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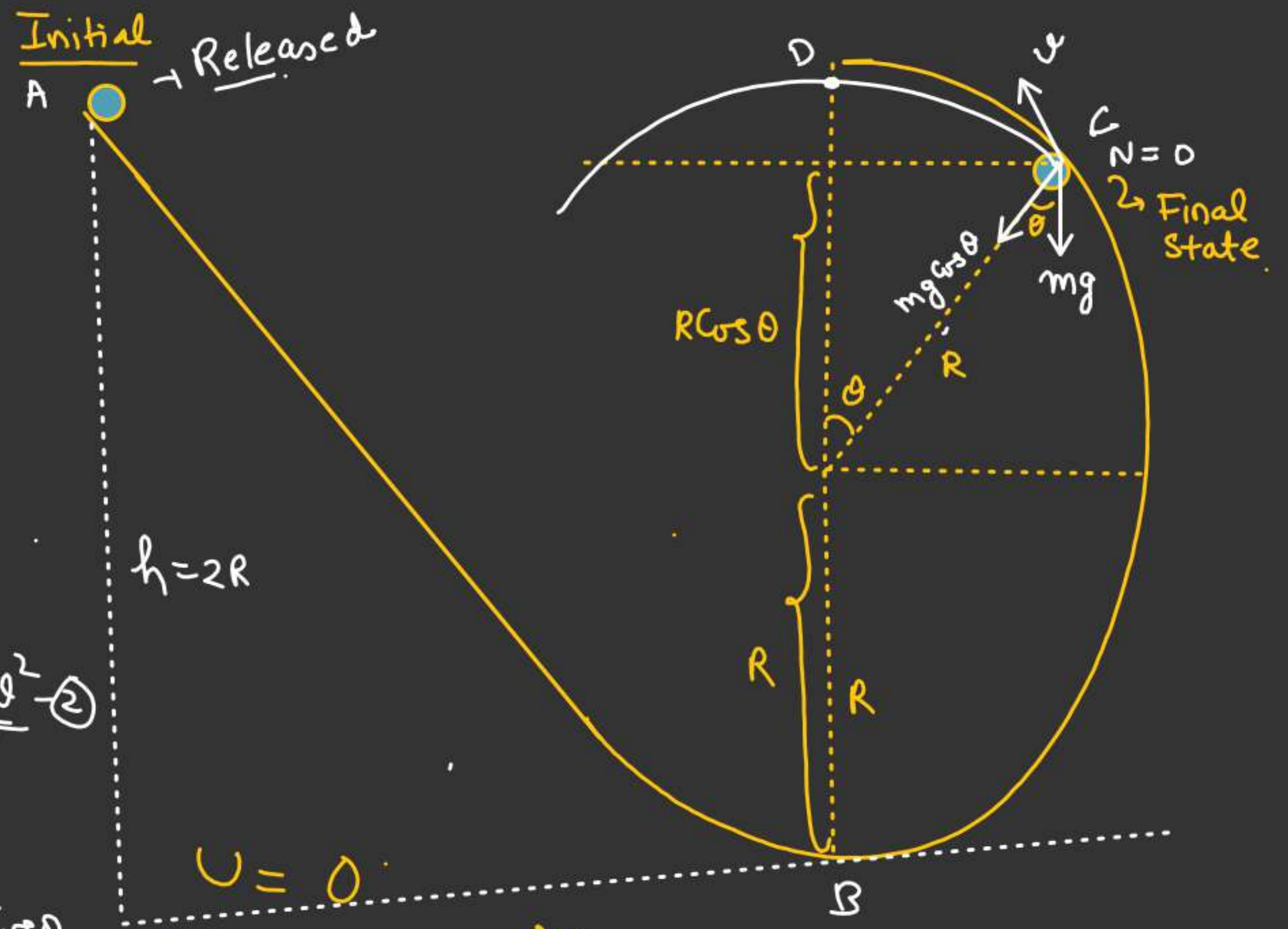
W.P.E (VERTICAL CIRCULAR MOTION)

Here $h < h_{min}$

ie $h < \frac{5R}{2}$, so ball losses contact somewhere b/w BC.



① Angle from vertical where particle looses contact

$N = 0$ $\quad mg\cos\theta = \frac{mv^2}{R}$ — ①

Energy Conservation from A to C

$U_i + K.E_i = U_f + K.E_f$

$mg2R + 0 = mgR(1+\cos\theta) + \frac{1}{2}mv^2$ — ②

From ①

$mv^2 = mgR\cos\theta$ put in ②

$mg2R = mgR + mgR\cos\theta + \frac{mgR\cos\theta}{2}$

$mgR = \frac{3}{2}mgR\cos\theta \Rightarrow \cos\theta = \frac{2}{3}$

$\boxed{\theta = \cos^{-1}\left(\frac{2}{3}\right)}$

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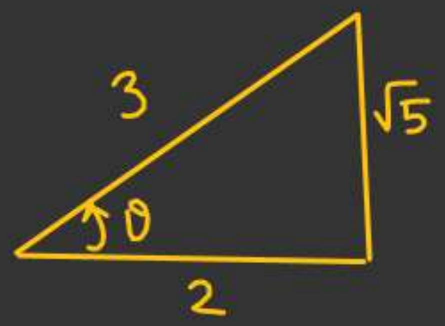
W.P.E (VERTICAL CIRCULAR MOTION)

