1.8 CHAPTER

Time, Speed & Distance

Time, Speed & Distance is a very important chapter to understand the logical development and the visualisation capacity of students. The problems on TSD are always favourite to the question setters. So for this chapter we need to come back on the basics of ratio and variation to solve the problem in TSD.

In this chapter, we will study

- Relative speed
- Average speed
- Races
- Circular tracks
- Application of variation

The whole chapter is based on one relation i.e.

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

The units of speed & distance have to be kept same so if speed has to be converted we can use

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

$$\text{or} \quad 1 \text{ m/s} = \frac{18}{5} \text{km/hr}$$

Example 1.

A car travels 200 m with the speed 72 km/hr. How much time it takes to travel the distance.

Solution.

$$\text{The speed} = 72 \text{ km/hr} = 72 \times \frac{5}{18} = 20 \text{ m/s}$$

$$\text{Time} = \frac{200}{20} = 10 \text{ sec}$$

Average Speed

For calculating the average speed the first thing that has to be wiped out from the mind is that the averge speed is not the average value of different speeds. It is the ratio of the total distance travelled & the total time taken to cover that distance.

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

Example 1.

A car covers first 400 meters with the speed 72 km/hr and next 300 meters with the speed 36 km/hr. Find out the average speed of the car.

Solution.

Time taken to cover first

$$400 \text{ m} = \frac{400}{72 \times \frac{5}{18}} = 20 \text{ s}$$

Time taken to cover next

$$300 \text{ m} = \frac{300}{36 \times \frac{5}{18}} = 30 \text{ s}$$

Total time = 50 s

Total distance = 700 m

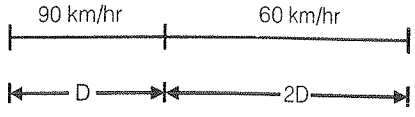
$$\text{Average speed} = \frac{700}{50} = 14 \text{ m/s}$$

Where equal distances are covered with different uniform speed, the value of distance does not matter while calculating the average speed.

Example 2.

A train covers a distance with the speed 90 km/hr and then double of the previous distance with the speed 60 km/hr find out its average speed.

Solution.



$$\text{Time taken for first distance} = \frac{D}{90}$$

$$\text{Time taken for second distance} = \frac{2D}{60} = \frac{D}{30}$$

Net distance = D + 2D = 3D

$$\text{So average speed} = \frac{3D}{\frac{D}{90}+\frac{D}{30}} = \frac{3D}{\frac{D+3D}{90}}$$

$$= \frac{3D}{4D}\times 90 = \frac{270}{4} = 67.5 \text{ km/hr}$$

Relative Speed

Relative speed is very good application part of TSD. Relative speed is defined as the speed of one moving body with respect to the another moving body.

If two bodies are running with the speed a and b then the relative speed of one body when

- They are moving on same plane (FOR is same)
  (a – b) for same direction
  (a + b) for opposite direction
- They are moving as one on another
  (As man on an moving escalator)
  (a + b) for same direction
  (a – b) for opposite direction

The basic funda of using relative speed in the problems is make one body as constant and let the other bodies run with the relative speed.

Problems on Trains

When a train crosses any body it has to cover its own length apart from the length of other object so relative distance will be the sum of length of train and length of the object if L_T is length of train, L_O is length of the object U_T is speed of train and U_O is speed of object then the time taken for the crossing will be given by

$$t = \frac{L_T + L_O}{U_T \pm U_O}$$

For same direction we will take –ve sign while for opposite we will take +ve sign.

Example 1.

A train running with the speed of 90 km/hr crosses a platform in 20 secs. If the length of train be 200 m. Find the length of platform.

Solution.

Here $L_T = 200$ m, $t = 20$ sec

$$U_T = 90 \text{ km/hr} = 90\frac{5}{18} = 25 \text{ m/s}$$

$U_O = 0$, $L_O = ?$

$$\text{So } 20 = \frac{200 + L_O}{25 \pm 0}$$

$$\Rightarrow 200 + L_O = 500$$

or $L_O = 300$ m

Rivers & Boats

For the case of boats and river the condition is similar as of the trains problems. Only thing to understand is

- Upstream → Moving against the river flow
- Downstream → Moving along the river flow

If U_O is speed of object and U_r is the speed of river then

for upstream → relative speed is $U_O - U_r$

for downstream → relative speed is $U_O + U_r$

Example 1.

A person covers a distance downstream in 3 hrs. While returns back in 9 hrs. If the speed of river is 10 m/s find out speed of Man.

Solution.

Upstream speed = $U_O - 10$

Downstream speed = $U_O + 10$

Since the distance covered are same

$$(U_O - 10)9 = 3(U_O + 10)$$

$$\Rightarrow 9U_O = 3U_O + 30 + 90$$

$$\Rightarrow 9U_O = 120$$

$$U_O = 20 \text{ m/s}$$

Circular Tracks

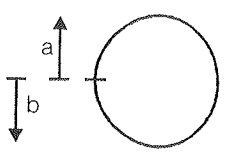
When talking about circular track the first thing to be kept in mind is the time interval between any two consecutive meetings is same. There are 3 basic things that can be asked

- First ever meeting time (T_f)
- First meeting time at starting point (T_s)
- No. of distinct point on the track where the meeting occurs. (η)

There are two cases that can be taken.

Case 1.

When two persons are running on the track. If the length of the track be D and the speed of person be a and b then



$$T_f = \frac{D}{a \pm b} \text{ (based on direction)}$$

$$T_s = \text{LCM of } \left\{\frac{D}{a}, \frac{D}{b}\right\}$$

$$\eta = \frac{T_s}{T_f}$$

Case 2.

When more than two persons are running then

$$T_f = \text{LCM of } \left\{\frac{D}{b-a}, \frac{D}{c-a}, \frac{D}{d-a} \ldots\right\}$$

$$T_s = \text{LCM of } \left\{\frac{D}{a}, \frac{D}{b}, \frac{D}{c} \ldots\right\}$$

$$\eta = \frac{T_s}{T_f}$$

Example 1.

Two persons start running on a circular track with speed 20 m/s & 30 m/s in opposite direction if length of the track is 100 m. Then find out at how many distinct point they will meet.

Solution.

For opposite direction $T_f = \frac{100}{20+30} = 2s$

$$I_s = \text{LCM of } \frac{100}{20}, \frac{100}{30} = \frac{100}{10} = 10 \text{ s}$$

So $\eta = \frac{T_s}{T_f} = \frac{10}{2} = 5$

Application of Variation

There are three different sort of variations possible in TSD

- When distance is constant

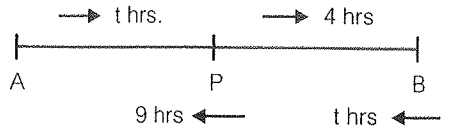
$$\text{Speed} \propto \frac{1}{\text{Time}} \text{ (inverse variation)}$$

As per this variation if speed becomes m/n times of previous speed then time will become n/m times of previous time.

Example 1.

Two trains start from different stations towards each other at same time & meet at point P from point P both trains take 4 hrs & 9 hrs to reach their destination find out the ratio of their speeds.

Solution.



