DPP – 5 (WEP)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/75

Video Solution on YouTube:- https://youtu.be/DdX4khMXWMw

Written Solutionon Website:- https://physicsaholics.com/note/notesDetalis/77

Q 1. A ring of radius R lies in vertical plane. A bead of mass 'm' can move along the ring without friction. Initially the bead is at rest at the bottom most point on ring. The minimum constant horizontal speed v with which the ring must be pulled such that the bead completes the vertical circle

(a) $\sqrt{3gR}$ (b) $\sqrt{4gR}$ (c) $\sqrt{5gR}$ (d) $\sqrt{5.5gR}$

Q 2. A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break

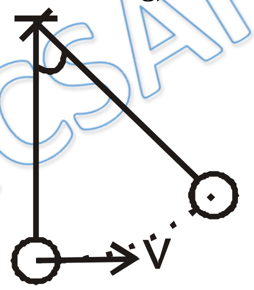
(a)When the mass is at the highest point of the circle

(b) When the mass is at the lowest point of the circle

(c) When the wire is horizontal

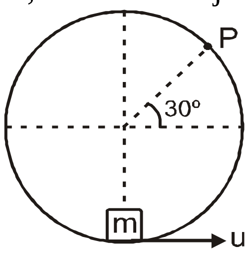
(d) At an angle of $\cos^{-1}$ (1/3) from the upward vertical

Q 3. As shown in the given figure the ball is given sufficient velocity at the lowest point to complete the circle. Length of string is 1m. Find the tension in the string, when it is at 60° with vertical position. (Mass of ball = 5kg)



(a) 160 N (b) 180 N (c) 200 N (d) 225 N

Q 4. A horizontal cylinder is fixed, its inner surface is smooth and its radius is R. A small block is initially at the lowest point. the minimum velocity that should by given to the block at the lowest point, so that it can just cross the point P is u then



(a) If the block moves anti clockwise then u = $\sqrt{3.5gR}$

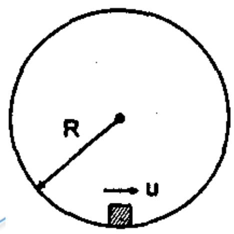
(b) If the block moves anti clockwise then u = $\sqrt{3gR}$

(c) If the block moves clockwise then u = $\sqrt{3.5gR}$
(d) If the block moves clockwise then u = $\sqrt{5gR}$

Q 5. A ball of mass m is attached to one end of a light rod of length l, the other end of which is hinged. What minimum velocity u should be imparted to the ball downwards, so that it can complete the circle?

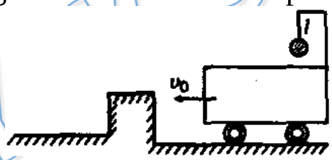
(a) $\sqrt{gl}$ (b) $\sqrt{5gl}$ (c) $\sqrt{3gl}$ (d) $\sqrt{2gl}$

Q 6. A particle is given an initial speed is inside a smooth spherical shell of radius R =1 so that it is just able to complete the circle. Acceleration of the particle when its velocity is vertical is:



(a) $g\sqrt{10}$ (b) g (c) $g\sqrt{2}$ (d) 3g

Q 7. A bob is suspended from a crane by a cable of length l = 5m. The crane and load are moving at a constant speed v_0. The crane is stopped by a bumper and the bob on the cable swings out an angle of 60°. The initial speed v_0 is: (g = 9.8 m/s^2)

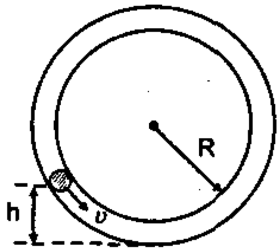


(a) 10 m/s (b) 7 m/s (c) 4 m/s (d) 2 m/s

Q 8. A particle suspended from a fixed point, by a light inextensible thread of length L is projected horizontally from its lowest position with velocity $\sqrt{7gL/2}$. The string will slack after swinging through an angle θ, such that θ equals:
(a) 30° (b) 135° (c) 120° (d) 150°

Q 9. A pendulum of mass 1 kg and length l = 1 m is released from rest at angle θ = 60° The power delivered by all the forces acting on the bob at angle θ = 30° will be (g = 10 m/s^2)
(a) 13.4 W (b) 20.4 W (c) 24.6 W (d) zero

Q 10. With what minimum speed V must a small ball should be pushed inside a smooth vertical tube from a height h so that it may reach the top of the tube? Radius of the tube is R:

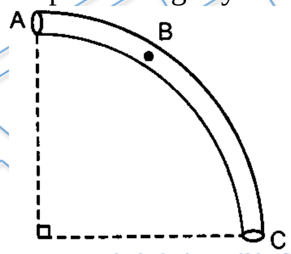


(a) $\sqrt{2g(h+2R)}$
(b) $\frac{5}{2}$R
(c) $\sqrt{g(5R-2h)}$
(d) $\sqrt{2g(2R-h)}$

Q 11. A ball suspended by a thread swings in a vertical plane so that its acceleration in the extreme position and lowest position are equal. The angle θ of thread deflection in the extreme position will be:

(a) $\tan^{-1}(2)$ (b) $\tan^{-1}(\sqrt{2})$ (c) $\tan^{-1}\left(\frac{1}{2}\right)$ (d) $2\tan^{-1}\left(\frac{1}{2}\right)$

Q 12. The tube AC forms a quarter circle in a vertical plane. The ball B has an area of cross-section slightly smaller than that of the tube, and can move without friction through it. B is placed at A and displaced slightly. It will



(a) always be in contact with the inner wall of the tube
(b) always be in contact with the outer wall of the tube
(c) initially be in contact with the inner wall and later with outer wall
(d) initially be in contact with the outer wall and later with the inner wall

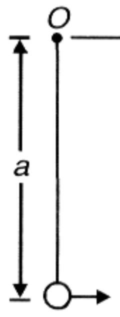
Q 13. A stone tied to a string of length L is whirled in a vertical circle, with the other end of the string at the center. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of the change in its velocity as it reaches a position where the string is horizontal is

(a) $\sqrt{u^2-2gL}$
(b) $\sqrt{2gL}$
(c) $\sqrt{u^2-gL}$
(d) $\sqrt{2(u^2-gL)}$

Q 14. A stone of mass 1 kg, tied to a string of length 2m is whirled in a vertical circle, with the other end of the string at the center. Velocity of stone at bottommost point is 20 m/Sec^2 . Difference in tension in string at topmost position to bottommost position is (g = 10 m/ Sec^2)

(a) 20 N
(b)30 N
(c)50 N
(d)60 N

Q 15. A particle is hanging from a fixed-point O by means of a string of length a. There is a small smooth nail O' in the same horizontal line with O at a distance b (< a) from O'. The minimum velocity with which particle should be projected from its lowest position in order that it may make a complete revolution round the nail without string becoming slack



