YAKEEN NEET 2.0

2026

Motion in a Plane

PHYSICS | Lecture - 12

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Todays Goal

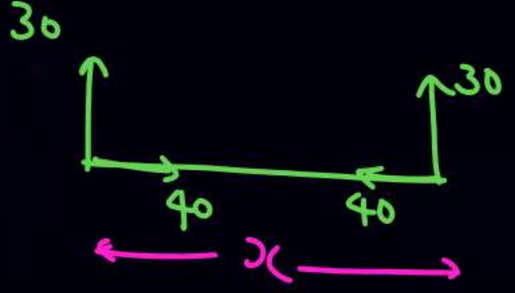
- Relative chasing ques
- Lift coin problem
- River-man (just started)

Q ✱

for collision

$u\sin 37 = 50\sin 37$

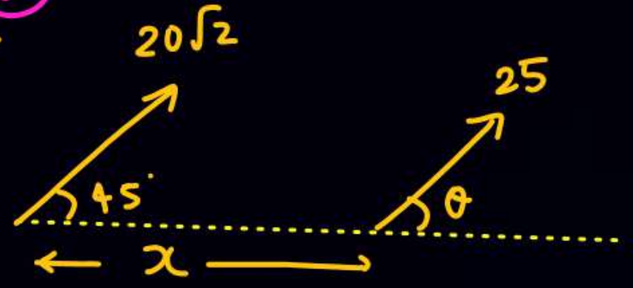
$\boxed{u = 50}$ $\quad T_{max} = 3+3 = 6$



$x \leq 80 \times 6$

$\boxed{x \leq 480}$

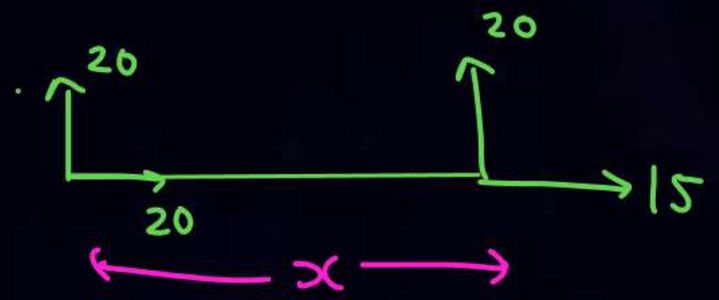
Q ✱✱



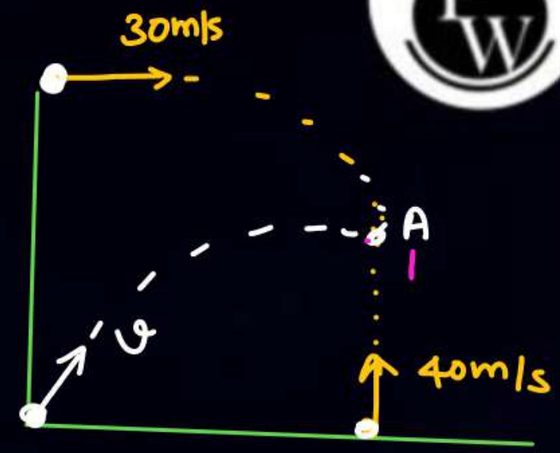
For collision

$20 = 25\sin\theta$

$\sin\theta = \frac{20}{25} = \frac{4}{5}$, $\boxed{\theta = 53^\circ}$



$\boxed{x \leq 20}$

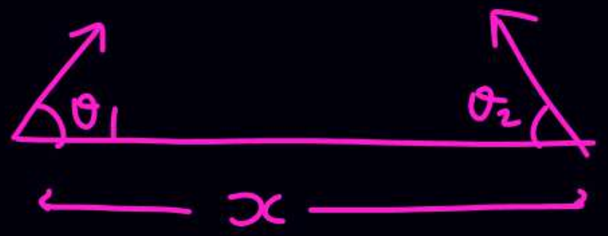


If three particle are thrown at same time and they collide each other at same time. at same place

$v = ?$

Sol: $\vec{v} = 30\hat{i} + 40\hat{j}$

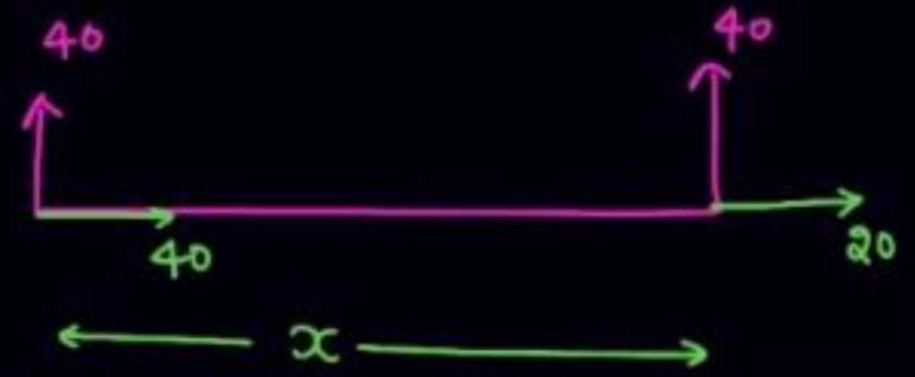
$|\vec{v}| = 50$



$x \leq R_1 + R_2$

$x \leq R_1 - R_2$

Q3 H/W



$T_{max} = 8$

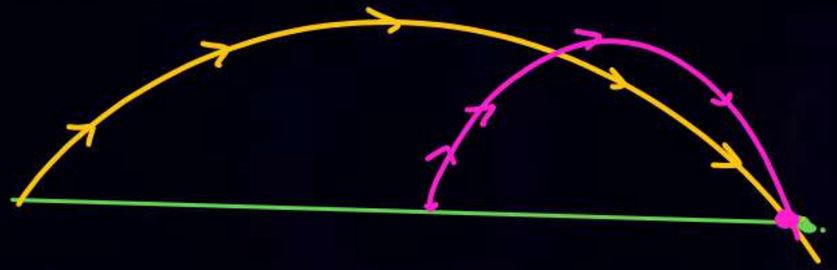
$x \leq 20 \times 8$

$\boxed{x \leq 160}$

① If $x = 500$

No collision

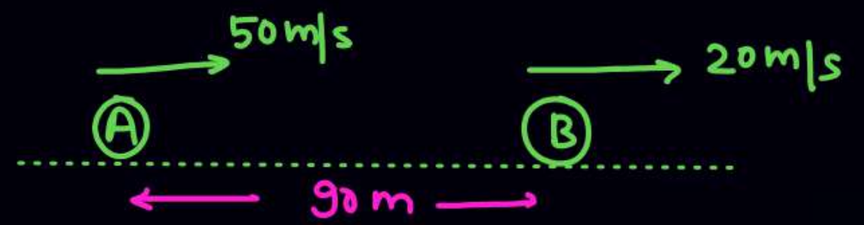
② $x = 160$



③ $x = 80$

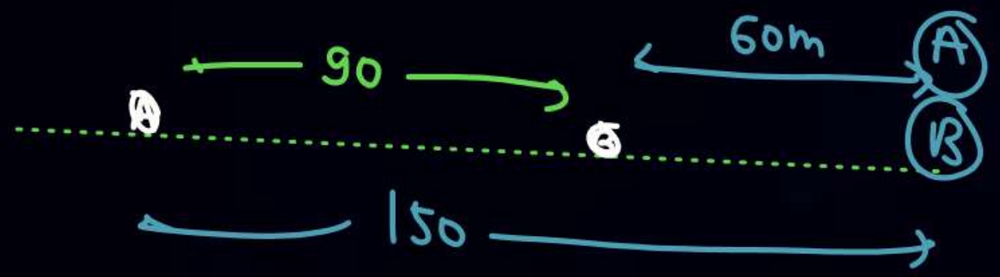
$t = 4$ sec Collin.

