$S = \frac{D}{T}$

Time, Speed & Distance

Avg. Speed

90 km/hr — 100 km/hr

A — B — C

$\frac{54\text{ km}}{1\text{ hr}} = \frac{54 \times 1000}{1 \times 60 \times 60}$

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

Avg.

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

20 m/s → $20 \times \frac{18}{5} = 72$ km/hr

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

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

Avg. Speed = $\frac{T \cdot D \cdot T}{T \cdot T \cdot T}$

Q.

40 km/hr — 60 km/hr

A — B — C

x — x

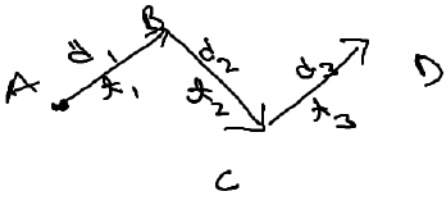
AB = BC

Avg. Speed = ?

$\frac{T \cdot D \cdot T}{T \cdot T \cdot T} = \frac{x + x}{\frac{x}{40} + \frac{x}{60}} = \frac{2x}{x\left(\frac{3+2}{120}\right)}$

$= 2 \times \frac{24}{5} = 48$ km/hr

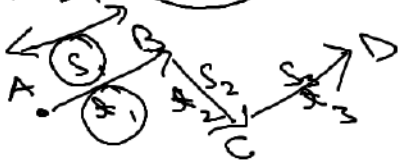
(i) when distance & time is given



Avg. Speed = $\frac{T \cdot D \cdot T}{T \cdot T \cdot T} = \frac{d_1 + d_2 + d_3}{t_1 + t_2 + t_3}$

(ii)

$S_1 = \frac{d_1}{t_1} \Rightarrow d_1 = S_1 t_1$

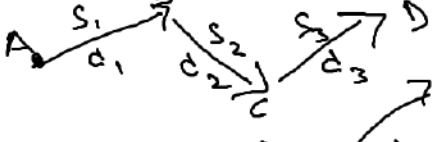


Avg. Speed = $\frac{T \cdot D \cdot T}{T \cdot T \cdot T}$

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

$S_1 = \frac{d_1}{t_1} \Rightarrow t_1 = \frac{d_1}{S_1}$

(iii)



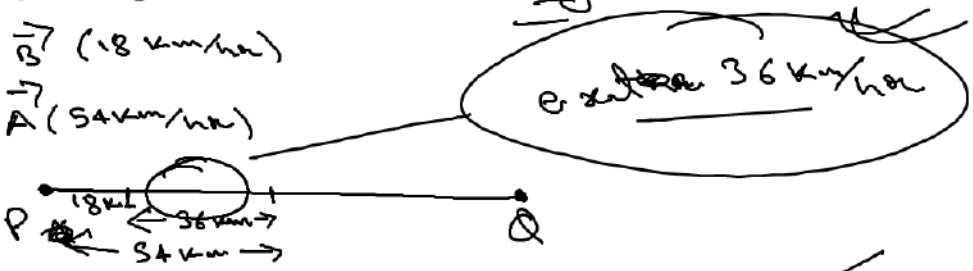
Avg. Speed = $\frac{T \cdot D \cdot T}{T \cdot T \cdot T} = \frac{d_1 + d_2 + d_3}{\frac{d_1}{S_1} + \frac{d_2}{S_2} + \frac{d_3}{S_3}}$

* Relative motion —

Same direction case :- w.r.t another body

B → (18 km/hr)

A → (54 km/hr)



$$R.S = s_A - s_B$$

$= 54 - 18$

$= 36$ km/hr

(ii)

$$R.S = s_A + s_B$$

$= 54 + 18$

$= 72$ km/hr

$s = \frac{d}{t}$

If t is const. $s_A : s_B = 2:3$ $d_A : d_B = 2:3$

If d is const. $s_A : s_B = 2:3$, $t_A : t_B = 3:2$

Q. $s_{Kanan} = 40$ km/hr $\quad s_{Anjum} = 60$ km/hr

Find ratio of time taken to cover the same distance.

Sol.

