YAKEEN NEET 2.0

2026

Motion in a Plane

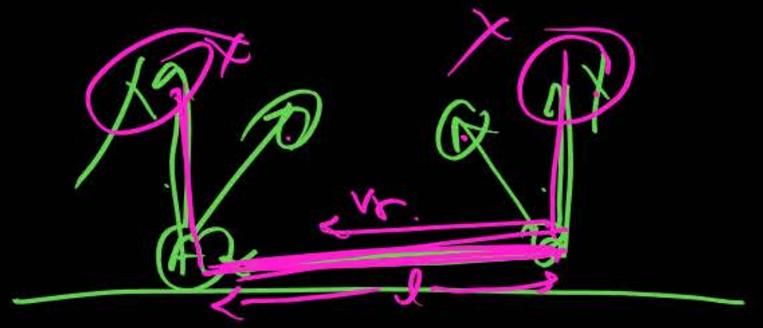
Physics | Lecture - 10

By- Manish Raj (MR Sir)

Topics to be covered

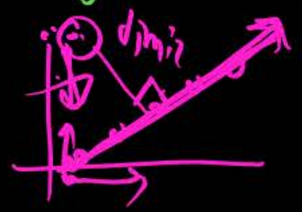
1. #
2.
3.
4.

- River man Problem.
- Rain man Problem.



MR² Box

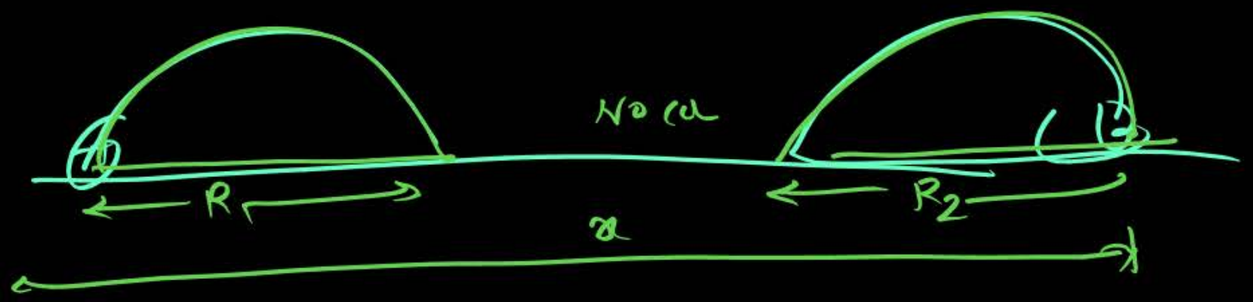
for minimum sepration, ek object par baith kar usko rest me man lo and, dusre ka relative velocity nikalo, relative velocity ke dirⁿ me move karao, relative velocity ke line se observer par lr line draw karo wo d_{min} hoga.



MR² Box → for collsion ✓

Done objec ke line Joining ke Perpendicular relative velocity zero hogo.
(Vret = 0, hence component of velocity Perpendicular to line Joining must be same)

$t = \frac{\text{(line Joining ka length)}}{\text{(V relativ along line Joining)}}$ ✓



MR* Box:-

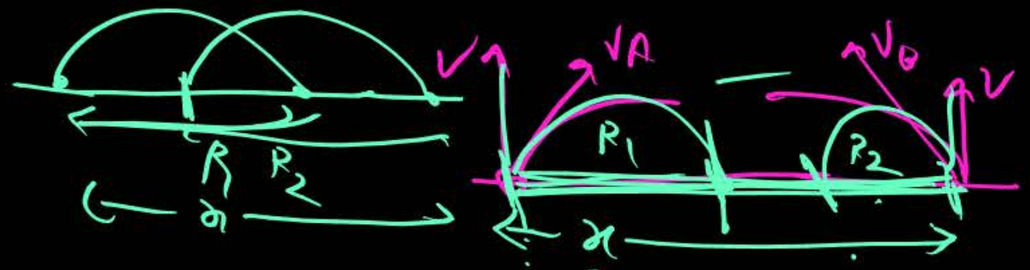
- Collision in Projectile [ground to ground]

Their vertical velocity must be same

✓ x (dist^n b/w them) $\leq (R_1+R_2)$

$t = \dfrac{x}{V_{relative\ along\ line\ joining}}$

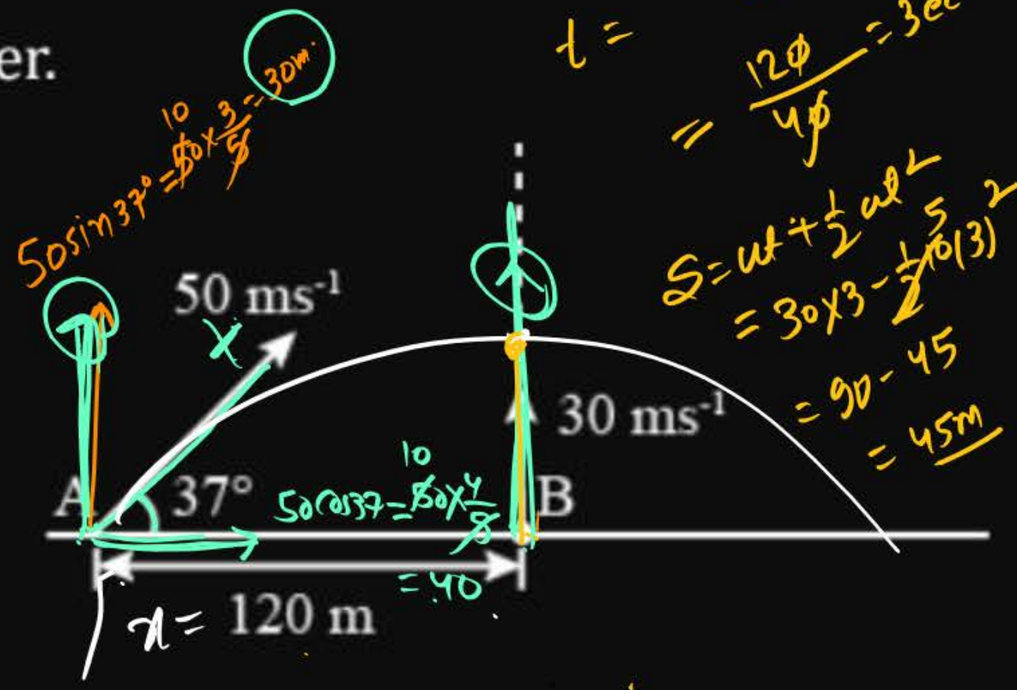
If $x > R_1+R_2$ {No collision}



Question

Balls A and B are thrown from two points lying on the same horizontal plane separated by a distance of 120 m. Which of the following statements is correct?

