

9

TIME, SPEED AND DISTANCE

It is sure and certain that it is one of the most important chapter, which includes various fundamental and logical concepts and therefore most of the problems are complex in their nature. Every year 4-6 problems are generally asked in CAT. Besides CAT almost every aptitude exam contains the questions pertaining to the concepts of TSD.

This chapter includes the following :

- (a) Motion in a straight line
- (b) Circular motion and races
- (c) Problems based on trains, boats, river and clocks etc.

CONCEPT OF MOTION

When a body moves from a point A to another point B at a distance of D , then it requires some time (T) to cover a distance (D) with a particular speed (S).

The relation between T , S and D is as follows:

$$T \times S = D$$

i.e., Time \times Speed = Distance

Therefore, when D is constant,

$$T \propto \frac{1}{S}$$

and when T is constant,

$$D \propto S$$

and when S is constant,

$$D \propto T$$

NOTE This relation of proportionality is very important.

Formulae : Distance = Speed \times Time

EXAMPLE 1 Abhishek drives his bike at the speed of 150 km/h. What is the distance covered by him in 3 hours.

SOLUTION $D = S \times T = 150 \times 3 = 450$ km

EXAMPLE 2 Uday travels half of his journey by train at the speed of 120 km/h and rest half by car at 80 km/h. What is the average speed?

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

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

NOTE To solve the problem, all the units involved in the calculation must be uniform i.e., either all of them be in metres and seconds or in kilometres and hours etc.

Conversion of unit:

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

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

$$[1 \text{ km} = 1000 \text{ m}, 1 \text{ h} = 60 \text{ min}, 1 \text{ min} = 60 \text{ s}]$$

HINT Try to find these relations by unitary method.

$$1 \text{ mile} = 1609.30 \text{ m} = 1.6093 \text{ km}$$

and $1 \text{ km} = 0.621 \text{ mile}$

$$1 \text{ yard} = 0.9144 \text{ m}$$

and $1 \text{ m} = 1.0936 \text{ yards}$

and $1 \text{ m} = 39.4 \text{ inches}$

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time taken}}$$

When distances are equal :

$$\text{Average speed} = \frac{2xy}{x + y} \quad (\text{speeds } x, y)$$

$$\text{and} \quad \text{Average speed} = \frac{3xyz}{xy + yz + zx} \quad (\text{speeds } x, y, z)$$

SOLUTION Let the total distance be $2D$ km, then
Total time = Time taken by train + Time taken by car

$$= \frac{D}{120} + \frac{D}{80}$$

$$\therefore \text{Average speed} = \frac{2D}{\frac{D}{120} + \frac{D}{80}}$$

EXAMPLE 7 Shweta when increases her speed from 24 km/h to 30 km/h she takes one hour less than the usual time to cover a certain distance. What is the distance usually covered by Shweta?
 (a) 160 km (b) 240 km (c) 120 km (d) 90 km

SOLUTION Let the original time be t hours, then

$$24t = 30 \times (t - 1) = D \quad (\text{distance})$$

then $t = 5$

$$\therefore \text{Distance} = 24 \times 5 = 120 \text{ km}$$

Alternatively: Go through options.

$$\begin{aligned} \frac{120}{24} &= 5 \text{ h} \\ \frac{120}{30} &= 4 \text{ h} \end{aligned} \quad \begin{array}{l} \text{1 hour less} \\ \curvearrowleft \end{array}$$

Hence, the option (c) is correct.

Alternatively: Since distance (D) is constant.

$$\text{Therefore, } D = S_1 \times t_1 = S_2 \times t_2$$

It means here we can apply product constancy

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{4} \uparrow & & \frac{1}{5} \downarrow \\ & & = 1 \text{ hour} \end{array}$$

$$\therefore \text{Original time taken} = 5 \times 1 = 5 \text{ hours}$$

$$\begin{aligned} \text{Therefore, Distance} &= \text{Original speed} \times \text{Original time} \\ &= 24 \times 5 = 120 \text{ km} \end{aligned}$$

NOTE In the given exercise or in the whole chapter you have to solve maximum problems through product constancy concept described in the chapter of ratio proportion and variation. Solving through product constancy gives faster results.

Alternatively: Let the distance be D , then

$$\frac{D}{24} - \frac{D}{30} = 1$$

$$\Rightarrow D = 120 \text{ km}$$

EXAMPLE 8 Kriplani goes to school at 20 km/h and reaches the school 4 minutes late. Next time, she goes at 25 km/h and reaches the school 2 minutes earlier than the scheduled time. What is the distance of her school?

SOLUTION Increase in speed = 5 km/h

$$\text{Decrease in time} = 6 \text{ min} (4 + 2)$$

By product constancy :

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{4} \uparrow & & \frac{1}{5} \downarrow \\ & & = 6 \text{ min} \end{array}$$

$$\text{It means original time} = 30 \text{ min}$$

$$\left(\because \frac{x}{5} = 6 \Rightarrow x = 30 \right)$$

$$\therefore \text{Total distance} = \text{Original speed} \times \text{Original time}$$

$$= 20 \times \frac{30}{60} = 10 \text{ km}$$

EXAMPLE 9 Amit covers a certain distance with his own speed, but when he reduces his speed by 10 km/h his time duration for the journey increases by 40 hours, while if he increases his speed by 5 km/h from his original speed he takes 10 hours less than the original time taken. Find the distance covered by him.

SOLUTION

$$\begin{aligned} \left. \begin{array}{l} S \\ -10 \end{array} \right\} \begin{array}{l} T \\ +40 \end{array} \} & 40S - 10T = |-400| \\ \left. \begin{array}{l} S \\ +5 \end{array} \right\} \begin{array}{l} T \\ -10 \end{array} \} & -10S + 5T = |-50| \end{aligned}$$

Solving eq. (i) and (ii), we get

$$S = 25 \quad \text{and} \quad T = 60$$

$$\text{Distance} (D) = S \times T$$

$$= 25 \times 60 = 1500 \text{ km}$$

where $D \rightarrow$ Distance, $S \rightarrow$ Speed, $T \rightarrow$ Time

'+' means increase in value.

and '-' means decrease in value.

Alternatively: Let distance be x km and usual speed be y km/h.

$$\begin{aligned} \frac{x}{(y-10)} - \frac{x}{y} &= 40 \\ \Rightarrow x \left[\frac{10}{y(y-10)} \right] &= 40 \\ \Rightarrow x &= 4y(y-10) \\ \text{and} \quad \frac{x}{y} - \frac{x}{(y+5)} &= 10 \\ \Rightarrow x &= 2y(y+5) \end{aligned}$$

from eq. (i) and (ii)

$$4y(y-10) = 2y(y+5)$$

$$2y - 20 = y + 5$$

$$y = 25 \text{ km/h}$$

$$\therefore x = 1500 \text{ km}$$

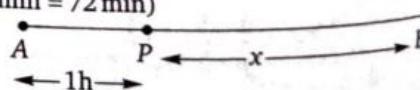
EXAMPLE 10 A train met with an accident 60 km away from Anantpur station. It completed the remaining journey at $\frac{5}{6}$ th of the previous speed and reached the Baramula station 1 hour 12 minutes late. Had the accident taken place 60 km further, it would have been only 1 hour late.

(a) What is the normal speed of the train?

(b) What is the distance between Anantpur and Baramula?

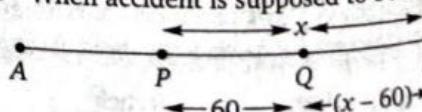
SOLUTION Case I. Since the speed is decreased by $\frac{1}{6}$. So, the time will be increased by $1/5$, which is equal to 1 hour 12 minutes. It means the normal time required for this remaining part of the journey is $5 \times 72 \text{ min} = 360 \text{ min} = 6 \text{ h}$.

($\because 1 \text{ h } 12 \text{ min} = 72 \text{ min}$)



P is the place of accident.

Case II. When accident is supposed to be happened at Q.



Since, the speed is decreased by $\frac{1}{6}$, hence, the time will be increased by $1/5$, which is equal to 1 hour, hence the normal time required for this remaining part $(x-60)$ of journey $= 5 \times 1 = 5 \text{ hours}$.

Time, Speed and Distance
Thus, it is clear that when the train runs 60 km of its normal speed it takes 1 hour less, which implies that in 1 hour the train can run 60 km with its normal speed. Thus, the normal speed of the train is 60 km/h.
(b) Since the train requires 6 hours at its normal speed of x km/h for the x km. Hence,

$$x = 6 \times 60 = 360 \text{ km}$$

Thus, the total distance = Distance travelled before accident + Distance travelled after accident
 $= 60 \times 1 + 60 \times 6 = 420 \text{ km}$

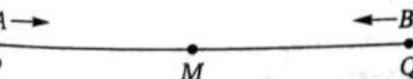
EXAMPLE 11 A and B started simultaneously towards each other from P and Q respectively. The distance between P and Q is 600 km and the ratio of speeds of A is to B is 5 : 7. If they meet at a point M:

RELATIVE MOTION WITH TWO OR MORE BODIES

(i) **When two bodies move in the same direction:** If the speeds of the two bodies A and B be S_A and S_B , then their relative speed = $S_A - S_B$ or $S_B - S_A$ i.e., in the same direction the relative speed or effective speed between two bodies is the difference of their speeds. (The difference is always considered

EXAMPLE 12 The distance between two places P and Q is 700 km. Two persons A and B started towards Q and P from P and Q simultaneously. The speed of A is 30 km/h and speed of B is 40 km/h. They meet at a point M which lies on the way from P to Q.

- (i) How long will they take to meet each other at M?
- (ii) What is the ratio of PM : MQ?
- (iii) What is the distance MQ?
- (iv) What is the extra time needed by A to reach at Q than to reach at P by B?
- (v) What is the ratio of time taken by A and B to reach their respective destinations after meeting at M?
- (vi) In how many hours will they be separated by only 560 km before meeting each other.
- (vii) How long will it take to separate them by 280 km from each other when they cross M (time to be considered after their meeting)?

SOLUTION 

(i) Since, they are coming towards each other from opposite ends, therefore the relative speed will be the sum of their speeds = $30 + 40 = 70 \text{ km/h}$.
Thus, the required time to meet at M

$$\begin{aligned} &= \text{Time required to cover } 700 \text{ km (combined)} \\ &= \frac{700}{70} = 10 \text{ h} \end{aligned}$$

Thus in 10 hours they will meet each other at M.
(ii) The ratio of their distances covered to meet at M

= Ratio of their speeds = 3 : 4
(Since, time is constant i.e., same for each)
Thus

$$PM : MQ = 3 : 4$$

$$(iii) MQ = \frac{4}{7} \times 700 = 400 \text{ km}$$

- (i) Find the ratio of PM : QM.
(ii) Find the distance PM.

SOLUTION (i) Since the time is constant so, the distance covered by A and B is directly proportional to the speeds of A and B.
Hence,

$$PM : QM = 5 : 7$$

(ii) Since, the ratio of their speeds (or their distances covered) is 5 : 7. Hence, A will cover $\frac{5}{12}$ of the total length.

$$\therefore PM = \frac{5}{12} \times 600 = 250 \text{ km}$$

$$(\text{Similarly } QM = \frac{7}{12} \times 600 = 350 \text{ km})$$

as positive)

(ii) **When two bodies move in the opposite direction:** If the speeds of the two bodies A and B be S_A and S_B , then their relative speed = $S_A + S_B$.

i.e., in the opposite direction the relative speed or effective speed between two bodies is the sum of their speeds.

$$(iv) \text{ Time required by A to reach at Q} = \frac{700}{30} = \frac{70}{3} \text{ h}$$

$$\text{Time required by B to reach at P} = \frac{700}{40} = \frac{70}{4} \text{ h}$$

$$\therefore \text{Extra time required by A} = \frac{70}{3} - \frac{70}{4} \\ = 70 \times \frac{1}{12} = 5 \text{ h } 50 \text{ min}$$

$$(v) \text{ Time required by A to cover } MQ = \frac{400}{30}$$

$$\text{and time required by B to cover } MP = \frac{300}{40}$$

$$\therefore \text{Required ratio} = \frac{400/30}{300/40} = \frac{16}{9}$$

Remember: If speed of A is S_A and speed of B is S_B and A takes t_A time to cover MQ and B takes t_B time to cover MP , then

$$\frac{S_A}{S_B} = \sqrt{\frac{t_B}{t_A}}$$

(vi) It means they have to cover $(700 - 560) = 140 \text{ km}$. Thus, the required time to cover 140 km distance

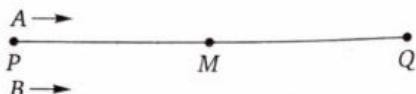
$$= \frac{140}{70} = 2 \text{ h}$$

(vii) Since in each hour they separate by 70 km from each other. Hence, to separate by 280 km, time required

$$= \frac{280}{70} = 4 \text{ h}$$

EXAMPLE 13 Two places P and Q are 800 km apart from each other. Two persons start from P towards Q at an interval of 2 hours. Whereas A leaves P for Q before B. The speeds of A and B are 40 km/h and 60 km/h respectively. B overtakes (or catches or meets) A at M, which is on the way from P to Q.

- How long will B take to overtake?
- What is the distance from P, where B overtakes A (i.e., PM)?
- What is the ratio of time taken by A and B to meet at M?
- What is the extra time required by A to reach at Q?
- How many hours late A will reach at Q than that of B?
- After how many hours A and B will be separated by 50 km before M, when both are moving?
- How many hours does B require to advance himself, by 100 km, in comparison to A?

SOLUTION

- (i) Since A moves 2 hours earlier than B at the speed of 40 km/h, so in 2 hours A will cover 80 km. Thus A will be 80 km away from B.

Now, since they are moving in the same direction therefore their relative speed will be $(60 - 40) = 20$ km/h i.e., with respect to A, B moves at 20 km/h. It means either they reduce (or create) the difference of 20 km in each hour between themselves.

Thus, the required time to overtake (or reduce the difference upto zero from 80 km)

$$= \frac{\text{Distance advanced}}{\text{Relative speed}} = \frac{80}{20} = 4 \text{ h}$$

- (ii) The distance between P and M

$$\begin{aligned} &= (\text{Time required to overtake} \times \text{Speed of the faster body}) \\ &= 4 \times 60 = 240 \text{ km} \end{aligned}$$

Since, B has to move for 4 hours at 60 km/h. Hence, distance covered = 240 km.

- (iii) Time taken by B to reach at M = 4 h

TO AND FRO MOTION IN A STRAIGHT LINE

This concept is just the extension of the previous concepts of relative motion between more than one dynamic (or moving) bodies.

(a) When two bodies start moving towards each other

- To meet each other they cover the distances in the ratio of their individual speeds.
- If the initial distance (or gaping) between two bodies A and B is D, then A and B together have to cover D unit of distance for the first meeting.
- For the next number of meeting (e.g., second, third, fourth meeting and so on) both A and B together have to cover $2D$ distance more from the previous meeting i.e., to meet for the fourth time they have to cover together $D + (3 \times 2D) = 7D$ unit of distances. Similarly for seventh meeting they have to cover together $D + (6 \times 2D) = 13D$ units of distance. Thus for each subsequent meeting they have to cover $2D$ distance extra from the previous one.

Time taken by A to reach at M = $(4 + 2) = 6$ h
Thus, the ratio of time taken by A and B = $6:4 = 3:2$
(Since, A has left 2 hours earlier)

(iv) Time taken by A to reach at Q = $\frac{800}{40} = 20$ h

Time taken by B to reach at Q = $\frac{800}{60} = 13 \text{ h } 20 \text{ min}$

Hence, A takes 6 hrs 40 min extra to reach at Q.
(v) Since, A leaves 2 hrs earlier, thus he will reach at Q only 4 hours 40 min late.

Since, A takes 6 hrs 40 min extra to reach at Q.

- (vi) When B starts to move towards Q the difference between A and B is 80 km.

The required difference between A and B = 50 km
Hence, they have to reduce it by 30 km.

$$\text{Thus, the required time} = \frac{(80 - 50)}{20} = 1.5 \text{ h}$$

$$= 1 \text{ h } 30 \text{ min}$$

Thus, after $3/2$ hrs A will be only 50 metres ahead of B.

- (vii) When B starts to follow A (towards Q) A was 80 km ahead of B. Also B wants to overtake A and further go ahead of A by 100 km. Thus, the net difference (required) = 180 km.

∴ Required time

$$= \frac{(\text{Distance advanced} + \text{Required difference})}{\text{Relative speed}}$$

$$= \frac{80 + 100}{20} = \frac{180}{20} = 9 \text{ h}$$

Thus, after 9 hrs (when B starts moving) B will be 100 km ahead of A i.e., they will be separated by 100 km from each other after crossing M.

NOTE Individually they will cover the distances in the ratio of their speeds for any number of meetings.
Thus, the total distance covered for the n^{th} meeting = $(2n - 1)D$.

(b) When two bodies start moving towards the same direction

- For the first meeting after they start to move they have to cover $2D$ distance, if the distance between two particular points (or places) be D unit. Since, the faster body reaches the next (or opposite) end first than the slower body and the faster body starts returning before the slower body reaches the same opposite end and thus the two bodies meet somewhere between the two ends covering individually the distances in their respective speeds

- For every subsequent meeting they have to cover together $2D$ unit distance more from the previous meeting.

Thus, for n^{th} meeting they have to cover together $(n \times 2D)$ unit of distance.

- At any point of time the distances covered by the bodies will be equal to the ratio of their speeds

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EXAMPLE 14 The distance between two points P and Q is 100 m and the speeds of A and B are 20 m/s and 30 m/s respectively. Initially A and B are at P.

- the distance covered by A in first meeting.
- the time required for the second meeting.
- the distance covered by B to meet for the third time.
- the ratio of distances covered by A and B till the fourth meeting.
- the distance between P and the place of fifth meeting.
- the distance between Q and the point of third meeting.

SOLUTION

Meeting	Total distance covered by A and B together	Distance covered by A	Distance covered by B	Point of meeting from P	Point of meeting from Q	Time (in second)
1 st	200 m	80 m	120 m	80 m	20 m	4
2 nd	400 m	160 m	240 m	40 m	60 m	8
3 rd	600 m	240 m	360 m	40 m	60 m	12
4 th	800 m	320 m	480 m	80 m	20 m	16
5 th	1000 m	400 m	600 m	0 m (at P)	100 m	20

(i) The distance covered by A in the first meeting = 80 m

(ii) Time required for the second meeting = $\frac{400}{50} = 8 \text{ s}$

(iii) The distance covered by B for the third time meeting = $12 \times 30 = 360 \text{ m}$

(iv) It is always (for any moment, after the starting of movement) will be in the ratio of their respective speeds.
So, the required ratio of distances covered by A and B = $20 : 30 = 2 : 3$ i.e.,

$$A : B = 20 : 30 = 2 : 3$$

(v) Since for the fifth meeting they have to cover $50 \times 20 = 1000 \text{ m}$.

(vi) 60 m.

EXAMPLE 15 The distance between two points P and Q is 100 m. A is initially at P and B is at Q. The speeds of A and B is 20 m/s and 30 m/s. They move between P and Q to and fro :

- Find the time required for the first meeting.
- Distance covered by A till the third meeting.
- Distance covered by B till the fifth meeting.
- The distance between P and the place of fourth meeting.
- The distance between Q and the place of fifth meeting.
- The ratio of distances covered by each one till the third meeting.

SOLUTION

No. of meeting	Distance covered by A and B together	Time (in second)	Distance covered by A	Distance covered by B	Distance between P and point of meeting	Distance between Q and point of meeting
1 st	100 m	2	40 m	60 m	40 m	60 m
2 nd	300 m	6	120 m	180 m	80 m	20 m
3 rd	500 m	10	200 m	300 m	at P	at P
4 th	700 m	14	280 m	420 m	80 m	20 m
5 th	900 m	18	360 m	540 m	40 m	60 m

(i) 2 second $\left(\text{Time} = \frac{100}{50} = 2 \right)$

(ii) 200 m (Distance = Speed \times Time = $20 \times 10 = 200 \text{ m}$)

(iii) 540 m ($D = 18 \times 30 = 540 \text{ m}$)

(iv) 80 m

(v) 60 m

(vi) 2 : 3 always equal to the ratio of respective speeds.

EXAMPLE 16 A and B are two friends. A lives at a place P and B lives at another place Q. Everyday A goes to Q to meet B at 120 km/h. Thus, it takes 3 hours. On a particular day B started to meet A so he moved towards P. On that day A took only 2 hours to meet B on the way instead

(i) What is the ratio of speeds of A is to B?

(ii) What is the speed of B?

326

SOLUTION Distance between P and Q = $120 \times 3 = 360$ km

Let the speed of B be S_B , then

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

$$2 = \frac{360}{(120 + S_B)}$$

$$\Rightarrow S_B = 60 \text{ km/h}$$

Here, A and B are moving towards each other. So, the relative speed will be the sum of the speeds of A and B both.

Therefore, ratio of speeds of $A : B = 2 : 1$.

$$(i) 2 : 1 \quad (ii) 60 \text{ km/h}$$

NOTE In this case ratio of speeds of

$$A : B = \frac{\text{Actual time required when } B \text{ is also moving}}{\text{Time difference when } B \text{ is also moving}}$$

$$= \frac{(3 - 1)}{1} = \frac{2}{1}$$

EXAMPLE 17 A lives at P and B lives at Q . A usually goes to meet B at Q . He covers the distance in 3 hours at 150 km/h. On a particular day B started moving away from A . While A was moving towards Q thus A took total 5 hours to meet B .

(i) What is the speed of B ?

(ii) What is the ratio of speeds of $A : B$?

SOLUTION

$$\text{Distance} = 3 \times 150 = 450 \text{ km}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Relative speed}}$$

$$5 = \frac{450}{(150 - S_B)} \quad S_B \rightarrow \text{Speed of } B$$

$$\Rightarrow S_B = 60 \text{ km/h}$$

$$\text{Ratio of speeds of } A : B = \frac{150}{60} = \frac{5}{2} = 5 : 2$$

(i) 60 km/h

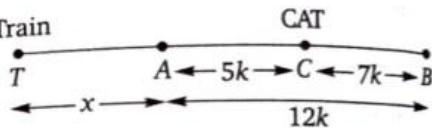
In this case ratio of speeds of

$$A : B = \frac{\text{Actual time required when } B \text{ is also moving}}{\text{Time difference}}$$

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

EXAMPLE 18 A train approaches a tunnel AB . Inside the tunnel, a cat located at a point $i.e.$, $\frac{5}{12}$ of the distance AB measured from the entrance A . When the train whistles, the cat runs. If the cat moves to the entrance of the tunnel A , the train catches the cat exactly at the entrance. If the cat moves to the exit B , the train catches the cat exactly at the exit. The speed of the train is greater than the speed of the cat by what order?

SOLUTION



Let the speed of train be u and the speed of cat be v and train whistles at a point T , x km away from A , then

$$\frac{u}{v} = \frac{x}{5k} = \frac{x + 12k}{7k}$$

$$\Rightarrow 7x = 5(x + 12k)$$

$$\Rightarrow \frac{x}{k} = \frac{30}{1}$$

$$\therefore \frac{u}{v} = \frac{30}{5 \times 1} = \frac{6}{1}$$

$$\text{Alternatively: } \frac{u}{v} = \frac{7k + 5k}{7k - 5k} = \frac{6}{1}$$

NOTE Since time is constant, therefore distances covered by train and cat will be in the ratio of their respective speeds.

is always equal to the sum of the length of train and the length of the particular object such as bridge, platform etc.

(v) Distance to be covered such as pole, man, tree etc. is always equal to the length of the train only.

(vi) If a man is travelling in a train, then this man has to cover the distance to cross another train is equal to the length of the train which is passing or crossing him. In this case the relative speed of both the trains will be considered.

CONCEPT BASED ON TRAINS

- (i) When two trains (or bodies) are moving in opposite direction, their relative speed will be equal to the sum of their individual speeds.
- (ii) When two trains are moving in the same direction their relative speed will be equal to the difference of their speeds.
- (iii) Distance to be covered to cross each other is always equal to the sum of their individual lengths.
- (iv) Distance to be covered such as bridge, platform etc.,

EXAMPLE 19 A train crosses a tree in 10 seconds. If the length of the train be 150 m, then find the speed of the train.

SOLUTION Distance = Length of train

$$= \text{Speed of train} \times \text{Time}$$

$$150 = \text{Speed} \times 10$$

$$\Rightarrow \text{Speed} = 15 \text{ m/s}$$

$$\text{Speed} = 15 \times \frac{18}{5} = 54 \text{ km/h}$$

NOTE A train starts to cross a stationary thin object (of inconsiderable thickness) when the engine of the train meets the object and completes the crossing when the last wagon (or backend) of the train just crosses the object.

EXAMPLE 20 A train crosses a man coming from the opposite direction in 7.5 seconds. If the speed of man be 10 m/s and speed of train is 20 m/s, find the length of the train.

SOLUTION Length of train = Time \times Relative speed
 $= 7.5 \times (10 + 20) = 7.5 \times 30 = 225$

EXAMPLE 21 A train of length 250 m crosses a bridge of length 150 m in 20 seconds. What is the speed of train?

SOLUTION (Length of train + Length of bridge) = Speed of train × Time
 $(250 + 150) = 20 \times \text{Speed}$
 $\text{Speed} = \frac{400}{20} = 20 \text{ m/s} = 72 \text{ km/h}$

EXAMPLE 22 Two trains coming from the opposite sides cross each other in 10 seconds if the lengths of first train and second train be 125 m and 175 m respectively, also the speed of first train be 36 km/h, find the speed of second train.

SOLUTION Speed of first train = 36 km/h = 10 m/s
Now, Time = $\frac{\text{Sum of length of the two trains}}{\text{Sum of their speeds}}$

CONCEPT BASED ON BOATS AND RIVERS (OR STREAMS)

- (i) When the boat and stream (or current) of river move in the same direction, then the relative speed of the boat is the sum of the individual speeds of boat and river. It is known as **downstream speed**.
- (ii) When the boat moves against the current of the river (i.e., in opposite direction), then the relative speed of the boat is the difference of the speeds of the boat and stream (of the river). It is known as **upstream speed**. Let the speed of boat in still water be B and speed of current of river be C then,

$$\begin{aligned}\text{Downstream speed} &= (B + C) ; & B > C \\ \text{Upstream speed} &= (B - C)\end{aligned}$$

EXAMPLE 24 A boat can move at 5 km/h in still water (i.e., when water is not flowing). The speed of stream of the river is 1 km/h. A boat takes 80 minutes to go from a point A to another point B and return to the same point.

- (i) What is the distance between the two points?
- (ii) What is the ratio of downstream speed and upstream speed?
- (iii) What is the ratio of time taken in downstream speed to the upstream speed?

SOLUTION Downstream speed of boat = $(5 + 1) = 6 \text{ km/h}$

$$\text{Upstream speed of boat} = (5 - 1) = 4 \text{ km/h}$$

Therefore, $\frac{\text{Downstream speed}}{\text{Upstream speed}} = \frac{\text{Upstream time}}{\text{Downstream time}}$
 $\frac{6}{4} = \frac{3}{2} = \frac{\text{Time taken in upstream direction}}{\text{Time taken in downstream direction}}$

$$\begin{aligned}\text{Time taken in downstream} &= \frac{2}{5} \times 80 = 32 \text{ min} \\ \text{and time taken in upstream direction} &= \frac{3}{5} \times 80 = 48 \text{ min} \\ \text{Distance between two points} &= \text{DS speed} \times \text{DS time} \\ &= \text{US speed} \times \text{US time}\end{aligned}$$

$$\begin{aligned}10 &= \frac{125 + 175}{(10 + x)} \\ x &= 20 \text{ m/s} = 72 \text{ km/h}\end{aligned}$$

EXAMPLE 23 A fast moving superfast express crosses another passenger train in 20 seconds. The speed of faster train is 72 km/hr and speed of slower train is 27 km/h. Also the length of faster train is 100 m, then find the length of the slower train if they are moving in the same direction.

SOLUTION Time = $\frac{\text{Sum of length of the two train}}{\text{Difference in speeds}}$
 $20 = \frac{(100 + x)}{25/2}$
 $x = 150 \text{ m}$

NOTE Relative speed = $(72 - 27) = 45 \text{ km/h}$
 $= 45 \times \frac{5}{18} = \frac{25}{2} \text{ m/s}$

$$\left\{ \begin{array}{l} \text{Speed of the boat in still water} = \frac{(D+U)}{2} \\ \text{Speed of current (or stream)} = \frac{(D-U)}{2} \end{array} \right.$$

where $D \rightarrow$ downstream speed of the boat
and $U \rightarrow$ upstream speed of the boat

When the distance covered by boat in downstream (i.e., with the flow of water) is same as the distance covered by boat in upstream (against the flow of the water) then,

$$\frac{\text{Time taken by boat in DS}}{\text{Time taken by boat in US}} = \frac{\text{Upstream speed}}{\text{Downstream speed}}$$

DS → Downstream, US → Upstream

where DS → Downstream and US → Upstream

$$D = \frac{6 \times 32}{60} = 3.2 \text{ km}$$

$$\text{or } D = 4 \times \frac{48}{60} = 3.2 \text{ km}$$

$$(i) 3.2 \text{ km} \quad (ii) 3 : 2 \quad (iii) 2 : 3$$

EXAMPLE 25 A man can row 9 km/h in still water. It takes him twice as long as to row up as to row down. Find the rate of stream of the river.

SOLUTION $\frac{\text{Time taken in upstream}}{\text{Time taken in downstream}} = \frac{2}{1}$
 $\frac{\text{Downstream speed}}{\text{Upstream speed}} = \frac{2}{1}$ where $\frac{B+R}{B-R} = \frac{2}{1}$

$B \rightarrow$ Speed of boat in still water

$R \rightarrow$ Speed of current

$$\begin{aligned}\Rightarrow \frac{B}{R} &= \frac{3}{1} && (\text{By componendo and dividendo}) \\ \Rightarrow \frac{9}{R} &= \frac{3}{1} \Rightarrow R = 3 \text{ km/h}\end{aligned}$$

Terminology

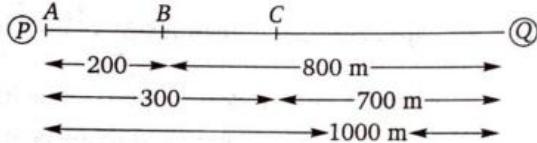
- (i) **Startup or headstart:** When a runner allows to another runner to stay ahead in the same race, then it is said that there is a startup in the race.

For example if A allows B to go ahead before starting the race, then it is said that A gives startup to B and B has the startup. If before starting the race B goes ahead of x metre, then we can say A gives x metre startup to B or B has startup (or headstart) of x metre.

- (ii) **Dead heat:** When the runners reach the finishing line (or the final post) then it is said that these runners finish (or end) the race in dead heat.

EXAMPLE 1 A can give B a 200 m startup and C a 300 m startup in a race of 1 km. How many metres startup can B give to C in a 1 km race?

SOLUTION



$$\text{Ratio of speeds of } A : B = 1000 : 800 = 5 : 4$$

$$\text{Ratio of speeds of } A : C = 1000 : 700 = 10 : 7$$

$$\text{Ratio of speeds of } B : C = 800 : 700 = 8 : 7$$

Since, when B moves 8 m, C moves 7 metre. Therefore, when B moves 1000 m, C moves 875 metre. Thus, B can give C a start of $1000 - 875 = 125$ m.

Alternatively: Since C is 12.5% slower than B . So, C will cover 12.5% less distance than B in the same time.

(Since when time is constant, they cover the distances in the ratio of their speeds.)

Thus, in 1000 m (or 1 km) when B runs 1000 m, C will run 125 m less than B .

Hence, B can give a start of 125 m to C in a 1 km race.

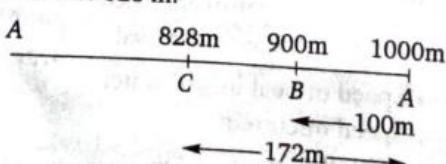
EXAMPLE 2 In a one km race A gives B a start of 100 m and in a one km race B gives a start of 80 m to C . In a 1 km race who will win and by how much distance from the worst performer between two losers?

SOLUTION Ratio of speeds of $A : B = 1000 : 900 = 100 : 90$

Ratio of speeds of $B : C = 1000 : 920 = 100 : 92$

Therefore, when A moves 1000 m, B moves 900 m and when B moves 900 m, C moves 828 m.

Thus,



Since, C moves 8% less than B in the same time. Thus, C is the worst performer and A will win by him by 172 m.

SOME MORE USEFUL CONCEPTS

- (i) When it is said that A can give B a start of x metre race, then it means in y metre race B runs metre less than A in the same time.

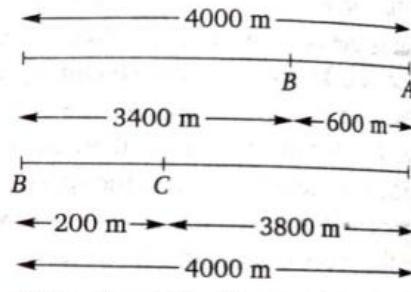
NOTE There is a great difference between 'can' and 'gives'.

- (ii) When A beats B by t seconds in a race of y metres, it means B is the loser and A is the winner and when A reaches the finishing line B is still some distance back to A . Thus B takes t seconds to cover the remaining distance. Hence, we can calculate the speed of loser (B).

- (iii) Throughout the race there is always a certain relationship among runners i.e., they always maintain the ratio of speeds. I think this is the rule of all the problems pertaining to the races. Go ahead.

EXAMPLE 3 In a 4 km race A wins by 600 m over B . B can give start of 200 m to C in a 4 km race. By how much distance C gets start up so that the race between A and C ends in dead heat in the same race of 4 km?

SOLUTION



$$\text{Ratio of speeds of } A : B = 4000 : 3400 = 20 : 17$$

and

$$\text{Ratio of speeds of } B : C = 20 : 19$$

$$\therefore \text{Ratio of speeds of } A : B : C = 400 : 340 : 323$$

Therefore, in 4000 m race A run 4000 m, B run 3400 m and C run 3230 m. Thus C can get 770 m start up from A .

EXAMPLE 4 In a 1500 m race A wins over B by 350 m and in 150 m race C can give a startup of 250 m to B . By how much distance C can give start up to C , so that A beats C by 50 metres?

SOLUTION Ratio of speeds of $A : B = 1500 : 1150 = 30 : 23$

$$\text{Ratio of speeds of } B : C = 5 : 6$$

$$\therefore \text{Ratio of speeds of } A : B : C = 150 : 115 : 138$$

So, when A moves 1500 m, B moves 1150 m and C moves 1380 m. Thus C moves 120 m less than A . To win A just by 50 m over C , A should give $120 - 50 = 70$ m startup to C .

EXAMPLE 5 In a race of 2500 m, A beats B by 500 m and in a race of 2000 m, B beats C by 800 m. By what distance A gives startup to C , so that they will end up with dead heat in 3 km race. Also find by what distance A will win over C in a 1 km race?

SOLUTION Ratio of speeds of $A : B = 2500 : 2000 = 5 : 4$

$$\text{Ratio of speeds of } B : C = 5 : 3$$

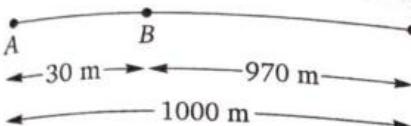
$$\therefore \text{Ratio of speeds of } A : B : C = 25 : 20 : 12$$

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In 3 km race A runs 3000 m. B runs 2700 m. C runs 2400 m, so to end up the race in dead heat A should give C the startup of 1560 m and therefore in 1 km the same will be 520 m.

EXAMPLE 6 A gives B, a start of 30 m or 10 seconds and end up the race of 1 km in dead heat. What is the ratio of speeds of A and B?

SOLUTION



Since, either B has the startup of 30 m or 10 seconds. It means B runs 30 m in 10 seconds. Hence, the speed of B is 3 m/s.

NOTE Don't be confused that A's speed = 3 m/s.
Also, it is very simple when A moves 1000 m, B moves 970 m. Since, the ratio of speeds is equal to the ratio of distances covered by A and B in the same time. Thus, the speed of

$$A : B = 1000 : 970 = 100 : 97$$

EXAMPLE 7 In a 1 km race A wins over B by 80 m or 20 seconds. B can give a start of 100 m to C in 1 km race. Find out that by how much time A will win over C? Also, find the ratio of speeds of B and C.

SOLUTION Ratio of speeds of A : B = 100 : 92

$$\text{Ratio of speeds of } B : C = 10 : 9$$

$$\therefore \text{Ratio of speeds of } A : B : C = 1000 : 920 : 828$$

$$\text{Also, Speed of } B = \frac{80}{20} = 4 \text{ m/s}$$

$$\text{Therefore, Speed of } C = 3.6 \text{ m/s}$$

Now, C has to cover 172 m distance in extra time. So, the time taken by C to cover the remaining distance = $\frac{172}{3.6} = 47.77 \text{ s}$.

$$\begin{aligned} \text{Ratio of speeds of } B : C &= \text{Ratio of distances covered by } B : C \\ &= 1000 : 900 = 10 : 9 \end{aligned}$$

$$\therefore \frac{\text{Speed of } B}{\text{Speed of } C} = \frac{10}{9}$$

EXAMPLE 8 A can win B by 250 m in a 2 km race. What should be the change in distance of startup? So, that B must cover 20% less distance than that by A in the same time.

SOLUTION

$$\frac{\text{Distance covered by } A}{\text{Distance covered by } B} = \frac{5}{4}$$

$$\frac{\text{Speed of } A}{\text{Speed of } B} = \frac{5}{4}$$

So, when A moves 2000 m, B should move 1600 m. But since initially B moves 1750 m. Therefore the new startup will be increased by 150 m.

EXAMPLE 9 The ratio of speeds of A and B is 4 : 7 and A loses the race by 270 m, then what is the length of the race course?

SOLUTION When B moves 7 m, A moves only 4 m. Hence, A loses the race by 3 m.

Now, since B loses by 3 m in the race of 7 m.
 \therefore B will lose 270 m in the race of 630 m.

EXAMPLE 10 The ratio of time taken to run a certain distance by Pythagorus and Hawkins is 4 : 3 and thus Hawkins wins the race by 360 m. What is the distance of race course?

SOLUTION

$$\frac{\text{Time taken by Pythagorus}}{\text{Time taken by Hawkins}} = \frac{4}{3}$$

$$\frac{\text{Speed of Pythagorus}}{\text{Speed of Hawkins}} = \frac{3}{4}$$

$$= \frac{\text{Distance covered by P}}{\text{Distance covered by H}}$$

Now, when Hawkins runs 4 m, Pythagorus runs 3 m and thus Hawkins wins by 1 m.

So, when Hawkins wins the race by 1 m, race course is 4 m.
when Hawkins wins the race by 360 m, race course is

$$360 \times 4 = 1440 \text{ m}$$

Alternatively : 360 = 25% of the total length of race.

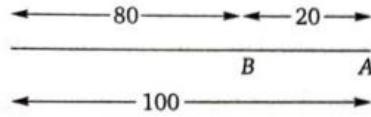
$$\therefore \text{length of race course} = 1440 \text{ m.}$$

EXAMPLE 11 In a race of D km, A wins over B by 0.2 D and in the same length of race B wins over C by 0.25 D. What should be the head-start to C, so that A and C finish the race at the same time.

SOLUTION Note: Instead of solving the problem using 'D' as a distance convert it into 100 i.e., suppose D = 100.

(It is just for your convenience.)

Now,



$$\text{Now, Speed of } A : B = 100 : 80 = 5 : 4$$

$$\text{Speed of } B : C = 4 : 3$$

$$\therefore \text{Speed of } A : B : C = 20 : 16 : 12$$

$$= 100 : 80 : 60$$

{40}

So, A can give 'C' a start of 40 m in 100 m race. Therefore, A can give 0.4 D. Start to 'C' in the race of D unit.

EXAMPLE 12 In a 3 km race the speeds of A and B are in the ratio of 6 : 5 and A wins by 10 seconds. What is the time taken by B to finish the race. Also, to end the race in dead heat what per cent of total distance A should give the startup to B?

SOLUTION Ratio of distances covered by A and B when A just reaches the finishing line = 6 : 5.

Thus, B has to cover 500 m distance in extra time and this 500 m distance is covered by B in 10 seconds. So, the speed of B = 50 m/s.

Thus, the total time required by B to complete the 3 km race

$$= \frac{3000}{50} = 60 \text{ s} = 1 \text{ min}$$

Since, B covers 16.66% distance less than A covers in the same time, so A should give 16.66% of the total distance as a startup to B.

EXAMPLE 13 In a 1 km race A gives B a startup of 5 seconds and still wins over B by 15 seconds. The ratio of speeds of A and B is 2 : 1. Find the time taken by A to finish 2.5 km race.

SOLUTION

$$\begin{aligned} \frac{\text{Speed of } A}{\text{Speed of } B} &= \frac{2}{1} \\ \frac{\text{Time taken by } A}{\text{Time taken by } B} &= \frac{1}{2} \\ \frac{t}{(t+20)} &= \frac{1}{2} \end{aligned}$$

$$\Rightarrow t = 20 \text{ s}$$

Thus, A needs 20 seconds to cover 1 km. Thus, to cover 2.5 km race he needs $20 \times 2.5 = 50$ seconds.

EXAMPLE 14 X can beat Y by 200 m in a race of 2000 m. Y can beat Z by 100 m in a race of 2500 m. By how many metres can X beat Z in a race of 1000 m?

SOLUTION Ratio of speeds of X and Y = 10 : 9 (2000 : 1800)

Ratio of speeds of Y and Z = 25 : 24 (2500 : 2400)

Ratio of speeds of X, Y and Z = 250 : 225 : 216

Since in a race of 250 m, X beats Z by 34 m.

So, in a race of 1000 m, X will beat Z by 136 m.

EXAMPLE 15 In a 6 km race B has 250 m headstart and C has 500 m headstart by A, still A beats C and B by 235 m and 350 m respectively. How many metres startup can B give to C so as to end up the race at the same time with C in the race of 6 km. Also find the ratio of speeds of A : B : C.

SOLUTION When A runs 6000 m, B runs 5400 m only and C runs 5265 m only.

So, when B runs 6000 m, C will run 5850 m. So, B can give 150 m startup to C.

$$\begin{aligned} \text{Ratio of speeds of } A : B : C &= 6000 : 5400 : 5265 \\ &= 1200 : 1080 : 1053 \\ &= 400 : 360 : 351 \end{aligned}$$

EXAMPLE 16 A can run 1 km in 2 min 20 second and B can run the same distance in 3 min. What is the distance travelled by B in the same time as A travels, when they start simultaneously in the race of 4.5 km.

$$\begin{aligned} \text{SOLUTION} \quad \frac{\text{Time taken by } A}{\text{Time taken by } B} &= \frac{140 \text{ s}}{180 \text{ s}} = \frac{7}{9} \end{aligned}$$

$$\therefore \frac{\text{Speed of } A}{\text{Speed of } B} = \frac{\text{Distance travelled by } A}{\text{Distance travelled by } B} = \frac{9}{7}$$

$$\text{Therefore, } B \text{ travels } \frac{7}{9} \times 4.5 = 3.5 \text{ km.}$$

EXAMPLE 17 Shahrukh takes 4 min to cover the same distance for which Urmila takes 6 min 30 sec. What is the ratio of distances covered by Shahrukh and Urmila in the race of 2.6 km and by what distance Shahrukh wins over Urmila?

$$\begin{aligned} \text{SOLUTION} \quad \frac{\text{Time taken by Shahrukh}}{\text{Time taken by Urmila}} &= \frac{240}{390} = \frac{8}{13} \end{aligned}$$

$$\begin{aligned} \text{Distance covered by Shahrukh} \\ \text{Distance covered by Urmila} &= \frac{13}{8} \end{aligned}$$

Hence, Shahrukh will win the race by 1 km.

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Time, Speed and Distance
EXAMPLE 18 A runs at the speed of $\frac{7}{4}$ times the speed of B. If calculation B finds that she has to run 300 m after A reaches to the winning post. What is the total distance of race?

SOLUTION

$$\frac{\text{Speed of } A}{\text{Speed of } B} = \frac{7}{4}$$

$$\frac{\text{Distance of } A}{\text{Distance of } B} = \frac{7}{4}$$

So, the total distance of race = 700 m.

$$(\because 7x - 4x = 300 \Rightarrow 7x = 700)$$

EXAMPLE 19 Time taken by A is $\frac{5}{7}$ of B's time for the same length of race. The speed of A is 84 m/s and A beats B by 240 m. What is the length of race course?

$$\text{SOLUTION} \quad \frac{\text{Speed of } A}{\text{Speed of } B} = \frac{\text{Time taken by } B}{\text{Time taken by } A} = \frac{7}{5}$$

$$\text{Now since, } 7x - 5x = 240$$

$$\Rightarrow 7x = 840 \text{ m}$$

EXAMPLE 20 In a race of 3000 m, Michal beats Nicholas by 60 m and Nicholas in a race of 2000 m beats Oscar by 600 m. In a 1 km race by how much distance Michal beats Oscar?

SOLUTION Ratio of speeds of M : N : O = 100 : 80 : 56

So, Michal (M) beats Oscar (O) by 440 m in 1 km race.

EXAMPLE 21 In a race of 500 m, President runs at 5 m/s. president gives chairman a start of 20 m and still beats him by 20 seconds, what is the chairman's speed?

SOLUTION Chairman has to cover only 480 m. He takes total

$$100 + 20 = 120 \text{ s}$$

$$\text{Therefore, speed of chairman} = \frac{480}{120} = 4 \text{ m/s}$$

EXAMPLE 22 In a race of 800 m Dholakiya gives Preetam a start of 200 m and then loses the race by 20 seconds. What is the speed of Preetam and Dholakiya respectively? If the ratio of respective speeds be 3 : 2.

SOLUTION Let the speed of Dholakiya be S_D and speed of Preetam be S_P and let the time taken by Preetam be t second then

$$\frac{S_D}{S_P} = \frac{\frac{800}{(t+20)}}{\frac{600}{t}} = \frac{2}{3}$$

$$\frac{800}{600} \times \frac{t}{(t+20)} = \frac{2}{3}$$

$$t = 20 \text{ s}$$

$$\therefore \text{Speed of Preetam} = \frac{600}{20} = 30 \text{ m/s}$$

$$\text{and} \quad \text{speed of Dholakiya} = \frac{800}{40} = 20 \text{ m/s}$$

EXAMPLE 23 In race of 1 km Sahara gives Birla a start of 250 m still Sahara wins by 150 m. What is the ratio of speeds of Sahara and Birla?

Time, Speed and Distance
SOLUTION When Sahara covers 1000 m, Birla covers only 600 m.
So, the ratio of speeds of Sahara and Birla
 $= 1000 : 600 = 5 : 3$

CIRCULAR MOTION

- (i) When the bodies are moving in the opposite direction, their relative speed becomes equal to the sum of their individual speed.
- (ii) When two bodies are moving in the same direction their relative speed becomes equal to the difference of the individual speeds.

First Meeting

- (i) Let A and B be two runners. Time taken by them to meet for the first time

$$= \frac{\text{Length of the circular track}}{\text{Relative speed}}$$

EXAMPLE 1 Arjun and Bhishma are running on a circular track of length 600 m (i.e., circumference of the track). Speed of Arjun is 30 m/s and that of Bhishma is 20 m/s. They start from the same point at the same time in the same direction. When will they meet again for the first time?

SOLUTION Time = $\frac{\text{Circumference}}{\text{Relative speed}}$
 $= \frac{600}{10} = 60 \text{ s}$

Actually Arjun (faster one) has to make a lead of 600 m, because when Arjun will be 600 m ahead (or extra distance) of Bhishma, they will be together again as a person when completes the total length (or circumference) it starts retracing the same path and thus Arjun and Bhishma can be together again.

Since, they make a difference (or Arjun makes a lead) of 10 m in 1 second. So, he will create 600 m difference in 60 second.

EXAMPLE 2 In the previous problem if they move in opposite direction, then what is the time taken by them to meet again for the first time?

SOLUTION Time = $\frac{\text{Circumference}}{\text{Relative speed}}$
 $= \frac{600}{50} = 12 \text{ s}$ $(30 + 20 = 50)$

EXAMPLE 3 Arjun and Bhishma run at the speed 30 m/s and 20 m/s respectively on the circular track of 600 m, as its circumference, when would the Arjun and Bhishma meet for the first time at the starting point if they start simultaneously from the same point?

SOLUTION Time taken by Arjun to complete one round

$$= \frac{600}{30} = 20 \text{ s}$$

Time taken by Bhishma to complete one round = $\frac{600}{20} = 30 \text{ s}$

EXAMPLE 24 Priyambada wins the race over Kokilaben by 150 m in a race of 1 km but when she gives a startup of 5 seconds to Kokilaben she wins by 65 m. Find the speed of Kokilaben.

SOLUTION In 5 seconds Kokilaben runs 85 m.
So, the speed of Kokilaben = 17 m/s.

- (ii) When there are more than two runners, then suppose A is the fastest runner and A meets B for the first time in t_{AB} seconds/hours and A meets C for the first time in t_{AC} seconds/hours and A meets D for the first time in t_{AD} seconds/hours and so on. Then time taken by all of them to meet for the first time is the LCM of t_{AB}, t_{AC}, t_{AD} etc.

First Meeting at the Starting Point

Let A takes t_A time to complete one round and B takes t_B time and C takes t_C time and so on, then the time taken to meet for the first time at the starting point = LCM of t_A, t_B, t_C etc.

Hence, after every 20 second, Arjun would be at the starting point and after every 30 second, Bhishma would be at the starting point. Thus the time taken by both to be at the starting point again for the first time

$$= \text{LCM of } 20 \text{ and } 30 = 60 \text{ s}$$

Thus, every 60 seconds they would be together at the starting point.

NOTE The required time for the bodies to meet for the first time at the starting point is immaterial to the direction of bodies i.e., whether they move in the same direction or in opposite direction.

EXAMPLE 4 Arjun, Bhishma and Nakul run on the circular path at the speed of 20 m/s, 30 m/s and 50 m/s respectively in the same direction. The circumference of the track (or path) is 600 m.

- (i) When will they be together again for the first time?
- (ii) When will they be together again for the first time at the starting point?

SOLUTION (i) Nakul meets Arjun after every $= \frac{600}{(50 - 20)} = 20 \text{ s}$

Nakul meets Bhishma after every $= \frac{600}{(50 - 30)} = 30 \text{ s}$

Therefore, all of the three would meet after every 60 seconds. ($60 = \text{LCM of } 20 \text{ and } 30$).

Hence, they would all meet for the first time after 60 seconds.

(ii) Arjun takes $\frac{600}{20} = 30 \text{ s}$ to complete one round

Bhismma takes $\frac{600}{30} = 20 \text{ s}$ to complete one round

and Nakul takes $\frac{600}{50} = 12 \text{ s}$ to complete one round

Hence, they would meet for the first time at the starting point after 60 seconds.

HINT $60 = \text{LCM of } 30, 20 \text{ and } 12.$

CLOCKS

Actually the movement of hour-hand and minute-hand follows the relative motion. The dial of the clock behaves like a circular track and where minute-hand is a faster runner and hour-hand is a slower one.

For better understanding with the clocks, assume 60 minutes shown on the dial as 60 points. Here we give an

EXAMPLE 1 How many times minute-hand coincides with hour-hand in 12 hours?

SOLUTION Time taken by minute-hand to meet hour-hand for the first time $= \frac{60}{55} = \frac{12}{11}$ hours.

(Assume initially both hands are at 12 i.e., 12 O' clock is shown by them.)

Therefore, after every $\frac{12}{11}$ hours minute hand and hour-hand meet each other (or coincide or overtake).

Now, since in $\frac{12}{11}$ hours they coincide 1 time

So, in 12 hours they will coincide

$$= \frac{12}{\frac{12}{11}} = \frac{12}{12} \times 11 = 11 \text{ times}$$

Remember: Between 11 O'clock and 1 O'clock, two hands coincide only one time, that's why they coincide with each other only 11 times in 12 hours.

NOTE In every $\frac{12}{11}$ hours (or $65 \frac{5}{11}$ min) two hands of a clock coincide.

EXAMPLE 2 In 12 hours how many times the two hands of clock will be just opposite to each other i.e., they make a straight line having the difference of 180° between them?

SOLUTION $180^\circ = 30 \text{ points}$

For the first time minute-hand and hour-hand will be separated in $\frac{30}{55} \text{ h}$ ($\text{Time} = \frac{\text{Required distance}}{\text{Relative speed}}$) and for every next

time they will take $\frac{60}{55}$ minutes more to occur as opposite to each other.

Since in $60/55$ hours they complete one round of clock's dial i.e., 60 points undergoing the relative motion, we have total 12 hours.)

Thus,

$$\frac{30}{55} + \frac{60}{55} + \frac{60}{55} + \frac{60}{55} + \dots = 12$$

\Rightarrow

$$\frac{30}{55} + \frac{60}{55} + \frac{60}{55} + \dots = \frac{12 \times 55}{55}$$

\Rightarrow

$$6 + 12 + 12 + \dots = 12 \times 11 = 132$$

\Rightarrow

$$6 + 12n = 132$$

\Rightarrow

$$12n = 126 \Rightarrow n = 10$$

only integral value is admissible.

Thus, total $10 + 1 = 11$ times both hands of a clock will be opposite to each other.

Remember:

Between 5 O'clock and 7 O'clock the two hands make 180° angle only one time, that's why they make 180° angle only 11 times in 12 hours, i.e., at exactly 6 O'clock they are 180° apart.

arbitrary new unit of distance as 'point'.

So, minute-hand (MH) runs on the circular track of 60 points at 60 points per hour and hour-hand (HH) runs at 5 points per hour. Now we become familiar with the relative motion of two hands of a clock.

Here, 1 point $= 6^\circ$ and 60 point $= 360^\circ$

also 1 point $= 6^\circ = 1 \text{ min}$

EXAMPLE 3 In 12 hours how many times a minute-hand and hour-hand of a clock makes 90° between them or becomes perpendicular to each other?

SOLUTION

$$90^\circ = 15 \text{ points}$$

This problem can be solved in two parts.

- (i) When minute-hand goes ahead of hour-hand.
- (ii) When hour-hand goes ahead of minute-hand.
- (iii) For the first time minute-hand and hour-hand will make 90° (or 15 points) difference in $\frac{15}{55}$ hours.

$$\text{time} = \frac{\text{distance}}{\text{relative speed}}$$

Now, after every $\frac{60}{55}$ hours they will occur at 90° . Since, in every $\frac{60}{55}$ hours they create a difference of 360° or 60 points (as the circumference of dial).

Now, we have 12 hours,

$$\therefore \frac{15}{55} + \frac{60}{55} + \frac{60}{55} + \dots = 12 \text{ h} = 12 \times \frac{55}{55}$$

$$\Rightarrow \frac{3}{11} + \frac{12}{11} + \frac{12}{11} + \dots = \frac{12 \times 11}{11}$$

$$\Rightarrow \frac{3}{11} + \left(\frac{12}{11} n \right) = \frac{12 \times 11}{11}$$

$$\Rightarrow 3 + 12n = 132$$

$$\Rightarrow n = \frac{129}{12} = 10$$

(only integral value of n is acceptable)

Therefore, $10 + 1 = 11$ times in 12 hours minute-hand makes 90° angle between the two hands, but when minute hand is ahead of hour-hand.

- (ii) For the first time minute-hand and hour-hand will make 90° (or 15 points) difference in $\frac{60 - 15}{55} = \frac{45}{55}$ hours.

Since, in this case minute-hand goes till it appears to be 15 points behind of hour-hand (consider initially they are showing 12 O'clock) then you will see that at 12 : 49 : 05 two hand are making 90° angle between them, while it appears to be hour-hand is ahead of minute-hand.

Now, for every next time after $\frac{60}{55}$ hours they will show the same situation.

we have 12 hours.

$$\text{So, } \frac{45}{55} + \frac{60}{55} + \frac{60}{55} + \frac{60}{55} + \dots = 12 \text{ h} = 12 \times \frac{55}{55}$$

$$\begin{aligned} \Rightarrow & \frac{3}{11} + \frac{4}{11} + \frac{4}{11} \dots = \frac{4 \times 11}{11} \\ \Rightarrow & 3 + 4 + 4 + \dots = 44 \\ \Rightarrow & 3 + 4n = 144 \end{aligned}$$

$\Rightarrow n = \frac{41}{4} = 10$, consider only integral value.

Thus, total $10 + 1 = 11$ times they will make 90° angle.

Hence, in 12 hours both hands make 90° angle $(11 + 11) = 22$ times in different positions.

Remember: At 3 O'clock and 9 O'clock they are at right angled. Since, except between 2-4 O'clock and 8-10 O'clock in each hour both hands make 90° angle 4 times while in the 2-4 O'clock and 8-10 O'clock two hands makes three-three times in every two hour.

EXAMPLE 4 Between 2 O'clock and 3 O'clock when two hands of a clock overlap each other?

SOLUTION To overlap or overtake minute-hand has to reduce the gap of 10 points. Since at 2 O'clock two hands are 10 point apart.

$$\begin{aligned} \text{Time} &= \frac{\text{Distance advanced}}{\text{Relative speed}} \\ &= \frac{10}{\frac{55}{55}} \text{ h} = \frac{10}{55} \times 60 \text{ min} \\ &= 10 \text{ min } 54 \text{ s} \end{aligned}$$

Thus, at 2 : 10 : 54 both hands of a clock coincide.

EXAMPLE 5 Between 6 am and 7 am when the two hands of a clock coincide.

SOLUTION Time = $\frac{30}{55} \text{ h} = \frac{30}{55} \times 60 \text{ min} = 32 \text{ min } 43 \text{ s}$

(Distance advanced = $6 \times 5 = 30$ points)

Thus at 6 : 32 : 43 two hands of a clock coincide.

EXAMPLE 6 Between 11 O'clock and 12 O'clock when will they coincide.

SOLUTION Distance advanced at 11 O'clock = 55 points

$$\begin{aligned} \text{Relative speed} &= 55 \text{ point/h} \\ \therefore \text{Time} &= \frac{55}{55} \text{ h} = 1 \text{ h} \end{aligned}$$

Hence, they will coincide at $(11 + 1) = 12$ O'clock.

EXAMPLE 7 Between 3 O'clock and 4 O'clock when will the two hands make 36° angle between them:

- (i) when hour-hand is ahead of minute-hand.
- (ii) when minute-hand is ahead of hour-hand.

SOLUTION (i) $36^\circ = 6$ points

Now, at 3 O'clock two hands are separated by exactly 15 points to which we have to reduce upto 6 points. Thus, we have to reduce $15 - 6 = 9$ points distance, with the relative speed of 55 point/h.
 \therefore Time required = $\frac{9}{55} \text{ h} = \frac{9}{55} \times 60$
 $= 9 \text{ min } 49 \text{ s}$

Thus at 3 : 09 : 49 they are 36° apart from each other.

(ii) At 3 O'clock both hands are 15 points apart so to make them 6 points apart minute-hand has to move for $(15 + 6) = 21$ points, since minute-hand has to go 6 points ahead of hour hand after crossing the hour-hand.

$$\therefore \text{Time} = \frac{21}{55} \text{ h} = \frac{21}{55} \times 60 \text{ min} = 22 \text{ min } 54 \text{ s}$$

Thus at 3 : 22 : 54, both hands will be 6 points (or 36°) apart from each other.

Did you notice something?

The same angle can be formed in two situations, one when hour-hand is ahead of minute-hand and when minute-hand is ahead of hour-hand.

Thus, you can find the required time by dividing the required difference of points (which you have to either create or reduce) by the relative speed.

EXAMPLE 8 What is the angle between the two hands at 3 : 10 am?

SOLUTION Assume 60th point (i.e., when it is 12 O'clock) as the origin.

Step 1. Find the distance of minute-hand from the origin.

Step 2. Find the distance of hour-hand from the origin.

Step 3. Take the difference between two values obtained in step 1 and step 2.

\therefore **Step 1.** 10 point = 60°

Step 2. $90^\circ + 5^\circ = 95^\circ$ (In 10 min hour-hand moves 5°)

Step 3. $95^\circ - 60^\circ = 35^\circ$

Thus, at 3 : 10 am two hands are 35° apart.

EXAMPLE 9 What is the angle between two hands of a clock at 7 : 35?

SOLUTION **Step 1.** At 7 : 35, minute-hand is $35 \times 6 = 210^\circ$ away from origin.

Step 2. At 7 : 35 hour-hand is $7 \times 30 + 35 \times \frac{1}{2} = 210 + 17.5 = 227.5^\circ$ away from the origin.

Step 3. $227.5^\circ - 210^\circ = 17.5^\circ$

Thus at 7 : 35, both hands make 17.5° angle between them.

NOTE A minute-hand moves 6° in one minute while a hour-hand moves $\left(\frac{1}{2}\right)^\circ$ in one minute.

EXERCISE

LEVEL 1

1. 'A' goes 10 km distance with average speed of 6 km/h while rest 20 km he travels with an average speed of 15 km/h. What is the average speed of 'A' **during** the whole journey?
- (a) 10 km/h (b) 12 km/h
 (c) 13 km/h (d) 14.5 km/h

2. A covers half of his distance with 20 km/h and rest with 30 km/h. What is the average speed during the whole journey?
- (a) 20 km/h (b) 24 km/h
 (c) 25 km/h (d) 26 km/h

3. A covers 1/3rd of his journey at the speed of 10 km/h and half of the rest at the speed of 20 km/h and rest at the speed of 30 km/h. What is the average speed of A?
- (a) $6\frac{2}{11}$ km/h (b) $16\frac{4}{11}$ km/h
 (c) $16\frac{4}{11}$ m/s (d) none of these

4. A covers 1/4th of his journey at 20 km/h and 1/3rd of the rest at 25 km/h and half of the rest at 30 km/h and rest at the speed of 40 km/h. What is the average speed of A?
- (a) $13\frac{78}{89}$ km/h (b) 12 km/h
 (c) $26\frac{86}{89}$ km/h (d) 28 km/h

5. A covered half of his journey at 20 km/h and rest at x km/h, then his average speed is 24 km/h. What is the value of x ?
- (a) 30 (b) 32
 (c) 36 (d) 40

6. A man covered half of the distance at $3x$ km/h and rest at $5x$ km/h. What is the average speed of the man?
- (a) $4x$ km/h (b) $3.5x$ km/h
 (c) $3.75x$ km/h (d) none of these

7. A person goes to his office at 1/3rd of the speed at which he returns from his office. If the average speed during the whole trip (i.e., one round) is 12 km/h. What is the speed of the person while he was going to his office?
- (a) 10 (b) 6
 (c) 8 (d) can't be determined

8. A person X starts from Lucknow and another persons Y starts from Kanpur to meet each other. Speed of X is 25 km/h, while speed of Y is 35 km/h. If the distance between Lucknow and Kanpur be 120 km and both X and Y start their journey at the same time, when will they meet?
- (a) 1 h later (b) 2 h later
 (c) $\frac{1}{2}$ h later (d) 3 h later

9. In the above question (no. 8), what is the distance from Lucknow where they meet?
- (a) 50 km (b) 60 km
 (c) 100 km (d) 80 km

10. Two persons A and B started from two different places towards each other. If the ratio of their speeds be 3 : 5, then what is the ratio of distance covered by A and B respectively till the point of meeting?
- (a) 1 : 2 (b) 3 : 4
 (c) 3 : 5 (d) 5 : 3

Directions for question number 11 to 16: A person P is at X and another person Q is at Y. The distance between X and Y is 100 km. The speed of P is 20 km/h. While the speed of Q is 60 km/h?

11. If they first time meet at point Z somewhere between X and Y then the distance between X and Z is :
- (a) 20 km (b) 40 km
 (c) 25 km (d) 30 km

12. If they continue to move to and fro between X and Y then what is the distance covered by P when they meet second time?
- (a) 105 km (b) 100 km
 (c) 80 km (d) 75 km

13. If they continue to move to and fro between X and Y then what is the distance travelled by Q, when they meet each other for the third time?
- (a) 375 km (b) 225 km
 (c) 350 km (d) 445 km

14. If P and Q continue to move between X and Y in the given manner and if they meet for the fourth time at a place M somewhere between X and Y, then the distance between X and M is :
- (a) 10 km (b) 90 km
 (c) 75 km (d) 25 km

15. If P and Q continue to move between X and Y, then the ratio of distances covered by P and Q when they meet for the 5th time?
- (a) 1 : 4 (b) 1 : 3
 (c) 2 : 3 (d) 3 : 4

16. If P and Q continue to move between X and Y, then the distance covered by P and Q together between any two consecutive meeting?
- (a) 100 (b) 300
 (c) 200 (d) can't be determined

Directions for questions number 17, 18 and 19: A persons P starts his journey from A and another person Q starts his journey from B, towards each other. The speeds of P and Q are 16 km/h and 25 km/h respectively and they meet at point M somewhere between A and B when they start their journey simultaneously.

17. What is the ratio of time taken by P and Q to reach at M?
 - 1 : 4
 - 1 : 1
 - 4 : 5
 - 16 : 25
18. What is the ratio of time taken by P and Q to reach B and A respectively?
 - 16 : 25
 - 1 : 1
 - 25 : 16
 - 4 : 5
19. What is the ratio of time taken by P and Q after meeting each other at M to reach B and A respectively?
 - 25 : 16
 - 625 : 256
 - 16 : 25
 - 4 : 5
20. The speeds of Vimal and Kamal are 30 km/h and 40 km/h. Initially Kamal is at a place L and Vimal is at a place M. The distance between L and M is 650 km. Vimal started his journey 3 hours earlier than Kamal to meet each other. If they meet each other at a place P somewhere between L and M, then the distance between P and M is :
 - 220 km
 - 250 km
 - 330 km
 - 320 km
21. In the above question (no. 20) what is the distance between L and P ?
 - 220 km
 - 320 km
 - 330 km
 - none of these

Directions for questions number 22 to 27: There are two places X and Y, 200 km apart from each other. Initially two persons P and Q both are at 'X'. The speed of P is 20 km/h and speed of Q is 30 km/h. Later on they starts to move to and fro between X and Y.

22. If they starts to move between X and Y, then for the first time when they will meet each other?
 - after 12 hours
 - after 24 hours
 - after 30 hours
 - after 8 hours
23. If they meet first time at a point M somewhere between X and Y, then what is the distance travelled by P?
 - 160 km
 - 150 km
 - 200 km
 - 210 km
24. If they meet second time each other at a point N somewhere between X and Y, then the distance travelled by Q is :
 - 240 km
 - 480 km
 - 360 km
 - none of these
25. If they meet third time each other at a point C, somewhere between X and Y, then the ratio of distances CX and CY is :
 - 3 : 2
 - 1 : 3
 - 2 : 3
 - 2 : 5
26. If they meet fourth time each other at a point D somewhere between X and Y, then what is the distance between D and X?
 - 75
 - 80
 - 150
 - 160
27. After starting their race, they meet each other for the n^{th} time at point X, then what is the minimum possible value of
 - 1
 - 2
 - 3
 - 5

Directions for questions number 28 to 33: A person X started 3 hours earlier at 40 km/h from a place P, then another person Y followed him at 60 km/h, started his journey at 3 O'clock, afternoon.

28. At what time will they meet to each other (or at what time will overtake X)?
 - 4:30 pm
 - 5 pm
 - 6 pm
 - 9 pm
29. At what time the difference between X and Y was 30 km, before Y overtakes X?
 - 6:30 pm
 - 7:30 pm
 - 8:75 pm
 - none of these
30. At what time Y will be 30 km ahead of X, after overtaking it?
 - 6:45 pm
 - 7:30 pm
 - 10:30 pm
 - 8 pm
31. What is the distance travelled by Y to overtake X?
 - 180 km
 - 420 km
 - 320 km
 - 360 km
32. What distance should Y cover so that he may reach 360 km ahead of X?
 - 1440 km
 - 1200 km
 - 920 km
 - 750 km
33. What is difference in time when X was 30 km ahead of Y and when Y was 30 km ahead of X?
 - 2
 - 3
 - 3.5
 - 4.25
34. A postman goes with a speed of 36 km/h what is the speed of postman in m/s?
 - 4.5 m/s
 - 6 m/s
 - 10 m/s
 - can't be determined
35. In the above question (no. 34) what is the speed in m/min?
 - 325
 - 432
 - 360
 - 600
36. In the above question (no. 34) what is the speed of postman in mile/h?
 - 22.37
 - 30.08
 - 28.30
 - 38.12
37. A train goes with a speed of 20 m/s. What is the speed of train in km/h?
 - 57 km/h
 - 72 km/h
 - 80 km/h
 - 120 km/h
38. As per the question (no. 37) what is the speed of train in km/min?
 - 1.2
 - 12
 - 1200
 - 120
39. A is twice fast as B and B is thrice as fast as C. The journey covered by C in 78 minutes will be covered by A in :
 - 12 min
 - 13 min
 - 15.5 min
 - none of these
40. The ratio of speeds of A is to B is 2 : 3 and therefore A takes 10 minutes less time than B takes. What is the ratio of time taken by A and B?
 - 2 : 3
 - 3 : 2
 - 2 : 5
 - 3 : 5
41. What is the time taken by A (in the above question)?
 - 1 h
 - 1.2 h
 - 0.6 h
 - 30 min

- 337

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Speed and Distance
Ques. Roorkee express normally reaches its destination at 50 km/h in 30 hours. Find the speed at which it travels to reduce the time by 10 hours?

