arihant

JAWAHAR NAVODAYA VIDYALAYA

Entrance Exam 2021

Conducted by
Navodaya Vidyalaya Samiti
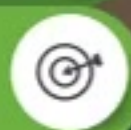
- ENGLISH
- HINDI
- GENERAL SCIENCE
- MATHEMATICS

9

With Solved Paper 2020

SYLLABUS

ENGLISH

Comprehension (Unseen Passage), Word and Sentence Structure, Spelling, Rearranging jumbled words , Passivation, Use of degrees of comparison, Modal auxiliaries , Use of prepositions , Tense forms, Reported speech

हिन्दी

(क) भाषिक अनुप्रयोग और व्याकरणिक कुशलताएँ

वर्ण विचार/वर्तनी विवेक, शब्दभेद (स्त्रोत/उत्पत्ति), पर्याय/विलोम, शब्द विवेक (शब्द प्रयोग में सूक्ष्म अंतर), पद भेद (व्याकरणिक कोटि) की पहचान, पद परिचय, अशुद्ध वाक्य को शुद्ध करना, वाक्य रचनान्तरण (सरल/संयुक्त/मिश्र), मुहावरा, लोकोक्ति

(ख) अपठित बोधात्मक प्रश्न

GENERAL SCIENCE

Food – Crop Production and Management; Microorganism; Food Preservation, Materials I – Synthetic fibers; Plastics; Metals and Non – metals, Material II – Coal and Petroleum; Refining of Petroleum; Fossil Fuels; Combustion and Flame, Living / Non living; Cell structure and Function; Conservation of Plants and Animals – Wildlife, Sanctuary and National Parks, Reproduction – Asexual and Sexual, Reproduction, Reaching the age of adolescence, Force – Frictional Force; Gravitational Force; Thrust and Pressure, Light – Reflection of Light; Multiple Reflection; Human eye; Care of the Eyes; Sound; Human ears; Loudness and Pitch, Audible and inaudible Sounds, Chemical Effects of Electric Current; Electroplating, Natural Phenomena – Lightning; Earthquakes, Pollution of Air and Water, Solar system; Stars and Constellations

MATHEMATICS

Rational Numbers, Squares and Square Roots, Cubes and Cube Roots, Exponents and Powers, Direct and Inverse Proportions, Comparing Quantities (Percentage, Profit and Loss, Discount, Simple and Compound Interest), Algebraic Expressions and Identities including Factorization, Linear Equations in One Variable, Understanding Quadrilaterals (Parallelogram, rhombus, rectangle, square, kite) , Mensuration: *(a) Area of plane figures , (b) Surface area and volume of cube, cuboid and cylinder* , Data Handling (Bar graph, pie chart, organizing data, probability)

RATIO AND PROPORTION

Ratio

The ratio of two quantities of the same kind and in the same unit is the fraction that one quantity is of the other.

Note : In the ratio $a : b$, the first term a is antecedent and second term b is consequent.

Properties of Ratios

(i) The value of a ratio remains unchanged, if each one of its terms is multiplied or divided by a same non-zero number.

(ii) If $a : b$ and $c : d$ are two ratios, then the compounded ratio is $ac : bd$.

Example 1 If $a : b = 2 : 5$, the value of $(3a + 4b) : (4a + 5b)$ is

(a) $\dfrac{26}{33}$ (b) $\dfrac{33}{26}$ (c) $\dfrac{44}{23}$ (d) $\dfrac{33}{25}$

Sol. (a) We have, $\dfrac{3a + 4b}{4a + 5b} = \dfrac{3\left(\dfrac{a}{b}\right) + 4}{4\left(\dfrac{a}{b}\right) + 5} = \dfrac{3 \times \dfrac{2}{5} + 4}{4 \times \dfrac{2}{5} + 5} = \dfrac{26}{33}$ $\left[\because \dfrac{a}{b} = \dfrac{2}{5} \text{given}\right]$

Proportion

If two ratio are equal, then we can say that both ratio are in proportion .

Direct Proportion

If the values of two quantities depend on each other in such a way that, a change in one, results in a corresponding change in the other and *vice-versa*, then the two quantities are said to be in direct proportion.

In other words, if two quantities a and b vary with each other in such a manner that the ratio $\dfrac{a}{b}$

(or $a : b$) remains constant, i.e. $\dfrac{a}{b} = k$ or $a = kb$

(where, k is any positive constant), then we say that a and b vary directly with each other or a and b are in direct proportion or a and b have a direct variation.

Example 2 The variable x varies directly as y and $x = 80$ when y is 160. What is y when x is 64?

(a) 127   (b) 128   (c) 129   (d) 130

Sol. (b) If x varies directly as y.

$\therefore$ $x / y = k$ (constant)   ...(i)

If $x = 80$ and $y = 160$

$\therefore$ $\dfrac{x}{y} = \dfrac{80}{160} = \dfrac{1}{2} \Rightarrow k = \dfrac{1}{2}$

When $x = 64$, then from Eq. (i),

$$\dfrac{64}{y} = \dfrac{1}{2} \quad \text{[putting the value of } k]$$

$\Rightarrow$ $y = 64 \times 2 = 128$

Inverse Proportion

The two quantities may vary in such a way that if one increases, the other decreases and *vice-versa*, then the two quantities are said to be inverse proportion. In other words if two quantities a and b vary with each other in such a manner that the product ab remains constant and is positive, then we say that a varies inversely with b and b varies inversely with a. Thus, two quantities a and b are said to vary in inverse proportion, if there exists a relation of the type $ab = k$ between them, where k is a positive constant.

Let a, b, c and d are four quantities, then the proportional are $a : b :: c : d$.

where a, b, c, d are known as first proportional, second proportional, third proportional and fourth proportional respectively.

Note (i) In the proportion $a : b :: c : d$, a and d are extreme values and b and c are mean values. i.e. Product of means = Product of extreme.

(ii) If x is the third proportional to a, b, then $a : b :: b : x$.

Example 3 If x varies inversely as y and $y = 60$ when $x = 1.5$. Find x, when $y = 4.5$.

(a) 20   (b) 21   (c) 22   (d) 23

Sol. (a) If x varies inversely as y.

$\therefore$ $xy = k$ (constant)   ...(i)

If $x = 1.5$ and $y = 60$

$\therefore$ $xy = 1.5 \times 60 = 90$

$\Rightarrow$ $k = 90$

When $y = 4.5$, then from Eq. (i),

$$4.5 \times x = k$$

$\Rightarrow$ $4.5 \times x = 90$ [putting the value of k]

$\Rightarrow$ $x = \dfrac{90}{4.5} = 20$

Example 4 In a camp, there is enough flour for 300 persons for 42 days. How long will the flour last, if 20 more persons join the camp?

(a) $\dfrac{315}{7}$ day   (b) $\dfrac{315}{8}$ day

(c) $\dfrac{126}{8}$ day   (d) None of these

Sol. (b) $\because$ For 300 persons flour is enough for 42 days.

$\therefore$ For 1 person flour enough

$$= 300 \times 42 = 12600 \text{ days}$$

Now, 20 more persons join the camp.

So, total persons $= 300 + 20 = 320$

$\therefore$ For 320 persons flour enough

$$= \dfrac{12600}{320} = \dfrac{315}{8} \text{ day}$$

Example 5 The fourth proportional of 6, 11 and 12 is

(a) 29   (b) 23

(c) 72   (d) 22

Sol. (d) Let fourth proportional be x, then

$$6 : 11 :: 12 : x$$

[$\because$ Product of means = Product of extreme]

$\Rightarrow$ $6 \times x = 11 \times 12$

$\Rightarrow$ $x = \dfrac{11 \times 12}{6} = 22$

PRACTICE EXERCISE

1. The number of teeth and the age of a person vary
   (a) directly with each other
   (b) inversely with each other
   (c) neither directly nor inversely with each other
   (d) sometimes directly and sometimes inversely with each other

2. Which of the following vary inversely with each other?
   (a) Speed and distance covered
   (b) Distance covered and taxi fare
   (c) Distance travelled and time taken
   (d) Speed and time taken

3. Both x and y are in direct proportion, then $\frac{1}{x}$ and $\frac{1}{y}$ are
   (a) in indirect proportion
   (b) in direct proportion
   (c) neither in direct nor in inverse proportion
   (d) sometimes in direct and sometimes in inverse proportion

4. If two quantities p and q vary inversely with each other, then
   (a) $\frac{p}{q}$ remains constant
   (b) $p + q$ remains constant
   (c) $p \times q$ remains constant
   (d) $p - q$ remains constant

5. The variable x is inversely proportional to y. If x increases by $p\%$, then by what per cent will y decrease?
   (a) $p\%$
   (b) $2p\%$
   (c) $3p\%$
   (d) None of these

6. l varies directly as m and $l = 5$, when $m = \frac{2}{3}$. Find l when $m = \frac{16}{3}$.
   (a) 38
   (b) 39
   (c) 40
   (d) 41

7. The fourth proportional to 3, 5 and 21 is
   (a) 35
   (b) $\frac{5}{7}$
   (c) $\frac{7}{5}$
   (d) None of these

8. What must be added to each term of the ratio $49 : 68$, so that it becomes $3 : 4$?
   (a) 11
   (b) 10
   (c) 7
   (d) 8

9. A bag contains ₹600 in the form of one rupee, 50 paise and 25 paise coins in the ratio $3 : 4 : 12$. The number of 25 paise coins is
   (a) 800
   (b) 900
   (c) 1205
   (d) None of these

10. The cost of making an article is divided between materials, labour and overheads in the ratio $5 : 3 : 1$. If the materials cost ₹6.90, then cost of the article is
    (a) ₹12.42
    (b) ₹13.20
    (c) ₹14.00
    (d) None of these

11. If $\frac{a}{3} = \frac{b}{4} = \frac{c}{7}$, then $\frac{a + b + c}{c}$ is equal to
    (a) $\frac{1}{7}$
    (b) $\frac{1}{2}$
    (c) 7
    (d) 2

12. Out of the ratios $7 : 20 ; 13 : 25 ; 17 : 30$ and $11 : 15$, the smallest one is
    (a) $10 : 7$
    (b) $7 : 20$
    (c) $17 : 20$
    (d) None of these

13. ₹770 have been divided among A, B, C in such a way that A receives $\frac{2}{9}$th of what B and C together receive. Then, A's share is
    (a) ₹140
    (b) ₹154
    (c) ₹165
    (d) ₹ 170

14. If x varies inversely as y and $x = 20$ when $y = 600$, find y when $x = 400$.
    (a) 30
    (b) 40
    (c) 32
    (d) 35

15. If $2x = 3y = 4z$, then $x : y : z$ is
(a) $6 : 4 : 3$ (b) $5 : 4 : 2$
(c) $2 : 3 : 4$ (d) None of these

16. The ratio of number of boys and girls in a school of 720 students is $7 : 5$. How many more girls should be admitted to make the ratio $1 : 1$?
(a) 160   (b) 145   (c) 120   (d) 170

17. The incomes of A and B are in the ratio $3 : 2$ and their expenditures in the ratio $5 : 3$. If each saves ₹1500, then B's income is
(a) ₹6000   (b) ₹4700
(c) ₹3000   (d) ₹7500

18. Third proportional to 9 and 12 is
(a) 16   (b) 10.5
(c) $6\sqrt{3}$ (d) None of these

19. If $a : b = 3 : 4$, then $(6a + b) : (4a + 5b)$ is
(a) $1 : 2$
(b) $3 : 5$
(c) $7 : 9$
(d) None of the above

20. The ratio of zinc and copper in a brass piece is $13 : 7$. How much zinc will be there in 100 kg of such a piece?
(a) 65 kg   (b) 40 kg
(c) 45 kg   (d) 50 kg

Answers

1	(d)	2	(d)	3	(b)	4	(c)	5	(a)	6	(c)	7	(a)	8	(d)	9	(b)	10	(a)
11	(d)	12	(b)	13	(a)	14	(a)	15	(a)	16	(c)	17	(a)	18	(a)	19	(d)	20	(a)

Hints and Solutions

1. The number of teeth and the age of a person vary sometimes directly and sometimes inversely with each other, we cannot predict about the number of teeth with exactly the age of a person. It change with person-to-person.