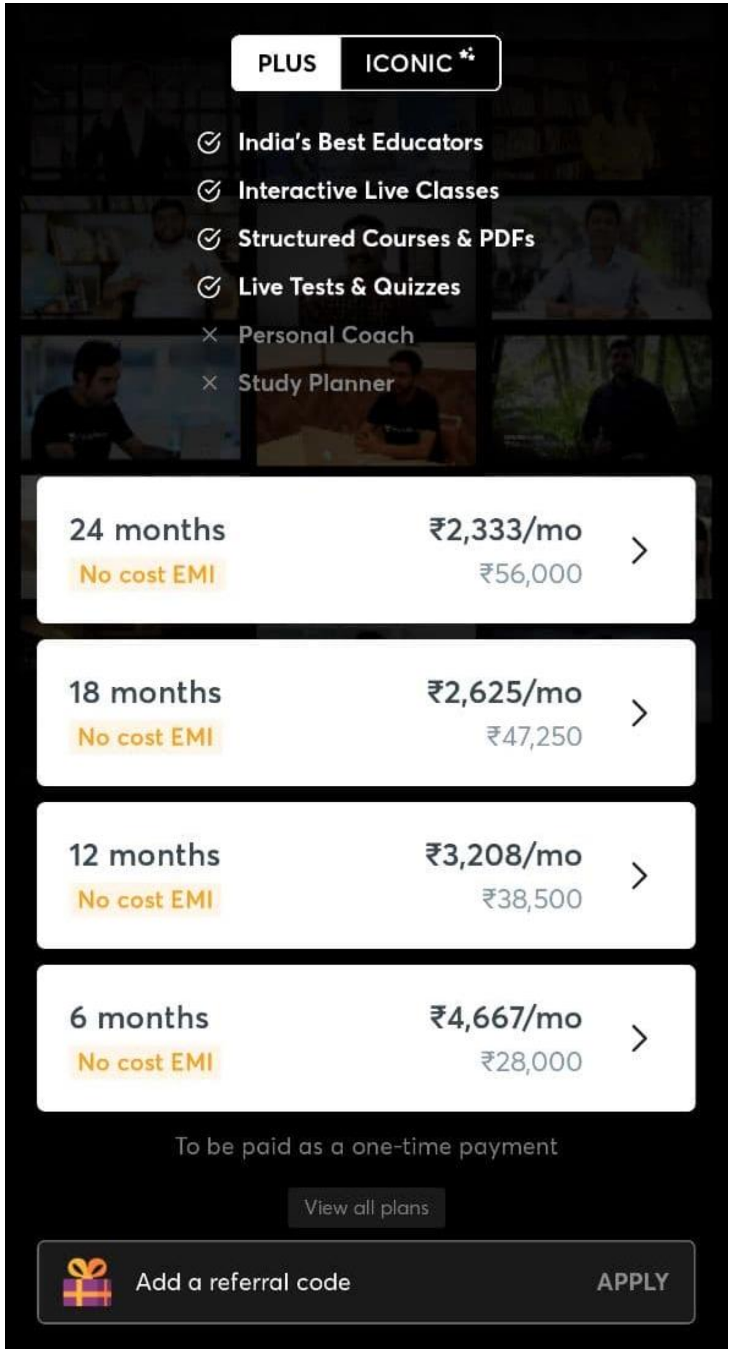
(a) $\sqrt{3ga}$ (b) $\sqrt{5ga}$

(c) $\sqrt{g(5a-3b)}$ (d) $\sqrt{g(5b-3a)}$

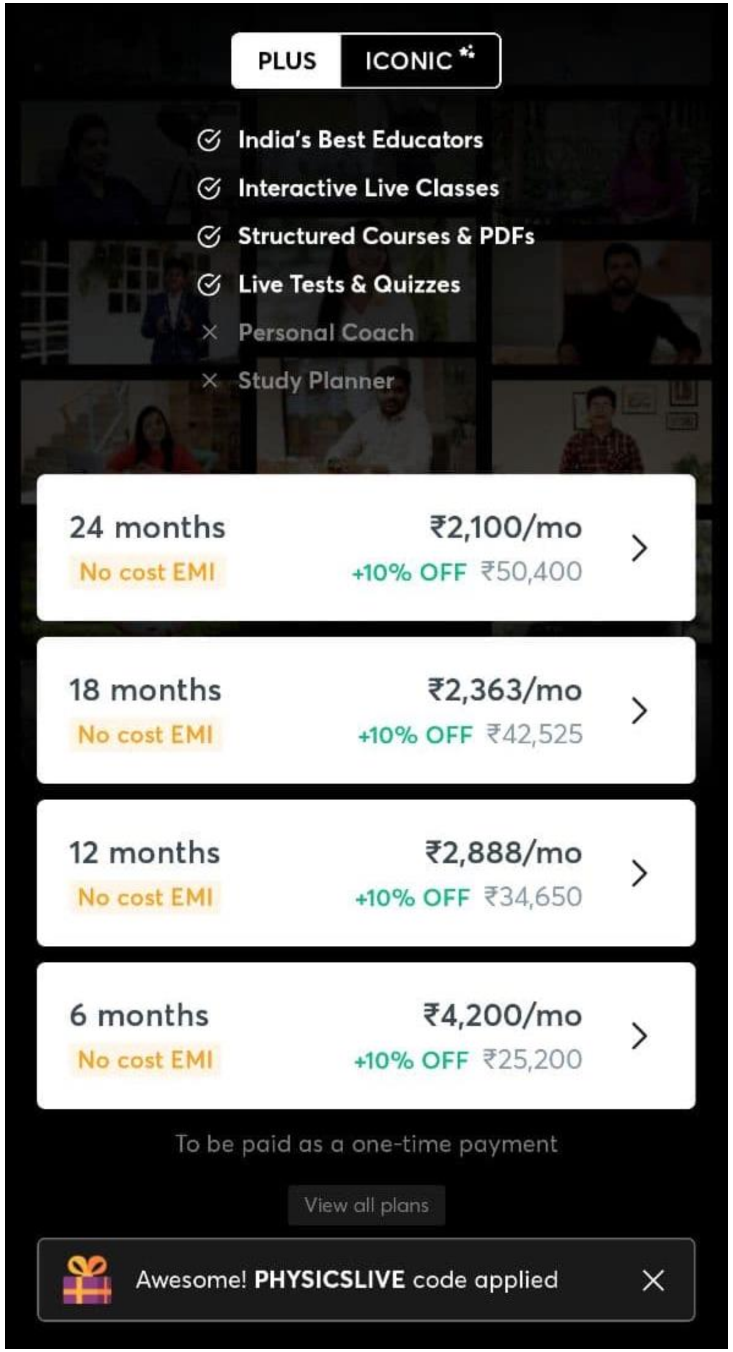
Answer Key

Q.1 b	Q.2 b	Q.3 d	Q.4 a, d	Q.5 d
Q.6 a	Q.7 b	Q.8 c	Q.9 a	Q.10 d

Q.11 d	**Q.12 c**	**Q.13 d**	**Q.14 d**	**Q.15 c**



PHYSICSLIVE



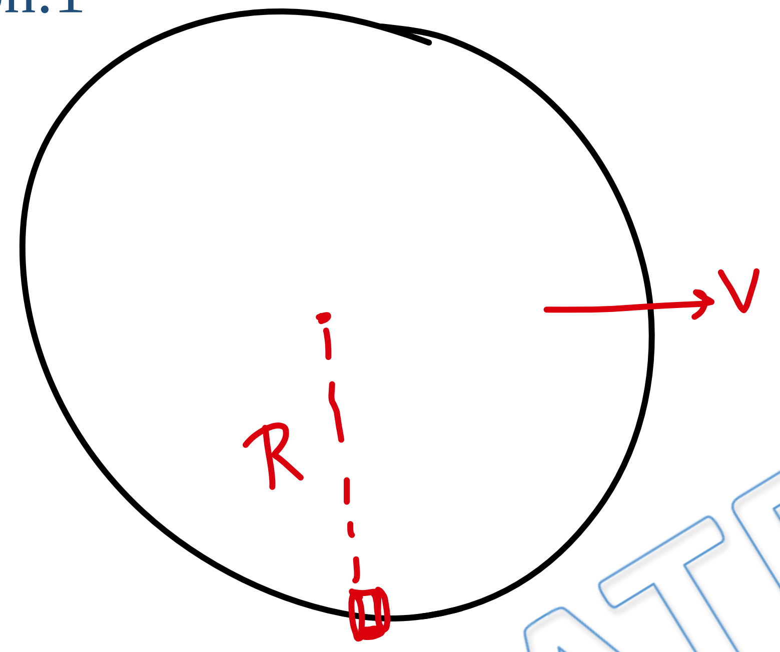
Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