1. The balls can never meet.
2. The balls can meet if the ball B is thrown 1 s later.
3. The two balls meet at a height of 45 m.
4. None of the above



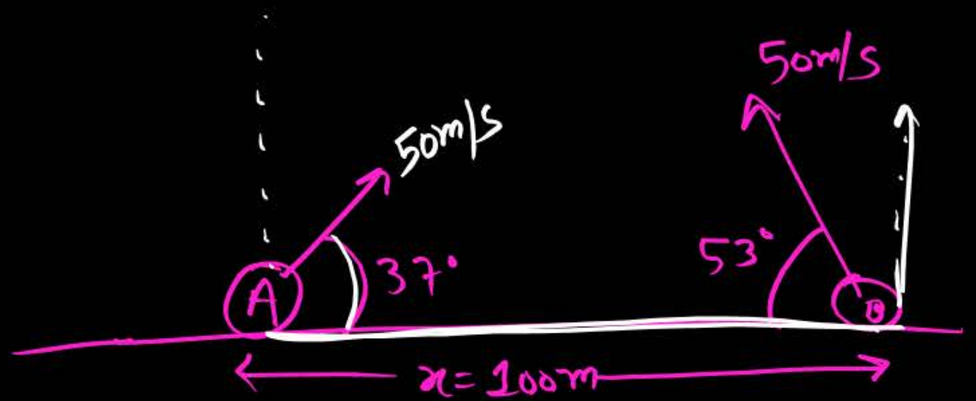
$R_2 = 0$

$R_1 = \frac{2u_x u_y}{g}$

$= \frac{2 \times 40 \times 30}{10}$

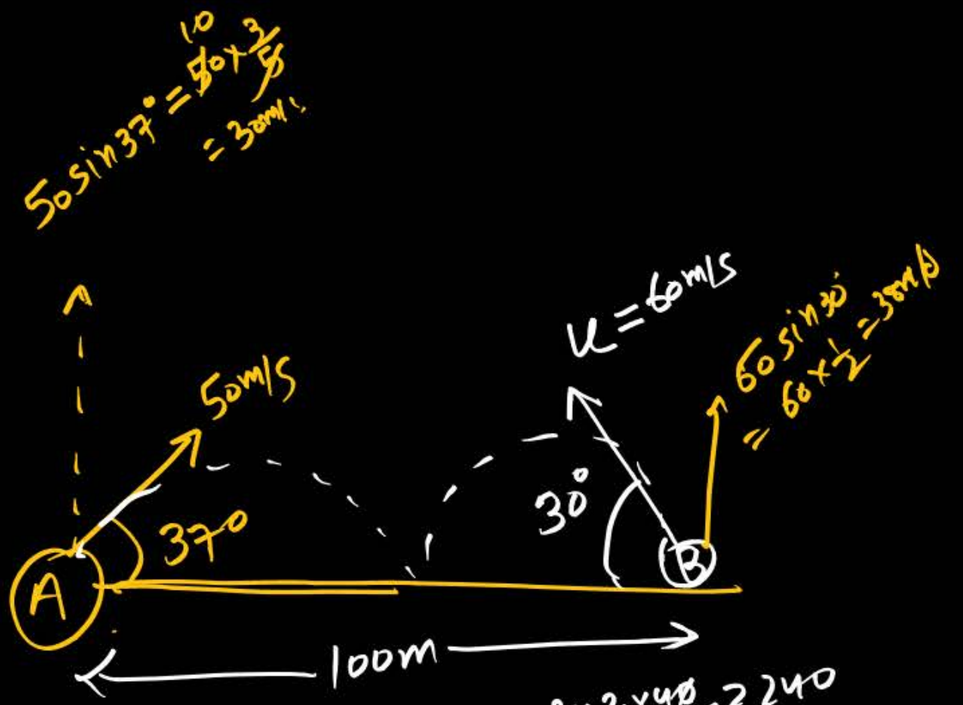
$= 240$ m

(a)



No Collision (vertical velocity is not same)

(a)



$$R_1 = \frac{2u_x u_y}{g} = \frac{2 \times 30 \times 40}{10} = 240$$

Yes collision

Find time when they will meet.

