ARJUNA NEET BATCH

ARJUNA

PW

LAWS OF MOTION

LECTURE - 08

Todays goal

MOKSHA in Constrain relation by MR*

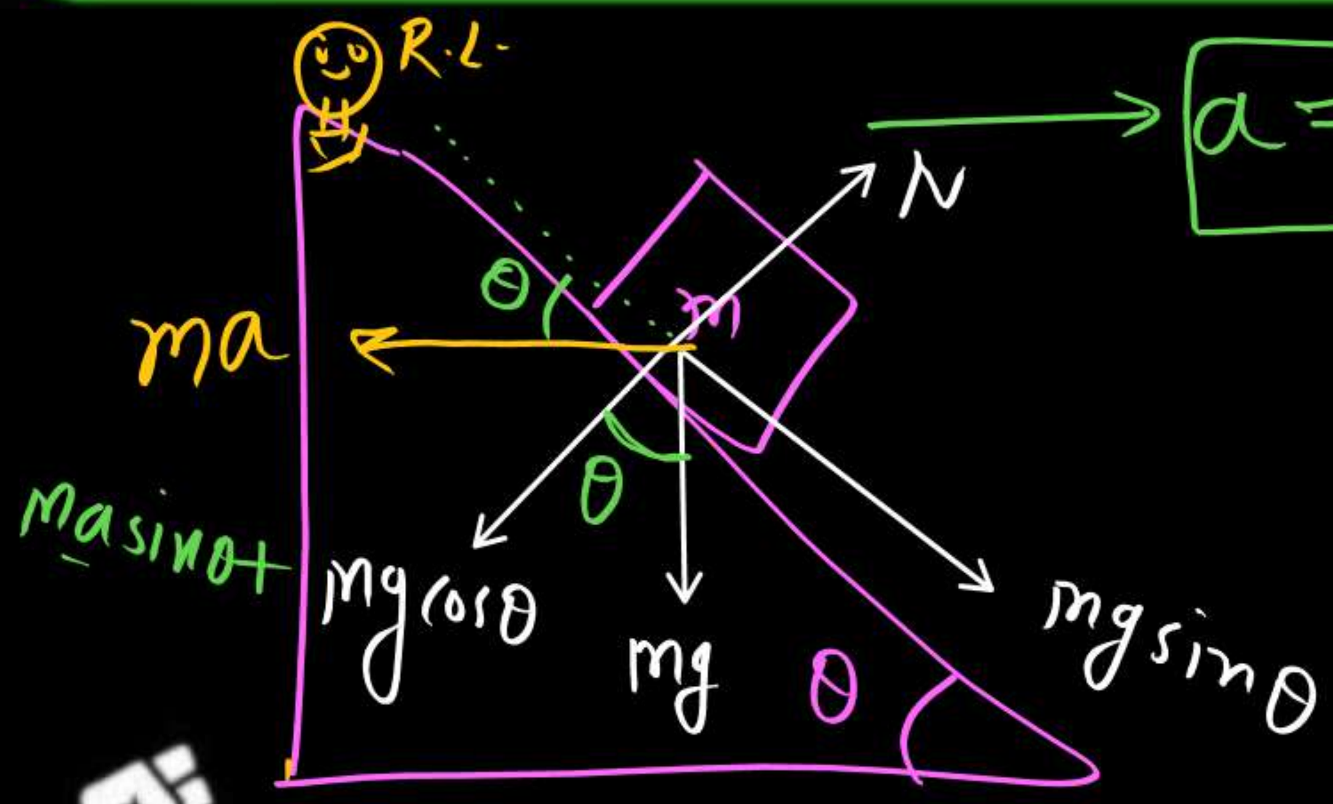
Feel of friction

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



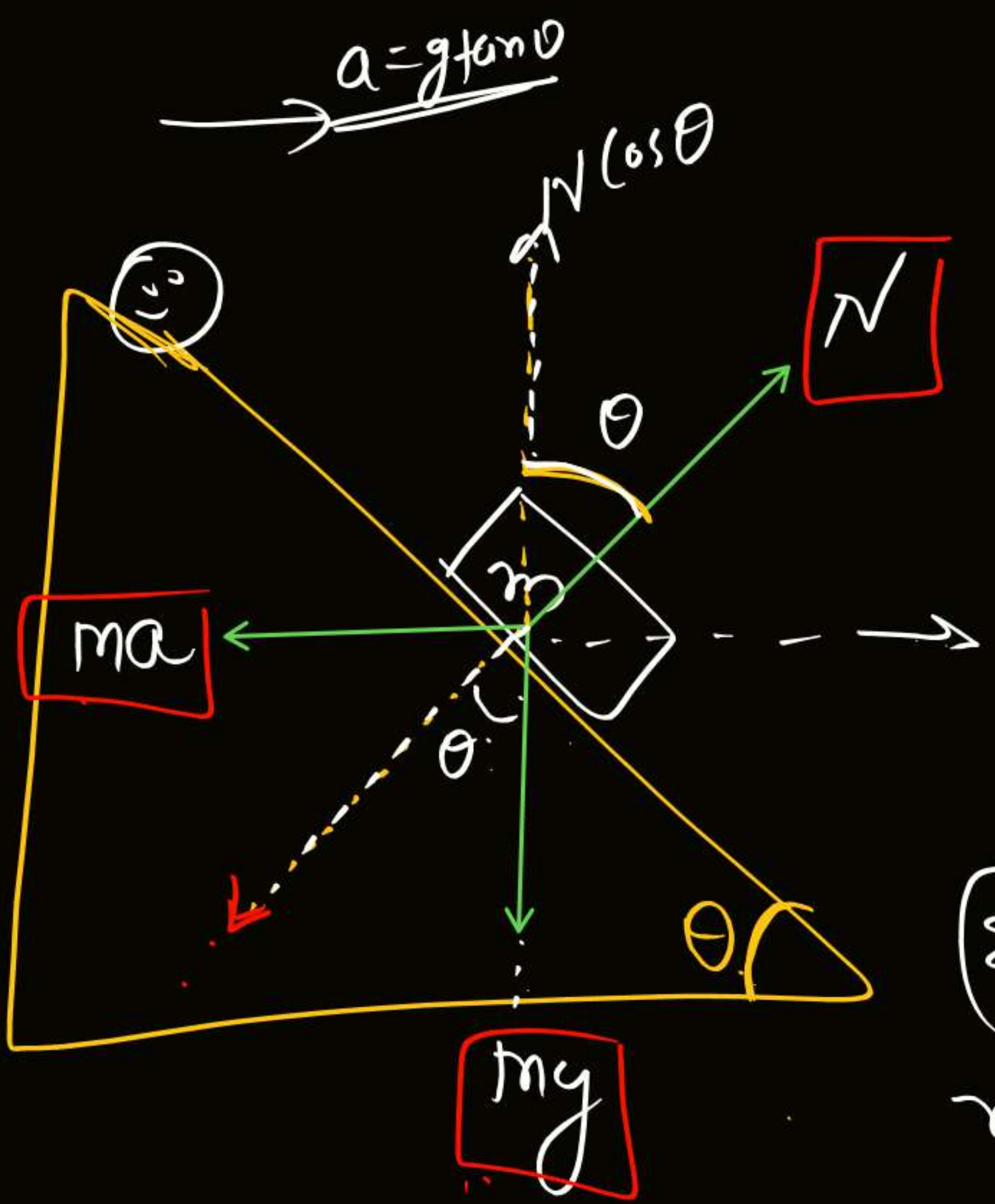
$\boxed{a = g\tan\theta}$

$$\boxed{N = mg\cos\theta + m a \sin\theta}$$

$$= mg\cos\theta + mg\frac{\sin\theta}{\cos\theta}\sin\theta$$

$$= \frac{mg\left[\cos^2\theta + \sin^2\theta\right]}{\cos\theta}$$

