



# PROBLEMS ON TRAINS



## FORMULAS

1. km/hr to m/s conversion:

$$a \text{ km/hr} = \left( a \times \frac{5}{18} \right) \text{m/s.}$$

2. m/s to km/hr conversion:

$$a \text{ m/s} = \left( a \times \frac{18}{5} \right) \text{km/hr.}$$

### 3. Formulas for finding Speed, Time and Distance

4. Time taken by a train of length  $l$  metres to pass a pole or standing man or a signal post is equal to the time taken by the train to cover  $l$  metres.
5. Time taken by a train of length  $l$  metres to pass a stationery object of length  $b$  metres is the time taken by the train to cover  $(l + b)$  metres.
6. Suppose two trains or two objects bodies are moving in the same direction at  $u$  m/s and  $v$  m/s, where  $u > v$ , then their relative speed is  $= (u - v)$  m/s.
7. Suppose two trains or two objects bodies are moving in opposite directions at  $u$  m/s and  $v$  m/s, then their relative speed is  $= (u + v)$  m/s

8. If two trains of length  $a$  metres and  $b$  metres are moving in opposite directions at  $u$  m/s and  $v$  m/s, then:

The time taken by the trains to cross each other =  $\frac{(a + b)}{(u + v)}$  sec.

9. If two trains of length  $a$  metres and  $b$  metres are moving in the same direction at  $u$  m/s and  $v$  m/s, then:

The time taken by the faster train to cross the slower train =  $\frac{(a + b)}{(u - v)}$  sec

10. If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take  $a$  and  $b$  sec in reaching B and A respectively, then:

$$(A's \text{ speed}) : (B's \text{ speed}) = (\sqrt{b} : \sqrt{a})$$

**A train 100m long is running at the speed of 30 km/hr. The time (in second) in which it passes a man standing near the railway line is:**

Length of train = 100 m

Speed = 30 kmph =  $30 \times \frac{5}{18} = \frac{25}{3}$  m/s

**Formula:**

Speed = Distance/time

**Calculation:**

Time =  $100 / (\frac{25}{3}) = 12$  seconds

**$\therefore$  In 12 seconds, train passes a man standing near railway line.**

**A train is moving at a speed of 132 kmph. If the length of the train is 110 meters, how long will it take to cross a railway platform 165 meters long?**

To cross railway platform train has to travel distance equal to the sum of length of train and length of platform

Total distance =  $165 + 110 = 275$  meters

Speed in m/sec

$\Rightarrow 132 \times (5/18)$  m/sec

Time = Distance/Speed

$\Rightarrow 275/(660/18)$

$\Rightarrow (275 \times 18)/660$

$\Rightarrow 7.5$  seconds

**$\therefore$  Time taken by train to cross the platform is 7.5 seconds.**

**A train 160 m long crosses a platform of 160 m length in 16 seconds. What is the speed of the train?**

- Distance =  $160 + 160 = 320$  m

- Time = 16 sec

- Speed =  $\frac{320}{16} = 20m/s$

A person standing on a railway platform noticed that a train took 21 seconds to completely pass through the platform which was 84 m long and it took 9 seconds in passing him. The speed of the train was .....

Let the length of the train be  $x$  metres. Then, Speed of the train in passing through the platform =  $\frac{x+84}{21}$  m/sec and speed of the train in passing the man =  $\frac{x}{9}$  m/sec

Since both the speeds are the same,

$$\frac{x+84}{21} = \frac{x}{9} \Rightarrow 9x + 756 = 21x$$

$$\Rightarrow 12x = 756$$

$$\Rightarrow x = \frac{756}{12} = 63 \text{ m}$$

$$\therefore \text{Speed of the train} = \frac{(63+84)}{21} \text{ m/sec} = 7 \text{ m/sec}$$

$$= 7 \times \frac{18}{5} \text{ km/hr} = \mathbf{25.2 \text{ km/hr.}}$$



**A train travelling with constant speed crosses a 90m long platform in 12 sec and a 120m long platform in 15 sec. Find the length of the train and its speed**

