Revision Booster
WORKSHOP
for
NEET & JEE Main

MECHANICS

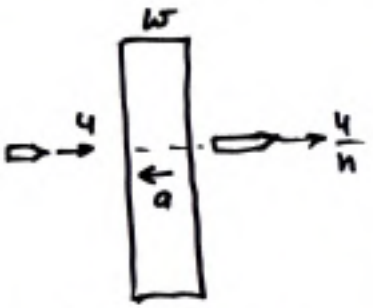
Kinematics & Laws of Motion

Notes of Revision Booster Workshop for JEE Main & NEET

9000+ Classes available on PHYSICS GALAXY Mobile app

QUESTIONS BASED ON

BULLET PENETRATING A PLANK



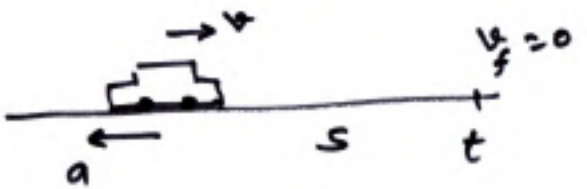
$\left(\frac{u}{n}\right)^2 = u^2 - 2aw \rightarrow a = ---$

$0 = u^2 - 2a(nw) \rightarrow n = ---$

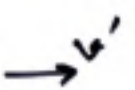
$\left(\frac{u}{m}\right)^2 = u^2 - 2aw' \rightarrow w' = ---$

