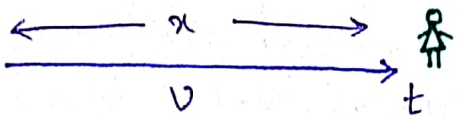
: Time Speed Distance :

24.08.2018

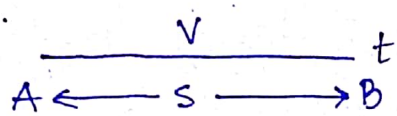
Section A (Formula Based) :

⇒ Important Formulas :

1. 

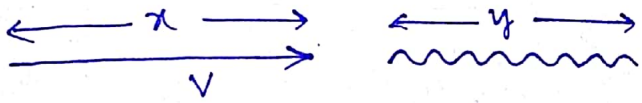
A train x m long crosses a person in t sec. When a train crosses a person, the distance cover by the train is the length of the train. If speed of train is V,

$$\therefore V = \frac{x}{t} \quad \text{or } t = \frac{x}{V} \quad \text{or } x = Vt .$$

2. 

A to B a terminal, distance is S. A car cover S distance in t time, the speed of the car is V,

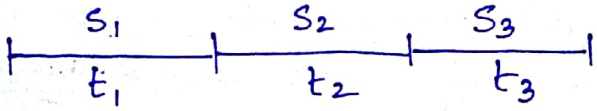
$$\therefore V = \frac{S}{t} \quad \text{or, } S = Vt, \text{ or } t = \frac{S}{V} .$$

3. 

A train x m long moving with a speed V crosses another train or bridge or platform having length, the distance cover by the train is (length of the train + length of the platform) / time.

$$\therefore V = \frac{x + y}{t} .$$

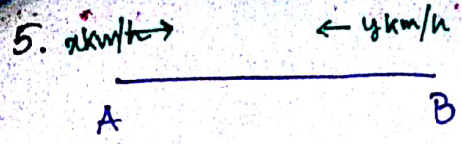
4. Avarage Speed :



A car covers S_1 dist in t_1, S_2 dist in t_2 times and S_3 dist in t_3 times. So, avarage

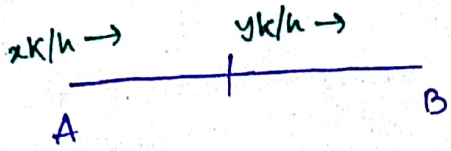
$$\text{Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$\text{Avg} = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3}$$

5. 

A man cover A to B with a ~~dist~~. ~~speed~~ speed xkm/hr and return back with a dist ykm/h.

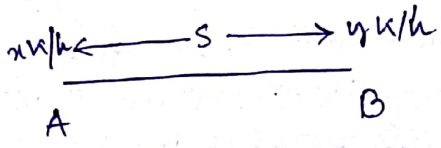
or,



A man covers half of the dist xk/h and half of the distance yk/h

$$\therefore \text{Avarage Speed} = \frac{2xy}{x+y}$$

Proof:



Let consider distance is s, forward journey xk/h backward journey yk/h

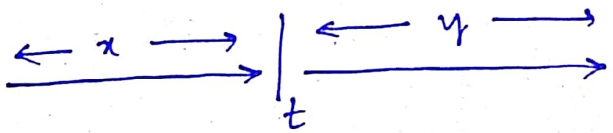
$$\therefore \text{Total journey} = s + s = 2s$$

$$\text{time} = \frac{\text{dist.}}{\text{Speed}} = \frac{s}{x} \text{ or } \frac{s}{y}.$$

$$\therefore \text{Avg. speed} = \frac{2s}{\frac{s}{x} + \frac{s}{y}} = \frac{2s}{s\left(\frac{1}{x} + \frac{1}{y}\right)}$$

$$= \frac{2}{\frac{x+y}{xy}} = \frac{2xy}{x+y}.$$

6. Relative Speed:



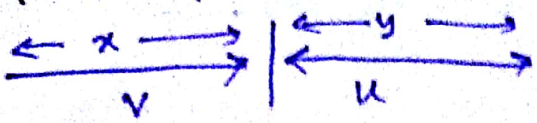
$v > u$

A train length x moving with a speed v, another train length y moving with a speed u **same dir.** if $v > u$, second train cross first train.

$\therefore$ Relative speed in same direction:

$$v - u = \frac{x+y}{t}.$$

7. Relative Speed :

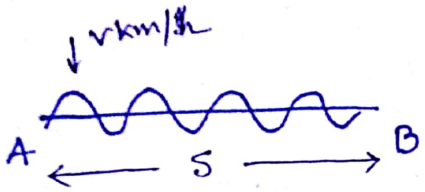


A train length x moving with a speed v. Second train of length y, move with a speed u in opposite direction.

∴ Relative speed in opposite direction :

$$v + u = \frac{x+y}{t}$$

8.



$t_1 \rightarrow$ D.S.

$t_2 \rightarrow$ U.S.

