ARJUNA NEET BATCH

KINEMATICS

LECTURE - 15

MR*

NEET

Today's goal

#Relative Motion
in one-Dim^{n}
With numerical
& MOKSHA

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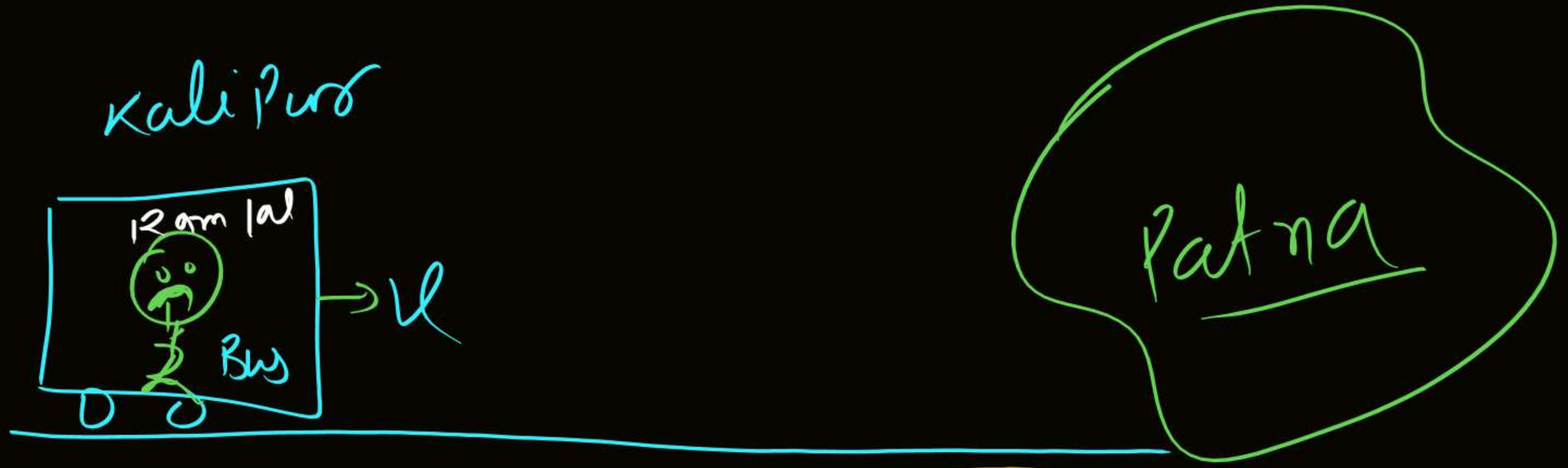
Relative Motion

- मंजु बुआ (manju)
- Munni Mami
- Pinki Mami
- Chacha
- Kallu uncle.

Change in Position w.r.t time

भोला रामलो Ram!

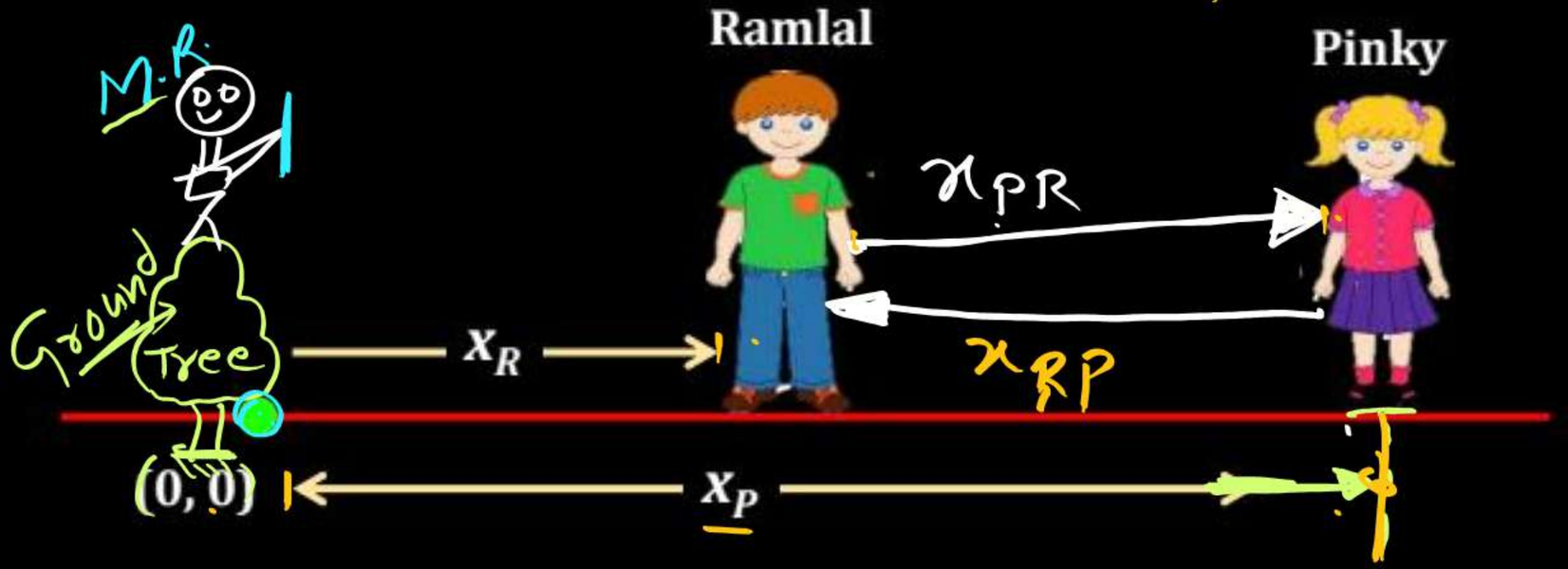


Velocity of Bus w.r.t Ramlal = 0

Velocity of Patna w.r.t Ramlal ≠ 0

RELATIVE MOTION IN 1-D

x_{PR} = (Position of Pinky w.r.t Ramlal) $= x_P - x_R$



$x_{PR} = -x_{RP}$

- x_R = Position of Ramlal from origin (Ground)
- x_P = Position of Pinky from origin (Ground)
- x_{RP} = Position of Ramlal with respect to Pinky. $= x_R - x_P$

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Ratta :-

x_{AB} = Position of [A] w.r.t [B] $= \vec{x}_A - \vec{x}_B$

$x_{PR} = x_P - x_R$ (Position of Pinky w.r.t Ramlal)

