

11.1: Speed, time & distance Introduction

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

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

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

If Speed ↑ time ↓

Unit of distance : metres, km, miles

$$1 \text{ km} = 1000 \text{ metres}$$

$$1 \text{ mile} = 1.61 \text{ km} \text{ (approx)}$$

Unit of speed = km/hr, km/min, m/s

Unit of time = hrs, min, sec

$$1 \text{ hr} = 60 \text{ min}$$

$$1 \text{ min} = 60 \text{ sec}$$

$$1 \text{ hr} = 3600 \text{ sec}$$

Conversion of kmph to mps

$$\text{kmph} = \frac{\text{km}}{\text{hour}} = \frac{1000 \text{ m}}{(60 \times 60) \text{ sec}} = \frac{5}{18} \text{ m/s}$$

$$\boxed{1 \text{ kmph} = \frac{5}{18} \text{ m/s}}$$

$$\Rightarrow 18 \text{ kmph} = 5 \text{ m/s}$$

$$36 \text{ kmph} = 10 \text{ m/s}$$

$$54 \text{ kmph} = 15 \text{ m/s}$$

$$63 \text{ kmph} = 15 \text{ m/s} + 2.5 \text{ m/s}$$

$$\begin{array}{c} 5 \\ \swarrow + \searrow \\ 5 + 9 \end{array} \quad \Rightarrow 17.5 \text{ m/s}$$

$$72 \text{ kmph} = 20 \text{ m/s}$$

$$\begin{array}{c} 45 \\ \swarrow + \searrow \\ 36 + 9 \end{array} \quad \begin{array}{l} = 10 \text{ m/s} + 2.5 \text{ m/s} \\ = 12.5 \text{ m/s} \end{array}$$

Basic Concepts

Distance is always directly proportional to speed and time.

If your travel time \uparrow Distance \uparrow

If your travel time \downarrow Distance \downarrow

Speed \uparrow Distance \uparrow

Speed \downarrow Distance \downarrow

1) When speed is constant
travelling with same speed.

$$\text{Ex} \quad \frac{200 \text{ kms}}{40 \text{ km/hr}}$$

5 hrs

$$\frac{280 \text{ kms}}{40 \text{ km/hr}}$$

7 hrs

$$\text{Time Ratio} = 5 : 7$$

$$\text{Distance Ratio} = 200 : 280$$

$$= 5 : 7$$

$$\frac{d_1}{d_2} = \frac{t_1}{t_2}$$

\therefore Distance \propto Time

2) When time is constant
travelled time is same or starting time is same.

$$\text{Ex} \quad \frac{200 \text{ kms}}{4 \text{ hrs}}$$

280 kms

\rightarrow Distance to be travelled

4 hrs

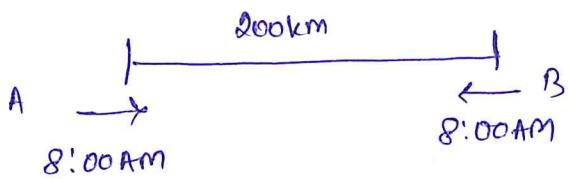
\rightarrow Time taken

$$\text{Speed} \rightarrow \frac{200}{4} = 50 \text{ km/hr}$$

$$\frac{280}{4} = 70 \text{ km/hr}$$

$$\frac{d_1}{d_2} \rightarrow \frac{s_1}{s_2}$$

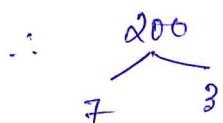
\therefore Distance \propto Speed

Ex

$$\text{Speed ratio} = 7 : 3$$

Find distance travelled by A when he met B.

$$\frac{D_1}{D_2} = \frac{s_1}{s_2}$$



$$\text{Distance travelled by A} = \frac{200 \times 7}{10} \\ = 140 \text{ km (Ans)}$$

$$\text{Distance travelled by B} = \frac{200 \times 3}{10} \\ = 60 \text{ km.}$$

3) When distance is constant
 ↳ travelled distance is same.

By

200kms

40km/hr

200kms → Distance

100km/hr → Speed

$$\text{Time} \rightarrow \frac{200}{40} = 5 \text{ hrs}$$

$$\frac{200}{100} = 2 \text{ hrs.}$$

Speed ↑ Time ↓
 Time ↓ Speed ↑

$$\frac{s_1}{s_2} = \frac{t_2}{t_1}$$

∴ speed ∝ $\frac{1}{\text{time}}$

Average Speed

Average Speed

When distance is equal

case 1) If 2 speeds are given s_1 and s_2

$$\text{Avg Speed} = \frac{s_1 + s_2}{s_1 + s_2}$$

when distance is not equal

case 2) If 3 speeds are given s_1, s_2 & s_3

$$\text{Avg Speed} = \frac{3s_1 + s_2 + s_3}{s_1 + s_2 + s_3 + s_3}$$

Relative Speed

When two bodies are moving (use concept of relative speed)

Case-1 : If bodies are moving in same direction \hookrightarrow difference

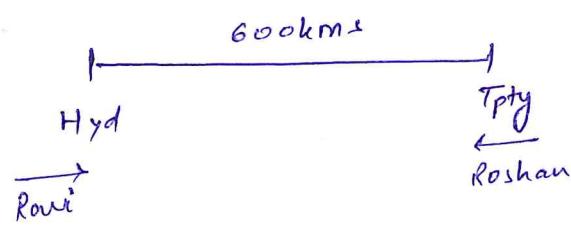
$$\text{Relative speed (R)} = s_1 - s_2 \quad (\because s_1 > s_2)$$

Case-2 : If bodies are moving in opposite direction \hookrightarrow sum

$$R_e = s_1 + s_2$$

$$\text{Time they meet} = \frac{\text{Distance b/w them at same time}}{\text{Relative Speed}}$$

Ex Ravi starts from Hyderabad to Timupati and the same time Roshan starts from Timupati to Hyderabad. Their speed is 25kmph and 35kmph respectively. If the distance between Hyderabad and Timupati is 600kms, when these two person meet?



$$\text{Time they meet} = \frac{\text{Distance b/w them}}{R_s}$$

(the time at which they start should be same)

$$R_s = S_1 + S_2$$

$$\text{Time} = \frac{600}{25 + 35}$$
$$\Rightarrow 10 \text{ hrs.}$$

Q.17 A bus is travelling at the rate of 45kmph. How many seconds, it will take to cover a distance of $\frac{4}{5}$ km?

