STAFF SELECTION COMMISSION – Solved Papers

TIME AND DISTANCE - RAIL (Some Important Exercises)

1. Express a speed of 36 km per hr. in metres per second.

(1) 10 m/sec. (2) 8 m/sec

(3) 12 m/sec. (4) 18 m/sec.

Ans : 1

36 km per hr. $=\left(36\times\frac{5}{18}\right)$ m per sec.

= 10 m per sec.

2. Express a speed of 60 metres per sec. in km per hour.

(1) 232 kmph (2) 216 kmph

(3) 116 kmph (4) 118 kmph

Ans : 2

60 metres per sec.

$=\left(60\times\frac{18}{5}\right)$ km per hr.

= 216 km per hr.

3. A man covers 20 kms in 2 hours. Find the distance covered by him in $5\frac{1}{2}$ hours.

(1) 50 km (2) 65 km

(3) 55 km (4) 45 km

Ans : 3

Distance = 20 kms

Time = 2 hours

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

$=\frac{20}{2}=10$ km per hr.

Now, we have, Speed = 10 km per hr.

Time $=\frac{11}{2}$ hr.

$\therefore$ Distance = Speed × Time

$=10\times\frac{11}{2}=55$ km.

4. A car runs at 60 km per hr. A man runs at one-third the speed of the car and reaches office from his house in 15 minutes. How far is his office from his house?

(1) 7 km (2) 5.5 km

(3) 6 km (4) 5 km

Ans : 4

Man's speed $=\frac{1}{3}$ of the speed of car

$=\frac{1}{3}\times 60=20$ km per hr.

Time taken to reach office = 15 minutes $=\frac{15}{60}=\frac{1}{4}$ hr.

$\therefore$ Distance between his house and office

= Speed × Time

$=20\times\frac{1}{4}=5$ km.

5. Walking at a speed of 6 kms per hour, a man takes 5 hours to complete his journey. How much time will he need to complete the same journey at the rate of 8 km per hour?

(1) $3\frac{3}{4}$ hours (2) 3 hours

(3) $2\frac{3}{4}$ hours (4) 3.5 hours

Ans : 1

Speed = 6 kms per hr.

Time taken = 5 hours

$\therefore$ Distance covered

$= 6 \times 5 = 30$ kms

$\therefore$ Time required to cover 30 kms at the speed of 8 kms per hr.

$=\frac{\text{Distance}}{\text{Speed}}=\frac{30}{8}=\frac{15}{4}$ hours

$=3\frac{3}{4}$ hours

6. A person covers 10 kms at 4 kms per hour and then further 21 kms at 6 kms per hour. Find his average speed for whole journey.

(1) $5\frac{1}{3}$ kmph (2) $5\frac{1}{6}$ kmph

(3) $5\frac{1}{2}$ kmph (4) $4\frac{1}{2}$ kmph

Ans : 2

Case I.

Distance = 10 kms

Speed = 4 kms per hr.

$\therefore$ Time taken (t_1) $=\frac{10}{4}=\frac{5}{2}$ hrs.

Case II.

Distance = 21 kms

Speed = 6 kms per hr.

$\therefore$ Time taken (t_2) $=\frac{21}{6}=\frac{7}{2}$ hrs.

Total time $= \frac{5}{2} + \frac{7}{2} = \frac{5+7}{2}$

$= 6$ hrs.

Total distance covered

$= 10 + 21 = 31$ kms

$\therefore$ Average speed

$= \frac{\text{Total Distance}}{\text{Total time}}$

$= \frac{31}{6}$ km per hr.

$= 5\frac{1}{6}$ km per hr.

7. P and Q are two cities. A boy travels on cycle from P to Q at a speed of 20 km per hour. and returns at the rate of 10 km per hour. Find his average speed for the whole journey.

(1) $13\frac{2}{3}$ kmph

(2) $12\frac{1}{3}$ kmph

(3) $13\frac{1}{3}$ kmph

(4) $12\frac{2}{3}$ kmph

Ans : 3

Let the speed between P and Q be x km.

Then time taken to cover x km.

From P to Q $= \frac{x}{20}$ hrs.

Time taken to cover x km from Q to P at 10 km per hr.

$= \frac{x}{10}$ hrs.

$\therefore$ Total distance covered

$= x + x = 2x$ km.

$= \frac{x}{20} + \frac{x}{10} = \frac{x+2x}{20} = \frac{3x}{20}$ hrs

$\therefore$ Average Speed

$= \frac{2x}{\frac{3x}{20}} = \frac{2x \times 20}{3x}$

$= \frac{40}{3}$ km per hr.

$= 13\frac{1}{3}$ km per hr.

Aliter :

Here, $x = 20$ km per her.

y = 10 km per hr.

$\therefore$ Average speed

$= \frac{2xy}{x+y} = \frac{2 \times 20 \times 10}{20+10}$

$= \frac{400}{30} = \frac{40}{3} = 13\frac{1}{3}$ km per hr.

8. A man walked a certain distance. One-third he walked at 5km per hour. Another one-third he walked at 10 km per hour and the rest at 15 km per hour. Find his average speed.

(1) $8\frac{1}{11}$ kmph

(2) $7\frac{1}{11}$ kmph

(3) $7\frac{2}{11}$ kmph

(4) $8\frac{2}{11}$ kmph

Ans : 4

Here, the man covers equal distance at different speeds. Using the formula, the Average Speed is given by

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

$= \frac{90}{11} = 8\frac{2}{11}$ km per hour.

9. An aeroplane travels a distance in the form of a square with the speeds of 400 km per hour, 600 km per hour, 800 km per hour, and 1200 km per hour respectively. Find the average speed for the whole distance along the four sides of the square.

(1) 640 kmph (2) 620 kmph

(3) 630 kmph (4) 650 kmph

Ans :

As distances are covered along four sides (equal) of a square at different speeds, the average speed of the aeroplane

$= \frac{4}{\frac{1}{400} + \frac{1}{600} + \frac{1}{800} + \frac{1}{1200}}$

$= \frac{4}{\frac{30+20+15+10}{12000}}$

$= \frac{48000}{75} = 640$ km per hr.

10. A man covers one-third of his journey at 30 km per hour and the remaining two-third at 45 km per hour. If the total journey is of 150 kms. What is his average speed for the whole journey?

(1) 38 kmph (2) $38\frac{4}{7}$ kmph

(3) 64 kmph (4) $39\frac{4}{7}$ kmph

Ans : 2

Length of journey = 150 kms $\frac{1}{3}$rd of journey = $\frac{150}{3}=50$ kms Remaining $\frac{2}{3}$rd journey

= 150 – 50 = 100 kms

Time takne in $\frac{1}{3}$rd journey at 30 km per hr.

$t_1 = \frac{50}{30}=\frac{5}{3}$ hrs.

Time taken in $\frac{2}{3}$rd journey at 45 km per hour.

$t_2 = \frac{100}{45}=\frac{20}{9}$ hrs.

Total time taken in whole journey = $t_1 + t_2$

$=\frac{5}{3}+\frac{20}{9}=\frac{15+20}{9}=\frac{35}{9}$ hrs.

Average Speed

$=\frac{150}{\frac{35}{9}}=\frac{150\times9}{35}=\frac{270}{7}$

$=38\frac{4}{7}$ km per hr.

11. When a person covers the distance between his house and office at 50 km per hour. he is late by 20 minutes. But when he travels at 60 km per hour. he reaches 10 minutes early. What is the distance between his office and his house?

(1) 140 km (2) 160 km

(3) 150 km. (4) 120 km.

Ans : 3

Let the distance between his house and office be *D* kms.

Time taken to reach office at 50 km per hr. $\frac{D}{50}$ hrs.

Time taken to reach office at 60 km per hr. $\frac{D}{60}$ hrs.

With the speed of 50 km per hr. he is 20 minutes late and at that of 60 km per hr. he is 10 minutes early, so we can write

$\frac{D}{50}-\frac{D}{60}=\frac{D}{60}+\frac{D}{60}$

$\Rightarrow \frac{D}{50}-\frac{D}{60}=\frac{20}{60}+\frac{10}{60}$

$\Rightarrow \frac{D}{50}-\frac{D}{60}=\frac{20+10}{60}=\frac{1}{2}$

$\Rightarrow \frac{6D-5D}{300}=\frac{1}{2}$

$\Rightarrow \frac{D}{300}=\frac{1}{2}$

$\therefore D=\frac{300}{2}=150$ kms.

12. A boy walks from his house at 4 km per hour and reaches his school 9 minutes late. If his speed had been 5 km per hour he would have reached his school 6 minutes earlier. How far his school from house?

(1) 6.5 km (2) 5.5 km

(3) 6 km (4) 5 km

Ans : 4

Let the required distance be *x* kms.

When speed is 4 km per hr, time taken $t_1 = \frac{x}{4}$ hours

Again, when speed is 5 kmper hr, time taken $t_2 = \frac{x}{5}$ hours

Difference in timings

= 9 + 6 = 15 minutes

$=\frac{15}{60}$ hours

i.e., $t_1 - t_2 = \frac{15}{60}=\frac{1}{4}$ hours

$\therefore \frac{x}{4}-\frac{x}{5}=\frac{1}{4}$

$\Rightarrow \frac{5x-4x}{20}=\frac{1}{4}$

$\Rightarrow \frac{x}{20}=\frac{1}{4}$

$\Rightarrow x=\frac{20}{4}=5$ kms.

Hence the required distance = 5 kms.

13. A car travels a distance of 300 kms at uniform speed. If the speed of the car is 5 km per hour, it takes two hours less to cover the same distance. Find the original speed of the car.

(1) 25 kmph (2) 20 kmph

(3) 24 kmph (4) 28 kmph

Ans : 1

Let the original speed of the car = *x* km per hr.