(b) Maximum height attained by ball from ground.

$$h_{max} = \frac{v^2 \sin^2\theta}{2g} \qquad v = \sqrt{gR\cos\theta}$$

$$= \frac{\cancel{g}R\cos\theta \cdot \sin^2\theta}{2\cancel{g}} = \frac{R}{2}\cos\theta \cdot \sin^2\theta$$



$$\cos\theta = \frac{2}{3}$$

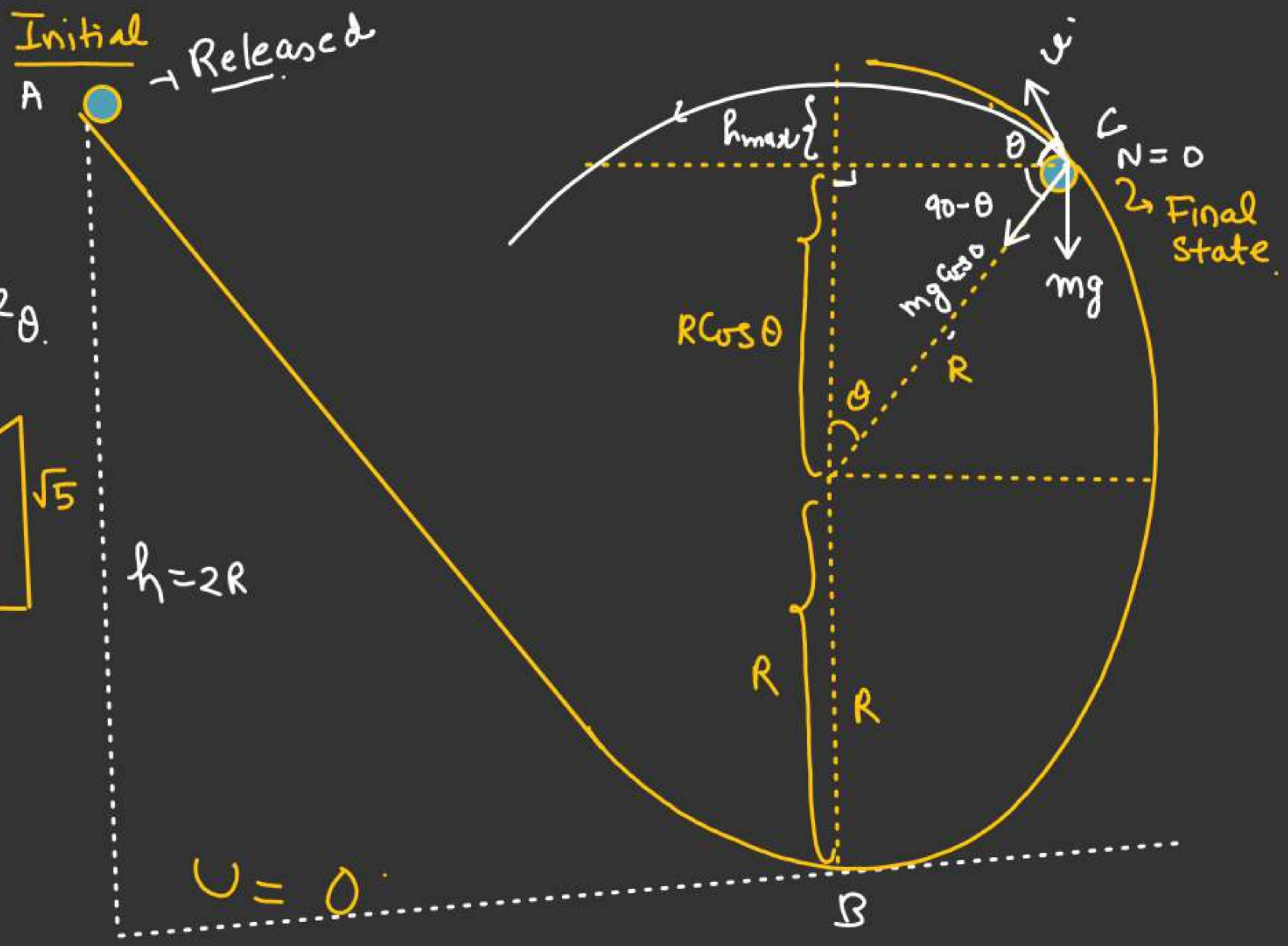
$$h_{max} = \frac{R}{\cancel{2}} \times \frac{\cancel{2}}{3} \times \frac{5}{9} = \left(\frac{5R}{27}\right)$$