Chasing वाले Ques

① 

when & where they will meet

Sol^{n} $t = \frac{90}{30} = 3$



$v = u + at$
$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$
} $\vec{a} \rightarrow$ const

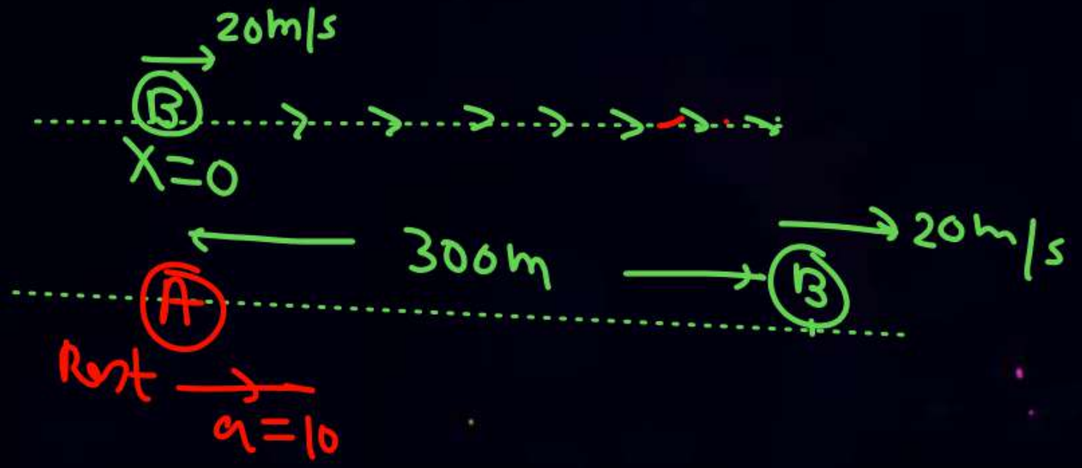
$v_{rel} = u_{rel} + a_{rel}\,t$
$s_{rel} = u_{rel}\,t + \frac{1}{2}a_{rel}\,t^2$
$v_{rel}^2 = u_{rel}^2 + 2a_{rel}s_{rel}$
} $\vec{a}_{rel} \rightarrow$ const

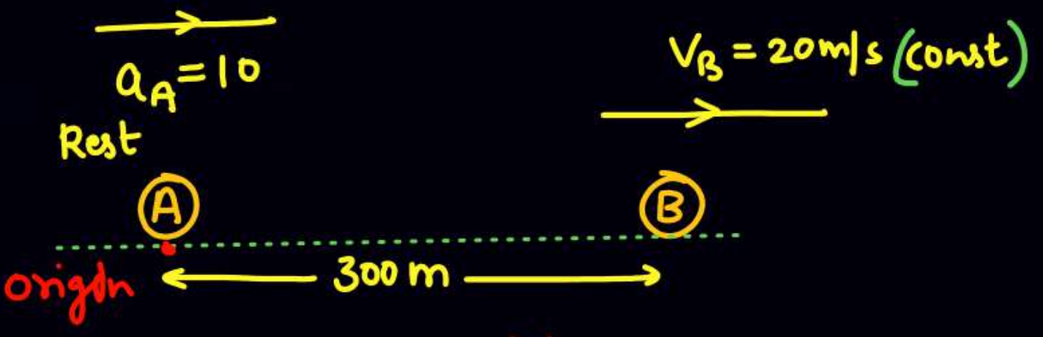
$v_{A/B} = u_{A/B} + a_{A/B}\,t$
$a_{A/B} \rightarrow$ const

Q

when 'A' will catch 'B' & where.

A girl on scooty crosses origin at $t = 0$, she is moving with const velocity 20 m/s. After 15 sec a boy start chasing her with initial velocity zero and and having acc $10 m/s^2$. Find when 'A' will catch 'B' & where.

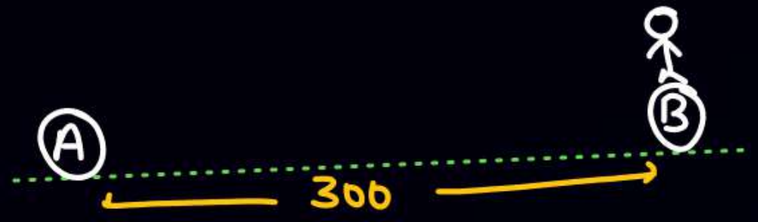




Q

When 'A' will catch 'B' & where.

Sol^n



$\vec{u}_{A/B} = 0 - 20 = -20$

$\vec{a}_{A/B} = 10 - 0 = 10$

$\vec{s}_{A/B} = +300$

$\vec{S}_{A/B} = \vec{u}_{A/B}t + \frac{1}{2}\vec{a}_{A/B}t^2$

$300 = -20t + \frac{1}{2} \times 10 \times t^2$

$60 = -4t + t^2$

$t^2 - 4t - 60 = 0$

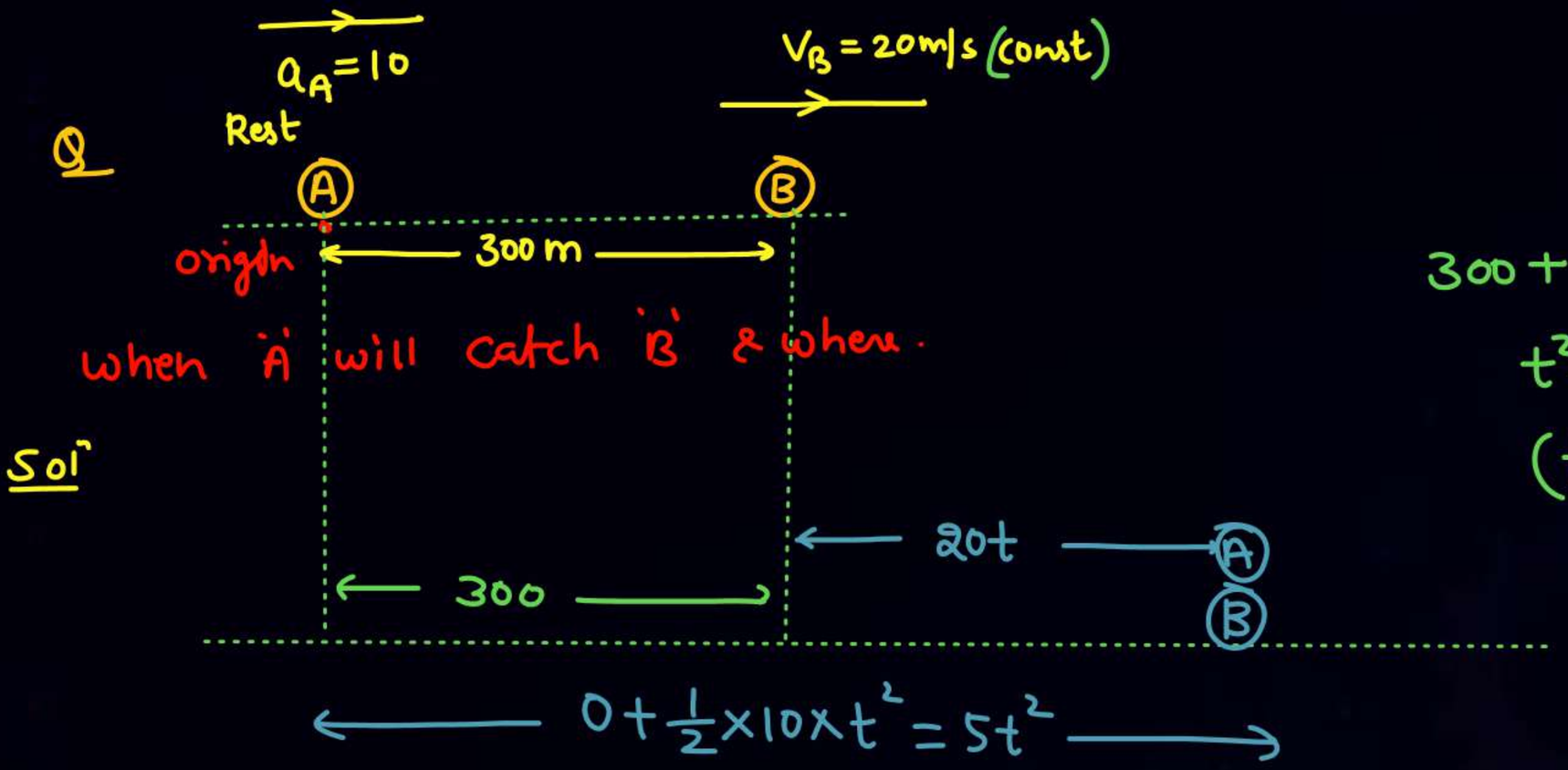
$(t-10)(t+6) = 0$

$\boxed{t = 10\,sec}$

* Sabse pahle aage wale particle par baith jao
* $u_{A/B}$ $a_{A/B}$ $s_{A/B}$ Nikalo
* Eq^n of motion Laga do

(A) $\equiv x = 0 + \frac{1}{2} \times 10 \times (10)^2$

$= 500$



Q

when 'A' will catch 'B' & where.

