Chapter

21 DISTANCE, TIME AND SPEED

Section-A

DISTANCE, TIME AND SPEED

KEY FACTS

1. (i) Speed $= \dfrac{\text{Distance}}{\text{Time}}$ (ii) Distance = Speed × Time (iii) Time $= \dfrac{\text{Distance}}{\text{Speed}}$

2. (i) To convert a speed in m/s to km/h, multiply by $\dfrac{18}{5}$.

(ii) To convert a speed in km/h to m/s, multiply by $\dfrac{5}{18}$.

3. Average speed $= \dfrac{\text{Total distance covered}}{\text{Total time taken}}$

Solved Examples

Ex. 1. ***A thief seeing a policeman from a distance of 200 metres, starts running with a speed of 8 km/hr. The policeman gives chase immediately with a speed of 9 km/hr and the thief is caught. What is the distance run by the thief?***

Sol. Relative speed of the policeman with respect to that of thief = (9 – 8) km/hr = $1 \times \dfrac{5}{18}$ m/sec

$\Rightarrow$ Time taken by the policeman to catch the thief $= \dfrac{200}{5/18}$ sec = 720 seconds

$\therefore$ The distance run by the thief $= \left(8 \times \dfrac{5}{18} \times 720\right)$ metres = 1600 metres

Ex. 2. ***In covering a distance of 30 km, Abhay takes 2 hours more than Sameer. If Abhay doubles his speed, then he would take 1 hour less than Sameer. What is Abhay's speed?***

Sol. Let Abhay's speed be x km/hr and Sameer's speed be y km/hr.

Then, $\dfrac{30}{x} - \dfrac{30}{y} = 2$ .... (i) and $\dfrac{30}{y} - \dfrac{30}{2x} = 1$ … (ii)

Adding equation (i) and (ii), we get $\dfrac{30}{x} - \dfrac{30}{2x} = 3$

$\Rightarrow \dfrac{30}{2x} = 3 \Rightarrow 2x = 10 \Rightarrow x = 5$ km/hr.

Ex. 3. ***I started on my bicycle at 7 A.M. to reach a certain place. After going a certain distance my bicycle went out of order. Consequently I rested for 35 minutes and came back to my house walking all the way. I reached my house at 1 P.M. If my cycling speed is 10 km/hr and my walking speed is 1 km/hr, then what distance did I cover on my bicycle?***

Sol. Let the distance covered on the bicycle was x km. Then,

$$\frac{x}{10}+\frac{35}{60}+x=6 \text{ hrs} \Rightarrow \frac{6x+35+60x}{60}=6 \Rightarrow 66x+35=360$$

$$\Rightarrow 66x=325 \Rightarrow x=\frac{325}{66} \text{ km} = 4\frac{61}{66} \text{ km.}$$

Ex. 4. ***In a race of 200 metres, B can give a start of 10 metres to A and C can give a start of 20 metres to B. What is the start that C can give to A in the same race?***

Sol. Ratio of the distances covered by A and B = 190 : 200 = 1710 : 1800

Ratio of the distances covered by B and C = 180 : 200 = 1800 : 2000

$\Rightarrow$ Ratio of the distances covered by A and C = 1710 : 2000 = 171 : 200

Hence C will give a start of (200 m – 171 m) = 29 m to A in the same race.

Ex. 5. ***A cyclist cycles non-stop from A to B, a distance of 14 km at a certain average speed. If his average speed reduces by 1 km / hr, then he takes $\frac{1}{3}$ hour more to cover the same distance. What was the original average speed of the cyclist?***

Sol. Let the original average speed of the cyclist be x km/hr.

Then, $\frac{14}{(x-1)}-\frac{14}{x}=\frac{1}{3} \Rightarrow \frac{14x-14(x-1)}{x(x-1)}=\frac{1}{3}$

$$\Rightarrow \frac{14}{x^2-x}=\frac{1}{3} \Rightarrow x^2-x-42=0 \Rightarrow x^2-7x+6x-42=0$$

$\Rightarrow x(x-7)+6(x-7)=0 \Rightarrow (x-7)(x+6)=0$

$\Rightarrow x=7$ or -6

Since speed cannot be negative, x = 7 km/hr.

Ex. 6. ***The ratio between the rates of walking of A and B is 2 : 3 and therefore A takes 10 minutes more than the time taken by B to reach the destination. If A had walked at double the speed, then in what time would he have covered that distance?***

Sol. Ratio of speeds = 2 : 3

$\Rightarrow$ Ratio of times taken = 3 : 2

Given $3x-2x=10 \Rightarrow x=10$

$\Rightarrow$ A would have taken 30 minutes.

But if A walks with double the speed, then he takes half the time, *i.e.*, 15 minutes.

Ex. 7. ***A train X starts from New Delhi at 4 pm and reaches Ghaziabad at 5 pm. While another train Y starts from Ghaziabad at 4 pm and reaches New Delhi at 5 : 30 pm. At what time will the two trains cross each other?***

Sol. Let Delhi – Ghaziabad distance be a km. Then,

Speed of train $X = a$ km/hr

Speed of train $Y = \frac{a}{3/2}$ km/hr = $\frac{2a}{3}$ km/hr

Suppose they meet after b hours, then $ab+\frac{2ab}{3}=a \Rightarrow \frac{5b}{3}=1 \Rightarrow b=\frac{3}{5}$ hrs = 36 minutes

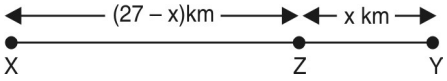
$\therefore$ They meet at 4 : 36 pm.

Ex. 8. ***A and B walk from X to Y, a distance of 27 km at 5 km/hr and 7 km/hr respectively. B reaches Y and immediately turns back meeting A at Z. What is the distance from X to Z?***

Sol. Time taken by A in covering $(27 - x)$ km is the same as time taken by B in covering $(27 + x)$ km.

$$\therefore \quad \frac{27-x}{5} = \frac{27+x}{7}$$

$$\Rightarrow \quad 189 - 7x = 135 + 5x \quad \Rightarrow \quad 12x = 54 \quad \Rightarrow \quad x = \frac{54}{12} = \frac{27}{6} \text{ km.}$$



$$\therefore \quad XZ = 27 - \frac{27}{6} = 27 \times \frac{5}{6} = 22.5 \text{ km.}$$

Ex. 9. ***A man travels from A to B at a speed of x km/hr. He then rests at B for x hours. He then travels from B to C at a speed of 2x km/hr and rests for 2x hours. He moves further to D at a speed twice as that between B and C. He thus reaches D in 16 hours. If the distance A – B, B – C and C – D are all equal to 12 km, then what could be the time for which he rested at B?***

Sol. Total time taken from A to $D = \frac{12}{x} + x + \frac{12}{2x} + 2x + \frac{12}{4x}$

$$= \frac{48}{4x} + \frac{24}{4x} + \frac{12}{4x} + 3x = \frac{21}{x} + 3x$$

Given, $\frac{21}{x} + 3x = 16$

$$\Rightarrow \quad 21 + 3x^2 - 16x = 0 \Rightarrow 3x^2 - 16x + 21 = 0 \Rightarrow 3x^2 - 9x - 7x + 21 = 0$$

$$\Rightarrow \quad 3x(x-3) - 7(x-3) = 0 \Rightarrow (x-3)(3x-7) = 0$$

$$\Rightarrow \quad x = 3 \text{ or } x = \frac{7}{3}$$

$$\therefore \quad x = 3 \text{ hrs or } \frac{7}{3} \text{ hrs.}$$

Ex. 10. ***A man travels three-fifths of a distance AB at a speed of 3a, and the remaining at a speed of 2b. If he goes from B to A and returns at a speed of 5c in the same time, then***

(a) $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$ ***(b)*** $a + b = c$ ***(c)*** $3a + 2b = 5c$ ***(d)*** $\frac{1}{a} + \frac{1}{b} = \frac{2}{c}$

Sol. Time taken to cover $AC = \frac{3x}{5 \times 3a} = \frac{x}{5a}$ hr

Time taken to cover $CB = \frac{2x}{5 \times 2b} = \frac{x}{5b}$ hr

Time taken to cover BA and back $AB = \frac{2x}{5c}$

Given, $\frac{x}{5a} + \frac{x}{5b} = \frac{2x}{5c} \quad \Rightarrow \quad \frac{1}{a} + \frac{1}{b} = \frac{2}{c}$.

Question Bank–21(a)

1. A person wants to travel a distance of 50 km by his bicycle. He travels with a speed of 12.5 km/hr. After every 12.5 km, he takes a rest of 20 minutes. How much time will he take to complete the whole distance?

(a) 4 hrs 20 min (b) 5 hrs 20 min
(c) 5 hrs (d) 6 hrs

2. Two cars start at the same time from one point and move along two roads at right angles to each other. Their speeds are 36 km/hr and 48 km/hr respectively. After 15 seconds, the distance between them will be

(a) 400 m (b) 150 m
(c) 300 m (d) 250 m

3. In a race of 800 m, A can beat B by 40 m. In a race of 500 m, B can beat C by 5 m. In a race of 200 m, A will beat C by
(a) 11.9 m (b) 1.19 m
(c) 12.7 m (d) 1.27 m

4. A constable follows a thief who is 200 m ahead of the constable. If the constable and the thief runs at the speeds of 8 km/hr and 7 km/hr respectively, the constable would catch the thief in
(a) 10 min (b) 12 min
(c) 15 min (d) 20 min

5. Two buses travel to a place at 45 km/hr and 60 km/hr respectively. If the second bus takes $5\frac{1}{2}$ hrs less than the first for the journey, the length of the journey is
(a) 900 km (b) 945 km
(c) 990 km (d) 1350 km

6. A cyclist covering a distance of 40 km would have reached 1 hour earlier, if he had run at an increased speed of 2 km/hr. His speed in (km/hr) was
(a) 6 (b) 8
(c) 10 (d) 12

7. Ram travels from P to Q at 10 km/hr and returns at 15 km/hr. Shyam travels from P to Q and returns at 12.5 km/hr. If he takes 12 minutes less than Ram, then what is the distance between P and Q?
(a) 60 km (b) 45 km
(c) 36 km (d) 30 km

8. A student reached his school late by 20 minutes by travelling at a speed of 9 km/hr. Had he travelled at the speed of 12 km/hr, he would have reached his school 20 minutes early. Find the distance between his house and the school?
(a) 12 km (b) 6 km
(c) 3 km (d) 24 km

9. An aircraft was to take off from a certain airport at 8 a.m., but it was delayed by 30 min. To make up for the lost time, it was to increase its speed by 250 km/hour from the normal speed to reach its destination 1500 km on time. What was the normal speed of the aircraft?
(a) 650 km/hr (b) 750 km/hr
(c) 850 km/hr (d) 1000 km/hr

10. Robert is travelling on his cycle and has calculated to reach point A at 2 p.m. if he travels at 10 km/hr, he will reach there at 12 noon if he travels at 15 km/hr. At what speed must he travel to reach A at 1 p.m.?
(a) 8 km/hr (b) 11 km/hr
(c) 12 km/hr (d) 14 km/hr

11. A is faster than B. A and B each walk 24 km. The sum of their speeds is 7 km/hr and sum of times taken by them is 14 hours. Then A's speed is equal to
(a) 3 km/hr (b) 4 km/hr
(c) 5 km/hr (d) 7 km/hr

12. A car travels the first one-third of a certain distance with a speed of 10 km/hr, the next one-third with a speed of 20 km/hr and the last one-third distance with a speed of 60 km/hr. The average speed of the car for the whole journey is
(a) 18 km/hr (b) 24 km/hr
(c) 30 km/hr (d) 36 km/hr

