Chapter 2

Arithmetic

Ratio and Proportion

- **Ratio :** If a and b $(b \neq 0)$ are two quantities of the same kind, then the fraction $\frac{a}{b}$ is called the ratio of a to b and written as $a : b$, read as a is to b also a is called the antecedent or first term and b is called consequent or second term.
- **Proportion :** Four (non-zero) quantities of the same kind a, b, c and d are said to be in proportion if the ratio of a to b is equal to the ratio of c to d.

  i.e., if $\frac{a}{b} = \frac{c}{d}$

  We can write as $a : b :: c : d$

  a, b, c, d are in proportion if ad = bc

  a and d are called extreme terms and b and c are called middle terms or mean terms.
- If $\frac{a}{b} = \frac{c}{d}$ then $\frac{b}{a} = \frac{d}{c}$ (invertendo)
- If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a}{c} = \frac{b}{d}$ (Alternendo)
- If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a+b}{b} = \frac{c+d}{d}$ (Componendo)
- If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a-b}{b} = \frac{c-d}{d}$ (Dividendo)
- If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ (Componendo and Dividendo)

Percentage

The word 'per cent' is an abbreviation of the Latin phrase 'per centum' which means per hundred or hundredths.
Thus, the term percent means per hundred or for every hundred.

So, $a\% = \frac{a}{100}$

By a certain per cent we mean that many hundredths.

Some Useful Results

- To convert a given percentage to a fraction or decimal, divide it by 100 and remove the sign %.
- To convert a given fraction or decimal into percentage, multiply it by 100 and put the sign %.

$$\frac{a}{b} = \left(\frac{a}{b} \times 100\right)\%$$

- Percentage increase $= \left(\frac{\text{Increase in quantity}}{\text{Original quantity}} \times 100\right)\%$

  Percentage decrease $= \left(\frac{\text{Decrease in quantity}}{\text{Original quantity}} \times 100\right)\%$
- If A's income is x % more than that of B. Then B's income is less than that of A by $\left\{\frac{x}{(100+x)} \times 100\right\}\%$
- If A's income is x % less than that of B. Then B's income is more than that of A by $\left\{\frac{x}{(100-x)} \times 100\right\}\%$
- If the price of an item is increased by r %, then the reduction in consumption, so that expenditure is not increased,

  $= \left\{\left(\frac{r}{r+100}\right) \times 100\right\}\%$
- If the price of commodity decreases by r%, then the increase in consumptions, so that expenditure remains the same,

  $= \left\{\left(\frac{r}{100-r}\right) \times 100\right\}\%$

Profit and Loss

- **Cost Price:** The price at which an article is made is known as its cost price.
  The cost price is abbreviated as C.P.
- **Selling Price:** The price at which an article is sold is known as its Selling price.
  The selling price is abbreviated as S.P.

- **Profit:** If the selling price (S.P.) of an article is greater than the cost price (C.P.), then the difference between the selling price and cost price is called Profit.
- **Loss:** If the selling price (S.P.) of an article is less than the cost price (C.P.), the difference between the cost price (C.P.) and the selling price (S.P.) is called Loss.

Some Useful Results

- Gain = S.P. – C.P., if S.P. > C.P.
- Loss = C.P. – S.P., if C.P. > S.P.
- $\text{Gain \%} = \frac{\text{Gain} \times 100}{\text{C.P.}}$, $\text{Loss \%} = \frac{\text{Loss} \times 100}{\text{C.P.}}$
- $\text{S.P.} = \frac{100 + \text{gain\%}}{100} \times \text{C.P.}$
- $\text{S.P.} = \frac{100 - \text{loss\%}}{100} \times \text{C.P.}$
- When the selling price and gain per cent are given,

  $$\text{C.P.} = \frac{100}{100 + \text{gain\%}} \times \text{S.P.}$$
- When the selling price and loss per cent are given

  $$\text{C.P.} = \frac{100}{100 - \text{loss\%}} \times \text{S.P.}$$
- If an article receives a gain of x% and other a loss of x%, then overall % loss = $\frac{x^2}{100}$%, when both articles sold at same price.

Discount

- Discount means reduction in the price. This reduction is always given on the marked price or list price.
- When discount is offered on an article, then we calculate the selling price (S.P.) as:

  S.P. = Marked price – Discount.
- Discount = M.P. – S.P. = Marked price – Selling price
- $\text{Discount \%} = \frac{\text{Discount}}{\text{M.P.}} \times 100.$
- $\text{S.P.} = \text{M.P.} - \text{Discount} = \text{M.P.} - \frac{\text{Discount\%} \times \text{M.P.}}{100}$

  $$\text{S.P.} = \text{M.P.} \times \left\{\frac{100 - \text{Discount\%}}{100}\right\}$$
- $\text{M.P.} = \frac{100 \times \text{S.P.}}{100 - \text{Discount\%}}$
- Two successive discounts of x% and y% allowed on an item are equivalent to a single discount of $\left(x + y - \frac{xy}{100}\right)\%$ which is less than the sum of individual discounts.

Simple Interest

- $\text{S.I.} = \frac{P \times R \times T}{100}$
- $P = \frac{100 \times \text{S.I.}}{R \times T}$
- $R = \frac{100 \times \text{S.I.}}{P \times T}$
- $T = \frac{100 \times \text{S.I.}}{R \times P}$

S.I. = Simple interest, P = Principal amount,

R = Rate of interest, T = Time

Compound Interest

If the interest earned of a specific period is added to the principal for calculating the interest for the next period and so on, then such calculated interest is called Compound interest (C.I.).