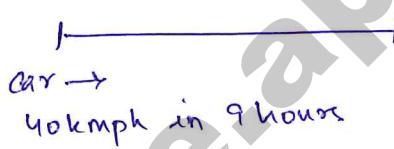
$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\begin{aligned}\text{Distance} &= \frac{4}{5} \text{ kms} \\ &= \frac{4}{5} \times 1000 \\ &= 800 \text{ metres}\end{aligned}$$

$$\begin{aligned}\text{Speed} &= 45 \text{ kmph} \\ &= 45 \times \frac{5}{18} = 12.5 \text{ m/s}\end{aligned}$$

$$\begin{aligned}\text{Time} &= \frac{800}{12.5} \\ &= 64 \text{ seconds.}\end{aligned}$$

Q.18 A car travelling at a speed of 40kmph can complete a journey in 9 hrs. How long will it take to travel the same distance at 60kmph?



$$\begin{aligned}\text{Distance travelled} &= \text{Speed} \times \text{Time} \\ &= 40 \times 9 = 360 \text{ kms.}\end{aligned}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{360}{60} = 6 \text{ hrs.}$$

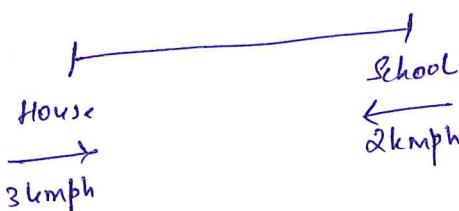
(OR)

When distance is same,

$$\begin{aligned}s &\propto \frac{1}{T}, \text{ Speed ratio} = 40 : 60 = 2 : 3 \\ \therefore \text{time ratio} &= 3 : 2 \\ \frac{1}{9} &\quad \downarrow \quad \downarrow \\ &\quad \frac{1}{6} \times 2 = \frac{1}{3}\end{aligned}$$

6 hrs. (ans)

Q.3) A boy goes to his school from his house at a speed of 3 kmph and returns at a speed of 2 kmph. If he takes 10 hours in going and coming, the distance between his house and school is:



Time taken house to school and school to house = 10 hrs.

Let Distance be x kms.

Time taken to travel from house to school = $\frac{x}{3}$ hrs

Time taken to travel from school to house = $\frac{x}{2}$ hrs.

$$\therefore \frac{x}{3} + \frac{x}{2} = 10$$

$$\Rightarrow 2x + 3x = 60$$

$$\Rightarrow x = 12 \text{ kms.}$$

(OR)

When distance is same

$$\text{Speed} \propto \frac{1}{\text{time}}$$

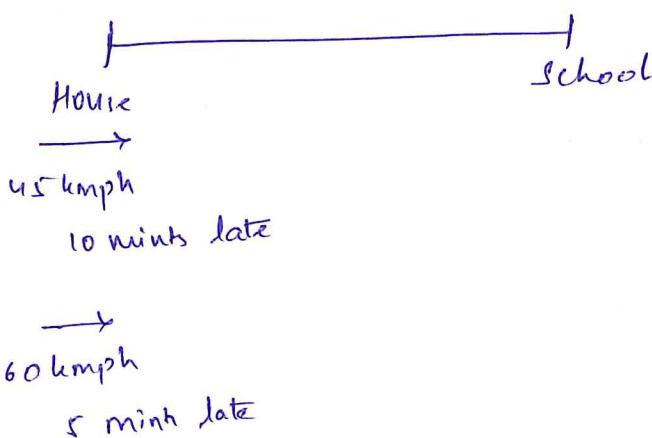
$$\text{Speed ratio} = 3 : 2$$

$$\Rightarrow \text{Time ratio} = 2 : 3$$

$$\text{Time taken to travel from house to school} = \frac{2 \times 10}{5} = 4 \text{ hrs.}$$

$$\text{Distance} = 4 \times 3 = 12 \text{ kms.}$$

Q.4) A boy walking at a speed of 45kmph reaches his school 10 min late, next time he increases his speed to 60kmph , but still be is late by 5 minutes . find the distance of his school from his house.



let distance be x kms

let correct time be ' t '

$$T_1 = t + 10 \quad] \text{ difference}$$

$$T_2 = t + 5 \quad T_1 - T_2 = 5 \text{ mins}$$

$$T_1 = \frac{x}{45}, \quad T_2 = \frac{x}{60}$$

$$T_1 - T_2 = 5 \text{ mins} \\ = \frac{5}{60} \text{ hrs.}$$

$$\frac{x}{45} - \frac{x}{60} = \frac{5}{60}$$

$$\frac{4x - 3x}{180} = \frac{5}{60}$$

$$x = 15 \text{ kms.}$$

(OR)

