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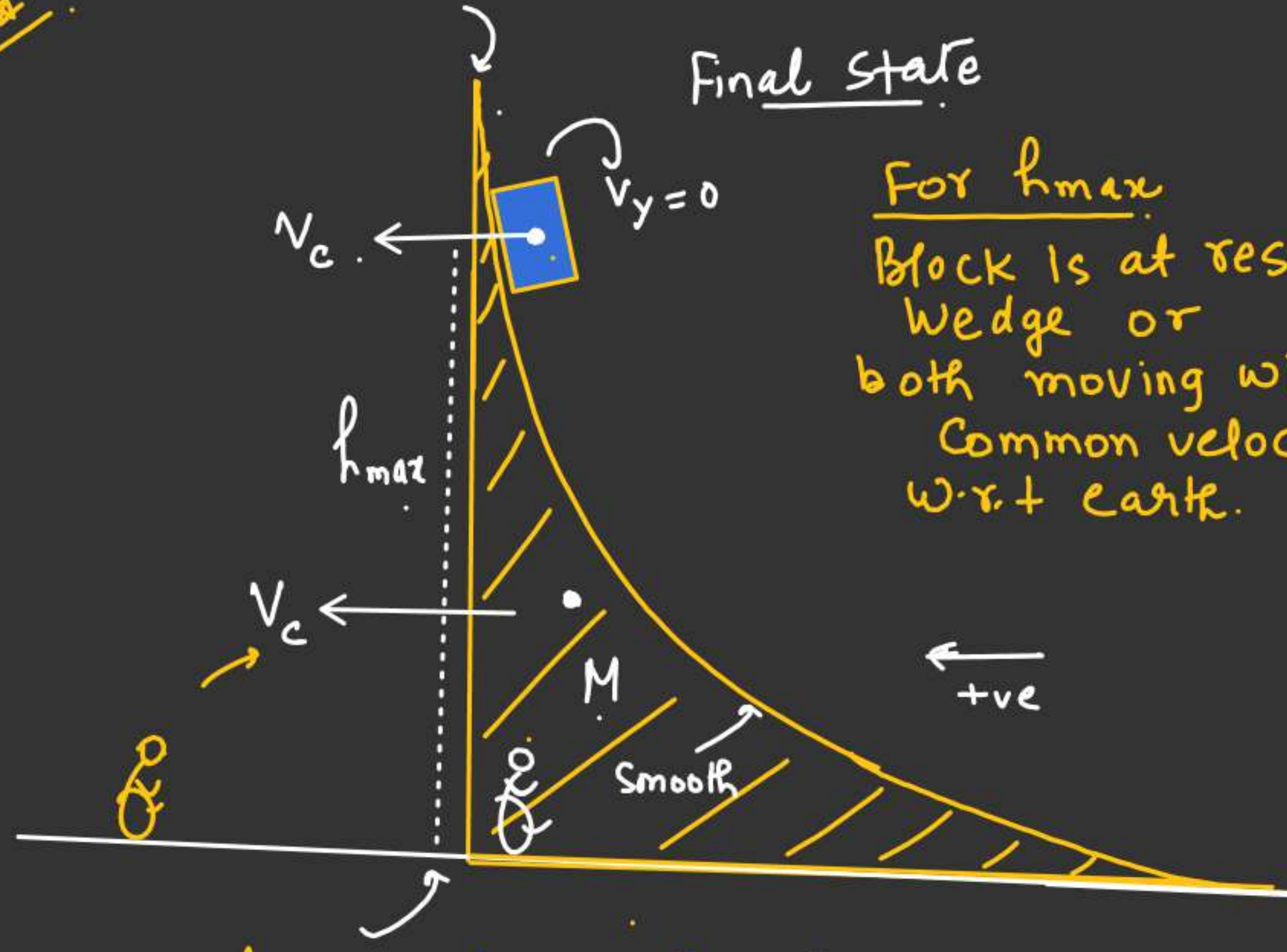
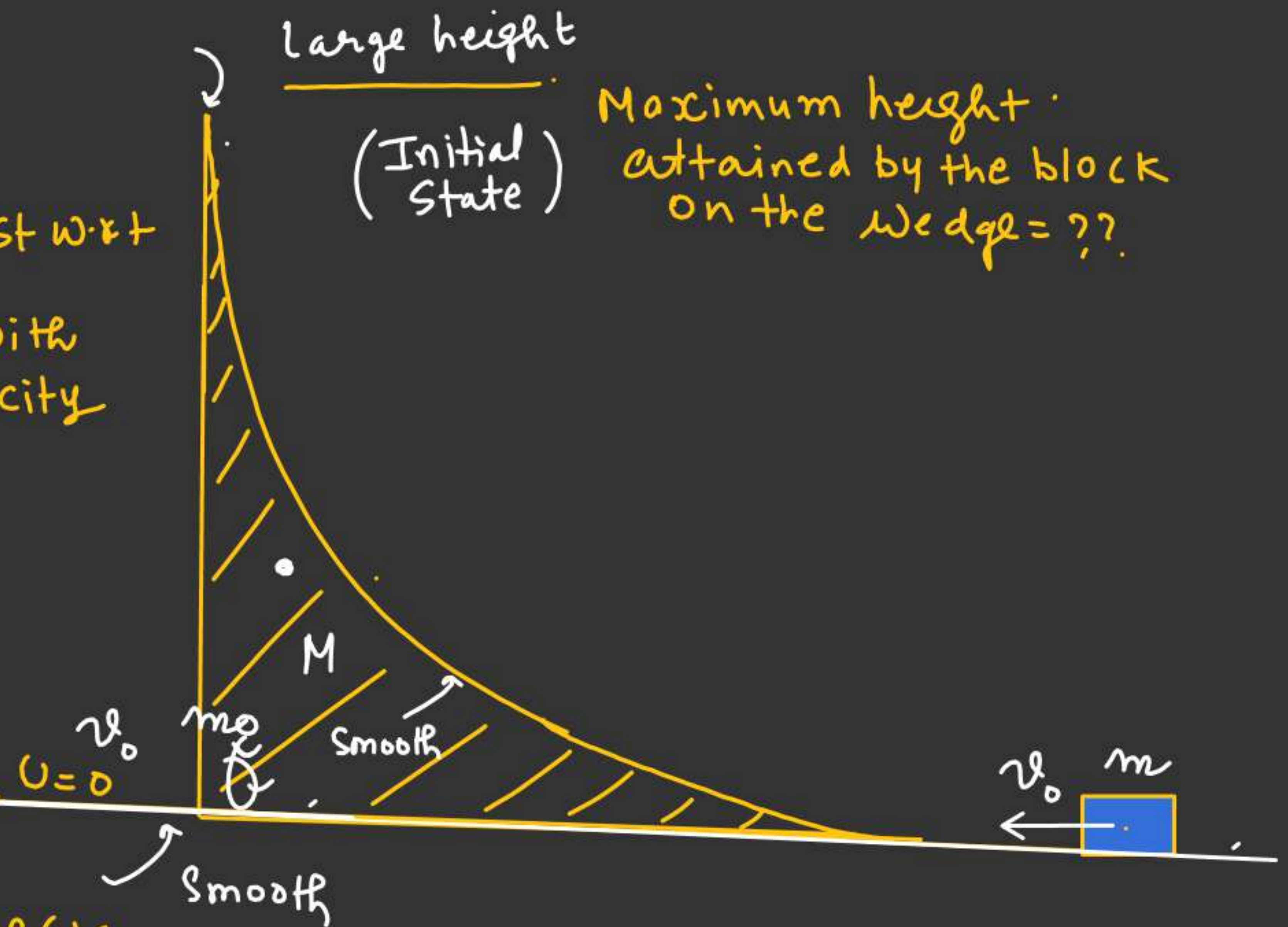