Some Useful Results

- If A is the amount, P is the principal, R% is the rate of interest compounded annually and n is the number of years, then

  $$A = P\left(1 + \frac{R}{100}\right)^n$$

  $$\text{C.I.} = A - P = P\left\{\left(1 + \frac{R}{100}\right)^n - 1\right\}$$
- If the interest is compounded half-yearly, then

  $\text{Rate} = \frac{R}{2}\%$ per half-year and time = 2n half-years.

  So, $A = P\left(1 + \frac{R}{2 \times 100}\right)^{2n}$
- If the interest is compounded quarterly, then

  $\text{Rate} = \frac{R}{4}\%$ per quarter, Time = 4n quarters.

  So, $A = P\left(1 + \frac{R}{4 \times 100}\right)^{4n}$
- Let P be the principal and the rate of interest be R_1% for first year, R_2% for second year, R_3% for third year and so on and in last R_n% for the nth year. Then, the amount A and the compound interest C.I. at the end of n years are given by respectively.

  $$A = P\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right)...\left(1 + \frac{R_n}{100}\right), \text{ and,}$$

  $$\text{C.I.} = P\left[\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right).....\left(1 + \frac{R_n}{100}\right) - 1\right]$$

- Let P be the principal and the rate of interest be R% per annum. If the interest is compounded annually but time is the fraction of a year, say $5\frac{1}{4}$ years, then amount A is given by

$$A = P\left(1+\frac{R}{100}\right)^5\left(1+\frac{\frac{R}{4}}{100}\right)$$

and, C.I. = A – P.

- Let P be the population of a city or town at the beginning of a certain year and the population grows at a constant rate of R% per annum, then

$$\text{Population after n years} = P\left(1+\frac{R}{100}\right)^n.$$

$$\text{Population n years ago} = \frac{P}{\left(1+\frac{R}{100}\right)^n}$$

- Let P be the population of a city or a town at the beginning of a certain year. If the population grows at the rate of R_1% during first year and R_2% during second year, then

$$\text{Population after 2 years} = P\left(1+\frac{R_1}{100}\right)\times\left(1+\frac{R_2}{100}\right).$$

This formula may be extended for more than 2 years.

- Let P be the population of a city or a town at the beginning of a certain year. If the population decreases at the rate of R% per annum, then

$$\text{Population after n years} = P\left(1-\frac{R}{100}\right)^n.$$

$$\text{Population n years ago} = \frac{P}{\left(1-\frac{R}{100}\right)^n}$$

Types of Variation

Direct Variation : If two quantities *a* and *b* are associated in such a way that increase in quantity *a* leads to corresponding increase in *b* in the same proportion and vice-versa then *a* and *b* are called in direct variation.

- If two quantities *a* and *b* vary with each other in such a manner that the ratio $\frac{a}{b}$ = K (K is positive real no.) or *a* = bK then, we say that *a* and *b* vary directly with each other or *a* and *b* are in direct variation.

Constant (K) is called the constant of variation.

Inverse Variation :

If two quantities a and b vary inversely as each other, then the product xy always remains constant. The product xy is called the constant of variation.

If two quantities a and b vary inversely as each other and b_1, b_2 are the values of b corresponding to the values a_1, a_2 of a respectively, then

$a_1 b_1$ = Constant (= k, say) and, $a_2 b_2 = k$

$\therefore \quad a_2 b_2 = a_2 b_2$

$$\Rightarrow \quad \frac{a_1}{a_2} = \frac{b_2}{b_1}$$

$$\Rightarrow \quad a_1 : a_2 = b_2 : b_1 \text{ or, } a_1 : a_2 :: b_2 : b_1$$

Time and Work

- If a person can do a work in n days then he/she will do $\frac{1}{n}$ th of the work in one day, i.e.,

  If A can do a work in 5 days, it means he can do $\frac{1}{5}$ th of the work in a day.
- Similarly, if many persons work together their work for one day, then this work done is the same as the sum of the works that they can separately do in a day.

Pipes and Cisterns

- As you know that a cistern or a water tank is always connected with two types of pipes. One which fills it up and the other which empties it out. The pipe which fills up the cistern is called an inlet and the one which empties it is called an outlet.
- The work done by the inlet is always positive whereas the work done by the outlet is always negative.
  If m_1 persons can do w_1 work (or part of work) in d_1 days and m_2 persons can do w_2 works (or part of work) in d_2 days, then we have a very general formula in the relationship of $m_1 d_1 w_2 = m_2 d_2 w_1$

Time and Distance

- $\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$
- Distance travelled = Speed × Time taken
- If two bodies are moving in the same direction with the speeds of u and v km/h starting from the same point, then their relative speed is (u – v) km/hr and it is (u + v) km/h when they are moving in opposite directions.
- If a man can row a boat at the rate of x km/h in still water and if y km/h is the speed of current in the river, then (x + y) km/h is the speed of the boat in downstream and (x – y) km/h is the speed of the boat in upstream.

- When a train passes a pole or a man standing on a platform, time taken to cross the man or pole is equal to the time taken to cover its own length with the given speed.
- Time taken to cover the bridge or a platform is the time to cover the sum of lengths of platform or bridge and its own length.
- If two trains start at the same time from two points A and B towards each other and after crossing each other they take a and b hours in reaching B and A, respectively, then

  Speed of A : Speed of B = $\sqrt{b} : \sqrt{a}$

(i) When a train is passing another train completely, it has to cover a distance equal to the sum of the lengths of the two trains.