Differentiate w.r.t time

$$\frac{d\vec{x}_{PR}}{dt} = \frac{d\vec{x}_P}{dt} - \frac{d\vec{x}_R}{dt}$$

$$\# \vec{V}_{PR} = \vec{V}_P - \vec{V}_R$$

↳ Relative velocity of Pinky W.r.t Ramlal

$x_{R(P)} = x_R - x_P$ (Position of Ramlal w.r.t Pinky)

diff^n w.r.t time

$$\# \vec{V}_{R(P)} = \vec{V}_R - \vec{V}_P$$

↳ velocity of Ramlal w.r.t Pinky

$$V_{RP} = V_R - V_P$$

$$V_{PR} = V_P - V_R$$

↳ velocity of Pinky w.r.t Ramlal

↳ diff^n w.r.t time

$$\vec{a}_{RP} = \vec{a}_R - \vec{a}_P$$

$$\vec{a}_{PR} = \vec{a}_P - \vec{a}_R$$

↳ acc^n of Pinky w.r.t Ramlal

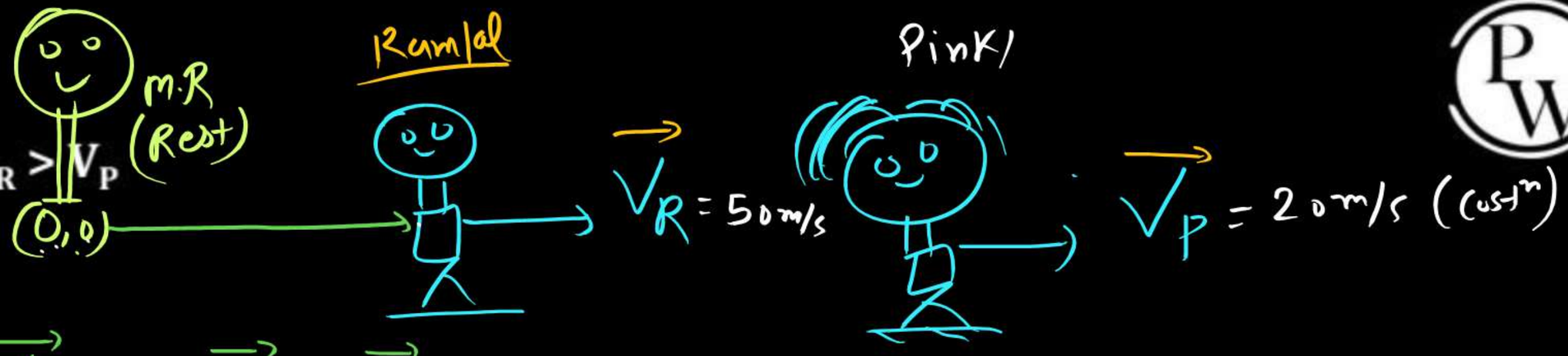
$\therefore$ $\vec{x}_{PR} = x_P - x_R$

↳ Position Pinky w.r.t Ramlal

$$\vec{V}_{PP} = 0 = V_P - V_P = 0$$

$$\vec{V}_{RR} = 0$$

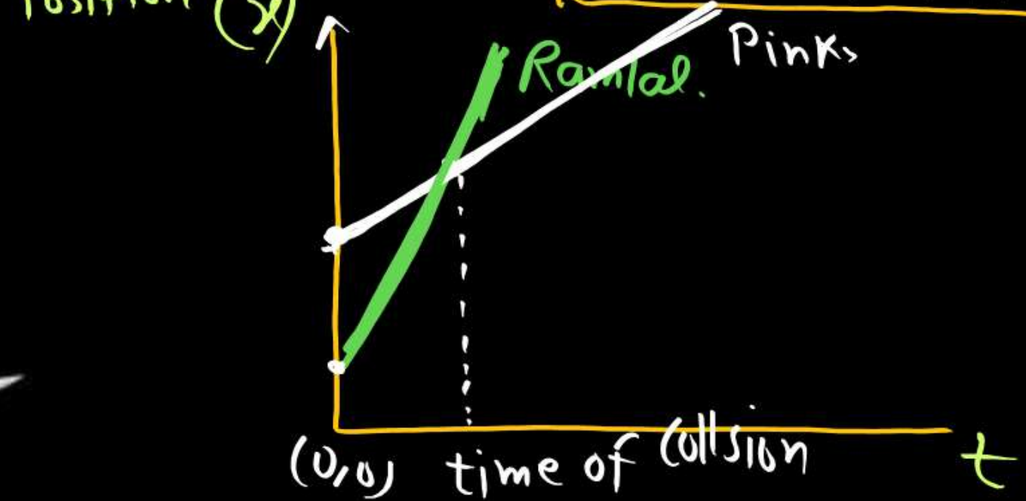
Case - 1 : $V_R > V_P$

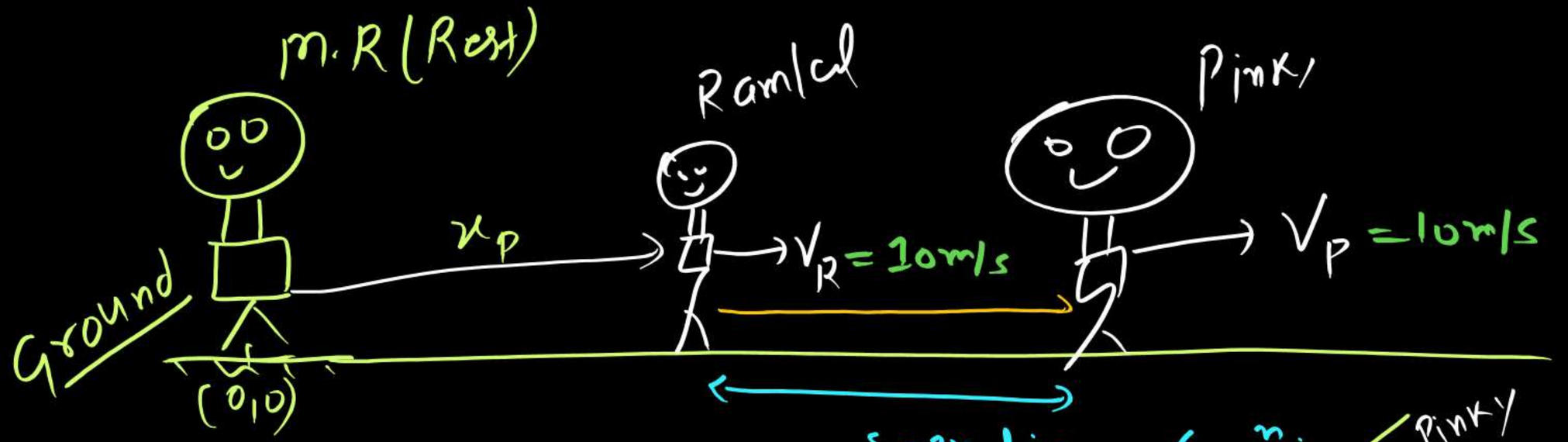


$$\vec{V}_{RP} = \vec{V}_R - \vec{V}_P = 50 - 20 = 30\,m/s$$

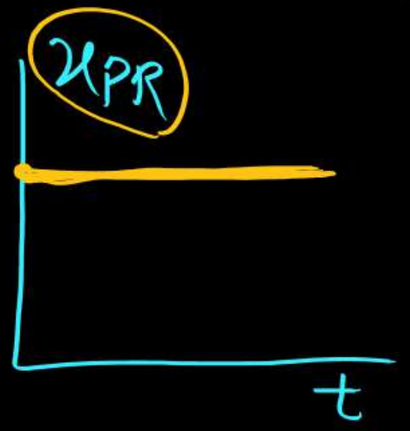
$$\vec{V}_{PR} = \vec{V}_P - \vec{V}_R = 20 - 50 = -30\,m/s$$

