

SPEED, DISTANCE AND TIME

7.1 SPEED

Speed of a body is the distance covered by the body in unit time.

$$\therefore \text{Speed} = \frac{\text{Distance}}{\text{Time}} \quad \Rightarrow \quad \text{(i) Distance} = \text{Speed} \times \text{Time}$$

$$\text{and,} \quad \text{(ii) Time} = \frac{\text{Distance}}{\text{Speed}}$$

1. In order **to find speed**, if :

- (i) **distance** is in metre (m) and **time** in second (s); then the **speed** is in metre per second (m s^{-1}).
- (ii) **distance** is in kilometre (km) and **time** in hour (h); then the **speed** is in kilometre per hour (km h^{-1}).

2. In order **to find distance**, if :

- (i) **speed** is in m s^{-1} , **time** must be in **second**.
- (ii) **speed** is in km h^{-1} , **time** must be in **hour**.

3. In order **to find time**, if :

- (i) **speed** is in km h^{-1} , **distance** must be in **kilometre**.
- (ii) **speed** is in m s^{-1} , **distance** must be in **metre**.

Example 1 :

A boy covers a distance of 1.2 km in 40 minutes. Find his speed in :

- (i) km per hour (km h^{-1})
- (ii) metre per second (m s^{-1})

Solution :

- (i) In order to get **speed in km per hour**; the **distance** covered must be in **km** and the **time taken** must be in **hour**.

$$\text{Given :} \quad \text{distance} = 1.2 \text{ km} \quad \text{and} \quad \text{time} = 40 \text{ min} = \frac{40}{60} \text{ h} = \frac{2}{3} \text{ h}$$

$$\begin{aligned} \therefore \quad \text{Speed} &= \frac{\text{Distance}}{\text{Time}} \\ &= \frac{1.2 \text{ km}}{\frac{2}{3} \text{ h}} = 1.2 \times \frac{3}{2} \text{ km h}^{-1} = \mathbf{1.8 \text{ km h}^{-1}} \quad \text{(Ans.)} \end{aligned}$$

- (ii) In order to get **speed in metre per second**; the **distance** covered must be in **metre** and the **time taken** must be in **second**.

$$\text{Given :} \quad \text{distance} = 1.2 \text{ km} = 1.2 \times 1000 \text{ m} = 1,200 \text{ m}$$

$$\text{And,} \quad \text{time} = 40 \text{ min} = 40 \times 60 \text{ sec} = 2400 \text{ sec}$$

$$\begin{aligned} \therefore \quad \text{Speed} &= \frac{\text{Distance}}{\text{Time}} \\ &= \frac{1200 \text{ m}}{2400 \text{ sec}} = \frac{1}{2} \text{ m s}^{-1} = \mathbf{0.5 \text{ m s}^{-1}} \quad \text{(Ans.)} \end{aligned}$$

7.2 UNIFORM SPEED AND VARIABLE SPEED

If a body covers equal distances in equal intervals of time, its speed is said to be uniform otherwise its speed is variable.

For example :

- (i) If a car covers 60 km in first hour, 60 km in second hour, 60 km in third hour and so on, its speed is uniform.
- (ii) If a car covers 60 km in first hour, 67 km in second hour, 58 km in third hour and so on, its speed is variable.
- (iii) If a car cover first 60 km in one hour, second 60 km in 1 hour 20 minutes, third 60 km in 1 hour 30 minutes and so on, then also its speed is variable.

Example 2 :

A man runs 200 metre in 25 second. Find :

- (i) his speed
- (ii) the distance run by him in 5 seconds
- (iii) the time taken by him to cover $\frac{2}{5}$ km.

Solution :

(i) $\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{200 \text{ m}}{25 \text{ sec}} = 8 \text{ m s}^{-1}$ (Ans.)

(ii) $\text{Distance run in 5 sec} = \text{Speed} \times \text{Time}$
 $= 8 \text{ m s}^{-1} \times 5 \text{ sec} = 40 \text{ m}$ (Ans.)

(iii) $\text{Time taken to cover } \frac{2}{5} \text{ km} = \frac{\text{Distance}}{\text{Speed}}$
 $= \frac{400 \text{ m}}{8 \text{ m s}^{-1}}$ $\left[\frac{2}{5} \text{ km} = \frac{2}{5} \times 1000 \text{ m} = 400 \text{ m} \right]$
 $= 50 \text{ seconds}$ (Ans.)