13. A motor car starts with a speed of 70 km/hr with its speed increasing every two hours by 10 km/hr. In how many hours will it cover 345 kms?
(a) $2\frac{1}{4}$ hrs (b) 4 hrs 5 min
(c) $4\frac{1}{2}$ hrs (d) 3 hrs

14. A train can travel 50% faster than a car. Both start from point A at the same time and reach point B 75 km away from A at the same time. On the way, however, the train lost about 12.5 minutes while stopping at the stations. The speed of the car is
(a) 100 km/hr (b) 110 km/hr
(c) 120 km/hr (d) 130 km/hr

15. Shyam went from Delhi to Shimla via Chandigarh by car. The distance from Delhi to Chandigarh is $\frac{3}{4}$ times the distance from Chandigarh to Shimla. The average speed from Delhi to Chandigarh was one and a half times that from Chandigarh to Shimla. If the average speed for the entire journey was 49 km/hr, what was the average speed from Chandigarh to Shimla?
(a) 39.2 km/hr (b) 63 km/hr
(c) 42 km/hr (d) 35 km/hr

16. A and B walk round a circular track. They start at 8 a.m. from the same point in opposite directions. A and B walk at a speed of 2 rounds per hour and 3 rounds per hour respectively. How many times shall they cross each other before 9.30 a.m.
(a) 5 (b) 6
(c) 7 (d) 8

17. A man covered a certain distance at some speed. Had he moved 3 km/hr faster, he would have taken 40 minutes less. If he had moved 2 km/hr slower, he would have taken 40 minutes more. The distance (in km) is:

(a) 35 (b) $36\frac{2}{3}$

(c) $37\frac{1}{2}$ (d) 40

18. A and B are 25 km apart. If they travel in opposite directions, they meet after one hour. If they travel in the same direction, they meet after 5 hours. If A travels faster than B, then the speed of A is

(a) 10 km/hr (b) 12.5 km/hr

(c) 15 km/hr (d) 20 km/hr

19. A small aeroplane can travel at 320 km/hr in still air. The wind is blowing at a constant speed of 40 km/hr. The total time for a journey against the wind is 135 minutes. What will be the time, in minutes for the return journey with the wind? (Ignore take off and landing times for the aeroplane.)

(a) 94.5 (b) 105

(c) 108.125 (d) 120

20. A man reduces his speed to two-third to walk a distance and consequently becomes late by 1 hour. With his usual speed, he covers the same distance in

(a) $\frac{1}{4}$ hour (b) $\frac{1}{2}$ hour

(c) 2 hours (d) $1\frac{1}{2}$ hours

21. If I walk at 3 km/hr, I miss a train by 2 minutes. If, however, I walk at 4 km/hr, then I reach the station 2 minutes before the arrival of the train. How far do I walk to reach the station?

(a) $\frac{3}{4}$ km (b) $\frac{4}{5}$ km

(c) $\frac{5}{4}$ km (d) 1 km

22. A car driver, driving in a fog, passes a pedestrian who was walking at the rate of 2 km/hr in the same direction. The pedestrian could see the car for 6 minutes and it was visible to him upto a distance of 0.6 km. What was the speed of the car?

(a) 15 km/hr (b) 30 km/hr

(c) 20 km/hr (d) 8 km/hr

23. A train increases its normal speed by 12.5% and reaches its destination 20 minutes earlier. What is the actual time taken by the train in the journey?

(a) 220 min (b) 180 min

(c) 145 min (d) 160 min

24. A bike travels a distance of 200 km at a constant speed. If the speed of the bike is increased by 5 km/hr, the journey would have taken 2 hours less. What is the speed of the bike?

(a) 30 km/hr (b) 25 km/hr

(c) 20 km/hr (d) 15 km/hr

25. Two persons P and Q start at the same time from city A to city B, 60 km away. P travels 4 km/hr slower than Q. Q reaches city B and at once turns back meeting P, 12 km from city B. What is the speed of P?

(a) 8 km/hr (b) 12 km/hr

(c) 16 km/hr (d) 20 km/hr

26. A starts from a place P to go to a place Q. At the same time, B starts from Q to P. If after meeting each other A and B took 4 hrs and 9 hrs more respectively to reach their destination, the ratio of their speeds is

(a) 3 : 2 (b) 5 : 2

(c) 9 : 4 (d) 9 : 13

27. In covering a certain distance, the speeds of A and B are in the ratio 3 : 4. A takes 30 minutes more than B to reach the destination. The time taken by A to reach the destination is

(a) 1 hour (b) $1\frac{1}{2}$ hours

(c) 2 hours (d) $2\frac{1}{2}$ hours

28. A and B run a kilometre and A wins by 25 seconds. A and C run a kilometre and A wins by 275 m. B and C run the same distance and B wins by 30 sec. The time taken by A to run a kilometer is

(a) 2 min 25 sec (b) 2 min 50 sec

(c) 3 min 20 sec (d) 3 min 30 sec

29. A hare sees a dog 200 m away from her and scuds off in the opposite direction at a speed of 24 km/hr. Two minutes later, the dog perceives her and gives chase at a speed of 32 km/hr. How soon will the dog overtake the hare and what is the distance from the spot from where the hare took flight?

(a) 8 min 2 km (b) $7\frac{1}{2}$ min, 2 km

(c) $7\frac{1}{2}$ min, 3 km (d) $7\frac{1}{2}$ min, 1 km

30. A, B and C start from the same place and travel the same directions at speeds of 30, 40 and 60 km/hr respectively. B starts two hours after A. If B and C overtake A at the same instant, how many hours after A did C start .

(a) 3 (b) 3.5

(c) 4 (d) 4.5

Answers

1. (c)	**2.** (d)	**3.** (a)	**4.** (b)	**5.** (c)	**6.** (b)	**7.** (d)	**8.** (d)	**9.** (b)	**10.** (c)
11. (b)	**12.** (a)	**13.** (c)	**14.** (c)	**15.** (c)	**16.** (c)	**17.** (d)	**18.** (c)	**19.** (b)	**20.** (c)
21. (b)	**22.** (d)	**23.** (b)	**24.** (c)	**25.** (a)	**26.** (a)	**27.** (c)	**28.** (a)	**29.** (c)	**30.** (c)

Hints and Solutions

1. (c) Time taken to travel 50 km $= \frac{50}{12.5}$ hrs = 4 hrs.

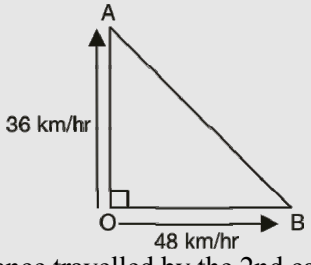
Number of stoppages $= \frac{50}{12.5} - 1 = 3$

$\therefore$ Total duration of stoppages = (3 × 20) min = 60 min = 1 hrs

$\therefore$ Total time to complete the whole distance = 5 hrs.

2. (d) Distance travelled by the 1st car in 15 seconds

$= OA = \left(36 \times \frac{5}{18}\right) \times 15$ m = 150 m



Distance travelled by the 2nd car in 15 seconds

$= OB = \left(48 \times \frac{5}{18}\right) \times 15$ m = 200 m

$\therefore$ Distance between them after 15 seconds

$= AB = \sqrt{OA^2 + OB^2} = \sqrt{150^2 + 200^2}$

$= \sqrt{22500 + 40000}$

$= \sqrt{62500} = 250$ m.

3. (a) Ratio of distances covered by A and B = 800 : 760 = 20000 : 190000

Ratio of distances covered by B and C = 500 : 495 = 190000 : 18810

$\therefore$ Ratio of distances covered by A and C = 20000 : 18810 = 200 : 188.1

Hence A will beat C in a 200 m race by 200 m – 188.1 m = 11.9 m.

4. (b) Relative speed = (8 – 7) = 1 km/hr

($\because$ Both are in the same direction)

$= 1 \times \frac{5}{18} = \frac{5}{18}$ m/sec

$\therefore$ Required time $= \frac{200}{5/18} = \frac{20 \times 18}{5}$ seconds

= 720 seconds = 12 min.

5. (c) Let the length of the journey be x km. Then,

$$\frac{x}{45} - \frac{x}{60} = \frac{11}{2} \Rightarrow \frac{4x - 3x}{180} = \frac{11}{2} \Rightarrow \frac{x}{180} = \frac{11}{2}$$

$$\Rightarrow x = \frac{11 \times 180}{2} = 990 \text{ km.}$$

6. (b) Let the speed of the cyclist be x km/hr.

$$\therefore \frac{40}{x} - \frac{40}{x+2} = 1 \Rightarrow \frac{40(x+2) - 40x}{x(x+2)} = 1$$

$\Rightarrow 80 = x^2 + 2x \Rightarrow x^2 + 2x - 80 = 0$

$\Rightarrow x^2 + 10x - 8x - 80 = 0$

$\Rightarrow x(x + 10) - 8(x + 10) = 0$

$\Rightarrow (x - 8)(x + 10) = 0$

$\Rightarrow x = 8$ or -10.

Neglecting –ve values, we take x = 8 km/hr.

7. (d) Let the distance between P and Q be x km.

Then, Total time taken by Ram in the round trip – Total time taken by Shyam in the round trip = 12 min

$$\Rightarrow \left(\frac{x}{10} + \frac{x}{15}\right) - \left(\frac{x}{12.5} + \frac{x}{12.5}\right) = \frac{12}{60}$$

$$\Rightarrow \left(\frac{3x + 2x}{30}\right) - \frac{2x}{12.5} = \frac{12}{60}$$

$$\Rightarrow \frac{x}{6} - \frac{2x}{12.5} = \frac{12}{60} \Rightarrow \frac{12.5x - 12x}{75} = \frac{12}{60}$$

$$\Rightarrow 0.5x = 75 \times \frac{12}{60} \Rightarrow x = \frac{75 \times 12}{0.5 \times 60} = 30 \text{ km.}$$

8. (d) Let the distance of the house from the school be x km.

Then, $\frac{x}{9}-\frac{1}{3}=\frac{x}{12}+\frac{1}{3} \Rightarrow \frac{x}{9}-\frac{x}{12}=\frac{1}{3}+\frac{1}{3}=\frac{2}{3}$

$\Rightarrow \frac{4x-3x}{36}=\frac{2}{3} \Rightarrow \frac{x}{36}=\frac{2}{3}$

$\Rightarrow x=\left(\frac{2}{3}\times 36\right)$ km = 24 km.

9. (b) Let the normal speed of the aircraft be x km/hr.

$\therefore \frac{1500}{x}-\frac{1500}{250+x}=\frac{1}{2}$

$\Rightarrow \frac{1500(250+x)-1500x}{x(x+250)}=\frac{1}{2}$

$\Rightarrow x^2 + 250x = 2 \times 1500 \times 250$

$\Rightarrow x^2 + 250x - 750000 = 0$

$\Rightarrow x^2 + 1000x - 750x - 750000 = 0$

$\Rightarrow x(x + 1000) - 750(x + 1000) = 0$

$\Rightarrow (x + 1000)(x - 750) = 0 \Rightarrow x = -1000$ or 750

Neglecting –ve values, x = 750 km/hr.

10. (c) Let the distance travelled be x km. Then,

$\frac{x}{10}-\frac{x}{15}=2 \Rightarrow 3x - 2x = 60 \Rightarrow x = 60$ km

Time taken to travel 60 km at 10 km/hr

$=\left(\frac{60}{10}\right)$ hrs = 6 hrs.

So Robert started 6 hours before 2 P.M., *i.e.*, at 8 P.M.

$\therefore$ Speed required to reach A at 1 P.M.

