CHAPTER 13

Time, Speed and Distance

The concept of time, speed and distance is related to a particular object in motion. A set of typically asked questions from the topic 'time, speed and distance' that acquaints you to different concepts in the topic including relative speed, average speed, different units for measurement of time, speed and distance and the conversion of these units. Also includes questions on boats and stream and train and platform.

Time

Time is defined as quantity, which governs the order or sequence of an occurrence. In the absence of time, the actual sequence of any occurrence or incident would be lost. If we did not have the concept of time, we would not be able know in what period or in what order something took place.

Unit of Time Hour (h) and second (s) are mostly taken as the unit of time.

Speed

It is define as the distance covered per unit time. It is the rate at which the distance is covered.

Unit of Speed Though we commonly take km/h. As units of speed.

Distance

When an object is moving with a certain speed in a particular time, the displacement made by an object is called the distance.

Unit of Distance kilometer (km) and metre (m) is usually taken as the unit of distance.

Relationship between Time, Speed and Distance

Relationship between time, distance and speed is expressed by

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

This expression shown that

1. **Speed** is directly proportional to distance. If the speed is doubled, then distance travelled in the same time, will also be doubled.

2. **Distance** and **time** are directly proportional. If distance to be travelled is doubled, then the time taken would also be doubled at the same speed.

3. **Time** is inversely proportional to speed. If the distance remains the same and speed is doubled, then time taken to travel the same distance becomes half of the original time taken at the original speed.

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Average Speed

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

e.g. A person goes to Delhi from Mumbai at the speed of 60 km/h and comes back at the speed of 50 km/h.

Calculate the average speed of the person for the entire trip.

Sol. Average Speed $= \frac{2 \times 60 \times 50}{60 + 50}$

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

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

Concept of Relative Speed in Motion of Trains

Some important points in problems on trains

1. If two trains of length x km and y km are moving in opposite directions at ukm/h and vkm/h, then time taken by the trains to cross each other $= \left(\frac{x+y}{u+v}\right)$ h
2. If two trains of length x km and y km are moving in the same direction at ukm/h and vkm/h are, where $u > v$, then time taken by faster train to cross the slower train $= \left(\frac{x+y}{u-v}\right)$ h

e.g., Two persons are moving in the direction opposite to each other. The speeds of the both persons are 5 km/h and 3 km/h, respectively. Find the relative speed of the two persons in respect of each other.

Sol. Required relative speed $= 5 + 3 = 8$ km/h

Boats and Streams

The problems of boats and streams are also based on the basic relation of speed, distance and time

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

In their questions, the direction along the stream (water) is called downstream and direction against the stream is called upstream.

- If the speed of a boat in still water is x km/h and the speed of the stream is y km/h, then Downstream speed $= (x + y)$km/h

  Upstream speed $= (x - y)$km/h
- From the above relationship we conclude, if the downstream speed is u km/h and upstream speed v km/h then,

  Speed of boat in still water $= \left(\frac{u+v}{2}\right)$ km/h

  Speed of stream $= \left(\frac{u-v}{2}\right)$ km/h

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Solved Examples:

1. The speed of a bus is 72 km/h. The distance covered by the bus in 5 s is

(a) 50 m
(b) 74.5 m
(c) 100 m
(d) 60 m

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

$\therefore$ Distance travelled in 5 s $= 20 \times 5$(Speed $\times$ Time) $= 100$ m

2. Two men start together to walk a certain distance, one at 4 km/h and another at 3 km/h. The former arrives half an hour before the latter. Find the distance.

(a) 6 km
(b) 9 km
(c) 8 km
(d) 7 km

Sol. (a) Let the distance $= x$ km

By given condition, $\frac{x}{3} - \frac{x}{4} = \frac{1}{2} \Rightarrow \frac{4x-3x}{12} = \frac{1}{2} \Rightarrow x = \frac{12}{2}$

$\therefore x = 6$ km

3. If a train 110 m long passes a telegraph pole in 3 s, then the time taken by it to cross a railway platform 165 m long will be

(a) 6.50 s
(b) 8.5 s
(c) 7.5 s
(d) 6.55 s

Sol. (c) Speed $= \frac{\text{Distance}}{\text{Time}} = \frac{110}{3}$ m/s

Time taken to cross the platform $= \frac{110+165}{110/3} = \frac{275 \times 3}{110} = 7.5$ s

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4. Two trains A and B, travelling in opposite directions, cross each other in 6 s. The speed of train A is 126 km/h, while that of train B is 90 km/h. If the length of train A is 160 m, what is the length of train B ?