Example 3 :

A train covers first 120 km in 2 hours, next 160 km in 3 hours and last 140 km again in 2 hours. Find the average speed of the train.

Solution :

$$\text{Average speed of an object} = \frac{\text{Total distance covered by it}}{\text{Total time taken}}$$

Since, total distance covered = 120 km + 160 km + 140 km
= 420 km

And, total time taken = 2 hr + 3 hr + 2 hr = 7 hr.

$\therefore \text{Average speed} = \frac{420 \text{ km}}{7 \text{ hr}} = 60 \text{ km h}^{-1}$ (Ans.)

Example 4 :

A man covers first 60 km of his journey at 30 km h^{-1} and remaining 50 km at 20 km h^{-1} .

- Find : (i) the total time taken,
(ii) his average speed during the whole journey.

Solution :

$$(i) \quad \text{Time taken to cover 1st 60 km} = \frac{60}{30} \text{ h} \quad \left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right]$$
$$= 2 \text{ h}$$

$$\text{And, time taken to cover remaining 50 km} = \frac{50}{20} \text{ h} = \frac{5}{2} \text{ h}$$

$$\therefore \text{Total time taken} = 2 \text{ h} + \frac{5}{2} \text{ h} = \frac{9}{2} \text{ h} = 4\frac{1}{2} \text{ h} \quad (\text{Ans.})$$

$$(ii) \quad \text{Since, total distance covered} = 60 \text{ km} + 50 \text{ km} = 110 \text{ km}$$

$$\text{and total time taken} = \frac{9}{2} \text{ h}$$

$$\therefore \text{Average speed} = \frac{110}{\frac{9}{2}} \text{ km h}^{-1} \quad \left[\because \text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}} \right]$$

$$= \frac{110 \times 2}{9} \text{ km h}^{-1} = 24\frac{4}{9} \text{ km h}^{-1} \quad (\text{Ans.})$$

EXERCISE 7 (A)

1. Fill in the blanks :

- A distance of 40 m is covered in 8 sec \Rightarrow speed = m/s.
- A distance of 1.4 km is covered in 10 min \Rightarrow speed = km/min.
- A distance of 32 km is covered in 1.6 hrs \Rightarrow speed = km/h.
- A car moves at 60 km h^{-1} for 40 min \Rightarrow distance covered = km.
- If speed = 30 m s^{-1} , distance covered in 15 min = m = km.
- Speed = 15 km min^{-1} and time = 1 hour \Rightarrow distance covered = km.
- If speed = 1.2 km min^{-1} and distance covered = 36 km; time taken min.
- If speed = 18 m sec^{-1} and distance covered = 2.7 km; time taken = sec = min.

- A train covers 51 km in 3 hours. Calculate its speed. How far does the train go in 30 minutes ?
- A motorist travelled the distance between two towns, which is 65 km in 2 hours and 10 minutes. Find his speed in metre per minute.
- A train travels 700 metres in 35 seconds. What is its speed in km h^{-1} ?
- A racing car covered 600 km in 3 hours 20 minutes. Find its speed in metre per second. How much distance will the car cover in 50 sec ?

6. Rohit goes 350 km in 5 hours. Find :
- his speed
 - the distance covered by Rohit in 6.2 hours
 - the time taken by him to cover 210 km,
- [Assume that throughout the journey, the speed of Rohit remains uniform].
7. A boy drives his scooter with a uniform speed of 45 km h^{-1} . Find :
- the distance covered by him in 1 hour 20 min.
 - the time taken by him to cover 108 km.
 - the time taken to cover 900 m.
8. I travel a distance of 10 km and come back in $2\frac{1}{2}$ hours. What is my speed ?
9. A man walks a distance of 5 km in 2 hours. Then he goes in a bus to a nearby town, which is 40 km in further 2 hours. From there, he goes to his office in an autorickshaw, a distance of 5 km in $\frac{1}{2}$ hour. What was his average speed during the whole journey.
10. Jagan went to another town such that he covered 240 km by a car going at 60 km h^{-1} . Then he covered 80 km by a train, going at 100 km h^{-1} and the rest 200 km, he covered by a bus, going at 50 km h^{-1} . What was his average speed during the whole journey ?
11. The speed of sound in air is about 330 m s^{-1} . Express this speed in km h^{-1} . How long will the sound take to travel 99 km ?