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



$$\boxed{\Sigma F_y = 0}$$

$$N\cos\theta = mg$$

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

JAI MR*

$$[\Sigma F_x = 0]_{\text{w.r.t R.L.}}$$

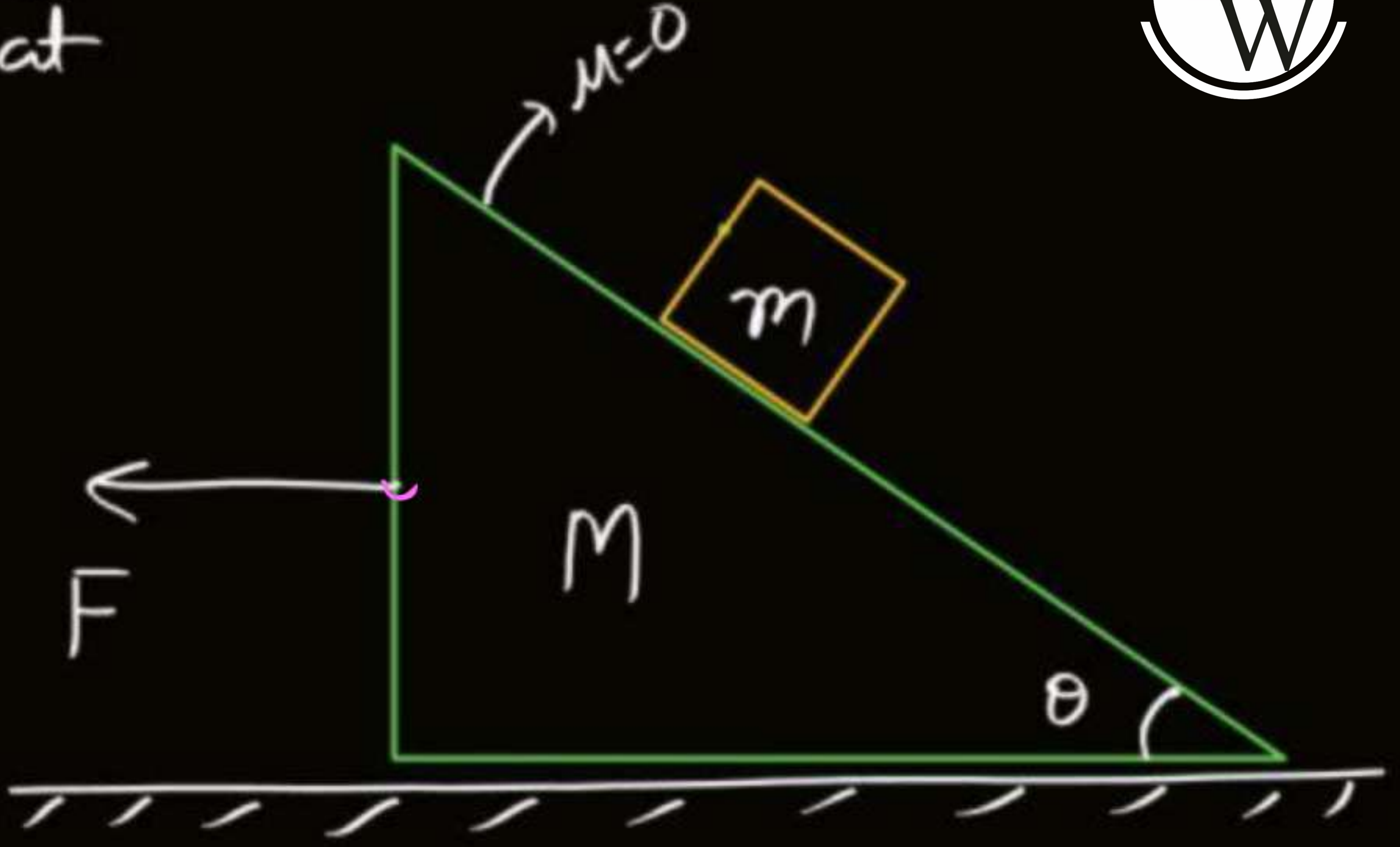
$$ma = N\sin\theta$$

$$mg\frac{\cancel{\sin\theta}}{\cos\theta} = N\cancel{\sin\theta}$$

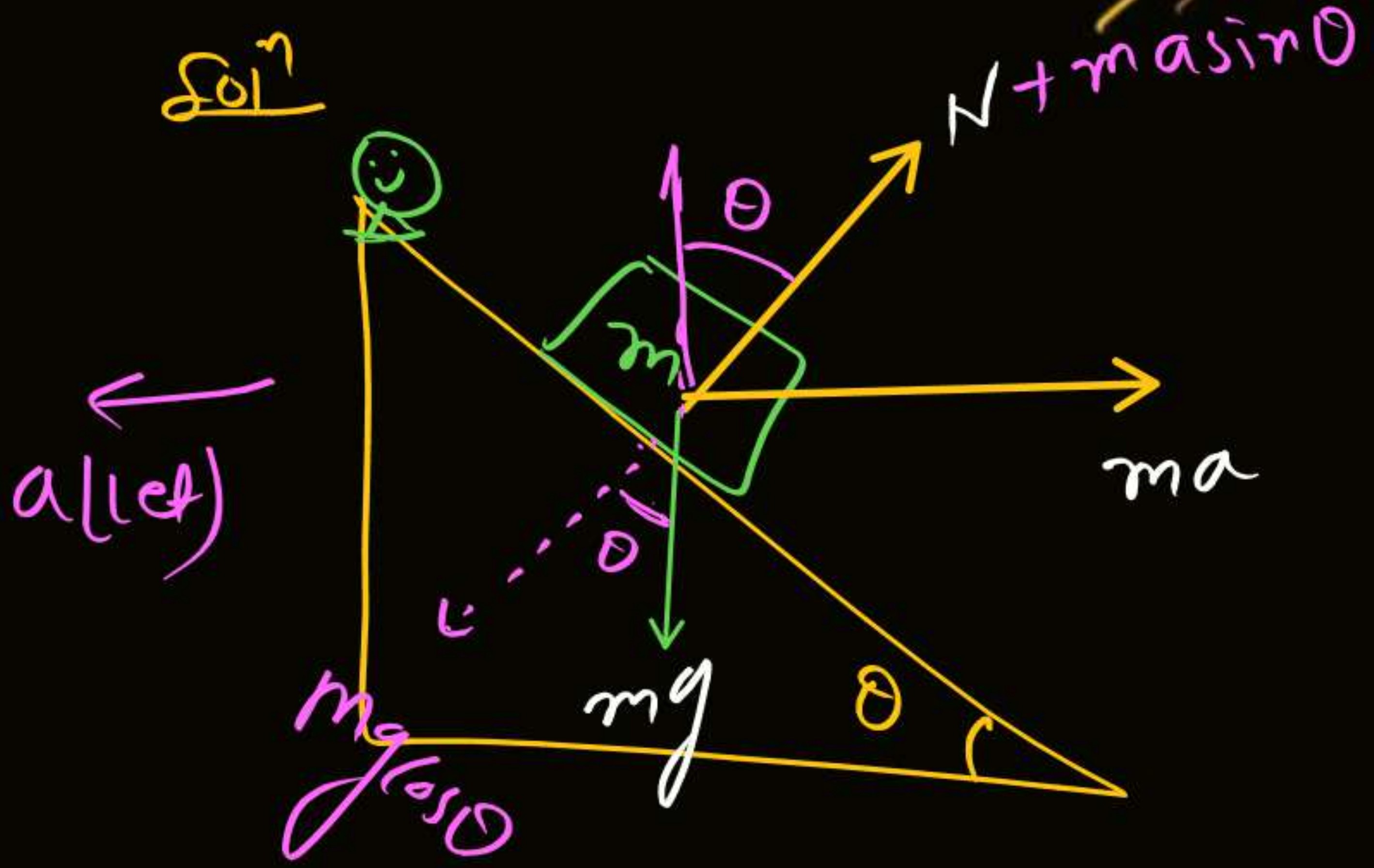
$$\boxed{N = \frac{mg}{\cos\theta}}$$

Q) find force on Inclined or acceleration of Inclined so that block can free fall.