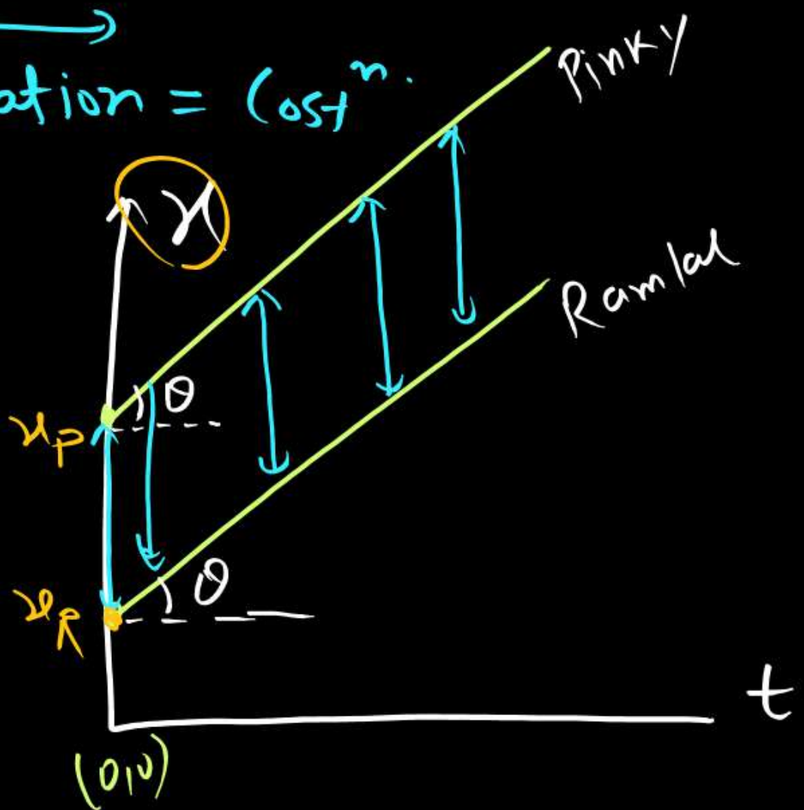
→ velocity of Pinky w.r.t Ramlal





Case -2 : $\vec{V_R} = \vec{V_P}$





$V_{PR} = 10 - 10 = 0 \ m/s$

$V_{RP} = 0 \ m/s$

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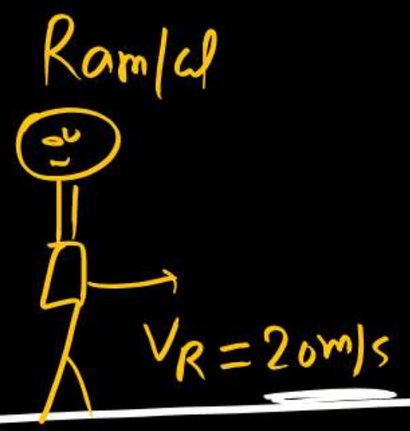
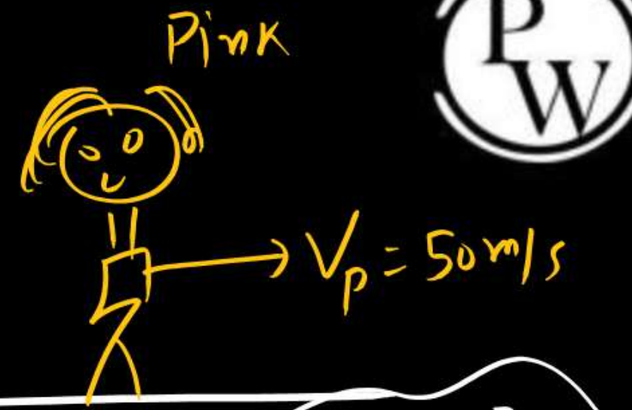
Case – 3 : $V_P > V_R$

$V_{R(M.R)} = 20\ m/s \;|\; V_{P(M.R)} = 50\ m/s$

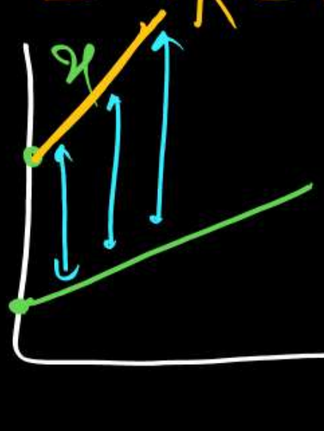




$$\# \vec{V}_{PR} = \vec{V}_P - \vec{V}_R = V_P - (-V_R)$$

$$= 50 - 20 = 30\ m/s$$

$$\# \vec{V}_{RP} = \vec{V}_R - \vec{V}_P = 20 - 50 = -30\ m/s \text{ (Backward)}$$



$\vec{V}_{RP} = -\vec{V}_{PR}$

always valid

⇒ True

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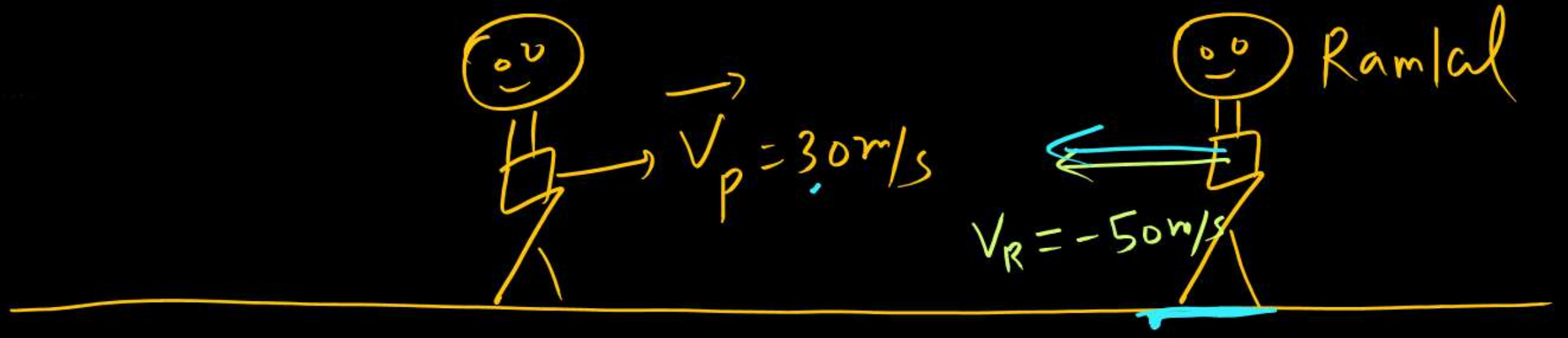