Hence, option (d) is correct.

2. We know that, when we increases the speed, then the time taken by vehicle decreases.

Hence, speed and time taken vary inversely with each other.

So, option (d) is correct.

3. If both x and y are in directly proportion, then $\frac{1}{x}$ and $\frac{1}{y}$ are in direct proportion.

Hence, option (b) is correct.

4. If two quantities p and q vary inversely with each other, then $p \times q$ remains constant. Since, in inverse proportion, an increase in p cause a proportional decrease in q and vice-versa.

Hence, option (c) is correct.

5. The variable x is inversely proportionls to y.

$\therefore \qquad xy = k \text{ (constant)}$

Since, we know that two quantities x and y are said to be in inverse proportion, if an increase in x cause a proportional decrease in y and vice-versa.

So, we can say y decrease by $p\%$.

6. If l varies directly as m.

$\therefore \qquad l / m = k \text{ (constant)} \qquad \qquad \text{...(i)}$

If $\qquad l = 5$ and $m = \dfrac{2}{3}$

$\therefore \qquad \dfrac{l}{m} = \dfrac{5}{2/3} = \dfrac{5}{1} \times \dfrac{3}{2} = \dfrac{15}{2}$

$\Rightarrow \qquad k = \dfrac{15}{2}$

When, $m = \dfrac{16}{3}$, then from Eq. (i),

$\qquad \dfrac{l}{16/3} = \dfrac{15}{2} \qquad$ [putting the value of k]

$\Rightarrow \qquad l = \dfrac{15}{2} \times \dfrac{16}{3} = 40$

7. Let the fourth proportional be x.

$\therefore \qquad 3 : 5 :: 21 : x$

$\Rightarrow \qquad x = \dfrac{5 \times 21}{3} = 35$

8. Let the number be x added in the given ratio.

$\therefore \quad \dfrac{49 + x}{68 + x} = \dfrac{3}{4}$

$\Rightarrow \quad 4(49 + x) = 3(68 + x)$

$\Rightarrow \qquad\qquad x = 8$

9. Given ratio is $3 : 4 : 12$.

The ratio of values in coins $= \dfrac{3}{1} : \dfrac{4}{2} : \dfrac{12}{4} = 3 : 2 : 3$

Value of 25 paise coins $= ₹\left(600 \times \dfrac{3}{8}\right) = ₹225$

$\therefore$ Number of these coins $= 225 \times 4 = 900$

10. If material cost be ₹5, then cost of article be ₹9.

$\therefore \qquad\qquad 5 : 9 :: 6.90 : x$

$\Rightarrow \qquad\qquad x = \dfrac{9 \times 6.90}{5}$

$\Rightarrow \qquad\qquad x = ₹12.42$

11. Let $\dfrac{a}{3} = \dfrac{b}{4} = \dfrac{c}{7} = k$.

Then, $a = 3k$, $b = 4k$ and $c = 7k$.

$\therefore \quad \dfrac{a + b + c}{c} = \dfrac{3k + 4k + 7k}{7k} = 2$

12. Now, $\dfrac{7}{20} = 0.35$, $\dfrac{13}{25} = 0.52$, $\dfrac{17}{30} = 0.56$ and

$\dfrac{11}{15} = 0.73$.

$\therefore$ The smallest value is 0.35 i.e. ratio $7 : 20$.

13. $\therefore \quad A : (B + C) = 2 : 9$

$\therefore \quad A\text{'s part} = ₹\left(770 \times \dfrac{2}{11}\right) = ₹140$

14. If x varies inversely as y.

$\therefore \qquad\qquad xy = k \text{ (constant)} \qquad\qquad ...(i)$

If $\qquad\qquad x = 20 \text{ and } y = 600$

$\therefore \qquad\qquad xy = 20 \times 600 = 12000$

$\Rightarrow \qquad\qquad k = 12000$

When $x = 400$, then from Eq. (i),

$\qquad\qquad y \times 400 = k$

$\Rightarrow \qquad y \times 400 = 12000 \quad$ [putting the value of k]

$\Rightarrow \qquad\qquad y = \dfrac{12000}{400} = 30$

15. Let $2x = 3y = 4z = k$

Then, $x = \dfrac{k}{2}$, $y = \dfrac{k}{3}$ and $z = \dfrac{k}{4}$

$\therefore \quad x : y : z = \dfrac{k}{2} : \dfrac{k}{3} : \dfrac{k}{4} = \dfrac{1}{2} : \dfrac{1}{3} : \dfrac{1}{4} = 6 : 4 : 3$

16. Number of boys $= 720 \times \dfrac{7}{12} = 420$

Number of girls $= 720 - 420 = 300$

$\therefore \qquad$ Number of girls to be admitted

$\qquad\qquad = 420 - 300 = 120$

17. Let their incomes be $3x$ and $2x$ and their corresponding expenditure be $5y$ and $3y$. According to the given conditions,

$\qquad\qquad 3x - 5y = 1500 \quad \text{and} \quad 2x - 3y = 1500$

On solving, we get

$\qquad\qquad x = 3000 \text{ and } y = 1500$

Hence, $B\text{'s income} = 2x = ₹6000$

18. Let third proportion be x.

$\therefore \qquad\qquad 9 : 12 :: 12 : x$

$\Rightarrow \qquad\qquad 9x = 12 \times 12$

$\Rightarrow \qquad\qquad x = 16$

19. Now, $\dfrac{6a + b}{4a + 5b} = \dfrac{6\left(\dfrac{a}{b}\right) + 1}{4\left(\dfrac{a}{b}\right) + 5}$

$= \dfrac{6 \times \dfrac{3}{4} + 1}{4 \times \dfrac{3}{4} + 5} = \dfrac{11}{16}$

20. Amount of zinc $= \left(100 \times \dfrac{13}{20}\right) \text{kg}$

$\qquad\qquad = 65 \text{ kg}$

COMPARING QUANTITIES

Sometimes, we have to measure and compare our daily life quantities such as height, distance, price of commodity, rate of interest etc. The best measure of these compare quantities in the percentage.

Percentage

The meaning of term per cent is per hundred or hundred part.

e.g. Meaning of 38% is $\dfrac{38}{100}$ i.e. 38 parts out of 100 parts.

e.g. $\dfrac{30}{100} = 30\%$

Important Rules

(i) For expressing 'x' % as a fraction, then $x\% = \dfrac{x}{100}$.

(ii) For expressing a fraction $\dfrac{x}{y}$ as a per cent. Then, $\dfrac{x}{y} = \left(\dfrac{x}{y} \times 100\right)\%$

(iii) If A's income is $x\%$ more than that of B, then B's income is less than that of A by $\left[\dfrac{x}{100 + x} \times 100\right]\%$.

(iv) If A's income is $x\%$ less than that of B, then B's income is more than that of A by $\left[\dfrac{x}{100 - x} \times 100\right]\%$.

In this chapter, we study about the percentage and its important rules, profit, loss and discount with their important rules. Apart from this we will also study Simple and Compound Interest.

Example 1 What per cent of $\frac{2}{7}$ is $\frac{1}{35}$?

(a) 10% (b) 11% (c) 12% (d) 13%

Sol. (a) Required per cent $= \left[\dfrac{\frac{1}{35}}{\frac{2}{7}} \times 100 \right]\%$

$$= \left(\frac{1}{35} \times \frac{7}{2} \times 100 \right)\%$$

$$= 10\%$$

Example 2 The salary of a worker is first increased by 10% and thereafter it was reduced by 10%. What was the change in his salary ?

(a) 4% (b) 2% (c) 3% (d) 1%

Sol. (d) Let the salary of the worker be ₹ 100. After increase, it becomes ₹100 + 10% of 100 = ₹ 110
After decrease, it becomes ₹110 − 10% of ₹110 = ₹99
The percentage reduction = 100 − 99 = 1%

Example 3 The length of a rectangle is increased by 60%. By what per cent would the breadth be decreased to maintain the same area?

(a) $37\frac{1}{2}\%$ (b) 38% (c) 39% (d) 40%

Sol. (a) Let the length be 100 m and breadth be 100 m, then
New length = 160 m, new breadth = x,
then $160 \times x = 100 \times 100$

$\Rightarrow \qquad x = \dfrac{100 \times 100}{160} \Rightarrow x = \dfrac{125}{2}$

$\therefore$ Decrease in breadth $= \left(100 - \dfrac{125}{2} \right)\%$

$$= 37\frac{1}{2}\%$$

Profit and Loss

- The price at which an article or item is bought is called its **cost price** and it is denoted by CP.
- And if the price at which an article is sold is called its **selling price** and it is denoted by SP.

- If the selling price of an article is greater than cost price, then it is **profit** (SP > CP) otherwise it is **loss** (CP > SP).

- The list price of an item is known as its **marked price**. It is the price that appers on the item's tag.

- If the shopkeeper given a some rebate on an article is called **discount**.

Note : Discount is always given on a marked price.

Important Formulae

(i) Profit = SP − CP

(ii) Loss = CP − SP

(iii) Profit per cent $= \dfrac{\text{Profit}}{\text{CP}} \times 100$

$$= \dfrac{\text{SP} - \text{CP}}{\text{CP}} \times 100$$

(iv) Loss per cent $= \dfrac{\text{Loss}}{\text{CP}} \times 100$

$$= \dfrac{\text{CP} - \text{SP}}{\text{CP}} \times 100$$

(v) If there is a profit of r%, then

$$\text{SP} = \dfrac{100 + r}{100} \times \text{CP}$$

(vi) If there is a loss of r%, then

$$\text{SP} = \dfrac{100 - r}{100} \times \text{CP}$$

(vii) Discount = Marked price − Sale price

(viii) Rate of discount = Discount%

$$= \dfrac{\text{Discount}}{\text{MP}} \times 100$$

(ix) $\text{SP} = \text{MP} \dfrac{(100 - \text{Discount}\%)}{100}$

or $\text{MP} = \dfrac{100 \times \text{SP}}{100 - \text{Discount}\%}$

Example 4 A boy buys a pen for ₹ 25 and sells it for ₹ 20. Find his loss per cent.