7.3 CONVERTING SPEED FROM ONE UNIT TO OTHER UNIT

To convert speed in kilometre per hour (km h^{-1}) into metre per second (m s^{-1}), multiply by $\frac{5}{18}$. And, to convert m s^{-1} into km h^{-1} , multiply by $\frac{18}{5}$.

$$\text{Reason : } 1 \text{ km h}^{-1} = \frac{1 \text{ kilometre}}{1 \text{ hour}} = \frac{1000 \text{ metre}}{60 \times 60 \text{ second}} = \frac{5}{18} \text{ m s}^{-1}.$$

Example 5 :

- Convert :
- 90 km h^{-1} into m s^{-1}
 - 15 m s^{-1} into km h^{-1}
 - 75 cm s^{-1} into km h^{-1}
 - 45 km h^{-1} into m min^{-1}

Solution :

$$(i) \quad 90 \text{ km h}^{-1} = 90 \times \frac{5}{18} \text{ ms}^{-1} = 25 \text{ m s}^{-1} \quad (\text{Ans.})$$

$$(ii) \quad 15 \text{ m s}^{-1} = 15 \times \frac{18}{5} \text{ km h}^{-1} = 54 \text{ km h}^{-1} \quad (\text{Ans.})$$

$$(iii) \quad 75 \text{ cm s}^{-1} = 0.75 \text{ m s}^{-1} \quad \left[\because 75 \text{ cm} = \frac{75}{100} \text{ m} = 0.75 \text{ m} \right]$$

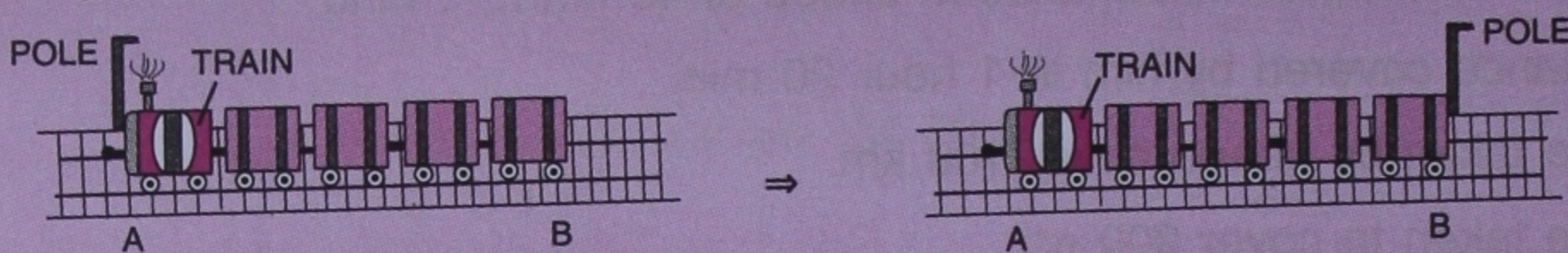
$$= 0.75 \times \frac{18}{5} \text{ km h}^{-1} = 2.7 \text{ km h}^{-1} \quad (\text{Ans.})$$

$$(iv) 45 \text{ km h}^{-1} = \frac{45 \text{ km}}{1 \text{ h}} = \frac{45 \times 1000 \text{ m}}{60 \text{ min}} = 750 \text{ m min}^{-1} \quad (\text{Ans.})$$

When a train passes a :

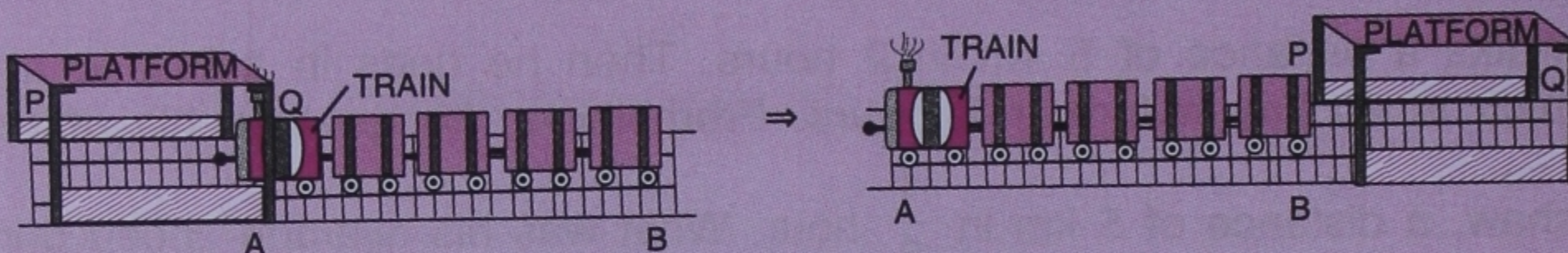
- (i) **pole** or any other stationary object, etc.,

the minimum distance covered by the train = length of the train



- (ii) **platform**, the minimum distance covered by the train

= length of the train + length of the platform.



