ARJUNA NEET BATCH

ARJUNA

PW

LAWS OF MOTION

LECTURE - 07

Todays Goal:

- questions on Pseudo force.
- Constraint Relation.
-

rest $(v=0)$

moving with constⁿ $(v = \text{const}^n)$

Inertial observer

Inertial frame of refrence.

good frame

law of motion is valid.

accelerated frame

→ Non-Inertial fram of refrence.
→ Bad frame (Ramlal frame)
→ Laws of motion is not valid in non inertial frame.

Pseudo force → Not a real force, it is a imaginary force, A technique to validate Laws of Motion.

Select the correct statement regarding pseudo force

(a) It is electromagnetic in origin

(b) Newton's 3^{rd} law is applicable for it

(c) It is a fundamental force

(d) It is used to make Newton's law applicable in non-inertial frame

$\Downarrow$

Ram lal fram

$\boxed{\text{accelerated}}$

A man of mass m is standing in an elevator moving downward with an acceleration $\frac{g}{4}$. The force exerted by the bottom surface of the elevator on the man will be

(a) $\frac{3mg}{4}$ (b) $\frac{mg}{4}$

(c) $\frac{5mg}{4}$ (d) $\frac{7mg}{4}$

F.B.D of man w.r.t 'Ramlal'

ma ↑ (rest) ↑ N, m, ↓ mg

$\Sigma F_y = 0$

$ma + N = mg$

$N = mg - ma$

$= m(g - a)$

$= m(g - g/4) = \frac{3gm}{4}$

F.B.D of man w.r.t (Kallu)

↑N, m, ↓mg, ↓a

"F = ma"

"mg − N = ma"

$\boxed{N = mg - ma}$

↓ $a = g/4$

A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2. What would be the reading on the scale ? ($g = 10\ m/s^2$)

↳ normal = ??

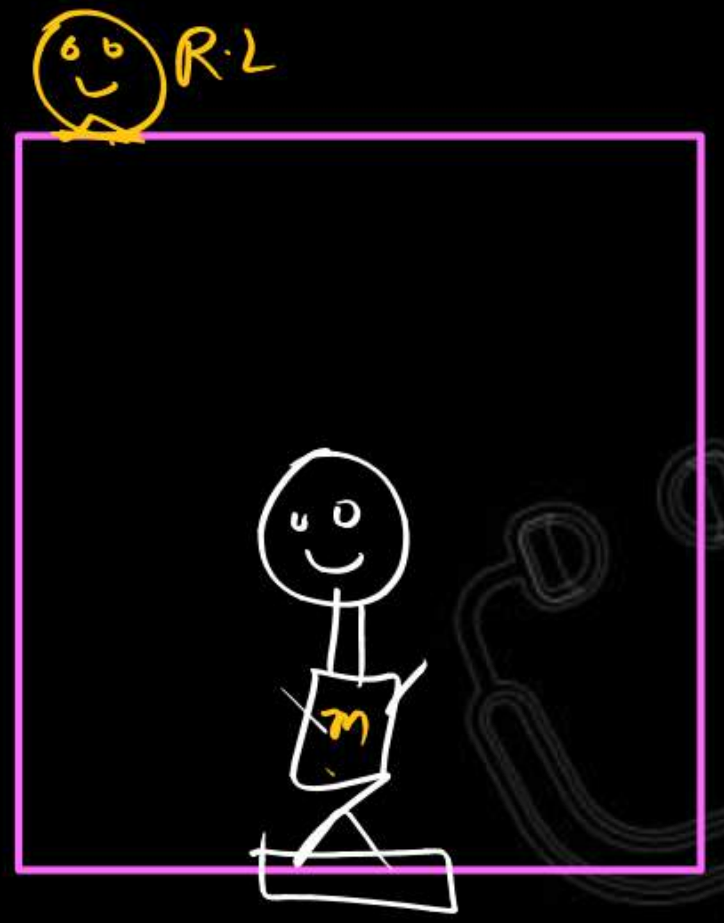
(a) Zero

(b) 400 N

(c) 800 N

(d) 1200 N

F.B.D of man w.r.t to R.L.



$a = 5\ m/s^2$

$N = m(g+a)$

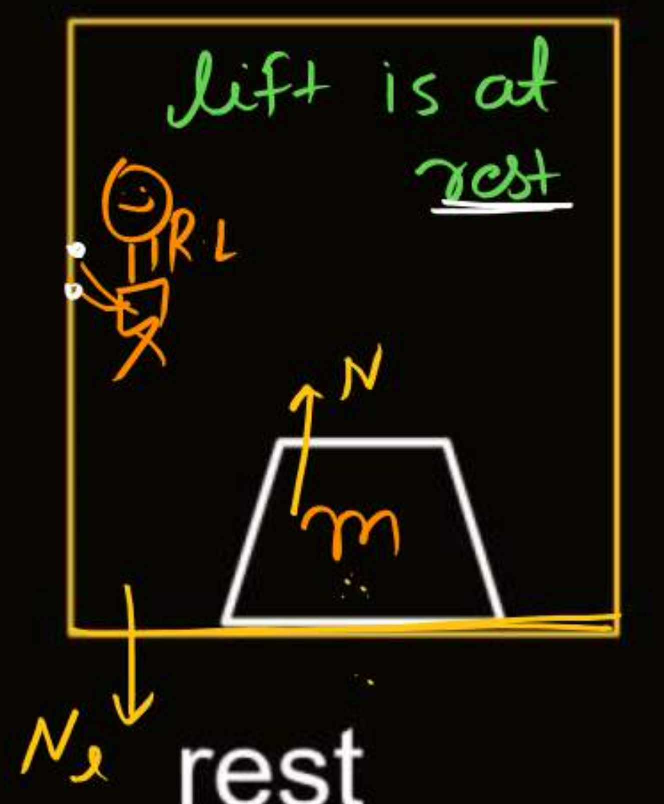
$= 80(10+5) = 1200\ N$

$$\boxed{N = m\, g_{eff}}$$

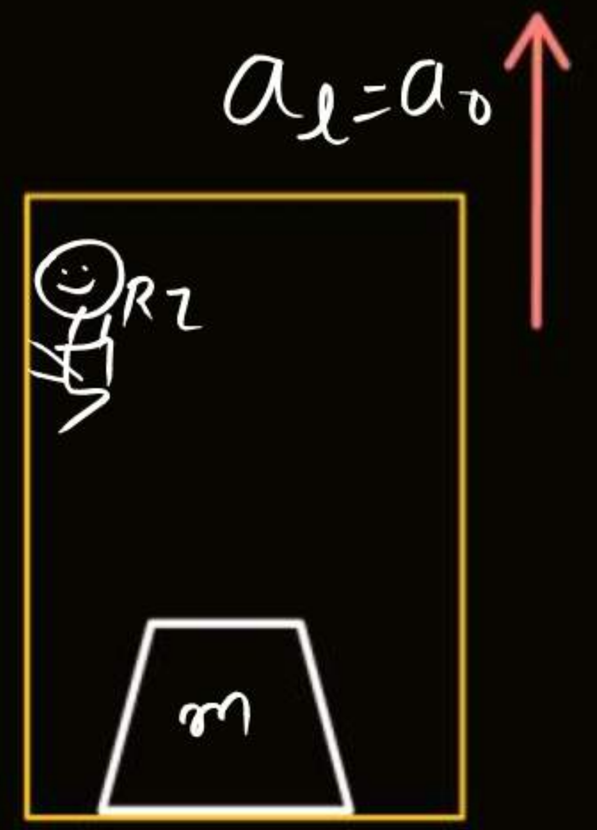
$g_{eff} = (g+a)$ lift is accⁿ upward

$g_{eff} = (g-a)$ lift is accⁿ downward

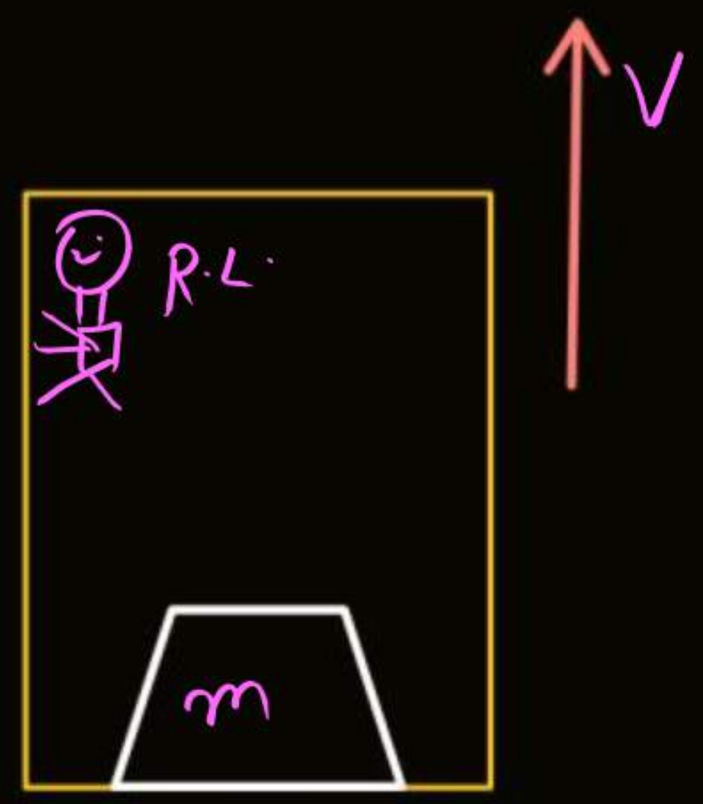
Appt weight:



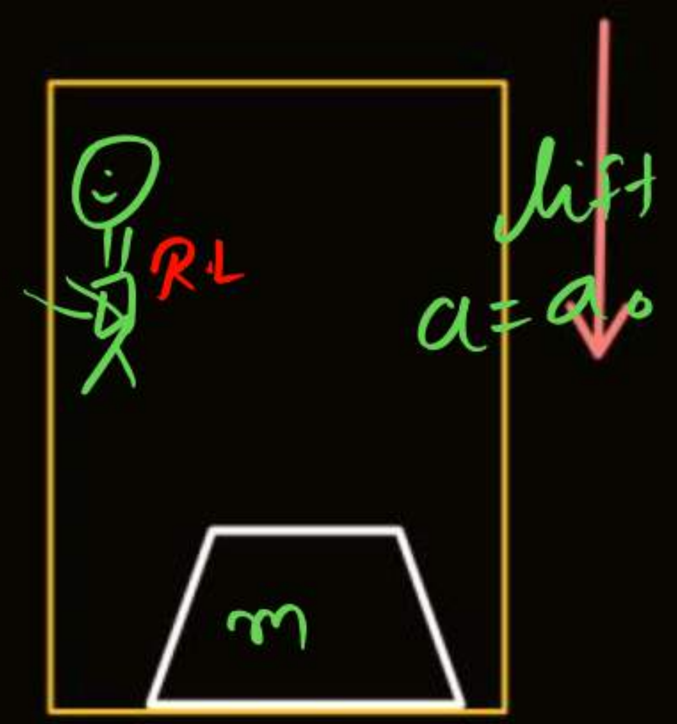
rest



accelerating upward



moving up with uniform velocity



accelerating downward

F.B.D OF m w.r.t R.L

N, m, mg

$N = mg$

F.B.D OF m w.r.t R.L.