H.W



Sol^n



Perpendicular to the Inclined

$\cancel{m}g\cos\theta = \cancel{N}^{0} + \cancel{m}a\sin\theta$

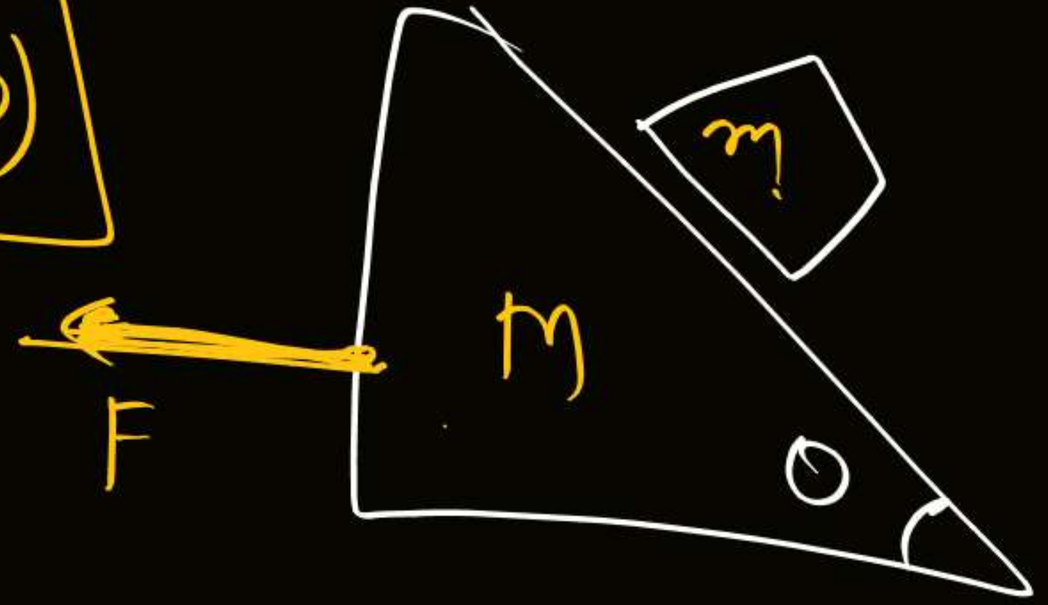
for free fall

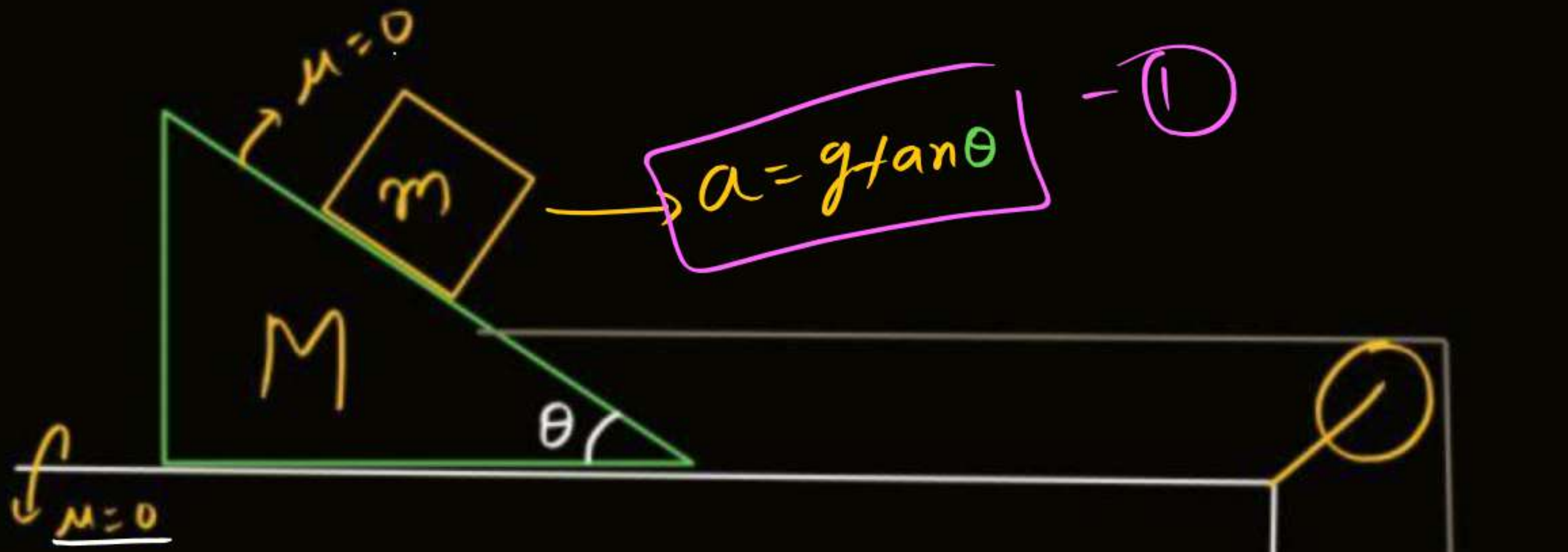
$$\boxed{a = \frac{g\cos\theta}{\sin\theta} = g\cot\theta}$$

Force = M a

$$\boxed{F = m(g\cot\theta)}$$

$$\boxed{\begin{array}{l}\text{Force so that block will not slide} \\ a = g\tan\theta \\ F = (M+m)g\tan\theta\end{array}}$$



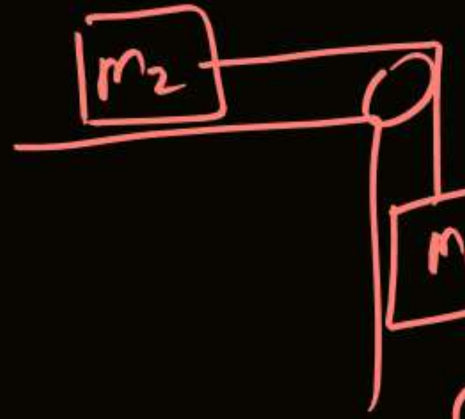


$$\boxed{a = g\tan\theta} \quad -\ \text{(I)}$$

$$\boxed{a = \frac{m'g}{m' + m + M}} \quad -\ \text{(II)}$$

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

H.W



$$\boxed{a = \frac{m_1 g}{m_1 + m_2}}$$

$$\frac{m'\cancel{g}}{M+m+m'} = \cancel{g}\tan\theta$$

$$m' = (M+m+m')\tan\theta$$

$$m' - m'\tan\theta = (M+m)\tan\theta$$

$$m'(1-\tan\theta) = (M+m)\tan\theta$$

$$m' = \frac{(M+m)\tan\theta}{1-\tan\theta}$$

$\boxed{\text{hint: if } \theta = 0^\circ}$

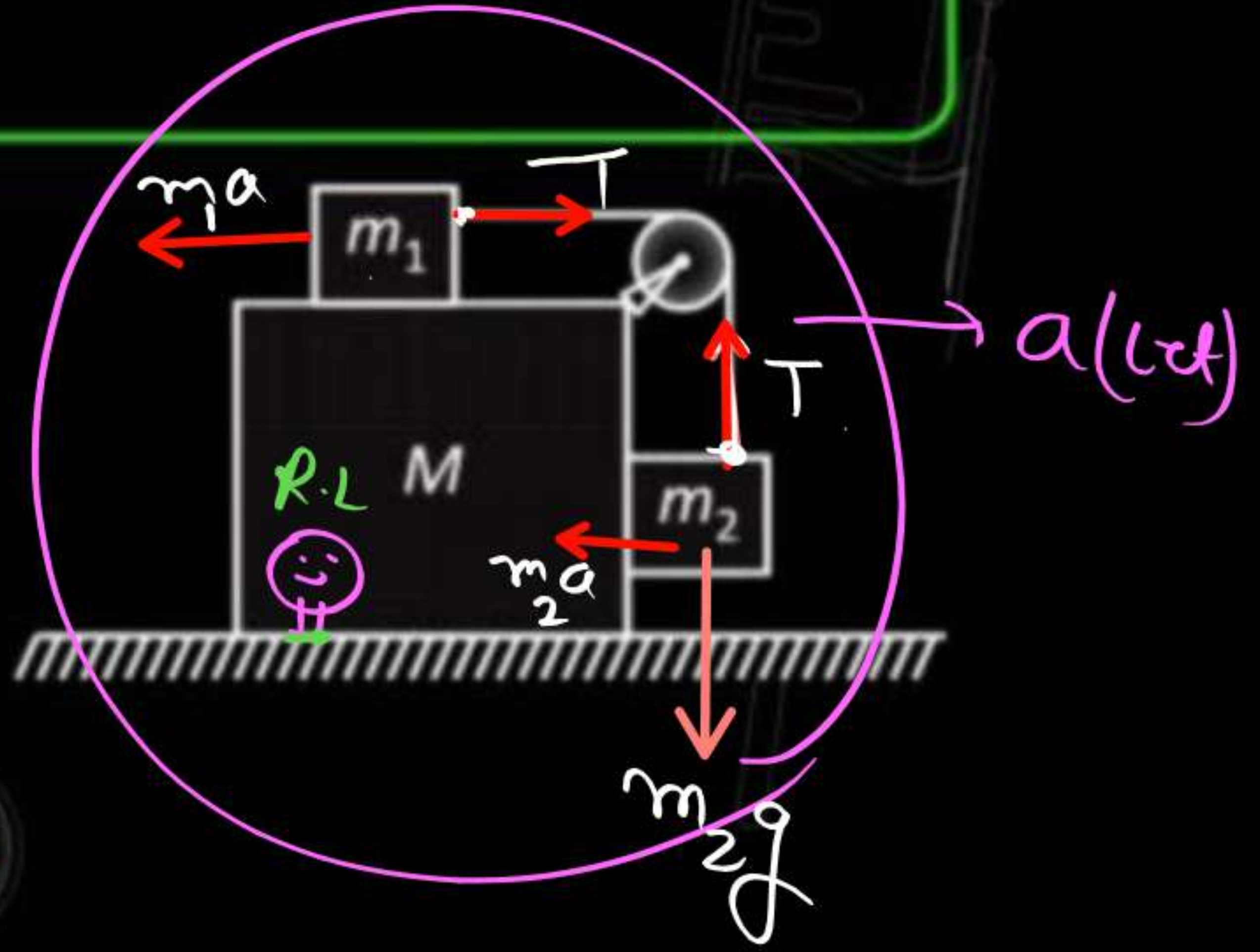
In the given arrangement all surfaces are smooth. What acceleration should be given to the system, for which the block m_2 doesn't slide down ?

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

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

MR* if $m_1 = 0$
$a = \infty$

$\boxed{T = m_2 g}$ — (I)



$\left(\sum F_x\right)_{on\ m_1} = 0$

(I) = (II)