Written Solution

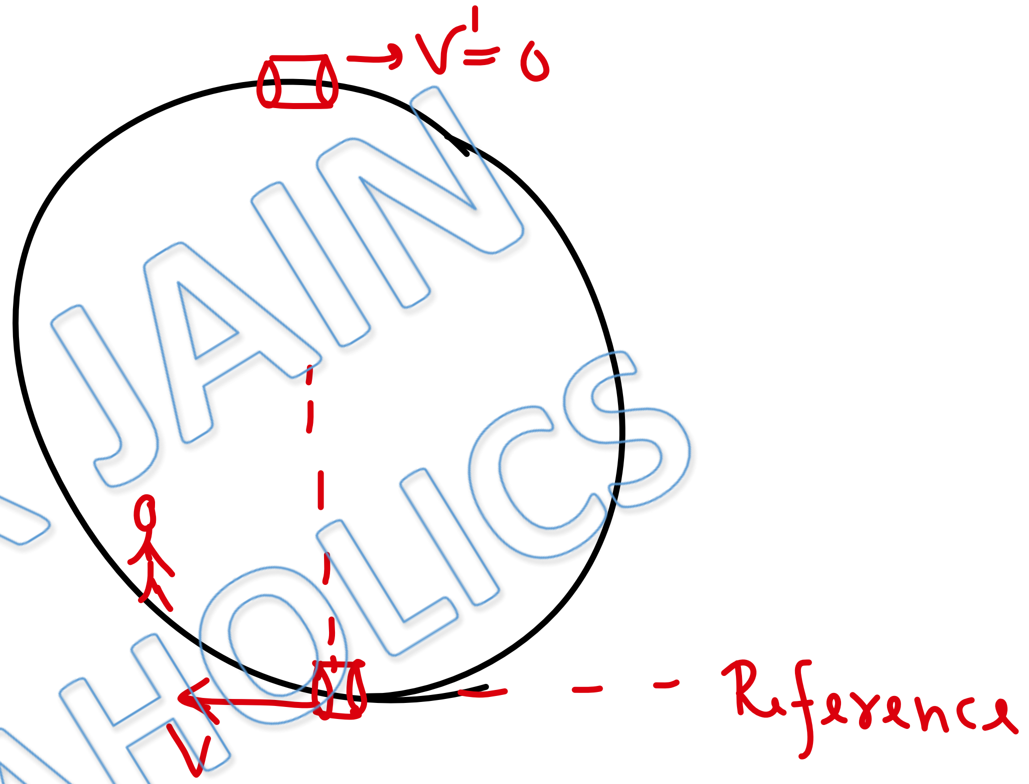
DPP- 5 Vertical circular motion

By Physicsaholics Team

Solution:1



w.r.t. Ring $\Rightarrow$



Ring is an inertial frame. We can use Conservation of mechanical energy from ring.

$$0+\frac{1}{2}mV^2 = 0 + 2mgR$$

$$\Rightarrow V = \sqrt{4gR}$$

Ans(b)

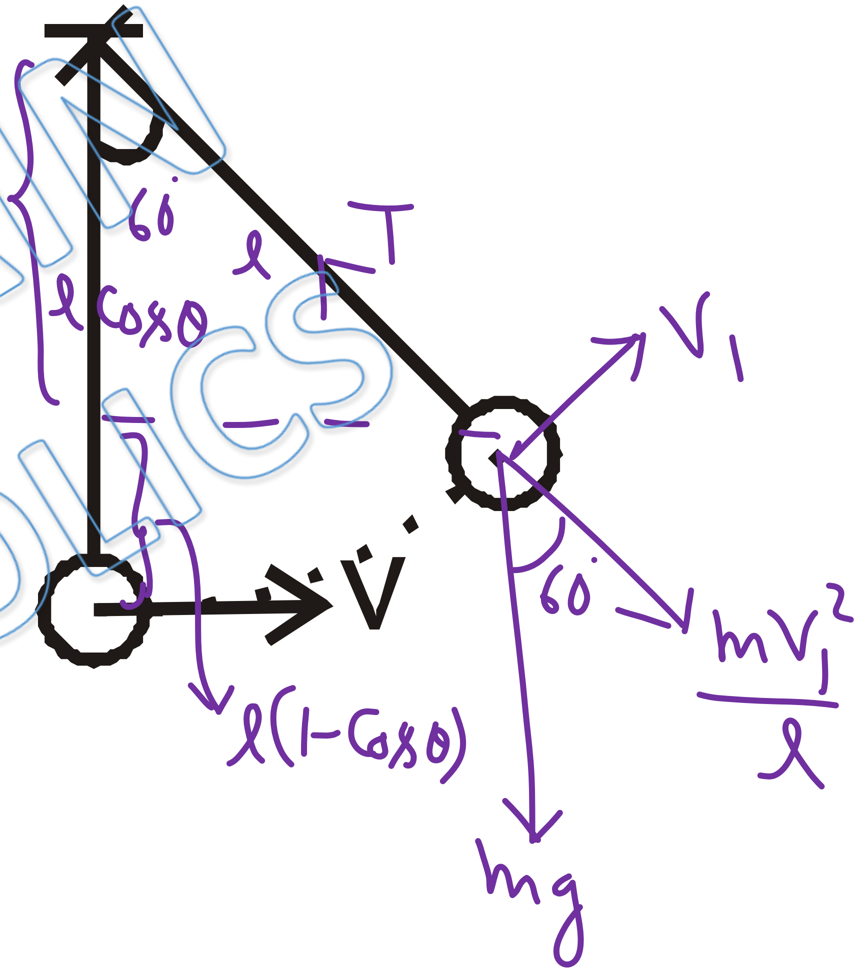
Solution:2

In vertical circular motion, tension is maximum at bottom most point. So wire is most likely to break at bottommost point.

Ans (b)

Solution:3

Velocity at bottommost point to Complete vertical circular motion $V = \sqrt{5gl}$



by Conservation of machenical energy →

$$\frac{1}{2}mv^2 + 0 = \frac{1}{2}mV_1^2 + mgl(1-\cos\theta)$$

$$\frac{5gl}{2} = \frac{V_1^2}{2} + gl\left(1-\frac{1}{2}\right)$$

$$V_1^2 = 4gl$$

now $T = \frac{mV_1^2}{l} + mg\cos 60° = \frac{4mgl}{l} + \frac{mg}{2} = 4.5mg = 225\,N$

ANS(d)

Solution:4

At point P →

$$\frac{mv^2}{R} = mg\cos 60^\circ \quad (\text{as } N=0)$$

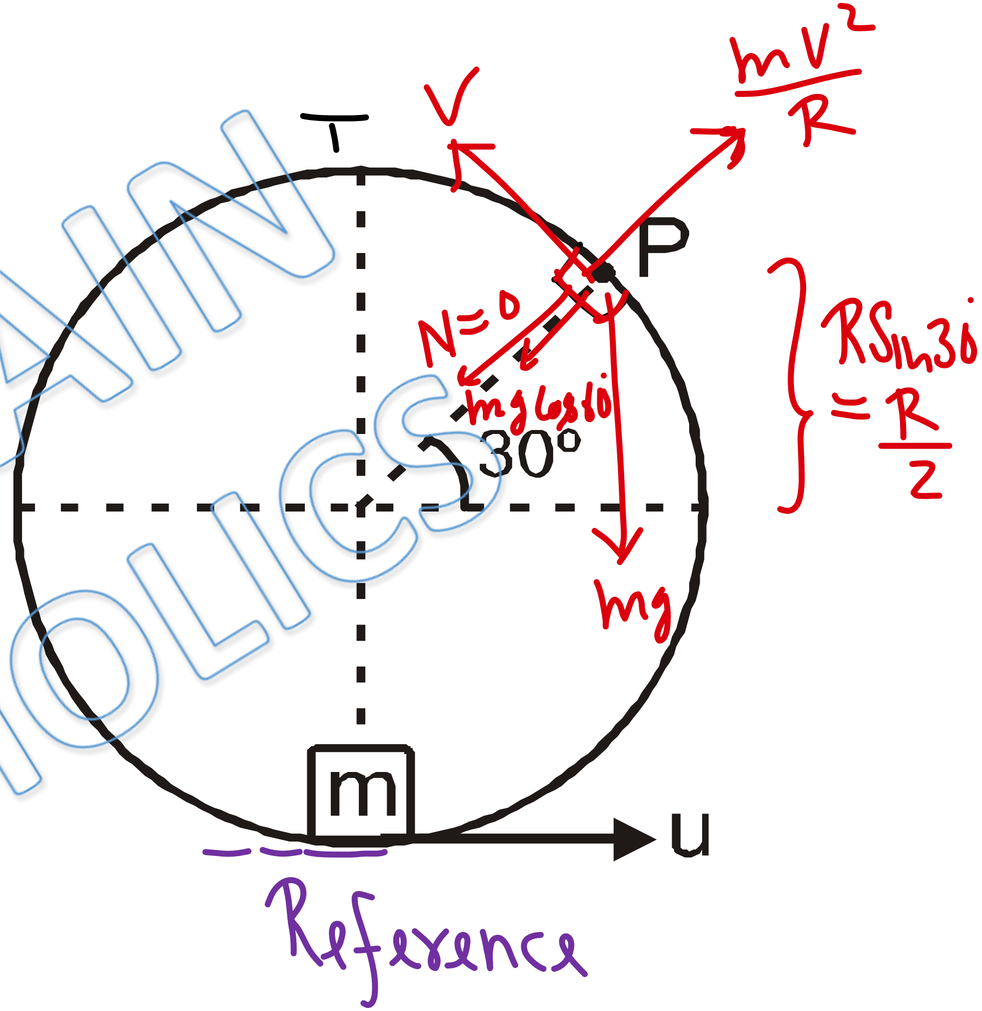
$$v^2 = \frac{gR}{2} \quad --(1)$$

by Conservation of machenical energy →

$$\frac{1}{2}mu^2 + 0 = \frac{1}{2}mv^2 + mg\left(R+\frac{R}{2}\right)$$

$$u^2 = \frac{gR}{2} + 3gR$$

$$\Rightarrow \quad u = \sqrt{3.5gR}$$ if block moves anticlockwise.