When distance is same

$$\text{Speed} \propto \frac{1}{\text{Time}}$$

$$\begin{aligned}\text{Speed Ratio} &= 45:60 \\ &\Rightarrow 3:4\end{aligned}$$

$$\therefore \text{Time Ratio} = \frac{4}{3}$$

$$\text{Time Difference} = 10 - 5 = 5$$

$$\begin{aligned}1 &\rightarrow 5 \\ 4 &\rightarrow \frac{\Sigma}{1} \times 4 \\ &= 20 \text{ mins}\end{aligned}$$

$$3 \rightarrow \frac{\Sigma}{1} \times 3 = 15 \text{ mins}$$

$$\begin{aligned}\text{Distance} &= \frac{20}{60} \times 45 \\ &= 15 \text{ kms.}\end{aligned}$$

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

(OR)

$$\begin{aligned}\text{Distance} &= \frac{15}{60} \times 45 \\ &\Rightarrow 15 \text{ kms.}\end{aligned}$$

Trick

Time difference	
late	late
late	early
early	early

Q.5) A man covers a certain distance between his house and office on scooter. Having an average speed of 30 kmph, he is late by 10 min. However, with a speed of 40 kmph, he reaches his office 5 min earlier. Find the distance between his office and house.



@ 30 kmph
late 10 mins

@ 40 kmph
early 5 mins

when distance is same

$$\text{Speed} \propto \frac{1}{\text{time}}$$

$$\text{Speed ratio} = 30 : 40 = 3 : 4$$

$$\therefore \text{Time ratio} = 4 : 3$$

$$\text{Time difference} = 10 + 5 = 15 \text{ mins}$$

$$1 \longrightarrow 15$$

$$4 \longrightarrow 15 \times 4 = 60 \text{ mins}$$

$$\text{Distance} = \frac{60}{60} \times 30$$

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

Q.6) Walking $\frac{6}{7}$ th of usual speed, a man is 12 min late. The usual time taken by him to cover that distance is:

Let usual speed be s

$$\text{New speed} = \frac{6}{7} s$$

Distance is same.

$$\text{Speed Ratio} = s : \frac{6}{7} s$$

$$= 7 : 6$$

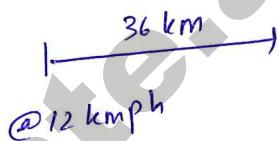
$$\therefore \text{Time Ratio} = \underbrace{6 : 7}_{1}$$

$$1 \rightarrow 12$$

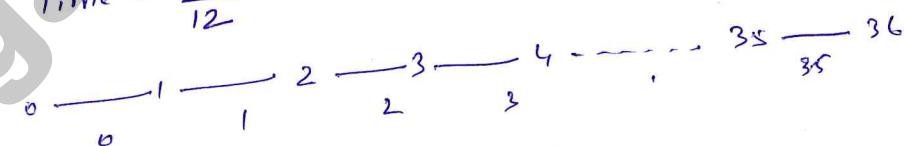
$$6 \rightarrow 12 \times 6 \\ = 72 \text{ mins (Ans)} \\ = 1 \text{ hr } 12 \text{ mins.}$$

$$7 \rightarrow 12 \times 7 \\ = 84 \text{ mins}$$

Q.7) A man is walking at a speed of 12 kmph. After every km he takes rest for 12 mins. How much time will he take to cover a distance of 36 km?



$$\text{Time} = \frac{36}{12} = 3 \text{ hrs.}$$



Took the rest 35 times to cover 36 kms.

$$\text{Total time rest} = \frac{35 \times 12}{60} = 7 \text{ hrs.}$$

$$\text{Total time taken} = 3 + 7 = 10 \text{ hrs.}$$

Q8) Without stoppage, a train travels at an average speed of 75 kmph and with stoppages it covers the same distance at an average speed of 60 kmph. How many minutes per hour does the train stop?

$$\begin{array}{l} \text{75 kmph} \\ 1 \text{ hrs} \rightarrow 75 \text{ km} \\ \text{after stoppage} \quad \left[\begin{array}{l} 15 \text{ km due to stoppage} \\ \downarrow \text{difference} \end{array} \right] \\ 1 \text{ hr} \rightarrow 60 \text{ km} \end{array}$$

$$\begin{array}{l} 60 \text{ min} \longrightarrow 75 \text{ km} \\ 1 \text{ min} \longrightarrow \frac{75}{60} \text{ km i.e. } \frac{5}{4} \text{ km.} \end{array}$$

$$1 \text{ min} \longrightarrow \frac{5}{4} \text{ km}$$

$$? \longrightarrow 15 \text{ kms}$$

$$\frac{15}{\frac{5}{4}} = 12 \text{ mins.}$$

(OR)

$$\text{Time (in mins)} = \frac{\text{Difference in Speed}}{\text{Speed without stoppage}} \times 60$$

$$= \frac{75 - 60}{75} \times 60$$

$$= \frac{15}{75} \times 60$$

$$= 12 \text{ mins.}$$

Q.97 One aeroplane started 1 hour later than the scheduled time from a place 300km away from its destination. To reach the destination at the scheduled time the pilot had to increase the speed by 500 km/hr. What was the speed of the aeroplane per hour during the journey?

→ when speed was increased

$$T_1 = \text{let the scheduled time be } 't'$$

$$T_2 > \frac{\text{Delayed time}}{\text{(actual time)}} = 't+1'$$

$$\text{Difference in time} = t+1-t = 1 \text{ hr}$$

$$T_2 - T_1 = 1 \text{ hr}$$

$$\frac{3000}{s} - \frac{3000}{s+500} = 1$$

while checking with option, we get $s = 1000 \text{ km/hr}$. (option b).