Example 6 :

A 160 m long train is travelling at a speed of 72 km h^{-1} , find the time taken by the train to pass :

- (i) a telegraph post (ii) a 200 m long platform.

Solution :

- (i) Distance to be covered = length of the train = 160 m

And, $\text{speed} = 72 \text{ km h}^{-1} = 72 \times \frac{5}{18} \text{ m s}^{-1} = 20 \text{ m s}^{-1}$

$$\therefore \text{Time taken} = \frac{\text{Distance}}{\text{Speed}} = \frac{160}{20} \text{ sec} = 8 \text{ sec} \quad (\text{Ans.})$$

- (ii) Distance to be covered = length of the train + length of the platform
= 160 m + 200 m = 360 m

$$\therefore \text{Time taken} = \frac{\text{Distance}}{\text{Speed}} = \frac{360}{20} \text{ sec} = 18 \text{ sec} \quad (\text{Ans.})$$

Example 7 :

P and Q run with speeds 8 km h^{-1} and 11 km h^{-1} . They start running from the same point, find the distance between them after 2 hours, if they run in the

- (i) same direction. (ii) opposite directions (moving away from each other).

Solution :

- (i) Required distance = Difference between the distances covered by P and Q

- (ii) Required distance = Sum of the distances covered by P and Q.

$$\begin{aligned} \text{Distance run by P in 2 hours} &= \text{speed} \times \text{time} \\ &= 8 \text{ km h}^{-1} \times 2 \text{ hours} = 16 \text{ km} \end{aligned}$$

$$\text{Distance run by Q in 2 hours} = 11 \text{ km h}^{-1} \times 2 \text{ hours} = 22 \text{ km}$$

(i) **Required distance** = 22 km - 16 km = **6 km** (Ans.)

(ii) **Required distance** = 22 km + 16 km = **38 km** (Ans.)

EXERCISE 7 (B)

1. Convert :

- (i) 54 km/h into m/s (ii) 2.5 m/s into km/h (iii) 16.2 km/h into m/s
(iv) 9 m/s into km/h (v) 8 km/min into km/h (vi) 8 km/min into m/s
(vii) 75 cm/s into m/sec and then km/h
(viii) 120 cm/min into m/s and then km/h
(ix) 7.2 km/h into m/s and then m/min.

2. A train 180 m long is running at a speed of 90 km/h. How long will it take to pass a railway signal ?

3. A train whose length is 150 m, passes a telegraph pole in 10 sec. Find the speed of the train in km/h.

4. A train 120 m long passes a railway platform 160 m long in 14 sec. How long will it take to pass another platform which is 100 m long ?

5. Mr. Amit can walk 8 km in 1 hour 20 minutes.

(a) How far does he go in :

- (i) 10 minutes (ii) 30 seconds

(b) How long will it take him to walk :

- (i) 2500 m (ii) 6.5 km

6. Which is greater : a speed of 45 km/h or a speed of 12.25 m/sec ?
How much is the distance travelled by each in 2 seconds ?

7. A and B start from the same point and at the same time with speeds 15 km/h and 12 km/h respectively. Find the distance between A and B after 6 hours if both move in :

- (i) same direction (ii) the opposite directions.

8. A and B start from the same place, in the same direction and at the same time with speeds 6 km/h and 2m/sec respectively. After 5 hours who will be ahead and by how much ?

9. Mohit covers a certain distance in 6 hrs by his scooter at a speed of 40 km h⁻¹.

(i) Find the time taken by Manjoor to cover the same distance by his car at the speed of 60 km h⁻¹.

(ii) Find the speed of Joseph, if he takes 8 hrs to complete the same distance.

10. A boy swims 200 m in still water and then returns back to the point of start in total 10 minutes. Find the speed of his swim in (i) m s⁻¹ (ii) km h⁻¹.

11. A distance of 14.4 km is covered in 2 hours 40 minutes. Find the speed in m s⁻¹.

With this speed Sakshi goes to her school, 240 m away from her house and then returns back. How much time, in all, will Sakshi take ?