H_{max} from the ground

$$= R + R\cos\theta + h_{max}$$

$$= R + \frac{2R}{3} + \frac{5R}{27}$$

$$= \frac{27R + 18R + 5R}{27} = \frac{50R}{27} \text{ Ans.}$$



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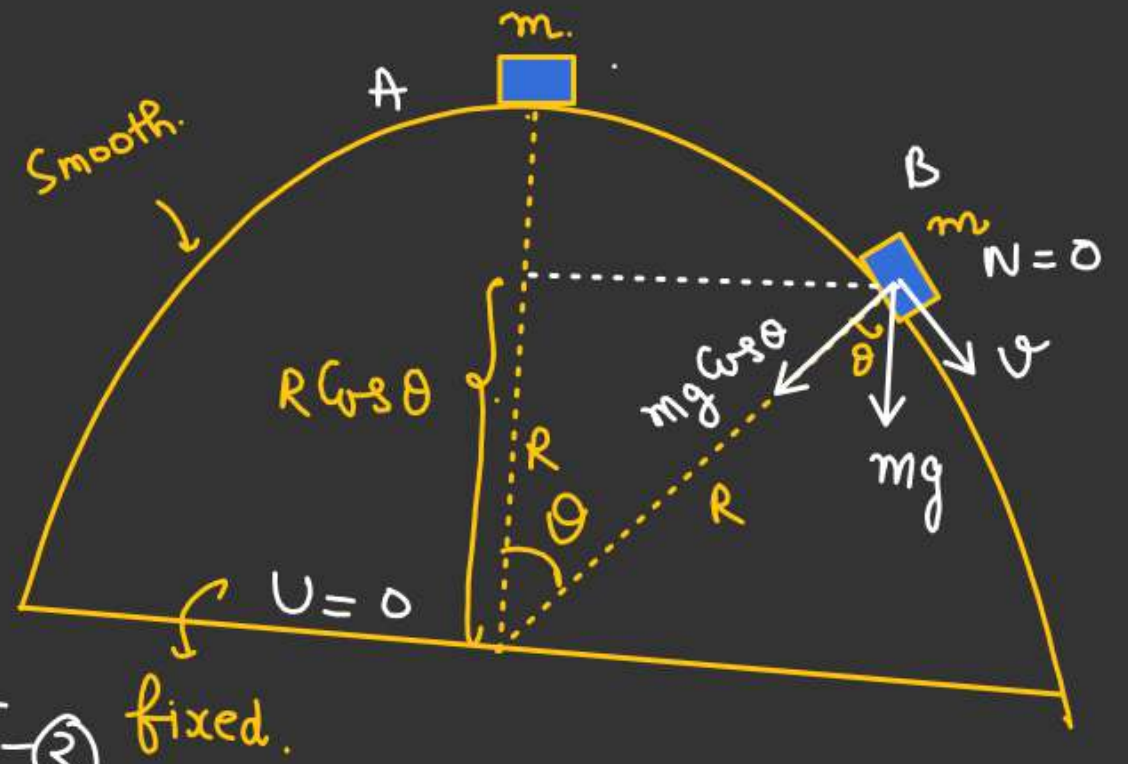
W.P.E (VERTICAL CIRCULAR MOTION)

Motion of block on a Spherical wedge

Block is slightly displaced and released. Find the angle from vertical where block looses contact.



$$mg\cos\theta = \frac{mv^2}{R} \quad -①$$

A to B Energy Conservation

$$U_i + K.E_i = U_f + K.E_f$$

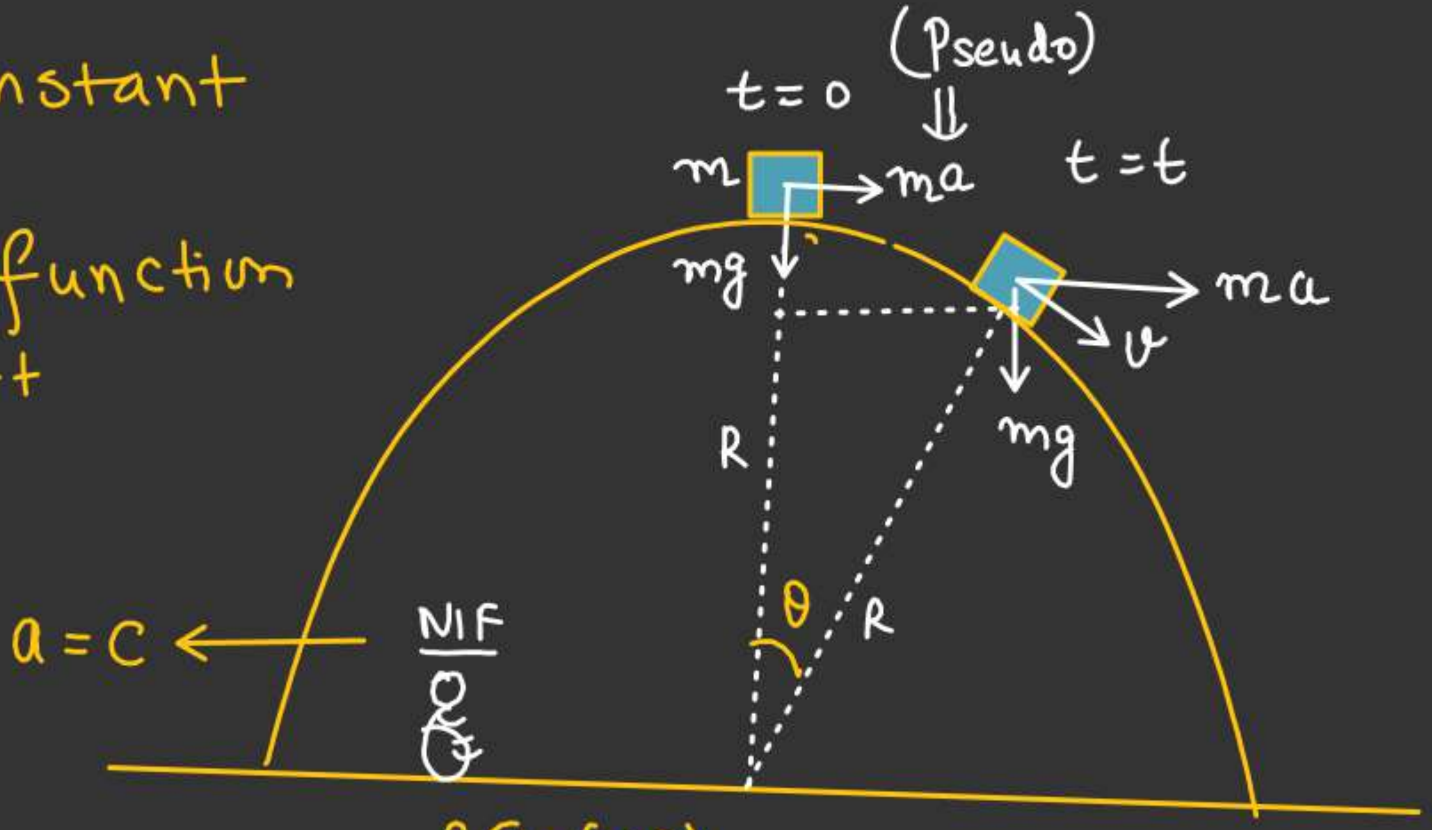
$$mgR + 0 = mgR\cos\theta + \frac{1}{2}mv^2 \quad -②$$