Ans.a,d

If block moves clockwise $u=\sqrt{5gR}$ since block will reach P through T.

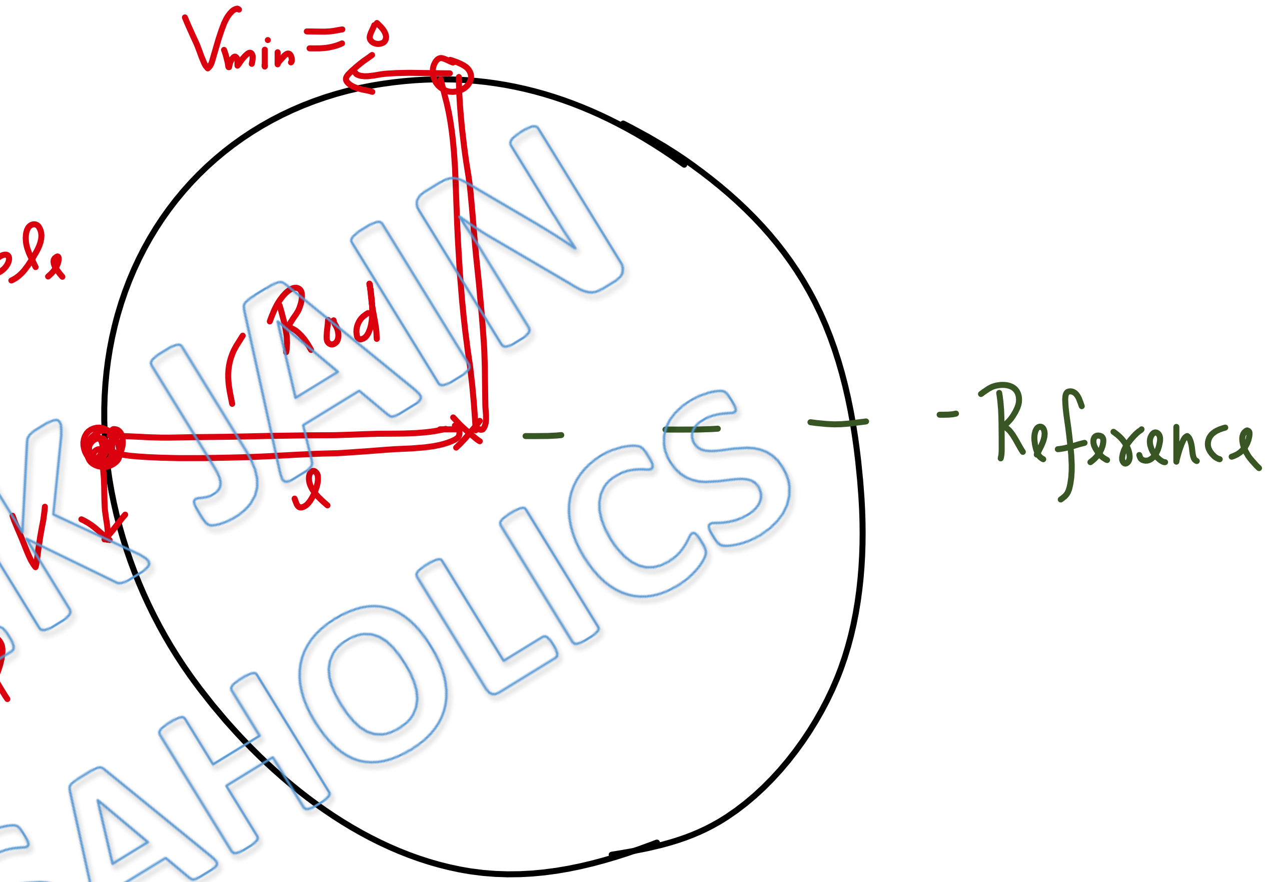
Solution:5

In case of rod, minimum possible velocity at topmost point is zero.

