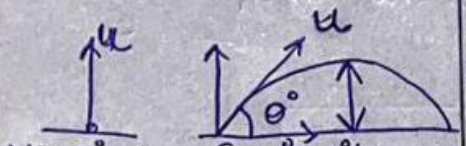
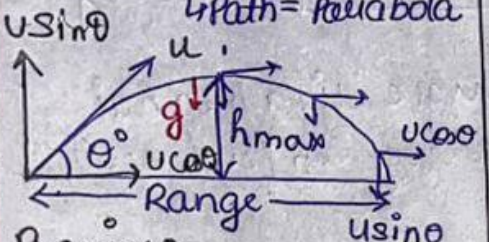
MOTION IN A PLANE

#Projectile motion :-



Vertical motion — Projectile motion

↳Path = Parabola



Basics :-

$u_x = u\cos\theta$ $a_x = 0$

$u_y = u\sin\theta$ $a_y = -g$

(-ve shows towards the gravity).

u_x = constant (due to $a=0$) horizontal velocity in projectile will remain constant.

$\cos 37° = 4/5$ $\cos 53° = 3/5$

$\sin 37° = 3/5$ $\sin 53° = 4/5$

$\tan 37° = \frac{3}{4}$ $\tan 53° = 4/3$

$$H_{max} = \frac{u_y^2}{2g}$$

$$\text{Time of flight} = \frac{2u_y}{g}$$

$$\text{Range} \rightarrow u_x T = \frac{u^2 \sin 2\theta}{g}$$

#Equation of Trajectory :-

$$y = x\tan\theta\left(1 - \frac{x}{R}\right)$$

dist° from

$x = \frac{1}{2}$ of Range (R).

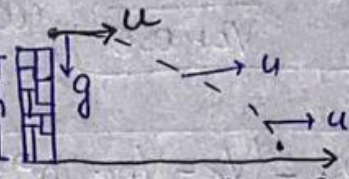
#Horizontal projection :-

$u = 0$

$t = \sqrt{\frac{2h}{g}}$

$v_f = \sqrt{2gh}$

vertical motion.



$u_y = 0$ $a_y = -g$

$u_x = u$ $a_x = 0$

$$\text{time of flight} = \sqrt{\frac{2h}{g}}$$

$$R = u\sqrt{\frac{2h}{g}}$$

$v_y = u_y + a_y t$

$v_y^2 = u_y^2 + 2a_y s$

#Relative motion :-

A → v_A $v_{AB} = v_A - v_B$

B → v_B $v_{BA} = v_B - v_A$

↓↓ V of wrt A

Frame = velocity = 0 (stationary)



How much time will I catch you?

$v_{AB} = v_A - v_B$

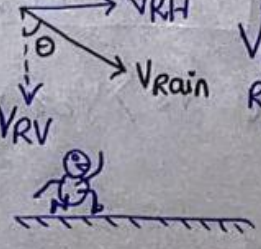
(WH) $= 20 - 10$

$= 10$ m/s

∴ new frame pe, B at rest and A at moving with this frame is 10 m/s

$t = \frac{d}{s} = \frac{100}{10} = 10$ sec

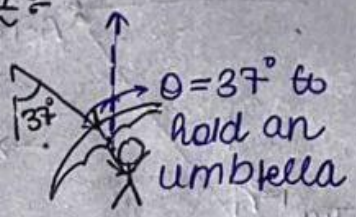
#Rain man problems :-



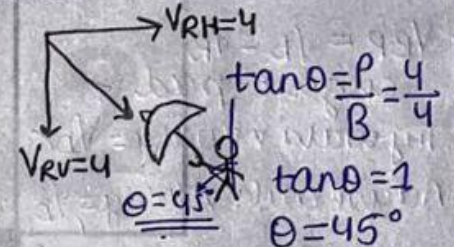
$v_{RM} = ?$ Rain wrt man

$v_{RM} = v_R - v_m$

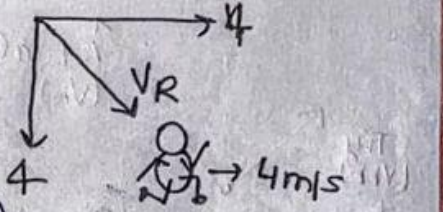
Case I :-



Case II :-



Case III :-

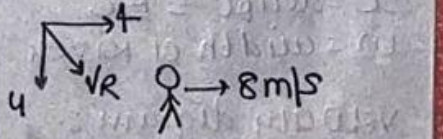


$(v_{RM}) = v_R - v_m$

$H = 4 - 4 = 0$ (zero)

Uske (aage ki Rain Horizontal hai hi nhi, to bas/ usee vertical dikai dega.

