CHAPTER 7

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.**

Given : distance = 1·2 km and time = 40 min = $\frac{40}{60}$ h = $\frac{2}{3}$ h

$$\therefore \quad \textbf{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{1{\cdot}2\text{ km}}{\frac{2}{3}\text{h}} = 1{\cdot}2 \times \frac{3}{2}\text{ km h}^{-1} = \textbf{1·8 km h}^{-1} \qquad \textbf{(Ans.)}$$

(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.**

Given : distance = 1·2 km = 1·2 × 1000 m = 1,200 m

And, time = 40 min = 40 × 60 sec = 2400 sec

$$\therefore \quad \textbf{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{1200\text{ m}}{2400\text{ sec}} = \frac{1}{2}\text{ m s}^{-1} = \textbf{0·5 m s}^{-1} \qquad \textbf{(Ans.)}$$

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

(ii) **Distance run in 5 sec** $=$ Speed $\times$ Time

$= 8\text{ m s}^{-1} \times 5\text{ sec} = \mathbf{40\ m}$ **(Ans.)**

(iii) **Time taken to cover $\frac{2}{5}$ 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 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.

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

Example 4 :

A man covers first 60 km of his journery 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) Time taken to cover 1st 60 km $= \frac{60}{30}$ h $\quad \left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}}\right]$

$= 2$ h

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

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

(ii) Since, total distance covered = 60 km + 50 km = 110 km

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

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

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

EXERCISE 7 (A)

1. Fill in the blanks :
   (i) A distance of 40 m is covered in 8 sec $\Rightarrow$ speed = ... m/s.
   (ii) A distance of 1·4 km is covered in 10 min $\Rightarrow$ speed = ... km/min.
   (iii) A distance of 32 km is covered in 1·6 hrs $\Rightarrow$ speed = ... km/h.
   (iv) A car moves at 60 km h^{-1} for 40 min $\Rightarrow$ distance covered = ... km.
   (v) If speed = 30 m s^{-1}, distance covered in 15 min = ... m = ... km.
   (vi) Speed = 15 km min^{-1} and time = 1 hour $\Rightarrow$ distance covered = ... km.
   (vii) If speed = 1·2 km min^{-1} and distance covered = 36 km; time taken ..... min.
   (viii) If speed = 18 m sec^{-1} and distance covered = 2·7 km; time taken = ... sec = ... min.
2. A train covers 51 km in 3 hours. Calculate its speed. How far does the train go in 30 minutes ?
3. 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.
4. A train travels 700 metres in 35 seconds. What is its speed in km h^{-1} ?
5. 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 :
   (i) his speed (ii) the distance covered by Rohit in 6·2 hours
   (iii) 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 :
   (i) the distance covered by him in 1 hour 20 min.
   (ii) the time taken by him to cover 108 km.
   (iii) 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 $\frac{18}{5}$.

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

Example 5 :

Convert : (i) 90 km h^{-1} into m s^{-1} (ii) 15 m s^{-1} into km h^{-1}
(iii) 75 cm s^{-1} into km h^{-1} (iv) 45 km h^{-1} into m min^{-1}

Solution :

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

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

(iii) **75 cm s^{-1}** = 0·75 m s^{-1} $\left[\because 75\text{ cm} = \frac{75}{100}\text{ m} = 0{\cdot}75\text{ m}\right]$

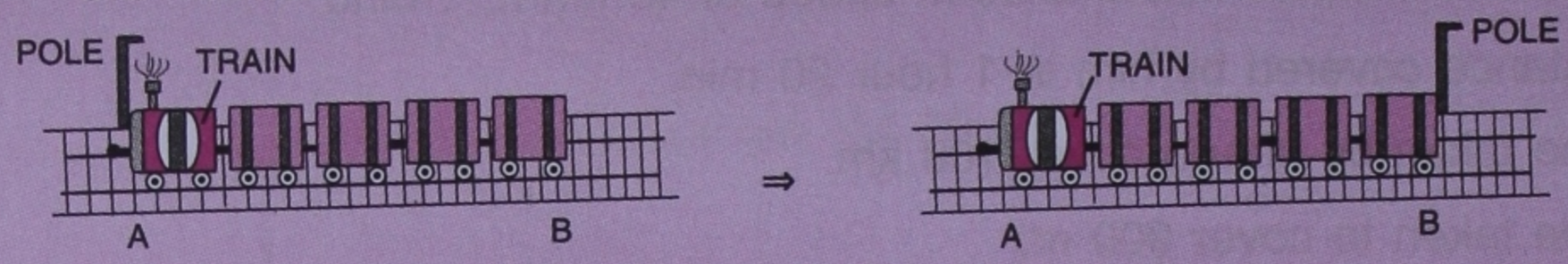
= $0{\cdot}75 \times \frac{18}{5}$ km h^{-1} = **2·7 km h^{-1}** **(Ans.)**

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

When a train passes a :

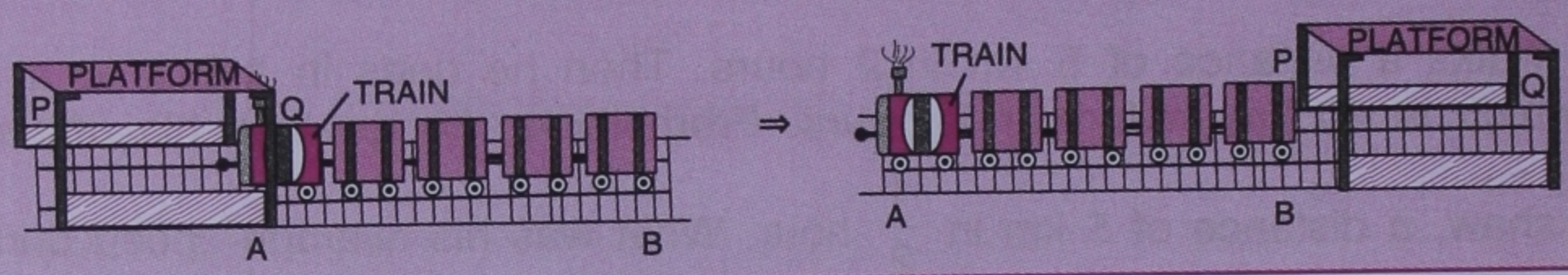
(i) **pole** or any other stationary object, etc.,

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

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

(ii) Distance to be covered = length of the train + length of the platform

= 160 m + 200 m = 360 m

$\therefore$ **Time taken** = $\dfrac{\text{Distance}}{\text{Speed}} = \dfrac{360}{20}$ sec = **18 sec** **(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.

Distance run by P in 2 hours = speed × time

= 8 km h^{-1} × 2 hours = 16 km

Distance run by Q in 2 hours = 11 km h^{-1} × 2 hours = 22 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 ?