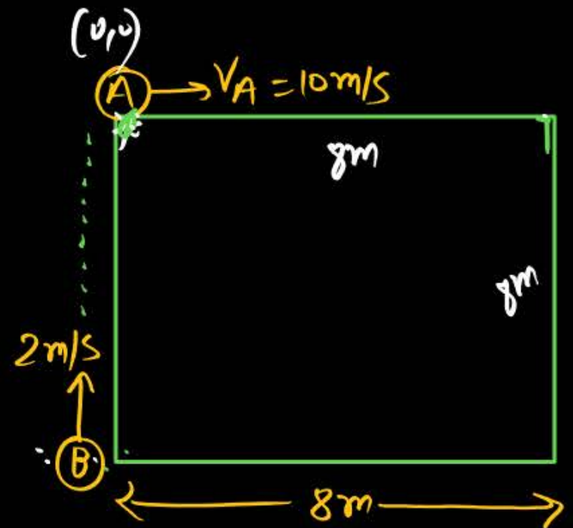
$v_{AB} = 8\,m/s$ ✗

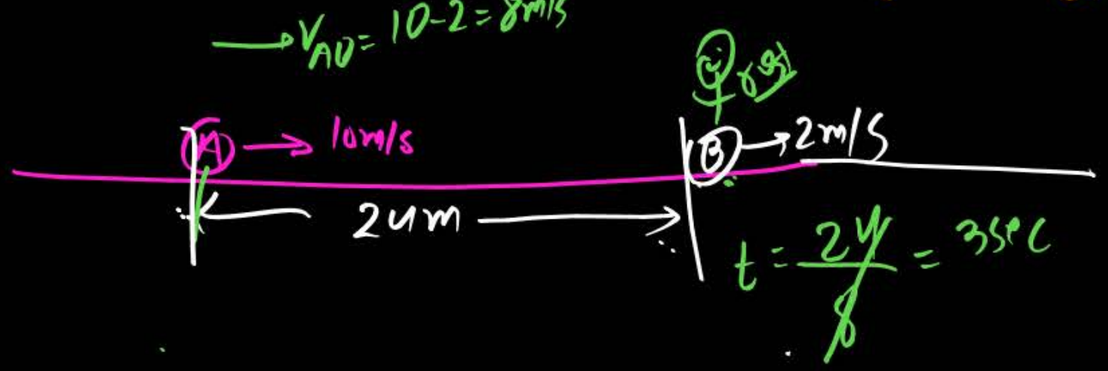
$dist_{AB} = 8\,m$

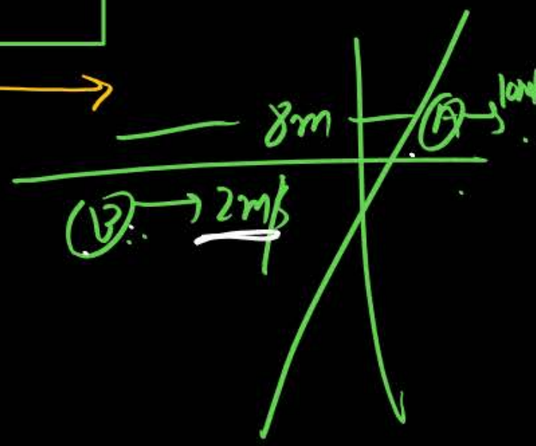
$t = \frac{8}{8} = 1\,sec$

✓ A, B ko Pakdega

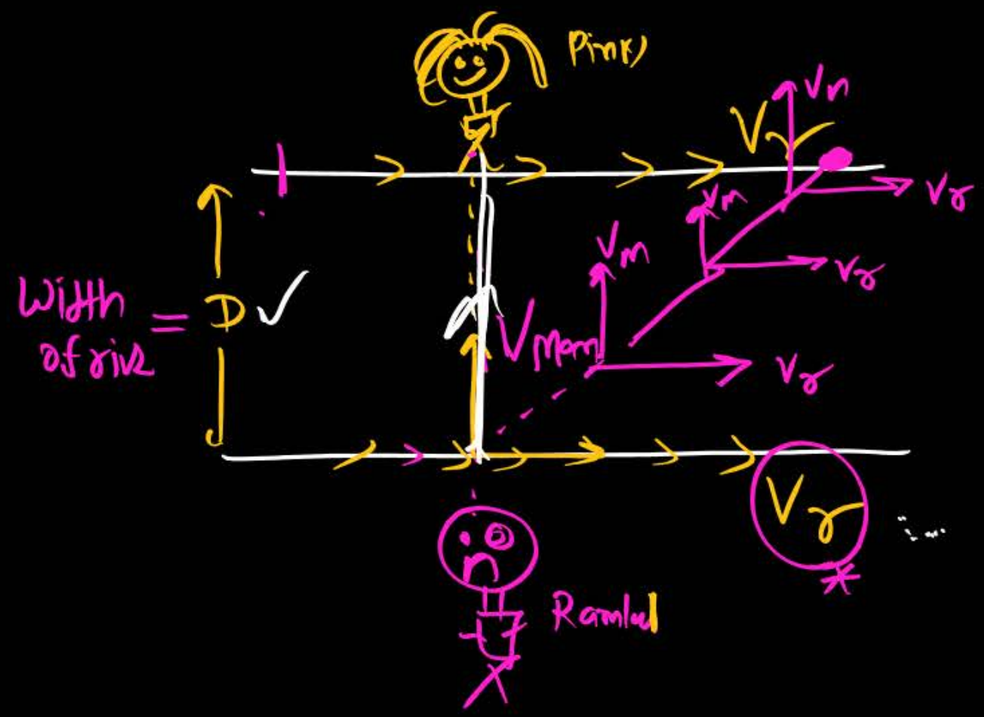
✗ Ya B, A ko Pakdga.







River man Prob^{m}



river is flowing in x-axis hence effect of V_r on Ramlal in along x-axis only.

V_r = velocity of river along river)

(1) flow of river will support or oppose in swimming of man in crossing river.

X (a) support

X (b) oppose

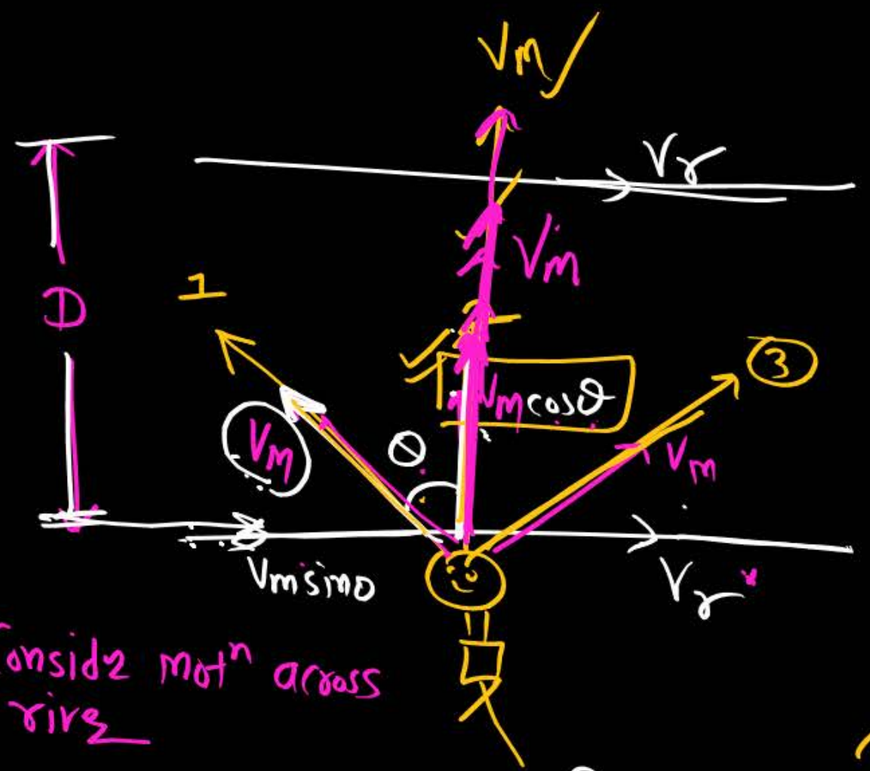
(c) Nither oppose or support

② man wants to cross the river in minimum time then he should swim in which direction.

~~30%~~
(a) 1

34%
(b) 2

34% (c) 3



Consider motn across river

$$t_{min} = \frac{D}{\text{velocity across river}} = \frac{D}{(V_m \cos\theta)_{max}} = \frac{D}{(V_m \times 1)_{max}}$$

$\cos\theta_{max} = 1$

$\theta = 0$

Jis direction me swimy karega = $\vec{V}_{man}$

Jis direction me more karega ($\vec{V}_m + \vec{V}_{R/w}$) = $\vec{V}_{m\,Grw}$

MR* Box

River apne dam pe cross kiya jata, hai, Ramlal apni puri jan River cross karne me lagayga.

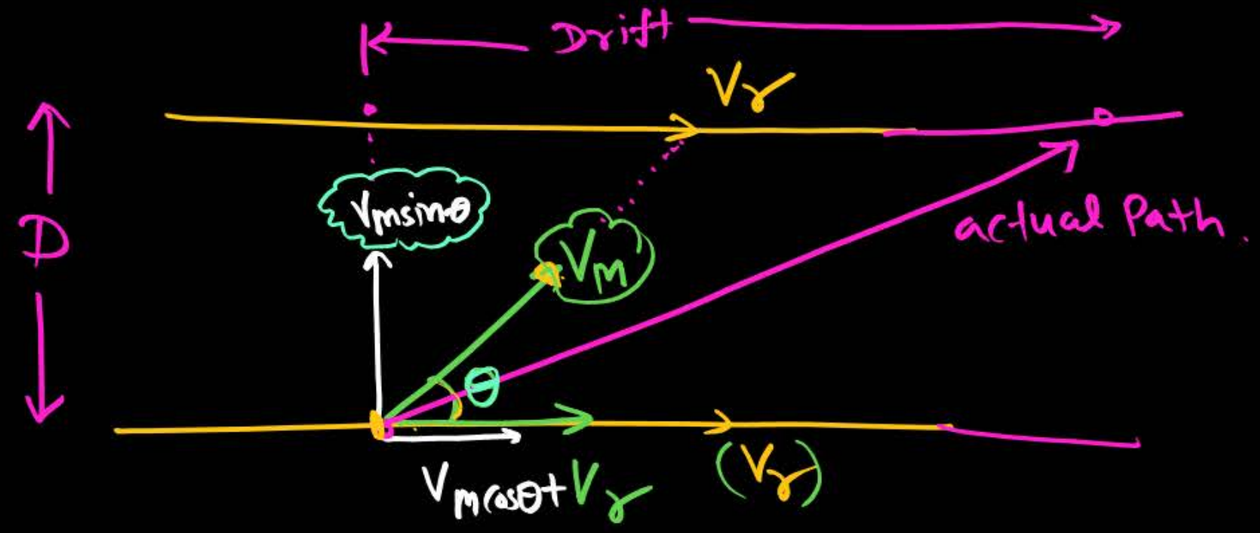
River ke flow ka effect along river hoga.