Let us assume that train takes 't' time to reach at 'P', then

$$\Rightarrow \text{ratio of speeds} = \frac{1}{\text{ratio of times}}$$

$$\Rightarrow \frac{A}{B} = \frac{1}{t/9} = \frac{9}{t} \quad \ldots(i)$$

Similarly for PB

$$\frac{A}{B} = \frac{1}{4/t} = \frac{t}{4} \quad \ldots(ii)$$

By eq. (i) & (ii)

$$\frac{9}{t} = \frac{t}{4} \Rightarrow t = 6$$

So $\frac{A}{B} = \frac{9}{6} = \frac{3}{2}$

Example 2.

Two trains strart from Delhi & Mumbai towards each other at 10 a.m. in morning & they reach their destination on same day at 4 pm & 8 m respectively find out at what time they cross each other.

Solution

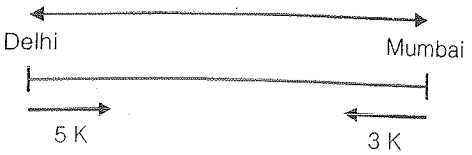
So Time taken by Delhi train = 6 hrs.
Time taken by Mumbai train = 10 hrs

So speed ratio $\frac{D}{M} = \frac{10}{6}$ (inverse variation)

$$= \frac{5}{3}$$

Let speed of D = 5 K
M = 3 K

The distance between Delhi & Mumbai
= 5 K × 6 = 30 K unit
or 3 K × 10 = 30 K unit



So now the problem is two trains are at a distance 30 K apart running towards each other

So time taken to meet = $\frac{30K}{5K+3K} = \frac{15}{4}$hrs

= 3 hr, 45 min

So both train will meet at 1 : 45 pm

Races

In races there are two sort of comparisons which are generally carried out.

- Compraison of distance & speed.
- Comparison of speed & time.

Let us see some examples.

Example 1.

In a 100 meter race A beats B by 20 m & B beats C by 20 m. Find out by what distance A beats C.

Solution

A beats B by 20 m ⇒

When A covers 100 m, B covers 80 m so ratio of speds of A : B = 10 : 8

so ratio of speed of A : B = 5 : 4

Similarly B : C = 5 : 4

So A : C = 25 : 16

So when A covers 25 m, 'C' covers 16 m. So when A will cover 100 m, 'C' will cover 16 × 4 = 64 m.

So 'A' beats 'C' by 36 meters.

□□□□

Solved Exampls

1. Walking at 3/4 of his normal speed, Ankur is 16 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is

(a) 48 minutes (b) 60 minutes

(c) 42 minutes (d) 62 minutes

Ans. (a)

Speed × Time = Distance

S × T = D

Here S is changed to $\frac{3}{4}$S, so T must be changed to $\frac{4}{3}$T to keep D constant i.e.

$$\frac{3}{4}S \times \frac{4}{3}T = D$$

Now $\frac{3}{4}T = T + 16$

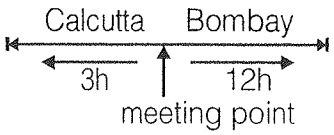
So $\frac{1}{3}T = 16$; T = 48

2. Two trains, Calcutta Mail and Bombay Mail, start at the same time from stations Calcutta and Bombay respectively towards each other. After passing each other, they take 12 hours and 3 hours to reach Bombay and Calcutta respectively. If the Calcutta Mail is moving at the speed of 48 km/h. the speed of the Bombay Mail is

(a) 24 km/h (b) 22km/h

(c) 21 km/h (d) 96 km/h

Ans. (d)



in this case $\frac{S_1}{S_2} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$

$= \frac{48}{S_2} = \frac{\sqrt{3}}{\sqrt{12}} = \frac{1}{2}$ S_2 = 96 km/h

3. Rajdhani Express travels 650 km in 5 h and another 940 km in 10 h. What is the average speed of train?

(a) 1590 km/h (b) 63 km/h

(c) 106 km/h (d) 126 km/h

Ans. (c)

Average speed = $\frac{\text{Total Distance Travelled}}{\text{Total Time taken}}$

$= \frac{650 + 940}{15}$ = 106 km/h

4. A car travels from A to B at V_1 km/h, travels back from B to A at V_2 km/h and again goes back from A to B at V_2 km/h. The average speed of the car is :

(a) $\frac{2V_1V_2}{V_1 + 2V_2}$ (b) $\frac{2V_1V_2}{V_2 + 2V_1}$

(c) $\frac{3V_1V_2}{V_2 + 2V_1}$ (d) $\frac{3V_1V_2}{V_1 + 2V_2}$

Ans. (c)

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$= \frac{3D}{\frac{D}{V_1}+\frac{D}{V_2}+\frac{D}{V_2}} = \frac{3}{\frac{1}{V_1}+\frac{2}{V_2}} = \frac{3V_1V_2}{2V_1+V_2}$$

5. Narayan Murthy walking at a speed of 20 km/h reaches his college 10 minutes late. Next time he increases his speed by 5 km/h, but finds that he is still late by 4 minutes. What is the distance of his college from his house.
(a) 20 km (b) 6 km
(c) 12 km (d) None of these

Ans. (d)

Let distance be D km

$$\frac{D}{20} = T + \frac{10}{60} \quad \ldots(i)$$

Also $\frac{D}{25} = T + \frac{4}{60}$ ...(ii)

From (i) and (ii) we get,

$$D \times \frac{1}{100} = \frac{1}{10}$$

$$D = \frac{100}{10} = 10 \text{ km}$$

6. A motor car does a journey in 17.5 hours, covering the first half at 30 km/h and the second half at 40 km/h. Find the distance of the journey.
(a) 684 km (b) 600 km
(c) 120 km (d) 540 km

Ans. (b)

Here Total time = 17.5 hours

let total Distance be 2 D km

then $\frac{D}{30}+\frac{D}{40} = 17.5$

$$D\left[\frac{1}{30}+\frac{1}{40}\right] = 17.5$$

$$D \times \frac{7}{120} = 17.5$$

$$D = \frac{17.5 \times 120}{7}$$

$$D = 300 \text{ km}$$

Total Distance = 2D = 600 km

7. Manish travels a certain distance by car at the rate of 12 km/h and walks back at the rate of 3 km/h. The whole journey took 5 hours. What is the distance he covered on the car?
(a) 12 km (b) 30 km
(c) 15 km (d) 6 km

Ana. (a)

Let Distance be D km

$$\frac{D}{12}+\frac{D}{3} = 5 \qquad D\left(\frac{1}{12}+\frac{1}{3}\right) = 5$$

$$D = \frac{5 \times 12}{5} = 12 \text{ km}$$

8. Two tains A and B start simultaneously in the opposite direction from two points A and B and arrive at their destinations 9 and 4 hours respectively after their meeting each other. At what rate does the second train B travel If the first train travels at 80 km per hour.
(a) 60 km/h (b) 100 km/h
(c) 120 km/h (d) None of these

Ans. (c)

A Meeting point B

Here $\frac{S_1}{S_2} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$

$$\frac{80}{S_2} = \frac{\sqrt{4}}{\sqrt{9}} \qquad \frac{80}{S_2} = \frac{2}{3}$$

$S_2 = 120$ km/hour

9. A journay of 192 km takes 2 hours less by a fast train than by a slow train. If the average speed of the slow train be 16 kmph less than that of fast train, what is the average speed of the faster train.
(a) 32 kmph (b) 16 kmph
(c) 12 kmph (d) 48 kmph

Ans. (d)

let speed of fast train be S km/hour then

$$\frac{192}{S-16} - \frac{192}{S} = 2 \quad \ldots(i)$$

This type of questions can be directly solved by going through option.