$=\left(\frac{60}{5}\right)$ km/hr = 12 km/hr

11. (b) Let A's speed = x km/hr. Then B's speed = $(7 - x)$ km/hr

So, $\frac{24}{x}+\frac{24}{(7-x)}=14$

$\Rightarrow 24(7 - x) + 24x = 14x(7 - x)$

$\Rightarrow 168 = 98x - 14x^2 \Rightarrow 14x^2 - 98x + 168 = 0$

$\Rightarrow x^2 - 7x + 12 = 0 \Rightarrow (x - 3)(x - 4) = 0$

$\Rightarrow x = 3$ or 4

Since A is faster than B, A's speed = 4 km/hr and B's speed = 3 km/hr.

12. (a) Let the total distance travelled be x km. Then,

Total time taken $=\frac{x/3}{10}+\frac{x/3}{20}+\frac{x/3}{60}$

$=\frac{x}{30}+\frac{x}{60}+\frac{x}{180}$

$=\frac{6x+3x+x}{180}=\frac{10x}{180}=\frac{x}{18}$ hrs.

Then, average speed $=\frac{\text{Total distance travelled}}{\text{Total time taken}}$

$=\frac{x}{x/18}$ km/hr = 18 km/hr.

13. (c) Distance covered in the first 2 hours

= (70 × 2) km = 140 km

Distance covered in the next 2 hours

= (80 × 2) km = 160 km

Remaining distance = 345 – (140 + 160) = 45 km

Now, speed in the fifth hour = 90 km/hr

$\therefore$ Time taken to cover 45 km $=\left(\frac{45}{90}\right)$ hr $=\frac{1}{2}$ hr

$\therefore$ Total time taken $=\left(2+2+\frac{1}{2}\right)$ hr $=4\frac{1}{2}$ hrs.

14. (c) Let the speed of the car be x km/hr

Then, speed of the train $=\frac{150x}{100}$ km/hr

$=\frac{3x}{2}$ km/hr

Time taken by car to reach point $B=\frac{75}{x}$ hrs

Time taken by train to reach point $B=\frac{75}{\frac{3}{2}x}$ hrs

Given, $\frac{75}{x}-\frac{75}{3/2x}=\frac{12.5}{60}$

$\Rightarrow \frac{75}{x}-\frac{50}{x}=\frac{125}{10\times 60}=\frac{5}{24} \Rightarrow \frac{25}{x}=\frac{5}{24}$

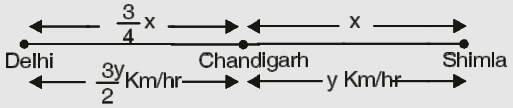
$\Rightarrow x=\frac{25\times 24}{5}$ = 120 km/hr.

15. (c) Let the distance from Chandigarh to Shimla be x km and the average speed from Chandigarh to Shimla be y km/hr.

Then, average speed from Delhi to Chandigarh

$=\frac{3}{2}y$ km/hr

Distance from Delhi to Chandigarh $=\frac{3}{4}x$ cm



$\therefore$ Average speed for entire journey

$$= \frac{\frac{3}{4}x + x}{\frac{3}{4}x \times \frac{2}{3y} + \frac{x}{y}} \text{ km/hr}$$

$$= \frac{\frac{7x}{4}}{\frac{x}{2y} + \frac{x}{y}} = \frac{\frac{7x}{4}}{\frac{3x}{2y}} = \frac{7x}{4} \times \frac{2y}{3x} = \frac{7y}{6}$$

Given, $\frac{7y}{6} = 49 \Rightarrow y = \frac{49 \times 6}{7} = 42$ km/hr.

16. (c) Relative speed = (2 + 3) km/hr = 5 km/hr
This means that A and B cross each other 5 times in a hour and at least 2 times in half an hour.
$\therefore$ They cross each other 7 times before 9:30 a.m.

17. (d) Let the distance = x km and usual rate = y km/hr. Then,

$$\frac{x}{y} - \frac{x}{y+3} = \frac{40}{60} \Rightarrow \frac{x(y+3) - xy}{y(y+3)} = \frac{2}{3}$$

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

$\Rightarrow 2y(y + 3) = 9x$ …(*i*)

and $\frac{x}{y-2} - \frac{x}{y} = \frac{40}{60} \Rightarrow \frac{xy - x(y-2)}{y(y-2)} = \frac{2}{3}$

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

$\Rightarrow y(y - 2) = 3x$ …(*ii*)
On dividing eqn (*i*) by eqn (*ii*), we get

$$\frac{2(y+3)}{y-2} = 3 \Rightarrow 2y + 6 = 3y - 6 \Rightarrow y = 12$$

$\therefore$ Putting the value of y in (*i*), we get
$2 \times 12 \times 15 = 9x \Rightarrow x = 40$ km/hr.

18. (c) Let the speeds of A and B be u km/hr and v km/hr respectively.
When they travel in opposite directions,
$1 \times u + 1 \times v = 25 \Rightarrow u + v = 25$ …(*i*)
When they travel in same directions,
$5 \times u - 5 \times v = 25 \Rightarrow u - v = 5$ …(*ii*)
Adding (*i*) and (*ii*), we get $2u = 30$
$\Rightarrow u = 15$ km/hr.

19. (b) Speed of the aeroplane in still air = 320 km/hr
Speed of wind = 40 km/hr
$\therefore$ Aeroplane will travel with the wind at (320 + 40) = 360 km/hr and Aeroplane will travel against the wind at (320 – 40) = 280 km/hr
Suppose the distance to be travelled = x km
Then,

$$\frac{x}{280} = \frac{135}{60} \text{ hrs} = \frac{9}{4} \text{ hrs}$$

$$\Rightarrow x = \frac{280 \times 9}{4} = 630 \text{ km}$$

$\therefore$ Time taken to cover a distance of 630 km at 360 km/hr is $= \left(\frac{630}{360} \times 60\right)$ min = 105 min.

20. (c) Let the distance to be covered be x km at y km/hr.

$$\therefore \frac{x}{y} = \frac{x}{\frac{2}{3}y} - 1 \Rightarrow \frac{x}{y} - \frac{3x}{2y} = -1 \Rightarrow \frac{2x - 3x}{2y} = -1$$

$\Rightarrow -x = -2y \Rightarrow x = 2y$.
$\therefore$ With his usual speed the time taken to cover a distance x km. $= \frac{x}{y} = \frac{2y}{y}$ hrs = 2 hrs.

21. (b) Let the distance which I walk to the station be x km. Then,
Time needed to reach the station at 3 km/hr
$= \left(\frac{x}{3} + \frac{2}{60}\right)$ hrs and
Time needed to reach the station at 4 km/hr
$= \left(\frac{x}{4} - \frac{2}{60}\right)$ hrs

But, $\frac{x}{3} + \frac{1}{30} = \frac{x}{4} - \frac{1}{30} \Rightarrow \frac{x}{3} - \frac{x}{4} = \frac{2}{30} = \frac{1}{15}$

$$\Rightarrow \frac{4x - 3x}{12} = \frac{1}{15} \Rightarrow \frac{x}{12} = \frac{1}{15} \Rightarrow x = \frac{12}{15} = \frac{4}{5} \text{ km.}$$

22. (d) Let the speed of the car be x km/hr. Then,
Relative speed of the pedestrian with respect to the car = $(x - 2)$ km/hr ($\because$ Both move in the same direction)

$$\therefore \frac{0.6}{(x-2)} = \frac{6}{60} \Rightarrow 6 = x - 2 \Rightarrow x = 8 \text{ km/hr.}$$

23. (b) Let the normal speed of the train be x metres/minute and the actual time taken by the train in the journey be t minutes. Then,

$$x \times t = \frac{112.5x}{100} \times (t - 20)$$

$$\Rightarrow t = \frac{112.5t}{100} - 22.5 \Rightarrow \frac{112.5t}{100} - t = 22.5$$

$$\Rightarrow \frac{12.5t}{100} = 22.5 \Rightarrow t = \frac{22.5 \times 100}{12.5} \text{ minutes} = 180 \text{ min.}$$

24. (c) Let the constant speed of the bike be x km/hr.

Then, $\frac{200}{x} - \frac{200}{(x+5)} = 2$

$$\Rightarrow \frac{200(x+5) - 200x}{x(x+5)} = 2 \Rightarrow \frac{1000}{x^2 + 5x} = 2$$

$\Rightarrow x^2 + 5x - 500 = 0 \Rightarrow x^2 + 25x - 20x - 500 = 0$

$\Rightarrow x(x + 25) - 20(x + 25) = 0$

$\Rightarrow (x + 25)(x - 20) = 0$

$\Rightarrow x = -25$ or $20 \Rightarrow x = 20$ km/hr.

($\because$ speed is not negative)

25. (a) Let the speed of P be x km/hr.

Speed of $Q = (x + 4)$ km/hr

Distance travelled by $Q = (60 + 12)$ km $= 72$ km

Distance travelled by $P = (60 - 12)$ km $= 48$ km

$$\Rightarrow \frac{72}{x+4} = \frac{48}{x} \Rightarrow 72x = 48x + 192 \Rightarrow 24x = 192$$

$$\Rightarrow x = \frac{192}{24} = 8 \text{ km/hr.}$$

26. (a) Let the speed of A is x km/hr and speed of B is y km/hr.

Let them meet after t hours. Then,

$xT + yT$ = Total distance

After the meeting, distance left for $A = yT$ and the distance left for $B = xT$

Now, $yT = 4x$ and $xT = 9y$

$$\therefore \frac{yT}{xT} = \frac{4x}{9y} \Rightarrow \frac{x^2}{y^2} = \frac{9}{4} \Rightarrow \frac{x}{y} = \frac{3}{2} \Rightarrow x : y = 3 : 2$$

27. (c) Ratio of speeds = 3 : 4

$\Rightarrow$ Ratio of times taken = 4 : 3

Let A and B take $4x$ and $3x$ hrs to reach the destination. Then, $4x - 3x = \frac{30}{60} = \frac{1}{2} \Rightarrow x = \frac{1}{2}$

$\therefore$ Time taken by $A = \left(4 \times \frac{1}{2}\right)$ hrs $= 2$ hrs.

28. (a) If A covers a distance of 1 km in x seconds, then B covers the distance of 1 km in $(x + 25)$ seconds.

If A covers a distance of 1 km, then in the same time C covers only 725 metres.

If B covers the distance of 1 km in $(x + 25)$ seconds, then C covers the distance of 1 km in $(x + 55)$ seconds. Also C covers a distance of 725 metres in x seconds. Then,

$$\frac{x}{725} \times 1000 = x + 55 \Rightarrow x = 145$$

$\Rightarrow$ A covers a distance of 1 km in 145 seconds, *i.e.*, 2 min 25 sec.

29. (c) Distance covered by hare in 2 min

$$= \frac{24}{60} \times 1000 \times 2 = 800 \text{ m}$$

Now to overtake the hare, the dog has to cover a distance of $(800 + 200) = 1000$ m with a relative speed = $(32 - 24)$ km/hr $= 8$ km/hr

$\therefore$ Time taken $= \frac{1}{8}$ hrs $= \left(\frac{1}{8} \times 60\right)$ min $= 7\frac{1}{2}$ min

$\therefore$ Distance travelled by hare in $\frac{1}{8}$ hrs

$$= \left(\frac{1}{8} \times 24\right) \text{ km} = 3 \text{ km.}$$

30. (c) B starts when A has already travelled for 2 hours and covered a distance = (2×30) km $= 60$ km

$\therefore$ Time taken by B to cover A with a relative speed of $(40 - 30)$ km/hr $= 10$ km/hr $= \frac{60}{10}$ hrs $= 6$ hrs

$\therefore$ When B overtakes A, A has travelled for 8 hrs and B for 6 hrs

It is given that B and C overtake A at the same instance. Therefore, when C overtakes A, both of them have covered the same distance. Let C take t hours to cover the same distance as covered by A in 8 hours.

$\therefore$ $8 \times 30 = t \times 60 \Rightarrow t = 4$ hours

$\therefore$ C started after $(8 - 4 = 4)$ hrs after A started.