(a) 10% (b) 20% (c) 22% (d) 23%

Sol. (*b*) Loss per cent $= \dfrac{\text{Loss}}{\text{CP}} \times 100$

$$= \dfrac{5}{25} \times 100$$

$$= 20\%$$

Example 5 A shopkeeper sells a pen set at 30% profit to another shopkeeper who sells it at a loss of 30%. If price of pen set ₹ 150, what is net profit or loss on total transaction?

(a) profit 9%   (b) loss 9%
(c) profit 10%   (d) loss 10%

Sol. (*b*) Cost price of pen is ₹ 150.

Initially shopkeeper sells a pen in 30% profit.

∴ SP of a pen $= 150 + 30\%$ of 150

$$= 150 + \dfrac{30}{100} \times 150$$

$$= 150 + 45 = ₹ 195$$

Now, shopkeeper sells a pen to another shopkeeper at an loss of 30%. Then,

SP of a pen $= 195 - \dfrac{30}{100} \times 195$

$$= 195 - 58.5 = ₹ 136.5$$

Now, loss % in transaction $= \dfrac{150 - 136.5}{150} \times 100$

$$= \dfrac{13.5}{150} \times 100 = \dfrac{1350}{150} = 9\%$$

Example 6 The marked price of a ceiling fan is ₹ 1250 and the shopkeeper allows a discount of 6% on it. Find the selling price of the fan.

(a) ₹ 1190   (b) ₹ 1175
(c) ₹ 1200   (d) ₹ 1180

Sol. (*b*) Marked price $= ₹ 1250$ and discount $= 6\%$

Discount $= 6\%$ of MP

$$= (6\% \text{ of } ₹ 1250)$$

$$= ₹ \left(1250 \times \dfrac{6}{100} \right) = ₹ 75$$

Selling price $=$ (MP) $-$ (discount)

$$= ₹ (1250 - 75) = ₹ 1175$$

Hence, the selling price of the fan is ₹ 1175.

Example 7 Two successive profits of 50% and 50% is equivalent to

(a) 100%   (b) 75%   (c) 50%   (d) 125%

Sol. (*d*) Let the cost price of an item be x. Then

After profit of 50%, SP of an item

$$= x + 50\% \text{ of } x$$

$$= x + \dfrac{50}{100} \times x = x + \dfrac{x}{2} = \dfrac{3x}{2}$$

Again profit of 50%, SP of an item

$$= \dfrac{3x}{2} + 50\% \text{ of } \dfrac{3x}{2}$$

$$= \dfrac{3x}{2} + \dfrac{50}{100} \times \dfrac{3x}{2}$$

$$= \dfrac{3x}{2} + \dfrac{3x}{4} = \dfrac{9x}{4}$$

Now, total profit % in whole transaction

$$= \dfrac{\dfrac{9x}{4} - x}{x} \times 100\%$$

$$= \dfrac{5x}{4 \times x} \times 100 = 125\%$$

Simple Interest

If the interest is paid to the lender regularly every year or half year on the same principal, then it is called simple interest.

Or The interest is said to be simple, if it is calculated on the original principal throughout the loan period.

i.e. $\text{SI} = \dfrac{PRT}{100}$

where, P is the principal amount

R is the rate of interest

T is the time period

Compound Interest

If the borrower and the lender agree to fix up a certain interval of time (say, a year or half year or a quarter of a year, etc), so that the amount at the end of an interval becomes the principal for the next interval, then the total interest over all the intervals calculated in this way is called the compound interest.

$$CI = P\left[\left(1 + \frac{R}{100}\right)^{T} - 1\right]$$

where, P is the principal amount

T is the time period

R is the rate of interest

Note The simple interest and compound interest for one year will be same, if the rate of interest is annually.

Important Rules

- **Rule 1.** When interest is compounded annually

  Then, Amount $= P\left(1 + \dfrac{R}{100}\right)^{n}$

  where, n is number of time for which interest is calculated,

- **Rule 2.** When interest is compounded half-yearly then, interest would be calculated after every six months,

  So, $\qquad n = T \times 2$ and rate $= \dfrac{R}{2}$

  $\therefore \qquad$ Amount $= P\left(1 + \dfrac{R/2}{100}\right)^{n}$

- **Rule 3.** When interest is compounded quarterly. Then, interest would be calculated after every three months, So

  $$n = T \times 4$$

  and $\qquad$ Rate of interest $= \dfrac{R}{4}$

  $\therefore$ Amount $= P\left(1 + \dfrac{R/4}{100}\right)^{n}.$

- **Rule 4.** When rate of interest are different for different years say $R_1, R_2, R_3\%$ for first, second and third year respectively, then

  Amount $= P\left(1 + \dfrac{R_1}{100}\right)\left(1 + \dfrac{R_2}{100}\right)\left(1 + \dfrac{R_3}{100}\right).$

Note If the difference between the simple interest and compound interest on the same sum ₹ P at r % per annum for 2 yr is ₹ d, then

$$d = P\left(\frac{r}{100}\right)^{2}$$

When interest is compounded yearly, then on the same sum and at the same rate, then

Compound interest for the first year
$\qquad\qquad$ = Simple interest for the first year

If A and B are the amounts of a certain sum for two consecutive year, then

Simple interest for 1 yr $= B - A$.

Example 8 The sum required to earn a monthly interest of ₹ 400 at 10% per annum at simple interest.

(a) ₹ 47000 (b) ₹ 48000 (c) ₹ 49000 (d) ₹ 50000

Sol. (b) Total interest amount needed in a year

$$= ₹ 400 \times 12 = ₹ 4800$$

$\therefore \qquad P = \dfrac{100 \times SI}{R \times T}$

$\qquad\qquad = \dfrac{4800 \times 100}{10 \times 1} = ₹ 48000$

Example 9 Find CI on a sum ₹ 8000 for 2 yr at 5% per annum compounded annually.

(a) ₹ 821 $\qquad\qquad$ (b) ₹ 820

(c) ₹ 822 $\qquad\qquad$ (d) None of these

Sol. (b) Given, principal $(P) = ₹ 8000$,

time $(n) = 2$ yr, rate $(R) = 5\%$

$\therefore \qquad$ Amount $(A) = P\left(1 + \dfrac{R}{100}\right)^{n}$

$\qquad\qquad = 8000\left(1 + \dfrac{5}{100}\right)^{2}$

$\qquad\qquad = 8000\left(\dfrac{105}{100}\right)^{2}$

$\qquad\qquad = 8000 \times \dfrac{21}{20} \times \dfrac{21}{20}$

$\qquad\qquad = ₹ 8820$

$\therefore$ Compound Interest (AI)

$\qquad\qquad$ = Amount (A) – Principal (P)

$\qquad\qquad = ₹ (8820 - 8000)$

$\qquad\qquad = ₹ 820$

Example 10 Find the compound interest on ₹ 5000 for 4 yr if the rate of interest is 10% per annum for the first two years and 15% for the next two years.

(a) ₹3001   (b) ₹3003
(c) ₹3008   (d) ₹3009

Sol. (a) Let $R_1 = 10\%$, $T_1 = 2$ yr

and $\quad R_2 = 15\%$, $T_2 = 2$ yr

and $\quad P = ₹5000$

$$\therefore \quad \text{Amount} = 5000 \left(1 + \frac{10}{100}\right)^2 \left(1 + \frac{15}{100}\right)^2$$

$$= 5000 \times \left(\frac{110}{100}\right)^2 \left(\frac{115}{100}\right)^2$$

$$= 5000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{23}{20} \times \frac{23}{20}$$

$$= ₹8001 \text{ (approx)}$$

$\therefore$ Compound interest $= 8001 - 5000$

$$= ₹3001$$

PRACTICE EXERCISE

1. If 90% of x is 315 km, then the value of x is
(a) 325 km   (b) 350 km   (c) 350 m   (d) 325m

2. A toy is purchased at ₹1500 including 5% SGST and 5% CGST. Find the actual price of the toy without GST.
(a) ₹14500   (b) ₹1350   (c) ₹1500   (d) ₹1400

3. If 11% of a number exceeds 7% of the same by 18, the number is
(a) 300   (b) 450   (c) 350   (d) 370

4. If A's income is 30% less than B's, then how much per cent is B's income more than A's?
(a) $42\frac{6}{7}\%$ (b) $32\frac{1}{10}\%$ (c) 30%   (d) 40%

5. A man spent 20% of his monthly earning on house rent. Out of the balance, he spent 75% on the other house expenses. If he had a balance of ₹250 at the end of the month, the monthly earning of the man is
(a) ₹1250   (b) ₹1200
(c) ₹1150   (d) None of these

6. If the numerator of a fraction is increased by 20% and its denominator is diminished by 10%, the value of the fraction is $\frac{16}{21}$. The original fraction is
(a) $\frac{3}{5}$ (b) $\frac{4}{5}$
(c) $\frac{4}{7}$ (d) None of these

7. In an examination, it is required to get 36% of maximum marks to pass. A student got 113 marks and was declared failed by 85 marks. The maximum marks are
(a) 500   (b) 1008   (c) 640   (d) 550

8. The price of cooking oil has increased by 25%. The percentage of reduction that a family should affect in the use of cooking oil so as not to increase the expenditure on this account is
(a) 20%   (b) 15%   (c) 22%   (d) 25%

9. A boy who asked to find $3\frac{1}{2}\%$ of a sum of money misread the question and found $5\frac{1}{2}\%$ of it. His answer was ₹220, what would have been the correct answer?
(a) ₹140   (b) ₹150   (c) ₹157   (d) ₹160

10. A's salary increased by 12% over last year and has become ₹6720. If it increased by 20% over last year's salary, then the next salary will be
(a) ₹8000   (b) ₹8064
(c) ₹7500   (d) ₹7200

11. The ratio of the number of boys and girls in a school is 3:2. If 20% of the boys and 30% of the girls are scholarship holders, the percentage of the students who are not scholarship holder is
(a) 50%   (b) 72%   (c) 75%   (d) 76%

12. If 50% of $(x - y) = 30\%$ of $(x + y)$, then what per cent of x is y?

(a) 25%   (b) $33\frac{1}{3}\%$ (c) 40%   (d) 400%

13. If 15% of 40 is greater than 25% of a number by 2, then the number is

(a) 12   (b) 16   (c) 24   (d) 32

14. If 35% of a number is 12 less than 50% of that number, then the number is

(a) 80   (b) 60   (c) 50   (d) 40

15. 60% of that the students in a school are boys. If the number of girls in the school is 300, then the number of boys is

(a) 300   (b) 450   (c) 500   (d) 750

16. Profit after selling an article for ₹ 425 is the same as loss after selling it for ₹ 355. The cost of the article is

(a) ₹ 390   (b) ₹ 405

(c) ₹ 380   (d) None of these

17. The difference between a discount of 40% on ₹ 500 and two successive discounts of 36% and 4% on the same amount is

(a) ₹ 0   (b) ₹ 2   (c) ₹ 5   (d) ₹ 7.20

18. The marked price of an article is 10% higher than the cost price. A discount of 10% is given on the marked price. In this kind of sale, the seller

(a) bears no loss, no gain

(b) gains 1%

(c) loses 1%

(d) None of the above

19. On selling an article for ₹ 240, a trader loses 4%. In order to gain 10%, he must sell that article for

(a) ₹ 264   (b) ₹ 275

(c) ₹ 250   (d) ₹ 280

20. A sweet seller declares that he sells sweets at the cost price. However, he uses a weight of 450 g instead of 500 g. His percentage profit is