(a) 150 m
(b) 120 m
(c) 220 m
(d) 200 m

Sol. (d) $T = \dfrac{L_1 + L_2}{S_1 + S_2}$

$\Rightarrow \quad 6 = \dfrac{160 + L_2}{(126 + 90)\dfrac{5}{18}}$

$\Rightarrow \quad 6 \times 216 \times \dfrac{5}{18} = 160 + L_2$

$\Rightarrow \quad L_2 = 200$ m

5. A train takes 18 s to pass completely through a station 162 m long and 15 s through another station 120 m long. Find the length of the train.

(a) 80 m
(b) 90 m
(c) 85 m
(d) 95 m

Sol. (b) $18 = \frac{162+l}{5}$ and $15 = \frac{120+l}{5}$

$\therefore \; l - 185 + 162 = 0$

and $\; l - 155 + 120 = 0$

On solving the above two equations, we have $l = 90$ m

6. A train 100 m long completely passes a man walking in the same direction at 6 km/h in 5 s and a car travelling in the same direction in 6 s. At what speed was the car travelling?

(a) 15 km/h
(b) 20 km/h
(c) 18 km/h
(d) 16 km/h

Sol. (c) In case of man,

$$5 = \frac{100 \times 18}{(x - 6) \times 5} \Rightarrow x = 78 \text{ km/h}$$

In case of car, $6 = \dfrac{100 \times 18}{(78 - y)5}$

$$\Rightarrow \; y = (78 - 60) = 18 \text{ km/h}$$

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Practice Questions

1. A motorcycle covers 40 km with a speed of 20 km/h. Find the speed of the motorcycle for the next 40 km journey so that the average speed of the whole journey will be 30 km/h.

(a) 70 km/h
(c) 60 km/h
(b) 52.5 km/h
(d) 60.5 km/h

2. A bus can complete a journey in 12 h. The first half is completed at 22 km/h and the second half at 26 km/h. Find the distance.

(a) 280 km
(b) 284 km
(c) 286 km
(d) 288 km

3. A man takes 6 h30 min in walking to a certain place and riding back. He would have gained 2 h10 min by riding both ways. How long would he take to walk both ways?

(a) 8 h20 min
(b) 4 h10 min
(c) 8 h40 min
(d) 4 h20 min

4. Raghubir after travelling 84 km, found that if he travelled 5 km an hour more, he would take 5 h less, he actually travelled at a rate of

(a) 7 km/h
(b) 10 km/h
(c) 5 km/h
(d) 6 km/h

5. If a man covers $10\frac{1}{5}$ km in 3 h, the distance covered by him in 5 h is

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

6. A man covers a certain distance on scooter. Had he moved 3 km/h faster, he would have taken 40 min less. If he had moved 2 km/h slower, he would have token 40 min more. The distance (in km) is

(a) 42.5
(b) 36
(c) 37.5
(d) 40

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7. A man walking with 3/4 of his usual speed, reaches office 20 min late. His usual time is

(a) 50 min
(b) 80 min
(c) 70 min
(d) 60 min

8. When a person cycled at 10 km/h he arrived at his office 6 min late. He arrived 6 min early, when he increased his speed by 2 km/h. The distance of his office from the starting place is

(a) 6 km
(b) 7 km
(c) 12 km
(d) 16 km

9. Walking at the rate of 4 km an hour, a man covers a certain distance in 3 h45 min. If he covers the same distance on cycle, cycling at the rate of 16.5 km/h, the time taken by him is

(a) 55.45 min
(b) 54.55 min
(c) 55.44 min
(d) 45.55 min

10. If a man runs at 2 m/s, how many kilometres does he run in 1 h20 min?

(a) 8.4
(b) 6.9
(c) 9.6
(d) 7.4

11. Nalanda and Nawada are two towns. Sabir goes from Nalanda to Nawada at 30 km/h and comes back to the starting point at 70 km/h. What is the average speed during the whole journey?