$s \propto \frac{1}{t}$ (d)

↓ inverse

$\frac{s_K}{s_A} = \frac{40}{60} = \frac{2}{3}$

$\frac{t_K}{t_A} = \frac{3}{2}$

Q.

(K)

20 km/hr → 4 min late

Scheduled time

25 km/hr → 4 min early

$d = ?$

distance of school.

Q. Shweta when increases her speed 24 km/hr to 30 km/hr she takes one hour less than the usual time to cover a certain distance. what is the distance usually covered by Shweta?

Sol.

$d = 24 \times x = 30(x-1)$

$d = 24 \times 5$

$= 120$ km

$24x = 30x - 30$

$30 = 6x$

$x = 5$

Distance → D

$t_1 - t_2 = 1$

$\frac{D}{24} - \frac{D}{30} = 1$

$D\left(\frac{1}{24} - \frac{1}{30}\right) = 1$

$D\left(\frac{5-4}{120}\right) = 1$

$D\left(\frac{1}{120}\right) = 1$

$D = 120$ km

II nd method

$t_1 - t_2 = \frac{6}{60}$

$\frac{d}{20} - \frac{d}{25} = \frac{1}{10}$

$d\left(\frac{1}{20} - \frac{1}{25}\right) = \frac{1}{10}$

$d\left(\frac{5-4}{100}\right) = \frac{1}{10}$

$d = 10$ km

10 m

$\frac{10}{60} = \frac{1}{6}$ hr

$d = 20\left(x + \frac{4}{60}\right) = 25\left(x - \frac{2}{60}\right)$

$20x + \frac{80}{60} = 25x - \frac{50}{60}$

$\frac{130}{60} = 5x$

$30 \quad x = \frac{13}{30}$

$d = 20 \times \left(\frac{26+4}{60}\right)$

$= 20 \times 30$

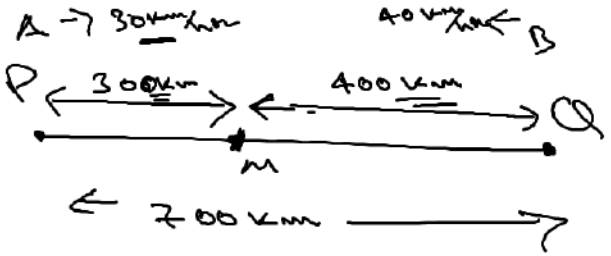
$d = 600$

$d = 20 \times \left(\frac{13}{30} + \frac{4}{60}\right)$

$= 20 \times \left(\frac{26+4}{60}\right)$

$= \frac{10}{20} \times \frac{30}{60} \times$ = 10 km

Q.



(i) $t = \frac{700}{R.S} = \frac{700}{70} = 10 hr$

(ii) $\frac{PM}{MQ} = \frac{300}{400} = \frac{3}{4}$.

(iii) MQ → 400

(iv)

$t_A \rightarrow \frac{700}{30} = \frac{70}{3}$

$t_B \rightarrow \frac{700}{40} = \frac{70}{4}$

$\frac{400}{30} \times \frac{40}{300}$ → $\frac{16}{9}$

$t_A - t_B = \frac{70}{3} - \frac{70}{4}$

$= 70\left(\frac{1}{3} - \frac{1}{4}\right)$

$= 70\left(\frac{4-3}{12}\right) = \frac{70}{12}$ hr

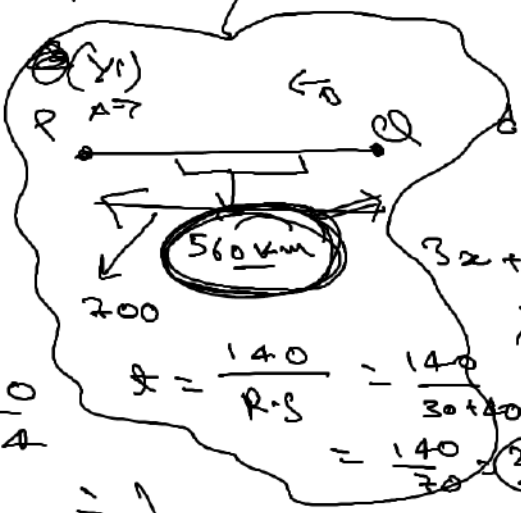
$= 5\frac{5}{6}$ hr → 5 hrs $\frac{5}{6} \times 60$ → 5 hrs 50 min.