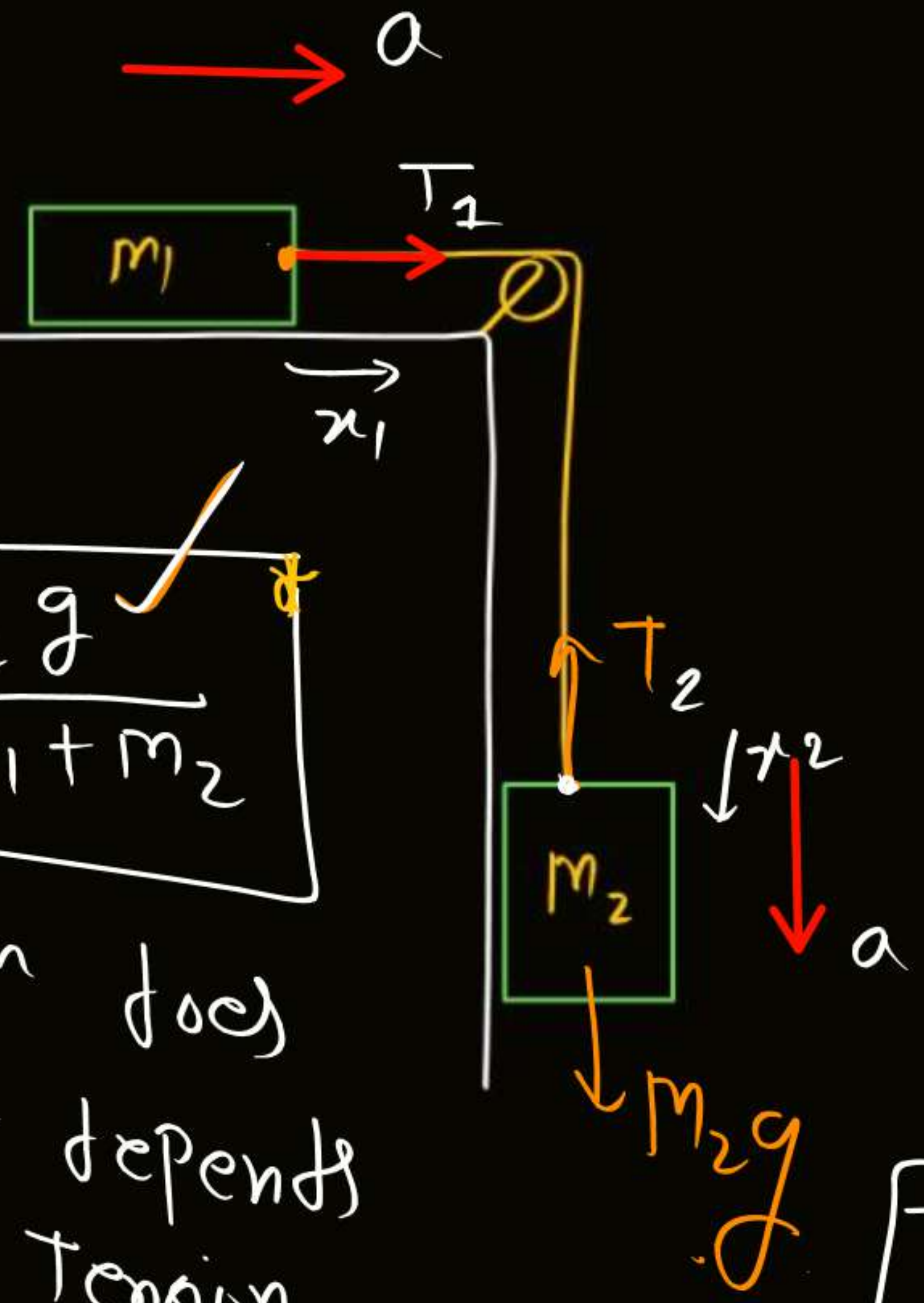
$m_1 a = m_2 g$

The MR*
$m_1 = 0$
$a = 0$

$T = m_1 a$ — (II)

$\boxed{a = \frac{m_2 g}{m_1}}$

Constraint relation



$$\boxed{a = \frac{m_2 g}{m_1 + m_2}}$$

⇒ accⁿ does not depends on Tension

String नहीं है।

✓ U (does not depend on Tension)

✓ $K.E = \frac{1}{2} m v^2$ (does not depend on Tension)

$\boxed{W_T = \Delta K.E = 0}$ system

Work done must be zero by Tension on system

$$W = T_1 x_1 - T_2 x_2 = 0$$

$$T_1 x_1 = T_2 x_2$$

diffⁿ w.r.t. time

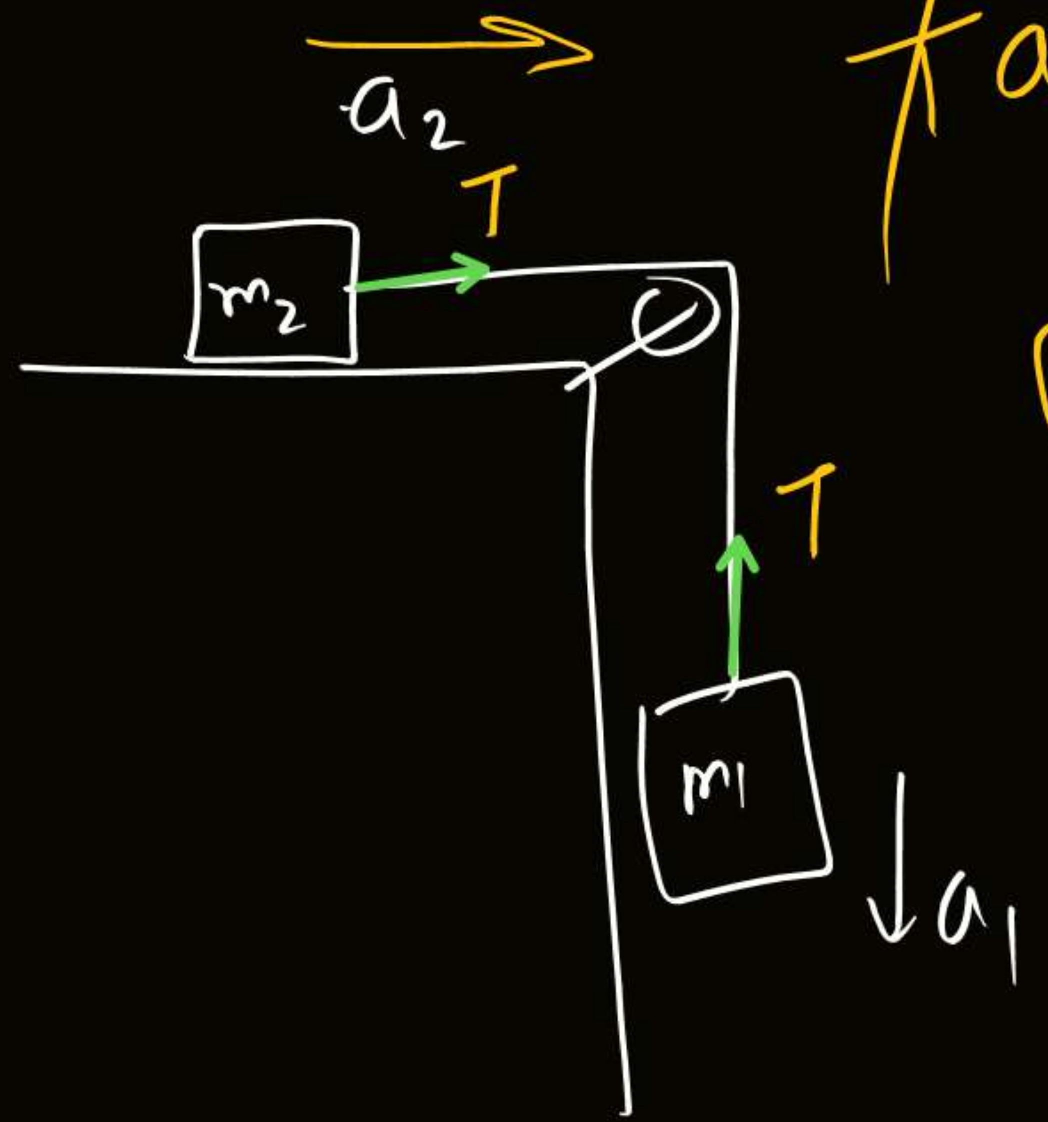
$$\boxed{T_1 a_1 = T_2 a_2} \xleftarrow{\text{diffⁿ}} \boxed{T_1 v_1 = T_2 v_2}$$