(a) $11\frac{1}{9}\%$ (b) 12%

(c) 13%   (d) None of these

21. A radio is sold at a gain of 16%. If it had been sold for ₹ 20 more, 20% would have been gained. The cost price of the radio is

(a) ₹ 420   (b) ₹ 410   (c) ₹ 485   (d) ₹ 500

22. A dealer sold a radio at a loss of 2.5%. Had he sold it for ₹ 100 more, he would have gained $7\frac{1}{2}\%$. In order to gain $12\frac{1}{2}\%$, he should sell it for

(a) ₹ 850   (b) ₹ 925   (c) ₹ 1000   (d) ₹ 1125

23. By selling sugar at ₹ 11.16 per kg, a man loses 7%. To gain 7%, it must be sold (per kg) at

(a) ₹ 11.24   (b) ₹ 12.84   (c) ₹ 14.64   (d) ₹ 13.24

24. If a commission of 10% is given to the marked price of a book, the publisher gains 20%. If the commission is increased to 15%, the gain is

(a) $16\frac{2}{3}\%$ (b) $13\frac{1}{3}\%$

(c) $15\frac{1}{6}\%$ (d) 15%

25. Oranges are bought at 7 for ₹ 3. At what rate per hundred must they be sold to gain 33%?

(a) ₹ 56   (b) ₹ 60

(c) ₹ 58   (d) ₹ 57

26. A reduction of 20% in the price of oranges enables a man to buy 5 oranges more for ₹ 10. The price of an orange before reduction was

(a) 20 paise   (b) 40 paise

(c) 50 paise   (d) 60 paise

27. Kiran buys an article with 25% discount on the marked price. She makes a profit of 10% by selling it at ₹ 660. What was the marked price?

(a) ₹ 900   (b) ₹ 600

(c) ₹ 700   (d) ₹ 800

28. If a shirt cost ₹ 64 after a 20% discount, what was its original price?

(a) ₹ 76.80   (b) ₹ 80

(c) ₹ 88   (d) ₹ 86.80

29. The cost price of 19 chairs is equal to the selling price of 16 chairs. Then the gain is
    (a) $3\frac{9}{17}\%$
    (b) $15\frac{15}{19}\%$
    (c) $18\frac{3}{4}\%$
    (d) None of these

30. The ratio between the sales price and the cost price of an article is 7 : 5. What is the ratio between the profit and the cost price of that article ?
    (a) 2 : 5
    (b) 7 : 2
    (c) 2 : 7
    (d) Data inadequate

31. By selling a table for ₹ 350 instead of ₹ 400, loss percent increased by 5%. The cost price of the table is
    (a) ₹ 1050 (b) ₹ 417.50 (c) ₹ 435 (d) ₹ 1000

32. A house worth ₹150000 is sold by X at 5% profit to Y. Y sells the house back to X at a 2% loss. Then, in the entire transaction
    (a) X gains ₹ 4350
    (b) X loses ₹ 4350
    (c) X gains ₹ 3150
    (d) X loses ₹ 3150

33. Find interest and amount to be paid on ₹ 15000 at 5% per annum after 2 yr.
    (a) ₹ 1500, ₹ 16600
    (b) ₹ 1500, ₹ 16500
    (c) ₹ 1600, ₹ 16500
    (d) None of the above

34. A sum of money at simple interest amount to be ₹ 1260 in 2 yr and ₹ 1350 in 5 yr, then the rate per cent per annum is
    (a) 30%
    (b) 10%
    (c) 2.5%
    (d) 5%

35. The difference of 13% per annum and 12% of a sum in one year is ₹ 110. Then, the sum is
    (a) ₹ 12000 (b) ₹ 13000 (c) ₹ 11000 (d) ₹ 16000

36. The amount of a certain sum at compound interest for 2 yr at 5% is ₹ 4410. The sum is
    (a) ₹ 4000 (b) ₹ 4200 (c) ₹ 3900 (d) ₹ 3800

37. Two equal amounts of money are deposited in two banks, each at 15% per annum, for $3\frac{1}{2}$ yr and 5 yr. If the difference between their interest is ₹ 144, each sum is
    (a) ₹ 460 (b) ₹ 500 (c) ₹ 640 (d) ₹ 720

38. If the simple interest on ₹ 1500 increases by ₹ 30, when the time increases by 8 yr. The rate per cent per annum is
    (a) 0.5% (b) 0.25% (c) 0.75% (d) 1.25%

39. What annual payment will discharge a debt of ₹ 19350 due 4 yr hence at the rate of 5% simple interest ?
    (a) ₹ 4500
    (b) ₹ 5400
    (c) ₹ 4000
    (d) None of these

40. The simple interest on a sum of money for 3 yr at $6\frac{2}{3}\%$ per annum is ₹ 6750. The compound interest on the same sum at the same rate of interest for the same period will be
    (a) ₹ 7200
    (b) ₹ 7210
    (c) ₹ 7120
    (d) ₹ 7012

41. The difference of the compound interest and the simple interest on ₹ 60000 at 6% annually for 2 yr will be
    (a) ₹ 215 (b) ₹ 216 (c) ₹ 220 (d) ₹ 250

42. The compound interest on ₹ 350 for 1 year at 4% per annum, the interest being payable half yearly, will be
    (a) ₹ 364.14
    (b) ₹ 365.15
    (c) ₹ 14.14
    (d) ₹ 15.15

43. The compound interest on ₹ 2000 for $1\frac{1}{4}$ yr is 10% per annum, the interest being payable quarterly will be
    (a) ₹ 2262.81
    (b) ₹ 262.81
    (c) ₹ 261.81
    (d) None of these

44. A sum of money doubles itself at compound interest in 15 yr. In how many years will it become eight times ?
    (a) 20 yr
    (b) 40 yr
    (c) 35 yr
    (d) 45 yr

45. A certain sum amounts to ₹ 7350 in 2 yr and to ₹ 8575 in 3 yr. The the rate per cent and sum are
    (a) $16\frac{2}{3}\%$, ₹ 5400
    (b) $16\frac{2}{3}\%$, ₹ 2400
    (c) $12\frac{1}{2}\%$, ₹ 5400
    (d) None of these

Answers

1	(b)	2	(b)	3	(b)	4	(a)	5	(a)	6	(c)	7	(d)	8	(a)	9	(a)	10	(d)
11	(d)	12	(a)	13	(b)	14	(a)	15	(b)	16	(a)	17	(d)	18	(c)	19	(b)	20	(a)
21	(d)	22	(c)	23	(b)	24	(b)	25	(d)	26	(c)	27	(d)	28	(b)	29	(c)	30	(a)
31	(d)	32	(a)	33	(b)	34	(c)	35	(c)	36	(a)	37	(c)	38	(b)	39	(a)	40	(b)
41	(b)	42	(c)	43	(b)	44	(d)	45	(a)										

Hints and Solutions

1. We have, 90% of $x = 315$

$$\Rightarrow \quad \frac{90}{100} \times x = 315$$

$$\Rightarrow \quad x = \frac{315 \times 100}{90}$$

$$= \frac{315 \times 10}{9} = 350$$

$$\Rightarrow \quad x = 350 \, km$$

2. Now, SGST = 5% of 1500

$$\therefore \quad = \frac{5}{100} \times 1500 = ₹ 75$$

Similarly, CGST = 5% of 1500 = ₹ 75

∴ Actual price of toy = 1500 − SGST − CGST

$$= 1500 - 75 - 75 = 1500 - 150$$

$$= ₹ 1350$$

3. Let x be the given number.

Then, according to the question,

11% of x − 7% of $x = 18$

$$\Rightarrow \quad 4\% \text{ of } x = 18$$

$$\Rightarrow \quad x = \frac{18 \times 100}{4}$$

$$\Rightarrow \quad x = 450$$

4. ∴ Required percentage

$$= \left[\frac{30}{(100 - 30)} \times 100 \right]\%$$

$$= 42\frac{6}{7}\%$$

5. Let total income be ₹ x.

Then, 25% of (80% of x) = 250

$$\Rightarrow \quad \frac{25}{100} \times \frac{80}{100} \times x = 250$$

$$\Rightarrow \quad x = 250 \times 5 = ₹ 1250$$

6. Let the fraction be $\frac{x}{y}$.

New fraction $= \frac{120\% \text{ of } x}{90\% \text{ of } y} \Rightarrow \frac{4x}{3y} = \frac{16}{21}$

$$\therefore \quad \frac{x}{y} = \frac{16}{21} \times \frac{3}{4} = \frac{4}{7}$$

7. Let maximum marks be x.

Then, 36% of $x = 113 + 85 = 198$

$$\therefore \quad x = \frac{198 \times 100}{36} = 550$$

8. Reduction in consumption $= \left[\frac{25}{100 + 25} \times 100 \right]\%$

$$= 20\%$$

9. Since, $5\frac{1}{2}\% \equiv 220 \Rightarrow 3\frac{1}{2}\% \equiv \frac{220 \times (7/2)}{11/2} = ₹ 140$

10. Last year's salary $= \frac{6720 \times 100}{100 + 12} = ₹ 6000$

∴ The next year's salary $= \frac{6000 \times 120}{100} = ₹ 7200$

11. Let the number of boys and girls be $3x$ and $2x$.

Number of those who are not scholarship holder

$$= (80\% \text{ of } 3x + 70\% \text{ of } 2x)$$

$$= \frac{12x}{5} + \frac{7x}{5} = \frac{19x}{5}$$

∴ Required percentage $= \left(\frac{19x}{5} \times \frac{1}{5x} \times 100 \right)\%$

$$= 76\%$$

12. Since, $\frac{50}{100}(x - y) = \frac{30}{100}(x + y)$

$$\Rightarrow \quad 5(x - y) = 3(x + y) \quad 2x = 8y$$

$$\Rightarrow \quad \frac{y}{x} \times 100 = \frac{20}{80} \times 100 = 25\%$$

13. According to the given condition,

$$\frac{15}{100} \times 40 - \frac{25}{100} x = 2 \Rightarrow x = 16$$

14. Since, $(50 - 35)\%$ of $x = 12$

$$\Rightarrow \qquad x = \frac{12 \times 100}{15} = 80$$

15. Here, 40% are girls in a school.

$$\therefore \qquad 40\% = 300$$

$$\Rightarrow \qquad 60\% = \frac{300 \times 60}{40} = 450$$

16. Let cost price of an article be ₹ x.
According to the given condition,

$$425 - x = x - 355$$

$$\Rightarrow \qquad 2x = 780 \Rightarrow x = ₹ 390$$

17. SP at 40% discount = 60% of ₹ 500 = ₹ 300
SP after two successive discounts of 36% and 4%

$$= 96\% \text{ of } (64\% \text{ of } 500)$$

$$= \frac{96}{100} \times \frac{64}{100} \times 500 = ₹ 307.20$$

$$\therefore \quad \text{Required difference} = ₹ 7.20$$

18. Let CP of article be Rs 100, then marked price be Rs 110.

$$\therefore \qquad SP = 90\% \text{ of Rs } 110$$

$$= \frac{90}{100} \times 110 = \text{Rs } 99$$

$$\therefore \quad \text{Loss per cent} = 100 - 99 = 1\%$$

19. $CP = \dfrac{100}{96} \times 240 = ₹ 250$

Now, $\quad CP = ₹ 250$, Gain = 10%

$$\therefore \qquad SP = \frac{110}{100} \times 250 = ₹ 275$$

20. Let CP of each gram be ₹ 1.
Then, CP of 450 g = ₹ 450, SP of 450 g = ₹ 500

$$\therefore \quad \text{Profit per cent} = \left(\frac{50}{450} \times 100 \right)\% = 11\frac{1}{9}\%$$