by Conservation of mechanical energy →

$$0+\frac{1}{2}mv^2 = mgl + 0$$

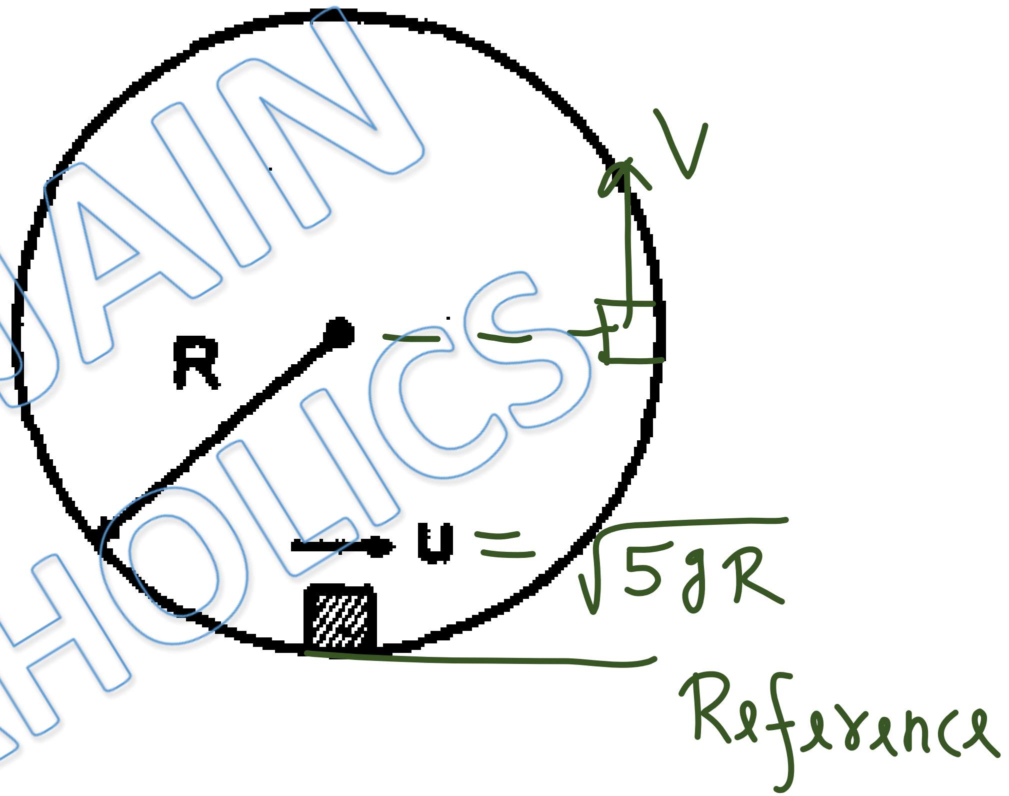
$$V = \sqrt{2gl}$$



Ans.d

Solution:6

by Conservation of machenical energy →



$$\frac{1}{2}m(5gR)+0=\frac{1}{2}mv^2+mgR$$

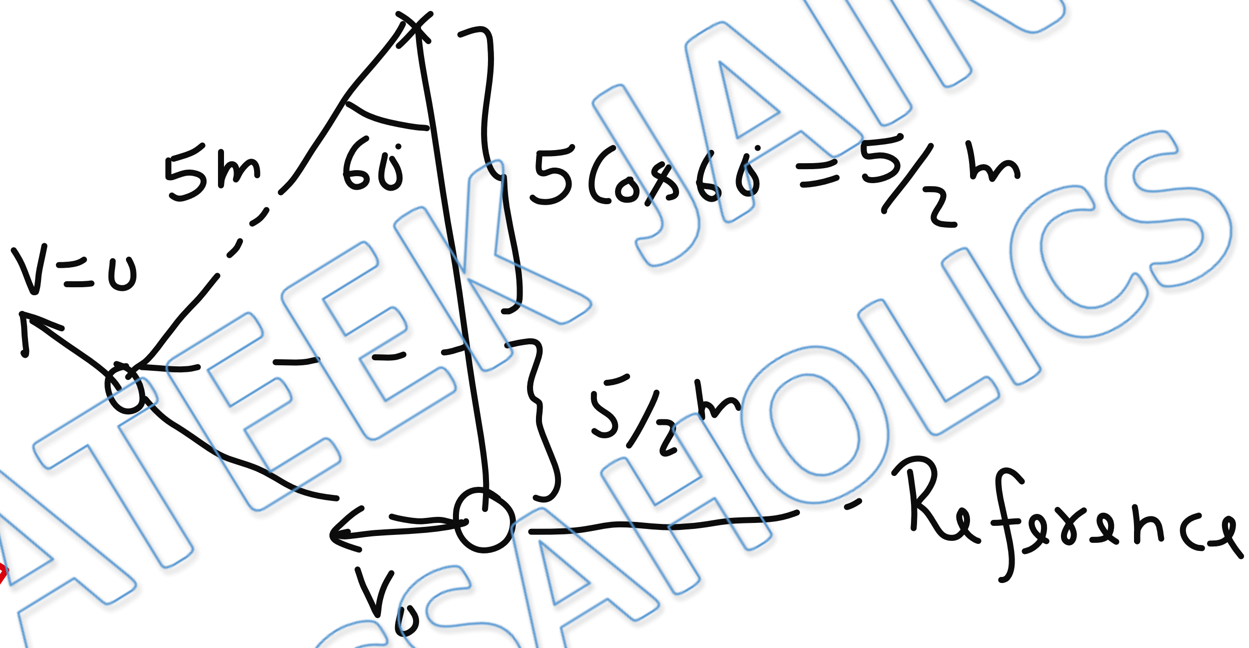
$$\Rightarrow \quad \frac{3}{2}mgR=\frac{1}{2}mv^2$$

$$\Rightarrow \quad V=\sqrt{3gR} \Rightarrow a_c=\frac{V^2}{R}=3g$$

$$a_T=\frac{mg}{m}=g \Rightarrow a=\sqrt{(3g)^2+g^2}=g\sqrt{10}$$

Ans (a)

Solution:7



by Conservation of mechanical energy →

$$\frac{1}{2}mV_0^2 = mg\left(5/2\right)$$

$$V_0 = \sqrt{5g} \simeq 7\ m/sec$$

Ans(b)

Solution:8

at $\theta = \theta = 90 + \alpha$

$$\frac{mv^2}{l} = mg\sin\alpha$$

$$\Rightarrow \quad v^2 = gl\sin\alpha \quad --(1)$$

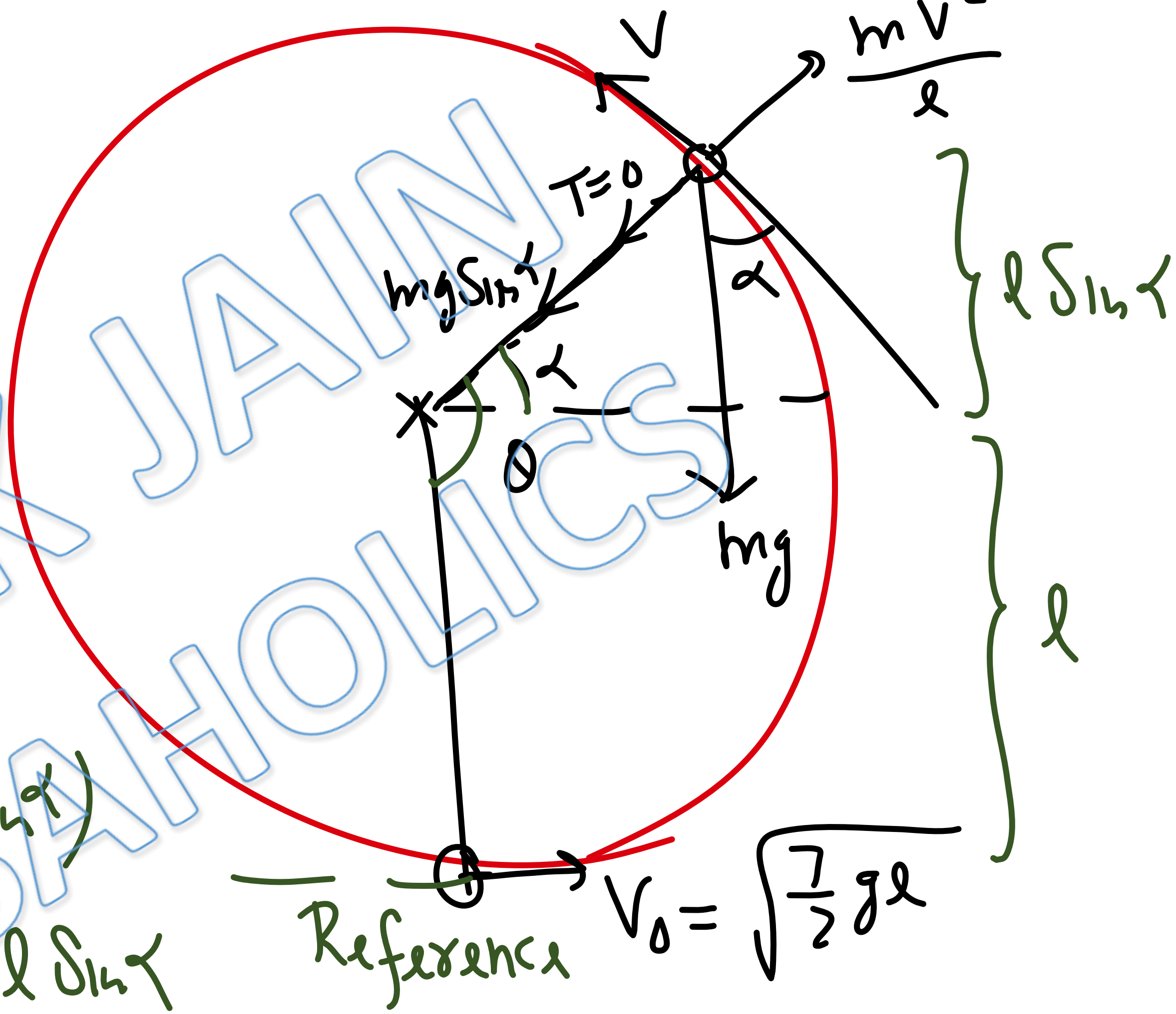
by Conservation of machenical energy—

$$\frac{1}{2}m\left(\frac{7}{2}gl\right) + 0 = \frac{1}{2}mv^2 + mgl(1+\sin\alpha)$$

$$\frac{7}{4}gl = \frac{gl}{2}\sin\alpha + gl + gl\sin\alpha$$

$$\frac{3}{4}gl = \frac{3}{2}\sin\alpha \Rightarrow \sin\alpha = 1/2 \Rightarrow \alpha = 30^\circ$$

$$\Rightarrow \theta = 90^\circ + 30^\circ = 120^\circ$$



Ans(c)

Solution:9

by Conservation of machenical energy →

$$0 - mg\left(\frac{1}{2}\right) = \frac{1}{2}mv^2 - mg\left(\frac{\sqrt{3}}{2}\right)$$