$\boxed{MR^{\cancel{x}}}$

#

$$\underbrace{a_1T_1}_{+ve} = \underbrace{a_2T_2}_{-ve}$$

$$\boxed{aT = \text{Const}^n}$$



$\cancel{+}a_2 = \cancel{+}a_1$

$\boxed{a_1 = a_2}$

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

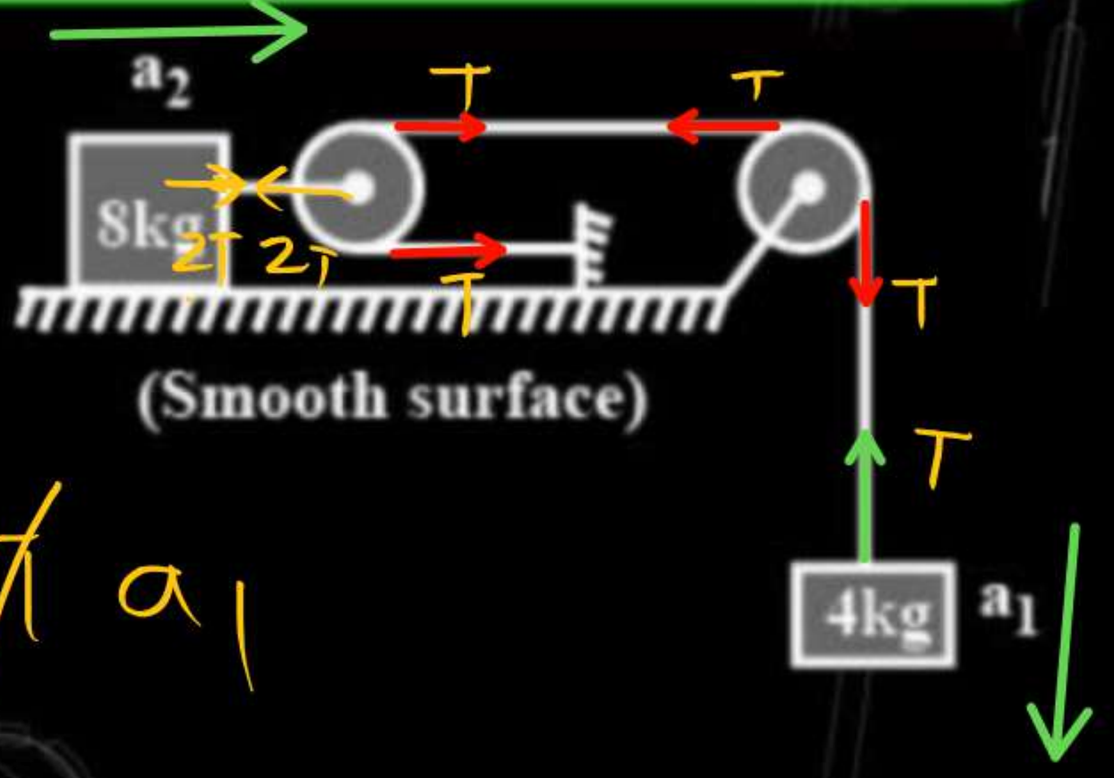
(a) $a_1 = a_2$

(b) $a_1 = 2a_2$

(c) $2a_1 = a_2$

(d) $a_1 = 4a_2$

$$\boxed{Ta = \text{cost}^n}$$



$$2\cancel{T}a_2 = \cancel{T}a_1$$

$$\boxed{2a_2 = a_1}$$

Constrain Motion :

Find relation between a_1 and a_2

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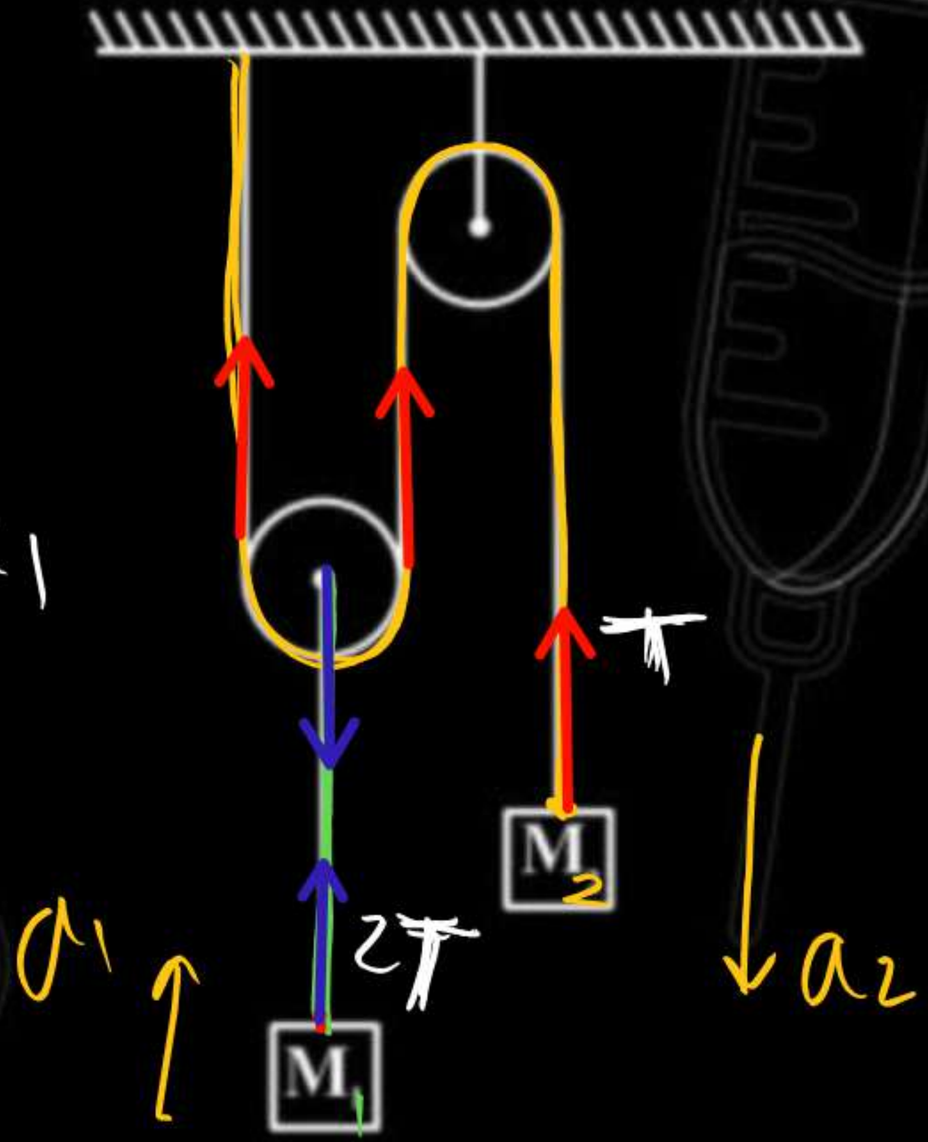
$$2\cancel{T}a_1 = 3\cancel{T}a_2$$

$$\boxed{2a_1 = 3a_2}$$

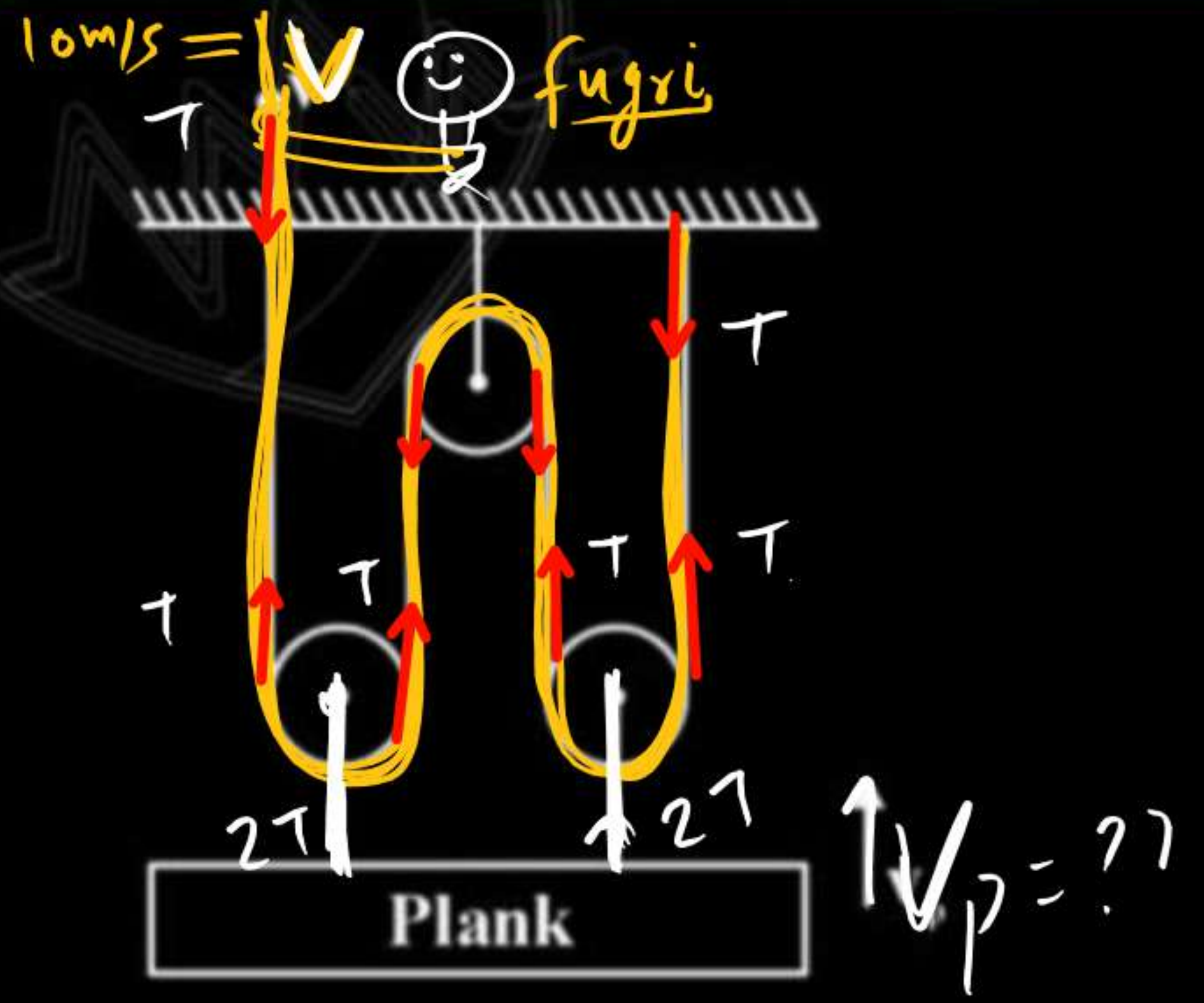


$$\cancel{T}a_2 = 2\cancel{T}a_1$$

$$\boxed{a_2 = 2a_1}$$

Constrain Motion :