- (b) 76 km/h
(d) 60 km/h

Ques. Two trains A and B start simultaneously in the opposite direction from two points P and Q and arrive at their destinations 16 and 9 hours respectively after their meeting each other. At what speed does the second train B travel if the first train travels at 120 km/h per hour :

- (a) 90 km/h
(b) 160 km/h
(c) 67.5 km/h
(d) none of these

Ques. There are two trains running on two parallel tracks. Length of each train is 120 m. When they are running in opposite directions, they cross each other in 4 seconds and when they are running in the same direction they cross in 12 seconds. What is the speed of the faster train?

- (a) 80 km/h
(b) 72 km/h
(c) 120 km/h
(d) 144 km/h

Ques. Two trains are travelling in the same direction at 22.5 km/h and 7.5 km/h respectively. The faster train crosses a man in the slower train in 18 seconds. What is length of the faster train?

- (a) 87.5 m
(b) 75 m
(c) 122.5 m
(d) none of these

Ques. A train covers a certain distance moving at a speed of 60 km/h. However if it were to halt for a fixed time every hour, its average speed comes out to be 50 km/h. For how much time does the train halt for every hour?

- (a) 6 min
(b) 10 min
(c) 12 min
(d) none of these

Ques. Two horses start trotting towards each other, one from A to B and another from B to A. They cross each other after one hour and the first horse reaches B, $\frac{5}{6}$ hour before the second horse reaches A. If the distance between A and B is 50 km. What is the speed of the slower horse?

- (a) 30 km/h
(b) 15 km/h
(c) 25 km/h
(d) 20 km/h

Ques. Pankaj walked at 5 km/h for certain part of the journey and then he took an auto for the remaining part of the journey travelling at 25 km/h. If he took 10 hours for the entire journey. What part of journey did he travelled by auto if the average speed of the entire journey be 17 km/h :

- (a) 750 km
(b) 100 km
(c) 150 km
(d) 200 km

Ques. A car travelled first 36 km at 6 km/h faster than the usual speed, but it returned the same distance at 6 km/h slower than the usual speed. If the total time taken by car is 8 hours, for how many hours does it travelled at the faster speed?

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

Ques. A dog starts chasing to a cat 2 hours later. It takes 2 hours to dog to catch the cat. If the speed of the dog is 30 km/h, what is the speed of cat?

- (a) 10 km/h
(b) 15 km/h
(c) 20 km/h
(d) can't be determined

Ques. Prachi starts from Barabanki at 6 am at constant speed of 60 km/h. She halts at Lucknow for half an hour and then drives at 40 km/h. If she reaches Kanpur at 9 : 30 am, which is 160 km from Barabanki, how far is Barabanki from Lucknow?

- (a) 75 km
(b) 80 km
(c) 100 km
(d) 120 km

Ques. Two trains whose respective lengths are 200 m and 250 m cross each other in 18 s, when they are travelling in opposite direction and in 1 min, when they are travelling in the same direction. What is the speed of the faster train (in km/h)?

- (a) 38.5
(b) 48.5
(c) 54
(d) 58.5

Ques. Abhinav started for the station half a km from his home walking at 1 km/h to catch the train in time. After 3 minutes he realised that he had forgotten a document at home and returned with increased, but constant speed to get it succeeded in catching the train. Find his latter speed in km/h :

- (a) 1.25
(b) 1.1
(c) $\frac{11}{9}$
(d) 2

Directions for question number 96-97: The ratio of speeds at which Anil and Mukesh walk is 3 : 4. Anil takes 30 minutes more than the time taken by Mukesh in reaching the destination.

Ques. If Anil drives the car at twice the speed of his walking then the time required to reach his destination by car is :

- (a) 45 min
(b) 60 min
(c) 1.5 h
(d) 1 h 20 min

Ques. What is the total distance travelled by each of them, if the average of speeds of Anil and Mukesh is 28 km/h?

- (a) 48
(b) 60
(c) 17 km
(d) 70

Ques. Train X starts from point A for point B at the same time that train Y starts from B to A. Point A and B are 300 km apart. The trains are moving at a constant speed atleast at 25 km/h. The trains meet eachother 3 hours after they start. If the faster train takes atleast 2 more hours to reach the destination. By which time will the slower train have definitely reached its destination? (Ignoring the length of trains in crossing)

- (a) 4 hours after the start
(b) 7.5 hours after the start
(c) 6 hours after the start
(d) none of the above

Ques. In reaching the Purnagiri a man took half as long again to climb the second third as he did to climb the first third and a quarter as long again for the last third as for the second third. He took altogether 5 hs 50 minutes. Find the time he spent on the first third of the journey?

- (a) 72 min
(b) 80 min
(c) 81 min
(d) 88 min

Ques. Walking at four fifth of his usual speed Vijay Malya reaches his office 15 minutes late on a particular day. The next day, he walked at $\frac{5}{4}$ of his usual speed. How early would he be to the office when compared to the previous day?

- (a) 27 min
(b) 32 min
(c) 30 min
(d) none of these

Directions for question number 122 and 123: A motor boat went downstream for 120 km and immediately returned. It took the boat 15 hours to complete the round trip. If the speed of the river were twice as high, the trip downstream and back would take 24 hours.

124. A boat sails 15 km of a river towards upstream in 5 hours. How long will it take to cover the same distance downstream, if the speed of current is one-fourth the speed of the boat in still water :

Directions for question number 128-129 : In a kilometre race, A can give B a start of 20 m and also in a half kilometre race C beats A by 50 m.

0. In a 1600 m race, A beats B by 80 m and C by 60 m. If they run at the same time then by what distance will C beat B in a 400 m race?

- (a) $5\frac{15}{77}$ m (b) $5\frac{20}{76}$ m
 (c) $15\frac{5}{77}$ m (d) none of these

132. A runs $\frac{7}{4}$ times as fast as B. If A gives B a start of 300 m, how far must the winning post be if both A and B have to end the race at same time?

- 135.** In a 1000 metres race Ravi gives Vinod a start of 40 m and beats him by 19 seconds. If Ravi gives a start of 30 seconds then Vinod beats Ravi by 40 m. What is the ratio of speed of Ravi to that of Vinod?

- 136.** In a race, the man who came two places ahead of the last man finished one place ahead of the man who came three places behind the man just ahead of the one who stood second. How many men finished the race?

- 138.** A gives both B and C a start of 60 m in a 1500 m race. However, while B finishes with him, C is 15 m behind them when A and B cross the finishing line. How much start can B give C for the 1500 m race course?

- (a) $7\frac{6}{23}$ m (b) $15\frac{7}{8}$ m
 (c) $7\frac{11}{16}$ m (d) $5\frac{5}{24}$ m

139. In a 600 m race Prabhat has a start of 200 m and the ratio of speeds of Prabhat and Nishith is 4 : 5, then the distance by which Prabhat wins by : (a) 80 m

- (a) 100 m (b) 80 m
 (c) 120 m (d) none of these

LEVEL 2

Directions for question number 1-4 : Aishwarya is going to cover a distance of 360 km from Ambala to Khandala. The first one-third of the distance she covers on a cycle. The second one-third she covers by an auto-rickshaw and the remaining distance she travels by car. The average speed of the journey by a car is 5 times the average speed by cycle and 20 km/h more than the average speed by auto-rickshaw, but she took 1 hour more by auto-rickshaw than by car.

- What is the average speed of the whole journey?
(a) 15 km/h (b) 24 km/h
(c) 20 km/h (d) none of these
 - What is the time taken in the whole journey?
(a) 10 h (b) 12 h
(c) 15 h (d) none of these
 - What is the distance covered by her in last five hours of her journey?
(a) 250 km (b) 240 km
(c) 200 km (d) can't be determined
 - Instead of travelling the first one-third by cycle if she travels by same auto-rickshaw with the same average speed, then what is the percentage decrease/increase in time taken during the entire journey?
(a) 46.66% (b) 33.33%
(c) 50% (d) 25%
 - Bipasha and Mallika leave towns Kolkata and Ambala at 6 am and travel towards Ambala and Kolkata respectively. Speed of Bipasha is 60 km/h and speed of Mallika is 120 km/h. Rani leaves Kolkata for Ambala sometime later and travels at a speed of 90 km/h. If the distance between Kolkata and

Ambala is 1080 km and all three meet at the same point on the way, at same time, then at what time did Rani leave Kolkata?

9. Kareena and Shahid start from Kurla and Worli towards Worli and Kurla respectively, at the same time. After they meet at Shantakruz on the way from Kurla to Worli, Kareena reduces her speed by 33.33% and returns back to Kurla and Shahid increases his speed by 33.33% and returns back to Worli. If Kareena takes 2 hours for the entire journey, what is the time taken by Shahid for the entire journey?

- the time taken by ~~train~~ for the entire journey?

 - (a) 96 min
 - (b) 84 min
 - (c) 168 min
 - (d) can't be determined

10. Due to the technical snag in the signal system two trains start approaching each other on the same rail track from two different stations, 240 km away from each other. When the train starts a bird also starts moving to and fro between the two trains at 60 km/h touching each time each train. The bird is initially sitting on the top of the engine of one of the trains and it moves so till these trains collide. If these trains collide one and a half hour after the start, then how many kilometres bird travells till the time of collision of trains?

 - (a) 90 km
 - (b) 130 km
 - (c) 120 km
 - (d) none of these

11. Einstein walks on an escalator at a rate of 5 steps per second and reaches the other end in 10 seconds. While coming back, walking at the same speed he reaches the starting point in 40 seconds. What is the number of steps on the escalator?

 - (a) 40
 - (b) 60
 - (c) 120
 - (d) 80

12. A girl while walking diametrically across a semicircular playground, takes 3 minutes less than if she had kept walking round the circular path from A to B. If she walks 60 metres a minute, what is the diameter of the play ground :

 - (a) 60 m
 - (b) 48 m
 - (c) 84 m
 - (d) 315 m

13. Two trains start simultaneously from two stations Howrah and Bandra, respectively towards each other on the same track. The distance between the two stations is 560 km and the speed of trains are 30 and 40 km/h. Simultaneously with the trains, a sparrow sitting on the top of one of the train starts towards the other and reverses its direction on reaching the other train and so on. If the speed of sparrow is 80 km/h then the distance that the sparrow flies before being crushed between the train is :

 - (a) 70 km
 - (b) 560 km
 - (c) 640 km
 - (d) 650 km

14. A surveillance plane is moving between two fixed places Pukhwara and Kargil at 120 km/h. The distance between two places is 600 km. After 18 hour what will be the distance between the Kargil and its position if it is starts moving from Pukhwara?

 - (a) 360 km
 - (b) 300 km
 - (c) 240 km
 - (d) none of these

15. The speed of a car during the second hour of its journey is thrice that in the first hour. Also its third hours speed is the average speed of the first two hours. Had the car travelled at the second hours speed during all the first three hours, then it would have travelled 150 km more. Find the percentage reduction in time in the second case for the first three hours :

- 343
- (a) $33\frac{1}{3}\%$
 (b) 40%
 (c) 25%
- (d) 50%
16. There are three runners Tom, Dick and Harry with their respective speeds of 10 km/h, 20 km/h and 30 km/h. They are initially at P and they have to run between the two points P and Q which are 10 km apart from each other. They start their race at 6 am and end at 6 pm on the same day. If they run between P and Q without any break, then how many times they will be together either at P and Q during the given time period?

(a) 5
 (b) 7
 (c) 4
 (d) 12
- Directions for question number 17 and 18 :** Arjun and Srikrishna go by chariot from Mathura to Kurukshetra which is on the way to Hastinapur. Abhimanyu goes from Hastinapur to Kurukshetra. The distance between Mathura to Hastinapur is 700 km and the distance between Hastinapur and Kurukshetra is 300 km. Speed of Arjun and Srikrishna's chariot is 25 km/h and speed of Abhimanyu is 10 km/h. All the three persons start their journey at 10 am. After travelling some miles Srikrishna sees Duryodhan going (by riding on his horse) at 20 km/h to Kurukshetra. Arjun and Srikrishna go ahead meet Abhimanyu and pick him up. Then they return immediately to Kurukshetra and thus all the four reach at the same time.
17. What is the total distance travelled by Arjun?

(a) 400
 (b) 500
 (c) 600
 (d) can't be determined

18. What is the total time taken to reach Kurukshetra?

(a) 10 h
 (b) 15 h
 (c) 18 h
 (d) 24 h

19. Priyanka, Akshay and Salman started out on a journey to watch the newly released movie "Mujhse Shaadi Karogi", which was being shown at wave cine-multiplex. The multiplex was 120 km away from their starting point of journey. Priyanka and Salman went by car at the speed of 50 km/h, while Akshay travelled by Tonga (horse cart) at 10 km/h. After a certain distance Salman got off and travelled the rest distance by another Tonga at 10 km/h, while Priyanka went back for Akshay and reached the destination at the same time that Salman arrived. The number of hours required for the trip was :

(a) 4 h
 (b) 5 h
 (c) 4.8 h
 (d) can't be determined
- Directions for question number 20 and 21 :** Ajai and Kajol start towards each other at the same time from Barabanki and Fatehpur for their destinations Fatehpur and Barabanki respectively which are 300 km apart. They meet each other 120 km away from Barabanki.
20. Shahrukh starts from Barabanki to Fatehpur, 1 hour after Ajai starts. Shahrukh meets Kajol 1.5 hours after Shahrukh starts. If the speed of Shahrukh is atleast 20 km/h faster than the speed of Kajol.

Which of the following statements is true?

Time, Speed and Distance
24 min
can't determine

- 344

 - (a) The minimum possible speed of Ajai is 45 km/h
 - (b) The maximum possible speed of Ajai is 45 km/h
 - (c) The minimum possible speed of Kajol is 60 km/h
 - (d) The maximum possible speed of Kajol is 60 km/h

Directions for question number 22-24 : Raghupati goes at a speed of 60 km/h. Raghav goes at a speed of 36 km/h. Raja Ram can go from Azamgarh to Barelley in 2 hours. The distance between Azamgarh to Barelley is equal to the distance between Azamgarh to Chandoli. Raghav takes the same time travelling from Barelley to Azamgarh as from Barelley to Chandoli at his regular speed which is twice the speed of Raja Ram.

- 24.** If Raghupati and Raja Ram travel towards each other from Barelley and Chandoli respectively, how far from Barelley will they meet each other?

Directions for question number 25-26 : Mohan, Namit and Pranav travel from Shantipur to Hulchulpur. They have a two seater bike which can be driven by only Mohan. It is known that due to very stringent traffic rules only two persons can ride at a time. Hulchulpur is 180 km away from Shantipur. All of them can walk at 6 km/h, but reach to Hulchulpur simultaneously also they started their journey simultaneously.

27. While walking down on the pavements of New York city. I notice that every 20 minute there is a city bus coming in the opposite direction and every 30 minute there is a city bus overtaking me from behind. What is the time gap between one city bus passing a stationary point known as Local Bus Stop beside the route and the immediately next city bus in the same direction passing the same stationary point?

- 28.** Abhinav and Brijesh start from Allahabad and Barabanki respectively with uniform velocities. Abhinav is heading towards Barabanki and Brijesh towards Allahabad and both cities are 600 km apart. Abhinav rests whenever Brijesh is on the move and Brijesh rests whenever Abhinav is on the move. Abhinav's speed is 25 km/h and Brijesh's speed is 30 km/h. If Abhinav starts first and reaches Barabanki in 36 hours, then find the least time that Brijesh would take to reach his destination after Abhinav makes a start :

29. A man can cross a downstream river by steamer in 40 minutes and same by boat in 1 hour. If the time of crossing the river in upstream direction by steamer is 50% more than downstream time by the steamer and the time required by boat to cross the same river by boat in upstream is 50% more than the time required in downstream by boat. What is the time taken for the man to cross the river downstream by steamer and then return to same place by boat half the way and by steamer the rest of the way?

Directions for question number 30 and 31 : Awadh express and Bokaro express start simultaneously from Lucknow and Jamshedpur towards each other and continuously shuttle between these two places. Every time these trains meet each other, they turn back after exchanging their respective speeds. The initial ratio of their speeds is 2 : 1.

33. A soldier fired two bullets at an interval of 335 seconds moving at a uniform speed v_1 . A terrorist who was running ahead of the soldier in the same direction, hears the two shots at an interval of 330 seconds? If the speed of sound is 1188 km/h, then who is the faster and by how much?

34. Speed and distance
 (a) Soldier, 22 km/h
 (c) Soldier, 18 km/h
 (d) Terrorist, 20 km/h

34. A hunter fired two shots from the branch of a tree at an interval of 76 seconds. A tiger separating too fast hears the two shots at an interval of 83 seconds. If the velocity of the sound is 1195.2 km/h, then find the speed of tiger?
 (a) 112.8 km/h
 (b) 100.8 km/h
 (c) 80.16 km/h
 (d) none of these

35. A man goes to the fair in Funcity with his son and faithful dog. Unfortunately man misses his son which he realises 20 minutes later. The son comes back towards his home at the speed of 20 m/min and man follows him at 40 m/min. The dog runs to the son (child) and comes back to the man (father) to show him the direction of his son. It keeps moving to and fro at 60 m/min between son and father, till the man meets the son. What is the distance travelled by the dog in the direction of the son?
 (a) 800 m
 (b) 1675 m
 (c) 848 m
 (d) 1000 m

36. Amarnath express left Amritsar for Gorakhpur. Two hours later Gorakhnath express left from Amritsar to Gorakhpur. Both trains reached Gorakhpur simultaneously. If Amarnath express had started from Amritsar and Gorakhnath express had started from Gorakhpur at the same time and travelled towards each other they would meet in 1 h 20 min. Find the time taken by Amarnath express to travel from Amritsar to Gorakhpur (in hours):

- (a) 2
 (b) 4
 (c) 5
 (d) 6

37. Akbar and Birbal set out at the same time to walk towards each other respectively from Agra and Banaras 144 km apart. Akbar walks at the constant speed of 8 km/h, while Birbal walks 4 km in the first hour, 5 km in the second hour, 6 km in the third hour and so on. Then the Akbar and Birbal will meet:
 (a) in 6 h
 (b) in 8 h
 (c) midway between Agra and Banaras
 (d) 80 km away from Banaras

38. A tiger is 50 of its own leaps behind a deer. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 m and 5 m per leap respectively, what distance will the tiger have to run before it catches the deer?
 (a) 600 m
 (b) 700 m
 (c) 800 m
 (d) 1000 m

39. Soniya and Priyanka started from Amethi and Bellari for Bellari and Amethi, which are 645 km apart. They meet after 15 hours. After their meeting, Sonia increased her speed by 3 km/h and Priyanka reduced her speed by 3 km/h, they arrived at Bellari and Amethi respectively at the same time. What is their initial speeds?
 (a) 24 km/h and 30 km/h
 (b) 25 km/h and 18 km/h
 (c) 18 km/h and 21 km/h
 (d) 20 km/h and 23 km/h

40. Den Bosch and Eastbourne are two famous cities 300 km apart. Maradona starts from Den Bosch at 8 : 24 am. An hour later Pele starts from Den Bosch. After travelling for 1 hour, Pele reaches Nottingham that Maradona had passed

40 minutes earlier. Nottingham falls on the way from Den Bosch to Eastbourne. If Pele and Maradona just reaches Eastbourne at the same time, what are the speeds of the Maradona and Pele respectively?

- (a) 100 km/h, 125 km/h
 (b) 60 km/h, 80 km/h
 (c) 60 km/h, 75 km/h
 (d) 75 km/h, 100 km/h

41. A thief sees a jeep at a distance of 250 m, coming towards him at 36 km/h. Thief takes 5 seconds to realise that there is nothing but the police is approaching him by the jeep and start running away from police at 54 km/h. But police realise after 10 seconds, when the thief starts running away, that he is actually a thief and gives chase at 72 km/h. How long after thief saw police did police catch up with him and what is the distance police had to travel to do so?
 (a) 50 s, 1000 m
 (b) 65 s, 1150 m
 (c) 65 s, 1300 m
 (d) 45 s, 1050 m

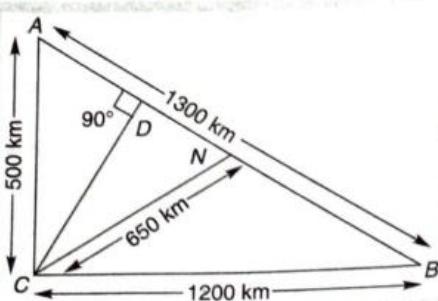
42. Inspired by the 'Golden quadrilateral project' UP Government recently accomplished a diamond triangular project. Under this project the State Government laid down 6 lane roads connecting three cities Ayodhya, Banaras and Chitrakoot, which are equally separated from each other i.e., in terms of geometry they form an equilateral triangle. Angad and Bajrang start simultaneously from Ayodhya and Banaras respectively, towards Chitrakoot. When Angad covers 100 kms, Bajrang covers such a distance that the distance between Angad and Bajrang makes 90° angle with the road joining Banaras and Chitrakoot. When Bajrang reaches Chitrakoot, Angad is still 150 km away from Chitrakoot. What is the distance between Ayodhya and Banaras?
 (a) 250 km
 (b) 450 km
 (c) 300 km
 (d) none of these

43. Two trains Ajanta express and Barouni express simultaneously started on two parallel tracks from Meerut to Nagpur, which are 390 km apart. The ratio of the speed of Ajanta express and Barouni express is 6 : 7. After how long (in kms) travelling, Barouni express exchanges the speed with Ajanta express so that both the trains reach at their destination simultaneously:

- (a) 150 km
 (b) 190 km
 (c) 210 km
 (d) can't be determined

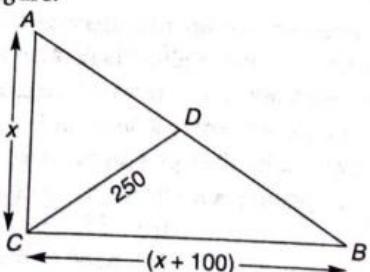
44. In a circus there was a leopard and a tiger walking in the two different rings of same radii. There I observed that when leopard moved 3 steps, tiger moved 5 steps in the same time, but the distance traversed by leopard in 5 steps is equal to the distance traversed by tiger in 4 steps. What is the number of rounds that a leopard made when tiger completed 100 rounds?
 (a) 120
 (b) 48
 (c) 75
 (d) none of these

45-48 : Directions for question number 45-48 : In the following figure the route is shown which is followed by Professor Jai and Professor Jaya, who are visiting faculty at IIM-A and IIM-B respectively. A, B denote IIM-A and IIM-B respectively and C denotes the residence of Prof. Jai and Prof. Jaya. They leave home for classes at the same time and their driving speeds are $\frac{500}{13}$ km/h and $\frac{1200}{13}$ km/h respectively. Also they finish the classes at the same time to reach home.



The path adopted by Jai and Jaya is $CADC$ and $CBDC$ respectively. Prof. Jai and Prof. Jaya are husband and wife respectively.

45. If both of them start and finish the classes at the same time, then who returned home earlier than other, if no one of them halts for anywhere in the route and they just leave the institution as soon as they finish the lectures?
- Prof. Jai
 - Prof. Jaya
 - Return at the same time
 - Can't be determined
46. In the shown figure N and D denotes Noida and Delhi respectively, who returned home late and by how much time, if Jaya turned from Noida instead of Delhi :
- Jai, 9 h 10 min
 - Jaya, 9 h 50 min
 - Jai, 2 h 55 min
 - Jai, 16 h 10 min
47. In the above question how many per cent time Jaya saved in going via Noida of the total time taken previously :
- 10%
 - 25%
 - 50%
 - 17%
48. If Mrs. Jaya wants to watch the premier show of a movie at Wave Cinema in Noida while returning from institute through BNC. When will she return home given that she spends total time 3 hours at wave cinema?
- at the same time as normal
 - 5 min late than her husband
 - at the same time when her husband returns
 - can't be determined
49. Preetam and Devi start running a race on the given track as shown in figure.



Where AC and BC are mutually perpendicular and CD is the median of triangular paths ABC . BC is 100 km longer than that of AC , again CD is 250 km. The speeds of Preetam and Devi are 30 km/h and 40 km/h, initially and their respective paths of running are $CADC$ and $CBDC$. After how much time they reverse their speeds so that they return C at the same time?

- $\frac{50}{7}$ h
- $\frac{120}{7}$ h
- $\frac{80}{11}$ h
- none of these

Directions for question number 50, 51, and 52: The numbers M_1, M_2, M_3, \dots etc of Vyapaar city are lying besides the circular paths P_1, P_2, P_3, \dots etc. All the circular paths are concentric at centre 'O' and their distances are 1 km, 2 km, 3 km, ... etc from the centre 'O' respectively. At the centre 'O' there is a "Khoob Khao" tiffin agency which supplies the tiffins to all the markets M_1, M_2, M_3, \dots etc. A tiffin carrier starts from 'O' directly east of the shop and then on reaching the circular path P_1 moved 1 km in counter clock direction on it. After completing a 1 km distance on P_1 the carrier moves to P_2 in the radial direction. Then it goes 2 km on P_2 . Similarly 3 km on P_3 and 4 km on P_4 etc and motion of the carrier continued in this manner till it reaches exactly in the east direction.

50. After reaching east of the shop it can't move on further than the given distance on the current path. For how many markets can it supply its tiffins directly?
- 4
 - 5
 - 7
 - can't be determined
51. The total distance covered by the carriers in providing the tiffins from centre 'O' to the last point in one way only is :
- 30 km
 - 28 km
 - 35 km
 - none of these
52. The ratio of distances covered on the circular path P_2 to that on the last path, where the carrier reaches directly eastward of its shop is :
- 1 : 1
 - 2 : 7
 - 2 : π
 - none of these

Directions for question number 53-57: A train enters into tunnel AB at A and exits at B . A jackal is sitting at O in another by passing tunnel AOB , which is connected to AB at A and B , where OA is perpendicular to OB . A cat is sitting at P inside the tunnel AB making the shortest possible distance between O and P , such that $AO : PB = 30 : 32$. When a train before entering into the tunnel AB makes a whistle (or siren) somewhere before A , the jackal and cat run towards A . Further if the cat moves towards B instead of A it again meets with accident at the exit of the tunnel by the same train coming from the same direction.

53. What is the ratio of speeds of jackal and cat?
- 4 : 3
 - 5 : 3
 - 1 : 1
 - can't be determined
54. The ratio of speeds of jackal is to train is :
- 5 : 1
 - 3 : 5
 - 1 : 5
 - can't be determined
55. If jackal moves towards OPA , it will meet with train at M_1 then AM_1 is :
- 20 km
 - 16 km
 - 10 km
 - can't be determined
56. If jackal moves towards OPB and cat moves towards POA will not meet with accident with the train?
- Jackal
 - Cat
 - Both (a) and (b)
 - Can't be determined
57. The ratio of time taken by cat and jackal in moving OPA and $PBOP$ respectively given that they do not meet with accident
- 1 : 1
 - 3 : 4
 - 5 : 4
 - none of these

58. A candle of 6 cm long burns at the rate of 5 cm in 5 h and another candle of 8 cm long burns at the rate of 6 cm in 4 h. What is the time required by each candle to remain of equal lengths after burning for some hours, when they start to burn simultaneously with uniform rate of burning?

(b) 1.5 h
(d) none of these

59. Two boats start at the same instant to cross a river W metre wide. The faster boat reaches the other bank and returns back immediately. What are the distances travelled by them when they meet, where the speeds of these boats are b_1 & b_2 ?

$$(a) \frac{2W}{(b_1 + b_2)}, \frac{2W}{(b_1 - b_2)}$$

$$(b) \frac{2W}{(b_1 + b_2)} b_1 \text{ and } \frac{2W}{(b_1 + b_2)} b_2$$

$$(c) \frac{W}{(b_1 + b_2)} b_1, \frac{W}{(b_1 + b_2)} b_2$$

$$(d) \text{data insufficient}$$

60. Mariya was travelling in her boat when the wind blew her hat off and the hat started floating back downstream. The boat continued to travel upstream for twelve more minutes before Mariya realized that her hat had fallen off and turned back downstream. She caught up with that as soon as it reached the starting point. Find the speed of river if Mariya's hat flew off exactly 3 km from where she started :

(a) 5 km/h
(b) 6 km/h
(c) 7.5 km/h
(d) can't be determined

61. Akbar, Birbal and Chanakya run around a circular track of length 500 m. Akbar and Birbal run with the speeds of 15 m/s and 20 m/s in the same direction respectively and Chanakya being very intelligent run in the opposite direction with a speed of 25 m/s. If all three of them start at the same time, then :

(a) Akbar meets Chanakya more frequently than Birbal does
(b) Akbar and Chanakya meets as frequently as Birbal and Chanakya
(c) Akbar meets Birbal least frequently
(d) Nothing can be concluded

62. Arun and Barun run with the speeds of 30 m/s and 20 m/s around a circular track of 600 m. They participate in a 3000 m race. What is the distance covered by Arun when he passes Barun for the 5th time?

(a) 2200 m
(b) 2250 m
(c) 2850 m
(d) none of these

63. Akkal and Bakkal are running on a circular track of radius 175 metres. Akkal can complete a round in 100 seconds and the speed of Bakkal is twice the speed of Akkal. They started simultaneously towards each other from two points 350 metres diametrically opposite on the circular path. If they first meet at a point they called it love point, which is between the two points P and Q from where they have started their race, after how much time from the start do they meet at love point for the third time?

(a) $218\frac{2}{5}$ s
(b) $216\frac{2}{3}$ s
(c) 221 s
(d) none of these

64. Arti and Barkha start swimming towards each other from the deep end and shallow end respectively of a swimming pool in Funcity. They start their swimming simultaneously in the length of 300 m pool. The ratio of their speeds is 1 : 2 respectively. Each swimmer rests for 6 seconds once she

reaches the other end and starts swimming back. Where will they meet for the second time in the still water of swimming pool?

(a) 30 m from the shallow end
(b) at the shallow end
(c) at the deepend
(d) can't be determined

65. A and B runs around a circular track. A beats B by one round or 10 minutes. In this race, they had completed 4 rounds. If the race was only of one round, find the A's time over the course :

(a) 8 min
(b) 7.5 min
(c) 12.5 min
(d) 12 min

66. A, B and C participated in a race. A covers the same distance in 49 steps, as B covers in 50 steps and C in 51 steps. A takes 10 steps in the same time as B takes 9 steps and C takes 8 steps. Who is the winner of the race?

(a) A
(b) B
(c) C
(d) can't be determined

67. Shambhu drives his car very fast at 360 m/s. Moving ahead for some hours he finds some problem in headlights of the car. So he takes 20 seconds in changing the bulb of the headlight by stopping the car. Mean while he notices that another car which was 400 m back is now 200 m ahead of his car. What is the speed of this car?

(a) 100 km/h
(b) 92 km/h
(c) 108 km/h
(d) 300 km/h

68. Two persons start from the opposite ends of a 90 km straight track and run to and fro between the two ends. The speed of first person is 30 m/s and the speed of other is $125/6$ m/s. They continue their motion for 10 hours. How many times they pass each other?

(a) 10
(b) 9
(c) 12
(d) none of these

69. At what time after 3 : 10 am, the acute angle made by the minute and hour-hand is double to that of at 3 : 10 am, for the first time?

(a) 4 h 43 min
(b) 3 h 48 min
(c) $3\frac{320}{11}$ min
(d) none of these

70. If the two incorrect watches are set at 12 : 00 noon at correct time, when will both the watches show the correct time for the first time given that the first watch gains 1 min in 1 hour and second watch loses 4 min in 2 hours :

(a) 6 pm, 25 days later
(b) 12 : 00 noon, 30 days later
(c) 12 noon, 15 days later
(d) 6 am 45 days later

71. Rajeev and Sanjeev are too close friends. Rajeev's watch gains 1 minute in an hour and Sanjeev's watch loses 2 minutes in an hour. Once they set both the watches at 12 : 00 noon, with my correct watch. When will the two incorrect watches of Rajeev and Sanjeev show the same time together?

(a) 8 days later
(b) 10 days later
(c) 6 days later
(d) can't be determined

72. At a railway station a 24 hour watch loses 3 minutes in 4 hours. If it is set correctly on Sunday noon when will the watch show the correct time?

(a) 6 pm after 40 days
(b) 12 noon after 75 days
(c) 12 pm after 100 days
(d) 12 noon after 80 days

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after every $\frac{65}{11}$ minutes. How much time do you save?

SPEED TEST (TSD)



Directions for question number 1 to 3: Arun took part in a triathlon, an athletic event. He had to swim, run and bicycle to 10 km, 24 km and 30 km, respectively and return the same way. Arun's average speed for the triathalon is 4 km/h. He took a total of 4 min for swimming and 20 min for bicycling in the triathalon.

Directions for the question number 6 to 9: City X and City Y are connected to a straight road. A and B start moving simultaneously towards each other. After travelling some distance, B takes a 60° turn to his left. Two hours later after B turns, A takes a 60° turn to his right. A travels 60 km after turning, before he meets B. A and B meet 10 hours after they start their journey. A and B together travel 200 km before turning and they arrive at the meeting point simultaneously.

6. How many hours after turning does A meet B ?
 (a) 1 (b) 3 (c) 4 (d) 5

7. What distance does A travel before turning 60 degree to his right?
 (a) 140 km (b) 150 km
 (c) 160 km (d) 170 km

8. If A and B had not turned, after how many hours would they have met?
 (a) $7\frac{1}{8}$ h (b) $9\frac{1}{8}$ h (c) $6\frac{1}{8}$ h (d) $8\frac{1}{8}$ h

9. What is B's speed?
 (a) 10 km/h (b) 12.5 km/h
 (c) 12 km/h (d) 15 km/h

10. Chetak and Ashwa, two horses, start galloping from Patna to Ranchi which are 80 km apart. The speed of Chetak is 160 km/h and that of Ashwa is 150 km/h. They start galloping simultaneously, from Patna to Ranchi. Chetak reached to Ranchi and returned to Patna but Ashwa returned from Jamshedpur (which is somewhere between Patna and Ranchi) to Patna at the same time. What is the ratio of distances between Patna and Jamshedpur and Jamshedpur and Ranchi?
 (a) 15 : 1 (b) 3 : 25
 (c) 15 : 2 (d) none of these

INTRODUCTORY EXERCISE-9.1

1 (a)	2. (c)	3. (c)							
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LEVEL-1

1 (a)	2. (b)	3. (b)	4. (c)	5. (a)	6. (c)	7. (c)	8. (b)	9. (a)	10. (c)
11. (c)	12. (d)	13. (a)	14. (d)	15. (b)	16. (c)	17. (b)	18. (c)	19. (b)	20. (c)
21. (b)	22. (d)	23. (a)	24. (b)	25. (c)	26. (d)	27. (d)	28. (d)	29. (b)	30. (c)
31. (d)	32. (a)	33. (b)	34. (c)	35. (d)	36. (a)	37. (b)	38. (a)	39. (b)	40. (c)
41. (a)	42. (b)	43. (b)	44. (c)	45. (c)	46. (c)	47. (c)	48. (b)	49. (a)	50. (b)
51. (b)	52. (a)	53. (b)	54. (c)	55. (c)	56. (c)	57. (a)	58. (b)	59. (d)	60. (b)
61. (a)	62. (c)	63. (c)	64. (c)	65. (b)	66. (d)	67. (d)	68. (c)	69. (d)	70. (a)
71. (a)	72. (a)	73. (b)	74. (c)	75. (b)	76. (c)	77. (b)	78. (c)	79. (a)	80. (c)
81. (d)	82. (b)	83. (c)	84. (c)	85. (b)	86. (d)	87. (b)	88. (b)	89. (d)	90. (c)
91. (c)	92. (b)	93. (d)	94. (d)	95. (c)	96. (b)	97. (a)	98. (b)	99. (b)	100. (a)
101. (d)	102. (a)	103. (c)	104. (b)	105. (b)	106. (c)	107. (d)	108. (a)	109. (b)	110. (c)
111. (b)	112. (d)	113. (c)	114. (d)	115. (a)	116. (b)	117. (d)	118. (b)	119. (b)	120. (b)
121. (b)	122. (b)	123. (c)	124. (b)	125. (b)	126. (c)	127. (d)	128. (b)	129. (a)	130. (a)
131. (d)	132. (b)	133. (c)	134. (b)	135. (b)	136. (b)	137. (b)	138. (b)	139. (a)	140. (c)
141. (c)	142. (d)	143. (d)	144. (d)	145. (b)	146. (a)	147. (b)	148. (d)	149. (a)	150. (c)

LEVEL-2

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

SPEED TEST-1

1 (b)	2. (c)	3. (b)	4. (b)	5. (d)	6. (b)	7. (a)	8. (d)	9. (c)	10. (a)
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LEVEL (1)

1. Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{10 + 20}{\frac{10}{6} + \frac{20}{15}}$

$$= \frac{30}{\left(\frac{90}{30}\right)} = \frac{30}{3} = 10 \text{ km/h}$$

2. Average speed (when distances are same) = $\frac{2uv}{u+v}$

$$= \frac{2 \times 20 \times 30}{(20+30)} = 24 \text{ km/h}$$

where u, v are the different speeds.

(or use the general formula—Total distance/Total time)

3. Average speed = $\frac{3uvw}{uv + vw + uw}$

$$= \frac{3 \times 10 \times 20 \times 30}{200 + 600 + 300} = \frac{18000}{1100}$$

$$= 16 \frac{4}{11} \text{ km/h}$$

Alternatively: Suppose the total distance 3 times the LCM of the given speeds, then solve by general formula.

Total distance = 180 km (say)

then Total time = $\frac{60}{10} + \frac{60}{20} + \frac{60}{30}$

$$= 6 + 3 + 2 = 11 \text{ h}$$

∴ Average speed = $\frac{180}{11} = 16 \frac{4}{11} \text{ km/h}$

Alternatively: Suppose the total distance equals to $3x$ km then solve as above.

4. Suppose the total distance equals to 4 times the LCM of the speeds.

∴ Total distance = 2400 km

∴ Total time = $\frac{600}{20} + \frac{600}{25} + \frac{600}{30} + \frac{600}{40}$

$$= 30 + 24 + 20 + 15 = 89 \text{ h}$$

∴ Average speed = $\frac{2400}{89} = 26 \frac{86}{89} \text{ km/h}$

5. $\frac{2 \times 20 \times x}{(20+x)} = 24$

⇒ $x = 30 \text{ km/h}$

Alternatively: Go through options.

6. Average speed = $\frac{2uv}{u+v}$

$$= \frac{2 \times 3x \times 5x}{(3x+5x)} = 3.75x \text{ km/h}$$

7. $u = k, v = 3k$

$$\therefore \frac{2uv}{u+v} \Rightarrow \frac{2 \times k \times 3k}{(k+3k)} = 12$$

$1.5k = 12$

$k = 8 \text{ km/h}$

Alternatively: Go through options.

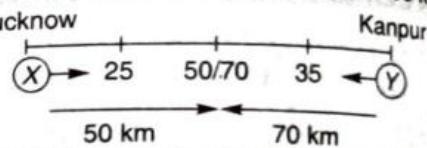
Alternatively: Solve through alligations.

8. Effective speed = $25 + 35 = 60 \text{ km/h}$

Total distance to be covered = 120 km

∴ Time taken = $\frac{120}{60} = 2 \text{ h}$

HINT Since in each hour X and Y together covers 60 km.

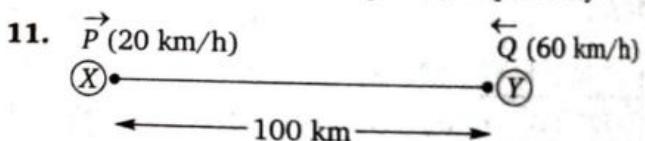


9. Since they take 2 hours to meet each other. Thus in 2 h, 50 km away from Lucknow.

Alternatively: Both X and Y will cover the respective distances in the ratio of their speeds.

So, distance from Lucknow = $\frac{5}{12} \times 120 = 50 \text{ km}$

10. When time is constant the distances covered by A and B will be in the ratio of their speeds, respectively.



To meet each other they have to cover 100 km distance together and the ratio of distances covered by each one is directly proportional to the ratio of their speeds, respectively. Since the time taken by each one is same (i.e., constant).

Hence, $\frac{XZ}{YZ} = \frac{20}{60} = \frac{1}{3}$

∴ $XZ = \frac{1}{4} \times 100 = 25 \text{ km}$

12. To meet the second time they have to cover 300 km distance together [for n^{th} time distance = $(2n-1)d$] Time taken by them to meet each other, for the second time

$$= \frac{300}{80} = 3 \frac{3}{4} \text{ h}$$

Distance covered by P = $20 \times 3 \frac{3}{4} = 75 \text{ km}$

Alternatively: The ratio of distance covered = Ratio of their speeds

∴ Distance covered by P = $\frac{1}{4} \times 300 = 75 \text{ km}$

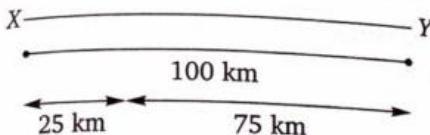
13. The ratio of distance covered by each of them
= Ratio of their respective speeds

$$\therefore \text{Distance covered by } Q \text{ for the third meeting} = \frac{3}{4} \times 500 \\ = 375 \text{ km}$$

14. Consider the distance travelled by any one of them, then find the distance between X and M , where they meet.

$$\therefore \text{The distance travelled by } P \text{ for the fourth meeting} \\ = \frac{1}{4} \times 700 = 175 \text{ km}$$

Therefore P will be 75 km from Y . It means P will be 25 km away from X .



15. This is constant for any number of meeting and is equal to the ratio of their speeds. Hence, 1 : 3.

16. It is always twice the length of race course. Hence, between any two consecutive meeting they have to cover total 200 km distance to meet each other for the next meeting.

HINT
For the first meeting they will cover 100 km.
For the second meeting they will cover 300 km.
For the third meeting they will cover 500 km.
For the fourth meeting they will cover 700 km and so on.

17. To meet each other they will take equal time since they start their journey simultaneously.

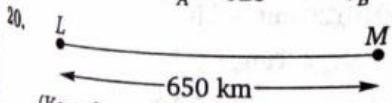
18. To reach their destination the time taken by A and B is equal to the ratio of reciprocal to their speeds. Since when distance is constant time is inversely proportional to the respective speeds.

$$\text{Hence, time taken by } A \text{ and } B = \frac{1}{16} : \frac{1}{25} = 25 : 16$$

$$19. \frac{A's \text{ speed}}{B's \text{ speed}} = \sqrt{\frac{\text{Time taken by } B (t_B)}{\text{Time taken by } A (t_A)}}$$

$$\frac{16}{25} = \sqrt{\frac{t_B}{t_A}}$$

$$\Rightarrow \frac{t_B}{t_A} = \frac{256}{625} \Rightarrow \frac{t_A}{t_B} = \frac{625}{256}$$



In the first 3 hours Vimal covers 90 km.

So, the rest distance = 560 km

Now, Kamal and Vimal both travel together, towards each other.

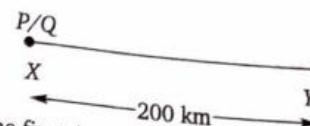
$$\text{So, the time} = \frac{\text{Distance}}{\text{Speed}} = \frac{560}{70} = 8 \text{ h}$$

Thus, Vimal travels total = $3 + 8 = 11 \text{ h}$

Thus, the distance travelled by Vimal = $11 \times 30 = 330 \text{ km}$

21. The distance covered by Kamal = $8 \times 40 = 320 \text{ km}$

22.



To meet the first time they have to cover $200 \times 2 = 400 \text{ km}$

Now, the time taken to meet each other = $\frac{400}{50} = 8 \text{ h}$

23. Distance travelled by $P = 20 \times 8 = 160 \text{ km}$

24. Distance travelled by $Q = 30 \times \frac{800}{50} = 480 \text{ km}$

25. Distance travelled by $P = 20 \times \frac{1200}{50} = 480 \text{ km}$

So, P will be 80 km away from X . Therefore ratio of distances
 $= \frac{80}{120} = \frac{2}{3}$

26. The distance travelled by $P = \frac{1600}{50} \times 20 = 640 \text{ km}$

Thus, P will be 160 km away from X .

[Since $640 = (200 \times 2) + 240$]

\therefore Distance between D and X is 160 km.

27. This is possible only when the distance covered by P in n round be the multiple of 400.

28. X started at 12 : 00 noon
 Y started at 3 pm

$$\text{Required time} = \frac{\text{Distance advanced in 3 h}}{\text{Relative speed}}$$

$$= \frac{40 \times 3}{20} = 6 \text{ h} \quad (20 = 60 - 40)$$

Hence, Y will overtake X at 9 pm. $(3 + 6 = 9)$

29. Required time = $\frac{\text{Distance advance} - \text{Required difference}}{\text{Relative speed}}$

$$= \frac{120 - 30}{20} = \frac{90}{20} = 4.5 \text{ h}$$

Thus, at 7 : 30 pm X and Y will be 30 km apart.

30. Required time = $\frac{\text{Distance advanced} + \text{Required difference}}{\text{Relative speed}}$

$$= \frac{120 + 30}{20} = \frac{150}{20} = 7.5 \text{ h}$$

Thus at 10 : 30 pm X and Y will be 30 km apart.

31. Distance travelled by Y to overtake X
= Time taken \times Speed of Y
 $= 6 \times 60 = 360 \text{ km}$

Thus, Y will overtake X at a distance of 360 km from P .

32. Required distance

$$= \left(\frac{\text{Distance advanced} + \text{Required difference}}{\text{Relative speed}} \right) \times (\text{Speed of } Y)$$

$$= \frac{120 + 360}{20} \times 60 = 1440 \text{ km}$$

33. Time (when X was 30 km ahead of Y) = $\frac{120 - 30}{20} = 4.5 \text{ h}$

Time (when Y was 30 km ahead of X) = $\frac{120 + 30}{20} = 7.5 \text{ h}$

Thus, required difference in time = 3 h

352

34. Speed = 36 km/h

$$= 36 \times \frac{5}{18} = 10 \text{ m/s}$$

35. Since in 60 minutes postman goes 36000 metre.

$$\text{So in 1 minute postman goes } \frac{36000}{60} = 600 \text{ metre}$$

Thus, his required speed = 600 m/min

36. 1 mile = 1609.3 m = 1.6093 km

$$\therefore 1 \text{ km} = \frac{1}{1.6093} \text{ mile} = 0.6213882 \text{ mile}$$

$$\therefore \text{Required speed} = 36 \times 0.6213882 \text{ mile/h} \\ = 22.37 \text{ mile/h}$$

37. Speed = 20 m/s = $20 \times \frac{18}{5} = 72 \text{ km/h}$

38. In one hour train goes 72 km. So in one minute train will go $\frac{72}{60}$.

$$\therefore \text{Speed} = \frac{6}{5} = 1.2 \text{ km/min}$$

39. The ratio of speeds of A, B, C = 6 : 3 : 1

\therefore The ratio of time taken by A, B, C = 1 : 2 : 6

\therefore Time taken by A = 13 min

40. $A : B$

$$\text{Speed} \quad 2 : 3$$

$$\text{Time} \quad 3x : 2x$$

41. $\therefore 3x - 2x = 20 \Rightarrow x = 20$

$$\therefore 3x = 60 \text{ min} = 1 \text{ h}$$

42. Let the original speed be S_1 and time t_1 and distance be D

$$\text{Now, } \frac{D/2}{2t_1} = S_2$$

$$\therefore S_2 = \frac{D}{4t_1} \text{ and } S_1 = \frac{D}{t_1}$$

$$\therefore \frac{S_1}{S_2} = \frac{D/t_1}{D/4t_1} = \frac{4}{1}$$

43. You can go through options to check the required difference.

Alternatively: Required distance

$$= \frac{S_1 S_2}{(S_1 - S_2)} \times \text{Time difference} \\ = \frac{5 \times 8}{3} \times \frac{3}{2} = 20 \text{ km}$$

Alternatively: Take the LCM of distances then solve by unitary method.

LCM of 5, 8 = 40

Now, consider 40 km as a distance, then there is a 3 hours difference in 40 km. So, 3/2 hours difference will be in 20 km.

Alternatively: Let x be the distance, then

$$\frac{x}{5} - \frac{x}{8} = \frac{3}{2}$$

$$x = 20 \text{ km}$$

\Rightarrow

44. $A : B$

$$\text{Speed} \quad 2 : 3$$

$$\text{Time} \quad 3 : 2$$

$\therefore B$ takes 48 minutes so A will take 72 minutes
 $= 1 \text{ h } 12 \text{ min}$

45. The ratio of distances = 160 : 140 = 8 : 7

The ratio of speeds = 8 : 7

$$\therefore \frac{x}{9} - \frac{x}{10} = \frac{20}{60}$$

$$x = 30 \text{ km}$$

47. Time taken by Abhinav = 4 h

Time taken by Praveen = 3.5 h

For your convenience take the product of times taken by both as a distance.

Then the distance = 14 km

Since, Abhinav covers half of the distance in 2 hours (i.e., 8 am)

Now, the rest half (i.e., 7 km) will be covered by both Praveen and Abhinav.

$$\text{Time taken by them} = \frac{7}{7.5} = 56 \text{ min}$$

Thus, they will cross each other at 8 : 56 am.

48. 9 km difference arises in the 99 km distance.

\therefore 72 km difference will arise in the 792 km distance.

49. Apply the product constancy concept

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{5} \downarrow & & \frac{1}{4} \uparrow = 15 \text{ min} \end{array}$$

$$\text{Since, } \frac{x}{4} = 15 \text{ min} \Rightarrow x = 60 \text{ min} = 1 \text{ h}$$

So, the original (or usual) time = 60 min = 1 h

50.

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{4} \downarrow & & \frac{1}{3} \uparrow = 2 \text{ h} \end{array}$$

$$\Rightarrow \text{Usual time} = 2 \times 3 = 6 \text{ h}$$

51.

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{2} \uparrow & & \frac{1}{3} \downarrow = 40 \text{ min} \end{array}$$

$$\Rightarrow \text{Usual time} = 3 \times 40 = 120 \text{ min} = 2 \text{ h}$$

52.

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{2}{20} = \frac{1}{10} \downarrow & & \frac{1}{9} \uparrow = 10 \text{ min} \end{array}$$

$$\Rightarrow \text{Usual time} = 9 \times 10 = 90 \text{ min} = \frac{3}{2} \text{ h}$$

\therefore Distance travelled = Speed \times Time

$$= 20 \times \frac{3}{2} = 30 \text{ km}$$

53. Increase in speed = 1 km
 Change in time = 25 min

$$\begin{array}{ccc} \text{Speed} & & \text{Time} \\ \frac{1}{5} \uparrow & & \frac{1}{6} \downarrow = 25 \end{array}$$

Time $\frac{5}{2}$
 Usual (normal) time = $6 \times 25 = 150$ min
 \therefore Distance = Normal speed \times Normal time
 $= 5 \times \frac{5}{2} = 12.5$ km

54. Since, they are 1.5 km apart in each hour.
 \therefore 7.5 km apart they will be in 5 hours.
 (Since, in the same direction speeds are subtracted)

55. In each hour they will be 720 km apart.
 (Since in opposite direction speeds are added)

56. Let the distance = x km and usual rate = y km/h

$$\begin{aligned} \frac{x}{y} - \frac{x}{(y+6)} &= 4 \text{ h} \\ \therefore \quad \frac{x}{(y-4)} - \frac{x}{y} &= 4 \end{aligned} \quad \dots(\text{i}) \quad \dots(\text{ii})$$

From Eqs. (i) and (ii), we get

$$\frac{x}{y} - \frac{x}{(y+6)} = \frac{x}{(y-4)} - \frac{x}{y}$$

$$\Rightarrow y = 24$$

Now putting the value of $y = 24$ in Eq (i), we get

$$x = 480$$

Alternatively:

$$\begin{array}{l} S \swarrow T \\ +6 \quad -4 \end{array} \Rightarrow -4S + 6T = |-4 \times 6|$$

$$\begin{array}{l} S \swarrow T \\ -4 \quad +4 \end{array} \Rightarrow 4S - 4T = |-4 \times 4|$$

$$\begin{aligned} -4S + 6T &= 24 & \dots(\text{i}) \\ 4S - 4T &= 16 & \dots(\text{ii}) \end{aligned}$$

Solving these two equations, we get

$$T = 20 \quad \text{and} \quad S = 24$$

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

$$= 24 \times 20 = 480 \text{ km}$$

57. Let the original speed be x km/h, then

$$\begin{aligned} \frac{600}{x} - \frac{600}{(x+20)} &= 1 \\ \therefore 600 \left(\frac{x+20-x}{x(x+20)} \right) &= 1 \\ \therefore x^2 + 120x - 12000 &= 0 \\ \therefore (x-120)(x+100) &= 0 \\ \therefore x = 100 \quad \text{and} \quad x = 120 & \\ \text{Original speed} &= 100 \text{ km/h} \end{aligned}$$

Alternatively:

$$S_1 \times S_2 = \text{Distance} \times \frac{\text{Difference in speed}}{\text{Difference in time}}$$

$$\therefore = 600 \times \frac{20}{1} = 600 \times 20 = 12000$$

$$S_1 \times S_2 = 12000$$

$$S_1 = 100 \quad \text{and} \quad S_2 = 120$$

(Factorise 12000 in such a way that the difference be 20) S_1 is the original speed and S_2 is the changed speed.

58. Very similar to question number 57.

$$180 \times \frac{5}{3} = 60 \times 5$$

$$S_1 \times S_2 = 300 = 15 \times 20$$

$$S_1 = 15 \text{ km/h}$$

$$S_2 = 20 \text{ km/h}$$

$$\text{Alternatively: } S_1 \times (S_1 + 5) = 300$$

$$\Rightarrow S_1 = 15 \text{ km/h}$$

59. Very similar to previous problems

$$t_1 \times t_2 = \text{Distance} \times \frac{\text{Difference in time}}{\text{Difference in speed}}$$

$$\Rightarrow t_1 \times t_2 = 1680 \times \frac{6}{14}$$

$$\Rightarrow t_1 \times t_2 = 120 \times 6 = 720 = 30 \times 24$$

$$[\text{since } t_2 = (t_1 - 6) \Rightarrow t_1 \times (t_1 - 6) = 720 \Rightarrow t_1 = 30]$$

$$\text{Therefore, usual time} = 30 \text{ h}$$

$$60. \text{Relative speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{60 + 40}{20} = 5 \text{ m/s}$$

$$\therefore 5 \text{ m/s} = 5 \times \frac{18}{5} = 18 \text{ km/h}$$

Now, Relative speed = 18 km/h

= Speed of ambulance - Speed of school bus

18 = 30 - speed of school bus

Speed of school bus = 12 km/h

$$61. \quad \begin{array}{ccc} \text{Time} & & \text{Speed} \\ \frac{1}{4} \downarrow & & \frac{1}{3} \uparrow \end{array}$$

Since he has to increase his speed by $\frac{1}{3}$ rd of the original speed.

So, the new speed = $15 + 5 = 20 \text{ km/h}$

$$\text{Alternatively: } 15 \times 4 = 3 \times x$$

$$\Rightarrow x = 20 \text{ km/h}$$

$$62. \text{Time (required)} = \frac{\text{Length of train}}{\text{Speed of train}}$$

$$= \frac{350}{70} = 5 \text{ s}$$

$$63. \text{Time taken to cross the bridge} = \frac{\text{Total length}}{\text{Speed of train}}$$

$$= \frac{270 + 130}{40} = \frac{400}{40}$$

$$= 10 \text{ s}$$

$$64. \text{Speed of train} = \frac{225}{9} = 25 \text{ s}$$

$$\text{Now, Time taken to cross the tunnel} = \frac{225 + 450}{25} = 27 \text{ s}$$

65. Let the length of the tunnel be x m, then

$$\text{Time} = \frac{\text{Length of train} + \text{Length of tunnel}}{\text{Speed}}$$

$$60 = \frac{350 + x}{10} \quad \left(\text{Speed} = 36 \times \frac{5}{18} = 10 \text{ m/s} \right)$$

$$\Rightarrow x = 250 \text{ m}$$

$$66. \text{ Speed of train} = \frac{\text{Length of train} + \text{Length of platform}}{\text{Time}}$$

$$= \frac{250 + 250}{25} = 20 \text{ m/s}$$

$$= 72 \text{ km/h}$$

67. Let the length of the Sabarmati express is x metre then,

$$\frac{x + 162}{18} = \frac{x + 120}{15} \quad \text{Speed of train}$$

$$\Rightarrow x = 90 \text{ m}$$

$$68. \text{ Time} = \frac{\text{Length of train}}{\text{Relative speed}}$$

$$= \frac{200}{19} = 10 \frac{10}{19} \text{ s}$$

$$(\text{Relative speed} = 72 - 3.6 = 68.4 \text{ km/h} = 19 \text{ m/s})$$

$$69. \text{ Time} = \frac{\text{Length of train}}{\text{Relative speed}}$$

$$= \frac{350}{35} \times 6 = 60 \text{ s}$$

$$(\text{Relative speed} = 20 + 1 = 21 \text{ km/h} = 21 \times \frac{5}{18} = \frac{35}{6} \text{ m/s})$$

$$70. \text{ Relative speed} = 50 - 40 = 10 \text{ km/h} = \frac{50}{18} \text{ m/s}$$

$$\therefore \text{Time taken} = \frac{\text{Sum of length of the trains}}{\text{Relative speed}}$$

$$= \frac{200}{50} \times 18 = 72 \text{ s}$$

$$71. \text{ Relative speed} = 50 + 40 = 90 \text{ km/h}$$

$$= 90 \times \frac{5}{18} = 25 \text{ m/s}$$

$$\therefore \text{Time taken} = \frac{\text{Sum of lengths of train}}{\text{Relative speed}} = \frac{200}{25} = 8 \text{ s}$$

$$72. \text{ Let the length of train be } x \text{ m, then}$$

$$\frac{x}{10} = \frac{120 + x}{18}$$

$$\Rightarrow x = 150 \text{ m}$$

$$73. \text{ Let the speed of train be } x \text{ km/h, then}$$

$$\frac{175}{10} = (9 + x) \times \frac{5}{18}$$

$$\Rightarrow x = 54 \text{ km/h}$$

$$74. \text{ Relative speed} = \text{Sum of speeds of two trains} \\ = (60 + x)$$

$$\text{Time} = \frac{\text{Sum of length of two trains}}{\text{Relative speed}}$$

$$10 = \frac{250}{(60 + x) \times 5} \times 18$$

$$(60 + x) = 90$$

$$x = 30 \text{ km/h}$$

75. Let the length of the train be x metre, and let the speed of the train be y km/h, then

$$x = (y + 3) \times \frac{5}{18} \times 36$$

and

$$x = (y + 6) \times \frac{5}{18} \times 30$$

From Eq. (i) and (ii), we get

$$(y + 3) \times 36 = (y + 6) \times 30$$

$$y = 12 \text{ km/h}$$

$$\therefore x = (y + 3) \times \frac{5}{18} \times 36$$

$$\text{or} \quad x = 15 \times \frac{5}{18} \times 36$$

$$\text{or} \quad x = 150 \text{ m}$$

$$76. \text{ Let the length of each train be } x \text{ m, then}$$

$$S_1 = \frac{x}{4} \quad \text{and} \quad S_2 = \frac{x}{5}; \quad S_1 \text{ and } S_2 \text{ are speeds}$$

$$\text{Now, required time} = \frac{2x}{\frac{x}{4} + \frac{x}{5}} = \frac{40}{9} \text{ s}$$

$$77. \quad \begin{array}{ccc} & \text{Pushpak} & \text{Bhopal} \\ \text{Time} \rightarrow & 10 & : 8 \\ \text{Speed} \rightarrow & 8 & : 10 \\ \Rightarrow & 4x & : 5x \end{array}$$

$$\text{Since, } 5x - 4x = 10$$

$$\Rightarrow 5x = 50 \quad \text{and} \quad 4x = 40$$

$$\therefore \text{Average speed} = \frac{2 \times 40 \times 50}{40 + 50} = 44 \frac{4}{9} \text{ km/h}$$

$$78. \text{ Required time} = \frac{\text{Distance advanced}}{\text{Relative speed}} = \frac{4 \times 40}{20} = 8 \text{ h}$$

Thus, the faster train will overtake at 8 pm.

$$79. \text{ Required distance} = \text{Time taken in overtaking} \times \text{Faster's speed} \\ = 8 \times 60 = 480 \text{ km from Meerut}$$

$$80. \text{ In 50 minute Rajdhani express can cover 50 km. So, the speed} \\ \text{distance} = 650 \text{ km, which will be jointly covered by both trains}$$

$$\therefore \text{Time taken} = \frac{650}{(60 + 70)} = 5 \text{ h}$$

$$\text{Distance from Lucknow} = 5 \times 70 = 350 \text{ km}$$

$$81. \text{ Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{560 + 360}{16} = 57 \frac{1}{2} \text{ h}$$

$$82. \text{ Average speed} = \frac{2 \times 80 \times 120}{200} = 96 \text{ km/h}$$

$$83. \quad \begin{array}{c} \text{Distance} = \text{Average speed} \times \text{Average time} \\ \text{or} \\ \text{Distance} = 96 \times \frac{25}{2} \end{array}$$

$$84. \quad \begin{array}{c} \text{Distance} = 1200 \text{ km} \\ \text{or} \\ 50 \times 30 = x \times 20 \\ \Rightarrow x = 75 \text{ km/h} \end{array}$$

$$\frac{s_1}{s_2} = \sqrt{\frac{t_2}{t_1}}$$

$$\frac{120}{s_2} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

$$s_2 = 160 \text{ km/h}$$

$$s_1 + s_2 = \frac{240}{4} = 60$$

$$s_1 - s_2 = \frac{240}{12} = 20$$

$$s_1 = 40 \text{ m/s} \quad \text{and} \quad s_2 = 20 \text{ m/s}$$

$$s_1 = 40 \times \frac{18}{5} = 144 \text{ km/h}$$

87. Time taken to cross the man = $\frac{\text{Length of the faster train}}{\text{Relative speed}}$

$$18 = \frac{x}{15 \times \frac{5}{18}} \Rightarrow x = 75 \text{ m}$$

88. Suppose the total distance be 300 km (LCM of 50 and 60) then in the first case it takes only 5 hours and in the second case it takes 6 hours.

Thus, in 6 hours trains halts for 1 hour.

Therefore in 1 hour train halts for $1/6$ hour = 10 m

Alternatively: Difference in speeds = 10 km/h

Faster speed = 60 km/h

$$\therefore \text{Required time per hour} = \frac{10}{60} = \frac{1}{6} \text{ h} = 10 \text{ min}$$

89. If the speed of faster horse be f_s and that of slower horse be s_s , then

$$f_s + s_s = \frac{50}{1} = 50$$

and

$$\frac{50}{s_s} - \frac{50}{f_s} = \frac{5}{6}$$

Now, you can go through options.

The speed of slower horse is 20 km/h.

Since,

$$20 + 30 = 50$$

and

$$\frac{50}{20} - \frac{50}{30} = \frac{5}{6}$$

90. Let he walked for x hours, then

$$5x + 25(10 - x) = 17 \times 10$$

$$x = 4$$

$$10 - x = 6 \text{ h}$$

Hence, distance travelled by auto = $25 \times 6 = 150 \text{ km}$.

91. Let the original speed be $x \text{ km/h}$ then,

$$\frac{36}{(x - 6)} + \frac{36}{(x + 6)} = 8$$

Now, you can go through options or solve it as follows

$$\frac{(x + 6) + (x - 6)}{(x^2 - 36)} = \frac{8}{36}$$

$$x = 12 \quad \text{and} \quad x = -3$$

Thus, the possible value of $x = 12$

Time taken by faster speed = 2 h

92.

$$\text{Time} = \frac{\text{Distance advanced}}{\text{Relative speed}}$$

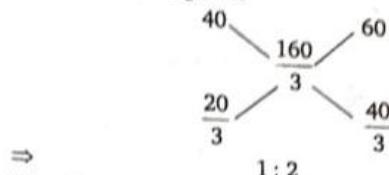
$$2 = \frac{2 \times x}{(30 - x)}$$

$$\Rightarrow x = 15 \text{ km/h}$$

93. Prachi travels only for 3 hours, since half an hour she halts at Lucknow.

Now, the average speed (except the halt) = $\frac{160}{3} \text{ km/h}$

Therefore, by alligation



$$\Rightarrow 1 : 2$$

Therefore, the ratio of time taken at 40 km/h and at 60 km/h is 1 : 2.

Thus, the distance between Lucknow and Kanpur
= $2 \times 60 = 120 \text{ km}$

94. Let the speed of the faster train be f_s and slower train be s_s , then

$$f_s + s_s = \frac{200 + 250}{18} = 25 \text{ m/s}$$

$$\text{and} \quad f_s - s_s = \frac{200 + 250}{60} = \frac{450}{60} = 7.5 \text{ m/s}$$

$$\therefore f_s = 16.25 \text{ m/s}$$

$$= 16.25 \times \frac{18}{5} = 58.5 \text{ km/h}$$

95. Distance covered in 3 minutes = $3 \times \frac{1000}{60} = 50 \text{ m}$

Now he has to cover $(500 + 50)$ metres in $(30 - 3)$ minutes

$$\therefore \text{New speed} = \frac{550/1000}{27/60} = \frac{11}{9} \text{ km/h}$$

96. Anil Mukesh

Speed →	3	:	4
Time →	4	:	3

$$\text{But} \quad 4x - 3x = \frac{1}{2} \text{ h}$$

$$\Rightarrow 4x = 2 \text{ h} \quad \text{and} \quad 3x = 1.5 \text{ h}$$

Now, since Anil doubles the speed so time will be half of the actual time. Hence, new time will be 1 hour.

97. Average speed of Anil and Mukesh = $\frac{3x + 4x}{2} = 28$

$$\Rightarrow x = 8$$

$$\therefore \text{Speed of Sameer} = 3 \times 8 = 24 \text{ km/h}$$

$$\therefore \text{Distance travelled} = 2 \times 24 = 48 \text{ km}$$

98. Let the speed of X and Y be the $x \text{ km/h}$ and $y \text{ km/h}$ respectively. Since they meet after 3 hours, so $x + y = 100$. Since, the faster train takes atleast $3 + 2 = 5$ hours to complete the 300 km journey. Hence, minimum possible speed for the slower train = 40 km/h at which speed it will take 7.5 h to complete the journey. ($7.5 = \frac{300}{40}$)

99. Let the time taken in first third part of the journey be x minutes, then the time required in second third part of the journey is $\frac{3x}{2}$ and in the last third part of the journey time required is $\frac{15x}{8}$.

$$\text{Therefore, } x + \frac{3x}{2} + \frac{15x}{8} = 350 \text{ min}$$

$$\Rightarrow x = 80 \text{ min}$$

100.

Speed	Time
$\frac{1}{5} \downarrow$	$\frac{1}{4} \uparrow$

 = 15 min

Therefore usual time = $4 \times 15 = 60$ min

Now,

Speed	Time
$\frac{1}{4} \uparrow$	$\frac{1}{5} \downarrow$

 = 12 min

(Since original time = 60 min)

Therefore he will be $15 + 12 = 27$ minutes early in comparison to the previous day.

101. Let the original speed be s km/h and scheduled time = t hours

and total distance = D km

then $s \times t = \frac{3}{4} D$... (i)

and $s \times (t + 3) = D$... (ii)

From Eq. (i) and (ii), we get

$$st = \frac{3}{4}[s(t+3)] \Rightarrow t = 9 \text{ h}$$

and let $s = 1$ km/h, then $D = 12$ km

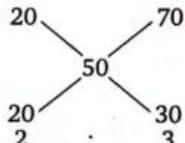
Again, since he doubles his speed after k hours then,

$$s_1 t_1 + s_2 t_2 = D$$

$$1 \times k + 2 \times (9 - k) = 12$$

$$\Rightarrow k = 6 \text{ h}$$

102. By alligation rule



Ratio of time = 2 : 3

∴ Ratio of distances = $2 \times 20 : 3 \times 70 = 4 : 21$

Alternatively: $\frac{x}{20} + \frac{y}{70} = \frac{x+y}{50}$

$$\Rightarrow \frac{76x + 20y}{1400} = \frac{x+y}{50}$$

$$\Rightarrow 42x = 8y \Rightarrow \frac{x}{y} = \frac{4}{21}$$

103. $\frac{(\text{Speed of wind})}{(\text{Speed of car})} = \frac{(\text{Time utilised})}{(\text{Time saved})}$

$$\frac{332}{x} = \frac{332}{28}$$

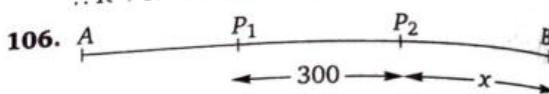
$$\Rightarrow x = 28 \text{ m/s}$$

104. Time = $\frac{\text{Total distance}}{\text{Relative speed}}$

$$\frac{4.5}{60} = \frac{450/1000}{x} \Rightarrow x = 6 \text{ km/h}$$

Relative speed = Speed of car - Speed of man
6 = $x - 6$
 $x = 12 \text{ km/h}$

105. $W + R \rightarrow 4 \text{ h } 20 \text{ min}$
 $W + W \rightarrow 5 \text{ h } 20 \text{ min}$
 $\therefore R + R \rightarrow 3 \text{ h } 20 \text{ min}$



$P_1 \rightarrow$ Place of accident
 $P_2 \rightarrow$ Imaginary place of accident

For the distance x

Speed	Time
$\frac{1}{6} \downarrow$	$\frac{1}{5} \uparrow = 1 \text{ h}$

Thus, the usual time required for the distance x km is $\frac{5}{6}$ hours.