When it is increased by 5 km per hr, the speed = *x* + 5 km per hr.

As per the given information in the question.

$\frac{300}{x}-\frac{300}{x+5}=2$

$\Rightarrow \frac{300(x+5)-300x}{x(x+5)}=2$

$\Rightarrow \frac{300x+1500-300x}{x^2+5x}=2$

$\Rightarrow \frac{1500}{x^2+5x} = 2$

$\Rightarrow \frac{750}{x^2+5x} = 1$

$\Rightarrow x^2 + 5x = 750$

$\Rightarrow x^2 + 30x - 25x - 750 = 0$

$\Rightarrow x(x + 30) - 25(x + 30) = 0$

$\Rightarrow (x + 30)(x - 25) = 0$

$\Rightarrow x = -30$ or 25

The negative value of speed is inadmissible.

Hence, the required speed = 25 km per hr.

14. A car finish a certain journey in 10 hours at a speed of 48 km per hour. In order to cover the same distance in 8 hours. How much the speed be increased by?

(1) 10 kmph (2) 12 kmph

(3) 14 kmph (4) 15 kmph

Ans : 2

Time = 10 hours

Speed = 48 km per hour.

$\therefore$ Distance = Speed × Time

= 48 × 10 = 480 kms

Now, this distance of 480 kms is to be covered in 8 hours. Hence, the required Speed

$= \frac{\text{Distance}}{\text{New Time}} = \frac{480}{8}$

= 60 km per hr.

$\therefore$ Increase in speed

= 60 – 48 = 12 km per hr.

15. If a boy walks from his house to school at the rate of 4 km per hour he reaches the school 10 minutes earlier than the scheduled time. However if he walks at the rate of 3 km per hour, he reaches 10 minutes late. Find the distance of his school from his house.

(1) 3.5 km (2) 3 km

(3) 4 km (4) 4.5 km

Ans : 3

Let the distance be x kms.

$\therefore$ Time taken at 4 km per hr.

$t_1 = \frac{x}{4}$ hrs.

Time taken at 3 km per hr. t_2

$= \frac{x}{3}$ hrs.

Difference in timings

= 10 + 10 = 20 minutes

$= \frac{20}{60} = \frac{1}{3}$ hour

$\therefore \frac{x}{3} - \frac{x}{4} = \frac{1}{3}$

$\Rightarrow \frac{4x-3x}{12} = \frac{1}{3}$

$\Rightarrow \frac{x}{12} = \frac{1}{3}$

$\therefore x = 4$ kms.

Hence the required distance = 4kms.

16. A man has to reach a place 40 kms away. He walks at the rate of 4 km per hour for the first 16 kms and then he hires a rickshaw for the rest of the journey. However if he had travelled by the rickshaw for the first 16 kms and the remaining distance on foot at 4 km per hour, he would have taken an hour longer to complete the journey. Find the speed of rickshaw.

(1) 6.5 kmph (2) 7.5 kmph

(3) 6 kmph (4) 8 kmph

Ans : 4

Let the speed of rickshaw be x km per hr.

Time taken to cover 16 kms at 4km per hr. on foot

$= \frac{\text{Distance}}{\text{Speed}} = \frac{16}{4} = 4$ hours

Time taken to cover (40 – 16)

= 24 kms in rickshaw

$= \frac{24}{x}$ hours

$\therefore$ Total time taken to cover whole journey

$= \left(4 + \frac{24}{x}\right)$ hours

Again, time taken to cover 16 kms in rickshaw = $\frac{16}{x}$ hours

and time taken to cover 24 kms on foot at 4 km per hr. $= \frac{24}{4} = 6$ hours

$\therefore$ Total time taken to cover whole journey

$= \left(6 + \frac{16}{x}\right)$ hours

$\therefore$ According to the question

$\left(6 + \frac{16}{x}\right) - \left(4 + \frac{24}{x}\right) = 1$

$\Rightarrow 6 + \frac{16}{x} - 4 - \frac{24}{x} = 1$

$\Rightarrow \frac{24}{x} - \frac{16}{x} = 2 - 1 = 1$

$\Rightarrow \dfrac{24-16}{x} = 1$

$\Rightarrow x = 8$

$\therefore$ The speed of rickshaw

= 8 km per hour.

17. Walking $\frac{3}{4}$ of my usual speed, a late is marked on my cards by 10 minutes. Find my usual time.

(1) 30 minutes

(2) 35 minutes

(3) 32 minutes

(4) 36 minutes

Ans : 1

Since I walk at $\frac{3}{4}$ of my usual speed the time that I take is $\frac{4}{3}$ of my usual time. This is because the speed and time are in the inverse ratio when the distance is same.

$\therefore \frac{4}{3}$ of usual time

= Usual Time + Time 1 reach late

$\Rightarrow$ Usual time + $\frac{1}{3}$ of usual time

= Usual time + Time 1 reach late

$\therefore \frac{1}{3}$ of usual time

= 10 minutes

$\therefore$ Usual time

= 10 × 3 = 30 minutes

18. By walking $\frac{5}{3}$ of usual speed a student reaches school 20 minutes earlier. Find his usual time.

(1) 45 minutes

(2) 50 minutes

(3) 60 minutes

(4) None of these

Ans : 2

$\frac{5}{3}$ of usual time speed means

$\frac{3}{5}$ of usual time as he reaches earlier.

$\therefore \frac{3}{5}$ usual time + 20 minutes

= Usual time

20 minutes $= \left(1 - \frac{3}{5}\right)$ usual time

$\frac{2}{5}$ usual time

$\therefore$ Usual time

$= \dfrac{20 \times 5}{2} = 50$ minutes.

19. Walking at $\frac{3}{4}$ of his usual speed a man is late by $2\frac{1}{2}$ hours. The usual time would have been what?

(1) 7 hours (2) 7.5 hours

(3) 8 hours (4) 8.5 hours

Ans : 2

New speed is $\frac{3}{4}$ of the usual speed

$\therefore$ New time taken $= \frac{4}{3}$ of the usual time

$\therefore \frac{4}{3}$ of the usual time – Usual time $= \frac{5}{2}$

$\Rightarrow \frac{1}{3}$ of the usual time $= \frac{5}{2}$

$\therefore$ Usual time $= \frac{5}{2} \times 3$

$= \frac{15}{2}$ hours $= 7\frac{1}{2}$ hours.

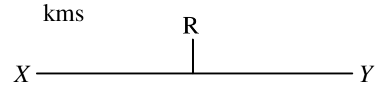
20. Two men A and B walk from X to Y a distance of 42 kms at 5 and 7 km an hour respectively. B reaches Y and returns immediately and meets A at R. Find the distance from X to R.

(1) 32 km (2) 30 km

(3) 35 km (4) 40 km

Ans : 3

When B meets A at R, by then B has walked a distance (XY + YR) and A, the distance XR. That is both of them have together walked twice the distance from X to Y i.e., 42 kms



Now, the ratio of speeds of A and B is 5 : 7 and they walk 84 kms.

$\therefore$ Hence, the distance XR travelled by

$A = \dfrac{5}{5+7} \times 84 = 35$ kms.

21. Two men A and B start walking simultaneously from P to Q, a distance of 21 kms, at the speeds of 3 km and 4km an hour respectively. B reaches

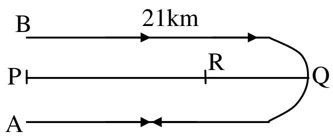
Q, returns immediately and meets A at R. Find the distance from P to R.

(1) 22 km (2) 20 km

(3) 16 km (4) 18 km

Ans : 4

Let A and B meet after time t hours



Distance covered by A in t hours = 3 t km.

Distance covered by B in t hours = 4 t km.

Total distance covered by A and B = (3t + 4t) km = 7 t km.

From the diagram we can see that the total distance covered by A and B is equal to twice the distance between P and Q.

$\therefore$ 7t = 2 × 21

$$t = \frac{2 \times 21}{7}$$

t = 6 hours

Distance PR = 6 × 3 = 18 kms.

22. Ram travelled one-third of a journey with a speed of 10 km per hour, the next one-third with a speed of 9 km per hour and the rest at a speed of 8 km per hour. If he had travelled half the journey at speed of 10 km per hour and the other half with a speed of 8 km per hour, he would have been 1 minute longer on the way. What distance did he travel?

(1) 36 km (2) 32 km

(3) 35 km (4) 40 km

Ans : 1

Let the total distance travelled be x kms.

Case I : Speed for the first one-third distance i.e. $\frac{x}{3}$ kms = 10km per hour.

$\therefore$ Time taken for the first one-third distance = $\frac{x}{30}$ hours

Similarly, time taken for the next one-third distance

$\frac{x}{27}$ hours

and time taken for the last one third distance = $\frac{x}{24}$ hours.

$\therefore$ Total time taken to cover x kms.

$$= \left(\frac{x}{30} + \frac{x}{27} + \frac{x}{24}\right) \text{hours.}$$

Case II :

Time taken for one-half distance at the speed of 10 km per hour = $\frac{x}{20}$ hrs.

and time taken for remaining $\frac{1}{2}$ of distance = $\frac{x}{16}$ hrs. at 8 km per hr.

Total time taken

$$= \left(\frac{x}{20} + \frac{x}{16}\right) \text{hrs.}$$

Difference between two times

= 1 minutes $= \frac{1}{60}$ hrs.

$\therefore$ According to the question

$$\frac{x}{20} + \frac{x}{16} - \left(\frac{x}{30} + \frac{x}{27} + \frac{x}{24}\right)$$

$$= \frac{1}{60}$$

$$\Rightarrow \frac{243x - 242x}{2160} = \frac{1}{60}$$

$$\Rightarrow \frac{2160}{60} = 36\text{kms.}$$

$$\Rightarrow x = \frac{2160}{60} = 36\text{kms.}$$

Hence the required distance = 36kms.