(v) Aft. meeting

$t_A = \frac{400}{30}$, $t_B = \frac{300}{40}$

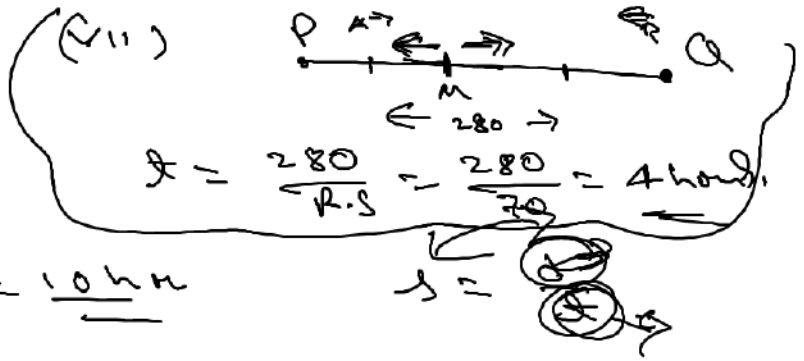
Req. ratio $= \frac{400/30}{300/40} = \frac{16}{9}$

(vi)



$t = \frac{140}{R.S} = \frac{140}{30+40} = \frac{140}{70} = 2 hr$

(vii)



$t = \frac{280}{R.S} = \frac{280}{70} = 4 hrs$.

Speed → $\frac{s_A}{s_B} = \frac{3}{4}$

$\frac{d_A}{d_B} = \frac{3}{4}$ → 300 → 400

$d_A = 3x$

$d_B = 4x$

$3x + 4x = 700$

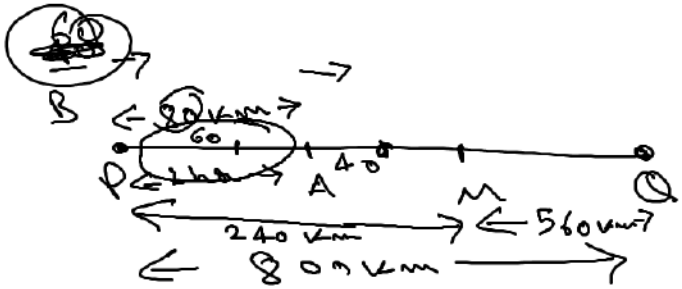
$7x = 100$

$x = 100$

6) 35 (5
30
5

5 5/6

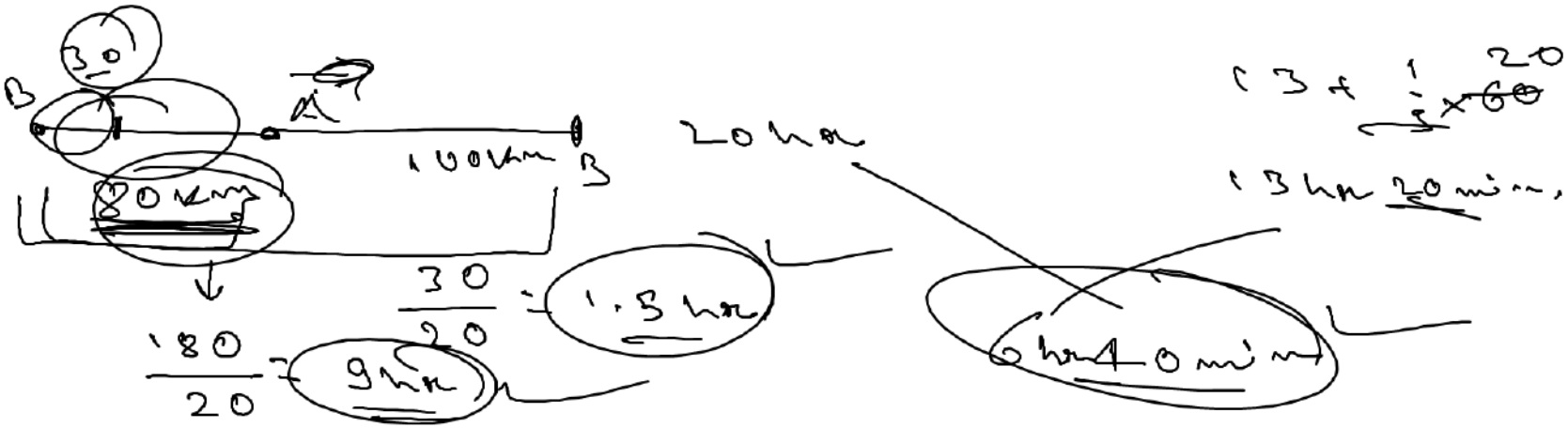
Q.



