

PROBLEMS ON TRAINS

(a) If a train of length l meters passes a platform or bridge of length m metres, then distance travelled is Distance = $l + m$

(b) If a train of length l meters passes a pole, man, tree etc, then Distance travelled is Distance = l meters

(c) If two trains of lengths L_1 & L_2 are travelling in the same direction with speeds S_1 & S_2 then. Time taken by faster train to cross slower train is given by $T = (L_1 + L_2) / (S_1 - S_2)$

(d) If two trains of length L_1 & L_2 are travelling in opposite direction with speeds S_1 & S_2 , then time taken by trains to cross each other is $T = (L_1 + L_2) / (S_1 + S_2)$

(e) Two trains of length L_1 & L_2 run on parallel tracks. When running in same direction, the faster train passes slower train in T_1 secs, but when they are running in opposite direction with same speeds, they pass each other in T_2 sec. Then,

$$\text{Speed of faster train} = \frac{L_1 + L_2}{2} \left(\frac{1}{T_1} + \frac{1}{T_2} \right)$$

$$\text{Speed of slower train} = \frac{L_1 + L_2}{2} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

Example 1: A 420 m long train crosses a pole in 70 seconds. What is the speed of the train?

Solution:

To solve this question, we can apply a short trick approach we get

$$\text{Speed of train} = \frac{\text{Length of train}}{\text{Time taken in crossing the pole}}$$

$$= \frac{420}{70} = 6 \text{ m/sec}$$

Example 2: A 240 m long train crosses a platform twice its length in 2 min. What is the speed of the train?

Solution:

"When a train passes a platform or crosses a bridge it should travel the length equal to the sum of the length of train and platform or bridge both"

$$\text{Speed of train} = \frac{\text{Length of train} + \text{Length of Platform}}{\text{Required time}}$$

Given,

Length of train = 240 m, crossing time of platform = $2 \times 60 = 120$ sec

Length of platform = $240 \times 2 = 480$, Speed of train = x

By the short trick approach, we get

$$\text{Speed of train} = \frac{240 + 480}{120} \Rightarrow x = \frac{720}{120} = 6 \text{ m/s.}$$

Example 3: A train, 120 m long, takes 6 seconds to pass a telegraph post; the speed of the train is?

Solution:

$$\text{Speed of train} = \frac{\text{Length of train}}{\text{Time taken in crossing the pole}}.$$

$$= \frac{120}{6} = 20 \text{ m/sec}$$

$$= 20 \times \frac{18}{5} = 72 \text{ kmph}$$

Example 4: A train 150 m long passes a pole in 15 seconds and crosses another train of the same length travelling in the opposite direction in 8 seconds. The speed of the second train in (km/h) is

Solution:

$$\text{Speed of the first train} = \frac{150}{15} = 10 \text{ m/sec}$$

Let the speed of the second train be x m/sec

$$\text{Relative speed} = (10 + x) \text{ m/sec}$$

$$\text{Length of train 1} + \text{length of train 2} = 150 + 150 = 300 \text{ m}$$

$$\text{In the second scenario equation will be like } \frac{300}{10 + x} = 8$$

$$\text{or, } 300 = 80 + 8x$$

$$\text{or, } x = \frac{220}{8} = \frac{55}{2} \text{ m/sec}$$

$$\therefore \text{ speed of the second train} = \frac{55}{2} \times \frac{18}{5} = 99 \text{ km/hr}$$

Example 5. Two trains 165 m and 135 m long run at the speed of 70 km/hr and 38 km/hr respectively in opposite directions on parallel tracks. The time (in seconds) which they take to cross each other is:

Solution:

Relative speed = $(70 + 38) = 108 \text{ km/hr}$ {As the trains are moving in opposite directions}

$$\Rightarrow (108 \times \frac{5}{18}) = 30 \text{ m/sec.}$$

Distance covered in crossing each other = $(165 + 135) = 300 \text{ m}$

$$\text{Reqd. time} = (300 \times \frac{1}{30}) \text{sec} \Rightarrow \frac{30}{3} \text{sec} = 10 \text{ sec.}$$