Section-B

PROBLEMS ON TRAINS

KEY FACTS

1. Time taken by a train a metres long to pass a stationary object = Time taken by it to cover a metres.
2. Time taken by a train a metres long to pass a platform or tunnel b metres long = Time taken by it to cover $(a + b)$ metres.
3. **Relative motion**

(i) If two objects are moving in opposite directions towards each other with speeds u km/hr and v km/hr respectively, then their relative speed is $(u + v)$ km/hr.

So, the time taken by two trains of lengths l_1 and l_2 metres running with speeds u km/hr and v km/hr in opposite directions to cross each other is the same as time taken to cover a distance equal to $(l_1 + l_2)$ metres with a relative speed equal to $(u + v)$ km/hr or $\frac{5}{18}(u + v)$ m/s.

$\therefore$ Required time = $\frac{18(l_1 + l_2)}{5(u + v)}$ seconds

(ii) If two objects are moving in the same direction with speeds u km/hr and v km/hr respectively such that $u > v_1$ then their relative speed is $(u – v)$ km/hr.

So, the time taken by two trains of lengths l_1 and l_2 metres moving in the same direction with speeds u km/hr and v km/hr respectively to cross each other is same as the time taken to cover a distance of $(l_1 + l_2)$ metres with a relative speed of $(u – v)$ km/hr or $\frac{5}{18}(u – v)$ m/s.

$\therefore$ Required time = $\frac{18(l_1 + l_2)}{5(u – v)}$ seconds

Solved Examples

Ex. 1. ***If a train with a speed of 60 km/hr crosses a pole in 30 seconds, what is the length of the train in metres?***

Sol. Speed of train = 60 km/hr = $\left(60 \times \frac{5}{18}\right)$ m/s = $\frac{50}{3}$ m/s

Time taken = 30 seconds

$\therefore$ Length of train = $\left(\frac{50}{3} \times 30\right)$ m = 500 m.

Ex. 2. ***Two trains 140 m and 160 m long run at the speed of 60 km/hr and 40 km/hr respectively in opposite directions on parallel tracks. What is the time (in seconds) which they take to cross each other?***

Sol. Required time = $\frac{\text{Total distance}}{\text{Relative speed}} = \frac{\text{Sum of the lengths of the two trains}}{\text{Sum of speeds}}$

$= \frac{(140+160) \times 18}{(60+40) \times 5}$ seconds = $\frac{300 \times 18}{100 \times 5}$ = 10.8 seconds.

Ex. 3. ***Two trains travel in the same direction at 50 km/hr and 32 km/hr respectively. A man in the slower train observes that the faster train passes him completely in 15 seconds. What is the length of the faster train in metres?***

Sol. Since the trains travel in the same direction, relative speed of the trains = (50 – 32) km/hr = 18 km/hr

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

$\therefore$ Length of the faster train = Speed × Time

= (5 × 15) m = 75 m.

Ex. 4. ***A train 110 m long passes a man running at a speed of 6 km/hr in the direction opposite to the train in 6 seconds. What is the speed of the train?***

Sol. Let the speed of the train be x km/hr.

Speed of man = 6 km/hr

Since the train and the man are in opposite directions

Relative speed = $(x + 6)$ km/hr

$$= \left((x+6) \times \frac{5}{18}\right) \text{ m/s}$$

$\therefore$ $(x+6) \times \frac{5}{18} \times 6 = 110$

$\Rightarrow$ $5x + 30 = 330 \Rightarrow 5x = 300 \Rightarrow x = 60$ km/hr.

Ex. 5. ***A train with a speed of 90 km/hr crosses a bridge in 36 seconds. Another train 100 metres shorter crosses the same bridge at 45 km/hr. What is the time taken by the second train to cross the bridge?***

Sol. Let the length of the bridge be x metres and length of the first train at 90 km/hr be y metres. Then,

$$(x + y) = \left[\left(90 \times \frac{5}{18}\right) \times 36\right] \text{ m} = 900 \text{ m}$$

$\therefore$ The second train crosses the bridge by covering a distance of $[x + (y - 100)]$ m at the rate of 45 km/hr or 12.5 m/s, *i.e.*, 800 m at 12.5 m/s $(\because x + y = 900$ m)

$\Rightarrow$ Time taken by the second train to cross the bridge = $\frac{800}{12.5}$ sec = 64 seconds.

Ex. 6. ***A train 108 m long moving at a speed of 50 km/hr crosses a train 112 m long coming from the opposite direction in 6 seconds. What is the speed of the second train?***

Sol. Let the speed of the second train be x km/hr. Then,

Relative speed of trains = $(x + 50)$ km/hr

$$= (x+50) \times \frac{5}{18} \text{ m/s}$$

$$\text{Total time taken} = \frac{\text{Sum of lengths of both the trains}}{\text{Relative speed}}$$

$$= \frac{108\,\text{m} + 112\,\text{m}}{(x+50) \times 5/18}$$

$\Rightarrow$ $\frac{220 \times 18}{(x+50) \times 5} = 6 \Rightarrow 44 \times 3 = x + 50 \Rightarrow 132 = x + 50 \Rightarrow x = 132 - 50 = 82$ km/hr.

Ex. 7. ***A train overtakes two persons walking along a railway track. The first one walks at 4.5 km/hr. The other one walks at 5.4 km/hr. The train needs 8.4 and 8.5 seconds respectively to overtake them. What is the speed of the train if both the persons are walking in the same direction as the train?***

Sol. Let the speed of the train be x km/hr. Then,

Relative speed of train w.r.t. first person = $(x - 4.5)$ km/hr = $(x - 4.5) \times \frac{5}{18}$ m/s

Relative speed of train w.r.t. second person = $(x - 5.4)$ km/hr = $(x - 5.4) \times \frac{5}{18}$ m/s

$\therefore$ Length of the train = $(x-4.5)\times\frac{5}{18}\times 8.4 = (x-5.4)\times\frac{5}{18}\times 8.5$

$\Rightarrow 8.4x - 37.8 = 8.5x - 45.9 \Rightarrow 0.1x = 45.9 - 37.8 = 8.1 \Rightarrow x = 81$ km/hr.

Ex. 8. ***A man sitting in a train travelling at the rate of 50 km/hr observes that it takes 9 sec for a goods train travelling in the opposite direction to pass him. If the goods train is 187.5 m long, find its speed ?***

Sol. Let the speed of the goods train be x km/hr.

Relative speed = $(50 + x)$ km/hr

$$= (50+x)\times\frac{5}{18} \text{ m/s}$$

$\therefore \frac{187.5}{(50+x)\times 5/18} = 9 \Rightarrow \frac{187.5\times 18}{250+5x} = 9$

$\Rightarrow 250 + 5x = 187.5 \times 2 = 375 \Rightarrow 5x = 375 - 250 = 125$

$\Rightarrow x = 25$ km/hr.

Question Bank–21(b)

1. In what time will a train 100 metres long with a speed of 50 km/hour cross a pillar?
(a) 7 seconds (b) 72 seconds
(c) 7.2 seconds (d) 70 seconds

2. Two trains 160 m and 140 m long are running in opposite directions on parallel rails, the first at 77 km/hr and the other at 67 km/hr. How long will they take to cross each other?
(a) 7 seconds (b) $7\frac{1}{2}$ seconds
(c) 6 seconds (d) 10 seconds

3. How much time does a train 50 m long moving at 68 km/hr take to pass another train 75 m long moving at 50 km/hr in the same direction?
(a) 5 seconds (b) 10 seconds
(c) 20 seconds (d) 25 seconds

4. A person standing on a railway platform noticed that a train took 21 seconds to completely pass through the platform which was 84 m long and it took 9 seconds in passing him. The speed of the train was
(a) 25.2 km/hr (b) 32.4 km/hr
(c) 50.4 km/hr (d) 75.6 km/hr

5. A moving train 66 m long overtakes another train 88 m long moving in the same direction in 0.168 min. If the second train is moving at 30 km/hr, at what speed is the first train moving?
(a) 85 km/hr (b) 50 km/hr
(c) 55 km/hr (d) 25 km/hr

6. A train of length 150 m takes 10 sec to pass over another train 100 m long coming from opposite direction. If the speed of the first train be 30 km/hr, the speed of the second train is
(a) 54 km/hr (b) 60 km/hr
(c) 72 km/hr (d) 36 km/hr

7. A train is running at a speed of 45 km/hr and a man is walking at a speed of 5 km/hr in the opposite direction. If the train crosses the man in 18 seconds, then its length is
(a) 200 m (b) 220 m
(c) 180 m (d) 250 m

8. Two trains of equal length take 10 seconds and 15 seconds respectively to cross a telegraph post. If the length of each train be 120 metres, in what time (in seconds) will they cross each other in opposite directions ?
(a) 16 (b) 15
(c) 12 (d) 10

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

10. A man standing on a platform finds that a train takes 3 seconds to pass him and another train of same length moving in the opposite direction takes 4 seconds. The time taken by the trains to pass each other will be

(a) $2\frac{3}{7}$ seconds (b) $3\frac{3}{7}$ seconds

(c) $4\frac{3}{7}$ seconds (d) $5\frac{3}{7}$ seconds

11. Two trains travel in the same direction at 60 km/hr and 96 km/hr. If the faster train passes a man in the slower train in 20 seconds, then the length of the faster train is

(a) 100 m (b) 125 m
(c) 150 m (d) 200 m

12. Two trains each 100 m long moving in opposite directions cross each other in 8 seconds. If one is moving twice as fast as the other, then the speed of the faster train is

(a) 30 km/hr (b) 45 km/hr
(c) 60 km/hr (d) 75 km/hr

13. If a train takes 1.5 seconds to cross a telegraph post and 1.75 seconds to overtake a cyclist racing along a road parallel to the track at 10 m/s, then the length of the train is

(a) 135 metres (b) 125 metres
(c) 115 metres (d) 105 metres

14. A train passes two persons walking in the same direction at a speed of 3 km/hr and 5 km/hr respectively in 10 seconds and 11 seconds. The speed of the train is

(a) 28 km/hr (b) 27 km/hr
(c) 25 km/hr (d) 24 km/hr

15. Two trains are running at 40 km/hr and 20 km/hr respectively in the same direction. Fast train completely passes a man sitting in the slower train in 5 seconds. What is the length of the fast train?

(a) 23 m (b) $23\frac{2}{9}$ m

(c) 27 m (d) $27\frac{7}{9}$ m

16. Two trains running in opposite directions cross a man standing on the platform in 27 seconds and 17 seconds respectively and they cross each other in 23 seconds. The ratio of their speeds is

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

17. Two trains 130 m and 110 m long are going in the same direction. The faster train takes one minute to pass the other completely. If they are moving in opposite directions, they pass each other completely in 3 seconds. Find the speed of each train?

(a) 38 m/s, 36 m/s (b) 42 m/s, 38 m/s
(c) 36 m/s, 42 m/s (d) 40 m/s, 36 m/s

18. A train 75 m long overtook a person who was walking at the rate of 6 km/hr and passes him in $7\frac{1}{2}$ seconds. Subsequently, it overtook a second person and passed him in $6\frac{3}{4}$ seconds. At what rate was the second person travelling?

(a) 4 km/hr (b) 1 km/hr
(c) 2 km/hr (d) 5 km/hr

19. A train travelling at 36 km/hr passes in 12 seconds another train half its length, travelling in the opposite direction at 54 km/hr. If it also passes a railway platform in $1\frac{1}{2}$ minutes, what is the length of the platform?

(a) 800 m (b) 700 m
(c) 900 m (d) 1000 m

20. Train *A* leaves Ludhiana for Delhi at 11 am running at a speed of 60 km/hr. Train *B* leaves Ludhiana for Delhi by the same route at 2 pm on the same day running at a speed of 72 km/hr. At what time will the two trains meet each other?