A and B are two terminal of a river, the relative speed of the river is u km/h and speed of water is v km/h The dist between A and B is S. The boat takes t_1 hour to cover a stream in down stream and takes t_2 hour to cover a stream in upstream

downstream: $v + u = \frac{S}{t_1}$ — (1)

upstream: $v - u = \frac{S}{t_2}$ — (2).

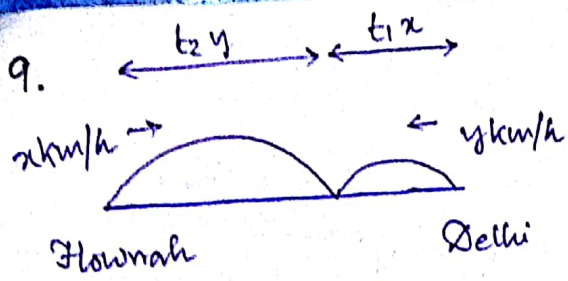
$$v = \frac{S}{2}\left(\frac{1}{t_1} + \frac{1}{t_2}\right)$$

$$u = \frac{S}{2}\left(\frac{1}{t_1} - \frac{1}{t_2}\right)$$

} (if S is given)

if S is not given,

$$\frac{v}{u} = \frac{t_2 + t_1}{t_2 - t_1}$$

9. 

Two train one started from Howrah, one started from Delhi with a speed of x k/h and with a speed of y k/h. After their crossing 1st train reach Delhi in t_1 hour, 2nd train reach Howrah in t_2 hour.

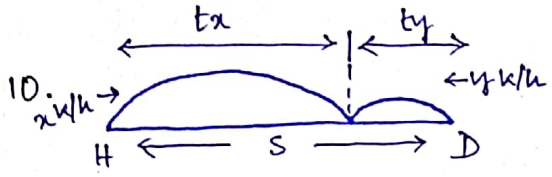
∴ The speed ratio of 2 train,

$$\frac{x}{y} = \sqrt{\frac{t_2}{t_1}}$$

proof : $t_2 y = t_1 x$.

or, $t_1 x^2 = t_2 y^2$

or, $\frac{x^2}{y^2} = \frac{t_2}{t_1}$ or, $\frac{x}{y} = \sqrt{\frac{t_2}{t_1}}$

10. 

Here the qv statement is same as above, . The dist. S is given here.

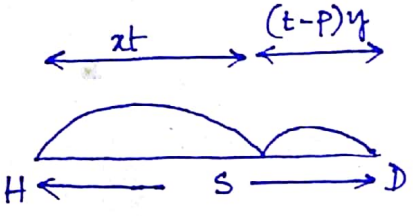
So, they will meet each other after time —

$$t = \frac{S}{x + y}.$$

proof : $tx + ty = S$.

$t(x+y) = S$.

$t = \frac{S}{x+y}$.

11. 

Two train one started from Howrah with a speed of x k/h and 2nd train started p hour after 1st train.

∴ When and where they will meet after t time?

$$t = \frac{S + p \times y}{x + y}.$$

proof : $tx + (t-p)y = S$ or, $xt + ty - py = S$.

or, $t = \frac{S + py}{x+y}$.

12. Convert km/h → m/s

$$\text{km/h} \times \frac{5}{18} = \text{m/s}$$

proof :- $\text{k/h} = \frac{1000}{60 \times 60} = \frac{5}{18}$ m/s.

⇒ 18 k/h = 5 m/s.
⇒ 36 k/h = 10 m/s.
⇒ 72 k/h = 20 m/s.

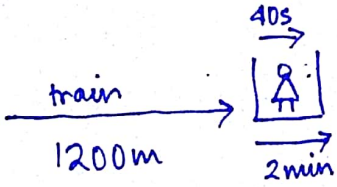
Problems :

1. A train 1200m. long crosses a platform in 40 sec. Find out the speed of the train in terms of km per hour.

— Apply rule (1).

speed of the train $= \frac{1200}{40} \times \frac{18}{5} = 108$ km/h.

2. A person standing on a platform observe a train 1200 m long crosses him in 40 sec & crosses the platform in 2 min Find out the length of platform.



As speed = $\frac{\text{dist.}}{\text{time}}$.

∴ when it crosses the man, speed is —

$$\frac{1200}{40}$$

& when it crosses the platform speed is —

$$\frac{1200+x}{2 \times 60}$$ [From rule 3].

$$\therefore \frac{1200}{40} = \frac{1200+x}{2 \times 60}$$

or, $1200 \times 30 = 1200 + x$

or, $x = 2400$

∴ length of platform is 2400 m.

k@ust@r

3. A train 1200m long moving with a speed 40m/sec. Another train which is 200m ahead from first train 800m long moving in a same direction with a speed of 20 m/s. Find out what time is requaired to cros the 2nd train by 1st train.

(from rule 3)

$$40 - 20 = \frac{1200 + 200 + 800}{t}$$

$$20 = \frac{2200}{t}$$

or, $t = 110$ s.