(ii) Let the faster train has length x km and slower train has length y km. Let u km/h is the speed of faster train and v km/h is the speed of slower train then time taken by faster train to cross the slower train if both running in the same direction $= \left(\frac{x+y}{u-v}\right)$ hrs.

(iii) Relative speed if running in same directions $= (u - v)$ km/h $(u > v)$

Relative speed if running in opposite directions $= (u + v)$ km/h.

(iv) Time taken by train to cross each other if running in opposite directions $= \left(\frac{x+y}{u+v}\right)$ hrs.

(v) **Convertion**

$1 \text{ km/h} = \frac{5}{18}$ m/s $\qquad 1 \text{ m/s} = \frac{18}{5}$ km/h.

Exercise 1

DIRECTIONS : *This section contains multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which only one is correct.*

1. In a cricket coaching camp, 1200 children are trained out of which 900 are selected for various matches. Ratio of non-selected children to the total number of children is
(1) 300 : 120 (2) 4 : 1
(3) 1 : 4 (4) 120 : 300

2. In a quiz programme the ratio of correct answers to incorrect answers is 5 : 2. If 16 incorrect answers are given then the number of correct answers given is
(1) 80 (2) 40
(3) 20 (4) 30

3. Asha can stitch 'x' shirts in $\frac{3}{4}$ minutes. At this rate, how many shirts can she stitch in $\frac{3}{4}$th of an hour?
(1) 50 x (2) $\frac{9}{16}$x
(3) 60 x (4) $\frac{16}{9}$x

4. A cistern can be filled separately by two pipes in 12 and 16 minutes separately. If both fill pipes are opened together, when will the cistern be filled?
(1) $8\frac{1}{7}$min (2) $4\frac{6}{7}$min
(3) $6\frac{6}{7}$min (4) $4\frac{1}{2}$min

5. Marked price of an article is 20% above the CP. He allows his customers a discount and makes a profit of 8%. The rate of discount is
(1) 10% (2) 12%
(3) 20% (4) 18%

6. A shopkeeper sold two watches for ₹ 425 each, gaining 10% on one and losing 10% on the other. Then he
(1) neither gains nor loss (2) gains 1%
(3) loses 1% (4) None of these

7. At what rate of interest per annum will a sum double itself in 8 years, if calculated as per Simple Interest formula.
(1) 25% (2) $6\frac{1}{4}$%
(3) $12\frac{1}{2}$% (4) None of these

8. Bhanu borrowed a certain sum of money at 12% per annum for 3 years and Madhuri borrowed the same sum at 24% per annum for 10 years. The ratio of their amounts is
(1) 1 : 3 (2) 2 : 1
(3) 2 : 3 (4) 2 : 5

9. The difference in SI and CI on a certain sum of money in 2 years at 15% p.a. is ₹ 544. The sum is
(1) ₹ 6000 (2) ₹ 6200
(3) ₹ 6300 (4) ₹ 6400

10. The selling price when goods which cost ₹65 are sold at a loss of 10% is
(1) ₹ 71.50 (2) ₹ 58.50
(3) ₹ 59.75 (4) ₹ 66.50

11. A cycle is sold for ₹880 at a loss of 20%. For how much should it be sold to gain 10%?
(1) ₹ 1400 (2) ₹ 1210
(3) ₹ 1100 (4) ₹ 1000

12. Two bicyclists do the same journey by travelling respectively at the rate of 9 and 10 km an hour. The distance travelled when one takes 32 minutes longer than the other is
(1) 42 km (2) 44 km
(3) 48 km (4) 50 km

13. 8% of ₹625 is equal to
(1) ₹ 50 (2) ₹ 75
(3) ₹ 80 (4) ₹ 100

14. If the cost of the book worth ₹50 is increased by ₹25, the rate of increase is
(1) 25% (2) 20%
(3) 50% (4) 10%

15. If A's salary is 50% more than B's, then by what % B's salary is less than A's salary ?
(1) $33\frac{1}{3}$ (2) $23\frac{1}{3}$
(3) 33 (4) 30

16. The price of wheat has increased by 60%. In order to restore the original price, the new price must be reduced by
(1) 37.5% (2) 33%
(3) 34% (4) 40%

17. The fourth proportion of 5, 15, 20 is
(1) 30 (2) 25
(3) 60 (4) $6\frac{2}{3}$

18. A man buys 5 apples for ₹ 3 and sold each for ₹ 2. What did he gain or lose?

(1) $\frac{700}{3}$% gain (2) 50% gain

(3) $\frac{200}{3}$% loss (4) $\frac{100}{3}$% gain

19. If x : y = 5 : 2, then value of $\frac{(8x+9y)}{(8x+27)}$ is

(1) 22 : 29 (2) 29 : 22

(3) 61 : 26 (4) 26 : 61

20. If 10% of m is the same as 20% of n then m : n is equal to

(1) 1 : 2 (2) 2 : 1

(3) 5 : 1 (4) 10 : 1

21. If 2A = 3B = 4C, then A : B : C : is

(1) 2 : 3 : 4 (2) 4 : 3 : 2

(3) 6 : 4 : 3 (4) 3 : 4 : 2

22. Some men promised to do a job in 18 days, but 6 of them became absent and remainder men did the job in 20 days. What is the original number of men?