23. A man walks a distance of 35 kms. He walks for some time at 4 km per hour and for some time at 5 km per hour instead of 4 km per hour and 4 km per hour instead of 5km per hour, he will walk 2 kms more in the same span of time. Find his total time of total journey.

(1) 8.5 hours (2) 7.5 hours

(3) 8 hours (4) 7 hours

Ans : 3

Let the man walks for x hours at 4 km per hr. and y hours at 5 km per hr. and covers a distance of 35 kms.

$\therefore$ Distance = 4x + 5y = 35 …(i)

Now, he walks at 5km per hr. for x hours and at 4km per hr. for y hours and covers a distance (35 + 2) = 37 kms

$\therefore$ Distance = 5x + 4y = 37 …(ii)

By 5 × (i) – 4 × (ii) we have

$$\begin{array}{r} 20x + 25y = 175 \\ 20x + 16y = 148 \\ - \quad - \quad - \\ \hline 9y = 27 \end{array}$$

$\Rightarrow$ y = 3

Putting the value of (y) in equation (i), we have

$4x + 5 \times 3 = 35$

$\Rightarrow 4x = 35 - 15 = 20$

$\Rightarrow x = 5$

$\therefore$ Total time taken

$= x + y = 5 + 3 = 8$ hours

24. A man travels 400 kms in 4 hours partly by air and partly by train. If he had travelled all the way by air, he would have saved $\frac{4}{5}$ of the time he was in train and would have arrived his destination 2 hours early. Find the distance he travelled by train.

(1) 95 km. (2) 85 km.

(3) 90 km. (4) 100 km.

Ans : 4

Obviously, $\frac{4}{5}$ of total time in train = 2 hours

$\therefore$ Total time in train

$$= \frac{5}{4} \times 2 = \frac{5}{2} \text{ hours}$$

Total time to cover 400 kms is 4 hours.

$\therefore$ Time spent in travelling by air $= 4 - \frac{5}{2} = \frac{8-5}{2} = \frac{3}{2}$ hours

As per given information,

If 400 kms is travelled by air, then time taken = 2 hours

$\therefore$ In 2 hours, distance covered by air = 400 kms

In $\frac{3}{2}$ hours distance covered

$$= \frac{400}{2} \times \frac{3}{2} = 300 \text{ kms.}$$

Distance covered by the train

$= 400 - 300 = 100$ kms.

25. On increasing the speed of a train at the rate of 10 km per hour, 30 minutes is saved in a journey of 100 kms. Find the initial speed of train.

(1) 40 kmph (2) 45 kmph

(3) 90 km. (4) 100 km.

Ans : 1

Let the original speed of the train be x km per hr.

$\therefore$ Time taken to cover 100 kms $= \frac{100}{x}$ hrs.

On increasing its speed by 10km per hr. new speed

$= x + 10$ km per hr.

$\therefore$ Time taken to cover 100 kms at $x + 10$ km per hr.

$$= \frac{100}{x+10} \text{hrs}$$

Now, 30 minutes $= \frac{30}{60}$ hr. $= \frac{1}{2}$ hr. is saved due to increased speed.

$$\therefore \frac{100}{x} - \frac{100}{x+10} = \frac{1}{2}$$

$$\Rightarrow \frac{100(x+10) - 100(x)}{x(x+10)} = \frac{1}{2}$$

$$\Rightarrow \frac{100x + 1000 - 100x}{x^2 + 10x} = \frac{1}{2}$$

$$\Rightarrow \frac{1000}{x^2 + 10x} = \frac{1}{2}$$

$\Rightarrow x^2 + 10x = 2000$

$\Rightarrow x^2 + 10x - 2000 = 0$

$\Rightarrow x^2 + 50x - 40x - 2000 = 0$

$\Rightarrow x(x + 50) - 40(x + 50) = 0$

$\Rightarrow (x + 50)(x - 40) = 0$

$\Rightarrow x = -50$ or 40

But speed can't be negative.

$\therefore x$ = 40 km per hr. is admissible value.

Hence, the original speed of train = 40 km per hr.

26. Ravi can walk a certain distance in 40 days when he rests 9 hours a day. How long will he take too walk twice the distance, twice as fast and rest twice as long each day?

(1) 80 days (2) 100 days

(3) 90 days (4) 95 days

Ans : 2

Working hours per day

$= 24 - 9 = 15$ hrs

Total working hours for 40 days

$= 15 \times 40 = 600$ hrs

On doubling the distance, the time required becomes twice but on walking twice as fast the time required gets haived. Therefore, the two together cancel each other with respect to time required. Increasing rest to twice reduces walking hours per day to

$24 - (2 \times 9) = 6$ hrs.

$\therefore$ Total number of days required to cover twice the distance, at twice speed with twice the rest.

$$= \frac{600}{6} = 100 \text{ days}$$

27. A monkey climbing up a greased pole ascends 12 metres and slips down 5 metres in alternate minutes. If the pole is

63 metres high, how long will it take him to reach the top?

(1) 18 minutes

(2) 16 minutes

(3) $16\frac{7}{12}$ minutes

(4) 18 minutes 20 seconds

Ans : 3

In 1 minute the monkey climbs 12 metres but then he takes 1 minute to slip down 5 metres. So, at the end of 2 minutes the net ascending of the monkey is 12 – 5 = 7 metres. Thus to have a net climbing of 7 metres, the process of climbing up and down happens once. So, to cover 63 metres the above process is repeated

$\frac{63}{7}$ = 9 times. Obviously, in 9 such happenings the monkey will slip 8 times, because on 9^{th} time, it will climb to the top. Thus, in climbing 8 times and slipping 8 times, he covers 8 × 7 = 56 metres.

Time taken to cover 56 metres

$$= \frac{56\times2}{7} = 16 \text{ minutes}$$

Remaining distance

= 63 – 56 = 7 metres

Time taken to ascend 7 metres

$= \frac{7}{12}$ minutes

$\therefore$ Total time taken $= 16 + \frac{7}{12}$

$= 16\frac{7}{12}$ minutes.

28. A hare sees a dog 100 metres away from her and scuds off in the opposite direction at a speed of 12 km per hr. A minute later the dog perceives her and chases her at a speed of 16 km per hr. How soon will the dog overtake the hare and at what distance from the spot when the hare took flight?

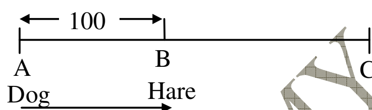
(1) 900 metre

(2) 950 metre

(3) 1000 metre

(4) 1100 metre

Ans : 4



Let the hare at B sees that dog is at A.

$\therefore AB$ = 100 metres

Again, let C be the position of the hare when the dog sees her.

$\therefore BC$ = the distance covered by the hare in 1 minute.

$= \frac{12\times1000\times1}{60} = 200$ metres

$\therefore AC = AB + BC$

= 100 + 200 = 300 metres

Thus, hare has a start of 300 metres.

Now, the dog gains 16 – 12 = 4 kms

4000 metres in 1 hour i.e. 60 minute

$\therefore$ The distance gained by dog in 1 minute

$= \frac{4000}{600} = \frac{200}{3}$ metres

$\because \frac{200}{3}$ metres is covered in 1 minute

$\therefore$ 300 metres is covered in

$\frac{300\times3}{200} = \frac{9}{2}$ minutes

Again the distance walked by hare in $\frac{9}{2}$ minutes

$= \frac{12000}{60}\times\frac{9}{2} = 900$ metres

$\therefore$ Required distance from

B = 200 + 900 = 1100 metres.

29. A hare, pursued by a grey hound is 50 of her own leaps before him. While the hare takes 4 leaps, the grey hound takes 3 leaps. In one leap, the hare goes 1.75 metres and the grey hound 2.75 metres. In how many leaps, will the grey hound overtake the hare?

(1) 210 leaps (2) 220 leaps

(3) 230 leaps (4) 250 leaps

Ans : 1

Grey hound and hare make 3 leaps and 4 leaps respectively. This happens at the same time.

The hare goes 1.75 metres in 1 leap.

$\therefore$ Distance covered by hare in 4 leaps = 4 × 1.75 = 7 metres

The grey hound goes 2.75 metres in one leap.

$\therefore$ Distance covered by it in 3 leaps

= 3 × 2.75 = 8.25 metres

Distance gained by grey hound in 3 leaps = (8.25 – 7)

= 1.25 metres

Distance covered by hare in 50 leaps = 50 × 1.75 metres

= 87.5 metres

Now, 1.25 metres is gained by grey hound in 3 leaps

$\therefore$ 87.5 metres is gained in

$$\frac{3}{1.25}\times 87.5 = 210 \text{ leaps.}$$

30. In a flight of 600 kms an aircraft was slowed down due to bad weather. Its average speed for the trip was reduced by 200 km per hr. and the time of flight increased by 30 minutes. Find the duration of flight.

(1) 1.2 hours (2) 1 hour

(3) 1.5 hours (4) 2 hours

Ans: 2

Let the original speed of the aircraft be x km per hr.

Then, new speed

= (x – 200) km per hr.

Duration of flight at original

$$\text{speed} = \frac{600}{x}\text{hrs.}$$

$$\therefore \frac{600}{x-200}-\frac{600}{x}=\frac{1}{2}$$

$$\Rightarrow \frac{600x-600(x-200)}{x(x-200)}=\frac{1}{2}$$

$$\Rightarrow \frac{120000}{x^2-200x}=\frac{1}{2}$$

$\Rightarrow x^2 - 200x - 240000 = 0$

$\Rightarrow x^2 - 600x + 400x - 240000 = 0$

$\Rightarrow x(x - 600) + 400(x - 600) = 0$

$\Rightarrow (x - 600)(x + 400) = 0$

$\Rightarrow x = 600 - 400$

But speed cannot be negative

$\therefore$ The original speed of the aircraft = 600 km per hr.