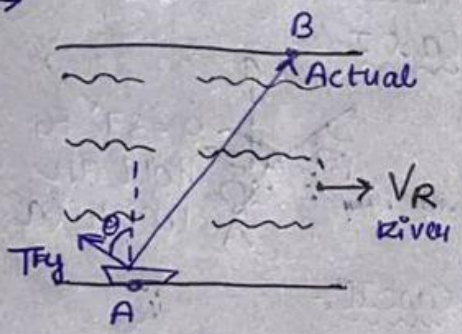
Case IV



$v_{RM} = v_R - v_M = 4 - 8 = -4$

man ko lagega ki Rain Horizontal peche jaa raha hai, and ubbe hit karegi.

#RIVER BOAT PROBLEM



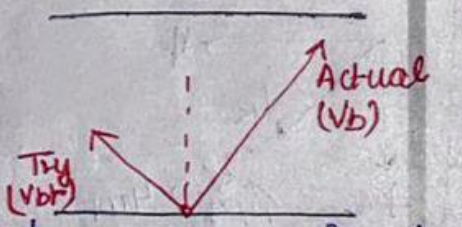
$V_{BR} = V_b - V_R$

engine speed ↑

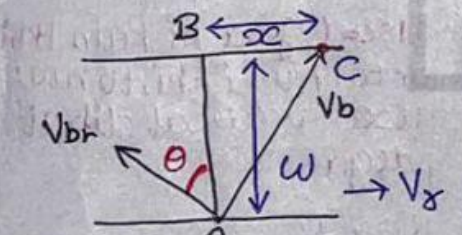
Try wala velocity = V_{br}

Actual wala velocity = V_b

observe from ground.



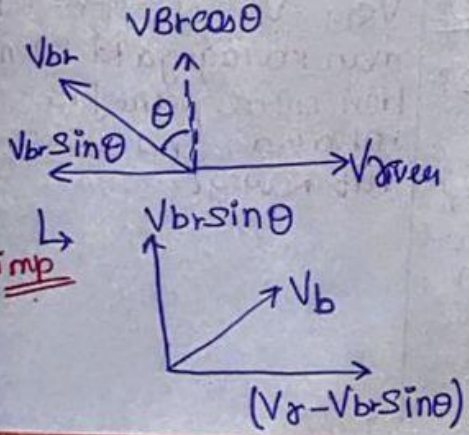
↳ we can see this only if river is at rest



x = drift = BC

w = width of River

Velocity digram :-



↳ imp

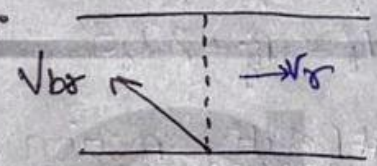
$$t = \frac{w}{V_{br}\cos\theta}$$ time to cross the river $t = \frac{d}{s}$

$$x = (V_r - V_{br}\sin\theta)\frac{w}{V_{br}\cos\theta}$$ → drift velocity

River flow se agar angle diya hua hai toh (90 − angle) karenge to find out θ (theta).

#Special Case :-

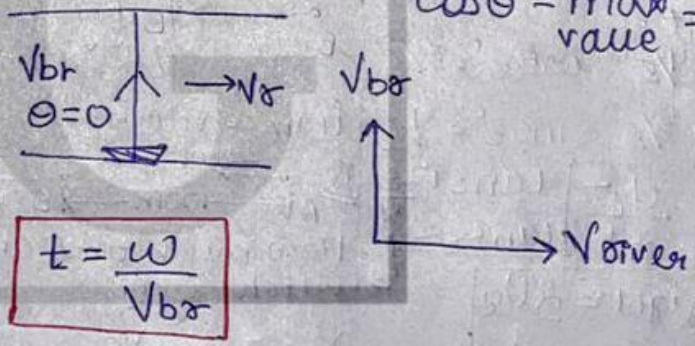
1.



min time :-

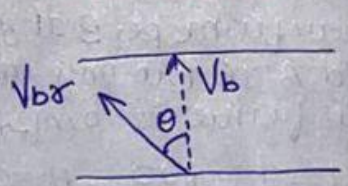
$$\downarrow t = \frac{w}{V_{br}(\cos\theta)\uparrow}$$

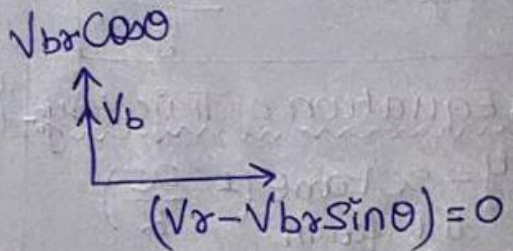
$\cos\theta = \max$ value $= \theta = 0°$



$$t = \frac{w}{V_{br}}$$

#Zero drift :-





$$\sin\theta = \frac{V_r}{V_{br}}$$

if $V_r > V_{br}$ → the zero drift is impossible!!

1:06:06

1:24:55