$$\cos\theta = \frac{2}{3}$$

$$\boxed{\theta = \cos^{-1}\left(\frac{2}{3}\right)}$$

W.P.E (VERTICAL CIRCULAR MOTION)

☆☆ Wedge acclerated with constant accleration $a\ m/s^2$ at $t=0$. Find velocity of block as a function of θ. (θ from vertical) w.r.t Wedge.



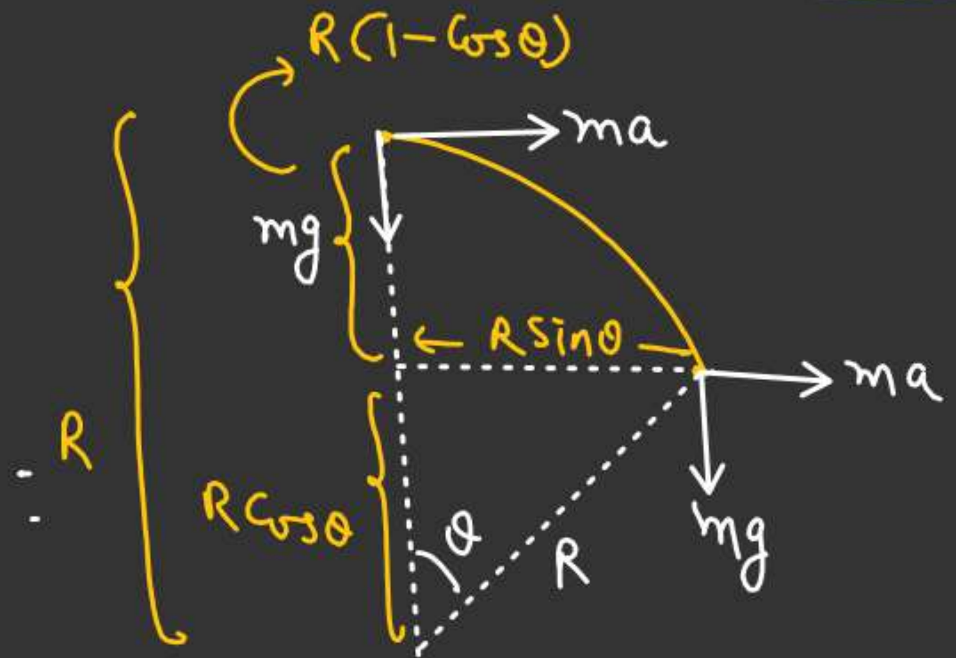
By work-Energy theorem

$$W_{mg} + W_{pseudo} + \cancel{W_N}^{\,0} = \Delta K.E$$

(Internal force)

$$mgR(1-\cos\theta) + maR\sin\theta = \frac{1}{2}mv^2$$

$$\sqrt{2gR(1-\cos\theta) + 2aR\sin\theta} = v.$$



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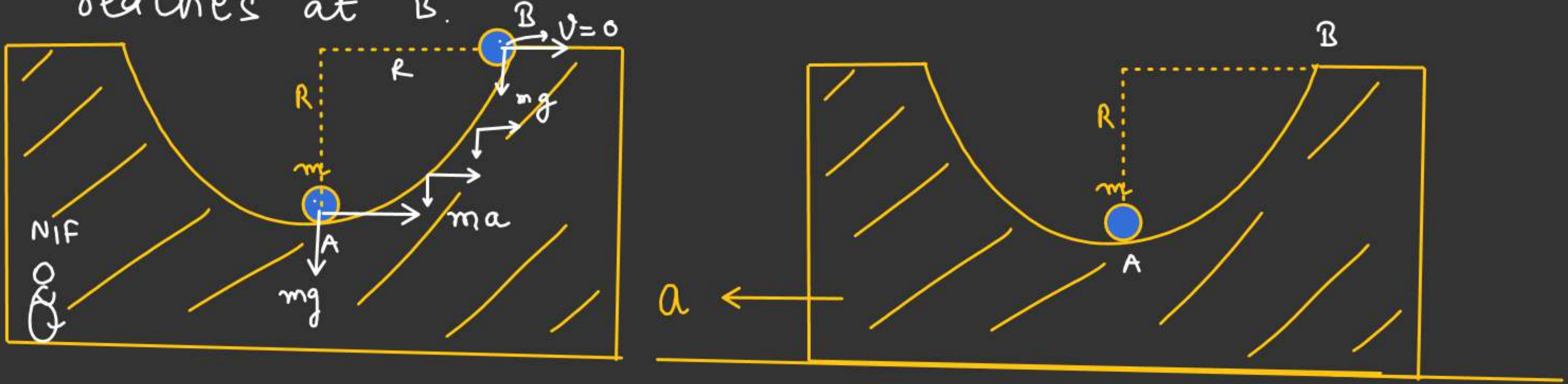
W.P.E (VERTICAL CIRCULAR MOTION)