मजदूरी

Case – 4 : $\vec{V}_P$ = +ve $\quad$ $\vec{V}_R$ = –ve $= -50\,m/s$

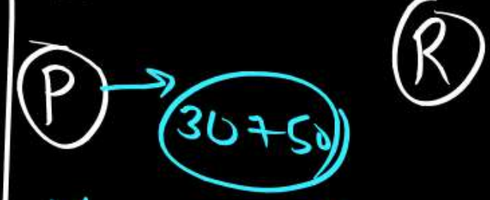
$= 30\,m/s$

$$V_{PR} = \vec{V}_P - \vec{V}_R = 30 - (-50) = 80\,m/s$$

$$V_{RP} = V_R - V_P = -50 - 30 = -80\,m/s$$

$\Rightarrow V_{PR}$

mR^{α}



$V_{PR} = 80$

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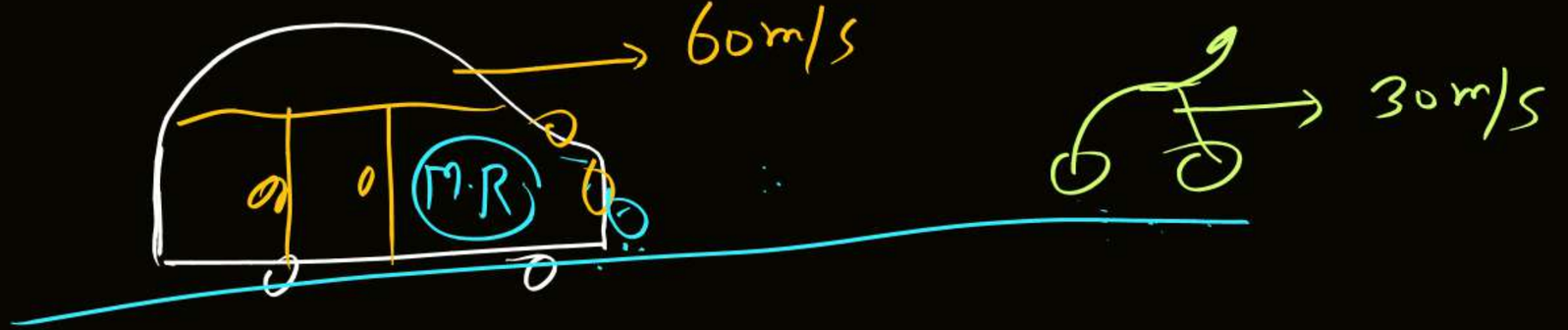
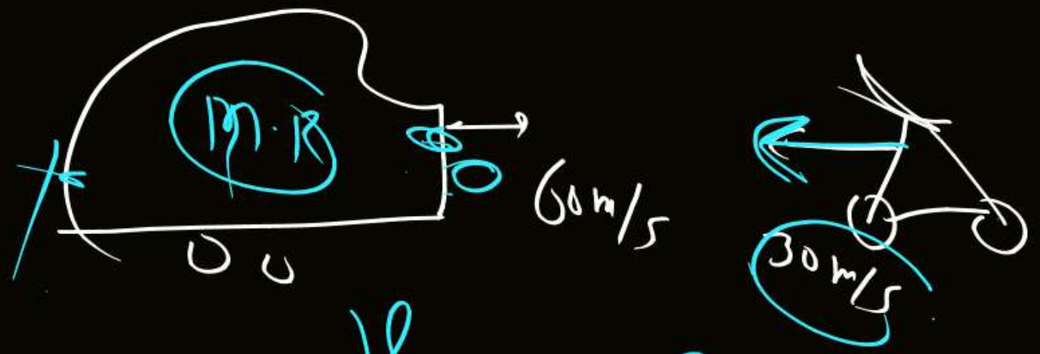
$\vec{V}_{PR} = \vec{V}_P - \vec{V}_R = \vec{V}_P + (-\vec{V}_R)$ = velocity of Pinky + (− velocity of Rawle)

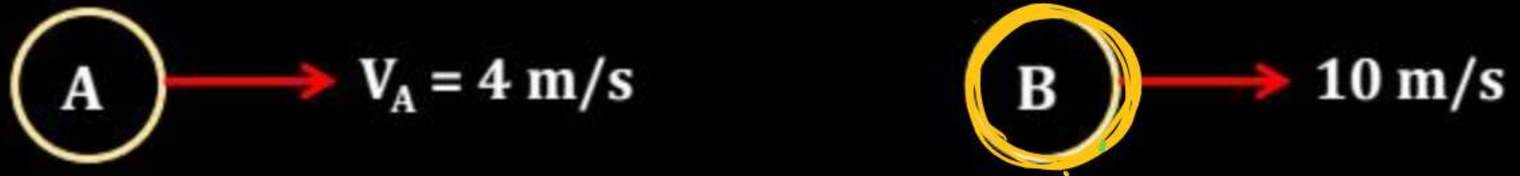
$V_{collision} = 30\ m/s$





$V_{collision} = 90\ m/s$

Find V_{AB} / V_{BA}



soln

$$V_{A(B)} = V_A - V_B = 4 - 10 = -6 \text{ m/s}$$

assume to be at rest.

$$V_{B(A)} = +6 \text{ m/s}$$

observer

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Find

A → $V_A = 15$ m/s

B → $V_A = 54$ km/hr $= 54 \times \frac{5}{18}$

$= 15$ m/s

$\vec{v}_{AB} = 0$

$\vec{v}_{BA} = 0$

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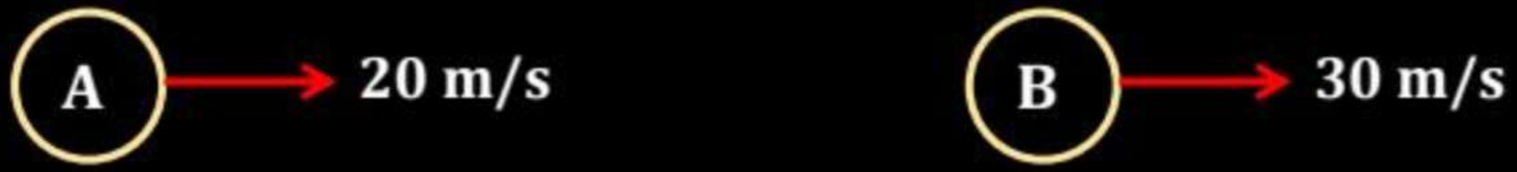
Find



$V_{AB} = -10 m/s$

$V_{BA} = 10 m/s$

A train is moving in the north at a speed 10 m/sec. Its length is 150 m. A parrot is flying parallel to the train in the south with a speed of 5 m/s. The time taken by the parrot to cross the train will be –

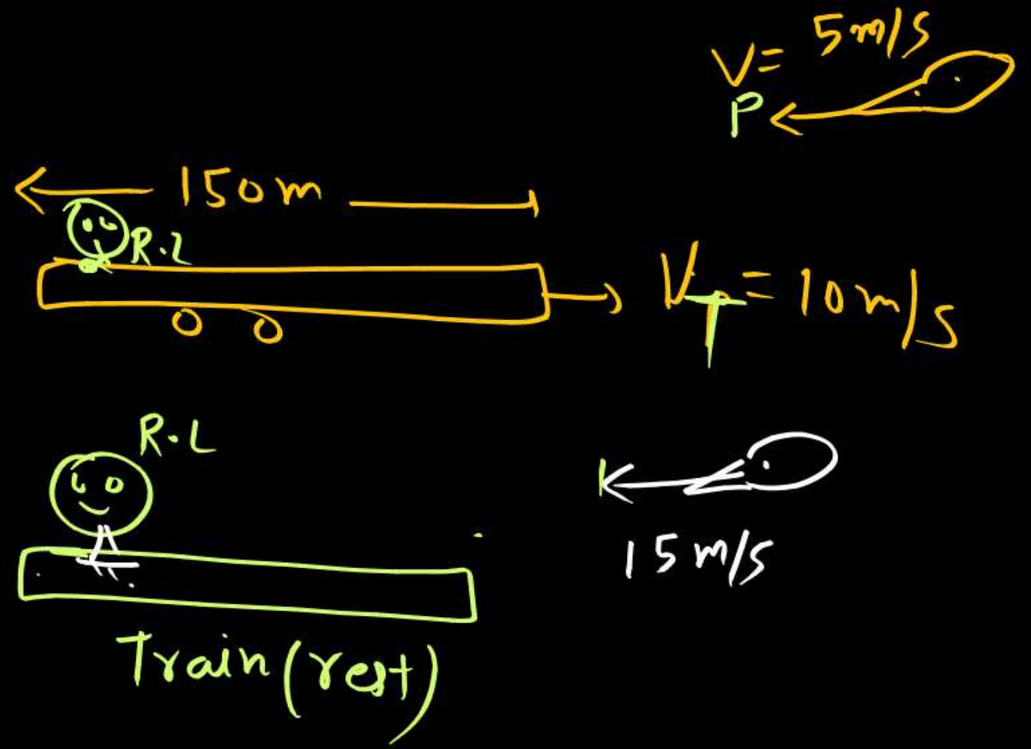
(AIPMT)