For the distance $(x + 300)$

Speed	Time
$\frac{1}{6} \downarrow$	$\frac{1}{5} \uparrow = 2 \text{ h}$

Thus, the usual time required for the distance $(x + 300)$ is $5 \times 2 = 10 \text{ h}$.

It means he covers 300 km distance in 5 h

$$\therefore \text{Speed} = \frac{300}{5} = 60 \text{ km/h}$$

107. Since, he can cover x km at 60 km/h in 5 h it means x km.

Therefore, total distance = $(120 + 300 + 300) = 720 \text{ km}$

108. Circumference means one revolution.

Therefore, distance covered in 10 revolutions = $300 \times 10 = 3000 \text{ m}$

i.e., 30 metre in 6 seconds.

$$\therefore \text{Speed of wheel} = \frac{30}{6} \text{ m/s} = 5 \text{ m/s}$$

$$\therefore 5 \text{ m/s} = 5 \times \frac{18}{5} = 18 \text{ km/h}$$

109. Speed of man in still water = $\frac{S_D + S_U}{2}$

$$= \frac{12 + 8}{2} = 10 \text{ km/h}$$

$S_D \rightarrow$ Speed in downstream (= Boat + River)

$S_U \rightarrow$ Speed in upstream (= Boat - River)

110. Speed of water current = $\frac{S_D - S_U}{2} = \frac{21 - 15}{2} = 3 \text{ km/h}$

111. $S_D = 12 \text{ km/h}$

$S_U = 5 \text{ km/h}$

$$\text{Speed of current} = \frac{12 - 5}{2} = 3.5 \text{ km/h}$$

Time, Speed and Distance
 112. $S_D \rightarrow 15 \text{ km/h}$
 $S_U \rightarrow 9 \text{ km/h}$

$$\text{Speed of man} = \frac{15 + 9}{2} = 12 \text{ km/h}$$

113. Let the required distance be D km, then

$$\frac{D}{6} + \frac{D}{4} = \frac{5}{4}$$

$$D \left(\frac{10}{24} \right) = \frac{5}{4}$$

$$D = 3 \text{ km}$$

$$\therefore 14. \frac{16}{8} + \frac{16}{2} = 10 \text{ h}$$

115. Let the downstream speed be D and upstream speed be U , then

$$\frac{48}{U} + \frac{72}{D} = 12$$

$$\frac{48}{D} + \frac{72}{U} = 13$$

$$\therefore 48m + 72n = 12 \quad \dots(i)$$

$$\text{and} \quad 48n + 72m = 13 \quad \dots(ii)$$

Solving Eq. (i) and (ii), we get

$$m + n = \frac{5}{24} \quad \text{and} \quad m - n = \frac{1}{24}$$

$$\therefore D = 12 \text{ km/h} \quad \text{and} \quad U = 8 \text{ km/h}$$

$$\therefore \text{Speed of current} = 2 \text{ km/h}$$

$$116. D_S = \frac{9}{2} = 4.5 \text{ km/h}$$

$$U_S = \frac{9}{6} = 1.5 \text{ km/h}$$

$$\therefore \text{Speed of boat in still water} = \frac{4.5 + 1.5}{2} = 3 \text{ km/h}$$

$$\text{and Speed of river in still water} = \frac{4.5 - 1.5}{2} = 1.5 \text{ km/h}$$

$$117. \frac{D_T}{U_T} = \frac{1}{2} \Rightarrow \frac{D_S}{U_S} = \frac{2}{1} \Rightarrow \frac{B + S}{B - S} = \frac{2}{1} \Rightarrow \frac{B}{S} = \frac{3}{1}$$

HINT D_T and U_T are the downstream and upstream times and D_S and U_S are the downstream and upstream speeds. Here we can use componendo and dividendo.

$$\frac{\text{Speed of boat}}{\text{Speed of stream}} = \frac{3}{1} = \frac{15}{x}$$

$$\text{Speed of stream} = 5 \text{ km/h}$$

118. If t_1 and t_2 are the upstream and downstream times. Then time taken in still water is given by

$$\frac{2 \times t_1 \times t_2}{t_1 + t_2} = \frac{2 \times 12 \times 24}{36} = 16 \text{ h}$$

Alternatively: $D = (B + S) \times 12$

and

$$D = (B - S) \times 24$$

where $(B + S)$ is downstream speed
 $(B - S)$ is upstream speed

\Rightarrow

$$\frac{B + S}{B - S} = \frac{2}{1}$$

$$\Rightarrow \frac{B}{S} = \frac{3}{1} \quad (\text{By componendo and dividendo})$$

$$\text{Now} \quad D = 4S \times 12 = 48S$$

$$D = 48S = 16B \quad (\text{Distance} = \text{Time} \times \text{Speed})$$

$$\therefore \text{Required time} = 16 \text{ h}$$

$$119. \frac{D_S}{U_S} = \frac{B + S}{B - S} = \frac{3}{2}$$

where $B \rightarrow$ Speed of boat in still water
 $S \rightarrow$ Speed of current/stream

$$\Rightarrow \frac{2B}{2S} = \frac{5}{1} \quad (\text{By componendo and dividendo})$$

$$\Rightarrow \frac{B}{S} = \frac{5/2}{1/2} \Rightarrow B = \frac{5}{2}$$

$$\text{Average speed of downstream and upstream} = \frac{2 \times 3 \times 2}{3 + 2} = \frac{12}{5}$$

$$\therefore \text{Required ratio} = \frac{5/2}{12/5} = \frac{25}{24}$$

120. Let x be the upstream speed, then the downstream speed will be $(x + 3)$.

$$\therefore \frac{3}{x} + \frac{3}{x+3} = 3$$

$$\Rightarrow x^2 + x - 3 = 0$$

$$\Rightarrow x = \frac{-1 + \sqrt{13}}{2}$$

$$= \frac{-1 + 3.6}{2} = 1.3 \text{ km/h}$$

$$\therefore (x + 3) = 4.3 \text{ km/h}$$

121. Upstream speed of first boat = 8 km/h

Upstream speed of second boat = 4 km/h

$$\therefore \text{Relative speed} = 4 \text{ km/h}$$

$$\therefore \text{Required time} = \frac{10}{4} = 2.5 \text{ h}$$

122. Downstream speed = $B + S$

$B \rightarrow$ Speed of boat

Upstream speed = $B - S$

$S \rightarrow$ Speed of stream

$$\therefore \frac{120}{B + S} + \frac{120}{B - S} = 15$$

$$\Rightarrow \frac{B}{B^2 - S^2} = \frac{1}{16} \quad \dots(i)$$

$$\text{Again} \quad \frac{120}{B + 2S} + \frac{120}{B - 2S} = 24$$

$$\Rightarrow \frac{B}{B^2 - 4S^2} = \frac{1}{10} \quad \dots(ii)$$

From Eq. (i) and (ii), we get

$$B = (B^2 - S^2) 16$$

$$B = (B^2 - 4S^2) 10$$

$$\text{and} \quad 10B^2 - 40S^2 = 16B^2 - 16S^2$$

$$\Rightarrow \frac{B^2}{S^2} = 9 \Rightarrow \frac{B}{S} = 3$$

$$\therefore B : S = 3 : 1$$

i.e.,

Now, you can go through options or solve by equations. Since now you know the ratio of speeds of boat and stream. The correct choice is (b).

124. Upstream speed = $B - S$

Downstream speed = $B + S$

$$B - S = \frac{15}{5} = 3 \text{ km/h}$$

Again

$$B = 4S$$

∴

$$B - S = 3 = 3S$$

⇒

$$S = 1 \text{ and } B = 4 \text{ (km/h)}$$

∴

$$B + S = 5 \text{ km/h}$$

∴ Time during downstream = $\frac{15}{5} = 3 \text{ h}$

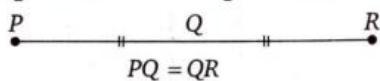
125. $\frac{24}{(5.5 - R)} - \frac{24}{(5.5 + R)} = 5$

⇒ $R = 2.5 \text{ km/h}; R \rightarrow \text{Speed of river/current}$

Again $(B_2 + R) = \frac{24}{4} = 6$

⇒ $(B_2 + 2.5) = 6 \Rightarrow B_2 = 3.5 \text{ km/h}$

126.



$P \rightarrow Q \rightarrow R (7 \text{ h})$

It means $P \rightarrow Q (3.5 \text{ h})$

Again $\{P \rightarrow Q \text{ and } Q \rightarrow P\} (8 \text{ h})$

It means $Q \rightarrow P (4.5 \text{ h})$

Therefore $R \rightarrow Q (4.5 \text{ h})$

Thus, from R to P boat will take 9 hours.

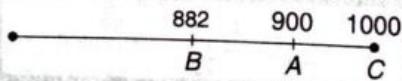
HINT $P \rightarrow R$ (Downstream)
 $R \rightarrow P$ (Upstream)

127. $\frac{40}{(B - S)} + \frac{55}{(B + S)} = 13$

$$\frac{30}{(B - S)} + \frac{44}{(B + S)} = 10$$

HINT Go through options for quicker answer and prefer the value which can help in dividing 44 and 55.

Solutions for question number 128 and 129: B is 2% slow than A and A is 10% slow than C. Therefore, in 1 km race,

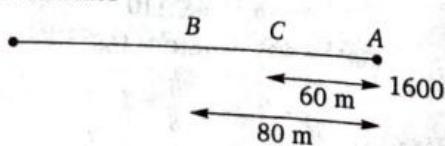


128. Since in 1000 m (1 km) race difference between A and B is 18 m.

So in 2 km race it will be 36 m.

129. In a 1 km race C can give B a start of 118 m. Therefore in a half km race C can give B a start of 59 m.

130. In a 1600 m race



$C \rightarrow 1540, B \rightarrow 1520$

The ratio of speeds of C : B is 77 : 76. It means in 77 m race

beats B by 1 m. So, in 400 m race C will beat B by

$$400 \times \frac{1}{77} \text{ m} = 5 \frac{15}{77} \text{ m}$$

	Aman	Shakti
Time	190	200
Speed	$20x$	$19x$
	$20x = 1000 \text{ m}$	

$$\therefore x = 50 \text{ m}$$

$$\Rightarrow$$

Again $20x - 19x = x = 50 \text{ m}$

So, Aman can beat Shakti by 50 m.

	A	:	B
Speed	7	:	4
Time	4	:	7
Distance	4	:	7

(Since distance \propto time)

Now, $7x - 4x = 300$

$$3x = 300$$

$$\Rightarrow x = 100$$

$$\therefore 7x = 700$$

Thus, the winning post be 700 m away from the starting point.

133. Ratio of speeds of $A : B = 12 : 11$

and ratio of speeds of $B : C = 8 : 7$

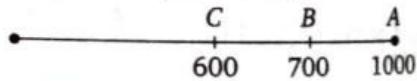
Therefore ratio of speeds of $A : B : C = 96 : 88 : 77$

So in 9600 m race A will beat C by 1900 m.

134. When Ameesha runs 1000 m, then Bipasha runs only 700 m [1000 - (100 + 200)]

when Ameesha runs 1000 m, then Celina runs only 600 m [1000 - (100 + 300)]

Therefore,



Now, since in 700 m race Bipasha beats Celina by 100 m, in 50 m race Bipasha will beat Celina by

$$50 \times \frac{100}{700} = 7.14 \text{ m}$$

Alternatively: Bipasha beats Celina by 14.28% of the distance then in 50 m race Bipasha will beat Celina by 7.14%

135.

	Distance	Time
Case I:	Ravi 1000	t_1
	Vinod 960	$t_1 + 19$
Case II:	Ravi 960	t_1
	Vinod 1000	$t_1 + 30$

Therefore, $\frac{1000}{t_1} = \frac{960}{t_2} = \text{Speed of Ravi}$

$$\Rightarrow t_1 = \frac{25}{24} t_2$$

Also $\frac{960}{t_1 + 19} = \frac{1000}{t_2 + 30} = \text{Speed of Vinod}$

$$\therefore (t_2 + 30) 24 = 25 \left[\frac{25}{24} t_2 + 19 \right]$$

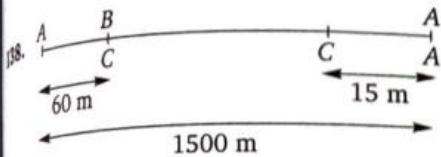
$$\Rightarrow 49t_2 = 5880$$

$$\text{Required ratio} = \frac{960/t_2}{1000/t_2 + 30} = \frac{6}{5}$$

137. Since, the speeds of Vinay and Versha are in the ratio of 5 : 3 i.e., when Vinay covers 5 rounds, then Versha covers 3 rounds, but first time Vinay and Versha meet when Vinay completes $2\frac{1}{2}$ round and Versha completes $1\frac{1}{2}$ round.

For Vinay to pass Versha 7th time, Vinay would have completed $7 \times 2\frac{1}{2}$ rounds. Since, each round is $1\frac{1}{2}$ km, the distance covered by Vinay is

$$7 \times 2\frac{1}{2} \times 1\frac{1}{2} = 7 \times \frac{5}{2} \times \frac{3}{2} = 26\frac{1}{4} \text{ km}$$



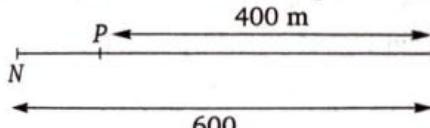
In the same time, when A covers 1500 m, B covers 1440 m and C covers 1425 m.

So, in 1440 m race B can give a start of 15 m.

∴ In 1500 m race B will give a start of

$$\frac{15}{1440} \times 1500 = 15\frac{5}{8} \text{ m}$$

139. In 600 m race Prabhat can have only start of 120 m. Now since he has more than 200 m start up so he will win the race.



Now, when Prabhat will cover 400 m distance, then in the same time Nishith will cover only 500 m. So, Prabhat will win by 100 m.

140. B is 25% slower than A and C is 20% slower than B.

Therefore in a game of 200 points B can have 150 points and C can have 120 points.

Thus, A can give C 80 points.

141. Since between 11 am and 1 pm and 11 pm and 1 am two hands of a clock coincide only once, each time.

LEVEL (2)

1.

Speed	Cycle	Auto	Car	(in km)
Time	x	$(5x - 20)$	$5x$	
Distance	120	$(t + 1)$	t	
	$\frac{120}{(5x - 20)} - \frac{120}{5x} = 1$			
	$x^2 - 4x - 96 = 0$			
	$x = 12$			
Average speed	$\frac{360}{(10 + 3 + 2)}$	$= 24 \text{ km/h}$		

142. Since between 2 am and 3 am (2 pm and 3 pm) and 8 am and 10 am (8 pm and 10 pm) two hands of a clock make 90° angle only 3 times in rest of the each hour two hands make 90° angle 2 times.

143. Since between 5 am and 7 am (5 pm and 7 pm) this happens only once. In rest each of the hours it happens one time.

144. Both (a) and (b) are correct.

Relative speed = Speed of minute-hand

- Speed of hour-hand

$$= 6^\circ - \frac{1}{2}^\circ = 5\frac{1}{2}^\circ$$

$$\text{and } 1 \text{ min} - \frac{1}{12} \text{ min} = \frac{11}{12} \text{ min}$$

$$145. \frac{5 \times 30}{11/2} = \frac{300}{11} = 27\frac{3}{11} \text{ min} = 27 \text{ min } 16 \text{ s}$$

Therefore, required time = 5 : 27 : 16

146. The angle made by minute-hand = $5 \times 30 = 150^\circ$

The angle made by hour-hand = $2 \times 30 + 25 \times \frac{1}{2} = 72.5^\circ$

Hence, required angle = $150 - 72.5 = 77.5^\circ$

$$147. \frac{90^\circ - 30^\circ}{5.5} = \frac{60}{11} \times 2 = \frac{120}{11} = 10\frac{10}{11} \text{ minute}$$

$$= 10 \text{ min } 54 \text{ s}$$

∴ Required time = 3 : 10 : 54

$$148. \frac{210}{5.5} = \frac{210}{11} \times 2 = \frac{420}{11} = 38\frac{2}{11} \text{ min} = 38 \text{ min } 11 \text{ s}$$

Therefore, required time = 7 : 38 : 11

149. The angle made by minute-hand = 90°

The angle made by hour-hand = $6 \times 30 + 15 \times \frac{1}{2} = 187.5^\circ$

∴ Required difference = 97.5°

$$150. \frac{90 - 35}{5.5} = \frac{55}{11} \times 2 = 10 \text{ min}$$

So, the required time = 3 : 10 : 00

$$\text{Again } \frac{90 + 35}{5.5} = \frac{125}{11} \times 2 = \frac{250}{11} = 22\frac{8}{11} \text{ min}$$

$$= 22 \text{ min } 43 \text{ s}$$

$$2. \text{ Time taken by cycle} = \frac{120}{12} = 10 \text{ h}$$

$$\text{Time taken by auto} = \frac{120}{40} = 3 \text{ h}$$

$$\text{Time taken by car} = \frac{120}{60} = 2 \text{ h}$$

Total time = 15 h

3. In last 5 hours she covers 240 km ($120 + 120$)

4. New time = $3 + 3 + 2 = 8 \text{ h}$

Hence, decrease in time = 7 h

∴ Percentage change = $\frac{7}{15} \times 100 = 46.66\%$

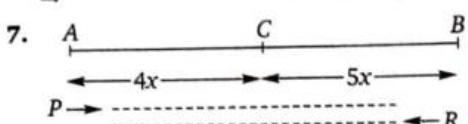
5. Time taken to meet Bipasha and Mallika = $\frac{1080}{(60 + 120)} = 6 \text{ h}$
 So, in 6 hours Bipasha covers 360 km and this 360 km distance Rani covers in $\frac{360}{90} = 4 \text{ h}$.
 Hence, Rani leaves Kolkata 2 hours later than Bipasha i.e., at 8 am. Rani leaves Kolkata.

NOTE: The distance 360 covered by Bipasha to meet Mallika can also be calculated by the ratio of their speeds.

6. Note here the length of the train in which passenger is travelling is not considered since we are concerned with the passenger instead of train. So, the length of the bridge will be directly proportional to the time taken by the passenger respectively.

Therefore, $\frac{t_1}{t_2} = \frac{l_1}{l_2}$ $t \rightarrow \text{Time}$
 $\frac{7}{4} = \frac{280}{x}$ $l \rightarrow \text{Length of bridge}$

$$\Rightarrow x = 160 \text{ m}$$



Note that the distances covered by them to meet at C are in the direct ratio of their speeds. Therefore

$$AC : BC = 4x : 5x$$

Now, for any particular person (say Pathik) the time required to cover different distances is directly proportional to the different distances. So, time taken by Pathik to cover AC and BC are the ratio of 4 : 5 (excluding staying or halt time at Chandni Chowk).

Thus time required to cover AC is 52 minutes only since he covers BC in 65 minutes.

But since he leaves Chandni Chowk for Bhavnagar at 9 : 27 am i.e., 67 minutes later, when he left Andheri. It means he must have stayed at C for $(67 - 52) = 15$ minutes.

8. Let the length of the train be L metres and speeds of the train Arjun and Srikrishna be R , A and K respectively, then

$$\frac{L}{R - A} = 36 \quad \dots(i)$$

and $\frac{L}{(R + K)} = 24 \quad \dots(ii)$

From eq. (i) and (ii)

$$3(R - A) = 2(R + K)$$

$$\Rightarrow R = 3A + 2K$$

In 30 minutes (i.e., 1800 seconds), the train covers $1800R$ (distance) but the Arjun also covers $1800A$ (distance) in the same time.

Therefore distance between Arjun and Srikrishna, when the train has just crossed Srikrishna

$$= 1800(R - A) - 24(A + K)$$

$$\therefore \text{Time required} = \frac{1800(R - A) - 24(A + K)}{(A + K)}$$

9.

 Let the time taken by Kareena in going from K to C be x minutes and the time taken by Shahid in going from $Worli$ to C be y min.

Since, the new speed of Kareena is $\frac{2}{3}$, therefore time taken in returning = $\frac{3}{2}x$.

$$x + \frac{3}{2}x = 120$$

$$\therefore x = 48 \text{ min}$$

$$\Rightarrow x = y$$

Again since the new speed of Shahid is $\frac{4}{3}$, therefore the time taken in returning = $\frac{3}{4}y$.

$$\therefore \text{Total time} = y + \frac{3}{4}y$$

$$= 48 + 36 = 84 \text{ min}$$

10. Time taken to collide the two trains = $\frac{3}{2} \text{ h}$

So, in $\frac{3}{2} \text{ h}$ bird travels $\frac{3}{2} \times 60 = 90 \text{ km}$

11. Let there be l steps in the escalator and x be the speed (steps/second) of escalator, then

$$\frac{l}{(5+x)} = 10 \quad \text{and} \quad \frac{l}{(5-x)} = 40$$

$$\text{then} \quad \frac{5+x}{(5-x)} = \frac{40}{10} \Rightarrow x = 3$$

\therefore Number of steps in the escalator = $l = 8 \times 10 = 80$

12. Let the radius be r , then difference in the distance

$$= (\pi r - 2r) = r(\pi - 2)$$

$$= r\left(\frac{22}{7} - 2\right) = 60 \times 3$$

$$\Rightarrow 2r = 315 \text{ m}$$

$[\pi r \rightarrow \text{semiperimeter and } 2r \rightarrow \text{diameter}]$

13. Time taken by trains to collide = $\frac{560}{70} = 8 \text{ h}$

In 8 h sparrow will cover $8 \times 80 = 640 \text{ km}$

- 14.

In 18 h plane will cover $18 \times 120 = 2160 \text{ km}$
 Now, $2160 = (600 \times 2) + 600 + 360$
 So, the plane will be 360 km away from Kargil it means it will be 240 km ($600 - 360$) away from Pukhwarra.

	First hour	Second hour	Third hour
Initial speed	x	$3x$	$2x$
New speed	$3x$	$3x$	$3x$

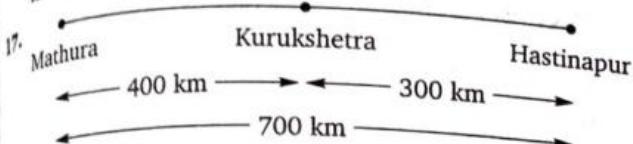
Percentage increase in speed = $\frac{3x}{6x} \times 100 = 50\%$

Since speed is increased by (50%) $\frac{1}{2}$

Therefore, time will reduce by (33.33%) $\frac{1}{3}$

16. P → Q

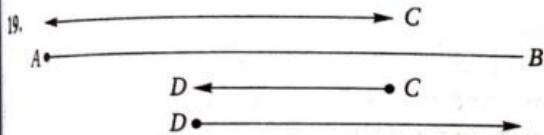
They will be together at every two hours. Therefore in 12 h they will be $(6 + 1) = 7$ times together at P and they will never meet altogether at Q.



Consider only one person either Arjun or Srikrishna since their speed is same and move together.

Now, the distance covered by Arjun and Abhimanyu is in the ratio of their speeds. So, Arjun will cover 500 km to meet Abhimanyu and thus Arjun has to return back 100 km for Kurukshetra. Therefore, Arjun will cover total 600 km distance.

$$18. \text{ Total time} = \frac{600}{25} = 24 \text{ h}$$



A is the starting point of journey.

B is the destination.

C → where Salman has got off.

D → where Priyanka picks up Akshay

Let $AD = l$ and $BC = k$ and $CD = x$

$$\text{then } \frac{CD + DB}{BC} = \frac{50}{10}$$

$$\frac{2x + k}{k} = \frac{5}{1}$$

$$\frac{x}{k} = \frac{2}{1}$$

$$\text{Again } \frac{AC + CD}{AD} = \frac{50}{10}$$

$$\frac{2x + l}{l} = \frac{5}{1}$$

$$\frac{x}{l} = \frac{2}{1}$$

$$\therefore x = 2k = 2l \quad \text{or} \quad k = l = \frac{x}{2}$$

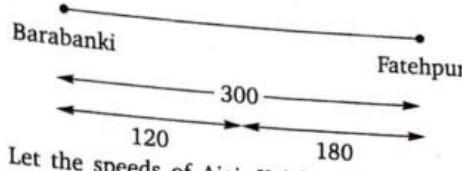
$$\therefore k + x + l = 120$$

$$\therefore k = 30 \text{ km}, \quad x = 60 \text{ km} \quad \text{and} \quad l = 30 \text{ km}$$

$$\text{Total distance travelled} = AC + CD + DB \\ = l + x + x + x + k = 240 \text{ km}$$

$$\text{Time (required)} = \frac{240}{50} = 4.8 \text{ h}$$

20.



Let the speeds of Ajai, Kajol and Shahrukh be x, y and z respectively, then

$$\frac{y}{x} = \frac{180}{120} \Rightarrow x = \frac{2y}{3}$$

Note Kajol is faster since she covers 180 km while Ajai covers only 120 km in the same time.

Shahrukh meets Kajol 1.5 hours after Shahrukh himself starts and 2.5 hours after Kajol starts.

Hence,

$$2.5y + 1.5z = 300$$

$$\Rightarrow z = \frac{600 - 5y}{3}$$

$$\text{Since } z \geq (y + 20) \Rightarrow \frac{600 - 5y}{3} \geq (y + 20)$$

$$\Rightarrow y \leq 67.5$$

$$\text{or} \quad x \leq 45 \text{ km/h}$$

21. Let t be the time after Kajol starts, when she meets Ajai, then

$$t = \frac{300}{(x + y)}$$

This should be less than 2.5 or $(x + y) > 120$

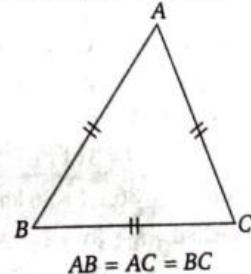
$$\text{Since } y = \frac{3x}{2} \Rightarrow y > 72$$

This ($y > 72$) is greater than 67.5 km/h and hence Shahrukh will always overtake Ajai before he meets Kajol.

22. Speed of Raghupati (R_P) = 60 km/h

Speed of Raghav (R_V) = 36 km/h

Speed of Raja Ram (RR) = 18 km/h



Time taken to cover AB by (RR) is 2 hours

\therefore Time taken to cover AB by Raghav is 1 hour

\therefore Time taken to cover AB by Raghupati = 36 min

$$(t_{RP} : t_{RV} : t_{RR} = \frac{1}{S_{RP}} : \frac{1}{S_{RV}} : \frac{1}{S_{RR}})$$

$t \rightarrow \text{Time}, S \rightarrow \text{Speed}$

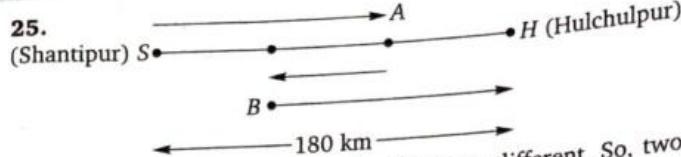
$$AB = 2 \times 18 = 36 \text{ km}$$

$$23. \text{ Time} = \frac{3 \times 36}{60} = \frac{9}{5} \text{ h} = 1 \text{ h } 48 \text{ min}$$

$$24. \text{ Distance from Barelley} = \frac{60}{(60 + 18)} \times 36$$

$$= \frac{360}{13} = 27 \frac{9}{13} \text{ km}$$

362



Since the speed of bike and walking are different. So, two people partially travelled by bike and rest by walking since all the three persons take equal time to reach the destination. It means initially Mohan will carry either Namit or Pranav to a point A, then this person reaches H by walking and Mohan return to B where he will pick up the third person and reach at H at the same time as the second person.

$$\text{Let } SB = k, AB = x \text{ and } AH = l$$

$$\text{Now, } \frac{SA + AB}{SB} = \frac{36}{6}$$

$$\frac{2x + k}{k} = \frac{6}{1}$$

$$\Rightarrow \frac{x}{k} = \frac{5}{2}$$

$$\text{and } \frac{AB + BH}{AH} = \frac{36}{6}$$

$$\Rightarrow \frac{2x + l}{l} = \frac{6}{1}$$

$$\Rightarrow \frac{x}{l} = \frac{5}{2}$$

$$\therefore x : k : l = 5 : 2 : 2$$

$$\Rightarrow x + k + l = 180$$

$$\Rightarrow x = 100, k = 40 \text{ and } l = 40 \text{ km}$$

Total distance travelled by bike = $SA + AB + BH$

$$= k + 3x + l = 380 \text{ km}$$

26. $\frac{2x + k}{k} = \frac{42}{6} = \frac{7}{1}$

$$\Rightarrow \frac{x}{k} = \frac{3}{1}$$

$$\text{Similarly } \frac{x}{l} = \frac{3}{1}$$

$$\therefore x : k : l = 3 : 1 : 1$$

$$\therefore x = 108, k = 36, l = 36 \text{ km}$$

Total distance travelled = $k + 3x + l = 396 \text{ km}$

$$\therefore \text{Required time} = \frac{396}{42} = 9 \frac{3}{7} \text{ h}$$

27. Let the buses leave from both the stations at time intervals of T , then the distance between any two consecutive buses coming opposite to me = the distance between any two consecutive buses coming in the same direction as me = VT . (where V is the velocity of the buses)

Let the speed of walking be W , then

$$\frac{VT}{V+W} = 20 \text{ and } \frac{VT}{V-W} = 30$$

$$\frac{V+W}{V-W} = \frac{30}{20} = \frac{3}{2}$$

$$\Rightarrow \frac{V}{W} = \frac{5}{1}$$

$$\frac{V+W}{V+W} = 20$$

$$\frac{5}{6} \times T = 20$$

$$T = 24 \text{ min}$$

28. Time taken by Abhinav = 36 h

$$\text{Ideal time required by Abhinav} = \frac{600}{25} = 24 \text{ h}$$

It means Abhinav rests for $(36 - 24) = 12 \text{ h}$

$$\text{Now, the required time for Brijesh} = \frac{600}{30} = 20 \text{ h}$$

But Brijesh utilised those 12 hours in which Abhinav rested, he needs only $(20 - 12) = 8 \text{ hours extra}$.

Thus, the total time taken by Brijesh = $36 + 8 = 44 \text{ h}$

29. Downstream (Steamer) = 40 min

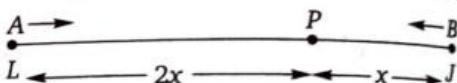
Downstream (Boat) = 60 min

Upstream (Steamer) = 60 min

Upstream (Boat) = 90 min

$$\text{Required time} = 40 + 30 + 45 = 115 \text{ min}$$

30.



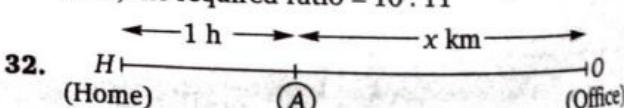
These two trains meet only at P and L i.e., there are only two points.

31. For the first meeting they have to cover only $2x$ distance and for the further meeting for each next meeting they have to cover $6x$ distance together.

Distance covered by A	2x	2x	4x	6x
Distance covered by B	x	4x	2x	4x
Point of meeting	P	L	P	J
Total distance travelled	3x	6x	6x	12x

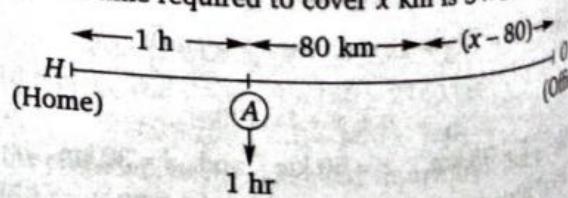
when A and B meet at P for the third time A goes $10x$ and B goes $11x$.

Thus, the required ratio = 10 : 11



Speed	Time
$\frac{1}{6} \downarrow$	$\frac{1}{5} \uparrow = 36 \text{ min}$

\Rightarrow actual time required to cover x km is $5 \times 36 = 180 \text{ min}$



Speed	Time
$\frac{1}{6} \downarrow$	$\frac{1}{5} \uparrow = 20 \text{ min}$

\Rightarrow actual time required for $(x - 80)$ km = $5 \times 20 = 100 \text{ min}$

It means he can move $= x - (x - 80) = 80 \text{ km in}$

$$(180 - 80) = 80 \text{ min}$$

It means his actual speed = 60 km/h

Thus, the total distance from his home to his office
 $= 60 \times 1 + 60 \times 3 = 240 \text{ km}$

NOTE Since 1 hour he lost at the place of accident, so the actual delay due to reduced speed is always 1 hour less than it is found to be in both the cases.
 It means due to reduced speed he becomes late only 36 minutes and 20 minutes in respective cases.

$$33. \frac{\text{Speed of wind (Sound)}}{\text{Relative speed of soldier and terrorist}} = \frac{\text{Time utilised}}{\text{Difference in time}}$$

$$\frac{1188}{x} = \frac{330}{5}$$

$$x = 18 \text{ km/h}$$

34. In case of increasing gap between two objects.

$$\frac{\text{Speed of sound}}{\text{Speed of tiger}} = \frac{\text{Time utilised}}{\text{Difference in time}}$$

$$\frac{1195.2}{x} = \frac{83}{7}$$

$$x = 100.8 \text{ km/h}$$

35. In 20 minutes the difference between man and his son
 $= 20 \times 20 = 400 \text{ m}$

Distance travelled by dog when he goes towards son

$$= \frac{400}{40} \times 60$$

= 600 m and time required is 10 minutes

In 10 minutes the remaining difference between man and son.

$$400 - (20 \times 10) = 200 \text{ m}$$

NOTE Relative speed of dog with child is 40 km/h and the same with man is 100 km/h.

Time taken by dog to meet the man = $\frac{200}{100} = 2 \text{ min}$

In 2 min the remaining distance between child and man

$$200 - (2 \times 20) = 160 \text{ m}$$

Now, the time taken by dog to meet the child again

$$= \frac{160}{40} = 4 \text{ min}$$

In 4 minutes he covers $4 \times 60 = 240 \text{ m}$ distance while going towards the son.

In 4 minute the remaining distance between man and child

$$= 160 - (4 \times 20) = 80 \text{ m}$$

Time required by dog to meet man once again

$$= \frac{80}{100} = 0.8 \text{ min}$$

In 0.8 min remaining distance between man and child

$$= 80 - (0.8 \times 20) = 64 \text{ m}$$

Now, time taken by dog to meet the child again

$$= \frac{64}{40} \times \frac{8}{5} \text{ min}$$

$$\therefore \text{Distance travelled by dog} = \frac{8}{5} \times 60 = 96 \text{ m}$$

Thus, we can observe that every next time dog just go 2/5th of the previous distance to meet the child in the direction of

So, we can calculate the total distance covered by dog in the direction of child with the help of GP formula.

Here, first term (a) = 600 and common ratio (r) = $\frac{2}{5}$

$$\therefore \text{Sum of the infinite GP} = \frac{a}{1-r}$$

$$= \frac{600}{\left(1 - \frac{2}{5}\right)} = \frac{600}{3/5} = 1000 \text{ m}$$

36. Let Amarnath express takes x hours, then Gorakhnath express takes $(x - 2)$ hours.

$$\therefore \frac{1}{x} + \frac{1}{(x-2)} = \frac{60}{80}$$

$$\Rightarrow x = 4 \text{ h}$$

37. Distance travelled by them in first hour = 12 km

Distance travelled by them in second hour = 13 km

Distance travelled by them in third hour = 14 km and so on

Thus, in 9 hours they will cover exactly 144 km and in 9 h each will cover half-half the total distance.

$$(8 \times 9 = 72 \text{ and } 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12 = 72)$$

38. Speed of tiger = 40 m/min

Speed of deer = 20 m/min

Relative speed = $40 - 20 = 20 \text{ m/min}$

Difference in distances = $50 \times 8 = 400 \text{ m}$

$$\therefore \text{Time taken in overtaking (or catching)} = \frac{400}{20} = 20 \text{ min}$$

\therefore Distance travelled in 20 min = $20 \times 40 = 800 \text{ m}$

$$39. \text{The sum of their speeds} = \frac{615}{15} = 43 \text{ km/h}$$

Notice that they are actually exchanging their speeds. Only then they can arrive at the same time at their respective destinations. It means the difference in speeds is 3 km/h.

$$\text{Thus, } x + (x+3) = 43$$

$$\Rightarrow x = 20 \text{ and } x+3 = 23.$$

The concept is very similar to the case when after meeting each other they returned to their own places of departure. It can be solved through option also.

40. Let Pele covers x km in 1 hour. So Maradona takes $(2 \text{ h} - 40 \text{ min}) = 1 \text{ h } 20 \text{ min}$ to cover x km. Let speed of Maradona and Pele be M and P respectively then

$$x = M \times \frac{4}{3} \text{ and } x = P \times 1$$

$$\Rightarrow \frac{M}{P} = \frac{3}{4}$$

$$\text{Again } \frac{300}{M} - \frac{300}{P} = 1$$

364

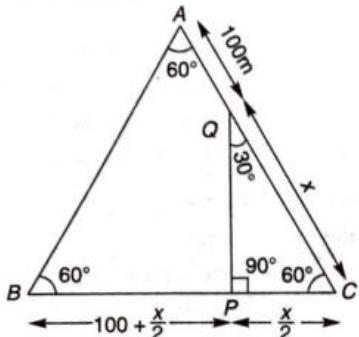
$$\begin{aligned} \Rightarrow & \frac{300}{3k} - \frac{300}{4k} = 1 \\ \Rightarrow & k = 25 \\ \Rightarrow & M = 3k = 75 \text{ km/h} \\ \Rightarrow & P = 4k = 100 \text{ km/h} \end{aligned}$$

and

(Through option it is very easy to solve.)

41. Initial speed of police = 10 m/s
 Increased speed of police = 20 m/s
 Speed of thief = 15 m/s
 Initial difference between thief and police = 250 m
 After 5 seconds difference between thief and police
 $= 250 - (5 \times 10) = 200 \text{ m}$
 After 10 seconds more the difference between thief and police
 $= 200 + (5 \times 10) = 250 \text{ m}$.
 Now, the time required by police to catch the thief
 $= \frac{250}{5} = 50 \text{ s}$
 Distance travelled = $50 \times 20 = 1000 \text{ m}$
 Total time = $50 + 15 = 65 \text{ s}$
 Total distance = $1000 + (15 \times 10) = 1150 \text{ m}$

42.



$$\frac{100 + \frac{x}{2}}{100} = \frac{100 + x}{(100 + x - 150)}$$

$$= \frac{\text{Speed of Bajrang}}{\text{Speed of Angad}}$$

$$\frac{200 + x}{200} = \frac{(100 + x)}{(x - 50)}$$

$$\Rightarrow (200 + x)(x - 50) = 200(100 + x)$$

$$\Rightarrow x^2 + 150x - 10000 = 20000 + 200x$$

$$\Rightarrow x^2 - 50x - 30000 = 0$$

$$\Rightarrow (x - 200)(x + 150) = 0$$

$$\Rightarrow x = 200 \text{ km}$$

Therefore distance between Ayodhya and Banaras is 300 km since $AB = BC = AC$.

(With the help of trigonometry we can find the value of PC in terms of x i.e., $\cos 60^\circ = \frac{PC}{QC} = \frac{1}{2}$. Hence $PC = \frac{x}{2}$)

43. Basically they will exchange their speeds just after half of the time required for the whole journey. It means after covering 210 km distance they will exchange their speeds.
 Check it out graphically for more clarification.

44. The ratio of speeds
 = The ratio of distances, when time is constant
 Again, ratio of rounds made by leopard to the tiger = $\frac{12}{13}$
 Hence, leopard makes 48 rounds, when tiger makes 65 rounds.

45. Length of $DC = \frac{6000}{13}$ (for this, refer geometry section)

Total distance covered in the returning by Jai

$$\begin{aligned} & = AD + CD \\ & = \frac{2500}{13} + \frac{6000}{13} = \frac{8500}{13} \text{ km} \end{aligned}$$

$$\text{Required time} = \frac{8500/13}{500/13} = 17 \text{ h}$$

Total distance covered by Jaya while returning

$$\begin{aligned} & = BD + DC \\ & = \frac{14400}{13} + \frac{6000}{13} \end{aligned}$$

$$\therefore \text{Required time} = \frac{20400/13}{1200/13} = 17$$

Hence, both will reach at the same time.

Alternatively: Since the ratio of speeds is same as the distances. So, they will take same time to reach the home.

46. The distance of route $ADC = \frac{8500}{13}$

and the distance of route $BNC = 1300$

and the time taken by Jai is $\frac{8500/13}{500/13} = 17 \text{ h}$

and the time taken by Jaya is $\frac{1300}{1200/13} = \frac{169}{12} \text{ h} = 14\frac{1}{12} \text{ h}$
 $= 14 \text{ h } 05 \text{ min}$

Hence, option (c) is correct.

47. Time saved in percentage = $\frac{175}{1020} \times 100 = 17.15\%$

48. Husband takes 17 hours and she takes 14 h 05 min
 $= 17 \text{ h } 05 \text{ min}$

So, she becomes late by 05 min than her husband.

49. $x^2 + (x + 100)^2 = (500)^2$ (Using Pythagoras theorem)
 $\Rightarrow x = 300 \text{ km}$

Now, let them change their speeds after t_1 hours and the rest time is t_2 then

$$30t_1 + 40t_2 = 800$$

$$40t_1 + 30t_2 = 900$$

Solving Eq. (i) and (ii), we get

$$t_1 = \frac{120}{7} \quad \text{and} \quad t_2 = \frac{50}{7}$$

50. Since it moves only one radian on every path and it has to move 2π radian to reach directly eastward. Hence, it has to run on more than 6 paths i.e., the last path is 7th one (as $n \times 1 \text{ radian} \geq 2\pi \text{ radian}$)

$$\Rightarrow$$

$$n \geq 2\pi$$

Time, Speed and Distance
or
 $n = 7$,
Hence, option (c) is correct.
for integer values
51. Since it stops directly eastward of the shop so the total distance covered so far
 $= 7 + (1 + 2 + 3 + 4 + 5 + 6 + 2) = 30 \text{ km}$

NOTE Total radial movement = 7 km
Again on the last path it will move only 2 km.

Actually it has to cover total 2π radian distance but on 6 paths it covers only 6 radian hence the remaining distance which will be covered on the 7th path i.e., $2\pi - 6$

$$= 2 \times \frac{22}{7} - 6 = \frac{2}{7} \text{ radian}$$

But, the radius of the last path (i.e., P_7) = 7 km

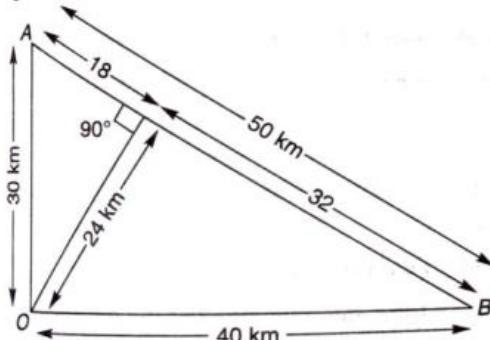
Hence, the distance covered in km = $\frac{2}{7} \times 7 = 2 \text{ km}$

$$\left(\theta = \frac{\text{Arc}}{\text{Radius}} \right)$$

Thus, on the last path it moves only 2 km. Hence, (a) is the correct choice.

52. The ratio of distance covered on P_2 and P_7 = $\frac{2}{2} : \frac{1}{1}$

53. Since it is clear from the statement itself that $\triangle AOB$ is a right angle triangle and further OP must be perpendicular to AB then we can find that $AO = 30 \text{ km}$ and $BO = 40 \text{ km}$ by using Pythagoras theorem and its corollaries.



$$OP^2 = OA^2 - AP^2$$

$$OP^2 = 900 - x^2$$

$$OB^2 = OP^2 + BP^2$$

$$OB^2 = 900 - x^2 + 1024$$

$$AB^2 = OA^2 + OB^2$$

$$(x + 32)^2 = 900 + 900 - x^2 + 1024$$

$$x = 18 \text{ km}$$

Hence, $AP = 18$, $OA = 30$ and $OB = 40$ and $OP = 24 \text{ km}$

Now, since jackal and cat reaches A at the same time, so the ratio of speeds = ratio of distances covered by them.

$$\frac{\text{Speed of jackal}}{\text{Speed of cat}} = \frac{30}{18} = \frac{5}{3}$$

54. Again, since jackal and train both arrive at A at the same time and let the train was $x \text{ km}$ away from A, before entering into the tunnels, i.e., when it makes a whistle then the ratio of distances covered by train and jackal.

$$= \frac{x}{30} = \frac{x + 50}{40}$$

$$\Rightarrow x = 150 \text{ km}$$

Thus, the ratio of speeds of Jackal is to train is $1 : 5$.

55. Since, when the train arrive at A, the jackal can move 30 km. So, at the time when train is at A the jackal will cover 6 km from P on PA in addition to 24 km at OP. Now, the rest distance at AP is 12 km this remaining distance will be covered by train and jackal according to their respective speeds.

$$\text{So, distance covered by train} = 12 \times \frac{5}{6} = 10 \text{ km}$$

$$\text{and distance covered by jackal} = 12 \times \frac{1}{6} = 2 \text{ km}$$

Hence, jackal will meet with train at M_1 which is 10 km away from A (inside AB).

NOTE It can be solved using options in lesser time.

56. It is obvious from the path of cat that if cat moves in the POA direction it will never meet with accident and now jackal follows the path OPB. Again when the train is at A then jackal will cover 30 km (i.e., 24 (OP) + 6 km on PB).

So, the ratio of distances covered by jackal is to train = ratio of their respective speeds.

Now let the jackal and train meet each other at AB, $(6 + x)$ km away from P towards B, then

$$\frac{x}{24 + x} = \frac{1}{5}$$

$$\Rightarrow 4x = 24 \Rightarrow x = 6$$

Hence, train meets with jackal at $(18 + 6 + 6) = 30 \text{ km}$ away from A.

$$\text{Alternatively: } \frac{150 + 18 + 6 + x}{30 + x} = \frac{5}{1} \Rightarrow x = 6$$

Hence, $18 + 6 + 6 = 30 \text{ km}$.

Thus, option (b) is correct.

57. The ratio of time taken by cat and jackal = $\frac{72/3}{96/5} = \frac{5}{4}$

Hence, option (c) is correct.

$$58. \quad (6 - x) = (8 - 1.5x)$$

$$\Rightarrow x = 4 \text{ cm}$$

So, it will take 4 hours to burn in such a way that they remain equal in length.

59. Total distance covered by them when they meet = $2W$

$$\text{and} \quad \text{Total time} = \frac{2W}{b_1 + b_2}$$

$$\therefore d_1 = \frac{2W}{(b_1 + b_2)} b_1 \quad \text{and} \quad d_2 = \frac{2W}{(b_1 + b_2)} b_2$$

60. Let the speed of boat be B and that of river be R . In 12 minutes the distance between boat and hat

$$= 12(B - R) + 12R = 12B$$

Now time taken by boat to reach to the hat

$$= \frac{12B}{(B + R) - R} = 12 \text{ min}$$

$$\text{Total time} = 24 \text{ min}$$

In 24 minutes had flown off = 3 km

$$\therefore \frac{24}{60} \times R = 3 \\ R = 7.5 \text{ km/h}$$

61. Akbar meets Birbal once $\frac{500}{20 - 15} = 100 \text{ s}$

Birbal meets Chanakya once $= \frac{500}{20 + 25} = 11 \frac{1}{9} \text{ s}$

Akbar meets Chanakya once $= \frac{500}{15 + 25} = 12.5 \text{ s}$

62. Time taken by them to meet $= \frac{600}{30 - 20} = 60 \text{ s}$

Time taken to meet 5th time $= 5 \times 60 = 300 \text{ s}$

Total duration of race $= \frac{3000}{30} = 100 \text{ s}$

So, they will not meet 5th time in the race of 3000 metre.

63. Length of the track $= 2 \times \frac{22}{7} \times 175 = 1100 \text{ m}$

Distance to be covered for the first meeting = 550 m

Speed of Akkal $= \frac{1100}{100} = 11 \text{ m/s}$

Speed of Bakkal $= \frac{1100}{50} = 22 \text{ m/s}$

Time taken from the start of the first meeting

$$= \frac{550}{(11 + 22)} = \frac{50}{3} \text{ s}$$

Time taken for Akkal and Bakkal to meet again at Love point = LCM of times taken by them to go around the track once.

$= \text{LCM of } \frac{1100}{11} \text{ and } \frac{1100}{22}$

$= \text{LCM of } 100 \text{ and } 50$

$= 100 \text{ s}$

So, the total required time $= \frac{50}{3} + 100 + 100$

$$= \frac{650}{3} = 216 \frac{2}{3} \text{ s}$$

64. Since both rest for 6 seconds so when B is just about to start the journey A reaches there at the shallow end so they meet at they shallow end.

65. B runs around the track in 10 min.

i.e., Speed of B = 10 min per round

$\therefore A$ beats B by 1 round

Time taken by A to complete 4 rounds

$$= \text{Time taken by B to complete 3 rounds}$$

$= 30 \text{ min}$

$\therefore A$'s speed $= \frac{30}{4} \text{ min per round}$

$= 7.5 \text{ min per round}$

Hence, if the race is only of one round A's time over the course $= 7 \text{ min } 30 \text{ sec.}$

Time, Speed and Distance

66. The ratio of speeds of A, B, C $= \frac{10}{49} : \frac{9}{50} : \frac{8}{51}$

Hence, A is the fastest.

67. Speed of this car $= \frac{400 + 200}{20} \times \frac{18}{5} \text{ km/h}$

$= 108 \text{ km/h}$

68. The speeds of two persons is 108 km/h and 75 km/h. If first person covers 1080 km in 10 hours and thus he makes 12 rounds. Thus, he will pass over another person 12 times in any one of the direction.

69. Angle between two hands at 3 : 10 am
 $= (90 + 5) - 60 = 35^\circ$

So, the required angle $= 70^\circ$, after 3 : 10 am
 Total time required to make 70° angle when minute-hand ahead of hour-hand.

$$= \frac{90 + 70}{11/2} = \frac{320}{11} \text{ min}$$

So, at $3 \text{ h } \frac{320}{11} \text{ min}$ the required angle will be formed.

Alternatively: Check through options.

70. For the first watch: When a watch creates the difference of 12 hours, it shows correct time.

So to create the difference of 12 h required time

$$= \frac{60 \times 12}{24} = 30 \text{ days}$$

For the second watch: To create the difference of 12 h required time

$$= \frac{30 \times 12}{24} = 15 \text{ days}$$

So, after 30 days at the same time both watches show correct time.

HINT Take the LCM of 30 and 15.

71. To show the same time together the difference between the watches must be 12 h.

Now, since they create 3 min difference in 1 h

So they will create 12 h difference in $\frac{1}{3} \times \frac{12 \times 60}{24}$

$= 10 \text{ days later}$

72. To show the correct time again, watch must create 24 h difference. (Since in one round hour-hand covers 24 h.)

So, the required time $= \frac{4}{3} \times \frac{60 \times 24}{24} = 80 \text{ day}$

73. ($n + 1$) times in n days

74. Actually the watch gains $(12 + 16)$

$= 28 \text{ min in } 7 \times 24 \times 60 \text{ min.}$

Thus, it gains 1 min in 360 minutes.

Therefore, it will gain $(12 + 8)$ min in $\frac{20 \times 360}{60 \times 24} = 5 \text{ hr}$

Hence, (b) is the correct choice.

75. Actually they create a difference of 3 min per hour and the two watches are showing a difference of 66 minutes. Thus, they must have been corrected 22 hours earlier.

Now, the correct time can be found by comparing any one of the watch.

Since, second watch gains 1 min in 1 hour so it will must show 22 min extra than the correct time in 22 hours.

Hence, the correct time can be found by subtracting 22 min from 10 : 06.

Hence, (d) is the correct answer.

NOTE For quick answer go through options.

16. Incorrect watch covers 1452 min in 1440 min

So, it will cover 1 min in $\frac{1440}{1452}$ min

Therefore it will cover 4840 min in $\frac{1440}{1452} \times 4840$

$$= 4800 \text{ min}$$

$$= 80 \text{ h}$$

Therefore $80 \text{ h} = 3 \text{ days and } 8 \text{ h.}$

77. You must know that a correct watch coincide just after $65 \frac{5}{11}$ min.

Therefore in every $65 \frac{5}{11}$ hours the watch gains $\frac{2}{11}$.

Hence, in 24 hours it will gain $\frac{2}{11} \times \frac{11}{720} \times 24 \times 60 = 4 \text{ min}$

78. In 72 hours my watch gains $(8 + 7) = 15 \text{ min}$. To show the correct time watch must gain 8 minutes.

Since the watch gains 15 min in $72 \times 60 \text{ min.}$

Therefore, the watch will gain 8 min in $\frac{72 \times 60 \times 8}{15} \text{ min}$

$$= \frac{72 \times 60 \times 8}{15} = 38 \text{ h } 24 \text{ min}$$

Hence, (a) is the correct choice.

80. To exchange the position both hands to cover 360° together.

In one minute, hour-hand moves $\frac{1}{2}^\circ$ and in one minute, minute-hand moves 6° . Let the required time be t min, then

$$6t + \frac{1}{2}t = 360$$

$$\Rightarrow t = \frac{360}{13} \times 2 = \frac{720}{13} = 55 \frac{5}{13} \text{ min}$$



8

TIME AND WORK

This chapter is one of the easiest chapter for the students. Even an average student can perform better than in other chapters. There is basically one concept involved in this chapter i.e., concept of efficiency. So most of the problems are very similar in their basic characteristic. Almost every aptitude exam ask the problems from this chapter. On an average 2-3 problems from this chapter have been asked in past years in CAT.

As it is very clear to all of us that the work is directly related with time. As one can say if a particular person or machine works for more time then more work will be done and if it devotes less time then it yields less work i.e., output of a machine or person is directly proportional to time, provided that he/she maintains his/her efficiency during the work.

CONCEPT OF EFFICIENCY

Suppose a person can complete a particular work in 2 days then we can say that each day he does half of the work or 50% work each day. Thus it is clear that his efficiency is 50% per day. Efficiency is generally considered with respect to the time. The time can be calculated either in days, hours, minutes or months etc. So if a person completes his work in 4 days, then his efficiency (per day) is 25%. Since each day he works 1/4th of the total work (i.e., 25% of the total work).

I would like to mention that the calculation of percentage and conversion of ratios and fractions into percentage and vice versa is the prerequisite for this chapter.

Now, if a person can complete a work in n days then his one day's work = $\frac{1}{n}$

and this one day's work in terms of percentage is called his efficiency.

Also if a person can complete $\frac{1}{n}$ work in one day, then he can complete the whole work in n days.

Relation between work of 1 unit of time and percentage efficiency.

A person can complete his work in n days, then his one day's work = $\frac{1}{n}$, his percentage efficiency = $\frac{1}{n} \times 100$

No. of days/hours etc. required to complete the whole work	Work of 1 day/hour	Percentage efficiency
n	$1/n$	$100/n$
1	$1/1$	100%
2	$1/2$	50%
3	$1/3$	$33.33\% = 33\frac{1}{3}\%$
4	$1/4$	25%
5	$1/5$	20%
6	$1/6$	$16.66\% = 16\frac{2}{3}\%$
7	$1/7$	$14.28\% = 14\frac{2}{7}\%$
8	$1/8$	12.5%
9	$1/9$	$11.11\% = 11\frac{1}{9}\%$
10	$1/10$	10%

This table is very similar to the percentage fraction table given in the chapter of percentage. This table just manifests model for efficiency conversion.

Basically for faster and smarter calculation you have to have your percentage calculation very smart.

All the problems of this chapter can be solved through two methods :

1. Unitary method
2. Percentage efficiency

Unitary method is generally obsolete in respect to high level aptitude exam of CAT since it involves typical calculation of LCM each and every time. But when the problems are solved through percentage efficiency it becomes inevitable to save the time which in turn helps to do some more problems within the stipulated time. I admit that initially it might be difficult to solve for those students who are not so good and confident in percentage and fraction calculation, but a little bit of extra practice will yield an unexpected result in quicker calculations. Now I have some good examples to show you both the methods of solving the same problems.

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SAMPLE 1 A can do a job in 12 days. In how many days working together they can complete the job?

$$A's \text{ 1 day's work} = \frac{1}{12}$$

$$B's \text{ 1 day's work} = \frac{1}{6}$$

$$(A+B)'s \text{ 1 day's work} = \frac{1}{12} + \frac{1}{6} = \frac{3}{12} = \frac{1}{4}$$

$$\therefore \text{Time taken by both to finish the whole work} = \frac{1}{\frac{1}{4}} = 4 \text{ days}$$

Alternatively :

$$\text{efficiency of } A = \frac{100}{12} = 8.33\%$$

$$\text{and efficiency of } B = \frac{100}{6} = 16.66\%$$

$$\text{Combined efficiency of } A \text{ and } B \text{ both} = 8.33 + 16.66 = 25\%$$

$$\therefore \text{Time taken by both to finish the work (working together)} = \frac{100}{25} = 4 \text{ days}$$

As per my experience, I have found that in this chapter only selected (numerals) numbers are always used and thus there are almost 20 - 25 numbers are frequently used. So one can very easily remember (and calculate) the percentage efficiency but with different combinations to calculate the LCM becomes a very tedious job. Still you can choose your own method, which is comfortable to you.

RELATION BETWEEN EFFICIENCY AND TIME

Efficiency is inversely proportional to the time (i.e., number of days, hours, minutes) etc.

SAMPLE 1 A takes 16 days to finish a job alone, while B takes 8 days to finish the same job. What is the ratio of their efficiency and who is less efficient?

SOLUTION Since A takes more time than B to finish the same job, A is less efficient or

$$\text{efficiency of } A = \frac{100}{16} = 6.25\%$$

$$\text{and efficiency of } B = \frac{100}{8} = 12.5\%$$

$$\text{ratio of efficiency of } A : B = \frac{1}{16} : \frac{1}{8} = 1 : 2$$

Hence, B is twice efficient as A.

SAMPLE 2 A is thrice efficient as B and A takes 20 days to do a job. Then in how many days B can finish the same job?

SOLUTION Ratio of efficiency of A : B = 3 : 1

$$\therefore \text{Ratio of required days of } A : B = \frac{1}{3} : \frac{1}{1} = 1 : 3$$

Now since A takes 20 days. So B will take 60 days to finish the job.

Ratio of number of days is equal to the ratio of the reciprocals of efficiency and vice-versa.

EXAMPLE 2 A can do a job in 10 days, B can do the same job in 12 days and C can do the same job in 15 days. In how many days they will finish the work together?

SOLUTION

$$A's \text{ 1 day's work} = \frac{1}{10}$$

$$B's \text{ 1 day's work} = \frac{1}{12}$$

$$C's \text{ 1 day's work} = \frac{1}{15}$$

$$(A+B+C)'s \text{ one day's work} = \frac{1}{10} + \frac{1}{12} + \frac{1}{15} = \frac{15}{60} = \frac{1}{4}$$

Since they can complete $\frac{1}{4}$ work in 1 day. So they will finish the whole work in $\frac{1}{\frac{1}{4}} = 4$ days.

Alternatively : A's efficiency = 10%

$$B's \text{ efficiency} = 8.33\%$$

$$C's \text{ efficiency} = 6.66\%$$

$$\text{Combined efficiency of } A, B \text{ and } C = 10 + 8.33 + 6.66 = 25\%$$

Hence, they will take $\frac{100}{25} = 4$ days to finish the job working together

(Since in one day they complete 25% work)

For example if A is twice efficient as B, it means, A takes half the time to finish the same job as B requires working alone.

EXAMPLE 3 P is thrice as efficient as Q and is therefore able to finish a piece of work in 60 days less than Q. Find the time in which P and Q can complete the work individually.

SOLUTION

$$\text{Efficiency of } P : Q = 3 : 1$$

$$\text{Required number of days of } P : Q = 1 : 3$$

i.e., if P requires x days then Q requires 3x days

$$\text{but } 3x - x = 60$$

$$\Rightarrow 2x = 60$$

$$\Rightarrow x = 30 \text{ and } 3x = 90$$

Thus P can finish the work in 30 days and Q can finish the work in 90 days.

EXAMPLE 4 A is twice as good a workman as B and is therefore able to finish a piece of work in 30 days less than B. In how many days they can complete the whole work; working together?

SOLUTION Ratio of efficiency = 2 : 1 (A : B)

$$\text{Ratio of required time} = 1 : 2 (A : B) \Rightarrow x : 2x$$

$$\text{but } 2x - x = 30$$

$$\Rightarrow x = 30 \text{ and } 2x = 60$$

$$\text{efficiency of } A = 3.33\%$$

$$\text{efficiency of } B = 1.66\%$$

Combined efficiency of A and B together = 5%
 ∴ time required by A and B working together to finish the work
 $= \frac{100}{5} = 20 \text{ days.}$

SOLUTION

$$A's \text{ one day's work} = \frac{1}{x}$$

$$B's \text{ one day's work} = \frac{1}{y}$$

So, both A and B completes $\frac{1}{x} + \frac{1}{y} = \frac{x+y}{xy}$ work in one day.

Now, by **Unitary method**

$\frac{x+y}{xy}$ work can be completed in 1 day

∴ 1 (means complete) work will be finished in $\frac{1}{\frac{x+y}{xy}} = \frac{xy}{x+y}$ days

(∴ Required time to complete the work = $\frac{1}{\text{one day's work}}$)

NOTE Efficiency $\propto \frac{1}{\text{number of time units}}$

Efficiency \times time = constant work

Hence Required time = $\frac{\text{work}}{\text{efficiency}}$

Whole work is always considered as 1, in terms of fraction and 100%, in terms of percentage.

In general, number of day's or hours = $\frac{100}{\text{efficiency}}$

EXAMPLE 5 A can do a works in x days while B can do the same work in y days then in how many days will they complete the work, working together?

CONCEPT OF NEGATIVE WORK

In this case one person works but another destroys it or cancels it. For example Sonu can write 20 pages per hour but his younger sister Rimjhim erases 10 pages per hour which

EXAMPLE 1 A tub can be filled in 20 minutes but there is a leakage in it which can empty the full tub in 60 minutes. In how many minutes it can be filled?

SOLUTION Filling efficiency = 5%

$$\left(\because 5 = \frac{100}{20} \right)$$

emptying efficiency = 1.66%

$$\left(\because 1.66 = \frac{100}{60} \right)$$

Net efficiency = $5 - 1.66 = 3.33\%$

∴ Required time to fill the tub = $\frac{100}{3.33} = 30 \text{ minutes}$

Sonu writes.

It means finally Sonu writes 10 pages per hour since each hour his sister erases 10 pages out of 20 written pages. Take another example :

Alternatively : In 1 minute tub is filling = $\frac{1}{20}$

In 1 minute tub is emptying = $\frac{1}{60}$

$$\therefore \text{In 1 minute, effective filling of tub} = \frac{1}{20} - \frac{1}{60} \\ = \frac{2}{60} = \frac{1}{30}$$

Since $\frac{1}{30}$ part of tub is filled in 1 minute.

Therefore complete tub will be filled in $\frac{1}{1/30} = 30 \text{ minutes}$

APPLICATION OF INVERSE PROPORTION (OR PRODUCT CONSTANCY)

As I have already discussed thoroughly the concept of inverse proportion and product constancy in ratio-proportion and it has been widely used in profit loss chapter also.

Since the efficiency or rate of work done in one unit of time (mentioned) is inversely proportional to the time i.e., if the rate of work done is greater then the time required will be less and if the rate of work done is less then the time required for the

EXAMPLE 1 If 20 persons can do a piece of work in 7 days then calculate the number of persons required to complete the work in 28 days

SOLUTION Number of persons \times days = work

$$20 \times 7 = 140 \text{ man-days}$$

$$x \times 28 = 140 \text{ man-days}$$

Now,

\Rightarrow

$$x = 5$$

Therefore in second case the required number of person is 5

Second Method : Since work is constant, therefore

$$M_1 \times D_1 = M_2 \times D_2 = \text{work done}$$

$$20 \times 7 = M_2 \times 28$$

$$M_2 = 5$$

Third Method : Men × Days = work, which is constant

$$\downarrow \frac{3}{4} \left(\begin{array}{c} 20 \\ 5 \end{array} \right) \quad \left(\begin{array}{c} 7 \\ 28 \end{array} \right) \uparrow 3$$

Since number of days is increased by 3 times (i.e., 300%). So the number of men will be decreased by $\frac{3}{4}$ times (i.e., 75%) (remember percentage change graphic)

EXAMPLE 2 If 25 men can do a piece of work in 36 days working 10 hours a day, then how many men are required to complete the work working 6 hours a day in 20 days?

SOLUTION

$$M_1 \times D_1 \times H_1 = M_2 \times D_2 \times H_2$$

$$25 \times 36 \times 10 = M_2 \times 20 \times 6$$

$$M_2 = 75 \text{ persons}$$

Alternatively :

$$\begin{matrix} \text{Men} & \times & \text{Time} \\ 25 & & 360 \\ \uparrow 2 & & \downarrow \frac{2}{3} \\ 75 & & 120 \end{matrix} \quad [\text{Since product (work) is constant}]$$

By percentage change graphic, when time is decreased by $\frac{2}{3}$ (i.e., 66.66%), number of men is increased by 2 times (i.e., 200%)

EXAMPLE 3 A contractor employed 30 men to complete the project in 100 days. But later on he realised that just after 25 days only 20% of the work had been completed.

- How many extra days, than the scheduled time are required?
- To complete the work on the scheduled time how many men he has to increase?
- If the amount of work is also increased by 20% of the actual work, then how many extra days are required (in comparison with scheduled time) but the number of men remained constant.
- How many men should be increased so that the work will be completed in 25 days less than the scheduled time.

SOLUTION (a) Men × days = work done

$$30 \times 25 = 750 = 20\% \text{ of the actual work}$$

Now, the work to be done is 4 times than the work done but the number of days is only 3 times. So he is required 4 times the number of days, thus he has to work for extra 25 days.

(b)

$$M_1 D_1 = M_2 D_2$$

$$4(30 \times 25) = M_2 \times 75$$

RELATION BETWEEN EFFICIENCIES

In this case the efficiencies of different persons are different but when they work in a group, so the efficiency of the group is required to know the time taken. For example 3 men can do a work in 4 days while 12 boys can do the same work in 3 days. It means we need $3 \times 4 = 12$ man-days i.e., 12 men can finish the job in 1 day.

⇒

$$M_2 = 40$$

(Since, the work to be done is 4 times of the work done. Hence he requires 4 times man-days.)

Alternatively : Since the new product (i.e., work) is 4 times of the original product (i.e., work). But the new product is being multiplied by 3. Thus to make it 4 times we have to multiply it by $4/3$. Thus without changing number of days we get the new value of number of men which is 40 (being multiplied by $4/3$). Therefore he has to increase 10 more men.

(c) New work = 3750 man-days

and the available number of men = 30

$$\therefore \text{number of days required} = \frac{3750}{30} = 125$$

So, he has to work for extra 50 days where

$$50 = (125 - 75)$$

(d) Work = 3000 unit (man days)

$$\text{number of available days} = 50(75 - 25)$$

$$\therefore \text{number of men required} = \frac{3000}{50} = 60$$

Thus he has to increase $(60 - 30) = 30$ more men.

EXAMPLE 4 16 workers working 6 hours a day can build a wall of length 150 metres, breadth 20 m and height 12 m in 25 days. In how many days 12 workers, working 8 hours a day can build a wall of length 800 m, breadth 15 m and height 6 m.

SOLUTION Here work is the volume of the wall. So the work force should be increased/decreased in the ratio of volume of the work. Therefore

$$\frac{L_1 B_1 H_1}{L_2 B_2 H_2} = \frac{M_1 D_1 T_1}{M_2 D_2 T_2}$$

where L, B, H are length, breadth and height of the wall respectively and M, D, T are men, days and time in hours per day, respectively. 1 indicates the first case, while 2 indicates second case. So the ratio of work force remains constant as the ratio of volume and work.

$$\therefore \frac{150 \times 20 \times 12}{800 \times 15 \times 6} = \frac{16 \times 6 \times 25}{12 \times 8 \times D_2}$$

$$\Rightarrow D_2 = 50$$

hence the required number of days = 50

Please notice that the volume of work becomes twice (in the second case) so the work force will also be twice to the previous work force.

Similarly we need $12 \times 3 = 36$ boys days i.e., 36 boys can finish the same job in 1 day.

Here we can see that to finish the work in only 1 day 12 men are needed while 36 boys are needed. Thus we can conclude that work of 12 men is equal to the work of 36 boys. Therefore efficiency of 12 men is equal to 36 boys i.e., we can say the efficiency of 1 man is equal to 3 boys. Thus a man is thrice efficient as a boy or we can say that a man is two times more efficient than a boy.