For h_{max}

Block is at rest w.r.t wedge or both moving with common velocity w.r.t earth.



Maximum height attained by the block on the wedge = ??

C.M.C in x-direction

$$m v_0 = (M+m) V_c$$

$$V_c = \left(\frac{m v_0}{M+m}\right) \quad \text{—(1)}$$

ENERGY CONSERVATION

$$\frac{1}{2} m v_0^2 = \frac{1}{2}(M+m) V_c^2 + m g h_{max} \quad \text{—(2)}$$

$$\frac{m v_0^2}{2} - \frac{(M+m)}{2} \times \frac{m^2 v_0^2}{(M+m)^2} = m g h_{max}$$

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$$\frac{mv_0^2}{2} - \frac{\cancel{(M+m)}}{2} \times \frac{m^2 v_0^2}{\cancel{(M+m)^2}} = mgh_{max}$$

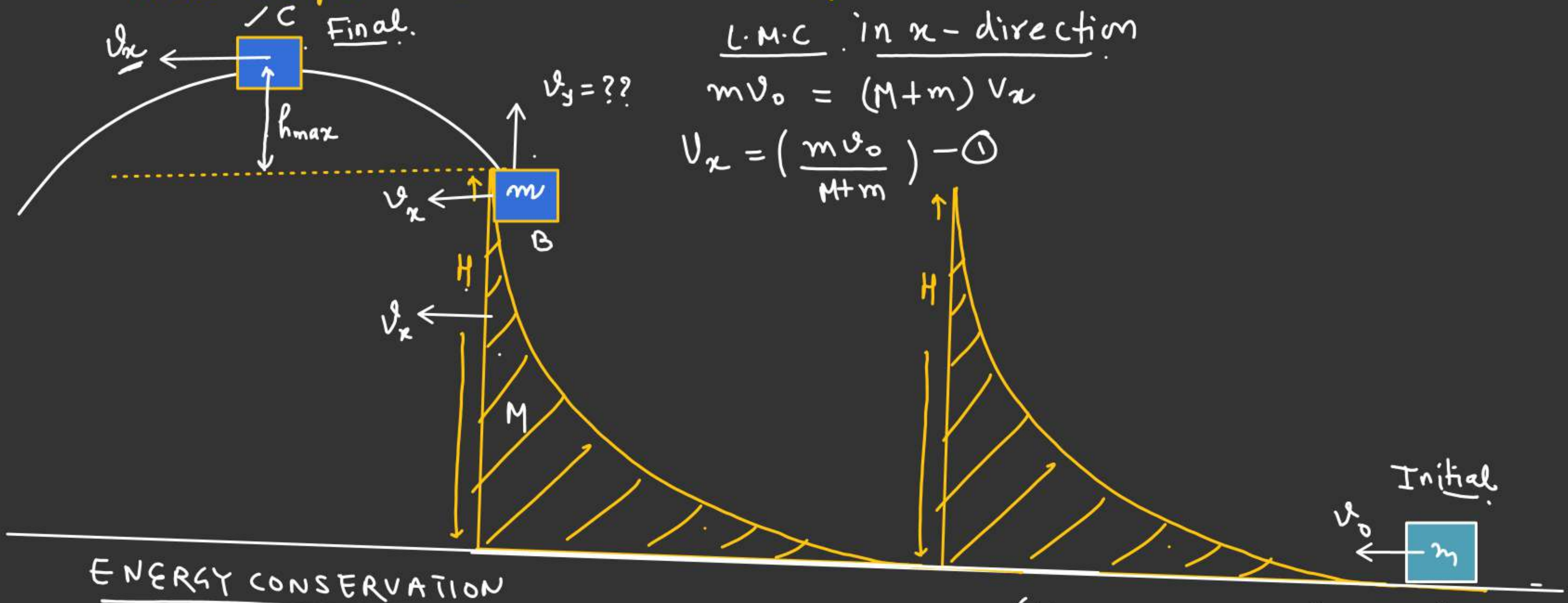
$$\frac{mv_0^2}{2} - \frac{m^2 v_0^2}{2(M+m)} = mg\,h_{max}.$$

$$h_{max} = \frac{v_0^2}{2g} - \frac{mv_0^2}{2g(M+m)}$$

$$h_{max} = \frac{v_0^2(M+m) - mv_0^2}{2g(M+m)}$$

$$\boxed{h_{max} = \frac{v_0^2}{2g}\left(\frac{M}{M+m}\right)}$$

⇒ If wedge not of sufficient height i.e before achiving max. height block leave the wedge.