(a) 12 km/h
(b) 60 km/h
(c) 24 km/h
(d) 42 km/h

12. A train 200 m long is running at 72 km/h. In how much time will it pass a platform 200 m long?

(a) 10 s
(b) 20 s
(c) 400 s
(d) 17 s

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13. A railway officer standing on a railway bridge which is 200 m long finds that the train crosses the bridge in 19 s but himself in 9 s. Find the length of the train.

(a) 135 m
(b) 180 m
(c) 72 m
(d) 90 m

14. Two buses, one of them takes $7\frac{1}{2}$ h to travel 300 km and another takes 9 h to travel 450 km. Find the ratio of speed of two buses.

(a) 2: 3
(b) 4: 3
(c) 4: 5
(d) 8: 9

15. A train 110 m long is running at the speed of 72 km/h to pass a 132 m long platform in how many times?

(a) 9.8 s
(b) 12.1 s
(c) 12.42 s
(d) 14.3 s

16. A boatman can row his boat at a speed of 8 km/h in still water. If a river flows at a speed of 2 km/h, then how long will the boatman take to row his boat 1200 m with the direction of the current?

(a) 7.2 min
(b) 7.4 min
(c) 7.6 min
(d) 7.8 min

17. Two cyclists start from the same place in opposite directions. One goes towards north at 18 km/h and the other goes towards south at 20 km/h. What time will they take to be 47.5 km apart?

(a) $1\frac{1}{4}$ h
(b) 2 h
(c) 3 h
(d) None of these

18. A man goes uphill with an average speed of 24 km/h and comes down with an average speed of 36 km/h. The distance travelled in both the cases being the same, the average speed for the entire journey is

(a) 30 km/h
(b) 28.8 km/h
(c) 32 km/h
(d) None of these

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19. A train 700 m long is running at the speed of 72 km/h. If it crosses a tunnel in 1 min, then the length of the tunnel is

(a) 650 m
(b) 500 m
(c) 550 m
(d) 700 m

20. Two trains of length 120 m and 80 m are running in the same direction with velocities of 40 km/h and 50 km/h respectively. The time taken by them to cross each other is

(a) 60 s
(b) 75 s
(c) 72 s
(d) 80 s

21. A motor boat takes 2 h to travel a distance of 9 km down the current and it takes 6 h to travel the same distance against the current. The speed of the boat in still water and that of the current (in km/h) respectively are

(a) 3,2
(b) 3.5,2.5
(c) 3,1.5
(d) 3,1

22. Distance between two towns P and Q is 240 km. A motor cycle rider starts from P towards Q at 8pm at a speed of 40 km/h. At the same time another motor cycle rider starts from Q towards P at 50 km/h. At what time will they meet?

(a) 9: 45pm
(b) 10: 40pm
(c) 11pm
(d) 10: 30pm

23. A man standing on a railway platform observes that a train going in one direction takes 4 s to pass him. Another train of same length going in the opposite direction takes 5 s to pass him. The time taken (in seconds) by the two trains to cross each other will be

(a) $\frac{49}{9}$
(b) $\frac{40}{9}$
(c) $\frac{50}{9}$
(d) $\frac{31}{9}$

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24. A boy is running at a speed of p km/h to cover a distance of 1 km. But due to the slippery ground, his speed reduced by q km/h$(p > q)$. If he takes r h to cover the distance, then

(a) $\frac{1}{r} = \frac{pq}{p+q}$
(b) $\frac{1}{r} = p + q$
(c) $r = p - q$
(d) $\frac{1}{r} = p - q$

25. A train is going at a speed of 180 km/h. Its speed is

(a) 15 m/s
(c) 40 m/s
(b) 30 m/s
(d) 50 m/s

26. A man completes 30 km of a journey at 6 km/h and the remaining 40 km in 5 h. His average speed for whole journey is

(a) $6\frac{4}{11}$ km/h
(b) 7 km/h
(c) $7\frac{1}{2}$ km/h
(d) 8 km/h

27. A is twice as fast as B and B is thrice as fast as C. The journey covered by C in 42 min will be covered by A in

(a) 7 min
(b) 28 min
(c) 63 min
(d) 14 min

28. A man covers half of his journey at 6 km/h and the remaining half at 3 km/h. His average speed is

(a) 4.5 km/h
(b) 3 km/h
(c) 4 km/h
(d) 9 km/h

29. If a train runs at 40 km/h, it reaches its destination late by 11 min. But, if it runs at 50 km/h, it is late by 5 min only. The correct time for the train to complete its journey is

(a) 15 min
(c) 13 min
(b) 21 min
(d) 19 min

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30. A constable is 114 m behind a thief. The constable runs 21 m the thief 15 m in a minute. In what time will the constable catch the thief?