Heare using equation (i) and puting options.

We get S = 48 km/hour.

10. A passenger train takes 2 h less for a journey of 300 kilometres if its speed is increased by 5 kmph over its usual speed. Find the usual speed.

(a) 10 kmph (b) 12 kmph
(c) 20 kmph (d) 25 kmph

Ans. (d)

$$\frac{300}{S}-\frac{300}{S+5}=2 \qquad ...(i)$$

Going directly through options and using equation (i) we get,
S = 25 km/hour

11. A plane left half an hour later than the scheduled time and in order to reach its destination 1500 kilometre away in time, it had to increase its speed by 33.33 per cent over its usual speed. Find its increased speed.
(a) 250 kmph (b) 500 kmph
(c) 750 kmph (d) None of these

Ans. (c)

33.33% = $\frac{1}{3}$ of normal speed

$$\frac{D}{S+\frac{1}{3}S}-\frac{D}{S}=\frac{1}{2}$$

$$\frac{1500}{(4/3)S}-\frac{1500}{S}=\frac{1}{2} \qquad ...(i)$$

Going through option and (i) we get,
S = 750 km/hour

12. A car travels 1/3 of the distance on a straight road with a velocity of 10 km/h, the next 1/3 with a velocity of 20 km/h and the last 1/3 with a velocity of 60 km/h. What is the average velocity of the car for the whole journey?
(a) 18 km/h (b) 10 km/h
(c) 20 km/h (d) 15 km/h

Ans. (a)

$$\text{Average speed} = \frac{\text{Distance Covered}}{\text{Time taken}}$$

$$=\frac{\frac{D}{3}+\frac{D}{3}+\frac{D}{3}}{\frac{D}{3}\times\frac{1}{20}+\frac{D}{3}\times\frac{1}{10}+\frac{D}{3}\times\frac{1}{60}}=\frac{3}{\frac{1}{20}+\frac{1}{10}+\frac{1}{60}}$$

= 18 km/hour

13. Walking at 3/4 of his usual speed, a man is 16 minutes late for his office. The usual time taken by him to cover that distance is
(a) 48 minutes (b) 60 minutes
(c) 42 minutes (d) 62 minutes

Ans. (a)

$S \times T$ = Distance (constant)

$$\frac{3}{4}S\times\frac{4}{3}T=D$$

Time has become $\frac{4}{3}T$

Now $\frac{4}{3}T - T = 16$ minutes

T = 48 minutes

14. Two trains for Patna leave Delhi at 6 a.m. and 6.45 a.m. and travel at 98 kmph and 136 kmph respectively. How many kilometres from Delhi will the two trains meet?
(a) 262.4 km (b) 260 km
(c) 200 km (d) None of these

Ans.(d)

Distance travelled by 1st train in 45 minutes

$$=98\times\frac{45}{60}=73.5\text{ km}=\frac{147}{2}\text{ km}$$

Relative speed = $S_2 - S_1$ = 136 – 98 = 38 km/hr
Time taken to cover 73.5 km is

$$\frac{73.5}{38}=\frac{147}{2/38}=\frac{147}{76}\text{ hour}$$

$$\text{Distance} = \frac{147}{76}\times 98 = 189.55$$

Total distance = 73.5 + 189.55
= 263 km approx.

15. A motorboat went downstream for 28 km and immediately returned. It took the boat twice as long to make the return trip. If the speed of the river flow were twice as high, the trip downstream and back would take 672 minutes. Find the speed of the boat in still water and the speed of the river flow.
(a) 9 km/h, 3 km/h (b) 9 km/h, 6 km/h
(c) 8 km/h, 2 km/h (d) 12 km/h, 3 km/h

Ans.(a)

Let speed of boat be S_B
Speed of stream = S_S

$$\text{Then } \frac{28}{S_B-S_S}=2\times\frac{28}{S_B+S_S}$$

$$\text{Also } \frac{28}{S_B+S_S}+\frac{28}{S_B-S_S}=672\text{ minutes}$$

Going directly by option

$S_B = 9$ km

$S_S = 3$ km

16. A train requires 7 seconds to pass a pole while it requires 25 seconds to cross a stationary train which is 378 metres long. Find the speed of the train.

(a) 75.6 km/h (b) 75.4 km/h

(c) 76.2 km/h (d) 21 km/h

Ans. (a)

To cross a pole

$$t = \frac{L_T}{S_T} = \frac{\text{length of train}}{\text{speed of train}}$$

$$7 = \frac{L_T}{S_T} \quad ...(i)$$

Also to cross a stationary train $t = \frac{L_T + L_S}{S_T}$

L_S = length of stationary train

$$25 = \frac{L_T + 378}{S_T} \quad ...(ii)$$

From (i) and (ii)

$7 \times S_T = L_T$

$25 \times S_T = L_T + 378$

$18\ S_T = 378$

$$S_T = 21 \text{ m/s} = 21 \times \frac{18}{5} = 75.6 \text{ km/h}$$

17. A boat sails down the river for 10 km and then up the river for 6 km. The speed of the river flow is 1 km/h. What should be the minimum speed of the boat for the trip to take a maximum of 4 hours?

(a) 2 kmph (b) 3 kmph

(c) 4 kmph (d) 5 kmph

Ans. (c)

$$\frac{D_1}{S_B + S_S} + \frac{D_2}{S_B - S_S} = 4 \text{ hour}$$

$$\frac{10}{S_B + 1} + \frac{6}{S_B - 1} = 4 \text{ hour} \quad ...(i)$$

Going by option and (i) we get,

$S_B = 4$ km/hour

18. Two trains are running on parallel lines in the same direction at speeds of 40 kmph and 20 kmph respectively. The faster train crosses a man in the second train in 36 seconds. The length of the faster train is

(a) 200 metres (b) 185 metres

(c) 225 metres (d) 210 metres

Ans. (a)

t = time required

$$\frac{L_T + L_o}{S_T - S_o} \quad ...(i)$$

$S_T - S_O = 40 - 20 = 20$ km/h

$$= 20 \times \frac{5}{18} = \frac{50}{9} \text{ m/s}$$

Now $t = \frac{L_T}{50/9} \Rightarrow 36 = \frac{L_T}{50/9}$

So, $L_T = 200$ m

19. The speed of the boat in still water is 12 km/h and the speed of the stream is 2 km/h. A distance of 8 km, going upstream, is covered in

(a) 1 hr (b) 1 hr 15 min

(c) 1 hr 12 min (d) None of these

Ans. (d)

$$t = \frac{D}{S_B - S_S} \text{ (upstream)}$$

$$= \frac{8}{12-2} = \frac{8}{10} = \frac{8}{10} \times 60 = 48 \text{ min}$$

20. A boat goes 15 km upstream in 80 minutes. The speed of the stream is 5 km/h. The speed of the boat in still water is

(a) 16.25 km/h (b) 16 km/h

(c) 15 km/h (d) 17 km/h

Ans. (a)

$$t = \frac{D}{S_B - S_S} \text{ (upstream)}$$

$$\frac{80}{60} = \frac{15}{S_B - 5} \Rightarrow \frac{4}{3} = \frac{15}{S_B - 5}$$

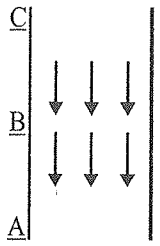
$S_B = 16.25$ km/h

21. In a stream, B lies in between A and C such that it is equidistant from both A and C. A boat can go from A to B and back in 6 hr 30 minutes while it goes from A to C in 9 hr. How long would it take to go from C to A?