(a) 12 sec

(b) 8 sec

(c) 15 sec

(d) 10 sec



$$\text{time} = \frac{150}{15} = 10 \text{ sec}$$

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A train of 150 metre length is going towards north direction at a speed of 10 m/s. A parrot flies at the speed of 5 m/s towards North direction parallel to the railways track. The time taken by the parrot to cross the train is

(a) 12 s

(b) 8 s

(c) 15 s

(d) 30sec

(1988)

$V_p = 5 m/s$

$$\text{time} = \frac{150}{5} = 30 sec$$

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A train of 150 m length is going towards a speed of 10 m/s. A bird is flying a to the track towards South. The time bird to cross the train is

(a) 10 s

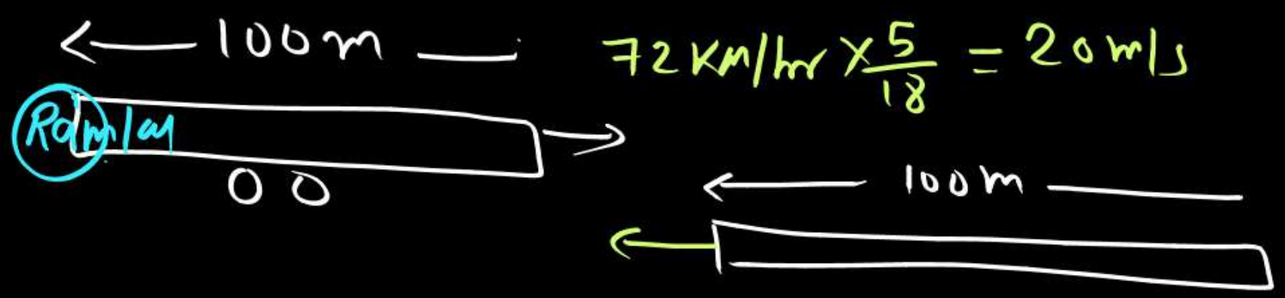
(b) 15 s

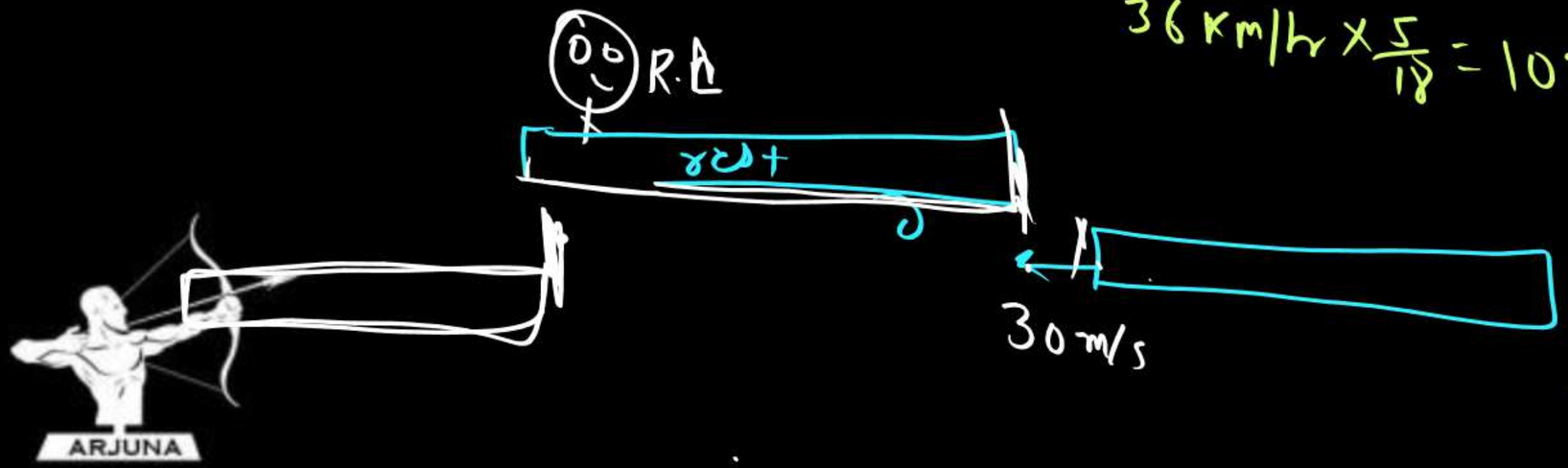
(c) 30 s

(d) 12 s

Two trains each of length 100 m moving parallel towards each other at speed 72 km/h and 36 km/h respectively. In how much time will they cross each other?

(a) 4.5 s
(b) 6.67 s
(c) 3.5s
(d) 7.25 s





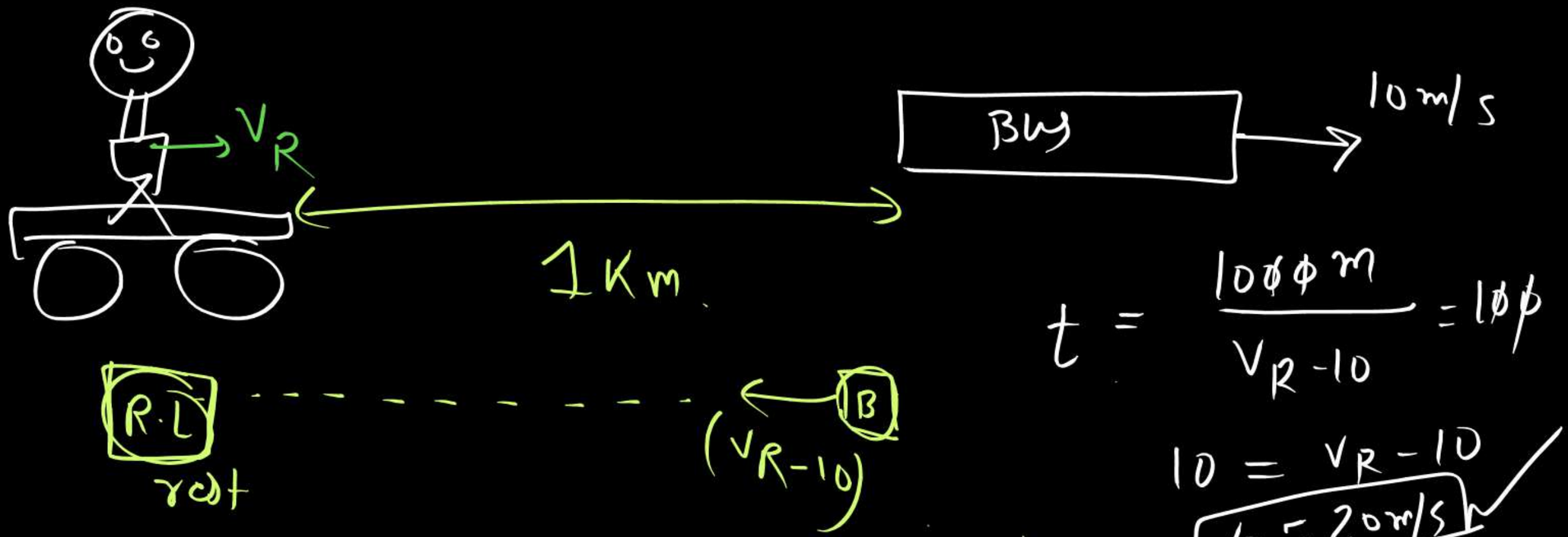
$$t = \frac{l_1 + l_2}{30} = \frac{200}{30}$$