Hence, duration of flight

$$= \frac{600}{x}\text{hr.} = \frac{600}{600}\text{hr.} = 1\text{hr.}$$

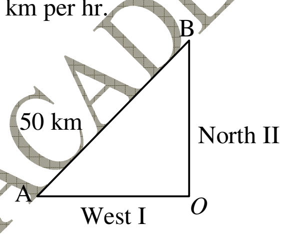
31. Two trains leave a railway station travels due west and the second train due north. The first train travels 5 km per hr. faster than the second train. If after two hours they are 50 km apart, find the average speed of faster train.

(1) 18 kmph (2) 15 kmph

(3) 20 kmph (4) 25 kmph

Ans : 3

Let the speed of the second train be x km per hr. Then the speed of the first train is x + 5 km per hr.



Let O be the position of the railway station from which the two trains leave. Distance travelled by the first train in 2 hours = OA 2 (x + 5) km.

Distance travelled by the 2nd train in 2 hours = OB = 2x km.

By Pythagoras theorem. $AB^2 = OA^2 + OB^2$

$$\Rightarrow 50^2 = \left[2(x+5)^2 + 2x^2\right]$$

$$\Rightarrow 2500 = 4(x+5)^2 + 4x^2$$

$2500 = 4(x^2 + 10x + 25) + 4x^2$

$$\Rightarrow 8x^2 + 40x - 2400 = 0$$

$$\Rightarrow x^2 + 20x - 15x - 300 = 0$$

$$\Rightarrow x(x+20) - 15(x+20) = 0$$

$$\Rightarrow (x-15)(x+20) = 0$$

$$\Rightarrow x = 15, -20$$

But x cannot be negative

$\therefore x = 15$

$\therefore$ The speed of the second train is 15 km per hr. and the speed of the first train is 20 km per hr.

32. A carriage driving in a flog passed a man who was walking at the rate of 6 km per hr. in the same direction. He could see the carriage for 4 minutes and it was visible to him up to a distance of 200 metres. Find the speed of the carriage.

(1) 8.75 kmph (2) 8.5 kmph

(3) 8 kmph (4) 9 kmph

Ans : 4

The distance covered by man in 4 minutes

$$= \frac{6\times 1000\times 4}{60} = 400 \text{ metres.}$$

The distance covered by carriage in 4 minutes

= 200 + 400 = 600 metres

$\therefore$ Speed of carriage

$$= \frac{600}{4}\times\frac{60}{1000} \text{ km per hr.}$$

= 9 km per hr.

33. Two bullets were fired at a place at an interval of 12 minutes. A person approaching the firing point in his car hears the two sounds at an interval of 11 minutes 40 seconds. The speed of sound is 330 metres per second. What is the approximate speed of the car?

(1) 34 kmph (2) 32 kmph

(3) 36 kmph (4) 38 kmph

Ans : 1

If the car were not moving, the person would have heard the two sounds at an interval of 12 minutes. Therefore, the distance travelled by car in 11 minutes 40 seconds is equal to the distance that could have been covered by sound in 12 min – 11 min. 40 seconds = 20 seconds.

Distance covered by sound in 20 seconds

$= 330 \times 20 = 6600$ m

In 11 min 40 seconds

= 700 seconds the car, travels 6600 m.

In 1 seconds the car will travel $\frac{6600}{700}$ metre per second = $\frac{66}{7}$ metre per second

Speed of the car = $\frac{66}{7}$ metre per second.

$= \frac{66}{7} \times \frac{18}{5}$ km per hr.

$= \frac{1188}{35}$ km per hr.

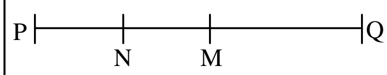
$= 33\frac{33}{35}$ km per hr.

34. *A* and *B* start simultaneously at 5 km per hr. and 4km per hr. from *P* and *Q*, 180 kms apart, towards *Q* and *P* respectively. They cross each other at M and after reaching *Q* and *P* turn back immediately and meet again at *N*. Find the distance *MN*.

(1) 45 km (2) 40 km

(3) 35 km (4) 42 km

Ans : 2



When A and B cross each other at M for the first time, they have together covered the whole distance $PQ = 180$ kms.

When they meet again at N, they have together covered total distance equal to 3 times of $PQ = 3 \times 180 = 540$ kms.

$$PM = \frac{5}{5+4} \times 180 = 100 \text{ kms}$$

(Distance covered by each will be in the ratio of their speeds)

$$QP + PN = \frac{4}{5+4} \times 540$$

$= 240$ kms

or, $PN = 240 - QP = 240 - 180$

$= 60$ kms.

Then, $MN = PM - PN$

$= 100 - 60 = 40$ kms.

35. A car driving in the morning fog passes a man walking at 4 km per hr. in the same direction. The man can see the car for 3 minutes and visibility is upto a distance of 130 meters. Find the speed of the car.

(1) 34 kmph (2) 32 kmph

(3) 36 kmph (4) 38 kmph

Ans : 2

Distance covered by man in 3 minutes

$$= \left(\frac{4 \times 1000}{60}\right) \frac{\text{m}}{\text{minutes}}$$

$\times$ 3 minutes = 200 metres

Distance covered by the car in 3 min.

$= (200 + 130)$ m = 330 metres

$\therefore$ Speed of the car

$= \frac{330}{3}$ m per min.

= 110 m per minutes

$$= \frac{\frac{110}{1000}}{\frac{1}{60}} = \frac{33}{5} \text{ km per hr.}$$

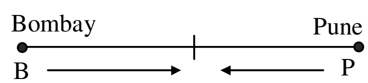
$= 6\frac{3}{5}$ km per hr.

36. Ram starts his journey from Bombay to Pune and simultaneously Mohan starts from Pune to Bombay. After crossing each other they finish their remaining journey in $6\frac{1}{4}$ and 4 hours respectively. What is Mohan's speed if Ram's speed is 20 km per hr.?

(1) 28 kmph (2) 24 kmph

(3) 25 kmph (4) 30 kmph

Ans : 3



Suppose that Ram and Mohan meet at *A*. Let Ram's speed be x km per hr. and Mohan's speed be y km per hr. Then AP $= \frac{25}{4}x$ kms and AB = 4y kms. Now time taken by Ram in going from B to A $= \frac{4y}{x}$ and the time taken by Mohan in going from P to A $= \frac{25x}{4y}$. It is obvious that these two times are equal.

$\therefore \frac{4y}{x} = \frac{25x}{4y}$

$\Rightarrow 16y^2 = 25x^2$

$\Rightarrow \frac{y^2}{x^2} = \frac{25}{16}$

$\Rightarrow \frac{y}{x} = \frac{5}{4}$

$\Rightarrow y = \frac{5}{4}x$

Here x = 20 km per hr.

$\therefore$ y = Mohan's speed

$= \frac{5}{4} \times 20 = 25$ km per hr.

37. A train meets with an accident after travelling 30 kms, after which it moves with $\frac{4}{5}$th of its original speed and arrives at the destination 45 minutes late. Had the accident happened 18 kms further on, it would have been 9 minutes before. Find the distance of journey and original speed of the train.

(1) 120 km ; 25 kmph

(2) 125 km ; 25 kmph

(3) 130 km ; 30 kmph

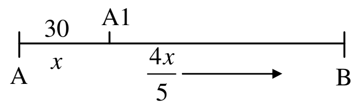
(4) 120 km ; 30 kmph

Ans : 4

Let the initital speed of the train be x km per hr.

and, length of journey y km.

Time taken in journey $= \frac{y}{x}$ hrs.



Case I. When the accident took place at A_1, AA_1 = 30 kms.

The train moved kms at x km per hr. and remaining (y – 30) km at $\frac{4x}{5}$ km per hr.

$\therefore$ Time taken in the journey

$$= \frac{30}{x} + \frac{y-30}{\frac{4x}{5}}$$

This time is more by 45 minutes from the scheduled time.

$\therefore \frac{30}{x} + \frac{5(y-30)}{4x} = \frac{y}{x} + \frac{3}{4}$

[45 minutes $= \frac{3}{4}$ hour]

Multiplying it by $4x$, we have

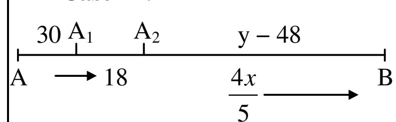
120 + 5 (y – 30) = 4y + 3x

$\Rightarrow$ 120 + 5y – 150 = 4y + 3x

$\Rightarrow$ 3x + 4y – 5y = – 30

$\Rightarrow$ 3x – y = – 30 ……(i)

Case II :



The accident took place at A2. Hence the train moved (30 + 18) = 48 km at x km per hr. and remaining distance A_2 B at $\frac{4x}{5}$ km per hr. Here A_2B = (y – 48) km.

Time taken in the journey

$$= \frac{48}{x} + \frac{y-48}{\frac{4x}{5}}$$

According to the question, the train took 9 minutes less time than the time taken after first accident. It means train reached (45 – 9) = 36 minutes $= \frac{36}{60} = \frac{3}{5}$ hours late. Therefore total time taken

$= \frac{y}{x} + \frac{3}{5}$ hours .

$\therefore \frac{48}{x} + \frac{5(y-48)}{4x} = \frac{y}{x} + \frac{3}{5}$

On multiplying by LCM of x, $4x$, x, 5 i.e. 20x, we have

960 + 25(y – 48) = 20 + y + 12x

$\Rightarrow$ 12x + 20y – 25y

= 960 – 1200

$\Rightarrow$ 12x – 5y = –240 ….(ii)

By (i) × 5 – (ii), we have

15x – 5y = –150

12x – 5y = –240

– + +

3x = 90

$\Rightarrow x = 30$

Putting x = 30 in equation (i) we have

90 – y = –30

$\Rightarrow$ y = 90 + 30 = 120

$\therefore x$ = speed of the train = 30 km per hr.

y = length of journey = 120 km.

