YAKEEN NEET 2.0

2026

Work, Energy and Power

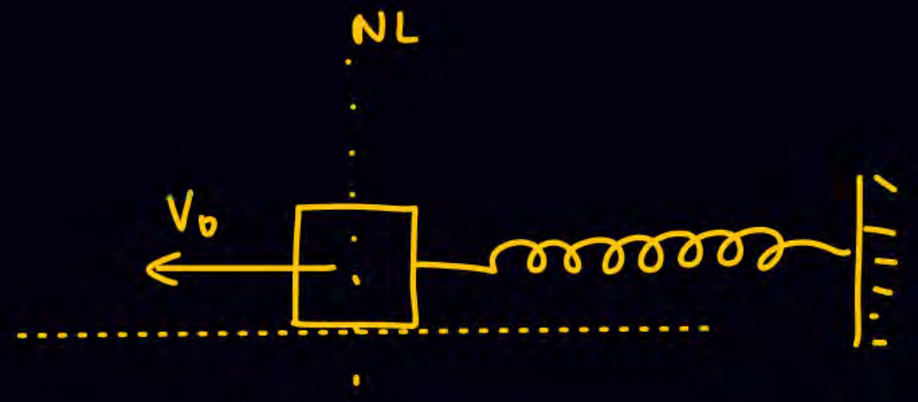
PHYSICS | Lecture 06

By - Saleem Ahmed Sir

Topics to be covered

1. Spring
2. Vertical Circular Motion
3.
4.

Q



$$\frac{1}{2}mV_0^2 = \frac{1}{2}kx^2$$

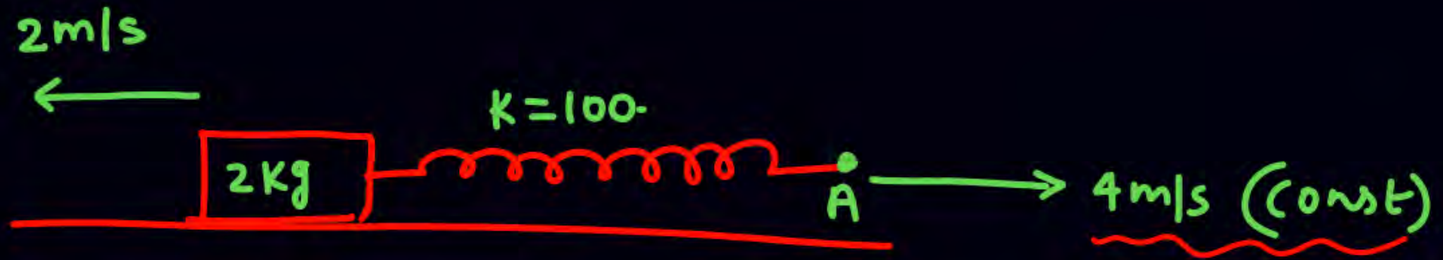
$$\boxed{x = \sqrt{\frac{m}{k}}\, V_0}$$

Rest x_{max} in Spring.

Sol $\quad W_g + W_N + W_{sp} = \Delta KE$

$$0 + 0 - \frac{1}{2}k(x^2 - 0^2) = 0 - \frac{1}{2}mV^2$$

Q



find max elongation in spring.

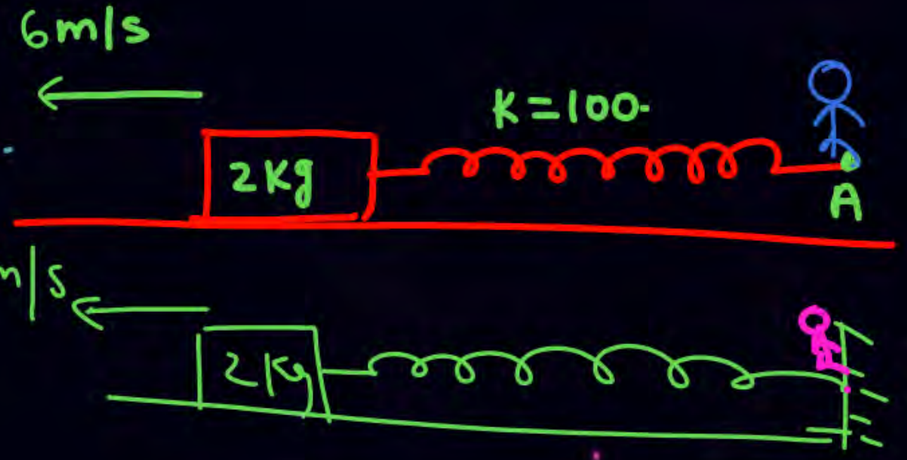
Soln $W_g + W_{sp} = \Delta KE$

$$0 - \frac{1}{2}k(x^2 - 0^2) = 0 - \frac{1}{2}mv^2$$

$$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$$

$$\frac{1}{2} \times 2 \times 36 = \frac{1}{2} \times 100\, x^2$$

$$x = \sqrt{.72}$$



$v_A < \sqrt{2gR}$ ⟶ B तक नहीं पहुचेगा
$v = 0$, B से पहले ही कटि

$v_A = \sqrt{2gR}$ ⟶ B tak pahuchega
$V_B = 0$

$\sqrt{2gR} < v < \sqrt{5gR}$ ⟶ V.C.M. Complete X
B को Cross.
↳ b/w B & C $T = 0$

$V_A = \sqrt{5gR}$ V.C.M. just Complete
mg में इजाफत बचा ली
$T_C = 0$, $v_C = \sqrt{gR}$ (बाल-2)

$V_A > \sqrt{5gR}$ ⟶ चमत्चमाता हुआ V.C.M.

