

17. TIME AND DISTANCE

IMPORTANT FACTS AND FORMULAE

$$1. \text{Speed} = \left(\frac{\text{Distance}}{\text{Time}} \right), \text{Time} = \left(\frac{\text{Distance}}{\text{Speed}} \right), \text{Distance} = (\text{Speed} * \text{Time})$$

$$2. x \text{ km / hr} = x * \frac{5}{18}$$

$$3. x \text{ m/sec} = (x * 18/5) \text{ km/hr}$$

4. If the ratio of the speeds of A and B is $a:b$, then the ratio of the times taken by them to cover the same distance is $\frac{1}{a} : \frac{1}{b}$

$a \quad b$

or $b:a$.

5. Suppose a man covers a certain distance at $x \text{ km/hr}$ and an equal distance at $y \text{ km/hr}$. Then, the average speed during the whole journey is $\frac{2xy}{x+y} \text{ km/hr}$.

SOLVED EXAMPLES

Ex. 1. How many minutes does Aditya take to cover a distance of 400 m, if he runs at a speed of 20 km/hr?

$$\text{Sol. Aditya's speed} = 20 \text{ km/hr} = \left\{ 20 * \frac{5}{18} \right\} \text{ m/sec} = \frac{50}{9} \text{ m/sec}$$

$$\therefore \text{Time taken to cover 400 m} = \left\{ 400 * \frac{9}{50} \right\} \text{ sec} = 72 \text{ sec} = 1 \frac{12}{60} \text{ min} = 1 \frac{1}{5} \text{ min.}$$

Ex. 2. A cyclist covers a distance of 750 m in 2 min 30 sec. What is the speed in km/hr of the cyclist?

$$\text{Sol. Speed} = \left\{ \frac{750}{150} \right\} \text{ m/sec} = 5 \text{ m/sec} = \left\{ 5 * \frac{18}{5} \right\} \text{ km/hr} = 18 \text{ km/hr}$$

Ex. 3. A dog takes 4 leaps for every 5 leaps of a hare but 3 leaps of a dog are equal to 4 leaps of the hare. Compare their speeds.

Sol. Let the distance covered in 1 leap of the dog be x and that covered in 1 leap of the hare be y .

$$\text{Then, } 3x = 4y \Rightarrow x = \frac{4}{3}y \Rightarrow 4x = \frac{16}{3}y.$$

\therefore Ratio of speeds of dog and hare = Ratio of distances covered by them in the same time

$$= 4x : 5y = \frac{16}{3}y : 5y = \frac{16}{3} : 5 = 16:15$$

Ex. 4. While covering a distance of 24 km, a man noticed that after walking for 1 hour and 40 minutes, the distance covered by him was $\frac{5}{7}$ of the remaining distance. What was his speed in metres per second?

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Sol. Let the speed be x km/hr.

Then, distance covered in 1 hr. 40 min. i.e., $1\frac{2}{3}$ hrs = $\frac{5x}{3}$ km

Remaining distance = $\{24 - \frac{5x}{3}\}$ km.

$$\therefore \frac{5x}{3} = \frac{5}{7} \left\{24 - \frac{5x}{3}\right\} \Leftrightarrow \frac{5x}{3} = \frac{5}{7} \left\{\frac{72-5x}{3}\right\} \Leftrightarrow 7x = 72 - 5x$$

$$\Leftrightarrow 12x = 72 \Leftrightarrow x = 6$$

$$\text{Hence speed} = 6 \text{ km/hr} = \left\{6 \times \frac{5}{18}\right\} \text{ m/sec} = \frac{5}{3} \text{ m/sec} = 1\frac{2}{3}$$

Ex. 5. Peter can cover a certain distance in 1 hr. 24 min. by covering two-third of the distance at 4 kmph and the rest at 5 kmph. Find the total distance.

Sol. Let the total distance be x km. Then,

$$\frac{\frac{2}{3}x}{4} + \frac{\frac{1}{3}x}{5} = \frac{7}{5} \Leftrightarrow \frac{x}{6} + \frac{x}{15} = \frac{7}{5} \Leftrightarrow 7x = 42 \Leftrightarrow x = 6$$

Ex. 6. A man traveled from the village to the post-office at the rate of 25 kmph and walked back at the rate of 4 kmph. If the whole journey took 5 hours 48 minutes, find the distance of the post-office from the village.