290

EXAMPLE 1 6 boys and 8 women finish a job in 6 days and 14 boys and 10 women finish the same job in 4 days. In how many days working together 1 boy and 1 woman can finish the work?

SOLUTION In this kind of questions we find the work force required to complete the work in 1 day (or given unit of time) then we equate the work force to find the relationship between the efficiencies (or work rate) between the different workers.

$$\text{Therefore } 6B + 8W = 6 \text{ days}$$

$$\Rightarrow 6(6B + 8W) = 1 \text{ day} \quad (\text{inversely proportional})$$

$$\Rightarrow 36B + 48W = 1 \quad (\text{by unitary method})$$

$$\text{Again } 14B + 10W = 4 \text{ days}$$

$$\Rightarrow 56B + 40W = 1$$

So, here it is clear that either we employ 36B and 48W to finish the work in 1 day or 56B and 40W to finish the same job in 1 day. Thus, we can say

$$\Rightarrow 36B + 48W = 56B + 40W$$

$$\Rightarrow 20B = 8W$$

$$\Rightarrow W = 2.5B$$

Thus a woman is 2.5 times as efficient as a boy.

$$\text{Now, since } 36B + 48W = 1$$

$$\Rightarrow 36B + 48 \times (2.5B) = 1$$

$$\Rightarrow 156B = 1$$

i.e., to finish the job in 1 day 156 boys are required or the amount of work is 156 boys-days.

$$\text{Again } 1W + 1B = 2.5B + 1B = 3.5B$$

Now, since 156 boys can finish the job in 1 day

So 1 boy can finish the job in 1×156 days

$$\therefore 3.5 \text{ boys can finish the job in } \frac{1 \times 156}{3.5} = 44 \frac{4}{7} \text{ days}$$

NOTE There is a great difference between 'and' & 'or'. For example 4 men and 8 women can do a piece of work in 10 days : means it is unknown that who is faster or slower (i.e., we don't know the relation between efficiencies of a man and a woman)

Again, 4 men or 8 women can do a piece of work in 10 days : means 4 men are equal to 8 women. Hence a man is twice efficient as a woman.

EXAMPLE 2 6 men and 8 women can do a job in 10 days. In how many days can 5 men and 9 women do the same job?

SOLUTION Since we don't know the relation between work rate (or efficiency) between a man and that of a woman so we can't find the required number of days.

EXAMPLE 3 6 men and 8 women can do a job in 10 days. In how many days can 3 men and 4 women finish the same job working together?

SOLUTION Notice here we don't know the relation of efficiencies but we can solve the problem due to clear relation between the work force.

Since

$$6M + 8W = 10 \text{ days}$$

$$2(3M + 4W) = 10 \text{ days}$$

20 days

Since, the work force has become half of the original force

number of days must be double.

Thus required number of days = 20

EXAMPLE 4 A can complete a work in 12 days, B in 15 days. Find the time taken by them :

- (a) when A and B worked together.
- (b) when A and B worked alternatively started by A.
- (c) when A and B worked alternatively started by B.
- (d) if A started two days later, in comparison to B.
- (e) if B started two days later, in comparison to A.
- (f) if A leaves two days before the actual completion of the work.
- (g) if B leaves two days before the actual completion of the work.
- (h) if A leaves two days before the scheduled completion of the work.
- (i) if B leaves two days before the scheduled completion of the work.
- (j) if B does negative work with his same work rate.

SOLUTION (a) A's efficiency = 8.33%

B's efficiency = 6.66%

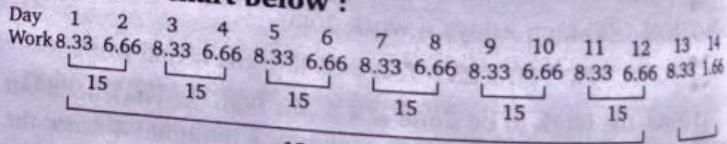
Combined efficiency = 15%

$$\text{So, the required time} = \frac{100}{15} = 6 \frac{2}{3} \text{ days.}$$

(b) In every two days A and B work 15%. So in 12 days they will complete 90% work. Now on the 13th day, A will finish 8.33% of the remaining (i.e., 10% work) and the rest 1.66% will be finished by B on 14th day by taking time = $\frac{1.66}{6.66} = \frac{1}{4}$ day.

Thus, total required time = $12 + 1 + \frac{1}{4} = 13 \frac{1}{4}$ days.

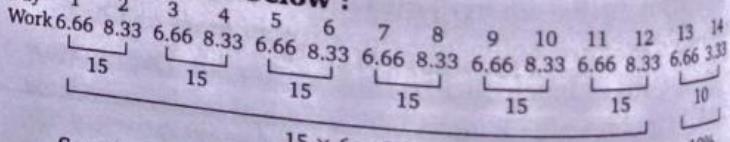
See the chart below :



$$15 \times 6 = 90\%$$

(c) Here the difference is in the last day/days only.

See the chart below :



$$15 \times 6 = 90\%$$

So, after the completion of 90% work in 12 days, on the 13th day 6.66% work will be finished by B and then 3.33% (the last part of the work) will be finished by A by taking time = $\frac{3.33}{8.33} = \frac{2}{5}$ day.

Thus, the required time = $12 + 1 + \frac{2}{5} = 13 \frac{2}{5}$ days.

(d) It means B worked for 2 days more than A has worked for. Now, since B completes $2 \times 6.66 = 13.33\%$ work in two days So the remaining work will be done by A and B together.

Time and Work

Therefore the time taken by A and B, working together
 $= \frac{86.66}{15} \times \frac{\text{(remaining work)}}{\text{(combined efficiency)}} = 5\frac{7}{9}$ days

Thus the total required time to finish the whole work
 $= 2 + 5\frac{7}{9} = 7\frac{7}{9}$ days.

(e) It means A alone worked for 2 days which is equal to
 $8.33 \times 2 = 16.66\%$

So, the remaining (83.33%) work will be done by A and B together.

Time taken together $= \frac{83.33}{15} = 5\frac{5}{9}$ days

Thus, the total required time $= 2 + 5\frac{5}{9} = 7\frac{5}{9}$ days.

(f) 'A leaves two days before the actual completion of the work' means in the last two days B has worked alone which is $6.66 \times 2 = 13.33\%$

Therefore the remaining work i.e., 86.66% work was only done by A and B together in $\frac{86.66}{15} = 5\frac{7}{9}$ days

Thus, the required time $= 2 + 5\frac{7}{9} = 7\frac{7}{9}$ days.

NOTE: This case is exactly same as part (d) of the same example. The difference is only in order of days. In part (d) B worked alone initially for 2 days and in part (f) B worked alone in the last 2 days.

(g) Applying the same concept as above we can calculate the required number of days which is same as in case (e)

Work	$A + B$	A
	$15 \times 5\frac{2}{5}$	8.33×2
	83.33%	16.66%

(h) 'A leaves two days before the scheduled completion of the work' means A works with B only for $4\frac{2}{3}$ days since

the scheduled time is $6\frac{2}{3}$ [see the case (a)]

Scheduled time is the time in which work could be finished by working together without any change in efficiency or work force.

Now since both A and B have worked together for $4\frac{2}{3}$ days it

means the last 2 days work (scheduled) which is equal to 30% (since if A and B working together can finish 30% work in 2 days) will be done by B only.

∴ required time to complete 30% work by B alone

$$= \frac{30}{6.66} = 4.5 \text{ days}$$

Thus the total required time to finish the whole work
 $= 4\frac{2}{3} + 4\frac{1}{2} = 9\frac{1}{6}$ days.

(i) Very similar to the case (h) A and B worked only for $4\frac{2}{3}$ days (2 days less than the scheduled time $6\frac{2}{3}$ days)

(It is obvious that in $4\frac{2}{3}$ days A and B, working together completes 70% work, but we can directly calculate that they can complete 30% if they work together, in 2 days)

Thus 30% work is done by A alone

$$\therefore \text{time taken} = \frac{30}{8.33} = 3\frac{3}{5} \text{ days}$$

$$\text{Thus, the total time} = 4\frac{2}{3} + 3\frac{3}{5} = 8\frac{4}{15} \text{ days.}$$

$$(j) \text{ Combined efficiency of A and B} = (8.33) + (-6.66) \\ = 1.66\%$$

∴ Time required by A and B working together

$$= \frac{100}{1.66} = 60 \text{ days}$$

(Negative work means, B works against A)

EXAMPLE 5 A can complete a work in 10 days, B in 12 days and C in 15 days. All of them began the work together, but A had to leave the work after 2 days of the start and B 3 days before the completion of the work. How long did the work last?

SOLUTION See the diagram and then interpret the language of the question.

Initial 2 days	Last 3 days
$A + B + C$	C
$25 \times 2 = 50\%$	$15\% \times 2 = 30\%$

$$[100 - (50 + 30)] = 20\%$$

Since initially for 2 days all of them A, B and C work together so they complete the 50% work and for the last 3 days only C works which is equal to 20% work.

Thus, the remaining work $= 30\%[100 - (50 + 20)]$

This 30% work was done by B and C in 2 days $= \left(\frac{30}{15}\right)$.

NOTE

Efficiency of A = 10%

Efficiency of B = 8.33%

Efficiency of C = 6.66%

So, the total number of required days $= 2 + 2 + 3 = 7$ days.

EXERCISE

LEVEL 1

- # yoursmahboob.wordpress.com
- 293
- Time and Work

19. A and B can do a piece of work in 8 days, B and C can do the same work in 12 days and A and C complete it in 8 days. In how many days A, B and C can complete the whole work, working together?

(a) 4
(b) 6
(c) 12
(d) 9

20. A and B can do a piece of work in 12 days, B and C in 15 days C and A in 20 days. In how many days can C alone do it?

(a) 60
(b) 50
(c) 25
(d) 24

21. Ganga, Jamuna and Saraswati can do a piece of work, working together, in 1 day. Ganga is thrice efficient as Jamuna and Jamuna takes twice the number of days as Saraswati takes to do it alone. What is the difference between the number of days taken by Ganga and Saraswati?

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

22. A can finish a work in 12 days and B can do it in 15 days. After A had worked for 3 days, B also joined A to finish the remaining work. In how many days, the remaining work will be finished?

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

23. Raja can do a piece of work in 14 days, while Rani can do the same work in 21 days. They started the work together but 3 days before the completion of the work, Raja left the work. The total number of days to complete the work is :

(a) 7
(b) 8.5
(c) 5
(d) $10\frac{1}{5}$

24. A and B can complete a task in 30 days when working together after A and B have been working together for 11 days, B is called away and A, all by himself completes the task in the next 28 days. Had A been working alone, the number of days taken by him to complete the task would have been :

(a) $33\frac{3}{19}$
(b) $19\frac{6}{25}$
(c) $44\frac{4}{19}$
(d) none of these

25. Sonu can do a piece of work in 20 days. He started the work and left after some days, when 25% work was done. After it Abhijeet joined and completed it working for 10 days. In how many days Sonu and Abhijeet can do the complete work, working together?

(a) 6
(b) 8
(c) 10
(d) 12

26. Efficiency of Asha is 25% more than Usha and Usha takes 25 days to complete a piece of work. Asha started a work alone and then Usha joined her 5 days before actual completion of the work. For how many days Asha worked alone?

(a) 9
(b) 11
(c) 10
(d) 15

27. Krishna can do a work in 10 days while Mohan can do the same work in 20 days. They started work together. After 3 days Krishna left the work and Mohan completed it. For how many days Mohan worked alone more than the number of days required when both worked together?

(a) $4\frac{1}{3}$
(b) $3\frac{1}{4}$
(c) $2\frac{3}{5}$
(d) $3\frac{2}{3}$

28. Kareena can do a piece of work in 9 days and Karishma can do the same work in 18 days. They started the work. After 3 days Shahid joined them, who can complete alone the same whole work in 3 days. What is the total number of days in which they had completed the work?

(a) 12
(b) 8
(c) 4
(d) 6

29. Kavita, Babita and Samita started a work. 5 days later Samita left the work and Babita left the work after working 8 days. In how many more days Kavita would have completed the rest work if they take 20, 60 and 30 days individually to finish a work?

(a) 4
(b) 5
(c) 6
(d) 8

30. 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 completes 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
(b) 5
(c) 6
(d) $9\frac{1}{3}$

31. Anand can do a piece of work in 45 days, but Bahuguna can do the same work in 5 days less, than Anand, when working alone. Anand and Bahuguna both started the work together but Bahuguna left after some days and Anand finished the remaining work in 56 days with half of his efficiency but he did the work with Bahuguna with his complete efficiency. For how many days they had worked together?

(a) 6
(b) 8
(c) 9
(d) 12

32. Chandni and Divakar can do a piece of work in 9 days and 12 days respectively. If they work for a day alternatively, Chandni beginning, in how many days, the work will be completed?

(a) $10\frac{1}{4}$
(b) $9\frac{1}{5}$
(c) 11.11
(d) 10

33. Fatima and Zahira can do a piece of work in 12 days and 15 days respectively. If they work for alternate day and Fatima starts the work first, then in how many days the work will be completed?

(a) $12\frac{1}{5}$
(b) $13\frac{1}{4}$
(c) $13\frac{1}{5}$
(d) 15

34. In the previous question (number 33) if Zahira starts first then in how many days, the work will be completed?

(a) $14\frac{1}{5}$
(b) 14
(c) $13\frac{1}{5}$
(d) $13\frac{2}{5}$

35. The number of days required by A, B and C to work individually is 6, 12 and 8 respectively. They started a work doing it alternatively. If A has started then followed by B and so on, how many days are needed to complete the whole work?

(a) 8
(b) 7.5
(c) 8.5
(d) $9\frac{1}{2}$

36. In the previous question if the order of working days be as $B, C, A, B, C, A \dots$ (starting with B and followed by C and A respectively), then in how many days the work will be completed?
- (a) $7\frac{3}{4}$ (b) 8
 (c) $8\frac{1}{4}$ (d) 9

37. A takes 6 days less than B to do a certain job and 2 days more than C . A and B together can do the work in the same time as C . In how many days B alone can do the complete work?
- (a) 10 (b) 14
 (c) 12 (d) 16

38. A and B undertook a work for Rs. 350. A got Rs. 150 more than that of B , when they worked together. B takes 9 days more than A , when they work individually. In how many days A and B working together can do the whole work :
- (a) 5 (b) $4\frac{2}{7}$
 (c) $4\frac{5}{7}$ (d) $5\frac{4}{7}$

39. Alen and Border can do a work individually in 21 and 42 days respectively. In how many days they can complete the work, working alternatively?
- (a) 14 (b) 28
 (c) 42 (d) 35

40. C takes twice the number of days to do a piece of work than A takes. A and B together can do it in 6 days while B and C can do it in 10 days. In how many days A alone can do the work?
- (a) 60 (b) 30
 (c) 6 (d) 7.5

41. When A , B and C are deployed for a task, A and B together do 70% of the work and B and C together do 50% of the work. Who is most efficient?
- (a) A (b) B
 (c) C (d) can't be determined

42. Colonel, Major and General started a work together for Rs. 816. Colonel and Major did $\frac{8}{17}$ of the total work, while Major and General together did $\frac{12}{17}$ of the whole work. What is the amount of the least efficient person?
- (a) Rs. 256 (b) Rs. 144
 (c) Rs. 85 (d) can't be determined

43. Sharma is 20% less efficient than Kelkar. If Kelkar can do a piece of work in 24 days. The number of days required by Sharma to complete the same work alone?
- (a) 20 (b) 30
 (c) 28.8 (d) can't be determined

44. 30 persons can do a piece of work in 24 days. How many more people are required to complete the work in 20 days?
- (a) 4 (b) 5
 (c) 6 (d) none of these

45. 12 women can do a piece of work in 20 days. If the 4 women deny to work, then how many more days are required?
- (a) 6 (b) 10
 (c) 15 (d) none of these

46. 35 boys can do a piece of work in 15 days. The work was completed in 25 days. How many boys did not turn up for the job?
- (a) 14 (b) 20
 (c) 6 (d) 7
47. 24 men can complete a job in 40 days. The number of men required to complete the job in 32 days is :
- (a) 30 (b) 40
 (c) 25 (d) 50
48. 16 men finished one-third work in 6 days. The number of additional men are required to complete the job in next 5 days :
- (a) 10 (b) 8
 (c) 16 (d) 32
49. If 10 persons can do a job in 20 days, then 20 person with twice the efficiency can do the same job in :
- (a) 5 days (b) 40 days
 (c) 10 days (d) 20 days
50. A certain job was assigned to a group of men to do in 20 days. But 12 men did not turn up for the job and the remaining men did the job in 32 days. The original number of men in the group was :
- (a) 32 (b) 36
 (c) 42 (d) 40
51. 30 workers can finish a work in 20 days. After how many days should 9 workers leave the job so that the work is completed in total 26 days :
- (a) 12 (b) 10
 (c) 6 (d) none of these
52. 25 men can complete a job in 30 days. After how many days should the strength of work force be increased by 50 men so that the work will be completed in $\frac{2}{3}$ rd of the actual time:
- (a) 15 (b) 10
 (c) 18 (d) 5
53. A group of workers can complete a job in 120 days. If there were 4 more such workers then the work could be finished in 12 days less. What was the actual strength of workers?
- (a) 30 workers (b) 40 workers
 (c) 42 workers (d) 36 workers
54. Mr. Modi can copy 40 pages in 10 minutes, Mr Xerox and Mr. Modi both working together can copy 250 in 25 minutes. In how many minutes Mr. Xerox can copy 36 pages?
- (a) 5 minutes (b) 6 minutes
 (c) 3 minutes (d) 12 minutes
55. 20 persons completed $\frac{1}{3}$ rd of the work in 12 days. How many more person are required to finish the rest work in next 12 days?
- (a) 20 (b) 12
 (c) 18 (d) 40
56. A contractor undertook a work to complete in 60 days. But just after 20 days he observed that only $\frac{1}{5}$ th of the project work had been completed. To complete the work in time (i.e.

Time and Work
 in rest days) minimum how many workers he had to increase, if there were initially 75 workers were deployed for the task?

- (b) 50
 (d) can't be determined
 (a) 25
 (c) 75

57. 6 men or 10 women can reap a field in 15 days, then the number of days that 12 men and 5 women will take to reap the same field is :

- (b) 6
 (d) 12
 (a) 5
 (c) 8

58. If 2 men or 3 women or 4 boys can do a piece of work in 52 days, then the same piece of work will be done by 1 man, 1 woman and 1 boy in :

- (b) 36 days
 (d) none of these
 (a) 48 days
 (c) 45 days

59. 2 men or 5 women or 7 boys can finish a work in 469 days, then the number of days taken by 7 men, 5 women and 2 boys to finish the work is :

- (b) 106
 (d) 98
 (a) 134
 (c) 100

60. 6 children and 2 men complete a certain piece of work in 6 days. Each child takes twice the time taken by a man to finish the work. In how many days will 5 men finish the same work?

- (b) 8
 (d) 15
 (a) 6
 (c) 9

61. 2 men and 3 women finish 25% of the work in 4 days, while 6 men and 14 women can finish the whole work in 5 days. In how many days will 20 women finish it?

- (b) 25
 (d) 88
 (a) 20
 (c) 24

Directions : For question number 62 and 63:

A can do a work in 15 days and B can do it in 18 days. With the help of C, all of them complete the work in 6 days.

62. How long will it take C to finish the work alone?

- (a) 30 days
 (b) 22 days
 (c) $\frac{45}{2}$ days
 (d) 25 days

63. A, B and C received total Rs. 27,000 for the whole work. What is the share of C, if the money is distributed in the ratio of amount of work done, individually?

- (a) 2700
 (b) 7200
 (c) 14400
 (d) 6300

Directions : Solve the following questions individually.

64. 314 weavers weaves 6594 shawls in $\frac{1}{6}$ hours. What is the

- number of shawls weaved per hour by an average weaver?
 (a) 42
 (b) 21
 (c) 102
 (d) 126

65. Three men and two women can do a piece of work in 4 days, while two men and three women can do the same work in 5 days. Rs 44 is given to a woman for her contribution towards work, per day. What is the amount received by a man per day?

- (a) Rs. 88
 (b) Rs. 144
 (c) Rs. 154
 (d) can't be determined

66. 30 girls can finish a work in 40 days. After how many days should 10 girls leave the work so that it may be finished in 46 days, if all the 30 girls started the work?

- (a) 18 days
 (b) 28 days
 (c) 22 days
 (d) 30 days

67. If 8 women collect 200 kg of tea leaves in 10 hours. How many more (in kg) of tea leaves will 12 women collect in 8 hours?

- (a) 24 kg
 (b) 40 kg
 (c) 50 kg
 (d) 100 kg

68. 450 man-days of work can be completed by a certain number of men in some days. If the number of people (men) are increased by 27, then the number of day required to complete the same work is decreased by 15. The number of days are required to complete the three times work (than the previous/actual work) by 27 men?

- (a) 50
 (b) 60
 (c) 54
 (d) 45

69. 4 boys and 5 girls can do a piece of work in 10 days. 6 boys and 6 girls can do the same work in 7 days. In how many days can 2 boys and 7 girls complete the same work, working together?

- (a) 15 days
 (b) 14 days
 (c) 21 days
 (d) 18 days

70. If 20 engineers and 20 workers can together construct a 20 km road in 20 days. 40 engineers and 40 workers together construct 40 km road in how many days?

- (a) 10
 (b) 20
 (c) 40
 (d) can't be determined

71. $(x - 2)$ men can do a piece of work in x days and $(x + 7)$ men can do 75% of the same work in $(x - 10)$ days. Then in how many days can $(x + 10)$ men finish the work?

- (a) 27 days
 (b) 12 days
 (c) 25 days
 (d) 18 days

72. A man, a woman and a girl worked for a contractor for the same period. A man is twice efficient as a woman and a woman is thrice efficient as a girl. Rs. 10000 were given to all of them. What is the sum of money received by a woman and a girl together?

- (a) Rs. 5500
 (b) Rs. 4500
 (c) Rs. 4000
 (d) Rs. 6000

73. 33 men can do a job in 30 days. If 44 men started the job together and after every day of the work, one person leaves. What is the minimum number of days required to complete the whole work?

- (a) 21
 (b) 42
 (c) 45
 (d) none of these

74. Abhishek can do a piece of work in 40 days. He alone worked at it for 8 days and then Bacchhan completed alone the rest work in 24 days. In how many days they will complete the whole work, working together?

- (a) $17\frac{1}{7}$ days
 (b) $18\frac{1}{7}$ days
 (c) $9\frac{1}{6}$ days
 (d) 14 days

75. C is twice efficient as A. B takes thrice as many days as C. A takes 12 days to finish the work alone. If they work in pairs (i.e., AB, BC, CA) starting with AB on the first day then BC on the second day and AC on the third day and so on, then how many days are required to finish the work?

- (a) $6\frac{1}{5}$ days (b) 4.5 days
 (c) $5\frac{1}{9}$ days (d) 8 days

76. Ahluwalia and Bimal together take 6 days to finish the work. Bimal and Jalan together take 10 days to finish the work. What is the difference between number of days taken by Ahluwalia and Jalan when they worked alone to complete the whole work?

- (a) 12 days (b) 16 days
 (c) 15 days (d) can't be determined

77. B is twice efficient as A and A can do a piece of work in 15 days. A started the work and after a few days B joined him. They completed the work in 11 days, from the starting. For how many days they worked together?

- (a) 1 day (b) 2 days
 (c) 6 days (d) 5 days

78. A, B and C can complete a piece of work in 15, 30 and 40 days respectively. They started the work together and A left 2 days before the completion of the work and B left 4 days before the completion of the work. In how many days was the work completed?

- (a) $7\frac{3}{10}$ (b) $10\frac{2}{15}$
 (c) $10\frac{7}{30}$ (d) none of these

79. There was a leakage in the container of the refined oil. If 11 kg oil is leaked out per day then it would have lasted for 50 days, if the leakage was 15 kg per day, then it would have lasted for only 45 days. For how many days would the oil have lasted, if there was no leakage and it was completely used for eating purpose?

- (a) 80 days (b) 72 days
 (c) 100 days (d) 120 days

80. A contractor undertook to complete the work in 40 days and he deployed 20 men for his work. 8 days before the scheduled time he realised that $\frac{1}{3}$ rd of the work was still to be done. How many more men were required to complete the work in stipulated time?

- (a) 16 (b) 15
 (c) 20 (d) 25

81. 7 Indian and 4 Chinese finish a job in 5 days. 7 Japanese and 3 Chinese finish the same job in 7 days. Given that the efficiency of each person of a particular nationality is same but different from others. One Indian, one Chinese and one Japanese will complete the work in :

- (a) $18\frac{3}{13}$ days (b) $20\frac{5}{12}$ days
 (c) $21\frac{6}{14}$ days (d) $20\frac{7}{12}$ days

82. M, N and O are three book binders. A takes 8 minutes, B takes 12 minutes and C takes 15 minutes to bind a book. If they work each day for 12 hours, then on an average, how many books each one bind per day?

- (b) 52
 (a) 65 (d) 70
 (c) 48

83. A piece of work can be completed by 10 men and 6 women in 18 days. Men works 9 hours per day while women works $\frac{2}{3}$ hours per day. Per hour efficiency of a woman is $\frac{2}{3}$ rd of a man's efficiency. In how many days 10 men and 9 women complete the work?

- (b) 20 days
 (a) 16 days (d) 25 days
 (c) 30 days

84. B and C are equally efficient, but the efficiency of A is half of each B and C. A and B started a work and 3 days later C joined them. If A alone can do the work in 14 days, then in how many more days the work will be completed?

- (a) 1 (b) 2
 (c) 3 (d) 4.5

85. A can do a piece of work in 10 days, B in 15 days. They work together for 5 days, the rest of the work is finished by C in two more days. If they get Rs. 3000 as wages for the whole work, what are the daily wages of A, B and C respectively (in Rs.):

- (a) 200, 250, 300 (b) 300, 200, 250
 (c) 200, 300, 400 (d) none of these

86. A can do a piece of work in 2 hours, B can do thrice the work in 8 hours and C can do the same work as A in 8 hours. If all of them work together, how long it would take them to complete the work :

- (a) 1 hour (b) 2 hours
 (c) 3 hours (d) 4 hours

87. A is twice efficient as B and together they do the same work in as much time as C and D together. If C and D can complete the work in 20 and 30 days respectively, working alone, then in how many days A can complete the work individually:

- (a) 12 days (b) 18 days
 (c) 24 days (d) 30 days

88. 4 men and 2 boys can finish a piece of work in 5 days. 3 women and 4 boys can finish the same work in 5 days. Also 1 men and 3 women can finish the same work in 5 days. In how many days 1 man, 1 woman and one boy can finish the work at their double efficiency?

- (a) $4\frac{8}{13}$ (b) $4\frac{7}{13}$
 (c) $3\frac{7}{13}$ (d) none of these

89. If m men can do a work in r days, then the number of days taken by $(m+n)$ men to do it is :

- (a) $\frac{m+n}{mn}$ (b) $\frac{m+n}{mr}$
 (c) $\frac{mr}{(m+n)}$ (d) $\frac{(m+n)r}{mn}$

90. Pipe A can fill a tank in 36 minutes and pipe B can fill it in 45 minutes. If both the pipes are opened to fill an empty tank, how many minutes will it be full?

Time and Work
 (a) 15
 (c) 20
 (d) 25

91. Tap A can fill the empty tank in 12 hours, but due to a leak in the bottom it is filled in 15 hours. If the tank is full and then tap A is closed then in how many hours the leak can empty it?
- (a) 45 hours
 (b) 48 hours
 (c) 52 hours
 (d) 60 hours

92. Pipe A and B can fill a cistern in 10 hours and 15 hours respectively. When a third pipe C which works as an outlet pipe is also open then the cistern can be filled in 18 hours. The outlet pipe can empty a full cistern in :
- (a) 12 hours
 (b) 8 hours
 (c) 9 hours
 (d) 14 hours

93. A cistern has a leak which would empty it in 6 hours. A tap is turned on which fills the cistern @ 10 liters per hour and then it is emptied in 15 hours. What is the capacity of the cistern?
- (a) 100 litres
 (b) 166.66 litres
 (c) 60.66 litres
 (d) none of these

94. Tap A fills a tank in 10 hours and B can fill it in 15 hours. Both are opened simultaneously. Sometimes later tap B was closed, then it takes total 8 hours to fill up the whole tank. After how many hours B was closed?
- (a) 2
 (b) 3
 (c) 4
 (d) 5

95. Tap A can fill a tank in 20 hours, B in 25 hours but tap C can empty a full tank in 30 hours. Starting with A, followed by B and C each tap opens alternatively for one hour period till the tank gets filled up completely. In how many hour the tank will be filled up completely?

- (a) $51\frac{11}{15}$
 (b) $52\frac{2}{3}$
 (c) $24\frac{4}{11}$
 (d) none of these

96. If one pipe A can fill a tank in 20 minutes, then 5 pipes, each of 20% efficiency of A, can fill the tank in :

LEVEL (2)

1. A, B and C three weavers have to supply an order of 100 shawls. A can weave a shawl in 2 hours, B in 3 hours and C in 4 hours respectively. It is known that even being a joint contract each one weaves his own shawl completely i.e., no other weaver help to the rest weavers. In how many hours they will complete the order irrespective of day or night?
- (a) 93 hours
 (b) 100 hours
 (c) $92\frac{4}{13}$ hours
 (d) 94 hours

2. Arun and Satyam can complete a work individually in 12 working days and 15 working days respectively with their full efficiencies. Arun does work only on Monday, Wednesday and Friday while Satyam does the work on Tuesday, Thursday and Saturday. Sunday is always off. But Arun and Satyam both works with half of their efficiencies on Friday and Saturday respectively. If Arun started the work on 1st January which falls on Monday followed by Satyam on the next day and so on (i.e., they work collectively in alternate days), then on which day work will be completed?

(a) 80 min
 (c) 20 min
 (b) 100 min
 (d) 25 min

97. Pipe A basically used as inlet pipe and pipe B is used as outlet pipe. Pipes A and B both are opened simultaneously, all the time. When pipe A fills the tank and B empty the tank, it will take double the time than when both the pipe fill the tank. When pipe B is used for filling the tank, its efficiency remains constant. What is the ratio of efficiency of pipe A and pipe B respectively?
- (a) 3 : 1
 (c) 1 : 3
 (b) 5 : 2
 (d) 3 : 2

98. Pipe A can fill the tank in 4 hours, while pipe B can fill it in 6 hours working separately. Pipe C can empty whole the tank in 4 hours. He opened the pipe A and B simultaneously to fill the empty tank. He wanted to adjust his alarm so that he could open the pipe C when it was half-filled, but he mistakenly adjusted his alarm at a time when his tank would be $\frac{3}{4}$ th filled. What is the time difference between both the cases, to fill the tank fully :
- (a) 48 min.
 (b) 54 min.
 (c) 30 min.
 (d) none of these

99. Two pipes A and B can fill a cistern in 15 hours and 10 hours respectively. A tap C can empty the full cistern in 30 hours. All the three taps were open for 2 hours, when it was remembered that the emptying tap had been left open. It was then closed. How many hours more would it take for the cistern to be filled?
- (a) 30 min.
 (b) 1.2 hours
 (c) 24 min.
 (d) 35 min.

100. Pipe A can fill an empty tank in 30 hours while B can fill it in 45 hours. Pipe A and B are opened and closed alternatively i.e., first pipe A is opened, then B, again A and then B and so on for 1 hour each time without any time lapse. In how many hours the tank will be filled when it was empty, initially?
- (a) 36
 (b) 54
 (c) 48
 (d) 60

(a) Tuesday
 (c) Thursday
 (b) Wednesday
 (d) Friday

3. Kaushalya can do a work in 20 days, while Kaikeyi can do the same work in 25 days. They started the work jointly. Few days later Sumitra also joined them and thus all of them completed the whole work in 10 days. All of them were paid total Rs. 700. What is the share of Sumitra?
- (a) Rs. 130
 (b) Rs. 185
 (c) Rs. 70
 (d) can't be determined

4. A and B can complete the work individually in 24 days and 30 days respectively, working 10 hours a day. Work is to be done in two shift. Morning shift lasts for 6 hours and evening shift lasts for 4 hours. On the first day A works in the morning shift while B works in the evening shift. Next day A works in the evening shift while B works in the morning shift and so on. It means they work alternatively with respect to their shifts. Thus they work on this pattern till the work is completed. On which day the work got completed?

- to complete the job alone.

(a) 8 days (b) $\frac{38}{35}$ days
 (c) $\frac{15}{2}$ days (d) $13\frac{1}{3}$ days

12. A single reservoir supplies the petrol to the vehicles. The reservoir is fed by a single pipeline filling it with the stream of uniform volume. When the reservoir is full, it takes 90 days to empty it. If 40,000 litres of petrol is used daily, the reservoir will last 90 days. If 32,000 litres of petrol is used daily, how much petrol can be used daily without failing?

(a) 64000 litres (b) 56000 litres
 (c) 78000 litres (d) 60000 litres

13. Railneer is packaged in a water bottling plant. It is processed by two machines M_1 and M_2 . M_1 and M_2 produce 600 bottles per minute. One day's production is processed by M_1 operating alone for 9 hours, or by M_2 operating alone for 6 hours or by both M_1 and M_2 simultaneously for 3 hours and 36 minutes. Production is processed by M_1 operating alone for 2 hours, M_2 operating alone for 4.5 hours, and M_1 and M_2 simultaneously operating for 3 hours, then in how many hours total production be completed?

(a) 2 (b) 3
 (c) 4.5 (d) 4.8

Directions for questions 14 and 15: A contractor engaged 100 workers to finish construction of a road in 100 days. He had to complete the work in 80 days. He engaged 100 workers to start the work. After 40 days, he realised that the work was delayed by three-fourth of the scheduled time, so he doubled the number of workers and thus he managed to complete the road on the scheduled time.

14. How much work he had been completed, before the number of workers?

(a) 10% (b) 30%
 (c) $14\frac{2}{7}\%$ (d) can't be determined

15. Some-time after the new workers were introduced, the efficiency of the remaining workers reduced to which the work finally got completed by decreasing the scheduled time then how much work was incomplete by the end of the scheduled time?

(a) $17\frac{3}{5}\%$ (b) 21%
 (c) $27\frac{5}{7}\%$ (d) 28%

Time and Work

Directions for questions 16 to 20 : A typist employed a certain number of typists for his project. 8 days later 20% of the typist left the job and it was found that it took as much time to complete the rest work from then as the entire work needed with all the employed typists. The average speed of a typist is 20 pages/hour.

16. How many typists left the work?
 - (a) 10
 - (b) 5
 - (c) 16
 - (d) can't be determined
17. Minimum how many typist could be employed?
 - (a) 10
 - (b) 5
 - (c) 15
 - (d) 4
18. What could be the number of typists remained at work when 20% of the employed typists left the job?
 - (a) 15
 - (b) 18
 - (c) 68
 - (d) 78
19. What is the actual number of days required, when it is done with actual work force, through out the completion :
 - (a) 32 days
 - (b) 48 days
 - (c) 40 days
 - (d) can't be determined
20. 16 days after the 20% typist left the job it was decided to complete the work on time by increasing the work-force again. By how much percentage increase in work-force is required?
 - (a) 100%
 - (b) 50%
 - (c) 200%
 - (d) none of these
21. Five tailors A, B, C, D and E stich 1800 shirts in 90 days working alternatively. Find the minimum possible number of shirts that can be stiched in a single day by working together :
 - (a) 100
 - (b) 20
 - (c) 50
 - (d) 4

Directions for question number 22, 23 : 8 men and 5 women working 6 hours a day can complete a work in 4 days. Also 4 men and 5 women working for 8 hours a day can complete the same job in 5 days. Similarly 5 boys working 8 hours a day can complete the same job in 30 days.

22. If 4 men, 3 women and 4 boys worked together everyday for 5 hours, then in how many days they have completed the work?
 - (a) 3
 - (b) 4
 - (c) 8
 - (d) 6
23. If women and children (boys) can't be employed, then minimum how many men are required to complete the job in 6 days if the working hours per day cannot exceed 9?
 - (a) 4
 - (b) 5
 - (c) 6
 - (d) 7
24. Eklavya can do the 6 times the actual work in 36 days while Faizal can do the one-fourth of the original work in 3 days. In how many days will both working together complete the 3 times of the original work?
 - (a) 6
 - (b) 10
 - (c) 12
 - (d) 15

25. Progressive Company Pvt. Ltd. hired some employees in a fix pattern. On the first day it hired one person, on the second day one more joined him. On the third, fourth etc (i.e., every

next day) one more person increased in this group. The capacity of each person was same. The whole work was completed on the 24th day then out of total Rs. 5000, maximum how much a person had earned?

- (a) Rs. 500
 - (b) Rs. 400
 - (c) Rs. 200
 - (d) Rs. 250
26. Two persons having different productivity of labour, working together can reap a field in 2 days. If one-third of the field was reaped by the first man and rest by the other one working alternatively took 4 days. How long did it take for the faster person to reap the whole field working alone?
- (a) 12
 - (b) 8
 - (c) 6
 - (d) 3
27. The total number of men, women and children working in a factory is 18. They earn Rs. 4000 in a day. If the sum of the wages of all men, all women and all children is in the ratio of 18 : 10 : 12 and if the wages of an individual man, woman and child is in the ratio 6 : 5 : 3, then how much a woman earn in a day?
- (a) Rs. 400
 - (b) Rs. 250
 - (c) Rs. 150
 - (d) Rs. 120
28. A group of workers was put on a job. From the second day onwards, one worker was withdrawn each day. The job was finished when the last worker was withdrawn. Had no worker been withdrawn at any stage, the group would have finished the job in 55% of the time. How many workers were there in the group?
- (a) 50
 - (b) 40
 - (c) 45
 - (d) 10
29. Two workers undertake to do a job. The second worker started working 2 hours after the first. Five hours after the second worker has begun working there is still $\frac{9}{20}$ of the work to be done. When the assignment is completed, it turns out that first worker has done 60% of the work, while second worker has done rest of the work. How many hours would it take each one to do the whole job individually?
- (a) 10 hours and 12 hours
 - (b) 15 hours and 10 hours
 - (c) 20 hours and 25 hours
 - (d) 18 hours and 20 hours
30. A group of men decided to do a job in 4 days. But since 20 men dropped out every day, the job completed at the end of the 7th day. How many men were there at the beginning?
- (a) 240
 - (b) 140
 - (c) 280
 - (d) 150
31. Brahma, Vishnu and Mahesh are three friends with different productivity. Brahma working alone needs as much time as Vishnu and Mahesh working together, while Vishnu himself needs 8 hours more working alone than when he works with Mahesh. Brahma working alone needs 8 hours less than Vishnu needs working alone. In how much time Brahma, Vishnu and Mahesh working together can complete the job?
- (a) 4 hours
 - (b) 5 hours
 - (c) 6 hours
 - (d) 8 hours

- Time and Work
 (a) $9\frac{2}{3}$ hours
 (b) $3\frac{1}{3}$ hours
 (c) 10 hours
 (d) none of these

Directions for question number 45 and 46: A tank has an inlet and outlet pipe. The inlet pipe fills the tank completely in 2 hours when the outlet pipe is plugged. The outlet pipe empties the tank completely in 6 hours when the inlet pipe is plugged.

45. If both pipes are opened simultaneously at a time when the tank was one-third filled, when will the tank fill thereafter?
 (a) $\frac{3}{2}$ hours
 (b) $\frac{2}{3}$ hour
 (c) 2 hours
 (d) $1\frac{2}{3}$ hours

46. If there is a leakage also which is capable of draining out the liquid from the tank at half of the rate of outlet pipe, then what is the time taken to fill the empty tank when both the pipes are opened?

- (a) 3 hours
 (b) $3\frac{2}{3}$ hours
 (c) 4 hours
 (d) none of these

47. An inlet pipe can fill a tank in 5 hours and an outlet pipe can empty the same tank in 36 hours, working individually. How many additional number of outlet pipes of the same capacity are required to be opened, so that the tank never overflows?

- (a) 3
 (b) 6
 (c) 8
 (d) 7

Directions for question number 48 and 49: In a public bathroom there are n taps 1, 2, 3... n . Tap 1 and tap 2 take equal time to fill the tank while tap 3 takes half the time taken by tap 2 and tap 4 takes half the time taken by tap 3. Similarly each next number of tap takes half the time taken by previous number of tap i.e., K^{th} tap takes half the time taken by $(K-1)^{\text{th}}$ tap.

48. If the 10th tap takes 2 hours to fill the tank alone then what is the ratio of efficiency of 8th tap and 12th tap, respectively?
 (a) 4 : 1
 (b) 5 : 3
 (c) 16 : 1
 (d) 1 : 16

49. If the 8th tap takes 80 hours to fill the tank then the 10th and 12th taps working together take how many hours to fill the tank?
 (a) 2 hours
 (b) 4 hours
 (c) 6 hours
 (d) none of these

50. Pipe A takes $\frac{3}{4}$ of the times required by pipe B to fill the empty tank individually. When an outlet pipe C is also opened simultaneously with pipe A and pipe B, it takes $\frac{3}{4}$ more time

to fill the empty tank than it takes, when only pipe A and pipe B are opened together. If it takes to fill 33 hours when all the three pipes are opened simultaneously, then in what time pipe C can empty the full tank operating alone?
 (a) 66 hours
 (b) 50 hours
 (c) 44 hours
 (d) can't be determined

Directions for question number 51, 52 and 53: A contractor undertook a project to complete it, in 20 days which needed 5 workers to work continuously for all the days estimated. But before the start of the work the client wanted to complete it earlier than the scheduled time, so the contractor calculated that he needed to increase 5 additional men every 2 days to complete the work in the time the client wanted it :

51. How many men were working on the day the project was completed as per the date of client wanted to complete it?
 (a) 5
 (b) 10
 (c) 20
 (d) none of these

52. Find the number of days in which client wanted to complete his work.

- (a) 15
 (b) 10
 (c) 8
 (d) can't be determined

53. If the work was further increased by 50% but the contractor continues to increase the 5 workers on every 2 days then how many more days are required over the initial time specified by the client?

- (a) 1 day
 (b) 2 days
 (c) 5 days
 (d) none of these

54. A tank is connected with 8 pipes. Some of them are inlet pipes and rest work as outlet pipes. Each of the inlet pipe can fill the tank in 8 hours, individually, while each of those that empty the tank i.e., outlet pipe, can empty it in 6 hours individually. If all the pipes are kept open when the tank is full, it will take exactly 6 hours for the tank to empty. How many of these are inlet pipes?

- (a) 2
 (b) 4
 (c) 5
 (d) 6

55. A tank has two inlet pipes which can fill the empty tank in 12 hours and 15 hours working alone and one outlet pipe which can empty the full tank in 8 hours working alone. The inlet pipes are kept open for all the time but the outlet pipe was opened after 2 hours for one hour and then again closed for 2 hours then once again opened for one hour. This pattern of outlet pipe continued till the tank got completely filled. In how many hours the tank has been filled, working on the given pattern?

- (a) 8 hours 24 minutes
 (b) 10 hours 15 minutes
 (c) 9 hours 10 minutes
 (d) 9 hours 6 minutes

Final Round

Directions for question number 1 to 5 : In a nut-bolt factory 180 workers are working for 6 hours a day. Out of 180 workers there are some men, some women and rest are boys. All the workers can produce either nut or bolt or both of them. A man can produce 60 nuts and 80 bolts in each hour and a woman

can produce 30 nuts and 60 bolts per hour. A man is thrice as efficient as a boy and $\frac{3}{2}$ times as efficient as a woman. Given that all men, all women and all boys produce equal number of articles of one kind (i.e., either nut or bolt) per hour.

Directions for Questions 9, 10 and 11: Read the following additional data for question number 9, 10 and 11. The profit per unit for product 1, 2 and 3 is Rs. 3, Rs. 4 and Rs. 5.

Directions for question number 7 to 11: A company produces three products. The products are processed on 3 different machines. The time required to manufacture one unit of each the three products and the daily capacity of three machines are given in the table below :

Machine	Time per unit (in min.)			Machine capacity (min./day)
	Product 1	Product 2	Product 3	
M_1	2	2	3	450
M_2	2	5	-	410
M_3	3	-	4	480

- 4 480

7. How many units of product 1 can be produced in one day?
 (a) 160 (b) 205
 (c) 225 (d) 64

8. If minimum 20 units of P_1 and 30 units of P_2 have to be produced, then what is the maximum units of P_3 that can be produced in a day?
 (a) 116 (b) 105
 (c) 205 (d) 220

Directions for question number 12-15 : Ready Tailoring Services is very well known in its quality and time bound services. The company (Ready Tailoring Services) received a large order for stitching military uniforms. It has two different orders to prepare the shirts one for Officers and second for Jawans (non-officers). It has three cutters who will cut the fabric. Six tailors who will do the stitching and 3 assistant to stitch the buttons and iron the shirts. Each of these 12 persons will work for exactly 8 hours a day. Each of the Officers uniform requires 20 minutes for cutting the fabric, 1 hour for stitching and 20 minutes for stitching buttons and ironing the shirts. Whereas the Jawan's uniform requires 15 minutes for cutting the fabric and 60 minutes for stitching and 10 minutes for buttons and ironing.

12. If the company has to supply 40 officers uniforms only and no other on a particular day, how many man-hours are utilised on that day?

(a) $33\frac{1}{3}$ hours (b) $66\frac{2}{3}$ hours
(c) 40 hours (d) 60 hours

13. If the number of tailors will be increased by 50% then maximum how many uniforms for officers can be completed in one day?

(a) 48 (b) 50
(c) 60 (d) 72

14. If the company can increase maximum 3 employees of any category then for which category should it hire to get maximum increase in production capacity, assuming that it needs to stitch only officer's uniform :

(a) cutter (b) tailor
(c) assistant (d) can't be determined

15. If the company has to produce the shirts for only one category then of which category it can produce maximum number of uniforms?

(a) Officers (b) Jawans
(c) either (a) or (b) (d) none of these



LEVEL-1

1. (c)	2. (b)	3. (c)	4. (a)	5. (d)	6. (b)	7. (b)	8. (c)	9. (b)	10. (c)
11. (b)	12. (c)	13. (a)	14. (a)	15. (b)	16. (b)	17. (a)	18. (a)	19. (b)	20. (a)
21. (a)	22. (c)	23. (d)	24. (c)	25. (b)	26. (b)	27. (a)	28. (c)	29. (c)	30. (c)
31. (b)	32. (a)	33. (b)	34. (d)	35. (a)	36. (c)	37. (c)	38. (b)	39. (b)	40. (d)
41. (a)	42. (b)	43. (b)	44. (c)	45. (b)	46. (a)	47. (a)	48. (c)	49. (a)	50. (a)
51. (c)	52. (a)	53. (d)	54. (b)	55. (a)	56. (c)	57. (b)	58. (a)	59. (d)	60. (a)
61. (a)	62. (c)	63. (b)	64. (d)	65. (c)	66. (b)	67. (b)	68. (a)	69. (b)	70. (b)
71. (b)	72. (c)	73. (d)	74. (a)	75. (c)	76. (d)	77. (b)	78. (b)	79. (b)	80. (c)
81. (b)	82. (a)	83. (a)	84. (a)	85. (b)	86. (a)	87. (b)	88. (d)	89. (c)	90. (c)
91. (d)	92. (c)	93. (a)	94. (b)	95. (a)	96. (c)	97. (a)	98. (b)	99. (c)	100. (a)

LEVEL-2

1. (a)	2. (c)	3. (c)	4. (b)	5. (c)	6. (c)	7. (c)	8. (b)	9. (c)	10. (d)
11. (d)	12. (b)	13. (c)	14. (b)	15. (c)	16. (d)	17. (b)	18. (c)	19. (c)	20. (d)
21. (a)	22. (c)	23. (b)	24. (c)	25. (b)	26. (d)	27. (b)	28. (d)	29. (c)	30. (b)
31. (c)	32. (d)	33. (b)	34. (c)	35. (a)	36. (c)	37. (d)	38. (d)	39. (c)	40. (b)
41. (c)	42. (b)	43. (b)	44. (a)	45. (c)	46. (c)	47. (d)	48. (d)	49. (b)	50. (c)
51. (c)	52. (c)	53. (b)	54. (b)	55. (c)					

FINAL ROUND

1. (c)	2. (b)	3. (a)	4. (c)	5. (c)	6. (c)	7. (a)	8. (b)	9. (d)	10. (b)
11. (c)	12. (b)	13. (d)	14. (b)	15. (c)					



Hints & Solutions

LEVEL 1

1. Efficiency of $A = \frac{100}{12} = 8.33\%$

Efficiency of $B = \frac{100}{15} = 6.66\%$

Combined efficiency of A and $B = 8.33 + 6.66 = 15\%$
Number of days taken by A and B , when worked together

$$= \frac{100}{15} = 6 \frac{10}{15} = 6 \frac{2}{3} \text{ days}$$

NOTE Efficiency \times Time period = Fixed amount of work

Also, in terms of percentage total work to be done is considered as 100% (in fraction it is 1), unless otherwise stated.

Alternatively : It can be done through unitary method, also.

2. Efficiency of $A = \frac{100}{10} = 10\%$

Efficiency of $B = \frac{100}{12} = 8.33\%$

Efficiency of $C = \frac{100}{15} = 6.66\%$

Combined efficiency of A , B and $C = 10 + 8.33 + 6.66 = 25\%$

\therefore Required number of days, when A , B and C worked together

$$= \frac{100}{25} = 4 \text{ days}$$

3. Efficiency of $A = 20\% \left(= \frac{100}{5}\right)$

Efficiency of $B = 10\% \left(= \frac{100}{10}\right)$

Efficiency of A , B and $C = 50\% \left(= \frac{100}{2}\right)$

\therefore Efficiency of $C = (\text{Efficiency of } A, B \text{ and } C) - (\text{Efficiency of } A \text{ and } B)$
 $= (50) - (20 + 10) = 20\%$

\therefore Number of days required by C to work alone $= \frac{100}{20} = 5 \text{ days}$

Alternatively : Go through options and satisfy the values.

Days	A	B	C	$(A + B + C)$
5	20%	10%	20%	50%
Efficiency	20%	10%	20%	50%

Consider option (c)

4. Efficiency of $A = 12.5\%$

Efficiency of $B = 6.25\%$

Efficiency of $C = 1.25\%$

Efficiency of $(A + B + C) = 20\% (= 12.5 + 6.25 + 1.25)$

Required number of days $= \frac{100}{20} = 5 \text{ days}$

5. Efficiency of $A = 10\%$

Efficiency of $B = 6.66\%$

\therefore Required number of days $= \frac{100}{16.66} = 6 \text{ days}$

6. Efficiency of $A = \frac{100}{24} = 4.16\%$

Efficiency of $B = \frac{100}{30} = 3.33\%$

Efficiency of $(A + B + C) = \frac{100}{12} = 8.33\%$

\therefore Efficiency of $C = (8.33) - (4.16 + 3.33) = 0.83\%$

\therefore Number of days required by C to complete the work alone

$$= \frac{100}{0.83} = \frac{100}{5/6} = 120 \text{ days}$$

NOTE $\frac{5}{6} = 0.833$

7. Efficiency of $A = 10\%$

Efficiency of $B = 4.16\%$

Efficiency of $(A + B + C) = 16.66\%$

Efficiency of $C = (16.66) - (10 + 4.16) = 2.5\%$

Number of days required by C alone to finish the work

$$= \frac{100}{2.5} = 40 \text{ days}$$

8.

Efficiency of $A = 7.14\%$

Efficiency of $B = 4.76\%$

Efficiency of $A + B = 11.9\%$

\therefore Number of days required by A and B , working together

$$= \frac{100}{11.9} = 8.4 \text{ days}$$

HINT You can see that there is only one option between 8 and 9 which is 8.4 hence (c) is the correct choice.

Explanation : For 8 days denominator should be 12.5 and for 9 days denominator should be almost 11.

Alternatively : One day's work of A and B

$$= \frac{1}{14} + \frac{1}{21} = \frac{5}{42}$$

\therefore Required number of days $= \frac{42}{5} = 8.4 \text{ days}$

HINT and Work
Efficiency of $A = 4.16\%$
Efficiency of $B = 1.6 \times 4.16 = 6.66\%$

$$\therefore \text{Number of days required by } B = \frac{100}{6.66} = 15 \text{ days}$$

Alternatively :

Efficiency	\rightarrow	A	B
Days	\rightarrow	x	$1.6x$
(Since number of days are inversely proportional to efficiency)		$1.6k$	k

$$\therefore 1.6k = 24 \Rightarrow k = 15 \text{ day}$$

Now A 's one day's work = $\frac{1}{24}$

$$B$$
's one day's work = $160\% \text{ of } \frac{1}{24} = \frac{1}{15}$

$$\therefore \text{Required number of days} = 15$$

$$10. \quad \text{Efficiency of } A + B = \frac{100}{14} = 7.14\%$$

Again the ratio of efficiency of A and $B = 2:1$

$$\therefore \text{Efficiency of } A = \frac{2}{3} \times 7.14 = 4.76\%$$

$$\therefore \text{Required number of days by } A = \frac{100}{4.76} = 21 \text{ days}$$

NOTE Only choice (c) lies between 20 and 24.

Explanation : For 20 days denominator should be 5 and for 24 days, denominator should be 4.16 also the only choice (c) gives a value which is multiple of 7 and very close to the answer (as appears).

Alternatively : One day's work of

$$A \text{ and } B = \frac{1}{x} + \frac{1}{2x} = \frac{1}{14}$$

$$\therefore x = 21$$

Since A is twice efficient as B so A will take half of the days taken by B .

$$11. \quad \text{Efficiency of } A + B = 14.28\% \left(= \frac{100}{7}\right)$$

Now, since the ratio of efficiency of A and B is $2:1$

$$\text{So, the efficiency of } A = \frac{2}{3} \times 14.28 = 9.52\%$$

$$\therefore \text{Number of days required by } A = 10.5 \text{ days}$$

HINT Only choice (b) is correct since there is no other value (in option) lies between 10 and 11.

Explanation : For 10 days, denominator should be 10 and for 11 days, denominator should be 9.09.

Alternatively : Let A takes x days and then B takes $2x$ days

$$\text{then } 1 \text{ day's work of } A \text{ and } B = \frac{1}{x} + \frac{1}{2x} = \frac{1}{7}$$

$$\therefore x = 10.5$$

Thus A takes 10.5 days.

Efficiency	\rightarrow	A	B
Days	\rightarrow	3	1
		:	:

(Since number of days are inversely proportional to the efficiency)
Now if A requires x days, so B requires $3x$ days

$$\therefore \text{Difference of required days} (= 3x - x) = 2x = 10 \\ \Rightarrow x = 5$$

Hence the number of days required by $B = 3x = 3 \times 5 = 15$ days

Efficiency	\rightarrow	A	B
Days	\rightarrow	2	1
		:	:

$\left(\text{Days} \propto \frac{1}{\text{Efficiency}} \right)$

Now, let A requires x days, then B requires $2x$ days
∴ difference in number of days ($= 2x - x$) = $x = 6$

$$\Rightarrow x = 6 \\ \therefore B \text{ requires } 2x = 2 \times 6 = 12 \text{ days}$$

Alternatively : If A takes x days, then B takes $x + 6$ days

$$\text{Now, } A \text{ 's 1 day's work} = \frac{1}{x} \\ B \text{ 's 1 day's work} = \frac{1}{x+6} \\ \therefore \frac{1/x}{1/(x+6)} = \frac{2}{1}$$

(Since A does twice the work as B does)

$$\Rightarrow x = 6$$

∴ B takes $2x = 12$ days.

$$\text{Alternatively : } \frac{1}{x} + \frac{1}{(x+6)} = \frac{1}{4}$$

$$\Rightarrow x = 6 \text{ and } 2x = 12 \text{ days (required by } B)$$

Alternatively : Go through option and satisfy all the conditions.

	A	$:$	B	$:$	C
Ratio of efficiency	3		1		2
Ratio of number of days	$\frac{1}{3}$		$\frac{1}{1}$		$\frac{1}{2}$
or	2		6		3

Hence, (a) is correct $\left[\because \text{Time} \propto \frac{1}{\text{Efficiency}} \right]$

15.	Efficiency	Ajit	$:$	Bablu
		3		1

No. of days

$\therefore \frac{1}{3} : \frac{1}{1} = 3 : 1$

$\therefore \frac{X}{Y} = 3 : 1$

16.	Efficiency	Ajit	$:$	Bablu
		5		1

No. of days

$\therefore \frac{1}{5} : \frac{1}{1} = 1 : 5$

17.	Efficiency	Ajit	$:$	Bablu
		20		3

No. of days

$\therefore \frac{4}{5} : \frac{1}{3} = 4 : 5$

$\therefore \frac{Efficiency}{Efficiency} = \frac{5}{4} : 1$

$$\therefore \text{Efficiency of } B = \frac{4}{9} \times 15 = \frac{20}{3} = 6\frac{2}{3}\%$$

18. Efficiency of $A + B = 33.33\% \left(= \frac{100}{3}\right)$

Ratio of efficiency of A and $B = 3 : 1$

$$\therefore \text{Efficiency of } A = \frac{3}{4} \times 33.33 = 25\%$$

$$\therefore \text{Number of days taken by } A = 4 \left(= \frac{100}{25}\right)$$

Alternatively :

	A	B
Efficiency	3	: 1
No. of days	$1(x)$	$3(x)$

$$\therefore \text{Difference in days} = 2x = 8$$

$$\Rightarrow x = 4 \text{ and } 3x = 12$$

Therefore number of days taken by A , working alone = 4 days

Alternatively : $\frac{1}{x} + \frac{1}{(x+8)} = \frac{1}{3}$

Now, you can use the options, or solve the equations to get the value of x which is equal to 4.

19. Efficiency of $(A + B) = 12.5\%$

Efficiency of $(B + C) = 8.33\%$

Efficiency of $(C + A) = 12.5\%$

$$\therefore \text{Efficiency of } [(A + B) + (B + C) + (C + A)] = 33.33\%$$

$$\therefore \text{Efficiency of } (A + B + C) = 16.66\%$$

∴ Number of days required by A , B and C together = 6 days

$$\left(= \frac{100}{16.66}\right)$$

20. Efficiency of $(A + B) = 8.33\%$

Efficiency of $(B + C) = 6.66\%$

Efficiency of $(C + A) = 5.00\%$

$$\therefore \text{Efficiency of } A + B + C = \frac{1}{2} (8.33 + 6.66 + 5) = 10\%$$

$$\therefore \text{Efficiency of } C = \text{Efficiency of } [(A + B + C) - (A + B)] \\ = (10 - 8.33) = 1.66\%$$

$$\therefore \text{Number of days required by } C \text{ alone} = \frac{100}{1.66} = 60 \text{ days}$$

21. Remember

$$\text{Time} \propto \frac{1}{\text{Efficiency}}$$

Now,

	Ganga	:	Jamuna	:	Saraswati
Efficiency	→ 3	:	1	:	2
No. of days	→ 2	:	6	:	3

Again, efficiency of Ganga, Jamuna and Saraswati

$$= \frac{100}{1} = 100\%$$

$$\therefore \text{Efficiency of Ganga} = \frac{3}{6} \times 100 = 50\%$$

$$\text{Efficiency of Saraswati} = \frac{2}{6} \times 100 = 33.33\%$$

$$\text{Now, number of days taken by Ganga} = \frac{100}{50} = 2$$

$$\text{Number of days taken by Saraswati} = \frac{100}{33.33} = 3$$

∴ Difference in number of days taken by Ganga and Saraswati
= 3 - 2 = 1 day

22. Day 1 2 3 4 5 6 7 8
 $\begin{array}{l} A \\ A \\ A \\ | \\ (A+B) \\ (A+B) \\ (A+B) \\ (A+B) \\ (A+B) \end{array}$

$$3 \times \frac{1}{12} = \frac{3}{12} = 25\% \quad \left\{ \begin{array}{l} \text{Remaining work} \\ = 75\% = (100 - 25) \end{array} \right.$$

work completed
Now, efficiency of $A + B = 15\% = (8.33 + 6.66)$

$$\therefore \text{Number of days required by } A + B = \frac{75}{15} = 5$$

to complete rest work (= 75%)

23. '3 days before the completion of the work Raja left the work means in last 3 days only Rani has worked alone.

$$\text{So, in last 3 days worked done by Rani} = 3 \times \frac{1}{21} = \frac{1}{7}$$

So, the rest $\left(1 - \frac{1}{7}\right) = \frac{6}{7}$ work was done by Raja and Rani both.

Number of days in which Raja and Rani worked together

$$= \frac{6/7}{5/42} = \frac{36}{5} = 7 \frac{1}{5} \text{ days}$$

NOTE Work done by Raja and Rani in one day = $\frac{1}{14} + \frac{1}{21} = \frac{5}{42}$

$$\left(\text{Also, number of days} = \frac{\text{Total work to be done}}{\text{Work to be done in one day}} \right)$$

24. Work done in 11 days = $\frac{11}{30}$

$$\text{Rest work} = \frac{19}{30}$$

$$1 \text{ day's work of } A = \frac{19/30}{28} = \frac{19}{30 \times 28} = \frac{19}{840}$$

Total number of days required to complete the whole work alone

$$= \frac{1}{19/840} = \frac{840}{19} = 44 \frac{4}{19} \text{ days}$$

25. Efficiency of Sonu = $5\% = \left(\frac{100}{20}\right)$

Rest work = 75%

$$\text{Efficiency of Abhijeet} = \frac{75}{10} = 7.5\%$$

∴ Combined efficiency of Sonu and Abhijeet

$$= 12.5\% = (7.5 + 5)$$

∴ Number of days required by Sonu and Abhijeet, to work together

$$= \frac{100}{12.5} = 8 \text{ days}$$

26. Asha 5 Usha 4
 Efficiency 5 No. of days 4x 5x = 25

∴ Number of days required by Asha to finish the work alone
= 20 ∵ $(4x = 4 \times 5)$

(Alternatively, from percentage change graphic, number of days taken by Asha will be 20% less than Usha, if efficiency of Asha is 25% more than Usha)
 Now, since Asha and Usha did work together for last 5 days
 $= 5 \times 9 = 45\%$

(Since efficiency of Asha = 5% and Usha's efficiency = 4%)
 It means Asha completed 55% work alone
 ∴ Number of days taken by Asha to complete 55% work
 $= \frac{55}{5} = 11 \text{ days}$

17. Krishna's efficiency = 10%
 Mohan's efficiency = 5%
 Work done by Krishna and Mohan together in 3 days
 $= 15 \times 3 = 45\%$

Now, number of days in which B completed rest (55%) work alone
 $= \frac{55}{5} = 11$

Total number of days in which B worked = $3 + 11 = 14$
 Now number of days required by B, when A and B both worked together = $\frac{100}{15} = 6 \frac{2}{3}$

∴ Required difference in number of days = $(11) - (6 \frac{2}{3})$
 $= \frac{13}{3} = 4 \frac{1}{3} \text{ days}$

18. Efficiency of Kareena and Karishma

$$= 11.11 + 5.55 = 16.66\%$$

$$\text{Work done in 3 days} = 3 \times 16.66 = 50\%$$

Rest work done by Kareena, Karishma and Shahid = $\frac{50}{50} = 1 \text{ day}$

(Since efficiency of Shahid = 33.33%)

Thus in 4 ($= 3 + 1$) days they have completed the work.

19. Efficiency of Kavita = 5%

Efficiency of Babita = 1.66%

Efficiency of Samita = 3.33%

Work done in 5 days by K + B + S = $5 \times (10) = 50\%$

Work done in 3 days by K + B = $3 \times (6.66) = 20\%$

Remaining work (30%) done by Kavita alone = $\frac{30}{5} = 6 \text{ days}$

	A	:	B	:	C
Efficiency →	10	:	9	:	6
No. of days →	$9x$:	$10x$:	$15x$

$$\text{Now, } 15x - 9x = 6$$

$$x = 1$$

Number of days taken by A = 9

Number of days taken by B = 10

Number of days taken by C = 15

Work done by B and C in initial 2 days = $\frac{2 \times 1}{6} = \frac{1}{3}$

$$\text{rest work} = \frac{2}{3}$$

Number of days required by A to finish $\frac{2}{3}$ work = $\frac{2/3}{1/9} = 6 \text{ days}$

31.

No. of days	Anand	Bahuguna
Efficiency	45	40
	$2.22\% \left(= \frac{1}{45} \right)$	$2.5\% \left(= \frac{1}{40} \right)$

Anand did the work in 56 days = $56 \times \frac{1}{45 \times 2} = \frac{28}{45}$

∴ Rest work $\left(\frac{17}{45} \right)$ was done by Anand and Bahuguna

$$= \frac{17/45}{17/360} = 8 \text{ days}$$

(Since Anand and Bahuguna do the work in one day
 $= \frac{1}{45} + \frac{1}{40} = \frac{17}{360}$)

32. Efficiency of Chandni = 11.11%

Efficiency of Divakar = 8.33%

They do 19.44% work in 2 days

∴ They need 10 days to do 97.22% work,

Now the rest work (2.78) was done by Chandni in $\frac{2.78}{11.11} = \frac{1}{4}$ day

Therefore total number of days required = $10 + \frac{1}{4} = 10 \frac{1}{4}$ days

Alternatively : Chandni's one day's work = $\frac{1}{9}$

Divakar's one day's work = $\frac{1}{12}$

Chandni's and Divakar's $(1 + 1) = 2$ day's work = $\frac{1}{9} + \frac{1}{12} = \frac{7}{36}$

So, in 10 days they do $\frac{7 \times 5}{36} = \frac{35}{36}$ work

So, the remaining $\frac{1}{36} \left(= 1 - \frac{35}{36} \right)$ work will be done by

$$\text{Chandni} = \frac{1/36}{1/9} = \frac{1}{4} \text{ day}$$

Thus total number of required days = $10 + \frac{1}{4} = 10 \frac{1}{4}$ days

HINT

Day	1	2	3	4	5	6	7	8	9	10	11
Turn	C	D	C	D	C	D	C	D	C	D	C
1	1	1	1	1	1	1	1	1	1	1	1
Work	$\frac{1}{9}$	$\frac{1}{12}$	$\frac{1}{36}$								
	<u>$7/36$</u>	<u>$1/36$</u>									

33.

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
F	Z	F	Z	F	Z	F	Z	F	Z	F	Z	F	Z	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<u>12</u>	<u>15</u>	<u>12</u>												
<u>9/60</u>														

In two days Fatima and Zahira do $\frac{1}{12} + \frac{1}{15} = \frac{1}{60}$ work. In 12

days they do $\frac{6 \times 9}{60} = \frac{54}{60}$ work

So, the remaining work = $\frac{6}{60} = \frac{1}{10}$

308

Now, $\frac{1}{12}$ work will be done by Fatima in 13th day

So, the remaining work = $\frac{1}{10} - \frac{1}{12} = \frac{1}{60}$

This $\frac{1}{60}$ work will be done by Zahira = $\frac{1/60}{1/15} = \frac{1}{4}$ day

Thus the total number of days required

$$= 12 + 1 + \frac{1}{4} = 13\frac{1}{4} \text{ days}$$

Alternatively : A's efficiency = 8.33%
B's efficiency = 6.66% [15%]

Thus in 12 days 90% work will be done and in 13th day 8.33% more work will be done so the rest work 1.66% will be done by Zahira

$$= \frac{1.66}{6.66} = \frac{1}{4} \text{ day}$$

Thus, total number of required days = $12 + 1 + \frac{1}{4} = 13\frac{1}{4}$

34. The difference will arise only on the last two days only. The work done on 13th day = $\frac{1}{15}$

$$\text{rest work} = \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

This rest work $\left(\frac{1}{30}\right)$ will be done by Fatima = $\frac{1/30}{1/12} = \frac{2}{5}$ day

Thus total number of required days = $12 + 1 + \frac{2}{5} = 13\frac{2}{5}$ days.

1	2	3	4	5	6	7	8
A	B	C	A	B	C	A	B
$\frac{1}{6}$	$\frac{1}{12}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{12}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{12}$

$$\frac{6}{8} = \frac{3}{4}$$

In 3 days A, B, C do $\frac{3}{8}$ work

In 6 days A, B, C do $\frac{3}{4}$ work

Rest work = $\frac{1}{4}$, which is less than $\frac{3}{8}$

On the 7th day, $\frac{1}{6}$ more work will be done by A

$$\text{Now rest work} = \frac{1}{4} - \frac{1}{6} = \frac{1}{12}$$

Now, this rest work $\left(\frac{1}{12}\right)$ will be done by B in 1 complete day.

Thus, total number of days = $6 + 1 + 1 = 8$ days

Alternatively : Efficiency of A = 16.66%

Efficiency of B = 8.33%

Efficiency of C = 12.5%

Efficiency of A + B = 25%

Efficiency of A + B + C = 37.5%

In 3 days A, B, C completes 37.5% work

In 6 days A, B, C completes 75% work

Rest work = 25%

This 25% work will be completed by A and B in next 2 days

Thus total $6 + 2 = 8$ days are needed.