(a) 17 min
(b) 19 min
(c) 16 min
(d) 18 min

31. The distance between two places A and B is 15 km. Ram walks from A to B at 4 km/h and Shyam walks from B to A at 6 km/h. Both start at 7am. At what time will they meet?

(a) 7: 45am
(b) 8: 30am
(c) 7: 14am
(d) 8: 30pm

32. A car covers a certain distance in 8 h. If the speed is increased by 4 km/h. This distance could be covered in $7\frac{1}{2}$ h. This distance is

(a) 420 km
(b) 480 km
(c) 640 km
(d) 700 km

33. The ratio of the speeds of three cars is 2: 3: 4. What is the ratio of the times taken by them in covering the same distance?

(a) 2: 3: 4
(b) 4: 3: 2
(c) 4: 3: 6
(d) 6: 4: 3

34. If the speed of a train is increased by 5 km/h from its normal speed it would have taken 2 h less to cover 300 km. What is its normal speed?

(a) 20 km/h
(b) 25 km/h
(c) 30 km/h
(d) 45 km/h

35. A 200 m long train crosses a platform of double its length in 36 s. The speed of the train is

(a) 60 km/h
(b) 48 km/h
(c) 64 km/h
(d) 66 km/h

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36. A train 270 m long is moving at a speed of 25 km/h. It will cross a man coming from the opposite direction at 2 km/h in

(a) 36 s
(b) 32 s
(c) 28 s
(d) 24 s

37. A train running at 36 km/h takes 10 s to pass a telegraph pole. How long would it take to cross a platform 110 m long?

(a) 24 s
(b) 31 s
(c) 21 s
(d) 33 s

38. A train running at a uniform speed crosses a 122 m long platform in 17 s and a 210 m long bridge in 25 s. The speed of the train is

(a) 46.5 km/h
(b) 37.5 km/h
(c) 37.6 km/h
(d) 39.6 km/h

39. A train is moving at a speed of 132 km/h. If the length of the train is 110 m, how long will it take to cross a railway platform 165 m long?

(a) 7.5 s
(b) 15 s
(c) 10 s
(d) 5 s

40. A train crosses a platform 100 m long in 60 s at a speed of 45 km/h. The time taken by the train to cross an electric pole is

(a) 8 s
(b) 52 s
(c) 1 min
(d) 40 s

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ANSWERS

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

Hints & Solutions

1. Let speed of the motor cycle for the next 40 km journey be x km/h.Then,

$$30 = \frac{2 \times 20 \times x}{20 + x}$$

$$\Rightarrow \quad 3(20 + x) = 4x$$

$$\Rightarrow \quad 60 + 3x = 4x$$

$$\Rightarrow \quad x = 60 \text{ km/h}$$

2. Let distance of the journey be d km.

Then, $\frac{d}{2\times22} + \frac{d}{2\times26} = 12$

$$\Rightarrow \quad \frac{d}{11} + \frac{d}{13} = 48$$

$$\Rightarrow \quad \frac{24d}{143} = 48$$

$$\Rightarrow d = 286 \text{ km}$$

3. Let W be the time taken to walk one way and R be the time taken to ride one way.

We are given: $W+R$=6 hours and 30 minutes

$W-R$=2 hours and 10 minutes

Add the two equations to eliminate R: $(W+R) + (W-R)$ =
6 hours and 30 minutes+2 hours and 10 minutes

$2W$=8 hours and 40 minutes

W=4 hours and 20 minutes

The total time for walking both ways is $2W$=8 hours and 40 minutes

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4. Let the speed of Raghubir be x km/h.

