

## Problem on Trains Concepts

### Type I - Conversion

1.  $a \text{ km/hr} = [a \times (5/18)] \text{ m/s}$ .

2.  $a \text{ m/s} = [a \times (18/5)] \text{ km/hr}$ .

### Type II- Train is crossing standing man/pole

3. Time taken by a train of length  $l$  metres to pass a pole or a standing man or a signal post is equal to the time taken by the train to cover  $l$  metres.

### Type III- Train is crossing bridge/tunnel/platform/another stationary train

4. Time taken by a train of length  $l$  metres to pass a stationary object of length  $b$  metres is the time taken by the train to cover  $(l + b)$  metres.

### Type IV- Train is crossing another moving object (Both are going in same direction)

5. Suppose two trains or two bodies are moving in the same direction at  $u \text{ m/s}$  and  $v \text{ m/s}$ , where  $u > v$ , then their relative speed =  $(u - v) \text{ m/s}$ .

### Type V- Train is crossing another moving object (Both are going in opposite direction)

6. Suppose two trains or two bodies are moving in opposite directions at  $u \text{ m/s}$  and  $v \text{ m/s}$ , then their relative speed =  $(u + v) \text{ m/s}$ .

7. If two trains of length  $a$  metres and  $b$  metres are moving in opposite directions at  $u \text{ m/s}$  and  $v \text{ m/s}$ , then time taken by the trains to cross each other =  $(a+b)/(u+v) \text{ sec}$ .

8. If two trains of length  $a$  metres and  $b$  metres are moving in the same direction at  $u \text{ m/s}$  and  $v \text{ m/s}$ , then the time taken by the faster train to cross the slower train =  $(a+b)/(u-v) \text{ sec}$ .

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

### **Solved Examples**

1) 1. A train 150 m long is running at a speed of 90kmph. Time taken by the train to cross a tree is :

Solution:-

Speed of the train = 90 kmph =  $90 \times 18/5 = 324 \text{ m/sec}$ .

Distance to cross the tree = Length of the train / Required time =  $150 \text{ m} / 324 = 0.46 \text{ sec}$ .

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

Solution:-

Speed of the train = 132 kmph =  $132 \times 5/18 = 36 \text{ m/s}$

Distance covered in passing the platform

= Length of the train + Length of the Platform

=  $(110 + 165) = 275 \text{ m}$ . Required time =  $275 / 36 = 7.6 \text{ sec}$ .

3) A train 110 m long is traveling at a speed of 59kmph. The time in which it will pass a passer by, walking at 4kmph in the same directions, is:

Solution:

Speed of the train = 59 km/hr.

Speed of the man = 4 km/hr.

Since both are in the same direction

Relative speed =  $(59-4) = 55 \text{ km/hr}$ .

Length of the train = 110

Time =  $\frac{110 \times 18}{55 \times 5} = \frac{36}{5} \text{ sec}$       **Time =  $7\frac{1}{5}$**

4) A train 150 m long moving at a speed of 35 meters per second overtakes a man moving at 5 meters/sec in opposite direction. The train will pass the man in:

Solution:-

Speed of the train = 35 m/s

Speed of the man = 5 m/s

Since both are moving in opposite direction

Relative speed =  $(35+5) = 40 \text{ m/sec}$ .

Length of the train = 150 m

Time =  $\frac{150}{40} = 3.75 \text{ sec}$