$$= 6.67$$

A bus is moving with a speed of 10 m s^{-1} on a straight road. A scooterist wishes to overtake the bus in 100 s. If the bus is at a distance of 1 km from the scooterist, with what speed should the scooterist chase the bus?

(a) 40 m s^{-1} (b) 25 m s^{-1}

(c) 10 m s^{-1} (d) 20 m s^{-1} (2009)



$$t = \frac{1000\ m}{V_R - 10} = 100$$

$$10 = V_R - 10$$

$$V_R = 20\ m/s$$

Two trains each of length 50 m are approaching each other on parallel rails. Their velocities are 10 m/sec and 15 m/sec. They will cross each other in -

(a) 2 sec

(b) 4 sec

(c) 10 sec

(d) 6 sec

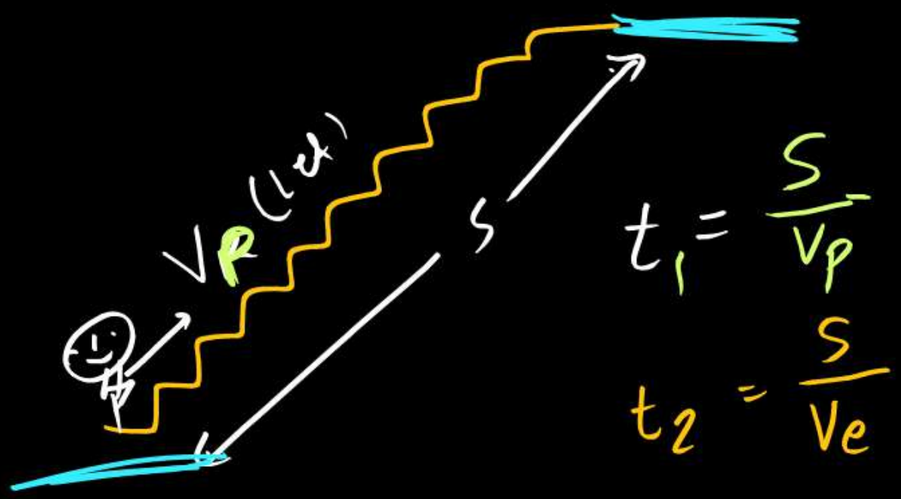
Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be [NEET-2017]