N, m, ma, mg

$$\boxed{N_{APP} = mg + ma}$$

F.B.D OF m w.r.t. R.L.

N, m, mg

$$\boxed{N = mg}$$

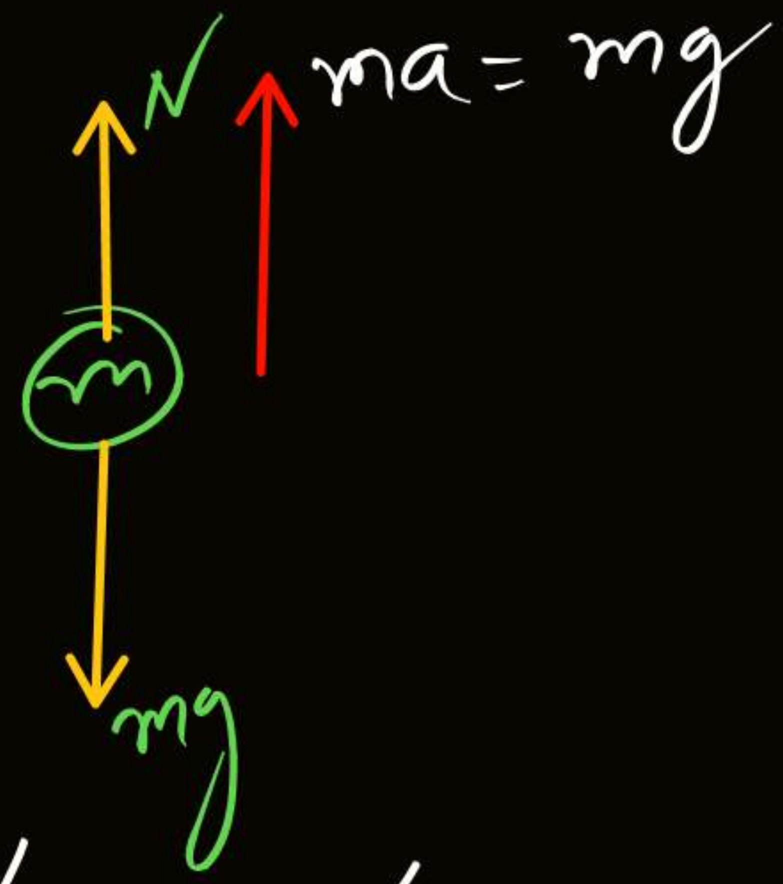
F.B.D OF m w.r.t. R.L

ma, N, m, mg, rest

$$\boxed{N = mg - ma}$$

$\downarrow a_{lift} = g$

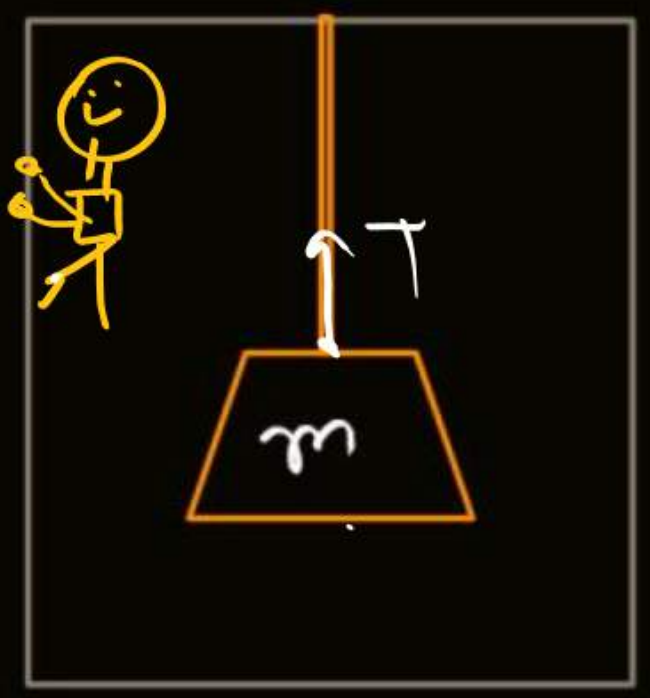
appt weight of this man??



Sol^n

$$N + \cancel{mg} = \cancel{mg}$$

$$\boxed{N_{appt} = 0}$$

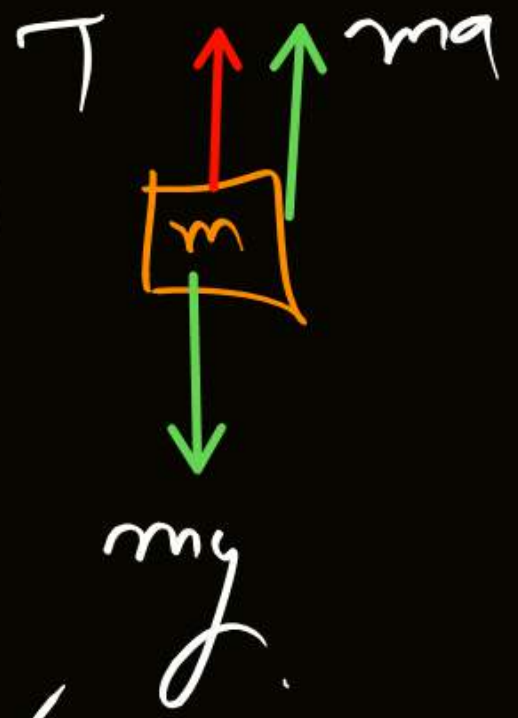


$\downarrow a_{lift} = a_0$

then Find Tension in String.

F.B.D of Mass m

w.r.t Ramu



(rest)

$T + ma = mg$

$T = mg - ma$

$\boxed{T = m(g-a)}$ Ans

A block of mass m kg is kept on a weighing machine in an elevator. If the elevator is retarding upward by a ms^{-2}, the reading of weighing machine is (in kgf)

↳ Speed is ↓ in upward dir

(a) mg

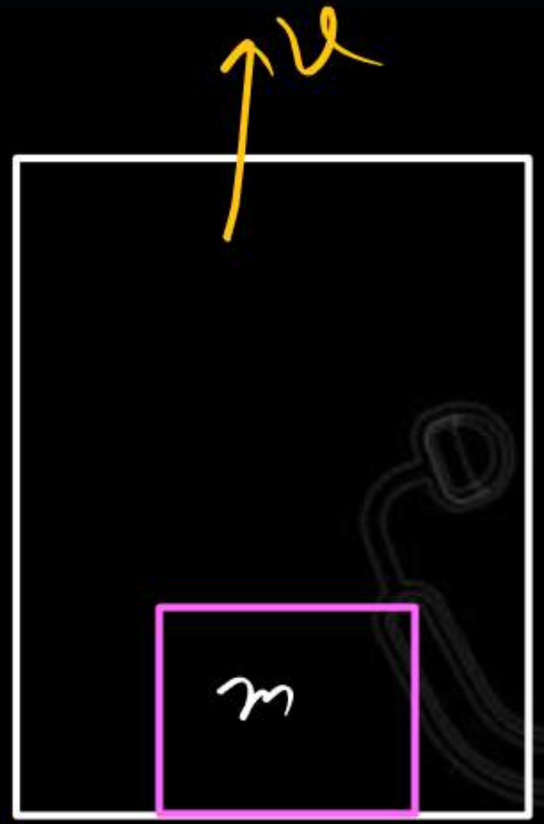
(b) $m(g-a)$

(c) $m\left(1-\frac{a}{g}\right)$

(d) $m(g+a)$

Pseudo force is opposite to the direction of acceleration

Pseudo force is in the direction of retardation.



$\uparrow a_{dir}$ (retarding upward) $= a$

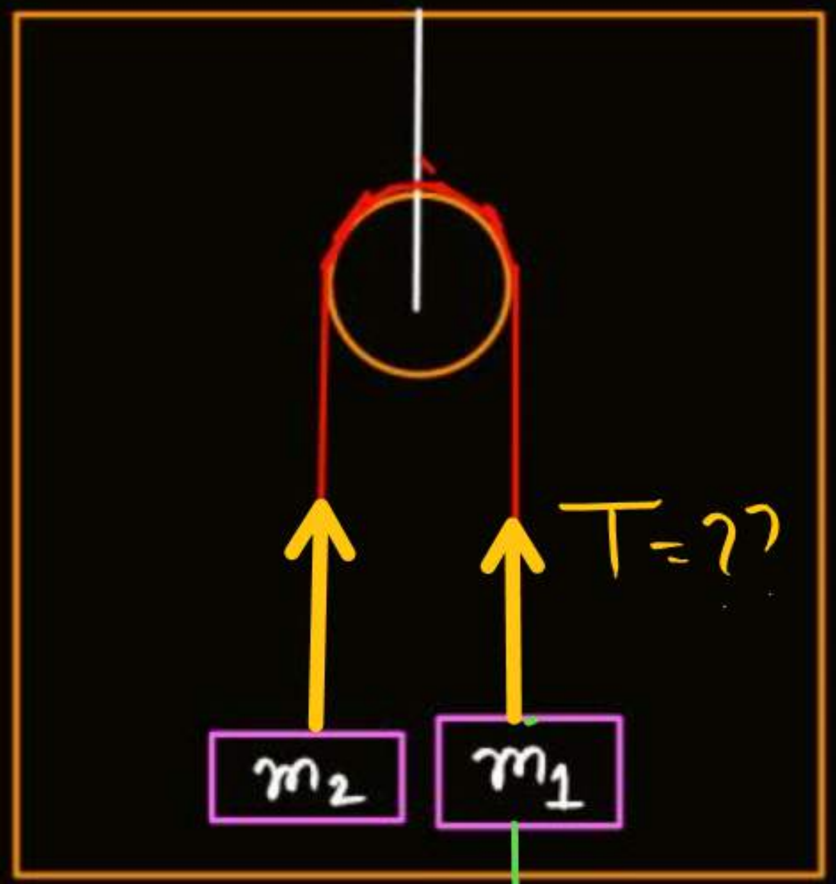
$\boxed{N = mg - ma}$

find Tension in String.