- Length of the train =  $x$  m
- Distance =  $x+90$ , time = 12 sec
- $\text{speed} = \frac{x+90}{12}$
- Distance  $x+120$ , time = 15 sec
- $\text{Speed} = \frac{x+120}{15}$
- $\frac{x+90}{12} = \frac{x+120}{15}$
- $15x+1350 = 12x + 1440$
- $3x = 90$
- $x = 30\text{m}$
- $\text{Speed} = \frac{x+90}{12} = \frac{120}{12} = 10\text{m/s}$

**Two trains 230 m and 270 m long, are running on parallel tracks in the opposite directions at a speed of 40 km/h and 50 km/h, respectively. What is the time taken by the trains to cross each other completely?**

Total length of both train =  $230 + 270 = 500$  m

(Opposite directions), sum of speed of both trains =  $50 + 40 = 90$  km/h =  $90 \times [5/18] = 25$  m/s

As we know, Time = Distance/Speed

$\therefore$  Required time =  $500/25 = 20$  s

**Two trains 100 metres and 120 metres long are running in the same direction with speeds of 72 km/hr, and 54km/hr. In how much time will the first train cross the second?**

Relative speed of the trains =  $(72 - 54) \text{ km/hr} = 18 \text{ km/hr} = (18 * 5/18) \text{ m/sec} = 5 \text{ m/sec}.$

Time taken by the trains to cross each other = Time taken to cover  $(100 + 120) \text{ m}$  at  $5 \text{ m/sec} = (220/5) \text{ sec} = 44 \text{ sec}.$

**A train 220 m long is running with a speed of 59 kmph.. In what time will it pass a man who is running at 7 kmph in the direction opposite to that in which the train is going?**

- Speed of the train relative to man =  $(59 + 7) \text{ kmph} = 66 \times \frac{5}{18} \text{ m/sec} = \frac{55}{3} \text{ m/sec}$ .
- Time taken by the train to cross the man = Time taken by it to cover 220 m at  $(\frac{55}{3}) \text{ m / sec} = (220 \times \frac{3}{55}) \text{ sec} = 12 \text{ sec}$

**A train passes by a stationary man standing in platform in 7 seconds and passes by the platform completely in 28 seconds. If the length of platform is 330 metres, what is the length of the train**

- Let the length of the train be  $x$  m
- Speed of the train =  $x/7$  m/s
- Speed of train =  $x+330/28$  m/s
- $x/7 = x+330/28$
- $28x = 7x+330 \times 7$
- $X=110$  m

**Two stations A and B are 110 km apart on a straight line. One train starts from A at 7 a.m. and travels towards B at 20 kmph. Another train starts from B at 8 a.m. and travels towards A at a speed of 25 kmph. At what time will they meet?**

Let the two trains meet after  $x$  hrs after 7 a.m.

Distance covered by train from A in  $x$  hours =  $20x$  km

Distance covered by train from B in  $(x - 1)$  hours =  $25(x - 1)$  km

$$\Rightarrow 20x + 25(x - 1) = 110$$

$$\Rightarrow 45x = 135$$

$$\Rightarrow x = 3$$

$\therefore$  They meet at  $(7 + 3)$  a.m. = 10 a.m

**A train running at 25 km per hour take 18 seconds to pass a platform. Next, it takes 12 seconds to pass a man walking at the rate of 5 km per hr. In the opposite direction. Find the length of the platform.**

Speed of the train relative to man =  $25 + 5 = 30 \text{ km/hr} = 30 \times 5/18 \text{ m/s} = 25/3 \text{ m/s}$

Distance travelled in 12 s =  $25/3 \times 12 = 100 \text{ m}$

Length of train = 100m

Again speed of train =  $25 \text{ km/hr} = 25 \times 5/18 = 125/18 \text{ m/s}$

Distance travelled in 18 sec =  $125/18 \times 18 = 125$

Length of train + platform = 125m

Length of platform =  $125 - 100 = 25 \text{ m}$