38. A train met with an accident 3 hours after starting, which detains it for one hour, after which it proceeds at 75% of its original speed. It arrives at the destination 4 hours late. Had the accident taken place 150 km further along the railway line, the train would have arrived only $3\frac{1}{2}$ hours late. Find the length of the trip and the original speed of the train.

(1) 1100 km ; 100 kmph

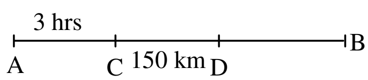
(2) 1200 km ; 100 kmph

(3) 1200 km ; 90 kmph

(4) 1600 km ; 90 kmph

Ans : 2

Let A be the starting point, B the terminus. C and D are points where accidents take place.



$\therefore 0.75 = \frac{3}{4}$

By travelling at $\frac{3}{4}$ of its original speed, the train would take $\frac{4}{3}$ of its usual time i.e., $\frac{1}{3}$ more of the usual time.

$\therefore \frac{1}{3}$ of the usual time taken to travel the distance CB.

= 4 – 1 = 3 hrs. …..(i)

and $\frac{1}{3}$ of the usual time taken to travel the distance

DB = $3\frac{1}{2} - 1 = 2\frac{1}{2}$ hrs. ….(ii)

Subtracting equation (ii) from (i) we can write,

$\frac{1}{3}$ of the usual time take to travel the distance

CD = $= 3 - 2\frac{1}{2} = \frac{1}{2}$ hr.

$\therefore$ Usual time taken to travel

CD (150 km) $= \frac{\frac{1}{2}}{\frac{1}{2}} = \frac{3}{2}$ hr.

Usual speed of the train $= \frac{150}{\frac{3}{2}} = 100$ km per hr.

Usual time taken to travel CB

$= \frac{3}{\frac{1}{3}} = 9$hrs.

Total time = 3 + 9 = 12 hrs.

$\therefore$ Length of the trip = 12 × 100 = 1200 km.

39. A train after travelling 100 kms from *P* meets with an accident and then proceeds at $\frac{3}{4}$th of its original speed and arrives at the terminus Q90 minutes late. Had the accident occurred 60 kms further on, it would have reached 15 minutes sooner. Find the original speed of the train and the distance *PQ*.

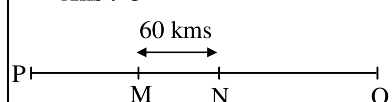
(1) 65 kmph ; 480 km

(2) 75 kmph ; 450 km

(3) 80 kmph ; 460 km

(4) 85 kmph ; 460 km

Ans : 3



Let P be the starting point, Q the terminus, M and N the places where accidents occur.

At $\frac{3}{4}$th of the original speed, the train will take $\frac{4}{3}$ of its usual time to cover the same distance i.e., $\frac{1}{3}$rd more than the usual time.

$\frac{1}{3}$rd of the usual time to travel a distance of 60 kms between MN = 15 min.

$\therefore$ Usual time to travel 60 kms

= 15 ×3 = 45 min. = $\frac{3}{4}$ hr.

$\therefore$ Usual time taken to travel MQ = 90 × 3

= 270 min. = $\frac{9}{2}$ hrs.

$\therefore$ The distance MQ

$= 80 \times \frac{9}{2} = 360$ kms.

Therefore, the total distance

PQ = PM + MQ

= 100 + 360 = 460 kms.

40. Two trains A and B are 110 km apart on a straight line. One train starts from A at 7 a.m. and travels towards B at 20 km per hour. Another train starts from B at 8 am. and travels towards *A* at a speed of 25 km per hr. At what time will they meet?

(1) 10 : 15 a.m.

(2) 09 : 50 a.m.

(3) 09 : 30 a.m.

(4) 10 : 00 a.m.

Ans : 4

Let they meet x hrs after 7 am.

Distance covered by A in x hours = $20x$ kms

Distance covered by B in (x-1) hr. = $25(x - 1)$ kms

$\therefore 20x + 25(x - 1) = 110$

$\Rightarrow 20x + 25x - 25 = 110$

$\Rightarrow 45x = 110 + 25 = 135$

$\Rightarrow x = 3$

$\therefore$ Trains meet at 10 a.m.

41. Two boys begin together to write out a booklet containing 817 lines. The first boy starts with the first line, writing at the rate of 200 lines an hour and the second boy starts with the last lines then writes line 816 and so on. Backward proceeding at the rate of 150 lines an hour. At what line will they meet?

(1) 467th line (2) 468th line

(3) 470th line (4) 475th line

Ans : 1

Writing ratio = 200 : 150

= 4 : 3

In a given time first boy will be writing the line number

$\frac{4}{7} \times 817$

$= \frac{3268}{7}$ th line $= 466\frac{6}{7}$ th line or, 467th line

Hence, both of them shall meet on 467th line.

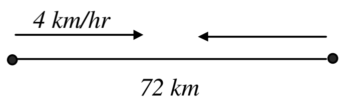
42. Two men set out the same time to walk towards each other from two points A and B, 72 km apart. The first man walks at the rate of 4km per hr. The second man walks 2km in the first hour, $2\frac{1}{2}$ km in the second hour, 3 km in the third hour and so on. Find the time after which the two men will meet.

(1) 8 hours (2) 9 hours

(3) 8.5 hours (4) 9.5 hours

Ans : 2

Let the two men meet after t hours.



Distance covered by the first man starting from A = 4 t km. Distance covered by the second man starting from B

$= 2 + 2.5 + 3 + \ldots\ldots + \left[2 + \left(\frac{t-1}{2}\right)\right]$

This is an arithmetic series of t terms with $\frac{1}{2}$ as common difference.

$\therefore$ By applying formula

$$S = \frac{n}{2}[2a + (n-1)d]$$

Where, n = no. of terms

a = first term

d = common difference

we have its sum

$$= \frac{t}{2}\left[(2 \times 2) + (t-1) \times \frac{1}{2}\right]$$

$$= 2t + \frac{t^2 - 1}{4}$$

Total distance covered by two men $= 4t + 2t + \frac{t^2 - 1}{4} = 72$

or, $6t + \frac{t^2 - t}{4} = 72$

or, $24t + t^2 - t = 288$

or, $t^2 + 23t - 288 = 0$

or, $t^2 - 9t + 32t - 288 = 0$

or, $t(t - 9) + 32(t - 9) = 0$

or, $(t - 9)(t + 32) = 0$

$\therefore$ Either $t - 9 = 0 \Rightarrow t = 9$

or, $(t + 32) = 0 \Rightarrow t = -32$

Time cannot be negative. Hence, the two men will meet after 9 hrs.

43. A man is standing on a railway bridge which is 50 metres long. He finds that a train crosses the bridge in $4\frac{1}{2}$ seconds but himself in 2 seconds. Find the length of the train and its speed.

(1) 60 m ; 20 m/sec

(2) 40 m ; 20 m/sec

(3) 40 m ; 20 m/sec

(4) 40 m ; 25 m/sec

Ans : 3

Let the length of the train be x metres.

Then, the time taken by the train to cover (x + 50) metres is $4\frac{1}{2}$ seconds

Speed of the train $= \frac{x + 50}{\frac{9}{2}}$ m per second

$= \frac{2x + 100}{9}$ m per second …(i)

Again, the time taken by the train to cover x metres in 2 seconds.

$\therefore$ Speed of the train $= \frac{x}{2}$ metre per second …….(ii)

From equations (i) and (ii), we have

$$= \frac{2x+100}{9} = \frac{x}{2}$$

$\Rightarrow 4x + 200 = 9x$

$\Rightarrow 5x = 200$

$\Rightarrow x = 40$

$\therefore$ Length of the train

= 40 metres

$\therefore$ Speed of the train

$$= \frac{x}{2} = \frac{40}{2} = 20 \text{m per sec.}$$

44. To places A and B are 162 kms apart. A train leaves. A for B and at the same time another train leaves B for A. The two trains meet at the end of 6 hours. If the train travelling from A to B travels 8 km per hr. faster than the other, find the speed of the faster train.

(1) 16.5 kmph

(2) 16 kmph

(3) 17 kmph

(4) 17.5 kmph

Ans : 4

Both trains meet after 6 hours.

$\therefore$ The relative speed of two trains $= \frac{160}{2} = 27 \text{m per hr}$.

The speed of the slower train starting from B

$$= \frac{27-8}{2} = \frac{19}{2} = 9\frac{1}{2} \text{ km per hr.}$$

45. A train running at 25 km per hour take 18 seconds to pass a platform. Next, it takes 12 seconds to pass a man walking at the rate of 5 km per hr. in the same direction. Find the length of the platform.

(1) 25 metre (2) 20 metre

(3) 24 metre (4) 28 metre

Ans : 1

Let the length of train be x metres and length of platform be y metres.

Speed of the train

$$= \left(25 \times \frac{5}{18}\right) \text{m per sec.}$$

$$= \frac{125}{18} \text{ m per sec.}$$

Time taken by train to pass the platform

$$= \left[(x + \text{y}) \times \frac{18}{125}\right] \text{sec.}$$

$$\therefore (x + \text{y}) \times \frac{18}{125} = 18$$

or, x + y = 125 …….(i)

Speed of train relative to man

= (25 + 5) km per hr.

$$= \frac{25}{3} \text{ m per sec.}$$

Time taken by the train to pass the man

$$= \left(x \times \frac{3}{25}\right) \text{sec.} = \frac{3x}{25} \text{ sec.}$$

$$\therefore \frac{3x}{25} = 12$$

$$\Rightarrow x = \left(\frac{25 \times 12}{3}\right) = 100 \text{ metres}$$

Putting x = 100 in equation (i), we get, y = 25 metres.

