellers, 9 pickmen; \$1512. 5. $\$1\frac{28}{65}$ per cent. 6. $\$2.01\frac{3}{5}$. 7. $2\frac{3}{16}$ miles. 8. 20 times. 9. $11\frac{2}{3}$ days. 10. 750 marks. 11. *A*, £1327 12*s*. $0\frac{3}{4}d$.; *B*, £1237 16*s*. $3\frac{1}{4}d$. 12. 11 inches.

Ex. XXIII. (p. 46.)

2. \$45050. 3. 65 per cent. 4. 51·3 lbs. lead, 11·13 lbs. tin. 5. $2\frac{5}{12}$ gain. 6. *B*'s is the better by \$1064·59. 7. $5\frac{13}{185}$. 8. \$828.83$\frac{1}{73}$. 9. 14900. 10. 1344 oz. gold, 128 oz. alloy. 11. $1\frac{1}{2}$ hrs. 12. \$50000.

Ex. XXIV. (p. 48.)

2. \$50. 3. $6\frac{1}{4}$ per cent. 4. 2nd way; $468\frac{3}{4}$ piastres. 5. 39000. 6. \$60000. 7. 20 days. 8. $3496\frac{1}{2}$ tons. 9. $90\frac{855}{1768}$. 10. \$2240. 11. \$870.

Ex. XXV. (p. 51.)

2. 10*s.* $7\frac{1}{2}$*d.* 3. 50107. 4. $2\frac{751}{120096}$. 5. $\frac{9}{83}$. 6. *A*'s, 58 ac. 1 ro. 4 per.; *B*'s, 33 ac. 3 ro. 39 per. 7. 750 men. 8. $2\frac{274}{807}$. 9. 4800 wine gallons; customs lost \$960. 10. *A* or *B* in $74\frac{2}{17}$ days; *C* in $157\frac{1}{2}$ days. 11. \$480 gain. 12. Nothing.

Ex. XXVI. (p. 53.)

2. $\frac{123}{8}$. 3. ·0178. 4. \$500. 5. 694090141. 6. $\frac{5}{8}$. 7. $706\frac{2}{7}$ hours. 8. $3\frac{3}{4}$ minutes. 9. Length, 30 feet; breadth, 12 feet. 10. $66\frac{737}{915}$ per cent. 11. 76 lbs. gold, 36 lbs. silver.

Ex. XXVII. (p. 54.)

2. 3968901531620. 3. 986723. 4. $\frac{1731151}{272205}$. 5. House, \$967.20; lot, \$322.40; barn, \$80.60. 6. \$4500. 7. 1 lb. 4 oz. 2 dwts. $6\frac{3}{8}$ grs. 8. £3 18*s.* 9*d.* 9. 24 and 30. 10. *A* takes £1026 18*s.* 11*d.* more than *B*. 11. $4\frac{16}{21}$ per cent. 12. 36 oxen.

Ex. XXVIII. (p. 56.)

2. £4 7*s.* 9*d.*, wages of men with oxen; £3 18*s.* $9\frac{3}{4}$*d.*, wages of men with horses. 3. 42 trains. 4. $1\frac{307}{305}$ ft. 5. 220 miles. 6. 1280; diameter of wheel is $1\frac{5}{16}$ ft. 7. $8\frac{15}{16}$. 8. 5*s.* $11\frac{617}{1073}$*d.* 9. 10 per cent. 10. $14\cdot\dot{1}14724480578139\dot{}$. 11. A franc = a drachm. 12. 48 in.

Ex. XXIX. (p. 58.)

1. 15 tons 12 cwt. 2 qrs. 2. $\frac{5}{7}$. 3. 7·1 per cent.

4. $14\frac{14}{127}$ cents. 5. Oct. 15. 6. \$2352·993. 7. \$24·225$\frac{3}{13}$.
8. \$436.359. 9. 8 per cent. 10. March 10th, 1800.
11. \$102.45. 12. \$1.42$\frac{8}{7}$.