★★

Find a_{min} So that ball just reaches at B.

$v = 0$



By work- Energy theorem.

$$W_{pseudo} + W_{gravity} = \Delta \cancel{K.E}$$

$$maR - mgR = 0.$$

$$\boxed{a = g}$$

0

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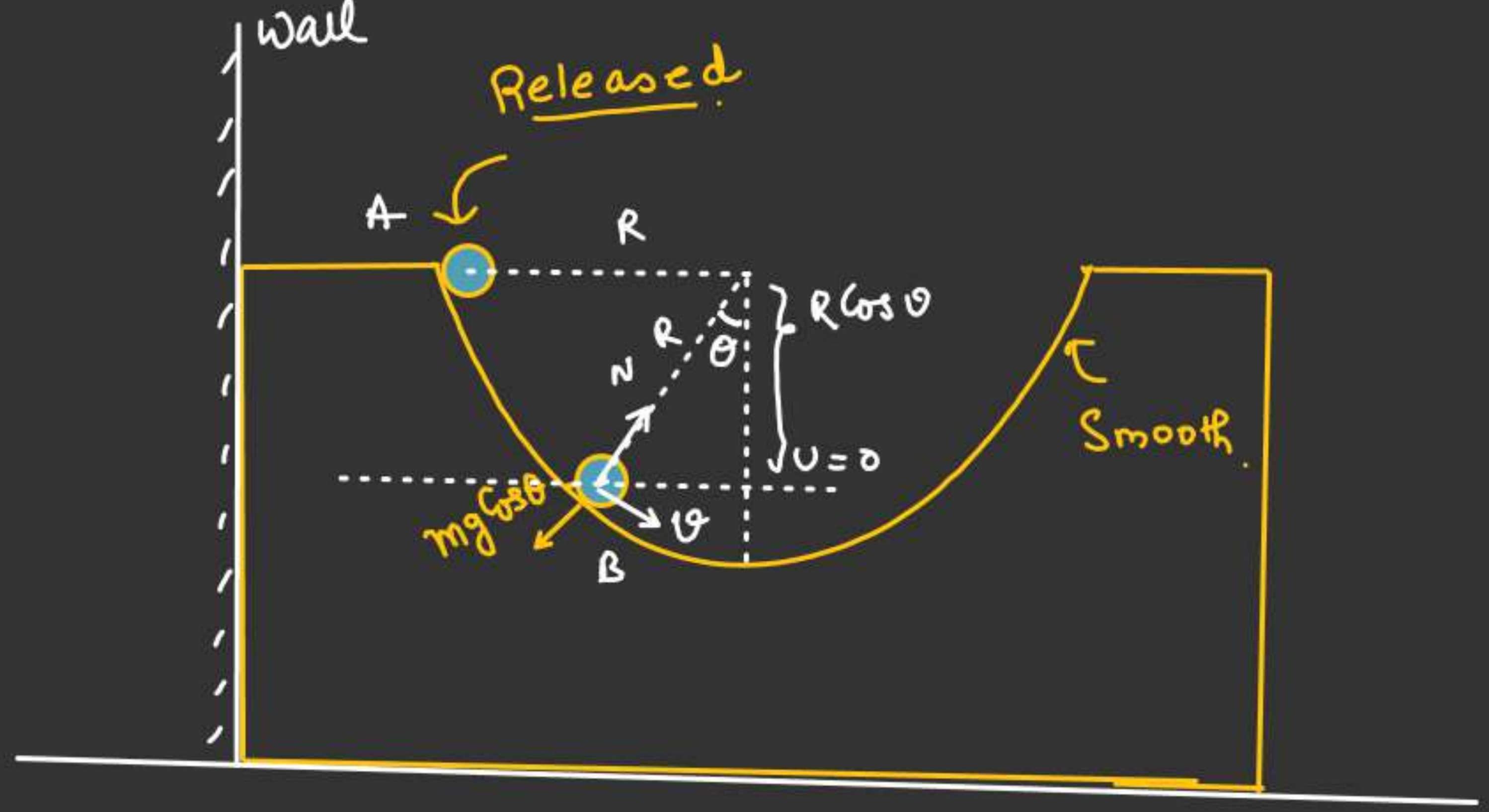
W.P.E (VERTICAL CIRCULAR MOTION)

★★: Normal reaction exerted by wall on the wedge when ball is at an angle θ from vertical.