(a) 5 am on the next day
(b) 2 am on the next day
(c) 5 pm on the next day
(d) 2 pm on the next day

21. Two men are running in the same direction with a speed of 6 km/hr and $7\frac{1}{2}$ km/hr. A train running in the same direction crosses them in 5 sec and $5\frac{1}{2}$ sec respectively. The length and the speed of the train are

(a) 22.92 m (approx) and 22 km/hr
(b) 22 m (approx) and 22.5 km/hr
(c) 22.90 m (approx) and 20.5 km/hr
(d) 22.92 m (approx) and 22.5 km/hr

22. An express train left Delhi for Howrah at 3 pm at an average speed of 60 km/hr. At 1 pm, a goods train also had left Delhi for Howrah on a parallel track at an average speed of 40 km/hr. How far from Delhi is the express train expected to overtake the goods train?

(a) 200 km (b) 220 km
(c) 240 km (d) 280 km

23. Two persons are walking in the same direction at rates 3 km/hr and 6 km/hr. A train comes running from behind and passes them in 9 and 10 seconds. The speed of the train is

(a) 22 km/hr (b) 40 km/hr
(c) 33 km/hr (d) 35 km/hr

24. Two trains are 2 km apart and their lengths are 200 m and 300 m. They are approaching towards each other with a speed of 20 m/s and 30 m/s respectively. After how much time will they cross each other.

(a) 50 seconds (b) 100 seconds
(c) $\frac{25}{3}$ seconds (d) 150 seconds

25. Two trains pass each other on parallel lines. Each train is 100 m long. When they are going in the same direction, the faster one takes 60 seconds to pass the other completely. If they are going in opposite directions, they pass each other completely in 10 seconds. Find the speed of the slower train in km/hr.

(a) 30 km/hr (b) 42 km/hr
(c) 48 km/hr (d) 60 km/hr

Answers

1. (c)	**2.** (b)	**3.** (d)	**4.** (a)	**5.** (a)	**6.** (b)	**7.** (d)	**8.** (c)	**9.** (c)	**10.** (b)
11. (d)	**12.** (c)	**13.** (d)	**14.** (c)	**15.** (d)	**16.** (b)	**17.** (b)	**18.** (c)	**19.** (b)	**20.** (a)
21. (d)	**22.** (c)	**23.** (c)	**24.** (a)	**25.** (a)					

Hints and Solutions

1. (c) Speed of the train = 50 km/hr = $50 \times \frac{5}{18}$ m/sec

$= \frac{125}{9}$ m/sec

Distance travelled = Length of train = 100 m

$\therefore$ Time taken to cross the pillar = $\frac{100}{125/9}$ seconds

$= \frac{36}{5}$ seconds = 7.2 sec.

2. (b) Since the two trains are moving in opposite direction, the relative speed of the faster train w.r.t. the slower train = Sum of their speeds

$= (77 + 67)$ km/hr $= 144$ km/hr $= \left(144 \times \frac{5}{18}\right)$ m/sec

= 40 m/sec

Distance travelled = Sum of the lengths of the two trains = 160 m + 140 m = 300 m

$\therefore$ Required time = $\frac{300\,\text{m}}{40\,\text{m/sec}} = 7\frac{1}{2}$ sec.

3. (d) Since the trains are moving in the same direction the relative speed of the faster train w.r.t. the slower train = Difference of their speeds

$= (68 - 50)$ km/hr $= 18$ km/hr $= \left(18 \times \frac{5}{18}\right)$ m/sec

= 5 m/sec

Distance travelled = Sum of the lengths of the two trains = (50 + 75) m = 125 m

$\therefore$ Required time = $\frac{125}{5}$ seconds = 25 seconds.

4. (a) Let the length of the train be x metres. Then,

Speed of the train in passing through the platform = $\frac{x+84}{21}$ m/sec

and speed of the train in passing the man

$= \frac{x}{9}$ m/sec

Since both the speeds are the same,

$\frac{x+84}{21} = \frac{x}{9} \Rightarrow 9x + 756 = 21x$

$\Rightarrow 12x = 756 \Rightarrow x = \frac{756}{12} = 63$ m

$\therefore$ Speed of the train = $\frac{(63+84)}{21}$ m/sec = 7 m/sec

$= 7 \times \frac{18}{5}$ km/hr = 25.2 km/hr.

5. (a) Let the speed of the first train be x km/hr. Then,

Relative speed of first train w.r.t. second train

$= (x - 30)$ km/hr $= (x-30) \times \frac{5}{18}$ m/sec

Total distance travelled = (66 + 88) m = 154 m

Time taken = 0.168 min = (0.168 × 60) sec
= 10.08 sec

$\therefore \quad (x-30)\times\frac{5}{18}\times 10.08 = 154$

$\Rightarrow \quad x-30 = \frac{154\times 18}{5\times 10.08} = 55 \quad \Rightarrow \quad x = 85$ km/hr.

6. (b) Let the speed of the second train = x km/hr
Since both the trains are running in opposite directions. Their relative speed = $(30 + x)$ km/hr

$= (30 + x) \times \frac{5}{18}$ m/sec

$\therefore$ Time taken to pass another train

$= \frac{\text{Sum of the lengths of both the trains in metres}}{\text{Relative speed in m/sec}}$

$\Rightarrow \quad 10 = \frac{(150+100)}{(30+x)\times 5/18}$

$\Rightarrow \quad (30 + x) = \frac{250\times 18}{10\times 5} = 90$

$\Rightarrow \quad x = (90 - 30)$ km/hr = 60 km/hr.

7. (d) Since the man is walking in the opposite direction of the moving train,
Relative speed of the train = (45 + 5) km/hr

$= \left(50\times\frac{5}{18}\right)$ m/sec $= \frac{250}{18}$ m/sec

Length of the train
= Relative speed × Time taken in crossing the man

$= \left(\frac{250}{18}\times 18\right)$ m = 250 m.

8. (c) Speed of the first train $= \frac{120}{10} = 12$ m/s

Speed of the second train $= \frac{120}{15} = 8$ m/s

$\therefore$ Required time $= \frac{\text{Total distance}}{\text{Relative speed}}$

$= \frac{120+120}{12+8} = \frac{240}{20}$ seconds
= 12 seconds.

9. (c) Let the length of the train be x metres.

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

$\Rightarrow \quad 2400 + 3x = 2000 + 5x$

$\Rightarrow \quad x = 200$ metres.

10. (b) Let the length of 1st train = length of the 2nd train
= x metres

Then, speed of the 1st train = $\frac{x}{3}$ m/s

Speed of the 2nd train = $\frac{x}{4}$ m/s

Since both the trains are moving in opposite directions, their relative speed = $\left(\frac{x}{3}+\frac{x}{4}\right) = \frac{7x}{12}$ m/s

$\therefore$ Time taken to pass each other

$= \frac{\text{Distance to be covered}}{\text{Relative speed}}$

$= \frac{x+x}{7x/12} = \frac{2x\times 12}{7x} = \frac{24}{7}$ seconds

$= 3\frac{3}{7}$ sec.

11. (d) Relative speed = (96 – 60) km/hr = 36 km/hr

$= \left(36\times\frac{5}{18}\right)$ m/s = 10 m/sec

As we know $D = s \times t$

$\therefore$ Length of faster train = 10 × 20 = 200 m.

12. (c) Let the speeds of the two trains be x m/s and $2x$ m/s respectively.
Since both the trains are moving in opposite directions, their relative speed = $(x + 2x)$ m/s
= $3x$ m/s

Given, $\frac{100\text{ m}+100\text{ m}}{3x} = 8$

$\Rightarrow \quad x = \frac{200}{24}$ m/s $= \left(\frac{200}{24}\times\frac{18}{5}\right)$ km/hr = 30 km/hr

$\therefore$ Speed of the faster train = 60 km/hr.

13. (d) Let the length of train be l metres and its speed be x m/s.

Then, $\frac{l}{x} = 1.5 \quad \Rightarrow \quad l = 1.5x \qquad \ldots(i)$

and $\frac{l}{(x-10)} = 1.75 \quad \Rightarrow \quad l = 1.75(x - 10)$

$\Rightarrow \quad l = 1.75x - 17.5 \qquad \ldots(ii)$

From (i) and (ii),

$1.5x = 1.75x - 17.5 \quad \Rightarrow \quad 0.25x = 17.5$

$\Rightarrow x = \dfrac{17.5}{0.25} = 70$ m/s

$\therefore$ Length of the train = (1.5 × 70) metres
= 105 metres.

14. (c) Distance covered by the first person in 10 seconds $= \left[\left(3\times\dfrac{5}{18}\right)\times 10\right]$ m $= \dfrac{25}{3}$ m

Distance covered by the second person in 11 seconds $= \left[\left(5\times\dfrac{5}{18}\right)\times 11\right]$ m $= \dfrac{275}{18}$ m

$\therefore$ The train travels a distance $= \dfrac{275}{18} - \dfrac{25}{3} = \dfrac{125}{18}$ m in (11 – 10) = 1 second.

$\therefore$ Speed of the train $= \left(\dfrac{125}{18}\times\dfrac{18}{5}\right)$ km/hr = 25 km/hr.

15. (d) Relative speed = (40 – 20) km/hr

$= \left(20\times\dfrac{5}{18}\right)$ m/s $= \dfrac{50}{9}$ m/s.

$\therefore$ Length of the faster train $= \left(\dfrac{50}{9}\times 5\right)$ m

$= \dfrac{250}{9}$ m $= 27\dfrac{7}{9}$ m

16. (b) Let the speeds of the two trains be x m/s and y m/s respectively.

$\therefore$ Length of the first train = $27x$ m and length of the second train = $17y$ m

Since the trains are moving in opposite directions.

Relative speed = $(x + y)$ m/s

$\therefore \dfrac{27x+17y}{x+y} = 23 \Rightarrow 27x + 17y = 23x + 23y$

$\Rightarrow 4x = 6y \Rightarrow \dfrac{x}{y} = \dfrac{3}{2}$.

17. (b) Let the speeds of the faster train be x m/s and that of the slower train be y m/s. Then,

When the two trains are moving in the same direction,

Relative speed = $(x - y)$ m/s

$\therefore \dfrac{130\text{m}+110\text{m}}{x-y} = 60$

$\Rightarrow \dfrac{240}{x-y} = 60 \Rightarrow x - y = 4$ …(*i*)

When the two trains are moving in opposite direction,

Relative speed = $(x + y)$ m/s

$\therefore \dfrac{130\text{m}+110\text{m}}{x+y} = 3 \Rightarrow x + y = 80$ …(*ii*)

Adding eqn (*i*) and (*ii*), we get $2x = 84$

$\Rightarrow x = 42$ m/s

$\therefore$ Putting in (*i*), we get $y = 38$ m/s.

18. (c) Let the speed of the train be x m/s.

Speed of the 1st man = 6 km/hr $= \left(6\times\dfrac{5}{18}\right)$ m/s

$= \dfrac{5}{3}$ m/s

$\dfrac{75}{(x-5/3)} = \dfrac{15}{2}$

$\Rightarrow 150 = 15\times\dfrac{(3x-5)}{3} = 15x - 25$

$\Rightarrow 15x = 175 \Rightarrow x = \dfrac{175}{15} = \dfrac{35}{3}$ m/s

Let the speed of the second man be y m/s. Then

$\dfrac{75}{\left(\frac{35}{3}-y\right)} = \dfrac{27}{4}$

$\Rightarrow 300 = 27\times\left(\dfrac{35-3y}{3}\right) = 315 - 27y$

$\Rightarrow 27y = 15 \Rightarrow y = \dfrac{15}{27}$ m/s $= \left(\dfrac{15}{27}\times\dfrac{18}{5}\right)$ km/hr

= 2 km/hr.