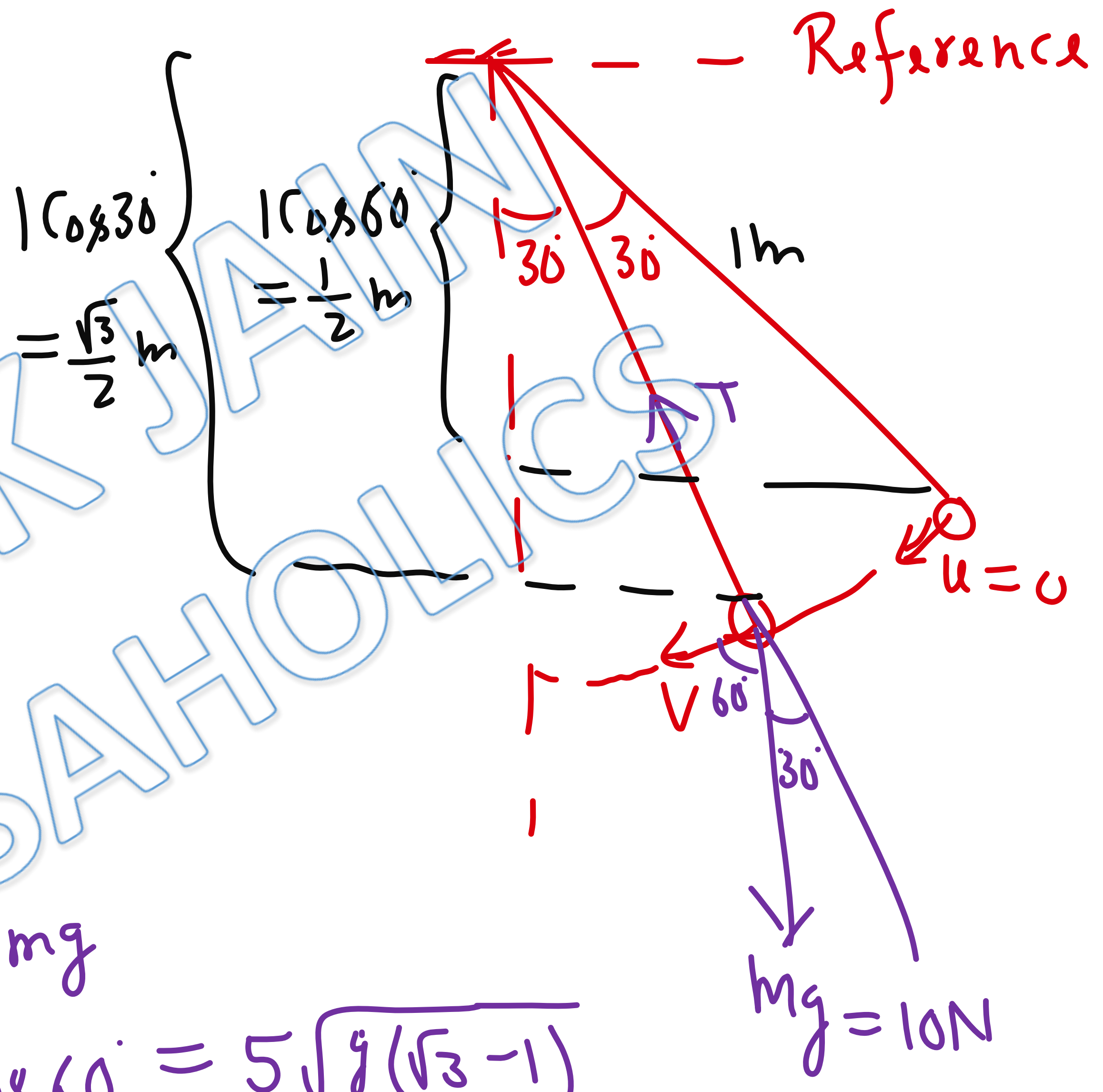
$$v^2 = g(\sqrt{3}-1)$$

Net Power at $\theta = 30^\circ$

$\Rightarrow$ P = Power of T + Power of mg

$$= 0 + 10 \times \sqrt{g(\sqrt{3}-1)}\cos 60^\circ = 5\sqrt{g(\sqrt{3}-1)}$$

$$\simeq 13.4\,W$$



Ans(a)

Solution:10

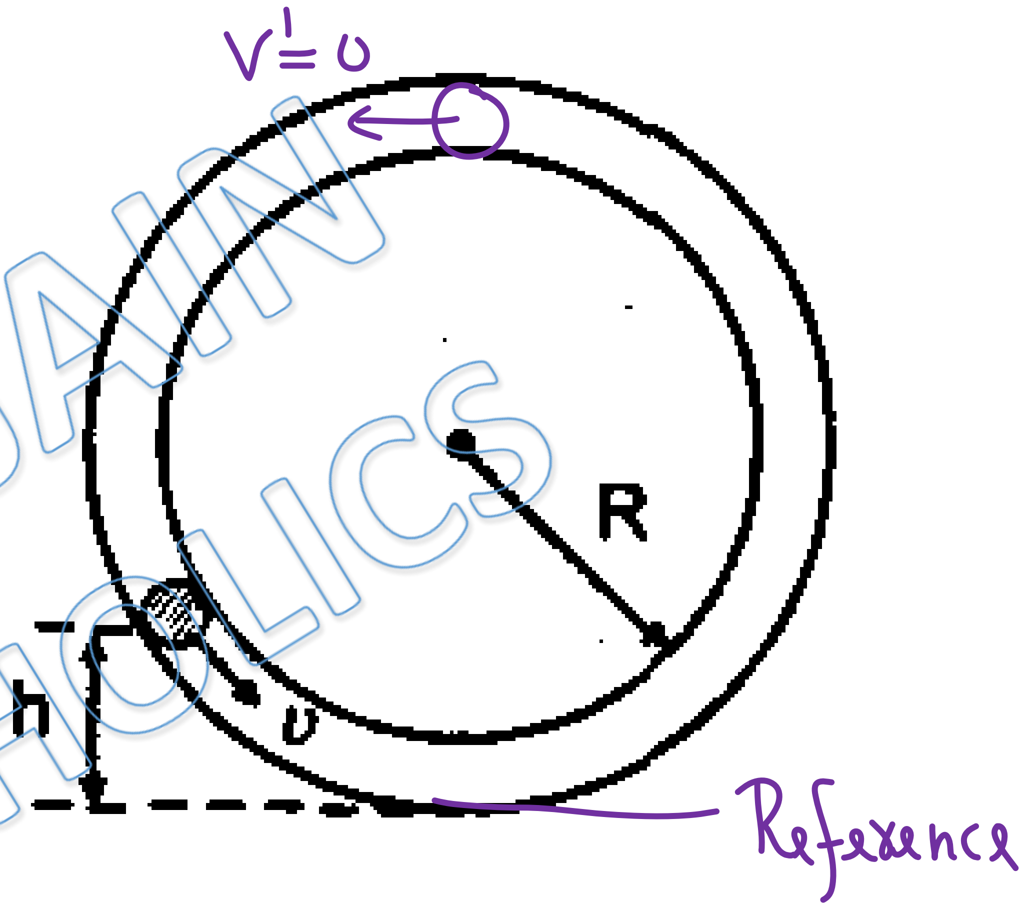
Minimum possible velocity at top of tube = 0

by Conservation of mechanical energy →

$$\frac{1}{2}mv^2 + mgh = 2mgR$$

$$\frac{v^2}{2} = g(2R-h)$$

$$v = \sqrt{2g(2R-h)}$$



Ans(d)

Solution:11

Acceleration at bottom most point →

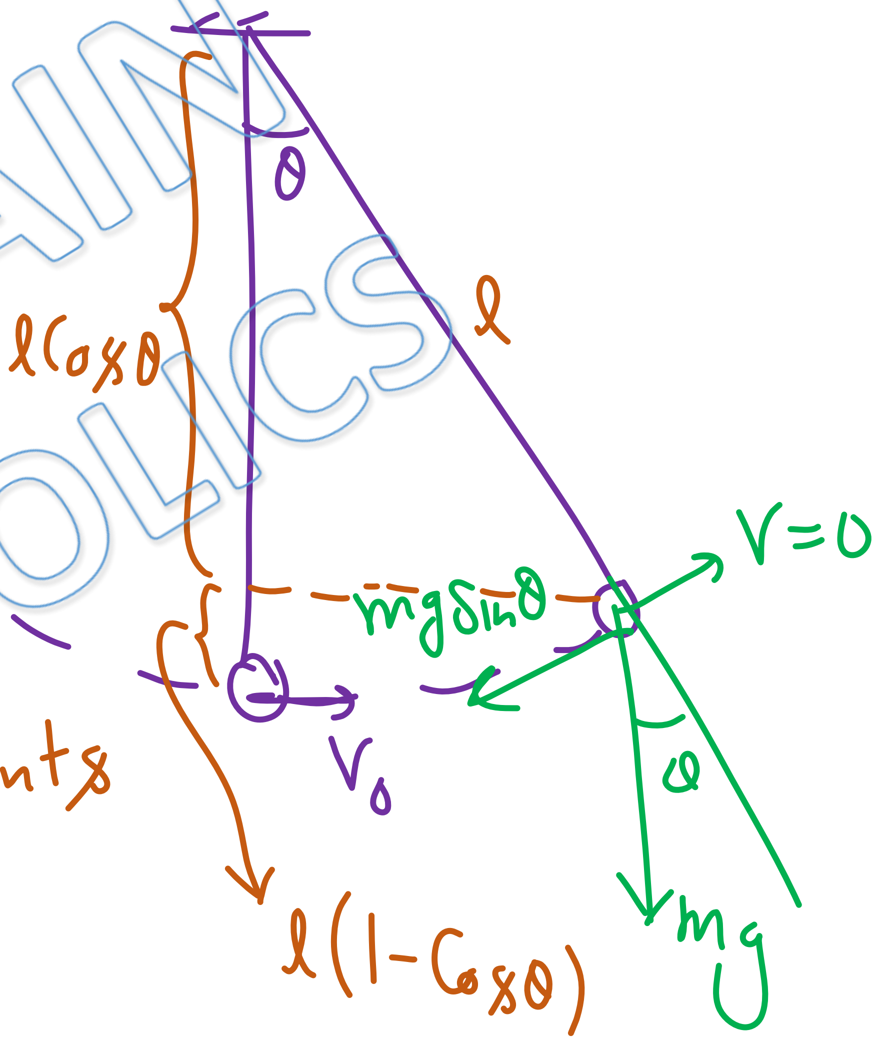
$a_c = \frac{v_0^2}{l}$, $a_T = 0 \Rightarrow a = \frac{v_0^2}{l}$