L.M.C in x-direction

$$mv_0 = (M+m)V_x$$

$$V_x = \left(\frac{mv_0}{M+m}\right) \quad -(1)$$

ENERGY CONSERVATION

$$\frac{1}{2}mv_0^2 = \frac{1}{2}mv_x^2 + \frac{1}{2}MV_x^2 + mg(H+h_{max}) \quad -(2)$$

$$(H+h_{max}) = \frac{v_0^2}{2g}\left(\frac{M}{M+m}\right)$$

$v_y = ??$

$v_{block} = \sqrt{v_x^2 + v_y^2}$

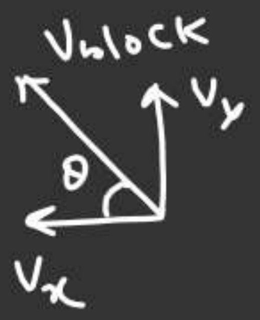
Energy Conservation from A to B.

$$\frac{1}{2} m v_0^2 = \frac{1}{2} m \left[v_x^2 + v_y^2\right] + \frac{1}{2} M V_x^2 + mgH.$$

$$v_x = \left(\frac{m v_0}{M+m}\right)$$

$$\Downarrow$$

$v_y = ??$



$$\tan\theta = \left(\frac{V_y}{V_x}\right)$$

$$\boxed{\theta = \tan^{-1}\left(\frac{V_y}{V_x}\right)} \checkmark$$

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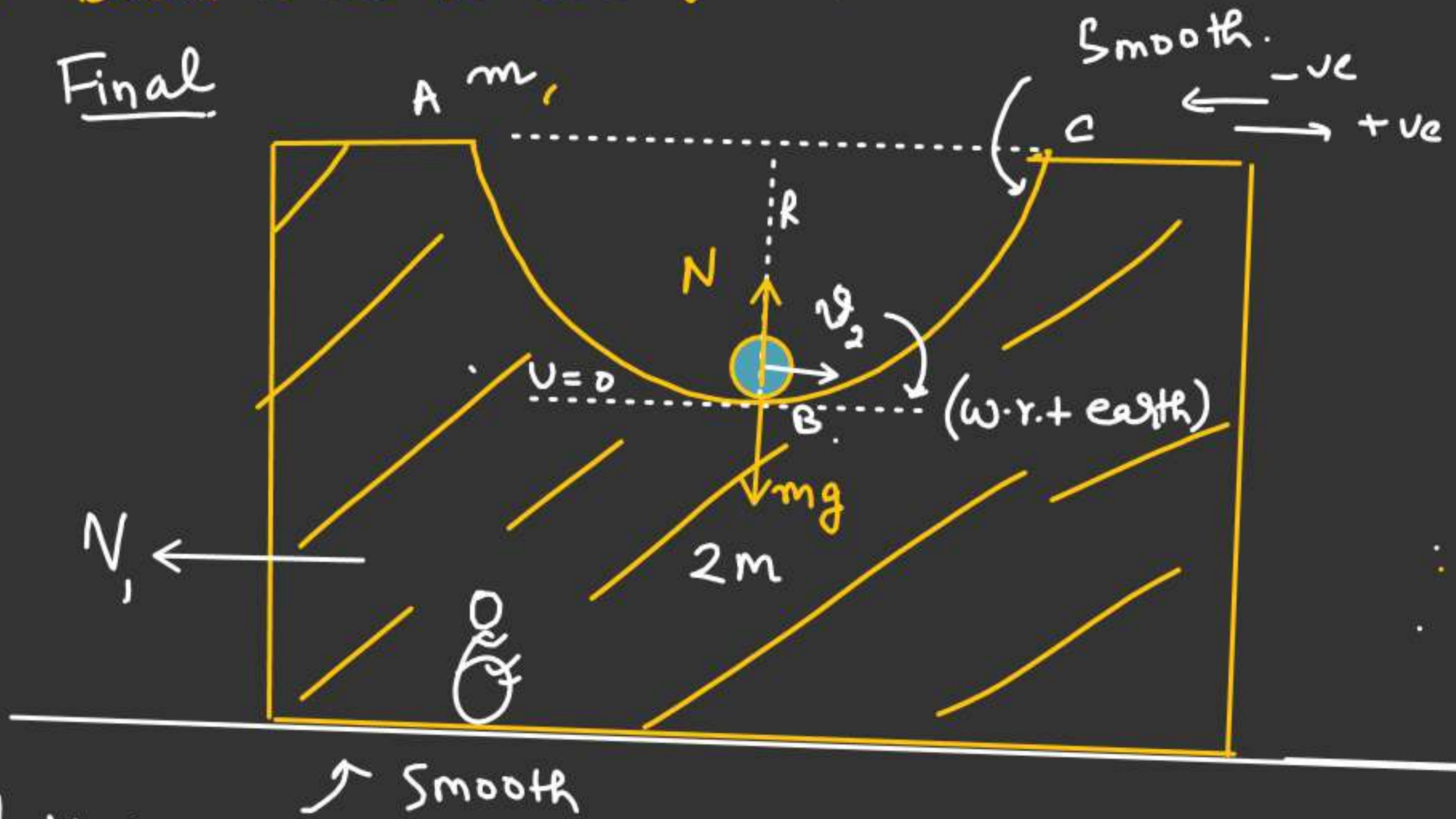
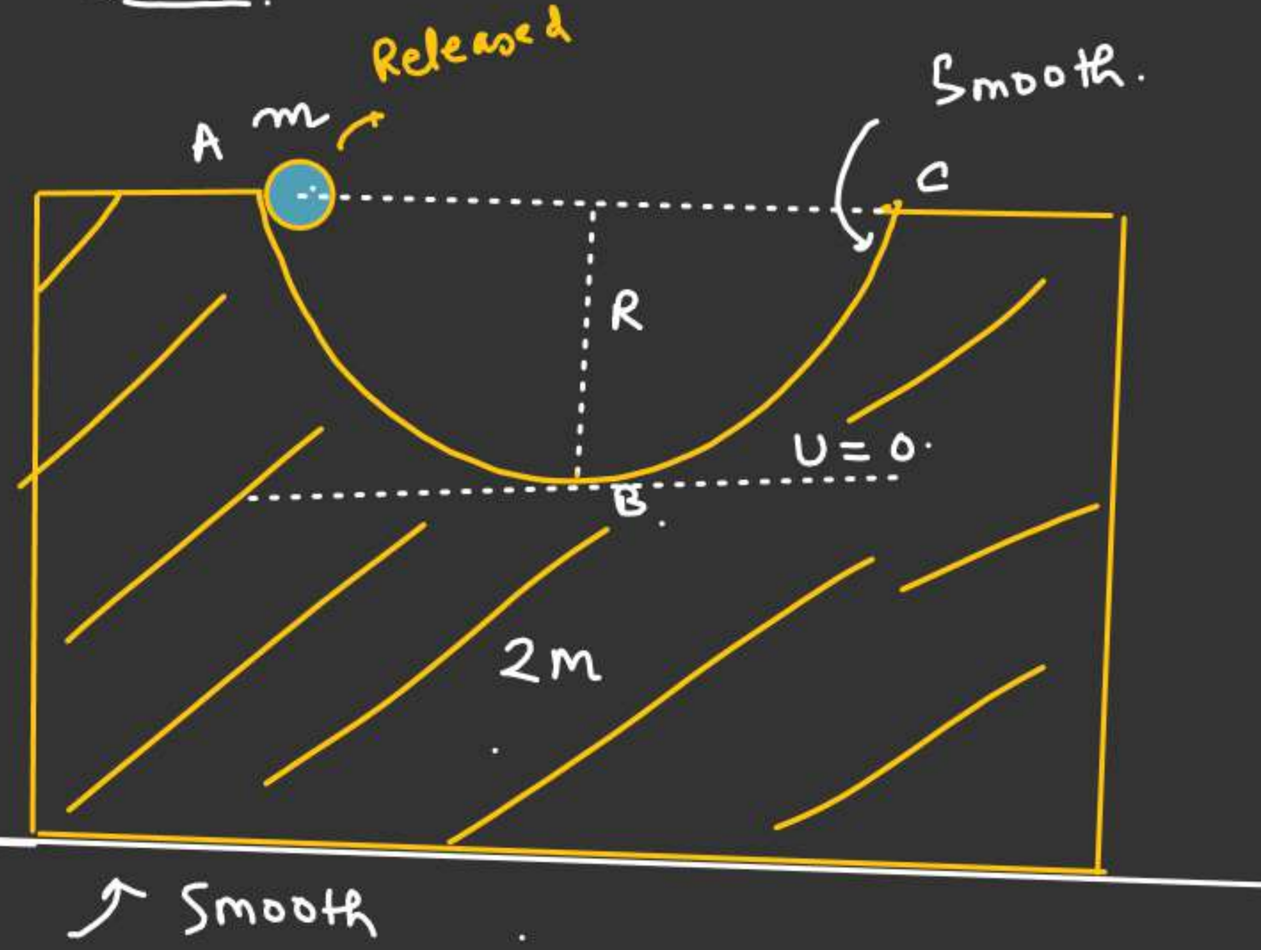
When ball reaches at B.
find velocity of wedge.
Also find the Normal reaction acting on ball due to wedge at B.