19. (b) Let the length of the first train be x metres.

Then, length of the second train $= \dfrac{x}{2}$ metres

Relative speed = (36 + 54) km/hr = 90 km/hr

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

$\therefore \dfrac{x + x/2}{25} = 12 \Rightarrow \dfrac{3x}{2} = 300 \Rightarrow x = 200.$

$\therefore$ Length of the first train = 200 m.

Let the length of the platform be y metres.

Speed of the first train $= \left(36\times\dfrac{5}{18}\right)$ m/s = 10 m/s

$\therefore (200 + y)\times\dfrac{1}{10} = 90$

$\Rightarrow 200 + y = 900 \Rightarrow y = 700$ m.

20. (a) Distance covered by train A before train B leaves Ludhiana = $60 \times 3 = 180$ km

Relative speed = $(72 - 60)$ km/hr = 12 km/hr

$\therefore$ Time taken to cross each other = $\frac{180}{12}$ hrs

= 15 hrs

$\therefore$ Required time = 2 pm + 15 hrs

= 5 am on the next day.

21. (d) Let the length of the train be l m and its speed be x km/hr.

Then, relative speed of train w.r.t.1st man

$= (x - 6)$ km/hr $= (x-6)\times\frac{5}{18}$ m/s

Relative speed of train w.r.t. 2nd man

$= (x - 7.5)$ km/hr

$= (x-7.5)\times\frac{5}{18}$ m/s

Length of the train

= Distance travelled in both the cases

$\Rightarrow (x-6)\times\frac{5}{18}\times 5 = (x-7.5)\times\frac{5}{18}\times 5.5$

$\Rightarrow (x - 6) \times 5 = (x - 7.5) \times 5.5$

$\Rightarrow 5x - 30 = 5.5x - 41.25 \Rightarrow 0.5x = 11.25$

$\Rightarrow x = \frac{11.25}{0.5} = 22.5$ km/hr

$\therefore$ Length of the train = $\left((22.5-6)\times\frac{5}{18}\times 5\right)$ m

= 22.92 m (approx)

22. (c) Distance covered by goods train before express train leaves = $40 \times 2 = 80$ km

Relative speed = $(60 - 40)$ km/hr = 20 km/hr

$\therefore$ Time taken to cross each other = $\frac{80}{20}$ hrs

= 4 hrs

$\therefore$ Distance from Delhi where the express train is expected to overtake the goods train

$= (4 \times 60)$ km = 240 km.

23. (c) Similar to Q. 21.

24. (a) Relative speed of the trains = $(20 + 30)$ m/s

= 50 m/s

Total distance covered

$= (2 \times 1000 + 200 + 300)$ m

= 2500 m

$\therefore$ The two trains will cross each other after

$\frac{2500}{50}$ seconds = 50 seconds.

25. (a) Let the speed of the faster train be x km/hr and that of the slower train be y km/hr.

Relative speed when both move in same direction = $(x - y)$ km/hr

Relative speed when both move in opposite directions = $(x + y)$ km/hr

Total distance travelled

= Sum of lengths of both the trains

= 200 m

Given, $\frac{200}{(x-y)\times\frac{5}{18}} = 60$ and $\frac{200}{(x+y)\times\frac{5}{18}} = 10$

$\Rightarrow \frac{3600}{5(x-y)} = 60$ and $\frac{3600}{5(x+y)} = 10$

$\Rightarrow x - y = \frac{3600}{300} = 12$ …(*i*)

and $x + y = \frac{3600}{50} = 72$ …(*ii*)

Adding eqn (*i*) and eqn (*ii*), we get

$2x = 84 \Rightarrow x = 42$ km/hr

$\therefore$ From (*i*), $y = 30$ km/hr.

Section-C

BOATS AND STREAMS

KEY FACTS

1. In water, the direction along the stream is called **downstream** and the direction against the stream is called **upstream**.

2. If the speed of a boat in still water is x km/hr and the speed of the stream is y km/hr, then

Speed downstream = $(x + y)$ km/hr

Speed upstream = $(x - y)$ km/hr

3. If the speed downstream is u km/hr and speed upstream is v km/hr, then

Speed in still water = $\frac{1}{2}(u+v)$ km/hr

Rate of stream = $\frac{1}{2}(u-v)$ km/hr

Solved Examples

Ex. 1. ***A man rows upstream 13 km and downstream 28 km taking 5 hrs each time. What is the velocity in (km/hr) of the current?***

Sol. Speed upstream = $\frac{13}{5}$ km/hr = 2.6 km/hr

Speed downstream = $\frac{28}{5}$ km/hr = 5.6 km/hr

$\therefore$ Velocity of current = $\frac{1}{2}(5.6-2.6)$ km/hr

$= \left(\frac{1}{2}\times 3\right)$ km/hr = 1.5 km/hr.

Ex. 2. ***In one hour a boat goes 11 km along the stream and 5 km against the stream. What is the speed of the boat in still water (in km/hr)?***

Sol. Speed downstream = 11 km/hr

Speed upstream = 5 km/hr

$\therefore$ Speed of boat in still water = $\frac{1}{2}$ (11 + 5) km/hr = 8 km/hr.

Ex. 3. ***A motor boat whose speed is 15 km/hr in still water goes 30 km downstream and comes back in 4 hours 30 minutes. Determine the speed of the stream.***

Sol. Let the speed of the stream be x km/hr. Then,

Speed of boat downstream = $(15 + x)$ km/hr

and speed of boat upstream = $(15 - x)$ km/hr

$\therefore \quad \frac{30}{15+x}+\frac{30}{15-x}=4\frac{1}{2}=\frac{9}{2}$

$\Rightarrow \quad \frac{30(15-x)+30(15+x)}{(15+x)(15-x)}=\frac{9}{2} \Rightarrow \frac{900}{225-x^2}=\frac{9}{2} \Rightarrow 200 = 225 - x^2$

$\Rightarrow x^2 = 25 \Rightarrow x = 5$ km/hr.

Ex. 4. ***A boat takes 4 hours for travelling downstream from point A to point B and coming back to point A upstream. If the velocity of the stream is 2 km/hr and the speed of the boat in still water is 4 km/hr, what is the distance between A and B?***

Sol. Speed of boat downstream = (4 + 2) km/hr = 6 km/hr

Speed of boat upstream = (4 – 2) km/hr = 2 km/hr

Let the distance between point A and point B be x km. Then,

$\frac{x}{6}+\frac{x}{2}=4 \Rightarrow \frac{x+3x}{6}=4 \Rightarrow 4x = 24 \Rightarrow x = 6$ km.

Ex. 5. ***A boat goes 20 km downstream in one hour and the same distance upstream in two hours. What is the speed of the boat in still water?***

Sol. Let the speed of the boat in still water be x km/hr and speed of the stream = y km/hr

Then, speed of boat downstream = $(x + y)$ km/hr

Speed of boat upstream = $(x - y)$ km/hr

Given $(x + y) \times 1 = 20$ and $(x - y) \times 2 = 20$

$\Rightarrow$ $x + y = 20$ …(*i*) and $x - y = 10$ …(*ii*)

Adding eqn (*i*) and (*ii*), we get

$2x = 30 \Rightarrow x = 15$ km/hr.

Ex. 6. ***A man rows to a place at a distance of 48 km and back in 14 hours. He finds that he can row 4 km with the stream in the same time as 3 km against the stream. What is the rate of the stream?***

Sol. Ratio of the downstream speed to upstream speed = 4 : 3

$\therefore$ Ratio of times taken to cover a certain distance downstream and upstream = 3 : 4

Given $3x + 4x = 14$ hrs $\Rightarrow$ $x = 2$

$\therefore$ The man took 6 hours to row 48 km downstream and 8 hours to row 48 km upstream.

$\therefore$ Speed downstream $= \frac{48}{6}$ km/hr = 8 km/hr

Speed upstream $= \frac{48}{8}$ km/hr = 6 km/hr

$\therefore$ Rate of stream $= \frac{1}{2}(8 - 6)$ km/hr = 1 km/hr.

Ex. 7. ***A boat goes 6 km in an hour in still water. It takes thrice as much time in covering the same distance against the current. What is the speed of the current?***

Sol. Speed of boat in still water = 6 km/hr

Time taken by boat to move upstream = 3 hours

$\therefore$ Speed of boat upstream $= \frac{6}{3}$ km/hr = 2 km/hr

Let the speed of the current be x km/hr.

Then, $6 - x = 2 \Rightarrow x = 4$ km/hr.

Question Bank–21(c)

1. A boat moves downstream at the rate of 1 km in 6 min and upstream at the rate of 1 km in 10 min. The speed of the current (in km/hr) is

(a) 1 (b) 1.5

(c) 2 (d) 2.5

2. A boat goes 40 km upstream in 8 hours and 36 km downstream in 6 hours. The speed of the boat in still water is

(a) 6.5 km/hr (b) 5.5 km/hr

(c) 6 km/hr (d) 5 km/hr

3. A man can row the boat at 5 km/hr in still water. If the velocity of the current is 1 km/hr and it takes him 1 hour to row to a place and come back, how far is the place?

(a) 2.5 km (b) 3 km

(c) 2.4 km (d) 3.6 km

4. A boat covers a distance of 14 km in 4 hours along the flow. What is the speed of the boat in still water, if the speed of the flow of water is 2 km/hr?

(a) 2 km/hr (b) 3 km/hr

(c) 2.5 km/hr (d) 1.5 km/hr

5. A river is running at 2 km/hr. It took a man twice as long to row up as to row down the river. The rate (in km/hr) of the man in still water is

(a) 8 (b) 10

(c) 4 (d) 6

6. A man rows a boat 18 km in 4 hours downstream and returns upstream in 12 hours. The speed of the stream (in km/hr) is

(a) 1 (b) 1.5

(c) 2 (d) 1.75

7. A boat covers a certain distance downstream in 8 hours and comes back upstream in 10 hours. If the speed of the current be 1 km/hr, the distance (in km) of the one way journey is

(a) 60 (b) 70

(c) 80 (d) 90

8. A motor in still water travels at a speed of 36 km/hr. It goes 56 km upstream in 1 hour 45 min. The time taken by it to cover the same distance downstream is

(a) 2 hours 25 min (b) 3 hours

(c) 1 hour 24 min (d) 2 hours 21 min

9. A streamer 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 is 2 km/hr, the distance between the two ports is

(a) 50 km (b) 60 km

(c) 70 km (d) 80 km

10. The speed of a motorboat is to that of the current of water as 36 : 5. The boats goes along with the current in 5 hours 10 min. It will come back in

(a) 5 hrs 50 min (b) 6 hrs

(c) 6 hrs 50 min (d) 12 hrs 10 min

11. A man can row at 5 km/hr in still water. If the river is running at 1 km/hr, it takes him 75 minutes to row to a place and back. How far is the place?

(a) 2.5 km (b) 3 km

(c) 4 km (d) 5 km

12. A man rows $\frac{3}{4}$ of a km against the stream in $11\frac{1}{4}$ minutes and returns in $7\frac{1}{2}$ min. Find the speed of the man in still water.

(a) 4 km/hr (b) 3 km/hr

(c) 5 km/hr (d) 6 km/hr

13. Twice the speed of a boat downstream is equal to thrice the speed upstream. The ratio of its speed in still water to its speed in current is

(a) 1 : 5 (b) 1 : 3

(c) 5 : 1 (d) 2 : 3

14. A boatman goes 2 km against the current of the stream in 1 hour and goes 1 km along the current in 10 minutes. How long will he take to go 5 km in stationary water?

(a) 1 hour (b) $1\frac{1}{2}$ hours

(c) 1 hour 15 min (d) 40 min

15. A boat running upstream takes 8 hours 48 min to cover a certain distance, while it takes 4 hours to cover the same distance running downstream. What is the ratio between the speed of the boat and the speed of the water current respectively?