MR* Box

for minimum time Ramlal pure jan apne jan ki taraf lgayga.

$\theta = 90$ from flow of River for tmin.

③ Man is swiming with V_m at angle θ from flow of River V_r.
then time to cross river and Drift in this case :-



Consider man across river

$$t = \frac{D}{[V_m \sin\theta]}$$

$$(\text{Drift})_{\text{man across}} = (V_m \cos\theta + V_r) \times t$$

$$= (V_m \cos\theta + V_r) \frac{D}{V_m \sin\theta}$$

$$\vec{V}_{\text{man ground}} = \underbrace{(V_m \cos\theta + V_r)\hat{i}}_{\text{along river man move karega}} + \underbrace{V_m \sin\theta \hat{j}}_{\text{across River}}$$

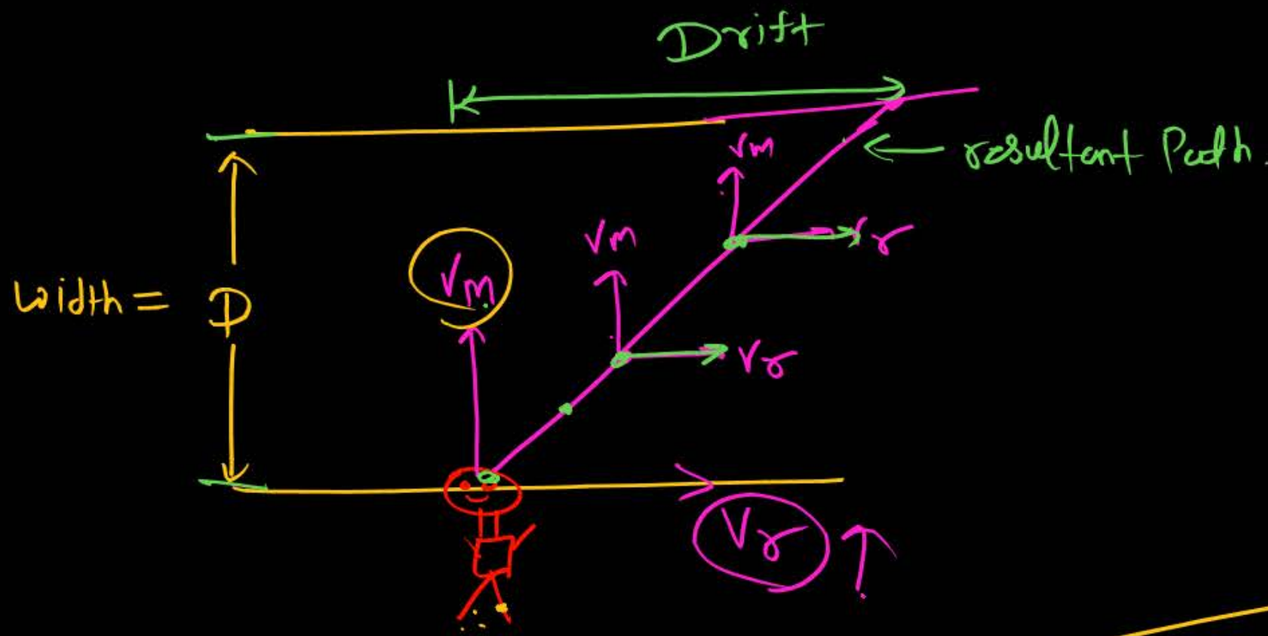
for minimum time:

$$t_{min} = \frac{D}{[V_m \sin\theta]_{max}}$$

$\sin\theta_{max} = 1$ at $\theta = 90^\circ$

$$t_{min} = \frac{D}{V_m} \quad (\text{minimum at } \theta = 90^\circ)$$

for minimum time



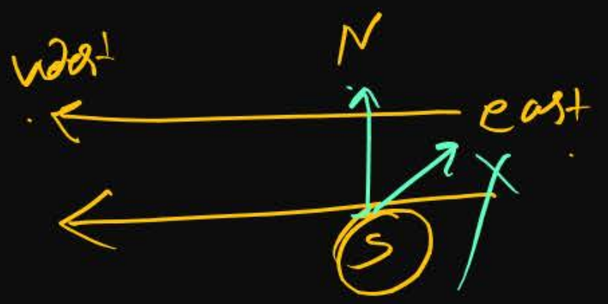
$$t = \frac{(\text{Disⁿ})_{y\text{-axis}}}{V_{y\text{-axis}}}$$

$$t_{min} = \frac{D}{V_m}$$

$$\text{Drift } (x) = v_r t$$
$$= v_r \times \frac{D}{v_m}$$

Question

A river is flowing from east to west at a speed of 5 m/min. A man on south bank of river, capable of swimming 10 m/min in still water, wants to swim across the river in shortest time; he should swim :-



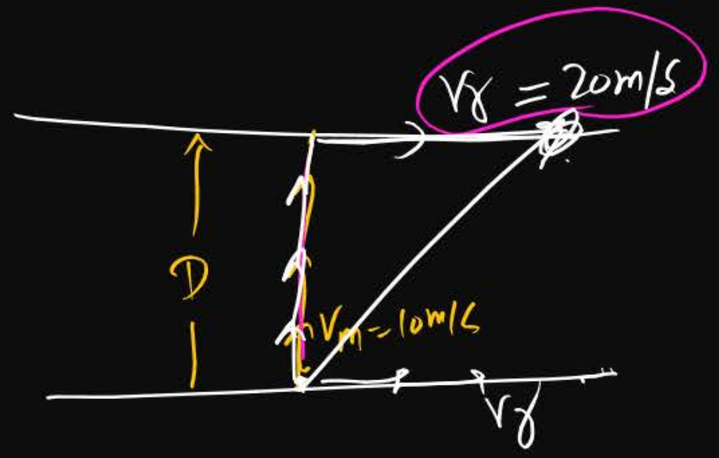
1. due north
2. due north-east
3. Due north-east with double the speed of river
4. none of the above

Question

लिखलो

River is flowing with speed 20 m/s a man can swim in flowing river with speed 10 m/s then find drift in a case of minimum time while the width of river is 60 m.

v_m = Velocity by which Man Can Swim.
= Velocity of man w.r.t River
= Velocity of man w.r.t still water