Acceleration at extreme position →

$a_c = 0$, $a_T = \frac{mg\sin\theta}{m} \Rightarrow a = g\sin\theta$

Since |acceleration| is equal at both points

$\Rightarrow \frac{v_0^2}{l} = g\sin\theta$ ——— (1)



by Conservation of mechanical energy →

$$\frac{1}{2}mv_0^2 = mgl(1-\cos\theta)$$

$$\Rightarrow \frac{1}{2}\sin\theta = 1-\cos\theta = 1-1+2\sin^2\theta/2$$

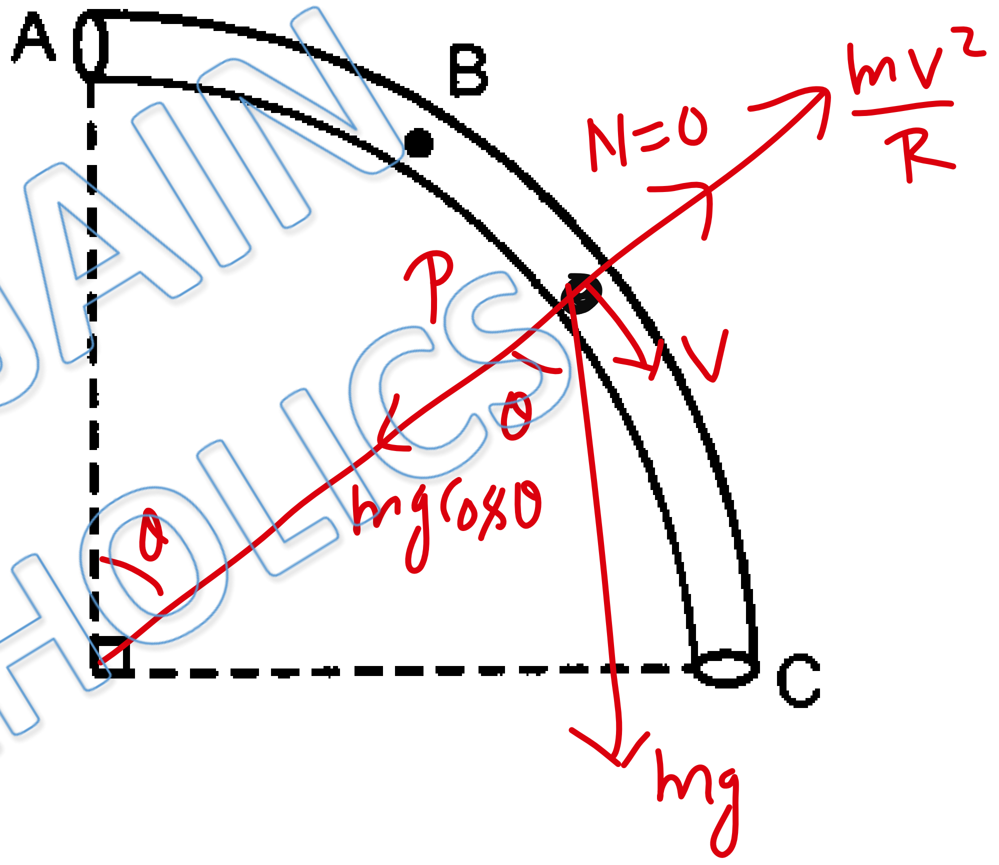
$$\Rightarrow \frac{1}{2}\times 2\sin\theta/2 \cdot \cos\theta/2 = 2\sin^2\theta/2$$

$$\tan\theta/2 = 1/2$$

$$\Rightarrow \theta = 2\tan^{-1}(1/2)$$

Ans(d)

Solution: 12



from A to C

V is increasing

$\Rightarrow \frac{mv^2}{R}$ is increasing from zero 2mg.

$mg\cos\theta$ is decreasing from mg to zero

If P is point where $\frac{mv^2}{R} = mg\cos\theta$

$\Rightarrow$ N at P is zero.

before P , $mg\cos\theta > \frac{mv^2}{R} \Rightarrow$ Contact is with inner surface.

After P , $\frac{mv^2}{R} > mg\cos\theta \Rightarrow$ " " " outer surface.

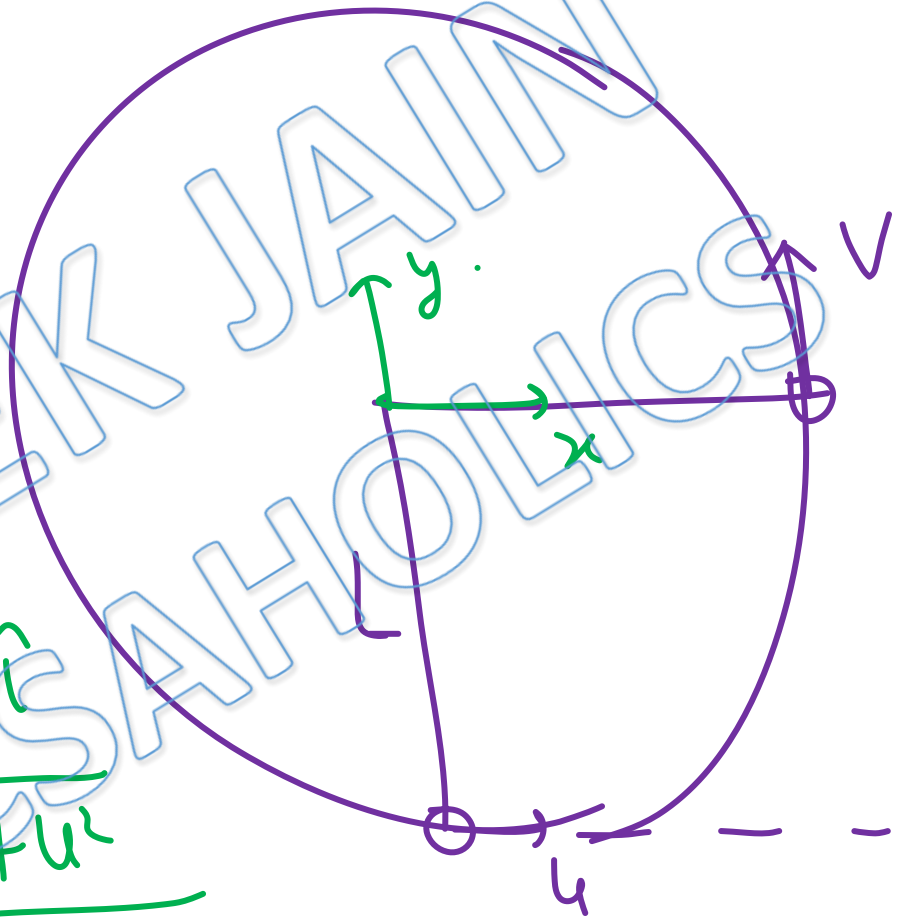
Ans (c)