QUESTIONS BASED ON

BREAKING OF A CAR



$$a = \frac{v^2}{2s} = \frac{v}{t}$$

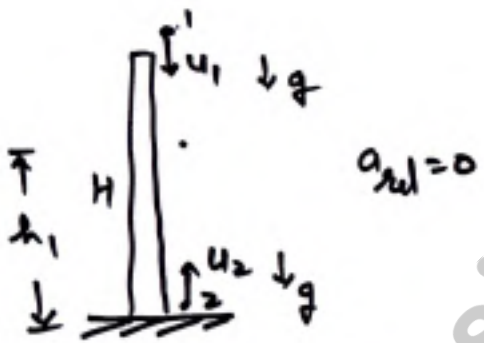


$s' = ?$ $\left[t' = ? = \frac{v'}{v} \cdot t\right]$

$$\left[s' = \frac{v'^2}{2a} = \frac{v'^2}{v^2} \cdot s\right]$$

QUESTIONS BASED ON

PROJECTION FROM TOWER

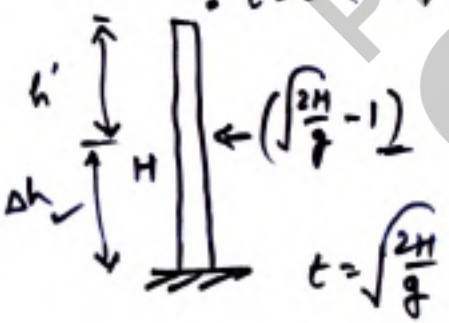


$a_{rel} = 0$

time to collide

$$t = \frac{H}{u_1 + u_2}$$

$$h_1 = u_2 t - \tfrac{1}{2} g t^2$$



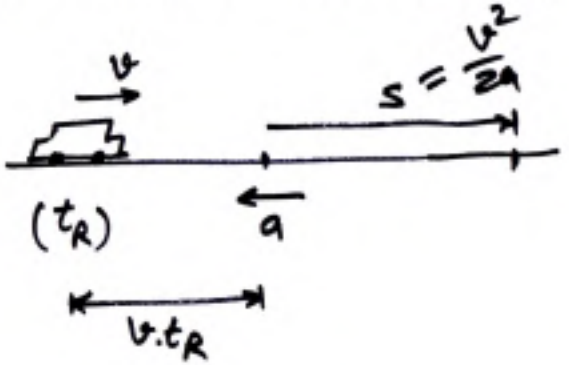
find dist travel in last sec of motion

$$h' = \tfrac{1}{2} g \left(\sqrt{\frac{2H}{g}} - 1\right)^2$$

$\Delta h = H - h' =$ —

QUESTIONS BASED ON

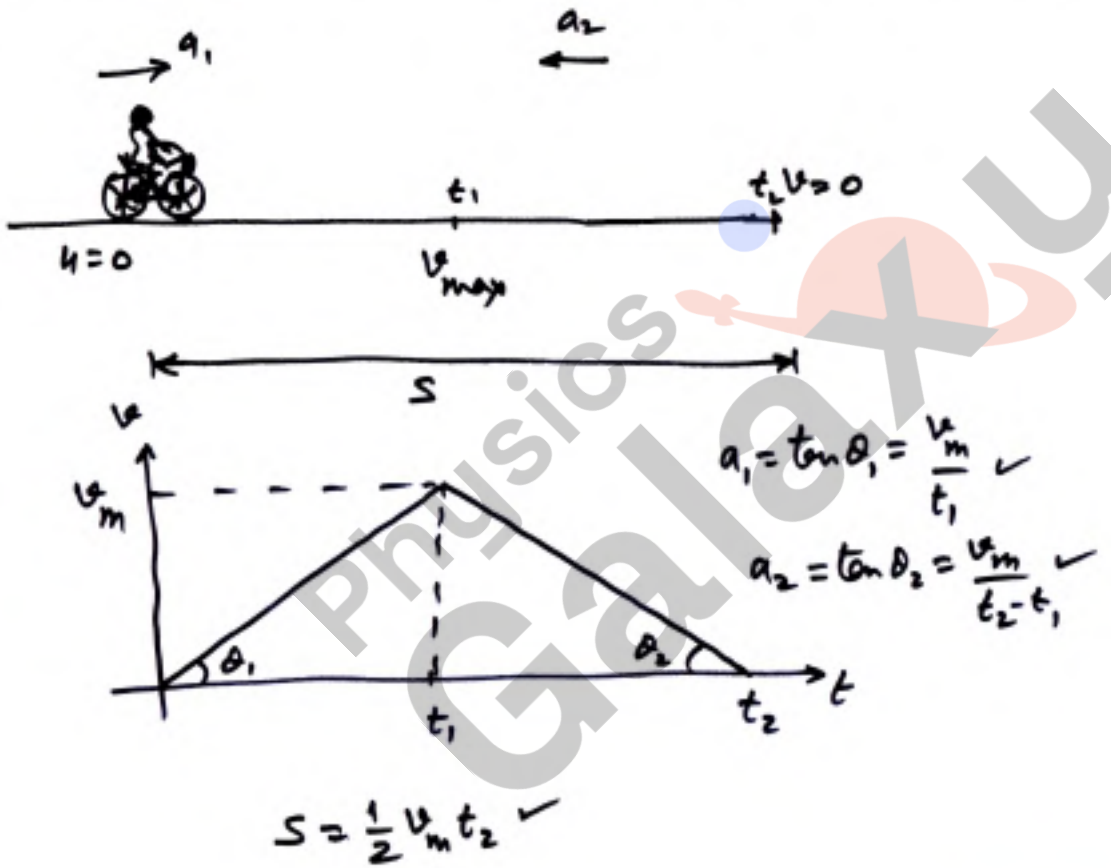
CASES OF REACTION TIME



Total breaking distance $= v.t_R + \frac{v^2}{2a}$

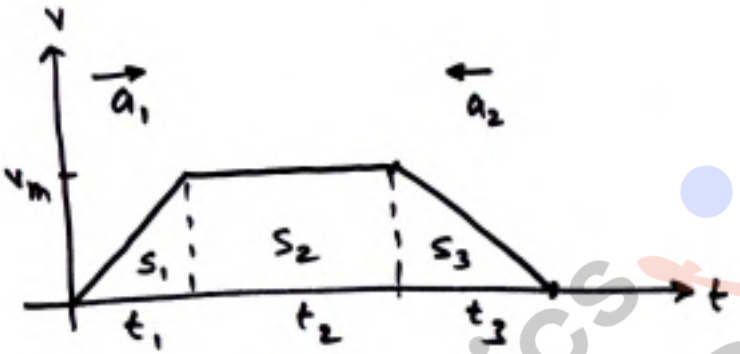
QUESTIONS BASED ON

DISTANCE COVERED IN ACCELERATION & RETARDATION CASES



QUESTIONS BASED ON

JOURNEY WITH ACCELERATION, UNIFORM MOTION & RETARDATION



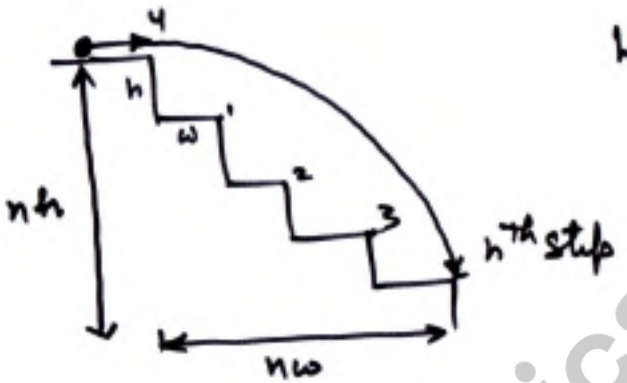
$$s_2 = v_m t_2$$

$$s_1 = \frac{1}{2} v_m t_1 = \frac{v_m^2}{2a_1} \qquad s_3 = \frac{1}{2} v_m t_3 = \frac{v_m^2}{2a_2}$$

