11.1 : Speed, time & distance Introduction

Distance = Speed × Time

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

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

If Speed ↑ time ↓

Unit of distance : metres, km, miles

1 KM = 1000 metres

1 mile = 1.61 km (approx)

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

Unit of time = hrs, min, sec

1 hr = 60 min

1 min = 60 sec

1 hr = 3600 secs.

Conversion of kmph to mps

$$\text{kmph} = \frac{\text{km}}{\text{hour}} = \frac{1000\text{m}}{(60\times60)\text{sec}} = \frac{5}{18}\text{ m/s}$$

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

$\Rightarrow$ 18 kmph = 5 m/s

36 kmph = 10 m/s

54 kmph = 15 m/s

63 kmph = 15 m/s + 2.5 m/s

54 + 9

= 17.5 m/s

72 kmph = 20 m/s

45 kmph = 10 m/s + 2.5 m/s

36 + 9

= 12.5 m/s

Basic Concepts

Distance is always directly proportional to speed and time.

If your travel time ↑ Distance ↑

If your travel time ↓ Distance ↓

Speed ↑ Distance ↑

Speed ↓ Distance ↓

1) When speed is constant

travelling with same speed.

Ex

200kms
40km/hr
5hrs

280kms
40km/hr
7hrs.

Time Ratio = 5 : 7

Distance Ratio = 200 : 280
= 5 : 7

∴ Distance ∝ Time

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

2) When time is constant

travelled time is same or starting time is same.

Ex

200kms
4hrs

280 kms → Distance to be travelled

4hrs → Time taken

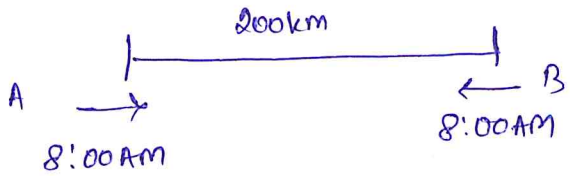
Speed → $\frac{200}{4} = 50$ km/hr

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

∴ Distance ∝ Speed

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

Ex



Speed Ratio = 7 : 3

Find distance travelled by A when he met B.

$$\frac{D_1}{D_2} = \frac{S_1}{S_2}$$

$\therefore$ 200 (7 : 3)

Distance travelled by A = $200 \times \frac{7}{10}$

= 140kms (ans)

Distance travelled by B = $200 \times \frac{3}{10}$

= 60kms.

3) When distance is constant

↳ travelled distance is same.

Ex

200kms	200kms → Distance
40km/hr	100km/hr → Speed
Time → $\frac{200}{40}$ = 5hrs	$\frac{200}{100}$ = 2hrs.

Speed ↑ Time ↓

Time ↓ speed ↑

$\therefore$ speed $\propto \frac{1}{\text{time}}$

$$\frac{S_1}{S_2} = \frac{t_2}{t_1}$$

Average Speed

Average Speed

When distance is equal

When distance is not equal

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

case 1 ⇒ If 2 speeds are given s_1 and s_2

$$\text{Avg Speed} = \frac{2 s_1 s_2}{s_1 + s_2}$$

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

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

Relative Speed

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

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

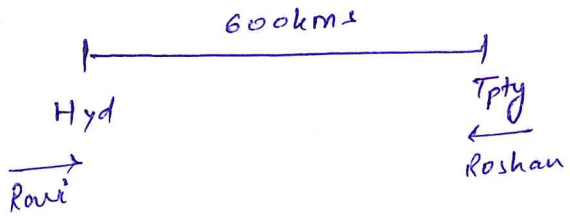
Relative Speed (R_s) = $s_1 - s_2$ $(\because s_1 > s_2)$

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

$R_s = s_1 + s_2$

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

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



Time they meet = $\frac{\text{Distance b/w them}}{R_s}$ → (the time at which they start should be same)

$R_s = S_1 + S_2$

Time $= \frac{600}{25+35}$

$= 10$ hrs.

Q.1) A bus is travelling at the rate of 45kmph. How many seconds, it will take to cover a distance of $\frac{4}{5}$ km?

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

$$\text{Distance} = \frac{4}{5} \text{ kms}$$

$$= \frac{4}{5} \times 1000$$

$$= 800 \text{ metres}$$

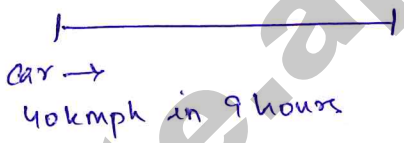
$$\text{Speed} = 45 \text{kmph}$$

$$= 45 \times \frac{5}{18} = 12.5 \text{ m/s}$$

$$\text{Time} = \frac{800}{12.5}$$

$$= 64 \text{ seconds.}$$

Q.2) 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?