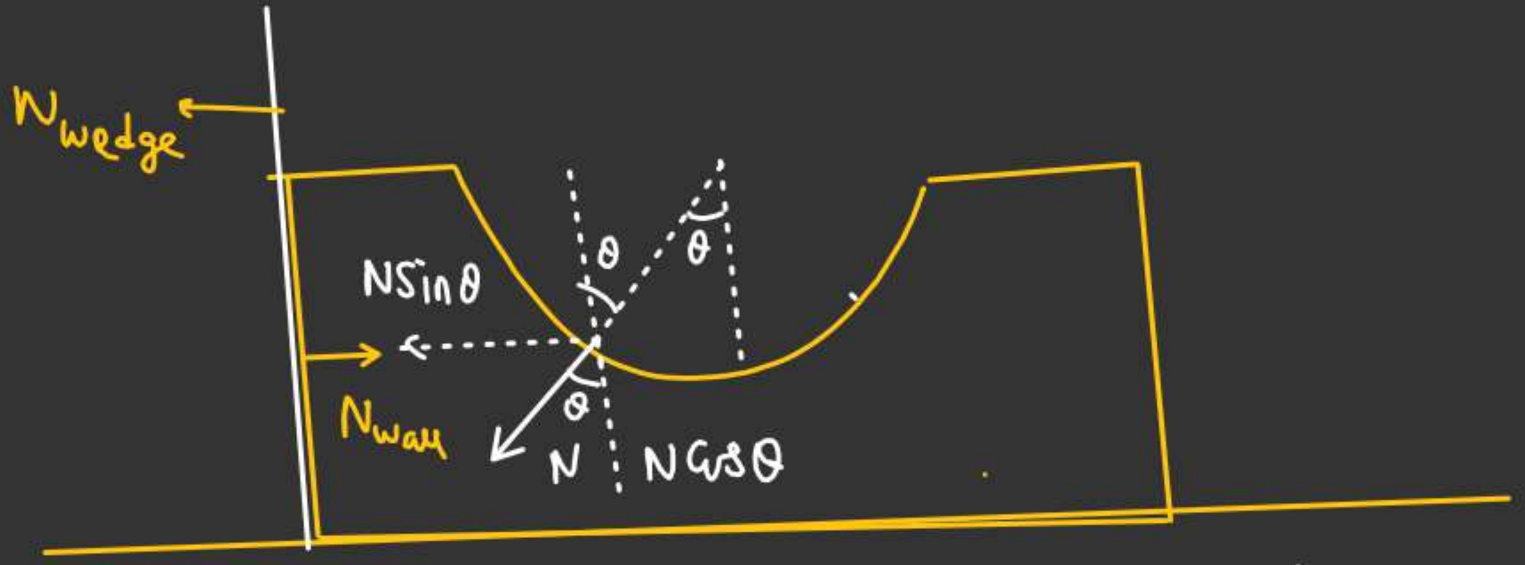
$$N - mg\cos\theta = \frac{mv^2}{R}$$

Energ Conservation.

$$mgR\cos\theta = \frac{1}{2}mv^2$$

$$mv^2 = 2mgR\cos\theta$$

$$\boxed{N = 3mg\cos\theta}$$



$$N_{wall} = N\sin\theta$$

$$= 3mg\cos\theta . \sin\theta$$

$$= \frac{3}{2}mg\,(2\sin\theta\cos\theta) = \frac{3}{2}(mg\sin 2\theta)$$

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W.P.E (VERTICAL CIRCULAR MOTION)

Case of String-bob

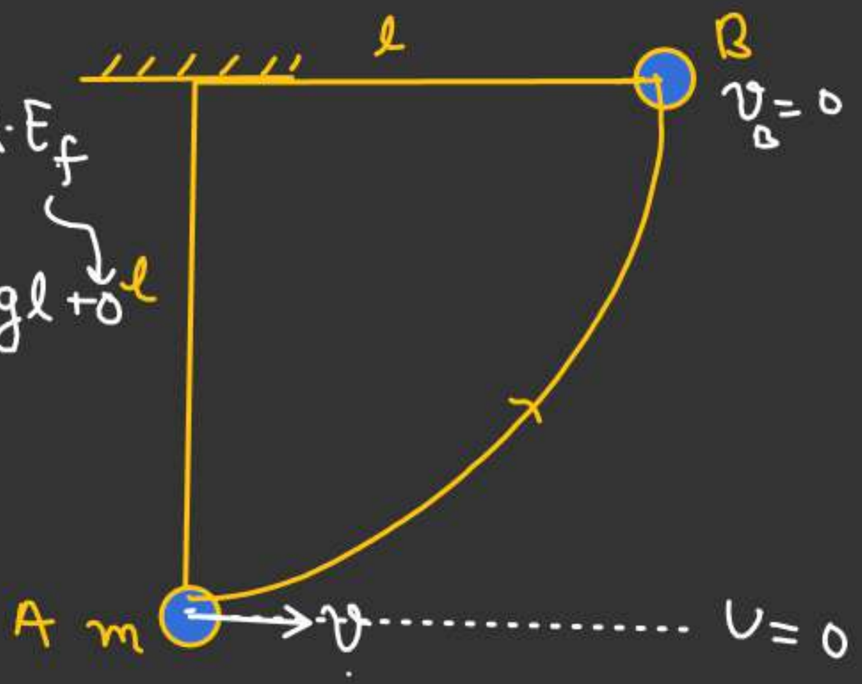
Case-1 :- v_{min} so that bob just become horizontal

For v_{min}, bob just become hortizontal and for this.
$v_B = 0$.