Sol^n

$$0 + \frac{1}{2} \times 10 \times t^2 = 5t^2$$

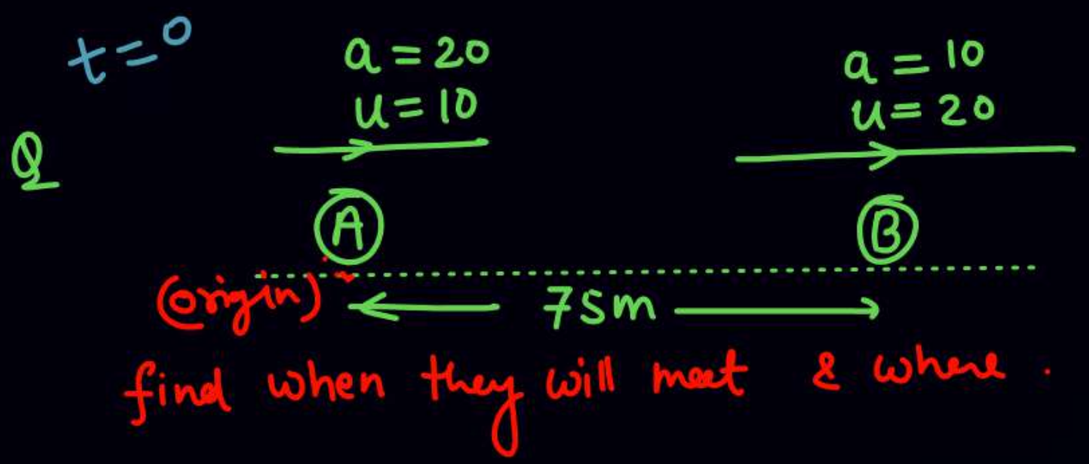
$$300 + 20t = 5t^2$$

$$t^2 - 4t - 60 = 0$$

$$(t-10)(t+6) = 0$$

$$t = 10\ sec$$

Q



find when they will meet & where.

Sol^n

$$20t + \frac{1}{2}\times 10\times t^2 + 75 = 10t + \frac{1}{2}\times 20\times t^2$$

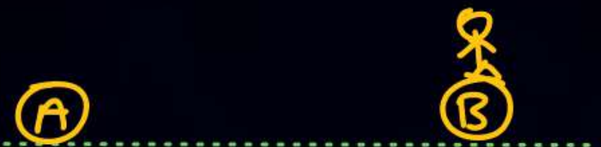
solve & get

$t = 5$

$$x = 10\times 5 + \frac{1}{2}\,20\times 5^2$$

$$= 50 + 250 = 300$$

Relative



$u_{A/B} = 10 - 20 = -10$

$a_{A/B} = 20 - 10 = 10$

$S_{A/B} = +75$

$$75 = -10t + \frac{1}{2}\times 10\times t^2$$

$$75 = -10t + 5t^2$$

$$t^2 - 2t - 15 = 0$$

$$(t-5)(t+3) = 0$$

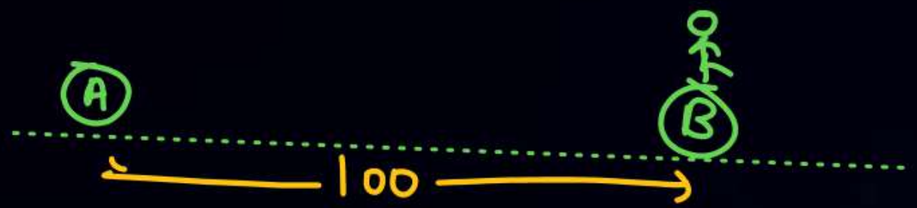
$t = 5$

Q

Soln

$$10t + \frac{1}{2} \times 5 \times t^2 + 100 = -20t + \frac{1}{2} \times 10 \times t^2$$

Relative



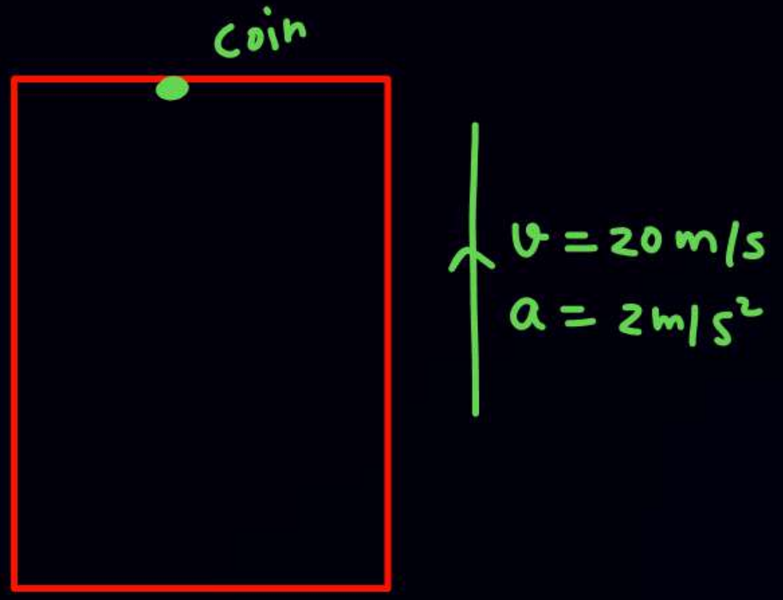
$$\vec{S}_{A/B} = \vec{u}_{A/B}\, t + \frac{1}{2} a_{A/B} t^2$$

$$+100 = -30t + \frac{1}{2} \times 5 \times t^2$$

$$\vec{u}_{A/B} = -20 - 10 = -30$$

$$a_{A/B} = 10 - 5 = 5$$

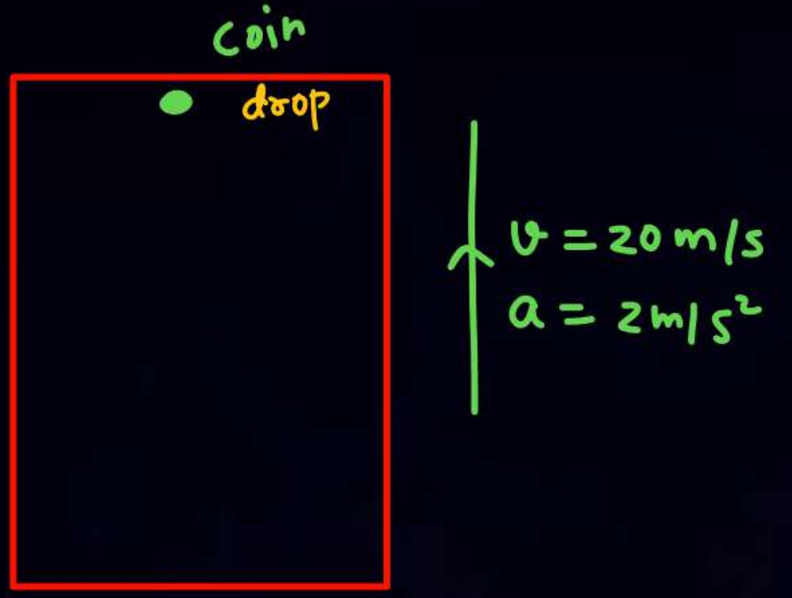
Lift - Coin Problem



$a_c = a_l = 2$

$v_c = v_l = 20$

t = 0



just after coin drop

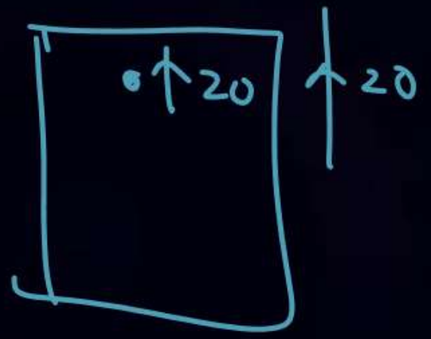
$u_{coin/lift} = 0$

$a_{coin/lift} = a_c - a_l = -10 - 2$

$= -12$

$u_{coin/ground} = +20$

$a_{coin/ground} = -10$



Q At $t=0$, coin is drop
find when coin will strike the floor of lift.