$\therefore$ Length of train = 100 metres and length of the platform = 25 metres.

46. Two trains 200 metres and 175 metres long are running on parallel lines. They take $7\frac{1}{2}$ seconds when running in opposite directions and $37\frac{1}{2}$ seconds when running in the same direction to pass each other. Find their speeds in km per hour.

(1) 118 kmph ; 75 kmph

(2) 108 kmph ; 72 kmph

(3) 120 kmph ; 75 kmph

(4) 125 kmph ; 80 kmph

Ans : 2

Let the speed of the train be x metres per sec. and y meters per sec. respectively.

Sum of the lengths of the trains

= 200 + 175 = 375 metres

When the trains are moving in opposite directions

Relative speed = (x + y) m per sec. In this case the time taken by the trains to cross each other

$$= \frac{375}{x + \text{y}} \text{ sec.}$$

$$\therefore \frac{375}{x + \text{y}} = \frac{15}{2}$$

$\Rightarrow x$ + y = 50 ……(i)

When the trains are moving in the same direction.

Relative speed = (x – y)m per sec. In this case the time taken by the trains to cross each other

$$= \frac{375}{x-y} \text{sec.}$$

$$\therefore \frac{375}{x-y} = \frac{75}{2}$$

$\Rightarrow x - y = 10$ .....(ii)

Now, x + y = 50

$$\begin{array}{r} x - y = 10 \\ \hline 2x = 60 \end{array}$$

$\Rightarrow x = 30$

Putting this value in equation (i), we have

y = 50 – 30 = 20

$\therefore$ Speed of trains = 30 m per sec.

$$= 30 \times \frac{18}{5} = 108 \text{ km per hr.}$$

and 20 m per sec.

$$= 20 \times \frac{18}{5} = 72 \text{ km per hr.}$$

47. A train travelling at the rate of 60 km per hr. while inside a tunnel, meets another train of half its length travelling at 90 km per hr. and passes completely in $4\frac{1}{2}$ seconds. Find the length of the tunnel if the first train passes completely through it in 4 minutes $37\frac{1}{2}$ seconds.

(1) 5 km (2) 3.5 km

(3) 4.5 km (4) 6 km

Ans : 3

Trains are running in opposite direction.

$\therefore$ Relative speed of the two trains

= 90 + 60 = 150 km per hr.

Distance travelled in $4\frac{1}{2}$ seconds with this speed of 150 km per hr $= 150 \times \frac{5}{18}$ m per sec.

$$= 150 \times \frac{5}{18} \times \frac{9}{2} = \frac{375}{2} \text{ metres}$$

Let the length of the first train be x metres.

Then the length of the second train be $\frac{x}{2}$ metres

$$\therefore x + \frac{x}{2} = \frac{375}{2}$$

$$\Rightarrow \frac{3x}{2} = \frac{375}{2}$$

$\Rightarrow 3x = 375$

$\Rightarrow x = 125$ metres

Hence, the length of the first train = 125 metres

Speed of the first train = 60 km per hr.

$$= 60 \times \frac{5}{18} = \frac{50}{3} \text{ m per sec.}$$

Time taken by the first train to cross the tunnel = 4 minutes $37\frac{1}{2}$ sec.

$$= 240 + \frac{75}{2} = \frac{480+75}{2}$$

$$= \frac{555}{2} \text{ sec.}$$

Speed of first train = $\frac{50}{3}$ m per sec.

$\therefore$ Distance covered by it in $\frac{555}{2}$ sec.

$$= \frac{50}{3} \times \frac{555}{2} = 4625 \text{ metres}$$

Hence, length of tunnel

= 4625 – 125 = 4500 metres

= 4 km 500 metres.

48. A train overtakes two person walking at 2 km per hr. and 4 km per hr. respectively and passes completely them in 9 sec. and 10 sec. respectively. What is the length of the train?

(1) 65 metre (2) 60 metre

(3) 55 metre (4) 50 metre

Ans : 4

Let the length of the train be x km and its speed y km per hr.

Case I : When it passes the man walking at 2km per hr. in the same direction

Relative speed of train

= (y – 2) km per hr.

$$\therefore \frac{x}{y-2} = 9 \text{ seconds}$$

$$= \frac{9}{3600} = \frac{1}{400} \text{ hour} \quad .....(i)$$

Case II : When the train crosses the man walking at 4 km per hr. in the same direction.

Relative speed of train = (y – 4) km per hr.

$$\therefore \frac{x}{y-4} = 10 \text{ sec.}$$

$$\Rightarrow \frac{x}{y-4} = \frac{10}{3600} \text{ hrs.}$$

$\Rightarrow \dfrac{x}{y-4} = \dfrac{1}{360}$ hrs. ….(ii)

On dividing equation (i) by (ii). we have

$$\frac{y-4}{y-2} = \frac{\frac{1}{400}}{\frac{1}{360}} = \frac{360}{400} = \frac{9}{10}$$

$\Rightarrow$ 10y – 40 = 9y – 18

$\Rightarrow$ 10y – 9y = 40 – 18

$\Rightarrow$ y = 22 km per hr.

$\therefore$ From equation (i), we have

$$\frac{x}{22-2} = \frac{1}{400}$$

$$\Rightarrow x = \frac{1}{20}\text{km}$$

$$= \frac{1000}{20} = 50 \text{ metres}$$

49. A train takes 18 seconds to pass completely through a station 162 metres long and 15 seconds to pass completely through another station 120 metres long. Find the speed of train in km per hr.

(1) 50.4 kmph (2) 52 kmph

(3) 55 kmph (4) 60 kmph

Ans : 1

Let the length of the train = x metres

Then, in 18 sec. the train travels (x + 162) metres …..(i)

and in 15 sec. the train travels (x + 120) metres.

$\therefore$ In (18 – 15) = 3 sec. the train travels (x + 162) – (x + 120) = 42m.

$\therefore$ In 1 sec the train travels = $= \dfrac{42}{3} = 14$ metres. ….(ii)

$\therefore$ In 18 sec. the train travels =

14 × 18 = 252 metres. …(iii)

From equations (i) and (iii)

$\therefore$ x + 162 = 252

$\Rightarrow$ x = 252 – 162 = 90

$\therefore$ Length of the train = 90 metres

Also from equation (ii) we see that in 1hr. the train travels

= 14 × 60 × 60 metres

$= \dfrac{14 \times 60 \times 60}{1000}$ km = 50.4 km

$\therefore$ The speed of the train

= 50.4 km per hr.

50. Two trains of which one is 50 metres longer than the other are running in opposite directions and cross ech other in 10 seconds. If they be running in the same direction then faster train would have passed the other train in 1 minute 30 seconds. The speed of faster train is 90 km per hr. Find the speed of other train.

(1) 25 m/sec. (2) 20 m/sec

(3) 30 m/sec. (4) 35 m/sec

Ans : 2

Let the lengths of trains be x m and (x + 50)m and the speed of other train be y m per sec.

The speed of the first train = 90 km per hr.

$$= 90 \times \frac{5}{18} = 25 \text{ m per sec.}$$

Case I : Opposite direction, Their relative speed

= (25 – y) m per sec.

Distance covered = x + x + 50

= 2x + 50m

$\therefore$ Time taken $= \dfrac{2x+50}{25-y} = 90$

$\Rightarrow$ 2x + 50 = 90 (25 – y) ….(ii)

From equations (i) and (ii)

10y + 250 = 2250 – 90y

$\Rightarrow$ 10y + 90y = 2250 – 250

$$\Rightarrow y = \frac{2000}{100} = 20$$

Putting y = 20 in equation (i) we have

2x + 50 = 10 × 20 + 250 = 450

$\Rightarrow$ 2x = 450 – 50 = 400

$$\Rightarrow x = \frac{400}{2} = 200$$

$\therefore$ x + 50 = 200 + 50

= 250 metres.

Hence,

The length of the 1st train = 20 metres.

The length of the 2nd train = 250 metres

The speed of the 2nd train = 20m per sec.

51. A man standing on a 170 metre long platform watches that a train takes $7\frac{1}{2}$ seconds to pass him and 21 seconds to cross the platform. Find the speed of train.

(1) $12\frac{16}{27}$ m/sec.

(2) 12.5 m/sec.

(3) $12\frac{13}{27}$ m/sec.

(4) None of these

Ans : 1

Let the length of the trail be x m and its speed y m/sec. Distance covered in crossing the platform

= 170 + x metres

and time taken = 21 seconds

$\therefore$ Speed $y = \frac{170+x}{21}$ …(i)

Distance covered to cross the man = x metres

and time taken

$= 7\frac{1}{2} = \frac{15}{2}$ seconds.

$\therefore$ Speed $y = \frac{x}{\frac{15}{2}} = \frac{2x}{15}$ ….(ii)

From equations (i) and (ii),

$\frac{170+x}{21} = \frac{2x}{15}$

$\Rightarrow 2550 + 15x = 42x$

$\Rightarrow 42x - 15x = 2550$

$\Rightarrow 27x = 2550$

$\Rightarrow x = \frac{2550}{27} = 94\frac{4}{9}$ metres

From equation (ii),

$y = \frac{2\times 2550}{15\times 27}$

$= \frac{340}{27} = 12\frac{16}{27}$ m per sec.

Hence, length of train $= 94\frac{4}{9}$ metres

and speed = $12\frac{16}{27}$ m per sec.

52. A goods train 158 metres long and travelling at the speed of 32km per hr. leaves Delhi at 6 a.m. Another mail train 130 metres long and travelling at the average speed of 80 km per hr. leaves Delhi at 12 noon and follows the goods train. At what time will the mail train completely cross the goods train?

(1) 4 hours

(2) 4 hours 21.6 sec.

(3) 5 hours 21.6 sec.