(OR)

$$\text{let Original time} = 't' \text{ hours}$$

$$\text{let original speed} = s \text{ km/hr}$$

$$\text{Reached time} = 't-1' \text{ hour}$$

$$\text{Reached speed} = (s+500) \text{ km/hr}$$

$$s \times t = 3000 \Rightarrow s = \frac{3000}{t}$$

$$(s+500)(t-1) = 3000$$

$$(s+500) \left(\frac{3000}{s} - 1 \right) = 3000$$

$$s = 1000 \text{ km/hr.}$$

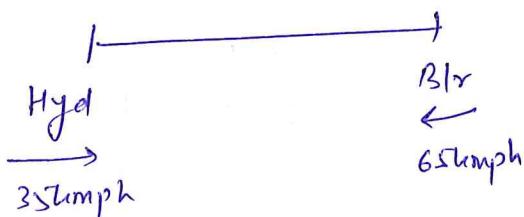
(a) 1500 km/hr

(b) 1000 km/hr

(c) 800 km/hr

(d) 1200 km/hr

Q.10 A man goes from Hyderabad to Bangalore at a uniform speed of 35 kmph and comes back to Hyderabad at a uniform speed of 65 kmph. His average speed for the whole journey is :



Avg speed
Distance travelled is same.

$$\begin{aligned} \text{Avg speed} &= \frac{2s_1 s_2}{s_1 + s_2} \\ &= \frac{2 \times 35 \times 65}{35 + 65} \\ &= 45.5 \text{ kmph.} \end{aligned}$$

Q.11 A man completes 30 km of a journey at the speed of 6 kmph and the remaining 40 km of the journey in 5 hours. His average speed for the whole journey is :

Distance travelled is not same.

$$\begin{aligned} \text{Avg Speed} &= \frac{\text{Total Distance}}{\text{Total Time}} \\ &= \frac{30 + 40}{\frac{30}{6} + 5} \\ &= \frac{30 + 40}{10} \\ &= 7 \text{ kmph.} \end{aligned}$$

Q.12) One-third of a certain journey is covered at the rate of 25 kmph, one-fourth at the rate of 30 kmph and the rest at 50 kmph. The average speed for the whole journey is:

$$\frac{1}{3} + \frac{3}{4} = \frac{7}{12}$$

$$1 - \frac{7}{12} = \frac{5}{12}$$

$\frac{1}{3}$ @ 25 kmph, $\frac{1}{4}$ @ 30 kmph and $\frac{5}{12}$ @ 50 kmph.

Let distance be LCM(3, 4, 12) = 12 km.

$$\text{Total Time} = T_1 = \frac{1}{3} \times 12 = 4 \text{ km}$$

$$= \frac{4}{25}$$

$$T_2 = \frac{\frac{1}{4} \times 12}{30} = \frac{3}{30}$$

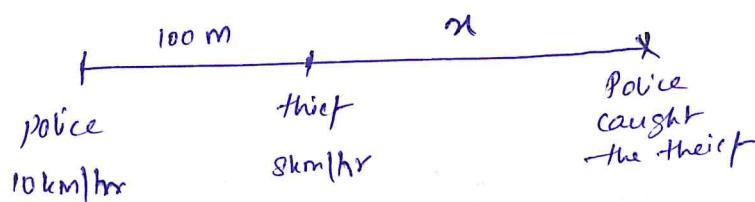
$$T_3 = \frac{5}{50}$$

$$\text{Total Time} = \frac{4}{25} + \frac{3}{30} + \frac{5}{50} = \frac{54}{150} = \frac{9}{25}$$

$$\text{Avg Speed} = \frac{12}{\frac{9}{25}} = \frac{12 \times 25}{9} = 33\frac{1}{3} \text{ kmph.}$$

Problems on Relative Speed

Q.13) A thief running at 8kmph is chased by a policeman whose speed is 10kmph. If the thief is 100m ahead of the police, then the time required for the policeman to catch the thief will be:



$$\text{Police distance travelled} = x + 100 \quad] \text{Time are same for both,}$$

$$\text{Thief distance travelled} = x$$

Police travelled time = Thief travelled time.

$$\frac{x+100}{10 \times \frac{5}{18}} = \frac{x}{8 \times \frac{5}{18}}$$

$$\Rightarrow 8x + 800 = 10x$$

$$\Rightarrow x = 400 \text{ M}$$

$$\text{Police travelled time} = \frac{x+100}{10 \times \frac{5}{18}}$$

$$= \frac{400+100}{50} \times 18$$

$$= 180 \text{ secs.}$$

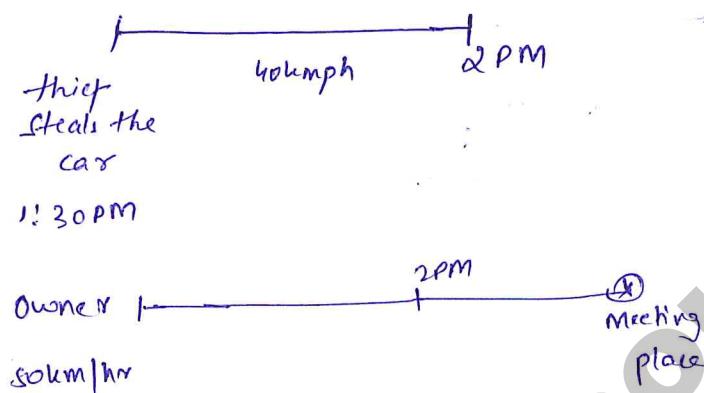
(OR)

$$\text{Time they meet} = \frac{\text{Distance b/w them}}{R_s}$$

$$= \frac{100}{(10-8) \times \frac{5}{18}} = \frac{100}{2 \times \frac{5}{18}} = \frac{50}{5} \times 18 = 180 \text{ secs.}$$

Q.14) A thief steals a car at 1:30pm and drives it at 40km/hr. The thief is discovered at 2PM and the owner sets off in another car at 50kmph. He will overtake the thief at

- (a) 2:30 pm (b) 3:30 pm (c) 4:00 pm (d) 3:00 pm



Let the owner caught the thief at 't' hours.