According to the question,

$$\frac{84}{x} - \frac{84}{x+5} = 5$$
$$\Rightarrow\ 84\left[\frac{1}{x} - \frac{1}{(x+5)}\right] = 5$$
$$\Rightarrow\ 84\left[\frac{x+5-x}{x(x+5)}\right] = 5$$
$$\Rightarrow\ \frac{84 \times 5}{x(x+5)} = 5$$
$$\Rightarrow\ x(x+5) = 84$$
$$\Rightarrow\ x^2 + 5x - 84 = 0$$
$$\Rightarrow\ x(x+12) - 7(x+12) = 0$$
$$\Rightarrow\ (x+12)(x-7) = 0$$
$$\Rightarrow\ x - 7 = 0$$
$$\therefore\ x = \frac{7\ \text{km}}{\text{h}}$$

5. Distance covered by man in 3 h

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

Distance covered by man in 1 h

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

Distance covered by man in 5 h will be $= \frac{17}{5} \times 5 = 17$ km

6. Let distance and original speed of the man be d km and s km/h. Then,

$$\frac{d}{s} - \frac{d}{s+3} = \frac{2}{3}$$
$$\Rightarrow\ \frac{d(s+3-s)}{s(s+3)} = \frac{2}{3}$$
$$\Rightarrow\ 9d = 2s(s+3)$$

and $\frac{d}{s-2} - \frac{d}{s} = \frac{2}{3}$

$$\Rightarrow\ \frac{d(s-s+2)}{s(s-2)} = \frac{2}{3}$$
$$\Rightarrow\ 3d = s(s-2)$$

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

$$\begin{aligned} & 3s(s-2) = 2s(s+3) \\ \Rightarrow \quad & 3s^2 - 6s = 2s^2 + 6s \\ \Rightarrow \quad & s^2 = 12 \text{ s} \\ \Rightarrow \quad & s = 12 \end{aligned}$$

From Eq. (ii), we get

$$\begin{aligned} 3d &= 12(12-2) \\ d &= 40 \text{ km} \end{aligned}$$

7. Let usual speed and usual time taken by the man are S km/h and T h, respectively.

$\therefore\ D = ST$

According to the question, we get

$$D = \frac{3}{4}S \cdot \left(T + \frac{1}{3}\right)$$

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

$$\begin{aligned} ST &= \frac{3}{4}S \cdot \left(T + \frac{1}{3}\right) \\ \Rightarrow\ 4T &= 3T + 1 \\ \therefore\ T &= 1 \text{ h} = 60 \text{ min} \end{aligned}$$

8. Let the distance of his office from the starting point be x km. By given condition,

$$\frac{x}{10} - \frac{6}{60} = \frac{x}{(10+2)} + \frac{6}{60}$$

$$\frac{x}{10} - \frac{x}{12} = \frac{12}{60}$$

$$x = \frac{12 \times 60}{60} = 12 \text{ km}$$

9. Speed $= 4$ km/h

Time $= 3$ h45min $= 3\frac{3}{4}$ h

$\therefore$ Distance covered by man

$\therefore$ Required time $= \frac{15}{16.5}$ h

$$\begin{aligned} &= \frac{15}{16.5} \times 60 \text{ min} \\ &= 54.55 \text{ min} \end{aligned}$$

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10. Speed of man $= 2$ m/s

$$= \frac{2 \times 18}{5} \text{ km/h} = \frac{36}{5} \text{ km/h}$$

Time $= 1$ h 20min $= \frac{80}{60}$ h $= \frac{4}{3}$ h

Distance = Time × Speed

$$= \frac{36}{5} \times \frac{4}{3} = \frac{48}{5} = 9.6 \text{ km}$$

11. Average speed of Sabir

$$= \frac{2xy}{x+y} = \frac{2 \times 30 \times 70}{30+70}$$

$$= \frac{4200}{100} = 42 \text{ km/h}$$

12. Length of train $= 200$ m Length of platform $= 200$ m Total distance cover by train to pass the platform $= 400$ m Speed of train $= 72$ km/h

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

Time taken by train to pass the platform

$$= \frac{\text{Distance}}{\text{Speed}} = \frac{400}{20} = 20 \text{ s}$$

13. Let length of train $= x$ m

According to the question,

Speed $= \frac{x+200}{19}$

Speed $= \frac{x}{9}$

From Eqs. (i) and (ii),

$$\frac{x}{9} = \frac{x+200}{19}$$
$$\Rightarrow \quad 19x - 9x = 1800$$
$$\Rightarrow \quad 10x = 1800$$
$$\Rightarrow \quad x = 180 \text{ m}$$

Hence, length of train is 180 m.