$\uparrow a_{lift} = a_0$

When lift is at rest or moving with Constant velocity

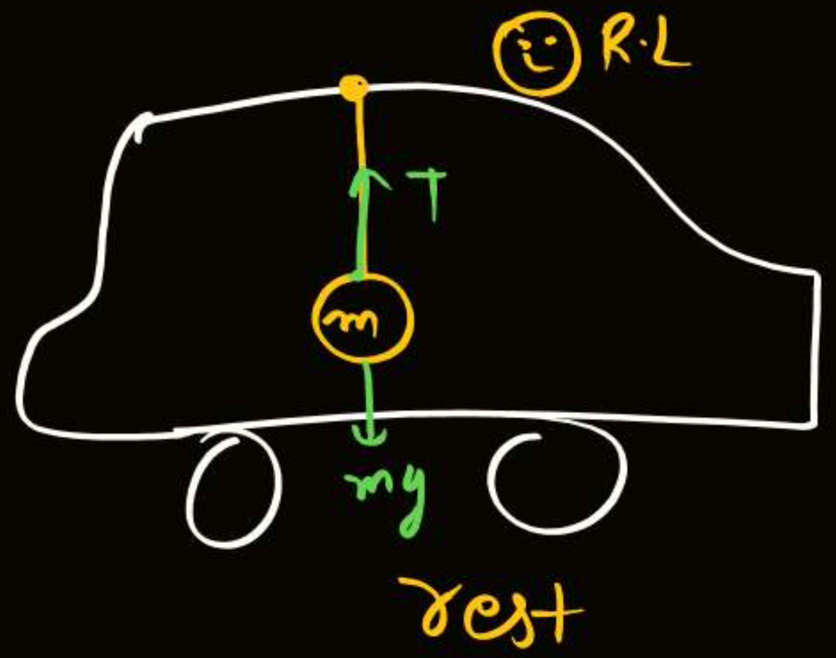
$$\boxed{T = \left(\frac{2 m_1 m_2}{m_1 + m_2}\right) g}$$



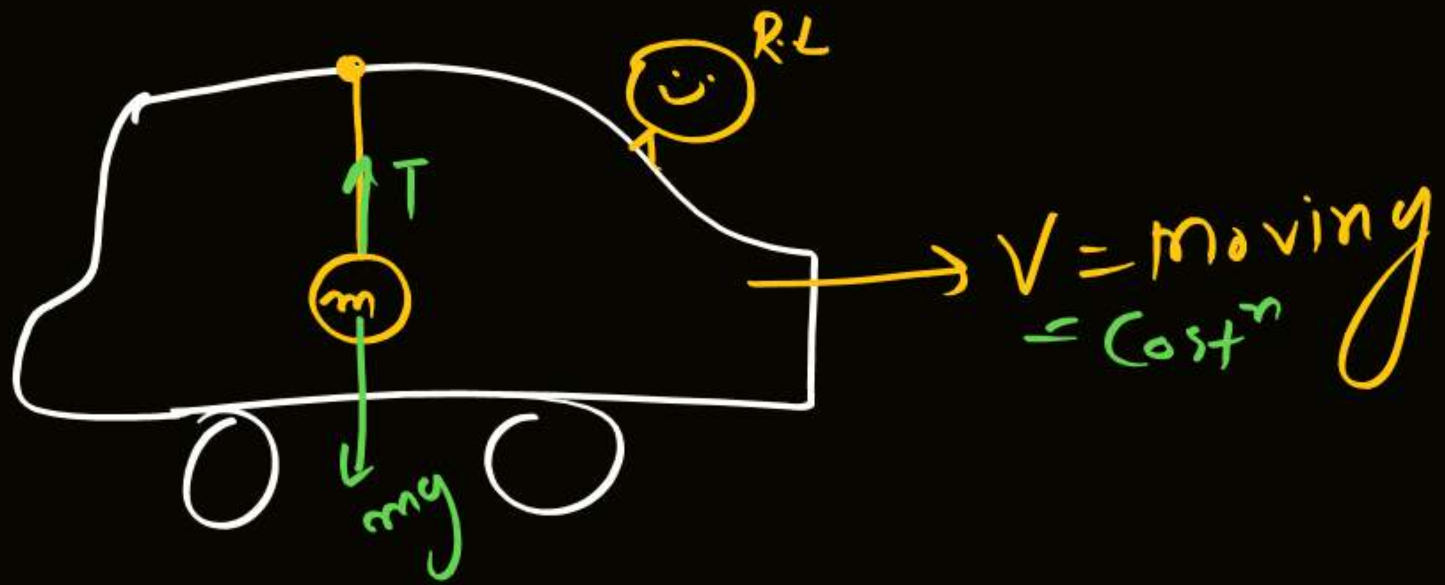
$(m_1 g + m_1 a)$

$$T = \left(\frac{2 m_1 m_2}{m_1 + m_2}\right) g_{eff}$$

$$\boxed{T = 2\left(\frac{m_1 m_2}{m_1 + m_2}\right)(g + a)}$$

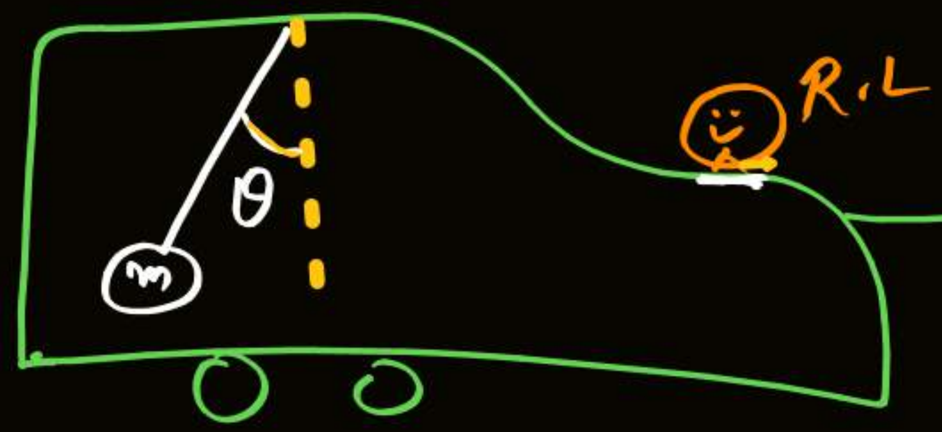


$$T = mg$$

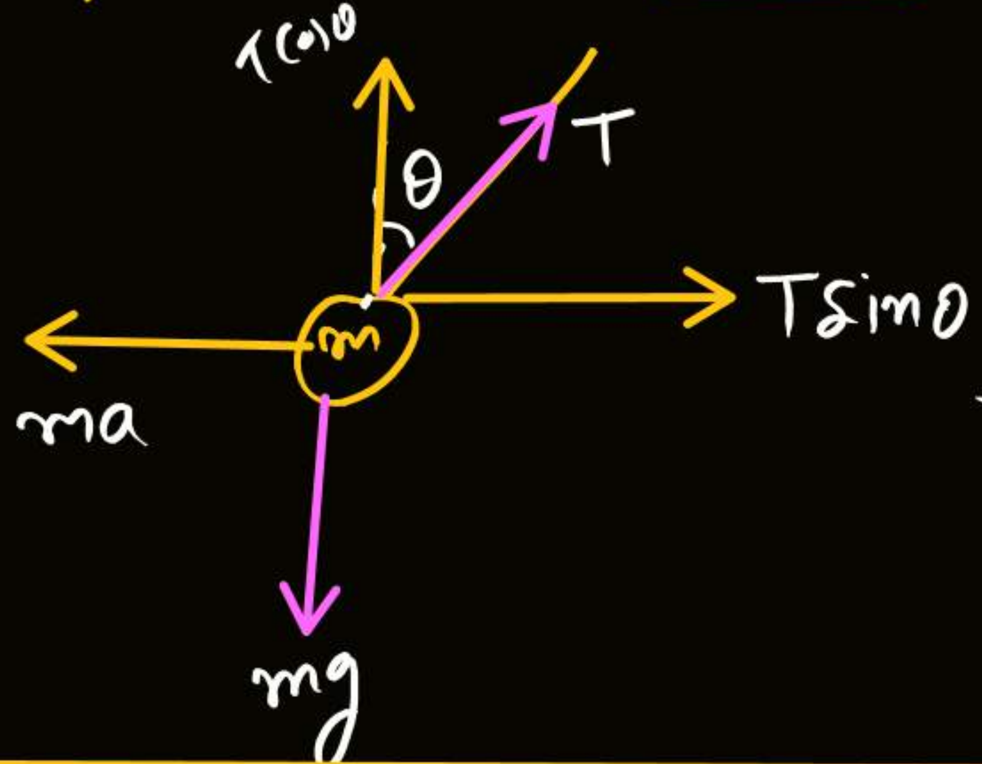


$$\boxed{T = mg}$$

F.B.D w.r.t "Ramlal"



$\vec{a} = \text{const}^{n}$

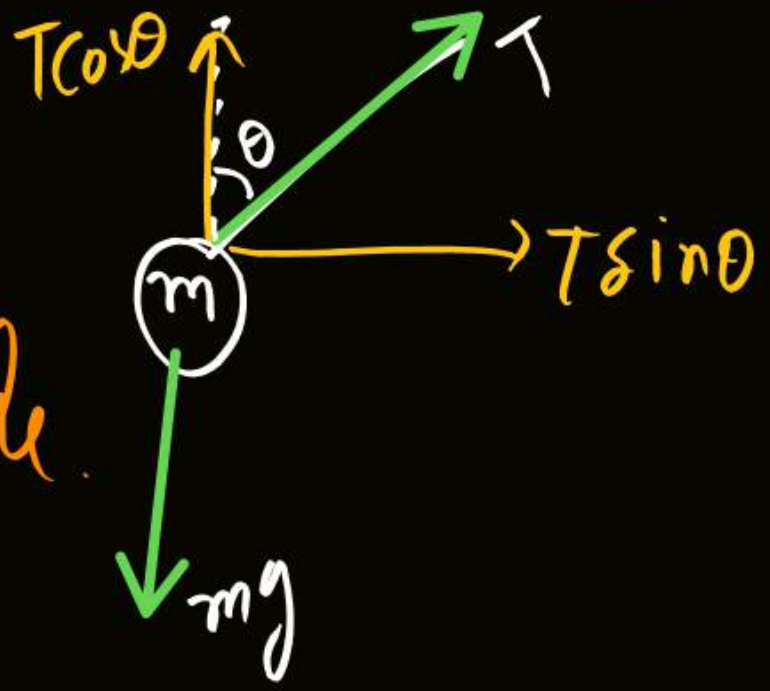


object is at rest w.r.t Ramlal

$$\frac{\cancel{T}\sin\theta = ma}{\cancel{T}\cos\theta = mg}$$

$$\boxed{\tan\theta = \frac{a}{g}}$$

F.B.D of object w.r.t Kallu



$\Sigma F_y = 0$

$T\cos\theta = mg$ — (I)

$\Sigma F_x = T\sin\theta$

$F_x = m a_x$

$T\sin\theta = ma$ — (II)

