Relative Speed. [VQAR - II]

Time = $\frac{\text{Distance}}{\text{Speed difference}}$

Three kinds of concept :

1) When two objects are moving in opposite direction [2 cases]
2) When two objects are moving in the same direction
3) When two objects start moving at different time.

General formula :

Gap = Relative Speed x Time taken.

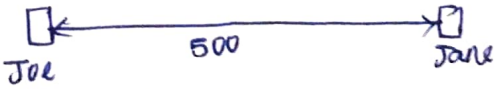
Relative Speed concept :

When two objects move in opposite direction the R.S basically the sum of the speeds. $[S_1 + S_2]$.

Sum [Problem].

Moving in opp direction : [case 1]

1. Joe and Jane are 500km away from each other and are traveling in the opposite direction towards each other at 60kmph and 40 kmph respectively. If they start travelling at 10 am, then at what time will they meet ?



Soln:

$D_{Joe} = S_1 \times t$

$D_{Jane} = S_2 \times t$

$D = D_{Joe} + D_{Jane} \Rightarrow 500$

$500 = S_1 \times t + S_2 \times t$

$500 = (S_1 + S_2)\, t$

gap — Rel. speed

$500 = (60+40) \times t$

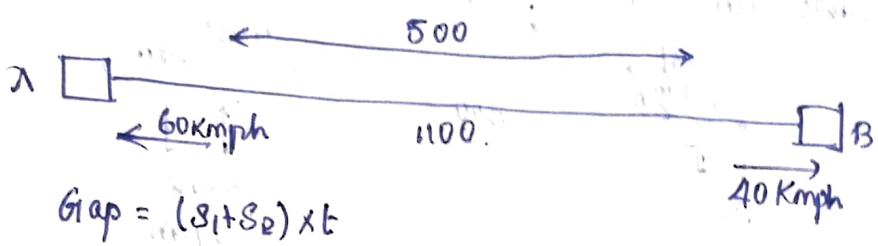
$t = \frac{500}{100}$

$\boxed{t = 5 \text{ hours}}$

∴ So they meet at 3.00 pm.

Objects Moving Away from Each Other. [Case 2]

2. Joe and Jane, standing 500 Km apart, start moving away from each other simultaneously in the opposite direction at 60 Kmph and 40 Kmph respectively. After how much time will the distance between them be 1100 Km ?



$$\text{Gap} = (S_1 + S_2) \times t$$

$$[1100 - 500] = [60 + 40] \times t$$

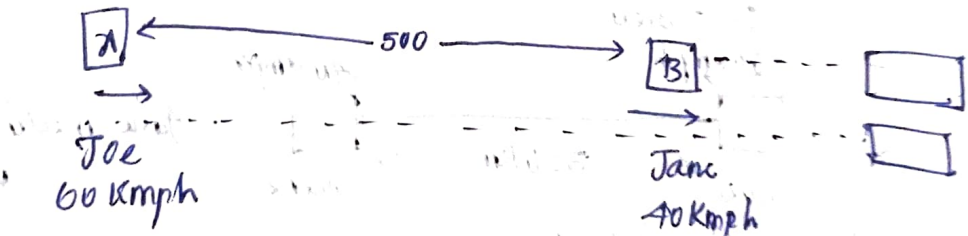
$$600 = 100t$$

$$\boxed{t = 6}$$

Objects Moving in same direction.

3. Jane is standing 500 Km towards east of Joe. If both start moving simultaneously towards the east of 40 Kmph and 60 Kmph simultaneously after how much time will the two of them meet ?

Soln:-



$$\text{Gap} = \text{R.S} \times t$$

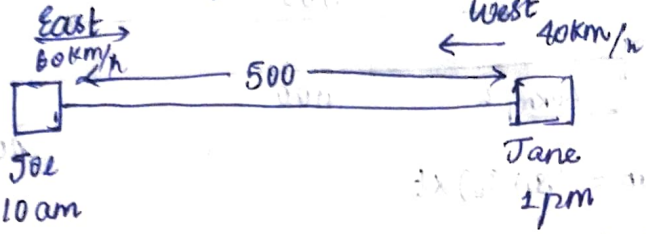
$$500 = (60 - 40) \times t$$

$$t = \frac{500}{20} \quad 25$$

$$\boxed{t = 25 \text{ Kmph}}$$

Objects moving in different direction and at different time.

4. Jane is standing 500km away from Joe. Joe start moving towards east at 60kmph at 10:00 am and Jane starts moving towards west at 1.00pm. At what time two of them will meet?



① If same time then only we can take net distance 500 & t.