Soln wrt lift

$u_{c/l} = 0$

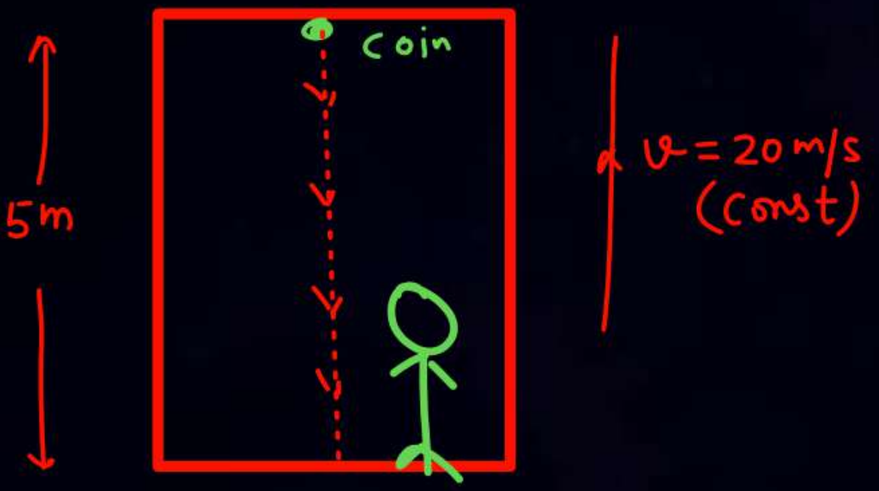
$s_{c/l} = -5$

$a_{c/l} = -10 - 0 = -10$

$s = ut + \frac{1}{2}at^2$ (wrt lift)

$-5 = 0 - \frac{1}{2} \times 10 \times t^2$

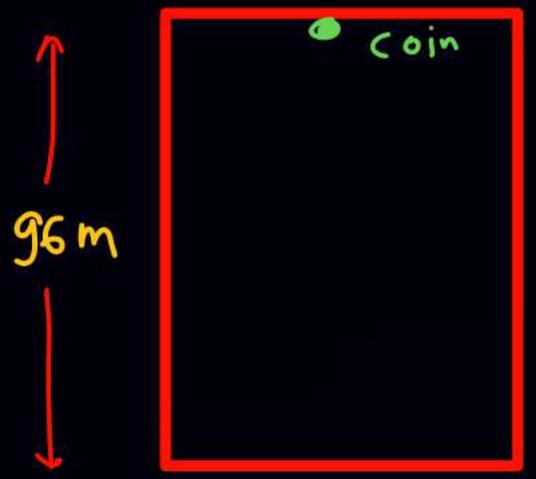
$\boxed{t = 1\ sec}$



SKC
- chupchap Lift ke andar jakar baith jao
- Solve wrt lift
$s_{c/l}$, $a_{c/l}$, $u_{c/l}$
2nd eq^ of motion

SSSB

Q At $t=0$, coin is drop
find when coin will strike the floor of lift.



$a = 2$
$u = 10$

Soln $\vec{u}_{c/l} = 0$

$a_{c/l} = a_c - a_l$

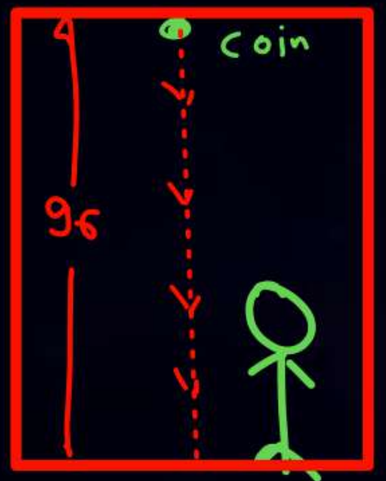
$= -10 - (+2)$

$\vec{a}_{c/l} = -12$

$\vec{s}_{c/l} = -96$

$-96 = 0 - \frac{1}{2} \times 12 \times t^2$

$t = 4$ sec



* (b) Find displacement of coin wrt ground before it hit the floor.

Soln $u_c = 10$, $a_c = -10$ (इदा)

$s = ut + \frac{1}{2}at^2$ $\quad (t = 4)$

$s = 10 \times 4 - \frac{1}{2} \times 10 \times 4^2 = -40$

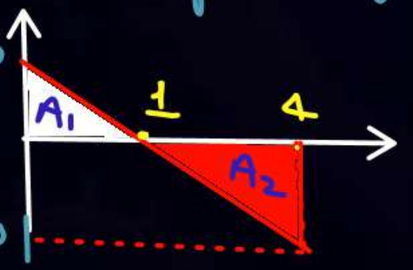
$s_{coin/ground} = -40$

(c) distance traval by coin before strike the floor. in ground frame

Distance $= A_1 + A_2$

$= \frac{1}{2} \times 1 \times 10 + \frac{1}{2} \times 3 \times 30$

$= 50$



(d) what is the displacement of lift before coin hit the floor.

Sol^n $t = 4$,

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

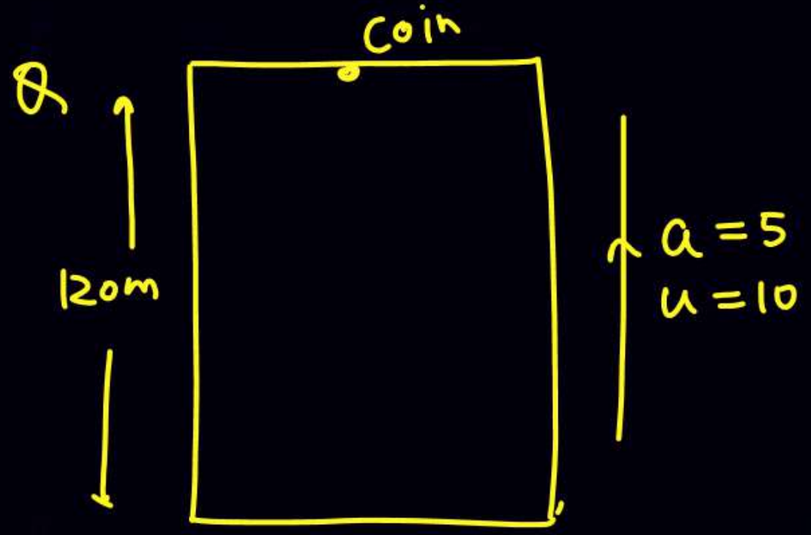
$$S_l = 10 \times 4 + \frac{1}{2} \times 2 \times 4^2$$

$$S_l = 40 + 16 = 56$$

$$S_{cl} = S_c - S_l$$

$$S_{cl} = -40 - 56$$

$$\boxed{S_{cl} = -96}$$



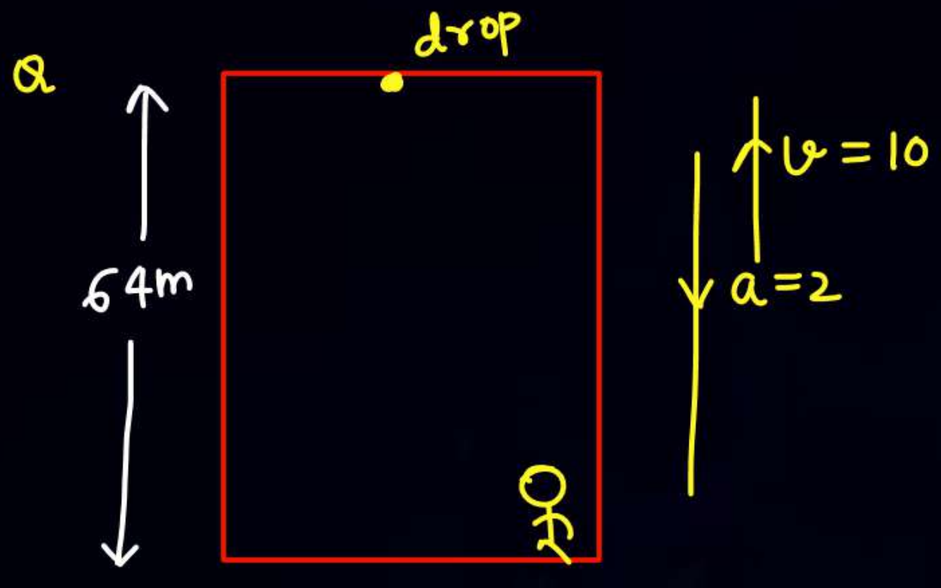
At $t=0$ coin is drop
when it will strike floor.