(II)/(I)

$$\frac{\cancel{T}\sin\theta = \cancel{m}a}{\cancel{T}\cos\theta \quad \cancel{m}g}$$

$$\boxed{\tan\theta = \frac{a}{g}}$$

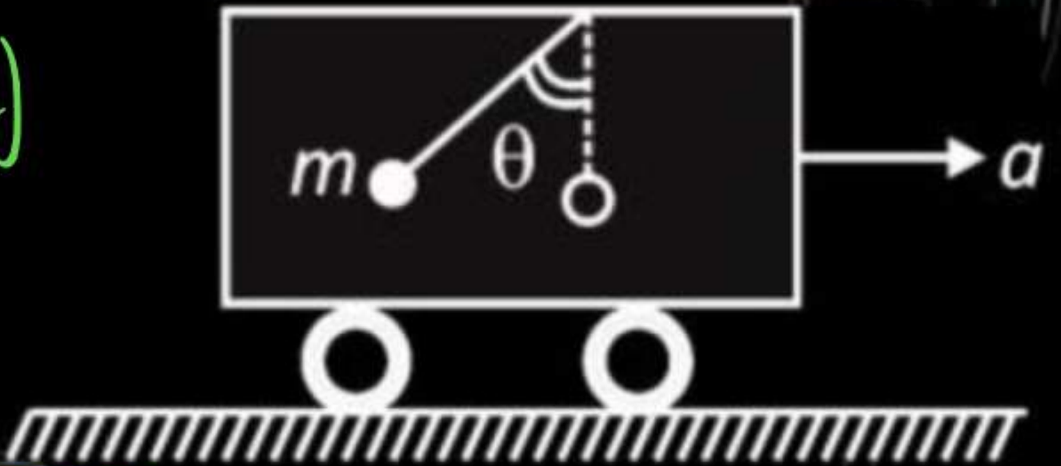
If trolley accelerates horizontally with acceleration a then bob is displaced backward from its initial vertical position. The angular deflection of the bob in equilibrium is

(a) $\theta = \cos^{-1}\left(\frac{a}{g}\right)$ (b) $\theta = \sin^{-1}\left(\frac{a}{g}\right)$

(c) $\theta = \cot^{-1}\left(\frac{a}{g}\right)$ (d) $\theta = \tan^{-1}\left(\frac{a}{g}\right)$

$\tan\theta = \frac{a}{g}$

$\theta = \tan^{-1}(a/g)$



(Q) If $\tan\theta = \frac{a}{g}$ then find $\sin\theta$.

$\tan\theta = \frac{P}{B} = \frac{a}{g}$

$H = \sqrt{P^2+B^2} = \sqrt{a^2+g^2}$

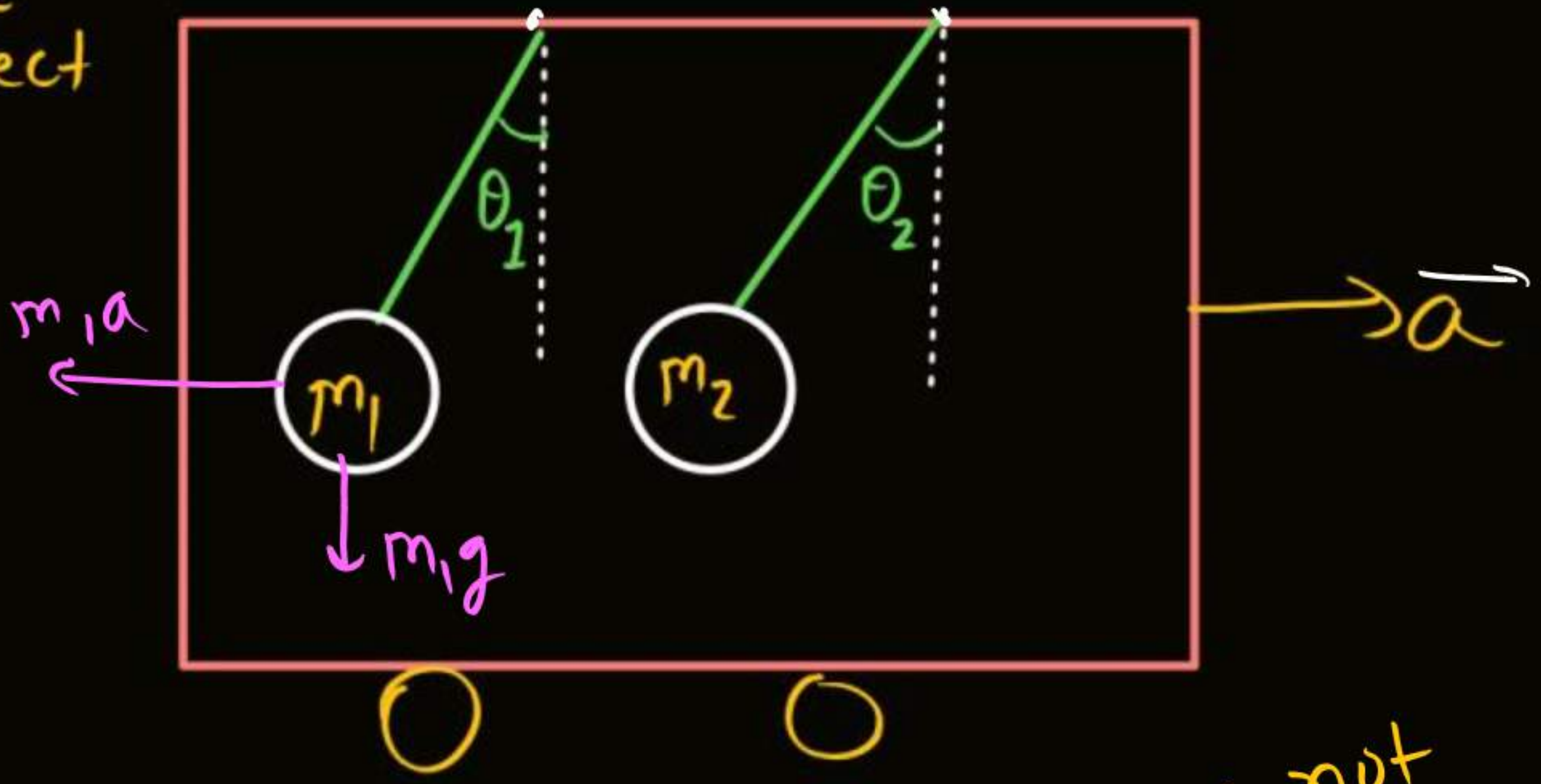
$\boxed{\sin\theta = \frac{P}{H} = \frac{a}{\sqrt{g^2+a^2}}}$

Q) If CAR is accelerating then which of the following option is correct if $m_1 > m_2$.

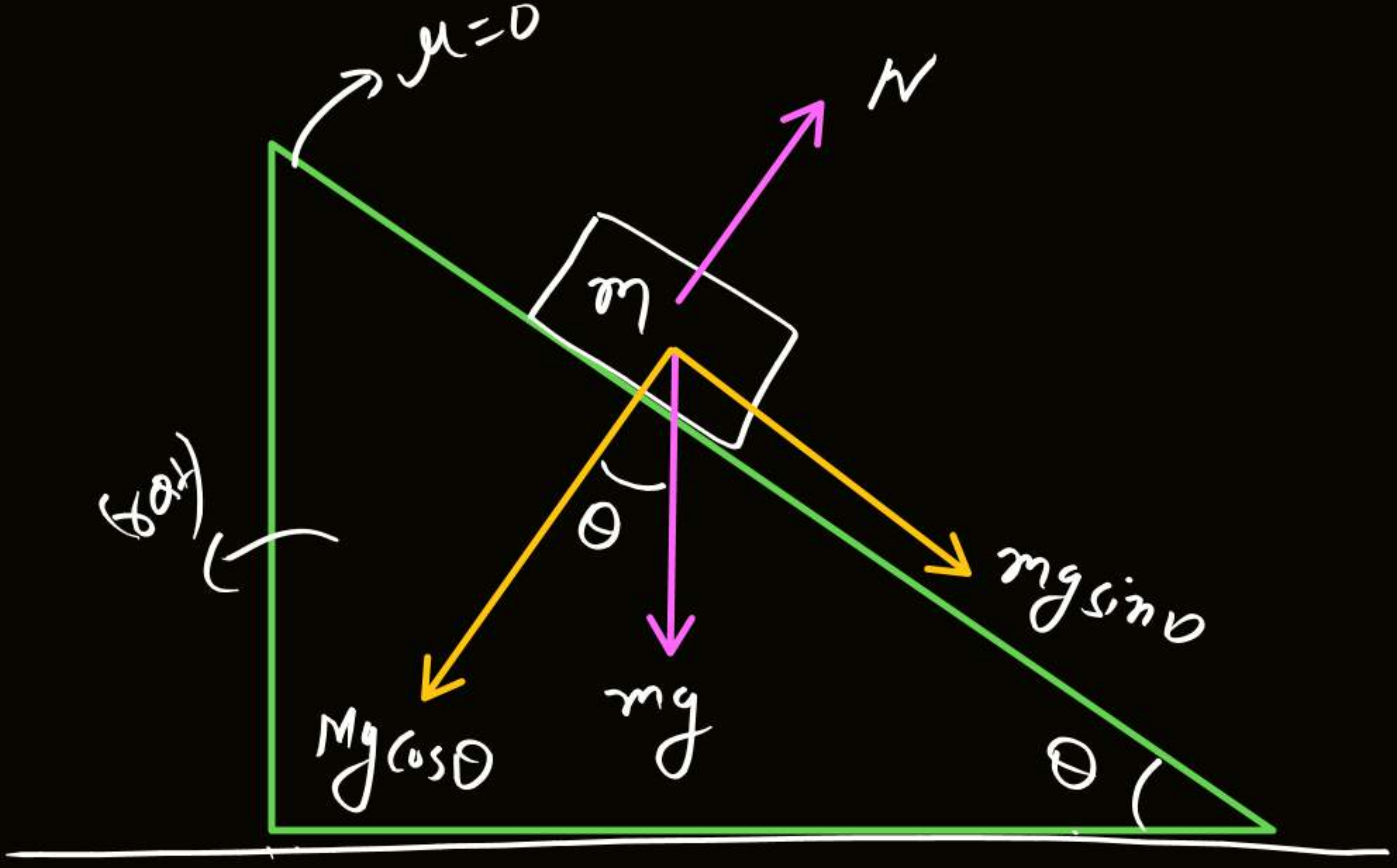
(i) $\theta_1 = \theta_2$

(ii) $\theta_1 > \theta_2$

(iii) $\theta_1 < \theta_2$



$$\boxed{\tan\theta = \frac{a}{g}}$$ does not depend on mass.