21. Let CP of radio be ₹ x. Then,
120% of $x - 116\%$ of $x = 20$

$$\Rightarrow \qquad 4\% \text{ of } x = 20$$

$$\Rightarrow \qquad x = \frac{20 \times 100}{4} = ₹ 500$$

22. Let CP of radio be ₹ x. Then,

$$107\frac{1}{2}\% \text{ of } x - 97\frac{1}{2}\% \text{ of } x = 100$$

$$\Rightarrow \qquad 10\% \text{ of } x = 100$$

$$\Rightarrow \qquad x = \frac{100 \times 100}{10}$$

$$\Rightarrow \qquad x = ₹ 1000$$

23. Let CP of sugar per kg be ₹ x.

$$\therefore \qquad 93\% \text{ of } x = 11.16$$

$$\Rightarrow \qquad x = \frac{11.16 \times 100}{93} = 12$$

So, $\qquad CP = ₹ 12$ per kg

$$\therefore \qquad SP = 107\% \text{ of } ₹ 12$$

$$= \frac{107}{100} \times 12 = ₹ 12.84$$

24. Let CP be ₹ 100, then SP be ₹ 120.
Now, SP = ₹ 120, commission = 10%

$$\therefore \quad \text{Marked price} = \frac{100}{90} \times 120 = ₹ \frac{400}{3}$$

Now, marked price $= \dfrac{400}{3}$, commission = 15%

$$\therefore \ SP = 85\% \text{ of } \frac{400}{3} = \frac{85}{100} \times \frac{400}{3} = \frac{340}{3}$$

$$\therefore \quad \text{Gain per cent} = \frac{340}{3} - 100 = 13\frac{1}{3}\%$$

25. CP of an orange $= \dfrac{3}{7}$

$$\therefore \quad \text{CP of 100 orange} = \frac{300}{7}$$

$$\Rightarrow \text{SP of 100 oranges} = \frac{300}{7} \times \frac{(100 + 33)}{100} = ₹ 57$$

$$\left[\because SP = CP \left(\frac{100 + r}{100} \right) \right]$$

26. Reduced price $= \dfrac{10 \times 20}{5 \times 100} = ₹ \dfrac{2}{5}$ per orange

$$\therefore \text{Original price} = \frac{2 \times 100}{5 \times 80} = \frac{1}{2} = 50 \text{ paise}$$

27. $\because \quad SP = ₹ 660$, Profit % = 10%

$$\Rightarrow CP = ₹ 600$$

$$\therefore \quad MP = \frac{600 \times 100}{75} = ₹ 800$$

28. Let the original CP be ₹ x.

$$\therefore \qquad x \times \frac{80}{100} = 64 \quad \Rightarrow \quad x = ₹\, 80$$

29. $\therefore$ Gain % $= \dfrac{19-16}{16} \times 100$

$$= \frac{3 \times 100}{16} = \frac{75}{4} = 18\frac{3}{4}\%$$

30. Let SP = $7x$ and CP = $5x$

$$\therefore \text{ Profit} = 7x - 5x = 2x$$

$$\therefore \frac{\text{Profit}}{\text{CP}} = \frac{2x}{5x} = \frac{2}{5}$$

31. Given, 5% = ₹ 50

$$\Rightarrow \quad 100\% = \frac{50}{5} \times 100 = ₹\, 1000$$

32. Final cost of the house

$$= 150000 \times \frac{100+5}{100} \times \frac{(100-2)}{100}$$

$$= ₹\,154350$$

$$\therefore \quad X \text{ gains } ₹\, 4350.$$

33. $\because$ Interest $= \dfrac{P \times R \times T}{100}$

$$= \frac{15000 \times 5 \times 2}{100} = ₹\, 1500$$

$$\therefore \quad \text{Amount} = \text{Principal} + \text{Interest}$$

$$= ₹\,(15000 + 1500) = ₹\, 16500$$

34. Interest in three years = $1350 - 1260 = ₹\, 90$

$$\therefore \text{ Interest in one year} = ₹\,\frac{90}{3} = ₹\, 30$$

and interest for two years = ₹ 60
and Principal = ₹ (1260 − 60)

$$= ₹\,1200$$

Hence, rate of interest $= \dfrac{100 \times 60}{1200 \times 2} = 2.5\%$

35. Let sum = ₹ x

Then, according to given condition

$$\frac{x \times 13 \times 1}{100} - \frac{x \times 12 \times 1}{100} = 110$$

$$\Rightarrow \qquad\qquad \frac{x}{100} = 110$$

$$\Rightarrow \qquad\qquad x = ₹\, 11000$$

36. According to given condition,

$$4410 = P\left(1 + \frac{5}{100}\right)^2$$

$$\Rightarrow \qquad P = \frac{4410}{(21/20)^2}$$

$$= \frac{4410 \times 400}{441} = ₹\, 4000$$

37. Let the sum be ₹ x. Then,

$$\frac{x \times 5 \times 15}{100} - \frac{x \times 15}{100} \times \frac{7}{2} = 144$$

$$\Rightarrow \qquad \frac{x}{100}\left(75 - \frac{105}{2}\right) = 144$$

$$\Rightarrow \quad x = \frac{144 \times 100 \times 2}{45} \Rightarrow x = ₹\, 640$$

38. $t = 8\,\text{yr}$

SI increase by ₹ 30 in 8 yr

$$\therefore \text{ SI increases in 1 yr} = \frac{30}{8} = 3.75$$

Let the rate be $x\%$ per annum

$$3.75 = \frac{1500 \times 1 \times x}{100}$$

$$x = 0.25\%$$

39. Let the annual instalment be ₹ x, then

$4x + \{\text{interest on } x \text{ for } (3 + 2 + 1)\text{ yr}\} = 19350$

$$\Rightarrow \qquad 4x + \frac{x \times 6 \times 5}{100} = 19350$$

$$\therefore \qquad\qquad x = ₹\, 4500$$

40. Since, SI $= \dfrac{PRT}{100}$

$$\therefore \qquad 6750 = \frac{P \times \dfrac{20}{3} \times 3}{100}$$

$$\Rightarrow \qquad P = 33750$$

Now, CP $= 33750\left[\left(1 + \dfrac{20}{300}\right)^3 - 1\right]$

$$= 33750\left[\frac{4096}{3375} - 1\right] = ₹\, 7210$$

41. Now, simple interest for two years, SI $= \dfrac{PRT}{100}$

$$= \frac{60000 \times 6 \times 2}{100} = ₹\,7200$$

and compound interest for two years CI $= A - P$

$$= P\left(1 + \frac{R}{100}\right)^n - P = 60000\left(1 + \frac{6}{100}\right)^2 - 60000$$

$$= 60000\left(\frac{53}{50}\right)^2 - 60000$$

$$= 67416 - 60000 = ₹7416$$

$$\therefore \text{Required difference} = CI - SI$$

$$= 7416 - 7200 = ₹216$$

42.
$$A = P\left(1 + \frac{R/2}{100}\right)^{2n}$$

$$= 350 \times \frac{102}{100} \times \frac{102}{100}$$

$$= ₹364.14$$

$$\therefore \text{Compound interest} = ₹364.14 - ₹350$$

$$= ₹14.14$$

43. $A = 2000\left(1 + \frac{10}{400}\right)^{4 \times \frac{5}{4}}$

$$= 2000\left(\frac{41}{40}\right)^5 = ₹2262.81$$

$$\therefore \text{Compound interest} = 2262.81 - 2000$$

$$= ₹262.81$$

44. $P\left(1 + \frac{R}{100}\right)^{15} = 2P$

or $\left(1 + \frac{R}{100}\right)^{15} = 2$ ...(i)

Now, $P\left(1 + \frac{R}{100}\right)^n = 8P$

$$\Rightarrow \left(1 + \frac{R}{100}\right)^n = 8 = (2)^3 = \left\{\left(1 + \frac{R}{100}\right)^{15}\right\}^3$$

[from Eq. (i)]

$$\Rightarrow \left(1 + \frac{R}{100}\right)^n = \left(1 + \frac{R}{100}\right)^{45}$$

$$\Rightarrow n = 45$$

45. SI on ₹7350 for 1 yr

$$= ₹(8575 - 7350) = ₹1225$$

$$\therefore \text{Rate} = \left(\frac{100 \times 1225}{7350 \times 1}\right)\% = 16\frac{2}{3}\%$$

Let the sum be ₹ x.

Then, $x\left(1 + \frac{50}{3 \times 100}\right)^2 = 7350$

$$\Rightarrow x \times \frac{7}{6} \times \frac{7}{6} = 7350$$

$$\Rightarrow x = 7350 \times \frac{36}{49} = 5400$$

or Sum = ₹5400

SPEED, TIME AND DISTANCE

In this chapter, we study speed of a person/object /train to cover a distance from a point to another point in certain time.

Speed

The rate at which a body or an object travels to cover a certain distance is called speed of body. The unit of speed is km/h and m/s.

Time

The duration in hours, minutes or seconds spent to cover a certain distance is called the time. The unit of time is hours, minute and seconds.

Distance

The length of the path travelled by any object or any person between two places is known as distance. The unit of distance is m, km, etc.

Relationship between Time, Speed and Distance

Relationship between time, distance and speed is expressed by

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \text{ or Distance} = \text{Speed} \times \text{Time}$$

This expression shown that

1. Speed is directly proportional to distance.

2. Distance and time are directly proportional.

3. Time is inversely proportional to speed.

Average Speed

When a certain distance is covered at speed A and the same distance is covered at speed B, then the average speed during the whole journey is given by $\dfrac{2AB}{A+B}$.

Note If a body covers a distance D_1 at S_1 km/h, D_2 at S_2 km/h, D_3 at S_3 km/h and so on upto D_n at S_n km/h then

Average speed

$$= \dfrac{D_1 + D_2 + D_3 + D_4 + \ldots + D_n}{\dfrac{D_1}{S_1} + \dfrac{D_2}{S_1} + \dfrac{D_3}{S_3} + \dfrac{D_4}{S_4} + \ldots + \dfrac{D_n}{S_n}}$$

Average speed $\neq \dfrac{S_1 + S_2 + S_3 + S_4 \ldots S_n}{n}$

Example 1 A person goes to Delhi from Mumbai at the speed of 60 km/h and comes back at the speed of 50 km/h. Calculate the average speed of the person for the entire trip.
(a) 54.75 km/h   (b) 54.54 km/h
(c) 57.57 km/h   (d) 75.57 km/h

Sol. (b) Average Speed $= \dfrac{2 \times 60 \times 50}{60 + 50}$

$[\because A = 60 \text{ km/h}, B = 50 \text{ km/h}]$

$= \dfrac{6000}{110} = 54.54 \text{ km/h}$

Example 2 A teacher reaches the school in 30 min with average speed of 15km/h. If they want to reach school in 10 minute earlier, their speed should be
(a) 80 km/h   (b) 90 km/h
(c) 50 km/h   (d) 75 km/h

Sol. (b) Let the distance covered by the teacher to reach to the school in d km with time t.