Solution:13

by Conservation of mechanical energy $\rightarrow$

$$0+\frac{1}{2}mu^2 = mgL+\frac{1}{2}mV^2$$

$$V^2 = u^2-2gL \quad --(1)$$



Change in velocity $= V\hat{j}-u\hat{i}$

$$\Rightarrow |\ \text{,,}\quad \text{,,}\quad \text{,,}\ | = \sqrt{V^2+u^2}$$

$$= \sqrt{2u^2-2gL}$$

$$= \sqrt{2(u^2-gL)}$$

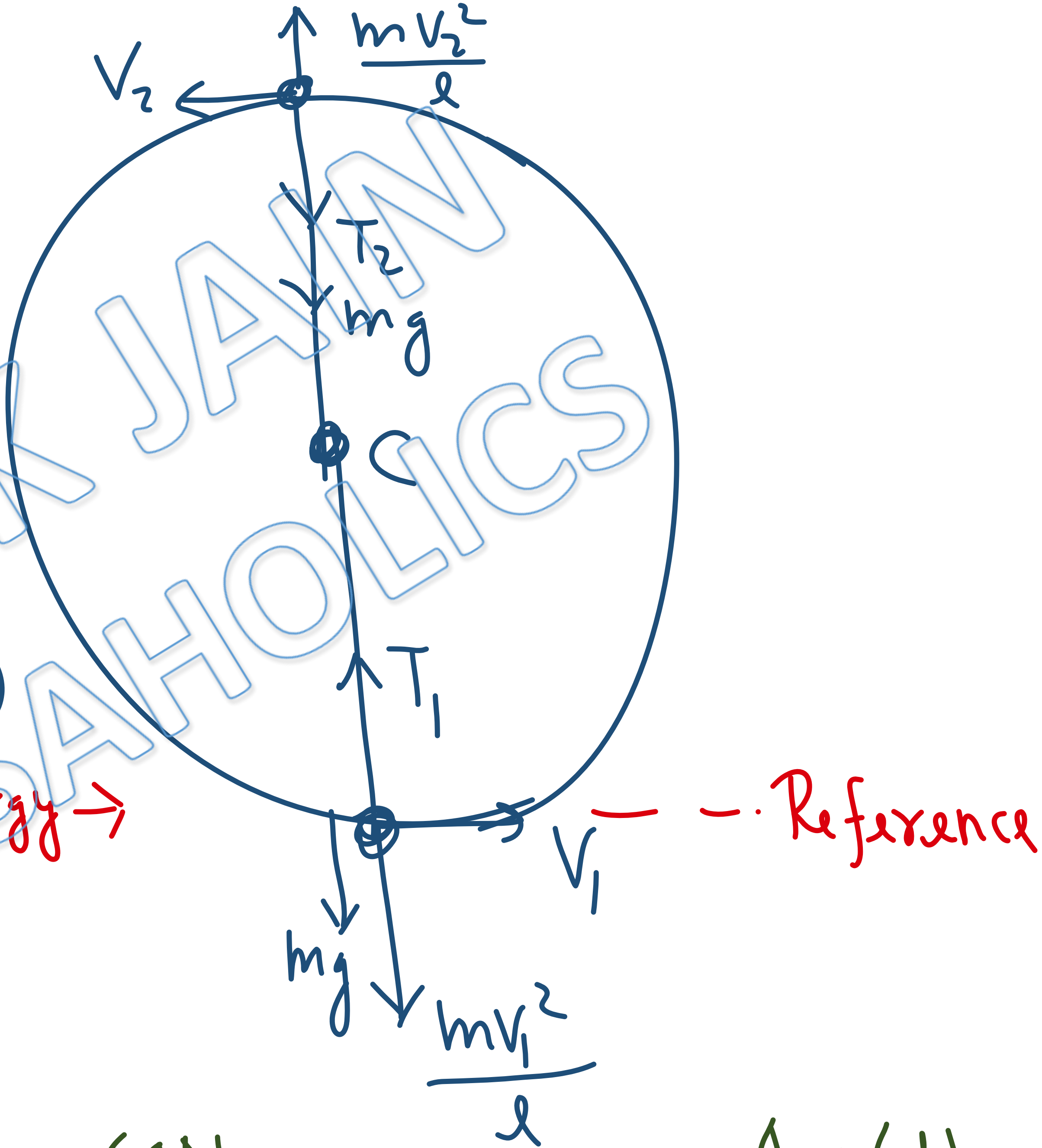
Ans(d)

Solution:14

$$T_1 = mg + \frac{mV_1^2}{\ell}$$

$$T_2 = -mg + \frac{mV_2^2}{\ell}$$

$$T_1 - T_2 = 2mg + \frac{m}{\ell}\left(V_1^2 - V_2^2\right) \quad \text{---} (1)$$



by Conservation of mechanical energy →

$$\frac{1}{2}mV_1^2 + 0 = \frac{1}{2}mV_2^2 + 2mg\ell$$

$$m\left(V_1^2 - V_2^2\right)/\ell = 4mg$$

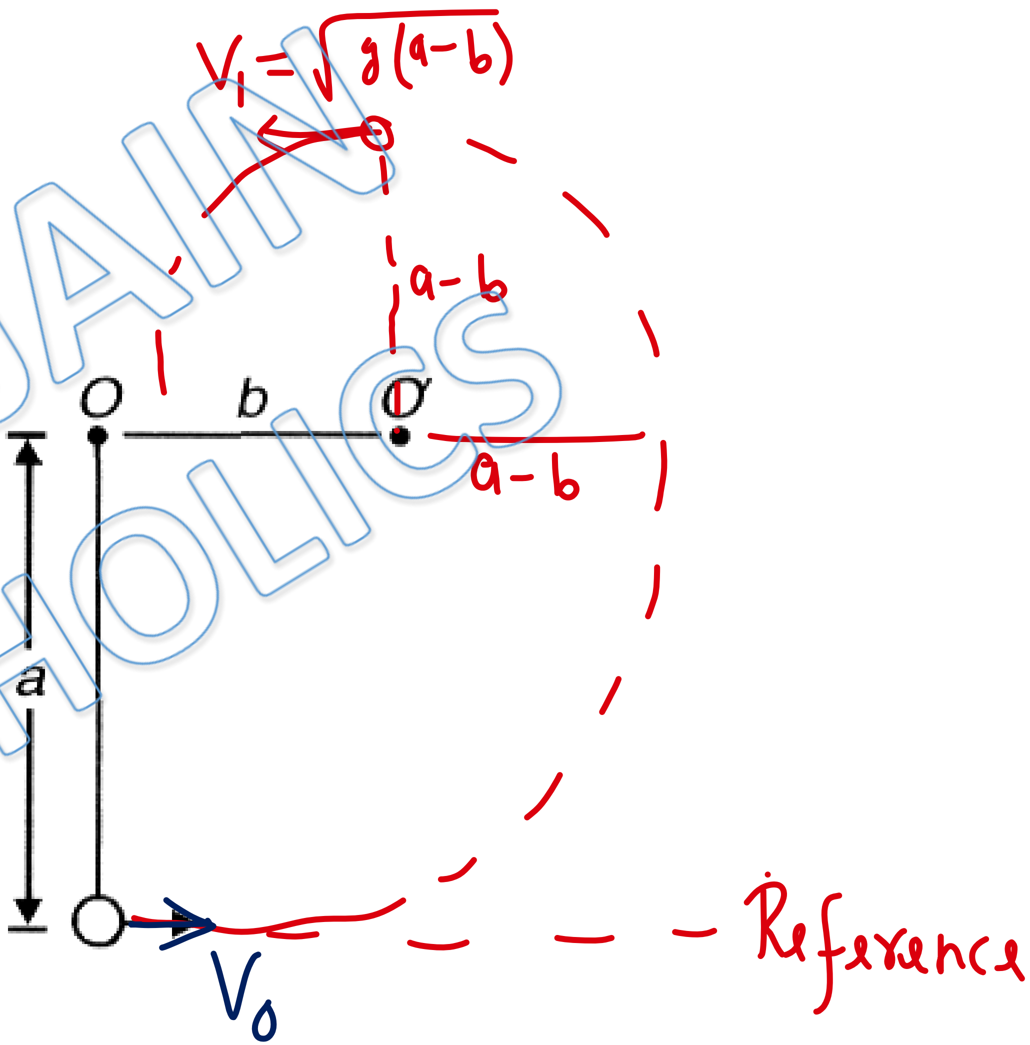
$$\Rightarrow T_1 - T_2 = 2mg + 4mg = 6mg = 60N$$

Ans (d)

Solution:15

minimum speed at topmost point $V_1 = \sqrt{g(a-b)}$

by Conservation of machenical energy →



$$0 + \frac{1}{2} m V_0^2 = \frac{1}{2} m V_1^2 + mg(a+a-b)$$

$$V_0^2 = g(a-b) + 2g(2a-b)$$

$$= g(5a-3b)$$

$$V_0 = \sqrt{g(5a-3b)}$$

Ans (c)

For Video Solution of this DPP, Click on below link

Video Solution on Website:-	https://physicsaholics.com/home/courseDetails/75
Video Solution on YouTube:-	https://youtu.be/DdX4khMXWMw
Written Solution on Website:-	https://physicsaholics.com/note/notesDetalis/77

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo