Ratio and Proportion

RATIO

A *ratio* is a comparison of two quantities by division. It is a relation that one quantity bears to another with respect to magnitude. In other words, ratio means what part one quantity is of another. The quantities may be of same kind or different kinds. For example, when we consider the ratio of the weight 45 kg of a bag of rice to the weight 29 kg of a bag of sugar we are considering the quantities of same kind but when we talk of allotting 2 cricket bats to 5 sportsmen, we are considering quantities of different kinds. Normally, we consider the ratio between quantities of the same kind.

If a and b are two numbers, the ratio of a to b is $\dfrac{a}{b}$ or $a \div b$ and is denoted by $a{:}b$. The two quantities that are being compared are called *terms*. The first is called *antecedent* and the second term is called *consequent*.

For example, the ratio 3:5 represents $\dfrac{3}{5}$ with antecedent 3 and consequent 5.

Notes:

1. A ratio is a number, so to find the ratio of two quantities, they must be expressed in the same units.
2. A ratio does not change if both of its terms are multiplied or divided by the same number. Thus,

$$\frac{2}{3} = \frac{4}{6} = \frac{6}{9} \text{ etc.}$$

TYPES OF RATIOS

1. **Duplicate Ratio** The ratio of the squares of two numbers is called the *duplicate ratio* of the two numbers.

   For example, $\dfrac{3^2}{4^2}$ or $\dfrac{9}{16}$ is called the duplicate ratio of $\dfrac{3}{4}$.

2. **Triplicate Ratio** The ratio of the cubes of two numbers is called the *triplicate ratio* of the two numbers.

   For example, $\dfrac{3^3}{4^3}$ or $\dfrac{27}{64}$ is triplicate ratio of $\dfrac{3}{4}$.

3. **Sub-duplicate Ratio** The ratio of the square roots of two numbers is called the *sub-duplicate ratio* of two numbers.

   For example, $\dfrac{3}{4}$ is the sub-duplicate ratio of $\dfrac{9}{16}$.

4. **Sub-triplicate Ratio** The ratio of the cube roots of two numbers is called the *sub-triplicate ratio* of two numbers.

   For example, $\dfrac{2}{3}$ is the sub-triplicate ratio of $\dfrac{8}{27}$.

5. **Inverse Ratio or Reciprocal Ratio** If the antecedent and consequent of a ratio interchange their places, the new ratio is called the *inverse ratio* of the first. Thus, if $a{:}b$ be the given ratio, then $\dfrac{1}{a}{:}\dfrac{1}{b}$ or $b{:}a$ is its inverse ratio.

   For example, $\dfrac{3}{5}$ is the inverse ratio of $\dfrac{5}{3}$.

6. **Compound Ratio** The ratio of the product of the antecedents to that of the consequents of two or more given ratios is called the *compound ratio*. Thus, if $a{:}b$ and $c{:}d$ are two given ratios, then $ac{:}bd$ is the compound ratio of the given ratios.

   For example, if $\dfrac{3}{4}$, $\dfrac{4}{5}$ and $\dfrac{5}{7}$ be the given ratios, then their compound ratio is $\dfrac{3 \times 4 \times 5}{4 \times 5 \times 7}$, that is, $\dfrac{3}{7}$.

PROPORTION

The equality of two ratios is called *proportion*.

If $\dfrac{a}{b} = \dfrac{c}{d}$, then a, b, c and d are said to be in proportion and we write $a:b::c:d$. This is read as "a is to b as c is to d".

For example, since $\dfrac{3}{4} = \dfrac{6}{8}$, we write $3:4::6:8$ and say 3, 4, 6 and 8 are in proportion.

Each term of the ratio $\dfrac{a}{b}$ and $\dfrac{c}{d}$ is called a *proportional*. a, b, c and d are, respectively, the first, second, third and fourth roportionals.

Here a, d are known as *extremes* and b, c are known as *means*.

SOME BASIC FORMULAE

1. If four quantities are in proportion, then

Product of means = Product of extremes

For example, in the proportion $a:b::c:d$, we have $bc = ad$.

Product of means

$$a \;:\; b \;:\;:\; c \;:\; d$$

Product of extremes
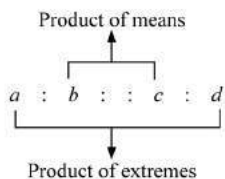
From this relation, we see that if any three of the four quantities are given, the fourth can be determined.

2. Fourth proportional If $a:b::c:x$, x is called the *fourth proportional* of a, b, c.

We have $\dfrac{a}{b} = \dfrac{c}{x}$ or, $x = \dfrac{b \times c}{a}$

Thus, fourth proportional of a, b, c is $\dfrac{b \times c}{a}$.

Illustration 1 Find a fourth proportional to the numbers 2, 5, 4.

Solution: Let x be the fourth proportional, then

$$2:5::4:x \text{ or, } \dfrac{2}{5} = \dfrac{4}{x}$$

$$\therefore \qquad x = \dfrac{5 \times 4}{2} = 10$$

3. Third Proportional If $a:b::b:x$, x is called the third proportional of a, b.

We have $\dfrac{a}{b} = \dfrac{b}{x}$ or, $x = \dfrac{b^2}{a}$.

Thus, third proportional of a, b is $\dfrac{b^2}{a}$.

Illustration 2 Find a third proportional to the numbers 2.5, 1.5.

Solution: Let x be the third proportional, then

$$2 \times 5 : 1 \times 5 :: 1 \times 5 : x \text{ or, } \dfrac{2 \cdot 5}{1 \cdot 5} = \dfrac{1 \cdot 5}{x}$$

$$\therefore \qquad x = \dfrac{1 \cdot 5 \times 1 \cdot 5}{2 \cdot 5} = 0.9$$

4. Mean Proportional If $a:x::x:b$, x is called the *mean* or *second proportional* of a, b.

We have $\dfrac{a}{x} = \dfrac{x}{b}$ or, $x^2 = ab$ or, $x = \sqrt{ab}$.

$\therefore$ Mean proportional of a and b is $\sqrt{ab}$

We also say that a, x, b are in *continued proportion*.

Illustration 3 Find the mean proportional between 48 and 12.

Solution: Let x be the mean proportional. Then,

$$48:x::x:12 \text{ or, } \dfrac{48}{x} = \dfrac{x}{12}$$

or, $$x^2 = 576 \text{ or, } x = 24$$

5. If $\dfrac{a}{b} = \dfrac{c}{d}$, then

(i) $\dfrac{a+b}{b} = \dfrac{c+d}{d}$ (Componendo)

(ii) $\dfrac{a-b}{b} = \dfrac{c-d}{d}$ (Dividendo)

(iii) $\dfrac{a+b}{a-b} = \dfrac{c+d}{c-d}$ (Componendo and dividendo)

(iv) $\dfrac{a}{b} = \dfrac{a+c}{b+d} = \dfrac{a-c}{b-d}$.

Illustration 4 The sum of two numbers is c and their quotient is $\frac{p}{q}$. Find the numbers.

Solution: Let the numbers be x, y.

Given $\qquad x + y = c \qquad\qquad (1)$

and, $\qquad \dfrac{x}{y} = \dfrac{p}{q} \qquad\qquad (2)$

$\therefore \qquad \dfrac{x}{x+y} = \dfrac{p}{p+q}$

$\Rightarrow \qquad \dfrac{x}{c} = \dfrac{p}{p+q} \qquad$ [Using (1)]

$\Rightarrow \qquad x = \dfrac{pc}{p+q}$

SOME USEFUL SHORT-CUT METHODS

1. (*a*) If two numbers are in the ratio of $a:b$ and the sum of these numbers is x, then these numbers will be $\dfrac{ax}{a+b}$ and $\dfrac{bx}{a+b}$, respectively.

or

If in a mixture of x litres, two liquids A and B are in the ratio of $a:b$, then the quantities of liquids A and B in the mixture will be $\dfrac{ax}{a+b}$ litres and $\dfrac{bx}{a+b}$ litres, respectively.

(*b*) If three numbers are in the ratio of $a:b:c$ and the sum of these numbers is x, then these numbers will be $\dfrac{ax}{a+b+c}$, $\dfrac{bx}{a+b+c}$ and $\dfrac{cx}{a+b+c}$, respectively.

Explanation

Let the three numbers in the ratio $a:b:c$ be A, B and C.

Then,
$$A = ka,\ B = kb,\ C = kc$$
and, $\quad A + B + C = ka + kb + kc = x$

$\Rightarrow\quad k(a+b+c) = x \Rightarrow k = \dfrac{x}{a+b+c}$

$\therefore \qquad A = ka = \dfrac{ax}{a+b+c}$

$\qquad\qquad B = kb = \dfrac{bx}{a+b+c}$

$\qquad\qquad C = kc = \dfrac{cx}{a+b+c}.$

Illustration 5 Two numbers are in the ratio of 4:5 and the sum of these numbers is 27. Find the two numbers

Solution: Here $a = 4$, $b = 5$ and $x = 27$

$\therefore \qquad$ The first number $= \dfrac{ax}{a+b} = \dfrac{4 \times 27}{4+5} = 12$

and, the second number $= \dfrac{bx}{a+b} = \dfrac{5 \times 27}{4+5} = 15$

Illustration 6 Three numbers are in the ratio of 3:4:8 and the sum of these numbers is 975. Find the three numbers

Here $a = 3$, $b = 4$, $c = 8$ and $x = 975$

$\therefore$ The first number $= \dfrac{ax}{a+b+c} = \dfrac{3 \times 975}{3+4+8} = 195$

The second number $= \dfrac{bx}{a+b+c} = \dfrac{4 \times 975}{3+4+8} = 260$

and, the third number $= \dfrac{cx}{a+b+c} = \dfrac{8 \times 975}{3+4+8} = 520$

2. If two numbers are in the ratio of $a:b$ and difference between these numbers is x, then these numbers will be

(*a*) $\dfrac{ax}{a-b}$ and $\dfrac{bx}{a-b}$, respectively (where $a > b$)

(*b*) $\dfrac{ax}{b-a}$ and $\dfrac{bx}{b-a}$, respectively (where $a < b$).

Explanation

Let the two numbers be ak and bk.

Let $a > b$.

Given $\qquad ak - bk = x$

$\Rightarrow \qquad (a-b)k = x$ or, $k = \dfrac{x}{a-b}$

Therefore, the two numbers are $\dfrac{ax}{a-b}$ and $\dfrac{bx}{a-b}$.

Illustration 7 Two numbers are in the ratio of 4:5. If the difference between these numbers is 24, then find the numbers.

Solution: Here $a = 4$, $b = 5$ and $x = 24$

$\therefore$ The first number $= \dfrac{ax}{b-a} = \dfrac{4 \times 24}{5-4} = 96$

and the second number $= \dfrac{bx}{b-a} = \dfrac{5 \times 24}{5-4} = 120$

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3. (a) If $\qquad a{:}b = n_1{:}d_1$ and $b{:}c = n_2{:}d_2$, then
$\qquad\qquad a{:}b{:}c = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$.

(b) If $\qquad a{:}b = n_1{:}d_1$, $b{:}c = n_2{:}d_2$
and $\qquad c{:}d = n_3{:}d_3$, then
$\qquad a{:}b{:}c{:}d = (n_1 \times n_2 \times n_3){:}(d_1 \times n_2 \times n_3)$
$\qquad\qquad : (d_1 \times d_2 \times n_3){:}(d_1 \times d_2 \times d_3)$.

Illustration 8 If $A{:}B = 3{:}4$ and $B{:}C = 8{:}9$, find $A{:}B{:}C$.

Solution: Here $n_1 = 3$, $n_2 = 8$, $d_1 = 4$ and $d_2 = 9$

$\therefore \qquad a : b : c = (n_1 \times n_2){:}(d_1 \times n_2){:}(d_1 \times d_2)$
$\qquad\qquad = (3 \times 8){:}(4 \times 8){:}(4 \times 9)$
$\qquad\qquad = 24{:}32{:}36$ or, $6{:}8{:}9$

Illustration 9 If $A{:}B = 2{:}3$, $B{:}C = 4{:}5$ and $C{:}D = 6{:}7$, find $A{:}D$.

Solution: Here $n_1 = 2$, $n_2 = 4$, $n_3 = 6$, $d_1 = 3$, $d_2 = 5$ and $d_3 = 7$

$\therefore \qquad A{:}B{:}C{:}D = (n_1 \times n_2 \times n_3){:}(d_1 \times n_2 \times n_3)$
$\qquad\qquad : (d_1 \times d_2{:}n_3){:}(d_1 \times d_2 \times d_3)$
$\qquad = (2 \times 4 \times 6){:}(3 \times 4 \times 6){:}(3 \times 5 \times 6)$
$\qquad\qquad : (3 \times 5 \times 7)$
$\qquad = 48{:}72{:}90{:}105$ or, $16{:}24{:}30{:}35$

Thus, $\qquad A{:}D = 16{:}35$

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4. (a) The ratio between two numbers is $a{:}b$. If x is added to each of these numbers, the ratio becomes $c{:}d$. The two numbers are given as:
$$\dfrac{ax(c-d)}{ad-bc} \text{ and } \dfrac{bx(c-d)}{ad-bc}.$$

Explanation

Let two numbers be ak and bk.

Given $\dfrac{ak+x}{bk+x} = \dfrac{c}{d} \Rightarrow akd + dx = cbk + cx$

$\qquad\qquad \Rightarrow k(ad-bc) = x(c-d)$

$\qquad\qquad \Rightarrow k = \dfrac{x(c-d)}{ad-bc}$

Therefore, the two numbers are $\dfrac{ax(c-d)}{ad-bc}$ and $\dfrac{bx(c-d)}{ad-bc}$

(b) The ratio between two numbers is $a{:}b$. If x is subtracted from each of these numbers, the ratio becomes $c{:}d$.

The two numbers are given as:
$$\dfrac{ax(d-c)}{ad-bc} \text{ and } \dfrac{bx(d-c)}{ad-bc}.$$

Explanation

Let the two numbers be ak and bk.

Given $\dfrac{ak-x}{bk-x} = \dfrac{c}{d} \Rightarrow akd - xd = bck - xc$

$\qquad\qquad \Rightarrow k(ad-bc) = x(d-c)$

$\qquad\qquad \Rightarrow k = \dfrac{x(d-c)}{ad-bc}$

Therefore, the two numbers are $\dfrac{ax(d-c)}{ad-bc}$ and $\dfrac{bx(d-c)}{ad-bc}$

Illustration 10 Given two numbers which are in the ratio of 3:4. If 8 is added to each of them, their ratio is changed to 5:6. Find the two numbers.

Solution: We have

$\qquad\qquad a{:}b = 3{:}4$, $c{:}d = 5{:}6$ and $x = 8$

$\therefore \qquad$ The first number $= \dfrac{ax(c-d)}{ad-bc}$

$\qquad\qquad = \dfrac{3 \times 8 \times (5-6)}{(3 \times 6 - 4 \times 5)} = 12$

and, the second number $= \dfrac{bx(c-d)}{ad-bc}$

$\qquad\qquad = \dfrac{4 \times 8 \times (5-6)}{(3 \times 6 - 4 \times 5)} = 16$

Illustration 11 The ratio of two numbers is 5:9. If each number is decreased by 5, the ratio becomes 5:11. Find the numbers.

Solution: We have $a{:}b = 5{:}9$, $c{:}d = 5{:}11$ and $x = 5$

$\therefore \qquad$ The first number $= \dfrac{ax(d-c)}{ad-bc}$

$\qquad\qquad = \dfrac{5 \times 5 \times (11-5)}{(5 \times 11 - 9 \times 5)} = 15$

and the second number $= \dfrac{bx(d-c)}{ad-bc}$

$$= \dfrac{9 \times 5 \times (11-5)}{(5 \times 11 - 9 \times 5)} = 27$$

5. (a) If the ratio of two numbers is $a:b$, then the numbers that should be added to each of the numbers in order to make this ratio $c:d$ is given by

$$\dfrac{ad-bc}{c-d}.$$

Explanation

Let the required number be x

Given $\dfrac{a+x}{b+x} = \dfrac{c}{d} \Rightarrow ad+xd = bc+xc$

$$\Rightarrow x(d-c) = bc-ad$$

or $\quad x = \dfrac{ad-bc}{c-d}.$

(b) If the ratio of two numbers is $a:b$, then the number that should be subtracted from each of the numbers in order to make this ratio $c:d$ is given by

$$\dfrac{bc-ad}{c-d}.$$

Explanation

Let the required number be x

Given, $\dfrac{a-x}{b-x} = \dfrac{c}{d} \Rightarrow ad-xd = bc-xc$

$$\Rightarrow x(c-d) = bc-ad$$

or, $\quad x = \dfrac{bc-ad}{c-d}.$

Illustration 12 Find the number that must be subtracted from the terms of the ratio 5:6 to make it equal to 2:3.

Solution: We have $a:b = 5:6$ and $c:d = 2:3$

$\therefore$ The required number

$$= \dfrac{bc-ad}{c-d} = \dfrac{6 \times 2 - 5 \times 3}{2-3} = 3$$

Illustration 13 Find the number that must be added to the terms of the ratio 11:29 to make it equal to 11:20

Solution: We have $a:b = 11:29$ and $c:d = 11:20$

$\therefore$ The required number

$$= \dfrac{ad-bc}{c-d} = \dfrac{11 \times 20 - 29 \times 11}{11-20} = 11$$

6. There are four numbers a, b, c and d.

(i) The number that should be subtracted from each of these numbers so that the remaining numbers may be proportional is given by

$$\dfrac{ad-bc}{(a+d)-(b+c)}.$$

Explanation

Let x be subtracted from each of the numbers.

The remainders are $a-x$, $b-x$, $c-x$ and $d-x$

Given $\quad \dfrac{a-x}{b-x} = \dfrac{c-x}{d-x}$

$\Rightarrow \quad (a-x)(d-x) = (b-x)(c-x)$

$\Rightarrow \quad ad - x(a+d) + x^2 = bc - x(b+c) + x^2$

$\Rightarrow \quad (b+c)x - (a+d)x = bc - ad$

$\therefore \quad x = \dfrac{bc-ad}{(b+c)-(a+d)}$ or, $\dfrac{bc-ad}{(b+c)-(a+d)}$

(ii) The number that should be added to each of these numbers so that the new numbers may be proportional is given by

$$\dfrac{bc-ad}{(a+d)-(b+c)}.$$

Explanation

Let x be added to each of the numbers.

The new numbers are $a+x$, $b+x$, $c+x$ and $d+x$

Given, $\quad \dfrac{a+x}{b+x} = \dfrac{c+x}{d+x}.$

$\Rightarrow \quad (a+x)(d+x) = (b+x)(c+x)$

$\Rightarrow \quad ad + x(a+d) + x^2 = bc + x(b+c) + x^2$

$\Rightarrow \quad (a+d)x - (b+c)x = bc - ad.$

$\therefore \quad\quad x = \dfrac{bc-ad}{(a+d)-(b+c)}$

Illustration 14 Find the number subtracted from each of the numbers 54, 71, 75 and 99 leaves the remainders which are proportional.

Solution: We have $a = 54$, $b = 71$, $c = 75$ and $d = 99$

The required number $= \dfrac{ad-bc}{(a+d)-(b+c)}$

$$= \dfrac{54 \times 99 - 71 \times 75}{(54+99)-(71+75)} = 3$$

7. The incomes of two persons are in the ratio of $a:b$ and their expenditures are in the ratio of $c:d$. If the saving of each person be ₹S, then their incomes are given by

$$₹\frac{aS(d-c)}{ad-bc} \text{ and } ₹\frac{bS(d-c)}{ad-bc}$$

and their expenditures are given by

$$₹\frac{cS(b-a)}{ad-bc} \text{ and } ₹\frac{dS(b-a)}{ad-bc}.$$

Explanation

Let their incomes be ₹ak and ₹bk, respectively. Since each person saves ₹S,

∴ expenditure of first person = ₹$(ak - S)$

and expenditure of second person = ₹$(bk - S)$

Given, $\quad \dfrac{ak - S}{bk - S} = \dfrac{c}{d}$

$\Rightarrow \quad akd - Sd = bkc - Sc$

$\Rightarrow \quad k(ad - bc) = (d - c)S$ or, $k = \dfrac{(d-c)S}{ad-bc}$

Therefore, the incomes of two persons are

$$\frac{a(d-c)S}{ad-bc} \text{ and } \frac{b(d-c)S}{ad-bc}$$

and, their expenditures are

$$ak - S \text{ and } bk - S$$

that is, $\quad \dfrac{a(d-c)S}{ad-bc} - S$ and $\dfrac{b(d-c)S}{ad-bc} - S$

or, $\quad \dfrac{cS(b-a)}{ad-bc}$ and $\dfrac{dS(b-a)}{ad-bc}$.

Illustration 15 Annual income of A and B is in the ratio of 5:4 and their annual expenses bear a ratio of 4 : 3. If each of them saves ₹500 at the end of the year, then find their annual income.

Solution: We have $a:b = 5:4$, $c:d = 4:3$ and $S = 500$

∴ Annual income of $A = \dfrac{aS(d-c)}{ad-bc}$

$$= \frac{5 \times 500 \times (3-4)}{(5\times3 - 4\times4)}$$

$$= ₹2500.$$

and, annual income of $B = \dfrac{bS(d-c)}{ad-bc}$

$$= \frac{4 \times 500 \times (3-4)}{(5\times3 - 4\times4)}$$

$$= ₹2000$$

Illustration 16 The incomes of Mohan and Sohan are in the ratio 7:2 and their expenditures are in the ratio 4:1. If each saves ₹1000, find their expenditures.

Solution: We have $a:b = 7:2$, $c:d = 4:1$ and $S = 1000$

∴ A's expenditure $= \dfrac{cS(b-a)}{ad-bc} = \dfrac{4\times1000\times(2-7)}{(7\times1 - 2\times4)}$

$$= ₹20000$$

B's expenditure $= \dfrac{dS(b-a)}{ad-bc} = \dfrac{1\times1000\times(2-7)}{(7\times1 - 2\times4)}$

$$= ₹5000$$

8. (a) If in a mixture of x litres of two liquids A and B, the ratio of liquids A and B is $a:b$, then the quantity of liquid B to be added in order to make this ratio.

$$c:d \text{ is } \frac{x(ad-bc)}{c(a+b)}.$$

Explanation

Quantity of liquid A in the mixture $= \dfrac{ax}{a+b}$

Quantity of liquid B in the mixture $= \dfrac{bx}{a+b}$

Let litres of liquid B to be added in order to make this ratio as $c:d$.

Then, $\quad \dfrac{ax}{a+b} : \dfrac{bx}{a+b} + l = c:d$

or, $\quad \dfrac{ax}{a+b} : \dfrac{bx + l(a+b)}{a+b} = c:d$

or, $\quad \dfrac{ax}{bx + l(a+b)} = \dfrac{c}{d}$

or, $\quad axd = bcx + cl(a+b)$

or, $\quad l = \dfrac{x(ad-bc)}{(a+b)c}.$

(b) In a mixture of two liquids A and B, the ratio of liquids A and B is $a:b$. If on adding x litres of liquid B to the mixture, the ratio of A to B becomes $a:c$, then in the beginning the quantity of liquid A in the mixture was $\dfrac{ax}{c-b}$ litres and that of liquid B was $\dfrac{bx}{c-b}$ litres.

Explanation

Let the quantity of mixture be M litres.

Then, the quantity of liquid $A = \dfrac{aM}{a+b}$ litres

and, the quantity of liquid $B = \dfrac{bM}{a+b}$ litres

If x litres of liquid B is added, then

$$\dfrac{aM}{a+b} : \dfrac{bM}{a+b} + x = a{:}c$$

or, $\quad \dfrac{aM}{a+b} : \dfrac{bM + x(a+b)}{a+b} = a{:}c$

or, $\quad \dfrac{aM}{bM + x(a+b)} = \dfrac{a}{c}$

or, $\quad cM = bM + x(a+b)$

or, $\quad M = \dfrac{x(a+b)}{c-b}$

$\therefore$ Quantity of liquid

$$A = \dfrac{ax(a+b)}{(c-b)(a+b)} = \dfrac{ax}{c-b} \text{ litres}$$

and quantity of liquid

$$B = \dfrac{bx(a+b)}{(c-b)(a+b)} = \dfrac{bx}{c-b} \text{ litres}$$

Illustration 17 729 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 of 7:3.

Solution: Here $x = 729$, $a:b = 7:2$ and $c{:}d = 7{:}3$

$\therefore$ The quantity of water to be added

$$= \dfrac{x(ad - bc)}{c(a+b)} = \dfrac{729 \times (7 \times 3 - 2 \times 7)}{7(7+2)} = 81 \text{ ml}$$

Illustration 18 A mixture contains alcohol and water in the ratio of 6:1. On adding 8 litres of water, the ratio of alcohol to water becomes 6:5. Find the quantity of water in the mixture.

Solution: We have $a{:}b = 6{:}1$, $a{:}c = 6{:}5$ and $x = 8$.

$\therefore$ The quantity of water in the mixture

$$= \dfrac{bx}{c-b} = \dfrac{1 \times 8}{5-1} = 2 \text{ litres}$$

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9. When two ingredients A and B of quantities q_1 and q_2 and cost price/unit c_1 and c_2 are mixed to get a mixture c having cost price/unit cm, then

(a) $\dfrac{q_1}{q_2} = \dfrac{c_2 - c_m}{c_m - c_1}$ and (b) $cm = \dfrac{c_1 \times q_1 + c_2 \times q_2}{q_1 + q_2}$

Illustration 19 In what ratio the two kinds of tea must be mixed together into one at ₹9 per kg and another at ₹15 per kg, so that mixture may cost ₹10.2 per kg?

Solution: We have $c_1 = 9$, $c_2 = 15$, $cm = 10.2$

$\therefore \qquad \dfrac{q_1}{q_2} = \dfrac{c_2 - c_m}{c_m - c_1}$

$$= \dfrac{15 - 10.2}{10.2 - 9} = \dfrac{4.8}{1.2}$$

$$= \dfrac{4}{1}$$

Thus, the two kinds of tea are mixed in the ratio 4:1.

Illustration 20 In a mixture of two types of oils O_1 and O_1, the ratio $O_1{:}O_2$ is 3:2. If the cost of oil O_1 is ₹4 per litre and that of O_2 is ₹9 per litre, then find the cost/litre of the resulting mixture

We have $q_1 = q_2 = 2$, $c_1 = 4$ and $c_2 = 9$

$\therefore$ The cost of resulting mixture

$$= \dfrac{c_1 \times q_1 + c_2 \times q_2}{q_1 + q_2}$$

$$= \dfrac{4 \times 3 + 9 \times 2}{3+2} = \dfrac{30}{5} = ₹6$$

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10. (a) If a mixture contains two ingredients A and B in the ratio $a{:}b$, then

percentage of A in the mixture $= \dfrac{a}{a+b} \times 100\%$ and percentage of B in the mixture $= \dfrac{b}{a+b} \times 100\%$

(b) If two mixtures M_1 and M_2 contain ingredients A and B in the ratios $a{:}b$ and $c{:}d$, respectively, then a third mixture M_3 obtained by mixing M_1 and M_2 in the ratio $x{:}y$ will contain

$$\left[\dfrac{\dfrac{a \times x}{a+b} + \dfrac{c \times y}{c+d}}{x+y} \right] \times 100\% \text{ ingredient } A, \text{ and}$$

$$\left[100\% - \left\{ \dfrac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y} \right\} \right]$$

or, $\left[\dfrac{\dfrac{bx}{a+b} + \dfrac{dy}{c+d}}{x+y} \right] \times 100\% \text{ ingredient } B.$

Illustration 21 If a mixture contains water and alcohol in the ratio 2:3, what is the percentage quantity of water in the mixture?

Solution: Here $a = 2$, $b = 3$

$\therefore$ Percentage quantity of water in the mixture

$$= \frac{a}{a+b} \times 100\%$$

$$= \frac{2}{2+3} \times 100\%$$

$$= \frac{2}{5} \times 100\%$$

$$= \frac{200}{5} \text{ or, } 40\%$$

Illustration 22 Two alloys contain silver and copper in the ratio 3:1 and 5:3. In what ratio the two alloys should be added together to get a new alloy having silver and copper in the ratio of 2:1?

Solution: We have $a{:}b = 3{:}1$, $c{:}d = 5{:}3$

Let the two alloys be mixed in the ratio $x{:}y$

Then, percentage quantity of sliver in the new alloy

$$= \left[\frac{\dfrac{ax}{a+b} + \dfrac{cy}{c+d}}{x+y} \right] \times 100\% = \left[\frac{\dfrac{3x}{4} + \dfrac{5y}{8}}{x+y} \right] \times 100\%$$

$$= \frac{6x+5y}{8(x+y)} \times 100\% \qquad (1)$$

Since the ratio of silver and copper in the new alloys is 2:1

$\therefore$ Percentage quantity of sliver in the new alloy

$$= \frac{2}{2+1} \times 100\% = \frac{200}{3}\% \qquad (2)$$

From (1) and (2), we get

$$\frac{6x+5y}{8(x+y)} = \frac{2}{3}$$

or, $\qquad 18x + 15y = 16x + 16y$

or, $\qquad 2x = y$

or, $\qquad x{:}y = 1{:}2$

Hence, the two alloys should be mixed in the ratio 1:2.

Practice Exercises

DIFFICULTY LEVEL-1
(BASED ON MEMORY)

1. The ratio of the rate of flow of water in pipes varies inversely as the square of the radius of the pipes. What is the ratio of the rates of flow in two pipes of diameters 2 cm and 4 cm?

   (a) 1:2 (b) 2:1
   (c) 1:8 (d) 4:1

2. Half the girls and one-third of the boys of a college reside in the hostel. What fractional part of the student body is hostel dwellers if the total number of girls in the college is 100 and is one-fourth of the total strength?

   (a) Two-fifths (b) Five-twelfths
   (c) One-fifth   (d) Three-eighths

3. In a class room, three-fourths of the boys are above 160 cm in height and they are 18 in number. Also out of the total strength, the boys form only two-thirds and the rest are girls. The total number of girls in the class is:

   (a) 18 (b) 24
   (c) 12 (d) 20

4. A box filled with paper bundles weighs 36 kilograms. If the weight of the box and paper bundles, respectively, are in the ratio of 3:22, then find the weight of the papers in grams.

   (a) 30,680 (b) 30,710
   (c) 31,500 (d) 31,680

5. A, B and C scored 581 runs such that four times A's runs are equal to 5 times B's runs which are equal to seven times C's runs. Determine the difference between A's runs and C's runs.

   (a) 125 (b) 120
   (c) 105 (d) 90

6. A person spends one-third of the money with him on clothes, one-fifth of the remaining on food and one-fourth of the remaining on travel. Now, he is left with ₹100. How much did he have with him in the beginning?

(a) ₹200   (b) ₹250
(c) ₹300   (d) ₹450

7. One-third of the contents of a container evaporated on the 1st day. three-fourths of the remaining evaporated on the second day. What part of the contents of the container is left at the end of the second day?

(a) One-fourth   (b) One-half
(c) One-eighteenths   (d) One-sixth

8. The monthly incomes of two persons are in the ratio of 4:5 and their monthly expenditures are in the ratio of 7:9. If each saves ₹50 a month, then what are their monthly incomes?

(a) ₹100, ₹125   (b) ₹200, ₹250
(c) ₹300, ₹375   (d) ₹400, ₹500

9. When a bus started from the first stop, the number of male passengers to the number of female passengers was 3:1. At the first stop, 16 passengers got down and 6 more female passengers got in. The ratio of the male to female passengers now became 2:1. What was the total number of passengers in the bus when it started from the first stop?

(a) 64   (b) 48
(c) 54   (d) 72

10. If the ratio of boys to girls in a class is B and the ratio of girls to boys is G, then $3 (B + G)$ is:

(a) Equal to 3   (b) Less than 3
(c) More than 3   (d) Less than one-third

11. If $a:b = 2:5$, then the value of $(2a + 3b):(7a + 5b)$ is:

(a) $\dfrac{19}{39}$ (b) $\dfrac{99}{13}$

(c) $\dfrac{31}{19}$ (d) $\dfrac{19}{31}$

12. If two numbers are in the ratio 6:13 and their least common multiple is 312, the sum of the numbers is:

(a) 75   (b) 57
(c) 76   (d) 67

13. The ratio of boys to girls in an engineering college is 20:1. How many girls need to be added to make this ratio 8:3?

(a) 26   (b) 43
(c) 20   (d) Cannot be determined

14. Two numbers are in the ratio 2:3. If eight is added to both the numbers, the ratio becomes 3:4. The numbers are:

(a) 15 and 20   (b) 16 and 24
(c) 13 and 17   (d) 17 and 9

15. ₹770 have been divided among A, B and C such that A receives two-ninths of what B and C together receive. Then, A's share is:

(a) ₹140   (b) ₹154
(c) ₹165   (d) ₹170

16. What least number must be subtracted from each of the numbers 14, 17, 34 and 42 so that the remainders are proportional?

(a) 0   (b) 1
(c) 2   (d) 7

17. The mean proportional between 45 and a certain number is three times the mean proportional between 5 and 22. The number is:

(a) 24   (b) 49
(c) 22   (d) 9

18. If the mean proportional between X and Y is n times the third proportional, then the ratio $X:Y$ will be:

(a) $n2:1$ (b) $1:n^2$
(c) $n^{2/3}:1$ (d) $1:n^{2/3}$

19. If x varies inversely as $(y^2 - 1)$ and is equal to 24 when $y = 10$, the value of x when $y = 5$ will be:

(a) 100   (b) 101
(c) 99   (d) None of the above

20. Which of the following is the ratio between a number and the number obtained by adding one-fifth of that number to it?

(a) 6:5   (b) 5:6
(c) 5:4   (d) 4:5

21. The ratio of the age of a man and his wife is 4:3. After 4 years, this ratio will be 9:7. If at the time of the marriage, the ratio was 5:3, then how many years ago they were married ?

(a) 12 years   (b) 8 years
(c) 10 years   (d) 15 years

22. X's income is three-fourths of Y's income, and X's expenditure is four-fifths of Y's expenditure. If X's income is nine-tenths of Y's expenditure, find the ratio of X's savings to Y's savings.

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

23. If $x:y = 1:2$, $y:z = 1:3$, $z:w = 3:8$ and $u:w = 2:5$, find the value of $(xyu):(w^2z)$.

(a) 1:90　　　　　　　(b) 3:80
(c) 1:120　　　　　　(d) 3:160

24. A man spends ₹500 in buying 12 tables and chairs. The cost of one table is ₹50 and that of one chair is ₹40. What is the ratio of the numbers of the chairs and the tables purchased?

(a) 5:4　　　　　　　(b) 3:2
(c) 1:5　　　　　　　(d) None of these

25. If x varies directly as $3y + 1$ and $x = 9$ when $y = 1$, then what is the value of x when $y = 5$?

(a) 11　　　　　　　(b) 10
(c) 20　　　　　　　(d) 36

26. Two numbers are in the ratio of 1:2. If 7 be added to both, their ratio changes to 3:5. The greater number is:

(a) 20　　　　　　　(b) 24
(c) 28　　　　　　　(d) 32

27. The prices of a room air conditioner and an automatic washing machine are in the ratio of 3:2. What would be the price of the washing machine if it costs ₹6000 less than the air conditioner?

(a) ₹18000　　　　　(b) ₹10000
(c) ₹12000　　　　　(d) ₹6000

28. A dog takes 6 leaps for every 4 leaps of a hare and 2 leaps of the dog are qual to 5 leaps of the hare. What is the ratio of their speed?

(a) 8:13　　　　　　(b) 24:15
(c) 12:7　　　　　　(d) 15:4

29. A jar contains black and white marbles. If there are ten marbles in the jar, then which of the following could NOT be the ratio of black to white marbles?

(a) 9:1　　　　　　　(b) 7:3
(c) 1:10　　　　　　(d) 1:4

30. Eight people are planning to share equally the cost of a rental car. If one person withdraws from the arrangement and the others share equally the entire cost of the car, then the share of each of the remaining persons increased by:

(a) One-ninth　　　　(b) One-eighth
(c) One-seventh　　　(d) Seven-eighths

31. To win an election, a candidate needs three-fourths of the votes cast. If, after two-thirds of the votes have been counted, a candidates has five-sixths of what he needs, then what part of the remaining ratio does he still need?

(a) One-eighth　　　　(b) One-tenth
(c) One-fourth　　　　(d) Three-eights

32. When 30 per cent of a number is added to another number the second number increases by its 20 per cent. What is the ratio between the first and the second number?

(a) 3:2　　　　　　　(b) 2:3
(c) 2:5　　　　　　　(d) Data inadequate

33. An amount of money is to be distributed among A, B and C in the ratio 5:8:12, respectively. If the total share of B and C is our times that of A. What is A's share?

(a) ₹3,000
(b) ₹5,000
(c) Cannot be determined
(d) None of these

34. A and B are two different alloys of gold and copper prepared by mixing metals in the proportion 7:2 and 7:11, respectively. If equal quantities of the alloys are melted to form a third alloy C, find the ratio of gold and copper in C.

(a) 5:7　　　　　　　(b) 6:6
(c) 7:5　　　　　　　(d) 14:13

35. A sum of money is divided among A, B, C and D in the ratio of 3:7:9:13 respectively. If the share of B is ₹9180 more than the share of A, then what is the total amount of money of A and C together?

(a) ₹27540　　　　　(b) ₹27560
(c) ₹26680　　　　　(d) ₹24740

36. A shopkeeper mixes two kinds of flour, one costing ₹3.50 per kg and the other at ₹2.75 per kg. The ratio of first kind of flour to that of the second is:

(a) 1:2　　　　　　　(b) 1:3
(c) 3:4　　　　　　　(d) None of these

37. The numbers x, y, z are proportional to 2, 3, 5. The sum of x, y and z is 100. The number y is given by the equation $y = ax - 10$. Then, a is:

(a) 2　　　　　　　　(b) $\dfrac{3}{2}$

(c) 3　　　　　　　　(d) $\dfrac{5}{2}$

38. If x varies as the cube of y, and y varies as the fifth root of z, then x varies as the nth power of z, where n is:

(a) $\dfrac{1}{15}$　　　　　(b) $\dfrac{5}{3}$

(c) $\dfrac{3}{5}$　　　　　(d) 15

39. Two persons are climbing up on two moving escalators which have 120 steps. The ratio of 1st person's speed to that of 1st escalator is 2:3 (steps). The ratio of 2nd person's speed to that of 2nd escalator is 3:5 (steps). Find the total number of steps they both have taken together.

(a) 85   (b) 93

(c) 80   (d) 75

[Based on SNAP, 2007]

40. A driver's income consists of his salary and tips. During one week, his tips were five-fourths of his salary. What fraction of his income came from tips?

(a) Four-ninths   (b) Five-ninths

(c) Five-eighths   (d) Five-fourths

[Based on MAT, 2000]

41. A man ordered 4 pairs of black socks and some pairs of brown socks. The price of a black pair is double that a brown pair. While preparing the bill, the clerk interchanged the number of black and brown pairs by mistake which increased the bill by 50 per cent. The ratio of the number of black and brown pairs of socks in the original order was:

(a) 4:1   (b) 2:1

(c) 1:4   (d) 1:2

[Based on MAT, 1999]

42. If P varies as QR and the three corresponding values of P, Q, R be 6 ,9, 10 respectively, then the value of P, when $Q = 5$ and $R = 3$, is:

(a) 3   (b) 2

(c) 1   (d) 4

[Based on MAT, 1999]

43. Two numbers are such as the square of one is 224 less than 8 times the square of the other. If the numbers be in the ratio of 3:4, their values are:

(a) 12, 16   (b) 6, 8

(c) 9, 12   (d) None of these

[Based on MAT, 1999]

44. If $x:y:z::1:3:5$, then the value of $\dfrac{\sqrt{x^2 + 7y^2 + 9z^2}}{x}$ is:

(a) 7   (b) 17

(c) 13   (d) 1

[Based on SNAP, 1999]

45. An amount of money is to be distributed among A, B and C in the ratio 3:1:5. The difference between B's and C's shares is ₹3600. What is the total of A's and B's shares?

(a) ₹5400   (b) ₹3600

(c) ₹2700   (d) ₹1800

[Based on MAT, 1999]

46. The ratio of the prices of two houses A and B was 4:5 last year. This year, the price of A is increased by 25 per cent and that of B by ₹50,000. If their prices are now in the ratio 9:10, the price of A last year was:

(a) ₹3,60,000   (b) ₹4,50,000

(c) ₹4,80,000   (d) ₹5,00,000

[Based on MAT, 1998]

47. Two numbers are in the ratio 5:4 and their difference is 10. What is the larger number?

(a) 30   (b) 40

(c) 50   (d) 60

[Based on MAT, 1998]

48. If A gets 25 per cent more than B and B gets 20 per cent more than C, the share of C out of a sum of ₹7400 is:

(a) ₹3000   (b) ₹2000

(c) ₹2400   (d) ₹3500

[Based on MAT, 1998]

49. A, B, C and D have ₹40, 50, 60 and 70 respectively when they go to visiit a fair. A spends ₹18, B spends ₹21, C spends ₹24, and D spends ₹27. Who has done the highest expenditure proportionate to his resources?

(a) A (b) B

(c) C (d) D

[Based on MAT, 1998]

50. The total emoluments of A and B are equal. However, A gets 65 per cent of his basic salary as allowances and B gets 80 per cent of his basic salary as allowances. What is the ratio of the basic salaries of A and B?

(a) 16:13   (b) 5:7

(c) 12:11   (d) 7:9

[Based on MAT, 1997]

51. A contractor employed 25 labourers on a job. He was paid ₹275 for the work. After retaining 20 per cent of this sum, he distributed the remaining amount amongst the labourers. If the number of men to women labourers was in the ratio 2:3 and their wages in the ratio 5:4, what wages did a woman labourer get?

(a) ₹10   (b) ₹8

(c) ₹12   (d) ₹15

[Based on MAT, 1997]

52. Railway fares of 1st, 2nd and 3rd classes between two stations were in the ratio of 8:6:3. The fares of 1st and 2nd class were subsequently reduced by 1/6 and 1/12, respectively. If during a year, the ratio between the passengers of 1st, 2nd and 3rd classes was 9:12:26 and total amount collected by the sale of tickets was

₹1088, then find the collection from the passengers of 1st class.

(a) ₹260   (b) ₹280

(c) ₹300   (d) ₹320

53. Ajay, Aman, Suman and Geeta rented a house and agreed to share the rent as follows:
Ajay:Aman = 8:15,
Aman:Suman = 5:8 and
Suman:Geeta = 4:5.
The part of rent paid by Suman will be:

(a) 24/77   (b) 13/66

(c) 12/55   (d) 13/77

54. Mira's expenditure and savings are in the ratio 3:2. Her income increases by 10% Her expenditure also increases by 12 per cent. By how much per cent do her savings increase?

(a) 7%   (b) 9%

(c) 10%   (d) 13%

55. The ratio between the number of passengers travelling by I and II classes between the two railway stations is 1:50, whereas the ratio of I and II classes fares between the same stations is 3:1. If on a particular day, ₹1325 were collected from the passengers travelling between these stations, then what was the amount collected from the II class passengers?

(a) ₹750   (b) ₹1000

(c) ₹850   (d) ₹1250

56. What should be subtracted from 15, 28, 20 and 38 so that the remaining numbers may be proportional?

(a) 6   (b) 4

(c) 2   (d) None of these

57. The sum of money is to be divided amongst A, B and C in the respective ratio of 3:4:5 and another sum of money is to be divided between E and F equally. If F got ₹1050 less than A, how much amount did B receive?

(a) ₹750   (b) ₹2000

(c) ₹1500   (d) Cannot be determined

58. The number that must be added to each of the numbers 8, 21, 13 and 31 to make the ratio of first two numbers equal to the ratio of last two numbers is:

(a) 7   (b) 5

(c) 9   (d) None of these

59. Men, women and children are employed to do a work in the proportion of 1:2:3 and their wages are in the proportion of 6:3:2. When 50 men are employed, total wages of all amount to ₹4500. What is the weekly wages paid to a man, a woman and a child, in rupees?

(a) 210, 105, 80   (b) 210, 105, 70

(c) 210, 105, 90   (d) 200, 105, 70

60. One year ago, the ratio between Mahesh's and Suresh's salaries was 3:5. The ratio of their individual salaries of last year and present year are 2:3 and 4:5 respectively. If their total salaries for the present year are ₹43000, what is the present salary of Mahesh?

(a) ₹19000   (b) ₹18000

(c) ₹16000   (d) ₹15500

61. The first, second and third class fares between two stations were 10:8:3 and the number of first, second and third class passengers between the two stations in a day was 3:4:10. The sale of tickets to passengers running between two stations on that day was ₹8050. How much was realized by the sale of second class tickets?

(a) ₹3000   (b) ₹2800

(c) ₹4500   (d) ₹3500

62. A person distributes his pens among four friends A, B, C and D in the ratio 1/3:1/4:1/5:1/6. What is the minimum number of pens that the person should have?

(a) 65   (b) 55

(c) 23   (d) 57

63. At the start of a seminar, the ratio of the number of male participants to the number of female participants was 3:1. During the tea break, 16 male participants left and 6 more female participants registered. The ratio of the male to the female participants became 2:1. The total number of participants at the start of the seminar was:

(a) 112   (b) 48

(c) 54   (d) 72

64. The prime cost of an article is three times the value of the raw material used. The cost of raw materials increases in the ratio of 5:12 and manufacturing expenses in the ratio 4:5. The article, which originally cost ₹6, will new cost:

(a) ₹10   (b) ₹17

(c) ₹20.50   (d) None of these

65. The sum of the reciprocals of the ages of two brothers is five times the difference of the reciprocals of their ages. If the ratio of the product of their ages to the sum of their ages is 14.4:1, find their ages.

(*a*) 36 and 24 years

(*b*) 24 and 20 years

(*c*) 18 and 15 years

(*d*) 12 and 9 years

66. Three numbers *A*, *B* and *C* are in the ratio of 12:15:25. If sum of these numbers is 312, ratio between the difference of *B* and *A* and the difference of *C* and *B* is:

(*a*) 3:7　　　　　　　(*b*) 10:3

(*c*) 3:10　　　　　　　(*d*) 5:1

67. A man left one-half of the property for his wife. One-third to his son and the remainder to his daughter and her share was worth ₹45000, how much money did the man leave?

(*a*) ₹245000　　　　　(*b*) ₹260000

(*c*) ₹270000　　　　　(*d*) ₹275000

68. A man ordered 4 pairs of black socks and some pairs of brown socks. The price of a black pair is double that of a brown pair. While preparing the bill, the clerk did a mistake and interchanged the number of black and brown pairs. This increased the bill by 50 per cent. The ratio of the number of black and brown pairs of socks in the original order was:

(*a*) 4:1　　　　　　　(*b*) 2:1

(*c*) 1:4　　　　　　　(*d*) 1:2

69. Three friends Anita, Bindu and Champa divided ₹1105 amongst them in such a way that if ₹10, ₹20 and ₹15 are removed from the sums that Anita, Bindu and Champa received respectively, then the share of the sums that they got will be in the ratio of 11:18:24. How much did Champa receive?

(*a*) ₹495　　　　　　　(*b*) ₹510

(*c*) ₹480　　　　　　　(*d*) ₹375

70. A, B, C together earn ₹1450 and spend 60%, 65% and 70% of their salaries respectively. If their saving are in the ratio 14:21:15, the salary of B is:

(*a*) ₹500　　　　　　　(*b*) ₹600

(*c*) ₹450　　　　　　　(*d*) ₹750

71. ₹9000 were divided equally among a certain number of person. Had there been 20 more persons, each would have got ₹160 less. The original number of persons were:

(*a*) 30　　　　　　　　(*b*) 45

(*c*) 25　　　　　　　　(*d*) 55

72. There are a total of 43800 students in 4 schools of a city. Half the number of students of the first school, two-third of the second, three-fourth of the third and four-fifth of the fourth are all equal. What is the ratio of the number of students of A to D, if A, B, C, and D be the first, second, third, and fourth schools, respectively?

(*a*) 8:5　　　　　　　(b) 1:3

(*c*) 2:3　　　　　　　(d) 7:9

73. Two companies A and B quote for a tender. On the tender opening day, A realizes that the two quotes are in the ratio 7:4 and hence decreases its price during negotiations to make it ₹1 lakh lower than B's quoted price. B then realises that the final quotes of the two were in the ratio 3 : 4. By how much did A decrease its price in order to win the bid?

(*a*) ₹7 lakhs　　　　　(*b*) ₹4 lakhs

(c) ₹9 lakhs　　　　　(*d*) None of these

74. Ratio of the earnings (in ₹) of A and B is 4:7. If the earnings of A increase by 50% and those of B decrease by 25%, the new ratio of their earnings becomes 8:7. How much is A earning?

(*a*) ₹28000　　　　　(*b*) ₹21000

(*c*) ₹26000　　　　　(*d*) Data inadequate

75. One-fourth of sixty percent of a number is equal to two-fifth of twenty percent of another number. What is the respective ratio of the first number to the second number?

(*a*) 8:15　　　　　　　(*b*) 5:9

(*c*) 8:13　　　　　　　(*d*) 4:7

76. A sum of ₹53 is divided among A, B and C in such a way that A gets ₹7 more than what B gets and B gets ₹8 more than what C gets. The ratio of their shares is:

(*a*) 15:8:30　　　　　(*b*) 18:25:10

(*c*) 25:18:10　　　　　(*d*) 16:18:10

77. The ratio of efficiency of A is to C is 5:3. The ratio of number of days taken by B is to C is 2:3. A takes 6 days less than C, when A and C complete the work individually. B and C started the work and left after 2 days. The number of days taken by A to finish the remaining work is:

(*a*) 4.5 days　　　　　(*b*) 5 days

(*c*) 6 days　　　　　　(*d*) $9\frac{1}{3}$ days

78. A student is studying for a test from 11:00 am to 08:00 pm on weekdays and one-third of that on Saturdays. On Sundays he takes a break from school and goes fishing. For what fractional part of the entire week is the student studying?

(a) 2/5   (b) 3/7
(c) 2/7   (d) 3/8

79. The number of balls in three baskets are in the ratio of 3:4:5. In which ratio the number of balls in first two baskets must be increased so that the new ratio becomes 5:4:3?

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

80. Two numbers are in the ratio $P:Q$. When 1 is added to both the numerator and the denominator, the ratio gets changed to R/S. Again, when 1 is added to both the numerator and the denominator, it becomes $\frac{1}{2}$. Find the sum of P and Q.

(a) 3   (b) 4
(c) 5   (d) 6

81. Kajal spends 55% of the monthly income on grocery, clothes and education in the ratio of 4:2:5 respectively. If the amount spent on clothes is ₹5540, what is Kajal's monthly income?

(a) ₹55,400   (b) ₹54,500
(c) ₹55,450   (d) ₹55,650

82. A certain amount was to be distributed among A, B and C in the ratio 2:3:4 respectively, but was erroneously distributed in the ratio 7:2:5 respectively. As a result of this, B got ₹ 40 less. What is the amount?

(a) ₹210   (b) ₹270
(c) ₹230   (d) ₹280

83. ₹73,689 are divided between A and B in the ratio 4:7. What is the difference between thrice the share of A and twice the share of B?

(a) ₹36,699   (b) ₹46,893
(c) ₹20.097   (d) ₹13.398

84. Profit earned by an organization is distributed among the officers and clerks in the ratio of 5:3. If the number of officers is 45 and the number of clerks is 80 and the amount received by each officer is ₹25,000, what was the total amount of profit earned?

(a) ₹22 lakhs   (b) ₹18.25 lakhs
(c) ₹18 lakhs   (d) ₹23.25 lakhs

85. Mrs. X spends ₹535 in purchasing some shirts and ties for her husband. If shirts cost ₹43 each and the ties cost ₹21 each, then what is the ratio of the shirts to the ties, that are purchased?

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

86. In an express train, the numbers of passengers travelling in A.C. Sleepers class, 1st Class and Sleeper Class are in the ratio 1:2:3, and the fares to each of these classes are in the ratio 5:4:2. If the total income from the train is ₹54000, then the income from the A.C. sleeper class is:

(a) ₹8000   (b) ₹12000
(c) ₹14210   (d) None of these

87. Consider the formula, $S = \dfrac{\alpha\omega}{\tau+\rho\omega}$, where all the parameters are positive integers. If ω is increased and a, τ and ρ are kept constant, then S:

(a) Increases
(b) Decreases
(c) Increases and then decreases
(d) Decreases and then increases

1. Let a, b, c, d and e be integers such that $a = 6b = 12c$, and $2b = 9d = 12e$. Then, which of the following pairs contain a number that is not an integer?

   (a) $\left(\dfrac{a}{27}, \dfrac{b}{e}\right)$

   (b) $\left(\dfrac{a}{36}, \dfrac{c}{e}\right)$

   (c) $\left(\dfrac{a}{12}, \dfrac{bd}{18}\right)$

   (d) $\left(\dfrac{a}{6}, \dfrac{c}{d}\right)$

   [Based on CAT, 2004]

2. A man fell in love with a woman who lived 63 miles away. He decided to propose his beloved and invited her to travel to his place and offered to meet her en route and bring her home. The man is able to cover 4 miles per hour to the woman's 3 miles per hour. How far will each have travelled upon meeting?

   (a) Man = 27 miles; woman = 36 miles
   (b) Man = 36 miles; woman = 27 miles
   (c) Man = 40 miles; woman = 23 miles
   (d) Man = 45 miles; woman = 18 miles

3. The price of branded PC (personal computer) and assembled PC is in the ratio of 64:27. If from now on, every year price of branded PC goes on decreasing by 10 per cent and price of assembled PC goes on increasing by 20 per cent, how after many years the price of both will be equal?

   (a) 2 years
   (b) 3 years
   (c) $3\dfrac{1}{3}$ years
   (d) $2\dfrac{1}{2}$ years

4. A certain product C is made of two ingredients A and B in the proportion of 2:5. The price of A is three times that of B. The overall cost of C is ₹5.20 per kg including labour charges of 80 paisa per kg. Find the cost of B per kg?

   (a) ₹8.40
   (b) ₹4.20
   (c) ₹4.80
   (d) ₹2.80

5. A sum of ₹430 has been distributed among 45 people consisting of men, women and children. The total amounts given to men, women and children are in the ratio 12:15:16. But, the amounts received by each man, woman and child are in the ratio 6:5:4. Find, what each man, woman and child receives (in ₹).

   (a) 12, 10, 8
   (b) 18, 15, 12
   (c) 120, 150, 160
   (d) 60, 75, 80

6. The total salary of A, B, C is ₹444. If they spend 80%, 85%, 75% of their salaries, respectively, their savings are as 7:6:9. The salary of B is:

   (a) ₹140
   (b) ₹160
   (c) ₹144
   (d) None of the above

7. A factory employs skilled workers, unskilled workers and clerks in the proportion 8:5:1 and the wage of a skilled worker, an unskilled worker and a clerk are in the ratio 5:2:3. When 20 unskilled workers are employed, the total daily wages of all amount to ₹3180. Find the daily wages paid to each category of employees.

   (a) 2100, 800, 280
   (b) 2400, 480, 300
   (c) 2400, 600, 180
   (d) 2200, 560, 420

8. The soldiers in two armies when they met in a battle were in the ratio of 10:3. Their respective losses were as 20:3 and the survivors as 40:13. If the number of survivors in the larger army be 24,000, find the original number of soldiers in army.

   (a) 28000, 8400
   (b) 25000, 7500
   (c) 29000, 2750
   (d) 26000, 7800

9. What must be added to each of the numbers 7, 11 and 19, so that the resulting numbers may be in continued proportion?

   (a) 3
   (b) 5
   (c) 4
   (d) –3

10. At Narmada Sarovar Bachao demonstration, supporters of Ms. Patkar outnumbered the police by 9:1. The police arrested 135 NSB supporters averaging 5 for every 3 policemen. How many supporters of NSB were there in the demonstration?

    (a) 405
    (b) 665
    (c) 1215
    (d) None of the above

    [Based on FMS (Delhi), 2004]

11. The intensity of illumination on a surface from a source of light varies inversely as the square of the distance of the surface from the source. The effect of moving a piece of paper 3 times as far from the source is to:

    (a) Divide the intensity by 3
    (b) Multiply the intensity by 3
    (c) Divide the intensity by 9
    (d) Multiply the intensity by 9

    [Based on REC Tiruchirapalli, 2003]

12. Suppose y varies as the sum of two quantities of which one varies directly, as x and the other varies inversely as x. If $y = 6$ when $x = 4$ and $y = 3\dfrac{1}{3}$ when $x = 3$, then the relation between x and y is:

(a) $y = x + \dfrac{4}{x}$

(b) $y = -2x + \dfrac{4}{x}$

(c) $y = 2x + \dfrac{8}{x}$

(d) $y = 2x - \dfrac{8}{x}$

[Based on FMS (Delhi), 2003]

13. Pressure varies inversely with volume while temperature varies directly with volume. At a time, Volume = 50 m^3, Temperature = 25° K and Pressure = 1 atmosphere. If the volume is increased to 200 m^3, then the temperature will be:

(a) 100° K

(b) 50° K

(c) $12\dfrac{1}{2}$° K

(d) 0° K

[Based on IIFT, 2003]

14. x^2 varies directly as y^3 and when $x = 6$, $y = 3$. Which of the following equations correctly represents the relationship between x and y?

(a) $6x^2 = 3y^3$

(b) $3y^2 = 6x^3$

(c) $3x^2 = 2y^3$

(d) $3x^2 = 4y^3$

[Based on IMT Ghaziabad, 2002]

15. It is given that $y \propto \dfrac{1}{x^3 - x}$. For $x = 2$, value of y is $\dfrac{1}{6}$. If $x = 1$, then the value of y will be:

(a) 1

(b) 0

(c) −1

(d) None of these

[Based on IMT Ghaziabad, 2002]

16. Between two stations, the first, second and third class fares are in the ratio 9:7:2. The number of passengers travelling in a day are in the ratio 5:3:2, respectively, in the above classes. If the sale of tickets generated revenue of ₹98,000 that day and if 200 passengers travelled by third class, what was the fare for a first class ticket?

(a) ₹84

(b) ₹92

(c) ₹106

(d) ₹126

17. If $(x - y + z):(y - z + 2w):(2x + z - w) = 2:3:5$, find the value of S, where S is $(3x + 3z - 2w):w$. $z:w = 3:8$ and $u:w = 2:5$, find the value $(xyu):(w^2z)$.

(a) 7:1

(b) 6:1

(c) 13:2

(d) None of these

18. How many boys are studying Science?

(a) 52

(b) 65

(c) 115

(d) None of these

[Based on IRMA, 2002]

19. What is the ratio between the girls studying Arts & Science respectively?

(a) 13:23

(b) 26:79

(c) 8:13

(d) 23:36

[Based on IRMA, 2002]

20. The cost of a bat increased by 10 per cent and the cost of a ball increased by 18 per cent. Before the price rise, the ratio of the cost of the bat to the cost of the ball was 9:2. If the cost of 12 bats and 54 balls before the price rise was ₹C, what is their cost (in ₹) now?

(a) 1.12 C

(b) 1.13 C

(c) 1.14 C

(d) 1.15 C

21. Radhika purchased one dozen bangles. One day she slipped on the floor fell down. What cannot be the ratio of broken to unbroken bangles?

(a) 1:2

(b) 1:3

(c) 2:3

(d) 1:5

22. A precious stone worth ₹6,800 is accidently dropped and breaks into three pieces. The weight of three pieces are in the ratio 5:7:8. The value of the stone is proportional to the square of its weight. Find the loss.

(a) ₹4,260

(b) ₹4,273

(c) ₹4,454

(d) ₹3,250

23. A man spends ₹8,100 in buying tables at ₹1,200 each chairs at ₹300 each. The ratio of chairs to tables when the maximum number of tables is purchased is:

(a) 1:4

(b) 5:7

(c) 1:2

(d) 2:1

24. From a number of mangoes, a man sells half the number of existing mangoes plus 1 to the first customer, then sells one-third of the remaining number of mangoes plus 1 to the second customer, then one-fourth of the remaining number of mangoes plus 1 to the third customer and one-fifth of the remaining number of mangoes plus 1 to the fourth customer. He then finds that he does not have any mango left. How many mangoes did he have originally?

(a) 12

(b) 14

(c) 15

(d) 13

[Based on FMS (Delhi), 2002]

25. The ratio between the number of passengers travelling by I and II class between the two railway stations is 1:50, whereas the ratio of I and II class fares between the same stations is 3:1. If on a particular day, ₹1325 were collected from the passengers travelling between these stations, then what was the amount collected from the II class passengers?

(a) ₹750

(b) ₹850

(c) ₹1000

(d) ₹1250

[Based on I.P. Univ., 2002]

26. A sporting goods store ordered an equal number of white and yellow tennis balls. The tennis ball company delivered 45 extra white balls, making the ratio of white balls to yellow balls $\dfrac{1}{5}:\dfrac{1}{6}$. How may white tennis balls did the store originally order for?

(a) 450   (b) 270

(c) 225   (d) None of these

27. Determine the ratio of the number of people having characteristic X to the number of people having characteristic Y in a population of 100 subjects from the following table:

Having X and Y	10
Having X but not Y	30
Having Y but not X	20
Having neither X nor Y	40

(a) 4:3   (b) 3:2

(c) 1:2   (d) 2:3

[Based on REC Tiruchirapalli, 2002]

Directions (Questions 28 to 30): *Answer the questions based on the following information.*

Alphonso, on his death bed, keeps half his property for his wife and divides the rest equally among his three sons: Ben, Carl and Dave. Some years later, Ben dies leaving half his property to his widow and half to his brothers Carl and Dave together, sharing equally. When Carl makes his will, he keeps half his property for his widow and rest he bequeaths to his younger brother Dave. When Dave dies some years later, he keeps half his property for his widow and the remaining for his mother. The mother now has ₹15,75,000.

28. What was the worth of the total property?

(a) ₹30 lakhs   (b) ₹8 lakhs

(c) ₹18 lakhs   (d) ₹24 lakhs

29. What was Carl's original share?

(a) ₹4 lakhs   (b) ₹12 lakhs

(c) ₹6 lakhs   (d) ₹5 lakhs

30. What was the ratio of the property owned by the widows of the three sons in the end?

(a) 7:9:13   (b) 8:10:15

(c) 5:7:9   (d) 9:12:13

31. Fresh grapes contain 90 per cent water by weight while dried grapes contain 20 per cent water by weight. What is the weight of dry grapes contain 20 per cent water by weight. What is the weight of dry grapes available from 20 kg of fresh grapes?

(a) 2 kg   (b) 2.4 kg

(c) 2.5 kg   (d) None of these

32. One year ago, the ratio between A's and B's salary was 4:5. The ratio of their individual salaries of last year and present year are 3:5 and 2:3 respectively. If their total salaries for the present year is ₹680, the present salary of A is (₹):

(a) 4080.00   (b) 3200.00

(c) 4533.40   (d) 2720.00

[Based on ATMA, 2008]

33. In a certain company, the ratio of the number of managers to the number of production-line workers is 5 to 72. If 8 additional production-line workers were to be hired, the ratio of the number of managers to the production-line workers would be 5 to 74. How many managers does the company have?

(a) 10   (b) 20

(c) 30   (d) 25

[Based on ATMA, 2005]

34. In a cricket match, Team A scored 232 runs without losing a wicket. The score consisted of byes, wides and runs scored by two opening batsmen: Ram and Shyam. The runs scored by the two batsmen are 26 times wides. There are 8 more byes than wides. If the ratio of the runs scored by Ram and Shyam is 6:7, then the runs scored by Ram is:

(a) 88   (b) 96

(c) 102   (d) 112

[Based on XAT, 2008]

35. The number of students in three rooms is 138. The ratio of the number of students in 1st and the 2nd room is 3:4. The ratio of the number of students in 2nd and 3rd room is 7:5. The number of students in the 1st, 2nd and 3rd room respectively is:

(a) 56, 40, 42   (b) 42, 56, 40

(c) 40, 56, 42   (d) 56, 42, 40

[Based on IIFT, 2005]

36. Indiacate in which one of the following equations y is neither directly nor inversely proportional to x:

(a) $x + y = 0$ (b) $3xy = 10$

(c) $x = 5y$ (d) $3x + y = 10$

[Based on FMS, 2011]

37. Instead of walking along two adjacent sides of a rectangular field, a boy took a short-cut along the diagonal of the field and saved a distance equal to half of the longer side. The ratio of the shorter side of the rectangle to the longer side is:

(a) $\dfrac{1}{2}$ (b) $\dfrac{2}{3}$

(c) $\dfrac{1}{4}$ (d) $\dfrac{3}{4}$

[Based on FMS, 2011]

38. In counting n coloured balls, some red and some black, it was found that 49 of the first 50 counted were red. Thereafter, 7 out of every 8 counted were red. If, in all, 90 per cent or more of the balls counted were red, the maximum value of n is:

(a) 225   (b) 210

(c) 200   (d) 180

[Based on FMS, 2010]

39. The income distribution in the villages of Delhi is symmetrical. Two surveys estimated that the implementation of Gramin Rozgar Yozna of central government in a village of Delhi will increase the income of every villager either:

(i) by a certain proportion or

(ii) by ₹3650.

Will the symmetry of income distribution be affected?

(a) Change in income distribution in case of (i)

(b) Change in income distribution in case of (ii)

(c) Change in income distribution in both the cases (i) and (ii)

(d) No change in income distribution in both the cases (i) and (ii)

[Based on FMS, 2009]

40. Four milkmen rented a pasture. A grazed 18 cows for 4 months, B 25 cows for 2 months, C 28 cows for 5 months and D 21 cows for 3 months. If A's share of rent is ₹360, the total rent of the field (in rupees) is:

(a) 1500   (b) 1600

(c) 1625   (d) 1650

[Based on FMS, 2006]

41. What is the ratio whose terms differ by 40 and the measure of which is two-sevenths?

(a) 6:56   (b) 14:56

(c) 16:56   (d) 16:72

[Based on FMS, 2005]

42. $p \propto q, q \propto \dfrac{1}{s}, s \propto \dfrac{1}{r}.$

$p = 1$, when $q = 2, q = 3$; when $s = 4, s = 4$; when $r = 5$. Find r, when $p = 6$.

(a) 35   (b) 30

(c) 20   (d) 16

[Based on CAT, 2009]

43. In a T-shirt stiching factory, the approved pieces were 95% of the total production on Friday and the rejected pieces were 10% of the total production on Saturday. The overall rejection rate for the two days combined works out to be 8.33% What was the ratio of the production of Friday to the production of Saturday?

(a) 1:2   (b) 2:1

(c) 1:3   (d) 1:1.75

[Based on CAT, 2009]

44. Instead of walking along two adjacent sides of a rectangular field, a boy took a short cut along the diagonals and saved a distance equal to half the longer side. Then, the ratio of the shorter side to the longer side is:

(a) $\dfrac{1}{2}$ (b) $\dfrac{2}{3}$

(c) $\dfrac{1}{4}$ (d) $\dfrac{3}{4}$

[Based on CAT, 2002]

45. Mayank, Mirza, Little and Jaspal bought a motorbike for ₹60,000. Mayank paid one half of the sum of the amounts paid by the other boys, Mirza paid one third of the sum of the amounts paid by the other boys. How much did Jaspal has to pay?

(a) ₹15,000

(b) ₹13,000

(c) ₹17,000

(d) None of these

[Based on CAT, 2002]

46. A piece of string is 40 cm long. It is cut into three pieces. The longest piece is 3 times as long as the middle-sized and the shortest piece is 23 cm shorter than the longest piece. Find the length of the shortest piece (in cm).

(a) 27   (b) 5

(c) 4   (d) 9

[Based on CAT, 2002]

47. You can collect rubies and emeralds as many as you can. Each ruby is of ₹4 crore and emerald is of ₹5 crore. Each ruby weighs 0.3 kg and emerald weighs 0.4 kg. Your bag can carry at the most 12 kg. What you should collect to get the maximum wealth?

(a) 20 rubies and emeralds

(b) 40 rubies

(c) 28 rubies and 9 emeralds

(d) None of these

[Based on CAT, 1998]

48. I have one rupee coins, fifty paise coins and twenty five paise coins. The number of coins is in the ratio 2:5:3:4. If the total amount with me is Rs 210, find the number of one rupee coins.

(a) 90   (b) 85

(c) 100   (d) 105

[Based on CAT, 1998]

49. The cost of diamond varies directly as the square of its weight. Once, this diamond broke into four pieces with weights in the ratio 1:2:3:4. When the pieces were sold, the merchant got ₹70,000 less. Find the original price of the diamond.

(a) ₹1.4 lakhs

(b) ₹2 lakhs

(c) ₹1 lakh

(d) ₹2.1 lakhs

[Based on CAT, 1996]

50. Two oranges, three bananas and four apples cost ₹15. Three oranges, two bananas and one apple cost ₹10. I bought 3 oranges, 3 bananas and 3 apples. How much did I pay?

(*a*) ₹10

(*b*) ₹8

(*c*) ₹15

(*d*) Cannot be determined

[Based on CAT, 1993]

51. From each of two given numbers, half the smaller number is subtracted. Of the resulting numbers, the larger one is three times as large as the smaller. What is the ratio of the two numbers?

(*a*) 2:1

(*b*) 3:1

(*c*) 3:2

(*d*) None of these

[Based on CAT, 1993]

52. Four numbers are in proportion .The sum of the squares of the four numbers is 50 and the sum of the mean is 5. The ratio of first two terms is 1:3. What is the average of the four numbers?

(*a*) 1

(*b*) 3

(*c*) 5

(*d*) 6

[Based on MAT, 2012]

53. A and B quote for a tender. On the tender opening day, A realizes that their quotes are in the ratio 7:4 and hence decreases its price during negotiations to make it ₹1 lakh lower than B's quoted price. B then realizes that the final quotes of the two were in the ratio 3:4. What was the price at which B won the bid?

(*a*) ₹7 lakhs

(*b*) ₹4 akhs

(*c*) ₹3 lakhs

(*d*) ₹1 lakh

[Based on MAT, 2013]

Answer Keys

DIFFICULTY LEVEL-1

1. (*d*)	**2.** (*d*)	**3.** (*c*)	**4.** (*d*)	**5.** (*c*)	**6.** (*b*)	**7.** (*d*)	**8.** (*d*)	**9.** (*a*)	**10.** (*c*)	**11.** (*a*)	**12.** (*c*)	**13.** (*d*)
14. (*b*)	**15.** (*a*)	**16.** (*c*)	**17.** (*c*)	**18.** (*c*)	**19.** (*c*)	**20.** (*b*)	**21.** (*a*)	**22.** (*a*)	**23.** (*c*)	**24.** (*d*)	**25.** (*d*)	**26.** (*c*)
27. (*c*)	**28.** (*d*)	**29.** (*c*)	**30.** (*c*)	**31.** (*d*)	**32.** (*b*)	**33.** (*c*)	**34.** (*c*)	**35.** (*a*)	**36.** (*d*)	**37.** (*a*)	**38.** (*c*)	**39.** (*b*)
40. (*b*)	**41.** (*c*)	**42.** (*c*)	**43.** (*b*)	**44.** (*b*)	**45.** (*b*)	**46.** (*a*)	**47.** (*c*)	**48.** (*b*)	**49.** (*a*)	**50.** (*c*)	**51.** (*b*)	**52.** (*d*)
53. (*a*)	**54.** (*a*)	**55.** (*d*)	**56.** (*c*)	**57.** (*d*)	**58.** (*b*)	**59.** (*b*)	**60.** (*b*)	**61.** (*b*)	**62.** (*d*)	**63.** (*a*)	**64.** (*d*)	**65.** (*a*)
66. (*c*)	**67.** (*c*)	**68.** (*c*)	**69.** (*a*)	**70.** (*b*)	**71.** (*c*)	**72.** (*a*)	**73.** (*b*)	**74.** (*d*)	**75.** (*a*)	**76.** (*c*)	**77.** (*c*)	**78.** (*c*)
79. (*b*)	**80.** (*c*)	**81.** (*a*)	**82.** (*a*)	**83.** (*d*)	**84.** (*d*)	**85.** (*b*)	**86.** (*c*)	**87.** (*a*)				

DIFFICULTY LEVEL-2

1. (*d*)	**2.** (*b*)	**3.** (*b*)	**4.** (*d*)	**5.** (*a*)	**6.** (*b*)	**7.** (*c*)	**8.** (*a*)	**9.** (*d*)	**10.** (*d*)	**11.** (*c*)	**12.** (*d*)	**13.** (*a*)
14. (*d*)	**15.** (*d*)	**16.** (*d*)	**17.** (*a*)	**18.** (*d*)	**19.** (*a*)	**20.** (*c*)	**21.** (*c*)	**22.** (*c*)	**23.** (*c*)	**24.** (*b*)	**25.** (*d*)	**26.** (*c*)
27. (*a*)	**28.** (*d*)	**29.** (*a*)	**30.** (*b*)	**31.** (*c*)	**32.** (*b*)	**33.** (*b*)	**34.** (*b*)	**35.** (*b*)	**36.** (*d*)	**37.** (*d*)	**38.** (*b*)	**39.** (*b*)
40. (*c*)	**41.** (*c*)	**42.** (*c*)	**43.** (*a*)	**44.** (*d*)	**45.** (*b*)	**46.** (*c*)	**47.** (*b*)	**48.** (*d*)	**49.** (*c*)	**50.** (*c*)	**51.** (*a*)	**52.** (*b*)
53. (*d*)												

Explanatory Answers

DIFFICULTY LEVEL-1

1. (*d*) Radii of the two pipes are 1 cm and 2 cm.

Squares of the radii of the two pipes are 1 cm and 4 cm.

∴ Rates of flow of the two pipes are in the ratio

$$1:\frac{1}{4}, \text{ i.e., } 4:1.$$

2. (*d*) Number of girls = 100

∴ Number of boys = 300

∴ Number of hostel dwellers = 50 + 100 = 150

⇒ Required ratio = 150:400

$$= 3:8 = \frac{3}{8}.$$

3. (*c*) Total number of boys in the class = 24

Total number of girls in the class = 12

Total strength of the class = 36.

4. (*d*) The box to paper ratio is 3:22. To arrives the weight of the box, we first divide 36000 by 25 to get 1440. Multiplying this by 3 we get 4320 which is the weight of the box. Therefore, weight of the paper is

36000 – 4320 = 31,680 kg.

5. (*c*) Given, $4A = 5B = 7C$

$$\Rightarrow \quad \frac{A}{35} = \frac{B}{28} = \frac{C}{20}$$

So, $A:B: = 35:28:20$

$$\therefore \quad A\text{'s Runs} = \frac{35}{(35+28+20)} \times 581 = 245$$

and, C's runs $= \dfrac{20}{83} \times 581 = 140$

Thus, difference between A's score and B's score

$$= (245 - 140) = 105.$$

6. (*b*) Suppose the amount in the beginning was ₹x

Money spent on clothes $= ₹\dfrac{1}{3}x$

Balance $= ₹\dfrac{2}{3}x$

Money spent on food $= \dfrac{1}{5}$ of $\dfrac{2}{3}x = ₹\dfrac{2}{15}x$

Balance $= \dfrac{2}{3}x - \dfrac{2}{15}x = ₹\dfrac{8x}{15}$

Money spent on travel $= \dfrac{1}{4}$ of $\dfrac{8x}{15} = ₹\dfrac{2x}{15}$

$$= \frac{8x}{15} - \frac{2x}{15}$$

$$= \frac{6x}{15} = ₹\frac{2x}{5}$$

$$\therefore \qquad \frac{2x}{5} = 100$$

$$\Rightarrow \qquad x = 250.$$

7. (*d*) After first day, $\dfrac{2}{3}$ rd of the contents remain.

After second day, $\dfrac{2}{3} - \dfrac{3}{4}\left(\dfrac{2}{3}\right) = \dfrac{2}{3} - \dfrac{1}{2} = \dfrac{1}{6}$ of the contents remain.

8. (*d*) Let the incomes of the two persons be 4I and 5I respectively.

Let the expenditure of the two persons be 7E and 9E respectively.

∴ $4I - 7E = 50$ and $5I - 9E = 50$

⇒ $20I - 35E = 250$

$20I - 36E = 200$

⇒ $E = 50$ and $I = 100$

∴ Monthly incomes of the two persons are ₹400 and ₹500 respectively.

9. (*a*) Let, initially, the number of males and females in the bus be $3x$ and x respectively.

At the first stop, suppose m males and f females left the bus.

∴ At the first stop: No. of the Males is $3x - m$

and No. of females

$$(x - f) + 6$$

$$\therefore \quad \frac{3x - m}{(x - f) + 6} = \frac{2}{1}$$

$$\Rightarrow \qquad 3x - m = 2x - 2f + 12$$

Also $m + f = 16$

$$\Rightarrow \qquad x = 28 - 3f$$

$$\therefore \qquad f = 4, x = 16$$

∴ Total number of passengers in the beginning

$$= 4x = 64$$

For no other value of f any of the other alternatives holds good.

10. (*c*) Let number of boys = x

Let number of girls = y

$$\therefore \qquad \frac{x}{y} = B \text{ and } \frac{y}{x} = G$$

$$\therefore \quad 3(B + G) = 3\left[\frac{x}{y} + \frac{y}{x}\right]$$

$$= \frac{3(x^2 + y^2)}{xy} > 3.$$

11. (a)
$$\frac{a}{b} = \frac{2}{5}$$

$$\frac{2a+3b}{7a+5b} = \frac{2\dfrac{a}{b}+3}{7\dfrac{a}{b}+5}$$

$$= \frac{\dfrac{4}{5}+3}{\dfrac{14}{5}+5} = \frac{19}{39}.$$

12. (c) Let the two numbers be $6K$ and $13K$.

L.C.M. of $6K$ and $13K = 78K$

$$\therefore \qquad 78K = 312$$
$$\Rightarrow \qquad K = 4$$

$\therefore$ Sum of the numbers
$$= 6K + 13K = 19K = 76.$$

13. (d) Since the ratio is 20:1, the number of boys can be 20, 40, 60, ... and number of girls can be 1, 2, 3, ...

Thus, as the number of students is not known, we cannot say for sure the number of girls to be required. Hence, data is insufficient.

14. (b) Let x and y be the two numbers

$$\therefore \qquad \frac{x}{y} = \frac{2}{3}, \frac{x+8}{y+8} = \frac{3}{4}$$
$$\Rightarrow \qquad x = 16, y = 24.$$

15. (a)
$$A = \frac{2}{9}(B+C)$$
$$A+B+C = 770$$
$$\Rightarrow \quad A + \frac{9A}{2} = 770$$
$$\Rightarrow \qquad 11A = 770 \times 2$$
$$\Rightarrow \qquad A = 140.$$

16. (c)
$$\frac{14-x}{17-x} = \frac{34-x}{42-x}$$
$$\Rightarrow 588 - 56x + x^2 = 578 - 51x + x^2$$
$$\Rightarrow \qquad x = 2.$$

17. (c) If X be the required number, then

$$\sqrt{(45 \times X)} = 3 \times \sqrt{(5 \times 22)}$$

or, $\qquad 45X = 9 \times 110$ or, $X = 22.$

18. (c) If A and B are mean & third proportional, then

$$X/A = A/Y$$

or, $\qquad A = \sqrt{(XY)}$ and $X/Y = Y/B$

or, $\qquad B = Y^2/X$

Now $\sqrt{(XY)} = n \times Y^2/X$

or, $\qquad (X/Y)^{3/2} = n/1$

or, $\qquad X/Y = n^{2/3}:1.$

19. (c) Let, $\qquad X = K/(Y^2-1)$

Now, $\qquad 24 = K/(100-1)$

or, $\qquad K = 24 \times 99. \ X = K/(Y^2-1)$

When, $\qquad Y = 5, X = 24 \times 99/(25-1) = 99.$

20. (b) Let the number be x

$$\therefore \ \text{Required ratio} = \frac{x}{x+\dfrac{1}{5}x} = \frac{x}{\dfrac{6x}{5}} = \frac{5}{6}.$$

21. (a) Man's age $= 4k$, say

Wife's age $= 3k$, say

$$\therefore \qquad \frac{4k+4}{3k+4} = \frac{9}{7} \Rightarrow k = 8.$$

$\therefore$ Man's age $= 32$ years

Wife's age $= 24$ years

Suppose they were married x years ago.

$$\therefore \qquad \frac{32-x}{24-x} = \frac{5}{3} \Rightarrow x = 12.$$

22. (a) Let X's income be $3k$ then Y's income is $4k$. Let, X's expenditure be $4g$ then Y's expenditure is $5g$.

But $3k = 9/10 \ (5g)$ or, $k = 3/2g$

$\Rightarrow X$'s saving/Y's saving $= (3k-4g)/(4k-5g)$

$$\Rightarrow \qquad \frac{3(3/2g)-4g}{4(3/2g)-5g} = \frac{1}{2}$$
$$\Rightarrow \qquad X\text{'s saving}:Y\text{'s saving} = 1:2.$$

23. (c) Given $x:y = 1:2$, therefore $y = 2x$

Similarly, $z = 3y = 6x$ and $w = \left(\dfrac{8}{3}\right)z = 16x$

and, $x = \left(\dfrac{2}{5}\right)w = \left(\dfrac{32}{5}\right)x$

Therefore, $\left(\dfrac{xyu}{w^2 z}\right) = \dfrac{1}{120}.$

24. (d)
$$50T + 40C = 500$$
$$T + C = 12$$
$$\Rightarrow \qquad C = 10, T = 2$$

$\therefore$ Ratio of the number of chairs and tables $= 5:1.$

25. (d)
$$x \propto 3y+1$$
$$\Rightarrow \qquad x = K(3y+1)$$

Put $x = 9, y = 1$,

we get, $\qquad K = \dfrac{9}{4}$

$$\therefore \qquad x = \frac{9}{4}(3y+1)$$

$\therefore$ When, $y = 5, x = 36.$

26. (c) $\dfrac{x}{y} = \dfrac{1}{2}$, $\dfrac{x+7}{y+7} = \dfrac{3}{5}$

$\Rightarrow \qquad x = 14, y = 28.$

27. (c) $\dfrac{AC}{W} = \dfrac{3}{2}$

$\qquad\qquad W = AC - 6000$

$\Rightarrow \qquad W = \dfrac{3W}{2} - 6000$

$\Rightarrow \qquad 2W = 3W - 12000$

$\Rightarrow \qquad W = 12000.$

28. (d) 2 leaps of the dog = 5 leaps of the hare, or 1 leap of the dog = 2.5 leaps of hare

$\therefore$ 6 leaps of dog = 15 leaps of hare. Hence, ratio of leaps of dog to hare = 15:4.

29. (c) $1:10 \Rightarrow$ There are atleast 11 marbles in the jar.

30. (c) When there are eight people, the share of each person is $\dfrac{1}{8}$ of the total cost.

When there are seven people, the share of each person is $\dfrac{1}{7}$ of the total cost.

$\therefore$ Increase in the share of each person

$= \dfrac{1}{7} - \dfrac{1}{8} = \dfrac{1}{56}$, i.e., $\dfrac{1}{7}$ of $\dfrac{1}{8}$, i.e., $\dfrac{1}{7}$

of the original share of each person.

31. (d) Suppose total votes $= x$

To win a candidate required $= \dfrac{3}{4} \times x = \dfrac{3}{4}x$

When $\dfrac{2}{3} \times x = \dfrac{2}{3}x$ votes were counted, a candidate has

$\qquad \dfrac{5}{6} \times \dfrac{3}{4}x = \dfrac{5}{8}x$

So now he needed

$\qquad \dfrac{3}{4}x - \dfrac{5}{8}x = \dfrac{6x - 5x}{8} = \dfrac{x}{8}$

Votes out of remaining

$\qquad x - \dfrac{2}{3}x = \dfrac{x}{3}$

$\therefore$ required ratio $= \dfrac{x}{8} \times \dfrac{3}{x} = \dfrac{3}{8}.$

32. (b) 30% of I + II = II $\times \dfrac{120}{100}$

or, $\quad \dfrac{3}{10}$ I + II $= \dfrac{12}{10}$ II

or, $\quad \dfrac{3}{10}$ I $= \dfrac{2}{10}$ II

$\Rightarrow \qquad$ I:II = 2:3.

33. (c) It cannot be determined because the total money to be distributed is not given.

34. (c) Suppose 18 kg each is melted. Ratio of gold and copper in one alloy will be 14:4 and in another 7 : 11.

$\therefore$ Ratio of gold and copper in the new alloys
$C = 14 + 7:4 + 11 = 21:15 = 7:5.$

35. (a) Total amount of A and C

$\qquad = \dfrac{2580}{(7-3)} \times (3+9)$

$\qquad = \dfrac{2580}{4} \times 12 = 27540.$

36. (d) We do not know the average price of two flours.

37. (a) Let the value of x, y and z be $2k$, $3k$ and $5k$ respectively.

Sum of x, y and z will be

$\qquad 2k + 3k + 5k = 100$

$\qquad\qquad 10k = 100$

$\Rightarrow \qquad\qquad k = 10$

So, the numbers are 20, 30 and 50.

$\qquad\qquad y = ax - 10$

$\Rightarrow \qquad 30 = a \times 10 - 10$

$\Rightarrow \qquad 10a = 20$

$\qquad\qquad a = 2.$

38. (c) X varies as the cube of Y and Y varies as the fifth root of Z.

$\qquad X \propto Y^3$ and $Y \propto Z^{1/5}$

$\qquad X = K_1 Y^3$ and $Y = K_2 Z^{1/5}$

$\qquad X = K_1 (K_2 Z^{1/5})^3$

$\Rightarrow \qquad X = K_1 (K_2)^3 Z^{3/5}$

$\qquad X = K_3 Z^{3/5}$

As X varies as the nth power of Z, so, $n = \dfrac{3}{5}.$

39. (b) Steps for 1st person $= \left[\dfrac{2}{3} \times \dfrac{120}{1 + \dfrac{2}{3}} \right]$

$$= 120 \times \dfrac{3}{5} \times \dfrac{2}{3} = 48$$

Steps for 2nd person

$$= \dfrac{3}{5} \times \dfrac{120}{1 + \dfrac{3}{5}}$$

$$= \dfrac{3}{5} \times 120 \times \dfrac{5}{8} = 45$$

$\therefore$ Total steps taken together $= 48 + 45 = 93$.

40. (b) Let salary of the driver be ₹k. Therefore, income from tips $= ₹\dfrac{5}{4}k$

Therefore, total income $= k + \dfrac{5}{4}k = \dfrac{9}{4}k$

$\Rightarrow \qquad \dfrac{5}{9}$ of $\dfrac{9k}{4} = \dfrac{5k}{4}$

$\Rightarrow \dfrac{5}{9}$ of total income = Income from tips.

41. (c) Let x pairs of brown socks were ordered.

Let p be the price of a brown pair.

$\therefore$ $2p$ is the price of a black pair.

$\therefore$ $(2p \times 4 + px) + 50\%$ of $(2p \times 4 + px)$

$$= 2p \times x + 4p$$

$\Rightarrow \qquad x = 16$

$\therefore$ Required ratio = 1:4.

42. (c) $P \propto QR$, $P = 6$, $Q = 9$, $R = 10$.

$\Rightarrow \qquad P = KQR$,

where K is the constant of proportionality

$\Rightarrow \qquad 6 = K \times 9 \times 10$

$\Rightarrow \qquad K = \dfrac{1}{15}$

$\Rightarrow \qquad 15P = QR$

When $Q = 5$ and $R = 3$, then $P = 1$.

43. (b) Let the numbers be x and y.

$\therefore \qquad \dfrac{x}{y} = \dfrac{3}{4} \Rightarrow \dfrac{x}{3} = \dfrac{y}{4} = K$, say

$\therefore \qquad x = 3K, y = 4K$.

Also $\qquad y^2 = 8x^2 - 224$

$\Rightarrow \qquad 16K^2 = 72K^2 - 224$

$\Rightarrow \qquad K = 2$

Therefore, the numbers are 6 and 8.

44. (b) $\qquad \dfrac{x}{1} = \dfrac{y}{3} = \dfrac{z}{5} = k$, say

$\therefore \qquad x = k, y = 3k, z = 5k$

$\therefore \dfrac{\sqrt{x^2 + 7y^2 + 9z^2}}{x} = \dfrac{\sqrt{k^2 + 7 \times 9k^2 + 9 \times 25k^2}}{k}$

$$= \sqrt{289} = 17 .$$

45. (b) Suppose A, B and C get ₹$3K$, ₹K and ₹$5K$, respectively.

$\therefore \qquad 5K - K = 3600$

$\Rightarrow \qquad K = 900$

$\therefore$ A's share = ₹2,700

B's share = ₹900

C's share = ₹4,500

$\therefore$ Required total = ₹3,600.

46. (a) Let the price of the two houses A and B be $4k$ and $5k$, respectively.

According to the question,

$$\dfrac{4k + 25\% \text{ of } 4k}{50000} = \dfrac{9}{10}$$

$\Rightarrow \qquad \dfrac{5k}{5k + 50000} = \dfrac{9}{10}$

$\Rightarrow \qquad k = 90000$

$\therefore \qquad$ Price of house A = ₹360000.

47. (c) Let the number be $5k$ and $4k$.

$\therefore \quad 5k - 4k = 10$

$\Rightarrow \qquad k = 10$

$\Rightarrow$ Largest number = 50.

48. (b) Suppose the share of C = ₹100

$\therefore$ Share of B = ₹$100 \times \dfrac{100 + 20}{120}$

$$= ₹100 \times \dfrac{120}{100} = ₹120$$

Share of A = ₹$120 \times \dfrac{100 + 25}{100}$

$$₹120 \times \dfrac{125}{100} = ₹150$$

$\therefore$ Ratio of shares of A, B, C = 150:120:100

$$= 15:12:10$$

Sum of ratios = $15 + 12 + 10 = 37$

Total amount = ₹7400

Hence, share of $C = ₹ \dfrac{7400}{37} \times 10 = ₹2000$.

49. (*a*) Percentage of A's expenditure

$$= \frac{18}{40} \times 100 = 45\%$$

Percentage of B's expenditure

$$= \frac{21}{50} \times 100 = 42\%$$

Percentage of C's expenditure

$$= \frac{24}{60} \times 100 = 40\%$$

Percentage of D's expenditure

$$= \frac{27}{70} \times 100 = 38\frac{4}{7}\%$$

Hence, A's expenditure is the highest.

50. (*c*) Suppose that the basic salaries of A and B be x and y respectively.

$\therefore$ $x + 65\%$ of $x = y + 80\%$ of y

$\Rightarrow x + \dfrac{65}{100}x = y + \dfrac{80}{100}y$

$\Rightarrow 165\,x = 180\,y$

$\Rightarrow \dfrac{x}{y} = \dfrac{180}{165} = \dfrac{12}{11}$.

51. (*b*) Suppose the wages of each man = ₹5K and wages of each woman = ₹4K

Number of men = $\dfrac{2}{5} \times 25 = 10$

Number of women = $\dfrac{3}{5} \times 25 = 15$

Now ₹220 are to be divided among 10 men and 15 women.

$\therefore$ $10 \times 5K + 15 \times 4K = 220$

$\Rightarrow 110K = 220$

$\Rightarrow K = 2$.

52. (*d*) New ratio of fares (1st, 2nd and 3rd)

$$= 8 \times \frac{5}{6} : 6 \times \frac{11}{12} : 3 \times 1$$

$$= 80:66:36 = 40:33:18$$

Ratio of passengers = 9:12: 26

$\Rightarrow$ Ratio of amount collected

$$= 40 \times 9 : 12 \times 33 : 26 \times 18$$

$$= 90:99:117$$

Amount collected from 1st class fares

$$= \frac{90}{306} \times 1088$$

$$= ₹320.$$

53. (*a*) Ajay:Aman = 8:15

Aman:Suman = 5:8

Suman:Geeta = 4:5

$\therefore$ Ajay:Aman:Suman:Geeta

$$= 8:15:24:30$$

$\therefore$ Part of rent paid by Suman

$$= \frac{24}{8 + 15 + 24 + 30} = \frac{24}{77}.$$

54. (*a*) Let expenditure be ₹60 and savings be ₹40.

Total income = ₹100

New income = ₹110

New expenditure = ₹67.2

New savings = $110 - 67.2 = ₹42.8$

$\therefore$ Percentage increase in savings

$$= \frac{2.8}{40} \times 100 = 7\%$$

55. (*d*) Let the number of passengers travelling by Class I and Class II be x and 50 x respectively.

Then, amount collected from Class I and Class II will be ₹$3x$ and ₹$50x$ respectively.

Given, $3x + 50x = 1325$

$\Rightarrow 53x = 1325$

$\Rightarrow x = 25$

$\therefore$ Amount collected from Class II = $50 \times 25 = ₹1250$.

56. (*c*) Let x should be subtracted from each number.

Then, $\dfrac{15 - x}{28 - x} = \dfrac{20 - x}{38 - x}$

$\Rightarrow 570 - 38x - 15x + x^2 = 560 - 28x - 20x + x^2$

$\Rightarrow 570 - 53x = -48x + 560$

$\Rightarrow x = 2$.

57. (*d*) As the sum of money that are to be divided among A, B and C and between E and F are not given. So, the amount that B receive cannot be determined.

58. (*b*) Let that number be x.

Then, $\dfrac{8+x}{21+x} = \dfrac{13+x}{31+x}$

$\Rightarrow 248 + 31x + 8x + x^2$

$\qquad = 273 + 21x + 13x + x^2$

$\Rightarrow \qquad 5x = 25$

$\Rightarrow \qquad x = 5.$

59. (*b*) Since, the total number of men employed is 50, then women and children are employed 100 and 150 respectively.

Let the men, women and children wages are $6x$, $3x$ and $2x$ respectively.

$\therefore \ 50 \times 6x + 100 \times 3x + 150 \times 2x = 4500$

$\Rightarrow \qquad\qquad 900x = 4500$

$\Rightarrow \qquad\qquad x = 5$

$\therefore$ Per day wages of men, women and children are ₹30, ₹15 and ₹10.

$\therefore$ Weekly wages of men, women and children are ₹210, ₹105 and ₹70.

60. (*b*) Let the present and last year salary of Mahesh's and Suresh's be x, x' and y, y' respectively.

According to the given condition,

$$\frac{x'}{y'} = \frac{3}{5}, \frac{x'}{x} = \frac{2}{3}$$

and, $\qquad \dfrac{y'}{y} = \dfrac{4}{5}$

$\therefore \qquad \dfrac{x'/x}{y'/y} = \dfrac{2/3}{4/5}$

$\Rightarrow \quad \dfrac{x'}{y'} \times \dfrac{y}{x} = \dfrac{10}{12} \Rightarrow \dfrac{3}{5} \times \dfrac{y}{x} = \dfrac{10}{12}$

$\Rightarrow \qquad \dfrac{y}{x} = \dfrac{50}{36}$

Also, $\quad x + y = 43000$

$\Rightarrow \quad x + \dfrac{50}{36}x = 43000$

$\Rightarrow \qquad x = \dfrac{43000 \times 36}{86} = ₹18000.$

61. (*b*) The sale of second class ticket

$$= \frac{8 \times 4}{30 + 32 + 30} \times 8050 = \frac{32}{92} \times 8050 = ₹2800.$$

62. (*d*) $\dfrac{1}{3} : \dfrac{1}{4} : \dfrac{1}{5} : \dfrac{1}{6} = 20 : 15 : 12 : 10$

So, the minimum number of pens that the person should have $= 20 + 15 + 12 + 10 = 57$.

63. (*a*) Let number of male and female participants at the start of seminar be $3x$ and x, respectively.

Then, $\dfrac{3x - 16}{x + 6} = \dfrac{2}{1}$

$\Rightarrow \qquad 3x - 16 = 2x + 12$

$\Rightarrow \qquad x = 28$

$\therefore$ Total number of participants at the start of seminar
$$= 3x + x = 4 \times 28 = 112.$$

64. (*d*) If the original cost of article is ₹6.

Then, original raw material cost $= ₹2$

New cost of raw material $= 2 \times \dfrac{12}{5} = ₹4.80$

Original manufacturing expenses $= (6 - 2) = ₹4$

New manufacturing expenses $= 4 \times \dfrac{5}{4} = ₹5$

$\therefore$ New cost of article $= 4.80 + 5 = ₹9.80$.

65. (*a*) Let their ages be x and y.

$\therefore \qquad \dfrac{1}{x} + \dfrac{1}{y} = 5\left(\dfrac{1}{x} - \dfrac{1}{y}\right)$

$\Rightarrow \qquad y + x = 5(y - x)$

$\Rightarrow \qquad 6x = 4y$

$\Rightarrow \qquad \dfrac{x}{y} = \dfrac{2}{3} \qquad\qquad (1)$

Now, $\quad \dfrac{xy}{x+y} = \dfrac{14.4}{1}$

$\Rightarrow \qquad xy = 14.4(x + y) \qquad (2)$

From Eqs. (1) and (2),

$\qquad x = 24$ year and $y = 36$ year.

66. (*c*) Let three numbers A, B and C are $12x$, $15x$ and $25x$ respectively.

$\therefore \ 12x + 15x + 25x = 312$

$\Rightarrow \qquad x = \dfrac{312}{52} = 6$

$\therefore$ Required ratio $= \dfrac{15 \times 6 - 12 \times 6}{25 \times 6 - 15 \times 6}$

$\qquad\qquad = \dfrac{3 \times 6}{10 \times 6} = \dfrac{3}{10}$

Short-cut method

There is no need to calculate the value of x.

Required ratio $= \dfrac{15x - 12x}{25x - 15x}$

$\qquad\qquad = \dfrac{3x}{10x} = \dfrac{3}{10}$.

67. (c) Let the man left ₹x.

∴ Share of daughter $= x - \dfrac{x}{2} - \dfrac{x}{3}$

$\Rightarrow \quad 45000 = \dfrac{x}{6}$

$\Rightarrow \quad x = ₹270000.$

68. (c) Let he purchase x pairs of brown socks.

Price of black socks and brown socks be ₹$2a$ and ₹a per pair respectively.

∴ $\quad \dfrac{3}{2}(4 \times 2a + x \times a) = x \times 2a + 4 \times a$

$\Rightarrow \quad 12a + \dfrac{3}{2}xa = 2xa + 4a$

$\Rightarrow \quad 12 + \dfrac{3}{2}x = 2x + 4$

$\Rightarrow \quad \dfrac{x}{2} = 8$

$\Rightarrow \quad x = 16$

∴ Required ratio $= \dfrac{4}{16} = \dfrac{1}{4}.$

69. (a) $\quad 1105 = 11x + 10 + 18x + 20 + 24x + 15$

$\Rightarrow \quad 1105 = 53x + 45$

$\Rightarrow \quad x = 20$

∴ Amount with Champa $= 24x + 15$

$= 24 \times 20 + 15 = ₹495.$

70. (b) Lat salaries of A, B and C be x, y and $(1450 - x - y)$, respectively.