$v_A < \sqrt{2gR}$ ⟶ B तक नहीं पहुचेगा
$v = 0$, B से पहले ही कटि

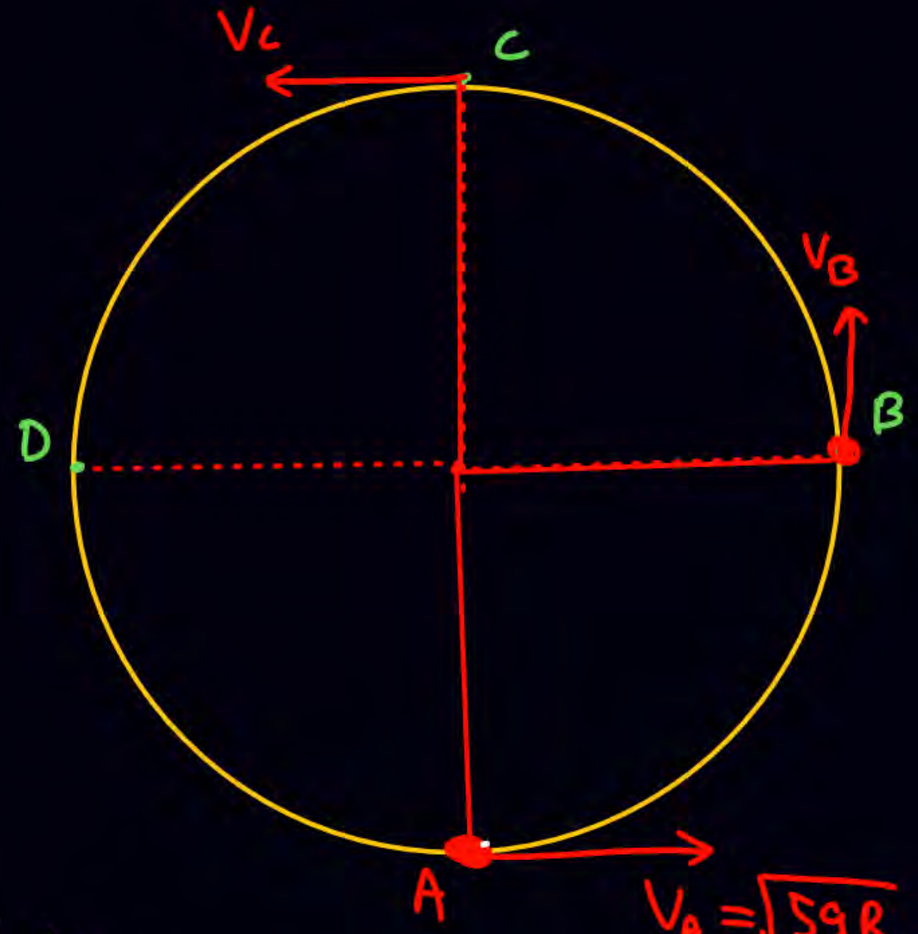
$v_A = \sqrt{2gR}$ ⟶ B tak pahuchega
$V_B = 0$

$\sqrt{2gR} < v < \sqrt{5gR}$ ⟶ V.C.m. Complete X
B को Cross.
⟶ b/w B & C $T = 0$
उसके बाद का motion → projectile.

$V_A = \sqrt{5gR}$ V.C.m. just Complete
mg में इज्जत बचा ली
$T_C = 0$, $v_C = \sqrt{gR}$ (बाल-बाल)

$V_A > \sqrt{5gR}$ ⟶ चमचमाता हुआ V.C.m.

Q



$V_B, V_C, V_D = ?$

A → B (WET)

$$W_g + W_T = \Delta KE$$

$$-mgR + 0 = \frac{1}{2}mV_B^2 - \frac{1}{2}m5gR$$

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

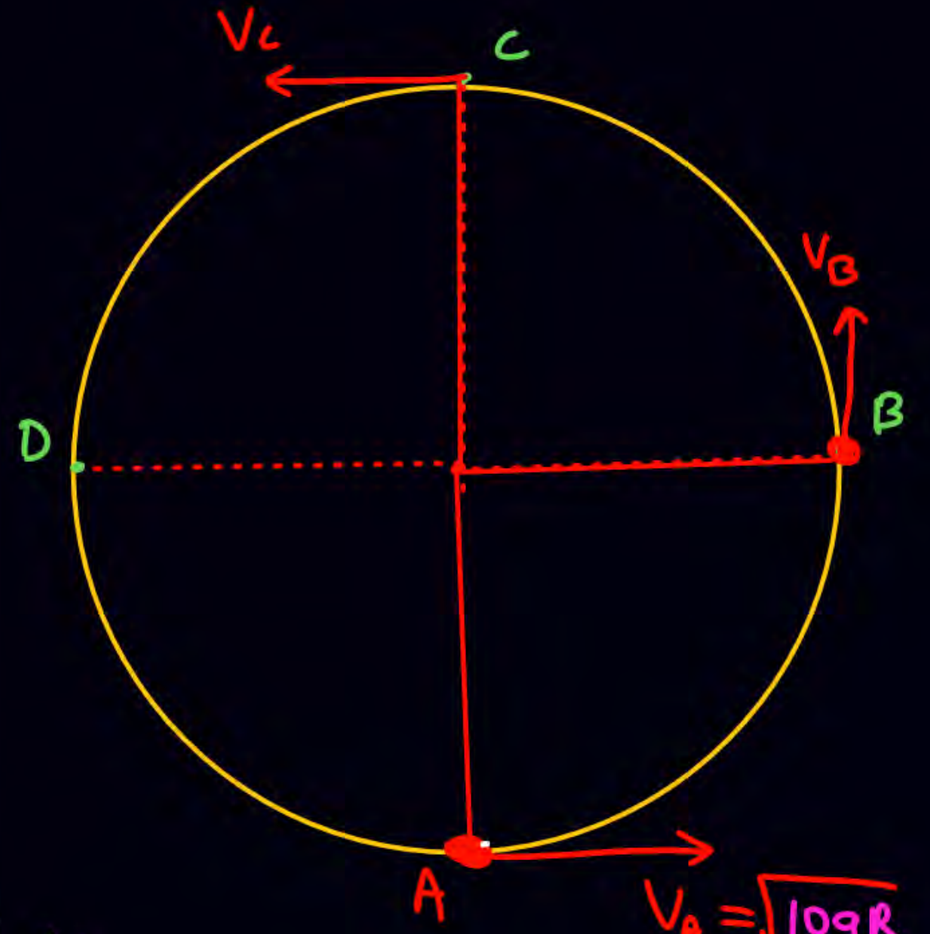
A → C (WET)

$$W_g + W_T = \Delta KE$$

$$-mg2R + 0 = \frac{1}{2}mV_c^2 - \frac{1}{2}m(5gR)$$

$$V_c = \sqrt{gR}$$

Q



$V_B, V_C, V_D = ?$

A → B (WET)