$$a_1 = \frac{v_m}{t_1} \; ; \; a_2 = \frac{v_m}{t_3}$$

QUESTIONS BASED ON

BALL ROLLING OVER STEPS



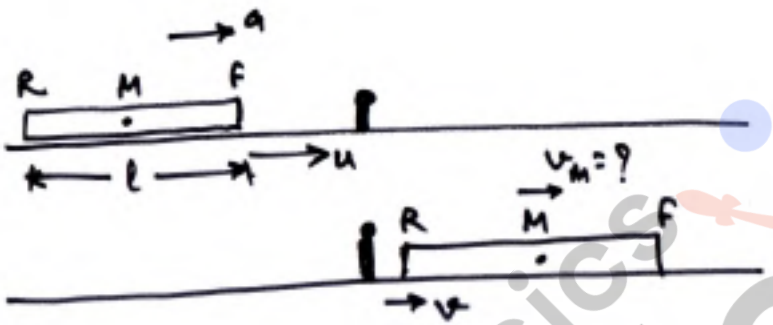
horiz proj → eqn

$$y = -\frac{gx^2}{2u^2}$$

$$nh = -\frac{g(n\omega)^2}{2u^2}$$

QUESTIONS BASED ON

TRAIN PASSING A POLE



$v^2 = u^2 + 2al$ | $v = u + at$

$v_m^2 = u^2 + 2a(l/2)$ | $v_m = u + at'$

$v_m = \sqrt{\frac{v^2 + u^2}{2}}$ $t' = \ldots$

QUESTIONS BASED ON

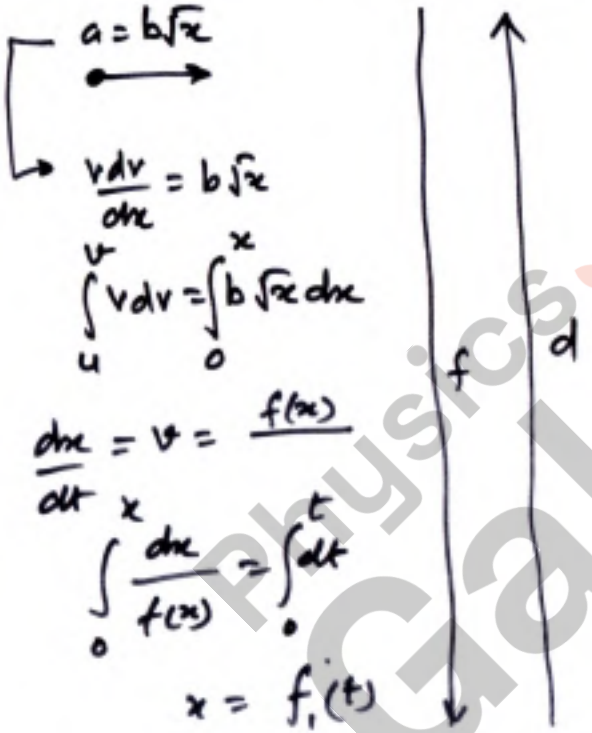
PERSON WALKING ON ESCALATOR

if only man is walking $t_2 = \frac{l}{v_2}$

if only esc is moving $t_1 = \frac{l}{v_1}$

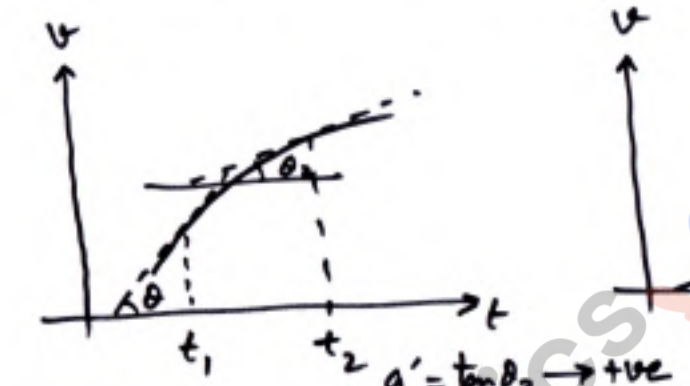
if man is walking on moving esc $t_f = \frac{l}{v_1 + v_2} = \frac{t_1 t_2}{t_1 + t_2}$

QUESTIONS BASED ON
VARIABLE MOTION CASES

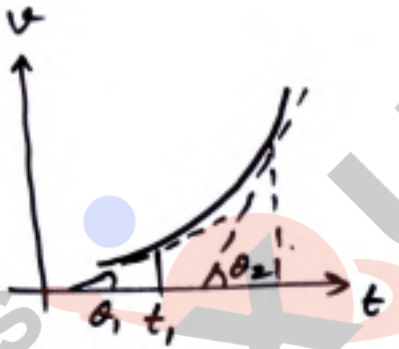


QUESTIONS BASED ON

SLOPE ANALYSIS OF CURVES



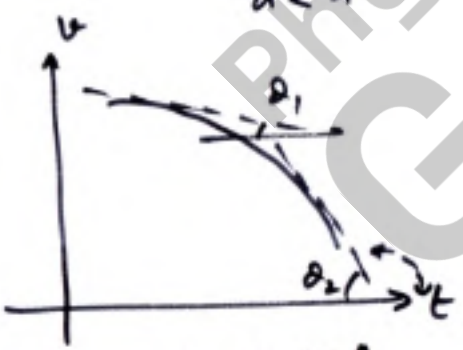
$a = \tan\theta \rightarrow +ve$



$a' = \tan\theta_2 \rightarrow +ve$

$a \uparrow +ve$

$a' < a$

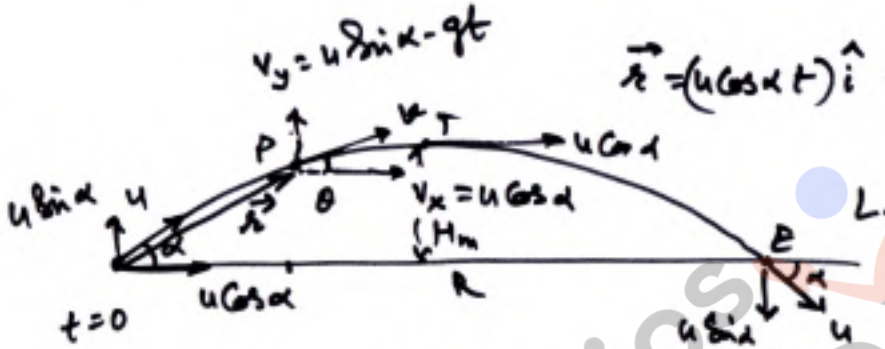


$a \rightarrow -ve \uparrow$

$a \rightarrow -ve \downarrow$

QUESTIONS BASED ON

ANGLE OF MOTION IN PROJECTILE



$$\vec{r} = (u\cos\alpha\, t)\hat{i} + (u\sin\alpha\, t - \tfrac{1}{2}gt^2)\hat{j}$$

$$L_T = m.(u\cos\alpha)\, H_m$$

$$L_E = m\, u\sin\alpha \cdot R$$

$$\theta = \tan^{-1}\frac{v_y}{v_x} = \tan^{-1}\left(\frac{u\sin\alpha - gt}{u\cos\alpha}\right)$$

 # Angular momentum in Projectile motion:

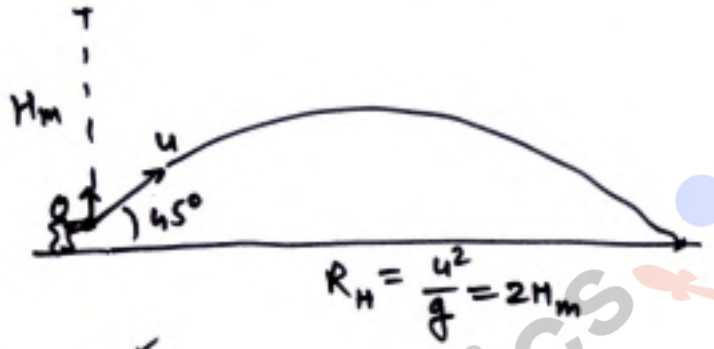
$$\vec{L} = m(\vec{r} \times \vec{v})$$

$$\vec{L} = m[\longrightarrow] \times [u\cos\alpha\,\hat{i} + (u\sin\alpha - gt)\hat{j}]$$

$$= \text{——}$$

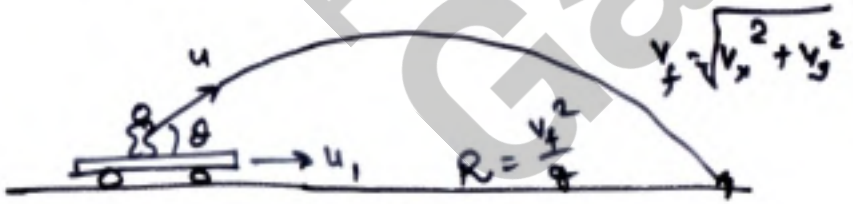
QUESTIONS BASED ON

MAXIMUM PROJECTION CAPACITY



$H_m = \frac{u^2}{2g}$

$u = \sqrt{2gH_m}$ (max speed)