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

$$= 40 \times 9 = 360 \text{ kms.}$$

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

(OR)

When distance is same,

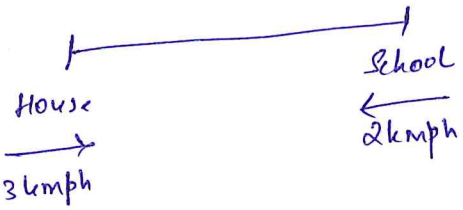
$S \propto \frac{1}{T}$, Speed ratio = 40 : 60 = 2 : 3

$\therefore$ time ratio = 3 : 2 → 6 hrs. (ans)

↓ ↓

9 $9/3 \times 2 = 6$

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



Time taken house to school and schoolto 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.

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

$\Rightarrow 2x + 3x = 60$

$\Rightarrow x = 12$ kms.

(OR)

When distance is same

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

Speed ratio = 3 : 2

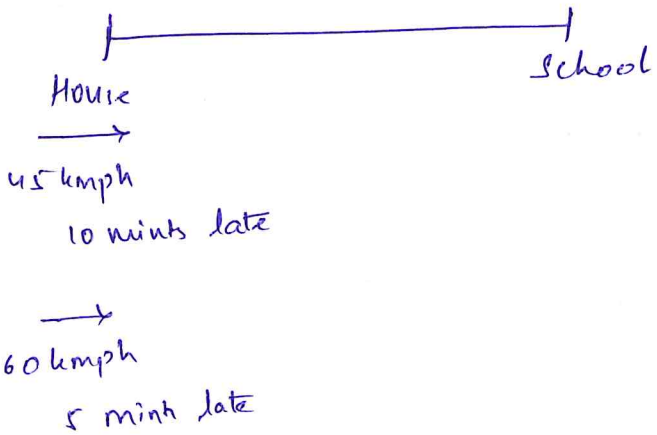
$\Rightarrow$ Time Ratio = 2 : 3

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

$= 4$ hrs.

Distance = $4 \times 3 = 12$ 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 he is late by 5 minutes. find the distance of his school from his house.



Let distance be x kms

Let correct time be 't'

$T_1 = t + 10$] difference $T_1 - T_2 = 5$ mins

$T_2 = t + 5$

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

$T_1 - T_2 = 5$ mins

$= \frac{5}{60}$ hrs.

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

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

$x = 15$ kms.

(OR)

When distance is same

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

Speed Ratio = 45 : 60
= 3 : 4

∴ Time Ratio = 4 : 3
(1)

Time Difference = 10 − 5 = 5

$1 \longrightarrow 5$

$4 \longrightarrow \frac{5}{1} \times 4$
= 20 mins

$3 \longrightarrow \frac{5}{1} \times 3$ = 15 mins

$$\text{Distance} = \frac{20}{60} \times 45$$
= 15 kms

Distance = Speed × Time

(OR)

$$\text{Distance} = \frac{15}{60} \times 45$$
= 15 kms.

Trick

Time difference

late late '−'
late early '+'
early early '−'

Q.57 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

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

Speed ratio = 30 : 40 = 3 : 4

∴ time ratio = 4 : 3

Time difference = 10 + 5 = 15 mins

1 ⟶ 15

4 ⟶ 15 × 4 = 60 mins

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

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

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

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

Distance is same.

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

$= 7 : 6$

$\therefore$ Time Ratio = $6 : 7$

$1 \longrightarrow 12$

$6 \longrightarrow 12 \times 6$

$= 72$ mins (ans)

$= 1$ hr 12 mins.

$7 \longrightarrow 12 \times 7$

$= 84$ mins

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

36 km

@12 kmph

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

0 —1— 2 —3— 4 ..... 35 —36

0 1 2 3 35

Taken the rest 35 times to cover 36 kms.

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

Total time taken = $3 + 7 = 10$ 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?

75 kmph

1 hr → 75 km

after stoppages

1 hr → 60 km

] 15 km due to stoppage ↓ difference

60 min ——— 75 km

1 min ——— $\frac{75}{60}$ km i.e $\frac{5}{4}$ km.

1 min ——— $\frac{5}{4}$ km

? ——— 15 km

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

(OR)

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 mins.

Q.97 One aeroplane started 1 hour later than the scheduled time from a place 3000km 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?

(a) 1500 km/hr (b) 1000 km/hr
(c) 800 km/hr (d) 1200 km/hr

T_1 = Let the scheduled time be 't' → when speed was increased

T_2 = Delayed time (actual time) = $t+1$

Difference in time = $t+1-t = 1$ hr

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

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

While checking with options, we get $s = 1000$ km/hr. (option b).