$$\frac{80}{R.S} = \frac{80}{20} = 4\text{ hr}$$

$6 : 4 = 3 : 2$

$40 \quad 1 \quad 3 \quad : \quad 3$
3



Train Based

Q.

A train crossed a tree in 10 s.

$l = 150\ m$

$s_t = ?$

$s_t = \frac{l}{t} = \frac{150}{10} = 15\ m/s$

$15 \times \frac{18}{5} = 54\ km/hr$

crossing $\Rightarrow$ 7.5 s.

Q.

$s_t = \frac{l}{t} = \frac{l}{7.5}$

$l = ?$

$30 = \frac{l}{7.5} \Rightarrow l = 30 \times 7.5$

$= 225m$

Q. $l = 250m$

$b = 150m$

20 s.

$s_t = \frac{l+b}{20}$

$= \frac{250+150}{20}$

$= \frac{400}{20} = 20\ m/s$

* Boats & Streams —

boat speed in still water (b)

River flow (s) → Speed of stream / current

Upstream — opp. to river flow (oppose)

Speed (u) ⇒ R·S ⇒ (b − s)

Downstream — same as river flow (support)

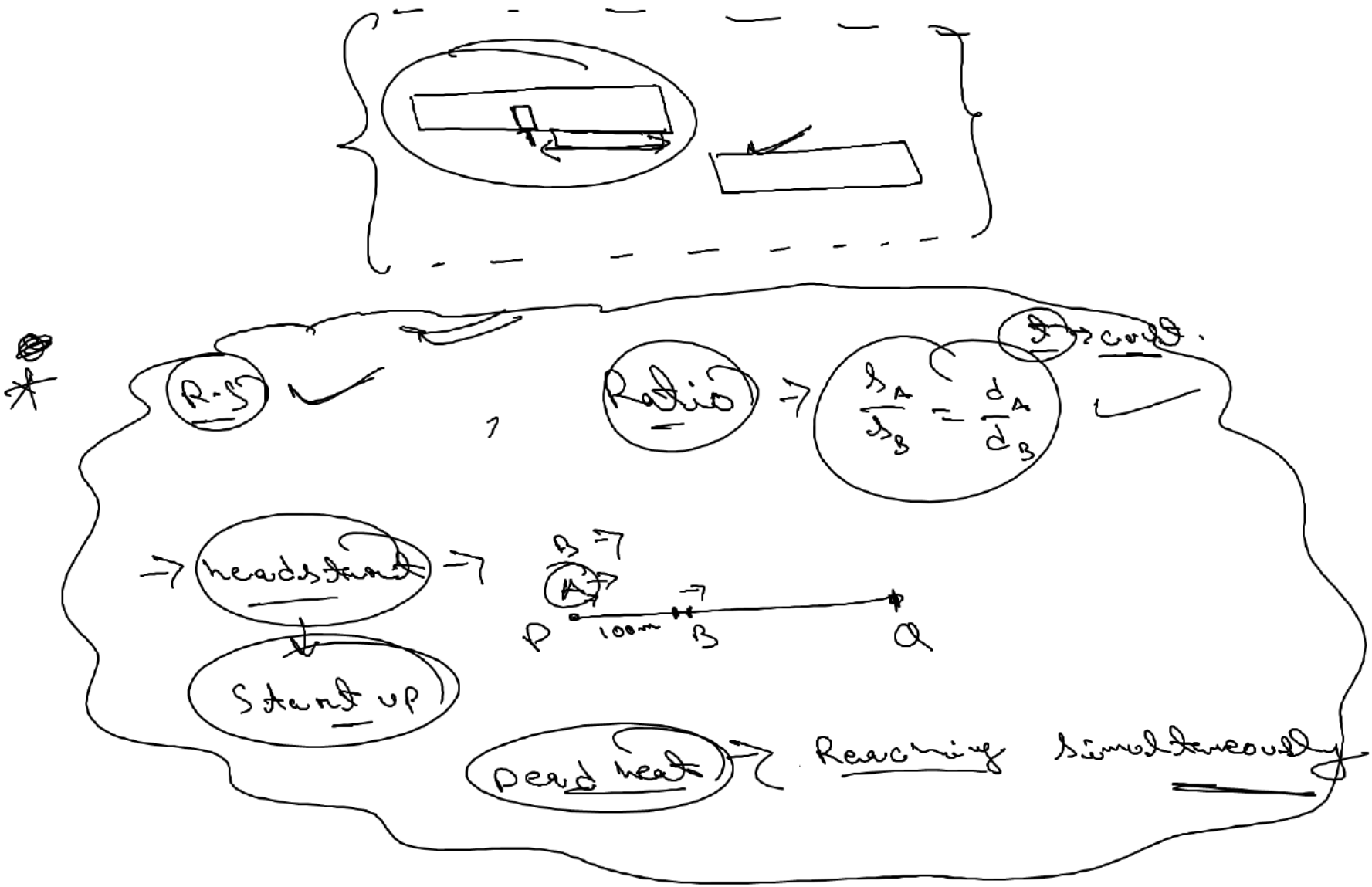
(d) ⇒ R·S ⇒ b + s

* If $d_u = d_d$

$$\frac{t_d}{t_u} = \frac{s_u}{s_d}$$

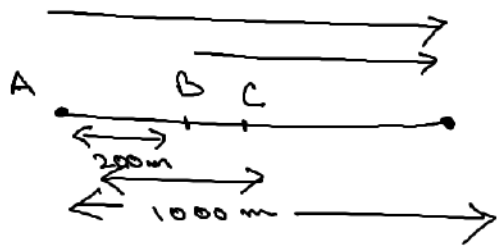
Speed of (boat) in still water = $\frac{d+u}{2} = \frac{b+s+b-s}{2} = \frac{2b}{2} = b$