(1) 50 (2) 52

(3) 56 (4) 60

23. If p is 95% of q, then what percentage of p is q?

(1) 105 % (2) 105.3 %

(3) 110 % (4) 115 %

24. Two successive discounts of 10% and 5% are equal to a single discount of

(1) 7 % (2) $12\frac{1}{2}$%

(3) $14\frac{1}{2}$% (4) 15 %

25. A bag contains ₹ 600 in the form of 1- rupee, 50 paise and 25 paise coins in the ratio 3 : 4: 12, the number of 25 paise coins is

(1) 600 (2) 900

(3) 1200 (4) 1376

26. A water tap fills a tank in p hours and the tap of the bottom of the tank empties it in q hours. If p is less than q and when both the taps are open, the tank is filled in r hours. Then

(1) $\frac{1}{r}=\frac{1}{p}+\frac{1}{q}$ (2) $\frac{1}{r}=\frac{1}{p}-\frac{1}{q}$

(3) r = p + q (4) r = p – q

27. If the cost price of 6 articles is equal to the selling price of 4 articles, then the gain per cent is

(1) 35 % (2) 45 %

(3) 40 % (4) 50 %

28. If a radio is sold at ₹ 972, then profit is 8%. If it is sold at ₹ 872, then there is a loss of

(1) ₹ 28 (2) ₹ 25

(3) ₹ 20 (4) ₹ 15

29. A number is increased by 10% and then reduced by 10%, then the number

(1) doesn't change (2) decreases by 1%

(3) increases by 1% (4) None of these

Exercise 2

MCQ Based Questions

DIRECTIONS (Qs. 1 to 11) : *This section contains multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which only one is correct.*

1. M men agreed to purchase a gift for ₹ C . If 3 men drop out, how much more will each have to contribute towards the purchase of the gift ?

(1) $\frac{3C}{M^2-3M}$ (2) $\frac{3C}{M^2-M}$

(3) $\frac{3C}{M^2+M}$ (4) $\frac{3C}{M^2+3M}$

2. Six diesel engines consume 900 liters of diesel, when each one is running for 5 hrs a day. How much diesel will be required by 9 engines, each running 8 hrs a day when 5 diesel engines of former type consume as much diesel as 8 diesel engines of the later type?

(1) 1500 lit (2) 1250 lit
(3) 1350 lit (4) None of these

3. A can do a job in 20 days, B in 30 days and C in 60 days. If A is helped on every 3rd day by B and C, then in how many days, the job is finished?

(1) 12 days (2) 15 days
(3) 20 days (4) 10 days

4. An empty pipe can empty $\frac{5}{6}$ of cistern in 20 minutes. In 9 minutes, what part of cistern will be emptied?

(1) $\frac{8}{9}$ (2) $\frac{8}{3}$

(3) $\frac{3}{5}$ (4) $\frac{3}{8}$

5. A man bought goods worth ₹ 6000 and sold half of them at a gain of 10%. At what gain per cent must he sell the remainder to get a gain of 25% on the whole?

(1) 40 % (2) 25 %
(3) 30 % (4) 20%

6. Two men and a boy can do a piece of work in 5 days. While a man and 2 boys can do it in 6 days. If a man is paid at the rate of ₹ 28 a week, what should be the wages of a boy?

(1) ₹ 10 (2) ₹ 12
(3) ₹ 16 (4) ₹ 18

7. In an examination 52% candidates failed in English, 42% in maths and 17% in both. The percentage of those passed in both the subjects is

(1) 23% (2) 40%
(3) 53% (4) 33%

8. 10 years ago the age of the father was 5 times that of the son. 20 years hence the age of the father will be the twice that of the son. The present age of the father (in years) is

(1) 40 years (2) 45 years
(3) 60 years (4) 70 years

9. 729 ml of a mixture contains milk and water in the ratio 7 : 2. How much more water is to be added to get a new mixture containing milk and water in the ratio 7 : 3?

(1) 600 ml (2) 710 ml
(3) 520 ml (4) none of these

10. The salaries of A, B and C together amount to ₹ 333, if they spend 80%, 85% and 75% of their respective salaries. If their savings are 7 : 6 : 9, then their respective salaries are

(1) ₹ 102, ₹ 118 ₹ 113 (2) ₹ 105, ₹ 120 ₹ 108
(3) ₹ 85, ₹ 125 ₹ 123 (4) None of these

11. Which discount series is profitable to the buyer 25%, 12%, 3%, or 18%, 1.7%, 5%?

(1) First (2) Second
(3) Both (4) Neither

Matching Based Question

DIRECTIONS (Q. 12) : *Match the Column-I with Column-II and select the correct answer given below the columns.*

12.

Column I		Column II	
(A)	The ratio of 3.5 kg to 280 gm is	(p)	10.20
(B)	The compound ratio of 3 : 4, 8 : 15 and 25 : 28 is	(q)	0.05
(C)	0.35% of a number is equivalent to multiplying it by the number	(r)	5 : 14
(D)	20% of 30% of 20% of ₹ 850 is	(s)	25 : 2
(E)	Half of 1 percent written as a decimal is	(t)	0.0035

(1) (A) → p, (B) → q, (C) → r, (D) → t, (E) → q
(2) (A) → s, (B) → r, (C) → p, (D) → t, (E) → q
(3) (A) → r, (B) → s, (C) → t, (D) → p, (E) → q
(4) (A) → s, (B) → r, (C) → t, (D) → p, (E) → q

Statement Based Question

13. Consider the following statements:
If a sum of money is lent at simple interest, then the:

I. money gets doubled in 5 years if the rate of interest is $16\frac{2}{3}\%$

II. money gets doubled in 5 years if the rate of interest is 20%

III. money becomes four times in 10 years if it gets doubled in 5 years.

Which of the above statements is/are correct?