Owner distance travelled by = $t \times 50$

Thief travelled time = $t + \frac{1}{2}$ hr

Thief travelled distance = $(t + \frac{1}{2}) \times 40$

Distance travelled by owner & thief are same

$$t \times 50 = (t + \frac{1}{2}) \times 40$$

$$5t = 4t + 2$$

$$t = 2 \text{ hrs.}$$

$$2:00 \text{ PM} + 2 \text{ hrs} = 4:00 \text{ PM. (Ans)}$$

(OR)

Time they meet = Distance b/w them at same time
Rs

$$= \frac{20}{50 - 40}$$

$$= 2 \text{ hrs}$$

$$2:00 \text{ PM} + 2 \text{ hrs} = 4:00 \text{ PM.}$$

Theft
1 hr \rightarrow 40km
2 hrs \rightarrow 20km

At 2 PM
20km
Owner thief

(x)

11.4: Trains concept & Problems

Concept & problems on trains

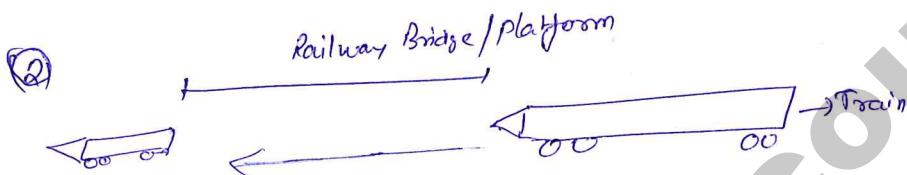
$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Distance = Train length

Speed = Train speed

When a man standing on a road, or a train passes a tree, or a train passes the standing man or standing pole.

(1) $\text{Time} = \frac{\text{Train length}}{\text{Train Speed}}$



The train passes the railway bridge / platform

$$\text{Time} = \frac{\text{Train length} + \text{Platform length}}{\text{Speed of train}}$$

(2) faster train passes the slower train.

(a) Same direction

$$\text{Time} = \frac{\text{faster train length} + \text{slower train length}}{\text{Relative Speed}}$$

(b) Opposite direction

(3) Train passes a man moving

(a) Same direction

$$\text{Time} = \frac{\text{Train length}}{\text{Relative Speed}}$$

(b) opposite direction

↳ Train speed (F) man speed

Q.15) How many seconds will a train 100m long running at the rate of 36 km an hour take to pass a certain telegraph post?

Time = ?

$$\text{Speed of train} = 36 \text{ km/hr}$$

$$= \frac{36 \times 5}{18}$$

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

$$\text{Time}(t) = \frac{\text{Train length}}{\text{Train speed}}$$

$$= \frac{100}{10} = 10 \text{ secs.}$$

Q.16) Find the length of the bridge, which a train 130m long, travelling at 45 kmph can cross in 30 secs.

$$\text{Time} = \frac{\text{length of train} + \text{length of bridge}}{\text{Train speed}}$$

$$\Rightarrow 30 = \frac{130 + B_L}{\frac{45 \times 5}{18}}$$

$$\Rightarrow 130 + B_L = 30 \times 45 \times \frac{5}{18}$$

$$\Rightarrow B_L = (375 - 130) \text{ m}$$

$$= 245 \text{ m.}$$

Q.17) A train 110m long travels at 60kmph. In what time will it pass a man who is walking against the train at 6kmph?



$$\text{Time} = \frac{\text{Train length}}{\text{Speed of train} + \text{Speed of Man}}$$

$$= \frac{110}{(60+6) \times \frac{5}{18}}$$

$$= 6 \text{ secs.}$$

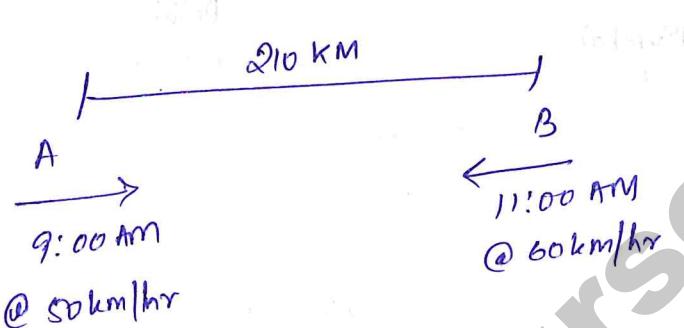
Q.18) A train 300m long is running at a speed of 18kmph. How many seconds will it take to cross a 200m long train running in the opposite direction at a speed of 12kmph?

$$\text{Time} = \frac{\text{Faster train length} + \text{Slower train length}}{\text{Relative Speed}}$$

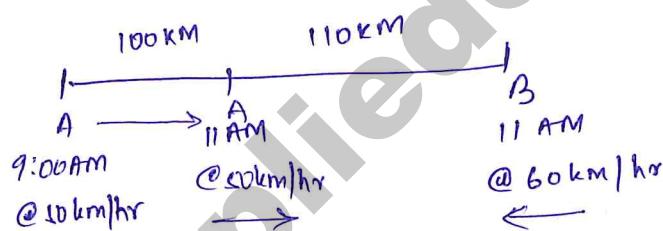
$$= \frac{300 + 200}{(18+12) \times \frac{5}{18}}$$

$$= 60 \text{ secs.}$$

Q.19) A train starts from station A at 9 AM and travels at 50 km/hr towards station B, 210 km away. Another train starts from station B at 11 AM and travels at 60 kmph towards station A. At what time will they meet and at what distance from A?