Then, we have

40% of x:35% of y:30% of $(1450 - x - y) = 14:21:15$

Taking first two terms of the above ratio, we get

$\dfrac{40x}{35y} = \dfrac{14}{21}$

$\Rightarrow \quad x = \dfrac{7}{12}y$

Now, taking last two ratio, we get

$\dfrac{35y}{30(1450 - x - y)} = \dfrac{21}{15}$

$\Rightarrow \quad \dfrac{7y}{6(1450 - x - y)} = \dfrac{7}{5}$

$\Rightarrow \quad 5y = 8700 - 6x - 6y$

$\Rightarrow \quad 11y + 6 \times \dfrac{7}{12}y = 8700$

$\Rightarrow \quad \dfrac{29}{2}y = 8700$

$\Rightarrow \quad y = ₹600$

Hence, salary of B is ₹600.

71. (c) Let the number of persons be x

Originally, each person gets ₹$\dfrac{9000}{x}$

In the second condition, each person gets $= ₹\dfrac{9000}{x + 20}$

We are given,

$\dfrac{9000}{x} - \dfrac{9000}{x + 20} = 160$

$\Rightarrow \quad 225(x + 20 - x) = 4(x)(x + 20)$

$\Rightarrow \quad x(x + 20) = 5 \times 225 = 45 \times 25$

$\Rightarrow \quad x = 25.$

72. (a) We are given,

$\dfrac{1}{2}A = \dfrac{2}{3}B = \dfrac{3}{4}C = \dfrac{4}{5}D$

$\Rightarrow \quad \dfrac{A}{2} = \dfrac{4D}{5}$

$\Rightarrow \quad \dfrac{A}{D} = \dfrac{8}{5}$

$\Rightarrow \quad A:D = 8:5.$

73. (b) Let the quotes of A and B be $7X$ and $4X$, respectively. After decreasing, quotes of $A = 4X - 1.$

Then, we are given,

$\dfrac{4X - 1}{4X} = \dfrac{3}{4}$

$\Rightarrow \quad 4X - 1 = 3X$

$\Rightarrow \quad X = 1$

Then, decrement by $A = 7X - (4X - 1)$

$= 3x + 1 = 3 + 1$

$= ₹4 \text{ lakhs.}$

74. (d) Let earnings of A and B be $4x$ and $7x$ respectively.

Then, we are given,

$\dfrac{4x + 50\% \text{ of } 4x}{7x - 25\% \text{ of } 7x} = \dfrac{8}{7}$

$\Rightarrow \dfrac{6x}{\dfrac{21x}{4}} = \dfrac{8}{7} \quad \Rightarrow \quad \dfrac{24x}{21x} = \dfrac{8}{7}$

From this equation, we cannot find the value of x. Hence, data is inadequate.

75. (a) Let the two numbers be x and y respectively.

Then, $\dfrac{1}{4}$ of 60% of $x = \dfrac{2}{5}$ of 20% of y

$\Rightarrow \dfrac{1}{4} \times \dfrac{60}{100} \times x = \dfrac{2}{5} \times \dfrac{20}{100} \times y$

$\Rightarrow \dfrac{6}{4}x = \dfrac{4}{5}y \quad \Rightarrow \quad \dfrac{x}{y} = \dfrac{16}{30} = \dfrac{18}{15}$

$\Rightarrow \quad x:y = 8:15.$

76. (c) Given, $B = C + 8$

and, $A = B + 7 = C + 15$

and, $A + B + C = 53$

$C + 15 + C + 8 + C = 53$

$3C = 59 - 23$

$3C = 30$

$\Rightarrow C = 10$

$\therefore B = C + 8 = 10 + 8 = 18$

and $A = C + 15 = 10 + 15 = 25$

Hence, required ratio $A{:}B{:}C = 25{:}18{:}10$.

77. (c) Efficiency $\propto \dfrac{1}{\text{Time taken}}$

Now, efficiency of A and C = $5x$ and $3x$.

As A takes 6 days less, therefore

$\dfrac{1}{3x} - \dfrac{1}{5x} = 6$

$\Rightarrow \dfrac{5-3}{15x} = 6 \Rightarrow \dfrac{1}{x} = \dfrac{15 \times 6}{2} \Rightarrow \dfrac{1}{x} = 45$

$\therefore$ Time taken by A $= \dfrac{1}{5x} = \dfrac{45}{5} = 9$ days

and time taken by B $= \dfrac{1}{3x} = \dfrac{45}{3} = 15$ days

Ratio of number of days taken by B and C = 2:3

$\therefore$ Time taken by B $= \dfrac{2}{5} \times 15 = 10$ days

Now, B and C's one day work when worked together

$= \dfrac{1}{10} + \dfrac{1}{15} = \dfrac{3+2}{30} = \dfrac{5}{30} = \dfrac{1}{6}$

Two days work of B and C $= 2 \times \dfrac{1}{6} = \dfrac{1}{3}$

Remaining work $= 1 - \dfrac{1}{3} = \dfrac{2}{3}$

$\therefore$ Number of days taken by A to finish the work

$= \dfrac{2}{3} \times 9 = 6$ days.

78. (c) Student studies for 9 hrs from 11 am to 8 pm on Monday to Friday.

Also, he studies 1/3rd of the time on Sunday, i.e.,

$\dfrac{1}{3} \times 9 = 3$ h

Total hours, he studied during the week

$= 5 \times 9 + 3 = 45 + 3 = 48$ h

Total hours, in a week $= 24 \times 7 = 168$

$\therefore$ Required fraction

$= \dfrac{48}{168} = \dfrac{2}{7}$.

79. (b) Suppose required ratio be $K{:}1$

Then, $3x + K : 4x + 1 : 5x = 5 : 4 : 3$

Using II and III parts of the ratio, $\dfrac{4x+1}{5x} = \dfrac{4}{3}$

$\Rightarrow 12x + 3 = 20x$

$\Rightarrow 8x = 3$

$\Rightarrow x = \dfrac{3}{8}$

Using I and II parts of the ratio, $\dfrac{3x+K}{4x+1} = \dfrac{5}{4}$

$\Rightarrow 12x + 4K = 20x + 5$

$\Rightarrow 4K = 8x + 5$

$= 8 \times \dfrac{3}{8} + 5 = 8$

$\Rightarrow K = 2$

$\therefore$ Required ratio = 2:1.

80. (c) Let $\dfrac{P}{Q} = \dfrac{1}{K}$

Then, on adding 1 to both numerator and denominator the ratio changes as $\dfrac{1+1}{K+1} = \dfrac{R}{S}$.

$\Rightarrow \dfrac{2}{K+1} = \dfrac{R}{S}$

When 1 is again added the ratio changes as

$\dfrac{2+1}{K+1+1} = \dfrac{R+1}{S+1} = \dfrac{1}{2}$ $\quad \left(\because \dfrac{R+1}{S+1} = \dfrac{1}{2}, \text{given} \right)$

or $\dfrac{2+1}{K+1+1} = \dfrac{1}{2} \Rightarrow \dfrac{3}{K+2} = \dfrac{1}{2}$

$\Rightarrow 6 = K + 2$

$\therefore K = 4$

So, $Q = K = 4$ and $P = 1$

$\therefore P{:}Q = 1{:}4$ and $P + Q = 1 + 4 = 5$.

81. (a) Let monthly income be y

Let money spent on grocery, clothes and education be $4x, 2x, 5x$

Money spent of clothes $= ₹5540 = 2x$

$x = 2770$

Now, $4x + 2x + 5x = 11x = 11 \times 2770 = 30470 = 55\%$ of y

$\Rightarrow y = \dfrac{30470 \times 100}{55}$

$\therefore y = 55,400$.

82. (a) Let amount of B = ₹ x

B's share without error $= \dfrac{\text{B's ratio}}{\text{Total ratio}} \times \text{Total Amount}$

$$x = \frac{3}{9} \times \text{Total amount} \qquad (1)$$

B's share after error $= \dfrac{\text{B's New ratio}}{\text{Total new ratio}} \times \text{Total Amount}$

$$\Rightarrow x - 40 = \frac{2}{14} \times \text{Total amount} \qquad (2)$$

From equations (1) and (2), we get
$3x = 7(x - 40)$
$\Rightarrow 3x - 7x = -280$
$\therefore x = 70$
Total amount $= 7(70 \ 40) = ₹210$.

83. (d) A and B ratio is 4:7
$\Rightarrow 4x + 7x = 73689$
$\Rightarrow 11x = 73689$
$\Rightarrow x = 6699$

Share of A $= ₹26796$
Share of B $= ₹46893$
Difference $=$ twice of share B $-$ thrice of share A
$= 2 \times 46893 - 3 \times 26796 = ₹13398$.

84. (d) Amount received by all the officers
$= 45 \times 25000 = 11,25,000$

Amount received by each clerk $= \dfrac{3}{5} \times 25000 = 15000$

Amount received by all the clerks
$= 80 \times 15000 = 12,00,000$

Total amount of profit earned $= 11,25,000 - 12,00,000$
$= ₹23.25$ lakhs.

85. (b) Mrs. X spends $= ₹353$
Total cost $= 43$ shirt $+ 21$ ties $= 535$
By hit and trial, $S = 10, T = 5$
$\Rightarrow$ Total cost $= 43 \times 10 + 21 \times 5 = 535$
Hence, ratio of shirts to ties $= 10:5 = 2:1$.

86. (c) Let the passengers in A.C. Sleeper Class, 1st Class and Sleeper Class be x, $2x$ and $3x$ respectively and the fares in these classes be $5y$, $4y$ and $2y$ respectively.

Then, the income from these classes are $5xy$, $8xy$, $6xy$ respectively.

$\therefore$ Required income $= \dfrac{5}{19} \times 54000 = 14210$.

87. (a) $\dfrac{1}{S} = \dfrac{\tau + \rho\omega}{\alpha\omega} = \dfrac{\tau}{\alpha\omega} + \dfrac{\rho}{\alpha} = \dfrac{k_1}{\omega} + k_2$

where k_1 and k_2 are constant
$\Rightarrow 1/S$ decreases with ω increases.
$\Rightarrow S$ increases with ω increases.

DIFFICULTY LEVEL-2

1. (d) $a = 6b = 12c$
$\Rightarrow a:b:c \equiv 1 : \dfrac{1}{6} : \dfrac{1}{12}$
$\Rightarrow a:b:c = 12:2:1 \qquad (1)$
It is also given
$2b = 9d = 12e$
$\Rightarrow b:d:e \equiv \dfrac{1}{2} : \dfrac{1}{9} : \dfrac{1}{12}$
$\Rightarrow b:d:e = 18:4:3 \qquad (2)$
From (1) and (2),
$a:b:c:d:e = 108:18:9:4:3$
$\Rightarrow a = 108K, b = 18K,$
$c = 9K, d = 4K, e = 3K$

Now, going through the options, the pair in option (d) is not an integer:

$\dfrac{a}{6}$ is an integer but $\dfrac{c}{d}$ is not an integer.

2. (b) Ratio of speed = Ratio of distance. Therefore, ratio of distance = 4:3. Hence, the man travels 36 miles and the woman 27 miles.

3. (b) Let, the price of branded PC be $= 64x$ and that of assembled $PC = 27x$.

Let, after n years the prices of both will become equal.
Then, $(0, 9)n \ 64x = (1.2)n \times 27x$

$\Rightarrow \dfrac{64}{27} = \left(\dfrac{4}{3}\right)^n$

Hence, $n = 3$ years.

4. (d) Let the price of B per kg be $₹X$. Then, the price of A per kg $= ₹3X$

1kg of C contains 2/7 kg of A and 5/7 kg of B

Price of 1 kg of $C = (2/7) \times 3X + (5/7)X = (11/7)X$

By the given condition, $11X/7$
$= 5.20 - 0.80$
$= ₹4.40$
$\Rightarrow X = 4.40 \times (7/11) = ₹2.80$

Hence the price of B per kg $= ₹2.80$.

5. (*a*) Ratio of personal shares = 6:5:4

Ratio of the amounts = 12:15:16

Ratio of men, women and children

$$= \frac{12}{6} : \frac{15}{5} : \frac{16}{4}$$

$$= 2:3:4$$

Sum of these ratios = (2 + 3 + 4) = 9

Number of men $= \left(\frac{45 \times 2}{9}\right) = 10$

Number of women $= \left(\frac{49 \times 3}{9}\right) = 15$

and, the number of children = 45 − (10 + 15) = 20

Now, dividing ₹430 in the ratio 12:15:16

Total amount of men's share

$$= ₹\left(\frac{430 \times 12}{43}\right)$$

$$= ₹120$$

Total amount of women's share

$$= ₹\left(\frac{430 \times 15}{43}\right)$$

$$= ₹150$$

Total amount of children's share

$$= ₹[430 − (120 + 150)]$$

$$= ₹160$$

∴ Each man's share $= ₹\left(\frac{120}{10}\right) = ₹12$

Each woman's share $= ₹\left(\frac{150}{15}\right) = ₹10$

Each child's share $= ₹\left(\frac{150}{15}\right) = ₹8.$

6. (*b*) Let their respective salaries be X, Y, Z.

Then, *A* saves 0.2 X, *B* saves 0.15 Y, and *C* saves 0.25 Z.

We have, $\quad X + Y + Z = 444 \quad$ (1)

$$0.2 X : 0.15 Y : 0.25 Z = 7:6:9$$

$\Rightarrow \quad 4X:3Y:5Z = 7:6:9$

or, $\quad X = 7Y/8, Z = 9Y/10$

Putting in (1), we have $Y = 160$.

7. (*c*) Skilled workers $= \left(\frac{8}{5} \times 20\right) = 32$

Number of clerks $= \left(\frac{1}{5} \times 20\right) = 4$

Ratio of amount of 32 skilled workers, 20 unskilled workers and 4 clerks

$$= 5 \times 32:2 \times 20:3 \times 4$$

$$= 160:40:12 \text{ or, } 40:10:3$$

Now, divide ₹3,180 in the ratio 40:10:3.

8. (*a*) Let the soldiers in the two armies be $10X$, $3X$ and losses be $20Y$, $3Y$, then we have

$$10X − 20Y = 24000 \quad (1)$$

and, $\quad 3X − 3Y = 24000 \times 13/40 = 7800 \quad (2)$

Solving, we have

$$10X = 28000, 3X = 8400.$$

9. (*d*) Let X be the required number, then

$$(7 + X):(11 + X) = (11 + X):(19 + X)$$

$\Rightarrow (7 + X)(19 + X) = (11 + X)^2$

$\Rightarrow X^2 + 26X + 133 = X^2 + 22X + 121$

$\Rightarrow \quad 4X = −12 \text{ or, } X = −3.$

10. (*d*) No. of policemen $= \frac{3}{5} \times 135 = 81$

Since number of supporters: number of policemen = 9:1, therefore number of supporters must be 729.

11. (*c*) $I \quad \alpha \frac{1}{R^2}.$

12. (*d*) Let $y \propto p + q$, where $p \propto x$ and $q \propto \frac{1}{x}$

∴ $\quad y = K(p + q),$

$$p = Mx, q = \frac{N}{x}$$

$\Rightarrow \quad y = K\left(Mx + \frac{N}{x}\right)$

$$y = \frac{10}{3},$$

when, $\quad x = 3$

$\Rightarrow K\left(3M + \frac{N}{3}\right) = \frac{10}{3}$

∴ $\quad MK = 2$ and $NK = −8$

∴ $\quad p = \frac{2x}{K}, q = \frac{−8}{Kx}$

and so, $\quad y = 2x − \frac{8}{x}.$

13. (*a*) ∵ Temperature $\propto$ Volume

If Temperature = 25° K,

Volume= 50 m³

If Volume= 200m³, then

Temperature = 100° K.

14. (*d*) $\quad x^2 \propto y^3 \Rightarrow x^2 = Ky^3$

∴ $\quad x = 6, y = 3$

$\Rightarrow \quad K = \frac{4}{3}$

∴ $\quad 3x^2 = 4y^3.$

15. (d)
$$y \propto \frac{1}{x^3 - x}$$

$$\Rightarrow \quad y = \frac{K}{x^3 - x}$$

When, $\quad x = 2, y = \frac{1}{6}$

$$\therefore \quad \frac{1}{6} = \frac{K}{8 - 2}$$

$$\Rightarrow \quad K = 1$$

$$\therefore \quad y = \frac{1}{x^3 - x}$$

$$\therefore \quad x = 1$$

$$\Rightarrow \quad y = \frac{1}{0} = \infty.$$

16. (d) Ratio of number of passengers is 5:3:2

∴ If 200 passengers travelled by third class, 500 must have travelled by first class.