(1) I and III (2) Only II
(3) III alone (4) II and III

Passage Based Questions

DIRECTIONS (Qs. 14 to 18) : *Read the passage(s) given below and answer the questions that follow.*

PASSAGE

If V_0 is the value of an article at certain time which increases at the rate of R_1 for first n_1 years and decreases at the rate of R_2 for next n_2 years, then the value of the article V at the end of $(n_1 + n_2)$ years is given by

$$V = V_0 \left(1+\frac{R_1}{100}\right)^{n_1} \left(1+\frac{R_2}{100}\right)^{n_2}$$

14. The production of an article of a company in 2002 was 10000. Due to increase in demand, the company increased its production by 20% in the next 2 years. After 2 years due to decrease in the demand, the company decreased its production by 10% in the next year, then the production after 3 years is

(1) 12950 (2) 12000
(3) 12900 (4) 12960

15. Population of Chhapra district was 200000 on the last day of the year 2005. During next year it increased by 5% but due to an epidemic it decreased by 2% in the following year, then the population at the end of the year 2007 is

(1) 205000 (2) 205800
(3) 206000 (4) 205700

16. Sandeep started a factory with an inital investment of ₹ 500000. In the next year, he incurred a loss of 20%. However, during the second year, he earned a profit of 10% and in the third year he earned a profit of 15%, then his net profit for the entire period of three years is

(1) ₹5000 (2) ₹6000
(3) ₹50000 (4) ₹60000

17. Consider the following statements

(i) If two quantities varies directly with each other, then their product is constant.

(ii) If two quantities varies inversly with each other, then their ratio is constant.

Which of the statements given above is/are correct

(1) only (i) (2) only (ii)
(3) both (4) none

18. Consider the following statements

(i) If P be the population of a city and R be the growth rate, then.

Population after n years = $P\left(1+\frac{R}{100}\right)^{1/n}$

(ii) If P is the population of a city and R be the decay rate,

then population after n years = $P\left(1-\frac{R}{100}\right)^{1/n}$

Which of the statements(s) given above is/are correct?

(1) only (i) (2) only (ii)
(3) both (i) and (ii) (4) neither (i) nor (ii)

Assertion Reason Based Questions

DIRECTIONS (Qs. 19 to 21) : *Following questions consist of two statements, one labelled as the* ***'Assertion' (A)*** *and the other as* ***'Reason' (R)****. You are to examine these two statements carefully and select the answer to these items using the code given below.*

Code :

(1) Both A and R are individually true and R is the correct explanation of A:

(2) Both A and R are individually true but R is not the correct explanation of A.

(3) A is true but R is false

(4) A is false but R is true.

19. **Assertion :** If 'a' is x% more than 'b' and 'b' is y % less than 'a'. Then the relation between x and y is $\frac{1}{y}-\frac{1}{x}=\frac{1}{100}$

Reason : If 'a' exceeds 'b' by P % then 'b' is short of 'a' by $\frac{100\times P}{100+P}\%$

20. **Assertion (A) :** The numbers 4, 6 and 9 are in continued proportion.

Reason (R) : The numbers 2, 4, 6 are also in continued proportion.

21. **Assertion (A) :** An article is sold at ₹ 1425 at a loss of 5%. Its C.P is ₹ 1500.

Reason (R) : If the shopkeeper has to make a 10% profit in question given in statement 1 then the S.P should be ₹6150.

Correct Definition Based Questions

22. Which of the following is correct definition of profit?

(1) Profit of an article is the price at which an article is sold.

(2) Profit of an article is the price at which an article is bought.

(3) Profit of an article is difference between selling price and cost price, if selling price < cost price.

(4) Profit of an article is difference between selling price and cost price, if selling price > cost price.

23. Which of the following is correct definition of cost price?

(1) The price at which an article is made is known as its cost price.

(2) The price at which an article is sold is known as its cost price.

(3) Difference between the selling price and discount is known as cost price.

(4) Sum of the marked price and discount is known as cost price.

24. Which of the following is correct definition of loss?

(1) The difference between the selling price and cost price is called Loss.

(2) The difference between the cost price and the selling price is called loss.

(3) The difference between the selling price and discount is called loss.

(4) The difference between the cost price and discount is called loss.

25. Which of the following is correct definition of discount?

(1) Discount = Marked price + Selling price

(2) Discount = Marked price ÷ Selling price

(3) Discount = Marked price – Selling price

(4) Discount = Marked price × Selling price

26. Which of the following is correct definition of Simple Interest?

(1) $\text{S.I.} = \frac{P \times R \times T}{100}$ (2) $\text{S.I.} = \frac{P + R + T}{100}$

(3) $\text{S.I.} = P \times R \times T \times 100$ (4) $\text{S.I.} = (P + R + T)100$

Hints SOLUTIONS

Exercise 1

1. **(3)** 1200 – 900 = 300 (non -selected)
300 : 1200
1 : 4

2. **(2)** Correct ans: incorrect ans = 5 : 2
Incorrect ans = 16
Correct ans = x

$$\frac{5}{2}=\frac{x}{16}$$

$$\frac{5\times16}{2}=x$$

40 = x
Correct answers = 40.