$$W_g + W_T = \Delta KE$$

$$-mgR + 0 = \frac{1}{2}mV_B^2 - \frac{1}{2}m(10gR)$$

$$V_B = \sqrt{8gR}$$

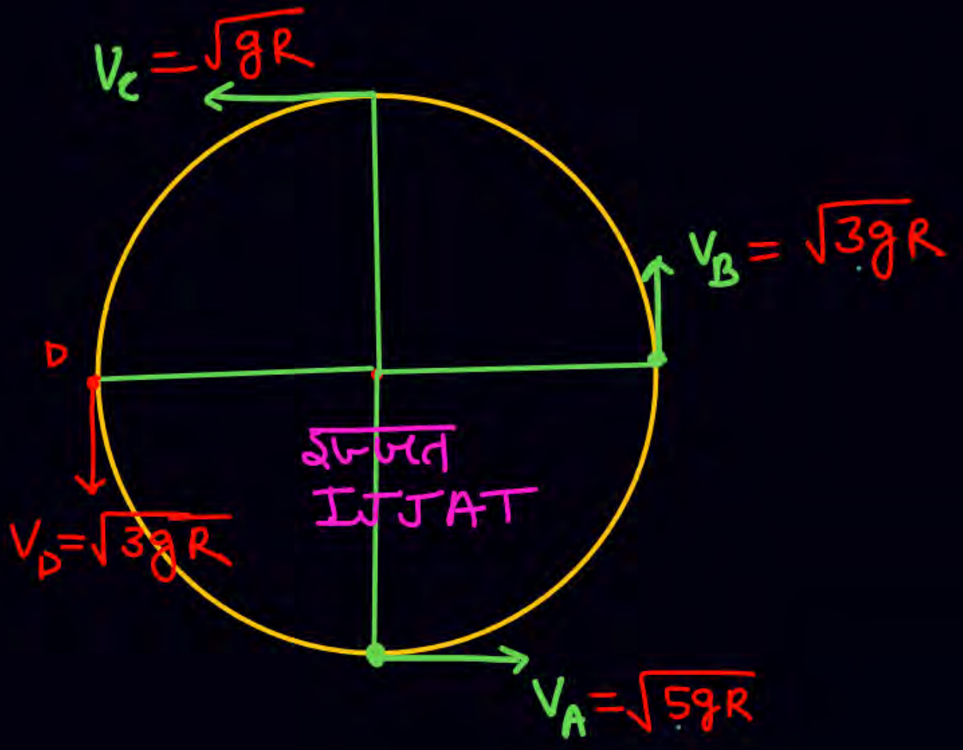
A → C (WET)

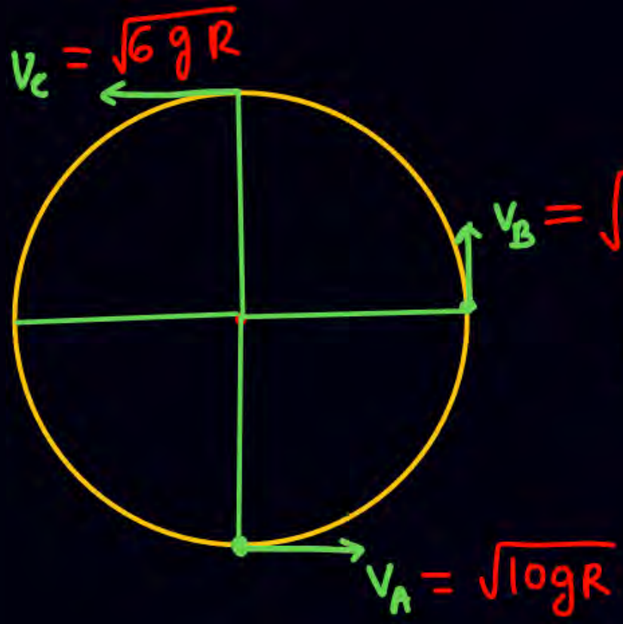
$$W_g + W_T = \Delta KE$$

$$-mg2R + 0 = \frac{1}{2}mV_C^2 - \frac{1}{2}m(10gR)$$

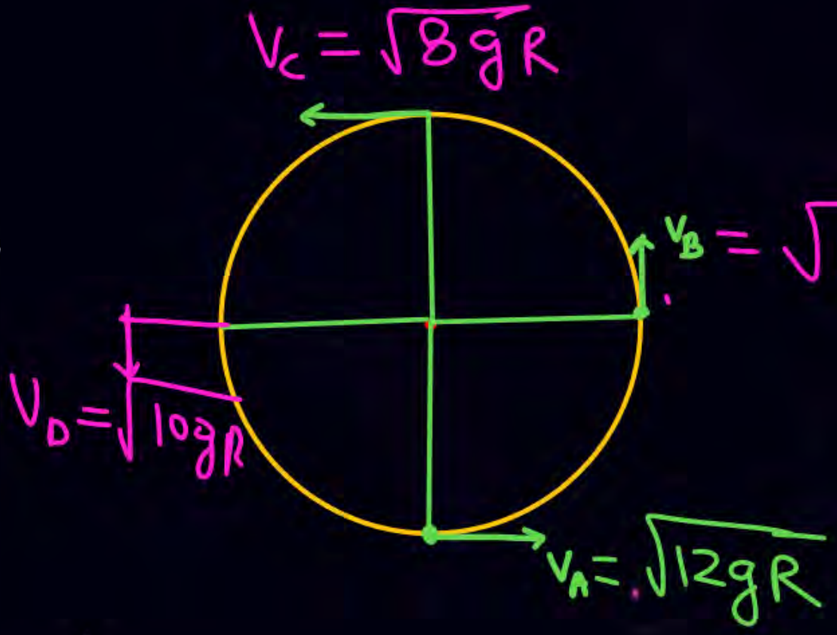
$$5mgR - 2mgR = \frac{1}{2}mV_C^2$$

$$V_C = \sqrt{6mgR}$$



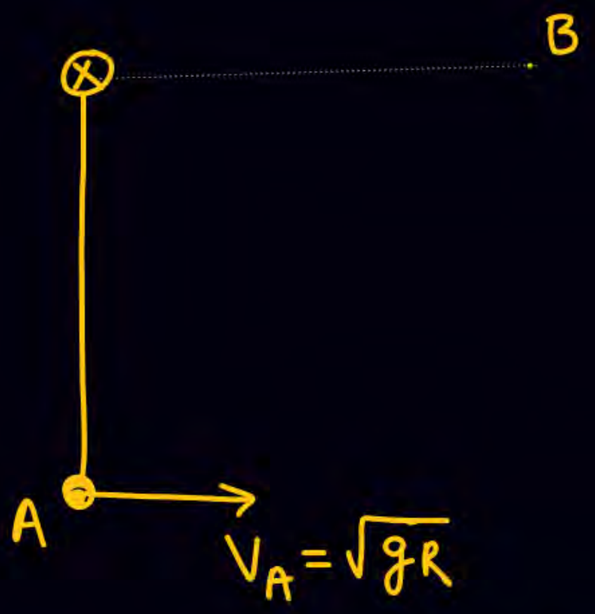


(चमचमाता हुआ)



(चमचमाता हुआ)

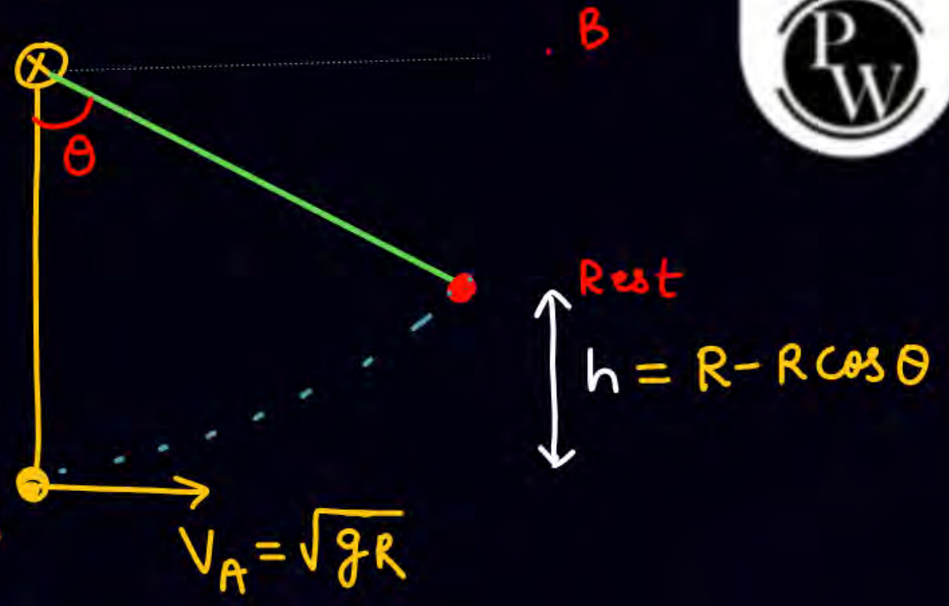
Q



① find max height attain by particle

② Find max. deflection of string.