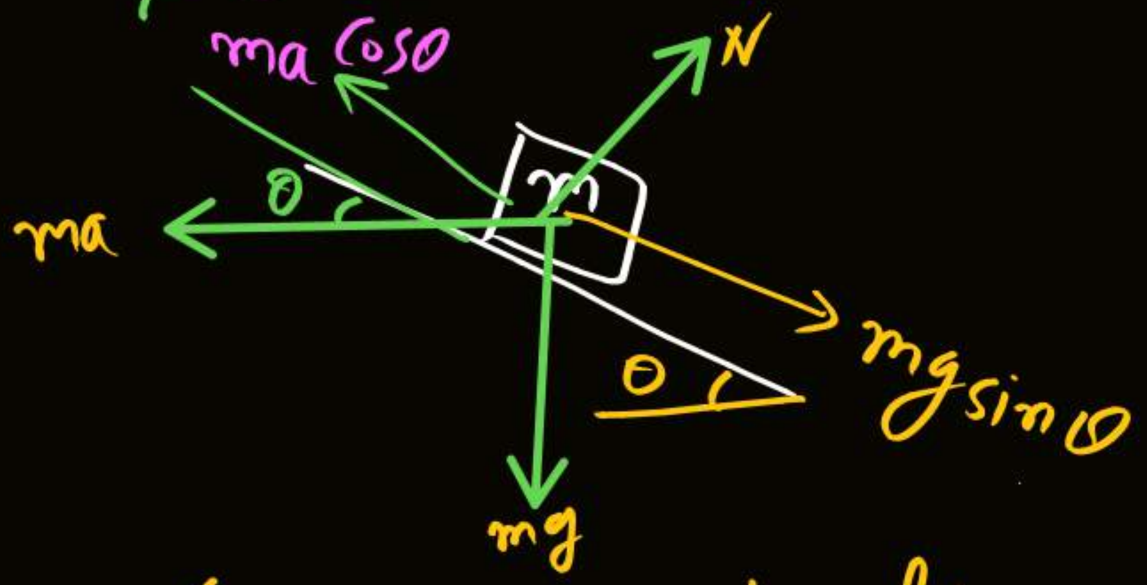
along the Inclined block

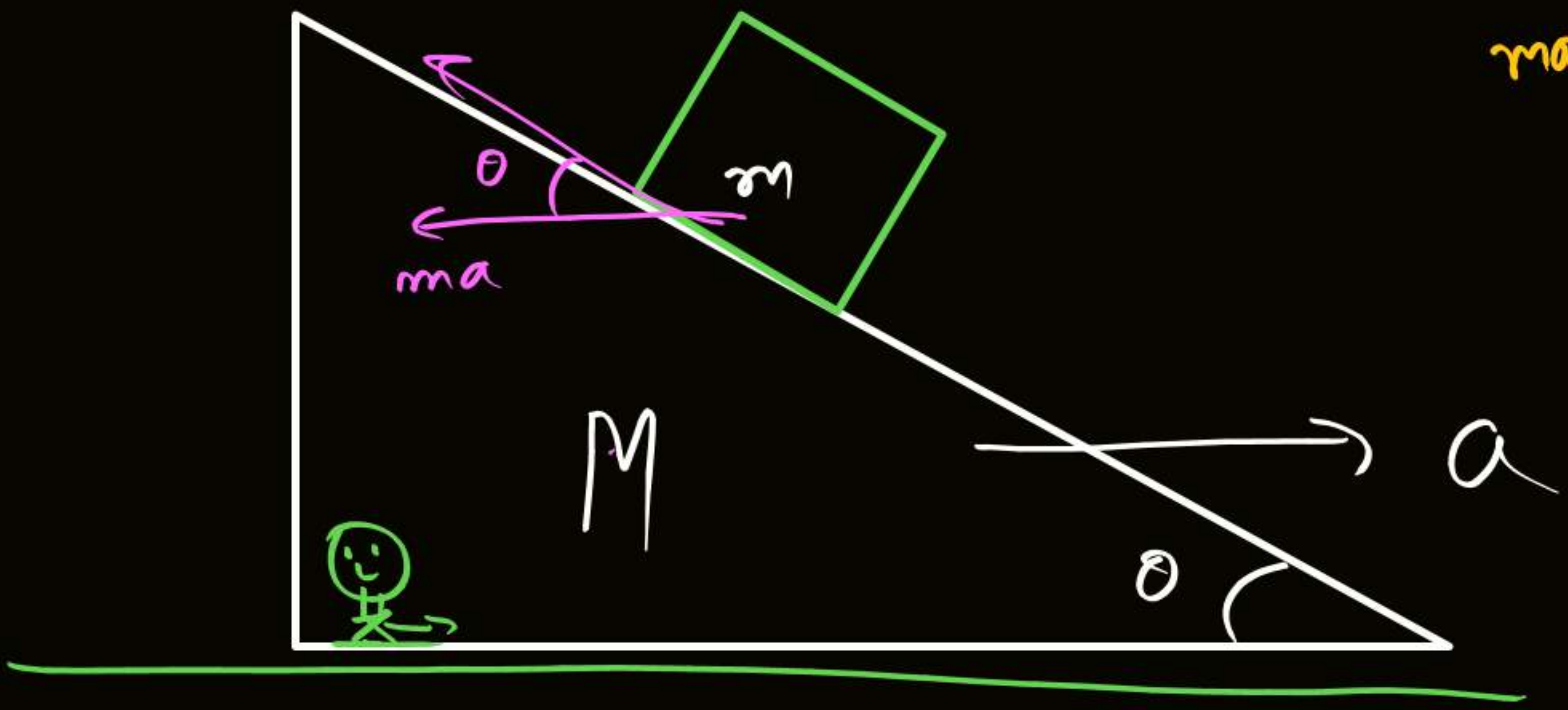
Will accelerate

With accⁿ $\boxed{a = g\sin\theta}$

$\boxed{N = mg\cos\theta}$

F.B.D of block w.r.t (Ram lal)





(find acceleration of this Inclined plane so that block of mass (m) does not slide on Inclined Plane

along Incline Plane

$\Sigma F_x = 0$

$\cancel{m} a \cos\theta = \cancel{m} g \sin\theta$

~~Ratta~~

$a = \dfrac{g \sin\theta}{\cos\theta}$

$\boxed{a = g\tan\theta}$

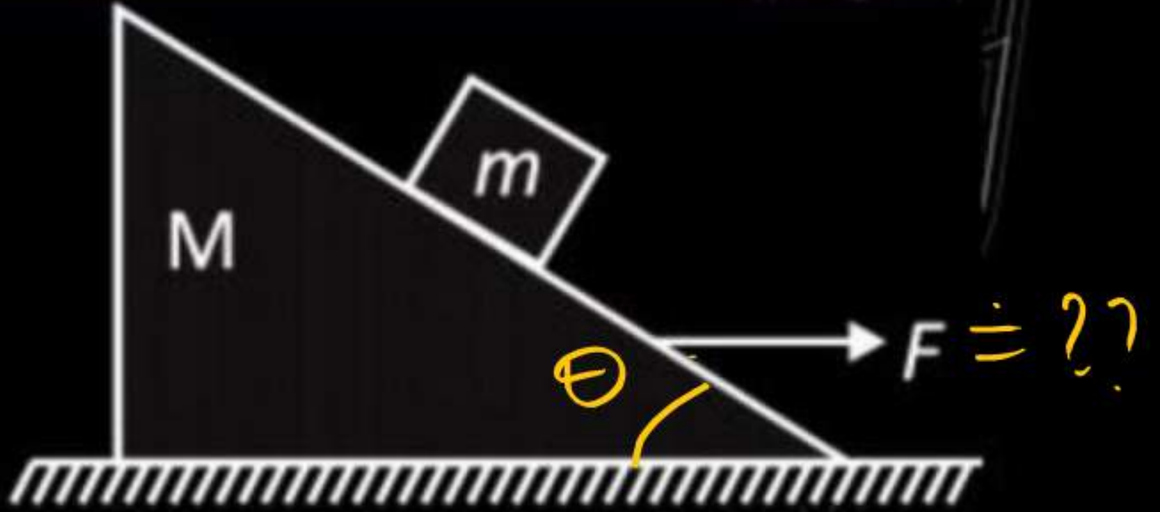
What force should be applied on the wedge so that block over it does not move ? (All surfaces are smooth)