$v_x = u_1 + u\cos\theta$

$v_y = u\sin\theta$

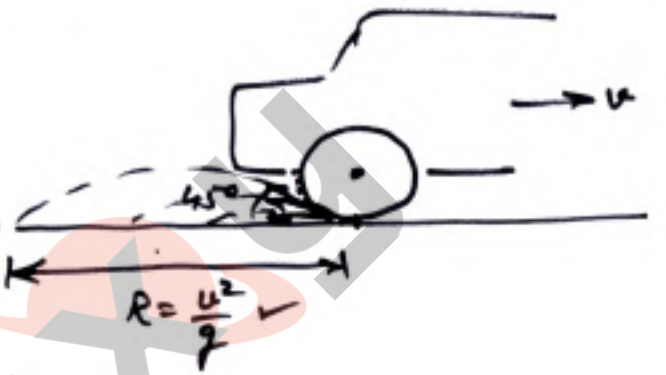
for $\theta_f = 45°$

$u_1 + u\cos\theta = u\sin\theta$

$\theta =$

QUESTIONS BASED ON

WATER FOUNTAIN WETTING THE GROUND

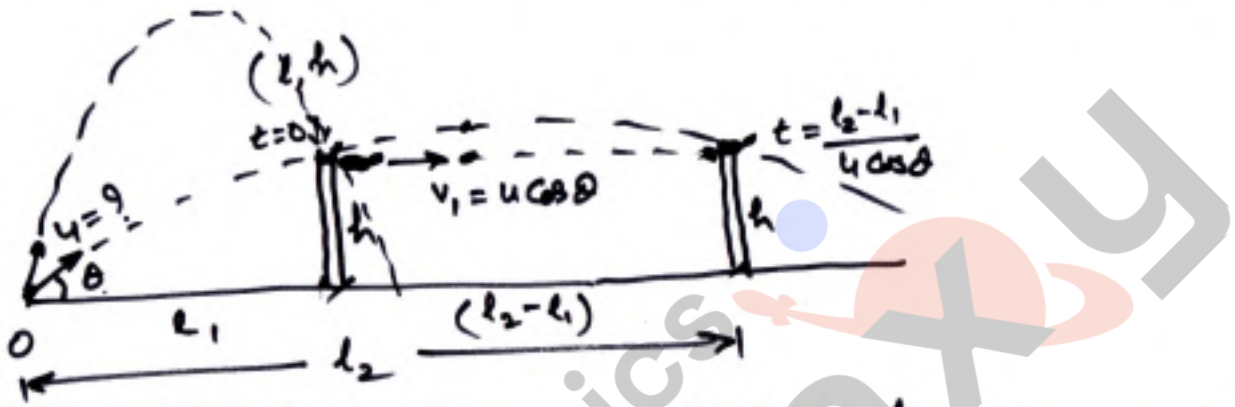


max area wetting is

$$A = \pi R^2 = \frac{\pi u^4}{g^2}.$$

QUESTIONS BASED ON

PROJECTILE CLEARING A WALL : BIRD FLIGHT CASE



eqⁿ of traj

$$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$$

$$h = l\tan\theta - \frac{gl^2}{2u^2\cos^2\theta}$$

$u = \text{—}$

if θ is Req^d

$$h = l\tan\theta - \frac{gl^2}{2u^2}(1+\tan^2\theta)$$

$\theta = \text{—}, \text{—}$

QUESTIONS BASED ON

ANGLE BETWEEN $\vec{v}$ & $\vec{a}$ IN GENERAL 2D MOTION

$a_x = 6\alpha t$ ← a ← $v_x = 3\alpha t^2$ ← d ← $x = \alpha t^3$

$a_y = 12\beta t^2 + 2\gamma$ ← a ← $v_y = 4\beta t^3 + 2\gamma t$ ← d ← $y = \beta t^4 + \gamma t^2$

$t = (x/\alpha)^{1/3}$

$y = f(x)$

$\vec{a} = a_x\hat{i} + a_y\hat{j}$

$\vec{v} = v_x\hat{i} + v_y\hat{j}$

$\frac{dy}{dx} = \text{——} = \tan\theta$

$\tan\theta = \frac{v_y}{v_x}$

at $t = t_1$

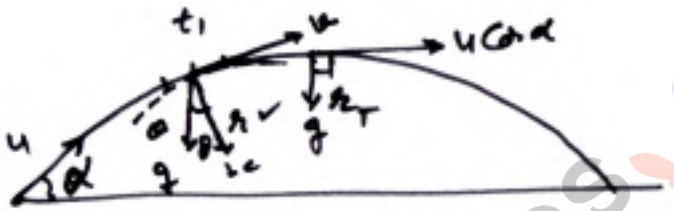
$\theta = \cos^{-1}(\hat{a}\cdot\hat{v})$

✓ = ——

eliminate t between x and y to get eqn of $t+aj$

QUESTIONS BASED ON

RADIUS OF CURVATURE IN A TRAJECTORY



$$\checkmark\ r = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\left|\frac{d^2y}{dx^2}\right|} = \text{——}$$

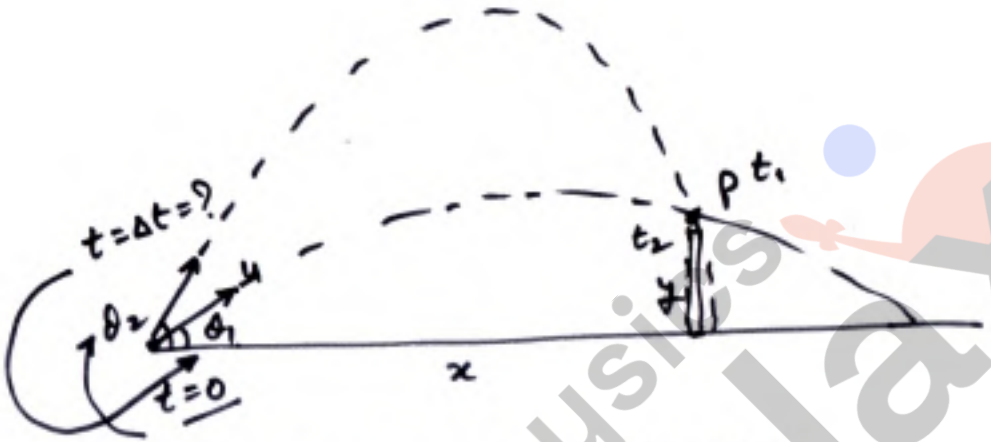
radial acc^n $a_r = g\cos\theta = \frac{v^2}{r}$

$$\Rightarrow r = \frac{v^2}{g\cos\theta}$$

at topmost pt $g = \frac{v^2}{r_T} = \frac{u^2\cos^2\theta}{r_T} \Rightarrow r_T = \frac{u^2\cos^2\theta}{g}$

