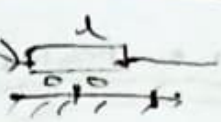
Problems on Trains — Concepts

- Km/hr → m/s
  - Measure of speed → how many (m) → travel in 1 s
  - how many (kms) → travel in 1 hr
- 1 km = 1000 metres
  1 hr = 3600 seconds (60×60)
- v → Km/hr → $\frac{5}{18}$ → p'roduct → Conversion factor
- m/s → Km/hr
  Vice versa → $\frac{18}{5}$ Km/hr → $\frac{5}{18}$ m/s
- 1 km → 1000 m
  1 hr → 3600 s
  $\frac{1}{3600} \times \frac{1000}{1} = \frac{1}{18}$
  $\frac{1}{1000} \times \frac{3600}{1} = \frac{18}{5}$ Km/hr
- Km/hr → m/s → $\frac{5}{18}$
  m/s → Km/hr → $\frac{18}{5}$
- Speed = $\frac{\text{distance}}{\text{time}}$
- $t = \frac{d}{s}$
- $d = s \times t$
- If → Ratio → Speed → a : b
  - When → Ratio = Time taken by them to cover same distance → $\frac{1}{b}$ for a : b
- If → Man → covers → certain distance at x Km/hr
  - equal distance at y Km/hr
  - Speed Avg (whole journey) = $\left(\frac{2xy}{x+y}\right)$ Km/hr

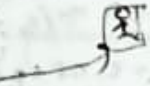
$s = \frac{d}{t} = \frac{2xy}{x+y}$

Length

Train → l



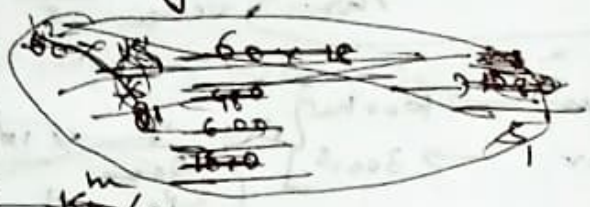
Pole/Standing Man/Signal Post



Time Taken → Train → pass ∩ = Time Taken by train to cover l meters

1) Train Running at speed of 60 km/hr crossed a pole in 9s. What is length of Train?

S = 60 km/hr (train)



$60 \times \frac{5}{18} = \frac{50}{3}$ m/s

Length of Train = speed × time

∴ $l = 50 \times 9 = 150$ m

4 Types → ① Conversion ② TSD formula ③ Train & object ④ Theory of Relativity

Conversion → kmph to m/s → $\times \frac{5}{18}$

m/s to kmph → $\times \frac{18}{5}$

TSD formula → $S = \frac{D}{t}$

2) A Train is 200m long runs at 50 m/s. Find t?

l = 200m = d = Distance covered by Train

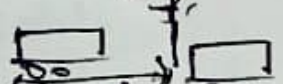
S = 50 m/s

t = ?

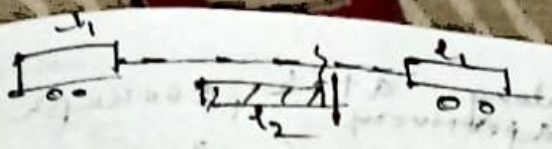
$S = \frac{D}{t} = \frac{200}{t} \Rightarrow 50 = \frac{200}{t} \Rightarrow t = \frac{200}{50} = 4$ s

Train & object → ① Pole/Man/tree ② Bridge/Tunnel/platform

1 →



$S = \frac{d}{t} = \frac{l}{t}$

2) 

$S = \frac{d}{t} = \frac{l_1 + l_2}{t_1}$

1) A Train 300m long is running at speed of 54 km/hr. In what time it will pass a bridge of 100m long.

$l_t = 300\ m$

$l_b = 100\ m$

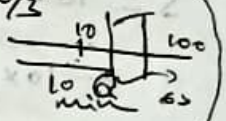
$54 \times \frac{5}{18} = 15\ m/s$

$S = \frac{d}{t} = \frac{l_t + l_b}{t} \Rightarrow t = \frac{300+100}{15} = \frac{400}{15} \Rightarrow 26.\overline{6}$

2) A Train covers 10kms in one min. If it takes 6s to pass a telegraph post, the length of train is ?

$d = 10kms \quad t = 10min$

$S = \frac{d}{t} = \frac{10 \times 1000}{10 \times 60} = \frac{100}{6} = 50/3$



$S = \frac{d}{t} \Rightarrow \frac{l}{t} \Rightarrow l = S \times t = \frac{50}{3} \times 6 = 100m$

3) A Train Moves past a man and a bridge of 260m long in 8s & 10s. Speed of train?

Man $\Rightarrow S = \frac{d}{t} = \frac{l_t}{t} = \frac{(s)}{8}$ — (1)

Bridge $\Rightarrow S = \frac{l_t + l_b}{t} = \frac{(s)}{10}$

$l_t + l_b = 10s$

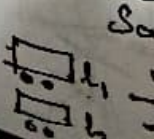
$l_t + 260 = 10s$ — (2)

$2 \quad 260 + 8s = 10s$

$10s - 8s = 260 \Rightarrow 2s = 260 \Rightarrow s = \frac{260}{2} = 120\ m/s$

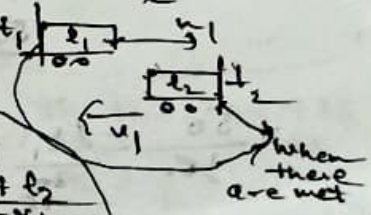
Theory of Relativity

Same direction



$S = \frac{d}{t} \Rightarrow t = \frac{d}{s} = \frac{l_1 + l_2}{u_1 - u_2}$

opposite direction



$S = \frac{d}{t} \Rightarrow t = \frac{d}{s} = \frac{l_1 + l_2}{u_1 + u_2}$

Two Trains 100m & 200m running along parallel tracks in opp direction with $s_1 = 60$ kmph, $s_2 = 30$ kmph. What t to cross

GD: $l_1 = 100$m $s_1 = 60$ kmph
$l_2 = 200$m $s_2 = 30$ kmph

$s_1 + s_2 = 90$ kmph
$90 \times \frac{5}{18} = 25$ m/s

$t = \frac{l_1 + l_2}{s_1 + s_2} = \frac{300}{25}$ s

Two Trains of equal length are running on ||el lines in same direction at $s_1 = 40$ kmph & $s_2 = 30$ kmph. Faster Train pass slower train in 30s. Find length.

$l_1 = l_2$

$s = 10$ kmph
$= 10 \times \frac{5}{18} = \frac{50}{18}$ s

$t = 30$ s

$s = \frac{d}{t} \quad \frac{l_1 + l_2}{t} \Rightarrow \frac{2l_1}{t}$

$s = \frac{2l_1}{t}$

$\frac{50}{18} = \frac{2l_1}{30}$ $\Rightarrow$ $\frac{10}{18} \quad l_1 \quad l_1$

$\frac{25}{9} = \frac{2l_1}{30}$

$\frac{25}{9} = \frac{l_1}{15}$

$4l_1 = 375$

$l_1 = \frac{375}{4}$

$\frac{50}{18} = \frac{2 \times l_1}{30}$

$\frac{50 \times 30}{18} = 2l \Rightarrow 2l = \frac{1500}{18}$

$l = \frac{1500}{36}$

$\frac{50}{18} = \frac{2l_1}{30}$

$l_1 = 125$ m