$\because \quad \text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$

$15 = \dfrac{d}{\dfrac{30}{60}} \Rightarrow d = \dfrac{15 \times 60}{30} = 30 \text{km}$

Again using formula,

$S = \dfrac{30}{\dfrac{(30-10)}{60}} = \dfrac{30 \times 60}{20} = 90 \text{ km/h}$

Some Another Formulae

1. To convert a m/s into km/h, multiply by $\dfrac{18}{5}$,

   i.e. $a \times \dfrac{18}{5}$ km/h. e.g. Convert 25 m/s to km/h.

   $$25 \text{ m/s} = \left(25 \times \dfrac{18}{5}\right) = 5 \times 18 = 90 \text{ km/h}$$

2. To convert a km/h into m/sec, multiply by $\dfrac{5}{18}$,

   i.e. $a \times \dfrac{5}{18}$ m/s. e.g. Convert 72 km/h into m/s

   $\therefore 72 \text{ km/h} = \left(72 \times \dfrac{5}{18}\right)$ m/s $= 4 \times 5 = 20$ m/s

3. When two bodies A and B are moving with speed a km/h and b km/h respectively, then the relative speed of two bodies is
   (i) $(a + b)$ km/h (if they are moving in opposite direction)
   (ii) $(a - b)$ km/h (if they are moving in same direction)

4. If a man changes his speed in the ratio $a : b$, then the ratio of time taken becomes $b : a$.

5. The distance covered by train in passing a pole or a standing man or a signal post or any other object (of negligible length) is equal to the length of the train.

6. If a train passes a stationary object (bridge, platform etc) having some length, then the distance covered by train is equal to the sum of the lengths of train and that particular stationary object which it is passing.

7. (i) If two trains of lengths x and y km are moving in opposite directions with speeds of u and v respectively, then time taken by the trains to cross each other
   $$= \dfrac{\text{Sum of lengths}}{\text{Sum of speeds}} = \dfrac{(x + y)}{(u + v)}$$

   (ii) If trains are moving in same directions, then time taken by faster train to cross slower train
   $$= \dfrac{\text{Sum of lengths}}{\text{Difference of speed}} = \dfrac{x + y}{u - v}$$

   Here, $u > v$.

Example 3 The speed of a bus is 72 km/h. The distance covered by the bus in 5 s is
(a) 50 m   (b) 74.5 m   (c) 100 m   (d) 60 m

Sol. (c) Speed of bus in m/s $= 72 \times \dfrac{5}{18} = 20$ m/s

∴ Distance travelled in 5 s $= 20 \times 5$ (Speed × Time)
$$= 100 \text{ m}$$

Example 4 Two trains are running in the same direction. The speeds of two trains are 5 km/h and 15 km/h, respectively. What will be the relative speed of second train with respect to first?
(a) 10 km/h (b) 15 km/h (c) 20 km/h (d) 5 km/h

Sol. (a) We know that, if two trains are running in same direction, then difference in speeds is the required relative speed.

∴   Required relative speed $= 15 - 5 = 10$ km/h

Example 5 Two trains of lengths 75 m and 95 m are moving in the same direction at 9 m/s and 8 m/s, respectively. Find the time taken by the faster train to cross the slower train.
(a) 120 s   (b) 170 s
(c) 140 s   (d) 190 s

Sol. (b) According to the formula,

Required time $= \dfrac{x + y}{u - v}$

where, $x = 75$ m,
              $y = 95$ m,
              $u = 9$ m/s
and $v = 8$ m/s

∴ Required time $= \dfrac{75 + 95}{9 - 8}$
$$= 170 \text{ s}$$

PRACTICE EXERCISE

1. A train runs at the rate of 120 km/s. The speed is m/s is
   (a) $66\dfrac{2}{3}$ (b) 25   (c) 30   (d) $33\dfrac{1}{3}$

2. An Athlete runs 200 m race in 24 s his speed (in km/h) is
   (a) 20   (b) 24   (c) 30   (d) 28.5

3. A person crosses a 600 m long street in 5 min. What is his speed in km per hour?
   (a) 3.6   (b) 7.2
   (c) 8.4   (d) 10

4. A train is 125 m long. If the train takes 30 s to cross a tree by the railway line, then the speed of the train is
   (a) 14 km/h   (b) 15 km/h
   (c) 16 km/h   (d) 12 km/h

5. A man riding on a bicycle at a speed of 15 km/h crosses a bridge in 5 min. Find the length of the bridge.
   (a) 1 km   (b) 2 km
   (c) $2\dfrac{1}{2}$ km   (d) $1\dfrac{1}{4}$ km

6. A train 110 m long is running at the speed of 72 km/h to pass a 132 m long platform in how many times?
   (a) 9.8 s   (b) 12.1 s   (c) 12.42 s (d) 14.3 s

7. If a man covers $10\dfrac{1}{5}$ km in 3 h, the distance covered by him in 5 h is
   (a) 16 km   (b) 15 km   (c) 18 km   (d) 17 km

8. A train 700 m long is running at the speed of 72 km/h. If it crosses a tunnel in 1 min, then the length of the tunnel is
   (a) 650 m   (b) 500 m   (c) 550 m   (d) 700 m

9. A car does a journey in 10 h, the first half at 21 km per hour, and the rest at 24 km per hour. The distance travelled by the car is
   (a) 264 km   (b) 244 km   (c) 254 km   (d) 224 km

10. Sunita reaches the coaching in 25 min with an average speed of 14 km/h. She want to reach school 5 min later, then her speed should be
    (a) 11.67 km/h   (b) 12 km/h
    (c) 13 km/h   (d) 13.5 kn/h

11. A man travels first 50 km at 25 km/h next 40 km at 20 km/h and then 90 km at 15 km/h. His average speed for the whole journey in (m/s)is
    - (a) 18
    - (b) 5
    - (c) 10
    - (d) 36

12. A car is ahead of a scooter by 30 km, car goes at the rate of 50 km/h and the scooter goes at the rate of 60 km/h. The scooter overtake the car after
    - (a) 3 h
    - (b) 3.5 h
    - (c) 4 h
    - (d) $3\frac{1}{4}$ h

13. A train passes two bridges of lengths 800 m and 400 m in 100 s and 60 s respectively. The length of the train is
    - (a) 80 m
    - (b) 90 m
    - (c) 200 m
    - (d) 150 m

14. Two runners cover the same distance at the rate of 15 km and 16 km per hour respectively. The distance travelled when one takes 16 min longer than the other is
    - (a) 64 km
    - (b) 60 km
    - (c) 52 km
    - (d) 58 km

15. Excluding stoppages, the speed of a bus is 54 km/h and including stoppages, it is 45 km/h. For how many minutes does the bus stop per hour?
    - (a) 9
    - (b) 10
    - (c) 12
    - (d) 20

16. Two persons are moving in the directions opposite to each other. The speeds of the both persons are 5 km/h and 3 km/h, respectively. Find the relative speed of the two persons in respect of each other
    - (a) 7 km/h (b) 3 km/h (c) 8 km/h (d) 5 km/h

17. A train 240 m long passes a pole in 24 s. How long will it take to pass a platform 650 m long?
    - (a) 65 sec (b) 89 sec (c) 100 sec (d) 150 sec

18. Distance between two towns P and Q is 240 km. A motor cycle rider starts from P towards Q at 8 pm at a speed of 40 km/h. At the same time another motor cycle rider starts from Q towards P at 50 km/h. At what time will they meet?
    - (a) 9 : 45 pm
    - (b) 10 : 40 pm
    - (c) 11 pm
    - (d) 10 : 30 pm

19. A car travels 25 km an hour faster than a bus a takes 10 hours less journey of 500 kms. The speed of the car and bus are given by respectively.
    - (a) 60 and 35
    - (b) 45 and 70
    - (c) 80 and 55
    - (d) 50 and 55

20. Two trains running in opposite directions cross a man standing on the platform in 54s and 34s respectively and they cross each other in 46 s. Find the ratio of their speeds.
    - (a) 3 : 2 (b) 2 : 3 (c) 5 : 3 (d) 3 : 5

Answers

1	(d)	2	(c)	3	(b)	4	(b)	5	(d)	6	(b)	7	(d)	8	(b)	9	(d)	10	(a)
11	(b)	12	(a)	13	(c)	14	(a)	15	(b)	16	(c)	17	(b)	18	(b)	19	(b)	20	(a)

Hints and Solutions

1. $120 \text{ km/h} = 120 \times \dfrac{5}{18} = 33\dfrac{1}{3} \text{ m/s}$

2. Distance $= 200 \text{ m}$, Time $= 24 \text{ s}$

Speed $= \dfrac{200}{24} \times \dfrac{18}{5} \text{ km/h} = 30 \text{ km/h}$

3. Speed $= \dfrac{\text{Distance}}{\text{Time}} = \dfrac{600}{5 \times 60} \text{ m/s} = 2 \text{ m/sec}$

$= 2 \times \dfrac{18}{5} \text{ km/hr} = 7.2 \text{ km/hr}$

4. Speed of train $= \dfrac{\text{Distance}}{\text{Time}} = \dfrac{125}{30} \times \dfrac{18}{5}$

$= 15 \text{ km/h}$

5. Length of bridge

$=$ Speed $\times$ time taken to cross the bridge

$= \dfrac{15 \times 5}{60} = 1\dfrac{1}{4} \text{ km}$

6. Speed of the train $= 72 \text{ km/h}$

$= 72 \times \dfrac{5}{18} \text{ m/s} = 20 \text{ m/s}$

$\therefore$ Required time $= \dfrac{110 + 132}{20}$

$= \dfrac{242}{20} = 12.1 \text{ s}$

7. Distance covered by man in 3h

$= 10\dfrac{1}{5} \text{ km}$

Distance covered by man in 1 h

$= \dfrac{51}{5 \times 3} = \dfrac{17}{5} \text{ km}$

Distance covered by man in 5 h will be

$= \dfrac{17}{5} \times 5 = 17 \text{ km}$

8. Speed $= 72 \times \dfrac{5}{18} = 20 \text{ m/s}$

Let the length of tunnel be x m.