So first we need to find out where is Joe at 1.00pm?

probably:

$10 - 1 \Rightarrow 3$ hrs

$D = 60 \times 3$

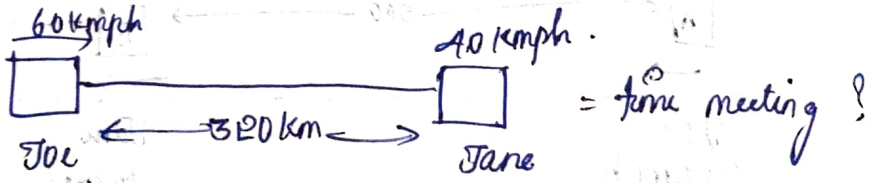
$\boxed{D = 180 Km}$

So Joe covered 180km at 1.00pm.

So now we need to calculate the distance:

$= 500 - 180$

$D = 320.$



So question becomes,

Jane is standing 500km away from Joe. Joe start moving towards east at 60 kmph at

$320 = (60+40)t$

$t = \frac{320}{100}$, 3hr 12 mins.

$\boxed{t = 3.2 hrs}$

So at the time 1.00 pm.

by adding 3 hrs & 12 mins to it,

So exactly they meet at 4.12 pm.

TRAIN PROBLEMS:

Four Main Concepts in Train Problems:

1) conversion
2) T&D Formula [Time & Distance]..
3) Train & Object
4) Theory of Relativity.

Type 1: Conversion.

Kmph to M/s $\longrightarrow \times 5/18$

M/s to Kmph $\longrightarrow \times 18/5$.

Type 2: Time & Distance Formula $\Rightarrow \left[S = D/t\right]$

1. A train is 200m long runs at 50m/s. Find t?

$l = 200\ m$

Length is nothing but distance covered by train.

$D = 200\ m, \quad S = 50\ m/s, \quad t = ?$

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

$$\Rightarrow t = \frac{200}{50}$$

$$\boxed{t = 4\ sec.}$$

Type 3: Train & Object:-

[Pole/man/tree] type 1 sums.

Eg: How much time the train took to cross the tree.

type 2 sums [Bridge/Tunnel/platform.]

Eg: When the Train crossed the bridge.

Problems:

1. A train 300m long is running at speed of 54 kmph. In what time it will pass a bridge of 100m long.

Soln:

Length of train $l_t = 300m$

Length of bridge $l_b = 100m$

$s = 54$ Kmph $\rightarrow \frac{54}{1} \times \frac{5}{18} = 15$ m/s

$s = \frac{d}{t} \Rightarrow \frac{l_t + l_b}{t}$

$t = \frac{300+100}{15}$

$t = \frac{400}{15}$ m/s.

$t = \frac{80}{3}$ m/s.

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

Soln:

Given Data:

10 kms in 10 mins

s t

$s = \frac{d}{t} = \frac{10 \times 1000}{10 \times 60}$

$s = \frac{100}{6} = \frac{50}{3}$ m/s.

$t = 6s$, $s = \frac{50}{3}$ m/s,

$s = \frac{d}{t} \Rightarrow \frac{l}{t} \Rightarrow l = s \times t$

$l = \frac{50}{3} \times 6 \times 2$

$\boxed{l = 100m}$

Length of the train is 100m.

3. A train moves past a man and a bridge of 260m long in 8s and 10s. What is the speed of train?

GD :- $d = l$.

$\Rightarrow$ man $s = \frac{d}{t} \Rightarrow l_t = (s)8 \longrightarrow (1)$

$\Rightarrow$ Bridge $l_t + l_b = (s)\,10$.

$l_t + 260 = 10(s) \longrightarrow (2)$.

$8(s) + 260 = 10s \Longrightarrow 2s = 260$.

$s = \frac{260}{2} \Rightarrow s = 130$ m/s.

$\therefore$ Speed = 130 m/s.

Type-4 : Theory of Relativity.

Train in Opp direction — Train in Same direction.

Problem.

1. Two trains 100m & 200m long at $s = 60$ kmph, $s = 30$ kmph in opp direction on parallel tracks what 't' to cross?

G.D :

$l_{t_1} = 100m$

$l_{t_2} = 200m$

$S_{t_1} = 60$ kmph

$S_{t_2} = 30$ kmph

$S_1 + S_2 = 60 + 30 = 90$ kmph

$= 90 \times \frac{5}{18}$

$S_{rel} = 25$ m/s

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

$\therefore t = \frac{300}{25} s$

2. 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 the slower train in 30s. Find length?

Soln:

$S = 10$ kmph.

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

$l_1 = l_2$

$t = 30s$

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

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

$\Rightarrow l_1 \Rightarrow \frac{125}{3} m$