$$t_{min} = \frac{D}{v_m}$$

$$= \frac{60}{10}$$

$$= 6sec$$

$$Drift = (v_{man})_{w.r.t} \times t$$

$$= 20 \times 6$$

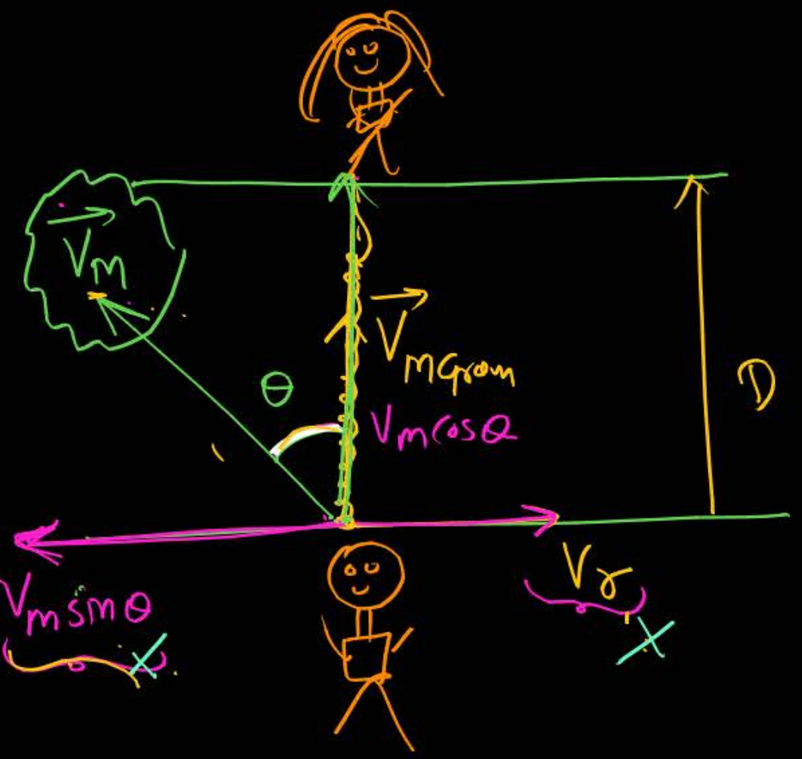
$$= 120m$$

MR* Box.

Kisi bhi case me river cross karne ke time me v_r gaa hi Nahi sakta.

(4) **Man wants to reach exactly opposite end of river [zero Drift]**
hence man crossing river along minimum path :-

(JVEET)



If Drift in x-axis is zero

$\vec{D}rif = (V_{mGrou})_x\, t$

$(V_{man\,Grou})_x = 0$

$V_m \sin\theta = V_r$ → only Possible (zero Drift) when $V_m > V_r$

$\sin\theta = \frac{V_r}{V_m}$

$t_{time} = \frac{D}{V_m\cos\theta}$

$\vec{V}_{man\,Groun} = \vec{V}_m\cos\theta$

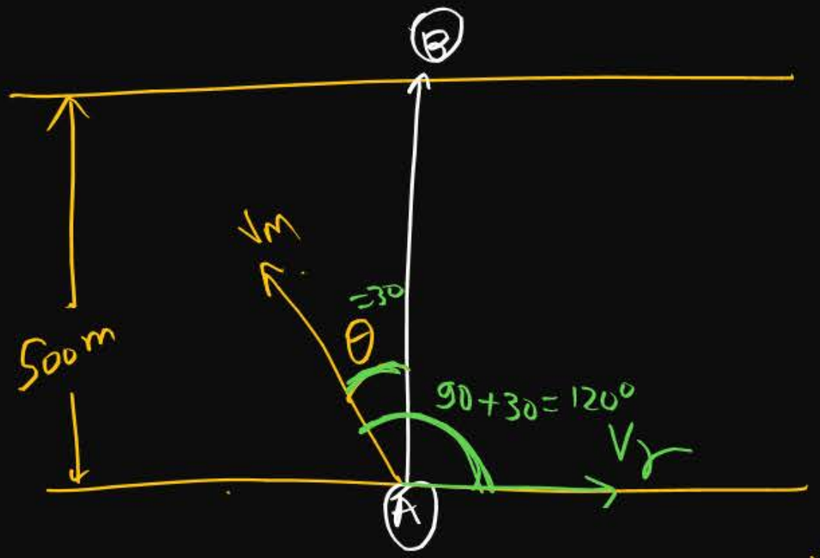
Question

धार पैं तिरना

A man wishes to swim across a river 0.5 km. wide. If he can swim at the rate of 2 km/h. in still water and the river flows at the rate of 1 km/h. The angle (w.r.t. the flow of the river) along which he should swim so as to reach a point exactly opposite his starting point, should be

(NEET)

1. 60°
2. 120°
3. 145°
4. 90°



$V_m = 2$ km/hr ✓

$V_r = 1$ km/hr ✓

$V_m \sin\theta = V_r$

$2 \sin\theta = 1$

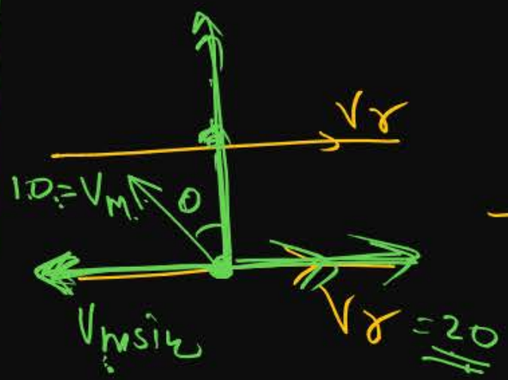
$\sin\theta = \frac{1}{2}$

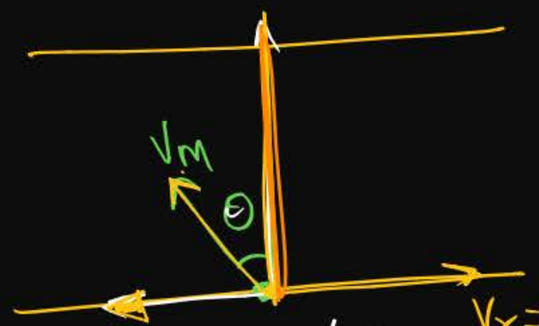
$\theta = 30°$

Question

Flow of river is 20 m/s and man can swim in river with speed 10 m/s then find angle at which man have to swim from flow. For zero drift/to reach exactly opposite point, minimum path?

1. 30°
2. 90°
3. 120°
4. None of these





$V_m = 10\,m/s$

$V_m \sin\theta = V_r$

$\sin\theta = \frac{V_r}{V_m}$

$\sin\theta = \frac{20}{10}$

$\sin\theta = 2$ Not Possible

Question

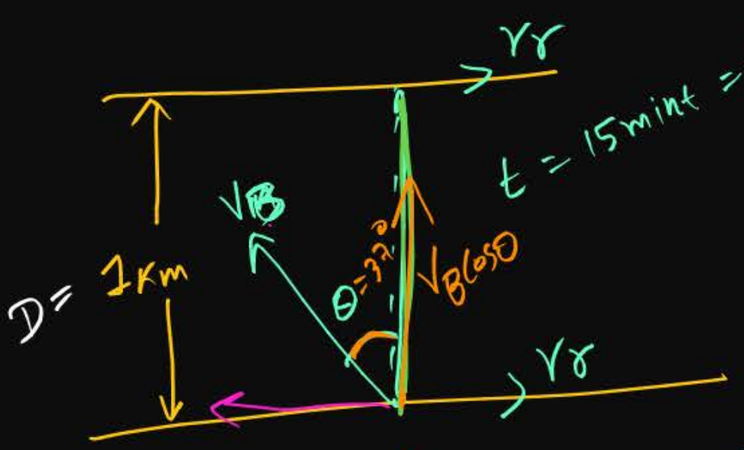
A boat, which has a speed of 5 km/h in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in km/h is