Sol^n



WET, $W_g + W_T = \Delta K.E.$

$$-mgh + 0 = 0 - \frac{1}{2}mgR$$

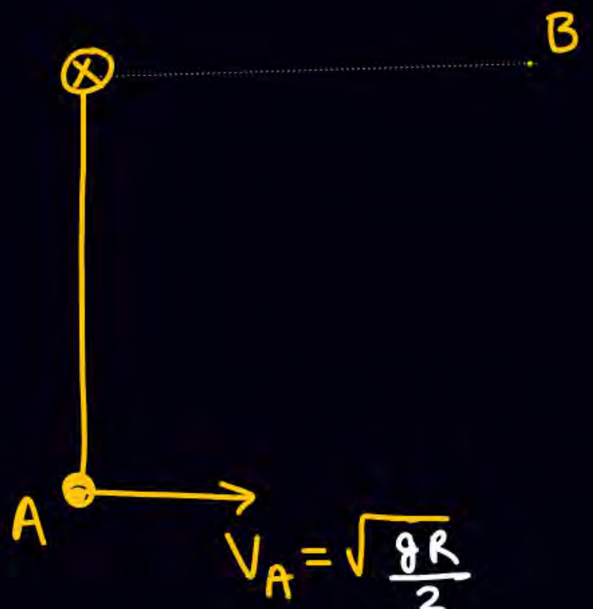
$$\boxed{h = R/2}$$

$$h = R - R\cos\theta$$

$$\frac{R}{2} = R - R\cos\theta \quad , \quad \boxed{\theta = 60^\circ}$$

Rough

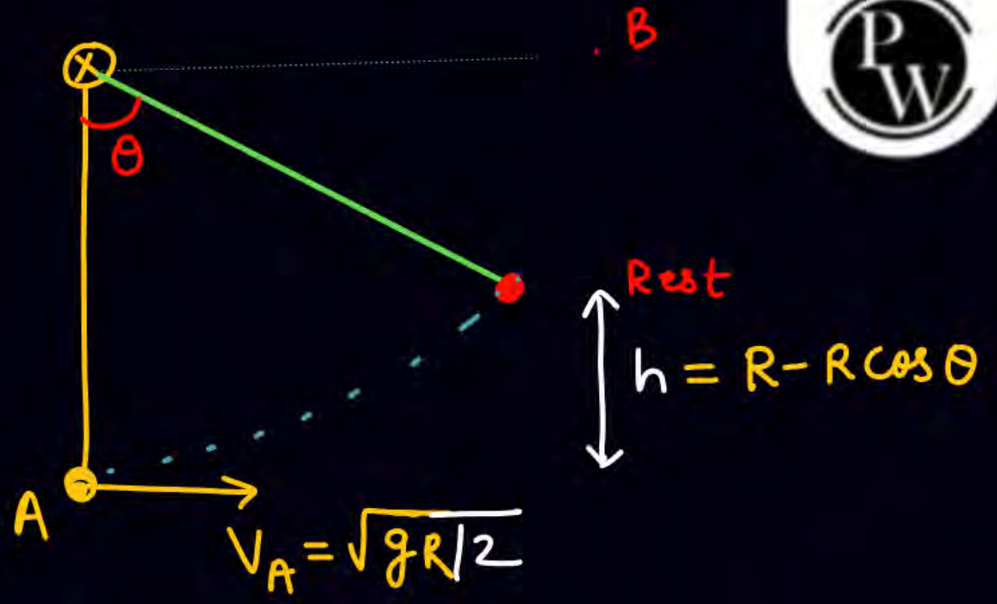
Q



① find max height attain by particle

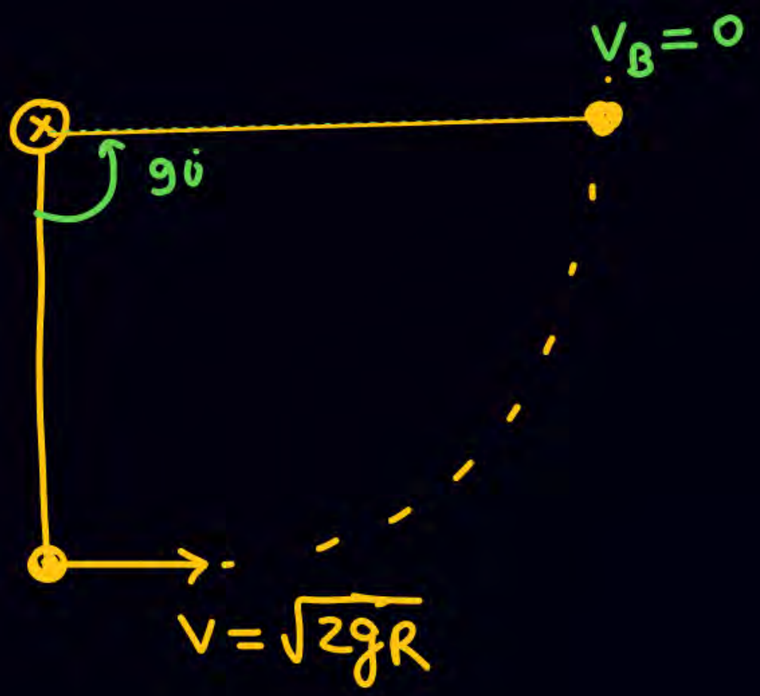
② Find max. deflection of string.

Sol^n

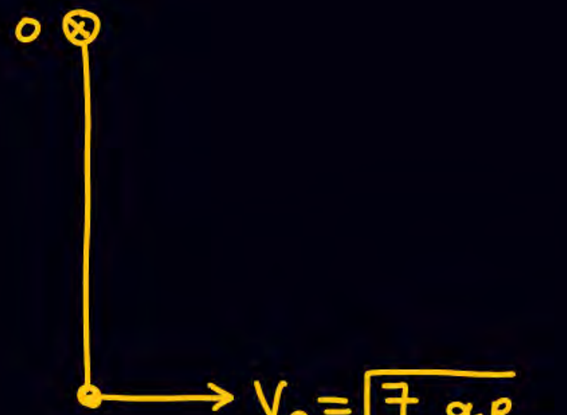


$W_{\in T}$, $W_g + W_T = \Delta K.\varepsilon$.