Find relation between a_1 and a_2

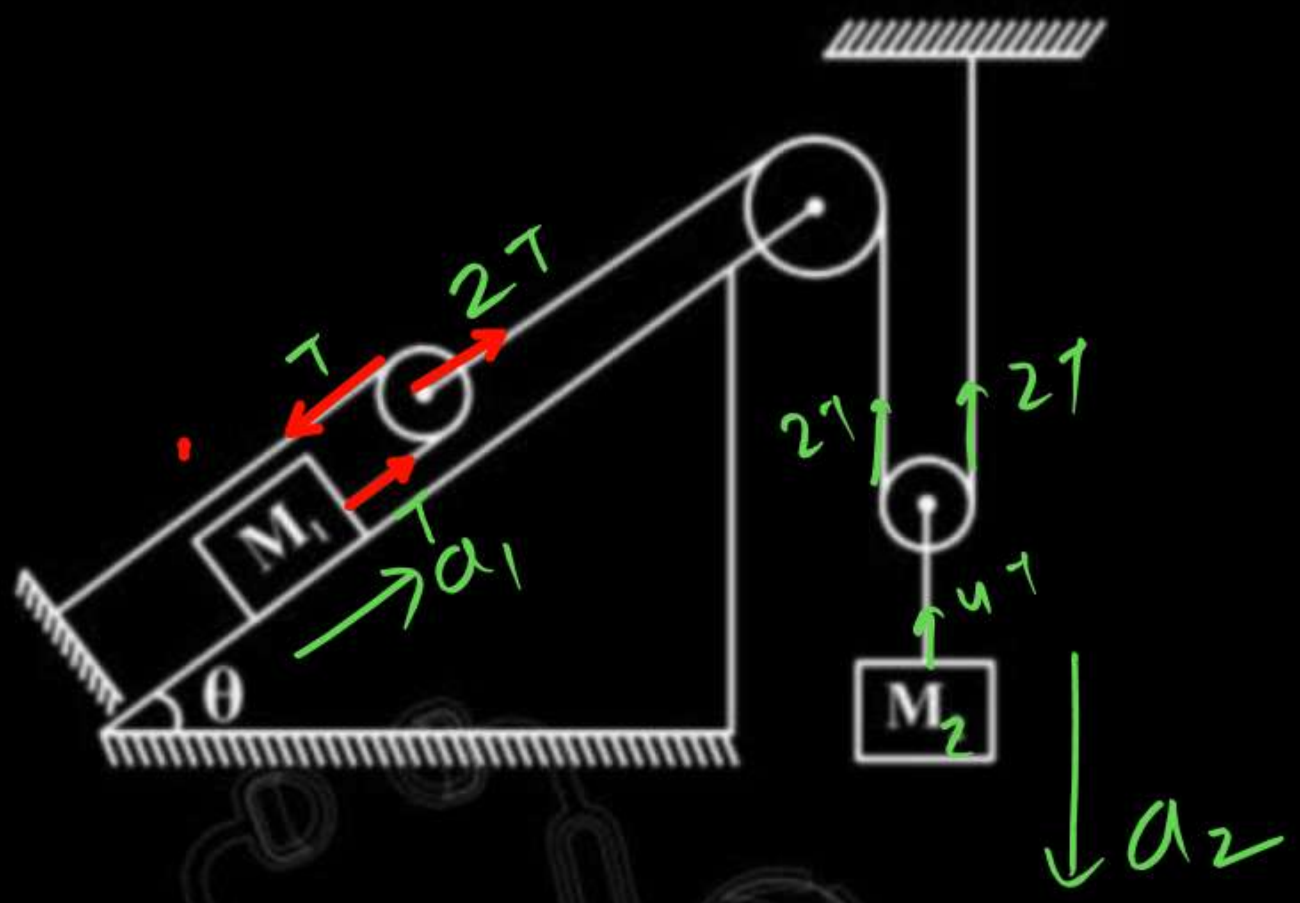


$$4 V_p = V$$

$$\boxed{V_p = \frac{v}{4}} = \frac{10}{4} = 2.5\,m/s$$

Constrain Motion :

Find relation between a_1 and a_2



$4\cancel{T}a_2 = \cancel{T}a_1$

$\boxed{4a_2 = a_1}$

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 $\frac{v_1}{v_2}$.

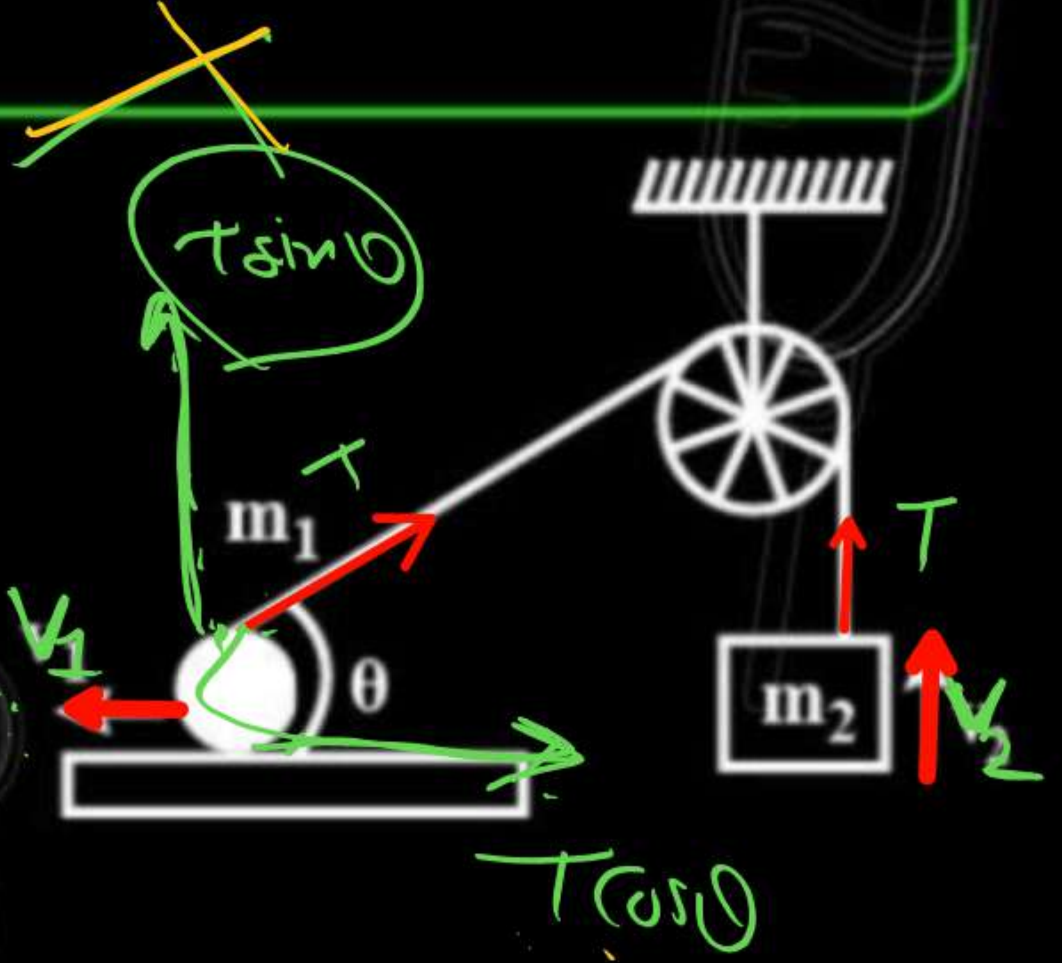
(a) $\cos\theta$ (b) $\sec\theta$

(c) $\tan\theta$ (d) $\sin\theta$

$\frac{V_1}{V_2} = ??$

$\cancel{T} V_2 = V_1 \cancel{T} \cos\theta$

$\frac{V_1}{V_2} = \frac{1}{\cos\theta} = \sec\theta$



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

AIPMT | JEE

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

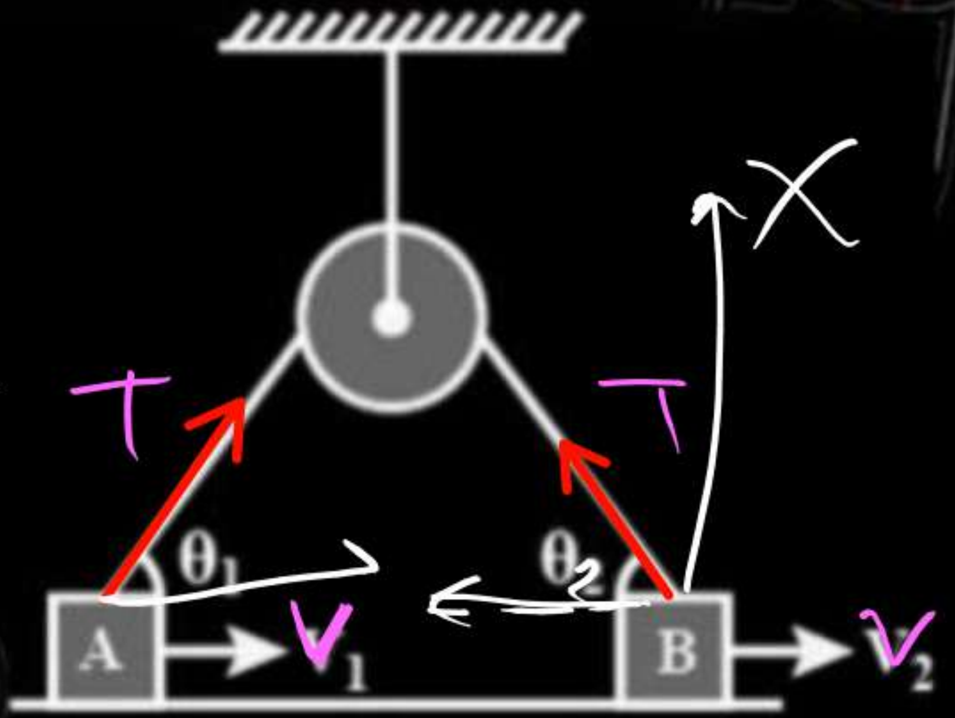
(b) $\frac{\sin\theta_1}{\sin\theta_2}$

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

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

$$\cancel{T}\cos\theta_1 v_1 = \cancel{T}\cos\theta_2 v_2$$

$$\boxed{\frac{v_1}{v_2} = \frac{\cos\theta_2}{\cos\theta_1}}$$



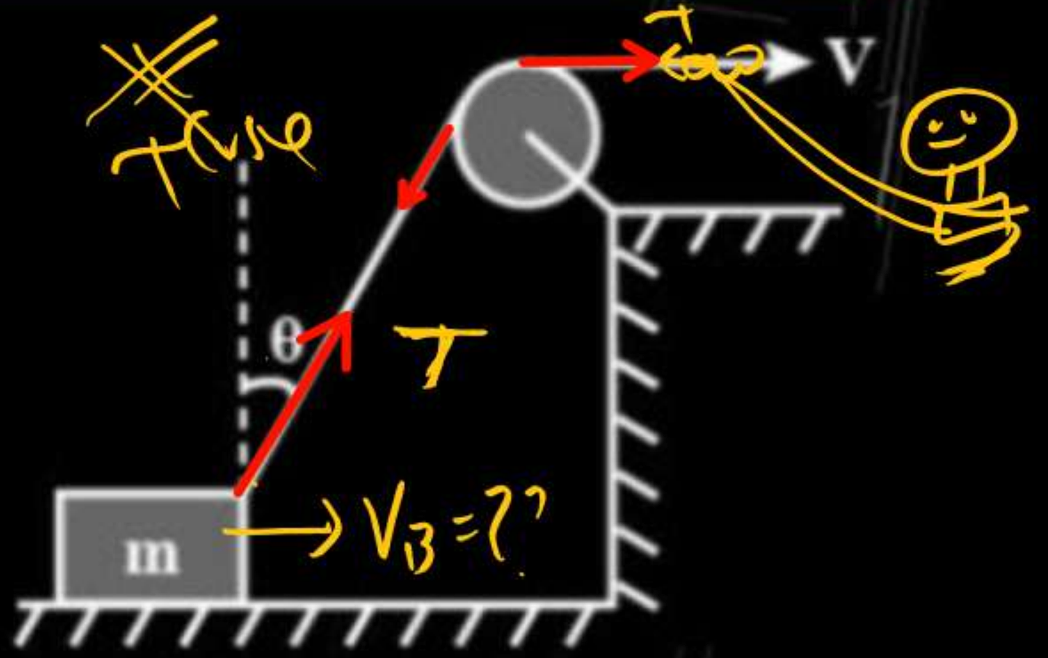
A block is dragged on smooth plane with the help of a rope which moves with velocity v. The horizontal velocity of the block is :

(a) v

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

(c) $v \sin \theta$

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



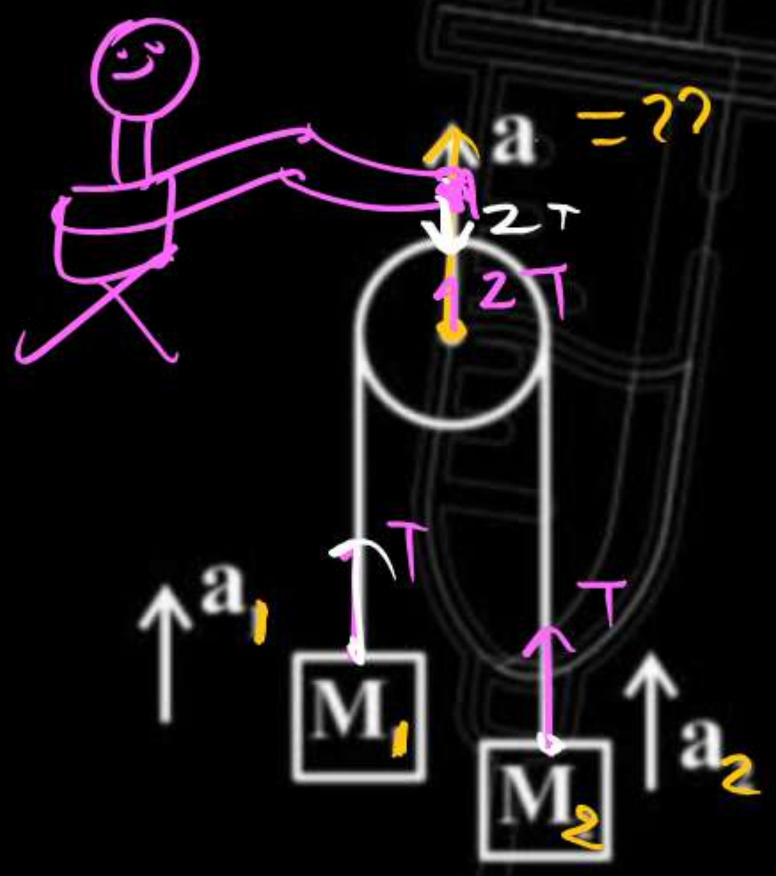
$T \sin\theta \, V_B = T V$

$$\boxed{V_B = \frac{V}{\sin\theta}}$$

find relation b/w a_1, a_2 & a.

$$a_1 \cancel{T} + a_2 \cancel{T} = 2\cancel{T}\, a$$

$$\# \quad \boxed{\frac{a_1 + a_2}{2} = a}$$



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

$$\frac{a_1 \cancel{+} a_2}{2} = A$$

A = accⁿ of Pw

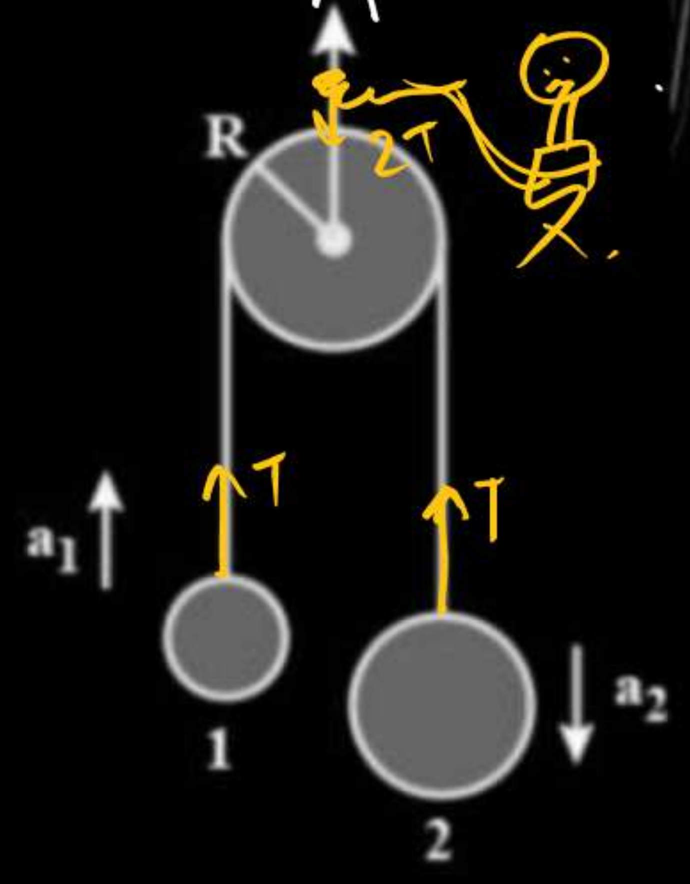


Figure shows a rod of length l resting on a wall and the floor. Its lower end A is pulled towards left with a constant velocity u. As a result of this, end B starts moving down along the wall. Find the velocity of the other end B downward when rod makes an angle θ with the horizontal.