1. 1
2. 3
3. 4
4. $\sqrt{41}$

Rough में Solve करो
घर पर Note में लिखना

$\# V_B = 5 km/hr$

$\# V_r = ??$



$V_B \sin 37° = v_r$

$5 \times \frac{3}{5} = v_r$

$V_r = 3$

$t = \frac{D}{V_B \cos\theta}$ ✓

$\frac{1}{4} = \frac{1}{5\cos\theta}$

$\cos\theta = \frac{4}{5}$

$\theta = 37°$ ✓

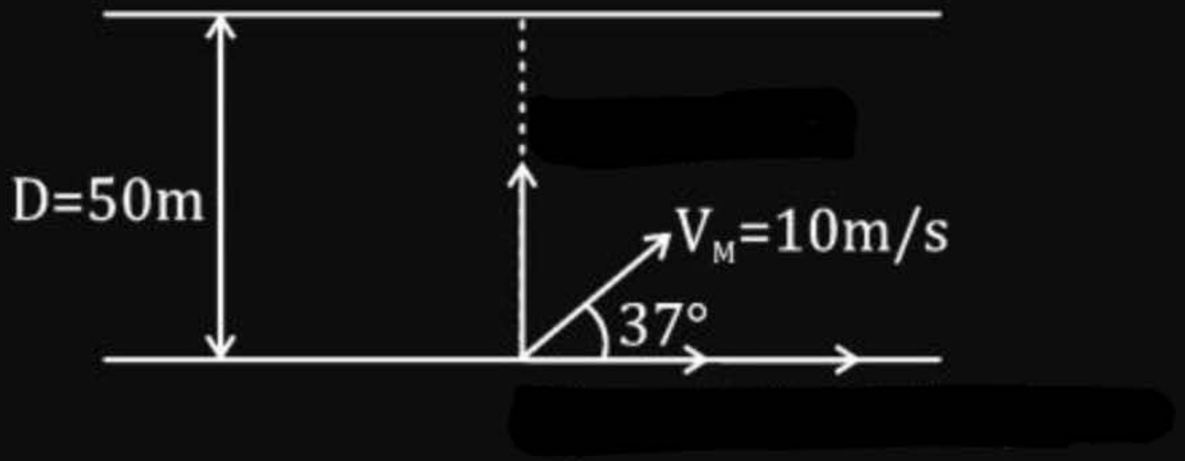
Question

A man is crossing a river flowing with velocity of 5 m/s. He reaches a point directly across at distance of 60 m in 5s. His velocity in still water should be:

1. 12 m/s
2. 13 m/s
3. 5 m/s
4. 10 m/s

Question

Find drift and time taken to cross the river.



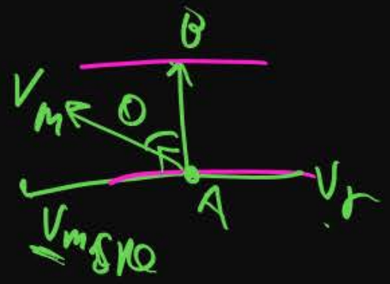
Question

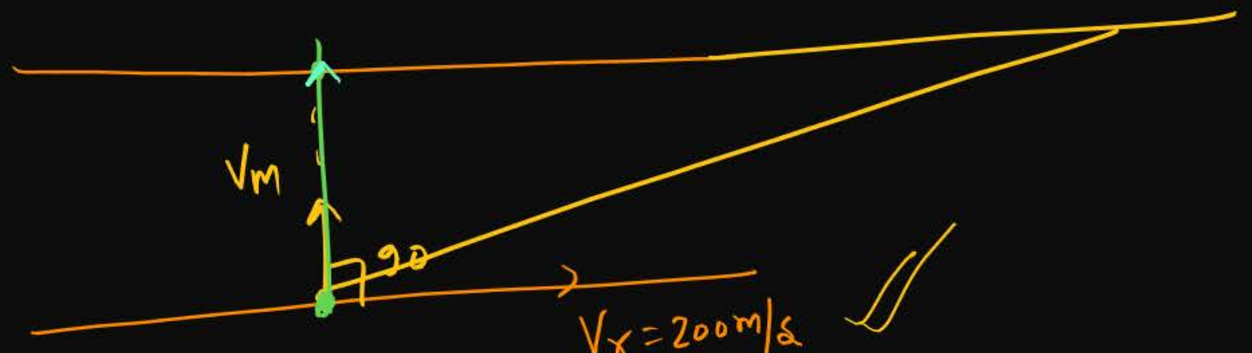
Flow of river is 200 m/s and man can swim in river with speed 10 m/s then find angle at which man have to swim for minimum time.

1. 30°
2. 90° (Ans)
3. 120°
4. None of these

65%

MR Scam



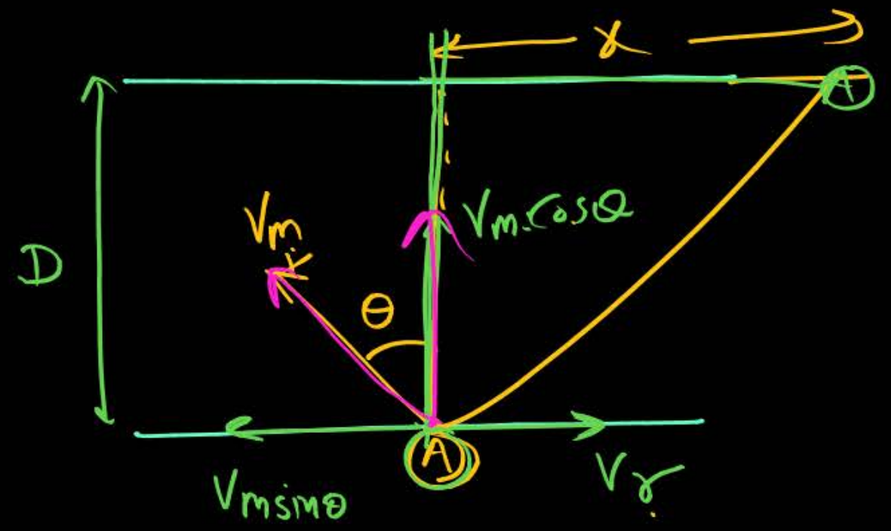


$t_{min} = \frac{d}{V_m}$

$V_m = 10 m/s$

(Q) At what angle man have to swim for minimum Path if ($V_m < V_r$) across river.

extra



$(V_r > V_m)$

velocity of river is more than velocity of man.

$$t = \frac{D}{V_m \cos\theta} \quad -(1)$$

Drift $x = (V_r - V_m \sin\theta)\, t = (V_r - V_m \sin\theta)\frac{D}{V_m \cos\theta}$

for minimum Drift $x \rightarrow \frac{dx}{d\theta} = 0$

$$\vec{v}_{man\ (ground)} = \underbrace{(V_r - V_m \sin\theta)\hat{i}}_{\text{Drift}} + \underbrace{(V_m \cos\theta)\hat{j}}_{\text{across river}}$$

$$x = \frac{V_r D}{V_m \cos\theta} - \frac{V_m D \sin\theta}{V_m \cos\theta}$$

$$x = \frac{V_r D}{V_m} \sec\theta - D\tan\theta$$

$$\frac{dx}{d\theta} = 0 = \frac{V_r D}{V_m} \sec\theta \cdot \tan\theta - D\sec^2\theta$$