Sol^n $\vec{a}_{cl} = -10-5 = -15$

$s = ut + \frac{1}{2}at^2$ (wot lift)

$-120 = 0 - \frac{1}{2}\times 15 \times t^2$

$t = 4$ sec

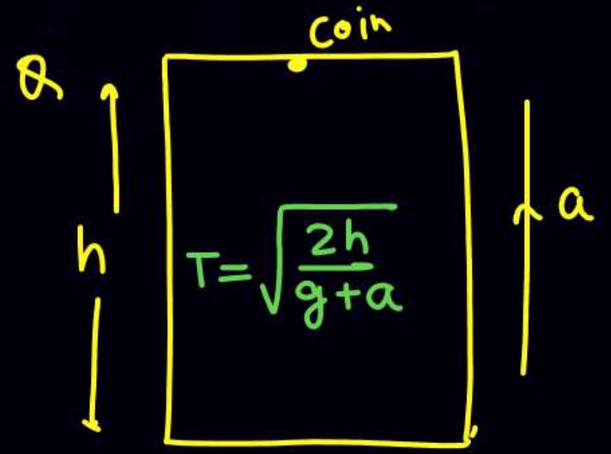


At $t=0$ coin is drop
when it will strike floor.

Sol^n $\vec{a}_{cl} = \vec{a}_c - \vec{a}_l = -10-(-2) = -8$

$-64 = 0 - \frac{1}{2}\,8\,t^2$

$t = 4$



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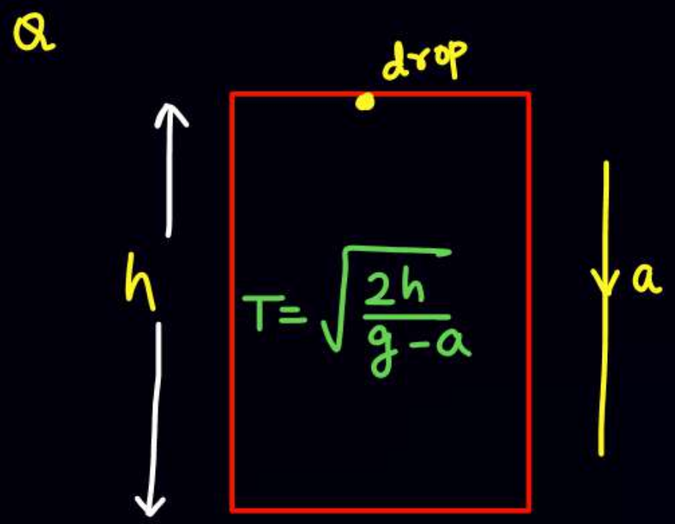
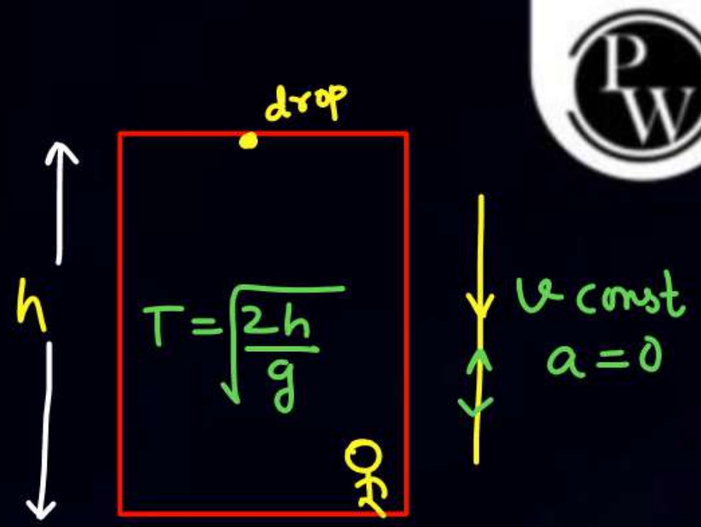
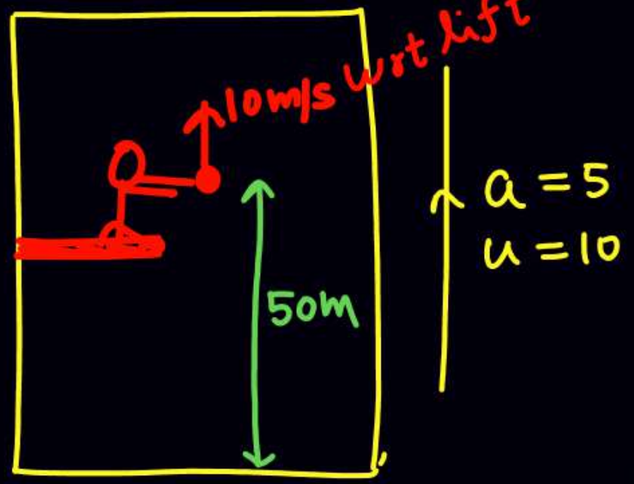




$$T=\sqrt{\frac{2h}{g_{eff}}}$$

Q



At $t=0$ coin is drop when it will strike floor.

Sol^n

Sol^n

$u_{c/l} = +10$

$a_{c/l} = -10-5 = -15$

$s_{c/l} = -50$

$s = ut + \frac{1}{2}at^2$ (wrt lift)

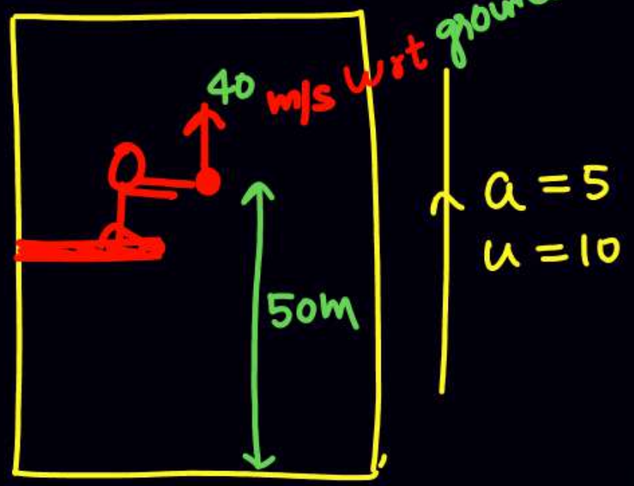
$-50 = 10t - \frac{1}{2} \times 15 \times t^2$

$(t+2)(3t-10) = 0$

$t = 10/3$ (Check)

(b) If man through coin with velocity 40 m/s up wrt ground. Repeat the above problem.

Q



At $t=0$ coin is drop when it will strike floor.