(OR)

Let Original time = 't' hours

Let original speed = s km/hr

Reached time = $t-1$ hour

Reached speed = $(s+500)$ km/hr

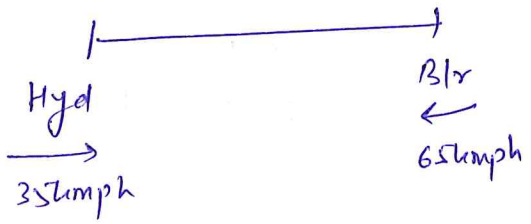
$$s \times T = 3000 \Rightarrow s = \frac{3000}{t}$$

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

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

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

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.

$$\text{Avg speed} = \frac{2S_1S_2}{S_1+S_2}$$

$$= \frac{2 \times 35 \times 65}{35+65}$$

$$= 45.5 \text{ kmph.}$$

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

Distance travelled is not same.

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

$$= \frac{30+40}{\frac{30}{6}+5}$$

$$= \frac{30+40}{10}$$

$$= 7 \text{ kmph.}$$

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 kms.

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

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

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

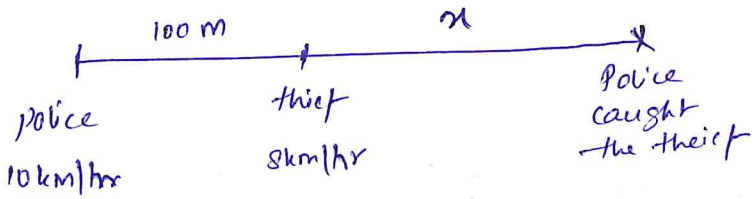
$$T_3 = \frac{5}{50}$$

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

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

Problems on Relative Speed

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



Police distance travelled : $x+100$
Thief distance travelled : x
] Time are same for both.

Police travelled time = Thief travelled time.

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

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

$$\Rightarrow x = 400\,m$$

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

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

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

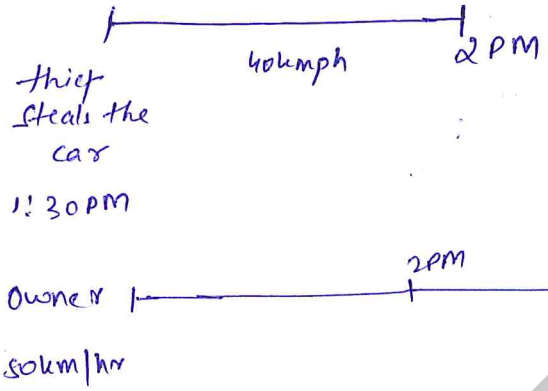
(OR)

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

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

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

Distance travelled by owner & thief are same

$$t \times 50 = \left(t + \frac{1}{2}\right) \times 100$$

$$5t = 4t + 2$$

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

2:00 PM + 2hrs = 4:00PM. (Ans)

(OR)

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

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

2hrs

2:00PM + 2 hrs = 4:00PM.

Their

1 hr → 40km

½ hr → 20km

At 2 PM

20km

Owner Their

11.4: Trains concept & Problems

Concept & Problems on trains

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

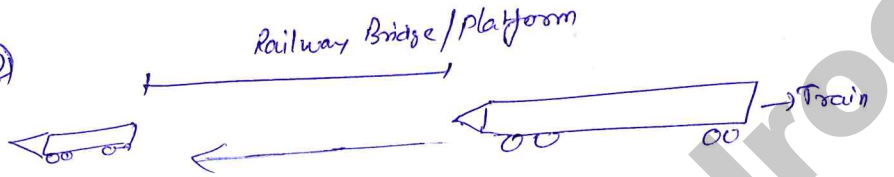
Distance = Train length

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

(2)



The train passes the railway bridge/platform

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

(3) faster train passes the slower train.

(a) Same direction

(b) Opposite direction

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

(4) Train passes a man moving

(a) Same direction

(b) opposite direction

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

↳ Train speed (∓) man speed

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

Time = ?

Speed of train = 36 km/hr

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

$= 10$ m/s

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

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

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

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

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

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

$\Rightarrow B_L = (375 - 130)$ m

$= 245$ m.