Sol. Average speed = $\left\{\frac{2xy}{x+y}\right\}$ km/hr = $\left\{\frac{2 \times 25 \times 4}{25+4}\right\}$ km/hr = $\frac{200}{29}$ km/hr

Distance traveled in 5 hours 48 minutes i.e., $5\frac{4}{5}$ hrs. = $\left\{\frac{200}{29} \times \frac{29}{5}\right\}$ km = 40 km

$$\text{Distance of the post-office from the village} = \left\{\frac{40}{2}\right\} = 20 \text{ km}$$

Ex. 7. An aeroplane flies along the four sides of a square at the speeds of 200, 400, 600 and 800 km/hr. Find the average speed of the plane around the field.

Sol. :

Let each side of the square be x km and let the average speed of the plane around the field be y km per hour then,

$$\frac{x}{200} + \frac{x}{400} + \frac{x}{600} + \frac{x}{800} = \frac{4x}{y} \Leftrightarrow \frac{25x}{2500} \Leftrightarrow \frac{4x}{y} \Leftrightarrow y = \frac{2400 \times 4}{25} = 384$$

hence average speed = 384 km/hr

Ex. 8. Walking at $\frac{5}{6}$ of its usual speed, a train is 10 minutes too late. Find its usual time to cover the journey.

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Sol. : New speed = $\frac{5}{6}$ of the usual speed

New time taken = $\frac{6}{5}$ of the usual time

So, $(\frac{6}{5} \text{ of the usual time }) - (\text{usual time}) = 10 \text{ minutes.}$
 $\Rightarrow \frac{1}{5} \text{ of the usual time} = 10 \text{ minutes.}$
 $\Rightarrow \text{usual time} = 10 \text{ minutes}$

Ex. 9. If a man walks at the rate of 5 kmph, he misses a train by 7 minutes. However, if he walks at the rate of 6 kmph, he reaches the station 5 minutes before the arrival of the train. Find the distance covered by him to reach the station.

Sol. Let the required distance be x km

Difference in the time taken at two speeds = 1 min = $\frac{1}{2}$ hr

Hence $\frac{x}{5} - \frac{x}{6} = \frac{1}{2} \Leftrightarrow 6x - 5x = 6$

$\Leftrightarrow x = 6$

Hence, the required distance is 6 km

Ex. 10. A and B are two stations 390 km apart. A train starts from A at 10 a.m. and travels towards B at 65 kmph. Another train starts from B at 11 a.m. and travels towards A at 35 kmph. At what time do they meet?

Sol. Suppose they meet x hours after 10 a.m. Then,

(Distance moved by first in x hrs) + [Distance moved by second in $(x-1)$ hrs] = 390.

$$65x + 35(x-1) = 390 \Rightarrow 100x = 425 \Rightarrow x = \frac{17}{4}$$

So, they meet 4 hrs. 15 min. after 10 a.m i.e., at 2.15 p.m.

Ex. 11. A goods train leaves a station at a certain time and at a fixed speed. After $\frac{1}{2}$ hours, an express train leaves the same station and moves in the same direction at a uniform speed of 90 kmph. This train catches up the goods train in 4 hours. Find the speed of the goods train.

Sol. Let the speed of the goods train be x kmph.

Distance covered by goods train in 10 hours = Distance covered by express train in 4 hours

$$10x = 4 \times 90 \text{ or } x = 36.$$

So, speed of goods train = 36 kmph.

Ex. 12. A thief is spotted by a policeman from a distance of 100 metres. When the policeman starts the chase, the thief also starts running. If the speed of the thief be 8 km/hr and that of the policeman 10 km/hr, how far the thief will have run before he is overtaken?

Sol. Relative speed of the policeman = $(10-8) \text{ km/hr} = 2 \text{ km/hr.}$

Time taken by police man to cover 100m $\left(\frac{100}{1000} \times \frac{1}{2} \right) \text{ hr} = \frac{1}{20} \text{ hr.}$

In $\frac{1}{20}$ hrs, the thief covers a distance of $8 \times \frac{1}{20} \text{ km} = \frac{2}{5} \text{ km} = 400 \text{ m}$

Ex.13. I walk a certain distance and ride back taking a total time of 37 minutes. I could walk both ways in 55 minutes. How long would it take me to ride both ways?

Sol. Let the distance be x km. Then,

(Time taken to walk x km) + (time taken to ride x km) = 37 min.

(Time taken to walk $2x$ km) + (time taken to ride $2x$ km) = 74 min.

But, the time taken to walk $2x$ km = 55 min.

Time taken to ride $2x$ km = $(74-55)$ min = 19 min.