Sol^n

Sol^n

$$\vec{u}_{c/l} = u_c - u_l = 40 - 10 = 30$$

$$a_{c/l} = -10 - 5 = -15$$

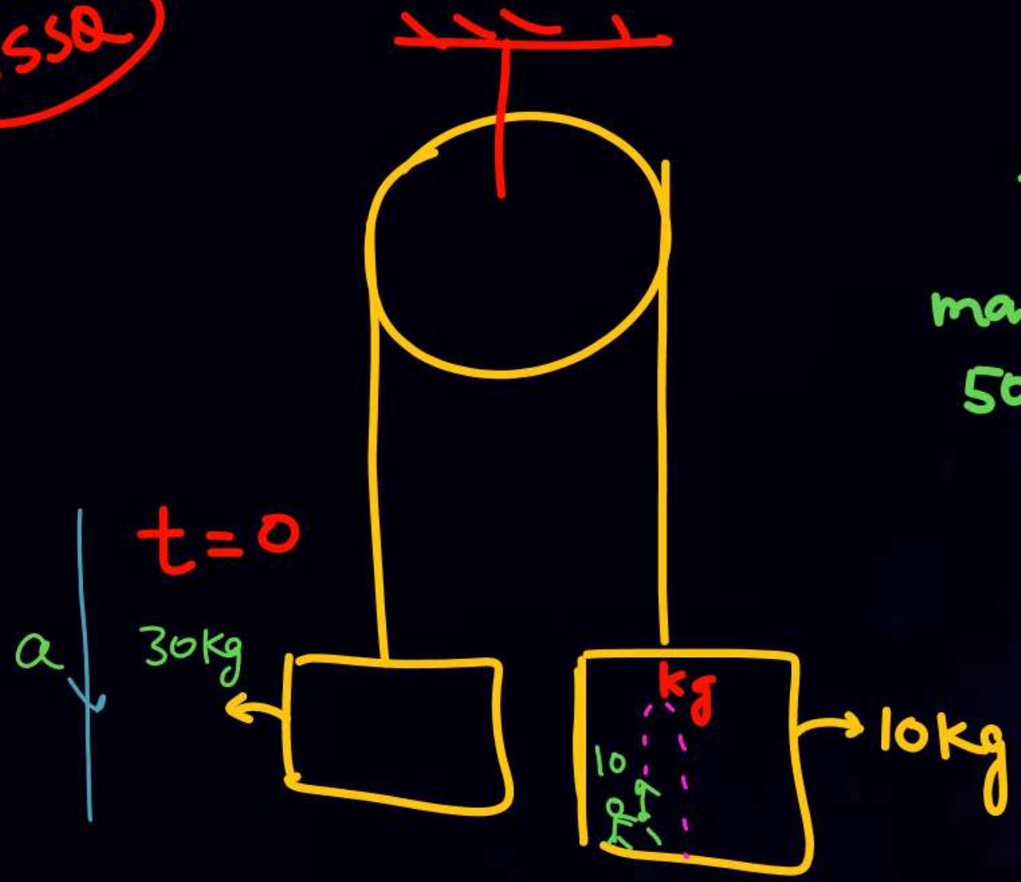
$$s_{c/l} = -50$$

$$s = ut + \frac{1}{2}at^2 \text{ (wrt lift)}$$

$$-50 = 30t - \frac{1}{2} \times 15 \times t^2$$

Solve & get but Dont solve.

SSSQ



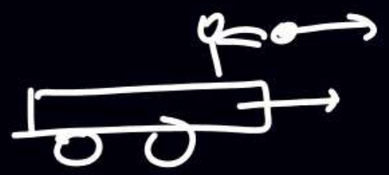
t=10 sec

man throw coin up with 50m/s wrt lift

a = 2

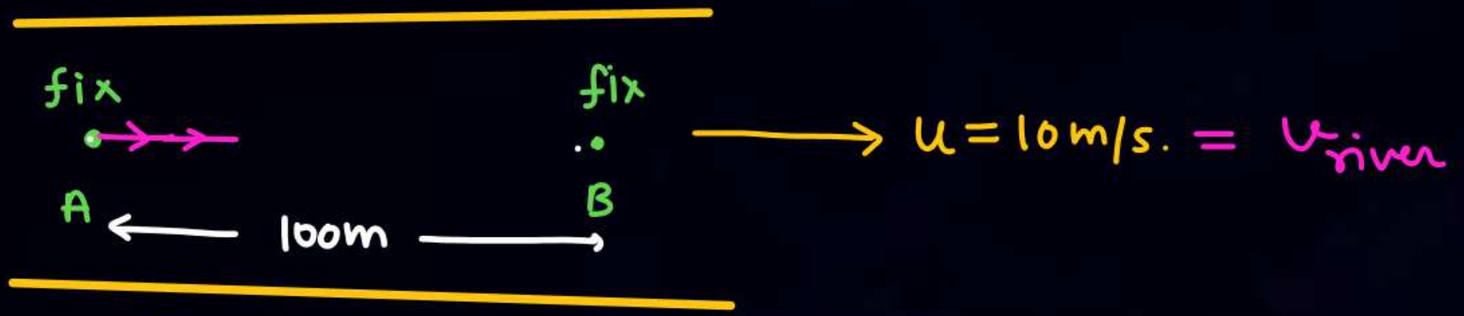
$$a = \frac{300 - 200}{50} = 2$$

River (boat-man) Problem



Q A man start swimming from fix point 'A' to fix point 'B' inside river.

If velocity of man wrt river is 15 m/s. find



① $t_{A \to B} = ?$ (Downstream)

So! $\vec{v}_{m/r} = \vec{v}_m - \vec{v}_r$

$15 = v_m - 10$

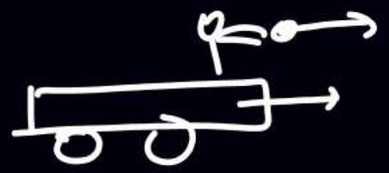
$\vec{v}_{m/ground} = 25$

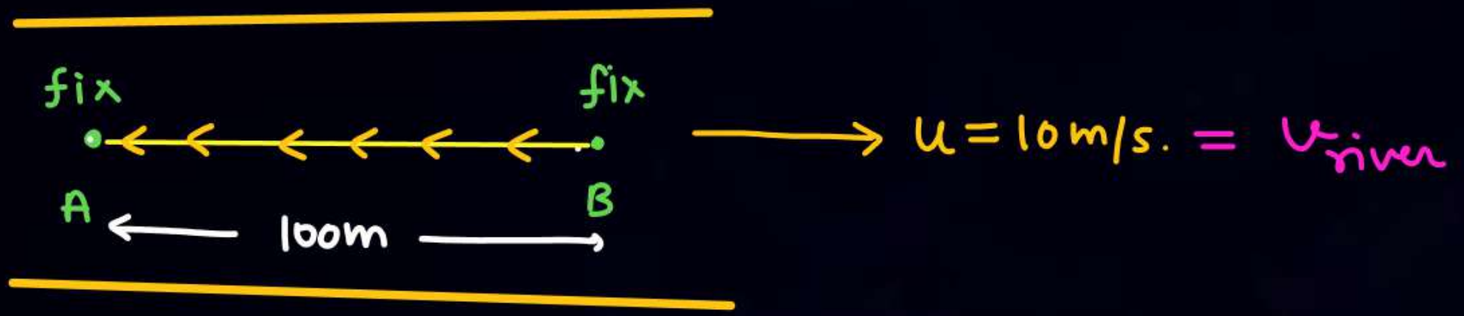
$t_{AB} = \frac{100}{25} = 4$

(wrt ground)

$t_{A \to B} = \frac{100}{u+v} = \frac{100}{10+15} = 4$

River (boat-man) problem





(a) $t_{A \to B} = \frac{100}{10+15} = 4$

(b) If man return to point A from B (upstream)

$t_{B \to A} = \frac{100}{5} = 20 \text{ sec}$

$t_{B \to A} = \frac{100}{v-u} = \frac{100}{15-10} = 20$

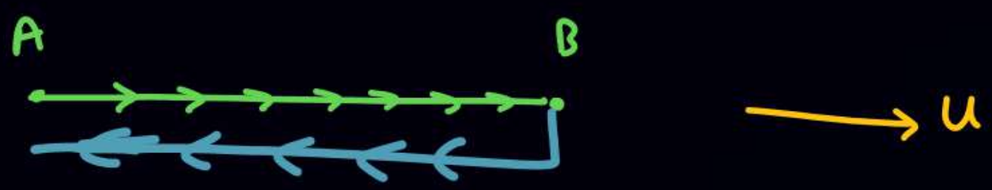
(c) Avg speed $= \frac{100+100}{4+20} = \frac{200}{24}$

(d) Avg velocity $= 0$

$v \rightarrow$ velocity of man wrt river.