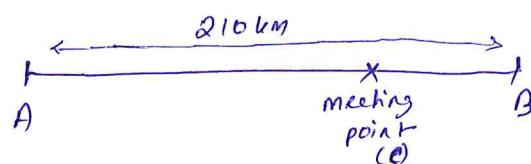


$$\text{Time they meet} = \frac{\text{Distance b/w same time}}{\text{Relative speed.}}$$



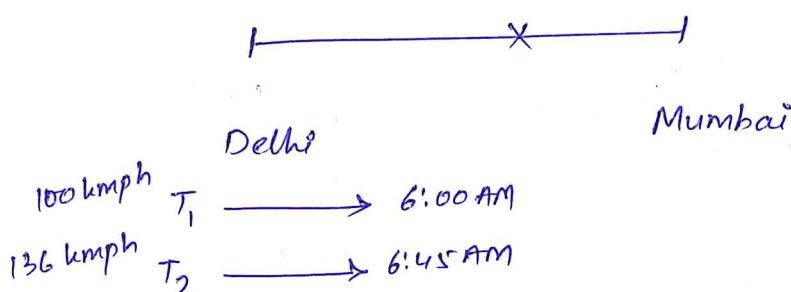
$$\begin{aligned}\text{Time they meet} &= \frac{110}{50+60} \\ &= 1 \text{ hour}\end{aligned}$$

∴ They meet at 11 + 1 = 12 noon.



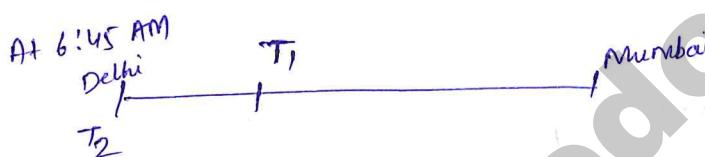
$$\begin{aligned}\text{Distance of AC} &= \text{time} \times \text{speed} \\ &= 3 \times 50 \\ &= 150 \text{ kms.}\end{aligned}$$

Q.20) Two trains for Mumbai leave Delhi at 6:00 AM and 6:45 AM and travel at 100 kmph and 136 kmph respectively. How many kilometers from Delhi will the two trains be together?



$$\text{Time they meet} = \frac{\text{Distance b/w at same time}}{\text{Relative Speed}}$$

$$(t)$$



$$T_1 =$$

$$1 \text{ hr} \rightarrow 100 \text{ km}$$

$$= 60 \text{ mins}$$

$$45 \text{ mins} \rightarrow \frac{100}{60} \times 45$$

$$= 75 \text{ kms.}$$

$$t = \frac{75}{136 - 100} = \frac{75}{36}$$

$$= \frac{25}{12} \text{ hrs.}$$

$$\text{Distance from delhi} = 136 \times \frac{25}{12}$$

$$= 283.33 \text{ kms.}$$

11.5 : Boats and Streams Concept and Problems.

Concept & Problems on Boats & Streams

When you go with the river flow then downstream.

When you go against the river flow then upstream.

$$\text{Speed of boat} = x \text{ km/hr}$$

$$\text{Speed of stream/river/current} = y \text{ km/hr}$$

$$\text{Speed of boat downstream/ along with river} = (x+y) \text{ km/hr}$$

$$\text{Speed of boat upstream/ against with river} = (x-y) \text{ km/hr}$$

$$\text{Downstream speed} = d \text{ km/hr}$$

$$\text{Upstream speed} = u \text{ km/hr}$$

$$\text{Speed of boat} = \frac{1}{2}(d+u) = x \text{ km/hr}$$

$$\text{Speed of current} = \frac{1}{2}(d-u) = y \text{ km/hr.}$$

Ex

$$\text{Downstream speed} = 8 \text{ km/hr} \quad x+y$$

$$\text{Upstream speed} = 6 \text{ km/hr} \quad x-y$$

$$x+y = 8$$

$$x-y = 6$$

$$\frac{2x = 8+6}{2x = 14}$$

$$\text{Speed of boat} \quad x = \frac{1}{2}(8+6)$$

$$2y = 8-6$$

$$y = \frac{1}{2}(8-6)$$

= Speed of stream.

Q.21) Speed of a man is 8 km/hr in still water. If the rate of current is 3 km/hr, find the speed of man upstream!

$$x = 8 \text{ km/hr}$$

$$y = 3 \text{ km/hr}$$

$$\text{Upstream} = (x-y) \text{ km/hr}$$

$$= 5 \text{ km/hr.}$$

Q.22) Speed of a boat in still water is 10 km/hr. If its speed downstream be 13 km/hr then speed of the stream is:

$$x = 10 \text{ km/hr}$$

$$x+y = 13 \text{ km/hr}$$

$$y = 13 - 10 \\ = 3 \text{ km/hr.}$$

Q.23) A man can row downstream at the rate of 14 km/hr and upstream at 5 km/hr. Find man's rate in still water!

$$\text{Downstream speed} = 14 \text{ km/hr} \quad (x+y)$$

$$\text{Upstream speed} = 5 \text{ km/hr} \quad (x-y)$$

$$\text{Man's speed} = x \text{ km/hr}$$

$$= \frac{1}{2} [14+5]$$

$$= \frac{19}{2} = 9.5 \text{ km/hr}$$

Q.24) A person rows a kilometer down the stream in 10 min and upstream in 30 min. Find the velocity of the stream.