Q



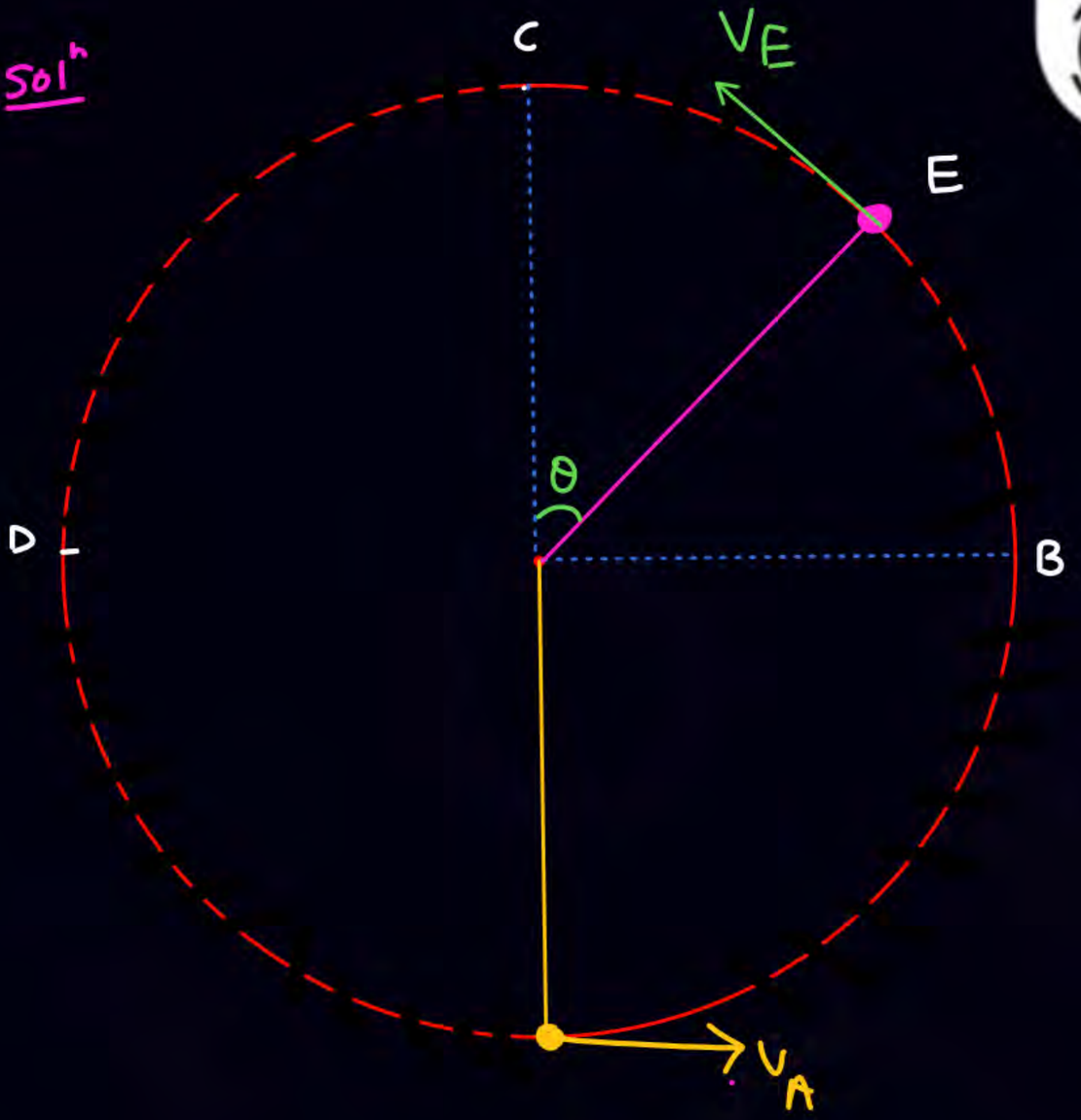
Q



① where string slack $\theta = ?$

② find speed of particle when string slack.

Sol^n



Sol^n

$(A \longrightarrow E)$

WET $\quad W_g + W_T = \Delta K.E.$

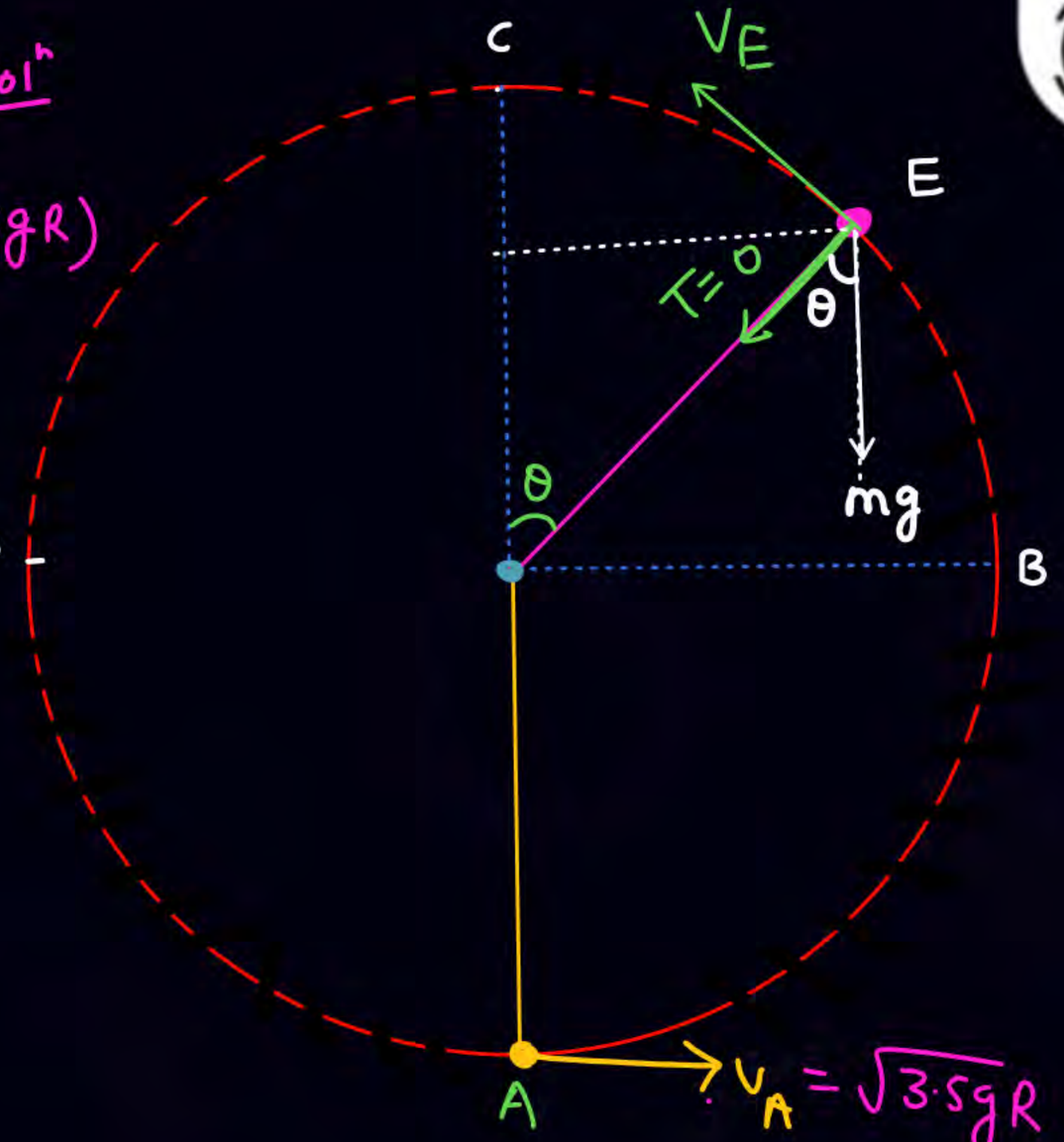
$$-mg(R+R\cos\theta) + 0 = \frac{1}{2}mV_E^2 - \frac{1}{2}\cdot m(3.5gR) \quad \text{——— (1)}$$

Circular $\longrightarrow$ $\quad mg\cos\theta + T^{\nearrow 0} = \frac{mV_E^2}{R}$ ——— (2)

RM Solve & get

$$\theta = 60^\circ \quad , \quad V_E = \sqrt{\frac{gR}{2}}$$

(Do yourself)



Sol^n $(A \longrightarrow E)$

WET $\quad W_g + W_T = \Delta K.E.$

$$-mg(R+R\cos\theta)+0 = \frac{1}{2}mV_E^2 - \frac{1}{2}\cdot m(3.5gR)$$

——— (1)

Circular $\longrightarrow$ $\quad mg\cos\theta + T^{\nearrow 0} = \frac{mV_E^2}{R}$

——— (2)

Sol^n $\quad mV_E^2 = mgR\cos\theta$

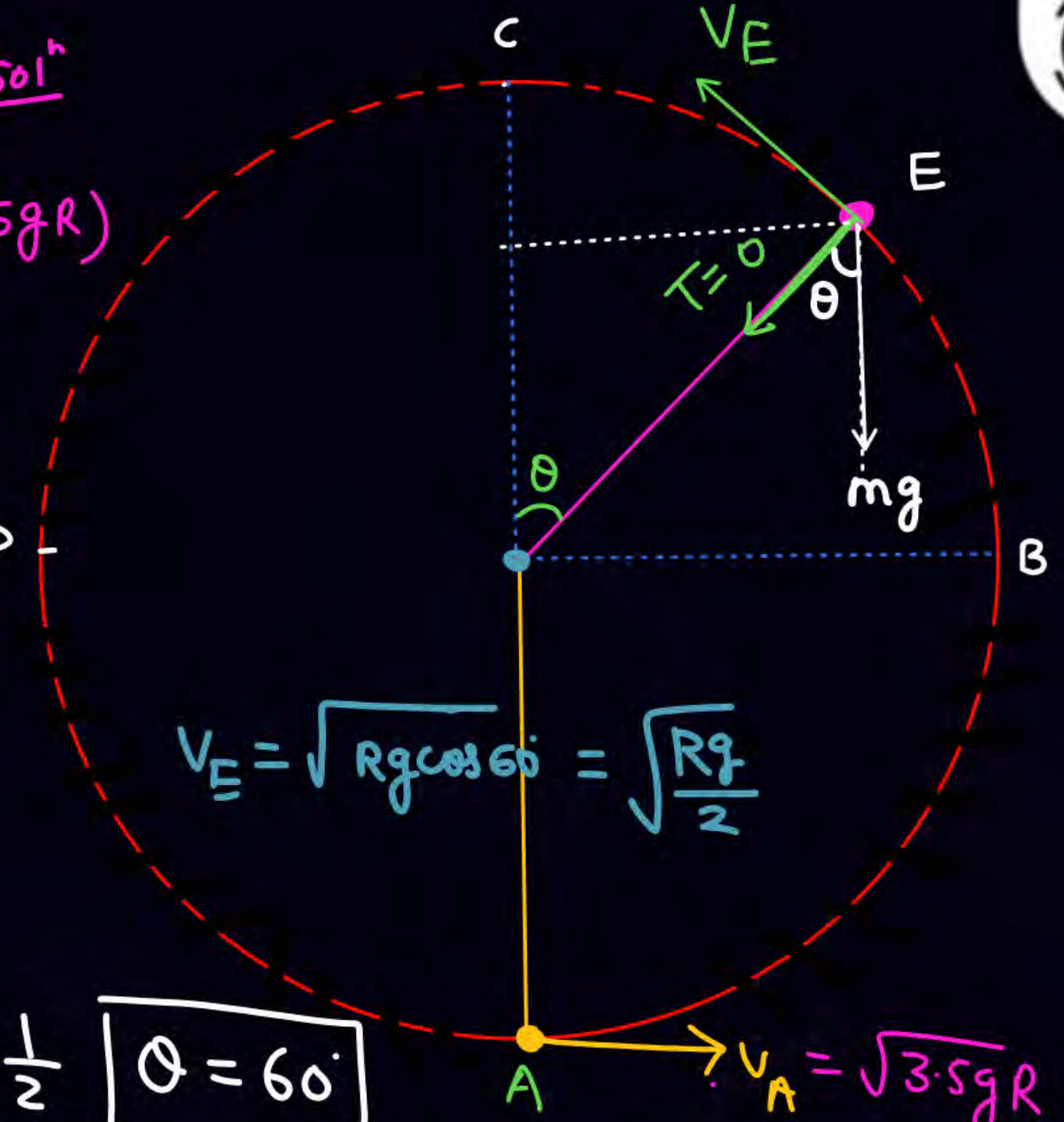
$$-mgR(1+\cos\theta) = \frac{1}{2}mgR\cos\theta - \frac{7}{4}mgR$$