(a) $F = (M + m)\,g\cot\theta$

(b) $F = (M + m)\,g\tan\theta$

(c) $F = (M + m)\,g\sin\theta$

(d) $F = (M + m)\,g\cos\theta$



$$\boxed{a = g\tan\theta}$$

$$F = M_{net}\,a_w$$
$$= (M+m)\,\underline{g\tan\theta}$$

A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be

(a) $mg \cos\theta$

(b) $mg \sin\theta$

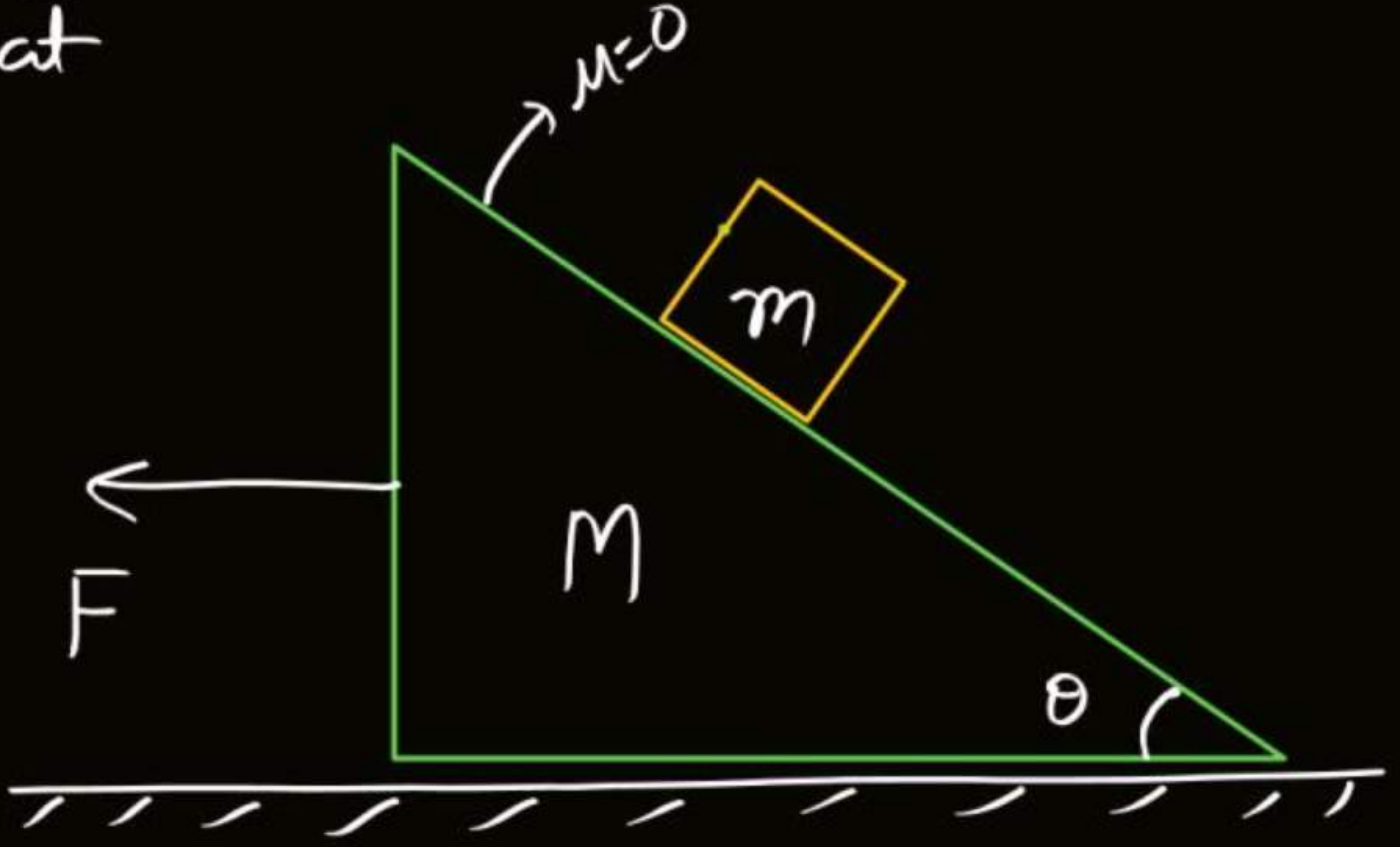
(c) mg

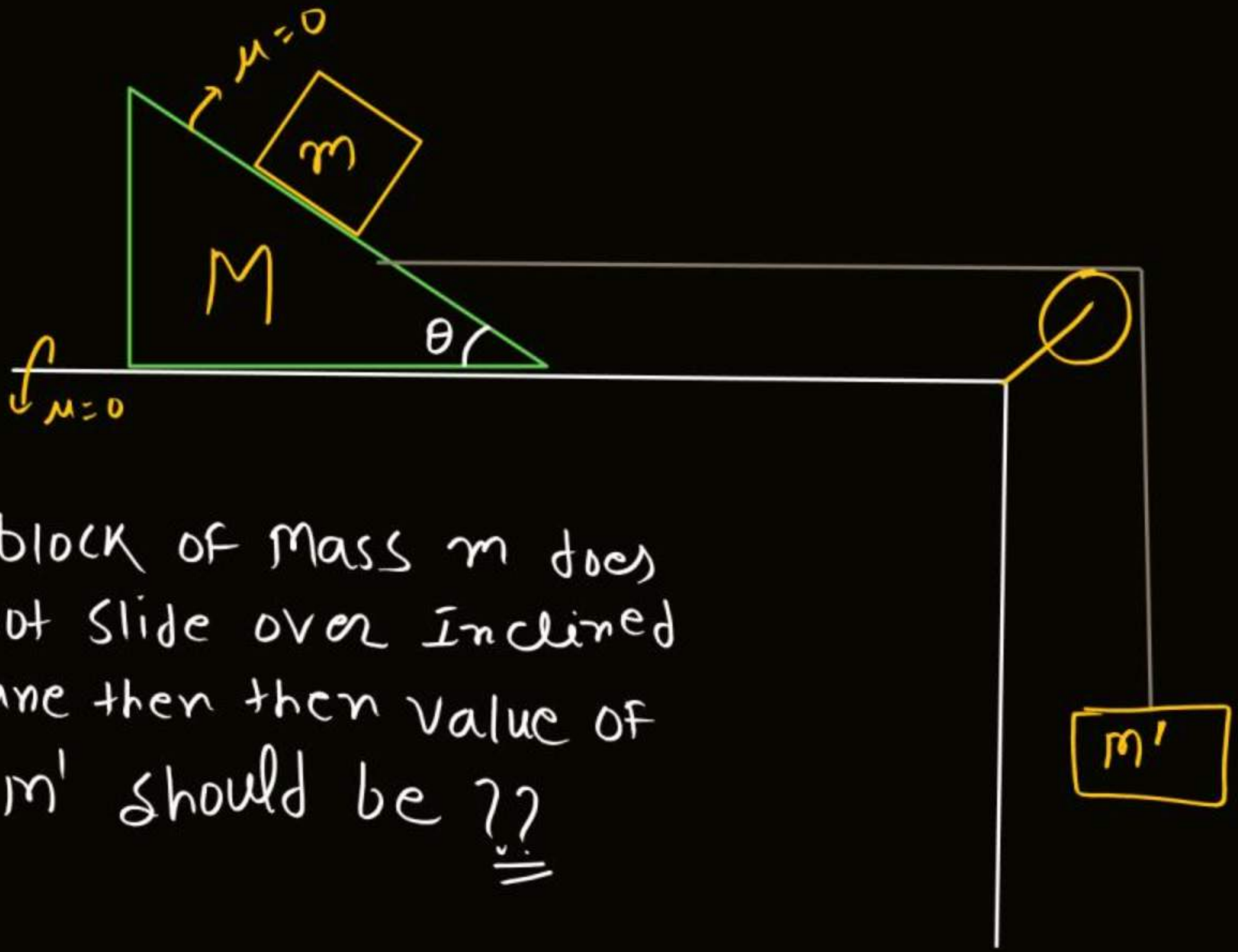
(d) $mg/\cos\theta$

H.W

(Q) find force on Inclined or Force on Inclined so that block can free fall.

H.W





$\boxed{H.W}$

If block of mass m does not slide over Inclined plane then then value of m' should be ??

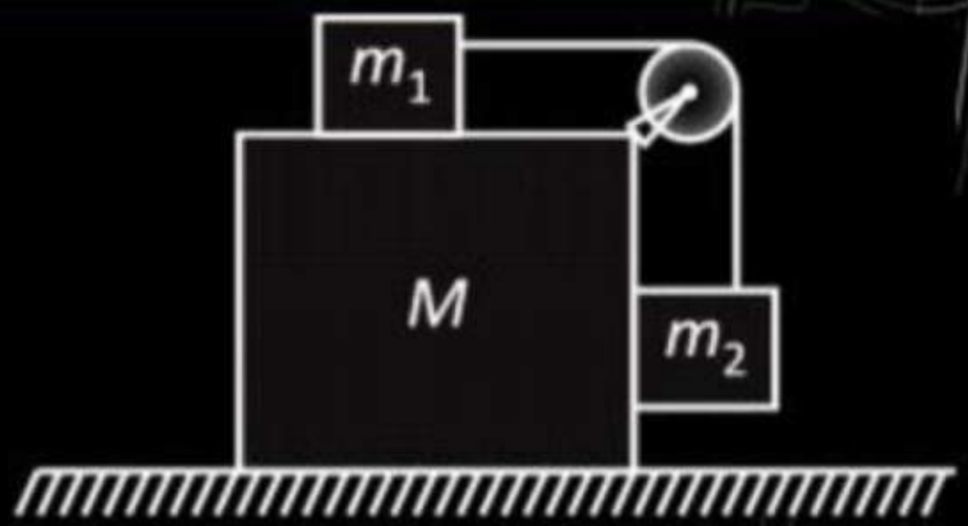
In the given arrangement all surfaces are smooth. What acceleration should be given to the system, for which the block m_2 doesn't slide down ?

(a) $\frac{m_2 g}{m_1}$

(b) $\frac{m_1 g}{m_2}$

(c) g

(d) $\frac{m_2 g}{m_1+m_2}$



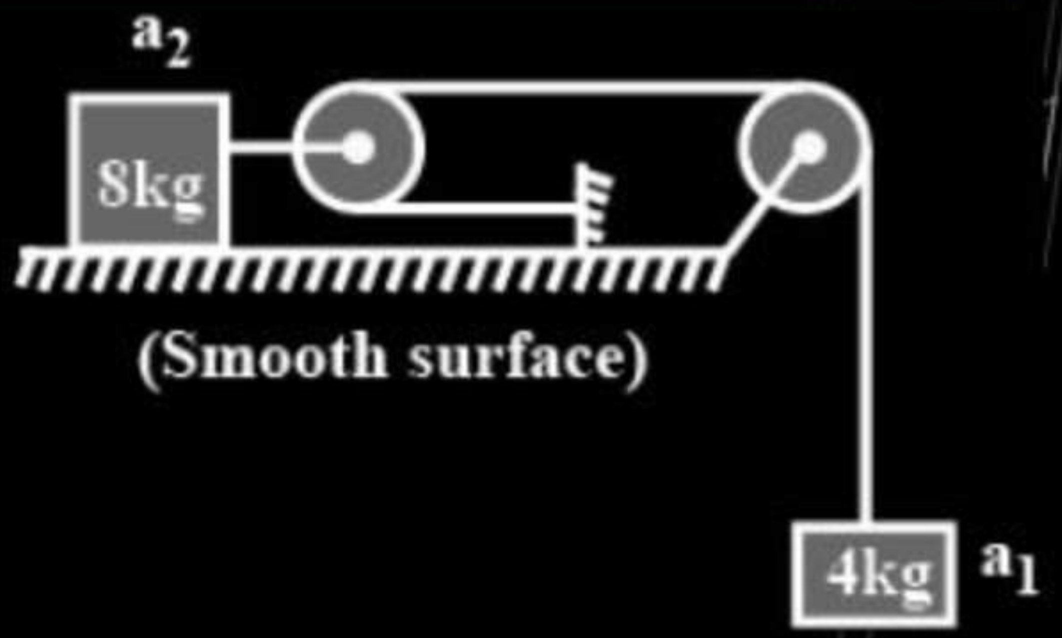
If pulleys shown in the diagram are smooth and massless and a_1 and a_2 are acceleration of blocks of mass 4 kg and 8 kg respectively, then

(a) $a_1 = a_2$

(b) $a_1 = 2a_2$

(c) $2a_1 = a_2$

(d) $a_1 = 4a_2$



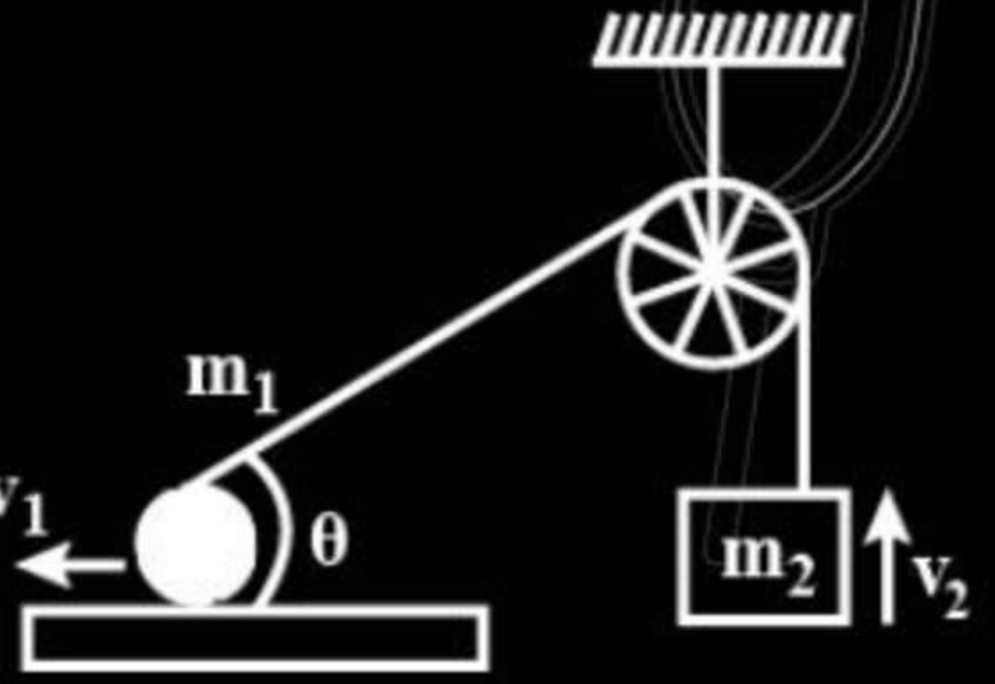
In figure, a ball of mass m_1 and a block of mass m_2 are joined together with an inextensible string. The ball can slide on a smooth horizontal surface. If v_1 and v_2 are the respective speeds of the ball and the block, Find $\frac{v_1}{v_2}$.