3. **(3)**

No. of shirts	Time
x	$\frac{3}{4}$min
s	$\frac{3}{4}\times60=45$min

$\because$ It is direct variation

$$x:\frac{3}{4}::s:45$$

$$s=\frac{45x}{3/4}=60x$$

4. **(3)** $\frac{1}{12}+\frac{1}{16}=\frac{4+3}{48}=\frac{7}{48}$

$\therefore$ The cistern will be filled in $\frac{48}{7}$ min $=6\frac{6}{7}$min.

5. **(1)** Let
CP = 100
MP = 120
Profit = 8%
We have

$$\frac{CP(100+g)}{100}=\frac{M.P.(100-d)}{100}$$

$100\times(100+8)=120\times(100-d)$

$$100-d=\frac{100\times108}{120}$$

$d = 100 - 90 = 10\%$.

6. **(3)** $\frac{10\times10}{100}=1\%$loss.

7. **(3)** T= 8 years; N = 2; R = ?

$$R\times T=100\times(N-1),\ N=\frac{A}{P}$$

$R\times8=100\times(2-1)$

$$R=\frac{100}{8}=12\frac{1}{2}\%$$

8. **(4)**

Bhanu	Madhuri
T_1 = 3 years	T_2 = 10 years
R_1 = 12%	R_2 = 24%

Let P = 100

$$\frac{A_1}{A_2}=\frac{P\left(1+\frac{R_1T_1}{100}\right)}{P\left(1+\frac{R_2T_2}{100}\right)}$$

$$\frac{100+T_1R_1}{100+T_2R_2}=\frac{100+3\times12}{100+10\times24}=\frac{136}{340}=\frac{2}{5}$$

$\therefore$ $A_1 : A_2 = 2 : 5$.

9. **(4)** $CI - SI = \frac{R\times SI}{2\times100}$

$$144=\frac{15\times SI}{200}$$

SI = ₹1920

$$\frac{PTR}{100}=₹1920$$

$$\frac{P\times2\times15}{100}=1920$$

P = ₹ 6400.

10. **(2)** Loss = $\frac{10}{100}\times65=6.50$

$\therefore$ SP = CP – loss = 65 – 6.50 = 58.50

11. **(2)** SP of cycle = ₹ 880
Loss = 20%

CP of cycle = $880\times\frac{100}{100-20}=₹1100$

If gain required is 10% then

SP = $1100\times\frac{100+10}{100}=₹1210$.

12. **(3)** Reasoning: Let the distance be x kms. First cyclist takes $\frac{x}{9}$ hours and the latter $\frac{x}{10}$ hours, whereas

$\frac{x}{9}-\frac{x}{10}=\frac{32}{60}$ (converting 32 min. into hour)

So, $\frac{x}{90}=\frac{32}{60}$

or $x = 90\times\frac{32}{60}=48$ kilometers.

13. **(1)** 8% of ₹ 625 = $\frac{8}{100}\times625=₹50$.

14. **(3)** Increase on ₹100 = $\frac{25}{50}\times100=50\%$

15. (1) Let B's salary be ₹100, so A's salary is ₹150.
So % of B's salary less than A

$$= \frac{50}{150} \times 100 = \frac{100}{3} = 33\frac{1}{3}\%$$

16. (1) The % of reduction = $\frac{60}{100+60} \times 100 = 37.5\%$

17. (3) 4^{th} proportion $= \frac{II \times III}{I} = \frac{15 \times 20}{5} = 60$.

Let fourth proportion is x

$5 : 15 :: 20 : x$

$$\frac{5}{15} = \frac{20}{x}$$

$x = 60$

18. (1) C.P. = ₹ 3
S.P. = ₹ 10
Gain = 10 –3 = 7

$$\text{Gain \%} = \frac{7}{3} \times 100 = \frac{700}{3}\%.$$

19. (2) Let x = 5K and y = 2K and proceed.

20. (2) 10% of m = $m \times \frac{10}{100} = \frac{m}{10}$

20% of n = $n \times \frac{20}{100} = \frac{n}{5}$

According to the question,

$$\frac{m}{10} = \frac{n}{5} \Rightarrow \frac{m}{2} = \frac{n}{1} \Rightarrow m : n = 2 : 1.$$

21. (4)

22. (4)

Men	**Days**
x	18
(x – 6)	20

$$\Rightarrow \frac{x}{x-6} = \frac{20}{18}$$

$$\Rightarrow x = 60$$

23. (2) Given: p = 95% of q = $\frac{95}{100}q$ (To find: q)

$$\Rightarrow \frac{100}{95}p = q$$

$$\Rightarrow 1.053\ p = q$$

To convert into percentage we multiply it by 100, we get q = 105.3% of p.