$$-1-\cos\theta = \frac{\cos\theta}{2} - \frac{7}{4}$$

$$-1+\frac{7}{4} = \frac{3\cos\theta}{2} = \frac{3}{4}$$

$$\cos\theta = \frac{1}{2} \quad \boxed{\theta = 60^\circ}$$

Sol^n



$$V_E = \sqrt{Rg\cos 60^\circ} = \sqrt{\frac{Rg}{2}}$$

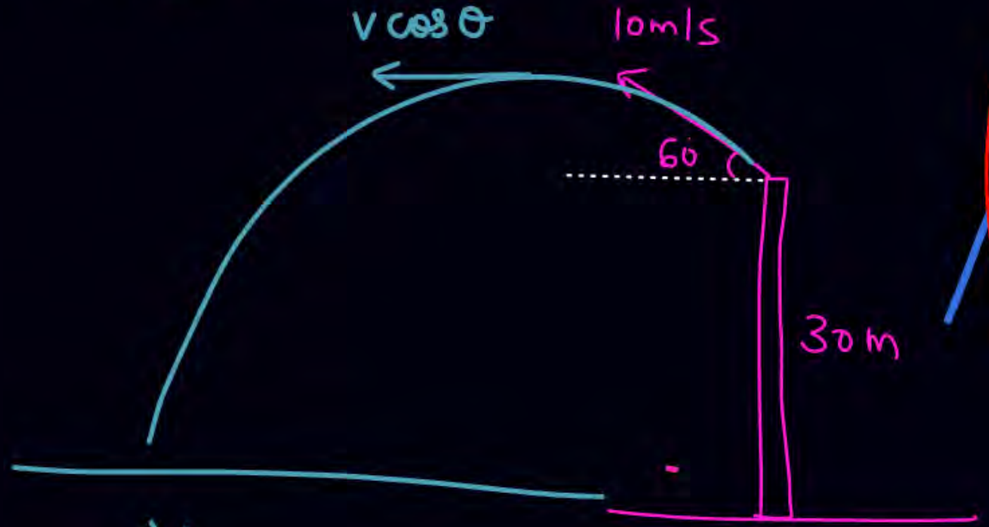
Sahan bhaia style

5582

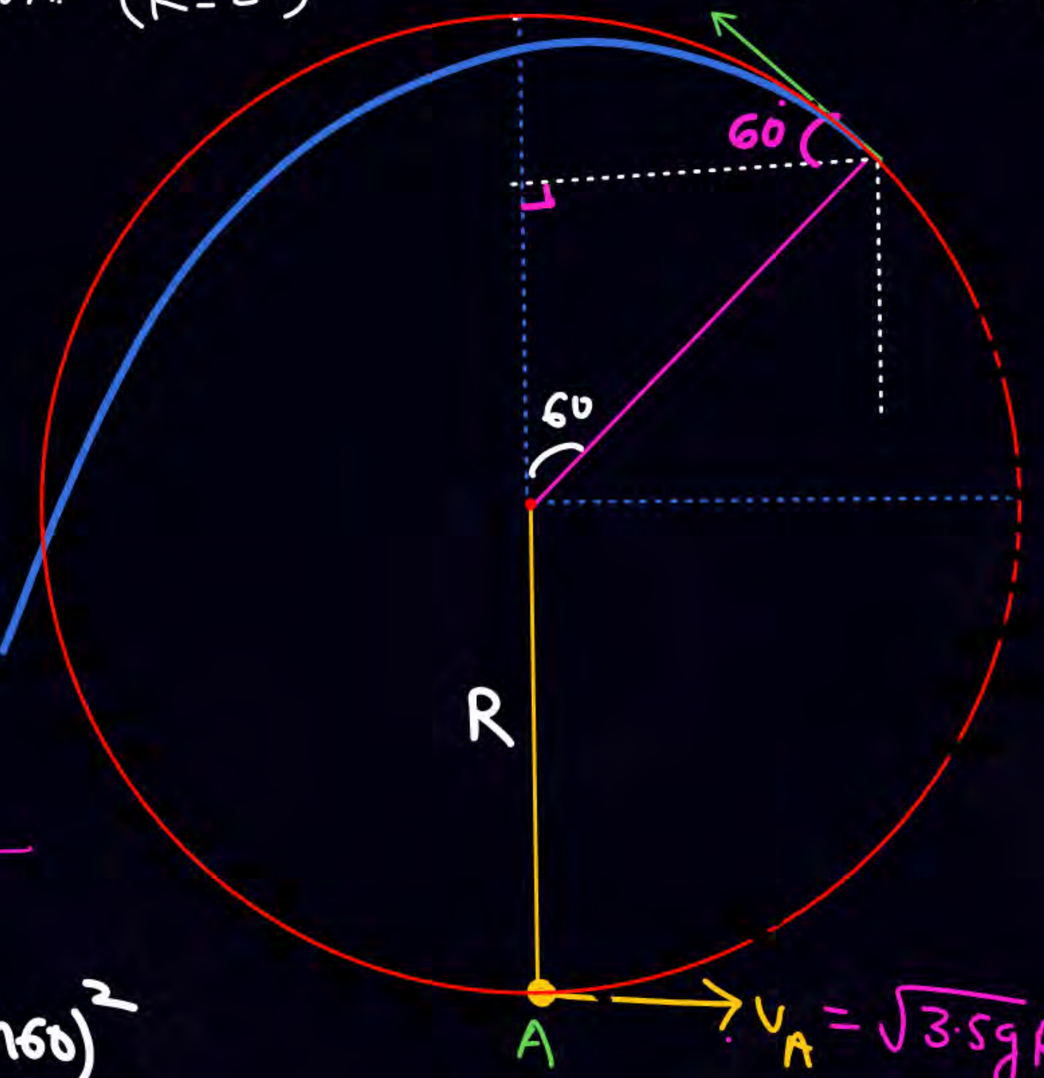
© find max height, & min speed of particle in entire motion. (R=20)

$R = 20$

$V_E = \sqrt{\frac{gR}{2}} = \sqrt{\frac{10 \times 20}{2}} = 10$



$V_{min} = 10\cos 60 = 5$



$V_E = \sqrt{\frac{gR}{2}}$

h_{max} from ground $= \frac{3R}{2} + \frac{(10\sin 60)^2}{2g}$

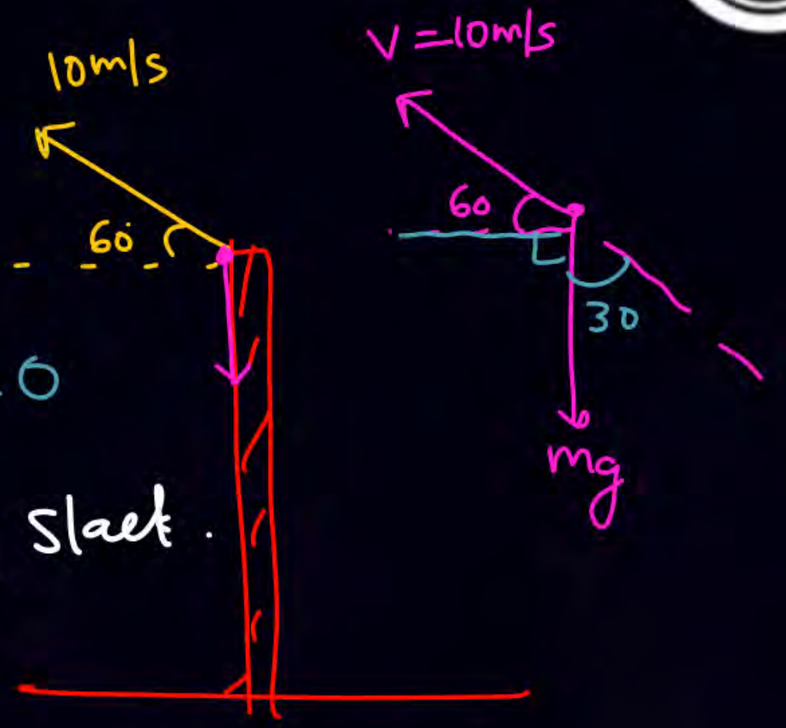
(d) find a_t when tension becom zero.