36. From the previous solution 75% work will be completed in 8 days. In the next two days (i.e., on 7th and 8th day) B and C will complete 20.83% ($12.5 + 8.33$) more work.
So the remaining work = 4.16%

This 4.16% work will be completed by A = $\frac{4.16}{16.66} = \frac{1}{4}$ day

So, the total number of required days = $6 + 2 + \frac{1}{4} = 8\frac{1}{4}$ days

37. Let B takes x days to complete the work individually,
the B's 1 day's work = $\frac{1}{x}$

Then,

$$\text{A's 1 day's work} = \frac{1}{x-6}$$

$$\text{C's 1 day's work} = \frac{1}{x-8}$$

$$\therefore \frac{1}{x-6} + \frac{1}{x} = \frac{1}{x-8}$$

Now either solve the equation or satisfy the equation from the choices given in the question.

Thus option (c) is correct.

Alternatively : Select an appropriate option and the solve through % efficiency.

38. A's share = Rs. 250
B's share = Rs. 100

It means the ratio of efficiency of A : B = $250 : 100 = 5 : 1$

\therefore Ratio of days taken by A and B = $2x : 5x$

$$\text{Now, } 5x - 2x = 9 \Rightarrow x = 3$$

\therefore Number of days taken by A = 6 (efficiency = 16.66%)

Number of days taken by B = 15 (efficiency = 6.66%)

Therefore number of days taken by A and B, working together

$$= \frac{100}{23.33} = \frac{300}{70} = 4\frac{2}{7} \text{ days}$$

39. Alen's one day's work = $\frac{1}{21}$

$$\text{Border's one day's work} = \frac{1}{42}$$

(working alternatively) Alen and Border's two days work

$$= \frac{1}{21} + \frac{1}{42} = \frac{1}{14}$$

So, Alen and Border do $\frac{1}{14}$ work in 2 days

So, they complete the work in $14 \times 2 = 28$ days.

40. Efficiency of A and B = 16.66%

Efficiency of B and C = 10%

But efficiency of A is twice that of C

\therefore Therefore,

$$A = 2C$$

Now A + B = 16.66 and B + C = 10

\Rightarrow

$$2C + B = 16.66$$

and

$$C + B = 10$$

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Time and Work
from eq. (1) and eq. (2)

$$A = 13.33\%$$

\therefore Number of days taken by A to complete the work alone
 $= \frac{100}{13.33} = 7 \frac{1}{2}$ days

$$\begin{aligned} 41. \quad & A + B = 70\% \\ & B + C = 50\% \end{aligned}$$

$$\left[\because A + B + B + C - (A + B + C) = B \right]$$

$$70 + 50 - 100 = 20\% \quad B = 20\%$$

$$\Rightarrow A = 50\%$$

$$C = 30\%$$

and

Hence, A is most efficient.

$$42. \quad C + M = \frac{8}{17}$$

$$M + G = \frac{12}{17}$$

$$\Rightarrow M = \frac{3}{17}$$

$$[\because (C + M + M + G) - (C + M + G) = M]$$

$$\left[\left(\frac{8}{17} + \frac{12}{17} \right) - 1 = \frac{3}{17} \right]$$

$$C = \frac{5}{17}$$

$$G = \frac{9}{17}$$

So the whole amount will be distributed in the ratio of 5 : 3 : 9 among C, M and G respectively.

Now since M is least efficient so he get his own share

$$= \frac{3}{17} \times 816 = \text{Rs. } 144$$

	Sharma	Kelkar
Efficiency	0.8x	x
Number of day	k	0.8k = 24

$$\therefore 0.8k = 24 \Rightarrow k = 30$$

Thus Sharma requires 30 days, to complete the work, alone.

	Man	Days
	$\frac{1}{5} \uparrow$ (30) 36	$\frac{1}{6} \downarrow$ (24) 20

Applying product constancy method.

For a constant work when days are reduced by $\frac{1}{6}$, then number of men is increased by $\frac{1}{5}$. Hence 6 men will increase.

$$\text{Alternatively : } 24 \times 30 = 20 \times x$$

$$\Rightarrow x = 36$$

Therefore 6 more men are required.

	Women	Days
	$\downarrow \frac{1}{3}$ (12) 8	$\frac{1}{2} \uparrow$ (20) 30

Thus 10 more days are required.

Alternatively : $12 \times 20 = 8 \times x$
 $\Rightarrow x = 30$

\therefore 10 more days are required.

Boys	Days
$\frac{2}{5} \downarrow$ (35) 21	$\frac{1}{3} \uparrow$ (15) 25

Thus 14 boys did not turn up for the job.

Alternatively : $35 \times 15 = 25 \times x$
 $\Rightarrow x = 21$

$\therefore 35 - 21 = 14$ boys did not turn up for the job.

$$47. \quad x \times 32 = 24 \times 40$$

$$48. \quad M_1 D_1 = M_2 D_2$$

$$M \times D = W$$

$$16 \times 6 = \frac{1}{3} W$$

$$\text{Rest work} = \frac{2}{3} W$$

For double work in same time we need double men. So 16 more men are required.

$$\text{Alternatively : } 2 \times (16 \times 6) = 6 \times M$$

$$\Rightarrow M = 32$$

\therefore 16 more men are required.

$$49. \quad M \times D = 10 \times 20 = 200 \text{ Man-days}$$

$$\text{New Man-days} = (20 \times 2) \times x$$

$$200 = 20 \times 2 \times x$$

$$x = 5 \text{ days}$$

$$\text{or } M_1 D_1 = M_2 D_2$$

$$10 \times 20 = (20 \times 2) \times x$$

$$x = 5$$

$$50. \quad M_1 D_1 = M_2 D_2$$

$$M_1 \times 20 = (M_1 - 12) \times 32$$

$$M_1 = 32$$

Also, using the above concept you can go through options.

51. Go through options. Consider option (c)

$$30 \times 20 = 30 \times 6 + 21 \times 20$$

600 = 600, hence presumed option is correct.

$$\text{Alternatively : } 30 \times 20 = 30 \times x + 21 \times (26 - x)$$

$$x = 6$$

52. Go through options. Consider choice (a)

$$25 \times 30 = 25 \times 15 + 75 \times 5$$

750 = 750, hence choice (a) is correct.

$$\text{Alternatively : } 25 \times 30 = 25 \times x + 75 \times (20 - x)$$

$$\therefore \left[30 \times \frac{2}{3} = 20 \right]$$

53. Go through options. Consider choice (d)

$$36 \times 120 = 40 \times 108$$

$$4320 = 4320$$

Hence, choice (d) is correct.

310

Alternatively :

$$\begin{array}{ccccc} & \text{Men} & \text{Days} & & \\ \frac{1}{9} \uparrow & x & 120 & \left(\frac{1}{10}\right) \downarrow & \\ & \downarrow & \downarrow & & \\ & \left(x \times \frac{10}{9}\right) & (12) & & \end{array}$$

From percentage change (product constancy) graphic when number of days are decreased by $\frac{1}{10}$ then the number of men are increased by $\frac{1}{9}$ and $\frac{1}{9}$ is equivalent to 4 men so the actual number of men are $9 \times 4 = 36$.

Alternatively : $M_1 D_1 = M_2 D_2$
 $x \times 120 = (x + 4) \times 108$

$$\Rightarrow x = 36$$

54. Efficiency (per minute) of Modi = 4 copies/min
 Efficiency of Modi and Xerox together = 10 pages/min
 ∴ Efficiency of Xerox alone = $10 - 4 = 6$ pages/min
 ∴ Mr. Xerox needs 6 minutes to copy 36 pages.

55. Work done = $\frac{1}{3}$

Remaining work = $\frac{2}{3}$

$$2 \times (20 \times 12) = 12 \times x$$

$$\Rightarrow x = 40$$

So, 20 men will be increased.

56. Work done = $\frac{1}{5}$

remaining work = $\frac{4}{5}$

$$4(20 \times 75) = 40 \times x$$

$$x = 150$$

Therefore 75 men should be increased.

57. Work done by 6 men = Work done by 10 women.

$$\Rightarrow \text{Work done by 1 man} = \text{work done by } \frac{10}{6} = \frac{5}{3} \text{ women}$$

$$\therefore 12 \text{ men} + 5 \text{ women} = 12 \times \frac{5}{3} + 5 = 25 \text{ women}$$

$$W_1 \times D_1 = W_2 \times D_2, \quad W = \text{women}, D = \text{days}$$

$$10 \times 15 = 25 \times D_2$$

$$D_2 = 6$$

58. Work done by 2 men = 3 women = 4 boys

$$1 \text{ man} = 2 \text{ boys}$$

$$1 \text{ woman} = \frac{4}{3} \text{ boys}$$

$$\text{boys} \times \text{days} = 4 \times 52 \text{ (boys-days)}$$

$$\text{Again } 1 \text{ man} + 1 \text{ woman} + 1 \text{ boy} = 2 + \frac{4}{3} + 1 = \frac{13}{3} \text{ boys}$$

$$B_1 \times D_1 = B_2 \times D_2, \quad B = \text{boys}, D = \text{days}$$

$$4 \times 52 = \frac{13}{3} \times D_2$$

$$D_2 = 48 \text{ days}$$

59. $2 \text{ men} = 7 \text{ boys} \Rightarrow 1 \text{ man} = \frac{7}{2} \text{ boys}$

$$5 \text{ women} = 7 \text{ boys} \Rightarrow 1 \text{ woman} = \frac{7}{5} \text{ boys}$$

$$7 \text{ men} + 5 \text{ women} + 2 \text{ boys} = 7 \times \frac{7}{2} + 5 \times \frac{7}{5} + 2 = \frac{67}{2} \text{ boys}$$

$$B_1 \times D_1 = B_2 \times D_2$$

$$7 \times 469 = \frac{67}{2} \times D_2$$

$$\Rightarrow D_2 = 98 \text{ days}$$

$$6C + 2M = 6 \text{ days}$$

60. $36C + 12M = 1 \text{ days}$

$$\Rightarrow 1M = 2C$$

$$\text{Again } 36 + 12 \times 2 = 1 \text{ day}$$

∴ 60 children can do the work in 1 day

$$\text{Now, } 5 \text{ men} = 10 \text{ children}$$

∴ 10 children can do the work in 6 days.

61. $8M + 12W = 4 \text{ days (whole work)}$

$$\Rightarrow 32M + 48W = 1 \text{ day}$$

$$\text{Again } 6M + 14W = 5 \text{ days}$$

$$\Rightarrow 30M + 70W = 1 \text{ day}$$

From eq. (1) and (2)

$$32M + 48W = 30M + 70W$$

$$\Rightarrow 2M = 22W$$

$$\Rightarrow 1M = 11W$$

$$\text{Now, } 30M + 70W = 1 \text{ day}$$

$$(30 \times 11 + 70)W = 1 \text{ day}$$

Therefore 400W requires 1 day to complete the whole work.
 Thus 20W needs 20 days to complete the whole work.

62. Efficiency of A = 6.66%

$$\text{Efficiency of B} = 5.55\%$$

$$\text{Efficiency of A + B + C} = 16.66\%$$

$$\therefore \text{Efficiency of C} = 4.44\%$$

Now, number of days required by

$$C = \frac{100}{4.44} = \frac{100}{(10 \times 4.44)} = \frac{45}{2} \text{ days}$$

63. Ratio of efficiencies of A, B and C = 6 : 5 : 4

$$\therefore \text{Share of C} = \frac{4}{15} \times 27000 = 7200$$

64. In 1 hour 314 weavers weave = 6594×6 shawls

$$\text{In 1 hour 1 weaver weaves} = \frac{6594 \times 6}{314} \text{ shawls} = 126 \text{ shawls}$$

65.

$$\Rightarrow 3M + 2W = 4 \text{ days}$$

$$\text{Again, } 12M + 8W = 1 \text{ day}$$

$$\Rightarrow 2M + 3W = 5D$$

$$\Rightarrow 10M + 15W = 1D$$

From eq. (1) and (2)

$$\Rightarrow 12M + 8W = 10M + 15W$$

$$2M = 7W$$

$$\frac{M}{W} = \frac{7}{2}$$

Since the ratio of efficiency of women : men = 2 : 7
 So, the amount of a man per day = Rs. 154
 $\left[\left(\frac{7}{2} \times 44 \right) = 154 \right]$

66. Go through options.

Alternatively :

$$30 \times 40 = 30 \times x + 20 \times (46 - x)$$

$$x = 28 \text{ days}$$

\Rightarrow Women \times hours = $8 \times 10 = 80$ women hours
 Now, women \times hours = $12 \times 8 = 96$ women hours

Since new work force is 20% greater than previous work force.

So, the new quantity of tea leaves will be increased by 20% which is equal to $200 \times \frac{20}{100} = 40$ kg, hence (b)

68. New work = 3×450 man-day

$$3 \times 450 = 27 \times x$$

$$\therefore x = 50 \text{ days}$$

... (1) $4B + 5G = 10$

... (2) $40B + 50G = 1$
 Again, $6B + 6G = 7$

$\Rightarrow 42B + 42G = 1$

Comparing eq. (1) and (2)

$$40B + 50G = 42B + 42G$$

$$\Rightarrow 2B = 8G \Rightarrow 1B = 4G$$

$$\text{Now, } (42 \times 4 + 42) \text{ girls} = 1 \text{ day}$$

210 girls can do a work in 1 day

$$\text{Again } 2B + 7G = 15 \text{ girls}$$

$$\text{So, } 15 \text{ girls require } \frac{210}{15} = 14 \text{ days}$$

70. Equate the man-days

For 20 km road, $20 \times 20 = 400$ man-days are required

\therefore For 40 km road 800 man-days are required

$$\text{So, } 800 = 40 \times x$$

$$\Rightarrow x = 20 \text{ days}$$

71. $\frac{3}{4} \times (x - 2)x = (x + 7)(x - 10)$

$$\Rightarrow x^2 - 6x - 280 = 0$$

$$\Rightarrow x = 20 \text{ and } x = -14$$

So, the acceptable values is $x = 20$

\therefore Total work = $(x - 2) \times x = 18 \times 20 = 360$ unit

$$\text{Now } 360 = 30 \times k \quad \therefore (30 = 20 + 10)$$

$$\Rightarrow k = 12 \text{ days}$$

72. Efficiency of a man : woman : girl = 6 : 3 : 1

$$\therefore \text{Share of a woman and girl} = \frac{(3+1)}{(6+3+1)} \times 10,000$$

$$= \frac{4}{10} \times 10000 = \text{Rs. } 4000$$

73. Total work = $33 \times 30 = 990$ man-days

$$\text{First day's work} = \frac{1}{990} \times 44$$

$$\text{Second day's work} = \frac{1}{990} \times 43$$

$$\text{Third day's work} = \frac{1}{990} \times 42 \text{ and so on}$$

$$\text{So, the total work in 44 days} = \frac{1}{990} (44 + 43 + 42 + \dots)$$

$$= \frac{1}{990} \times \frac{44 \times 45}{2} = 1$$

Hence in 44 days total work will be completed.

74. Efficiency of Abhishek = $2.5\% = \left(\frac{100}{40} \right)$

Work done in 8 days = 20%

Rest work = 80%

$$\text{Efficiency of Bacchhan} = \frac{80}{24} = 3.33\%$$

$$\therefore \text{Required number of days} = \frac{100}{(2.5 + 3.33)} \\ = \frac{100}{5.83} = \frac{100 \times 6}{35} = 17 \frac{1}{7}$$

HINT $0.83 = \frac{5}{6}$, so, $5.83 = 5 + \frac{5}{6} = \frac{35}{6}$

75.

	A	B	C
Efficiency	3	2	6
Number of days	2	3	1

\therefore Number of days taken by A = 12

Number of days taken by B = 18

Number of days taken by C = 6

$$1 \text{ day's work of } (A + B) = \frac{5}{36}$$

$$1 \text{ day's work of } (B + C) = \frac{8}{36}$$

$$1 \text{ day's work of } (C + A) = \frac{9}{36}$$

Day	1	2	3	4	5	6
Work	$\frac{5}{36}$	$\frac{8}{36}$	$\frac{9}{36}$	$\frac{5}{36}$	$\frac{8}{36}$	$\frac{1}{36}$

$$\text{In 5 days total work done} = \frac{35}{36}$$

Now, the rest work ($1/36$), which is done by AC.

\therefore Number of days taken by AC for the rest work

$$= \frac{1/36}{9/36} = \frac{1}{9}$$

Therefore, total time = $5 + \frac{1}{9} = 5 \frac{1}{9}$ days

76. Efficiency of A + B = 16.66

Efficiency of B + J = 10

We have no further relevant informations, so we cannot determine.

312

	A	B
Efficiency	x	$2x$
Number of days	15	$15/2$
A's one day's work	$\frac{1}{15}$	
B's one day's work	$\frac{2}{15}$	
(A + B)'s one day's work	$\frac{3}{15}$	

Now, let us assume B joined A after $(11 - x)$ days, then

$$\frac{(11-x)}{15} + \frac{x \times 3}{15} = 1$$

$$\Rightarrow (11-x) + 3x = 15$$

$$\Rightarrow x = 2$$

It means they worked together for 2 days.

Alternatively: Go through options and check easily with the percentage efficiency.

$$9 \times 6.66 + 2 \times 20 = 100\%$$

78.

$$\text{Efficiency of } A = 6.66\%$$

$$\text{Efficiency of } B = 3.33\%$$

$$\text{Efficiency of } C = 2.5\%$$

Work done in last two days (only C do it) = $2 \times 2.5 = 5\%$

Work done in the 3rd and 4th day from the last day (only A and C do it)

$$= 2 \times 9.16 = 18.33\%$$

$$\text{Remaining work} = 100 - (5 + 18.33) = 76.66\%$$

This 76.66% work was done by all of A, B and C.

$$\therefore \text{Number of days taken by them} = \frac{76.66}{12.5} = \frac{460}{75} = 6 \frac{2}{15}$$

$$\therefore \text{Total time required} = 6 \frac{2}{15} + 2 + 2 = 10 \frac{2}{15} \text{ days}$$

79. Let x kg of oil is used for eating purpose, daily, then

$$(x + 11) \times 50 = (x + 15) \times 45$$

$$x = 25$$

$$\therefore \text{Total quantity of oil} = (25 + 11) \times 50 = 1800$$

$$\therefore \text{Required number of days} = \frac{1800}{25} = 72 \text{ days}$$

80. Work done = $\frac{2}{3}$

Remaining work = $\frac{1}{3}$, which is half of $\frac{2}{3}$

$$\therefore \frac{1}{2} \times (20 \times 32) = 8 \times x$$

\Rightarrow

$$x = 40 \text{ men}$$

Therefore, 20 more men were required.

One day's work of 7 Indian with 4 Chinese = $\frac{1}{5}$

and one day's work of 7 Japanese and 3 Chinese = $\frac{1}{7}$

Therefore, one day's work of 7 Indian, 7 Chinese and 7 Japanese

$$= \frac{1}{5} + \frac{1}{7} = \frac{12}{35}$$

Therefore, one day's work of 1 Indian, 1 Chinese and 1 Japanese

$$= \frac{12}{35} \times \frac{1}{7} = \frac{12}{35 \times 7}$$

Therefore, number of days required by 1 Indian, 1 Chinese and 1 Japanese

$$= \frac{1}{12/(35 \times 7)} = \frac{35 \times 7}{12} = 20 \frac{5}{12} \text{ days}$$

82. In 1 minute A, B and C bind = $\frac{1}{8} + \frac{1}{12} + \frac{1}{16} = \frac{13}{48}$ book

In 12 hours A, B and C bind = $12 \times 60 \times \frac{13}{48} = 195$ books

\therefore Average number of books bind by each = $\frac{195}{3} = 65$ books

83. Work of a man for 1 hour = $\frac{3}{2}$ women's work for 1 hour

Again, work of a man for 1 day

$$= \left(\frac{3}{2} \times \frac{9}{7.5} \right) \text{ women's work for 1 hour}$$

\Rightarrow Work of a man for 1 day = $\frac{9}{5}$ women's work for 1 day

$$\Rightarrow 1 \text{ man} = \frac{9}{5} \text{ women}$$

$$\therefore 10 \text{ men} + 6 \text{ women} = 10 \times \frac{9}{5} + 6 = 24 \text{ women}$$

$$\therefore 10 \text{ men} + 9 \text{ women} = 10 \times \frac{9}{5} + 9 = 27 \text{ women}$$

Now,

$$D_1 \times W_1 = D_2 \times W_2$$

$$18 \times 24 = D_2 \times 27$$

$$\Rightarrow D_2 = 16 \text{ days}$$

84. Number of days taken by A to complete work alone = 14 days
Number of days taken by B to complete work alone = 7 days
Number of days taken by C to complete work alone = 7 days

$$\text{One day's work of } A \text{ and } B = \frac{1}{14} + \frac{1}{7} = \frac{3}{14}$$

$$\text{and one day's work of } A, B \text{ and } C = \frac{1}{14} + \frac{1}{7} + \frac{1}{7} = \frac{5}{14}$$

$$3 \text{ day's work of } A \text{ and } B = 3 \times \frac{3}{14} = \frac{9}{14}$$

$$\text{remaining work} = \frac{5}{14} \quad \left(1 - \frac{9}{14}\right)$$

This remaining work will be done by A, B and C

$$= \frac{5/14}{5/14} = 1 \text{ day}$$

$$A's 5 \text{ days work} = 50\%$$

$$B's 5 \text{ days work} = 33.33\%$$

$$C's 2 \text{ days work} = 16.66\%$$

$$[100 - (50 + 33.33)] : 16.66 \\ = 33 \frac{1}{3} : 16 \frac{2}{3} \\ = 3 : 2 : 1$$

85.

in

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A's total share = Rs. 1500

B's total share = Rs. 1000

C's total share = Rs. 500

A's one day's earning = Rs. 300

B's one day's earning = Rs. 200

and C's one day's earning = Rs. 250

Efficiency of A = 50% $\left(\frac{100}{2}\right)$

Efficiency of B = 37.5% $\left(\frac{100}{8/3}\right)$

Efficiency of C = 12.5% $\left(\frac{100}{8}\right)$

Combined efficiency of A, B and C = 100%

So, they complete the work in 1 hour.

$$\begin{array}{rcl} A & + & B \\ \downarrow & & \downarrow \\ \text{Ratio of efficiency} & 10x & + 5x \\ \hline 15x & & \end{array} \quad \begin{array}{rcl} C & + & D \\ \downarrow & & \downarrow \\ \text{Ratio of efficiency} & 9x & + 6x \\ \hline 15x & & \end{array}$$

Therefore, ratio of efficiency of A : C = 10 : 9

Therefore, ratio of days taken by A : C = 9 : 10

Therefore, number of days taken by A = 18 days

88. Efficiency of 4 men and 2 boys = 20%

Efficiency of 3 women and 4 boys = 20%

Efficiency of 2 men and 3 women = 20%

∴ Efficiency of 6 men, 6 women and 6 boys = 60%

∴ Efficiency of 1 man, 1 woman and 1 boy = 10%

Now, since they will work at double their efficiency

∴ Efficiency of 1 man, 1 woman and 1 boy = 20%

∴ Required number of days = 5

89. $M_1 \times D_1 = M_2 \times D_2$

$m \times r = (m + n) \times D_2$

$$D_2 = \frac{mr}{(m + n)}$$

90. Efficiency of A = 2.77%

Efficiency of B = 2.22%

∴ Combined efficiency of A and B = 5%

$$= (2.77 + 2.22)$$

Thus, it will take total of 20 minutes ($\because 20 = \frac{100}{5}$)

91. Efficiency of A = 8.33%

Effective efficiency = 6.66%, when there is leakage

∴ Efficiency of leakage = 1.66% = (8.33 - 6.66)

It means due to leakage a full tank will be empty in 60 hours.

92. Efficiency of A + B = $10 + 6.66 = 16.66\%$

Efficiency of A + B + C = 5.55%

∴ Efficiency of C (outlet pipe) = $16.66 - 5.55$

$$= 11.11\%$$

It means outlet pipe C can empty in 9 hours.

93. Efficiency of only leakage = 16.66%
Effective efficiency of leakage = 6.66%
It means the capacity of filling pipe = 10%
Therefore, the inlet pipe can fill the tank in 10 hours hence
the capacity of tank = 100 l

94. Efficiency of tap A and B = $16.66\% = (10 + 6.66)$
 $\therefore 16.66x + 10 \times (8 - x) = 100\%$

$$\Rightarrow x = 3$$

Efficiency of A = 5%

Efficiency of B = 4%

Efficiency of C = -3.33%

It means in every 3 consecutive hours tops A, B and C can fill 5.66% (= 5 + 4 - 3.33)

Therefore in 51 hours (= 3 × 17) tops A, B and C can fill 96.33% (= 5.66 × 17)

∴ the remaining part i.e., 3.66% (= 100 - 96.33) can be filled up by A in $\frac{11}{15}$ hours ($= \frac{3.66}{5}$), since it is now A's turn.

Hence, the total time required = $51 + \frac{11}{15} = 51 \frac{11}{15}$

97. Efficiency when both pipes used to fill = A + B
and efficiency when pipe A is used to fill and pipe B is used to empty the tank = A - B

$$\therefore \frac{A+B}{A-B} = \frac{2}{1}$$

$$\Rightarrow \frac{A}{B} = \frac{3}{1} \quad (\text{By componendo and dividendo})$$

Thus, the ratio of efficiency of pipe A and B = 3 : 1.

98. In ideal case:

Time taken to fill the half tank by A and B = $\frac{50}{41.66} = \frac{6}{5}$ hours

Time taken by A, B and C to fill rest half of the tank

$$= \frac{50}{16.66} = 3 \text{ hours}$$

$$\text{Total time} = \frac{6}{5} + 3 = 4 \text{ hours } 12 \text{ minutes}$$

In second case:

Time taken to fill $\frac{3}{4}$ tank by A and B = $\frac{75}{41.66} = \frac{9}{5}$ hours

Time taken by A, B and C to fill rest $\frac{1}{4}$ tank = $\frac{25}{16.66} = \frac{3}{2}$ hours

$$\text{Total time} = \frac{9}{5} + \frac{3}{2} = 3 \text{ hours } 18 \text{ minutes}$$

Therefore, difference in time = 54 minutes

99. Time taken by pipes A and B to fill the whole tank = $\frac{100}{16.66} = 6$ hours

Capacity filled in 2 hours by pipes A, B and C = $2 \times 13.33 = 26.66\%$

Remaining capacity = 73.33%

This remaining capacity can be filled by A and B

$$= \frac{73.33}{16.66} = 4 \frac{2}{5} \text{ hours}$$

So, the total time required = $2 + 4 \frac{2}{5} = 6 \text{ hours } 24 \text{ minutes}$

Thus, in this case 24 minutes extra are required.

100. In one hour pipe A can fill = $\frac{1}{30}$ part of the tank

In one hour pipe B can fill = $\frac{1}{45}$ part of the tank

Time and Work
In two hour pipes A and B can fill = $\frac{1}{18}$ part of the tank

Therefore in 36 hours the tank will be completely filled.

Alternatively: Efficiency of pipe A = 3.33%

Efficiency of pipe B = 2.22%

Combined efficiency = 5.55%

and

Therefore in 2 hours pipe A and B fill 5.55%.

Thus to fill 100% tank, these pipe will take 36 hours.

LEVEL (2)

1. LCM of 2, 3 and 4 = 12

In 12 hours A will make 6 shawls
 " " " B will make 4 shawls
 " " " C will make 3 shawls } 13 shawls

i.e., in 12 hours they will weave 13 shawls

so, in 84 hours they will weave 91 shawls

Now, in 9 hours A will make 4 shawls
 in 9 hours B will make 3 shawls } 9 shawls
 in 9 hours C will make 2 shawls }

So, they will complete 100 shawls in 93 hours.

NOTE Since, they cannot share each-others work so B will take completely 9 hours to make 3 shawls, even when A and C stay idle for the last 1 hour till B completes his own work.

2.

	M	T	W	Th	F	S
Work →	A	S	A	S	A	S
	15%		15%		7.5%	
					37.5%	

{This pattern continued for total 2 weeks only till 75% work got completed.}

Thus in 2 weeks they will complete 75% work.

Now 15% of the remaining (25% of the work) will be done in the third week in Monday and Tuesday. Again 10% work remained undone. Out of this 8.33% work will be done by Arun on Wednesday and remaining 1.66% work will be completed on Thursday by Satyam.

Final week

M	T	W	Th
A	S	A	S
15%		8.33%	1.66%
			25%

3. Efficiency of Kaushalya = 5%

Efficiency of Kaikeyi = 4%

Thus, in 10 days working together they will complete only 90% of the work.

$$[(5+4) \times 10] = 90$$

Hence, the remaining work will surely done by Sumitra, which is 10%.

Thus, Sumitra will get 10% of Rs. 700, which is Rs. 70.

↳ Solutions for question number 4 and 5:

Morning shift	1st day	2nd day
Evening shift	A	B
	B	A

It is clear that in two days finally they work very similar to the alternate days i.e., finally A work for 10 hours and B also works for 10 hours.

Thus in every two days they will complete 7.5% work. So, in 26 days they will complete 97.5% of the total work.

Now, the remaining work = 2.5%

Now, this is the turn of A,

Since A does 4.16% work in 10 hours.

So, he will do 2.5% work in 6 hours.

4. Thus, the work will be finished on 27th day.

5. Since, A does 2.5% work in 6 hours, which is the actual duration of morning shift. So 100% time of the morning shift was utilised.

6. From the first statement :

	(B + C)	(A + B + C)
Efficiency	2x	3x
Days	3y	2y

Thus, we can say that efficiency of A is $\frac{1}{3}$ the efficiency of $(A + B + C)$.

From the last statement:

$$\text{Share of B out of total amount} = \frac{120}{450} = \frac{4}{15}$$

From these two results we can conclude that:

Ratio of efficiency	$\frac{A}{15} \left(= \frac{1}{3} \right)$	$\frac{B}{15}$	$\frac{C}{15}$
	5	4	6
Ratio of number of days	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{6}$
	12x	15x	10x

One day's work of A and B = $\frac{1}{12x} + \frac{1}{15x} = \frac{9}{60x}$

∴ A and B will take $\frac{60x}{9}$ days to complete the whole work

Again one day's work of A, B and C

$$= \frac{1}{12x} + \frac{1}{15x} + \frac{1}{10x} = \frac{15}{60x}$$

∴ A, B and C working together complete the work in $\frac{60x}{15}$ days

$$\frac{60x}{9} - \frac{60x}{15} = \frac{8}{3}$$

Time and Work
Part of the tank
completely filled.
33%
22%
55%
%
e 36 hours.
very similar to the
hours and B also
work. So, in 26

Time and Work
(Since, A and B take $\frac{1}{3}$ days more than A, B and C)

$$x = 1$$

\Rightarrow Number of days required to complete the whole work by A, B and C = $4x = 4 \times 1 = 4$ days

Alternatively: You can solve through option.
Alternatively: Ratio of efficiencies of A, B and C = $5x : 4x : 6x$

Number of days required by A and B = $\frac{100}{9x}$... (1)

and number of days required by A, B and C = $\frac{100}{15x}$... (2)

$$\frac{100}{9x} - \frac{100}{15x} = \frac{8}{3} \Rightarrow x = \frac{5}{3}$$

From eq. (2) number of days required by A, B and C working together

$$= \frac{100}{15x} = \frac{100}{15 \times \frac{5}{3}} = \frac{100}{25} = 4 \text{ days}$$

MIT

$$4 \times 10 \times 60 \times E_1$$

NIT

$$= 5 \times 8 \times 80 \times E_2$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{4}{3}$$

where E_1 and E_2 are the respective working efficiencies per hour.

\therefore Each engineer from NIT is 25% less efficient than each engineer from MIT.

	T	C	B
16	10	15	
8	12	12	
128	120	180	← in one hour
1280	1200	1800	← in 10 hour

Since, restriction is imposed by composers i.e., since only 1200 books can be composed in 10 hours so not more than 1200 books can be finally prepared.

9. To maximise the production we locate 5 persons for composing and 7 persons for typing. Only then we can maximise our production which is 1800 books per day.

	T	C	B
(16 + 7)	(10 + 5)	15	
8	12	12	
184	180	180	
1840	1800	1800	

1st case	T	C	B
15	10	13	
8	12	12	
120	120	156	
1200	1200	1560	

No change in critical value

2nd case	T	C	B
16	10	12	
8	12	12	
128	120	144	

No change in critical value*

*Critical value means the minimum amount of job which creates the restriction.

NOTE

In third case it will reduce the production below 1200 books per day (or 120 books per hour)

So, option (d) is correct.

11. Efficiency of Bunty and Babli (jointly) = 12.5%
Now, go through options and satisfy the conditions.
Consider option (d).

Efficiency	Bunty	Babli
Days	7.5% 40 3	5% 20

Now, the new efficiency of Bunty = 15%

and the new efficiency of Babli = $\frac{5}{3}\%$

∴ Combined efficiency = $\frac{50}{3}\%$

∴ Number of days taken by them = $\frac{100}{50/3} = 6$ days

Hence, the presumed option (d) is correct.

NOTE Without solving the complete problem we can say that only option (d) is true since other 3 options gives the efficiency of Bunty equal to or more than 12.5% which is inadmissible i.e., cannot be equal to or greater than the combined efficiency of both persons together.

12. Let x litre be the per day filling and v litre be the capacity of the reservoir, then

$$90x + v = 40000 \times 90 \quad \dots(1)$$

$$\text{and } 60x + v = 32000 \times 60 \quad \dots(2)$$

Solving eq. (1) and (2), we get

$$x = 56000$$

Hence, 56000 litres per day can be used without the failure of supply.

13. One day's production = $400 \times 9 \times 60 = 2160000$ bottles per day

Ratio of time utilised by M_1 and $(M_1 + M_2) = 1 : 2$

Now, the production of bottles by M_1 in 1 minute = 400 and the production of bottles by M_1 and M_2 together in 2 minutes = 2000

Thus total 2400 bottles can be processed in 3 minutes

∴ 216000 bottles can be processed in

$$216000 \times \frac{3}{2400} = 4.5 \text{ hours}$$

14. Let he initially employed x workers which works for D days and he estimated 100 days for the whole work and then he doubled the worker for $(100 - D)$ days.

$$D \times x + (100 - D) \times 2x = 175x$$

$$D = 25 \text{ days}$$

⇒

NOTE $175 = 100 + \frac{3}{4} \times 100$, since required number of days are 75% more than the estimated number of days.

(i.e., $\frac{3}{4}$) more than the estimated number of days.

Now, the work done in 25 days = $25x$

$$\text{Total work} = 175x$$

∴ Work done before increasing the number of workers

$$= \frac{25x}{175x} \times 100 = 14\frac{2}{7}\%$$

- 15. Note:** For easier calculation consider some convenient value of x (i.e., number of workers). Let initially there were 20 workers employed.

It means work done till 25 days

$$= 25 \times 20 = 500 \text{ man-days}$$

Now, since delay in works is 60%.

It means the work was completed in 160 days. Let the increased workers worked for k days then

$$40 \times k + 16 \times (135 - k) = 75 \times 40$$

$$\Rightarrow k = 35 \text{ days}$$

∴ 40 workers work for only 35 days

Here 40 means twice the work force of 20

and 16 means 80% efficiency of the original work-force

and 135 means $(160 - 25)$ days

and 75 means $(100 - 25)$ days

Since, number of days are increased by 60 in which only 16 workers work.

∴ Remaining work after 100 days = $60 \times 16 = 960$

$$= \frac{960}{3500} \times 100 = 27 \frac{5}{7} \%$$

Solutions for 16–20: Let the actual number of typists be n required to work for D days, then

$$nD = (n \times 8) + \left(\frac{4n}{5} \times D \right)$$

$$\Rightarrow D = 40$$

- 16.** Since, the above equation is independent of n (i.e., number of typists) so cannot be calculated. It means there are many possible values.

- 17.** Since $20\% \left(i.e., \frac{1}{5} \right)$ typists left the job. So, there can be any value which is multiple of 5 i.e., whose 20% is always an integer. Hence, 5 is the least possible value.

- 18.** The remaining value must be divisible by 4.

Since, $\frac{4x}{5} = k$ $x \rightarrow$ actual number of typists

$$\Rightarrow x = \frac{k \times 5}{4} \quad k \rightarrow \text{remaining number of typists}$$

So, k must be divisible by 4, since a person cannot be a fraction. Hence, option (c) could be the possible answer.

- 19.** Since, $D = 40$

- 20.** Work done in 8 days = $8x$

$$\text{Work done in further 16 days} = 16 \times \frac{4}{5} x = \frac{64x}{5}$$

$$\text{Remaining work} = 40x - \left(8x + \frac{64x}{5} \right) = \frac{96x}{5}$$

$$\text{Remaining number of days} = 40 - (8 + 16) = 16$$

$$\therefore \text{New work-force} = \frac{96x/5}{16} = \frac{6x}{5}$$

∴ Change (or increase) in work-force

$$= \frac{\left(\frac{6x}{5} \right) - x}{x} \times 100 = 20\%$$

- 21.** Let A, B, C, D and E be the times taken by a, b, c, d and e shirts per day then
- $$\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d} + \frac{1}{e} = \frac{90}{1800} = \frac{1}{20}$$

when $a = b = c = d = e$, we get the minimum value

$$5 \times \frac{1}{a} = \frac{1}{20}$$

$$a = 100 = b = c = d = e$$

$$\Rightarrow (8M + 5W) \times 6 \times 4 = (4M + 5W) \times 8 \times 5$$

$$4M = 10W$$

$$1M = 2.5W$$

Now, substituting the value M by W , we get total work-done
Work = $(8 \times 2.5 + 5) \times 6 \times 4 = 600$ women-days-hours
= 240 man-days-hours

Again work = $5 \times 8 \times 30 = 1200$ boy-days-hours

$$1M = 2.5W = 5B$$

$$4M + 3W + 4B = 30 \text{ boys}$$

$$\therefore \text{Required number of days} = \frac{1200}{30 \times 5} = 8 \text{ days}$$

23.

$$9 \times 6 \times M = 240$$

$$M = \frac{240}{6 \times 9} = 4.4 \text{ men}$$

Therefore, minimum 5 men are required.

- 24.** Efficiency of Eklaya = 16.66%

Efficiency of Faizal = 8.33%

Total efficiency of Eklaya and Faizal = 25%

So, they can do actual work in 4 days

∴ 3 times work requires 12 days.

$$25. 1 + 2 + 3 + 4 + 5 + \dots + 24 = \frac{24 \times 25}{2} = 300$$

Total work = 300 man-days

But, the person who started the work on the first day works for 24 days. Hence, his share will be maximum which is equal to $\frac{24}{300} = \frac{2}{25}$.

Thus, he will receive $5000 \times \frac{2}{25} = \text{Rs. } 400$.

- 26.** Total efficiency of two persons = 50%
Ratio of efficiencies of first person to the second person = 1:1
Therefore, efficiency of second person = 33.33%
Hence, he will take 3 days to complete the work alone.

- 27.** Ratio of number of men, women and children

$$= \frac{18}{6} : \frac{10}{5} : \frac{12}{3} = 3x : 2x : 4x$$

$$(3x + 2x + 4x) = 18$$

$$x = 2$$

Therefore, number of women = 4

$$\text{Share of all women} = \frac{10}{40} \times 4000 = \text{Rs. } 1000$$

$$\therefore \text{Share of each woman} = \frac{1000}{4} = \text{Rs. } 250$$

Time and Work
It can be solved easily through option.

$$(10 + 9 + 8 + \dots + 1) = 10 \times \left(10 \times \frac{55}{100}\right)$$

$$55 = 55$$

Alternatively: $\frac{n(n+1)}{2} = n \times \frac{55n}{100}$ Hence correct.

$$n = 10$$

∴ In both cases total work is 55 man-days.

Go through option. Consider choice (c).

Efficiency of first worker = 5%

Efficiency of second worker = 4%

In 7 hours first worker completed 35% work

In 5 hours second worker completed 20% work

Thus, work completed = 55%

Remaining work = 45%

Hence, one condition is satisfied.

Again, they will take 5 more hours to complete 45% work

$$\left[\frac{45}{4+5} = 5 \right]$$

Thus, first person completes $7 \times 5 + 5 \times 5 = 60\%$ work

and second person completes $5 \times 4 + 5 \times 4 = 40\%$ work

Hence, second condition is also satisfied. Hence, correct option is (c).

10. Go through option

$$140 \times 4 = (140 + 120 + 100 + \dots + 20)$$

$$560 = 560$$

Alternatively: Let n be the initial number of workers then

$$n \times 4 = n + (n - 20) + (n - 40) + \dots + (n - 120)$$

$$4n = 7n - 420$$

$$\Rightarrow 3n = 420$$

$$\Rightarrow n = 140 \text{ workers}$$

11. From the first statement

	B	$(V + M)$
Number of days	x	x
Efficiency	1	: 1

From the second statement

	V	$(V + M)$
Number of days \rightarrow	$(K + 8)$	K

From the third statement

	B	V
Number of days \rightarrow	$(n - 8)$	n

Now, go through option and consider option (c).

Efficiency of $(B + V + M) = 16.66\%$ (number of days = 6)

∴ Efficiency of $B = 8.33\%$ (number of days = 12)

and Efficiency of $(V + M) = 8.33\%$ (number of days = 12)

Therefore, B will take 12 days.

Now, from third statement V will take 20 days.

Hence, the efficiency of V is 5%.

Therefore, V will take 20 days. Hence, second statement is also true. Thus, the presumed option (c) is correct.

12. Consider option (d)

Time taken by Bill = 12 hours

Efficiency of Bill = 8.33%

Therefore, time taken by Bill and Milinda working together

$$= 6 \frac{2}{3} \text{ hours}$$

Hence, the efficiency of Milinda and Bill = 15%

Therefore efficiency of Milinda = $15 - 8.33 = 6.66\%$

Thus, the number of days taken by Milinda = 15, which is $8 \frac{1}{3}$ days more than when both work together.
Hence, all the conditions satisfied.

Efficiency	M	$B + M$	B
Number of days	15	$6 \frac{2}{3}$	12

33. Efficiency of Pascal and Rascal = 10%
Pascal worked for 2.5 hours and Rascal worked separately 8.5 hours. Which means it can be considered that Pascal and Rascal worked together for 2.5 hours and Rascal worked alone for 6 hours.

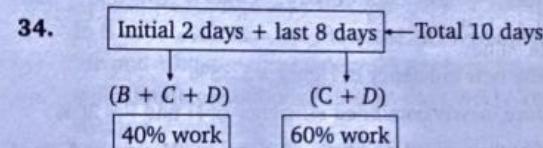
Thus, Pascal and Rascal in 2.5 hours can complete 25% work. It means the remaining $(50 - 25) = 25\%$ of the work was done by Rascal in 6 hours.

Therefore, Rascal can do 100% work in 24 hours. It means the efficiency of Rascal = 4.16%

Therefore, efficiency of Pascal = $(10 - 4.16) = 5.83\%$

Thus, Pascal require $\frac{100}{5.83} = 17 \frac{1}{7}$ hours to complete the work alone.

Alternatively: Go through option.



From the above diagram it is clear that efficiency of C and D is 7.5%, since C and D complete 60% work in 8 days and efficiency of B , C and D is 20%. It means efficiency of B alone is $12.5\% = (20 - 7.5)$.

Now	C	:	D
Number of days	$4x$:	$5x$
Efficiency	$5y$:	$4y$

∴ Efficiency of $C = \frac{5}{9} \times 7.5 = 4.16\%$

and Efficiency of $D = \frac{4}{9} \times 7.5 = 3.33\%$

Thus, D is the least efficient person.

Now share of work done by David

$$(D) = 3.33\% \times 10 = 33.33\%$$

Hence, his share of amount = $33.33\% \text{ of Rs. } 3000 = \text{Rs. } 1000$

35. Combined efficiency of all the three boats = 60 passenger/trip
Now, consider option (a).

15 trips and 150 passengers means efficiency of $B_1 = 10 \frac{p}{t}$

which means in carrying 50 passengers B_1 must have taken 5 trips. So the rest trips equal to $5 (10 - 5 = 5)$ in which B_2 and B_3 together carried remaining 250 (300 - 50) passengers.

Therefore the efficiency of B_2 and $B_3 = \frac{250}{5} = 50 \frac{P}{t}$

Since, the combined efficiency of B_1 , B_2 and B_3 is 60. Which is same as given in the first statement hence option (a) is correct.

Alternatively: It can be solved by framing quadratic equation.

36. Efficiency of 3 men + 5 women = 33.33%

Required number of days by 2 men = x

\therefore Required number of days by 3 women = $x + 5$

Now, consider option (c).

Therefore, $3M + 5W = 3M + 2M = 5$ men

Therefore, efficiency of a man = 6.66%

Hence, a man needs 15 days to finish the job, working alone.

Again $3M + 5W = 7.5W + 5W = 12.5W$

Therefore, efficiency of a woman = 2.66%

Therefore, a woman needs 37.5 days.

Thus, 2 men needs 7.5 days to work alone $\therefore \left(7.5 = \frac{15}{2}\right)$

and 3 women needs 12.5 days to work alone $\therefore \left(12.5 = \frac{37.5}{3}\right)$

Hence, the difference in number of days = 5 which is same as given in the problem. Hence correct option is (c).

37. Efficiency of Henry and Ford (combined) = 10%
Consider option (d).

$$\text{Efficiency of Ford} = 3.33\% \quad (30 \text{ days})$$

Therefore, Efficiency of Henry = 6.66%

Now, the new efficiency of Ford = 16.66%

and the new efficiency of Henry = 3.33%

Therefore, newly combined efficiency of H and F = 20%

Therefore, required number of days by Henry and Ford working together = 5

Since 5 is half of 10, hence the option (d) is correct.

38. From the last statement:

Efficiency of Anne (A), Benne (B) and Cenne (C) = 50%

From the first statement: Number of days taken by B is 2 more than C.

From the second statement: Anne had worked for 6 days and Benne had worked for 3 days only. Now, consider option (d).

Number of days taken by B = 6,

$$\text{Efficiency} = 16.66\%$$

It means Benne had completed $16.66 \times 3 = 50\%$ work in 3 days.

Therefore Anne had completed 50% work in 6 days.

Thus, the efficiency of Anne = $8.33\% \left(\frac{50}{6}\right)$

Hence, the efficiency of Cenne = $50 - (16.66 + 8.33) = 25\%$
Thus B takes 6 days (\because efficiency = 16.66%)
and C takes 4 days (\because efficiency = 25%)
which is true according to the first statement, hence option (d) is correct.

39. Number of pages typed by A, B and C together per day = 45
Now let the number of pages typed by B is x
then the number of pages typed by A = $x - d$
and the number of pages typed by C = $x + d$
 $\Rightarrow (x - d) + (x) + (x + d) = 45$
 $\Rightarrow x = 15$ pages per day.

Again let C types k pages per day then A types $\frac{k}{4}$ pages per day.

Therefore, the ratio of typing of pages per day of A and C = 1 : 4

\therefore Number of pages typed by C in one day

$$= \frac{4}{5} \times 30 = 24 \text{ pages}$$

(30 = 45 - 15)

\therefore Number of pages typed by C per hour = $\frac{24}{8} = 3$ pages/hour

40. Efficiency of P = 5%

Efficiency of Q = 4%

Efficiency of R = 2.5%

Efficiency of S = 2%

Till 10 am pipe P filled 20%

Till 10 am pipe Q filled 8% } 30.5%

Till 10 am pipe R filled 2.5%

Thus, at 10 am pipe P, Q and R filled 30.5% of the cistern.
Now, the time taken by P, Q, R and S together to fill the remaining capacity of the cistern

$$= \frac{69.5}{13.5} = \frac{139}{27} = 5 \text{ hours and 9 minutes (approx)}$$

Therefore, total time = 4 hours + 5 hours 9 minutes
= 9 hours and 9 minutes

It means cistern will be filled up at 3 : 09 pm

41. Efficiency of P + Q = 9% (inlet pipes)

Efficiency of R + S = 4.5% (outlet pipes)

Net efficiency = 4.5%

So, the time taken = $\frac{100}{4.5} = 22 \frac{2}{9}$ hours

42. Efficiency of A = 10%

Efficiency of B = 6.66%

Efficiency of C = 5%

Efficiency of D = 3.33%

Efficiency of A + B + C + D = 8.33

(time = 12 hours)

Now, go through options and consider A and B as inlet pipes and C and D as outlet pipes, then

$$(10 + 6.66) - (5 + 3.33) = 8.33$$

which is required hence it is certain that C and D are outlet pipes.

NOTE There is no any other such combination.

43. Efficiency of inlet pipe A = 4.16%

Efficiency of inlet pipe B = 5.83%

Time and Work
 Now, if the efficiency of outlet pipe be $x\%$ then in 10 hours the capacity of tank which will be filled = $10 \times (10 - x)$
 Now, since this amount of water is being emptied by C at $x\%$ per hour, then
 $\frac{10 \times (10 - x)}{x} = 2.5 \text{ hours} \Rightarrow x = 8\%$

Therefore in 10 hours 20% tank is filled only. Hence, the remaining 80% of the capacity will be filled by pipes A and B in $\frac{80}{10} = 8$ hours.

Efficiency of pipe A = 8.33%

Efficiency of pipe B = 6.67%

Efficiency of pipe C = 5%

When tap C was opened pipe A filled 16.66% capacity

When tap C was opened pipe B filled 6.67% capacity

Therefore rest capacity of the tank to be filled

$$= 100 - 23.34 = 76.66\%$$

Now, the net efficiency of A, B and C = 10%

Hence, pipes A, B and C will take = $\frac{76.66}{10} = 7.66 = 7 \frac{2}{3}$ hours

∴ Total time = 2 hours + $7 \frac{2}{3}$ hours = $9 \frac{2}{3}$ hours

Efficiency of inlet pipe = 50%

Efficiency of outlet pipe = 16.66%

Net efficiency of pipes A and B = 33.33%

Capacity of tank to be filled up = 66.66%

Hence, required time = $\frac{66.66}{33.33} = 2$ hours

Rate of leakage = 8.33% per hour

Net efficiency = $50 - (16.66 + 8.33) = 25\%$

Time required = $\frac{100}{25} = 4$ hours

Since, an inlet pipe is 7.2 times efficient than an outlet pipe. Therefore, in order to tank never overflow we will need total 8 outlet pipes.

Thus we need only 7 more ($8 - 1 = 7$) outlet pipes.

Time taken by 8th tap = $2 \times 2 \times 2 = 8$ hours

and time taken by 12th tap = $2 \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{2}$ hour

Ratio of time taken by 8th tap and 12th tap = $8 : \frac{1}{2} = 16 : 1$

Ratio of efficiencies of 8th tap and 12th tap = $1 : 16$

Time taken by 10th tap = $80 \times \frac{1}{2} \times \frac{1}{2} = 20$ hours

Time taken by 12th tap = $80 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 5$ hours

Thus 10th tap and 12th tap together will take 4 hours.

Let pipe A fill the tank in $3x$ hours then pipe B fill it in $4x$ hours.

Therefore, in 1 hour they will fill = $\frac{1}{3x} + \frac{1}{4x} = \frac{7}{12x}$

i.e.,

they will take $\frac{12x}{7}$ hours

When an inlet pipe C is also opened then it takes

$$= \frac{12x}{7} + \frac{12x}{7} \times \frac{3}{4} \\ = \frac{12x}{7} \left(\frac{7}{4} \right) = 3x \text{ hours}$$

Now, in one hour pipe A, B and C working together fill

$$= \frac{1}{3x} + \frac{1}{4x} - \frac{1}{C} = \frac{1}{3x}$$

$$\Rightarrow \frac{7}{12x} - \frac{1}{C} = \frac{1}{3x}$$

$$\Rightarrow \frac{1}{C} = \left(\frac{1}{12x} - \frac{1}{3x} \right)$$

$$\Rightarrow C = 4x$$

Hence in $4x$ hours pipe C can empty the whole tank.

Now, since $3x = 33 \Rightarrow x = 11$

$$\therefore 4x = 4 \times 11 = 44 \text{ hours}$$

51. Total work = $5 \times 20 = 100$ man-days.

Let the client needed to complete it in n days then

$$(5 \times 2) + (10 \times 2) + (15 \times 2) + (20 \times 2) = 100$$

Hence, in 8 days all the work will be completed as per the requirement of client.

And on the 8th day 20 men were working.

52. It requires total 8 days by adding the work force successively.

53. Total work = $100 + 50 = 150$ man-days

In 8 days 100 man-days work has been completed. Now on 9th and 10th day there will be 25 workers. So in 2 days they will complete additional 50 man-days work. Thus the work requires 2 more days.

54. Let there be ' n ' inlet pipes then there must be $(8 - n)$ outlet pipes.

$$\text{Therefore } (8 - n) \frac{1}{6} - n \times \frac{1}{8} = \frac{1}{6} \Rightarrow n = 4$$

Alternatively: $(8 - n) 16.66 - n \times 12.5 = 16.66$

$$\Rightarrow n = \frac{116.66}{29.16} = \frac{700}{175} = 4$$

Alternatively: It can be solve through options very easily.

55. Efficiency of two inlet pipes A and B = $8.33 + 6.66 = 15\%$

Efficiency of two inlet pipes A and B along with an outlet pipe

$$C = 8.33 + 6.66 - 12.5 = 2.5\%$$

Hours	1	2	3	4	5	6	7	8	9	10
Efficiency →	15	15	2.5	15	15	2.5	15	15	2.5	
	32.5		32.5		32.5		32.5		32.5	2.5%

In 9 hours 97.5% tank will be completely filled. On the 10th hour 2.5% (remaining capacity) will be fill by pipe A, B with its 15% efficiency.

Thus, A will take = $\frac{2.5}{15} = \frac{1}{6}$ hour = 10 minutes

Therefore, total time = 9 hours and 10 minutes.



5

PERCENTAGES

It is one of the most important chapters which is the backbone of calculations either involved in commercial arithmetic or in real life. Personally I do maximum arithmetical calculation using percentage and others too. So in the context of calculation it is necessary to know the clear concepts of percentage which plays a very vital role in Data Interpretation

PERCENTAGE AND ITS APPLICATION

A fraction with denominator 100 is called a per cent. Per cent is an abbreviation for the latin word "percentum" meaning "per hundred" or "hundredths" and is denoted by symbol %.

NOTE A fraction with denominator 10 is called as decimal.

Since per cent is a form of fraction, we can express per cent as fractions (or decimals) and vice-versa.

CONVERSION OF A FRACTION INTO PERCENTAGE

To convert a fraction into a percentage, multiply the fraction by 100 and put "%" sign.

EXAMPLE 1 Convert the following fractions into percentages:

$$(i) \frac{1}{2} \quad (ii) \frac{3}{4} \quad (iii) \frac{4}{5} \quad (iv) \frac{7}{8}$$

SOLUTION (i) $\frac{1}{2} \rightarrow \frac{1}{2} \times 100 = 50\%$

(ii) $\frac{3}{4} \rightarrow \frac{3}{4} \times 100 = 75\%$

(iii) $\frac{4}{5} \rightarrow \frac{4}{5} \times 100 = 80\%$

(iv) $\frac{7}{8} \rightarrow \frac{7}{8} \times 100 = 87.5\%$

CONVERSION OF A PERCENTAGE INTO A FRACTION

To convert a percentage into a fraction, replace the % sign with $\frac{1}{100}$ and reduce the fraction to simplest form.

besides quantitative Aptitude section. On an average two problems i.e., nearly 4–5 % problems in QA only, are being asked in CAT every year.

In other entrance/competitive exams like MAT, XAT and UPMCAT, etc there are too many questions asked from this chapter.

EXAMPLE 2 Express the following percentage as fraction

- | | | | |
|----------|----------|-----------|------------------------|
| (i) 20% | (ii) 30% | (iii) 45% | (iv) $5 \frac{1}{8}\%$ |
| (v) 155% | | | |

SOLUTION (i) $20\% = \frac{20}{100} = \frac{1}{5}$
 (ii) $30\% = \frac{30}{100} = \frac{3}{10}$
 (iii) $45\% = \frac{45}{100} = \frac{9}{20}$
 (iv) $5 \frac{1}{8}\% = \frac{41}{8 \times 100} = \frac{41}{800}$
 (v) $155\% = \frac{155}{100} = \frac{31}{20} = 1 \frac{11}{20}$

CONVERSION OF A PERCENTAGE INTO A RATIO

To convert a percentage into a ratio, first convert the given percentage into a fraction in simplest form and then to a ratio.

EXAMPLE 3 Solve the following :

- | | | |
|---------|----------|--------------|
| (i) 38% | (ii) 25% | (iii) 66.66% |
|---------|----------|--------------|

SOLUTION (i) $38\% = \frac{38}{100} = \frac{19}{50} = 19 : 50$

(ii) $25\% = \frac{25}{100} = \frac{1}{4} = 1 : 4$

(iii) $66.66\% = 66 \frac{2}{3}\% = \frac{200}{3 \times 100} = \frac{2}{3} = 2 : 3$

CONVERSION OF A RATIO INTO A PERCENTAGE

To convert a ratio into a percentage, first convert the given ratio into a fraction then to a percentage.

EXAMPLE 4 Express the following ratios as percentage :

- (i) 1 : 5 (ii) 2 : 3 (iii) 4 : 9

SOLUTION (i) $1 : 5 = \frac{1}{5} = \frac{1}{5} \times 100 = 20\%$

(ii) $2 : 3 = \frac{2}{3} = \frac{2}{3} \times 100 = 66.66\%$

(iii) $4 : 9 = \frac{4}{9} = \frac{4}{9} \times 100 = 44.44\%$

CONVERSION OF A PERCENTAGE INTO A DECIMAL

To convert a percentage into a decimal remove the % sign and move the decimal point two places to the left.

EXAMPLE 5 Convert the following percentages into decimals :

- (i) 36% (ii) 250% (iii) 57.5% (iv) $17 \frac{1}{5}\%$ (v) 7%

SOLUTION (i) $36\% = 0.36$

(ii) $250\% = 2.50 = 2.5$

(iii) $57.5\% = 0.575$

CONVERSION OF FRACTION INTO PERCENTAGE

NUMERATORS

DENOMINATORS	1	2	3	4	5	6	7	8	9	10	11	12
1	100	200	300	400	500	600	700	800	900	1000	1100	1200
2	50	100	150	200	250	300	350	400	450	500	550	600
3	33.33	66.66	100	133.33	166.66	200	233.33	266.66	300	333.33	366.60	400
4	25	50	75	100	125	150	175	200	225	250	275	300
5	20	40	60	80	100	120	140	160	180	200	220	240
6	16.66	33.33	50	66.66	83.33	100	116.66	133.33	150	166.66	183.33	200
7	14.28	28.56	42.85	57.13	71.42	85.71	100	114.28	128.56	142.85	157.13	171.42
8	12.5	25	37.5	50	62.5	75	87.5	100	112.5	125	137.5	150
9	11.11	22.22	33.33	44.44	55.55	66.66	77.77	88.88	100	111.11	122.22	133.33
10	10	20	30	40	50	60	70	80	90	100	110	120
11	9.09	18.18	27.27	36.36	45.45	54.54	63.63	72.72	81.81	90.9	100	109.09
12	8.33	16.66	25	33.33	41.66	50	58.33	66.66	75	83.33	91.66	100
15	6.66	13.33	20	26.66	33.33	40	46.66	53.33	60	66.66	73.33	80

(PERCENTAGE-FRACTION CONVERSION TABLE)

Remember : $\frac{1}{7} = 14.28\%$ and $\frac{1}{14} = 7.14\%$

$\frac{1}{6} = 16.66\%$ and $\frac{1}{15} = 6.66\%$

$\frac{1}{9} = 11.11\%$ and $\frac{1}{11} = 9.09\%$

$\frac{1}{15} = 6.66\%$ and $\frac{1}{16} = 6.25\%$

$\frac{1}{3} = 33.33\%$ and $\frac{3}{10} = 30\%$

99.99% is equivalent to 100% (in calculation)

(iv) $17 \frac{1}{5}\% = 17.2\% = 0.172$

(v) $7\% = 0.07$

CONVERSION OF A DECIMAL INTO A PERCENTAGE

To convert a decimal into a percentage, move the decimal point two place to the right (adding zeros if necessary) and put % sign.

EXAMPLE 6 Convert the following decimals into percentages :

- (i) 0.35 (ii) 8.12 (iii) 0.018

SOLUTION (i) $0.35 = 35\%$

(ii) $8.12 = 812\%$

(iii) $0.018 = 1.8\%$

- Work out some more examples so that all these things are on your finger tips.

Remember $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \dots = 50\%$ etc.

Learn and practice all the values given below.

SOME OTHER TYPICAL VALUES

$\frac{1}{13} = 7.69\% \approx 7.7\%$, $\frac{1}{17} = 5.88\%$, $\frac{1}{19} = 5.26\%$,

$\frac{1}{21} = 4.76\%$, $\frac{1}{23} = 4.35\%$, $\frac{1}{24} = 4.166\%$

Learnings from the table :

- This table is a first hand support as a percentage values of some frequently used fractions.
- All the percentage values whose decimal part is 0.33, 0.66, 0.00 contain the denominator 3 in the fraction.
- Similarly if there is 0.16, 0.33, 0.50, 0.66, 0.83, 0.00 means there is a 6 in the denominator of the fraction.

- Percentages
 (iv) Similarly if there is 0.28, 0.56, 0.85, 0.13, 0.42, 0.71 it means there is a 7 as denominator.
 (v) If there is 0.11, 0.22, 0.33, 0.44 ... 0.99 etc. It means there is 9 as the denominator of the fraction.

PERCENTAGE OF A QUANTITY

EXAMPLE 1 Find the no. of male students (i.e., boys), if there are 42% male students in the school and the total no. of students in the school is 1000.

SOLUTION Required number of male students

$$= 42\% \text{ of } 1000 \\ = \frac{42}{100} \times 1000 = 420$$

EXAMPLE 2 A student scored 85% marks. Total marks were 400. How much did he score?

SOLUTION Marks scored = 85% of 400

$$= \frac{85}{100} \times 400 \\ = 340$$

- (vi) If there is 0.09, 0.18, 0.27 ... it means there is 11 as the denominator of the fraction.
 (viii) If two percentage values have different decimal values (there must be different denominators) then their addition or subtraction results always in decimal i.e., never as an integer.

EXAMPLE 3 In an orchard $16\frac{2}{3}\%$ of the trees are mango trees. If the total number of trees in the orchard is 360, find the number of other types of trees in the orchard.

SOLUTION Total number of trees = 360

$$\text{Number of mango trees} = 16\frac{2}{3}\% \text{ of } 360 \\ = \frac{50}{3 \times 100} \times 360 = 60$$

Therefore, the number of other trees = $360 - 60 = 300$

Alternatively: Number of mango trees = $16\frac{2}{3}\%$

$$\text{It means no. of other types of trees} = \left(100 - 16\frac{2}{3}\%\right)\% \\ = 83\frac{1}{3}\%$$

Thus number of other types of trees = $83\frac{1}{3}\% \text{ of } 360 = 300$

INTRODUCTORY EXERCISE-5.1

- Find the value of :

(i) 25% of 200	(ii) 30% of 180
(iii) 37.5% of 300	(iv) 83.33% of 480
(v) 100% of 2 quintal	(vi) 165% of 330 litre
(vii) $5\frac{1}{2}\%$ of Rs. 1600	(viii) 10% of 1 hour
(ix) 66.66% of 300	
(x) 20% of 1 million rupees.	
- Mr. Arvind Vidyarthi spends 30% of his money on education and he has total Rs. 15,000. How many rupees he spends on education?
- Sonia purchased 80 metres of cloth, out of which 35% was used for making trousers. How much cloth was used by her for making trousers?
- The total no. of students in the school are 1250. 40% of the students are girls. Find the number of boys.
- William's monthly salary was Rs. 1140. His salary is increased by 16.66%. How much increase has he

CAT Tips Now I would like to suggest you that all the problems mentioned in the exercise must be done using fractions instead of percentage, in order to make the calculation simple and handy.

For example see the solution of question 2 :

$$15000 \times 0.3 = 4500 \quad \left[\text{Recall } \frac{x \times 30}{100} = 0.3x \right]$$

Solution for question 5 : Since $16.66\% = \frac{1}{6}$

gotten? Also find the salary if his salary increased by 33.33%.

- The population of Vatican city is 700. If it increases by 7.14% per annum (i.e., every year). Find the population of the Vatican city after one year.
- The speed of a car is 85 km/hr. It is increased by 20%. Find the increased speed of the car?
- A shopkeeper announces a reduction of 8.33% on all its prices after new year. If a wrist watch was earlier for Rs. 2400. How much would it costs now?
- 44% of the students in a class are females and the number of male students is 42. Find the total no. of students in the class.
- 30% of a number is 225. Find the number.
- A horse costing Rs 80,000 one year ago now costs 25% less. Find the changed price.
- 1700 students took an exam 85% students passed it. Find the number of students who failed in the exam.

So the new salary will increase by $\frac{1}{6}$ it means the absolute

value of new salary will be $\frac{7}{6} \left(= 1 + \frac{1}{6}\right)$ times of the original

salary.

So the increase in salary = $1140 \times \frac{1}{6} = \text{Rs. } 190$

and increased salary = original salary + increase in salary

$$= 1 + \frac{1}{6} = \frac{7}{6} = \frac{7}{6} \times 1140 = \text{Rs.} 1330$$

Similarly if the salary is increased by 33.33% it means

$$33.33\% = \frac{1}{3}$$

$$\text{Therefore new salary} = 1 + \frac{1}{3} = \frac{4}{3} = \frac{4}{3} \times 1140 = 1520$$

Solution for question 6: Since $7.14\% = \frac{1}{14}$

EXPRESSING ONE QUANTITY AS A PERCENTAGE OF ANOTHER QUANTITY

EXAMPLE 1 What per cent is number 3 of number 20?

SOLUTION As per cent means out of 100. Then by unitary method

$$\text{out of } 20 \rightarrow 3$$

$$\text{out of } 1 \rightarrow \frac{3}{20}$$

$$\text{out of } 100 \rightarrow \frac{3}{20} \times 100 = 15\%$$

Hence to find what per cent the first number is of second number, we divide the first number by the second number and multiply the result by 100.

EXAMPLE 2 Ravi obtained 325 marks out of a maximum of 400 marks. Find the percentage of marks obtained by him.

1. What per cent is :

- (i) 30 out of 600 ?
- (ii) 25 out of 160 ?
- (iii) 75 out of 225 ?
- (iv) 36 kg of 150 kg ?
- (v) 90 cm of 4.5 metre.
- (vi) 60 litres of 40 litres
- (vii) 800 shirts out of 1200 shirts?
- (viii) 875 m of 2 km. ?

2. Express:

- (i) 20 as a percentage of 500.
- (ii) 60 kg as a per cent age of 80 kg.
- (iii) 350 ml as a percentage of 5.6 litre.
- (iv) Rs. 13 as a percentage of Rs. 39.
- (v) 15 seconds as a percentage of 1 hour.
- (vi) 27° as a percentage of 360° .

3. Manu scored 384 marks out of 450. What per cent marks did she get?

4. In an election, out of 60,000 eligible voters 42000 cast their vote. Calculate the percentage of voters casting their votes.

$$\begin{aligned} \text{So the new population of the city} &= 700 \times \left(1 + \frac{1}{14}\right) \\ &= 700 \times \frac{15}{14} = 750 \end{aligned}$$

$$\begin{aligned} \text{Solution for question 8:} \quad \text{The reduced price of the watch} \\ &= 2400 \left(1 - \frac{1}{12}\right) \\ &= 2400 \times \frac{11}{12} = 2200 \end{aligned}$$

$$\begin{aligned} \text{SOLUTION} \quad \text{Required percentage of marks} &= \frac{325}{400} \times 100 = 81.25\% \end{aligned}$$

EXAMPLE 3 In a factory of 150 workers, 18 were absent in a day. What percentage were present?

$$\text{SOLUTION} \quad \text{Present} = 150 - 18 = 132$$

$$\text{Percentage presence} = \frac{132}{150} \times 100 = 88\%$$

EXAMPLE 4 Kurla obtained 480 marks out of 600 and Birla obtained 560 marks out of 800. Whose performance is better?

$$\text{SOLUTION} \quad \% \text{ marks of Kurla} = \frac{480}{600} \times 100 = 80\%$$

$$\% \text{ marks of Birla} = \frac{560}{800} \times 100 = 70\%$$

So, obviously Kurla's performance is better than that of Birla even though getting less absolute marks.

INTRODUCTORY EXERCISE-5.2

5. A tin contains 24 litres of milk. Due to leakage, 720 ml is lost. What per cent of milk is still present in the tin?

6. Price of an item increased from 16.50 to Rs. 41.25. Find the percentage increase in price.

7. The excise duty on a certain item has been reduced to Rs. 3480 from Rs. 5220. Find the percentage reduction in the excise duty for that item.

8. Out of total production of 6450 tonnes of a coalmine a quantity of 645 tonnes was lost during extraction. What per cent of the total production was the net coal extracted?

9. A cricket team played 24 matches. The team won 9 matches and lost 3 matches. 12 matches ended in draw. What per cent of the total matches did the team lose?

10. In a particular month, Rs. 10,000 were allocated for the food items in a hostel out of total Rs. 50,000 budget. Further Rs. 2000 is allocated for the fruits out of Rs. 10,000 (allocated for food items) what per cent of total budget is spent on fruits only?