Speed of stream = $\frac{d-u}{2} = \frac{(b+s)-(b-s)}{2} = \frac{b+s-b+s}{2} = \frac{2s}{2} = s$


R.S
Ratio
$\frac{s_A}{s_B} = \frac{d_A}{d_B}$
headstand
Stand up
A
B
P
100m
B
Q
Dead heat
Reaching
simultaneously

Q. A can give B a 200m startup and C a 300m startup in a race of 1 km. How many metre startup can B give to C in a 1 km race.

Sol.



$\frac{s_A}{s_B} = \frac{d_A}{d_B} = \frac{1000}{800} = \frac{5}{4}$

$\frac{s_A}{s_C} = \frac{d_A}{d_C} = \frac{1000}{700} = \frac{10}{7}$

$\frac{s_A}{s_B} = \frac{5}{4}$

$\frac{s_A}{s_C} = \frac{10}{7}$

$400x = 4000$

$x = 10$

$\frac{s_A/s_B}{s_A/s_C} = \frac{5/4}{10/7} \rightarrow \frac{s_A}{s_B} \times \frac{s_C}{s_A} = \frac{5}{4} \times \frac{7}{10} \Rightarrow \frac{s_C}{s_B} = \frac{7}{8}$

$\frac{d_C}{d_B} = \frac{7}{8}$

$d_C = 7x = 875$

$d_B = 8x = 1000$

$125\,m$

$\frac{s_A}{s_B} = \frac{20}{17}, \quad \frac{s_B}{s_C} = \frac{20}{19}$

$\frac{s_A}{s_C} = \frac{s_A}{s_B} \times \frac{s_B}{s_C} = \frac{20}{17} \times \frac{20}{19} = \frac{400}{323}$