QUESTIONS BASED ON

COLLISON OF TWO PROJECTILES



$$\left[\begin{array}{l} x = u\cos\theta_2 t_2 = u\cos\theta_1 \cdot t_1 \\ y = u\sin\theta_2 \cdot t_2 - \frac{1}{2}gt_2^2 = u\sin\theta_1 t_1 - \frac{1}{2}gt_1^2 \end{array}\right]$$

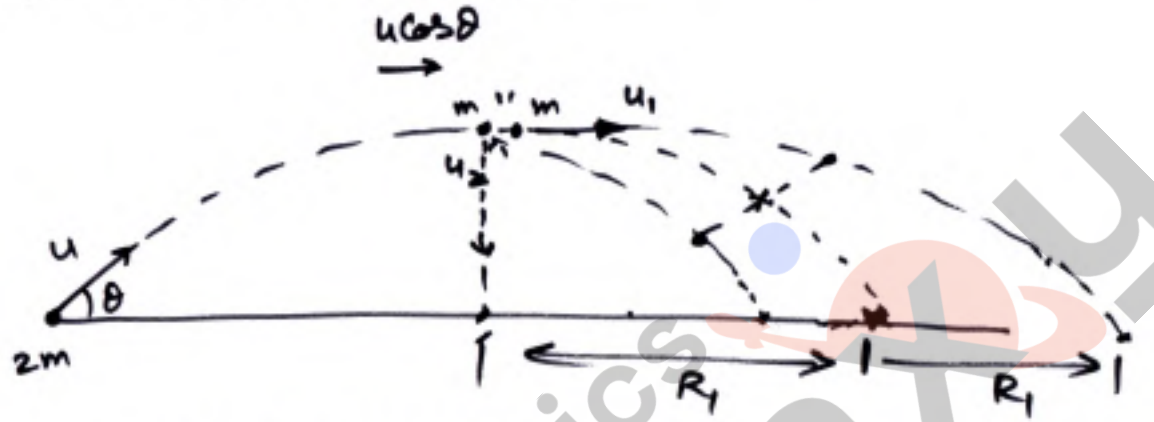
$t_1 =$ ——

$t_2 =$ ——

$\Delta t = t_2 - t_1$

QUESTIONS BASED ON

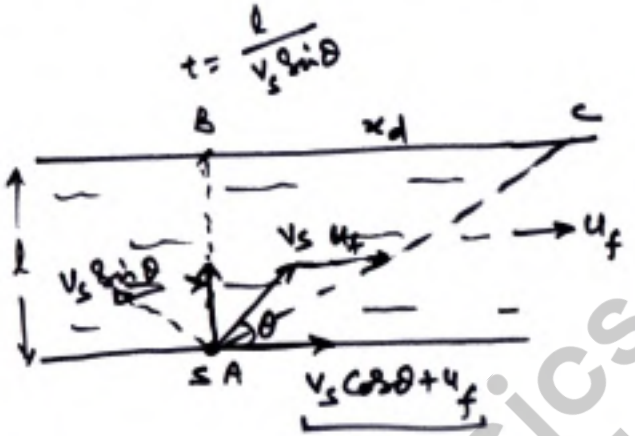
EXPLOSION IN A PROJECTILE



$$2m(u\cos\theta) = mu_1 + mu_2$$

If $u_2 = 0$

QUESTIONS BASED ON
RIVER-SWIMMER CASES



$$t = \frac{l}{v_s \sin\theta}$$

$$\left[x_d = (v_s\cos\theta + u_f) \cdot \frac{l}{v_s \sin\theta} \right]$$

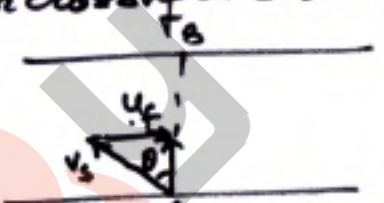
for x_d to be min $\left[\frac{dx_d}{d\theta} = 0 \right]$

$\theta = ?$

for min time to cross

$\theta = 90°$

for crossing at shortest path.



$$\left[\theta = \sin^{-1}\left(\frac{u_f}{v_s}\right) \right]$$

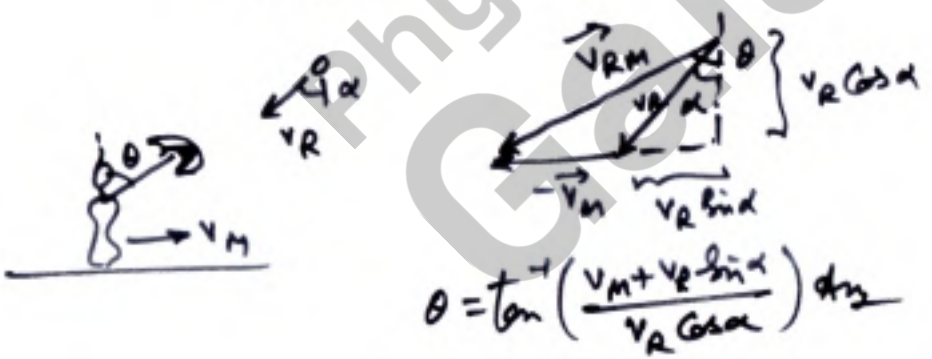
if $v_s < u_f$ then this is NOT possible.