Sum of ratio of amount collected = $(5 \times 9 + 3 \times 7 + 2 \times 2) = 45 + 21 + 4 = 70$.

∴ Amount collected from 1st class

$$= \frac{45}{70} \times 98000 = ₹63,000$$

∴ Fare for the first class

$$= ₹\left(\frac{63000}{500}\right) = ₹126.$$

17. (a) Let $(x - y + z) = 2k$, $(y - z + 2w) = 3k$
and $(2x + z - w) = 5k$

Then, $(x - y + z) + (y - z + 2w)$
$$= 2k + 3k$$
$$= 5k = 2x + z - w$$

or, $\quad x + z = 3w$

$$\therefore \quad S = (3x + 3z - 2w) : w = 7 : 1.$$

18. (d) Number of boys = 210

Number of girls = 180

Number of students studying Arts and Science are in the ratio of 3:7

∴ No. of student studying Arts = 117

No. of students studying Science = 273

No. of boys studying Arts = 52

No. of girls studying Arts = 65

∴ No. of boys studying Science = 210 − 52 = 158.

19. (a) No. of girls studying Arts = 65

No. of girls studying Science = 115

∴ Required ratio = 65:115 = 13:23.

20. (c) Let the prices of a bat and a ball be $9x$ and $2x$ respectively.

⇒ The new prices are $9.9x$ and $2.36x$

Given: $12 \times 9x + 54 \times 2x = C$.

$$\Rightarrow 108x + 108x = C$$

$$\Rightarrow \quad 108x = \frac{C}{2}$$

Hence, new price $= \dfrac{C}{2} \times 1.10 + \dfrac{C}{2} \times 1.18$

$$= \frac{C}{2}(2.28) = 1.14 \, C.$$

21. (c) Since there are 12 bangles, then the number of broken to unbroken bangles can not be 2:3, since $5x = (2x + 3x)$ can not divide 12 for any integral value of x i.e., all the sum of ratios which are the factors of 12 can possibly be the ratio of broken to unbroken.

22. (c) Total weight of the stone
$$= 5 + 7 + 8 = 20$$
Given value α (weight)^2
$$6800 = K(20)^2 \Rightarrow K = 17$$
Therefore, value of the pieces
$$= K(5)^2 + K(7)^2 + K(8)^2$$
$$= 17 \times 25 + 17 \times 49 + 17 \times 64$$
$$= ₹2,346$$
∴ Loss in value = ₹(6800 − 2346) = ₹4,454.

23. (c) Number of maximum number of tables costing ₹1200 each = 6 and from remaining money i.e., (8100 − 7200) = ₹900 he can buy 3 chairs costing ₹300 each. Hence ratio of chairs to tables = 3:6 = 1:2.

24. (b) Let the number of mangoes that the man had originally = x

No. of Mangoes sold to Balance

1st customer $= \dfrac{x}{2} + 1 \dfrac{x-2}{2}$

2nd customer $= \dfrac{x-2}{6} + 1 \dfrac{x-5}{3}$

3rd customer $= \dfrac{x-5}{12} + 1 \dfrac{x-9}{4}$

4th customer $= \dfrac{x-9}{20} + 10$

$$\therefore \quad \frac{x-9}{20} + 1 = \frac{x-9}{4}$$

$$\Rightarrow \quad x = 14.$$

25. (*d*) Ratio of the amount collected from the 1st class and the 2nd class passengers = 3:50

∴ Amount collected from the 2nd class passengers

$$= \frac{50}{53} \times 1325 = ₹1250.$$

26. (*c*) Ratio of white to yellow balls = 6:5

Difference in the number of white and yellow balls

$$= 6x - 5x = x = 45$$

Therefore, number of white balls now available

$$= 45 \times 6$$

Number of white balls ordered

$$= (45 \times 6) - 45 = 225.$$

27. (*a*) No. of people having characteristic X

$$= 10 + 30 = 40$$

No. of people having characteristic Y

$$= 10 + 20 = 30$$

Required ratio = 40:30 = 4:3.

28. (*d*) Let the total property of Alphonso be ₹x

After first distribution, money possessed by the family members would be

$$\text{wife} = \left(\frac{x}{2}\right), \text{Ben}\left(\frac{x}{6}\right), \text{Carl}\left(\frac{x}{6}\right), \text{Dave}\left(\frac{x}{6}\right)$$

After second distribution, money possessed by each of them would be Alphonso's wife = $\left(\frac{x}{12}\right)$, Ben (0),

Ben's wife $\left(\frac{x}{12}\right)$, Carl $\left(\frac{x}{6} + \frac{x}{24}\right)$, Dave $\left(\frac{x}{6} + \frac{x}{24}\right)$

After third distribution, money possessed by them would be Alphonso's wife $\left(\frac{x}{2}\right)$, Ben (0),

Ben's wife $\left(\frac{x}{12}\right)$, Carl (0), Carl's wife $\left(\frac{5x}{48}\right)$,

Dave $\left(\frac{x}{6} + \frac{x}{24} + \frac{5x}{48}\right) = \frac{15x}{48}$

After last distribution, money possessed by them

Alphonso's wife $\left(\frac{x}{2} + \frac{15x}{96}\right)$, Ben (0),

Ben's wife $\left(\frac{x}{12}\right)$, Carl (0), Carl's wife $\left(\frac{5x}{48}\right)$,

Dave (0), Dave's wife $\left(\frac{15x}{96}\right)$

Now, given that

$$\left(\frac{x}{2} + \frac{15x}{96}\right) = 157500$$

$$\Rightarrow \qquad x = 24,00,000.$$

29. (*a*) Carl's original share = $\left(\frac{x}{6}\right) = \left(\frac{24}{6}\right) = ₹4$ lakhs.

30. (*b*) Ratio of property owned by the widows of three sons

$$= \frac{x}{12} : \frac{5x}{48} : \frac{15x}{96} = 8:10:15.$$

31. (*c*) Fresh grapes contain 10% pulp.

∴ 20 kg fresh grapes contain 2 kg pulp.

Dry grapes contain 80% pulp.

2 kg pulp would contain

$$= \frac{2}{0.8} = \frac{20}{8} = 2.5 \text{ kg dry grapes.}$$

32. (*b*) Ratio of A's last year and present year Salary = 3:5 let salary be $3x$ and $5x$.

Ratio B's is last year and present year. Salary = 2:3 i.e., salary be $2y$ and $3y$ respectively

Given that, $\dfrac{3x}{2y} = \dfrac{4}{5}$

$$\Rightarrow \qquad 15x = 8y \qquad (1)$$

Also, given

$$5x + 3y = 6800 \qquad (2)$$

From Eq. (1) $15x = 8y$

$$\therefore \qquad 5x = \frac{8}{3}y$$

Putting this value in Eq. (2), we have

$$- \quad + 3y = 6800$$

$$\therefore \qquad y = 1200$$

Put the value of y in Eq. (1), we get $5x = 3200$

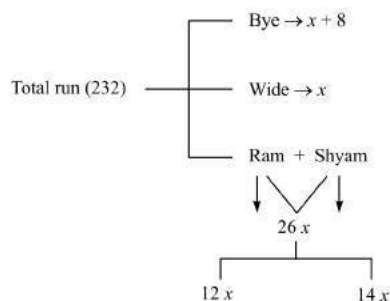∴ $A's$ present salary = $5x = 3200$.

33. (*b*) According to question,

$$\frac{5x}{72x + 8} = \frac{5}{74}$$

$$\Rightarrow \qquad x = 4$$

Managers = $5 \times 4 = 20$.

34. (b)

$\therefore\ x + 8 + x + 26x = 232$

$\Rightarrow\qquad 28x = 232 - 8 = 224$

$\qquad\qquad x = 8$

$\therefore$ Ram runs scored $= 12x = 96$.

35. (b) $\dfrac{1\text{st}}{3} : \dfrac{2\text{nd}}{4} : \dfrac{3\text{rd}}{5}$

$\therefore$ 1st : 2nd : 3rd $= 21 : 28 : 20$

$\left.\begin{array}{l} 1\text{st} = 42 \\ 2\text{nd} = 56 \\ 3\text{rd} = 40 \end{array}\right\}$ By option it can easily be found. 3rd.

36. (d) Option (a), $y = -x$. So, y is directly proportional to x.

Option (b), $y = \dfrac{10}{3x}$. So, y is inversely proportional to x.

Option (c), $y = \dfrac{1}{5}x$. So, y is directly proportional to x.

Option (d), y varies with x, but it is neither directly nor inversely proportional to x.

37. (d) Let the longer and shorter side of the rectangle $= L$ and B respectively.

When the boy took the short cut, the distance covered by him was $= \sqrt{L^2 + B^2}$

Given, boy covered $L + B - \dfrac{L}{2}$ as he saved a distance equal to half the longer side.

$$\sqrt{L^2 + B^2} = \dfrac{L}{2} + B$$

Taking the square on both sides,

$$L^2 + B^2 = \dfrac{L^2}{4} + B^2 + LB$$

$$\dfrac{3}{4}L^2 = LB \Rightarrow LB - \dfrac{3}{4}L^2 = 0$$

$$L\left(B - \dfrac{3}{4}L\right) = 0$$

$\because\qquad\qquad L \neq 0,\ B = \dfrac{3}{4}L$

$$\dfrac{L}{B} = \dfrac{4}{3}$$

Thus, the ratio of the shorter side to the longer side $= \dfrac{3}{4}$.

38. (b) In the first 50 balls, 49 are red. If $8x$ balls are counted after the first 50 balls, then $7x$ out of them are red.

So, the proportion of red balls is $\dfrac{7x + 49}{8x + 50}$

Here,$\qquad n = 8x + 50$

$$\dfrac{7x + 49}{8x + 50} \geq \dfrac{90}{100}$$

$\therefore\ 700x + 4900 \geq 720x + 4500$

$\therefore\qquad\qquad 20x \leq 400$

$\therefore\qquad\qquad x \leq 20$

$\because\qquad\qquad n = 8x + 50$

$\therefore\qquad\qquad n \leq 210$

The maximum value of n is 210.

39. (b) If income is increased in proportion, then the similarity will be unaltered but if it is increased by a fixed price it will change.

40. (c) Ratio of rent $= 18 \times 4 : 25 \times 2 : 28 \times 5 : 21 \times 3$

$$72x = 360$$

$$x = 5$$

Total rent $= 325 \times 5 = ₹1625$.

41. (c) By option method 16 : 56,

Now, $(56 - 16) = 40$

and$\qquad \dfrac{16}{56} = \dfrac{2}{7}$.

42. (c) We know that,

$$p \propto \dfrac{1}{s} \text{ and } s \propto \dfrac{1}{r}$$

Therefore, $p \propto r$

So, $p \propto q$ and $q \propto r$ and therefore $p \propto r$

When $p = 3$, $r = 5$

$\therefore q = 2 \Rightarrow r = \dfrac{10}{3}$

i.e., when $p = 1$, $r = \dfrac{10}{3}$

$\Rightarrow\ r = 20$ when $p = 6$.

43. (*a*) Let the production on Friday be X

So, the approved pieces are $0.95X$ and the rejected pieces are $0.05X$

Let production on Saturday be Y

So, the approved pieces are $0.9Y$ and the rejected pieces are $0.1Y$

$\therefore \dfrac{0.05X + 0.1Y}{X + Y} = 0.0833$

So, $X:Y = 1:2$.

44. (*d*) $\dfrac{3}{4}$

Given, $(x + y) - \sqrt{x^2 + y^2} = \dfrac{y}{2} \Rightarrow x + \dfrac{y}{2} = \sqrt{x^2 + y^2}$.

From the options, we find that option (d) satisfies the above relation $3 + 2 = \sqrt{9 + 16} \Rightarrow 5 = 5$.

45. (*b*) Mayank paid $\dfrac{1}{2}$ of the sum paid by other three. Let, the other three paid ₹ x jointly, then Mayank paid $\dfrac{x}{2}$.

So, $x + \dfrac{x}{2} = 60,000 \Rightarrow x = 40,000$.

Hence, Mayank paid ₹20,000.

Likewise, Mirza and Little paid ₹15,000 and ₹12,000, respectively.

Hence, the amount paid by Jaspal is ₹ $[60,000 - (20,000 + 15,000 + 12,000)] = ₹ 13,000$.

46. (*c*) Let the longest piece be $3x$, then the middle and the shortest piece would be x and $(3x - 23)$, respectively.

We have $3x + x + (3x - 22) = 40 \Rightarrow x = 9$.

Therefore, the shortest piece $= (3 \times 9 - 23) = 4$.

47. (*b*) Value of 1 kg of ruby $= \dfrac{4}{0.3}$ crores $= 13.33$ crores

Value of 1 kg of emerald $= \dfrac{5}{0.4}$ crores $= 12.5$ crores

To maximize wealth, maximum number of ruby and minimum number of emerald be collected, as price per kg of ruby is more than that of emerald. From the options, $40 > 28 + 9$.

48. (*d*) Ratio of number of one rupee, fifty paise, and twenty five paise coins $= 2.5:3:4$

$\therefore$ Ratio of value of coins $= 2.5 \times 1 : \dfrac{3}{2} : \dfrac{4}{4} = 5:3:2$.

Let amount of Re 1 50 paise and 25 paise coins be $5x, 3x$ and $2x$, respectively.

So, $5x + 3x + 2x = 210 \text{(given)} \Rightarrow x = 21$

$\therefore$ Value of one rupee coins

$=$ number of one rupee coins $= 21 \times 5 = 105$.

49. (*c*) Let the weight of the diamond be $10x$, then price of the diamond will be $k (10x)^2 = k\,100x^2$, k is a constant.

Weight of each piece $= x, 2x, 3x$ and $4x$. Therefore their price will be kx^2, $k4x^2$, $k\,9x^2$ and $k16x^2$

Total price of pieces $= kx^2(1 + 4 + 9 + 16) = 30kx^2$.

We are given

$k100x^2 - k30x^2 = 70,000$ or $kx^2 = 1000$.

$\therefore$ Original price of diamond $= k100x^2 = 1000 \times 100 = 100,000$.

50. (*c*) We have, $2O + 3B + 4A = 15$ (1)

and $3O + 2B + A = 10$ (2)

Adding Eqs. (1) and (2), we get

$5O + 5B + 5A = 25$ or, $O + B + A = 5$

$\therefore 3O + 3B + 3A = 3 \times 5 = 15$.

51. (*a*) Let the two numbers be x and y, and $x < y$. Then,

$\left(y - \dfrac{x}{2}\right) = 3\left(x - \dfrac{x}{2}\right) \Rightarrow \left(y - \dfrac{x}{2}\right) = \dfrac{3x}{2}$

or $\quad y = \dfrac{4x}{2} \Rightarrow y = 2x$

$\therefore y : x = 2 : 1$.

52. (*b*) Let the four numbers be $a, b, c,$ and d.

Then, $a:b = c:d = 1:3$

$\Rightarrow \quad \dfrac{a}{b} = \dfrac{c}{d} = \dfrac{1}{3}$

$\Rightarrow \quad b = 3a, d = 3c$ (1)

Also, $\quad a^2 + b^2 + c^2 + d^2 = 50$

$\Rightarrow \quad a^2 + 9a^2 + c^2 + 9c^2 = 50$

$\Rightarrow \quad 10a^2 + 10c^2 = 50$

$\Rightarrow \quad a^2 + c^2 = 5$ (2)

Also, sum of means $= 5$

$b + c = 5$

$\Rightarrow \quad b = 5 - c$

$\Rightarrow \quad a = \dfrac{5 - c}{3}$ [using Eq.(1)]

Putting this value of a in Eq. (2), we get

$$\left(\frac{5-c}{3}\right)^2 + c^2 = 5$$

$$\Rightarrow \quad \frac{25 + c^2 - 10c}{9} + c^2 = 5$$

$$\Rightarrow \quad 25 + c^2 - 10c + 9c^2 = 45$$

$$\Rightarrow \quad 10c^2 - 10c - 20 = 0$$

$$\Rightarrow \quad c^2 - c - 2 = 0$$

$$\Rightarrow \quad c = 2$$

Therefore, $\quad a = \dfrac{5-c}{3} = \dfrac{5-2}{3} = 1$

$$b = 3a = 3$$
$$c = 2$$
$$d = 3c = 6$$

Hence, required avearage

$$= \frac{a+b+c+d}{4} = \frac{1+3+2+6}{4} = \frac{12}{4} = 3.$$

53. (*d*) Using option (d),

Bid price of B = ₹100000

Then, initially ratio of bid is 7:4,

Bid price for A = ₹175000.

Then, *A* withdraws ₹100000

Amount of bid left for A

= ₹175000 − ₹100000 = ₹75000

∴ Ratio of bid after withdrawal of ₹100000

= 75000:100000 = 3:4.