$$\vec{v}_{m/r} = \vec{v}_m - \vec{v}_r$$

$$\vec{v}_m = \vec{v}_{m/r} + \vec{v}_r$$

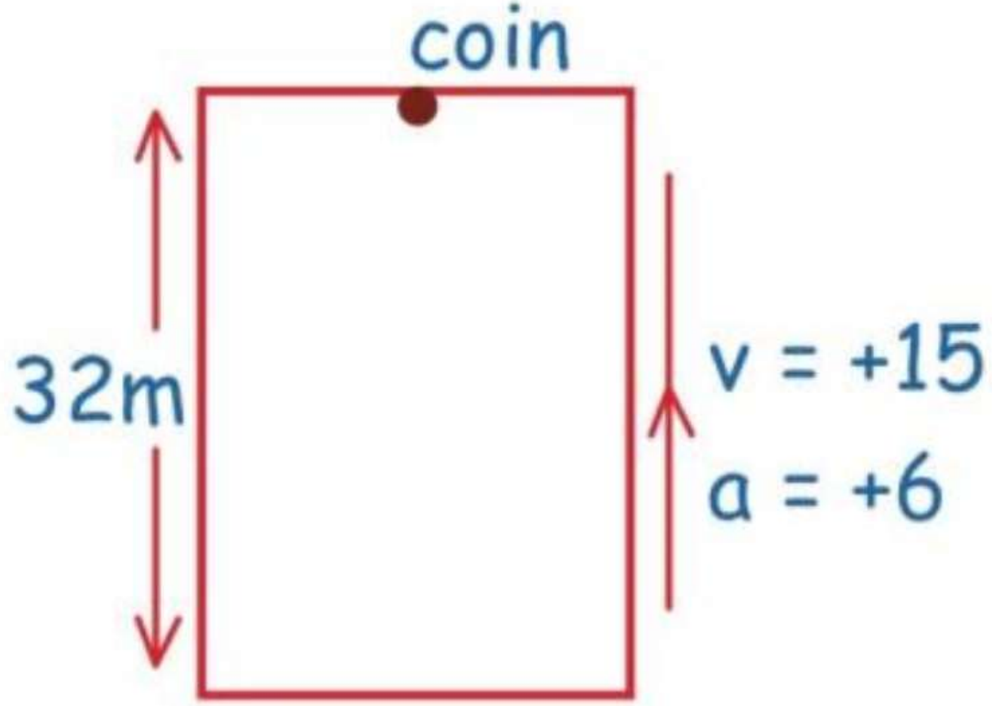


$$t_{AB} = \frac{AB}{u+v}$$

$$t_{BA} = \frac{AB}{v-u}$$

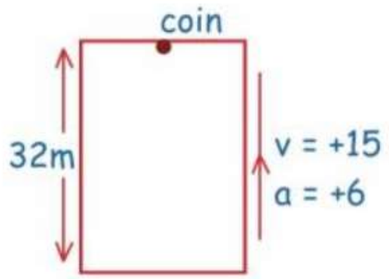
Q. A lift of height 32 m is going up with constant acc a = 6 m/s^2. When velocity of lift is 15 m/s upward, a coin is drop from cealing of lift at t = 0. Find time when coin will hit the floor.

HW



Sol^n

Q. A lift of height 32 m is going up with constant acc $a = 6\ m/s^2$. When velocity of lift is 15 m/s upward, a coin is drop from cealing of lift at $t = 0$. Find time when coin will hit the floor.



Sol. चुपचाप lift ke अंदर जाके बैठ जाओ.

wrt lift

$t=0^+$

(In lift frame or wrt lift)

At $t = 0$ $\vec{V}_{coin/lift} = 0$

$\vec{a}_{coin/lift} = -10 - (+6) = -16$

$\vec{s}_{coin/lift} = -32$

$S = ut + 1/2 \times 16 \times t^2$

$-32 = 0 - 1/2 \times 16 \times t^2$

$t = 2$ sec

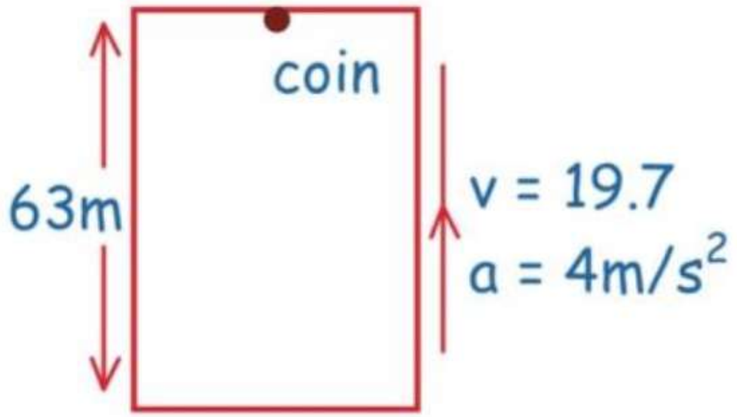
SKC

ऐसे सवालो मे सबसे पहले चुप चाप lift के अंदर जाके बैठ जाओ और coin की velocity, coin का acc lift के respect मे लिखकर eqn of motion लगादो. बस ये याद रखना अगर coin हवा मे है तो ground के respect मे उसका acc नीचे g होगा

Q. At t = 0 coin drop. Find time when coin will hit the floor

Hlw

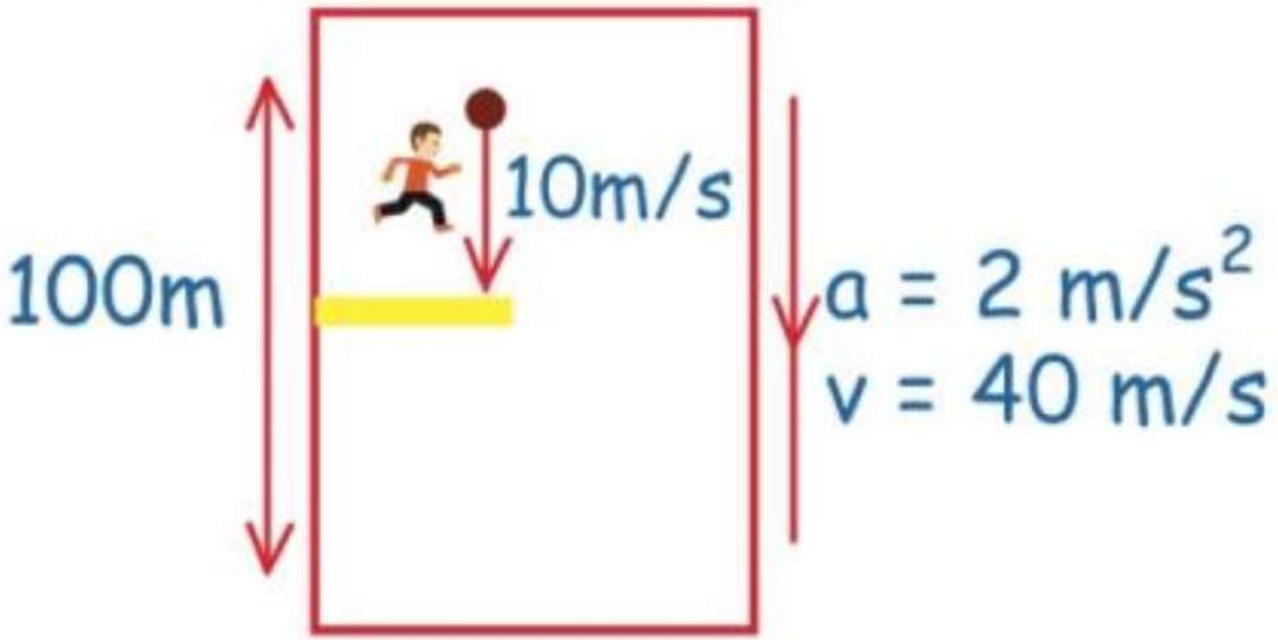
Ans → t = 3 sec.



Q. Ball thrown downward at 10m/s w.rt lift.

HW

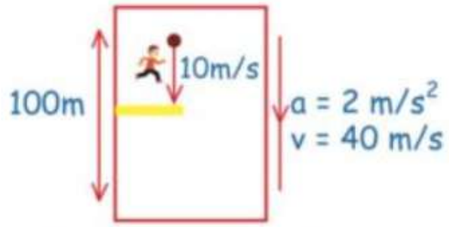
Soln next page



When will coin strike the floor?

Q. Ball thrown downward at 10m/s w.r.t lift.

H/W



When will coin strike the floor?

Sol. Lift ke अंदर आकर wrt lift.