(a) $\cos\theta$

(b) $\sec\theta$

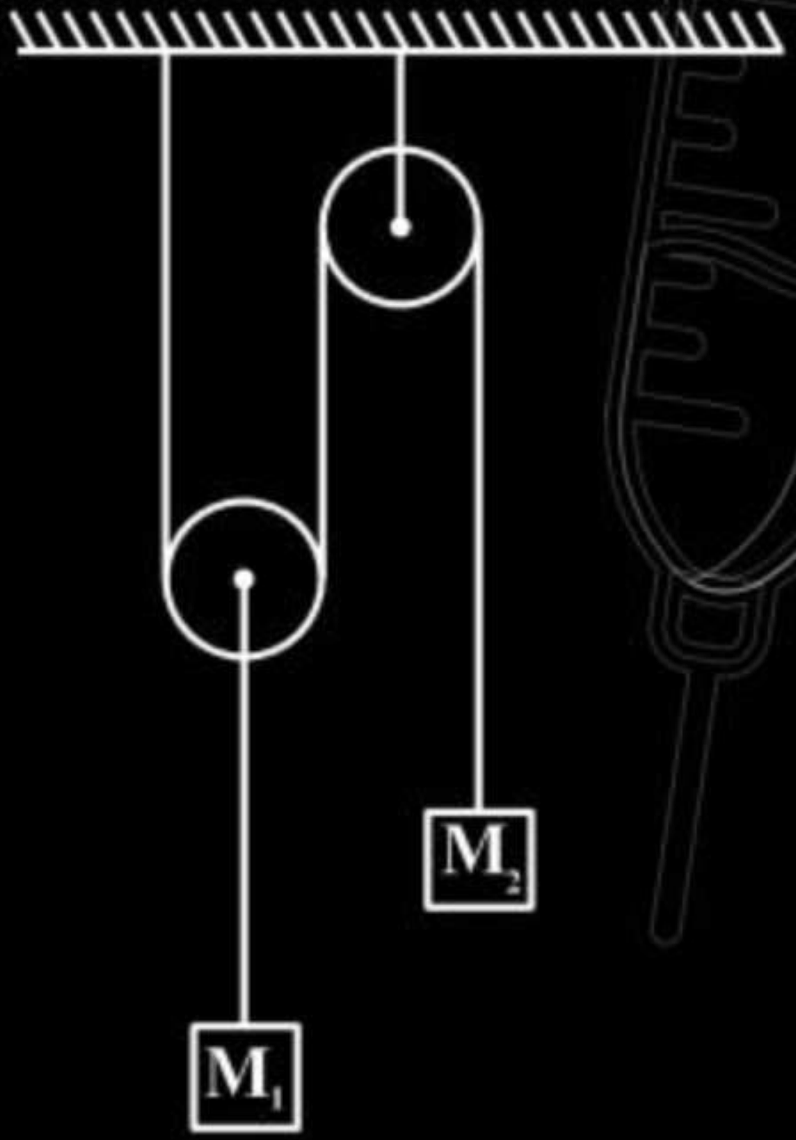
(c) $\tan\theta$

(d) $\sin\theta$



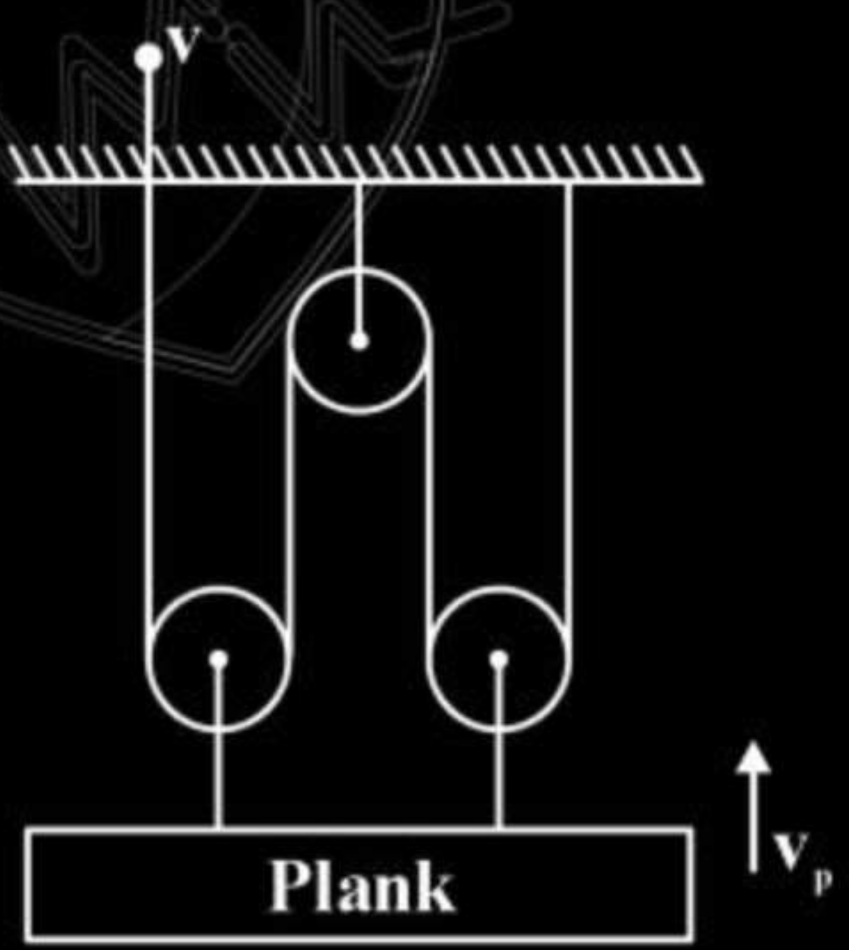
Constrain Motion :

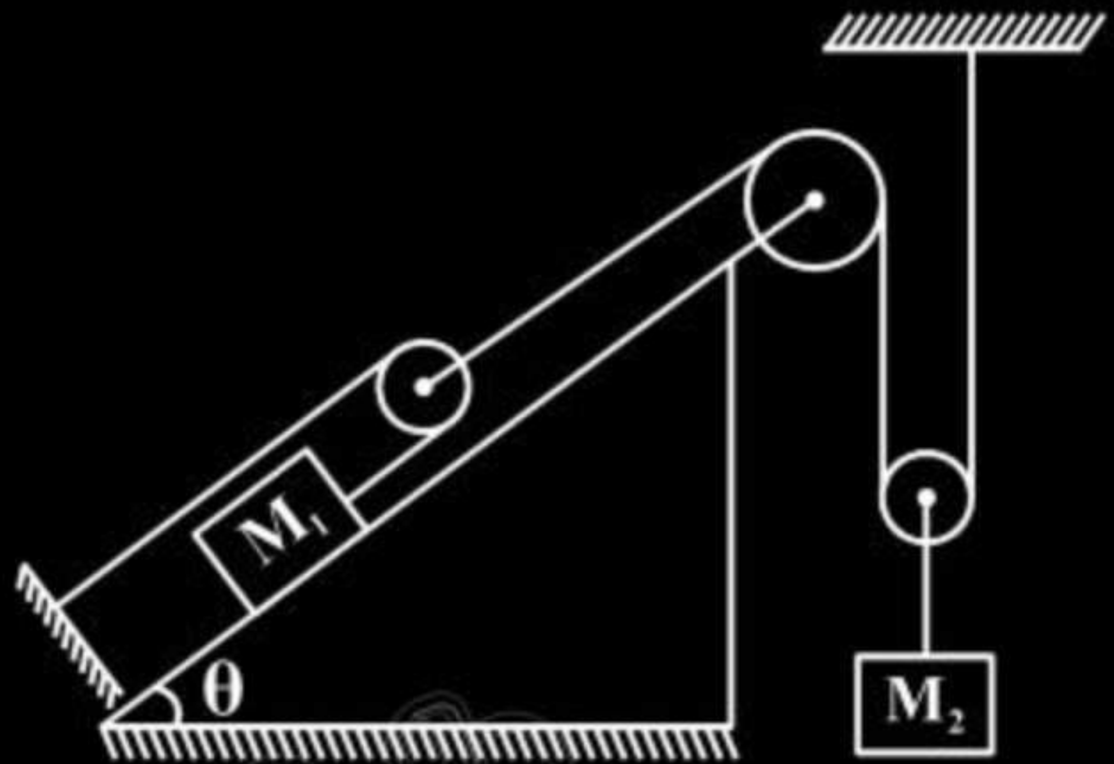
Find relation between a_1 and a_2

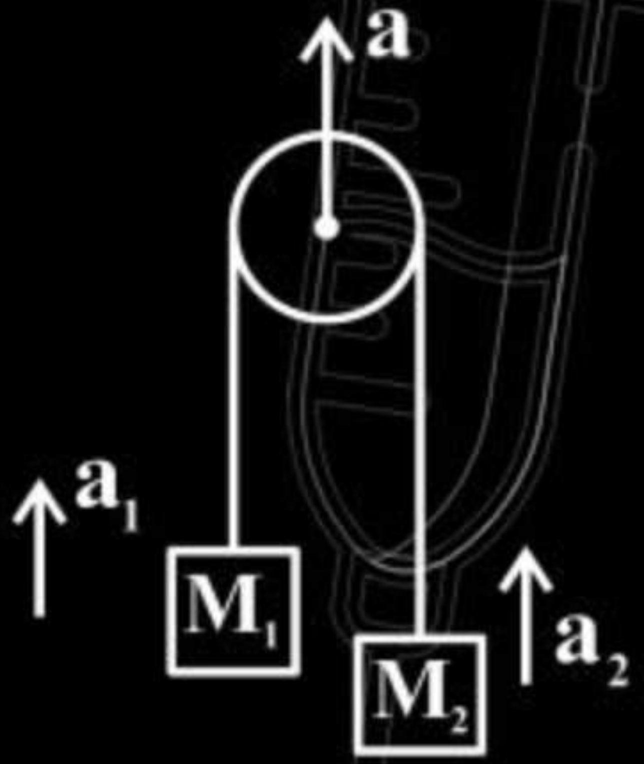


Constrain Motion :