$$D\sec\theta = \frac{V_r D}{V_m}\sec\theta\tan\theta$$

$$\frac{D}{\cos\theta} = \frac{V_r}{V_m}\frac{\sin\theta}{\cos\theta}$$

$$\sin\theta\,\frac{V_r}{V_m} = 1$$

$$\sin\theta = \frac{V_m}{V_r}$$

$(V_r > V_m)$

for minimum Drift

Not zero Drift

for minimum Drift $(V_m > V_r)$

$$\sin\theta = \frac{(V_r)_{\text{max}}}{(V_m)_{\text{min}}}$$

$(V_m < V_r)$

$$\sin\theta = \frac{(V_m)_{\text{max}}}{(V_r)_{\text{min}}}$$

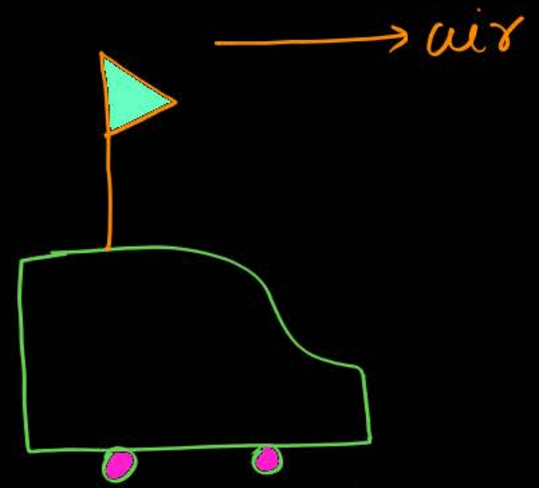
flag flutters

MRV Box

① flag flutts in the dirⁿ of flow of air flow.

② flag flutts opposite to the dirⁿ of motⁿ of CAR, Boat, when flag is fixed.

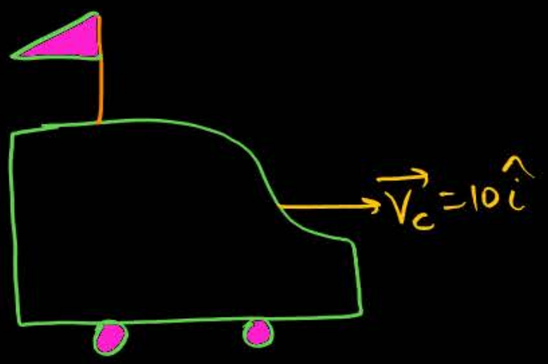
flag flutters:



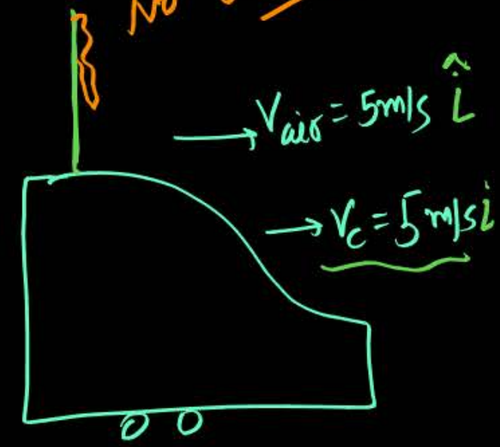
(CAR at rest)

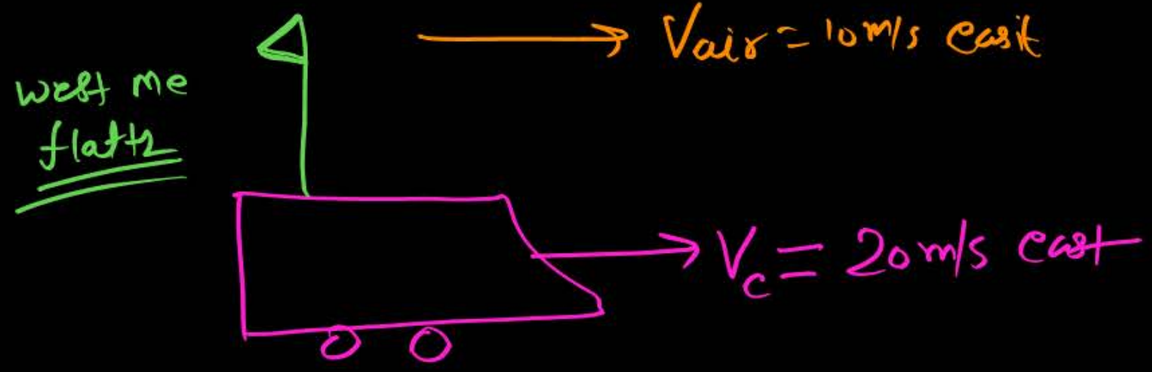
- flag will flutters in the direction of air

(No air)



No flutter




west me
flatte
V_{air} = 10 m/s east
V_c = 20 m/s east

Q CAR is moving in west with speed 10m/s and air is flowing in north with speed 10m/s then dir^n of Flag.

Sol^n

$\longrightarrow \vec{V}_{flg} = 10\ East + 10\ North$

North-east $\hat{i}$ Flag flath.

Question

A boat moving towards east with velocity 4 m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is