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

$$\text{Upstream speed} = \frac{1 \text{ km}}{\frac{30}{60} \text{ hr}} = 2 \text{ km/hr}$$

$$\text{Velocity of stream} = \frac{1}{2} [6-2] = 2 \text{ km/hr.}$$

Q.25) A man takes twice as long to row up as to row down the river. If the rate of river is 4 km/hr. Find the rate of the man in still water.

$$\text{Man's speed} = x \text{ km/hr}$$

$$\text{River speed} = y \text{ km/hr} = 4 \text{ km/hr.}$$

$$\text{Upstream speed} = (x-y) \text{ km/hr}$$

$$\text{Downstream speed} = (x+y) \text{ km/hr}$$

$$\text{Upstream travelled time} = 2 \times (\text{downstream travelled time})$$

$$\frac{D}{(x-y)} = 2 \times \frac{D}{(x+y)}$$

$$\Rightarrow x+y = 2x - 8$$

$$\Rightarrow x = 12 \text{ km/hr.}$$

Q.26) Speed of a boat is 5 kmph in still water and the speed of the stream is 3 kmph. If the boat takes 3 hours to go to a place and come back, the distance of the place is:

$$x = 5 \text{ km/hr}$$

$$y = 3 \text{ km/hr}$$

$$\text{Total time to and fro} = 3 \text{ hrs.}$$

$$\text{Downstream speed} = 8 \text{ km/hr}$$

$$\text{Upstream speed} = 2 \text{ km/hr.}$$

$$\frac{D}{8} + \frac{D}{2} = 3$$

$$\Rightarrow \frac{5D}{8} = 3$$

$$\Rightarrow D = \frac{24}{5}$$
$$= 4.8 \text{ kms.}$$

Q.27) A man rows to a place 48km distant and come back in 14 hours. He finds that he can row 4km with the stream in the same time as 3km against the stream. The rate of the stream is

$$\text{Downstream time} + \text{Upstream time} = 14 \text{ hrs.}$$

$$\text{Travel } 4\text{ km downstream in } x \text{ hours} = 3 \text{ km upstream in } x \text{ hours}$$

$$\text{Downstream speed} = \frac{4}{x} \text{ km/hr}$$

$$\text{Upstream speed} = \frac{3}{x} \text{ km/hr}$$

$$\frac{48}{(4/x)} + \frac{48}{(3/x)} = 14$$

$$\Rightarrow 12x + 16x = 14$$

$$\Rightarrow 28x = 14$$

$$\rightarrow x = \frac{1}{2} \text{ hr}$$

$$\text{Downstream speed} = \frac{4}{\frac{1}{2}} \\ = 8 \text{ km/hr}$$

$$\text{Upstream speed} = \frac{3}{\frac{1}{2}} \\ = 6 \text{ km/hr.}$$

$$\text{Speed of Stream} = \frac{1}{2}(8-6) \\ = 1 \text{ km/hr.}$$

11.6: Gate Previous Year Questions

Q.1) A tourist covers half of his journey by train at 60km/hr, half of the remainder by bus at 30km/hr and the rest by cycle at 10km/hr. The average speed of the tourist in kmph during his entire journey? (GATE 2013)

(A) 36

(B) 30

(C) 24

(D) 18

SolutionLet distance be x kms

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

$$\text{Time taken by train} = \frac{\frac{x}{2}}{60} = \frac{x}{120} \text{ hrs}$$

$$\begin{aligned}\text{Time taken by bus} &= \frac{\frac{x}{2} \times \frac{x}{2} \times \frac{x}{2}}{30} \\ &= \frac{x^3}{120} \text{ hrs}\end{aligned}$$

$$\text{Time taken by cycle} = \frac{\{1 - (\frac{x}{2} + \frac{x}{2})\} \times \frac{x}{2}}{10}$$

$$\text{Total Time} = \frac{x}{120} + \frac{x}{120} + \frac{x}{40} = \frac{5x}{120} \text{ hrs}$$

$$\begin{aligned}\text{Avg Speed} &= \frac{x}{\frac{5x}{120}} \\ &= \frac{120}{5} = 24 \text{ km/hr. } \underline{\text{(Ans)}}$$

- Q.2) A car travels 8 km in the first quarter of an hour, 6 km in the second quarter and 16 km in the third quarter. The average speed of the car in kmph over the entire journey is :
 (GATE 2013)
- (a) 30 (b) 36 (c) 40 (d) 24

Solution

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

$$\text{Total Distance} = 8 + 6 + 16 = 30 \text{ km}.$$

$$\text{Total time} = \frac{1}{4} \times 60 = 15 \text{ mins } (1^{\text{st}})$$

$$15 \text{ mins } (2^{\text{nd}})$$

$$15 \text{ mins } (3^{\text{rd}})$$

$$\hline$$

$$45 \text{ mins}$$

$$= \frac{45}{60} \text{ hours.}$$

$$\text{Avg Speed} = \frac{30}{\frac{45}{60}}$$

$$= 40 \text{ km/hr. } (\text{Ans})$$

- Q.3) A train that is 280 m long, travelling at a uniform speed, crosses a platform in 60 sec, and passes a man standing on the platform in 20 sec. What is the length of the platform in metres? (GATE 2014)

Solution Time = $\frac{\text{length of train} + \text{length of platform}}{\text{speed of train.}}$ [Passes Bridge] \Rightarrow ② $60 = \frac{280 + P_L}{14}$

$$\Rightarrow P_L = 560 \text{ m.}$$

Time = $\frac{\text{length of train}}{\text{speed of train}}$ [Passes the standing man]