(a) 3.75 hr (b) 4 hr

(c) 4.25 hr (d) 4.5 hr

Ans. (b)



Let AB = D km then
BC = D km
AC = 2D km

$$\frac{D}{S_B - S_S} + \frac{D}{S_B + S_S} = \frac{13}{2} \quad \text{...(i)}$$

$$\frac{2D}{S_B - S_S} = 9 \quad \text{...(ii)}$$

So $\frac{D}{S_B - S_S} = \frac{9}{2}$ ...(iii)

from (i) and (iii) we get,

$$\frac{9}{2} + \frac{D}{S_B + S_S} = \frac{13}{2}$$

$$\frac{D}{S_B + S_S} = 2$$

to go from C to A it takes

$$\frac{2D}{S_B + S_S} = 4 \text{ hours}$$

22. Two trains are travelling in the same direction at 50 km/h and 30 km/h respectively. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.
(a) 0.1 km (b) 1 km
(c) 1.5 km (d) 1.4 km

Ans. (a)

$$t = \frac{L_T + L_o}{S_T - S_o}$$

50 – 30 = 20 km/hr = 50/9 m/s

$$\text{now } 18 = \frac{L_T}{50/9} \Rightarrow L_T = 100 \text{ m}$$

23. Without stoppage, a train travels at an average speed of 75 km/h and with stoppages it covers the same distance at an average speed of 60 km/h. How many minutes per hour does the train stop?
(a) 10 minutes (b) 12 minutes
(c) 14 minutes (d) 18 minutes

Ans. (b)

Speed of trains are 75 km/h and 60 km/h. and to cover a distance of 60 km train will take 60 minutes in second case (with stoppage) while without stoppage it will take $\frac{60}{75}$ = 48 minuts

So, stoppage = 12 minutes

24. A boat rows 16 km up the stream and 30 km down stream taking 5 h each time. The velocity of the current
(a) 1.1 km/h (b) 1.2 km/h
(c) 1.4 km/h (d) 1.5 km/h

Ans. (c)

$$\frac{16}{S_B - S_S} = 5 \text{ hour}$$

$$\frac{30}{S_B + S_S} = 5 \text{ hour}$$

$16 = 5S_B - 5S_S$ ...(i)

$30 = 5S_B + 5S_S$ ...(ii)

$14 = 10 S_S$

$S_S = 1.4$ km/hr

25. A man can row 30 km upstream and 44 km downstream in 10 hours. It is also known that he can row 40 km upstream and 55 km downstream in 13 hours. Find the speed of the man in still water.
(a) 4 km/h (b) 6 km/h
(c) 8 km/h (d) 12 km/h

Ans. (c)

$$\frac{30}{S_B - S_S} + \frac{44}{S_B + S_S} = 10 \text{ also}$$

$$\frac{40}{S_B - S_S} + \frac{55}{S_B + S_S} = 13$$

Let $\frac{1}{S_B - S_T} = x$ and $\frac{1}{S_B + S_S} = y$

Then

$30x + 44y = 10$ ...(i)

$40x + 165 = 13$ ...(ii)

By solving we get,
$S_B = 8$ km/hr.

26. In a stream that is running at 2 km/h, a man goes 10 km upstream and comes back to the starting point in 55 minutes. Find the speed of the man in still water.

(a) 20 km/h (b) 22 km/h
(c) 24 km/h (d) 28 km/h

Ans.(b)

$$\frac{10}{S_B-2}+\frac{10}{S_B+2}=\frac{55}{60}=\frac{11}{12} \quad \text{...(i)}$$

On solving e.g. (i) we get,

$S_B = 22$ km/hr

27. A motorboat went down the river for 14 km and then up the river for 9 km. It took a total of 5 hours for the entire journey. Find the speed of the river flow if the speed of the boat in still water is 5 km/h.

(a) 1 kmph (b) 1.5 kmph
(c) 2 kmph (d) 3 kmph

Ans.(c)

$$\frac{14}{S_B+S_S}+\frac{9}{S_B-S_S}=5$$

$$\frac{14}{5+S_S}+\frac{9}{5-S_S}=5$$

Using equation and going by option we get

$S_S = 2$km/hr

28. A motorboat whose speed in still water is 10 km/h went 91 km downstream and then returned to its starting point. Calculate the speed of the river flow if the round trip took of 20 hours.

(a) 3 km/h (b) 4 km/h
(c) 2 km/h (d) 8 km/h

Ans.(a)

$$\frac{91}{S_B+S_S}+\frac{91}{S_B-S_S}=20$$

$$\frac{91}{10+S_S}+\frac{91}{10-S_S}=20$$

$S_S = 3$ km/hr.

□□□□

Time, Speed & Distance

Practice Exercise: I

1. A train passes a railway bridge 150 m long in 18 seconds. If the train is running at a speed of 60 km/hr., then the length of the train in metres is

(a) 160 m (b) 150 m
(c) 180 m (d) None of these

2. Sound travels 330 metres a second. If the sound of a thunder-cloud follows the flash after 10 seconds. The thunder-could is at a distance of

(a) 3.7 km (b) 3.5 km
(c) 3.3 km (d) None of these

3. The wheel of an engine is $3\frac{3}{4}$ metres in circumference and makes 4 revolutions in 2 seconds. The speed of the train is

(a) 27 km/hr (b) 31 km/hr
(c) 35 km/hr (d) None of these

4. On a tour a man travels at the rate of 64 km an hour for the first 160 km, then travels the next 160 km at the rate of 80 km an hour. The average speed in km per hour for the first 320 km of the tour is

(a) 81.13 km/hr (b) 73.11 km/hr
(c) 71.11 km/hr (d) None of these

5. Rakesh sets out to cycle from Delhi to Mathura and at the same time Suresh starts from Mathura to Delhi. After passing each other they complete their journeys in 9 and 16 hours, respectively. At what speed does Suresh cycle if Rakesh cycles at 16 km per hour?