(4) None of these

Ans : 2

The goods train leaves Delhi at 6 am and mail train at 12 noon, hence after 6 hours

The distance covered by the goods train in 6 hours at 32 km per hr. = 32 × 6 = 192 kms

The relative velocity of mail train with respect to goods train

= 80 – 32 = 48 km per hr.

To completely cross the goods train the mail train will have to cover a distance

= 192 km + 158m + 130m

= 192 km + 0.158km + 0.130 km

= 192.288 km more

Since the mail train goes 48 kms more in 1 hour.

$\therefore$ The mail train goes 192.288 kms more in

$= \frac{192288}{1000} \times \frac{1}{48} = \frac{203}{500}$

= 4 hours $21\frac{3}{5}$ sec.

53. A motor-boat goes 2 km upstream in a stream flowing at 3 km per hr. and then returns downstream to the starting point in 30 minutes. Find the speed of the motor-boat in still water.

(1) 9.5 kmph (2) 8.5 kmph

(3) 9 kmph (4) 8 kmph

Ans : 3

Let the speed of the motor boat in still water be Z km per hr.

Downstream speed = (Z + 3) km per hr.

Upstream speed

= (Z – 3) km per hr.

Total journey time

= 30 minutes = $\frac{30}{60}$ hr. = $\frac{1}{2}$ hour

We can write

$\frac{2}{Z-3} + \frac{2}{Z+3} = \frac{1}{2}$

or, $2\left[\frac{(Z+3)+(Z-3)}{(Z-3)(Z-3)}\right] = \frac{1}{2}$

or, $\frac{2Z}{Z^2-9} = \frac{1}{4}$

or, $Z^2 - 9 = 8Z$

or, $Z^2 - 8Z - 9 = 0$

or, $Z^2 + Z - 9Z = 0$

or, Z(Z + 1) – 9 (Z + 1) = 0

or, (Z + 1) (Z – 9) = 0

$\therefore$ Z = –1 or 9

Since speed can't be negative, we neglect – 1.

Therefore, the speed of the motor – boat in still water = 9 km per hr.

54. A person can row a boat 32 km upstream and 60 km downstream in 9 hours. Also, he can row 40 km upstream and 84 km downstream in 12 hours. Find the rate of the current.

(1) 3 kmph (2) 2.5 kmph

(3) 1.5 kmph (4) 2 kmph

Ans : 4

Let the upstream speed be x km per hr. and downstream speed be y km per hr.

Then, we can write,

$$\frac{32}{x}+\frac{60}{y}=9$$

and, $\frac{40}{x}+\frac{84}{y}=12$

Let $\frac{1}{x}$ = m and $\frac{1}{y}$ = n

The above two equations can now be written as

32m + 60n = 9 ….(i)

and, 40 m + 84 n = 12 ….(ii)

Now we have to solve above two simultaneous equations.

$7\times(\text{i})-5\times(\text{ii})$ gives 24 m = 3

or m = $\frac{1}{8}$ or x = 8 km per hr.

4 × (ii) – 5 × (i) gives 36 n = 3

or, n = $\frac{1}{2}$ or y = 12 km per hr.

Rate of current

$$=\frac{y-x}{2}=\frac{12-8}{2}$$

= 2 km. per hr.

55. A boatman takes his boat in a river against the stream from a place A to a place B where AB = 21 km and again returns to a. Thus he takes 10 hours in all. The time taken by him downstream in going 7 km is equal to the time taken by him against stream in going 3 km. Find the speed of river.

(1) 2 kmph (2) 2.5 kmph

(3) 3 kmph (4) 3.5 kmph

Ans : 1

Let the speed of boat and river be x km per hr. and y km per hr. respectively. Then, The speed of boatman downstream = (x + y) km per hr. and the speed of boatman upstream = (x - y) km per hr. Time taken by boatman in going 21 km downstream

$=\frac{21}{x+y}$ hours

Time taken by boatman in going 21 km upstream

$=\frac{21}{x-y}$ hrs.

According to the question,

$$\frac{21}{x+y}+\frac{21}{x-y}=10 \quad ….(i)$$

Now, time taken for 7 kms downstream $=\frac{7}{x+y}$ hrs. and time taken for 3 kms upstream $=\frac{3}{x-y}$ hrs.

According to the question

$$\frac{7}{x+y}-\frac{3}{x-y}=0 \quad ….(ii)$$

By (ii) × 7 + (i)

$$\frac{49}{x+y}-\frac{21}{x-y}+\frac{21}{x+y}+\frac{21}{x-y}$$

= 10

$\Rightarrow \frac{70}{x+y}=10$

$\Rightarrow x$ + y = 7 ….(iii)

Putting x + y = 7 in equation (ii) we have

$\frac{7}{7}-\frac{3}{x-y}=0$

$\Rightarrow 1-\frac{3}{x-y}=0$

$\Rightarrow x$ – y = 3 …..(iv)

On adding (iii) and (iv), we have 2x = 10

$\Rightarrow x$ = 5

$\therefore$ y = 7 – x = 7 – 5 = 2

$\therefore$ Speed of boat = 5 km per hr.

and speed of river = 2 km per hr.

56. A motorist and a cyclist start from A to B at the same time. AB is 18 km. The speed of motorist is 15 m per hr. more than the cyclist. After covering half the distance, the motorist rests for 30 minutes and there-after his speed is reduced by 20%. If the motorist reaches the destination B, 15 minutes earlier than that of the cyclist, then find the speed of the cyclist.

(1) 16 kmph (2) 12 kmph

(3) 14 kmph (4) 15 kmph

Ans : 2

Let the speed of the cyclist be x km per hr.

Speed of the motorist = $(x+15)$ km per hr.

Time taken by the motorist to cover half of the distance AB

$= \dfrac{18}{2\times(x+15)} = \dfrac{9}{x+15}$ hrs.

Total time taken by the motorist to reach B

$= \dfrac{9}{x+15} + \dfrac{1}{2} + \dfrac{45}{4(x+15)}$ hrs

Total time taken by the cyclist to cover AB = $\dfrac{18}{x}$ hrs.

Motorist reaches B 15 minutes, i.e., $\dfrac{1}{4}$ hr. earlier.

$\therefore \dfrac{18}{x} - \dfrac{9}{x+15} - \dfrac{1}{2} - \dfrac{45}{4(x+15)}$

$= \dfrac{1}{4}$

$\Rightarrow$

$\dfrac{18\times 4(x+15) - 36x - 2x(x+15) - 45x}{4x(x+15)}$

$= \dfrac{1}{4}$

$\Rightarrow 72x + 1080 - 36x - 2x^2 - 30x - 45x = x^2 + 15x$

$\Rightarrow 3x^2 + 54x - 1080 = 0$

$\Rightarrow x^2 + 18x - 360 = 0$

$\Rightarrow x^2 + 30x - 12x - 360 = 0$

$\Rightarrow x(x + 30)\ (x - 12) = 0$

$\Rightarrow x = -30, 12$

The speed cannot be negative. $\therefore$ The speed of the cyclist = 12 km per hr.

57. A man covered a distance of 3990 km partly by air, partly by sea and remaining by land. The time spent in air, on sea and on land is in the ratio 1 : 16 : 2 and the rratio of average speeds is 20 : 1 : 3 respectively. If total averge speed is 42 km per hr, find the distance covered by sea.

(1) 1720 km (2) 1620 km

(3) 1520 km (4)1820 km

Ans : 3

Total distance travelled = 3990 km

Distance = Time × Speed

Ratio of time spent = 1 : 16 : 2

Ratio of speeds = 20 : 1 : 3

$\therefore$ Ratio of time × speeds

= 20 × 1 : 16 × 1 : 2 × 3

= 20 : 16 : 6

Sum of the ratios

= 20 + 16 + 6 = 42

$\therefore$ Distance covered by sea

$= \dfrac{3990}{42} \times 16 = 1520$ kms

58. A railway engine is proceeding towards *A* at uniform speed of 30 km/hr. While the engine is 20 kms away from *A* an insect starting from *A* files again and again between A and the engine relentlessly. The speed of insect is 42 km per hr. Find the distance covered by the insect till the engine reaches A.

(1) 25 km (2) 32 km

(3) 30 km (4)28 km

Ans : 4

Relative speed of insect

= 30 + 42 = 72 km per hr.

Distance between railway engine and insect = 20 km.

Engine and insect will meet for the first time after $= \dfrac{20}{72}$ hr.

Distance covered in this period

$= \dfrac{20}{72} \times 42 = \dfrac{35}{3}$ km

The insect will cover $\dfrac{35}{3}$ km in returning to A.

The distance covered by engine in this period.

$= \dfrac{20}{72} \times 30 = \dfrac{25}{3}$ km

Since, the insect when reaches A, the engine will cover $\dfrac{25}{3}$ km to A.

$\therefore$ Remaining distance between A and engine

$= 20 - \dfrac{50}{3} = \dfrac{10}{3}$ km

and again the insect will cover $\dfrac{35}{18}$ km in returning.

$\therefore$ Total distance covered by the insect $= \dfrac{70}{3} + \dfrac{70}{18} + \ldots\ldots\ldots\ldots$

$$\begin{bmatrix} \dfrac{35}{3} + \dfrac{35}{3} = \dfrac{70}{3} \text{ and} \\ \dfrac{35}{18} + \dfrac{35}{18} = \dfrac{70}{18} \text{ and so on} \end{bmatrix}$$

$= \dfrac{70}{3}\left[1 + \dfrac{1}{6} + \ldots\ldots\ldots\infty\right]$

It is a Geometric Progression with common ratio $\dfrac{1}{6}$.

$$= \frac{70}{3}\left[\frac{1}{1-\frac{1}{6}}\right]\left[\because S_\infty = \frac{a}{1-r}\right]$$

$$= \frac{70}{3} \times \frac{1}{\frac{5}{6}} = \frac{70}{3} \times \frac{6}{5} = 28 \text{ km}$$

59. Distance between two stations X and Y is 220 km. Trains P and Q leave station X at 8 a.m. and 9.51 a.m. respectively at the speed of 25 km per hr. and 20 kmph respectively for journey towards Y. A train R leaves station Y at 11.30 a.m. at a speed of a 30 kmph, for journey towards X. When will P be at equal distance from Q and R?