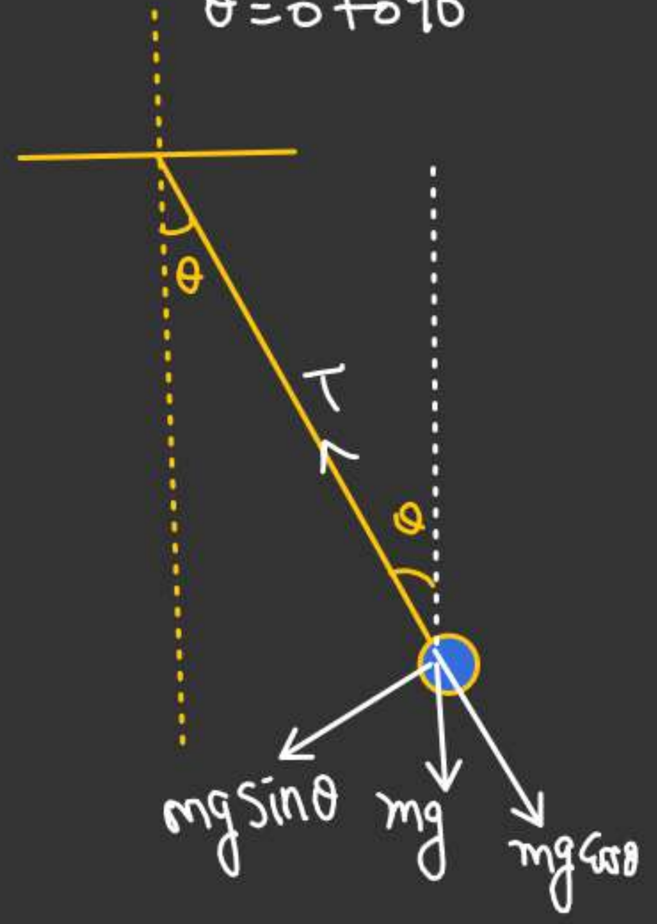
$$U_i + K.E_i = U_f + K.E_f$$
$$0 + \frac{1}{2}mv_{min}^2 = mgl + 0$$

$$\frac{1}{2}mv_{min}^2 = mgl$$

$$\boxed{V_{min} = \sqrt{2gl}}$$



T never zero b/w $\theta = 0$ to $90°$



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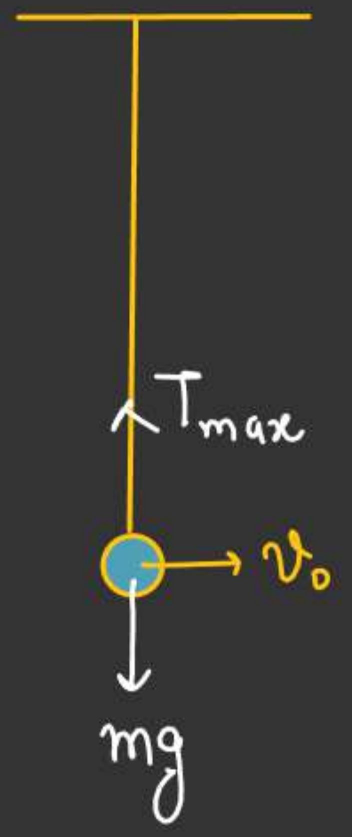
W.P.E (VERTICAL CIRCULAR MOTION)

$0 < \theta < \pi/2$, $v_0 = \sqrt{2gl}$

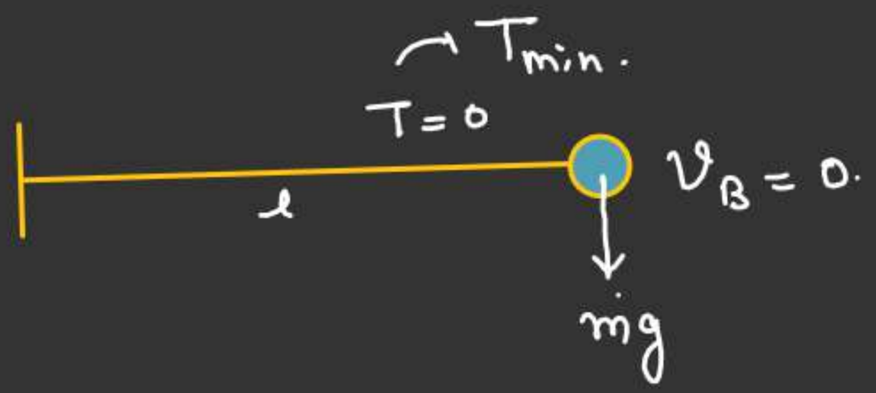
$T = ??$



$$T_{max} - mg = \frac{mv_0^2}{l}$$

$$T_{max} = mg + \frac{m}{l}(2gl)$$

$$\boxed{T_{max} = 3mg.}$$



For $v_0 = \sqrt{2gl}$.

$$\boxed{0 \leq T \leq 3mg.}$$

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W.P.E (VERTICAL CIRCULAR MOTION)

Case-2 v_{min} to just Complete the vertical circle.