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14. First bus speed $= \frac{300}{15} \times 2$

$= 40 \text{ km/h}$

Second bus speed $= \frac{450}{9}$

$= 50 \text{ km/h}$

$\therefore$ Required ratio $= 40:50 = 4:5$

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

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

$= 20 \text{ m/s}$

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

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

16. Speed of boatman in still water

$= 8 \text{ km/h}$

Speed of river $= 2 \text{ km/h}$

Speed of boatman with the direction of current

$= 8 + 2 = 10 \text{ km/h}$

Distance cover by boat in the direction of current $= 1200 \text{ m}$

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

$$= \frac{1200}{\frac{10 \times 1000}{60}}$$

$$= \frac{1200 \times 60}{10 \times 1000} = \frac{72}{10}$$

$$= 7.2 \text{ min}$$

17. Since, they are in opposite direction. So, total distance apart $= 18 + 20 = 38$ km For 47.5 km apart, it takes time

$= \frac{1}{38} \times 47.5$

$= 1\frac{1}{4} \text{ h}$

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18. Average speed $= \frac{2xy}{x+y}$

$$= \frac{2 \times 24 \times 36}{24 + 36}$$
$$= 28.8 \text{ km/h}$$

19. Speed $= 72 \times \frac{5}{18} = 20$ m/s

Let the length of tunnel be x m.

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

$\Rightarrow\ x = 500$ m

20. Since, the train is running in same direction therefore relative speed

$= (50 - 40)$km/h

$= 10 \times \frac{5}{18} = \frac{25}{9}$ m/s

∴ Required time

= Time taken to cover

$(120 + 80)$ at $\frac{25}{9}$ m/s

$= 200 \times \frac{9}{25} = 72$ s

21. Rate of downstream

$= \frac{9}{2} = 4.5$ km/h

Rate of upstream $= \frac{9}{6} = 1.5$ km/h

∴ Rate in still water

$= \frac{1}{2}(4.5 + 1.5) = 3$ km/h

Rate of the current

$= \frac{1}{2}(4.5 - 1.5) = 1.5$ km/h

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22. Suppose they meet x h after 8pm. Then, sum of distance covered by them in hours

$= 240$ km

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

$\Rightarrow\ x = \frac{240}{90} = 2$ h40 min

Hence, they will meet in 10:40 pm.

23. Let the length of each train be x m.

Then, speed of first train $= \frac{x}{4}$ m/s and speed of second train

$= \frac{x}{5}$ m/s

Relative speed $= \left(\frac{x}{4} + \frac{x}{5}\right)$ m/s

$= \frac{9x}{20}$ m/s

$\therefore$ Time taken to cross each other = Time taken to cover $2x$ m

at $\left(\frac{9x}{20}\right)$ m/s

$= 2x \times \frac{20}{9x} = \frac{40}{9}$ s

24. Actual speed of boy $= (p - q)$km/h

Time taken to cover 1 km

$= \frac{1}{p - q}$

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

$\Rightarrow\ \frac{1}{r} = p - q$

25. 180 km/h $= \left(180 \times \frac{5}{18}\right)$ m/s

$= 50$ m/s

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26. Total journey $= (30 + 40) = 70$ km

Total time taken $= \left(\frac{30}{6} + 5\right)$

$= 10$ h

Average speed $= \frac{70}{10}$ km/h

$= 7$ km/h

27. Let C 's speed be x m/min.

B s speed $= 3x$ m/min

A 's speed $= 6x$ m/min

Ratio of speeds of A and C

$= 6x : x = 6 : 1$

$2 : y$

$\Rightarrow\ y = \frac{42}{6} = 7$ min

$\therefore$ A takes 7 min to cover it.