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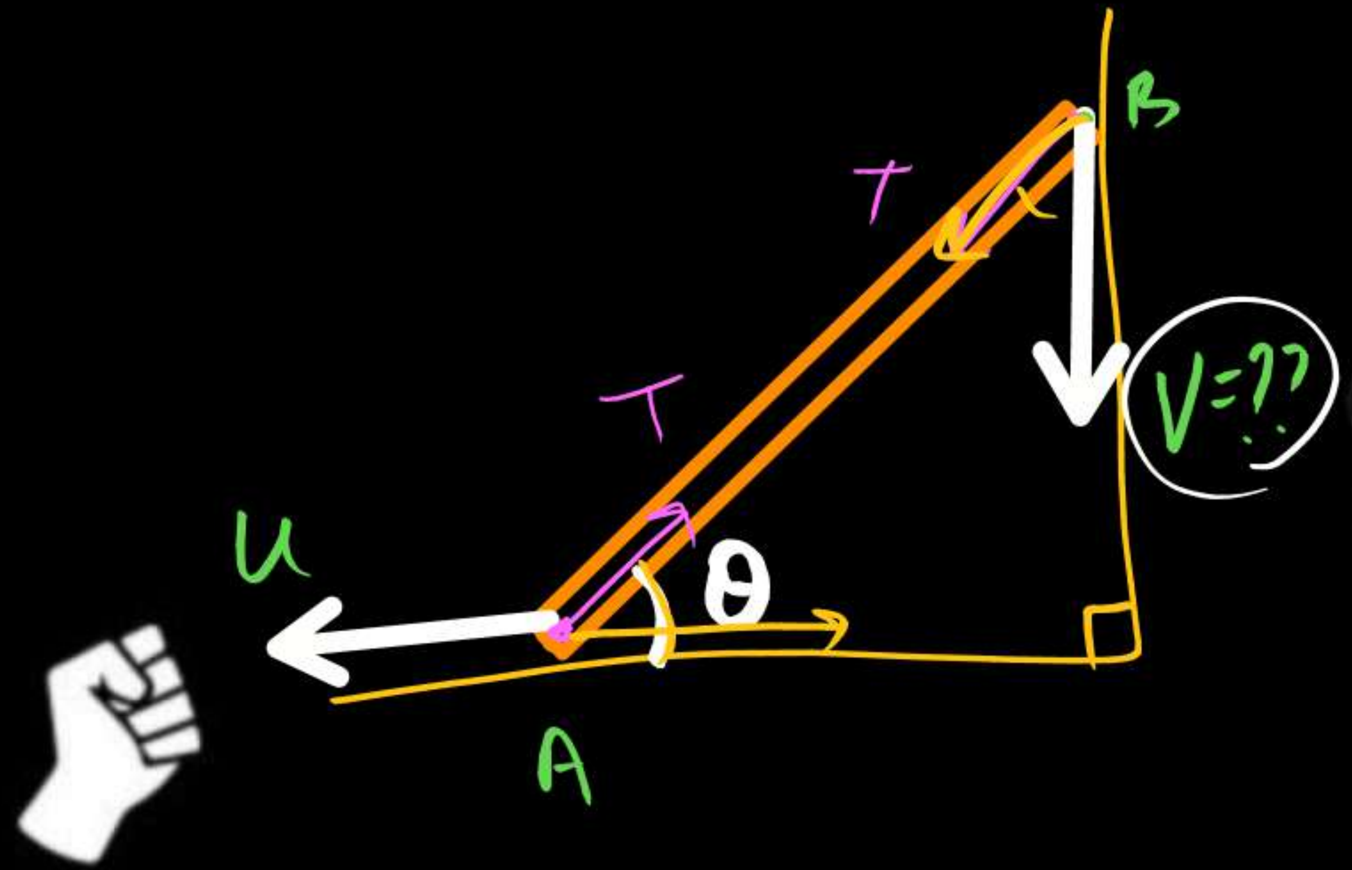
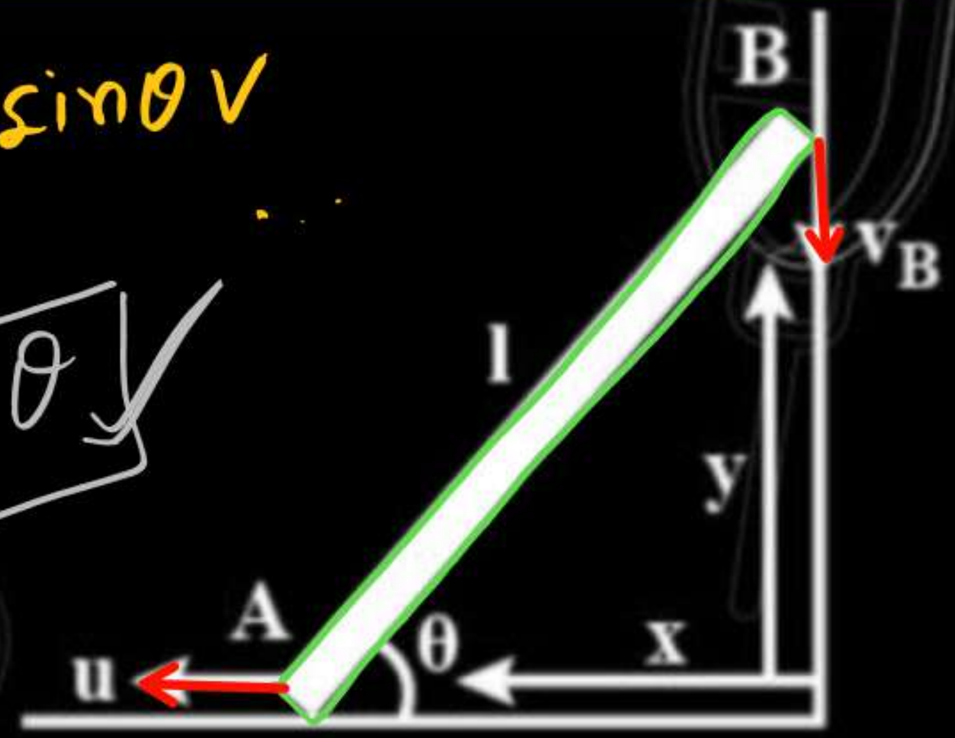
(a) $2u \sin\theta$ (b) $u \sin\theta$

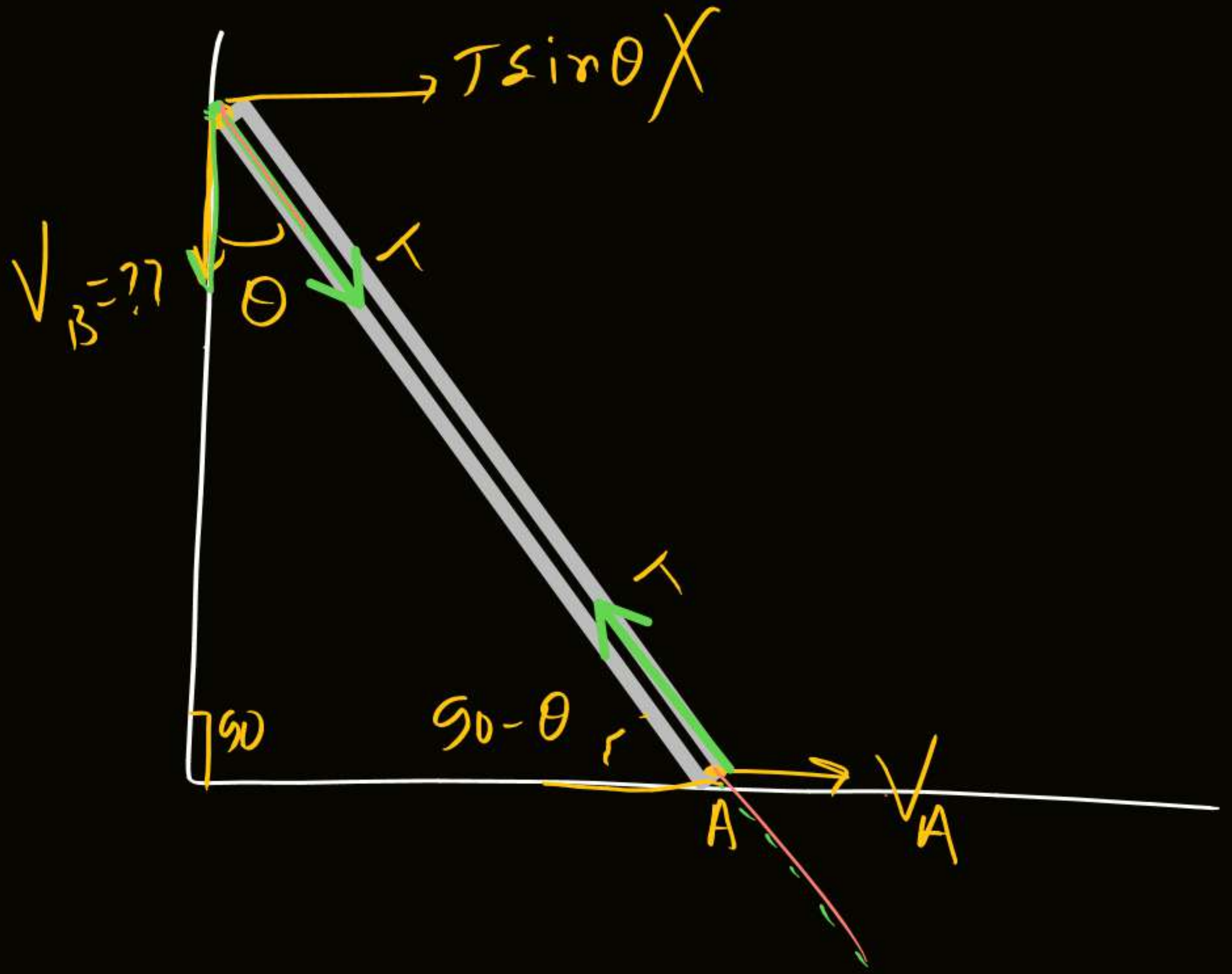
(c) $u \cot\theta$ (d) $2u \cos\theta$



$$\cancel{T}\cos\theta\, u = \cancel{T}\sin\theta\, v$$

$$\boxed{V = u \cot\theta}$$





$$\cancel{T}\cos\theta\, V_B = \cancel{T}\sin\theta\, V_A$$

$\boxed{V_B = V_A \tan\theta}$

velocity of two end of rod along the length of rod will be same

THANK YOU ☺