Final



Initial



L.M.C in x-direction

$$0 = mv_2 - 2mv_1$$

$$2v_1 = v_2 \quad -(1)$$

$v_r =$

$$\vec{v}_{ball/E} = \vec{v}_{ball/wedge} + \vec{v}_{wedge/E}$$

$$= (v_r - v_1)$$

$$\parallel$$

$$v_2$$

ENERGY CONSERVATION

$$mgR = \frac{1}{2} m v_2^2 + \frac{1}{2}(2m) v_1^2 \quad -(2)$$

From (1) $v_2 = 2v_1$ put in (2)

$$mgR = \frac{m}{2}(4v_1^2) + m v_1^2$$

$$\cancel{m}gR = 3\cancel{m}v_1^2$$

$$v_1 = \sqrt{\frac{gR}{3}}$$

Velocity of wedge.

$$v_2 = 2v_1 = \sqrt{\frac{4gR}{3}}.$$

velocity of ball

Normal reaction at B.

$$N - mg = \frac{m v_r^2}{R}$$

v_R = Relative velocity of ball w.r.t wedge.

$$v_2 = v_r - v_1$$

$$v_r = v_2 + v_1$$

$$v_r = 3v_1$$

$$= 3\sqrt{\frac{gR}{3}} = \sqrt{3gR}$$

$$N = mg + \frac{m}{R} \times (3gR)$$

$$N = 4mg$$ Ans

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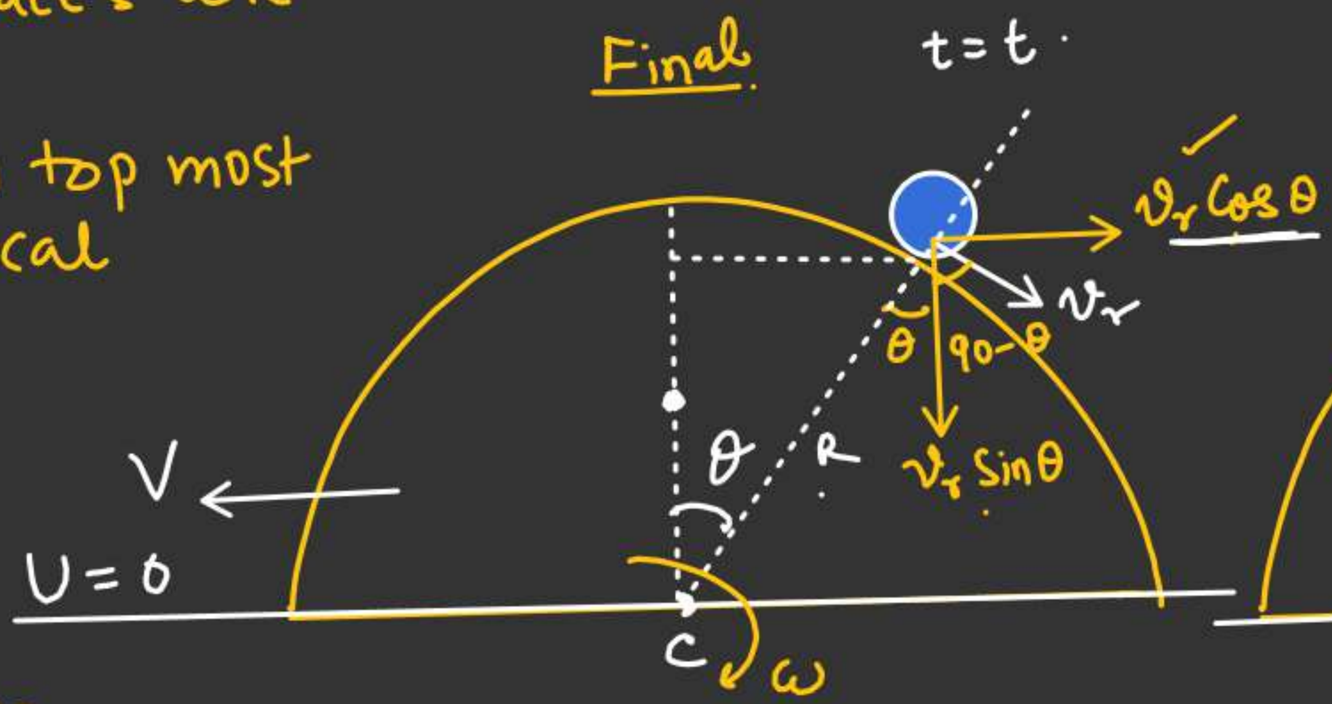
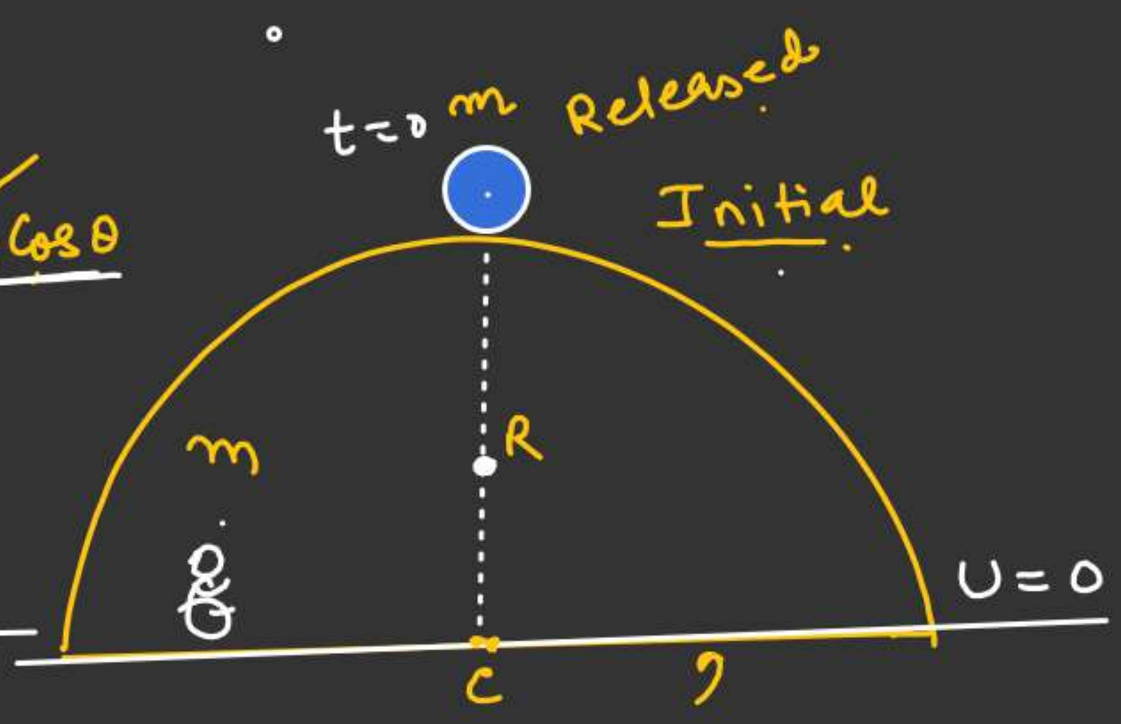
All Contact Surfaces are Smooth.
Ball is released from top most-point of hemispherical wedge. Find angular velocity of ball when it makes an angle θ from vertical w.r.t Center of hemisphere.





w.r.t center of hemispher. ball is in circular Motion.