SOME MOST IMPORTANT VALUES	
1 → 50%,	$\frac{1}{3} = 33.33\%$,
2 → 66.66%,	$\frac{1}{4} \rightarrow 25\%$,
3 → 75%,	$\frac{1}{5} \rightarrow 20\%$,
4 → 40%,	$\frac{3}{5} \rightarrow 60\%$,
5 → 16.66%,	$\frac{5}{6} \rightarrow 83.33\%$
6	

NOTE The application of percentage is very diverse in nature e.g. profit and loss, Simple and compound interest etc. All these are exactly based on the percentage increase/decrease of the original (or actual) value.

Percentage increase/decrease in a quantity

$$= \left(\frac{\text{change in quantity}}{\text{original quantity}} \times 100 \right) \%$$

EXAMPLE 1 The height of Abhimanyu some times ago was 110 cm. Now his height is 120 cm. Find the percentage change in his height.

SOLUTION $\frac{120 - 110}{110} \times 100 = 9.09\%$

PERCENTAGE CHANGE AND PERCENTAGE POINT CHANGE

Last year Abhijeet's salary was Rs. 10,000 and Sonu's salary was Rs. 8,000. This year Abhijeet's salary is Rs. 12,000 while Sonu's salary is Rs. 10,000.

- What is the percentage increase of Abhijeet's salary?
- What is the percentage increase of Sonu's salary?
- Percentage increase in Sonu's salary is how much percent greater than the percentage increase in Abhijeet's salary?
- What is the percentage point change in the salary of Sonu and Abhijeet?

SOLUTION (i) $\frac{12,000 - 10,000}{10,000} \times 100 = 20\%$

or $\frac{2}{10} \rightarrow \frac{1}{5} \rightarrow 20\%$

ADVANCED CONCEPT OF PERCENTAGE CHANGE

(A) If a value p is increased by $x\%$, then we have to decrease the resultant value by $\left(\frac{x}{x+100} \times 100 \right)\%$ to get back to the original value p .

$$\begin{aligned} \text{Original value } p &\xrightarrow{\text{increasing value}} \frac{p \times x}{100} \xrightarrow{\text{increasing value}} \left(p + \frac{px}{100} \right) \\ &= p \left(\frac{100+x}{100} \right) \end{aligned}$$

SHORTCUT

$$\frac{10}{110} \rightarrow \frac{1}{11} \rightarrow 9.09\%$$

Alternatively: $\frac{12}{11} \rightarrow 109.09\%$, so increase = 9.09%

EXAMPLE 2 The total expenses of a hostel were Rs. 8000 per month. Some students left the hostel due to which the new expenses come down by Rs. 1000. Find the percentage decrease in expenses of the hostel.

SOLUTION

$$\frac{1000}{8000} \rightarrow \frac{1}{8} \rightarrow 12.5\%$$

EXAMPLE 3 Salary of Raja is Rs. 9000 per month and salary of Rani is Rs. 10,000 per month.

- What per cent is the salary of Rani to that of Raja?
- What per cent is the salary of Raja to that of Rani?

SOLUTION (i) $\frac{10,000}{9,000} \times 100 = 111.11\%$

Alternatively:

$$\frac{10}{9} \rightarrow \frac{9}{9} + \frac{1}{9} \rightarrow 100\% + 11.11\% \rightarrow 111.11\%$$

(ii) $\frac{9}{10} \rightarrow 90\% \quad \left(\because \frac{1}{10} \rightarrow 10\% \right)$

Hence, salary of Raja is 90% to the salary of Rani.

(ii) $\frac{2}{8} \rightarrow \frac{1}{4} \rightarrow 25\%$

(iii) Percentage increase of Sonu's salary = 25
Percentage increase of Abhijeet's salary = 20

$$\text{So the required percentage} = \frac{25 - 20}{20} \times 100 = 25\%$$

It means percentage increase of Sonu's salary is 25% greater than the percentage increase of Abhijeet's salary.

(iv) Percentage point change

$$\begin{aligned} &= (\text{Percentage increase in Sonu's salary} \\ &\quad - \text{Percentage increase in Abhijeet's salary}) \\ &= 25 - 20 = 5 \text{ percentage point} \end{aligned}$$

Infact percentage point change is the difference between two percentage values.

Now the percentage decrease

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

In other words (i.e., in terms of fraction) if a value is increased by $\frac{n}{d}$ then to get back the same number p from the resultant value, we have to decrease the increased value by $\left(\frac{n}{d+n} \right)$.

EXAMPLE 1 Salary of Rajeev Ratan in 2001 was \$ 100 per day and his salary in 2002 was \$ 125 per day. Again in 2003 his salary was \$ 100 per day.

- What is the percentage increase in his salary in 2002?
- What is the percentage decrease in his salary in 2003 over 2002?

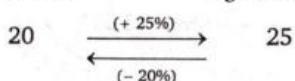
SOLUTION (i) $\frac{125 - 100}{100} \times 100 = 25\%$

(ii) $\frac{125 - 100}{125} \times 100 = 20\%$

In fact there is same absolute change but percentage change is different due to different denominator (i.e., base change). So the base change is as much important as the numerator or absolute change in quantity.

EXAMPLE 2 Age of Ravi is 20 years. If the Shyam's age is 25% greater than that of Ravi then how much per cent Ravi's age is less than Shyam's age?

SOLUTION Age of Ravi Age of Shyam



Solution using percentage change formula

Here $x = 25$, then

$$\text{percentage decrease (or less)} = \frac{25}{125} \times 100 = 20\%$$

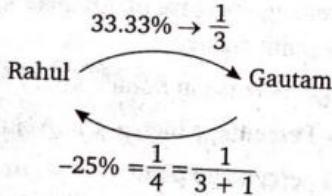
Solution using fractional change formula

$$\text{Since increase} = \frac{1}{4} \quad \therefore \left(25\% = \frac{1}{4} \right)$$

$$\text{Therefore decrease} = \frac{1}{4 + 1} = \frac{1}{5} \rightarrow 20\%$$

EXAMPLE 3 Gautam has 33.33% more pencils than Rahul has. By how much per cent less pencils Rahul has than that of Gautam?

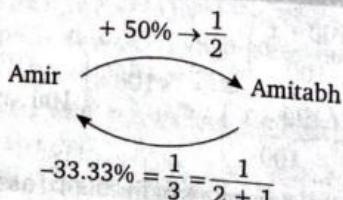
SOLUTION



So Rahul has 25% less pencils than Gautam has.

EXAMPLE 4 Height of Amitabh is 50% greater than the height of Amir Khan. Height of Amir Khan is how much per cent less than that of Amitabh?

SOLUTION



Thus the height of Amir is 33.33% less than Amitabh.

Explanation of Concept : Assume A has 10 apples and B has 20 apples, then we say that B has 100% more apples than A has. Again we can say that A has 50% less apples than B has.

To calculate the percentage change :

$$100\% \rightarrow \frac{1}{1}$$

$A \curvearrowright B$

$$-50\% = \frac{1}{2} = \frac{1}{1+1}$$

Consider another example : Let us assume A has chocolates and B has 10 chocolates then we can say that B has 66.66% more chocolates than A. So again we can also say that A has 40% less chocolates than B.

$$66.66\% \rightarrow \frac{2}{3}$$

$A \curvearrowright B$

$$-40\% = \frac{2}{5} = \frac{2}{3+2}$$

Remember the percentage change graphic is almost 70–80% better in giving quick and simple results. So instead of using the percentage formula, use the percentage change graphic method. For this you are just required to know the percentage fraction conversion table.

(B) If a value P is first decreased by $x\%$ then to get back the original value P , we have to increase the decreased (resultant) value by $\left(\frac{x}{100-x} \times 100 \right)$

$$\text{original value } P \xrightarrow[\frac{Px}{100}]{} \text{decreased value } \left(P - \frac{Px}{100} \right) = P \left(1 - \frac{x}{100} \right)$$

$$\text{Now, the per cent increase} = \frac{\left[P - P \left(1 - \frac{x}{100} \right) \right] \times 100}{P \left(1 - \frac{x}{100} \right)} = \frac{x}{100-x} \times 100$$

In terms of fraction, if a value P is first decreased by n/d then to get back the original number P . We have to increase the decreased (or resultant) value by $\frac{n}{d-n}$.

EXAMPLE 5 Due to irregular working habits of Ramachandran his salary was reduced by 20% but after some months his salary was increased to the original salary. What is the percentage increase in salary of Ramachandran?

SOLUTION Let initial salary be Rs. 100

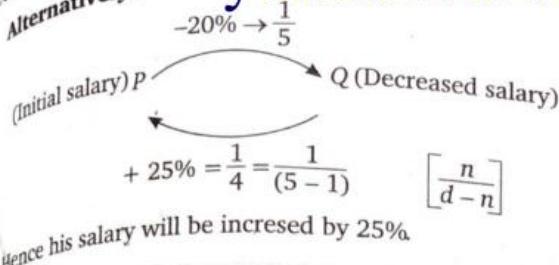
$$100 \xrightarrow{- 20\%} 80$$

$\xleftarrow{+ 25\%}$

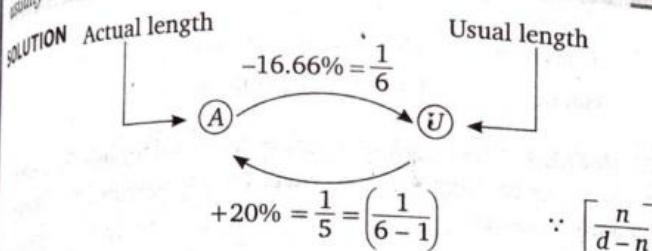
Alternatively : Here $x = 20$

$$\text{then \% increase} = \frac{20}{(100-20)} \times 100 = 25\%$$

Alternatively:



EXAMPLE 6 Kajol usually wears saree, which is 16.66% less than the actual length of the saree. By how much per cent the actual length of the saree is greater than the length of saree which kajol usually wears?



So the actual length of the saree is 20% greater than the usually used saree.

- NOTE**
- (1) If a value X is first increased by $p\%$ to Y then Y is again decreased to X by $q\%$ then p is always greater than q (for positive values)
 - (2) If a value X is first decreased by $p\%$ to Y and then Y is increased by $q\%$ to X , then p is always less than q .

CONCEPT OF PRODUCT CONSTANCY

It is the same as we know the inverse proportion in the chapter of Ratio, Proportion and Variation.

e.g., When the rate of a pencil is Rs. 1.25 then we can purchase 16 pencils by paying Rs. 20. If the rate of a pencil is decreased by Rs. 0.25 then we can purchase 20 pencils by paying Rs. 20.

Explanation : Rate \times No. of pencils = Price

$$1.25 \times 16 = 20$$

$$1.00 \times 20 = 20$$

So you can see that here the product (20) is constant in both the cases. Thus it is clear that if we reduce the price of a pencil to Rs. 0.50, then we can purchase 40 pencils in Rs. 20.

Some more examples of product constancy :

- (i) speed \times time = distance
- (ii) rate \times time = cost
- (iii) efficiency \times time = work
- (iv) length \times breadth = area
- (v) average \times no. of elements = total value
- (vi) rate \times quantity = price (or expenditure)

e.g., The price of sugar is increased by 25% then by how much per cent should a customer reduce the consumption (i.e., quantity used) of sugar so that he has not to increase his expenses on sugar.

$$\text{price} \times \text{quantity} = \text{expenditure}$$

- (3) If a value A is increased by $p\%$ then again by $q\%$ once again it is increased by $r\%$, then the final value will be same as if you change the order of p, q, r i.e., A can be first increased by $r\%$ then by $q\%$ and then by $p\%$ still the result will be same.

- (4) The rule 3 is also applicable for the decreasing of the values. A value ' A ' is first decreased by $p\%$, then by $q\%$ and then by $r\%$ and so on, the resultant value will be same as when A is first decreased by $q\%$ then by $p\%$ and then by $r\%$ etc.

Note : In case 3 and 4 we are discussing the successive increase or decrease in the value.

- (5) A value ' A ' is first increased by $p\%$ then by $q\%$ and then it is reduced by $r\%$ will give the same results as when A is first decreased by $r\%$, then increased by $q\%$ and then by $p\%$ etc.
- EXAMPLE 7** Initially Ms. Rakhi Sawant has Rs. 200 in her wallet then she increased it by 20%. Once again she increased her amount by 25%. The final value of money in her wallet will be how much per cent greater than the initial amount.
- SOLUTION**
- $$200 \xrightarrow{+ 20\%} 240 \xrightarrow{+ 25\%} 300$$
- $$\text{So the required \% increase} = \frac{300 - 200}{200} \times 100 = 50\%$$
- EXAMPLE 8** The age of B is 50% greater than the age of A . The age of C is 20% less than the age of B . By how much percentage the age of C is greater than the age of A .
- SOLUTION**
- $$A \xrightarrow{+ 50\%} B \xrightarrow{- 20\%} C$$
- $$\text{So the required percentage change} = \frac{20}{100} \times 100 \\ = 20\%$$
- $$100 \times 100 = 10,000$$
- $$125 \times x = 10,000$$
- $$\Rightarrow x = \frac{10,000}{125} = 80. \text{ Therefore \% reduction} = 20\%$$
- or
- $$1 \times 1 = 1$$
- $$1.25 \times k = 1 \Rightarrow k = 0.8$$
- thus there will be 20% decrease in the consumption of sugar in order to maintain the same expenditure on sugar.
- ### PRODUCT CONSTANCY CONDITIONS
- When one factor of a product is increased by $p\%$ then the other factor will be decreased by $\left(\frac{p}{100+p} \times 100 \right)\%$
- It means when one factor of a product is increased by $\frac{n}{d}$ then the other factor is decreased by $\frac{n}{(d+n)}$
- When one factor of a product is decreased by $p\%$ then the other factor will be increased by $\left(\frac{p}{100-p} \times 100 \right)\%$
- It means when one factor of a product is decreased by $\frac{n}{d}$ then the other factor will must be increased by $\frac{n}{(d-n)}$.

222

EXAMPLE 1 If the price of a commodity be raised by 20% then by how much per cent a house holder reduce his consumption of the same commodity so that his expenditure does not increase.

SOLUTION Since here product (i.e., expenditure) is constant
 $\text{rate} \times \text{consumption} = \text{expenditure}$

$$\text{initially} \rightarrow 1 \times 1 = 1$$

$$\text{After change} \quad 1.2 \times x = 1$$

$$\Rightarrow x = 0.833 \therefore \text{decrease in value} = 16.66\%$$

Alternatively:

Increase in rate	Decrease in consumption
$+ 20\% = + \frac{1}{5}$	$- 16.66\% = - \frac{1}{6}$

EXAMPLE 2 If the price of petrol falls down by 20% by how much per cent must a person increase its consumption, so as not to decrease the expenditure on this item?

SOLUTION Since product is constant

decrease by	increase by
$20\% = \frac{1}{5}$	$\frac{1}{4} = 25\% \quad \left[\because \frac{n}{d} \rightarrow \frac{n}{(d-n)} \right]$

EXAMPLE 3 Due to 50% increase in the price of rice. We purchased 5 kg less rice with the same amount of Rs. 60. What is the new price of rice?

CONCEPT OF 'BY' AND 'TO'

Please note that there is a clear difference between "by" and "to". e.g., the income is reduced by 40% it means the new income is 60% of the original and the income is reduced to 40% means the new income is 40% of the original value. Thus "by"

EXAMPLE 1 In an election between two candidates, the candidate who got 57% valid votes won by a majority of 420 votes. Find the total no. of valid votes.

SOLUTION Winner Loser
 $0.57x$ $0.43x$
 $0.14x$ $[100 - 57 = 43]$
 $0.14x = 420$ $[57 - 43 = 14]$
 $x = 3000$
Hence total valid votes = 3000

EXAMPLE 2 Due to fall in manpower, the production in the factory decreases by 60%. By what per cent should the working hours be increased to restore the original production in the factory?

SOLUTION Manpower \times Working hours = Production
 \downarrow \uparrow
 $(- 60\%) = \frac{3}{5} \rightarrow \frac{3}{2} = (+ 150\%) \quad \left[\frac{3}{5} \rightarrow \frac{3}{5-3} = \frac{3}{2} \right]$
Hence by 150% working hours will be increased. It means the new working hours will be 2.5 times (not 1.5 times) of the original time.

- (a) Rs. 4.66
(c) Rs. 4

SOLUTION Increase in price

$$50\% = \frac{1}{2} \rightarrow$$

- (b) Rs. 5
(d) Rs. 6

$$\frac{1}{3} = 33.33\%$$

Since the new quantity of rice decreases by 33.33% which is equal to 5 kg it means initially there was 15 kg rice to be used.

So, the initial price = Rs. 4

and final price = Rs. 6

Alternatively: From the options.

Let us consider choice (d).

Therefore $[6 \times 10 = 60]$ (finally)

Hence $[4 \times 15 = 60]$ (initially)

EXAMPLE 4 The length of a plot is decreased by 33.33%. By how much % the breadth of the plot will be increased so that the area remains constant?

SOLUTION (Decrease) (Increase)

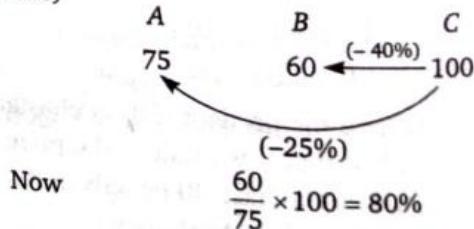
$$33.33 = \frac{1}{3} \rightarrow \frac{1}{2} = 50\% \quad \left[\frac{1}{2} = \frac{1}{3-1} \right]$$

represents difference and "to" represents final value.

e.g., The income of Sarika is increased by 20% means new income is $100 + 20 = 120\%$ of the original income. The income of Sarika is increased to 120% means the new income of Sarika is 120% of the original income.

EXAMPLE 3 Two numbers are respectively 25% and 40% less than a third number. What per cent is the second of the first?

SOLUTION Consider A, B, C three numbers and assume $C = 100$ (as a base)



Now

$$\frac{60}{75} \times 100 = 80\%$$

EXAMPLE 4 A person gives 10% to his wife 10% of the remaining to a hospital (as a donation) again 10% of the remaining to prime minister's relief Fund. Then he has only 7290 Rs. with him. What was the initial sum of money with that person?

SOLUTION Since he gives 10% so he is left with 90% of the original sum and since he does the same with the remaining (or left) amount. So it forms a chain.

$$\therefore \text{Remaining amount} = (x) \times 0.9 \times 0.9 \times 0.9$$

$$\Rightarrow x = 10,000, \text{ where } x \text{ is supposed to be initial amount.}$$

EXAMPLE 5 Initially a shopkeeper had n chocolates. A customer bought 10% chocolate from n then another customer bought 20% of the remaining chocolates, after that one more customer purchased 25% of the remaining chocolates. Finally shopkeeper is left with 270 chocolates in his shop. How many chocolates were there initially in his shop?

- (b) 450 (c) 500 (d) 600
 $n \times 0.9 \times 0.8 \times 0.75 = 270$

SOLUTION

POPULATION RELATED MATHEMATICAL PROBLEMS

If the original population of a locality (i.e., region) be P and the annual growth rate be $r\%$. The population after n years

$$P \left(1 + \frac{r}{100}\right)^n$$

change (or increase) in the population

$$= P \left[\left(1 + \frac{r}{100}\right)^n - 1 \right]$$

EXAMPLE 1 If the annual increase in the population be 20% and the present population be 10,000. What will be the population after 3 years hence?

- (a) 16,000 (b) 17,280
 (c) 14,400 (d) 1,728

SOLUTION $10,000 \left(1 + \frac{20}{100}\right)^3 = 10,000 \left(\frac{6}{5}\right)^3$
 $= 10,000 \times (1.2)^3 = 17,280$

Hence (b) is correct.

EXAMPLE 2 The population of a town in the first year increases by 10% in the next year it decreases by 10%. Once again in the third year it increase by 10% and in the fourth year it decrease by 10%. If the present population be 20,000 then the population after four years will be :

- (a) 16,902 (b) 19,602
 (c) 20,000 (d) none of these

SOLUTION $20,000 \left(1 + \frac{10}{100}\right) \left(1 - \frac{10}{100}\right) \left(1 + \frac{10}{100}\right) \left(1 - \frac{10}{100}\right)$
 $= 20,000 (1.1)(0.9)(1.1)(0.9)$
 $= 20,000 \times 1.21 \times 0.81 = 19,602$

Thus option (b) is correct.

NOTE If the value of a number is first increased by $x\%$ and then decreased by $x\%$, the net change is always a decreases (or loss) in original value.

Hence, $\% \text{ loss} = \left(\frac{x}{10}\right)^2 \%$

EXAMPLE 1 Shweta is a very expert in bargaining. Once she went to a nearby shop. When Shweta asked the price of Shampoo Sachet the shopkeeper told her the price by increasing 15% of the original cost. But Shweta insisted to decrease the price by 15% so the shopkeeper sold it by decreasing the price by 15% What is the loss or profit of shopkeeper and by how much percent?

$$n = \frac{270 \times 10,000}{9 \times 8 \times 75}$$

$$n = 500$$

NOTE

These type of problems (see example no. 4 and 5) can be solved with a great convenience if we solve in reverse order, with the aid of given choices.

Let us consider option (c)

$$500 \times 0.9 = 450$$

$$450 \times 0.8 = 360$$

$$360 \times 0.75 = 270$$

Hence presumed option is correct.

If there is decrease in population be $r\%$ then,

$$\text{total population after } n \text{ years} = P \left(1 - \frac{r}{100}\right)^n$$

$$\text{and decrease in population} = P \left[1 - \left(1 - \frac{r}{100}\right)^n\right]$$

(a) no loss

(b) profit of 1.5%

(c) loss of 2.25%

(d) none of these

SOLUTION Let the actual price be 100

$$100 \xrightarrow{+15\%} 115 \xrightarrow{-15\%} 97.75 \quad (\text{loss of } 2.25\%)$$

Alternatively: $\text{loss\%} = \left(\frac{15}{10}\right)^2 = 2.25\%$

There is always a loss.

EXAMPLE 2 If the length and breadth of a rectangle are changed by + 20% and - 10%. What is the percentage change in area of rectangle?

- (a) 8% (b) 10.8%
 (c) 20% (d) data insufficient

SOLUTION

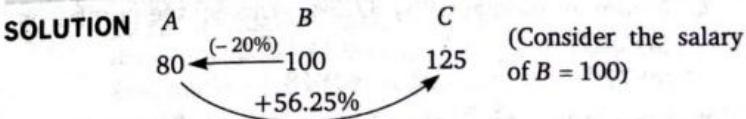
$$l \times b = \text{area}$$

$$1 \times 1 = 1$$

$$1.2 \times 0.9 = 1.08$$

So there is 8% increase in the area of rectangle.

EXAMPLE 3 The salary of A is 20% lower than B's salary and the salary of C is 56.25% greater than A's salary. By how much percent the salary of B is less than the salary of C.



The required value = $\frac{25}{125} \times 100 = 20\%$

Remember: Percentage change

$$= \left(\frac{\text{difference between original value and new value}}{\text{original value}} \right) \times 100$$

$$\text{Percentage increase} = \frac{\text{increased value} - \text{original value}}{\text{original value}} \times 100$$

$$\text{Percentage decrease} = \frac{\text{original value} - \text{decreased value}}{\text{original value}} \times 100$$

SOLUTION

$$20\% = \frac{2}{5}$$

$$\text{So new salary} = 80,000 \left(1 - \frac{1}{5}\right)$$

$$= 80,000 \times \frac{4}{5} = \$ 64,000$$

NOTE (1) There is a huge difference between "decreased value" and "decrease in value" and between "increased value" and "increase in value".

For example : Initial value = 70

$$\text{Final value} = 90$$

it means increased value is = 90

but increase in value is 20

$$\text{and \% increase} = \frac{90 - 70}{70} \times 100 = 28.57\%$$

(2) If there is increase of $\frac{x}{y}$ in any value P then the increased value will be $P \left(1 + \frac{x}{y}\right)$.

(3) If there is decrease of $\frac{x}{y}$ in any value, then the decreased value will be $P \left(1 - \frac{x}{y}\right)$.

NOTE Remember this type of problems can also be solved through percentages.

$$\text{As } 80,000 \times 0.8 = 64,000$$

but the technique given above is not less important. Some times it becomes very necessary to solve through fractions. So, keep your eyes open mind focussed and use your wits to solve the problems intelligently as per the situation.

EXAMPLE 3 Which one of the following is greatest?

$$\frac{3}{4} = 75\%$$

$$\frac{7}{8} = 87.5\%$$

$$\frac{16}{19} = 84.21\%$$

$$\frac{13}{15} = 86.66\%$$

So, $\frac{7}{8}$ is the greatest fraction (or rational number)

EXAMPLE 1 Nishith is now 20 years old. Some years later his age will increase by 50% of himself. What will be the new age at that time?

SOLUTION $20 \left(1 + \frac{1}{2}\right) = 30 \text{ years}$ $\left[\because 20 + 20 \times \frac{1}{2} = 20 \left(1 + \frac{1}{2}\right)\right]$

EXAMPLE 2 The average salary of Purushottam in Infosys is 20% less than that was in Microsoft. If the salary of Purushottam in Microsoft be \$ 80,000 per month then what is the salary of Purushottam in Infosys?

INTRODUCTORY EXERCISE-5.3

1. What per cent of $\frac{3}{7}$ is $\frac{1}{105}$?

(a) 10%	(b) 2.22%
(c) 45%	(d) 450%
 2. What per cent is 3% of 15%?

(a) 15%	(b) 20%
(c) 40%	(d) 66.66%
 3. If the cost of a calculator worth Rs 250 is increased by Rs. 100, the rate of increase is

(a) 100%	(b) 40%
(c) 25%	(d) none of these
 4. A number increased by 37.5% gives 99 the number is

(a) 140	(b) 61.5
(c) 72	(d) 48
 5. When 40% of a number is added to 42, the result is the number itself. The number is:

(a) 105	(b) 72
(c) 70	(d) 82
 6. In an examination 52% of the candidates failed in Science 42% in Mathematics and 17% in both. The no. of those who passed in both the subjects, is :

(a) 30%	(b) 33.33%
(c) 55%	(d) 28%
- (a) 83% (b) 64%
(c) 23% (d) 55.55%
 7. The price of an item is increased by 20% and then decreased by 20%. The final price as compared to original price

(a) 4% more	(b) 20% more
(c) 20% less	(d) 4% less
 8. Two candidates fought an election. One got 65% of votes and won by 600 votes. The total no. of votes polled is:

(a) 12,000	(b) 10,000
(c) 2,000	(d) 8,000
 9. Out of a no. of electronic items, a person purchases 65% coloured TVs 5% of these were found to be defective. The percentage of defective TVs in all is

(a) 3%	(b) 6%
(c) 12%	(d) can't be determined
 10. A's salary is half that of B. If A got a 50% rise in his salary and B got a 25% rise in his salary, then the percentage increase in combined salaries of both is

(a) 30%	(b) 33.33%
(c) 55%	(d) 28%

LEVEL 1

- 15.** Three candidates A, B and C contested an election. Out of the total votes on a voter list 25% did not vote and 6.66% votes polled were invalid. C got 2450 valid votes, which were 40% more than that of B. If A got only 40% of the total votes, then who is the winner?
 (a) A
 (b) B
 (c) C
 (d) can't be determined

16. The cost of a car is 400% greater than the cost of a bike. If there is an increase in the cost of the car is 15% and that of bike is 20%. Then the total increase in the cost of the 5 cars and 10 bikes is :
 (a) 17.5%
 (b) $16\frac{3}{7}\%$
 (c) 18.5%
 (d) 18.25%

17. The square of a positive number is 2,000% greater than the number itself, then the square of that number is :
 (a) 1762
 (b) 1635
 (c) 441
 (d) 139

18. The monthly salary of Shahid and Kareena together is \$ 28,000. The salary of Shahid and Kareena is increased by 25% and 12.5% respectively then the new salary of Kareena becomes 120% of the new salary of Shahid. The new (or increased) salary of Shahid is :
 (a) \$ 15,000
 (b) \$ 18,000
 (c) \$ 14,000
 (d) \$ 16,000

19. 80% of a smaller number is 4 less than 40% of a larger number. The larger number is 85 greater than the smaller one. The sum of these two numbers is :
 (a) 325
 (b) 425
 (c) 235
 (d) 500

20. 220% of a number 'X' is 44. What is 44% of 'X'?
 (a) 88
 (b) 8.8
 (c) 66
 (d) data insufficient

21. The shopkeeper increased the price of a product by 25% so that customer finds it difficult to purchase the required amount. But somehow the customer managed to purchase only 70% of the required amount. What is the net difference in the expenditure on that product ?
 (a) 10% more
 (b) 5% more
 (c) 12.5% less
 (d) 17.5% less

22. In the previous government, party Q was in the opposition. Now increasing the seats by 33.33% Q is the ruling party and thus party Q enjoys twice the majority than that of party P in the previous government. If there were only two parties P and Q and the fix no. of seats be 500 in the parliament of Hum-Tum, then the no. of seats of the Q in the new government is :
 (a) 225
 (b) 200
 (c) 275
 (d) 300

23. In an examination a candidate got 30% marks and failed by 30 marks. If the passing marks are 60% of the total marks, then the maximum marks will be :
 (a) 450
 (b) 600
 (c) 300
 (d) 100

24. In a school there are 1800 students. Last day except 4% of the boys all the students were present in the school. Today except 5% of the girls all the students are present in the school, but in both the days no. of students present in the school, were same. The no. of girls in the school is :
 (a) 1200
 (b) 800
 (c) 1000
 (d) 600

25. In a library remaining books are in English and rest of the books are in Urdu. If there are 3600 books in English, then the total no. of books in Urdu are :
 (a) 2400
 (b) 2500
 (c) 3000
 (d) none of these

26. In a test there are total n questions. Bhanu answers 20 out of 25 questions correctly in the first section. In the second section he answers 60% question correct and thus his total score is 66.66% in the test. Given that all the questions carry equal marks, without any negative marking. The total no. of questions in the test is :
 (a) 50
 (b) 60
 (c) 75
 (d) 100

27. In a class of MBA students 16.66% students are from Science background and 12.5% students are from commerce background and 6.66% students from arts background and rest are from Engineering background. The minimum possible students of engineering background are :
 (a) 45
 (b) 77
 (c) 100
 (d) 120

28. An alloy contains the copper and aluminium in the ratio of 7 : 4. While making the weapons from this alloy, 12% of the alloy got destroyed. If there is 12 kg of aluminium in the weapon, then the weight of the alloy required is :
 (a) 48 kg
 (b) 40 kg
 (c) 37.5 kg
 (d) 14.4 kg

29. Hariharan goes to a shop to buy an FM radio costing Rs. 1404 including sales tax at 8%. He asks the shopkeeper to reduce the price of radio so that he can save the amount equal to the sales tax. The reduction of the price of the radio is :
 (a) Rs. 108
 (b) Rs. 104
 (c) Rs. 112.32
 (d) none of these

30. The average weight of a class of students is 67.5 kg. The weight of the class teacher is 25% more than the average weight of the class. The average weight of the class is less than the class teacher by $x\%$. The value of x is :
 (a) 33.33%
 (b) 25%
 (c) 20%
 (d) can't be determined

31. Last year in CAT, each section of the question paper had different weightage. The weightage of QA, DI and VA/RC sections was 8, 9 and 10 respectively. The maximum marks in all the three sections together were 810. Wrong answer did not carry negative marks as a penalty. If Padma had gotten 20% more marks in QA and 8% more marks in DI and 7.14...% more marks in VA/RC, then she must have gotten 100% marks in all the three sections. The total marks that Padma had scored :
 (a) 730
 (b) 700
 (c) 750
 (d) 775

32. A salesman gets commission on total sales at 9%. If the sale is exceeded Rs. 10,000 he gets an additional commission as bonus of 3% on the excess of sales over Rs. 10,000. If he gets total commission of Rs. 1380, then the bonus he received is :
 (a) Rs. 180
 (b) Rs. 120
 (c) Rs. 480
 (d) data insufficient

33. In Veeru Bhai Pvt. limited company 60% of the employees are men and 48% of the employees are Engineers and 66.6% of these are men. The percentage of women who are not engineers :
 (a) 33.33%
 (b) 60%
 (c) 52%
 (d) 46.66%

44. Initially Veer had 60% more love letters than that of Zara. In the last month the no. of love letters of Veer increased by 25% and that of Zara decreased by 25%. Again in the present month the no. of love letters of Veer decreased to 60% and that of Zara increased by 60%. Then which of the following statements is correct regarding the present no. of love letters :
- Veer has 40% more letters than that of Zara
 - Zara has 20% less letters than that of Veer
 - Veer and Zara have equal no of letters
 - Zara has 37.5% less letters than that of Veer.
45. The charges per hour of internet surfing is increased by 25% then find the percentage decrease in the time period of surfing of a user (a net savvy) who can afford only a 10% increase in expenditure :
- 22%
 - 12%
 - 15%
 - 9.09%
46. The average earning of each member of the Ambani family is 20% less than the average earning of each member of the Sahara family and the total earning of Ambani's family is 20% more than the total earning of Saharas's family. The no. of family members in the Sahara is what per cent of the no. of family members of Ambani :
- 25%
 - 20%
 - 66.66%
 - none of these
47. From 2000 onwards, till 2003 the price of computers increased every year by 10%. After that due to government subsidy the price of computers decreases every year by 10%. The price of a computer in 2006 will be approx. how much per cent less than the price in 2000 if the same pattern of price is continued :
- 2
 - 3
 - 4
 - none of these
48. A book consists of 30 pages, 25 lines on each page and 35 characters on each line. If this content is written in another note book consisting of 30 lines and 28 characters per line, then the required no. of pages will how much per cent greater than the previous pages?
- 4.16%
 - 5%
 - 6.66%
 - none of these
49. The rate of increase of the price of sugar is observed to be two per cent more than the inflation rate expressed in percentage. The price of sugar on January 1, 2004 is Rs. 20 per kg. The inflation rates of the years 2004 and 2005 are expected to be 8% each. The expected price of sugar on January 1, 2006 would be :
- Rs. 23.60
 - Rs. 24.00
 - Rs. 24.20
 - Rs. 24.60
50. A club has raised 75% of the amount it needs for a new building by receiving an average donation of Rs. 600 from the people already solicited. The people already solicited represents 60% of the people the club will ask for donations. If the club is to raise exactly the amount needed for the new building, what should be the average donation from the remaining people to be solicited?
- 250
 - 300
 - 400
 - 600
51. A number x is mistakenly divided by 10 instead of being multiplied by 10. What is the percentage error in the result?
- 99%
 - + 99%
 - 100%
 - + 100%
42. What is the percentage change in the result when we add 50 to a certain number x , instead of subtracting 50 from the same number x ?
- 50%
 - 100%
 - 300%
 - can't be determined
43. In the Regional Science Centre, Lucknow the rate of ticket is increased by 50% to increase the revenue, but simultaneously 20% of the visitors decreased. What is percentage change in the revenue of Regional Science Centre. If it is known that the centre collects the revenue only from the visitors and it has no other financial supports :
- + 20%
 - 25%
 - + 30%
 - can't be determined
44. Recently when I visited a show room of shoes shopkeeper told me that he could reduce the price of Bata shoes by 49% and if I were to purchase woodland shoes he could reduce the price to 51% of the original price. If the marked price (i.e., printed price) of both the shoes was same, then which shoes was cheap to buy :
- Wood land
 - Bata
 - both
 - can't say
45. Selling price of a shirt and a coat is Rs. 4000. The cost price of a shirt is 58.33% of the cost price of a coat and so amount of profit on both the shirt and coat is same, then the price of the shirt could be :
- Rs 2100
 - Rs. 2525
 - Rs. 2499
 - Rs. 1120
46. On the April 1, 2005 my salary increased from Rs. 10,000 to Rs. 16,000. Simultaneously the rate of income tax decreased by 37.5%, So the amount of income tax paid by me remains constant what is the value of income tax paid by me :
- Rs. 3000
 - Rs. 6000
 - Rs. 1600
 - can't be determined
47. In the previous question, if the difference in the rate of income tax be 9 (in percent) then the income tax paid by me :
- Rs. 2000
 - Rs. 2400
 - Rs. 1600
 - none of these
48. The average of a set of whole numbers is 27.2. When the 20% of the elements (ie numbers) are eliminated from the set of numbers then the average becomes 34. The number of elements in the new set of numbers can be :
- 27
 - 35
 - 52
 - 63
49. In a class, the no. of boys is more than the no. of girls by 12% of the total strength. The ratio of boys to girls is :
- 15 : 11
 - 11 : 14
 - 14 : 11
 - 8 : 11
50. The population of a village is 5000 and it increases at the rate of 2% every year. After 2 years, the population will be :
- 5116
 - 5202
 - 5200
 - 5204
51. A customer asks for the production of x number of goods. The company produces y number of goods daily. Out of which $z\%$ are unfit for sale. The order will be completed in :
- $\frac{x}{100y(1-z)}$ days
 - $\frac{100yz}{x}$ days
 - $\frac{100x}{y(100-z)}$ days
 - $\frac{100}{y(z-1)}$ days

LEVEL 2

- 1.** In the Awadh school Gomti Nagar, there are 500 students. 60% of the students are boys, 40% of whom play hockey and the girls don't play hockey, 75% of girls play badminton. There are only two games to be played. The number of students who don't play any game is :

(a) 10% (b) 36%
(c) 46% (d) can't be determined

2. A fraction in reduced form is such that when it is squared and then its numerator is increased by 25% and the denominator is reduced to 80% it results in $\frac{5}{8}$ of the original fraction. The product of the numerator and denominator is :

(a) 6 (b) 12
(c) 10 (d) 7

3. In the Chidambaram's family the ratio of expenses to the savings is 5 : 3. But his expenses is increased by 60% and income increases by only 25% thus there is a deficit of Rs. 3500 in the savings. The increased income of Mr. Chidambaram's family is :

(a) Rs. 35,000 (b) Rs. 28,000
(c) Rs. 25,000 (d) Rs. 18,500

4. In the Presidency College two candidates contested a presidential election. 15% of the voters did not vote and 41 votes were invalid. The elected contestant got 314 votes more than the other candidate. If the elected candidate got 45% of the total eligible votes, which is equal to the no. of all the students of the college. The individual votes of each candidate are :

(a) 2250 and 1936 (b) 3568 and 3254
(c) 2442 and 2128 (d) 2457 and 2143

5. The annual earning of Mr. Sikkawala is Rs. 4 lakhs per annum for the first year of his job and his expenditure was 50%. Later on for the next 3 years his average income increases by Rs. 40,000 per annum and the saving was 40%, 30% and 20% of the income. What is the percentage of his total savings over the total expenditure if there is no any interest is applied on the savings for these four years :

(a) $49\frac{37}{87}\%$ (b) $41\frac{73}{83}\%$
(c) 53% (d) none of these

6. In an election only two candidates contested 20% of the voters did not vote and 120 votes were declared as invalid. The winner got 200 votes more than his opponents thus he secured 41% votes of the total voters on the voter list. Percentage votes of the defeated candidate out of the total votes casted is :

(a) 47.5% (b) 41%
(c) 38% (d) 45%

Directions for questions 7, 8 and 9: Pujari ji, the chief of a temple's trust, has a beautiful daughter Nirjala and a son in law, Radhey. Pujarin, the wife of Pujariji, lives her own life by receiving the alms from the devotees and receives 9.09% earning of her husband and the daughter together. The earning of Nirjala in each month is Rs. 8000 less than her husband Radhey. The earning of Pujariji and Radhey together is Rs. 30,000 per month. The earning of Radhey and Nirjala together is Rs. 133.33% greater than that of Pujariji.

7. The average of

(a) Rs. 13333.33 (b) Rs. 888.88
(c) Rs. 15,000 (d) none of these

8. What is the earning of Pujarin from the alms?

(a) Rs. 1800 (b) Rs. 2000
(c) Rs. 3600 (d) can't be determined

9. The earning of Radhey is how much per cent greater than that of his wife?

(a) 50% (b) 80%
(c) $\frac{11}{13}\%$ (d) none of these

10. A sales executive gets 20% bonus of the total sales value and 10% commission besides the bonus on the net profit after charging such commission. If the total sales value be Rs. 10 lakh per annum and the total profit of the company be Rs. 1.32 lakh, then his total earning per annum will be, given that he is not entitled to receive any fixed salary from the company :

(a) 2.3 lakh (b) 3.2 lakh
(c) 2.32 lakh (d) 2.12 lakh

11. Mr Scindia after selling 5.5% stock at Rs. 92 realizes Rs. 32200. Then he invested $\frac{1}{3}$ of the amount in 4.5% stock at Rs. 92, $\frac{2}{5}$ of the amount at Rs. 115 in 5% stock and the remaining in 6% stock at Rs. 56. The change in his income is :

(a) Rs. 56 loss (b) Rs. 78 profit
(c) Rs. 80 profit (d) Rs. 70 loss

12. Each edge of a cube is increased by 20% then the percentage increase in surface area of the cube is :

(a) 144% (b) 40%
(c) 44% (d) 72.8%

Directions for question number 13 and 14: Pati, Patni and Woh (the three persons) were playing a game. At the beginning of the game Pati and Patni together had 100% more money than Woh. Patni and Woh together had 300% more than Pati. By the end of the game Pati and Patni together had 100% more money than Woh had and Pati had 12.5% less money than Patni and Woh together had. Finally Pati gained Rs. 800 by the end of the game.

13. Who has suffered the loss?

(a) Patni (b) Woh
(c) Patni and Woh both (d) can't be determined

14. The percentage change of money of Patni is :

(a) 40% (b) 30%
(c) 57.1428% (d) 42.857%

15. The raw material and manufacturing cost formed individually 70% and 30% of the total cost and the profit percentage is 14.28% of the raw material. If the cost of raw material increase by 20% and the cost of manufacturing is increased by 40% and the selling price is increased by 80% then the new profit percentage is :

(a) 57% (b) 65.8%
(c) 60% (d) can't be determined

16. A, B, C and D purchased a cinema multiplex for Rs. 56 lakhs. The contribution of B, C and D together is 460% that of A, alone. The contribution of A, C and D together is 366.66% that of B's contribution and the contribution of C is 40% that of A, B and D together. The amount contributed by D is :
 (a) 10 lakh
 (b) 12 lakh
 (c) 16 lakh
 (d) 18 lakh

17. In a village three people contested for the post of village pradhan. Due to their own interest, all the voters voted and no one vote was invalid. The losing candidate got 30% votes. What could be the minimum absolute margin of votes by which the winning candidate led by the nearest rival, if each candidate got an integral per cent of votes?
 (a) 4
 (b) 2
 (c) 1
 (d) none of these

18. Every day a mango seller sells half his stock, 10% of the stock overnight gets spoiled. If 1983 mangoes rotted over 3 nights then how many did he start with on the first day?
 (a) 25,000
 (b) 24,000
 (c) 30,000
 (d) 32,000

19. A man lost half of his initial amount in the gambling after playing 3 rounds. The rule of gambling is that if he wins he will receive Rs. 100, but he has to give 50% of the total amount after each round. Luckily he won all the three rounds. The initial amount with which he had started the gambling was :
 (a) $\frac{500}{3}$
 (b) $\frac{700}{3}$
 (c) 300
 (d) 600

20. In a factory there are three types of Machines M_1 , M_2 and M_3 which produces 25%, 35%, and 40% of the total products respectively. M_1 , M_2 and M_3 produces 2%, 4% and 5% defective products, respectively. What is the percentage of non-defective products?
 (a) 89%
 (b) 97.1%
 (c) 96.1%
 (d) 86.1%

21. A company has 12 machines of equal efficiency in its factory. The annual manufacturing expenses are Rs. 24,000 and the establishment charges are Rs. 10,000. The annual output of the company is Rs. 48,000. The annual output and manufacturing costs are directly proportional to the no. of machines while the share holders get the 10% profit, which is directly proportional to the annual output of the company. If 8.33% machines remained close throughout the year. Then the percentage decrease in the amount of Share holders is :
 (a) 16.66%
 (b) 14.28%
 (c) 8.33%
 (d) none of these

22. In every month Ravindra consumes 25 kg rice and 9 kg wheat. The price of rice is 20% of the price of wheat and thus he spends total Rs. 350 on the rice and wheat per month. If the price of wheat is increased by 20% then what is the percentage reduction of rice consumption for the same expenditure of Rs. 350? Given that the price of rice and consumption of wheat is constant :
 (a) 36%
 (b) 40%
 (c) 25%
 (d) 24%

23. My friend Siddhartha Ghosh is working in the life insurance Corporation of India (LIC). He was hired on the basis of commission and he got the bonus only on the first years period of 10 year. His commission in the first second, third, fourth and for the rest of the years is 20%, 16% 12% 10% and 4% respectively. The bonus is 25% of the commission. If the annual premium is Rs. 20,000 then what is his total commission if the completion of the maturity of all the policies is mandatory :
 (a) Rs. 174,00
 (b) RS. 23, 600
 (c) Rs. 15,000
 (d) Rs. 15,500

24. **Directions for question number 24 and 25:** DELL Computer has two branches : One in Ohio and second in Texas : The total no. of employees in Ohio office grew this year by 25% to 750 but the ratio of male to female employees is same as in the previous year. The no. of employees in the Texas office grew this year by 9.09% to 1200. The ratio of male to female employees last year in the Texas office was 5 : 6 and the no. of male employees in the Ohio office was 20% less than that of Texas office.

24. The total no. of female employees this year in both the offices is :
 (a) 654
 (b) 546
 (c) 950
 (d) can't be determined
25. The total no. of employees in both the offices last year was :
 (a) 1500
 (b) 1700
 (c) 1650
 (d) can't be determined
26. A shepherd had n goats in the year 2000. In 2001 the no. of goats increased by 40%. In 2002 the no. of goats declined to 70%. In 2003 the no. of goats grew by 30%. In 2004, he sold 10% goats, then he had only 34,398 goats. The percentage increase of the no. of goats in this duration was :
 (a) 14.66%
 (b) 16.66%
 (c) 20%
 (d) 33.33%
27. In the above question in which year the no. of goats was minimum?
 (a) 2000
 (b) 2001
 (c) 2002
 (d) 2004

28. **Directions for questions number 28, 29 and 30:** In the IGNOU (Indira Gandhi National Open University) there are total 16,000 students pursuing MBA, which offers the specialization only in Finance, HR and Marketing. IGNOU accepts only Science, Commerce and Engineering students for the two years course of MBA. The number of science students is 166.66% of the Commerce students. Number of Engineering students is equal to the number of Science and Commerce students together. Each student can specialize in only one of the marketing, HR and Finance. 20% of Science students opted the Finance, which is 16.66% less than the no. of Commerce students who opted Finance. The total Finance students is equal to 18% the total strength of the MBA students. 32% of Science students opted HR. Commerce students who opted HR is equal to 25% of total students specializing in Finance and Engineering students equal to 6.5% of the total strength of the MBA students opted HR.

to type 23 pages with 40 lines on each page which he leaves 25% more margin than before. How much time is now required to type these 23 pages

Percentages

Direction for question number 42 to 45: After defeating Ravana, Ram and his family won a lot of valuable assets in the war. It consists of horses, chariots and some land of Ravans's kingdom. The cost of each horse and chariot was Rs. 20,000 and Rs. 8,000 respectively while the cost of 1 acre land was Rs. 5000. All the property was shared among the four persons in such a way that Ram and Sita got together the same wealth as Laxman and Urmila got together. Ram got more than Sita and Laxman got more than Urmila. Ram got $\frac{1}{3}$ rd horses and 20%

chariots while Laxman received 50% chariots as the 50% of his total wealth. The no. of horses that Ram and Sita got together was 50% more than that of Laxman and Urmila together had. Sita got 8 horses and Urmila got 7 horses but the Ram and Sita got equal no. of Chariots and Urmila got 20 chariots less than that of Laxman. Urmila got twice the land than that of Sita but 20% less than Laxman.

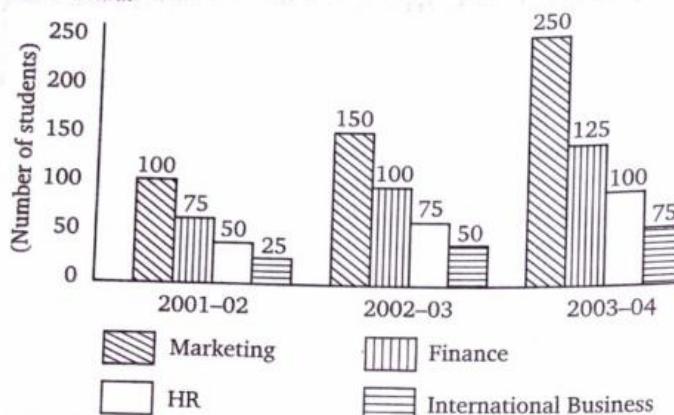
42. What is the difference between the wealth of Ram and wealth of Urmila?
 - (a) 1.2 lakh
 - (b) 1 lakh
 - (c) 1.4 lakh
 - (d) can't be determined
43. If Laxman wanted to exchange all his chariots with the horses, then who can exchange with his/her horses in terms of wealth :
 - (a) Ram
 - (b) Sita
 - (c) Urmila
 - (d) can't be determined
44. The wealth of Urmila is how many per cent less than that of Laxman :
 - (a) 42%
 - (b) 45%
 - (c) 35%
 - (d) none of these
45. The wealth due to land and chariot together is how much greater, in per cent, than the wealth due to horses.
 - (a) 25%
 - (b) 20%
 - (c) 33.33%
 - (d) none of these
46. A big cube is formed by rearranging the 160 coloured and 56 non-coloured similar cubes in such a way that the exposure of the coloured cubes to the outside is minimum. The percentage of exposed area that is coloured is:
 - (a) 25.9%
 - (b) 44.44%
 - (c) 35%
 - (d) none of these
47. Selection into IIMs (Indian Institutes of Management) is quite simple. In our coaching institute some students qualified CAT

(The first stage of entrance into IIMs) but coincidentally the no. of boys who qualified the CAT was equal to the no. of girls. Besides these boys and girls got the calls from only IIM Ahmedabad and IIM Bangalore, but each of these from both the IIMs. 60% of the boys failed in the group discussion (the second phase of the selection process) and thus equal no of boys (but distinct) appeared for the personnel interview of IIM-A and IIM-B (interview is the third and final stage of selection of a candidate) but 20% of the boys who appeared for the interview of IIM-A and 60% of the boys who appeared for the interview of IIM-B failed. If it is possible that a candidate can receive the calls from more than one IIMs but he/ she can face the interview of only one IIM. Given that only 24 boys from our coaching institute were selected by the IIM-A and IIM-B also a candidate can appear for the next stage only if he/she qualifies the previous stage of the exam, then find the no. of girls who qualified the CAT (Common Admission Test).

- (a) 100
 - (b) 250
 - (c) 300
 - (d) 600
48. In an office there were initially n employees. The HR manager first hired $P\%$ employees then after a month $q\%$ employees left the office, then there were finally n employees remained in the office, the value of $p - q$ is :
- (a) pq
 - (b) $\frac{pq}{100}$
 - (c) $\frac{p}{q}$
 - (d) none of these
49. In the Garbar Jhala, Aminabad a shopkeeper first raises the price of a Jewellery by $x\%$ then he decreases the new price by $x\%$. After one such up down cycle, the price of a Jewellery decreased by Rs. 21025. After a second updown cycle the jewellery was sold for Rs. 484416. What was the original price of the jewellery.
- (a) Rs. 5,00,000
 - (b) Rs. 6,00,625
 - (c) Rs. 525625
 - (d) RS. 5,26,000
50. The amount of work in a leather factory is increased by 50%. By what per cent is it necessary to increase the number of workers to complete the new amount of work in previously planned time, if the productivity of the new labour is 25% more.
- (a) 60%
 - (b) 66.66%
 - (c) 40%
 - (d) 33.33%


Final Round

Directions for question number 1, 2 and 3: The bar graph shown below reveals the data about the no. of students in different disciplines of MBA at a prominent Business School in India.



1. The growth rate of Finance compared to that of marketing is:
 (a) less
 (b) equal
 (c) greater
 (d) none of these
2. Total no. of MBA students in the session of 2004-05 if the no. of students in 2004-2005 is increasing by 9.09% over the previous year :
 (a) 555
 (b) 600
 (c) 777
 (d) none of these
3. In the session of 2002-03 what percentage of MBA students are studying International Business?
 (a) 13.33%
 (b) 25%
 (c) 6.66%
 (d) 24%

Directions for question number 4 to 7: The following table gives the sales details of the books for CAT written by Sarvesh.

Year	Quant. Aptitude	Data Interpretation	Verbal Ability	Log. Reasoning
2000	4000	3750	4140	4350
2001	4200	3870	4260	4400
2002	4370	3990	4255	4500
2003	4268	3868	5371	4690
2004	4750	4900	5476	4710
2005	4800	5000	5500	4800

4. What is the growth rate of sales of Quantitative Aptitude from 2000 to 2005?
 (a) 8%
 (b) 25%
 (c) 20%
 (d) 40%
5. Which of the categories shows the lowest growth rate from 2000 to 2005?
 (a) Q.A
 (b) DI
 (c) VA
 (d) LR
6. Which category had the highest growth rate in the period?
 (a) QA
 (b) DI
 (c) VA
 (d) LR

7. Which of the categories had either a consistent growth or consistent decline in the period shown?
 (a) QA
 (b) DI
 (c) VA
 (d) LR

Directions for question number 8 to 10 : In India there were only three bicycle making companies in the given period. The following table shows the production of units (in 000).

Year	HERO	ATLAS	AVON
1990	2.97	1.75	3.77
91	4.22	2.48	4.55
92	5.95	3.14	4.5
93	6.28	3.01	4.76
94	6.33	4.12	4.74
95	8.50	4.21	4.26

UPTREND IN BICYCLES PRODUCTION IN INDIA

8. The simple average rate of growth of production of Hero cycles from 1990-95 :
 (a) 37%
 (b) 42%
 (c) 27%
 (d) 31.5%
9. Which of the following statements is/are correct ?
 (i) Atlas cycles have recorded the fastest growth rate.
 (ii) Total bicycles production was the highest in 1993
 (iii) Hero cycles on an average account for 48% of total bicycles production
 (a) I only
 (b) II only
 (c) III only
 (d) none of these
10. Atlas cycles on an average account for what percentage of the total bicycles production :
 (a) 15%
 (b) 23.4%
 (c) 34.5%
 (d) 29%

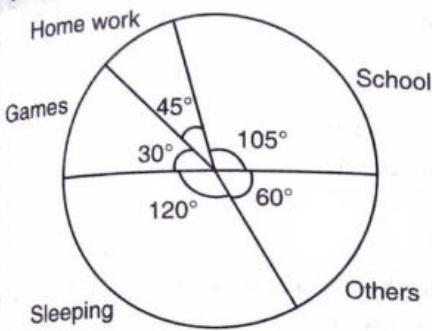
Directions for question number 11 to 14 : Answer the questions based on the following information, which gives data about certain butter producer companies in India.

Name of the Company	Production ('000 tonnes)	Capacity Utilisation (%)	Sales ('000 tonnes)	Total sales value (in crore)
Amul	1.54	59.35	1.47	17.45
Nestle	1.64	64.80	1.26	15.25
Parag	2.48	71.20	2.03	26.75
Amrit	2.97	76.50	2.55	31.15
Total (including others)	11.60	61.30	10.67	132.80

11. What is the maximum production capacity (in '000 tonnes) of Nestle for Butter?
 (a) 2.53
 (b) 2.07
 (c) 2.84
 (d) 2.97
12. Which company out of the four companies mentioned above has the maximum unutilised capacity in ('000 tonnes)?
 (a) Amul
 (b) Nestle
 (c) Parag
 (d) Amrit

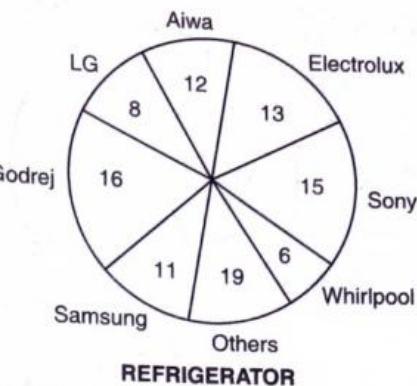
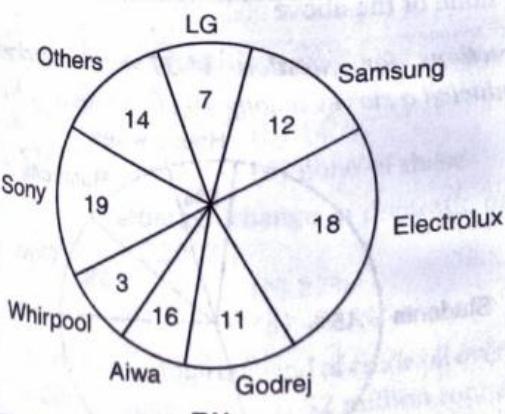
13. What is the approximate total production (in tonnes) for butter in India?
 (a) 7.8
 (b) 18.9
 (c) 11.60
 (d) data insufficient
14. What per cent of the total market share (by sales value) is controlled by others?
 (a) 32%
 (b) 83%
 (c) 67%
 (d) data insufficient

Directions for (Q. no. 15 to 19): The following pie chart shows the hourly distribution of all the major activities of a student.



15. The percentage of time which he spends in school is :
 (a) 38%
 (b) 30%
 (c) 40%
 (d) 25%
16. How much time (in per cent) he spends in games in comparison to sleeping?
 (a) 30%
 (b) 40%
 (c) 25%
 (d) none of these
17. If he spends the time in games equal to the home work and remains constant in other activities, then the percentage decrease in time of sleeping :
 (a) 15%
 (b) 12.5%
 (c) 20%
 (d) none of these
18. What is the difference in time (in hours) spends in school and in home work :
 (a) 2
 (b) 3
 (c) 4
 (d) 8
19. If he spends $\frac{1}{3}$ rd time of home work in Mathematics then the no. of hours spends in rest of the subjects in homework :
 (a) 1
 (b) 2
 (c) 3
 (d) 4

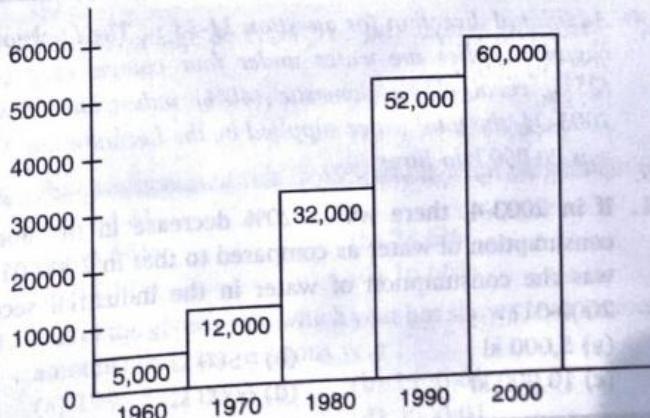
Directions for question number 20 to 23 : The two pie charts show the market share of different companies which produces TV and Refrigerator (both) in the first quarter of 2005-06.



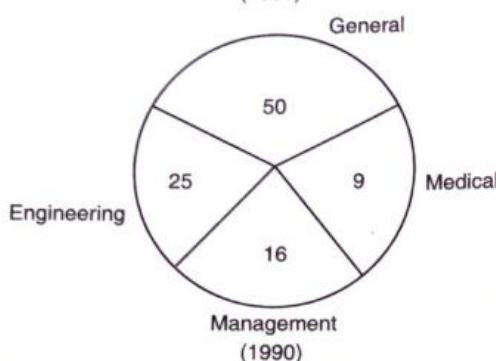
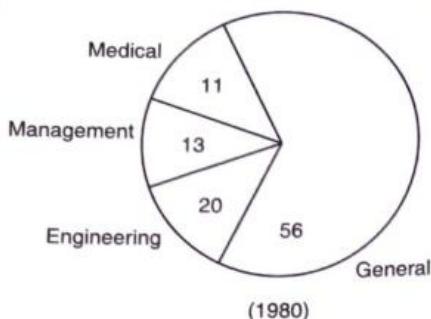
NOTE The graph is not shown to scale.

20. The difference in the angle subtended by Sony TV. and refrigerator is :
 (a) 7.2°
 (b) 14.4°
 (c) 21.6°
 (d) none of these
21. If the turn over of Samsung TV is Rs. 31 crores and of Samsung refrigerator is Rs. 9 crore, then what is the overall market share of Electrolux TV and refrigerator combined?
 (a) 33.33%
 (b) 28%
 (c) 16.7%
 (d) 65%
22. If the turnover in the first quarter of 2005-06 of Electrolux TV and Refrigerator is Rs. 42 crores and Rs. 6 crores respectively, then what is the average annual turnover of Godrej and Aiwa in both the product categories together?
 (a) Rs. 304 crores
 (b) Rs. 284 crores
 (c) RS. 178 crores
 (d) none of the above
23. Which of the following can't be deduced from the given data :
 (a) The angular difference between Samsung TV and Electrolux refrigerator is 3.6° .
 (b) Sony is the market leader in the TV and Refrigerator segment combined.
 (c) For every Rs. 100 turnover of Whirlpool Refrigerator, the difference in the turnover of Electrolux and Samsung Refrigerator is Rs. 33.34 crore
 (d) none of the above

Directions for question number 24 to 28 : Number of different colleges in India in different years is given in the graph below. Distribution of different colleges in the years 1980 and 1990 shown in the pie charts below :



NOTE General courses include all the courses except Medical Engineering and management

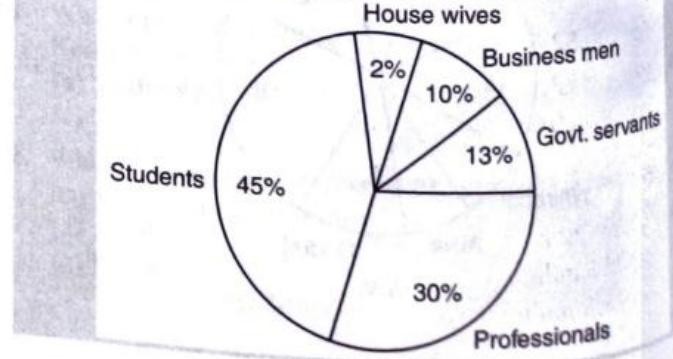


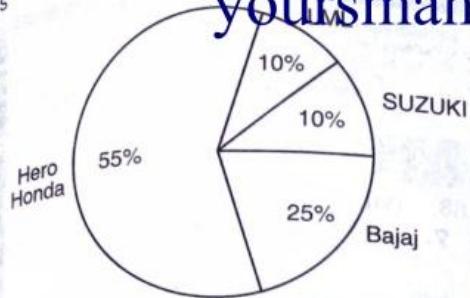
24. What is percentage increase in the number of colleges from 1960 to 1990?
 (a) 1000% (b) 940%
 (c) 1040% (d) 470%
25. The growth rate in no. of medical colleges in 1980 to 1990 is
 (a) 33% (b) 52%
 (c) 36% (d) 39%
26. By what percentage did the no. of Engineering colleges go up from 1960 to 1970?
 (a) 38% (b) 28%
 (c) 42% (d) can't be determined
27. Till 1990 what was the highest increase in the number of colleges in any decade?
 (a) 150% (b) 166.66%
 (c) 200% (d) 140%
28. If the projected increase in the number of colleges in 2000 over 1990 is to be the same in all the categories of colleges, the percentage of Medical colleges in 2000 will be:
 (a) 9% (b) 11%
 (c) 7% (d) 13%

Directions for question number 29 to 33 : Answer the questions based on the following information. The following table gives the tariff (in paisa per kilo-litre) levied by the Lucknow Jal Nigam in 2003-04 in four sectors and the region within them. (Each sector is divided into 5 regions). The table gives the percentage change in the tariff as compared to 2000-01.

	Region 1		Region 2		Region 3		Region 4		Region 5	
	P/kl	%								
Sector 1	1000	+ 25	400	+ 14.28	250	- 16.66	625	+ 4.166	720	+ 20%
Sector 2	800	+ 33.33	375	+ 7.14	350	- 12.5	750	+ 7.14	360	- 10
Sector 3	625	- 16.66	525	- 12.5	400	+ 14.28	240	- 4%	320	- 20
Sector 4	575	- 4.166	800	- 20%	500	- 16.66	360	+ 20%	400	- 11.11

29. If the amount of water consumed by the various regions in sector 1 is the same, then as compared to 2000-01 the net tariff in 2003-04 :
 (a) increased by 20% (b) increased by 13%
 (c) decreased by 12% (d) decreased by 20%
30. What was the approximate average tariff in region 2 in 2000-01?
 (a) 450 (b) 675
 (c) 575 (d) 525
- Additional direction for question 31-33 :** The Lucknow Jal Nigam supplies the water under four categories : Urban (25%) rural (15%) domestic (40%) industrial (20%). In 2003-04, the total water supplied by the Lucknow Jal Nigam was 20,000 kilo-litres.
31. If in 2003-4, there was a 20% decrease in the domestic consumption of water as compared to that in 2000-01 what was the consumption of water in the industrial sector in 2000-01?
 (a) 5,000 kl (b) 7500 kl
 (c) 10,000 kl (d) 6000 kl
32. In the given two years, what is the total tariff paid by the Urban sector?
 (a) Rs. 16,000 (b) Rs. 48,000
 (c) Rs. 23,000 (d) can't be determined
33. Which of the following statements is true?
 (a) The average tariff in region 2 is 625
 (b) The average tariff in region 4 is greater than the average tariff in region 5
 (c) In 2000-01 the industrial sector contributed about 30% of the total revenue from water supply
 (d) none of the above
- Directions for question 34-37 :** A marketing company conducted a survey among 10,000 person in Kanpur:





It was observed that some people have more than one bike but from only one company i.e., a particular person can have more than one bike of HeroHonda, but not from bajaj etc. and vice versa. Thus there were total 12,000 bikes with 10,000 persons used for survey. There are only four companies operating in this market.

34. If each of Students, Govt. Servants and housewives use a Hero Honda bike (motorcycle), what per cent of the remaining people drive Hero Honda bike?
 (a) 15% (b) 25%
 (c) 20% (d) none of these
35. If the number of people who drive one, two and three bikes are in the ratio 15 : 3 : 1 what is the number of people in the survey who do not drive even a single bike?
 (a) 750 (b) 400
 (c) 600 (d) 500
36. If all the persons driving more than one bike drive only Hero Honda what is the number of people who drive single Hero Honda bike (the data can be used from previous question if necessary)?
 (a) 2400 (b) 2100
 (c) 4200 (d) 2600
37. If 20% of the persons who drive Bajaj's bike also drive another bike. What is the number of people who drive only Bajaj' bike ?
 (a) 2400 (b) 2500
 (c) 2660 (d) none of these

Directions for question 38-42 : A table below shows the production and imports of crude oil (in '000 tonnes). Domestic production of crude oil is total of on-shore and off-shore production, which is supplemented by imports to meet the total demand of crude oil in the country.

Year	2001	2002	2003
On shore	12,000	11,500	11,000
Off shore	11,000	19,000	16,000
Imports	21,000	24,000	30,000

(in '000 tonnes)

38. What was the percentage of domestic production of crude oil over imports in 2001?
 (a) 80% (b) 140%
 (c) 109.52% (d) none of these
39. What was the percentage change in domestic production of crude oil from 2001-2003 ?
 (a) 14% (b) 27%
 (c) 17.4% (d) - 10%
40. What is the average of total demand of crude oil over the period?
 (a) 185 million tonnes (b) 52 million tonnes
 (c) 18.5 million tonnes (d) 35 million tonnes

41. What was the approx-percentage increase in imports of crude oil from 2001 to 2003 :
 (a) 49% (b) 65%
 (c) 43% (d) none of these
42. If in the year 2004, off-shore production declines by 12.5% production on-shore remains the same and total demand increases by 2% what will be the imports of crude oil in 2004 ?
 (a) 33.14 million tonnes (b) 63 million tonnes
 (c) 39 million tonnes (d) 25 million tonnes.

Directions : (Q. no. 43 to 50) Solve the following question on the basis of given data in the following table :

Production of Rice in India

Year	Quantity (in tonnes)	Percentage change over the previous year
1920-21	1,34,300	+ 06.25%
1930-31	10,97,172	+ 12.50%
1940-41	2,64,280	+ 11.11%
1950-51	1,27,890	- 09.09%
1960-61	2,01,924	+ 20.00%
1970-71	1,12,325	- 16.66%
1980-81	2,13,465	- 25.00%
1990-91	1,69,368	+ 33.33%
2000-01	100,956	+ 50.00%
2010-11	23,800	- 83.33%

43. What is the production of rice in 1959-60?
 (a) 1,84,250 (b) 1,68,270
 (c) 242308.8 (d) none of these
44. What is the production of rice in 1949-50?
 (a) 116263.6 3 (b) 1,23,460
 (c) 1,40,679 (d) none of these
45. What is the total production of rice in 1919-20 and 1929-30 and 1939-40 ?
 (a) 13,26,400 (b) 13,39,516
 (c) 1142693.75 (d) can't be determined
46. The production of rice in 2000-01 forms what percentage of total production out of the given years?
 (a) 3.12% (b) 3.23%
 (c) 4.128% (d) 6.45%
47. What is the difference in production of rice in 1969-70 and 1979-80 ?
 (a) 149830 (b) 175752
 (c) 53,890 (d) none of these
48. The percentage decrease in production of rice from 1929-30 to 1949-50
 (a) 88.3% (b) 85.57%
 (c) 66.66% (d) none of these
49. The production of rice in 1959-60 is what percentage of rice in 1960-61.
 (a) 86.66% (b) 75.6%
 (c) 83.33% (d) 16.66%
50. Out of the given years which year has shown least increase (in amount) over the previous year :
 (a) 1940-41 (b) 1960-61
 (c) 1920-21 (d) 2000-01



Answers

INTRODUCTORY EXERCISE-5.1

1. (i) 50, (ii) 54, (iii) 112.5, (iv) 400, (v) 2 quintal, (vi) 544.5, (vii) 88, (viii) 6 minutes, (ix) 200, (x) 2 lakh rupees
 2. Rs. 4,500 3. 28 metres 4. 750 5. 190 and 1520 6. 750 7. 102 km/hr 8. Rs. 2200 9. 75 10. 750
 11. 60000 12. 255

INTRODUCTORY EXERCISE-5.2

1. (i) 5%, (ii) 15.625, (iii) 33.33%, (iv) 24%, (v) 20%, (vi) 150%, (vii) 66.66%, (viii) 43.75%
 2. (i) 4%, (ii) 75%, (iii) 6.25%, (iv) 33.33%, (v) 0.4166%, (vi) 7.5%
 3. 85.33% 4. 70% 5. 97% 6. 150% 7. $33\frac{1}{3}\%$ 8. 90% 9. 12.5% 10. 4%

INTRODUCTORY EXERCISE-5.3

1. (b)	2. (b)	3. (b)	4. (c)	5. (c)	6. (c)	7. (d)	8. (c)	9. (a)	10. (b)
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LEVEL-1

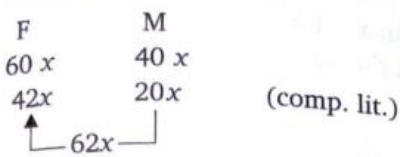
1. (b)	2. (b)	3. (b)	4. (c)	5. (d)	6. (d)	7. (d)	8. (c)	9. (b)	10. (d)
11. (d)	12. (b)	13. (c)	14. (b)	15. (a)	16. (b)	17. (c)	18. (a)	19. (c)	20. (b)
21. (c)	22. (d)	23. (d)	24. (b)	25. (a)	26. (c)	27. (b)	28. (c)	29. (b)	30. (c)
31. (a)	32. (b)	33. (b)	34. (c)	35. (b)	36. (c)	37. (b)	38. (c)	39. (c)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

LEVEL-2

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

FINAL ROUND

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

LEVEL 1


$$\therefore \text{Female comp. literate } 1600 \times \frac{42}{100} = 672$$

$$2. (10,00,000) \times 0.75 \times 0.80 \times 0.85 = \text{Rs. } 5,10,000$$

$$3. 2000 \times \frac{x}{100} + 4000 \times \frac{y}{100} = 320$$

$$\text{and } 2000 \times \frac{x}{100} + 10,000 \times \frac{y}{100} = 680$$

$$x = 4 \quad \text{and} \quad y = 6$$

$$x - y = -2$$

$$4. \text{ Go through option } (40 \times 0.4) + (40)^2 = 1616$$

$$\left(100 \times \frac{1616}{40} = 4040 \right)$$

$$\text{Alternatively: } (x \times 0.4) + x^2 = \frac{x \times 4040}{100}$$

$$\Rightarrow x^2 = 40x \Rightarrow x = 40$$

5. Can't be determined. We don't know whether there are some male employees who have exactly Rs. 8000 per month as their salary or not.

	Physics	Chemistry
Failed	35%	45%
Passed	65%	55%

Passed in both = 22% of total student

Percentage of students who are passed in any of the Physics or Chemistry or both = $(65 + 55) - 22 = 98\%$

So, the percentage of students who are failed in both = 2%

Therefore total failed (in both the subject) students = 12

	History	Geography
Pass	$70x$	$50x$
Fail	$30x$	$50x$
	both $20x$	

$$\therefore \text{Total failed candidates} = (30x + 50x) - 20x = 60x$$

$$\text{Passed in both} = (100x - 60x) = 40x = 500$$

$$\therefore x = \frac{25}{2}$$

$$\text{Therefore total students} = 100x = 1250$$

$$\text{My salary} = 100$$

$$\text{Salary of my brother} = 110$$

$$\text{Salary of my sister} = 120$$

$$\text{Salary of my wife} = 230 - \left(230 \times \frac{1300}{23 \times 100} \right) = 100$$

$$56 \frac{12}{23} = \frac{1300}{23}$$

$$9. \frac{60 \times 8 + 16 \times 30}{16 \times 60 \times 60} \times 100 = 1.66\%$$

$$10. \text{ Total land of Sukhiya} = \frac{480x}{0.6} = 800x$$

$$\therefore \text{Cultivated land of village} = 384000x$$

$$\therefore \text{Required percentage} = \frac{800x}{384000} \times 100 = 0.20833$$

$$11. \text{ Area} = l \times b$$

$$l = 1 \times 1$$

$$1 = 0.8 \times 1.25$$

So the area remained constant

12. Cost of fresh Mangoes + Packaging cost = Total cost

$$\begin{array}{ccc} 1 & + & 0.4 \\ 1.3 & + & 0.2 \end{array} = 1.4 \quad = 1.5$$

$$\text{Percentage increase in cost} = \frac{0.1}{1.4} \times 100 = 7.14\%$$

$$13. \frac{80}{100} + \frac{66}{100} + \frac{x}{200} = \frac{320}{400}$$

$$\Rightarrow x = 174 \Rightarrow 87\%$$

$$14. \begin{array}{ccc} \text{Male} & & \text{Female} \\ 55x & & 45x \\ \Rightarrow & & \\ 10x = 72 & & \end{array}$$

$$x = 7.2$$

$$100x = 7.2 \times 100$$

15. Let the total votes be x ,

$$\text{Polled votes} = 0.75x$$

$$\text{valid votes} = 0.70x$$

$$A + B + C = 0.70x$$

$$2450$$

$$0.4x$$

It means $B + C = 0.3x$ since given that $A = 0.4x$
Hence A is the winner.

$$16. \begin{array}{ccc} \text{Bike} & & \text{Car} \\ x & & 5x \\ 1.2x & & 5.75x \end{array}$$

$$\text{Initially total cost} = 25x + 10x = 35x$$

$$\text{Changed cost} = 28.75x + 12x = 40.75x$$

$$\text{Percentage change} = \frac{5.75}{35} \times 100 = 16 \frac{3}{7}\%$$

18. Go through option

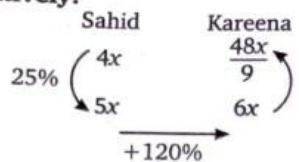
S	K
15,000	18,000
12,000	16,000

Going in the reverse direction.

Hence, the presumed option is correct.

238

Alternatively:



$$\Rightarrow \text{Initially } S : K = 4x : \frac{48x}{9} = 3 : 4$$

$$\Rightarrow \text{Sahid's initial salary} = 12,000 \\ \text{Sahid's changed salary} = 15000$$

19. Let the smaller number be x and larger number be y

$$0.8x + 4 = 0.4y$$

$$\Rightarrow 4y - 8x = 40$$

$$\text{and } y - x = 85$$

$$\Rightarrow x = 75 \text{ and } y = 160$$

$$\therefore x + y = 235$$

$$20. \quad \frac{x \times 220}{100} = 44$$

$$\Rightarrow x = 20 \text{ So } \frac{20 \times 44}{100} = 8.8$$

$$21. \quad \text{Quantity} \times \text{Rate} = \text{Price}$$

$$1 \times 1 = 1$$

$$0.7 \times 1.25 = 0.875$$

$$\therefore \text{Decrease in price} = \frac{0.125}{1} \times 100 = 12.5\%$$

22. Go through options

P Q

In the 1st government $275 \leftarrow 225$ Difference = 50

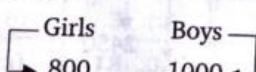
In the 2nd government $200 \leftarrow 300$ Difference = 100
Hence, the presumed option (d) is correct

NOTE It can also be solved through the equation and variables

23. Passing marks are $0.6x$

$$\text{So } 0.3x + 30 = 0.6x \Rightarrow x = 100$$

24. Go through options

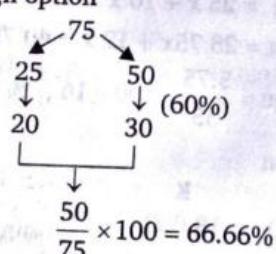


$$\text{Now, } 0.95 \times 800 + 1000 = 0.96 \times 1000 + 800$$

Hence the presumed option is correct.

$$25. \quad \begin{array}{ccc} H & E & U \\ 0.6x & 0.24x & \rightarrow 0.16x \\ \downarrow & & \\ 3600 & \longrightarrow 2400 & (\because E : U = 24 : 16 = 3 : 2) \end{array}$$

26. Go through option



Hence, the presumed option is correct.

$$27. \quad \begin{array}{cccccc} \text{Science} & & \text{Commerce} & & \text{Arts} & \text{Engineering} \\ \frac{x}{6} & + & \frac{x}{8} & + & \frac{x}{15} & K \\ \hline \end{array}$$

$$\text{No. of Engineering student} = 1 - \left(\frac{x}{6} + \frac{x}{8} + \frac{x}{15} \right) = k = \frac{77x}{120}$$

When $x = 120$ (the least possible number)
then the no of Engineering students = 77

$$28. \quad \begin{array}{ccc} \text{Copper} & & \text{Aluminium} \\ 7 & : & 4 \\ 21 \text{ kg} & & 12 \text{ kg} \rightarrow 33 \text{ kg} \\ \hline \end{array}$$

$$\text{Required total alloy} = \frac{33}{0.88} = 37.5 \text{ kg}$$

$$29. \quad \begin{array}{c} 1.08x = 1404 \\ x = 1300 \end{array}$$

Therefore reduction in price = $1404 - 1300 = \text{Rs. 104}$

$$\left[\text{Since } 1300 + 1300 \times \frac{8}{100} = 1404 \right]$$

So you can solve it by using options.

30. Very fundamental question.

$$31. \quad 8x + 9x + 10x = 810$$

$$\Rightarrow x = 30$$

$$\text{Total marks in QA} \longrightarrow 240$$

$$\text{DI} \longrightarrow 270$$

$$\frac{\text{VA}}{\text{RC}} \longrightarrow 300$$

$$\text{Now her score in QA} \longrightarrow \frac{240}{1.2} = 200$$

$$\text{Her score in DI} = \frac{270}{1.08} = 250$$

$$\text{Her score in VA} = \frac{300}{1.0714} = 280$$

$$\text{Her total score} = 200 + 250 + 280 = 730$$

$$32. \quad \text{Commission up to } 10000 = 10000 \times \frac{9}{100} = 900$$

Again after 10000,

$$\text{Commission} : \text{Bonus}$$

$$9 : 3$$

$$3x : x$$

$$\therefore \text{Bonus} = (1380 - 900) \times \frac{1}{4} = \text{Rs. 120}$$

33.

$$\begin{array}{ccc} \text{Men} & & \text{Women} \\ 600x & & 400x \end{array}$$

$$\text{Total Engineer} = 480x$$

$$\text{Male Engineer} = 480x \times 0.66 = 320x$$

$$\therefore \text{Women who are Engineers} = 160x$$

$$\therefore \text{Women who are not Engineers} = 400x - 160x = 240x$$

$$\text{Required percentage} = \frac{240}{400} \times 100 = 60\%$$

34.

	Veer	Zara
In the last month	160	100
After the first change	200	75
After final change	120	120

$$\begin{aligned} \text{Time} \times \text{Rate} &= \text{Total charge} \\ 1 \times 1 &= 1 \\ x \times 1.25 &= 1.1 \\ x = \frac{1.1}{1.25} \times 100 &= 88\% \end{aligned}$$

Thus decrease in time = 12%

Average earning	Ambani	Sahara
No. of family members	$4x$	$5x$
Total earning	$6y$	$5y$

$$\text{Average earning} \times \text{Number of family members} = \text{Total earning}$$

$$l = \frac{5y}{5x} = \frac{y}{x}$$

$$k = \frac{6y}{4x}$$

$$\begin{aligned} \text{Required percentage} &= \frac{l}{k} \times 100 = \frac{\frac{y}{x}}{\frac{6y}{4x}} \times 100 \\ &= \frac{4}{6} \times 100 = 66.66\% \end{aligned}$$

Alternatively : After some steps you can use the options.

Year	Value
2000	100
2001	110
2002	121
2003	133.1
2004	119.79
2005	107.811
2006	97.0299

$$\text{Hint } (100) \times 1.1 \times 1.1 \times 1.1 \times 0.9 \times 0.9 \times 0.9 = 97.0299$$

$$\text{Now, } \frac{100 - 97.0299}{100} \times 100 \approx 3\%$$

$$30 \times 25 \times 35 = x \times 30 \times 28$$

$$\Rightarrow x = 31.25$$

It means 32 pages.

So, the percentages increase in the no. of pages

$$= \frac{2}{30} \times 100 = 6.66\%$$

9. Rate of increase of the price

$$= (\text{rate of inflation} + 2)\% = 8 + 2 = 10\%$$

Jan 2004 Jan 2005 Jan 2006

$$\left. \begin{array}{c} 20 \\ \downarrow \\ 20 \end{array} \right\} \rightarrow \left. \begin{array}{c} 20 \\ +2 \end{array} \right\} \rightarrow \left. \begin{array}{c} 22 \\ +2.2 \end{array} \right\} 24.2$$

Alternatively: Expected price after 2 years

$$= 20 \times 1.1 \times 1.1 = 24.2$$

$$\begin{aligned} \text{Let the total number of people} &= x \\ \text{then the amount donated by } 0.6x \text{ people} &= 600 \times 0.6x = 360x \end{aligned}$$

Now since Rs. $360x$ is equal to 75% of the required amount. Hence we need only 25% more amount from the rest of the people i.e., from $0.4x$ people

$$\text{Hence average requirement} = \frac{120x}{0.4x} = 300$$

$$\text{Alternatively: } (600 \times 0.6 + k \times 0.4) \frac{3}{4} = 600 \times 0.6$$

$$\Rightarrow k = 300$$

$$41. \text{ By mistake } = \frac{x}{10}$$

$$\text{Actual value} = x \times 10$$

$$\begin{aligned} \% \text{ change} &= \frac{10x - \frac{x}{10}}{10x} \times 100 = \frac{99}{100} \times 100 \\ &= 99\% \text{ (negative)} \end{aligned}$$

Since actual value is greater than the wrong value

Alternatively :

$$\text{Actual result} = 10 \times 10 = 100 \quad (\text{suppose } x = 10)$$

$$\text{wrong result} = \frac{10}{10} = 1$$

$$\% \text{ change} = \frac{100 - 1}{100} \times 100 = 99\%$$

NOTE Percentage error is always calculated on the basis of actual (i.e., correct) value.

42. Use some different values for x then verify.

$$\text{Let } x = 150 \text{ then } \% \text{ error} = \frac{200 - 100}{100} \times 100 = 100\%$$

$$\text{Again if } x = 100 \text{ then } \% \text{ error} = \frac{150 - 50}{50} \times 100 = 200\%$$

Hence, we cannot determine.

43. Number of visitors \times Rate = Revenue collected

$$\left(\begin{array}{ccccc} 1 & \times 1 & = 1 \\ -20\% & & & +50\% \\ 0.8 & \times 1.5 & = 1.2 \end{array} \right)$$

Therefore percentage change in the revenue

$$= \frac{1.2 - 1}{1} \times 100 = 20\%$$

44. Bata Woodland

$$\begin{array}{ccc} \text{M.P.} & \begin{array}{c} 100 \\ \downarrow \\ 51 \end{array} & \text{S.P.} \end{array}$$

(Since the marked prices are same)

NOTE M.P. \rightarrow Marked price, S.P. \rightarrow Selling price decreased by 49% = reduced to 51%

45. Selling price = cost price + profit

$$\text{Shirt} = 7y + x$$

$$\text{Coat} = 12y + x$$

Since, the profit is same, so the selling price of shirt will certainly be less than Rs. 2000 (which is half of the total value) as it is clear that cost price of shirt is less than the cost price of coat.

NOTE If selling price of shirt is equal to or greater than the selling price of coat then the C.P. of coat will be equal to or less than the C.P. of shirt which is wrong. Hence the only possible choice is (d).

46. Since we don't have sufficient data. Further any value is possible as the required income tax.

Percentage of students no. of boys are greater than the no. of girls by 12 i.e., 12% Hence correct.

Alternatively :
Let the no. of boys and girls be x and y respectively
then $(x - y) = \frac{12 \times (x + y)}{100}$

$$47. 2004 \rightarrow 10000 \times x\% = k$$

$$2005 \rightarrow 16000 \times \frac{5}{8} x\% = k$$

$$\text{but } x - \frac{5}{8} x = 9 \Rightarrow x = 24\%$$

So, the income tax = 2400.

$$48. \text{ Only (c) is correct since it is divisible by 4.}$$

Let the original number of element be x then the new no. of elements will be

$$\frac{4x}{5} = K$$

So K must be divisible by 4

$$\text{Since, } x = \frac{K \times 5}{4}$$

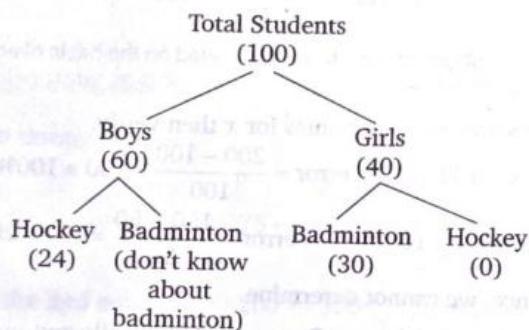
49. Go through option

Boys	Girls	Total
14	11	25
56	44	100

(12)

LEVEL (2)

1.



Since we do not have information that whether the rest of the boys playing badminton or not. So we can not determine the total no. of students who are not playing any of the two games.

2. Go through option. Let us assume option (c)

$$10 = 2 \times 5 = 5 \times 2 = 1 \times 10 \times 10 \times 1$$

$$\text{Consider the proper fraction } = \frac{2}{5}$$

[Since the given percentage values are 25% and 20% that's why we have picked up option (c)].

$$\frac{2}{5} \rightarrow \frac{4}{25} \rightarrow \frac{5}{20}$$

$$\text{To verify : } \frac{2}{5} \times \frac{5}{8} = \frac{1}{4} = \frac{5}{20}$$

Hence presumed option is correct

$$\text{Alternatively: } \frac{x}{y} \rightarrow \frac{x^2}{y^2} \rightarrow \frac{1.25 x^2}{0.8 y^2} = \frac{25 x^2}{16 y^2}$$

$$\text{Now since } \frac{25 x^2}{16 y^2} = \frac{5}{8} \left(\frac{x}{y}\right)$$

$$\Rightarrow \frac{x}{y} = \frac{2}{5}$$

3. Income = Expenditure + Savings

$$\begin{cases} 8x = (5x + 3x) \\ 10x = (8x + 2x) - x \end{cases}$$

$$\text{Now the deficit} = (3x - 2x) = x = 3500$$

and \therefore the new salary = $10x = 35,000$

Alternatively : Go through options.

4. Go through options

$$2457 - 2143 = 314$$

$$\text{Again } (2457 + 2143) + 41 = 4641$$

$$\text{Now } \frac{4641}{0.85} \rightarrow 5460$$

$$\text{Again } \frac{5460 \times 45}{100} = 2457$$

Hence the presumed option is correct.

Alternatively: Let there be total x eligible voters, and the no. of votes goes to loser is k then

$$0.85x - 41 = 2k + 314$$

$$k + 314 = 0.45x$$

$$x = 5460$$

$$\text{then, } 5460 \times 0.85 = 4641$$

$$\text{Again } 4641 - 41 = 4600$$

$$\text{Again } k + (k + 314) = 4600$$

$$\Rightarrow k = 2143$$

$$\text{and } k + 314 = 2457$$

5. Income \rightarrow 4 4.4 4.8 5.2] 18.4

Saving \rightarrow 2 1.76 1.44 1.04] 6.24

Exp. \rightarrow 2 2.64 3.36 4.16] 12.16

$$\text{So, } \frac{6.24}{12.16} \times 100 = 51 \frac{6}{19} \%$$

6. Let there be x voters and k votes goes to loser then

$$0.8x - 120 = k + (k + 200)$$

$$k + 200 = 0.41x$$

$$k = 1440$$

$$(k + 200) = 1640$$

$$\text{Therefore } \frac{1440}{3200} \times 100 = 45\%$$

Solutions for 7-9:

$$P + R = 30,000$$

$$N = R - 8000$$

... (1)

$$(R + N) = 233.3 (P)$$

... (2)

$$3(R + N) = 7P$$

... (3)

$$6R - 7P = 24,000$$

... (4)

$$R = 18,000$$

$$P = 12,000$$

$$N = 10,000$$

$$\frac{P+R+N}{3} = \frac{40,000}{3} = 1333.33$$

Can't be determined

$$\frac{8}{10} \times 100 = 80\%$$

$$(\text{Bonus}) \text{ Commission} = \frac{20 \times 10,00,000}{100} = 2 \text{ lakh}$$

$$\text{but total profit} = \text{net profit} + \frac{10}{100} \times \text{net profit}$$

$$1.32 \text{ lakh} = 1.1 \times \text{net profit}$$

$$\Rightarrow \text{net profit} = 1.2 \text{ lakh} = 1,20,000$$

$$\therefore \text{commission} = \text{total profit} - \text{net profit} \\ = 1,32,000 - 1,20,000 = 12,000$$

$$\text{hence total earning} = 2,00,000 + 12,000 = 2,12,000$$

11. Let Mr. Scindia has x shares of 5.5%

$$x \times 92 = 32,200$$

$$\Rightarrow x = 350 \text{ shares}$$

$$\text{Income} = 350 \times 5.5 = 1925$$

Now, after investment his income is

$$\left(\frac{1}{3} \times \frac{32200}{92} \times 4.5 \right) + \left(\frac{2}{5} \times \frac{32200}{115} \times 5 \right) + \left(\frac{4}{15} \times \frac{32200}{56} \times 6 \right)$$

$$= 525 + 560 + 920 = 2005$$

$$\text{Profit} = 2005 - 1925 = \text{Rs. } 80$$

12. The surface area of a cube = $6a^2 = 6 \times (\text{side})^2$

$$\text{New surface area} = 6 \times 1.44 a^2$$

$$\frac{0.44 a^2}{a^2} \times 100 = 44\%$$

13. Solution for 13 and 14 :

$\text{Pati} \rightarrow P_t, \text{ Patni} \rightarrow P_n, \text{ Woh} \rightarrow W$

$$(P_t + P_n) = 2W \quad \dots (i)$$

$$(P_n + W) = 4 P_t \quad \dots (ii)$$

Solving equation (i) and (ii) we get

$$\frac{P_n}{W} = \frac{7}{5} \text{ and } \frac{P_t}{W} = \frac{3}{5}$$

$$P_t : P_n : W = 3 : 7 : 5 \quad \dots (iii)$$

$$(P_t + P_n) = 2W \quad \dots (iv)$$

$$(P_n + W) \times 7 = 8 \times P_t$$

$$\frac{P_n}{W} = \frac{3}{5}, \frac{P_t}{W} = \frac{7}{5}$$

$$P_t : P_n : W = 7 : 3 : 5$$

$$\text{Gain of Pati} = 7x - 3x = 4x = 800$$

\Rightarrow

$$x = 200$$

$$\text{Amount at the begining of Game} = 600 \quad 1400 \quad 1000$$

$$\text{Amount at the end of the game} = 1400 \quad 600 \quad 1000$$

Pati Patni Woh

13. Only Patni has suffered the loss

$$14. \frac{1400 - 600}{1400} \times 100 = 57.1428\%$$

15.

$$\text{RM} + \text{MC} = \text{Total cost}$$

$$\text{Total cost} + \text{Profit} = \text{Sale price}$$

$$70 + 30 = 100 \quad 100 + 10 = 110 \\ 84 + 42 = 126 \quad 126 + 72 = 198 \quad \uparrow + 80\%$$

$$\text{Therefore profit \%} = \frac{72}{126} \times 100 = 57.14\%$$

16.

$$A + B + C + D = 56$$

$$B + C + D = 4.6A$$

$$\Rightarrow A + B + C + D = 5.6A \text{ (adding } A \text{ in both sides)}$$

$$56 \text{ lakh} = 5.6A$$

$$\Rightarrow A = 10 \text{ lakh}$$

$$\text{Similarly } A + C + D = \frac{11}{3} B$$

$$\Rightarrow A + B + C + D = \frac{14}{3} B$$

$$\Rightarrow B = 12 \text{ lakh}$$

$$\text{Similarly } 4(A + B + D) = C$$

$$\Rightarrow A + B + D = 2.5C$$

$$\Rightarrow A + B + C + D = 3.5C$$

$$\Rightarrow C = 16 \text{ lakh}$$

$$\text{Therefore } D = (A + B + C + D) - (A + B + C) = 18 \text{ lakh}$$

17. Losing candidate = $0.3x$

\therefore Other two candidates = $0.7x$

The share of winning candidate = $0.36x$

and the second ranker = $0.34x$

\therefore Margin (min. possible) = $0.02x$

\Rightarrow 2% of x

Let the minimum possible voters be 50 then

$$\frac{2 \times 50}{100} = 1$$

Hence the minimum possible margin of votes = 1

Day	Initial amount	Sales	Remaining over night	Rotten	Stock for next day
I	x	$0.5x$	$0.5x$	$0.05x$	$0.45x$
II	$0.45x$	$0.225x$	$0.225x$	$0.0225x$	$0.2025x$
III	$0.2025x$	$0.10125x$	$0.10125x$	$0.010125x$	

$$\therefore \text{Total rotten amount} = 0.082625x = 1983$$

$$x = 24,000$$

\Rightarrow

242

19. Check through option

Alternatively : Let the initial amount be x (with gambler), then

$$\left(\left((x + 100) \frac{1}{2} + 100 \right) \frac{1}{2} + 100 \right) \frac{1}{2} = \frac{x}{2}$$

$$\Rightarrow x = \frac{700}{3}$$

20. Non-defective products

$$25 \times 0.98 + 35 \times 0.96 + 40 \times 0.95 \times 100 = 96.1$$

No. of Machines	Output	Manf. cost	Est. cost	Total cost	Profit
12	48,000	24,000	10,000	34,000	14,000
11	44,000	22,000	10,000	32,000	12,000

$$\text{Profit} = \text{out put} - \text{Total cost}$$

$$= 44,000 - 32,000 = 12,000$$

$$\text{Initial value of share holders} = 14,000 \times \frac{10}{100} = 1400$$

$$\text{Changed value of share holders} = 12,000 \times \frac{10}{100} = 1200$$

$$\% \text{ decrease} = \frac{200}{1400} \times 100 = 14.28\%$$

22.

$$\begin{array}{rcl} \text{Rice} & & \text{Wheat} \\ 25 & & 9 \\ \times x & & \times 5x \\ \hline 25x & & 45x \end{array}$$

$$70x = 350$$

$$\Rightarrow x = 5$$

Hence the price of Rice = Rs. 5 per kg

Price of wheat = Rs. 25 per kg

Now, the price of wheat = Rs. 30 per kg

Let the new amount of Rice be M kg, then

$$M \times 5 + 9 \times 30 = 350$$

$$M = 16$$

Hence decrease (in%) of amount of rice

$$= \frac{25 - 16}{25} \times 100 = 36\%$$

Year	Rate of Commission	Commission in values
1	20%	$0.2 \times 20,000 = 4000$
	25% (bonus)	$0.25 \times 4000 = 1000$
2	16%	$0.16 \times 20,000 = 3200$
3	12%	$0.12 \times 20,000 = 2400$
4	10%	$0.1 \times 20,000 = 2000$
5-10	4%	$6 \times 0.04 \times 20,000 = 4800$

Total commission

$$= (4000 + 3200 + 2400 + 2000 + 4800) + 1000 = 17,400$$

Solution for 24-25

OHIO

TEXAS

Last year :	$600 \leftarrow (2:1)$	$(M:F)$
This year :	$750 \leftarrow (2:1)$	$(5:6) \rightarrow 1100$ (unknown) $\rightarrow 1200$

- Percentages
Employees in Texas
Percent
35.
24. Since we don't know the number of female employees in Texas office this year so we can't determine
25. $1100 + 600 = 1700$
26. There is no need to use the no. of goats i.e., initially there be 1000 goats then
 $1000 \rightarrow 1400 \rightarrow 980 \rightarrow 1274 \rightarrow 1146.6$
 Thus the % increase = $\frac{1146.6 - 1000}{1000} \times 100 = 14.66\%$

27. In 2002 (980 goats) as per the flow chart

Optional	Science	Commerce	Engineering	Total
	5000	3000	8000	
Finance	1000	1200	680	16,000
HR	1600	720	1040	2880
Marketing	2400	1080	6280	3360
				9760

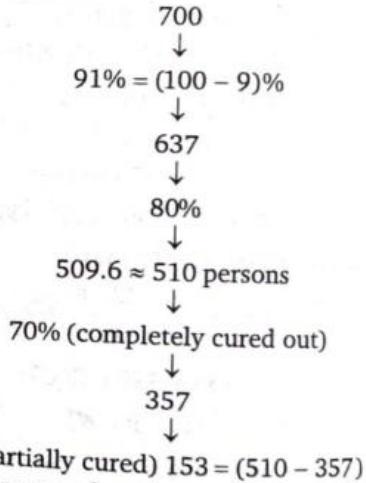
28. 6280 Students of Engineering opted marketing

$$29. \frac{720}{16,000} \times 100 = 4.5\%$$

30. Marketing, since maximum students have opted marketing

31. Consider some values and then verify the option.

32. Go through option :



Hence, the presumed option is correct

33. Total expenditure per kg

$$= 3.2 + 1.8 + 2 + 3 = 10 = \text{cost price}$$

Selling price = Rs. 18 (per kg)

Gross profit = Rs. 8 per kg = $(18 - 10)$

$$\text{Net profit} = 8 \times \frac{80}{100} (\text{since } 20\% \text{ is tax}) = \text{Rs. } 6.4$$

Hence the net profit of the factory = $6.4 \times 50,00,000$

$$= \text{Rs. } 3,20,00,000 = \text{Rs. } 3.2 \text{ crore}$$

34. Let the percentage marks in QA = $(10a + b)\%$

Let the percentage marks in DI = $(10b + a)\%$

Let the percentage marks in VA = $x\%$

then $(10a + b) + x + (10b + a) = x$

3

$$\Rightarrow 11a + 11b + x = 3x$$

⇒

$$x = \frac{11}{2}(a + b)$$

Thus the percentage of the VA section is a multiple of 11

$$P_1 = k \frac{T}{V}$$

$$P_2 = k \frac{1.4T}{0.8} = K \frac{7T}{4V}$$

$$\frac{P_2 - P_1}{P_1} = \frac{\frac{7T}{4V} - \frac{T}{V}}{\frac{T}{V}} = \frac{\frac{3T}{V}}{\frac{T}{V}} = \frac{3}{4}$$

Hence, the new pressure will be increased by 75%.

$$\frac{23 \times 40 \times 0.90}{20 \times 0.92} = 45$$

Thus the required time is 45 times than the previous time

$$450 \text{ minutes} = 7 \frac{1}{2} \text{ hrs.}$$

Hence, original volume = $16 \times 12 \times 5 = 960 (\text{inch})^3$

Required capacity = $1120 (\text{inch})^3$

Increase in area = $\frac{1120}{5} - 16 \times 12$

$$= 224 - 192 = 32 (\text{inch})^2$$

$$\% \text{ increase} = \frac{32}{192} \times 100 = 16.66\%$$

3. The total passengers in each compartment = $25 \times \frac{7}{5} = 35$

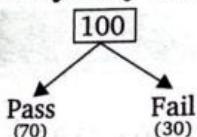
Total no. of seats = $(35)^2 = 1225$

Maximum available capacity = $1225 \times \frac{80}{100} = 980$ seats

	Tata	Reliance
Prepaid	100	81
Postpaid	90	72

Thus the % decrease in talk time = $\frac{90 - 72}{90} \times 100 = 20\%$

Half yearly exam



Annual exam

$$\underbrace{70 \times 0.6}_{42} + \underbrace{30 \times 0.8}_{24}$$

∴ Total pass in annual exam = $42 + 24 = 66$

41. Percentage of passed students = 68% [100 - 32]%

Number of girls passed the exam = 408

Number of boys passed the exam = 476

Total passed students = 884

Therefore total no. of students = $\frac{884}{68} \times 100 = 1300$

Solution for 42- 45 :

Name	Horse	Chariot	Land	Total (in Rs.)
Ram	2 lakh (10)	80,000 (10)	20 acre = 1 lakh	3.8 lakh
Sita	1.6 lakh (8)	80,000 (10)	8 acre = 40,000	2.8 lakh
Laxman	1 lakh (5)	2 lakh (25)	20 acre = 1 lakh	4 lakh
Urmila	1.4 lakh (7)	40,000 (5)	16 acre = 80,000	2.6 lakh

1. $R + S = L + U$ and $R > S$ and $L > U$

2. Horses $\rightarrow (R + S) : (L + U) = 3x : 2x = 18x : 12x$

Again Ram have $\frac{1}{3}$ rd horses

$$\text{Therefore } 30x \times \frac{1}{3} = 10x$$

$$\text{Therefore the horse of Sita} = 18x - 10x = 8x$$

$$\Rightarrow x = 1$$

$$\text{Therefore the horse of Ram} = 10 \text{ and Laxman} = 5$$

$$\text{No. of chariots of Sita} = \text{No. of chariots of Ram} = \frac{K}{5}$$

$$\text{and} \quad \text{no. of chariots of Laxman} = \frac{K}{2}$$

$$\text{Hence the no. of chariots of Urmila} = K - \left(\frac{K}{5} + \frac{K}{5} + \frac{K}{2} \right) = \frac{K}{10}$$

$$\text{Again} \quad \frac{k}{2} - \frac{k}{10} = 20 \Rightarrow k = 50 \text{ chariots}$$

Now the 50% property of Laxman = 25 chariots = 2,00,000

Hence the total property of Laxman = 4,00,000

$$\text{Thus the area of Land of Laxman} = \frac{2,00,000 - 5 \times 20,000}{5000}$$

$$= 20 \text{ acre} = (1 \text{ lakh})$$

Total property of Urmila

$$= 1,40,000 + 40,000 + 80,000 = 2,60,000$$

Thus the total property of Laxman and Urmila = 6.6 lakh

42. $3.8 - 2.6 = 1.2 \text{ lakh}$

43. Value of chariots of Laxman = 2 lakh

Now since only Ram has the horses of worth Rs. 2 lakh. So only Ram can exchange with Laxman.

$$45. \frac{7.2 - 6.0}{6.0} \times 100 = 20\%$$

46. Total cubes $160 + 56 = 216$

Therefore the side of cube = 6 unit

$$\text{No. of cubes without any exposure} = (6 - 2)^3 = 64$$

Thus 64 cubes will be inside of the big cube

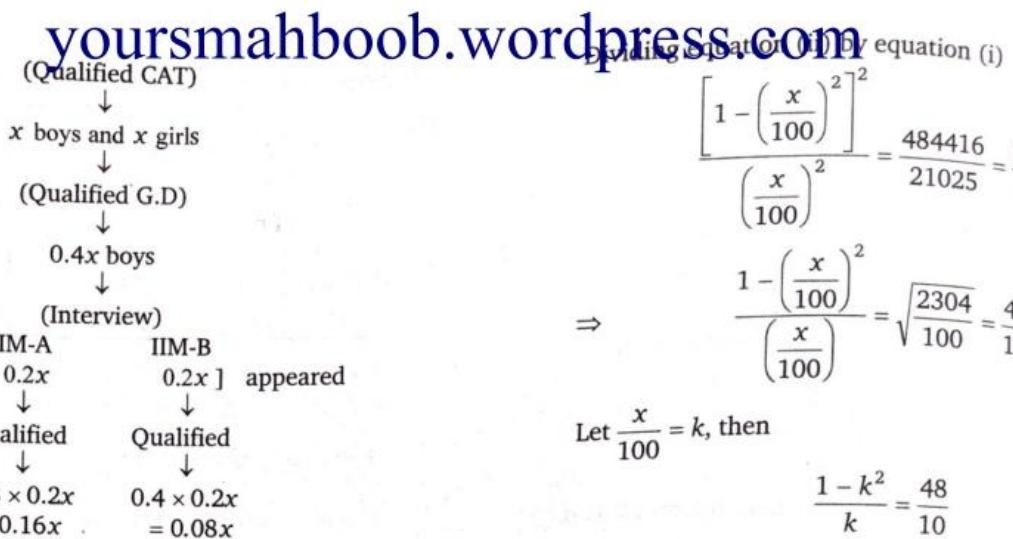
$$\text{Now rest of the cubes} = 160 - 64 = 96$$

Again the no. of cubes with one face outside

$$= 6 \times (4 \times 4) = 96$$

Hence the required percentage = $\frac{96}{216} \times 100 = 44.44\%$

47.



48. Go through option and consider some appropriate values

Alternatively : $\frac{p}{100+p} = \frac{q}{100}$

$\Rightarrow 100(p-q) = pq$

$\Rightarrow (p-q) = \frac{pq}{100}$

49. Let the original price be P , then the decrease in value of P after one cycle

$$= P \left(\frac{x}{100} \right)^2 = 21025 \quad \dots(i)$$

Again the final value after second cycle

$$\Rightarrow P \left(1 + \frac{x}{100} \right) \left(1 - \frac{x}{100} \right) \left(1 + \frac{x}{100} \right) \left(1 - \frac{x}{100} \right) = 484416$$

$$\Rightarrow P \left[1 - \left(\frac{x}{100} \right)^2 \right]^2 = 484416 \quad \dots(ii)$$

Putting value of (ii) in equation (i)

$$\left[1 - \left(\frac{x}{100} \right)^2 \right]^2 = \frac{484416}{21025} = \frac{2304}{100}$$

$$\Rightarrow \frac{1 - \left(\frac{x}{100} \right)^2}{\left(\frac{x}{100} \right)^2} = \sqrt{\frac{2304}{100}} = \frac{48}{10}$$

Let $\frac{x}{100} = k$, then

$$\frac{1 - k^2}{k} = \frac{48}{10}$$

$$\Rightarrow 10k^2 + 48k - 10 = 0$$

$$\Rightarrow 5k^2 - 24k - 5 = 0$$

$$\Rightarrow k = 5 \text{ or } k = -\frac{1}{5} \quad (\text{inadmissible value})$$

So $x = 20\%$

Hence, $P \left(\frac{x}{100} \right)^2 = 21025$

$$\Rightarrow P = 525625$$

50. Men × Time = Work

$$100 \times 1 = 100 \text{ unit}$$

$$150 \times 1 = 150 \text{ unit}$$

Extra man power required = 50

but since new workers are $\frac{5}{4}$ times as efficient as existing workers.

$$\therefore \text{Actual no. of workers} = \frac{50}{5/4} = 40 \text{ men}$$

$$\text{Hence, required percentage} = \frac{40}{100} \times 100 = 40\%$$

Final Round

1. Growth rate of Finance

$$= \frac{125 - 75}{75} \times 100 = \frac{2}{3} \times 100 = 66.66\%$$

$$\text{Growth rate of Marketing} = \frac{250 - 100}{100} \times 100 = 150\%$$

2. Total no. of students in 2003-04 is

$$= (250 + 125 + 100 + 75) = 550$$

No. of student in 2004-05

$$= 550 \left(1 + \frac{1}{11} \right) = 600 \text{ students}$$

$$3. \frac{50}{(150 + 100 + 75 + 50)} \times 100 = \frac{50}{375} \times 100 = 13.33\%$$

$$4. \frac{4800 - 4000}{4000} \times 100 = 20\%$$

$$5. \frac{450}{4350} \times 100 = 10.34\%, \text{ which is lowest in comparison to others}$$

Thus the growth rate of logical reasoning book is lowest.

$$6. DI \rightarrow \frac{5000 - 3750}{3750} \times 100 = 33.33$$

$$\text{and VA} \rightarrow \frac{5500 - 4140}{4140} \times 100 = 32.85\%$$

7. Only LR has consistent growth, others have been fluctuating
(QA - 2003, DI - 2003, VA - 2002)

$$8. \frac{\left[\frac{8.5 - 2.97}{2.97} \times 100 \right]}{5} = 37.23\%$$

9. Growth rate of Hero = 37.23%

Growth rate of Atlas = 28.1%

Avon is least which is clear from the data.

Total bicycle production is highest in 95 hence false

$$\text{Hero cycle's share} = \frac{2.97 + 4.22 + \dots 8.5}{79.84} = 43\%$$

Hence, (d) since none of (a), (b) and (c) is correct.

$$10. \frac{1.75 + 2.48 + \dots + 4.21}{79.84} = 23.4\%$$

$$11. \frac{1.64}{64.8} \times 100 = 2.53$$

12. Amul has max. unutilised capacity

$$13. \left(\frac{1.54}{59.35} \times 100 \right) - 1.54 = 1.05$$

HINT: Similarly for others can also be find out

$$14. \frac{11.6}{61.3} \times 100 \approx 18.9$$

$$15. \frac{42.20}{132.8} \times 100 = 31.81\%$$

$$16. \frac{105}{360} \times 100 = \frac{7}{24} \times 100 = 29.166\%$$

$$17. \frac{30}{120} \times 100 = 25\%$$

$$18. \frac{15}{120} \times 100 = 12.5\%$$

$$19. 15^\circ = 1 \text{ hour (Maths)}$$

$$30^\circ = 2 \text{ hours (other subjects)}$$

$$20. Sony TV \rightarrow 19\%$$

$$\text{Sony Refrigerator} \rightarrow 15\%$$

$$\text{difference} = 4\% = 14.4^\circ$$

(Since $1\% = 3.6^\circ$)

$$21. 12\% \rightarrow \text{Samsung TV} = 31 \text{ crore}$$

$$18\% \rightarrow \text{Electrolux TV} = 46.5 \text{ crore}$$

$$100\% \rightarrow \text{Total market} = 258 \text{ crore}$$

$$11\% \rightarrow \text{Samsung Refrg.} = 9 \text{ crore}$$

$$13\% \rightarrow \text{Electrolux Refrg.} = 10.6 \text{ crore}$$

$$100\% \rightarrow \text{Total market} = 81.8 \text{ crore}$$

$$\text{Market share} = \frac{46.5 + 10.6}{258 + 81.8} \approx 16.7\%$$

$$22. 18\% = \text{Rs. } 42 \text{ crores, so } 27\% (= 16 + 11) = \text{Rs. } 63 \text{ crore}$$

$$13\% = \text{Rs. } 6 \text{ crore, so } 28\% (= 12 + 16) = \text{Rs. } 13 \text{ crore}$$

$$\text{Total Rs. } 76 \text{ crores}$$

$$\therefore \text{Annual approx. turnover} = 4 \times 76 = \text{Rs. } 304 \text{ crores}$$

$$23. (a) (13 - 12) = 1\% = 3.6$$

(b) We don't know the turnover of TV and refrigerator market for each brand.

$$(c) 6\% \text{ total refrigerator market} = 100 \text{ crore}$$

$$\therefore \text{Total refrigerator market} \approx 1667 \text{ crore}$$

$$\therefore \text{Difference} = 2\% \text{ of } 1667 = 33.34 \text{ crore}$$

Thus, (b) can't be inferred.

$$24. \frac{52,000 - 5,000}{5000} \times 100 = 9.4 \times 100 = 940\%$$

$$25. \text{Medical college in 1980} = \frac{11}{100} \times 32,000 = 3520$$

$$1990 = \frac{9}{100} \times 52,000 = 4680$$

$$\frac{4680 - 3520}{3520} \times 100 = 32.95$$

26. We don't have the information about the proportion (share) of Engineering colleges in the given years.

$$27. \frac{32,000 - 12,000}{12,000} \times 100 = 166.66\%$$

28. Number of medical colleges in 1990

$$= \frac{52,000 \times 9}{100} = 4680$$

Increase in the total no. of colleges

$$= 60,000 - 52,000 = 8000$$

Increase in the no. of medical colleges = $\frac{8000}{4} = 2000$

Therefore, percentage of medical colleges in 2000

$$= \frac{4680 + 2000}{60,000} \times 100 = 11\%$$

29. If the amount of water consumed of sector 1 is the same then we can directly compare the tariffs to the two years.

	Tariff 2003-04	% change	Tariff 2000-01
Region 1	1000	+ 25%	800
Region 2	400	+ 14.28%	350
Region 3	250	-16.66%	300
Region 4	625	+ 4.166%	600
Region 5	720	+ 20%	600
	2995		2650

$$\frac{2995 - 2650}{2650} \times 100 = \frac{345}{2650} \times 100$$

$$= 13.01\%$$

30.

	Tariff 2003-04	% change over 2000-01	Tariff 2000-01
Sector 1	400	+ 14.28%	350
Sector 2	375	+ 7.14%	350
Sector 3	525	-12.5%	600
Sector 4	800	-20%	1000
	2100		2300

$$\text{Average tariff} = \frac{2300}{4} = 575$$

31. In 2003-04 the water consumed by various sectors out of 20,000 kilo-litres can be given as follow:

Category	Percentage	Consumption in 2003-04
Domestic	40	8,000
Urban	25	5,000
Rural	15	3,000
Industrial	20	4,000
		20,000

Since there was a 20% decrease in the domestic consumption in 2003-04 the domestic consumption in 2000-01 = $\frac{8,000}{0.8} = 10,000$

But this constitutes 40% of total water consumed in 2000-01 and the industrial consumption constitutes 20% of total water in 2000-01. Hence in 2000-01 the industrial consumption = $10,000 \times \frac{20}{40} = 5,000$ kilo-liters

32. We do not know the category-wise break up of tariffs ie the rates of Urban sector is unknown.

33. The average of Region 2 = $\frac{400 + 375 + 525 + 800}{4} = 525$

Average tariff in region 4 = $\frac{62.5 + 750 + 240 + 360}{4} = 487.5$

Average tariff in region 5 = $\frac{220 + 360 + 320 + 400}{4} = 450$

Statements (c) can not be determined

34. Total number of people = 10,000

Business men	10%	1000	LML	1200
Govt. Servant	13%	1300	SUZUKI	1200
Professionals	30%	3000	BAJAJ	3000
Students	45%	4500	HERO HONDA	6600
Housewives	2%	200		

The total number of Hero Honda bikes = 6600

Total numbers of Government servants housewives and students = 6000

Total no. of Businessmen and professional = 4000

∴ Percentage of remaining (i.e., Businessmen and prof.)

$$\text{driving Hero Honda} = \frac{600}{4000} \times 100 = 15\%$$

35. Let the no. of people who drive one two and three bikes be 15k, 3k and k respectively.

Number of bikes which are being driven

$$= 15k + 2(3k) + 3(k) = 24k$$

Since LML and Suzuki can not be driven by same person and a person can drive maximum 3 bikes.

Total bikes which are being used to drive = 12,000

$$\therefore 24k = 12,000 \Rightarrow k = 500$$

Total number of people driving the bikes

$$= 15k + 3k + k = 19k = 9500$$

∴ Number of people who do not drive any bike

$$= 10,000 - 9500 = 500$$

36. From the previous solution, number of people who drive more than 1 bike i.e., 2 bikes and 3 bikes are 1500 and 500 respectively.

These people have total 4500 bikes

$$(= 1500 \times 2 + 500 \times 3)$$

Hence, the remaining Hero Honda bikes

$$= 6600 - 4500 = 2100$$

Thus, the number of persons who drive single Hero Honda

$$= 2100$$

37. Since 20% drive other bikes 80% drive only bajaj bike
number of people who drive only Bajaj bike

$$= 0.8 \times 3000 = 2400$$

38. $\frac{11000 + 12000}{21,000} \times 100 = 109.52\%$

39. $\frac{27,000 - 23,000}{23,000} \times 100 = 17.4\%$

40. Demand = Domestic Production + Imports

Average demand = $\frac{44 + 54.5 + 57}{3} \approx 52$ million tonnes

41. (c) $\frac{30,000 - 21,000}{21,000} \times 100 \approx 43\%$

42. Offshore production in 2004 = $16,000 \times 0.875 = 14,000$ thousand tonnes

Onshore production = 11,000 thousand tonnes

Demand in 2004 = $57,000 \times 1.02 = 5814$ thousand tonnes

imports = 33.14 million tonnes ($\because 1$ million = 10^6)

43. $201924 \times \frac{5}{6} = 33654 \times 5 = 168270$

44. $127890 \times \frac{11}{10} = 140679$

45. $126400 + 975264 + 237852 = 1339516$

46. $\frac{100956}{2445480} \times 100 = 4.128\%$

Alternatively: $\frac{1}{24} \times 100 \approx 4.16\%$

47. $1969 - 70 \rightarrow 134790$ — $1979 - 80 \rightarrow 284620$ — 149830

48. $1929 - 30 \rightarrow 9,75,264$

$1949 - 50 \rightarrow 1,40,679$

% decrease = $\frac{975264 - 140679}{975264} \times 100 = 85.57\%$

49. $1959 - 60 \rightarrow 1960 - 61$

$168020 \xrightarrow{+ 20\%} 201924$

Therefore $\frac{168020}{201924} \times 100 = 83.33\%$

Alternatively: From percentage charge graphic

Increase	Decrease
20%	16.66%
1/5	1/6

∴ The required value = 83.33% (100 - 16.66%)

Alternatively: $x \times \frac{6}{5} = k$

$\Rightarrow x = \frac{5k}{6}$

$(x)\% = \frac{5k}{6} \times 100 = 83.33\% \text{ of } k$

50. Only 7,900 tonnes increase over the 1919 - 20.

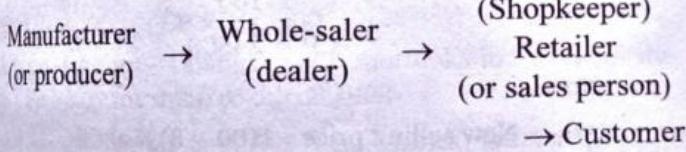
6

PROFIT, LOSS AND DISCOUNT

This chapter is as much important as other chapters in the arithmetic section, since it is a chapter of applications by which we calculate profit, loss, discount in day-to-day business. So in the entrance exams of MBA it plays a crucial role in determining the selection of an aspirant. Particularly in CAT the questions asked in QA are very logical in nature, apart from the simple application in Data interpretation (D.I.) and Data sufficiency (D.S.). Entrance exams like FMS, IIFT, NIFT and MAT ask plethora of questions. Infact a normal question paper seems to be incomplete without having the problems based on profit, loss and discount.

THEORY AND CONCEPTS

In day-to-day life we sell and purchase the things as per our requirement. A customer can get things in the following manner :



TERMINOLOGY

Cost price (CP) : The money paid by the shopkeeper to the manufacturer or whole-saler to buy the goods is called the cost price (CP) of the goods purchased by the shopkeeper.

NOTE If an article is purchased for some amount and there are some additional expenses on transportation labour, commission etc., these are to be added in the cost price. Such expenses are called overhead expenses or overheads.

EXAMPLE 1 A fruit seller buys 300 oranges at 5 for Rs. 8 and sold 2 for Rs. 5. Find :

- the cost price of each orange
- the selling price of each orange
- profit or loss on selling one orange
- his total profit or loss on selling all the oranges.

SOLUTION (i) Since the cost price of 5 oranges = Rs. 8
 Cost price of one (or each) orange = $\text{Rs. } \frac{8}{5} = \text{Rs. } 1.60$

Selling Price (SP) : The price at which the shopkeeper sells the goods is called the selling price (SP) of the goods sold by the shopkeeper.

Profit : If the selling price of an article is more than its cost price, then the dealer (or shopkeeper) makes a profit (or gain)

$$\text{i.e., Profit} = \text{SP} - \text{CP}; \quad \text{SP} > \text{CP}$$

Loss : If the selling price of an article is less than its cost price, then the dealer suffers a loss.

$$\text{i.e., loss} = \text{CP} - \text{SP}; \quad \text{CP} > \text{SP}$$

Important Formulae

$$(i) \text{ Profit} = \text{SP} - \text{CP}$$

$$(ii) \text{ Loss} = \text{CP} - \text{SP}$$

$$(iii) \text{ Profit percentage} = \frac{\text{profit}}{\text{cost price}} \times 100$$

$$(iv) \text{ Loss percentage} = \frac{\text{loss}}{\text{cost price}} \times 100$$

$$(v) \text{ SP} = \left(\frac{100 + \text{gain}\%}{100} \times \text{CP} \right) = \left(\frac{100 - \text{loss}\%}{100} \times \text{CP} \right)$$

$$(vi) \text{ CP} = \left(\frac{100}{100 + \text{gain}\%} \times \text{SP} \right) = \left(\frac{100}{100 - \text{loss}\%} \times \text{SP} \right)$$

$$(vii) \text{ SP} = (100 + k)\% \text{ of CP; when profit} = k\% \text{ of CP}$$

$$(viii) \text{ SP} = (100 - k)\% \text{ of CP; when loss} = k\% \text{ of CP}$$

NOTE Profit or loss is always calculated on the basis of cost price unless otherwise mentioned in the problem.

(ii) Since the selling price of 2 oranges = Rs. 5

∴ the selling price of one orange = $\text{Rs. } \frac{5}{2} = \text{Rs. } 2.50$

(iii) Since SP is more than CP, there is a profit.

So profit on selling one orange = $\text{SP} - \text{CP}$
 $= 2.5 - 1.6 = \text{Re. } 0.90$

(iv) Profit on selling all the oranges

$$= \text{Rs. } (0.90 \times 300) = \text{Rs. } 270$$

Hence the total profit on selling all oranges = Rs. 270

EXAMPLE 2 A shopkeeper buys 100 eggs at Rs. 1.20 per piece. Unfortunately 4 eggs got spoiled during transportation. The shopkeeper sells the remaining eggs at Rs. 15 a dozen. Find his profit or loss.

SOLUTION Cost price of all eggs = Rs. $100 \times 1.2 = \text{Rs. } 120$

$$\text{Selling price of one egg} = \frac{15}{12} = \text{Rs. } 1.25$$

$$\therefore \text{Selling price of 96 eggs} = 96 \times \frac{15}{12} = \text{Rs. } 120$$

HINT After spoiling 4 eggs, only 96 eggs are left.

Now, since the total selling price and total cost price is same, the shopkeeper neither makes a profit nor suffers a loss.

EXAMPLE 3 Aviral purchased a computer for Rs. 47,000. He had to sell it for Rs. 45,800. Find his profit or loss per cent.

SOLUTION Since $SP < CP$, there will be loss

$$\begin{aligned} \text{loss (\%)} &= \frac{\text{loss}}{\text{CP}} \times 100 = \frac{47000 - 45800}{47000} \times 100 \\ &= \frac{1200}{47000} \times 100 = 2 \frac{26}{47}\% \end{aligned}$$

EXAMPLE 4 A dealer sold 600 quintals of sugar at a profit of 7%. If a quintal of sugar cost him Rs. 1600, find his total profit and the selling price.

SOLUTION $CP = 1600 \times 600 = \text{Rs. } 9,60,000$

Rate of Profit = 7%

$$\text{Profit} = 9,60,000 \times \frac{7}{100} = \text{Rs. } 67200$$

$$\therefore SP = CP + \text{Profit} = \text{Rs. } 9,60,000 + \text{Rs. } 67,200 \\ = \text{Rs. } 1027200$$

Thus profit = Rs. 67200 and selling price = Rs. 10,27,200

EXAMPLE 5 A dealer buys 200 quintals of wheat at Rs. 1200 a quintal. He spends Rs. 10,000 on transportation and storage. Then he sells the wheat at Rs. 13 per kg. Find his profit or loss. Also calculate it as a percentage.

1. A towel is sold for Rs. 198 at a gain of 10%. What is the cost price of the towel? At what price must it be sold to gain 25%?

2. A man sold a watch at Rs. 6000, at a loss of $33\frac{1}{3}\%$. Find the cost price?

3. By selling a shirt for Rs. 285 a shopkeeper loses 5%. At what price should he sell the shirt so as to gain 15%?

MARK UP AND DISCOUNT

Marked price: Basically to avoid loss due to bargaining by the customer and to get the profit over the cost

SOLUTION $CP = 1200 \times 200 = \text{Rs. } 2,40,000$

Transportation and storage cost = Rs. 10,000

$$\text{Total CP} = 2,40,000 + 10,000$$

$$= \text{Rs. } 2,50,000$$

$$\text{Total SP} = 13 \times 200 \times 100$$

$$= \text{Rs. } 2,60,000$$

\therefore Now, since $SP > CP$, hence there will be profit.

$$\text{Profit} = SP - CP = \text{Rs. } (2,60,000 - 2,50,000) = \text{Rs. } 10,000$$

$$\text{Profit (\%)} = \frac{\text{Profit}}{\text{CP}} \times 100$$

$$= \frac{10,000}{2,50,000} \times 100 = 4\%$$

EXAMPLE 6 Find the cost price of an article which is sold for Rs. 220 at a loss of 12%.

SOLUTION $SP = \text{Rs. } 220$, Loss = 12%

$$\text{Let CP} = \text{Rs. } x$$

$$\text{then SP} = 88\% \text{ of CP}$$

$$220 = \frac{88}{100} \times x$$

$$\Rightarrow x = 250$$

Therefore cost price = Rs. 250

EXAMPLE 7 By selling a colour TV for Rs. 23520, a dealer suffers loss of 4%. What is the cost price of the colour TV? At what price should he sell it to gain 8%?

SOLUTION $SP = 96\% \text{ of CP}$

$$23520 = \frac{96}{100} \times CP$$

$$CP = 24500$$

$$\text{Now gain \%} = 8\%$$

$$\therefore \text{New selling price} = (100 + 8)\% \text{ of CP}$$

$$= \frac{108}{100} \times 24500 = \text{Rs. } 26460$$

INTRODUCTORY EXERCISE-6.1

- A towel is sold for Rs. 198 at a gain of 10%. What is the cost price of the towel? At what price must it be sold to gain 25%?
- A man sold a watch at Rs. 6000, at a loss of $33\frac{1}{3}\%$. Find the cost price?
- By selling a shirt for Rs. 285 a shopkeeper loses 5%. At what price should he sell the shirt so as to gain 15%?
- Sufyan bought 1200 eggs at Rs. 16 a dozen. At what price per hundred must he sell the eggs so as to earn a profit of 15%?
- Ram Singh purchased two camels for Rs. 18,000 and Rs. 15,000 respectively. He sold them at a loss of 15% and a gain of 19% respectively. Find the selling price of each camel. Also find the overall gain or loss per cent in the transaction.

price trader increases the cost price by a certain value, the increase in value over cost price is known as markup and the increased price (i.e., $CP + \text{Markup}$) is called the marked price or printed price or list price of the goods.

$$\text{Marked price} = \text{CP} + \text{Markup}$$

$$\text{Marked price} = \text{CP} + (\% \text{ markup on CP})$$

Generally goods are sold at marked price, if there is no further discount, then in this case selling price equals to marked price.

Discount: Discount means reduction of marked price to sell at a lower rate or literally discount means concession. Basically it is calculated on the basis of marked price.

$$\text{Selling price} = \text{Marked price} - \text{Discount}$$

$$\begin{aligned} \text{Selling price} &= \text{Marked price (MP)} \\ &\quad - (\% \text{ discount on MP}) \end{aligned}$$

EXAMPLE 8 If the cost price of an article is Rs. 300 and the per cent markup is 20%. What is the marked price?

SOLUTION $\text{MP} = \text{CP} + \% \text{ markup on CP}$

$$= 300 + 300 \times \frac{20}{100}$$

$$\text{MP} = \text{Rs. } 360$$

Alternatively: $\text{SP} = 300 \times 1.2 = 360$

EXAMPLE 9 If the marked price of an article is Rs. 450 and markup percentage is 12.5%, what is the cost price?

SOLUTION $\text{MP} = 112.5 \text{ of CP}$

$$450 = \frac{112.5}{100} \times \text{CP}$$

$$450 = \frac{9}{8} \times \text{CP}$$

$$\Rightarrow \text{CP} = \text{Rs. } 400$$

Alternatively: Change your outlook to visualize the problem differently for smarter calculation.

You can see that MP is 12.5% (i.e., $\frac{1}{8}$ times) greater than CP.

So CP will be $\frac{1}{9}$ times less than MP. This percentage (or fraction) change rule has been thoroughly discussed through different illustrations in percentage chapter. In my opinion if you change your observation i.e., you mould your thinking in a CAT oriented approach you will not change only your attitude and aptitude but the whole scenario will be changed. So look this problem like me :

$$\begin{array}{ccc} & 1/8 \uparrow & \\ \text{CP} & \curvearrowright & \text{MP} \\ & 1/9 \downarrow & \end{array}$$

$$\left(\frac{n}{d+n} \right) n \rightarrow \text{numerator} \quad d \rightarrow \text{denominator}$$

So, the CP will be $\frac{1}{9}$ times less than MP, which is rather too much easier to calculate than the traditional method given at the beginning of the solution.

EXAMPLE 10 If the marked price of an article is Rs. 660 and the discount is 10%, then what is the selling price of the article?

SOLUTION General Solution :

$$\text{SP} = \text{MP} - \text{Discount}$$

Since marked price = $\text{CP} + \% \text{ markup on CP}$

Remember **markup** is calculated on the basis of CP while **discount** is calculated on the basis of MP.

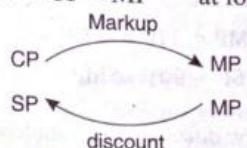
In general, $\text{CP} < \text{SP} < \text{MP}$ at profit

$\text{CP} = \text{SP} < \text{MP}$ at no profit no loss

$\text{SP} < \text{CP} < \text{MP}$ at loss

Also

and



NOTE You will find wide application of percentage calculation, percentage change graphic etc. so to move further you must know the concepts of percentages.

$$\text{SP} = 660 - 660 \times \frac{10}{100}$$

$$\text{SP} = 594$$

Alternatively: $\text{SP} = 90\% \text{ of MP}$

$$\text{SP} = 0.9 \times 660$$

$$\text{SP} = 594$$

Alternatively: We can see that when SP is 10% (i.e., $\frac{1}{10}$)

less than MP, it means MP is $\frac{1}{9}$ times greater than SP.

Therefore $\text{MP} = \frac{10}{9} \text{ SP} \quad \left(1 + \frac{1}{9} = \frac{10}{9} \right)$

Ultimately I would like to say that you should see the core of the problem and solution both, instead of taking help from any formula. In other words formulae make you logically blind particularly in context of CAT where your intelligence is tested rather than your memory and theory of the maths.

EXAMPLE 11 If the markup percentage of an article is 50% and discount percentage is also 20%, then the profit percentage will be :

- (a) 10% (b) 0% (c) 30% (d) 20%

SOLUTION See the smartest calculation technique and follow me to be smarter.

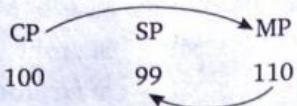
$$\begin{array}{ccc} \text{CP} & \text{SP} & \curvearrowright \text{MP} \\ 100 & 120 & \curvearrowleft 150 \\ \text{Therefore profit} & = 20\% & \left(\frac{120 - 100}{100} \times 100 = 20\% \right) \end{array}$$

Explanation: $\text{MP} = 150\% \text{ of CP}$ (\because markup is 50%)
 $\text{SP} = 80\% \text{ of MP}$ (\because discount is 20%)

Once again I am reiterating on the gist of this chapter. What is that gist? The gist is that this chapter test nothing but your grip on the concepts of percentage change. I think CP, SP, MP etc., are just the words, the crux is that how CP, SP and MP etc., change with respect to each other. So those students who have grasped and internalised the most important concept of percentage change, they will not find any difficulty in understanding the concept of the profit-loss problems. Believe me when your visualization will be improved, you will be master on this chapter. So try to have a different approach.

EXAMPLE 12 A trader markup the goods by 10% and then gives a discount of 10%. What is the profit or loss percentage?

SOLUTION



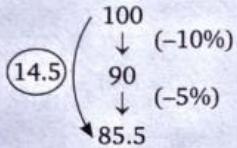
So there is a loss of 1%.

Explanation: $MP = 110\% \text{ of } CP$ (10% markup)
 $SP = 90\% \text{ of } MP$ (10% discount)

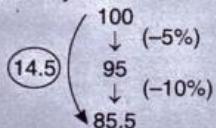
EXAMPLE 13 Successive discount of 10% and 5% is equivalent to :

- (a) 16.5% (b) 15%
(c) 15.5% (d) 14.5%

SOLUTION



NOTE There is no difference in two different cases i.e., either you decrease 100 at first by 10% and then by 5% or decrease 100 at first by 5% and then by 10%.



Explanation : $100 \times 0.9 \times 0.95 = 85.5$

\therefore Single discount equivalent to 10% and 5% is 14.5%
 $(100 - 85.5)\%$

or $(100 \times 0.95 \times 0.9 = 85.5)$

Some Important Concepts

(1) When two articles are sold at same price but one of them at a profit and another at a loss and the percentage profit is the same as the percentage loss. In this case there is always a loss.

$$\text{loss (\%)} = \left(\frac{\text{Common gain or loss}}{10} \right)^2$$

EXAMPLE 14 A man sells two wrist watches one at a profit of 10% and another at a loss of 10%, but the selling price of each watch is Rs. 200. Find the :

- (1) percentage profit or loss
(2) net amount of profit or loss

SOLUTION (1) Since there is always loss.

Logic: To get the logic you should refer the percentage chapter)

$$\text{Now, loss \%} = \left(\frac{\text{Common gain or loss}}{10} \right)^2 \%$$

$$\text{loss \%} = \left(\frac{10}{10} \right)^2 \% = 1\%$$

(2) Amount of loss.

$$\text{Total SP} = \text{Rs. 400}$$

$$\text{again, total SP} = 99\% \text{ of CP} \quad (200 + 200)$$

$$400 = \frac{99}{100} \times \text{CP} \quad (1\% \text{ loss})$$

$$\Rightarrow \text{loss} = \text{CP} - \text{SP} = \text{Rs. 4.04}$$

$$\therefore \text{loss} = \text{CP} - \text{SP} = \text{Rs. 4.04}$$

EXAMPLE 15 There were two articles and the sum of cost prices of these articles is Rs. 500. One of them was sold at a profit of 20% and another at a loss of 20%. Besides if the selling prices of both the articles were same. Find the amount of overall loss.

$$\text{SOLUTION} \quad x \times \frac{120}{100} = (500 - x) \frac{80}{100}$$

$$\Rightarrow x = 200$$

So, the CP of profit yielding article = Rs. 200

and the CP of loss giving article = Rs. 300

and the common SP = Rs. 240 = $(200 \times 1.2 = 300 \times 0.8)$

So the loss = $\text{CP} - \text{SP}$

$$= 500 - 2 \times 240 = \text{Rs. 20}$$

(2) When the selling price of 'm' articles is same as the cost price of 'n' similar articles.

EXAMPLE 16 If the cost price of 15 apples is same as the selling price of 20 apples. What is the gain or loss per cent?

SOLUTION CP of 15 apples = SP of 20 apples

$$\Rightarrow \text{CP} \times 15 = \text{SP} \times 20$$

$$\Rightarrow \frac{\text{CP}}{\text{SP}} = \frac{4}{3}$$

So you can see that $\text{CP} > \text{SP}$, therefore, there will be loss.

Now consider $\text{CP} = 4$, then $\text{SP} = 3$

$$\therefore \text{loss} = 1$$

$$\therefore \text{loss (\%)} = \frac{\text{loss}}{\text{CP}} \times 100$$

$$= \frac{1}{4} \times 100 = 25\%$$

$$\text{loss} = 25\%$$

EXAMPLE 17 If the selling price of 10 CDs is the same as the cost price of 12 CDs. What is the profit or loss per cent?

SOLUTION SP of 10 CDs = CP of 12 CDs

$$\Rightarrow \text{SP} \times 10 = \text{CP} \times 12$$

$$\Rightarrow \frac{\text{SP}}{\text{CP}} = \frac{12}{10} = \frac{6}{5}$$

$\Rightarrow \text{SP} > \text{CP}$, therefore there will be a profit

$$\text{Profit (\%)} = \frac{(\text{SP} - \text{CP})}{\text{CP}} \times 100$$

$$= \frac{(6 - 5)}{5} \times 100 = 20\% \text{ (profit)}$$

(3) When a person recovers the cost price of 'm' articles by selling 'n' articles ($n < m$), then

$$\text{Profit (\%)} = \frac{\text{goods left}}{\text{goods sold}} \times 100$$

$$= \frac{m - n}{n} \times 100$$

In this case money is equated in terms of no. of (or amount) articles.
For your convenience always assume the CP of an article
1 (or Rs. 100)

EXAMPLE 18. A dealer by selling 12 oranges gets the cost price of 11 oranges. What is the percentage profit?

$$\text{SOLUTION} \quad \text{Profit (\%)} = \frac{\text{goods left}}{\text{goods sold}} \times 100 = \frac{15 - 12}{12} \times 100 = 25\%$$

Alternatively : Suppose CP of one orange = Re. 1
 then CP of 12 oranges = Rs. 12
 and SP of 12 oranges = CP of 15 oranges = Rs. 15

$$\text{profit} = \frac{15 - 12}{12} \times 100 = 25\%$$

EXAMPLE 19. By selling 8 bananas, a fruit seller gains the selling price of 1 banana. Calculate his gain per cent.