Then, $\dfrac{700 + x}{20} = 60$

$\Rightarrow \qquad\qquad x = 500 \text{ m}$

9. Average speed

$= \dfrac{2 \times 21 \times 24}{21 + 24} = \dfrac{2 \times 21 \times 24}{45}$

$= \dfrac{2 \times 21 \times 24}{45} \times \dfrac{112}{5} \text{ km/hr}$

$\therefore$ Distance $= \dfrac{112}{5} \times 10 = 224 \text{ km}$

10. Let the distanve covered by Sunita to reach the school in d km withe time t. Then

Speed $= \dfrac{\text{Distance}}{\text{Time}}$

$14 = \dfrac{d}{\dfrac{25}{60}}$

$\Rightarrow \qquad d = \dfrac{14 \times 25}{60} = \dfrac{350}{60} = \dfrac{35}{6}$

Again using formula,

require speed $= \dfrac{\dfrac{35}{6}}{\dfrac{(25+5)}{60}} = \dfrac{35 \times 10}{30}$

$= \dfrac{35}{3} = 11.67 \text{ km/h}$

11. Total distance covered

$= 50 + 40 + 90 = 180 \text{ km}$

Total time taken $= \dfrac{50}{25} + \dfrac{40}{20} + \dfrac{90}{15} = 10 \text{ h}$

$\therefore$ Average speed for the whole journey

$= \dfrac{180}{10} = 18 = 18 \times \dfrac{5}{18} = 5 \text{ m/s}$

12. Distance between car and scooter $= 30 \text{ km}$

Difference of velocity

$= 60 - 50 = 10 \text{ km/h}$

So, time taken by scooter to travel 30 km extra than a car when its speed 10 km/h more

$= \dfrac{30}{10} = 3 \text{ h}$

13. Let train is x m long.

According to the question,

$$\frac{800+x}{100} = \frac{400+x}{60}$$

$$4800 + 6x = 4000 + 10x \Rightarrow 4x = 800$$

$$\therefore \qquad x = 200 \, m$$

14. Let distance covered by runners $= x$ km

Then, according to the question,

difference time in both runner $= 6$ min

$$\Rightarrow \qquad \frac{x}{15} - \frac{x}{16} = \frac{6}{60} \qquad [\because 1 \text{ hour} = 60 \text{ min}]$$

$$\Rightarrow \qquad \frac{x}{15 \times 16} = \frac{6}{60}$$

$$\Rightarrow \qquad x = \frac{15 \times 16}{10} = 64 \text{ km}$$

Hennce, distance covered by runners $= 64$ km

15. $\qquad$ Speed $= 54$ km/hr

After stopage $= 45$ km/hr

$$\Rightarrow \quad \text{Difference} = 54 - 45 = 9 \text{ km/hr}$$

$$\therefore \quad \text{Required time} = \frac{9}{54} \times 60 = 10 \text{ min}$$

16. We know that, the two speeds will be added, if the motions of two objects are in opposite directions.

$\therefore$ Required relative speed

$$= 5 + 3 = 8 \text{ km/h}$$

17. Speed of train $= \frac{240}{24}$ m/s $= 10$ m/s

$$\text{Time} = \frac{650 + 240}{10} = 89 \text{ s}$$

18. Suppose, they meet x h after 8 pm. Then, sum of distance covered by them in hours $= 240$ km.

$$\therefore \quad 40x + 50x = 240$$

$$\Rightarrow \qquad x = \frac{240}{90} = 2 \text{ h } 40 \text{ min}$$

$$= 8 \text{ pm} + 2 \text{ h } 40 \text{ min}$$

Hence, they will meet $= 10{:}40$ pm

19. Let speed of bus $= x$ km/hr

Speed of car $= (x + 25)$ km/hr

According to the question,

$$\frac{500}{x} - \frac{500}{x+25} = 10$$

$$\therefore \qquad \text{Car } x = 45 \text{ km/hr.}$$

$$\text{Bus} = 45 + 25 = 70 \text{ km/hr.}$$

20. Let the speed of two trains be x and y, respectively.

$\therefore$ Length of 1st train $= 54x$

Length of the 2nd train $= 34y$

According to the question,

$$\frac{54x + 34y}{x+y} = 46$$

$$\Rightarrow \quad 54x + 34y = 46x + 46y$$

$$\Rightarrow \quad 27x + 17y = 23x + 23y$$

$$\Rightarrow \quad 4x = 6y \Rightarrow 2x = 3y$$

$$\Rightarrow \qquad \frac{x}{y} = \frac{3}{2}$$

$$\therefore \quad x : y = 3 : 2$$

LINEAR EQUATIONS IN ONE VARIABLE

In this chapter, we study one and two variable types linear equations and various word problems by using linear equations.

Equation

An equation is an equality involving variables and it has an equality sign (=). The expression on the left of the equality sign is the Left Hand Side (LHS) and expression on the right of the equality sign is the Right Hand Side (RHS).

Linear Equations

The equations, in which the highest power of the variable appearing in the expression is 1, are called linear equations.

Linear Equations in One Variable

The expression, which form the equation contains only one variable and the highest power of the variable appearing in the equation is 1, are called linear equations in one variable.

e.g. $2x - 5 = 3$ and $\frac{5}{3}x + 3 = \frac{1}{2}$

Note The graph of the linear equation is always a straight line.

Properties of Linear Equations

(i) If same number is added or subtracted to both the sides of an equation, the equality remains the same.

(ii) If same number is multiplied to both the sides of an equation, the equality remains the same.

(iii) If both sides are divided by a same non-zero number, the equality remains the same.

Example 1 Solve $2(x-3)-(5-3x)$
$$= 3(x+1)-4(2+x)$$

(a) 2   (b) 1
(c) 3   (d) 0

Sol. *(b)* Given,

$$2(x-3)-(5-3x)=3(x+1)-4(2+x)$$
$$\Rightarrow 2x-6-5+3x=3x+3-8-4x$$
$$\Rightarrow \quad 5x-11=-x-5 \Rightarrow 6x=6$$
$$\Rightarrow \quad\quad\quad\quad\quad\quad\quad\quad x=1$$

Example 2 If $\dfrac{2x+1}{3x-1}=\dfrac{2x+1}{3x+2}$, the value of x is

(a) $-\dfrac{1}{2}$ (b) 0

(c) $\dfrac{1}{3}$ (d) $-\dfrac{2}{3}$

Sol. *(a)* We have, $\dfrac{2x+1}{3x-1}=\dfrac{2x+1}{3x+2}$

$$\Rightarrow \quad (2x+1)(3x+2)=(2x+1)(3x-1)$$
$$\Rightarrow \quad 6x^2+4x+3x+2=6x^2-2x+3x-1$$
$$\Rightarrow \quad 6x^2+7x+2=6x^2+x-1$$
$$\Rightarrow \quad 7x-x=-1-2 \Rightarrow 6x=-3$$
$$\therefore \quad\quad\quad x=-\dfrac{3}{6}=-\dfrac{1}{2}$$

Solving Word Problems by Using Linear Equation

I. Firstly, denote the unknown quantity by any letters, say x, y, z, etc.

II. Translate the statements of the problem into mathematical statements.

III. Using the conditions given in the problem, form the equation.

IV. Solve the equation for the unknown quantity.

Example 3 The digit in the ten's place of a two-digit number is 3 more than the digit in the unit's place. Let the digit at unit's place be b. Then, the number is

(a) $11b + 30$ (b) $10b + 30$
(c) $11b + 3$ (d) $10b + 3$

Sol. *(a)* Let digit at unit's place be b.

Then, digit at ten's place $= (3 + b)$

$\therefore$ Number $= 10(3 + b) + b$
$$= 30 + 10b + b = 11b + 30$$

Example 4 Thirty one is added 63 to twice a whole number gives. The number is

(a) 15   (b) 16   (c) 17   (d) 18

Sol. *(b)* Let whole number be x.

Then, $31 + 2x = 63$
$$\Rightarrow \quad\quad 2x=32 \Rightarrow x = 16$$

Example 5 A boy is now one-third as old as his father. Twelve years hence, he will be half as old as his father. The present age of the boy is

(a) 12 yr   (b) 20 yr   (c) 36 yr   (d) 25 yr

Sol. *(a)* Let the present age of the father be x yr and that of the son be $\dfrac{1}{3}x$ yr.

After twelve years,

Age of father $= (x + 12)$ yr

and age of son $= \left(\dfrac{1}{3}x + 12\right)$ yr

According to given condition,

$$\dfrac{1}{3}x + 12 = \dfrac{1}{2}(x + 12)$$
$$\Rightarrow \quad \dfrac{x+36}{3} = \dfrac{x+12}{2}$$
$$\Rightarrow \quad 2x + 72 = 3x + 36 \Rightarrow x = 36$$
$$\therefore \quad \text{Age of the boy} = \dfrac{x}{3} = \dfrac{36}{3} = 12 \text{ yr.}$$

PRACTICE EXERCISE

1. Linear equation in one variable has
   (a) only one variable with any power
   (b) only one term with a variable
   (c) only one variable with power 1
   (d) only constant term

2. Which of the following is a linear expression?
   (a) $x^2 + 1$
   (b) $y + y^2$
   (c) 4
   (d) $1 + z$

3. A linear equation in one variable has
   (a) only one solution
   (b) two solutions
   (c) more than two solutions
   (d) no solution

4. If $8x - 3 = 25 + 17x$, then x is
   (a) a fraction
   (b) an integer
   (c) a rational number
   (d) cannot be solved

5. If $7x : 63 = 1 : 9$, then x is equal to
   (a) 1
   (b) 2
   (c) 3
   (d) -1

6. If $\dfrac{3x+6}{8} - \dfrac{11x-8}{24} + \dfrac{x}{3} = \dfrac{3x}{4} - \dfrac{x+7}{24}$, then the value of x is
   (a) -3
   (b) 3/2
   (c) 3
   (d) 1/3

7. If $\sqrt{3}x - 2 = 2\sqrt{3} + 4$, then the value of x is
   (a) $2(1 - \sqrt{3})$
   (b) $2(1 + \sqrt{3})$
   (c) $1 + \sqrt{3}$
   (d) $1 - \sqrt{3}$

8. If $a(x - a^2) - b(x - b^2) = 0$, then x is equal to
   (a) $\dfrac{(-a+b)(a^2+ab+b^2)}{(a+b)}$
   (b) $\dfrac{a^3+b^3}{(a-b)}$
   (c) $\dfrac{a^3-b^3}{a+b}$
   (d) $a^2 + ab + b^2$

9. If one number is thrice the other and their sum is 20, then the numbers are
   (a) 5, 15
   (b) 4, 12
   (c) 3, 9
   (d) 6, 18

10. If the sum of five consecutive even numbers is 340, then the smallest numbers will be
    (a) 62
    (b) 64
    (c) 66
    (d) 68

11. The sum of 4 consecutive odd numbers is 56. The smallest number is
    (a) 12
    (b) 11
    (c) 13
    (d) 14

12. The sum of the two numbers is 11 and their product is 30, then the numbers are
    (a) 8, 3
    (b) 9, 2
    (c) 7, 4
    (d) 6, 5

13. Divide 60 into two parts, so that three times the greater may be exceed 100 by as much as 8 times the less falls short of 200. What is the greater part ?
    (a) 36
    (b) 24
    (c) 20
    (d) 25

14. The ages of two persons differ by 20 yr. If 5 yr ago, the elder one be 5 times as old as the younger one, their present ages are
    (a) 50 yr, 30 yr
    (b) 28 yr, 5 yr
    (c) 20 yr, 10 yr
    (d) 30 yr, 10 yr

15. Given that $\dfrac{4p+9q}{p} = \dfrac{5q}{p-q}$ and p and q are both positive. The value of $\dfrac{p}{q}$ is
    (a) $\dfrac{5}{3}$
    (b) $\dfrac{2}{3}$
    (c) $\dfrac{3}{2}$
    (d) $\dfrac{3}{5}$

16. A fraction becomes 4/5 when 5 is added to its numerator and 1 is subtracted from its denominator. It becomes 1/2 when 3 and 5 are subtracted from its numerator and denominator. The numerator of the fraction will be
    (a) 4
    (b) 11
    (c) 10
    (d) 9