Ex. XXX. (p. 59.)

2. \$246·0785. 3. Tea, 60 cts.; coffee, 40 cts.; sugar, 10 cts. 4. *A*, \$83.60; *B*, \$22; *C*, \$26.40; *D*, \$332.
5. \$800. 6. \$425.514. 7. \$225. 8. \$240000.
9. 5·25 inch. 10. Currency, \$4968; gold, \$4600.
11. (*a*) $77\frac{1}{56}$; (*b*) $77\frac{6}{17}\frac{8}{9}\frac{3}{2}\frac{7}{0}\frac{8}{0}\frac{4}{0}\frac{3}{0}$. 12. \$600.

Ex. XXXI. (p. 62.)

1. 4547. 2. $\frac{14}{15}$. 3. £41 1*s.* 5$\frac{1}{7}$*d.* 4. 222$\frac{1}{2}$ cwt.

5. \$93.75. 6. \$2.77$\frac{29}{73}$. 7. 37$\frac{1}{2}$ yds. 8. \$35.
9. $4\frac{2}{8}\frac{2}{0}\frac{1}{6}\frac{8}{3}\frac{3}{0} = 4\frac{5}{9}\frac{9}{9}\frac{9}{0} = 4{\cdot}605$. 10. \$210.65.

Ex. XXXII. (p. 63.)

1. 2*s.* 11$\frac{4}{8}\frac{7}{5}\frac{3}{1}$*d.* 2. *B* in $2\frac{3}{5}$ days. 3. 51$\frac{9}{16}$ lbs. old brass; 85$\frac{15}{16}$ lbs. refined copper; 37$\frac{1}{2}$ lbs. zinc. 4. \$89.01$\frac{3}{8}$.

5. \$1676.83$\frac{1}{3}$. 6. $\frac{192}{160}$. 7. \$98. 8. 68590142.

9. \$570. 10. 99·89 + yds. = breadth; 299·67 + yds. = length.

Ex. XXXIII. (p. 64.)

1. $\frac{2}{1}\frac{6}{1}\frac{9}{7}\frac{3}{9}\frac{8}{0}\frac{9}{0}\frac{9}{0}$. 2. 21735 bush. 3. 17$\frac{3}{16}$ per cent.
4. In 72 hours. 5. $7\frac{5}{0}\frac{6}{2}\frac{7}{3}$ oz. = $7\frac{8}{8}\frac{1}{9}$ oz. 7. \$848.
8. \$6000. 9. \$67.65. 10. 426·73 + lbs.

Ex. XXXIV. (p. 66.)

3. £4 5*s.* 4*d.* 4. \$52.65. 5. \$800; \$11987.50. 6. $21\frac{9}{20}$ mills. 7. 4·9 gallons. 8. 2·751 bushels. 9. \$207. 10. $\$117\frac{9}{16}$ per cent.

Ex. XXXV. (p. 67.)

1. In 864 hours. 2. 1281 lbs. 3. (1) \$580; $7\frac{1}{2}$ per cent.; (2) \$900. 4. $\$175\frac{5}{8}$. 5. $\$458.79\frac{1}{6}$. 6. $619{\cdot}4602\dot{3}\dot{1}\dot{8}$ lbs. copper = 1 lb. gold. 7. \$1583.85+. 8. In Bank of Commerce, \$1875; in Dominion Bank, \$2700; in Consolidated Bank, \$1140. 9. *A*, $\$65\frac{5}{11}$; *B*, $\$32\frac{8}{11}$; *C*, $\$21\frac{9}{11}$. 10. (1) $8\sqrt{3}$ feet; (2) 15·12+ miles.

Ex. XXXVI. (p. 70.)