$\frac{d_A}{d_C} = \frac{4000}{3230}$

1000

$270m$

$8x = 1000$

$x = 125$

Q.

$$\frac{s_A}{s_B} = \frac{d_A}{d_B} = \frac{2500}{2000} = \frac{5}{4}$$

$$\frac{s_B}{s_C} = \frac{2000}{1200} = \frac{5}{3}$$

$\frac{s_A}{s_C}$

$$\frac{s_A}{s_B} \times \frac{s_B}{s_C} = \frac{5}{4} \times \frac{5}{3} = \frac{25}{12}$$

$$\frac{d_A}{d_C} = \frac{25}{12}$$

$$\frac{d_A}{d_C} = \frac{3000}{1440} \text{ km}$$

$$25x = 3000$$

$$x = 120$$

$$d_A = 25x = 3000$$

$$d_C = 12x = 12 \times 120 = 1440$$

3 km → 1560

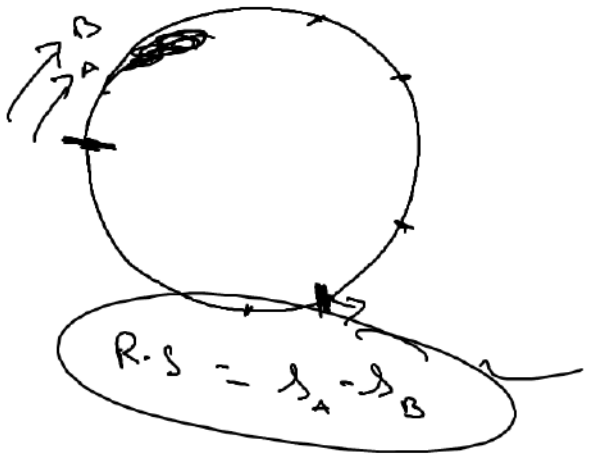
1 km → 520

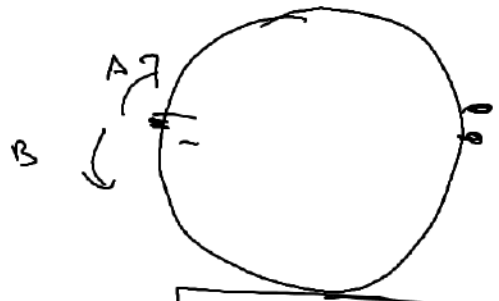
$$\frac{d_A}{d_C} = \frac{25 \times 40}{12 \times 40} = \frac{1000}{480} \text{ km}$$

$$25x = 1000$$

$$x = 40$$

Circular Motion





$H.C.F\left(\frac{2}{3}, \frac{5}{6}\right) = \frac{H.C.F(2,5)}{L.C.M(3,6)} = \frac{1}{6}$

H.C.F

4, 6

2 | 4
2 | 2
1

2 | 6
3 | 3
1

R.S

2 → 2
5 → 5

12, 18

H.C.F = 1

2 | 12
2 | 6
3 | 3

2 | 18
3 | 9
3

$12 = 2 \times 2 \times 3$

$18 = 2 \times 3 \times 3$

$4 \to 2 \times 2$

$6 \to 2 \times 3$

H.C.F = 2×3 = 6.

H.C.F = 2

5, 12, 13

1. 2 body system

3 body system

(a) 1st meeting - $t = \frac{\text{Length of track}}{R.S}$

(b) 1st meeting at starting pt. -

time = L.C.M (T_A, T_B)

$= L.C.M\left(\frac{1}{s_A}, \frac{1}{s_B}\right)$

$L.C.M\left(\frac{2}{3}, \frac{5}{6}\right) = \frac{L.C.M(2,5)}{H.C.F(3,6)} = \frac{10}{3}$