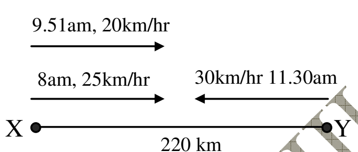
(1) 12:48 pm.

(2) 12:30 pm.

(3) 12:45 pm.

(4) 11 : 48 pm.

Ans : 1



Distance covered by P till 11.30 a.m.

= (11.3) a.m. – 8 a.m.) × 25km

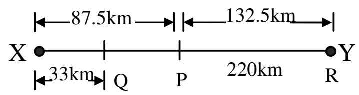
$= 3\frac{1}{2}$ hrs × 25 = 87.5 km.

Distance covered by Q till 11.30 a.m.

= (11.30 – 9.51 am) × 20

$= 1\frac{39}{60}$ hrs × 20 = 33 km

So, at 11.30 a.m. the three trains will be at positions shown below :



P gains 5 km every hour over Q.

Relative speed of P w.r.t. R

= 20 + 30 = 50 km per hr

Let P be at equal distance from Q and R after t hours.

$\therefore$ (87.5 – 33) + 5t

= 132.5 – 55t

or, 54.5 + 5t = 132.5 – 55t

or, 60 t = 78

or, $t = \frac{78}{60}$ hrs.

= 1 hr 18 minutes

11.30 am + 1 hr. 18 min.

= 12.48 pm

At 12.48 pm, P would have covered a distance

= (12.48 pm – 8 am) × 25

= 120 km

Therefore, P will be at equal distance from Q and R at 12.48 pm at 120 km. From X we can calculate each of the distance QP and PR be 61 km at 12.48 pm.

60. A person travels a certain distance on a bicycle at a certain speed. Had he moved 3 km/ hour faster, he would have taken 40 minutes less. Had he moved 2km/hour slower, he would have taken 40 minutes more. Find the distance.

(1) 45 km (2) 40 km

(3) 50 km (4)55 km

Ans : 2

Let the original speed of the person be x km/hr. and the distance be y km.

case I : $\frac{y}{x} - \frac{y}{x+3} = 40$ minutes

or, $\frac{y}{x} - \frac{y}{x+3} = \frac{40}{60} = \frac{2}{3}$

or, $y\left[\frac{1}{x} - \frac{1}{(x+3)}\right] = \frac{2}{3}$

or, $y\left[\frac{x+3-x}{x(x+3)}\right] = \frac{2}{3}$

or, $\frac{3y}{x(x+3)} = \frac{2}{3}$

or, $2x\,(x + 3) = 9y$ ….(i)

Case II : $\frac{y}{x-2} - \frac{y}{x} = \frac{40}{60}$

or, $y\left(\frac{1}{x-2} - \frac{1}{x}\right) = \frac{2}{3}$

or, $y\left[\frac{x-x+2}{x(x-2)}\right] = \frac{2}{3}$

or, $\frac{2y}{x(x-2)} = \frac{2}{3}$

or, $x(x-2) = 3y$ ….(ii) On dividing equation (i) by (ii) we have,

$$\frac{2x(x+3)}{x(x-2)} = \frac{9y}{3y}$$

or, $\frac{2(x+3)}{(x-2)} = 3$

or, $2x + 6 = 3x - 6$

or, $3x - 2x = 6 + 6 = 12$

or, $x = 12$ km/hr.

$\therefore$ Original speed of the person = 12 km / hr.

Putting the value of x in equation (ii)

$12(12 - 2) = 3y$

or, $3y = 12 \times 10$

or, $y = \frac{12 \times 10}{3} = 40$

$\therefore$ The required distance = 40 km.

61. A steamer goes downstream from one port to another in 4 hours. It covers the same distance upstream in 5 hours. If the speed of the stream be 2 km/hr, find the distance between the two ports.

(1) 60 km (2) 45 km

(3) 48 km (4) 65 km

Ans : 3

Let the speed of steamer in still water = x kmph

$\therefore$ Rate downstream

= $(x + 2)$ kmph

Rate upstream = $(x - 2)$ kmph

Distance covered downstream and upstream are equal

$\Rightarrow 4(x+2) = 5(x-2) \Rightarrow 4x + 8$

$= 5x - 10$

$\Rightarrow 5x - 4x = 10 + 8 \Rightarrow x = 18$

$\therefore$ Rate downstream

= 18 + 2 = 20 kmph

Therefore, the required distance

= Speed downstream × Time

= 20 × 4 = 80 km.

62. In a 200 metre race, A beats B by 20 metres; while in a 100 metre race, B beats C by 5 metres. Assuming that the speeds of A, B and C remain the same in various races, by how many metres will A beat C in one kilometer race?

(1) 140 metre (2) 145 metre

(3) 135 metre (4) 125 metre

Ans : 2

According to the question, when A covers the distance of 200 metres, B covers only 200 – 20 = 180 metres.

Again, in 100 metre race, B beats C by 5 metres.

Hence, if B runs 100 metres,

C runs 100 – 5 = 95 metres

$\because$ If B runs 100m. C runs = 95 m

$\therefore$ If B runs 180m, C runs

$= \frac{95 \times 180}{100} = 171$m

$\therefore$ A : B : C = 200 : 180 : 171

Hence, A will beat C by

= 200 – 171 = 29 m in 200 m race, i.e., 29 × 5 = 145m in 1km race.

63. Two places A and B are 80 km apart from each other on a highway. A car starts from A and another from B at the same time. If they move in the same direction, they meet each other in 8 hours. If they move in opposite directions towards each other, they meet in 1 hour 20 minutes. Determine the speeds of the faster car.

(1) 20 kmph (2) 25 kmph

(3) 35 kmph (4) 30 kmph

Ans : 3

Case I : When the cars are moving in the same direction.

A 80 km B C

Let A and B be two places and C be the place of meeting.

Let the speed of car starting from A be x kmph, and that of car starting from B be y kmph. Relative speed = $(x - y)$ kmph

According to the question.

$(x - y) \times 8 = 80$

$\Rightarrow x - y = 10$ …..(i)

Case II : When the cars are moving in the opposite directions and they meet at point C.

A B C

Relative speed = $(x + y)$ kmph

Time taken = 1 hour 20 minutes = $1 + \frac{1}{3} = \frac{4}{3}$ hours

$\therefore (x + y) \times \frac{4}{3} = 80$

$\Rightarrow x + y = \frac{80 \times 3}{4}$

$\Rightarrow x + y = 60$ ….(ii)

Adding equations (i) and (ii).

$2x = 70$

$\Rightarrow x = 35$

From equation (ii),

$x + y = 60$

$\Rightarrow 35 + y = 60$

$\Rightarrow y = 60 - 35 = 25$

$\therefore$ Speeds of the cars

= 35 kmph, 25 kmph.

64. In a one-kilometre race, A beats B by 15 seconds and B beats C by 15 seconds. If C is

100 metres away from the finishing mark, when B has reached it, find the speed of A.

(1) 9.5 m/sec. (2) 9 m/sec

(3) 8 m/sec. (4) 8.3 m/sec

Ans : 4

Let B take x seconds to run 1000m.

$\therefore$ Time taken by C

$= (x + 15)$ seconds

$$\therefore \frac{x}{x+15} = \frac{900}{1000} = \frac{9}{10}$$

$\Rightarrow 10x = 9x + 135$

$\Rightarrow x = 135$ seconds

Now in a one kilometer race. A beats B by 15 seconds.

It means A covers 1000 m in $135 - 15 = 120$ seconds

$\therefore$ Speed of A

$$= \frac{1000}{120} = \frac{25}{3} \text{ m/sec}$$

$= 8.3$ m/sec

65. A train running at the speed of 72 km/hr passes a tunnel completely in 3 minutes. While inside the tunnel, it meets another train of $\frac{3}{4}$ of its length coming from opposite direction at the speed of 90km/hr and passes it completely in $3\frac{1}{2}$ seconds. Find the length of the tunnel.

(1) 3510 metre

(2) 3500 metre

(3) 3400 metre

(4) 3600 metre

Ans : 1

Trains are running in opposite directions.

$\therefore$ Relative speed $= 72 + 90$

$= 162$ kmph

$$= 162 \times \frac{5}{18} = 45 \text{ m/sec}$$

Let the length of the first train be $= x$ metre.

$\therefore$ Length of the second train $= \frac{3}{4}x$ meter.

Now,

Distance travelled in $3\frac{1}{2}$ seconds at 45m/sec

$$= 45 \times \frac{7}{2} = \frac{315}{2} \text{ metre}$$

This distance is equal to sum of the lengths of trains.

$$\therefore x + \frac{3x}{4} = \frac{315}{2}$$

$$\Rightarrow \frac{4x + 3x}{4} = \frac{315}{2}$$

$$\Rightarrow \frac{7x}{4} = \frac{315}{2}$$

$$\Rightarrow x = \frac{315}{2} \times \frac{4}{7} = 90$$

Hence, the length of the first train = 90 metre.

Speed of first train = 72 kmph

$$= 72 \times \frac{5}{18} = 20 \text{ m/sec}$$

Time taken by the first train to cross the tunnel

= 3 minutes = 180 seconds

$\therefore$ Distance covered by it in 180 seconds

$= 180 \times 20 = 3600$ metre

$\therefore$ Length of (first train + tunnel)

$= 3600$ metre

$\therefore$ Length of tunnel

$= 3600 - 90 = 3510$ metre