2. $40\frac{11}{15}$. 3. £65; he loses £13. 4. \$10. 5. 2 years. 6. 4 hrs. $9\frac{2}{3}\frac{3}{3}$ min. 7. 1 fur. 26 per. 4 yds. 1 ft. 8. 1 lb. 1 oz. $4\frac{1}{2}\frac{2}{5}$ dr. 9. £88 10*s.* 10. $\frac{114092}{875}$. 11. 1st method, \$5605.60; 2nd method, \$5613.49, nearly. 12. 10·4 feet.

Ex. XXXVII. (p. 71.)

1. $1\frac{1}{7}$ hr. 2. 3 tons 12 cwt. 2 qrs. 6 lbs. 13 oz. 3. \$78.76. 4. 90 additional men. 5. $\$2.14\frac{2}{7}$. 6. \$150. 7. £1306 10*s.* 8. 32·25 per cent. 9. First class ticket, 10*s.*; second class, 6*s.* 6*d.*; rate per mile, 2*d.* 10. From 75 to 60. 11. \$10000. 12. \$4943.98 nearly.

Ex. XXXVIII. (p. 73.)

1. $33\frac{1}{3}$ per cent. 2. (*a*) 8 per cent.; \$700; (*b*) $\$694.44\frac{4}{9}$. 3. \$1000. 4. $\$63\frac{10}{17}$. 5. \$5740. 6. House, \$800; barn, \$1200. 7. £352. 8. 15000 lbs. 9. 16 days. 10. $\$30037\frac{1}{2}$; $\$35.50\frac{50}{169}$. 11. 120000000. 12. 70 bush.

Ex. XXXIX. (p. 75.)

1. \$1. 2. 25 miles. 3. 75 cents. 4. \$249.75$\frac{25}{51}$. 5. 300 and 200 acres. 6. \$1000. 7. \$40000. 8. Bank of Montreal, \$8181.25; Toronto, \$1140.93$\frac{3}{4}$. 9. £26600000. 10. \$190; \$18.18$\frac{18}{19}$. 11. 10 horses. 12. (*a*) 4 feet; (*b*) 4 miles.

Ex. XL. (p. 78.)

1. 1 sq. ft. 2. 42$\frac{1}{4}$ days. 3. 100. 4. 75 cents, 80 cents, and \$1. 5. \$92·79+. 6. Loss, 17$\frac{1}{2}$ per cent. 7. \$9.27+; 2942·04+ lbs. 8. 177$\frac{1}{12}$. 9. Loss, 2·8 per cent. 10. 180; \$48666.66$\frac{2}{3}$. 11. 117$\frac{1}{3}$. 12. 14 feet.

Ex. XLI. (p. 80.)

1. 700 lbs. Troy; 48 lbs. Avoirdupois. 3. 2667 cubic feet, 144 cubic inches. 4. \$371.25. 5. 16$\frac{2}{3}$ years. 6. 14700 ounces. 7. 5205·038412. 8. 8·84 per cent. 9. 576 cubic feet. 10. \$158$\frac{5}{32}$. 11. \$632.41. 12. \$5154·19.

Ex. XLII. (p. 82.)

2. 7$\frac{23}{46}$ ft. 3. \$4000. 4. 45 cents; \$18. 5. \$500. 6. \$20000. 7. \$8.56$\frac{13}{27}$. 8. 62$\frac{1}{2}$ per cent. 9. \$8000. 10. 5 per cent. 11. (1) $\frac{135}{292}$; (2) $\frac{133}{6975}$. 12. 2$\frac{2}{3}$ days.

Ex. XLIII. (p. 84.)

2. 25·20 francs; 4*s.* 5$\frac{3}{4}$·37*d.* 3. Eldest son, \$1200; younger son, \$450; wife, \$270. 4. 32810846·2868. 5. \$80000. 6. 7 per cent. 7. \$471.84. 8. 1607$\frac{1}{7}$ cubic inches. 9. The latter is the better investment by $\frac{1}{2}$*d.* nearly. 10. \$155.87. 11. 19 miles. 12. 774·4 years.