Find relation between a_1 and a_2







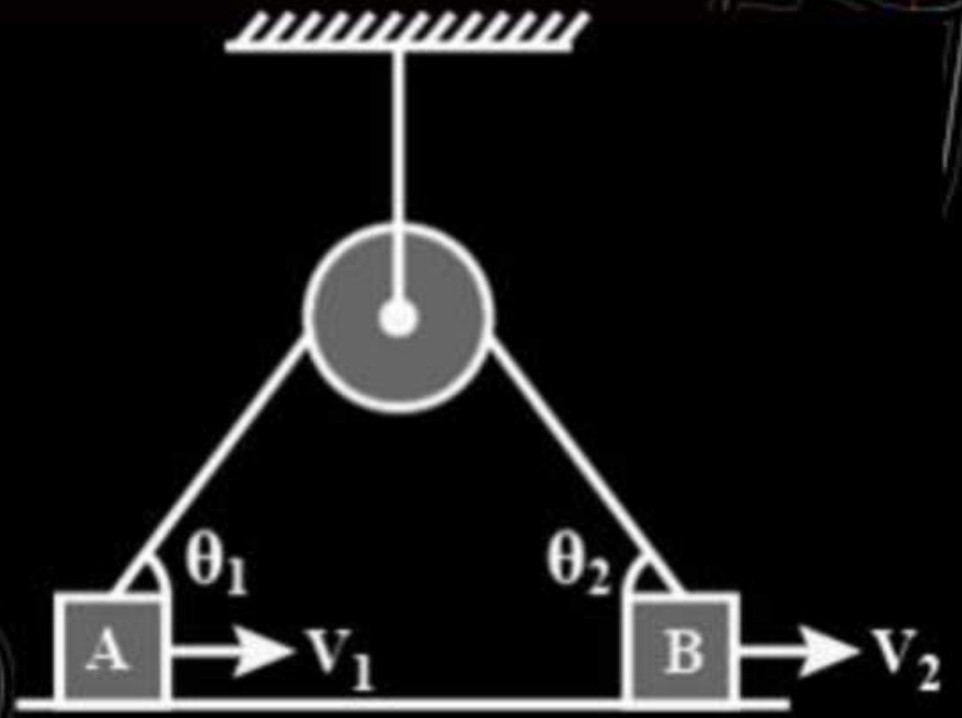
In the figure shown, blocks A and B move with velocities v_1 and v_2 along horizontal direction. The ratio of $\frac{v_1}{v_2}$:

(a) $\frac{\sin\theta_2}{\sin\theta_1}$

(b) $\frac{\sin\theta_1}{\sin\theta_2}$

(c) $\frac{\cos\theta_2}{\cos\theta_1}$

(d) $\frac{\cos\theta_1}{\cos\theta_2}$



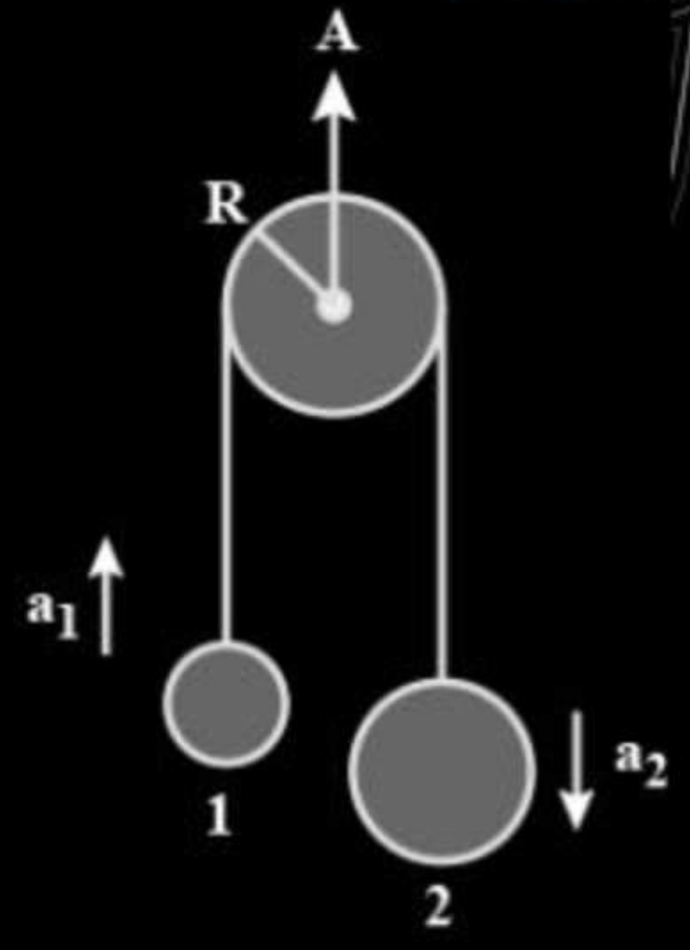
Two masses are connected by a string which passes over a pulley accelerating upward at a rate A as shown. If a_1 and a_2 be the acceleration of bodies 1 and 2 respectively then :

(a) $A = a_1 - a_2$

(b) $A = a_1 + a_2$

(c) $A = \frac{a_1 - a_2}{2}$

(d) $A = \frac{a_1 + a_2}{2}$



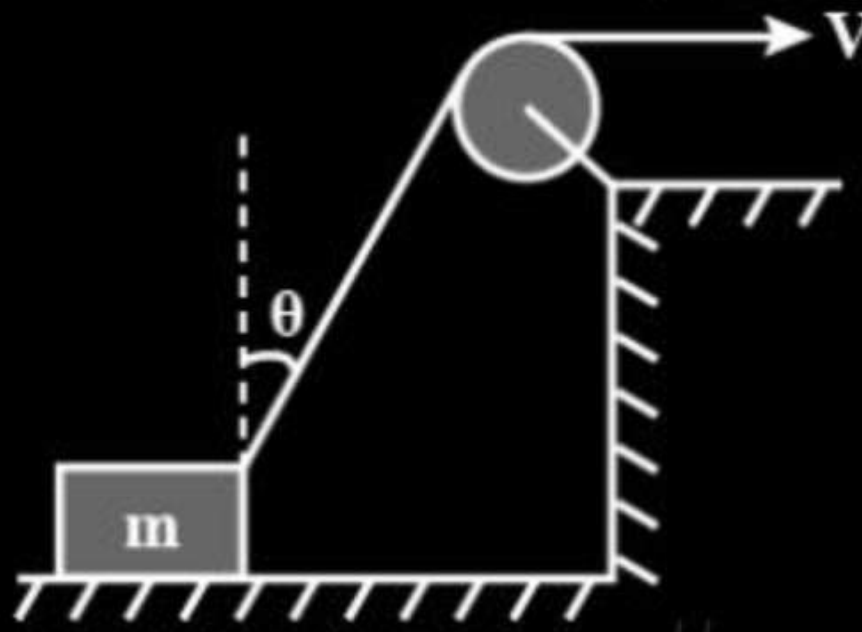
A block is dragged on smooth plane with the help of a rope which moves with velocity v. The horizontal velocity of the block is :

(a) v

(b) $\frac{v}{\sin\theta}$

(c) $v \sin \theta$

(d) $\frac{v}{\cos\theta}$



A man slides down a light rope whose breaking strength is η times the weight of man ($\eta < 1$). The maximum acceleration of the man so that the rope just breaks is

(a) $g(1 - \eta)$

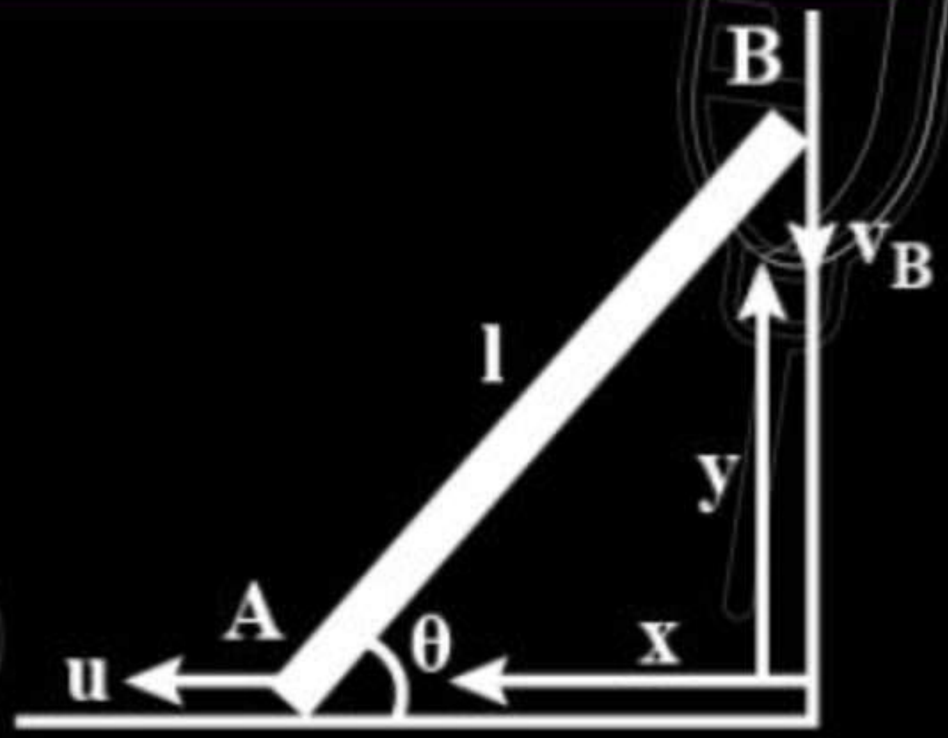
(b) $g(1 + \eta)$

(c) $g\eta$

(d) $\frac{g}{\eta}$

Figure shows a rod of length l resting on a wall and the floor. Its lower end A is pulled towards left with a constant velocity u. As a result of this, end B starts moving down along the wall. Find the velocity of the other end B downward when rod makes an angle θ with the horizontal.

(a) $2u \sin\theta$
(b) $u \sin\theta$
(c) $u \cos\theta$
(d) $2u \cos\theta$



THANK YOU ☺