17. The total cost of 6 books and 4 pencils is ₹ 34 and that of 5 books and 5 pencils is ₹ 30. The cost of each book and pencil (in ₹) respectively is
(a) 1 and 5 　　　　 (b) 5 and 1
(c) 6 and 1 　　　　 (d) 1 and 6

18. The age of a man is 4 times that of his son. Five years ago, the man was nine times as old as his son was at that time. The present age of the man is
(a) 28 yr 　(b) 45 yr 　(c) 32 yr 　(d) 48 yr

19. In a class $\dfrac{3}{5}$ of the students are girls and rest are boys. If $\dfrac{2}{9}$ of the girls and $\dfrac{1}{4}$ of the boys are absent. What part of the total number of students are present ?
(a) $\dfrac{23}{30}$ 　(b) $\dfrac{23}{36}$ 　(c) $\dfrac{18}{49}$ 　(d) $\dfrac{17}{25}$

20. If a sum of ₹ 275 is to be divided between Ram and Shyam so that Ram gets more than 3/4th of what Shyam gets, then the share of Ram will be
(a) ₹ 200 　(b) ₹ 175 　(c) ₹ 160 　(d) ₹ 100

21. Find a number such that if 5,15 and 35 are added to it, the product of the first and third results may be equal to the square of the second.
(a) 10 　　(b) 7 　　(c) 6 　　(d) 5

22. The length of a rectangle is 8 cm more than its breadth. If the perimeter of the rectangle is 68 cm, its length and breadth are respectively.
(a) 21 cm, 13 cm 　　(b) 21 cm, 32 cm
(c) 20 cm, 10 cm 　　(d) 13 cm, 15 cm

23. In a two digit number, the tens digit is twice the unit digit. When the digits are reversed, the new number formed is 18 less than the original number. The original number is
(a) 45 　　　　　　 (b) 42
(c) 43 　　　　　　 (d) 41

24. A man has a certain number of chickens and goats. Their head count is 30. If the total number of their legs is 84, what is the ratio between the number of chickens and goats ?
(a) 1 : 2 　　　　　 (b) 2 : 3
(c) 3 : 2 　　　　　 (d) 3 : 4

Answers

1	(c)	2	(d)	3	(a)	4	(c)	5	(a)	6	(c)	7	(b)	8	(d)	9	(a)	10	(b)
11	(b)	12	(d)	13	(a)	14	(d)	15	(c)	16	(b)	17	(b)	18	(c)	19	(a)	20	(b)
21	(d)	22	(a)	23	(b)	24	(c)												

Hints and Solutions

1. Linear equation in one variable has only one variable with power 1.

2. We know that, the algebraic expression in one variable having the highest power of the variable as 1, is known as the linear expression. Here, $1 + z$ is the only linear expression, as the power of the variable z is 1.

3. A linear equation in one variable has only one solution.

4. Given, $8x - 3 = 25 + 17x$
$\Rightarrow \qquad 8x - 17x = 25 + 3$
$\Rightarrow \qquad -9x = 28$
$\therefore \qquad x = \dfrac{-28}{9}$

Hence, x is a rational number.

5. $\dfrac{7x}{63} = \dfrac{1}{9} \Rightarrow x = \dfrac{63}{9 \times 7} = 1$

6. Given, $\dfrac{3x + 6}{8} - \dfrac{11x - 8}{24} + \dfrac{x}{3} = \dfrac{3x}{4} - \dfrac{x + 7}{24}$

$\Rightarrow \dfrac{3(3x + 6) - (11x - 8) + 8x}{24} = \dfrac{6(3x) - (x + 7)}{24}$

$\Rightarrow 9x + 18 - 11x + 8 + 8x = 18x - x - 7$

$$\Rightarrow \qquad 26 + 6x = 17x - 7$$
$$\Rightarrow \qquad 11x = 33$$
$$\Rightarrow \qquad x = 3$$

7. Given, $\sqrt{3}x - 2 = 2\sqrt{3} + 4$

$$\therefore \qquad \sqrt{3}x = 2\sqrt{3} + 6$$

$$\Rightarrow \qquad x = \frac{2\sqrt{3} + 6}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 2(1 + \sqrt{3})$$

8. Since, $\qquad ax - a^3 - bx + b^3 = 0$

$$\therefore \qquad (a - b)x - (a^3 - b^3) = 0$$
$$\Rightarrow (a - b)[x - (a^2 + b^2 + ab)] = 0$$
$$\Rightarrow \qquad x = a^2 + b^2 + ab$$

9. Let the one number be x and number be $3x$.
According to the given condition,
$$x + 3x = 20 \Rightarrow x = 5$$
$\therefore$ Other number is $(3x) = 3 \times 5 = 15$

10. Let the smallest number be x.
Then,
$$x + (x + 2) + (x + 4) + (x + 6) + (x + 8) = 340$$
$$\Rightarrow \qquad 5x + 20 = 340$$
$$\Rightarrow \qquad 5x = 320$$
$$\therefore \qquad x = 64$$

11. Let four consecutive odd number be
$x+1, x+3, x+5, x+7$.
Then, $(x+1) + (x+3) + (x+5) + (x+7) = 56$
$$4x = 40 \Rightarrow x = 10$$
$\therefore$ The smaller odd number is $x+1 = 10+1 = 11$

12. Let numbers be x and $11 - x$.
Since, product $\quad x(11 - x) = 30 \qquad$ [given]
$$\Rightarrow \qquad x^2 - 11x + 30 = 0$$
$$\Rightarrow \qquad (x - 5)(x - 6) = 0$$
$$\Rightarrow \qquad x = 5, 6$$

13. Let two parts be x and $60 - x$.
Then, $\quad 3x - 100 = 200 - 8(60 - x)$
$$\Rightarrow \qquad 3x - 100 = 200 - 480 + 8x$$
$$\Rightarrow \qquad 8x - 3x = 480 - 200 - 100$$
$$\Rightarrow \qquad 5x = 180$$
$$\therefore \qquad x = \frac{180}{5} = 36$$

Thus, another number $60 - 36 = 24$.
$\therefore$ Greater number $= 36$

14. Let their ages be x and $(x - 20)$ yr.
5 yr ago, their ages are $(x - 5)$ and $(x - 20 - 5)$ yr.
According to the given condition,
$$5(x - 20 - 5) = (x - 5)$$
$$\Rightarrow \qquad 5x - 125 = x - 5$$
$$\Rightarrow \qquad 4x = 120 \Rightarrow x = 30$$
Hence, their present ages are 30 yr and 10 yr.

15. Given, $\qquad \dfrac{4p + 9q}{p} = \dfrac{5q}{p - q}$

$$\Rightarrow \qquad \frac{4\left(\dfrac{p}{q}\right) + 9}{\left(\dfrac{p}{q}\right)} = \frac{5}{\left(\dfrac{p}{q}\right) - 1}$$

[on dividing by q in numerator and denominator]

$$\Rightarrow 4\left(\frac{p}{q}\right)^2 + 9\left(\frac{p}{q}\right) - 4\left(\frac{p}{q}\right) - 9 = 5\left(\frac{p}{q}\right)$$

$$\Rightarrow \quad 4\left(\frac{p}{q}\right)^2 - 9 = 0 \Rightarrow \left(\frac{p}{q}\right)^2 = \left(\frac{3}{2}\right)^2$$

$$\therefore \qquad \frac{p}{q} = \frac{3}{2}$$

16. Let the fraction be $\dfrac{x}{y}$.

Then, $\dfrac{x + 5}{y - 1} = \dfrac{4}{5} \Rightarrow 5x - 4y = 29 \qquad$ ...(i)

and $\dfrac{x - 3}{y - 5} = \dfrac{1}{2} \Rightarrow 2x - y = 1 \qquad$ ...(ii)

On solving Eqs. (i) and (ii), we get $x = 11$

17. Let CP of a book be ₹ x and CP of pencil be ₹y.
Then, $\qquad 6x + 4y = 34 \qquad$ ...(i)
and $\qquad 5x + 5y = 30 \qquad$ ...(ii)
On solving Eqs. (i) and (ii), we get
$$x = 5 \text{ and } y = 1.$$

18. Let the son's age be x yr, then man age's be $4x$.
Five years ago, their ages are $(x - 5)$ yr and $(4x - 5)$ yr respectively.
According to the given condition,
$$(4x - 5) = 9(x - 5)$$
$$\Rightarrow \qquad 5x = 40 \Rightarrow x = 8 \text{ yr}$$
Hence, the man's age $= 4x = 4 \times 8 = 32$ yr.

19. Let the number of students be x.

Then, number of girls $= \dfrac{3}{5}x$ and number of boys
$$= \dfrac{2}{5}x$$

Number of girls present $= \dfrac{7}{9} \times \dfrac{3}{5}x = \dfrac{7x}{15}$ and

Number of boys present $= \dfrac{3}{4} \times \dfrac{2}{5}x = \dfrac{3x}{10}$

$\therefore$ Total students present $= \left(\dfrac{7x}{15} + \dfrac{3x}{10}\right) = \dfrac{23}{30}x$

20. Let Shyam's share be ₹ x.

Then, Ram's share $= \left(x + \dfrac{3x}{4}\right) = ₹\dfrac{7x}{4}$

$\therefore \qquad x + \dfrac{7x}{4} = 275 \Rightarrow x = 100$

$\therefore \qquad$ Ram's share $= \dfrac{7}{4} \times 100 = ₹\,175$

21. Let the number be x.

Then, first number $= (x + 5)$
second number $= (x + 15)$
and third number $= (x + 35)$

According to the question,
$$(x + 5)(x + 35) = (x + 15)^2$$
$$\Rightarrow \quad 175 + 40x = 225 + 30x$$
$$\Rightarrow \quad 10x = 50$$
$$\therefore \qquad x = 5$$

22. Let breadth of rectangle be x.

Then, its length $= (x + 8)$ cm

$\therefore$ Perimeter of rectangle $= 2[x + (x + 8)]$
$$= 2(2x + 8) = 4x + 16$$

$\therefore \qquad 4x + 16 = 68 \qquad$ [given]
$$\Rightarrow \qquad 4x = 52$$
$$\Rightarrow \qquad x = 13$$

So, breadth of rectangle $= 13$ cm
and length $= 13 + 8 = 21$ cm

23. Let unit digit $= x$

Then, tens digit $= 2x$

$\therefore$ Original number $= 10 \times 2x + x = 20x + x = 21x$

New Number $= 10 \times x + 2x$
$$= 10x + 2x = 12x$$

Now, $21x - 12x = 18$
$$\Rightarrow \qquad 9x = 18$$
$$\Rightarrow \qquad x = 2$$

$\therefore$ Unit digit $= 2$ and Tens digit $= 2 \times 2 = 4$

Thus, required number $= 10 \times 4 + 2 = 42$

24. Let the number of chickens and goat be x and

According to the question,
$$x + y = 30 \qquad \ldots (i)$$
and $\qquad 2x + 4y = 84$
$$\Rightarrow \qquad x + 2y = 42 \qquad \ldots (ii)$$

On solving Eqs. (i) and (ii), we get
$$x = 18 \text{ and } y = 12$$

$\therefore$ Required ratio $= 18:12 = 3:2$