(a) 12 km/hr (b) 16 km/hr
(c) 14 km/hr (d) None of these

6. A car during its journey travels 30 minutes at a speed of 40 km/hr, another 45 minutes at a speed of 60 km/hr, and 2 hours at a speed of 70 km/hr. The average speed of the car is

(a) 63 km/hr (b) 65 km/hr
(c) 70 km/hr (d) None of these

7. By walking at $\frac{3}{4}$ of his usual speed, a man reaches office 20 minutes later than usual. His usual time is

(a) 65 minutes (b) 60 minutes
(c) 70 minutes (d) None of these

8. A car starts from A for B travelling 20 km an hour. $1\frac{1}{2}$ hours later another car starts from A and travelling at the rate of 30 km an hour reaches B $2\frac{1}{2}$ hours before the first car. Find the distance from A to B
(a) 280 km (b) 260 km
(c) 240 km (d) None of these

9. A train does a journey without stopping in 8 hours. If it had travelled 5 km an hour faster, it would have done the journey in 6 hours 40 min. What is its slower speed?
(a) 35 km/hr (b) 25 km/hr
(c) 40 km/hr (d) None of these

10. Without any stoppage a person travels a certain distance at an average speed of 42 km/hr and with stoppages he covers the same distance at an average speed of 28 km/hr. How many minutes per hour does he stop?
(a) 25 minutes (b) 30 minutes
(c) 20 minutes (d) None of these

11. A train 300 metres long is running at a speed of 90 km/hr. How many seconds will it take cross a 200 metres long train running in the same direction at a speed of 60 km/hr?
(a) 70 sec. (b) 60 sec.
(c) 50 sec. (d) None of these

12. Two trains are running in opposite directions with the same speed. If the length of each train is 135 metres and they cross each other in 18 seconds, the speed of each train is
(a) 29 km/hr (b) 35 km/hr
(c) 27 km/hr (d) None of these

13. Two trains are moving in the same direction at 50 km/hr and 30 km/hr. The faster train crosses a man in the slower train in18 seconds. Find the length of the faster train.
(a) 120 m (b) 110 m
(c) 100 m (d) None of these

14. Two trains, 130 m and 110 m long, while going in the same direction, the faster traintakes one minutes to pass the other completely. If they are moving in opposite direction, they pass each other completely in 3 seconds. Find the speed of each train.
(a) 42 m/sec., 38 m/sec.
(b) 38 m/sec., 36 m/sec.
(c) 36 m/sec., 42 m/sec.
(d) None of these

15. Two stations A and B are 100 km apart on a straight line. One train starts from A at 7 A.M. and travels towards B at 20 km/hr speed. another train starts from B at 8 A.M. and travels towards A at 25 km/hr. speed. At what time will they meet?
(a) 10.30 A.M. (b) 11 A.M
(c) 10 A.M (d) None of these

16. Two trains start at the same time from Mumbai and Pune and proceed towards each other at the rate of 60 km and 40 km per hour. respectively. When they meet, it is found that one train has travelled 20 km more than the other. Find the distance between Mumbai and Pune.
(a) 150 km (b) 100 km
(c) 120 km (d) None of these

17. A and B are two stations. A train goes from A to B at 64 km/hr and returns to A at a slower speed. If its average speed for the whole journey is 56 km/hr, at what speed did it return?
(a) 48 km/hr (b) 49.77 km/hr
(c) 30 km/hr (d) 47.46 km/hr

18. Ramesh sees a train passing over 1 km long bridge. The length of the train is half that of bridge. If the train clears the bridge in 2 minutes, the speed of the train is
(a) 45 km/hr (b) 43 km/hr
(c) 50 km/hr (d) None of these

19. A motor cyclist goes from Mumbai to Pune, a distance of 192 kms, at an average speed of 32 km p.h. Another man starts from Mumbai by car, $2\frac{1}{2}$ hours after the first and reaches Pune half an hour earilier. What is the ratio of the speed of the motorcycle and the car?
(a) 1 : 2 (b) 1 : 3
(c) 10 : 27 (d) 5 : 4

20. A person sets to cover a distance of 12 km in 45 minutes. If he covers $\frac{3}{4}$ of the distance in $\frac{2}{3}$ rd time,

what should be his speed to cover the remaining distance in the remaining time?

(a) 16 km/hr (b) 8 km/hr

(c) 12 km/hr (d) 14 km/hr

21. A train 110 metres in length passes a man walking at the speed of 6 km/hr. against it in 6 seconds. The speed of the train in km per hour is

(a) 60 km/hr (b) 45 km/hr

(c) 50 km/hr (d) 55 km/hr

□□□□

Solutions

1. Ans. (b)

Let the length of the train be x m.

$\therefore$ Total distance covered by the train = $(x + 150)$m

Speed of the train = 60 km/hr

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

Since, Distance = Speed × time

$$\therefore \quad x + 150 = \frac{50}{3} \times 18 = 300$$

or, $x = 300 - 150 = 150$ m.

$\therefore$ Length of the train = 150 m.

2. Ans. (c)

Distance of thunder-cloud

= distance travelled by sound in 10 sec.

= (330 × 10) metres

= 3.3 km.

3. Ans. (a)

Distance covered in 2 seconds

$$= \frac{15}{4} \times 4 = 15 \text{ m.}$$

$$\therefore \quad \text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{15}{2} \text{ m/sec}$$

$$= \left(\frac{15}{2} \times \frac{18}{5}\right) \text{km/hr} = 27 \text{ km/hr.}$$

4. Ans. (c)

Let the speed on the return journey be x km/hr.

$$\text{Then, } 56 = \left(\frac{2s_1s_2}{s_1 + s_2}\right) = \frac{2 \times 64 \times x}{64 + x}$$

$$\therefore \quad 7(64 + x) = 16x \text{ or } 9x = 448$$

$$\therefore \quad x = \frac{448}{9} = 49.78 \text{ km/hr.}$$

5. Ans. (a)

$$\frac{\text{Rakesh's speed}}{\text{Suresh's speed}} = \frac{\sqrt{T_2}}{\sqrt{T_1}} = \frac{\sqrt{16}}{\sqrt{9}} = \frac{4}{3}$$

$$\therefore \quad \text{Suresh's speed} = \frac{3}{4} \text{ Rakesh's speed}$$

$$= \frac{3}{4} \times 16 = 12 \text{km/hr}$$

6. Ans. (a)

Here, $T_1 = \frac{30}{60}$, $T_2 = \frac{45}{60}$, $T_3 = 2$, $s_1 = 40$

$s_2 = 60$ and $s_3 = 70$.

$\therefore$ The average speed of the car

$$= \frac{s_1T_1 + s_2T_2 + s_3T_3}{T_1 + T_2 + T_3}$$

$$= \frac{40 \times \frac{30}{60} + 60 \times \frac{45}{60} + 70 \times 2}{\frac{30}{60} + \frac{45}{60} + 2}$$

= 63 km/hr.

7. Ans. (b)

Here, change in time = 20 and $\frac{a}{b} = \frac{3}{4}$

We have, change in time

$$= \left(\frac{b}{a} - 1\right) \times \text{original time}$$

$$\Rightarrow \text{Original time} = \frac{\text{Change in time}}{\left(\frac{b}{a} - 1\right)}$$

$$= \frac{20}{\left(\frac{4}{3} - 1\right)} = 60 \text{ minutes}$$

8. Ans. (c)

Here, difference in speed = 30 – 20 = 10.

Difference in time = $2\frac{1}{2} + 1\frac{1}{2} = 4$.

And product of speed = 20 × 30 = 600.

We have,

$$\frac{\text{Product of speed}}{d} = \frac{\text{difference of speed}}{\text{difference of time}}$$

$$\Rightarrow d = \text{product of speed} \times \left(\frac{\text{Diff. of time}}{\text{Diff. of speed}}\right)$$

$$600 \times \frac{4}{10} = 240\text{km}$$

9. Ans. (b)

Let the slower speed = s km/hr.