4. A boy went to his school with a speed of 40 km/h & return 60 km/h. What is the avg. speed of the boy.

(Rule 5)

$$\text{avg speed} = \frac{2 \times 60 \times 40}{60 + 40}$$

$$= 48 \text{ km/h}.$$

5. A boat takes 8 hours to cover 400km in downstream and takes 12 hours to cover same distance in upstream What is speed of boat in stream water & speed of stream.

(Rule - 8)

$$v = \frac{400}{2}\left(\frac{1}{12} + \frac{1}{8}\right) = \frac{125}{3}$$

$$u = \frac{400}{2}\left(\frac{1}{8} - \frac{1}{12}\right) = \frac{25}{3}.$$

6. A boat takes 4 hrs to cover certain distance in down stream and takes 5 hrs to cover same distance in upstream What is the ratio of boat in stream water to speed of stream.

(Rule - 9)

$$\frac{v}{u} = \frac{5+4}{5-4} = \frac{9}{1} = 9:1.$$

7. 2 trains one started from Howrah & other from Delhi at the same time to ~~their~~ opp. direction. After their crossing, they reach dest. in 4hrs & in 9 hrs. respectively. What is the ratio of velocity of 2 train

$$\frac{x}{y} = \sqrt{\frac{9}{4}} = \frac{3}{2} = 3:2.$$

8. 2 train one started from Howrah & other from Delhi at the same time to opp. direction with a speed of 60k/hr & 40 km/hr respectively. If the distance between Howrah & Delhi is 1000 km. Then when & where they will meet?

$$t = \frac{1000}{60+40} = 10 \text{ km/h}.$$

9. 2 trains one started from Howrah other from Delhi to their opp. direction with speed of 40 km/h. & 60 km/h. Second train started 4 hr after 1st train if the dist. between Howrah & Delhi is 1000 km, then when and where they will meet.

(Rule - 11) $t = \frac{1000 + 4\times60}{60+40} = \frac{1240}{100} = 12.4 \text{ km/h}.$

Section - B (Conceptional Problem):

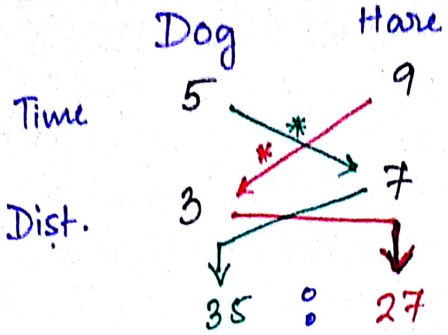
1. At the same time a dog jumps 5 steps. But a hare 9 steps. Dist. cover by dog in 3 steps is equal the distance cover by the hare in 7 steps are equal. What is speed ratio of dog & hare?

– General way :-

dog	hare
in 3 steps cover x dist	in 7 steps cover x dist.
" 1 " " $\frac{x}{3}$ "	in 1 " " $\frac{x}{7}$ "
" 5 " " $\frac{x}{3}\times5$ "	" 9 " " $\frac{x}{7}\times9$.

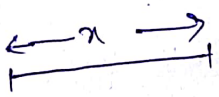
$\therefore \frac{5x}{3} : \frac{9x}{7} = 35 : 27.$

Shortcut way :



2. A man observed, if he moves with a speed of 40k/h He will be late by 15 min. But if he can move with a speed of 60 km/h, he will be earlier by 20 min. What dist. he have to cover? What will be the optimum speed so that the man can reach the dist. in scheduled time?

— **Normal Method :** Let us consider the man has to cover x dist.



$15 \text{ min} = \frac{15}{60} = \frac{1}{4}$ hour.

$30 \text{ min} = \frac{30}{60} = \frac{1}{2}$ hour

If he moves with a speed of 40 k/h and late by 15 min

$\therefore$ schedule time $= \frac{x}{40} - \frac{1}{4}$

If he moves with speed 60k/h, early by 20 min.

$\therefore$ scheduled time $= \frac{x}{60} + \frac{1}{3}$

$\therefore \frac{x}{40} - \frac{1}{4} = \frac{x}{60} + \frac{1}{3}$

$\therefore x = \frac{1/4 + 1/3}{1/40 - 1/60}$

Shortcut : $\text{Distance} = \frac{\text{Late Hours} + \text{Early hours}}{\frac{1}{\text{Late velocity}} - \frac{1}{\text{early velocity}}}$

40K — 15m → 1/4

60K — 20m → 1/3

$= \frac{1/4 + 1/3}{1/40 - 1/60}$

$= 70$ m.

Optimum speed = 40 (15 min) = 8 km/h.

3. A student got 40% marks and fail by 20 marks another student got 60% marks, he got 10 more than his pass marks.

i) What is the full marks?

ii) " " " pass marks?

$$\text{Full marks} = \frac{\text{shortage marks} + \text{Excess marks}}{\text{difference of \%}} \times 100$$

$$= \frac{20 + 10}{(60 - 40)} \times 100$$

$$= \frac{30}{20} \times 100 = 150$$

$$\therefore \text{Pass marks} = \left(150 \times \frac{40}{100}\right) + 20$$

$$= 60 + 20 = 80.$$