1. North-west
2. South-east
3. $\tan^{-1}(1/2)$ with east
4. North

$\vec{V}_B = 4$ East

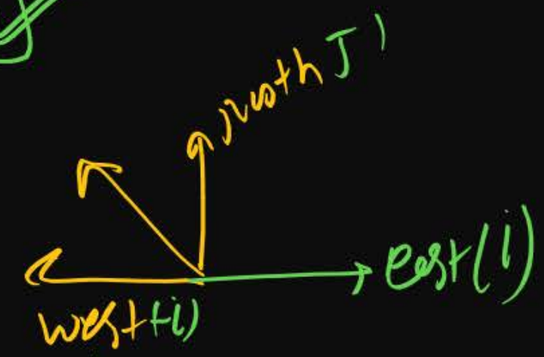
$\vec{V}_r = 2$ m/s North

$\vec{V}_{wind(air)} = 6\hat{j}$ m/s

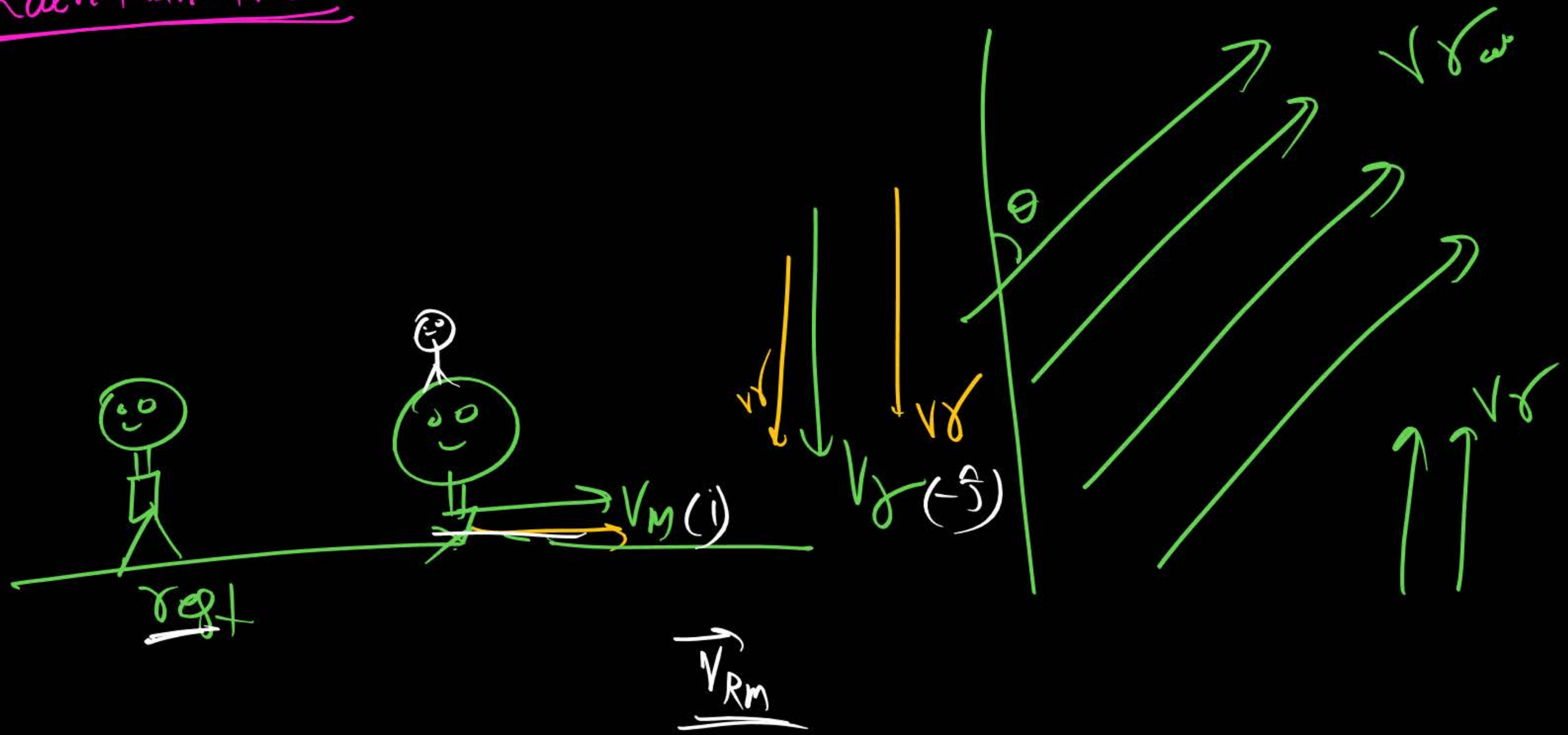
Soln $\vec{V}_{B\,ground} = 4\hat{i} + 2\hat{j}$

$\vec{V}_{flg} = -4\hat{i} - 2\hat{j} + 6\hat{j}$

$= -4\hat{i} + 4\hat{j}$



Rain man - Probm



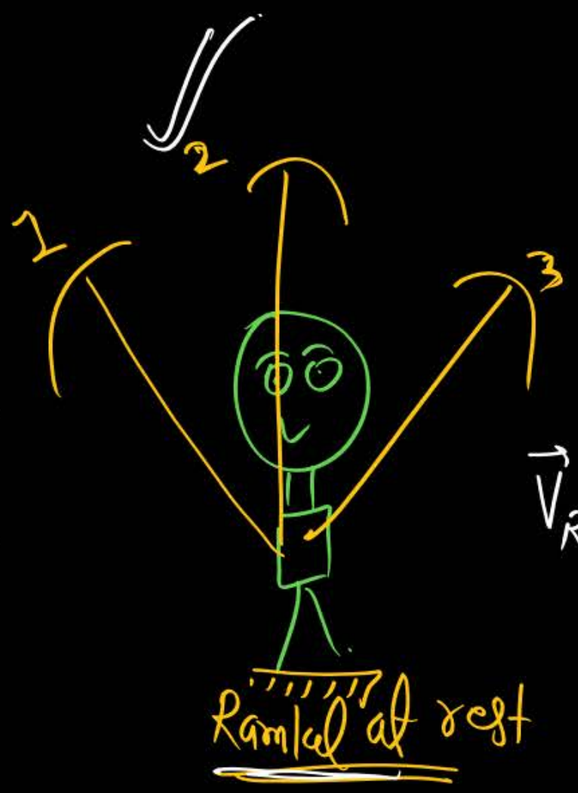
Rain - man Problem

V_r (ground) $= -10\hat{j}$

(a) 1

~~(b)~~ 2

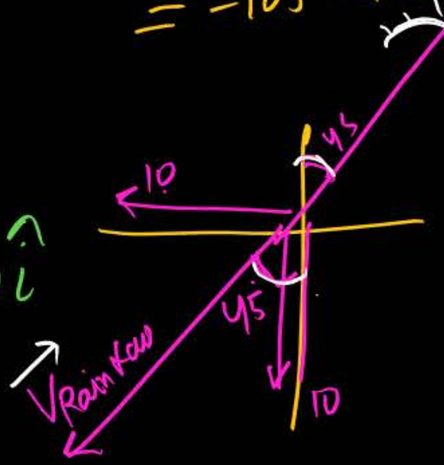
(c) 3



$\vec{V}_{Rain\ (Ramlal)} = \vec{V}_R - \vec{V}_{Ram} = -10\hat{j} - 0 = 10\hat{j}$

$\vec{V}_{Rain\ kallu} = \vec{V}_R - \vec{V}_K$

$= -10\hat{j} - 10\hat{i}$



RAIN MAN PROBLEM

$\vec{V}_{Rain\ (man.)\ obtz}$

MRP Boy

always find $\vec{V}_{Rman} = \vec{V}_R - \vec{V}_m$ (Velocity of rain w.r.t man)

Draw $\vec{V}_{Rm}$ in vector form and find Angle (diretion) using tanθ.

use umbrela in diretion of $-\vec{V}_{Rm}$

ek Bat or → given & ask kiske respect me hai ye dhyan se dekhna.

Question

A man sitting in a bus travelling in a direction from west to east with a speed of 40 km/h observes that the rain-drops are falling vertically downwards. To another man standing on ground the rain will appear.

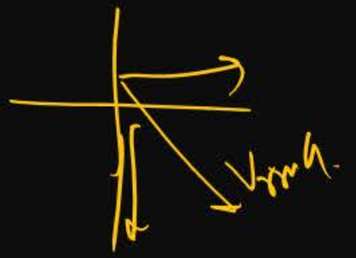
$\vec{v}_{RM} = \vec{v}_{Rg} - \vec{v}_{mg}$

$-\hat{j} = \vec{v}_{Rg} - \hat{i}$

$\vec{v}_{Rg} = \hat{i} - \hat{j}$

$v_{Rain\ ground} = ??$

1. To fall vertically downwards
2. To fall at an angle going from west to east
3. To fall at an angle going from east to west
4. The information given is insufficient to decide the direction of the rain



Question

A man walks in rain with a velocity of 5 kmh^{-1}. The rain drops strike at him at an angle of 45° with the horizontal. Velocity of rain if it is falling vertically downward

1. 5 kmh^{-1}
2. 4 kmh^{-1}
3. 3 kmh^{-1}
4. 1 kmh^{-1}

H/W

Question

Rain is falling vertically with a speed of 30 ms^{-1}. A woman rides a bicycle with a speed of 10 ms^{-1} in the north to south direction. What is the direction in which she should hold her umbrella?

H/W

Question

Man is at rest an find rain is falling with speed 50 m/s at angle 37° from vertical; now man starts moving with speed V_m, then find V_m so that rain appears to falling vertical downward with respect to moving man; also find V_{rm} / V_r

H/W

Question

A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/hr then he finds that rain drops are hitting his head vertically, then speed of rain drops with respect to moving man:

1. 20 km/hr
2. $10\sqrt{3}$ km/hr
3. $10/\sqrt{3}$ km/hr
4. 10 km/hr

H/W

THANK YOU

Do all H/W

Sanghash assignment will upload today

$V_{Rain\ (man)} = ??$