24. (3) Two successive discounts of x % and y % allowed on an item are equivalent to a single discount of $\left(x + y - \frac{xy}{100}\right)\%$

Here x = 10, y = 5

$$\therefore \text{ Two succesive discount} = \left(10 + 5 - \frac{50}{100}\right)\%$$

$$= \left(15 - \frac{50}{100}\right)\% = \left(\frac{1450}{100}\right)\% = \frac{145}{10}\% = 14\frac{1}{2}\%$$

25. (2) Let x = 1 rupee coin, y = 50 paise coin, z = 25 paise coin

$$\therefore \quad ₹\left(x + \frac{y}{2} + \frac{z}{4}\right) = ₹600$$

$$\Rightarrow 4x + 2y + z = 2400 \quad ...(i)$$

Also, let x = 3k, y = 4k, z = 12k

$\therefore$ From (i)

$4(3k) + 2(4k) + 12\ k = 2400$

$$\Rightarrow 12k + 8k + 12k = 2400 \Rightarrow 32k = 2400$$

$$\Rightarrow k = \frac{2400}{32} = 75$$

$\therefore$ Number of 25-paise coin = 12(k) = 12 × 75 = 900.

26. (2) Time taken by the tap to fill the tank = p hours
Time taken by the tap to empty the tank = q hours

$\therefore$ In one hour the tap fills $\frac{1}{p}$th part of the tank.

In one hour the tap empties $\frac{1}{q}$th part of the tank.

Thus, in one hour $\left(\frac{1}{p} - \frac{1}{q}\right)$ th part is filled.

But given tank is filled in r hours when both the taps are opened.

$\therefore$ In 1 hour $\frac{1}{r}$th part of tank is filled.

$\therefore \quad \frac{1}{r} = \frac{1}{p} - \frac{1}{q}$.

27. (4) Selling price of 4 articles = cost price of 6 articles then gain per cent =

$$\frac{\text{No. of articles on CP–No. of articles on SP}}{\text{No. of articles on SP}} \times 100$$

$$\Rightarrow \text{gain per cent} = \frac{6-4}{4} \times 100\% = \frac{2}{4} \times 100\% = 50\%.$$

28. (1) Selling price of radio = 972
gain % = 8%

We know, SP = $\left(\frac{100 + \text{gain\%}}{100}\right)$CP

$$972 = \left(\frac{100+8}{100}\right)CP$$

$$\Rightarrow CP = 900$$

Now, selling price = 872, CP = 900

$\therefore$ Loss = 900 – 872 = ₹ 28.

29. (2) Let the number be 'x'.

$$10\% \text{ of } x = \frac{x}{10}$$

Number increased by 10% i.e. number $= x + \frac{x}{10} = \frac{11x}{10}$

Now, 10% of $\frac{11x}{10} = \frac{11x}{100}$

Now, number $\frac{11x}{10}$ reduced by 10% i.e.

$$\text{number} = \frac{11x}{10} - \frac{11x}{100} = \frac{110x - 11x}{100} = \frac{99x}{100} = 99\% \text{ of } x$$

Thus, we get that the number is decreased by 1% .

Exercise 2

1. (1) **No. of men** **Contribution by each man**

M $\quad\quad$ $\frac{C}{M}$

(M – 3) $\quad\quad$ x

$$x = \frac{C}{M} \times \frac{M}{M-3} = \frac{c}{M-3}$$

The extra money each have to contribute

$$= \frac{C}{M-3} - \frac{C}{M} = \frac{3C}{M^2 - 3M}$$

2. (3) Let m and n be the number of engine of former type and later type respectively

So, $\frac{m}{n} = \frac{5}{8} = \frac{8m}{5}$

So, $n = \frac{8 \times 6}{5} = \frac{48}{5} = \frac{48}{5}$

No. of engines	**Diesel working (in litres)**	**hrs**
$\frac{48}{5}$	900	5
9	x	8

Since, number of engines is in direct variation with diesel and working hours.

So, $\left.\begin{matrix} \frac{48}{5} : 9 \\ 5 : 8 \end{matrix}\right\} :: 900 : x$

$$x = 900 \times \frac{9}{48/5} \times \frac{8}{5} = 1350 \text{ lit.}$$

3. (2) Part of work done by A,B and C together in

3 days = $\frac{1}{20} \times 3 + \frac{1}{30} \times 1 + \frac{1}{60} \times 1 = \frac{1}{5}$

$\therefore$ Total time for the work = 3 × 5 = 15 days.

4. (4) $\frac{5}{6}$ × capacity is emptied in 20 minutes

So, $\text{capacity} = 20 \times \frac{6}{5} = 24$

$\therefore$ In 1 min the pipe can empty $\frac{1}{24}$th part.

In 9 min the pipe can empty

$9 \times \frac{1}{24}$ th part $= \frac{3}{8}$ th part.

5. (1) Total CP = ₹6000

Profit = 25%

overall

$$SP = 6000 \times \frac{100+25}{100} = ₹7500$$

SP of half of the goods

$$= 3000 \times \frac{100+10}{100} = ₹3300$$

SP of remaining half goods

= 7500 – 3300 = ₹4200.

Profit on remaining half goods costing ₹3000

= ₹4200 – ₹3000 = ₹1200.

$$\text{Profit \%} = \frac{1200}{3000} \times 100 = 40\%$$

6. (3) Reasoning: 2 men and 1 boy can do job in 5 days means.

10 men and 5 boys can do a job in 1 day.

Again, 1 man and 2 boys can do the same job in 6 days means 6 men and 12 boys can do the same job in 1 day.