Ex. XLIV. (p. 86.)

1. 100 apple, 80 pear, 75 plum, and 45 cherry trees. 2. Sugar, $14\frac{2}{5}$ cents; tea, 55 cents. 3. 10 hours. 4. 3 houses. 5. \$663. 6. (*a*) 80; (*b*) 21. 7. 40 per cent. 8. \$7320; $3\frac{76}{183}$ per cent. 9. 79 weeks, 1 day, 22·83 hours.

Ex. XLV. (p. 88.)

1. £3·93 per cent. 2. $69\frac{103}{433}$ per cent. 3. £443200000. 4. \$49.02. 5. 16 hours. 6. *A*, \$2.02; *B*, \$3.18; *C*, 84 cents. 7. $15\frac{1}{5}$ cwt. of nitre, $1\frac{9}{10}$ cwt. of sulphur, $2\frac{9}{10}$ cwt. of charcoal. 8. 18. 9. \$194.18. 10. \$39. 11. 90 miles. 12. \$130, the second being the dearer.

Ex. XLVI. (p. 90.)

2. \$1050; \$1837.50; \$2362.50. 3. \$168.75. 4. 7·9 inches, nearly. 5. \$16057.50 gain. 6. $8\frac{64}{97}$ days; *A* mows $4\frac{62}{97}$ acres, *B* mows $5\frac{35}{97}$ acres; and they get \$$3.47\frac{91}{97}$ and \$$4.02\frac{76}{97}$ respectively. 7. $77\frac{1}{2}$ cents in the \$. 8. 360 lbs. 9. \$1·0392305; gains 7·696 cents yearly on \$10000. 10. 3 : 13. 11. 5 ft. $7\frac{1}{2}$ in. 12. \$10666.66$\frac{2}{3}$.

Ex. XLVII. (p. 92.)

1. 2·2360; ·7071. 2. 65 per cent. 3. *E* and *B*. 4. *A* will go round $16\frac{1}{2}$ times, and *B* 17 times; 405 hours. 5. $3\frac{3}{8}$ days. 6. 80 cents per bushel. 7. 160. 8. £82 9*s*. 1*d*. 9. \$303.33. 10. \$5000. 11. 54 miles; 3 miles. 12. \$30855.55$\frac{5}{9}$.

Ex. XLVIII. (p. 94.)

1. \$450; 4 per cent. 2. \$562.50; the four-oared boat. 3. The first. 4. \$100.62½. 5. 1·4375 miles. 6. £1000. 7. $3260\frac{840}{2343}$ francs. 8. $7\frac{57}{100}$ per cent. 9. \$144.55. 10. \$1850. 11. 48 books. 12. 40 : 41.

Ex. XLIX. (p. 96.)

1. 47·560. 2. 8572 lbs. 3. $\$119\frac{7}{22}$. 4. 1·213. 5. $3\frac{433}{603}$. 6. 315 quarts. 7. ·0584. 8. 18*s.* 2·2$\dot{4}$*d.* 9. 1 ac. 1 ro. 20 per. 1 yd. $2\frac{15}{19}$ ft. 10. ·5. 11. \$3600. 12. 6·581 lbs.

Ex. L. (p. 97.)

1. 5 : 6. 2. \$616. 3. \$200000. 4. $\frac{\sqrt{15}}{3}$ ft. 5. $-\cdot 8$. 6. 22 days. 7. 15 feet; 1¼ hours. 8. (*a*) 31¼ cents; (*b*) 43 : 25. 9. (*a*) 26 miles; (*b*) actual distance pulled per hour, 3½ miles. 10. 13 per cent. 11. (1) \$3200; (2) \$1200. 12. \$520. 13. Half eagle : sovereign :: 72330·3 : 70400; the difference is $13\frac{157}{411}$ cents, or $6\frac{3}{5}$*d.* stg.

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