(a) 2 : 1 (b) 3 : 1

(c) 8 : 3 (d) 4 : 3

16. A boatman rows to a place at a distance of 45 km and back in 20 hours. He finds that he can row 12 km with the stream in the same time as 4 km against the stream. Find the speed of the stream.

(a) 3 km/hr (b) 2.5 km/hr

(c) 4 km/hr (d) 3.5 km/hr

17. A boat takes 90 minutes less to travel 36 km downstream than to travel the same distance upstream. If the speed of the boat in still water is 10 km/hr, the speed of the stream is

(a) 4 km/hr (b) 3 km/hr

(c) 2.5 km/hr (d) 2 km/hr

18. A boat goes 24 km upstream and 28 km downstream in 6 hours. It goes 30 km upstream and 21 km downstream in 6 hours and 30 minutes. The speed of the boat in still water is

(a) 10 km/hr (b) 4 km/hr

(c) 14 km/hr (d) 6 km/hr

19. At his usual rowing rate, Rahul can travel 12 miles downstream in a certain river in 6 hours less than it takes him to travel the same distance upstream. But if he could double his usual rowing rate for his 24 mile round trip, the downstream 12 miles would then take only one hour less than the upstream 12 miles. What is the speed of the current in miles per hour?

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

(c) $2\frac{1}{3}$ (d) $2\frac{2}{3}$

20. A boat takes 11 hours for travelling downstream from point *A* to point *B* and coming back to point *C* midway between *A* and *B*. If the velocity of the stream be 3 km/hr and the speed of the boat in still water be 12 km/hr, what is the distance between *A* and *B*?

(a) 100 km (b) 90 km

(c) 110 km (d) 120 km

Answers

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

Hints and Solutions

1. (c) Speed downstream $= \left(\frac{1}{6}\times 60\right) = 10$ km/hr

Speed upstream $= \left(\frac{1}{10}\times 60\right) = 6$ km/hr

$\therefore$ Speed of the current $= \frac{1}{2}(10-6)$ km/hr
$= 2$ km/hr.

2. (b) Speed of boat downstream $= \frac{36}{6}$ km/hr
$= 6$ km/hr

Speed of boat upstream $= \frac{40}{8}$ km/hr $= 5$ km/hr

$\therefore$ Speed of boat in still water $= \frac{1}{2}(6+5)$ km/hr
$= 5.5$ km/hr.

3. (c) Let the distance of the destination be x km.
Speed of boat downstream = (5 + 1) km/hr
= 6 km/hr
Speed of boat upstream = (5 – 1) km/hr
= 4 km/hr

Then, $\frac{x}{6}+\frac{x}{4}=1 \Rightarrow \frac{2x+3x}{12}=1$

$\Rightarrow x = \frac{12}{5} = 2.4$ km.

4. (d) Speed of the flow of water = 2 km/hr

Speed of the boat downstream $= 3\frac{1}{2}$ km/hr

Let the speed of the boat in still water = x km/hr

Then, $x+2=3\frac{1}{2} \Rightarrow x=1\frac{1}{2}$ km/hr

5. (d) Let the distance travelled be D km and speed of the man in still water be x km/hr. Then,
Speed downstream = $(x + 2)$ km/hr
Speed upstream = $(x – 2)$ km/hr

Given, $\frac{D}{x-2}=2\times\frac{D}{x+2}$

$\Rightarrow x + 2 = 2x – 4 \Rightarrow x = 6$ km/hr.

6. (b) Let the speed of the boat in still water = x km/hr and the speed of the stream y km/hr.

Then, speed downstream $= x+y=\frac{18}{4}=\frac{9}{2}$ …(*i*)

and speed upstream $= x-y=\frac{18}{12}=\frac{3}{2}$ …(*ii*)

Subtracting eq (*ii*) from eq (*i*), we get,

$2y=\frac{6}{2}=3 \Rightarrow y = 1.5$ km/hr.

7. (c) Speed of boat in still water be u km/hr. Then,
Distance covered downstream = $(u + 1) \times 8$
$= 8u + 8$
Distance covered upstream = $(u – 1) \times 10$
$= 10u – 10$
Since the distance both ways is the same,
$8u + 8 = 10u – 10 \Rightarrow 2u = 18 \Rightarrow u = 9$ km/hr
$\therefore$ Distance covered one way = $(9 + 1) \times 8$ km
= 80 km.

8. (c) Let the speed of the stream be x km/hr

Then, $\frac{56}{7/4}=36-x \Rightarrow \frac{56\times 4}{7}=36-x$

$\Rightarrow x = 36 – 32 = 4$ km/hr

$\therefore$ Time taken by it to cover the same distance upstream $= \frac{56}{36+4}$ hrs $= \frac{56}{40}$ hrs
$= 1\frac{2}{5}$ hours = 1 hour 24 min.

9. (d) Let the distance between the two parts be x km.

Then, speed downstream $= \frac{x}{4}$ km/hr

and speed upstream $= \frac{x}{5}$ km/hr

$\Rightarrow$ Speed of stream $= \frac{1}{2}\left(\frac{x}{4}-\frac{x}{5}\right)$

Given, $\frac{1}{2}\left(\frac{x}{4}-\frac{x}{5}\right)=2 \Rightarrow \frac{x}{4}-\frac{x}{5}=4$

$\Rightarrow \frac{x}{20}=4 \Rightarrow x = 80$ km

10. (c) Let the speed of the motorboat be $36x$ km/hr and that of the current of water be $5x$ km/hr.
Speed downstream = $(36x + 5x)$ km/hr
$= 41x$ km/hr
Speed upstream = $(36x – 5x)$ km/hr
$= 31x$ km/hr
Time taken to travel downstream = 5 hrs 10 min

$= 5\frac{10}{60}$ hrs $= \frac{31}{6}$ hrs

$\therefore$ Distance covered downstream $= \left(41x \times \frac{31}{6}\right)$ km

$\Rightarrow$ Distance covered upstream $= \left(41x \times \frac{31}{6}\right)$ km

$\therefore$ Time taken to travel upstream $= \left(41x \times \frac{31}{6} \times \frac{1}{31x}\right)$ hrs

$= \frac{41}{6}$ hrs $= 6\frac{5}{6}$ hrs $= 6$ hrs 50 min.

11. (b) Let the distance to the place be x km.
Speed downstream = (5 + 1) km/hr = 6 km/hr
Speed upstream = (5 – 1) km/hr = 4 km/hr

Given, $\frac{x}{6} + \frac{x}{4} = \frac{75}{60}$ hrs $\Rightarrow \frac{2x+3x}{12} = \frac{5}{4}$

$\Rightarrow \frac{5x}{12} = \frac{5}{4} \Rightarrow x = 3$ km.

12. (c) Distance covered upstream in $\frac{45}{4}$ min $= \frac{3}{4}$ km

$\therefore$ Speed of man upstream $= \left(\frac{3}{4} \times \frac{4}{45} \times 60\right)$ km/hr
$= 4$ km/hr

Distance covered down stream in $\frac{15}{2}$ min $= \frac{3}{4}$ km

$\therefore$ Speed of man down stream $= \left(\frac{3}{4} \times \frac{2}{15} \times 60\right)$ km/hr
$= 6$ km/hr

$\therefore$ Speed of man in still water $= \frac{1}{2}$ (6 + 4) km/hr
$= 5$ km/hr.

13. (c) Let the speed downstream be u km/hr and speed upstream be v km/hr.

Given, $2u = 3v \Rightarrow u = \frac{3v}{2}$

Required ratio $= \frac{1}{2}(u+v) : \frac{1}{2}(u-v)$

$= \left(\frac{3v}{2} + v\right) : \left(\frac{3v}{2} - v\right)$

$= \frac{5v}{2} : \frac{v}{2} = 5:1$.

14. (c) Speed of the boatman upstream

$= \frac{2}{1}$ km/hr $= 2$ km/hr

Speed of the boatman downstream

$= \frac{1}{10/60}$ km/hr $= 6$ km/hr

$\therefore$ Speed of boatman in stationary water

$= \frac{1}{2}$ (6 + 2) km/hr $= 4$ km/hr

$\therefore$ Time taken to cover 5 km in stationary water

$= \frac{5}{4}$ hrs $= 1\frac{1}{4}$ hrs $= 1$ hr. 15 min.

15. (c) Let the distance covered in one direction be x km.

Then, speed upstream $= \frac{x}{44/5}$ km/hr

(8 hrs 48 min $= 8\frac{48}{60} = 8\frac{4}{5}$ hrs)

$= \frac{5x}{44}$ km/hr

Speed downstream $= \frac{x}{4}$ km/hr

$\therefore$ Speed of boat in still water $= \frac{1}{2}\left(\frac{5x}{44} + \frac{x}{4}\right)$

$= \frac{8x}{44} = \frac{2x}{11}$ km/hr

Speed of current $= \frac{1}{2}\left(\frac{x}{4} - \frac{5x}{44}\right) = \frac{3x}{44}$ km/hr

$\therefore$ Required ratio $= \frac{2x}{11} : \frac{3x}{44} = 8:3$.

16. (a) Ratio of upstream speed to downstream speed = 1 : 3

$\therefore$ Ratio of times taken to cover a certain distance upstream and downstream = 3 : 1
Given, the man took 20 hours to cover the 45 km distance and back $\Rightarrow$ He took 15 hours to cover 45 km upstream and 5 hours to the cover 45 km downstream.

$\therefore$ Speed downstream $= \frac{45}{5} = 9$ km/hr

Speed upstream $= \frac{45}{15} = 3$ km/hr

$\therefore$ Speed of stream $= \frac{1}{2}$ (9 – 3) km/hr $= 3$ km/hr.

17. (d) Let the speed of the stream be x km/hr.
Speed of boat in still water = 10 km/hr

$\therefore$ Speed of boat downstream = (10 + x) km/hr
Speed of boat upstream = (10 – x) km/hr

Given, $\frac{36}{(10-x)} - \frac{36}{(10+x)} = \frac{90}{60}$

$\Rightarrow \dfrac{36(10+x)-36(10-x)}{(10-x)(10+x)} = \dfrac{3}{2}$

$\Rightarrow \dfrac{72x}{100-x^2} = \dfrac{3}{2} \Rightarrow 144x = 300 - 3x^2$

$\Rightarrow 3x^2 + 144x - 300 = 0$

$\Rightarrow 3x^2 + 150x - 6x - 300 = 0$

$\Rightarrow 3x(x + 50) - 6(x + 50) = 0$

$\Rightarrow (3x - 6)(x + 50) = 0$

$\Rightarrow x = 2$ or -50.

Since speed is not negative, $x = 2$ km/hr.

18. (b) Let the speed downstream be x km/hr and speed upstream be y km/hr. Then,

$$\frac{28}{x} + \frac{24}{y} = 6 \quad \ldots(i)$$

and $\dfrac{21}{x} + \dfrac{30}{y} = \dfrac{13}{2}$ $\ldots(ii)$

Multiplying (i) by 3 and (ii) by 4 and then subtracting eqn (i) from eqn (ii), we get

$$4\left(\frac{21}{x} + \frac{30}{y}\right) - 3\left(\frac{28}{x} + \frac{24}{y}\right) = 4 \times \frac{13}{2} - 3 \times 6$$

$\Rightarrow \dfrac{84}{x} + \dfrac{120}{y} - \dfrac{84}{x} - \dfrac{72}{y} = 26 - 18$

$\Rightarrow \dfrac{48}{y} = 8 \Rightarrow y = 6$ km/hr

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

$\dfrac{28}{x} + 4 = 6 \Rightarrow \dfrac{28}{x} = 2 \Rightarrow x = 14$ km/hr

$\therefore$ Speed of the stream $= \dfrac{1}{2}(14 - 6)$ km/hr

$= 4$ km/hr.