Since the distance travelled is same in both the cases therefore,

$$\frac{s_1}{T_2} = \frac{s_2}{T_1} \Rightarrow s_1 \times T_1 = s_2 \times T_2$$

$$\Rightarrow \quad s \times 8 = (s+5) \times \frac{20}{3}$$

$$\Rightarrow \quad 24s = 20(s+5)$$

$$\therefore \quad s = 25 \text{ km/hr.}$$

10. Ans. (c)

Here, $s_1 = 42$ and $s_2 = 28$.

$$\therefore \quad \text{Stoppage time/hr} = \frac{s_1 - s_2}{s_1} = \frac{42-28}{42}$$

$$= \frac{1}{3} \text{ hour} = 20 \text{ minutes}$$

11. Ans. (b)

Here, $L_1 = 300$ m, $L_2 = 200$ m,

$s_1 = 90$ km/hr and $s_2 = 60$ km/hr

$$\therefore \quad s_1 - s_2 = 90 - 60 = 30 \text{ km/hr} = 30 \times \frac{5}{18} \text{ m/s}$$

$$\therefore \quad \text{Time taken} = \frac{L_1 + L_2}{s_1 - s_2} = \frac{300+200}{30 \times \frac{5}{18}}$$

$$= \frac{500 \times 18}{30 \times 5} = 60 \text{ sec.}$$

12. Ans. (c)

Let the speed of each train be x m/sec.

We have, $L_1 = L_2 = 135$ m

and $S_1 = S_2 = x$ m/sec.

$$\therefore \quad \text{Therefore time taken} = \frac{L_1 + L_2}{S_1 + S_2}$$

$$\Rightarrow \quad 18 = \frac{135+135}{x+x}$$

$$\text{or,} \quad x = \frac{270}{2 \times 18} \text{ m/s}$$

$$= \frac{270}{2 \times 18} \times \frac{18}{5} \text{ km/hr} = 27 \text{ km/hr.}$$

13. Ans. (c)

Relative speed = (50 – 30)km/hr = 20 km/hr

$$= \left(20 \times \frac{5}{18}\right) = \left(\frac{50}{9}\right) \text{m/sec.}$$

Distance covered in 18 sec at this speed

$$= \left(18 \times \frac{50}{9}\right) \text{m} = 100 \text{ m.}$$

$\therefore$ Length of faster train = 100 m.

14. Ans. (a)

Speed of the faster train

$$= \left(\frac{L_1 + L_2}{2}\right)\left(\frac{T_1 + T_2}{T_1 T_2}\right) = \left(\frac{130+110}{2}\right)\left(\frac{60+3}{60 \times 3}\right)$$

= 42 m/sec.

Speed of the slower train

$$\left(\frac{L_1 + L_2}{2}\right) \times \left(\frac{T_1 - T_2}{T_1 T_2}\right)$$

$$= \left(\frac{130+110}{2}\right)\left(\frac{60-3}{60 \times 3}\right) = 38 \text{ m/sec.}$$

15. Ans. (d)

Time from 7 A.M. to 8 A.M. = 1 hour.

Therefore, time of their meeting

$$= \left(\frac{d + s_2 T}{s_1 + s_2}\right) \text{hr} = \left(\frac{100 + 25 \times 1}{20 + 25}\right) \text{hr}$$

= 2 hrs 47 min. after 7 A.M.

16. Ans. (b)

Distance between Mumbai and Pune

$$= d\left(\frac{s_1 + s_2}{s_1 - s_2}\right) \text{km}$$

$$= 20\left(\frac{60+40}{60-40}\right) \text{km} = 100 \text{ km.}$$

17. Ans. (b)

Let the required speed by x km/hr.

$$\text{Then,} \quad \frac{2 \times 64 \times x}{64 + x} = 56$$

$\therefore \quad 128x = 64 \times 56 + 56x$

$\therefore \quad x = \dfrac{64 \times 56}{72} = 49.77$ km/hr

18. Ans. (a)

Distance travelled in 2 minutes

$= \left(1 + \dfrac{1}{2}\right)$km i.e. $\dfrac{3}{2}$ kms.

Distance covered in 1 hr. $= \left(\dfrac{3}{2} \times \dfrac{60}{2}\right)$km

$= 45$ km

$\therefore$ Speed of the train = 45 km/hr

19. Ans. (a)

Speed of the first man = 32 km/hr.

Time taken = 192 ÷ 32 = 6 hr

Second man covers 192 km in 3 hr

$\therefore$ Speed of the second man

$= 192 \div 3 = 64$ km/hr

Ratio = 32 : 64 or 1 : 2

20. Ans. (c)

Distance already covered = $\dfrac{3}{4} \times 12 = 9$ km

Time spent = $\dfrac{2}{3} \times 45$ min = 30 min

Distance left = (12 – 9) km = 3 km

Time left = (45 – 30)min = 15 min

$\therefore$ Required speed = $\dfrac{3}{15/60}$ km/hr

$= 12$ km/hr

21. Ans. (a)

Let the speed of the train in km/hr = x

Then, relative speed = $(x + 6)$ km/hr

$= (x + 6) \times \dfrac{5}{18}$ m/sec

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

$\therefore \quad x = 60$

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

□□□□

Boats & Streams

Practice Exercise: I

1. If a man can swim downstream at 6 kmph and upstream at 2 kmph, his speed in still water is:
   (a) 4 km/hr (b) 2 km/hr
   (c) 3 km/hr (d) 2.5 km/hr

2. If Anshul rows 15 km upstream and 21 km downstream taking 3 hours each time, then the speed of the stream is:
   (a) 1 km/hr (b) 1.5 km/hr
   (c) 2 km/hr (d) 12 km/hr

3. If a boat goes 7 km upstream in 42 minutes and the speed of the stream is 3 kmph, then the speed of the boat in still water is:
   (a) 4.2 km/hr (b) 9 km/hr
   (c) 13 km/hr (d) 21 km/hr

4. A man can row $9\dfrac{1}{3}$ kmph in still water and finds that it takes him thrice as much time to row up than as to row down the same distance in the river. The speed of the current is :
   (a) $3\dfrac{1}{3}$ km/hr (b) $3\dfrac{1}{9}$ km/hr
   (c) $4\dfrac{2}{3}$ km/hr (d) 14 km/hr

5. A man can row a boat at 10 kmph in still water. If the speed of the stream is 6 kmph, the time taken to row a distance of 80 km down the stream is :
   (a) 8 hours (b) 5 hours
   (c) 10 hours (d) 20 hours

6. 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 kmph and the speed of the boat in still water is 4 kmph, what is the distance between A and B?
   (a) 4 kms (b) 6 kms
   (c) 8 km (d) 9 km

7. Speed of a boat in standing water is 9 kmph and the speed of the stream is 1.5 kmph. A man rows to a distance of 10.5 km and comes back to the starting point. The total time taken by him is:

(a) 16 hours (b) 18 hours
(c) 20 hours (d) 24 hours

8. A man rows to a place 48 km distant and back in 14 hours. He finds that he can row 4 km with the steam in the same time as 3 km against the stream. The rate of the steam is :
(a) 1 km/hr (b) 1.8 km/hr
(c) 3.5 km/hr (d) 1.5 km/hr

9. A man can row three-quarters of a kilometre 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

10. A man can row 5 kmph in still water. If the river is running at 1 kmph, it takes him 75 minutes to row to a place and back. How far is the place?
(a) 3 km (b) 2.5 km
(c) 4 km (d) 5 km

□□□□

Solutions

1. Ans. (a)

Speed in still water $= \frac{1}{2}(6+2)$ kmph
$= 4$ kmph.