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

Train → Man ←

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

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

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

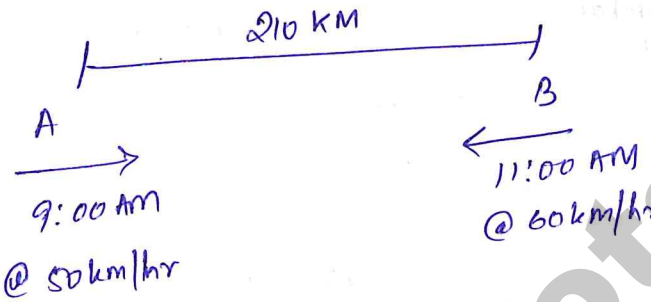
Q.18) A train 300 m long is running at a speed of 18kmph. How many seconds will it take to cross a 200 m long train running in the opposite direction at a speed of 12kmph?

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

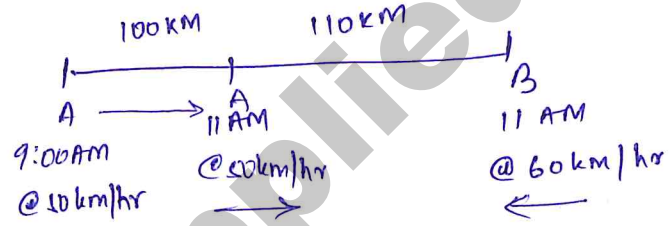
$$= \frac{300+200}{(18+12)\times\frac{5}{18}}$$

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

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?



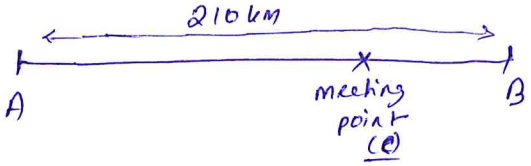
Time they meet = $\frac{\text{Distance b/w same time}}{\text{Relative speed.}}$



Time they meet = $\frac{110}{50+60}$

= 1 hour

∴ They meet at 11 + 1 = 12 noon.



Distance of AC = time × speed

= 3 × 50

= 150 kms.

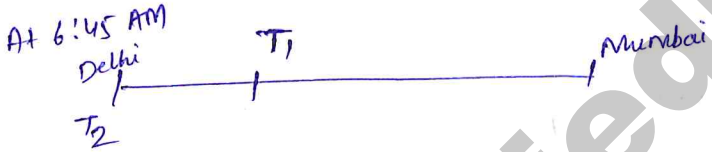
Q.20) Two trains for Mumbai leave Delhi at 6:00 AM and 6:45 AM and travel at 100kmph and 136 kmph respectively. How many kilometers from Delhi will the two trains be together?

Delhi Mumbai

100 kmph T_1 ⟶ 6:00 AM

136 kmph T_2 ⟶ 6:45 AM

Time they meet (t) = $\frac{\text{Distance b/w at Same time}}{\text{Relative Speed}}$



T_1

⇒

1 hr ⟶ 100km

=60 mins

45mins ⟶ $\frac{100}{60} \times 45$

$= 75$ kms.

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

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

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

$= 283.33$ kms.

Concept & Problems on Boats & Streams

When you go with the river flow then downstream.

When you go against the river flow then upstream.

Speed of boat = x km/hr

Speed of stream / river / current = y km/hr

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

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

Downstream speed = d km/hr

Upstream speed = u km/hr

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

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

Ex

Downstream speed = 8 km/hr $x+y$

Upstream speed = 6 km/hr $x-y$

$$x+y = 8$$
$$x-y = 6$$
$$2x = 8+6$$

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

$2y = 8-6$

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

= 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!

$x = 8$ km/hr

$y = 3$ km/hr

Upstream $= (x-y)$ km/hr

$= 5$ 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:

$x = 10$ km/hr

$x+y = 13$ km/hr

$y = 13-10$

$= 3$ 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!

Downstream speed = 14 km/hr $(x+y)$

Upstream speed = 5 km/hr $(x-y)$

Man's speed = x km/hr

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

$= \frac{19}{2} = 9.5$ 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.

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

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

Velocity of stream $= \frac{1}{2}[6-2] = 2$ 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 4km/hr. find the rate of the man in still water.

Man's speed = x km/hr

River speed = y km/hr = 4km/hr.

Upstream speed = $(x-4)$ km/hr

Downstream speed = $(x+4)$ km/hr

Upstream travelled time = 2 (downstream travelled time)

$$\frac{D}{(x-4)} = 2 \times \frac{D}{(x+4)}$$

$$\Rightarrow x+4 = 2x-8$$

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

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

$x = 5$ km/hr

$y = 3$ km/hr

Total time to and fro = 3hrs.

Downstream speed = 8 km/hr

Upstream speed = 2km/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

Downstream time + Upstream time = 14 hrs.

