Topic: 2 Train Problems

1. Trains crossing Stationary points

If a train of length l crossing a stationary point (like lamp post, a man) which is having incomparable length, then the time taken to cross the object is.

$$T = l/s$$

l -> length of train

s -> speed of train.

2. Train crossing stationary objects:-

If a train of length l_1 crossing a stationary object with length l_2, then time taken to cross is given by

$$T = \frac{l_1 + l_2}{s}$$ [s - speed of Train].

3. Train crossing moving objects or two trains crossing each other.

If 2 objects are moving, then we have to apply 'Relative speed' concept

If two objects moving

(i) In same direction means Relative speed is difference of their speeds.

(ii) In opposite direction means Relative speed is sum of their speeds

Time taken to cross $= \frac{l_1 + l_2}{S_1 - S_2}$.

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If two objects moving in same direction

Time taken to cross $= \frac{l_1 + l_2}{S_1 + S_2}$

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If Two objects moving in opposite direction.

(X) **Speed Conversions**

1 kmph $= \frac{5}{18}$ m/s & 1 m/s $= \frac{18}{5} = 3.6$ kmph.

Boats & Stream Problems:-

(X)

Downstream (X)	Speed (along the current) = Boat speed + (current (stream) speed
Upstream	Speed (against the current) = Boat speed − Current speed.

① A 280 metre long train speeds past a man in 20 seconds. What is its speed in kmphr.

Ans Time taken = $\frac{\text{length}}{\text{speed}}$

$$20 = \frac{280}{s}$$

$$s = \frac{280}{20}$$

$$s = 14 \times \frac{18}{5} = 50.4 \text{ kmph}$$

② A man running at 18 kmph crosses a bridge in 2 minutes. Then length of the bridge is

$$\text{Time taken} = \frac{\text{length}}{\text{speed}}$$

$$2 \times 60 = \frac{L}{18 \times \frac{5}{18}}$$

$$L = 600 \text{ metres}$$

③ A train 180 metres long passes a telegraph pole in 5 seconds. How long will it take to cross a platform of length 900 metres?

When train crosses the pole $\text{Time taken} = \frac{\text{length}}{\text{Speed}}$.

$$t_1 = \frac{180}{s} \Rightarrow s = \frac{180}{t} = \frac{180}{5}$$

When train crosses the platform (4)

$$t_2 = \frac{180+900}{S} = \frac{(180+900)\times 5}{180} = \frac{1080\times 5}{180} = 30s$$

$$\therefore \text{Speed} = \frac{180}{5}$$

$$\boxed{t_2 = 30 \text{ sec}}$$

(4) A train 100 meters long meets a man going in opposite direction at 5m/sec & passes him in $7\frac{1}{2}$ seconds. The speed of the train is?

Time to meet $7\frac{1}{2} = \frac{100}{S+5}$ (since train & the man are moving in opposite direction)

$$S+5 = \frac{\overset{20}{\cancel{100}}\times 2}{\cancel{15}_3}$$

$$S+5 = \frac{40}{3} \qquad S = \frac{40}{3} - 5$$

$$\boxed{S = \frac{25}{3} \text{ m/sec}}$$

(5) Two Trains of equal length are running on parallel lines in the same direction at the rate of 65 kmph & 44 kmph. The faster passes the slower by 48 seconds. The length of each train be

$$\text{Time taken} = \frac{l_1 + l_2}{S_1 + S_2} \qquad (l_1 = l_2)$$

$$48 = \frac{2l_1}{(65-44)\times 5/18} = \frac{2l_1}{21\times\frac{5}{18}} = \frac{2l_1 \times 18}{105}$$

$$48 = \frac{2l_1 \times 18}{105}$$

$$\frac{105 \times 48}{2 \times 18} = l_1 \quad \boxed{l_1 = 140 \text{ metres}}$$

b) Two Trains of length 190 m & 210 m having speeds 40 kmph & 32 kmph moving towards each other in parallel tracks. When they will cross each other?

$$\text{Time taken} = \frac{190 + 210}{(40+32)\,5/18}$$

$$= \frac{400}{72 \times 5/18} = \frac{400}{20} = 20$$

$\boxed{\text{Ans} : 20 \text{ secs}}$

Boats & streams

Ex 1 A person can swim in still water at 4 kmph. If the speed of the water is 2 kmph, how many hours will the man take to swim back against the current (stream) for 6 km.

U = Upstream speed = 4 − 2 = 2 kmph.

D = downstream speed = 4 + 2 = 6 kmph

$$\text{Time taken} = \frac{6}{2} = 3 \text{ kmph}$$

Ex 2 A man can row his boat with stream at 6 kmph & against the stream 4 kmph. The man speed.

Downstream = B + S = 6 kmphr

Upstream = B − S = 4 kmphr

B = 5 kmph & S = 1 kmph.