QUESTIONS BASED ON
RAIN MAN PROBLEMS

$$\theta = \tan^{-1}\left|\frac{v_M}{v_R}\right|$$

Vel of rain drops w.r.to man

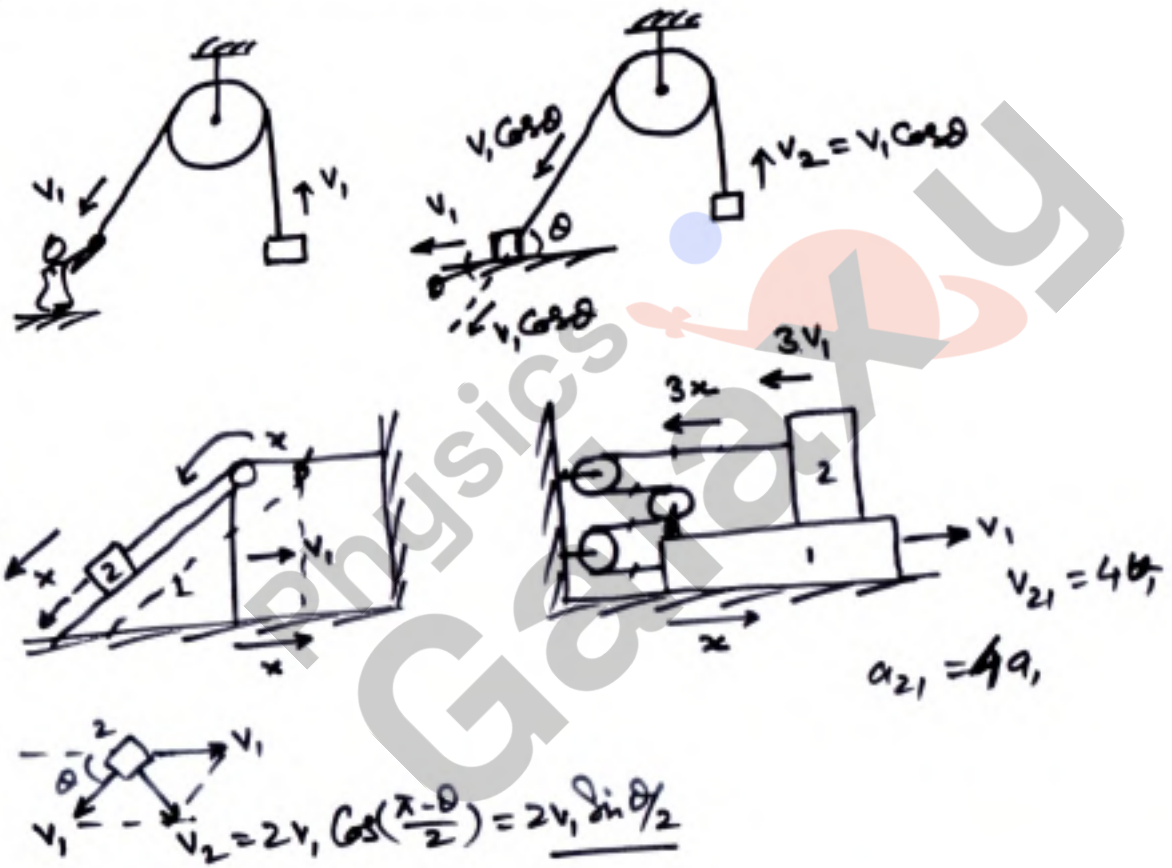
$$\left[\vec{v}_{RM} = \vec{v}_R - \vec{v}_M\right]$$



$$\theta = \tan^{-1}\left(\frac{v_M + v_R\sin\alpha}{v_R\cos\alpha}\right)$$ Ans

QUESTIONS BASED ON

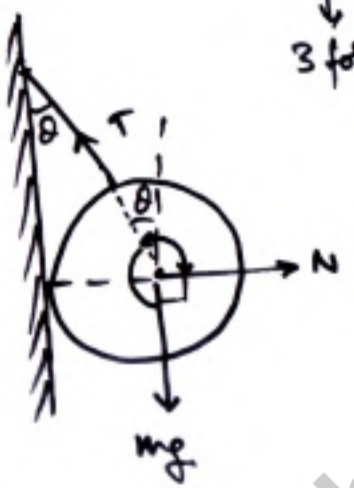
STRING CONSTRAINED RELATIONS



QUESTIONS BASED ON

APPLICATIONS OF LAMI'S THEOREM

Ex



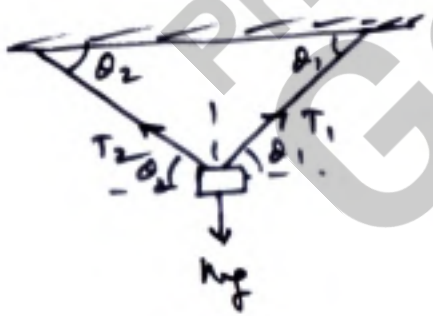
↓ 3 forces are in eqm

$$\frac{T}{\sin 90^\circ} = \frac{N}{\sin(\pi-\theta)} = \frac{mg}{\sin(\pi/2+\theta)}$$ ✓

T = —

N = —

Ex:

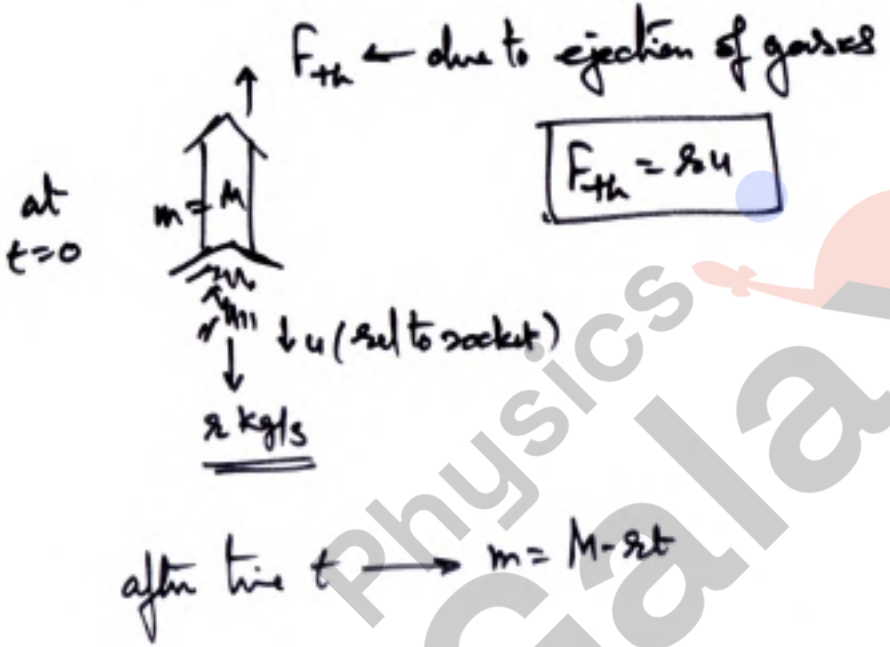


$$\frac{T_1}{\sin(90+\theta_2)} = \frac{T_2}{\sin(90+\theta_1)} = \frac{mg}{\sin(180-\theta_1-\theta_2)}$$ ✓