28. Average speed $= \frac{2xy}{x+y}$ km/h

$= \frac{2 \times 6 \times 3}{6 + 3}$

$= \frac{36}{9} = 4$ km/h

29. Let the distance travelled by the train is x km.

Then,

$$\frac{x}{\frac{40 \times 1000}{60}} - \frac{x}{\frac{50 \times 1000}{60}} = 60$$

$$\Rightarrow\ \frac{60x}{40000} - \frac{60x}{50000} = 6$$

$$\Rightarrow\ \frac{60}{10000}\left(\frac{x}{4} - \frac{x}{5}\right) = \frac{6}{1}$$

$$\Rightarrow\ \frac{x}{20} = 1000$$

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

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∴ The correct time for the train to complete its journey

$$= \frac{20}{40} \times 60 - 11$$
$$= 30 - 11$$
$$= 19 \text{ min}$$

30. $(21 - 15) = 6$ m is covered in 1 min 114 m will be covered in

$$\left(\frac{1}{6} \times 114\right) \text{min} = 19\text{min}$$

31. Suppose they meet after x h.

Then, $4x + 6x = 15$

$\Rightarrow$ $10x = 15$

$\Rightarrow$ $x = 1.5$ h

So, they meet at 8:30 am.

32. Let the required distance be x km.

Then,

$$\frac{x}{15/2} - \frac{x}{8} = 4$$

$$\Rightarrow \frac{2x}{15} - \frac{x}{8} = 4$$
$$\Rightarrow 16x - 15x = 480$$

$\Rightarrow$ $x = 480$ km

33. Required ratio $= \frac{1}{2} : \frac{1}{3} : \frac{1}{4} = 6 : 4 : 3$

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34. Let the normal speed be x km/h.

$$\frac{300}{x} - \frac{300}{(x+5)} = 2$$
$$\Rightarrow \frac{1}{x} - \frac{1}{x+5} = \frac{1}{150}$$
$$\Rightarrow \frac{x+5-x}{x(x+5)} = \frac{1}{150}$$
$$\Rightarrow x(x+5) = 750$$
$$\Rightarrow x^2 + 5x - 750 = 0$$
$$\Rightarrow x^2 + 30x - 25x - 750 = 0$$
$$\Rightarrow x(x+30) - 25(x+30) = 0$$
$$\Rightarrow (x-25)(x+30) = 0$$
$$\therefore x = \frac{25 \text{ km}}{\text{h}}$$

35. Length of train $= 200$ m and length of platform

$= 2 \times 200$ m $= 400$ m

Speed of the train $= \frac{200+400}{36}$

$$= \frac{600}{36} \text{ m/s}$$
$$= \frac{600}{36} \times \frac{18}{5}$$
$$= 60 \text{ km/h}$$

36. Relative speed $= (25 + 2)$

$$= 27 \text{ km/h}$$
$$= 27 \times \frac{5}{18} \text{ m/s}$$
$$= \frac{15}{2} \text{ m/s}$$

Required time $= \frac{270}{\frac{15}{2}} = \frac{270 \times 2}{15}$ s $= 36$ s

37. Speed of train $= \left(36 \times \frac{5}{18}\right)$ m/s

$$= 10 \text{ m/s}$$

Length of the train $= (10 \times 10)$m $= 100$ m

Time taken to cross the platform $= \frac{100+110}{10} = \frac{210}{10} = 21$ s

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38. Let the length of train be x m/s.

$$\frac{x+122}{17} = \frac{x+210}{25}$$

$\Rightarrow\ 17x + 3570 = 25x + 3050$

$\Rightarrow\ 8x = 520 \Rightarrow x = 65$

$\therefore$ Length of the train $= 65$ m

Speed of train $= \frac{65+122}{17}$ m/s

$= \frac{187}{17}$ m/s

$= \left(\frac{187}{17} \times \frac{18}{5}\right)$ km/h

$= 39.6$ km/h

39. Speed of train

$= \left(132 \times \frac{5}{18}\right) = \frac{110}{3}$ m/s

Time taken to cross the platform

$= \frac{110+165}{\frac{110}{3}} = \left(\frac{275 \times 3}{110}\right)$

$= \frac{15}{2}$ s

$= 7.5$ s

40. Let the length of the train be x m.

Speed $= \left(45 \times \frac{5}{18}\right)$ m/s $= \frac{25}{2}$ m/s

$\therefore\ \frac{x+100}{60} = \frac{25}{2}$

$\Rightarrow\ 2x + 200 = 1500$

$\Rightarrow\ 2x = 1300$

$\Rightarrow\ x = 650$

Time taken to cross a pole

$= \left(650 \times \frac{2}{25}\right) = 52$ s

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