Travel 4km downstream in x hours = 3 km upstream in x hours

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

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

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

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

$$\Rightarrow 28x = 14$$

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

Downstream speed = $\frac{4}{1/2}$

= 8 km/hr

Upstream speed = $\frac{3}{1/2}$

= 6 km/hr.

Speed of Stream = $\frac{1}{2}(8-6)$

= 1 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

Solution

let distance be x kms

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

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

$$\text{Time taken by bus} = \frac{1/2 \times 1/2 \times x}{30}$$

$$= \frac{x}{120} \text{ hrs}$$

$$\text{Time taken by cycle} = \frac{\{1 - (1/2 + 1/4)\} \times x}{10}$$

$$= \frac{x}{40} \text{ hrs.}$$

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

$$\text{Avg speed} = \frac{x}{\frac{5x}{120}}$$

$$= \frac{120}{5} = 24 \text{ km/hrs.} \quad \underline{\text{(ans)}}$$

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

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

Total Distance = 8 + 6 + 16 = 30 kms.

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

15 mins (2nd)

15 mins (3rd)

45 mins

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

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

$= 40$ km/hr. (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

$$\text{Time} = \frac{\text{length of train + length of platform}}{\text{Speed of train.}} \quad [\text{Passes Bridge}] \quad \textcircled{2}$$

$$\Rightarrow 60 = \frac{280 + P_L}{14}$$

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

$$\text{Time} = \frac{\text{length of train}}{\text{Speed of train}} \quad [\text{Passes the standing man}] \quad \textcircled{1}$$

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

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)

Man speed = x km/hr = 8 km/hr

Upstream time = 3 (Downstream time)

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

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

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

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

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 120 m and that of the second train is 150 m. 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

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

$$\Rightarrow 10 = \frac{120}{S_T} \qquad 15 = \frac{150}{S_T}$$

$$\Rightarrow S_T = 12 \text{ m/s} \qquad \Rightarrow S_T = 10 \text{ m/s.}$$

Difference : 12 − 10

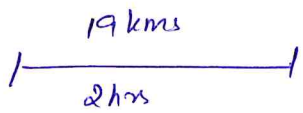
= 2 m/s. Ans

Q.6) Budhan covers a distance of 19kms in 2 hrs 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 26km in 2 hours. The speed in km/hr at which Budhan walks is:

(CAT 2017)

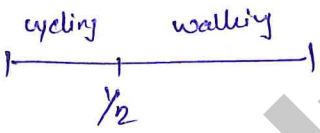
(a) 1 (b) 4 (c) 5 (d) 6

Solution



1) Cycling
2) walking

$\frac{1}{4} \times 2 = \frac{1}{2}$ hrs



Speed of cycling = x

Speed of walking = y

$D = S \times T$

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

$x + y = 26$ kms ..... (ii) $\times -\frac{1}{2}$

$\frac{1}{2} \times 2 = 1$

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

Ch solving (i) & (iii)

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

$y = 6$ km/hr (ans)

Q.7) From the time the front of an 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 take 14 second 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?

(GATE 2018)

(a) 210 and 140 (b) 162.5 and 187.5

(c) 245 and 130 (d) 175 and 200

Solution

Crosses Platform

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

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

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

Crosses a man running

$$\text{Time} = \frac{\text{Train length}}{S_T - S_M}$$

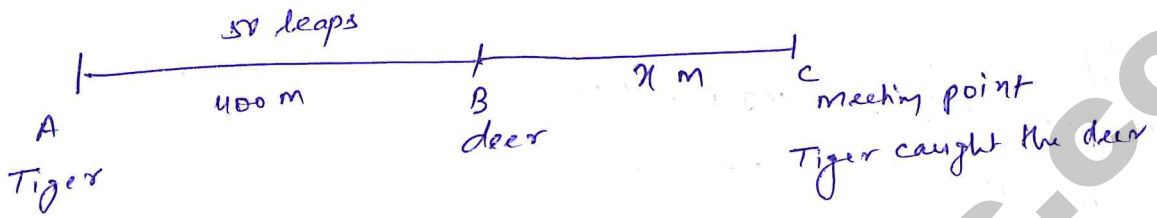
$$14 = \frac{T_L}{(54-9) \times \frac{5}{18}}$$

$$T_L = 14 \times 45 \times \frac{5}{18}$$

$$= 175 \text{ m}$$

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 leap = 8 meters

50 leap = 8 × 50
= 400 meters

Tiger Distance = AC = (400 + x) m

Deer Distance = BC = x m

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

Tiger speed = 5 leaps/min
= 40 m/min

Deer speed = 4 leaps/min
= 20 m/min

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

$$x = 400$$

Tiger distance = 400 + 400
= 800 m (Ans)