For bob to Complete the Circle velocity of bob at highest point be non-zero

$$T + mg = \frac{mv_1^2}{l} \quad - (1)$$

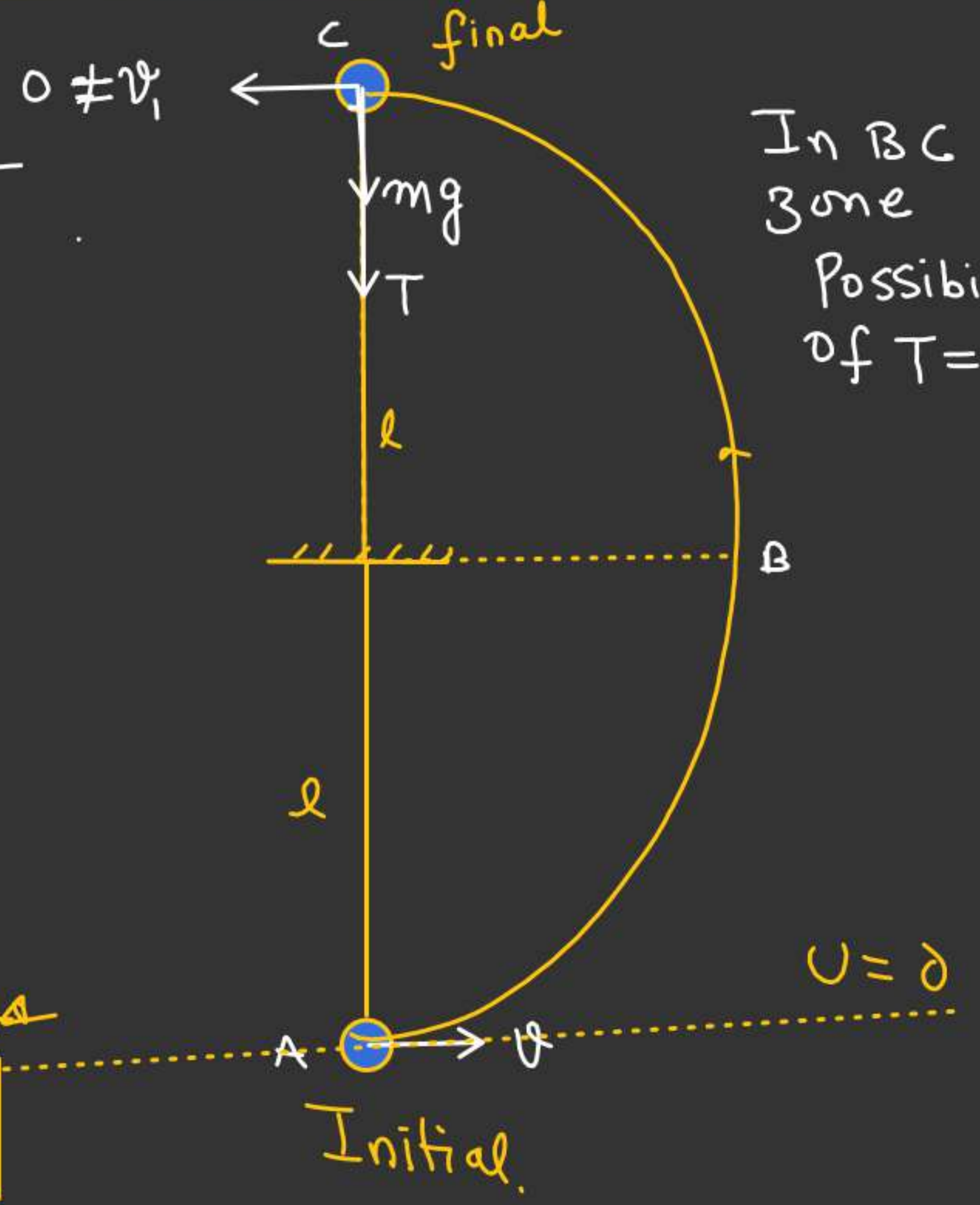
Energy Conservation from A to C.

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_1^2 + mg\,2l \quad - (2)$$

For $v \to$ Min $\Rightarrow v_1$ should be min.

& For $(v_1)_{min}$ $T = 0$

$$mv_1^2 = (mgl) \Rightarrow \boxed{v_{min} = \sqrt{5gl}}$$



In BC zone Possibility of T = 0.

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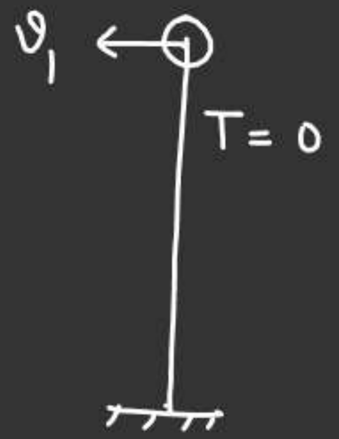
W.P.E (VERTICAL CIRCULAR MOTION)

Range of T for $v_0 = \sqrt{5gl}$. $\longrightarrow$ Range of T

At Lowest point T_{max}



$\Rightarrow$ $\boxed{0 \leq T \leq 6mg.}$

$$T_{max} - mg = \frac{m(5gl)}{l}$$

$$T_{max} = 6mg.$$