(a) 1st meeting - $t = L.C.M\left(\frac{L}{R.S_{AB}}, \frac{L}{R.S_{AC}}\right)$

$L.C.M\left(\frac{600}{50-20}, \frac{600}{50-30}\right)$

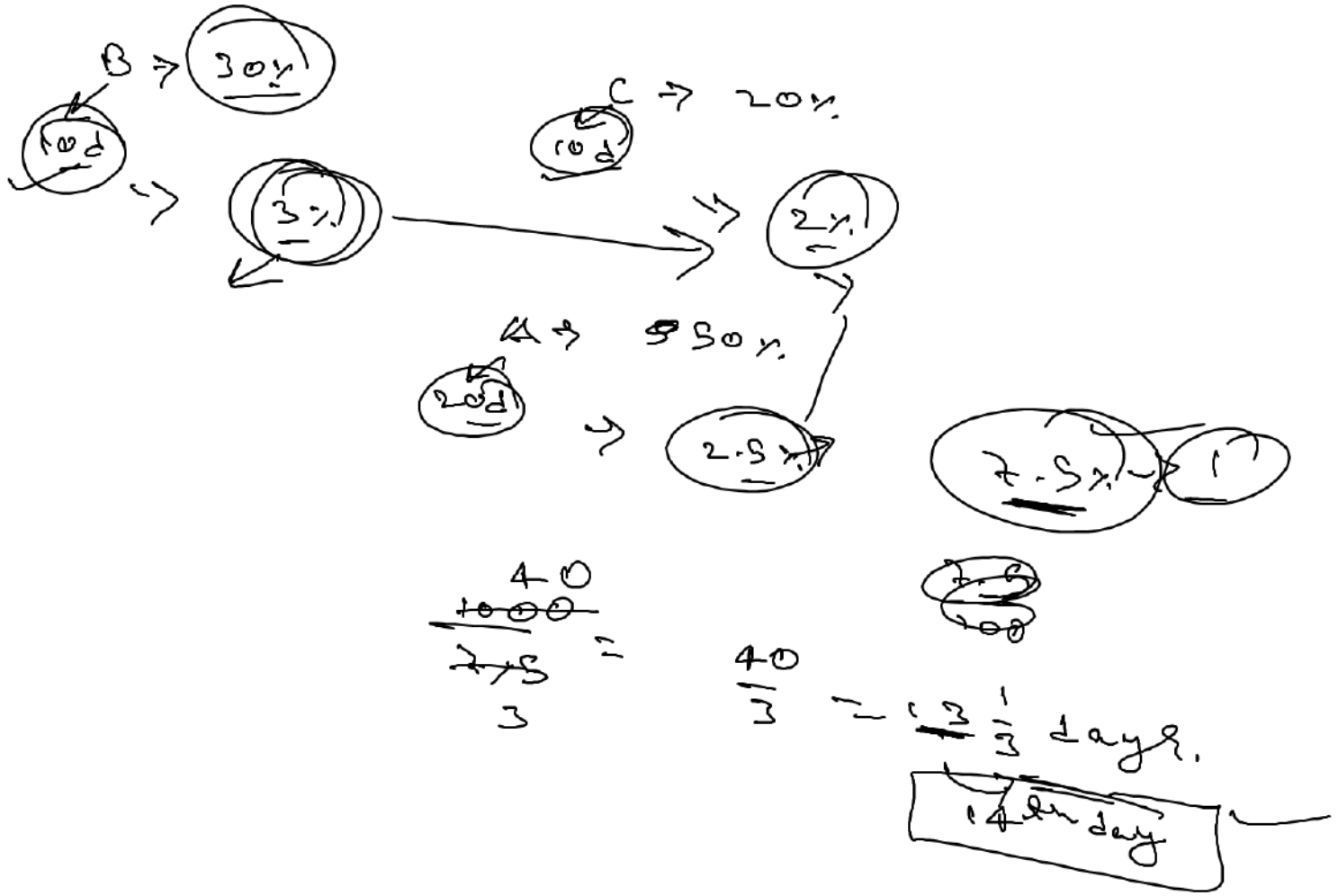
$L.C.M(20, 30) = 60$ s

(b) 1st meeting at starting pt. -

$t = \left(\frac{L}{s_A}, \frac{L}{s_B}, \frac{L}{s_C}\right)$

$L.C.M\left(\frac{L}{13-5}, \frac{L}{13+2}\right)$

speed


B → 30%
10d
3%
C → 20%
10d
2%
A → 50%
20d
2.5%
2.5%
1
40
1000
2.5
3
40
3
13 1/3 days.
14th day