$v_{coin/lift} = -10$

$a_{coin/lift} = -10 - (-2) = -8$

$S_{coin/lift} = -100$

$-100 = -10t + 1/2\ (-8) \times t^2$

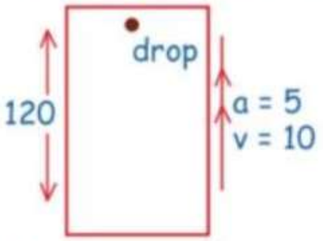
$100 = 10t + 4t^2$

$2t^2 + 5t - 50 = 0$

$t = 4$

Q. When will coin strike the floor of left.

H/W



Sol. $\vec{V}_{coin/lift} = 0$

$\vec{a}_{coin/lift} = -10 - (+5) = -15$

$\vec{S}_{coin/lift} = -120$

$-120 = 0 + 1/2\ (-15)t^2$

$t = 4$ sec

Q. Car A and car B start moving simultaneously in the same direction along the line joining them. Car A moves with a constant acceleration $a = 4\ m/s^2$, while car B moves with a constant velocity $v = 1\ m/s$. At time $t = 0$, car A is 10 m behind car B. Find the time when car A overtakes car B. How much time A take to overtake.

H/W

Ans 2.5 (Sol^n next page)

Q. Car A and car B start moving simultaneously in the same direction along the line joining them. Car A moves with a constant acceleration $a = 4\ m/s^2$, while car B moves with a constant velocity $v = 1\ m/s$. At time $t = 0$, car A is 10 m behind car B. Find the time when car A overtakes car B. How much time A take to overtake.

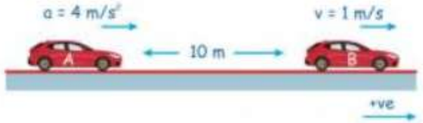
Sol. Given: $u_A = 0$, $u_B = 1\ m/s$, $a_A = 4\ m/s^2$ and $a_B = 0$

Assuming car B to be at rest, we have

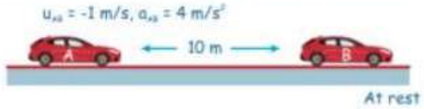
$u_{AB} = u_A - u_B = 0 - 1 = -1\ m/s$

$a_{AB} = a_A - a_B = 4 - 0 = 4\ m/s^2$

Now, the problem can be assumed in simplified form as follow:



Substituting the proper values in equation



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

we get $10 = -t + \frac{1}{2}(4)(t^2)$ or $2t^2 - t - 10 = 0$

Ignoring the negative value, the desired time is 2.5s.

Therefore, option (a) is the correct answer.

Note: The above problem can also be solved without using the concept of relative motion as under. At the time when A overtakes B,

$S_A = S_B + 10$

$\therefore \frac{1}{2} \times 4 \times t^2 = 1 \times t + 10$

or $2t^2 - t - 10 = 0$

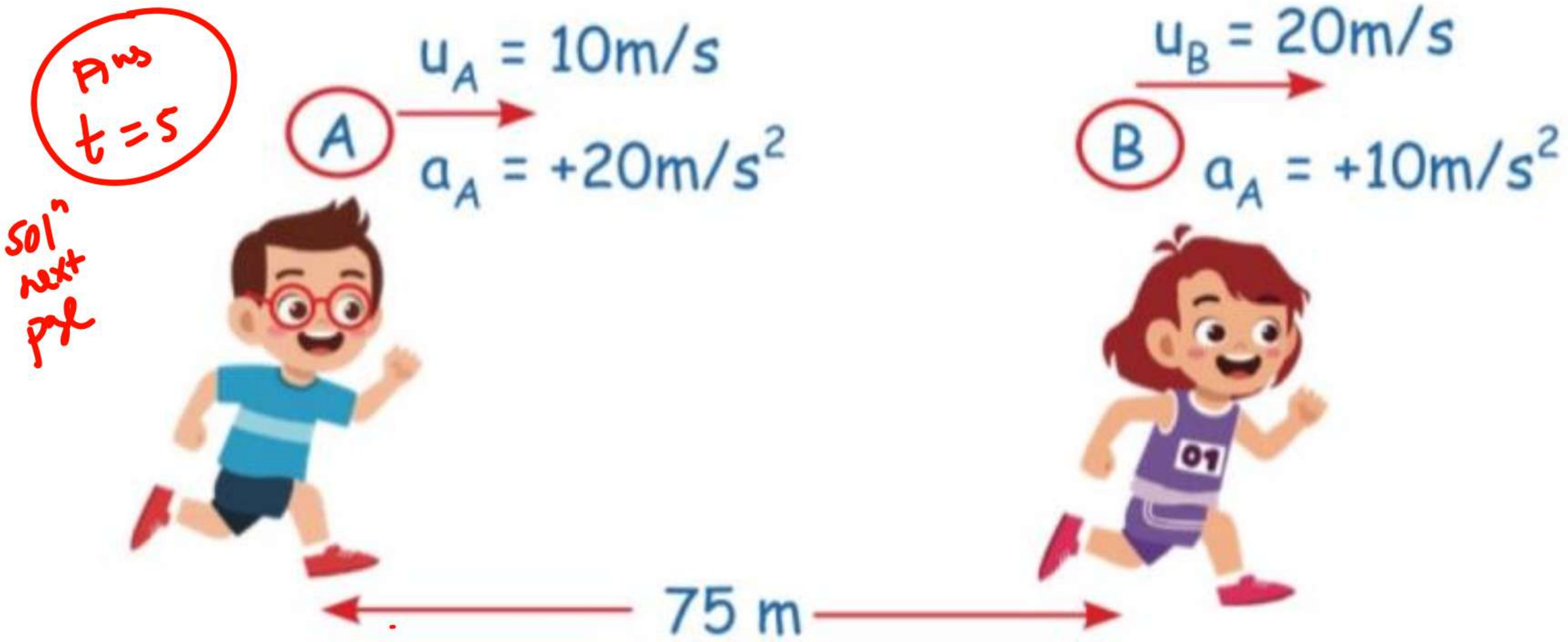
Which on solving gives $t = 2.5\ s$ and $-2\ s$, the same as we found above.

Q. At t = 0 gap between saleemian boy A and girl B is 75 m. Find when boy will catch the girl.

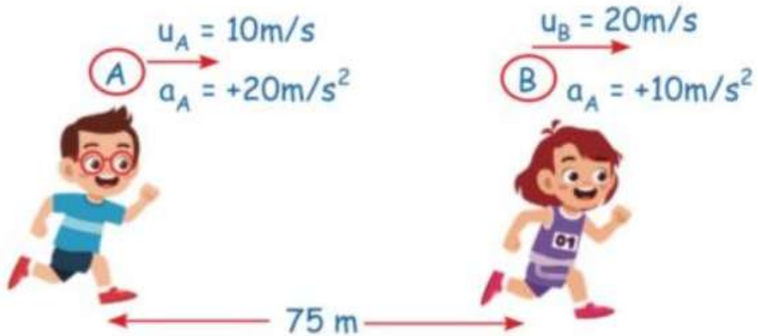
HW

Ans
t = 5

Soln next pg



Q. At t = 0 gap between saleemian boy A and girl B is 75 m. Find when boy will catch the girl.



Sol. M-1 (relative वाला method, आगे वाले के ऊपर जाके बैठ जाओ)

$\vec{u}_{A/B} = 10 - 20 = -10$

$\vec{a}_{A/B} = 20 - 10 = 10$

$s = ut + 1/2\ at^2$

$75 = -10t + (1/2)10\ t^2$

$5t^2 - 10t - 75 = 0$

Sol.e and get $t = 5$

M-2

$75 + x_b = x_a$

$75 + 20t + 1/2 \times 10 \times t^2 = 10t + 1/2 \times 20 \times t^2$

$75 + 20t + 5t^2 = 10t + 10t^2$

$5t^2 - 10t - 75 = 0$

$t^2 - 2t - 15 = 0$

$(t - 5)(t + 3) = 0$

$t = 5$

Home Work

- Revise today notes & full relative motion its very imp.
- Revise $v = u + at$, $v = \frac{dx}{dt}$, $a = \frac{dv}{dt}$ based ques vector, components of one vector along another vector must must must
- HCV ⟶ page 52 ⇒ 21, 23, 24, 25, 26, 27, 30, 32, 33 38, 39, 40, 43,

THANK YOU