19. (d) Let the speed of the boat in still water be x mph and speed of the current be y mph. Then,

Speed upstream = $(x - y)$ mph and stream downstream = $(x + y)$ mph

Given, $\dfrac{12}{(x-y)} - \dfrac{12}{(x+y)} = 6$

$\Rightarrow \dfrac{12(x+y) - 12(x-y)}{x^2 - y^2} = 6$

$\Rightarrow 24y = 6(x^2 - y^2) \Rightarrow x^2 - y^2 = 4y$

$\Rightarrow x^2 = 4y + y^2$ $\ldots(i)$

and $\dfrac{12}{(2x-y)} - \dfrac{12}{(2x+y)} = 1$

$\Rightarrow \dfrac{12(2x+y) - 12(2x-y)}{4x^2 - y^2} = 1$

$\Rightarrow 24y = 4x^2 - y^2 \Rightarrow 4x^2 - y^2 = 24y$

$\Rightarrow x^2 = \dfrac{24y + y^2}{4}$ $\ldots(ii)$

From (i) and (ii), $4y + y^2 = \dfrac{24y + y^2}{4}$

$\Rightarrow 16y + 4y^2 = 24y + y^2$

$\Rightarrow 3y^2 = 8y \Rightarrow y = 8/3$

$\therefore$ Speed of the current = 8/3 mph = $2\dfrac{2}{3}$ mph

20. (b) Speed downstream = (12 + 3) km/hr = 15 km/hr

Speed upstream = (12 – 3) km/hr = 9 km/hr

Let the distance between A and B be x km. Then,

$\dfrac{x}{15} + \dfrac{x/2}{9} = 11 \Rightarrow \dfrac{x}{15} + \dfrac{x}{18} = 11$

$\Rightarrow \dfrac{6x + 5x}{90} = 11 \Rightarrow \dfrac{11x}{90} = 11 \Rightarrow x = 90$ km.

Self Assessment Sheet–21

1. A student walks from his house at $2\dfrac{1}{2}$ km an hour and reaches his school 6 minutes late. The next day he increases his speed by 1 kilometre an hour and reaches 6 minutes early. How far is the school from the house ?

(a) 2.5 km (b) 3 km

(b) 1.75 km (d) 1 km

2. Distance between two points A and B is 110 km. A motor-cycle rider starts from A towards B at 7 am at a speed of 20 km/hr. Another motor-cycle rider starts from B towards A at 8 am at a speed of 25 km/hr. Find when will they cross each other.

(a) 11 am (b) 9 : 30 am

(c) 8 : 30 am (d) 10 am

3. A train leaves the station 1 hour before the scheduled time. The driver decreases its speed by 50 km/hr. At the next station 300 km away, the train reached on time. Find the original speed of the train.

(a) 100 km/hr (b) 150 km/hr

(c) 125 km/hr (d) 200 km/hr

4. A train of length 150 m takes 10 s to cross another train 100 m long coming from opposite direction. If the speed of the first trains is 30 km/hr, what is the speed of the second train?
(a) 72 km/hr (b) 60 km/hr
(c) 54 km/hr (d) 48 km/hr

5. Two trains of equal lengths are running on parallel lines in the same direction at the rate of 46 km/hr and 36 km/hr. The faster train passes the slower train in 36 seconds. The length of each train is :
(a) 50 m (b) 72 m
(c) 80 m (d) 82 m

6. Two persons are walking in the same direction at speeds of 3 km/hr and 6 km/hr. A train comes running from behind and passes them in 9 and 10 seconds. The speed of the train is :
(a) 33 km/hr (b) 40 km/hr
(c) 22 km/hr (d) 35 km/hr

7. A man can row three-quarters of a kilometer against the stream in $11\frac{1}{4}$ minutes and return in $7\frac{1}{2}$ minutes. The speed of the man in still water is :
(a) 2 km/hr (b) 3 km/hr
(c) 4 km/hr (d) 5 km/hr

8. A boat running upstream takes 8 hours 48 minutes to cover a certain distance, while it takes 4 hours to cover the same distance running downsteam. What is the ratio between the speed of the boat and the speed of the water current respectively?
(a) 2 : 1 (b) 3 : 1
(c) 8 : 3 (d) Cannot be determined

9. A boat covers 24 km upstream and 36 km downstream in 6 hours, while it covers 36 km upstream and 24 km downstream in $6\frac{1}{2}$ hours. The speed of the current is :
(a) 1 km/hr (b) 2 km/hr
(c) 1.5 km/hr (d) 2.5 km/hr

10. The average speed of a train is 20% less on the return journey than on the onward journey. The train halts for half an hour at the destination station before starting on the return journey. If the total time taken for the to and fro journey is 23 hours covering a distance of 1000 km, the speed of the trian on the return journey is :
(a) 60 km/hr (b) 40 km/hr
(c) 50 km/hr (d) 55 km/hr

Answers

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

Unit Test–3

1. If an amount of Rs 1,50,000 is shared between *A, B* and *C* in the ratio 2 : 3 : 5, then *A* receives the same amount as he would receive if another sum of money is shared between *A, B* and *C* in the ratio 5 : 3 : 2. The ratio of 1,50,000 to the second amount of money is :
(a) 2 : 3 (b) 3 : 2
(c) 5 : 3 (d) 5 : 2

2. In a chemical experiment, two NaOH solution bottles are used. Bottle *A* contains salt and water in the ratio 7 : 3 and bottle *B* contains salt and water in the ratio 4 : 3. In what proportion should the quantities be taken from *A* and *B* to give the 2 : 1 NaOH solution?
(a) 2 : 1 (b) 10 : 7
(c) 20 : 7 (d) 1 : 2

3. A man's income is increased by Rs 1200 and at the same time, the rate of tax to be paid is reduced from 12% to 10%. He now pays the same amount of tax as before. What is his increased income, if 20% of his income is exempted from tax in both the cases?
(a) Rs 6300 (b) Rs 7200
(c) Rs 4500 (d) Rs 6500

4. At a college in New Delhi, 60% of the students are boys and the rest are girls. Further 15% of the boys and 7.5% of the girls are getting a fee waiver. If the number of students getting a fee waiver is 90, find the total number of students getting 50% concession, if it is given that 50% of those not getting a fee waiver are eligible to get half fee concession?
(a) 360 (b) 280
(c) 320 (d) 330

5. Jai Pal sells a shirt at a profit of 25 per cent. Had he bought it at 25 per cent less and sold it far Rs 25 less, he still would have gained 25 per cent. The cost price of the shirt is :

(a) Rs 50 (b) Rs 75
(c) Rs 80 (d) Rs 100

6. A person bought two clocks. The cost price of one of them exceeds by $\frac{1}{4}$ the price of the other. He sold the dearer one at a gain of 10% and the other at a gain of 7.5% and thus got Rs 98 in all as S.P. Find the total cost price of two clocks.
(a) Rs 150 (b) Rs 90
(c) Rs 75 (d) Rs 100

7. An almirah is listed at Rs 1000. A retailer buys it with two successive discounts of 10% and 20% for cash. The other expenses are 10% of the cost of the almirah. At what price should he sell to earn a profit of 15%?
(a) Rs 910.80 (b) Rs 900.50
(c) Rs 910.50 (d) Rs 980.50

8. A merchant buys 40 bicycles and marks them at 25% above the cost price. He allows a discount on the marked price at 10% for cash sales, and at 5% for credit sales. If three-fourth of the stock is sold for cash and the rest for credit, and if the total profit be Rs 2025, what is the cost price of a bicycle?
(a) Rs 350 (b) Rs 720
(c) Rs 360 (d) Rs 460

9. The average of four consecutive even numbers is one-fourth of the sum of these numbers. What is the difference between the first and last number?
(a) 4 (b) 6
(c) 2 (d) 8

10. The average weight of three men *A, B* and *C* is 84 kg. *D* joins them and the average weight of the four becomes 80 kg. If *E*, whose weight is 3 kg more than that of *D,* replaces *A,* the average weight of *B, C, D* and *E* becomes 79 kg. Weight of *A* is :
(a) 65 kg (b) 70 kg
(c) 75 kg (d) 80 kg

11. A person invested some amount at the rate of 12% simple interest and some other amount at the rate of 10% simple interest. He received yearly interest of Rs 130, but if he had interchanged the amounts invested, he would have received Rs 4 more as interest. How much amount did he invest at different rates?
(a) Rs 500 @ 12% ; Rs 700 @ 10%
(b) Rs 700 @ 12% ; Rs 500 @ 10%
(c) Rs 700 @ 12% ; Rs 700 @ 10%
(d) Rs 500 @ 12% ; Rs 500 @ 10%

12. Rohit took a loan of Rs 20,000 to purchase a LCD TV set from a finance company. He promised to make the payment after three years. The company charges compound interest at the rate of 10% per annum for the same. But suddenly, the company announces the rate of interest as 15% per annum for the last one year of the loan period. What extra amount does Rohit have to pay due to this announcement of the new rate of interest?
(a) Rs 7830 (b) Rs 4410
(c) Rs 1210 (d) Rs 6620

13. Sanju puts equal amount of money one at 10% per annum compound interest payable half yearly and the second at a certain rate per cent per annum compound interest payable yearly. If he gets equal amounts after 3 years, what is the value of the second rate per cent?
(a) $10\frac{1}{4}\%$ (b) 10%
(c) $9\frac{1}{2}\%$ (d) $8\frac{1}{4}\%$

14. A machine depreciates in value each year at the rate of 10% of its previous value. However, every second year there is some maintenance work so that in that particular year, depreciation is only 5% of its previous value. If at the end of the fourth year, the value of the machine stands at Rs 1,46,205, then find the value of the machine at the start at the first year?
(a) Rs 1,90,000 (b) Rs 2,00,000
(c) Rs 1,95,000 (d) Rs 2,10,000

15. *A, B* and *C* can do a piece of work in 36, 54 and 72 days respectively. They started the work but *A* left 8 days before the completion of the work while *B* left 12 days before completion. The number of days for which *C* worked is :
(a) 4 (b) 8
(c) 12 (d) 24

16. A certain number of men, twice as many women and thrice as many boys earn in 6 days Rs 5100. A woman earns one and a half times as a boy and a man as much as a woman and a boy together per day. How many women were there, if a boy earned Rs 25 daily.
(a) 4 (b) 8
(c) 12 (d) 36

17. Tap *A* can fill the tank in two hours while taps *B* and *C* can empty it in six and eight hours respectively. All the taps remained open initially. After two hours, tap *C* was closed and after one more hour, tap *B* was also closed. In how much time now, would the remaining tank get filled?
(a) 12 min (b) 15 min
(c) 30 min (d) 20 min

18. At noon ship A starts from a point P towards a point Q and at 1.00 pm ship B starts from Q towards P. If the ship A is expected to complete the voyage in 6 hours and ship B is moving at a speed $\frac{2}{3}$ that of ship A, at what time are the two ships expected to meet one another?

(a) 4 pm (b) 4.30 pm
(c) 3 pm (d) 2.30 pm

19. Two trains are moving in the opposite directions on parallel tracks at the speeds of 64 km/hr and 96 km/hr respectively. The first train passes a telegraph post in 5 seconds whereas the second train passes the post in 6 seconds. Find the time taken by the trains to cross each other completely.

(a) 3 seconds (b) $4\frac{4}{5}$ seconds
(c) $5\frac{3}{5}$ seconds (d) 6 seconds

20. A man rows a boat upstream a certain distance and then returns back to the same place. If the time taken by him in going upstream is twice the time taken in rowing downstream, find the ratio of the speed of the boat in still water and the speed of the stream.

(a) 2 : 1 (b) 3 : 2
(c) 5 : 3 (d) 3 : 1

Answers

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