① $\Rightarrow 20 = \frac{280}{S_T} \Rightarrow S_T = 14 \text{ m/sec}$

Q.4) A man can row at 8 km/hr in still water, if it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in kmph? (GATE 2014)

$$\text{Man speed} = x \text{ km/hr} = 8 \text{ km/hr}$$

$$\text{Upstream time} = 3 (\text{Downstream time})$$

$$\frac{D}{\text{Upstream speed}} = 3 \left(\frac{D}{\text{Downstream speed}} \right)$$

$$\Rightarrow \frac{D}{8-y} = 3 \left(\frac{D}{8+y} \right)$$

$$\Rightarrow 8+y = 3(8-y)$$

$$\Rightarrow y = 4 \text{ km/hr. (Speed of Stream)}$$

Q.5) It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to completely pass a telegraph pole. The length of first train is 120m and that of the second train is 150m. The magnitude of the difference in the speeds of the two trains (in m/s) is: (GATE 2016)

(a) 2

(b) 10

(c) 12

(d) 22

Solution

$$\text{Time} > \frac{\text{length of train}}{\text{Speed of train}}$$

$$\Rightarrow 10 = \frac{120}{S_T}$$

$$\Rightarrow S_T = 12 \text{ m/s}$$

$$15 = \frac{150}{S_T}$$

$$\Rightarrow S_T = 10 \text{ m/s.}$$

$$\begin{aligned} \text{Difference} &= 12 - 10 \\ &= 2 \text{ m/s. (Ans)} \end{aligned}$$

Q.6) Budhan covers a distance of 19 km in 2 hr by cycling one fourth of time and walking the rest. The next day he cycles (at the same speed as before) for half the time and walks the rest (at the same speed as before) and covers 26 km in 2 hours. The speed in km/hr at which Budhan walks is :

(GATE 2017)

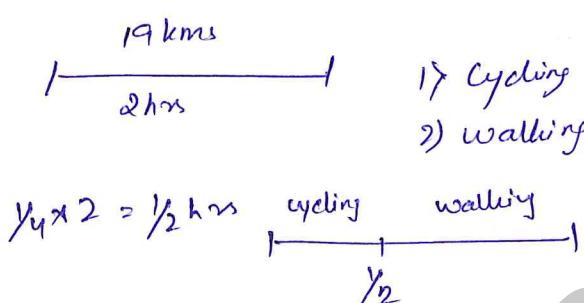
(a) 1

(b) 4

(c) 5

(d) 6

Solution



$$\text{Speed of cycling} = x$$

$$\text{Speed of walking} = y$$

$$D = S \times T$$

$$\frac{1}{2}x + \frac{3}{2}y = 19 \text{ kms} \quad \dots \text{(i)}$$

$$x + \frac{y}{2} = 26 \text{ kms} \quad \dots \text{(ii)} \quad x = -\frac{1}{2}$$

$$-\frac{1}{2}x - \frac{1}{2}y = -13 \text{ kms} \quad \dots \text{(iii)}$$

On solving (i) & (iii)

$$\frac{3}{2}y - \frac{1}{2}y = 19 - 13$$

$$y = 6 \text{ km/hr} \quad (\text{ans})$$

Q.7) From the time the front of a train enters a platform, it takes 25 seconds for the back of the train to leave the platform, while travelling at a constant speed of 54 kmph. At the same speed, it takes 14 seconds to pass a man running at 9 km/hr in the same direction as the train. What is the length of the train and that of the platform in meters, respectively?

- (a) 210 and 140 (b) 162.5 and 187.5
(c) 245 and 130 (d) 135 and 200

(GATE 2018)

Solution

$$\frac{\text{Time}}{\text{Crosses Platform}} = \frac{T_L + P_L}{S_T}$$

$$25 = \frac{T_L + P_L}{54 \times \frac{5}{18}}$$

$$T_L + P_L = 25 \times 15$$

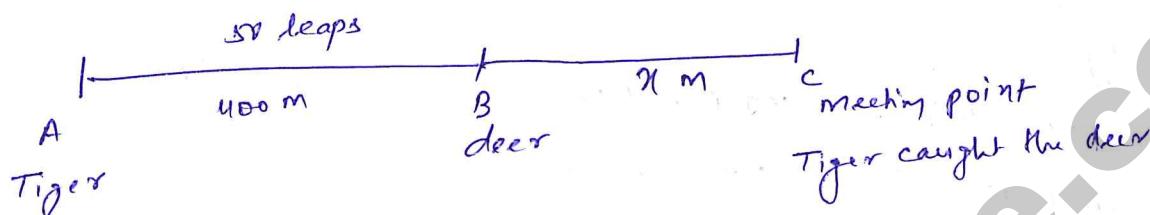
Crosses a man running

$$\text{Time} = \frac{\text{Train Length}}{S_T - S_m}$$

$$14 = \frac{T_L}{(54 - 9) \times \frac{5}{18}}$$

$$T_L = 14 \times 45 \times \frac{5}{18}$$
$$= 135 \text{ m} \quad \underline{\text{Ans (d)}}$$

Q.8} A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 m and 5 m per leap respectively, what distance in meters(m) will the tiger have to run before it catches the deer? (GATE 2015)



Tiger

$$1 \text{ leap} = 8 \text{ meters}$$

$$50 \text{ leap} = 8 \times 50 \\ = 400 \text{ meters}$$

$$\text{Tiger Distance} = AC = (400+x) \text{ m}$$

$$\text{Deer Distance} = BC = x \text{ m}$$

Tiger time to cover distance AC = Deer time to cover distance BC

$$\text{Tiger speed} = 5 \text{ leaps/min} \\ = 40 \text{ m/min}$$

$$\text{Deer speed} = 4 \text{ leaps/min} \\ = 20 \text{ m/min}$$

$$\frac{400+x}{40} = \frac{x}{20}$$

$$x = 400$$

$$\text{Tiger distance} = 400+400 \\ = 800 \text{ m } \underline{\text{(Ans)}}$$