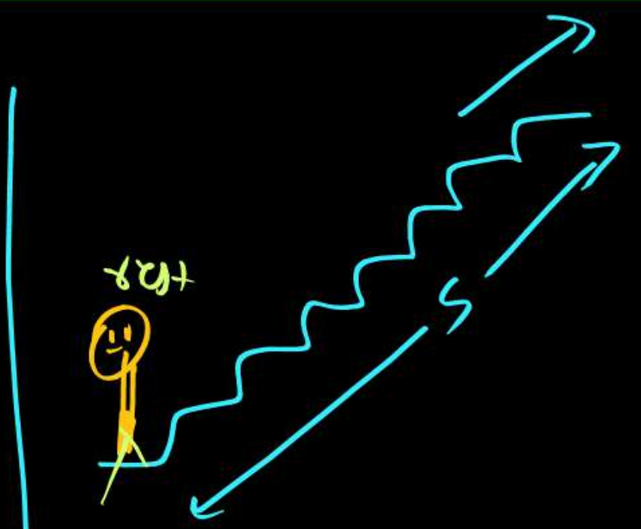
(a) $\frac{t_1 + t_2}{2}$

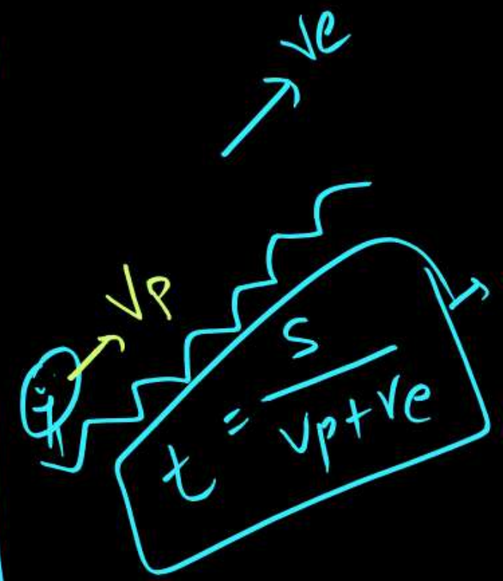
(b) $\frac{t_1 t_2}{t_2 - t_1}$

(c) $\frac{t_1 t_2}{t_2 + t_1}$

(d) $t_1 - t_2$







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$$t = \frac{S}{V_e + V_p}$$

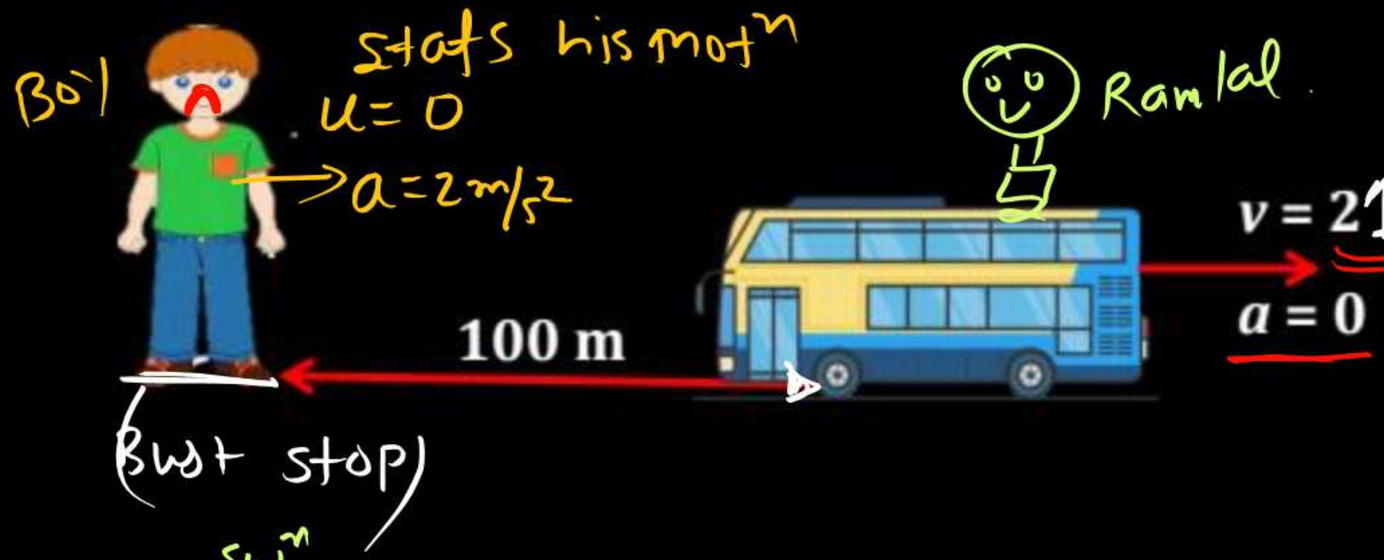
$$V_e + V_p = \frac{S}{t}$$

$$\frac{S}{t_2} + \frac{S}{t_1} = \frac{S}{t}$$

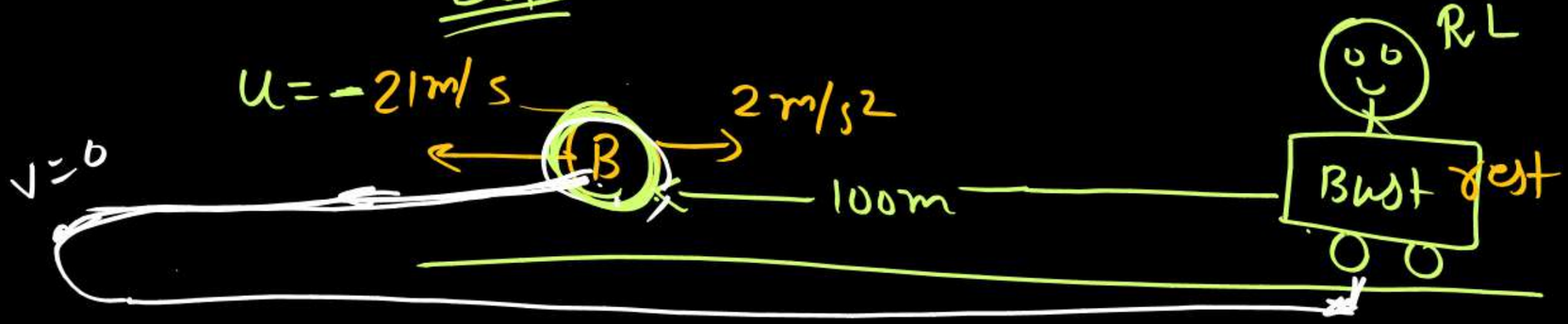
$$\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$$

$$t = \frac{t_1 t_2}{t_1 + t_2}$$

Find time when he will cath the bus.