$$v_r = R\omega$$

$$\omega = \left(\frac{v_r}{R}\right) \checkmark \quad —① $$

(L.M.C in x-direction)

$$(p_{i})_x = (p_f)_x$$

$$0 = m(v_r\cos\theta - V) - mV$$

$$v_r = \left(\frac{2V}{\cos\theta}\right) \checkmark \quad —②$$

$$\vec{v}_{ball/E} = \vec{v}_{ball/wedge} + \vec{v}_{wedge/E}$$

$$= v_r\cos\theta\,\hat{i} - v_r\sin\theta\,\hat{j} - V\hat{i}$$

$$= (v_r\cos\theta - V)\hat{i} - (v_r\sin\theta)\hat{j}$$

From ① & ②

$$\left(\omega = \frac{2V}{R\cos\theta}\right)$$

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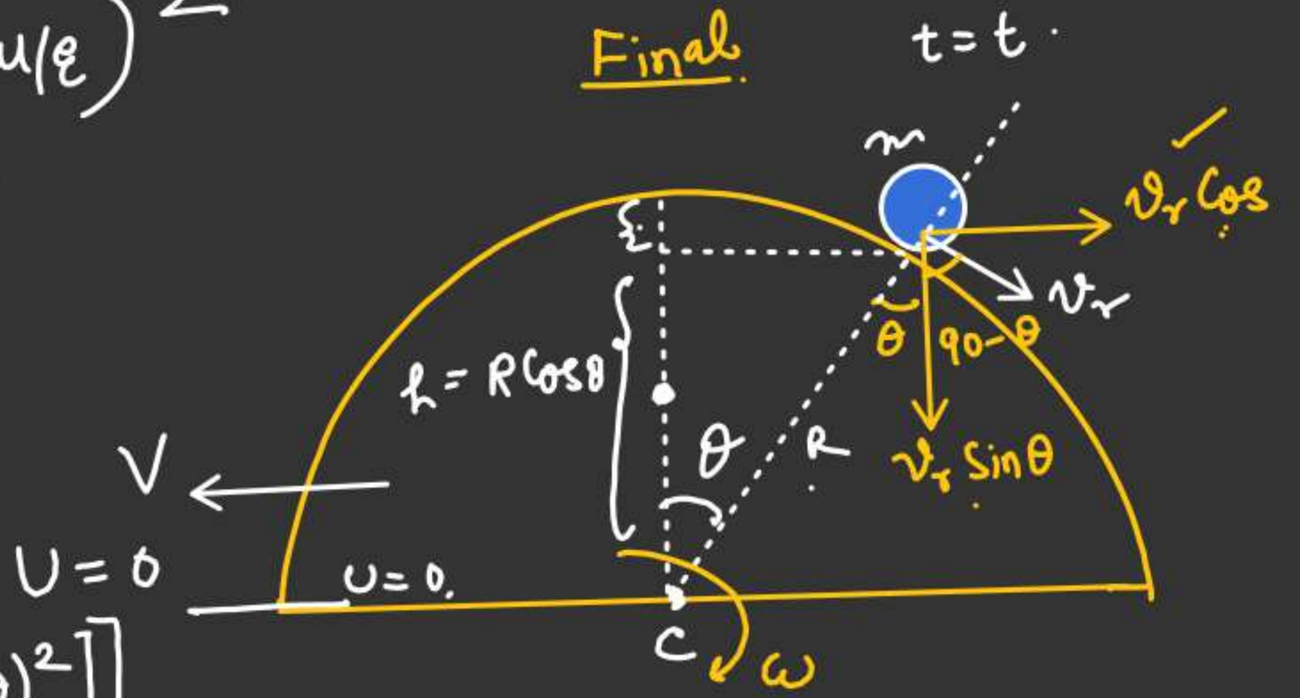
$$mgR = mgR\cos\theta + \frac{1}{2}mV^2 + \frac{1}{2}m\left(v_{ball/E}\right)^2$$



$$\left[mgR(1-\cos\theta) = \frac{1}{2}mV^2 + \frac{1}{2}m\left[(v_r\cos\theta - V)^2 + (v_r\sin\theta)^2\right]\right]$$

$$\vec{v}_{ball/E} = \vec{v}_{ball/wedge} + \vec{v}_{wedge/E}$$

$$= v_r\cos\theta\,\hat{i} - v_r\sin\theta\,\hat{j} - V\hat{i}$$

$$= (v_r\cos\theta - V)\hat{i} - (v_r\sin\theta)\hat{j}$$

$$\underbrace{|\vec{v}_{ball/E}|}_{\text{Speed}} = \sqrt{(v_r\cos\theta - V)^2 + (v_r\sin\theta)^2}$$

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H.C.V Page-No – (159 → 160)

Q.No 1 to Q.No – 14

Q – 19 ✓

Q – 29

Q – 54

Q – 60

Q – 61