SOLUTION Let the SP of one banana = Re. 1
 then SP of 8 bananas = Rs. 8
 and profit = Re. 1
 $\therefore \text{CP} = 8 - 1 = \text{Rs. } 7$
 $\therefore \text{profit \%} = \frac{1}{7} \times 100 = 14\frac{2}{7}\%$

EXAMPLE 20. By selling 18 chocolates, a vendor loses the selling price of 2 chocolates. Find his loss per cent.

SOLUTION Let the SP of 1 chocolate = Re. 1
 SP of 18 chocolate = Rs. 18
 and loss = Rs. 2

$$\therefore CP = SP + \text{loss}$$

$$= 18 + 2 = \text{Rs. } 20$$

Percentage loss = $\frac{\text{loss}}{\text{CP}} \times 100$

$$= \frac{2}{20} \times 100 = 10\%$$

251

EXAMPLE 21. A trader sell all his articles at the cost price but gives 10% less amount as he should give. What is his percentage profit?

SOLUTION Profit (%) = $\frac{\text{goods left}}{\text{goods sold}} \times 100$

$$= \frac{10}{90} \times 100 = 11\frac{1}{9}\%$$

Since if we assume that the CP of 1 article is Rs. 1.

Now since he gives only 90% article instead of 100% and save 10% article. So his profit will be the equal to the remaining articles (over the sold articles).

It means when he sells the articles (actually) worth Rs. 90 then he gains by articles worth Rs. 10.

$$\text{Hence profit \%} = \frac{10}{90} \times 100 = 11\frac{1}{9}\%$$

(The selling price = $\frac{100}{90} = \frac{10}{9}$ = Rs. 1.11)

EXAMPLE 22. A trader by means of his false balance defrauds to the extent of 10% in buying goods and also defrauds to 10% in selling. Find his gain per cent.

SOLUTION Let the actual CP of an article be Re. 1, then the effective CP = $\frac{100}{110} = \frac{10}{11}$

(Since he purchases 110 articles by paying Rs. 100)

$$\text{again } SP = \frac{100}{90} = \frac{10}{9}$$

(Since he sells only 90 articles charging the CP of 100 articles)

$$\therefore \text{Gain \%} = \frac{\text{SP} - \text{CP}}{\text{CP}} \times 100 = \frac{\frac{10}{9} - \frac{10}{11}}{\frac{10}{11}} \times 100$$

$$= \frac{20}{99} \times \frac{11}{10} \times 100$$

$$= \frac{200}{9} = 22\frac{2}{9}\%$$

INTRODUCTORY EXERCISE-6.2

Profit, Loss and Discount
Rs. 380
Rs. 525

EXERCISE

LEVEL 1

1. Abhishek and Bhanu both are dealers of KML scooters. The price of a KML Scooter is Rs. 28,000. Abhishek gives a discount of 10% on whole, while Bhanu gives a discount of 12% on the first Rs. 20,000 and 8% on the rest Rs. 8000. What is the difference between their selling prices?

 - Rs. 240
 - Rs. 420
 - Rs. 640
 - none of these

2. A trader sells two articles, one at a loss of 10% and another at a profit of 15% but finally there is no loss or gain. If the total sale price of these two articles is Rs. 30,000, find the difference between their cost prices :

 - Rs. 5000
 - Rs. 6000
 - Rs. 7500
 - none of these

3. A milkman purchases the milk at Rs. x per litre and sells it at Rs. $2x$ per litre still he mixes 2 litres water with every 6 litres of pure milk. What is the profit percentage?

 - 116%
 - 166.66%
 - 60%
 - 100%

4. 60% goods are sold at 5% loss while rest are sold at 10% profit. If there is a total profit of Rs. 100, then the worth of goods sold is :

 - Rs. 6000
 - Rs. 5000
 - Rs. 10000
 - none of these

5. A retailer bought 20 kg tea at a discount of 10%. Besides 1 kg tea was freely offered to him by the wholesaler at the purchase of 20 kg tea. Now he sells all the tea at the marked price to a customer. What is profit percentage of retailer?

 - 30%
 - 12%
 - 16.66%
 - none of these

6. Two articles are sold at the same price. One at a profit of 75% and another one at a loss of 30%. What is the overall profit or loss?

 - 22.5% profit
 - 57.5 profit
 - $13\frac{2}{7}\%$ loss
 - none of these

What is percentage profit in selling an article at a discount of 20% which was earlier being sold at a 40% profit?

 - 20%
 - 28%
 - 14%
 - 12%

A man bought 18 oranges for a rupee and sold them at 12 oranges for a rupee. What is the profit percentage?

 - 33.33%
 - 66.66%
 - 50%
 - none of these

A dealer buys a product at Rs. 1920, He sells at a discount of 20% still he gets the profit of 20%. What is the selling price of that product?

 - Rs. 2304
 - Rs. 2200
 - Rs. 1536
 - it is not possible

10. Tinkawala purchased the articles for Rs. 123684. He sold 60% of those at a profit of 16.66% and rest at a loss. Find the loss percentage on the remaining if the overall loss is 14%?

 - 20%
 - 30%
 - 60%
 - 66.66%

11. What should be the minimum markup percentage such that after giving a discount of $66\frac{2}{3}\%$, there will not be a loss?

 - 200%
 - 133.33%
 - 100%
 - 150%

12. The ratio of cost price and marked price of an article is 2 : 3 and ratio of percentage profit and percentage discount is 3 : 2. What is the discount percentage?

 - 16.66%
 - 20%
 - 25%
 - 33.33%

13. A dealer gives as much discount (in per cent) as the markup (in per cent) above the cost price. What is the profit or loss per cent?

 - 10%
 - 1%
 - 4%
 - can't be determined

14. In the above problem, what is the markup percentage when there is a loss in percentage be half of the percentage markup?

 - 20%
 - 40%
 - can't be determined
 - none of these

15. A shopkeeper sold 12 cameras at a profit of 20% and 8 cameras at a profit of 10%. If he had sold all the 20 cameras at a profit of 15%, then his profit would have been reduced by Rs. 36. What is the cost price of each camera?

 - 100
 - 150
 - 180
 - 220

16. Mr. Mittal purchased a car for Rs. 3,00,000 and a bike for his son for Rs. 1,00,000. He sold the car at a profit of 10% and bike at a loss of 20%. What is the net gain or loss?

 - 2% gain
 - 1.5% loss
 - 2.5% loss
 - 2.5% gain

17. A trader sells 20 kg of sugar at Rs. 400. A customer asks 20% discount and he agrees to it but instead of 1 kg he gives 4% less sugar. What is the effective discount that the customer gets?

 - 16%
 - 16.66%
 - 15.5%
 - 19.6%

18. The profit percentage on the three articles A, B and C is 10%, 20% and 25% and the ratio of the cost price is 1 : 2 : 4. Also the ratio of number of articles sold of A, B and C is 2 : 5 : 2, then the overall profit percentage is :

 - 18.5%
 - 21%
 - 75%
 - none of these

31. A fruit seller declares that he sells fruits at the cost price. However, he uses a weight of 450 g instead of 500 g. His percentage profit is :

 - 10%
 - $11\frac{1}{9}\%$
 - 12%
 - $12\frac{2}{9}\%$

32. A person loses Rs. 20 by selling some bananas at the rate of Rs. 3 per banana and gains Rs. 30, if he sells them at Rs. 3.25 per banana. The number of bananas sold by him :

 - 100
 - 200
 - 120
 - 2400

33. Due to an increase of 30% in the price of eggs, 3 eggs less are available for Rs. 9.10. The present rate per egg is :

 - 91 paise
 - 78 paise
 - 48 paise
 - 84 paise

34. By selling 12 apples for a rupee, a man loses 20%. How many for a rupee should he sell to gain 20%?

 - 8
 - 10
 - 15
 - 16

35. A dealer buys a washing machine, listed at Rs. 10000 and gets 10% and 20% successive discounts. He spends 10% of his Q on transport. At what price (in rupees) should he sell the washing machine to earn a profit of 10%?

 - 8722
 - 7892
 - 8712
 - 8840

36. 6% more is gained by selling a coat for Rs. 1425 than by selling it for Rs. 1353. The cost price of the coat is :

 - Rs. 1000
 - Rs. 1250
 - Rs. 1500
 - Rs. 1200

37. By selling a wrist watch at Rs. 405 the shopkeeper incurs a loss of 10%. What is the gain or loss percentage if he sells the same watch at Rs. 465?

 - profit of 10%
 - loss of 6%
 - profit of 3.33%
 - no profit no loss

38. Titan sells a wrist watch to a wholesaler making a profit of 10%. The wholesaler, in turn, sells it to the retailer making a profit of 10%. A customer purchases it by paying Rs. 990. Thus the profit of retailer is $2\frac{3}{11}\%$. What is the cost incurred by the Titan to produce it?

 - 768
 - 750
 - 800
 - 820

39. Pepsi and Coke, there are two companies, selling the packs of cold-drinks. For the same selling price Pepsi gives two successive discounts of 10% and 25%. While Coke sells it by giving two successive discounts of 15% and 20%. What is the ratio of their marked price?

 - 143 : 144
 - 19 : 11
 - 136 : 135
 - 73 : 77

40. When a shopkeeper reduces the selling price from 1080 to 1026 its loss increases by 4 percentage point. What is the selling price of this same article when it fetches a profit of 4%?

41. Profit, Loss and Discount
 (a) Rs. 1392
 (c) Rs. 1450
 (d) Rs. 1350
42. The difference between CP and SP of a table fan is Rs. 175 when it gives the profit of 14%. What is the selling price of that fan?
 (a) 1225
 (c) 1425
 (b) 1450
 (d) 1275
43. A company instead of raising the mark-up by 20% discounted the cost price by 20% while stitching the price tag on its product. Further the company offers a discount of 6.25% to its customer. In this process company incurs a loss of Rs. 37.5 on a single article. What is the selling price of that article?
 (a) 417.5
 (c) 365.5
 (b) 412.5
 (d) none of these
44. When an article is sold for Rs. 703 loss incurred is 25% less than the profit earned on selling it at Rs. 836. What is the selling price of the article when it earns a profit of 20%?
 (a) 912
 (c) 1532
 (b) 1576
 (d) 1092
45. Arun bought toffees at 6 for a rupee. How many for a rupee he should sell to gain 20%?
 (a) 3
 (c) 5
 (b) 4
 (d) can't be determined
46. A scientific calculator is available at Universal Shoppe in Hazratganz at 20% discount and the same is available at only 15% discount at Universal Shoppe Bhootnath Market. Ms. Agrawal has just sufficient amount of Rs. 800 to purchase it at Universal Shoppe Hazratganz. What is the amount that Ms. Agrawal has less than the required amount to purchase it at Universal Shoppe Bhootnath?
 (a) Rs. 70
 (c) Rs. 100
 (b) Rs. 50
 (d) data insufficient
47. A balance of a trader weighs 10% less than it should be. Still the trader marks-up his goods to get the overall profit of 20%. What is the markup on the cost price?
 (a) 40%
 (c) 25%
 (b) 8%
 (d) 16.66%
48. ITC sells one product at a profit of 20% another at a loss of 20% at the same selling price. What is the loss incurred by ITC?
 (a) 1%
 (c) 4%
 (b) 2%
 (d) 0%
49. In the previous question, if SP of each article be Rs. 200, what is the amount of loss?
 (a) Rs. 10
 (c) Rs. 16.66
 (b) Rs. 16
 (d) none of these
50. The cost price of 19 articles is same as the selling price of 29 articles. What is the loss %?
 (a) 35%
 (c) 52.63%
 (b) 34.48%
 (d) none of these
51. The selling price of 13 articles is same as the cost price of 23 articles. What is the profit percentage?
 (a) 43.47%
 (c) 78%
 (b) 74.83%
 (d) 76.92%
52. A trader can procure 34 pencils by selling 28 pencils. What is the ratio of cost price to the selling price of a pencil?

- (a) 2 : 3
 (c) 9 : 7
 (b) 14 : 17
 (d) 4 : 7
52. At style cloth emporium the shopkeeper measures 20% less for every metre of cloth also he marks-up goods by 20%. What is the profit percentage?
 (a) 50%
 (c) 75%
 (b) 80%
 (d) none of these
53. A bookseller procures 40 books for Rs. 3200 and sells them at a profit equal to the selling price of 8 books. What is the selling price of one dozen books, if the price of each book is same?
 (a) 720
 (c) 1200
 (b) 960
 (d) 1440
54. The profit percentage of A and B is same on selling the articles at Rs. 1800 each but A calculates his profit on the selling price while B calculates it correctly on the cost price which is equal to 20%. What is the difference in their profits?
 (a) Rs. 360
 (c) Rs. 540
 (b) Rs. 60
 (d) Rs. 450
55. Each of A and B sold their article at Rs. 1818 but A incurred a loss of 10% while B gained by 1%. What is the ratio of cost price of the articles of A to that of B?
 (a) 101 : 90
 (c) 81 : 75
 (b) 85 : 89
 (d) none of these
56. A trader sold an article at a loss of 5% but when he increased the selling price by Rs. 65 he gained 3.33% on the cost price. If he sells the same article at Rs. 936, what is the profit percentage?
 (a) 15%
 (c) 20%
 (b) 16.66%
 (d) data insufficient
57. Even after a discount of $q\%$ on marked price a trader gains by $p\%$. What is the markup percentage over the cost price?
 (a) $\frac{p+q}{(q-p)} \times 100$
 (c) $\frac{p+q}{(100-q)} \times 100$
 (b) $\frac{p+q}{(100-p)} \times 100$
 (d) not possible
58. A milkman mixes 10% water in pure milk but he is not content with it so he again mixes 10% more water in the previous mixture. What is the profit percentage of milkman if he sells it at cost price?
 (a) 11.11%
 (c) 21%
 (b) 20%
 (d) 12.1%
59. A person sold an electronic watch at Rs. 96 in such a way that his percentage profit is same as the cost price of the watch. If he sells it at twice the percentage profit of its previous percentage profit then the new selling price will be:
 (a) Rs. 132
 (c) Rs. 192
 (b) Rs. 150
 (d) Rs. 180
60. A trader mixes 25% kerosene to his petrol and then he sells the whole mixture at the price of petrol. If the cost price of kerosene be 50% of the cost price of petrol, what is the net profit percentage?
 (a) $11\frac{1}{9}\%$
 (c) $9\frac{1}{11}\%$
 (b) $12\frac{1}{9}\%$
 (d) 20%

- 61.** A retailer cheats both to his whole-seller and his customer by 10% by his faulty balance i.e., he actually weighs 10% more while purchasing from wholesaler and weighs 10% less while selling to his customer. What is his net profit percentage, when he sells at CP?
- (a) $22\frac{2}{11}\%$ (b) $22\frac{2}{9}\%$
 (c) 20% (d) 21%
- 62.** A trader procures his goods from a wholesaler, whose balance reads 1200 g for 1000 g. The trader sells all the procured goods to a customer after marking up the goods at 20% above the cost price. What is his overall percentage profit or loss in the whole transaction?
- (a) 38% profit
 (b) 50% profit
 (c) no profit no loss
 (d) none of the above
- 63.** A person wants to reduce the trade tax so he calculates his profit on the sale price instead of on the cost price. In this way by selling a article for Rs. 280 he calculates his profit as $14\frac{2}{7}\%$. What is his actual profit percentage?
- (a) 20% (b) 16.66%
 (c) 25% (d) data insufficient
- 64.** A vendor sells his articles at a certain profit percentage. If he sells his articles at $\frac{1}{3}$ of his actual selling price, then he incurs a loss of 40%. What is his actual profit percentage?
- (a) 72% (b) 120%
 (c) 80% (d) none of these

LEVEL (2)

- 1.** An automobile agency launched a scheme that if a customer purchases two Jabaaj Discover bikes, one extra Jabaaj Discover will be free and if he purchases 3 Jabaaj Pulser he will get one extra Jabaaj Pulser free. If the cost price of 3 Jabaaj Discover and 4 Jabaaj Pulser be Rs. 67500 and Rs. 232500 respectively. If a customer purchases 2 bikes of Jabaaj Discover and 3 bikes of Jabaaj Pulser as per scheme he availed 1 bike free of each category, then at what price these bikes should be sold so that the agency can get overall profit of 17.5% :
- (a) 235250 (b) 352500
 (c) 368000 (d) 268000
- 2.** Rahul went to purchase a Nokia mobile handset, the shopkeeper told him to pay 20% tax if he asked the bill. Rahul manages to get the discount of 5% on the actual saleprice of the mobile and he paid the shopkeeper Rs. 3325 without tax. Besides he manages to avoid to pay 20% tax on the already discounted price, what is the amount of discount that he has gotten?
- (a) 750 (b) 375
 (c) 875 (d) 525
- 3.** When a bicycle manufacturer reduced its selling price by 50%, the number of bicycles sold radically increased by 600%. Initially the manufacturer was getting only 140% profit. What is the percentage increase of his profit?
- (a) 10% (b) 14%
 (c) 0% (d) can't be determined

- 65.** A retailer increases the selling price by 25% due to which his profit percentage increases from 20% to 25%. What is the percentage increase in cost price?
- (a) 20% (b) 30%
 (c) 25% (d) 50%
- 66.** Abhinav saves Rs. 25 by getting 6.66% discount on a textbook. What is the amount of money (in Rs.) paid by him?
- (a) 450 (b) 350
 (c) 225 (d) 375
- 67.** At kul-kul petrol pump the operator gives 5% less petrol than he sells it at the cost price. What is his profit in this way?
- (a) 5% (b) 5.6%
 (c) 5.26% (d) 4.78%
- 68.** Due to reduction of 25% in price of oranges a customer can purchase 4 oranges more for Rs. 16. What is original price of an orange?
- (a) Re 1 (b) Rs. 1.33
 (c) Rs. 1.5 (d) Rs. 1.6
- 69.** A reduction of 20% in the price of sugar enables a housewife to purchase 6 kg more for Rs. 240. What is the original price per kg of sugar?
- (a) Rs. 10 per kg (b) Rs. 8 per kg
 (c) Rs. 6 per kg (d) Rs. 5 per kg
- 70.** A wholesaler sells toys at a profit of 20% to a retailer and the retailer sells these toys to its customer at a profit of 25%. What is the profit percentage of the retailer?
- (a) 5% (b) 80%
 (c) 20% (d) 25%
- 4.** A trader marks his goods such that he can make 32% profit after giving 12% discount. However a customer availed 20% discount instead of 12%. What is the new profit percentage of trader?
- (a) 20% (b) 44%
 (c) 30% (d) 28.8%
- 5.** A retailer bought 3850 Linc pens and 1848 Cello pens at the same price. He sells Linc pens in such a way that he can buy 650 Linc pens with the sale price of 481 Linc pens. Again he can buy only 408 Cello pens with the sale price of 629 pens. What is the overall percentage of profit of the retailer?
- (a) 4.8% (b) 9.6%
 (c) 13% (d) none of these
- 6.** The ratio of selling price of 3 articles A, B and C is 8 : 9 : 5 and the ratio of percentage profit is 8 : 7 : 14 respectively. If the profit percentage of A is 14.28% and the cost price of A is Rs. 400, what is the overall percentage gain?
- (a) 14.28% (b) 14.87%
 (c) 16.66% (d) none of these
- 7.** Anna sold his car to Boney at a profit of 20% and Boney sold to Chakori at a profit of 10%. Chakori sold it to mechanic at a loss of 9.09%. Mechanic spent 10% of his purchasing price and then sold it at a profit of 8.33% to Anna once again. What is the loss of Anna?
- (a) 23% (b) 29%
 (c) 50% (d) 40%

8. In an office the number of employees reduces in the ratio of 3 : 2 and the wages increases in the ratio of 20 : 27. What is the profit percentage of employees over the previous wages?
- 10%
 - 9.09%
 - 11.11%
 - none of these

9. I asked the shopkeeper the price of a wristwatch. I found that I had just the required sum of money. When the shopkeeper allowed me a discount of 25%, I could buy another watch worth Rs. 940 for my younger sister. What is the price which I have paid for my own watch?
- Rs. 2700
 - Rs. 1800
 - Rs. 2820
 - Rs. 3760

10. A and B are two partners and they have invested Rs. 54,000 and Rs. 90,000 in a business. After one year A received Rs. 1800 as his share of profit out of total profit of Rs. 3600 including his certain commission on total profit since he is a working partner and rest profit is received by B. What is the commission of A as a percentage of the total profit?
- 20%
 - 10%
 - 5%
 - 25%

11. A trader sells goods to a customer at a profit of $k\%$ over the cost price, besides it he cheats his customer by giving 880 g only instead of 1 kg. Thus his overall profit percentage is 25%. Find the value of k ?
- 8.33%
 - 8.25%
 - 10%
 - 12.5%

12. A trader sells two brands of petrol; one is Extra Premium (EP) and other one is 'Speed' (SP). He mixes 12 litres of EP with 3 litres of speed and by selling this mixture at the price of EP he gets the profit of 9.09%. If the price of Extra Premium be Rs. 48 per litre, then the price of Speed (SP) is :
- Rs. 38 per litre
 - Rs. 42 per litre
 - Rs. 28 per litre
 - none of these

13. A, B and C invest in the ratio of 3 : 4 : 5. The percentage of return on their investments are in the ratio of 6 : 5 : 4. Find the total earnings, if B earns Rs. 250 more than A :
- Rs. 6000
 - Rs. 7250
 - Rs. 5000
 - none of these

14. Ajay bought a motor cycle for Rs. 50,000. 2 years later he sold it to Bijoy at 10% less of the cost price. Bijoy spent 5% of the purchasing price on its maintenance. Later Bijoy displayed the sale price of his motorcycle Rs. 50,000. Chetan wanted to purchase it at 15% discount but Bijoy gave him two successive discounts of 10% and 5% instead of 15% in one time. What is the actual discount availed by Chetan?
- 15%
 - 15.5%
 - 14.5%
 - none of these

15. Kamal bought a house in Sushant city, whose sale price was Rs. 8 lakh. He availed 20% discount as an early bird offer and then 10% discount due to cash payment. After that he spent 10% of the cost price in interior decoration and lawn of the house. At what price should he sell the house to earn a profit of 25%?
- Rs. 9 lakh
 - Rs. 7.99 lakh
 - Rs. 7.92 lakh
 - none of these

16. I wanted to purchase 10 chairs for the class room whose cost was Rs. 200 each. The trader offered me a discount if I were to purchase a set of 12 chairs. So I calculated that if I assume

the normal price of 10 chairs then we can purchase 2 extra chairs which cost me only Rs. 80 each of two chairs at the cost price of 12 chairs after discount. What is the percentage discount?

- 6%
 - 8%
 - 12%
 - 10%
17. The cost of servicing of a Maruti car at Maruti care Pvt. Ltd. is Rs. 400. Manager of service centre told me that for the second service within a year a customer can avail a 10% discount and further for third and fourth servicing he can avail 10% discount of the previous amount paid, within a year. Further if a customer gets more than 4 services within a year he has to pay just 60% of the servicing charges on these services. A customer availed 5 services from the same servicing station, what is the total percentage discount fetched by the customer?
- 19.42%
 - 18.5%
 - 17.6%
 - 26%

18. The cost price of an article is C and the selling price of the same article is S , where Z is the profit or loss percentage. If the cost price and selling price both are increased by same amount then which of the following is true :
- Z increases
 - Z decreases
 - remains constant
 - none of these

19. Cost price of 12 oranges is equal to the selling price of 9 oranges and the discount on 10 oranges is equal to the profit on 5 oranges. What is the percentage point difference between the profit percentage and discount percentage?
- 20
 - 22.22
 - 16.66
 - 15

20. A car mechanic purchased four old cars for Rs. 1 lakh. He spent total 2 lakh in the maintenance and repairing of these four cars. What is the average sale price of the rest three cars to get 50% total profit if he has already sold one of the four cars at Rs. 1.2 lakh?
- 1.5 lakh
 - 1.1 lakh
 - 1.2 lakh
 - 1.65 lakh

21. The cost of setting up a magazine is Rs. 2800. The cost of paper and ink etc is Rs. 80 per 100 copies and printing cost is Rs. 160 per 100 copies. In the last month 2000 copies were printed but only 1500 copies could be sold at Rs. 5 each. Total 25% profit on the sale price was realized. There is one more resource of income from the magazine which is advertising. What sum of money was obtained from the advertising in magazine?
- Rs. 1750
 - Rs. 2350
 - Rs. 1150
 - Rs. 1975

22. DSNL charges a fixed rental of Rs. 350 per month. It allows 200 calls free per month. Each call is charged at Rs. 1.4 when the number of calls exceeds 200 per month and it charges Rs. 1.6 when the number of calls exceeds 400 per month and so on. A customer made 150 calls in February and 250 calls in March. By how much per cent the each call is cheaper in March than each call in February?
- 28%
 - 25%
 - 18.5%
 - none of these

Profit, Loss and Discount
37.

23. In the Bargain Bazar everyone purchases with a fair bargaining, so the traders markup the prices too much. A trader marked up an article at Rs. M expected huge profit if it is sold on the marked price. But a customer purchased it at $M/2$ with his fine bargaining skills, so the expected profit of the trader diminished by 66.66%. What is the percentage discount fetched by the customer through bargaining?
- (a) 33.33% (b) 50%
(c) 66.66% (d) none of these
24. Tika Chand has a weighing balance in which there is a technical fault. The right pan of his balance measures always 200 g more than its left pan. Tika Chand as usual misutilise this balance in his business. While purchasing the articles he puts goods in the left pan and weight in the right pan while selling he reverse the order i.e., goods in the right pan and weight in the left pan. He uses only 2 kg weight for the measurement and to measure $2n$ kg weight he measures n times by 2-2 kg but he sells goods at cost price. What is his profit percentage?
- (a) 20% (b) $22\frac{2}{9}\%$
(c) $18\frac{2}{11}\%$ (d) none of these
25. Akram Miya has two types of grapes. One is the fresh grapes containing 80% water and dry grapes containing 25% water. He sells 20 kg dry grapes, by adding water to the dry grapes, at cost price. What is the total profit percentage when after adding water the weight of 20 kg dry grapes increased in the proportion of water in fresh grapes?
- (a) 275% (b) 200%
(c) 80% (d) 125%
26. Pankaj and Sushil invested some amount of money in the ratio of 3 : 5 for the same period in a business. They decided that at the end of year 20% profit was to be given to AIDS Control Society of India as a donation. Out of the remaining, 75% was to be reinvested and the rest of the profit was to be divided as interest on their capitals. If the difference in their shares is Rs. 1200. Find the total profit?
- (a) Rs. 18000 (b) Rs. 24000
(c) Rs. 20000 (d) none of these
27. Jagran group launched a new magazine in January 2004. The group printed 10000 copies initially for Rs. 50000. It distributed 20% of its stock freely as specimen copy and 25% of the rest magazines are sold at 25% discount and rest at 16.66% discount whose printing price was Rs. 12 per copy. What is the overall gain or loss in the first month's issue of magazine, if the magazine could not realize the income from advertisements or other resources?
- (a) 56% profit (b) 27% loss
(c) 16.66% profit (d) 38% profit
28. Teenagers shoe company sells the shoes whose prices i.e., cost prices and selling prices are the multiples of either 13, 14, 15, 16, 17, 18 or 19, starting from Rs. 399 to Rs. 699 (i.e., $399 \leq CP/SP \leq 699$). What can be the maximum profit of the company?
- (a) Rs. 292 (b) RS. 398
(c) Rs. 298 (d) Rs. 300
29. Jhun Jhunwala makes 1000 toys and incurs a cost of Rs. 1.2 for each toy. He marks-up the price in such a way that if he sells only 70% of the manufactured toys he will realize 16.66% overall profit. He sells only 750 articles at the marked price since rest of the toys are found to be defective so can't be sold. What is the net profit or loss of Jhun Jhunwala?
- (a) 14.44% loss (b) 25% profit
(c) 33.33% profit (d) none of these
30. Anupam sells a painting to Bhargava at 4/5th the rate of profit at which Bhargava sells it to Chaudhary. Further Chaudhary sells it to Dara Singh at half the rate of profit at which Anupam sold it to Bhargava. If Chaudhary earns a profit of 10% by selling it to Dara Singh for Rs. 2805. What is the cost price of painting for Bhargava?
- (a) 1896 (b) 2040
(c) 1680 (d) 2000
31. A dishonest retailer cheats his wholesaler and customer both. He purchases 19% more from the wholesaler and sells 15% less while selling to its customer. What is profit percentage by selling the goods at cost price?
- (a) 36.78% (b) 34%
(c) 40% (d) 36.85%
32. Rotomac produces very fine quality of writing pens. Company knows that on an average 10% of the produced pens are always defective so are rejected before packing. Company promises to deliver 7200 pens to its wholesaler at Rs. 10 each. It estimates the overall profit on all the manufactured pens to be 25%. What is the manufacturing cost of each pen?
- (a) Rs. 6 (b) Rs. 7.2
(c) Rs. 5.6 (d) Rs. 8
33. Pratibha printers prepares diaries expecting to earn a profit of 40% by selling on the marked price. But during transportation 8% diaries were got spoiled due to at random rain and 32% could be sold only at 75% of the cost price. Thus the remaining 60% diaries could be sold at the expected price. What is the net profit or loss in the whole consignment?
- (a) 6% (b) 10%
(c) 8% (d) can't be determined
34. Radhey Lal markup the prices of sweets by 40% and he sold only 40% of those at this price. He sells half of the rest at $14\frac{2}{7}\%$ discount and rest at 25% discount. What is the net profit of Radhey Lal?
- (a) 26.5% (b) 23.5%
(c) 30% (d) 28.6%
35. The price of an article reduces to 576 after two successive discounts. The markup is 80% above the cost price of Rs. 500. What is the new profit percentage if instead of two successive discounts the markup price was further increased successively two times by the same percentage?
- (a) 259.2% (b) 59.2%
(c) 159.2% (d) can't be determined
36. A trader marks-up his goods by 80% and gives discount of 25%. Besides it he weighs 10% less amount while selling his goods. What is the net profit of trader?
- (a) 50% (b) 35%
(c) 45% (d) 55%

Profit, Loss and Discount

37. A dishonest trader marks up his goods by 80% and gives discount of 25%. Besides he gets 20% more amount per kg from wholesaler and sells 10% less per kg to customer. What is the overall profit percentage?

- (a) 80%
- (b) 60%
- (c) 70%
- (d) none of these

38. A dishonest dealer purchases goods at 20% discount of the cost price of Rs x and also cheats his wholesaler by getting 20% extra through false weighing, per kg. Then he marks up his goods by 80% of x , but he gives a discount of 25% besides he cheats his customer by weighing 10% less than the required. What is his overall profit percentage?

- (a) 125%
- (b) 100%
- (c) 98.66%
- (d) 120%

39. Anjuli, Bhoomika and Chawla went to market to purchase the rings whose costs were same. But each ring was available with two successive discounts. Anjuli availed two successive discounts of 5% and 20%. Bhoomika availed two successive discounts 10% and 15% while Chawla availed two successive discounts of 12% and 13%. Who gets the maximum possible discount?

- (a) Anjuli
- (b) Bhoomika
- (c) Chawla
- (d) all of these

40. An egg seller sells his eggs only in the packs of 3 eggs, 6 eggs, 9 eggs, 12 eggs etc., but the rate is not necessarily uniform. One day Raju (which is not the same egg seller) purchased at the rate of 3 eggs for a rupee and the next hour he purchased equal number of eggs at the rate of 6 eggs for a rupee. Next day he sold all the eggs at the rate of 9 eggs for Rs. 2. What is his percentage profit or loss?

- (a) 10% loss
- (b) 11.11% loss
- (c) 3% loss
- (d) 2.5% profit

41. Virendra and Gurindra purchased one camera each at the same prices. Later on Amrendra purchased both cameras at equal prices from Virendra and Gurindra. But the profit percentage of Virendra was P while the same of Gurindra was

Q since Gurindra calculated his profit on the selling price. Thus $Q = 41 \frac{2}{3} \%$ of P . If Amrendra sells one of the camera to Dholakiya at $P\%$ profit then what is the cost price for Dholakiya, while Amrendra purchased each of the camera at Rs. 240?

- (a) Rs. 676
- (b) Rs. 500
- (c) Rs. 576
- (d) none of these

42. A merchant earns 25% profit in general. Once his 25% consignment was abducted forever by some goondas. Trying to compensate his loss he sold the rest amount by increasing his selling price by 20%. What is the new percentage profit or loss?

- (a) 10% loss
- (b) 12.5% loss
- (c) 12.5% profit
- (d) 11.11% loss

43. A milkman purchases 10 litres of milk at Rs. 7 per litre and forms a mixture by adding freely available water which constitutes 16.66% of the mixture. Later on he replaced the mixture by some freely available water and thus the ratio of milk is to water is 2 : 1. He then sold the new mixture at cost price of milk and replaced amount of mixture at twice the cost of milk then what is the profit percentage?

- (a) 68%
- (b) 34%
- (c) 40%
- (d) none of these

44. Profit on selling 10 candles equals selling price of 3 bulbs. While loss on selling 10 bulbs equals selling price of 4 candles. Also profit percentage equals to the loss percentage and cost of a candle is half of the cost of a bulb. What is the ratio of selling price of candle to the selling price of a bulb?

- (a) 5 : 4
- (b) 3 : 2
- (c) 4 : 5
- (d) 3 : 4

45. Cost price of two motorcycles is same. One is sold at a profit of 15% and the other for Rs. 4800 more than the first. If the net profit is 20%. Find the cost price of each motorcycle :

- (a) Rs. 48000
- (b) Rs. 52000
- (c) Rs. 36000
- (d) Rs. 42500



Answers

INTRODUCTORY EXERCISE-6.1

- 1.** Rs. 180 and Rs. 225 **2.** Rs. 9000 **3.** Rs. 345 **4.** Rs. $153\frac{1}{3}$ per hundred **5.** Rs. 15300, Rs. 17850, gain = $\frac{5}{11}\%$

INTRODUCTORY EXERCISE-6.2

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

LEVEL-1

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

LEVEL-2

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

LEVEL 1

Abhishek

1. Discount \rightarrow 2800 Bhanu
 The difference in selling price is same as difference in discount which Rs. 240 ($= 3040 - 2800$)

2. $\because 10\% x = 15\% \text{ of } y$, where $x + y = 30000$

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

Hence, the difference $= k = 6000$

3. Let the cost price of 1 litre pure milk be Re. 1, then
 $\left\{ \begin{array}{l} 6 \text{ litres (milk)} \rightarrow CP = \text{Rs. 6} \\ 2 \text{ litres (water)} \rightarrow CP = \text{Rs. 0} \end{array} \right\} \rightarrow CP = \text{Rs. 6 only.}$

and 8 litre mixture $\rightarrow SP \rightarrow 8 \times 2 = \text{Rs. 16}$

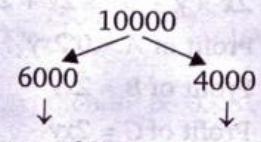
$$\text{Profit} = \frac{16 - 6}{6} \times 100 = \frac{1000}{6} = 166.66\%$$

4. $SP \text{ of } 60\% \text{ goods} = 0.6x \times 0.95 = 0.57x$
 $SP \text{ of } 40\% \text{ goods} = 0.4x \times 1.1 = 0.44x$ } Total $SP = 1.01x$

$$\text{Profit} = 0.01x = 100$$

$$x = 10000$$

Alternatively: From option (c)



$$\text{loss} = 300 \quad \text{gain} = 400$$

$$\text{net gain} = 400 - 300 = \text{Rs. 100},$$

Hence, option (c) is correct.

5. Let the MP of 1 kg tea be Re. 1, then CP of 20 kg with discount $= 20 \times 0.9 = \text{Rs. 18}$

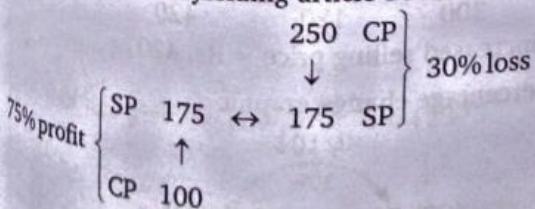
also 1 kg tea is free. So the retailer gets tea worth Rs. 21 by paying Rs. 18 only.

$$\text{Profit \%} = \frac{\text{goods left}}{\text{goods sold}} \times 100$$

$$= \frac{21 - 18}{18} \times 100 = 16.66\%$$

(Since the retailer earns Rs. 3 on each Rs. 18)

6. Let the CP of profit yielding article be Rs. 100 then



$$\text{Total CP} = 350, \quad \text{Total SP} = 350$$

So there is no profit no gain.

Alternatively: $1.75x = 0.7y$

$$\Rightarrow \frac{x}{y} = \frac{2}{5}$$

again

$$\text{and } \left[\begin{array}{l} 2 \times 1.75 = 3.5 \\ 5 \times 0.7 = 3.5 \end{array} \right]$$

Total cost price $= 2 + 5 = \text{Rs. 7}$

Total selling price $= 3.5 + 3.5 = \text{Rs. 7}$

Hence, no loss no gain.

Initially	CP : 100	SP : 140	MP : 140	(since profit = 40%)
New prices :	100	112	140	↓ profit ↓ discount = 12% = 20%

8. $\frac{CP}{SP} = \frac{2}{3}$

$$\therefore \text{profit (\%)} = \frac{1}{2} \times 100 = 50\%$$

Alternatively: $CP = \frac{100}{18} = 5.55 \text{ paise}$

$$SP = \frac{100}{12} = 8.33 \text{ paise}$$

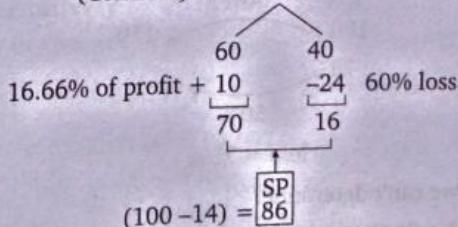
$$\text{Profit} = \frac{8.33 - 5.55}{5.55} \times 100 = 50\%$$

CP : 100	SP : 120	MP : 150
20% profit	20% discount	

But it can be directly solved as $SP = 1.2 CP = \text{Rs. 2304}$

NOTE There is no role of discount.

10. Note: There is no role of cost price of article (Rs. 123684)
 (Consider) $CP \rightarrow 100$



$$(100 - 14) = 86$$

Since, the overall % loss = 14%

Thus option (c) is correct.

Alternatively: $0.6x + k \times 0.4x = 0.86x$

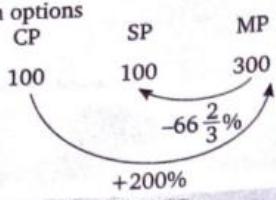
$$0.4kx = 0.16x$$

$$\Rightarrow k = 0.4$$

$$\Rightarrow \text{Therefore loss} = 1 - 0.4 = 0.6 \text{ i.e., } 60\%$$

262

11. Go through options



NOTE When there is no loss, $CP = SP$.

Alternatively: $CP = SP$ MP

From percentage change graphic :

Decrease	Increase
$\frac{2}{3} \downarrow$	$\frac{2}{3-2} = \frac{2}{1} \uparrow$
= 66.66%	= 200%

So, when $CP = 100$, markup % = 200, $MP = 300$

$$\text{Discount} = 66 \frac{2}{3} \% = 200, SP = 100 = CP$$

Alternatively : $(CP = SP) = \frac{1}{3} MP$

$$\Rightarrow (CP = SP) : MP = 1 : 3$$

12.

$$CP : MP = 2x : 3x$$

$$\Rightarrow \text{Profit} = x$$

$$(\%) \text{ profit} : (\%) \text{ discount} = 3 : 2$$

$$\text{Let } CP = 200, SP = 300$$

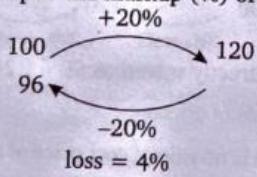
$$\text{But } \frac{3x}{100} \times 200 + \frac{2x}{100} \times 300 = 100$$

$$\Rightarrow x = 8.33\%$$

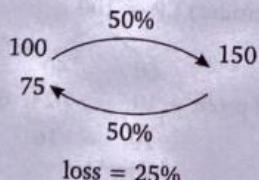
$$\text{Discount } 2x = 16.66\%$$

13. It is dependent upon the markup (%) or discount (%)

Since,



Again



Hence we can't determine.

14. $CP \rightarrow \text{Profit} (\%) \rightarrow MP$

$$\rightarrow 100 \rightarrow x\% \rightarrow 100 + \frac{100x}{100} = (100 + x)$$

Again, $MP \rightarrow \text{discount} \rightarrow SP$

$$\rightarrow (100 + x) \rightarrow x\% \rightarrow (100 + x) - (100 + x) \frac{x}{100}$$

$$= (100 + x) \left(1 - \frac{x}{100}\right)$$

Now

$$\frac{(100+x)}{(100+x)(1-\frac{x}{100})} = \frac{2}{1}$$

$$\Rightarrow \left(1 - \frac{x}{100}\right) = \frac{1}{2} \Rightarrow x = 50\%$$

This can be observed in the solution of the previous problem.

15. Go through option

$$180 \times 12 \times 1.2 + 180 \times 8 \times 1.1 = 180 [14.4 + 8.8]$$

$$= 180 (23.2) = 4176$$

$$\text{and } 180 \times 20 \times 1.15 = 4140$$

$$\text{Therefore loss} = 4176 - 4140 = 36$$

Hence option (c) is correct.

$$\text{Gain} = 30000$$

$$\text{loss} = 20000$$

net gain = 10000 over Rs. 4 lakh

$$\text{Hence, profit} = \frac{10000}{400000} \times 100 = 2.5\%$$

16. Let the $MP = \text{Re } 1 \text{ per kg}$ then

Weight	MP	Rate
100	100	1
96	80	80/96

$$\text{Effective discount} = 1 - \frac{80}{96} = \frac{16}{96}$$

$$\% \text{ discount} = \frac{16}{96} \times 100 = 16.66\%$$

$$17. CP \text{ of } A + B + C = 2x \times y + 5x \times 2y + 2x \times 4y = 20xy$$

$$\text{Profit of } A = 0.2xy$$

$$\text{Profit of } B = 2xy$$

$$\text{Profit of } C = 2xy$$

$$\text{Total profit} = 4.2xy$$

$$\% \text{ profit} = \frac{4.2xy}{20xy} \times 100 = 21\%$$

18. Initially

CP	Profit	SP	MP
100	x	(100 + x)	133.33

After change	100	2x	$(100 + x) \frac{7}{6}$

$$\text{Now, since } (100 + x) \frac{7}{6} - 100 = 2x$$

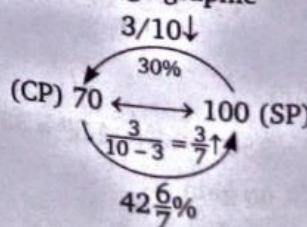
$$\Rightarrow x = 20\%$$

CP	Profit	SP	MP
100	20	120	133.33

So,	300	60	360
Again	300	120	420

So the increased selling price = Rs. 420

20. From percentage change graphic



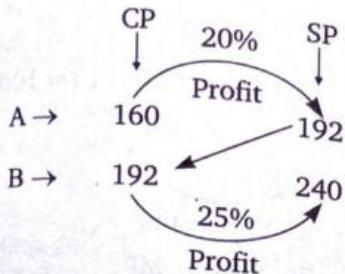
$$\text{Increase} = \frac{10}{(10 - 3)} = \frac{3}{7} \uparrow = 42\frac{6}{7}\%$$

21. Let the price be x , then

$$x \times 0.8 \times 0.9 = 468$$

$\Rightarrow x = 650$, therefore marked price = Rs. 650
Alternatively: $650 \times 0.8 \times 0.2 = 468$
Hence option (d) is correct.

22.



23. Reduced price = $100 \times 0.95 \times 0.90 \times 0.80 = 68.40$

\therefore Single discount = $(100 - 68.4)\% = 31.6\%$

24. $CP = \frac{10}{12}$, $SP = \frac{12}{10}$

$$\frac{12}{10} - \frac{10}{12}$$

$$\text{Profit (\%)} = \frac{\frac{12}{10} - \frac{10}{12}}{\frac{10}{12}} \times 100 = 44\%$$

25. Let the cost price of one gram be Re. 1, then the markup price be Rs. 1.2 per g.

Now he sells 1000 g which seems to be 1250 g so he charges to a customer $1250 \times 1.2 =$ Rs. 1500 for 1000 g (or Rs. 1000)

$$\text{Thus his profit \%} = \frac{1500 - 1000}{1000} \times 100 = 50\%$$

26. Let the CP be Rs. x , then SP be $0.96x$

$$0.96x = 240 \Rightarrow x = 250$$

Now the new SP = $250 \times 1.1 = 275$

27.

CP	SP	MP
x	$112.5x = 225$	300

(-25%)

$\therefore x = 200$, hence the cost price be Rs. 200.

NOTE It can also be solved by using option.

First of all find the SP by decreasing MP by 25% then this SP will be equal to 112.5% (12.5% is the profit) of the cost price so the CP can be find as given above.

28. $CP \xrightarrow{(-10\%)} (SP)_1 \xrightarrow{(-5\%)} (SP)_2$

200	180	171
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29. The CP of profitable cow = $\frac{9900}{1.1} = 9000$

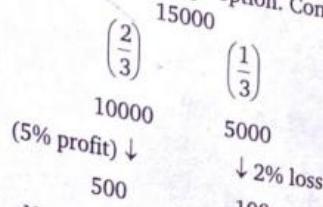
and profit = Rs. 900

The CP of loss yielding cow = $\frac{9900}{0.8} = 12375$

and loss = Rs. 2475

So, the net loss = $2475 - 900 = 1575$

30. The best way is to go through option. Consider option (a)



Net gain = Rs. 400 (= 500 - 100)
Hence, option (a) is correct.

Alternatively: $\left[\left(1.05 \times \frac{2x}{3} + 0.98 \frac{x}{3} \right) - x \right] = 400$

$$\Rightarrow x = 15000$$

31. Profit (%) = $\frac{\text{goods left}}{\text{goods sold}} \times 100 = \frac{50}{450} \times 100 = 11\frac{1}{9}\%$

Alternatively: Suppose CP of 1 g is Re. 1 then he sells goods worth Rs. 450 only and charges Rs. 500. So the profit is Rs. 50 over the sale price of Rs. 450.

32. Go through options. Consider option (b)

$$200 \times 3.25 - 200 \times 3 = \text{Rs. } 50 (= 30 + 20)$$

Hence, option (b) is correct.

Alternatively: Rs. 0.25 is the difference on 1 banana

\therefore Re 1 is the difference on $\frac{1}{0.25} = 4$ bananas

\therefore Rs. 50 is the difference on $4 \times 50 = 200$ bananas

33. By percentage change (or fraction change) graphic increase decrease

$$30\% = \frac{3}{10} \uparrow \quad \frac{3}{13} \downarrow \quad [\text{Since product i.e., price is constant}]$$

It means now $\frac{3}{13}$ times less eggs are available which is equal to 3 eggs.

$$i.e., \quad \frac{3x}{13} = 3$$

$$\Rightarrow x = 13 \text{ eggs (initially)}$$

Now available eggs on the same price = $13 - 3 = 10$

$$\text{Thus, the new price} = \frac{910}{10} = 91 \text{ paise}$$

Alternatively : Go through options.

$$\begin{array}{cccccc} \text{New or changed} & \text{No. of eggs} & \text{Rate} & & \text{total prices} \\ \text{Initial} \rightarrow & \begin{matrix} 10 \\ 13 \end{matrix} & \begin{matrix} \times 91 \\ \times 70 \end{matrix} & \begin{matrix} (+30\%) \\ (+30\%) \end{matrix} & = 910 \text{ paise} \\ & \text{(+3)} & & & = 910 \text{ paise} \end{array}$$

Therefore option (a) is correct.

34. $SP = \frac{100}{12} \text{ paise}$

$$CP = x, SP = 0.8x = \frac{100}{12} \Rightarrow x = \frac{100}{9.6} \text{ paise}$$

Therefore, $CP = \frac{100}{9.6} \text{ paise}$

$$\text{Thus, the new SP (with 20\% profit)} = \frac{100}{9.6} \times 1.2 = \frac{100}{8} \text{ paise}$$

Hence, 8 apples can be purchased for Re. 1 to gain 20%.

LEVEL (2)

1. Just a sitter but a logical problem.

$$CP \text{ of } 5 \text{ bikes} = 67500 + 232500 = 300000$$

$$\text{Now, since we require } 17.5\% \text{ profit, so } SP = 300000 \times \frac{117.5}{100}$$

$$= \text{Rs. } 352500$$

2. $CP = 100$, SP (with tax) = 120

$$\text{New } SP = 100 - 5 = 95$$

$$\therefore \text{Effective discount} = 120 - 95 = 25$$

So, at SP of 95 \rightarrow discount = 25

$$\text{and at } SP \text{ of } 3325 \rightarrow \text{discount} = \frac{25}{95} \times 3325 = 875$$

3. Let the CP of a bicycle = Rs. 100

Now, since profit 140%

$$SP = 240$$

Now, 7 bicycles are being sold instead if 1 bicycle, but the sale price of new bicycle = Rs. 120

Therefore total sale price of new sale of bicycles

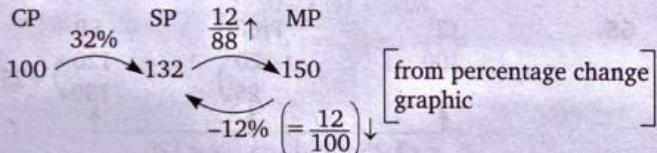
$$= 7 \times 120 = 840$$

$$\text{and the } CP = 7 \times 100 = 700$$

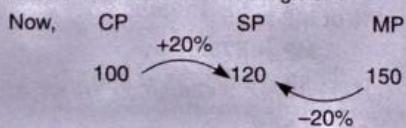
$$\text{So, the new profit} = 840 - 700 = \text{Rs. } 140$$

Since the initial profit is same as the new so there is no increase in percentage.

4. CP



NOTE In this case first of all find the SP , after adding profit percentage to CP then find the MP through SP .



Here first of all we subtract discount from the MP then the resultant value will be SP .

- 5.

Linc pens Cello pens

$$CP : SP \quad CP : SP$$

$$37 : 50 \quad 37 : 24$$

$$\text{Profit \%} = \frac{13}{37} \times 100$$

$$\text{and Loss \%} = \frac{13}{37} \times 100$$

Since Profit = loss

Hence option (d) is correct.

- 6.

$$SP \quad A \quad B \quad C$$

$$\frac{1}{7} \left(\frac{8}{7} \right) \frac{1}{8} : \frac{1}{8} \left(\frac{9}{8} \right) \frac{1}{9} : \frac{1}{4} \left(\frac{5}{4} \right) \frac{1}{5}$$

$$\text{Since } 14.28\% = \frac{1}{7}$$

So, the ratio of profit percentage of

$$\begin{array}{ccc} A & B & C \\ 8 & : & 7 \\ \downarrow & & \downarrow \\ 1 & & 1 \\ \hline 7 & & 8 & & 4 \end{array}$$

Thus the ratio of CP of $A : B : C$

$$7 : 8 : 4$$

$$\text{Therefore \% profit} = \frac{(8 + 9 + 5) - (7 + 8 + 4)}{(7 + 8 + 4)} \times 100$$

$$= \frac{3}{19} \times 100 = 15.78\%$$

	<i>A</i>	<i>B</i>	<i>C</i>	<i>M</i>
$CP \rightarrow$	100	120	132	$(120 + 12) = 132$
$SP \rightarrow$	120	132	120	143
$CP \rightarrow$	143			

$$\text{Loss of } A = 143 - 120 = 23$$

$$\% \text{ loss of } A = \frac{23}{100} \times 100 = 23\%$$

8. Total wages = no. of employees \times wage per employee

$$60xy = 3x \times 20y$$

$$54xy = 2x \times 27y$$

$$\text{Profit \%} = \frac{60 - 54}{60} \times 100 = 10\%$$

9. If I had Rs. 100

Discount = 25 = cost of my sister's watch

then cost of my own watch = 75

Thus the ratio of cost of my own watch to that of my sister's watch = 3 : 1

10. Ratio of profit of $A : B$ (excluding commission of A)

$$= 3 : 5 \quad (\because 54 : 90 = 3 : 5)$$

Now the share of profit of $B = 3600 - 1800 = \text{Rs. } 1800$

So the share of profit of A (excluding commission) = $\text{Rs. } 1080$

So the commission of $A = 1800 - 1080 = 720$

$$\text{Therefore the required percentage} = \frac{720}{3600} \times 100 = 20\%$$

$$11. \text{ Profit \%} = \frac{25}{100} = \frac{120 + k}{880} \text{ (Profit)} \Rightarrow k = 100 \text{ (Sale)}$$

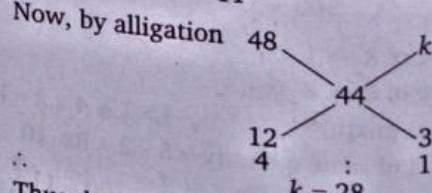
$$\text{Therefore, net profit \%} = \frac{100}{1000} \times 100 = 10\%$$

- 12.

$$SP = \frac{12}{11} \text{ of } CP$$

$$48 = \frac{12}{11} \text{ of } CP \Rightarrow CP = 44$$

Now, by alligation



Thus the price of speed brand is $\text{Rs. } 28/\text{litre}$.

	A	B	C
14. Investment	$3x$	$4x$	$5x$
Rate of return	$6y\%$	$5y\%$	$4y\%$
Return	$\frac{18xy}{100}$	$\frac{20xy}{100}$	$\frac{20xy}{100}$

$$\text{Total} = (18 + 20 + 20) = \frac{58xy}{100}$$

$$B's \text{ earnings} - A's \text{ earnings} = \frac{2xy}{100} = 250$$

$$\text{Total earning} = \frac{58xy}{100} = 7250$$

14. MP after first discount
100 90 after second discount
So, the net discount = $100 - 85.5 = 14.5\%$

15. MP CP Total CP
100 → 80 → 72 → 79.2
- 20% - 10% + 10%

$$SP = 125\% \text{ of CP}$$

$$SP = 1.25 \times 79.2$$

$$SP = 99$$

So, initially marked price = 100 ⇒ 8,00,000

Final sale price = 99 ⇒ 7,92,000

16. Price of 10 chairs = $10 \times 200 = 2000$

Price of 12 chairs (without discount) = $12 \times 200 = 2400$

Price of 12 chairs with discount = $10 \times 200 + 2 \times 80 = 2160$

therefore discount = $2400 - 2160 = 240$

$$\text{Hence discount \%} = \frac{240}{2400} \times 100 = 10\%$$

17. Amount paid in 1st service = 100 (suppose)

Amount paid in 2nd service = 90

Amount paid in 3rd service = 81

Amount paid in 4th service = 72.9

Amount paid in 5th service = 60

Total amount paid 403.9

$$\text{Discount} = 500 - 403.9 = 96.1$$

$$\text{Discount \%} = \frac{96.1}{500} \times 100 = 19.42\%$$

18. Consider some proper values and then check out.

$$\begin{array}{l} \text{CP : SP} \\ 3 : 4 \end{array}$$

Profit on 3 apples = Re 1 (consider CP = Re 1)

Profit = 33.33%

discount = 11.11%

$$\begin{array}{ccc} \text{CP} & \text{SP} & \text{MP} \\ 3 & 4 & 4.5 \\ & (1) & (0.5) \end{array}$$

Profit is double that of discount

So, the percentage point difference = $33.33\% - 11.11\% = 22.22\% \text{ point}$

20. Total cost of 4 cars = $1 + 2 = 3 \text{ lakh}$
Total SP of 4 cars = $3 \times 1.5 = 4.5 \text{ lakh}$
SP of 1 car = 1.2 lakh
SP of rest 3 cars = $4.5 - 1.2 = 3.3 \text{ lakh}$

Average SP of all the 3 cars = 1.1 lakh

21. Setup cost = Rs. 2800
Paper etc. = Rs. 1600
Printing cost = Rs. 3200
Total cost = Rs. 7600

$$\text{Total sale price} = 1500 \times 5 = 7500$$

Let the amount obtained from advertising is x then
 $(7500 + x) - 7600 = 25\% \text{ of } 7500$
 $x = 1975$

$$22. \text{ Charge of 1 call in February} = \frac{350}{150} = \frac{7}{3}$$

$$\text{Charge of 1 call in March} = \frac{350 + 50 \times 1.4}{250} = \frac{420}{250} = \frac{42}{25}$$

$$\% \text{ cheapness of a call in March} = \frac{\frac{7}{3} - \frac{42}{25}}{\frac{7}{3}} \times 100 = 28\%$$

23. Let the CP be 100 and % markup be $k\%$ then

$$MP = 100 + k$$

$$100 \xrightarrow{k\%} (100 + k) \text{ MP (also expected SP)}$$

$$\text{but actual SP} = \frac{100 + k}{2}$$

$$\therefore \left[\frac{(100 + k)}{2} \right] = \frac{200}{3 \times 100} (= 66.66\%)$$

$$\Rightarrow k = 300$$

$$\text{Therefore} \quad \begin{array}{ll} \text{CP} & \text{MP} \\ 100 & 400 \end{array} \quad (\text{initially})$$

$$\text{Finally SP} = \frac{400}{2} = 200$$

$$\therefore \text{Discount} = \frac{200}{400} \times 100 = 50\%$$

Alternatively: $MP \rightarrow M$

$$SP \rightarrow \frac{M}{2}$$

$$\text{Discount \%} = \frac{M/2}{M} \times 100 = 50\%$$

24. Let the CP and SP of 1 g = Re 1, then

He spends Rs. 2000 and purchase 2200 g
and he charges Rs. 2000 and sells 1800 g

$$\text{profit \%} = \frac{\text{goods left}}{\text{goods sold}} \times 100$$

$$= \frac{400}{1800} \times 100 = 22\frac{2}{9}\%$$

25.

Fresh grapes		
Water	Pulp	
80%	20%	
4	:	1
Dry grapes		
Water	Pulp	
25%	75%	
1	:	3
5 kg	15 kg	[out of 20 kg dry grapes]
+ (55 kg)	20%	Required proportion of
60 kg	1	water and pulp
	15 kg	

Thus to make dry grapes similar to the fresh grapes, Akram requires 55 kg water with 20 kg of dry grapes.

$$\text{So, the profit (\%)} = \frac{55}{20} \times 100 = 275\%$$

26. Let the total profit be 100

$$\text{Amount left after donation} = 80$$

$$\text{Amount left after reinvestment} = 20$$

$$\text{Now, } \frac{5x}{8} - \frac{3x}{8} = 1200$$

where x is the amount left after reinvestment

$$\frac{2x}{8} = 1200 \Rightarrow x = 4800$$

$$\text{Therefore, total profit} = 4800 \times 5 = 24000$$

Alternatively: Go through options.

27. Total cost = Rs. 50,000

$$\text{Total sale price (or revenue)} = 2000 \times 9 + 6000 \times 10 = 78,000$$

$$\text{profit (\%)} = \frac{28000}{50000} \times 100 = 56\%$$

28. The maximum possible profit

= maximum possible difference in SP and CP.

It means SP be maximum and CP be minimum

$$CP_{(\min)} = \text{Rs. } 399 \quad 19m = 399$$

where m is an integer.

Again $SP_{(\max)} = \text{Rs. } 697$, which is very close to 699

Here $697 = 17k$; k is a positive integer.

So, the maximum profit = $697 - 399 = \text{Rs. } 298$

29. Total cost price = $1000 \times 1.2 = \text{Rs. } 1200$

Expected selling price = $700 \times x = 1200 \times 1.1666 = 1400$

$$\Rightarrow x = \text{Rs. } 2 \text{ per toy}$$

Now the real selling price = $750 \times 2 = \text{Rs. } 1500$

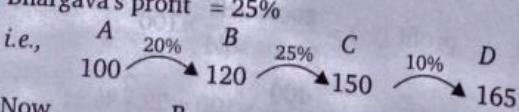
$$\text{Profit} = \text{Rs. } 300 (= 1500 - 1200)$$

$$\therefore \text{Profit \%} = \frac{300}{1200} \times 100 = 25\%$$

30. Chaudhary's profit = 10%

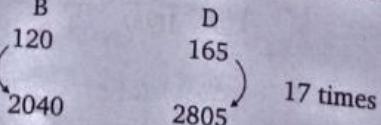
Anupam's profit = 20%

Bhargava's profit = 25%



Now

17 times



31. From the above statement it is clear that he purchases 119 g instead of 100 g. Therefore in this whole transaction he saves $19 + 15 = 34$ g
Thus the profit = $\frac{34}{85} \times 100 = \left(\frac{\text{Goods left}}{\text{Goods sold}} \times 100 \right) = 40\%$

NOTE In this type of question always equate either money or weight for simple solution.

32. You must know that the company is able to deliver only 90% of the manufactured pens. So let K be the manufacturing price of a pen, then total income (including 25% profit) = $(8000 \times K) \times 1.25$ also this same income is obtained by selling 90% manufactured pens at Rs. 10 which is equal to 7200×10 Thus $(8000 \times K) 1.25 = 7200 \times 10$

$$K = \text{Rs. } 7.2 \quad (90\% \text{ of } 8000 = 7200)$$

33. Let the number of diaries (produced) be 100 and the cost price of a diary be Re 1 then

$$\text{Total cost incurred} = 100 \times 1 = 100$$

$$\text{Total sale price} = 32 \times 0.75 + 60 \times 1.4 = 108$$

$$\text{Therefore profit} = \text{Rs. } 8$$

Thus there is 8% profit

NOTE Marked price (i.e., expected) = 40% above the cost price.

34. Let the number of sweets be 100 and the cost price of one piece of sweet = Re. 1

$$\text{then, total cost price} = 100 \times 1 = \text{Rs. } 100$$

$$\text{Total sale price} = 40 \times 1.4 + 30 \times 1.2 + 30 \times 1.05 = 123.5$$

$$\therefore \text{profit (\%)} = 23.5\% \quad (= 123.5 - 100)$$

CP	SP	MP
500	576	900

$$\text{Again } SP = MP \left[\left(1 - \frac{r}{100} \right)^2 \right] \quad [r \rightarrow \text{rate of discount in \%}]$$

$$\Rightarrow 576 = 900 \left(1 - \frac{r}{100} \right)^2$$

$$\Rightarrow \frac{24}{30} = \left(1 - \frac{r}{100} \right) \Rightarrow r = 20\%$$

$$\text{Again, new } SP = MP \left(1 + \frac{r}{100} \right)^2 = 900 \left(1 + \frac{20}{100} \right)^2 = 123.6$$

$$\text{New, profit percentage} = \frac{SP - CP}{CP} \times 100$$

$$= \frac{123.6 - 500}{500} \times 100 = 159.2\%$$

36. Consider actual price of 1 g goods = Re. 1 then he sells the product equals to Rs. 90 only (10% less weighing). Again MP = Rs. 1.8 and SP = 1.35 for 1 g. Thus he gives the goods worth Rs. 90 and charges Rs. 135 after 25% discount. Thus the profit %

$$= \frac{135 - 90}{90} \times 100 = 50\%$$

37.

$$CP = \frac{100}{120} = \frac{10}{12}$$

(since he purchases 120 g and pays Rs. 100, by assumption actual CP of 1 g = Re. 1)

(Since actual MP = 180, actual SP = 135, with 25% discount and he sells only 90 g instead of 100 g)

$$\text{profit (\%)} = \frac{\frac{18}{12} - \frac{10}{12}}{\frac{10}{12}} \times 100 = 80\%$$

38. Let the actual cost price of an article be Re 1 (in place of x). Now he purchases goods worth Rs. 120 and pays Rs. 80, since 20% discount is allowed.

$$\text{So the CP} = \frac{80}{120} = \frac{2}{3}$$

Again MP = 180, SP = 135 (since 25% discount)

Thus the trader sells goods worth Rs. 90 instead of 100 g and charges Rs. 135. Therefore the effective SP = $\frac{135}{90} = \frac{3}{2}$

$$\text{profit (\%)} = \frac{\frac{3}{2} - \frac{2}{3}}{\frac{2}{3}} \times 100 = 125\%$$

	Anjuli	Bhoomika	Chawla
100	100	100	100
↓ - 20%	↓ - 15%	↓ - 12%	↓ - 13%
80	23.5	85	88
↓ - 5%	↓ - 10%		
76	76.5		76.56

Thus it is clear from the graphical solution that the maximum discount is availed by Anjuli.

NOTE It does not matter that we first decrease by 20% and then by 5% or vice-versa. This concept has been already illustrated in percentage chapter. Try to do it for your concept clarification.

40. CP of one egg (in first case) = $\frac{1}{3} = 33.33$ paise

CP of one egg (in second case) = $\frac{1}{6} = 16.66$ paise

Average CP of one egg = $\frac{(33.33 + 16.66)}{2} = 25$ paise

SP of one egg = $\frac{200}{9}$ (Re. 1 = 100 paise)

$$\text{profit-loss} = \frac{25 - \frac{200}{9}}{25} \times 100 \quad \left(\text{loss \%} = \frac{\text{CP} - \text{SP}}{\text{CP}} \times 100 \right)$$

$$= 11.11\% \text{ loss}$$

41. This question is based on fundamental concept of percentage change.

$$\text{Virendra} = \text{CP}_V \xrightarrow{\rightarrow P\%} \text{SP}_V$$

$$\text{Gurindra} = \text{CP}_G \xrightarrow{Q\% \leftarrow} \text{SP}_G$$

$$\text{CP}_V = \text{CP}_G \quad \text{and} \quad \text{SP}_V = \text{SP}_G$$

$$P \neq Q$$

$$P\% \text{ of } \text{CP}_V = Q\% \text{ of } \text{SP}_G$$

$$Q = 41 \frac{2}{3}\% \text{ of } P = \frac{125}{3} \times \frac{P}{100}$$

$$\text{and} \quad Q = \frac{P}{100 + P} \times 100$$

(From the concept of percentage change)

$$\therefore \frac{P}{100 + P} \times 100 = \frac{125}{3} \times \frac{P}{100} \quad \left(41 \frac{2}{3} = \frac{125}{3} \right)$$

$$\Rightarrow P = 140$$

$$\text{CP} = 100 \text{ when SP} = 240$$

Where $\text{CP} = \text{CP}_V = \text{CP}_G$ and $\text{SP} = \text{SP}_V = \text{SP}_G$

Again SP for Amrindra = $240 + 140\% \text{ of } 240 = 576$

42. Let the CP of one article be Rs. 1 then the SP be Re. 1.25

Again the new SP be $(1.25) \times 1.2 = 1.5$

Now, if he sell initially 100 articles, then

$$\text{CP} = 100 \times 1 = \text{Rs. 100}$$

$$\text{SP} = 100 \times 1.25 = \text{Rs. 125}$$

New SP = $75 \times 1.5 = 112.5$ (since 25% articles were abducted)

New profit percentage = 12.5%

43. **Note :** First of all the price of milk does not matter. You can assume any convenient price. Besides it instead of 10 l of milk you can consider 100 l of milk to avoid calculations in decimal.

Now, since water is 16.66% in the mixture of milk, therefore with 100 l pure milk 20 l water is added. Again note that in replacement method the quantity of mixture does not increase except to the variation in ratio of contents.

Again by replacement formula

$$\frac{80}{120} = \frac{100}{120} \left(1 - \frac{K}{120} \right) \Rightarrow K = 24 \text{ l}$$

Thus he replaces 24 l of mixture with water.

(Note the required ratio of milk is to water is 2 : 1. It means in 3 l of new mixture, there will be 2 l of water)

Thus if the price of new mixture be Re 1, then the price of replaced mixture be Rs. 2.

Therefore, total SP = $120 \times 1 + 24 \times 2 = 168$

and $\text{CP} = 100 \times 1 = 100$

Profit % = 68%

44. Candle Bulb

CP	a	c
SP	b	d

and $c = 2a$

$$\text{Profit} = 10(b - a) = 3d$$

$$\text{Loss} = 10(c - d) = 4b$$

$$\text{Profit \%} = \frac{3d}{10a} \times 100$$

$$\text{and} \quad \text{Loss \%} = \frac{4b}{10c} \times 100$$

$$\text{Again} \quad \frac{3d}{10a} \times 100 = \frac{4b}{10c} \times 100$$

$$\Rightarrow \frac{3d}{a} = \frac{4b}{c} \Rightarrow \frac{3d}{a} = \frac{4b}{2a} \quad (\because c = 2a)$$

$$\Rightarrow \frac{b}{d} = \frac{3}{2}$$

45. Let the CP of each motorcycle be Rs. x , then

$$2(1.15x) + 4800 = 2(1.2x)$$

$$0. x = 4800 \Rightarrow x = 48000$$