2. Ans. (a)

Rate upstream $= \left(\frac{15}{3}\right)$ kmph $= 5$ kmph.

Rate downstream $= \left(\frac{21}{3}\right)$ kmph $= 7$ kmph.

$\therefore$ Speed of stream $= \frac{1}{2}(7-5)$ kmph
$= 1$ kmph.

3. Ans. (c)

Rate upstream $= \left(\frac{7}{42}\times 60\right)$ kmph $= 10$ kmph

Speed of stream = 3 kmph.
Let speed in still water be x km/hr
Then speed upstream $= (x-3)$ km/hr.
$\therefore \quad x-3=10$ or $x=13$ kmph.

4. Ans. (c)
Let speed upstream be x kmph.
Then, speed downstream $= 3x$ kmph.

$\therefore$ speed in still water $= \frac{1}{2}(3x+x)$ kmph
$= 2x$ kmph

$\therefore \quad 2x = \frac{28}{3} \quad \Rightarrow x = \frac{14}{3}$

$\therefore$ Speed upstream $= \frac{14}{3}$ km/hr,
Speed downstream = 14 km/hr

$\therefore$ Speed of the current

$= \frac{1}{2}\left(14-\frac{14}{3}\right)$ km/hr

$= \frac{14}{3}$km/hr $= 4\frac{2}{3}$km/hr

5. Ans. (b)
Speed downstream = (10 + 6) km/hr
= 16 km/hr.
Time taken to cover 80 km downstream

$= \left(\frac{80}{16}\right)$hrs $= 5$ hrs.

6. Ans. (b)
Let the distance between A and B be x km
Speed downstream = 6 kmph,
Speed upstream = 2 kmph.
$\therefore$ Distance A B = 6 km.

7. Ans. (d)
Speed upstream = 7.5 kmph,
Speed downstream = 10.5 kmph.

$\therefore$ Total time taken $= \left(\frac{105}{7.5}+\frac{105}{10.5}\right)$ hrs
= 24 hours

8. Ans. (a)
Suppose he moves 4 km downstream in x hours.
Then, speed downstream $= \left(\frac{4}{x}\right)$ km/hr, speed upstream $= \left(\frac{3}{x}\right)$km/hr.

$\therefore \quad \frac{48}{(4/x)} + \frac{48}{(3/x)} = 14 \text{ or } x = \frac{1}{2}$

$\therefore$ Speed downstream = 8 km/hr.
Speed upstream = 6 km/hr

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

= 1 km/hr.

9. Ans. (d)

Speed upstream $= \left(\frac{3}{4} \times \frac{4}{45} \times 60\right)$ kmph

= 4 kmph

Speed downstream $= \left(\frac{3}{4} \times \frac{2}{15} \times 60\right)$ kmph

= 6 kmph

Speed in still water $= \frac{1}{2}(6 + 4)$ kmph

= 5 kmph

10. Ans. (a)

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

Then, $\frac{x}{6} + \frac{x}{4} = \frac{75}{60}$ or, $2x + 3x = 15$ or $x = 3$.

$\therefore$ Required distance = 3 km.

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Problems on Trains

Practice Exercise: I

1. A train is moving at a speed of 132 kmph. If the length of the train is 110 metres, how long will it take to cross a railway platform 165 m long?
   (a) 5 sec (b) 7.5 sec
   (c) 10 sec (d) 15 sec.

2. A train 700 m long is running at 72 kmph. If it crosses a tunnel in 1 minute, the length of the tunnel is
   (a) 700 m (b) 600 m
   (c) 550 m (d) 500 m

3. A train 300 m long crossed a platform 900 m long in 1 minute 12 seconds. The speed of the train (in km/hr) is
   (a) 45 (b) 50
   (c) 54 (d) 60

4. A train speeds past a pole in 15 seconds and a platform 100 m long in 25 seconds. Its length is
   (a) 200 m (b) 150 m
   (c) 50 m (d) Data inadequate

5. If a train 110 m long passes a telegraph pole in 3 seconds, then the time taken by it to cross a railway platform 165 m long is
   (a) 3 sec (b) 4 sec
   (c) 5 sec (d) 7.5 sec

6. A train 150 m long moving at a speed of 25 metres per second overtakes a man moving at 5 metres/sec in opposite direction. The train will pass the man in
   (a) 5 sec (b) 6 sec
   (c) $4\frac{2}{7}$ sec (d) 8 sec

7. Two trains 200 m and 150 m long are running on parallel rails at the rate of 40 kmph and 45 kmph respectively. In how much time will they cross each other, if they are running in the same direction?
   (a) 72 sec (b) 132 sec
   (c) 192 sec (d) 252 sec

8. Two train 126 m and 114 m long are running in opposite directions, one at the rate of 30 kmph and another one at 42 kmph. From the moment they meet will cross each other in
   (a) 10 sec (b) 11 sec
   (c) 12 sec (d) 13 sec

9. A train 110 m long passes a man, running at 6 kmph in the direction opposite to that of the train, in 6 seconds. The speed of the train is
   (a) 60 km/hr (b) 66 km/hr
   (c) 54 km/hr (d) 72 km/hr

10. A train 108 m long moving at a speed of 50 km/hr crosses a train 112 m long coming from opposite direction in 6 seconds. The speed of the second train is
    (a) 48 kmph (b) 54 kmph
    (c) 66 kmph (d) 82 kmph

11. A train B speeding with 120 kmph crosses another train C, running in the same direction in 2 minutes. If the lengths of the trains B and C be 100 m and 200m respectively, what is the speed of the train C?
(a) 111 kmph (b) 127 kmph
(c) 123 kmph (d) 129 kmph

12. A train overtakes two persons who are walking in the same direction in which the train is going, at the rate of 2 kmph and 4 kmph and passes them completely in 9 and 10 seconds. respectively. The length of the train is
(a) 72 m (b) 54 m
(c) 50 m (d) 45 m

13. Two stations A and B are 110 km apart on a straight line. One train starts from A at 7 a.m. and travels towards B at 20 kmph. Another train starts from B at 8 a.m. and travels towards A at a speed of 25 kmph. At what time will they meet?
(a) 9 a.m. (b) 10 a.m.
(c) 11 a.m. (d) 10.30 a.m

14. Two train are running in opposite directions towards each other with speeds of 54 kmph and 48 kmph respectively. If the length of the train is 250 m and they cross each other in 18 seconds, the length of the other trains is:
(a) 145 m (b) 230m
(c) 260 m (d) 180 m

15. A train travelling at 48 kmph completely crosses another train having half its length and travelling in opposite direction at 42 kmph, in 12 seconds. It also passes a railway platform in 45 seconds. The length of the platform is
(a) 560 m (b) 400 m
(c) 600 m (d) 450 m

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

17. A man sees a train passing over a bridge 1 km long. The length of the train is half that of the bridge. If the train clears the bridge in 2 minutes, the speed of the train is
(a) 30 km/hr (b) 45 km/hr
(c) 50 km/hr (d) 60 km/hr

□□□□

Solutions

1. Ans. (b)

$$\text{Speed} = \left(132 \times \frac{5}{18}\right) \text{m/sec} = \frac{110}{3} \text{m/sec.}$$

Total distance covered
$= (110 + 165)\text{m} = 275 \text{ m.}$

$\therefore$ Required time $\left(275 \times \frac{3}{110}\right)$ sec.