T_1 = —

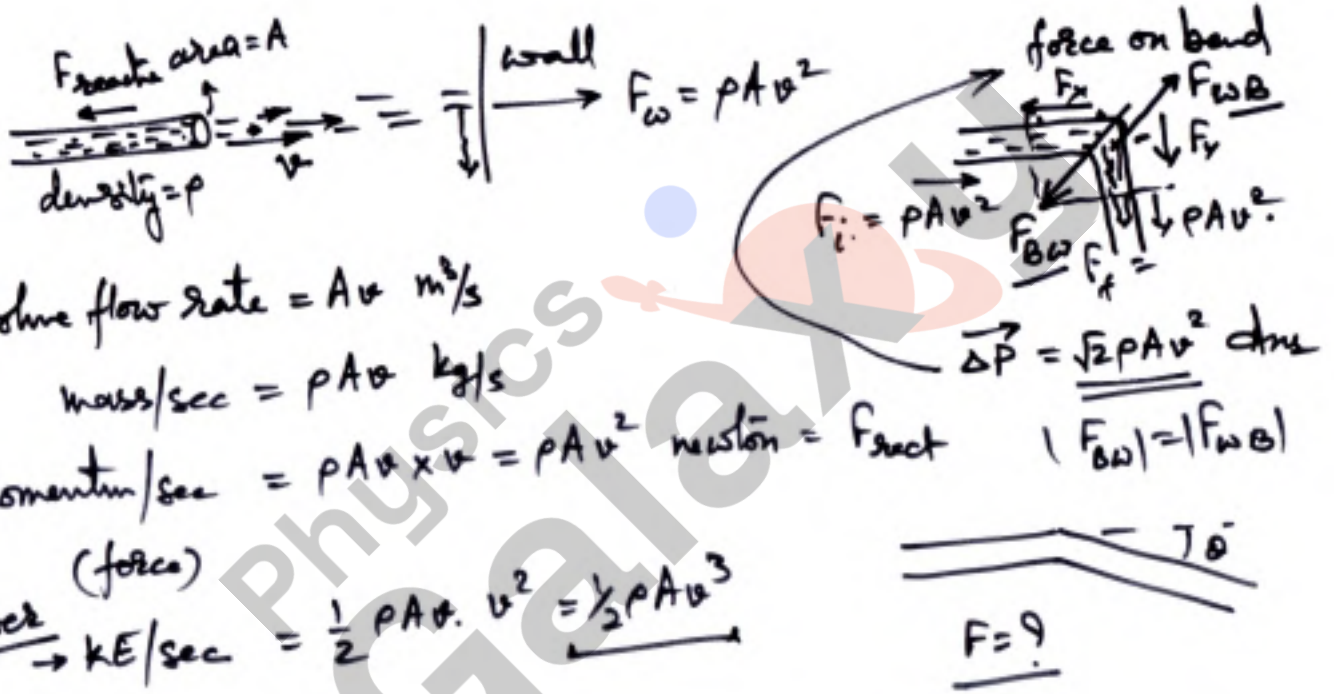
T_2 = —

QUESTIONS BASED ON
THRUST ON A ROCKET



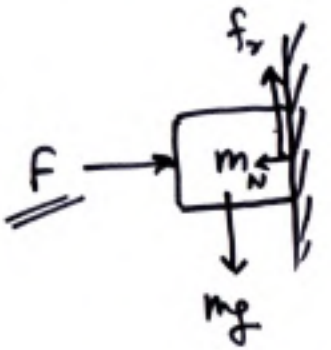
QUESTIONS BASED ON

FORCE DUE TO EJECTION OF WATER FROM PIPE



QUESTIONS BASED ON

FRICTION ON A BLOCK SUPPORTED ON WALL



$N = F$

if a horiz force parallel to wall F_ω is applied on block then we use

$\sqrt{F_\omega^2 + (mg)^2} \leq \mu F$

$F \geq \frac{\sqrt{F_\omega^2 + (mg)^2}}{\mu}$

$f_r = mg$. as block in at rest

$F_\omega = $ ——

$m = $ ——

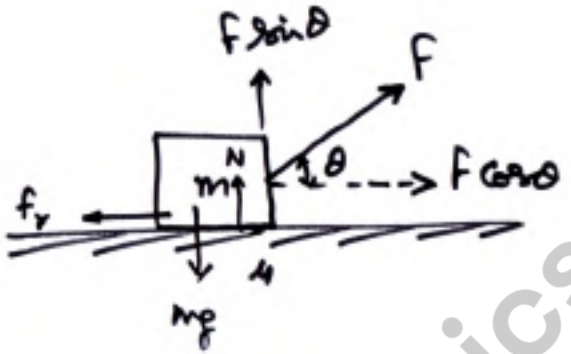
$f_{rL} = \mu F$

for block not to fall $mg \leq \mu F$

$F \geq \frac{mg}{\mu}$ ✓

QUESTIONS BASED ON

MINIMUM FORCE REQUIRED TO SLIDE A BLOCK



$N = mg - F\sin\theta$

to slide the block

$F\cos\theta \geq \mu(mg - F\sin\theta)$

$F \geq \dfrac{\mu mg}{\cos\theta + \mu\sin\theta}$

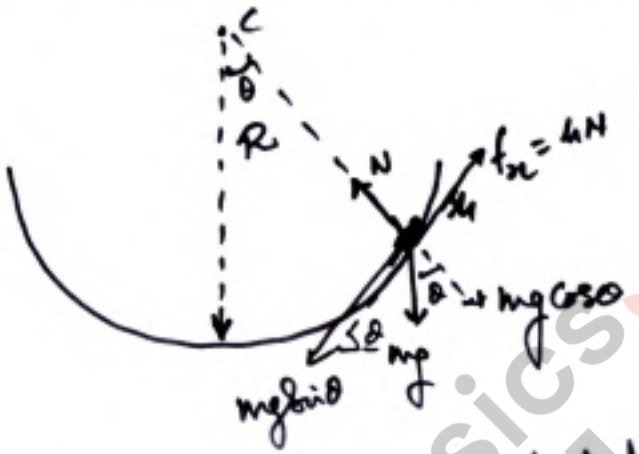
F is min when $\dfrac{dF}{d\theta} = 0$

$\theta = \tan^{-1}(\mu)$ ✓

$F = \dfrac{\mu mg}{\sqrt{1+\mu^2}}$ ✓

QUESTIONS BASED ON

SLIDING CONDITION ON A CIRCULAR TRACK



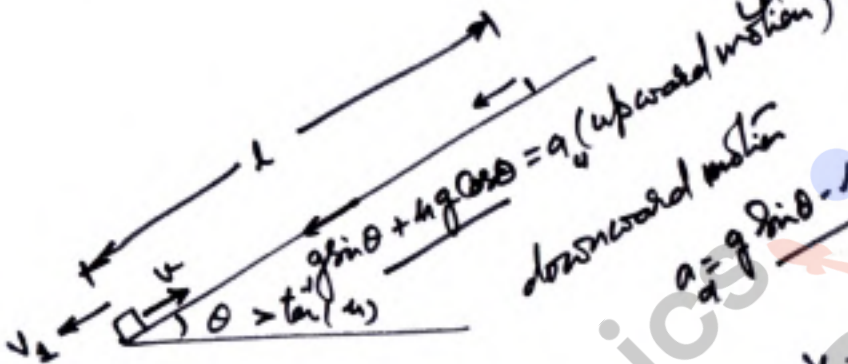
insect will reach a pt without sliding

$mg\sin\theta = \mu mg\cos\theta$

$\theta = \tan^{-1}(\mu)$

QUESTIONS BASED ON

SLIDING UP & DOWN AN INCLINE



$$v_1 = \sqrt{2 a_d \cdot l}$$

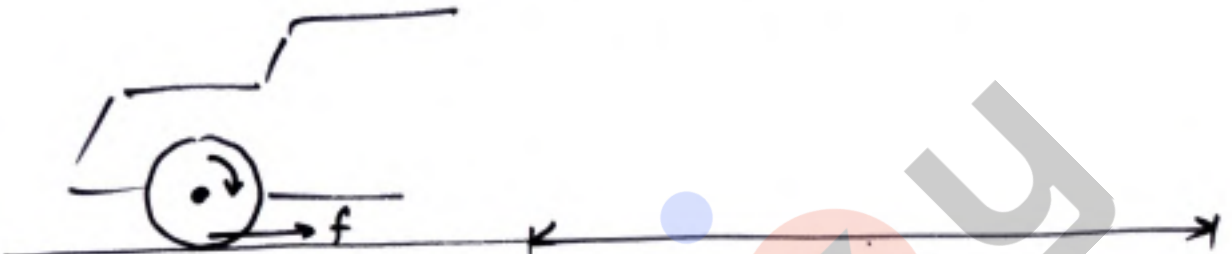
$$l = \frac{v^2}{2a_u}$$

$$t_{up} = \sqrt{\frac{2l}{a_u}} = \frac{v}{a_u} \qquad t_{down} = \sqrt{\frac{2l}{a_d}}$$

$$\frac{t_{up}}{t_{down}} = \sqrt{\frac{a_d}{a_u}} = \sqrt{\frac{g(\sin\theta - \mu g\cos\theta)}{g(\sin\theta + \mu\cos\theta)}}$$

QUESTIONS BASED ON

MAXIMUM ACCELERATION OF A CAR ON ROAD



μ

(max) $\rightarrow f_{2L} = \mu mg$

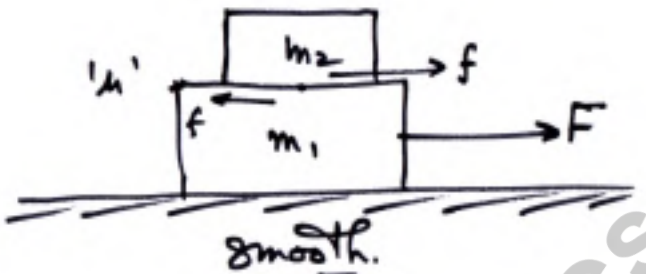
min time $= t_{min} = \sqrt{\frac{2l}{\mu g}}$

max acc^n $a_{max} = \frac{f_{2L}}{m} = \mu g$

max acc^n of a runner on a racing track!

QUESTIONS BASED ON

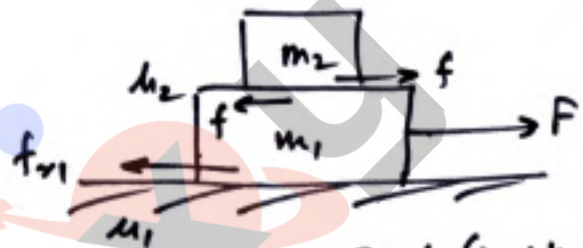
BLOCK OVER BLOCK BASIC CASES



Common acc^n $a_c = \dfrac{F}{m_1+m_2}$

motion of m_2 $f = m_2 a_c = \mu m_2 g$

m_2 will slide when $F =$ ——— Any



$a_c = \dfrac{F - \mu_1(m_1+m_2)g}{m_1+m_2}$

$f = m_2 a_c = \mu_2 m_2 g$

$F =$ ——— Any