Soln



$$S_{BR} = ut + \frac{1}{2}at^2$$

$$100 = -21t + \frac{1}{2}(2)t^2$$

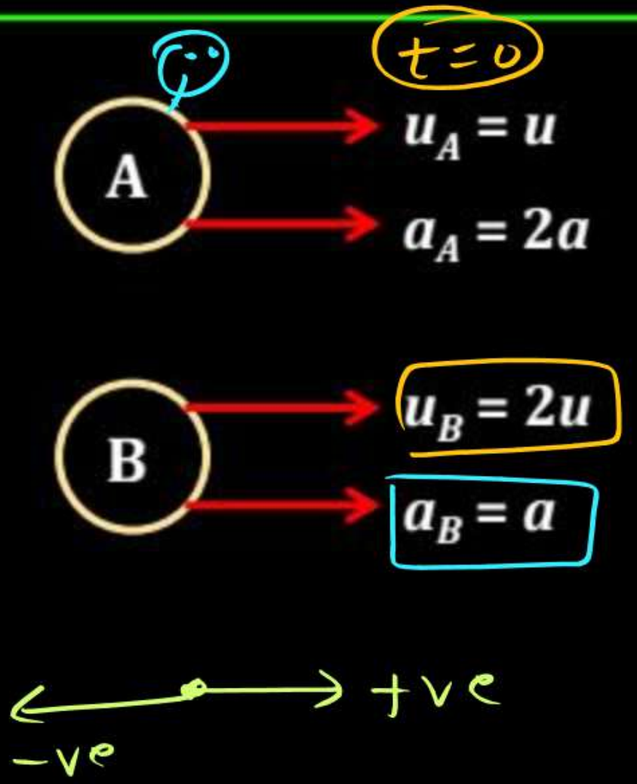
$$t^2 - 21t - 100 = 0$$

$$t^2 - 25t + 4t - 100 = 0$$

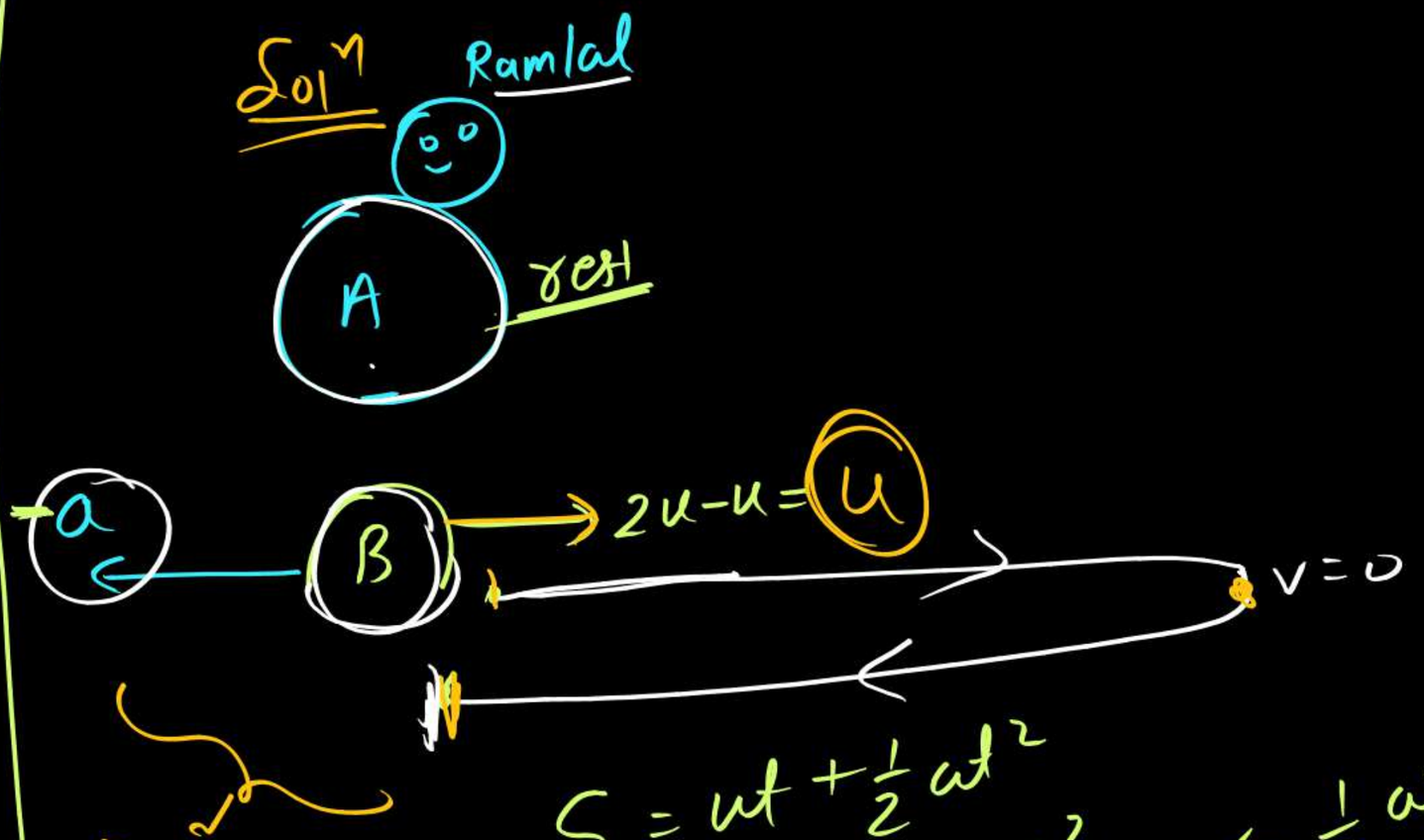
$$t(t-25) + 4(t-25) = 0$$

$$t = 25s \quad (t \neq -4)$$

Find time when they will meet again. (IIT)



Solⁿ Ramlal



Motion under gravity

$T = \frac{2u}{a}$

$S = ut + \frac{1}{2}at^2$

$0 = ut - \frac{1}{2}at^2$

$ut = \frac{1}{2}at^2$

$t = \frac{2u}{a}$

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Find :

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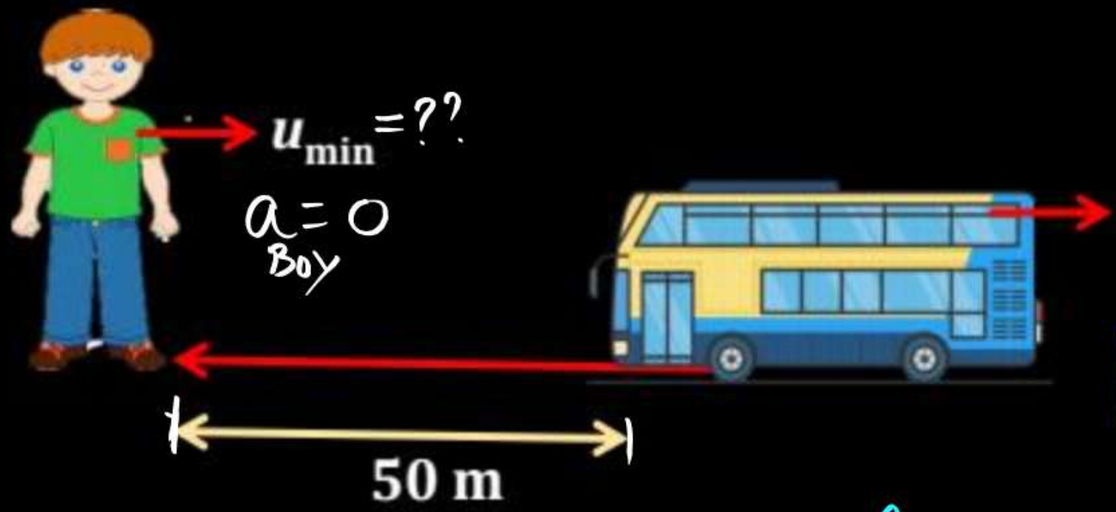
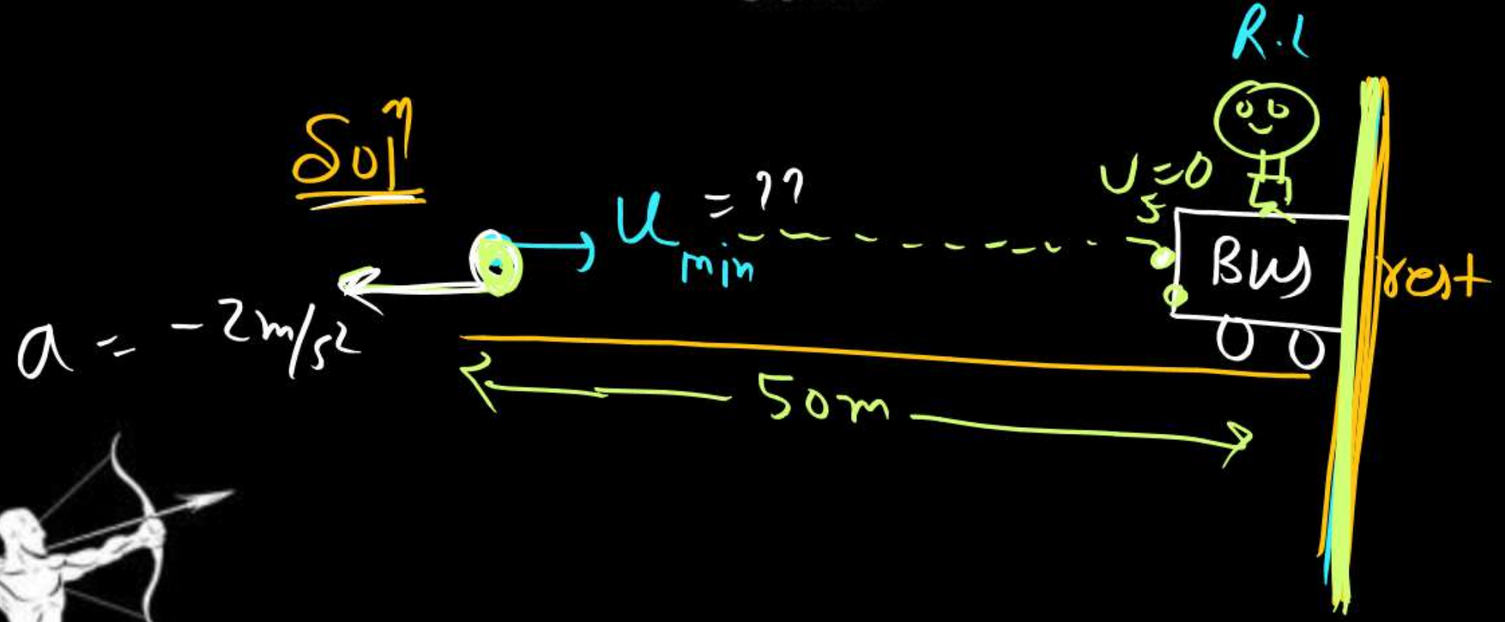


$u = 0$

$t = 0$

(Bus starts his motion with rest & Constant acc^n $2\ m/s^2$)

Sol^n



$$v_f^2 - u_i^2 = 2as$$

$$+u_{min}^2 = 2(+2)\times 50$$

$$u_m = \sqrt{200} = 10\sqrt{2}\ m/s$$

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THANK YOU ☺