$\therefore$ 10 men and 5 boys = 6 men and 12 boys

i.e. ₹16 per week.

i.e., 4 men = 7 boys

Now, 7 boys get ₹4 × 28 per week

$\therefore$ 1 boy gets ₹ $\frac{4 \times 28}{7}$

7. (1) Failed in Maths = 42

Failed in English = 52

Failed in both = 17

Failed in English only = 52 – 17 = 35

Failed in Maths only = 42 – 17 = 25

Failed in Maths or English or both

= 35 + 25 + 17 = 77

Pass % in both = 100 – 77 = 23%.

8. (3) Let the present age of father = x years and present age of son = y years.

10 years ago, father's age = (x – 10) yrs

Son's age = (y – 10) yrs

Now, according to the question,

(x – 10) = 5(y – 10)

$\Rightarrow$ x – 5y = – 40 ...(i)

20 years after, father's age = (x + 20)yrs

Son's age = (y + 20) yrs

Again, according to the question,

(x + 20) = 2(y + 20)

$\Rightarrow$ x – 2y = 20 ...(ii)

On solving equation (i) and (ii), we get

y = 20 and x = 60

$\therefore$ Father's present age = 60 years.

9. (4) Ratio of water and milk are 2: 7

Total mixture is 729 ml

$\therefore$ Quantity of milk $= \left[729 \times \frac{7}{9}\right] = 567\text{ml}$

Quantity of water = [729 –567] =162 ml

Now, $\frac{567}{162 + x} = \frac{7}{3}$

567 × 3 = 7[162 + x]

1701 = 1134 + 7x $\Rightarrow$ x = 81

10. (2) Let salaries of A, B, C be ₹x, y, z respectively.

Together their amount = x + y + z = 333.

Now,

Expenditure of A = 80% $\Rightarrow$ Savings = 20%

Expenditure of B = 85% $\Rightarrow$ Savings = 15%

Expenditure of C = 75% $\Rightarrow$ Savings = 25%

$\therefore$ Savings of $A = \frac{20x}{100}, B = \frac{15y}{100}, C = \frac{25z}{100}$

Also given savings are 7 : 6 : 9

$\therefore \quad \frac{20x}{700} = \frac{15y}{600} = \frac{25z}{900}$

$\Rightarrow \quad \frac{20x}{7} = \frac{15y}{6} = \frac{25z}{9}$

Now, $\frac{20x}{7} = \frac{15y}{6} \Rightarrow 8x = 7y = x = \frac{7y}{8}$ and $\frac{15y}{6} = \frac{25z}{9}$

$\Rightarrow \frac{9y}{10} = z$

$\therefore \quad x + y + z = 333$

$\Rightarrow \frac{7}{8}y + y + \frac{9}{10}y = 333$

$\Rightarrow \quad 222y = (333)(80)$

$\Rightarrow \quad y = 120$

$\therefore \quad x = \frac{7}{8}(120) = 105,\ z = \frac{9}{10}(120) = 108$

Hence, salary of A = ₹ 105, B = ₹120, C = ₹108.

11. (1)

12. (4) (A) $\rightarrow$ s, (B) $\rightarrow$ r, (C) $\rightarrow$ t, (D) $\rightarrow$ p, (E) $\rightarrow$ q

(B) $\frac{3}{4} \times \frac{8}{15} \times \frac{25}{28} = \frac{5}{14}$

(D) $\frac{20}{100} \times \frac{30}{100} \times \frac{20}{100} \times 850 = \frac{1020}{100}$

13. (2) I. 16.66 % means it will be 83.33 % of principal.

II. For any amount *x*, SI after 5 years at the rate of 5% is

$x \times \frac{5}{100} \times 20 = x$

$\therefore$ Amount = 2x.

III. After 10 yrs. interest will be = $\frac{10 \times 20 \times x}{100} = 2x$

so amount will be thrice i.e., 3*x*.

14. (4) Production of the article after 3 years

$= 10000\left(1 + \frac{20}{100}\right)^2 \left(1 - \frac{10}{100}\right)$

$= 10000 \times \frac{36}{25} \times \frac{9}{10} = 12960$

15. (2) Population of Chhapra district

$= 200000\left(1 + \frac{5}{100}\right)\left(1 - \frac{2}{100}\right)$

$= 200000 \times \frac{21}{20} \times \frac{49}{50} = 205800$

16. (2) Amount after three years

$500000\left(1 - \frac{20}{100}\right) \times \left(1 + \frac{10}{100}\right)\left(1 + \frac{15}{100}\right)$

$500000 \times \frac{4}{5} \times \frac{11}{10} \times \frac{23}{20} = 506000$

Net profit = ₹ (506000 – 500000) = ₹ 6000

17. (1)

18. (3)

19. (1) Both statements are correct and Reason is the correct explanation for Assertion.

We have, $y = \frac{100 \times x}{100 + x}$

$\frac{1}{y} = \frac{1}{x} + \frac{1}{100}$

$\frac{1}{y} - \frac{1}{x} = \frac{1}{100}$

20. (3) Assertion is true.

because $\frac{4}{6} = \frac{6}{9}$

Reason is false because $\frac{2}{4} \neq \frac{4}{6}$

21. (3) **Assertion :**

SP = ₹ 1425, loss = 5%

$\text{C.P} = \frac{\text{SP} \times 100}{100 - \text{loss}} = \frac{1425 \times 100}{95} = ₹\ 500$

Reason :

Profit = 10%, S.P = $\frac{1500 \times 110}{100} = ₹\ 650$

Reason is false.

22. (4)

23. (1)

24. (2)

25. (3)

26. (1)