$= 7.5$ seconds.

2. Ans. (d)

$$\text{Speed } \left(72 \times \frac{5}{18}\right) \text{m/sec} = 20\text{m/sec.}$$

Time = 60 sec.

$$\therefore \quad \frac{700 + x}{20} = 60 \Leftrightarrow 700 + x = 1200$$

$$\Rightarrow \quad x = 500 \text{ m}$$

3. Ans. (d)
Total distance covered = (300 +900)m
= 1200 m.
Time taken = 1 min. 12 sec = 72 sec,

$$\therefore \quad \text{Speed} = \left(\frac{1200}{72}\right) \text{m/sec.}$$

$$= \left(\frac{1200}{72} \times \frac{18}{5}\right) \text{km/hr} = 60 \text{ km/hr}$$

4. Ans. (b)
Let the length of train be x metres and its speed by y metres/sec.

$$\text{Then, } \frac{x}{y} = 15 \Rightarrow y = \frac{x}{15}$$

$$\frac{x + 100}{25} = \frac{x}{15} \quad \Rightarrow x = 150 \text{ m/s}$$

5. Ans. (d)

$$\text{Speed} = \left(\frac{110}{3}\right) \text{m/sec}$$

Time taken to cross railway platform

$$= \left[(110 + 165) \times \frac{3}{110}\right] \text{sec}$$

$$= \left(275 \times \frac{3}{110}\right) \text{sec} = 7.5 \text{ sec}$$

6. Ans. (a)

Speed of train relative to man

$= (25 + 5)$ m/sec

$= 30$ m/sec

$\therefore$ Time taken to pass the man

$= \left(\frac{150}{30}\right)$sec $= 5$ sec.

7. Ans. (d)

Relative speed $= (45-40)$kmph $= 5$ kmph.

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

Total distance covered = Sum of length of trains $= 350$ m

$\therefore$ Time taken $= \left(350 \times \frac{18}{25}\right)$ sec. $= 252$ sec.

8. Ans. (c)

Relative speed $= (30+42)$ kmph $= 72$ kmph

$= \left(72 \times \frac{5}{18}\right)$m/sec $= 20$ m/sec

Distance covered in crossing each other

$= (126 + 114)$ m $= 240$ m.

Required time $= \left(\frac{240}{20}\right)$ sec $= 12$ sec.

9. Ans. (a)

Speed of the train relative to man

$= \left(\frac{110}{6}\right)$m/sec. $= \left(\frac{110}{6} \times \frac{18}{5}\right)$kmph

$= 66$ kmph.

Let the speed of the train be x kmph.

Then, relative speed $= (x + 6)$ kmph.

$x + 6 = 66$ or $x = 60$ kmph.

10. Ans. (d)

Let the speed of the second train be x kmph

Relative speed $= (x + 50)$ kmph

$= \left[(x+50) \times \frac{5}{18}\right]$m/sec.

$= \left(\frac{250+5x}{18}\right)$m/sec.

Distance covered $= (108 + 112) = 220$ m.

$\therefore \quad \frac{220}{\left(\frac{250+5x}{18}\right)} = 6$ or $250 + 5x = 660$

or $x = 82$ kmph

11. Ans. (a)

Let the speed of train C be x kmph.

Speed of B relative to C $= (120 - x)$

$= \left[(120 - x) \times \frac{5}{18}\right]$m/sec

$= \left(\frac{600 - 5x}{18}\right)$ m/sec

Distance covered $= (100 + 200)$m $= 300$ m.

$\therefore \quad \frac{300}{\left(\frac{600-5x}{18}\right)} = 120 \quad \Rightarrow 5400$

$= 120(600 - 5x) \quad \Rightarrow x = 111.$

12. Ans. (c)

2 kmph $= \left(2 \times \frac{5}{18}\right)$m/sec

$= \frac{5}{9}$ m/sec and 4 kmph $= \frac{10}{9}$ m/sec

Let the length of the train be x metres and its speed by y m/sec.

Then, $\frac{x}{\left(y - \frac{5}{9}\right)} = 9$ and $\frac{x}{\left(y - \frac{10}{9}\right)} = 10.$

$\therefore \quad 9y - 5 = x$ and $10\,(9y - 10) = 9x$

$\therefore \quad 9y - x = 5$ and $90\,y - 9x = 100$

On solving we get $x = 50$.

$\therefore$ Length of the train is 50 m.

13. Ans. (b)

Suppose they meet x hours after 7 a.m.

Distance covered by A in x hours

$= 20x$ km

Distance covered by B in $(x - 1)$ hours

$= 25\,(x - 1)$km

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

or $45x = 135$ or $x = 3$.

So, they meet at 10 a.m.

14. Ans. (c)

Relative speed = (54 + 48) kmph

$$= \left(102 \times \frac{5}{18}\right) \text{m/sec} = \left(\frac{85}{3}\right) \text{m/sec}$$

Let the length of the other train be x metres.

Then, $(250 + x) \times \frac{3}{85} = 18$ or $750 + 3x$

$= 1530$ or $x = 260$ m

$\therefore$ The length of the other train is 260 m.

15. Ans. (b)

Let the length of first train be x metres.

Then, the length of second train is $(x/2)$ metres.

Relative speed = (48 + 42) kmph

$$= \left(90 \times \frac{5}{18}\right) \text{m/sec} = 25 \text{ m/sec.}$$

$$\therefore \quad \frac{\left(x + \frac{x}{2}\right)}{25} = 12 \text{ or } \frac{3x}{2} = 300$$

or $x = 200$.

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

Let the length of platform be y metres.

Speed of the first train

$$= \left(48 \times \frac{5}{18}\right) \text{m/sec} = \frac{25}{3} \text{m/sec.}$$

$$\therefore \quad (200 + y) \times \frac{3}{40} = 45 \Rightarrow 600 + 3y$$

$$= 1800 \Rightarrow y = 400 \text{ m}$$

16. Ans. (c)

Let the speed of second train be x kmph.

Relative speed = $(30 + x)$ kmph

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

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

$\Rightarrow \quad x = 60$

17. Ans. (b)

Length of bridge = 1000 m.

Length of train = 500 m.

Toal distance covered in clearing the bridge = 1500 m.

Time taken = 120 seconds.

$$\therefore \quad \text{Speed} = \left(\frac{1500}{120}\right) \text{m/sec}$$

$$= \left(\frac{25}{2} \times \frac{18}{5}\right) \text{kmph} = 45 \text{ kmph.}$$

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