$a_t = g\cos 30 = 10\,\frac{\sqrt{3}}{2} = 5\sqrt{3}$

find rate of chage of speed when $T = 0$

(e) Distance toaval by particle before string slack.

$\theta = 120^\circ \equiv \frac{2\pi}{3} = \frac{\text{Arc}}{R}$



Q

$W_g + W_N = \Delta KE$

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

$V = \sqrt{2gR}$

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

$N - mg = \frac{m\,2gR}{R}$

$N = 3mg$

Q

Q

$W_g + W_N = \Delta KE$

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

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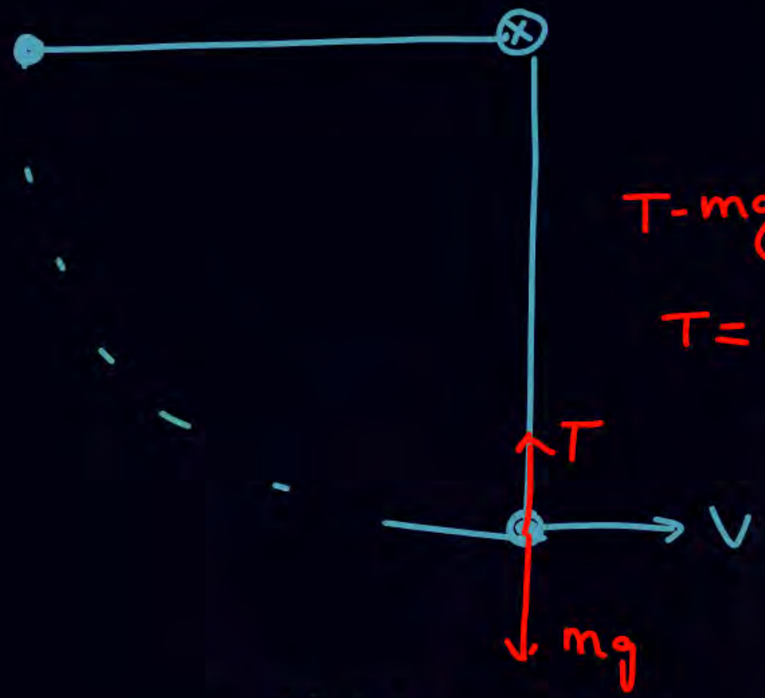


$T - mg = \frac{mV^2}{R}$

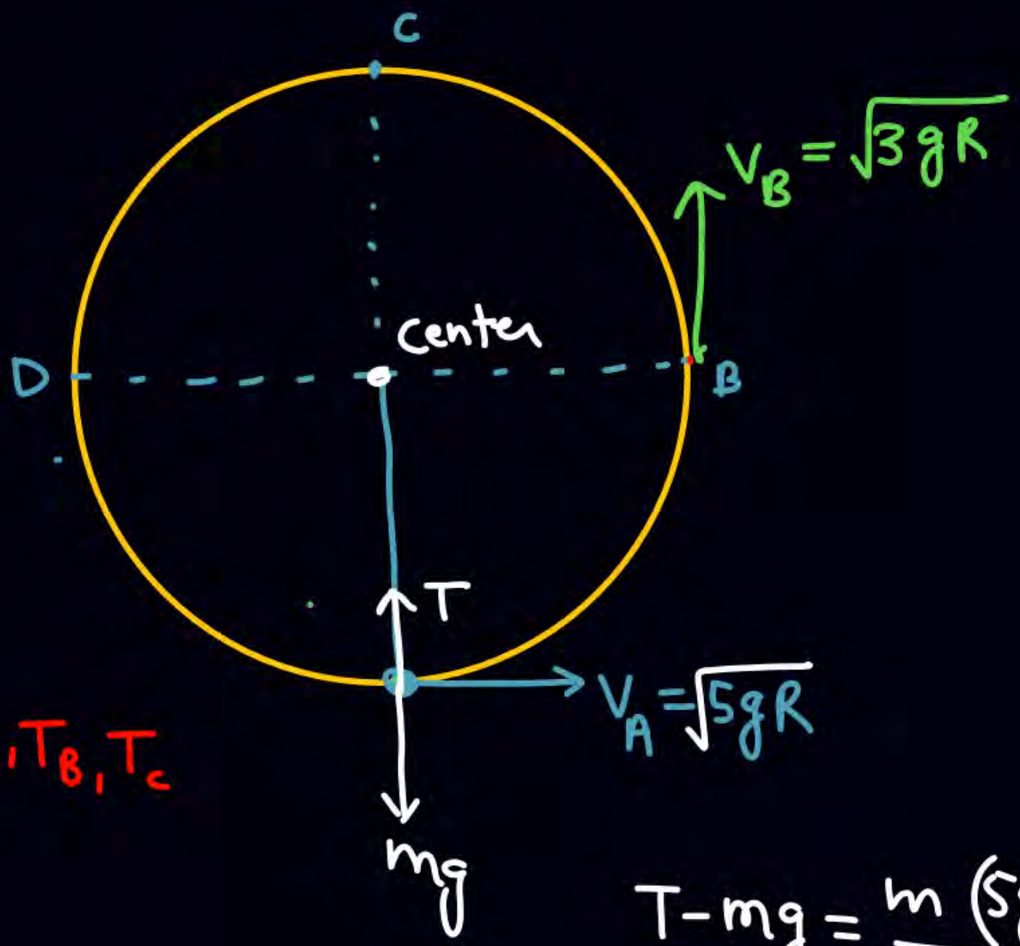
$T = 3mg$

$W_g + W_T = \Delta KE$

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

$V = \sqrt{2gR}$

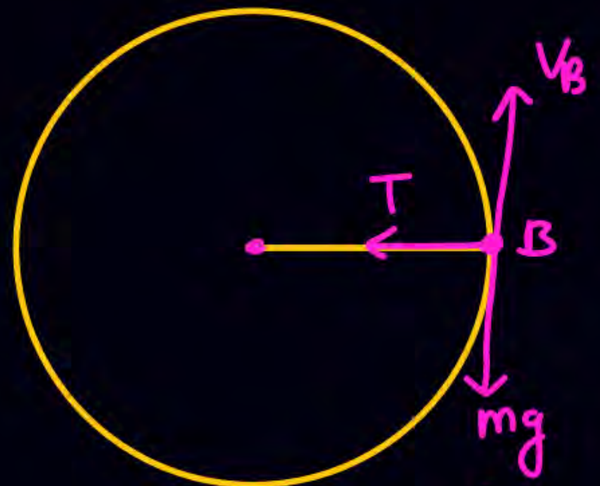
Q



find T_A, T_B, T_C

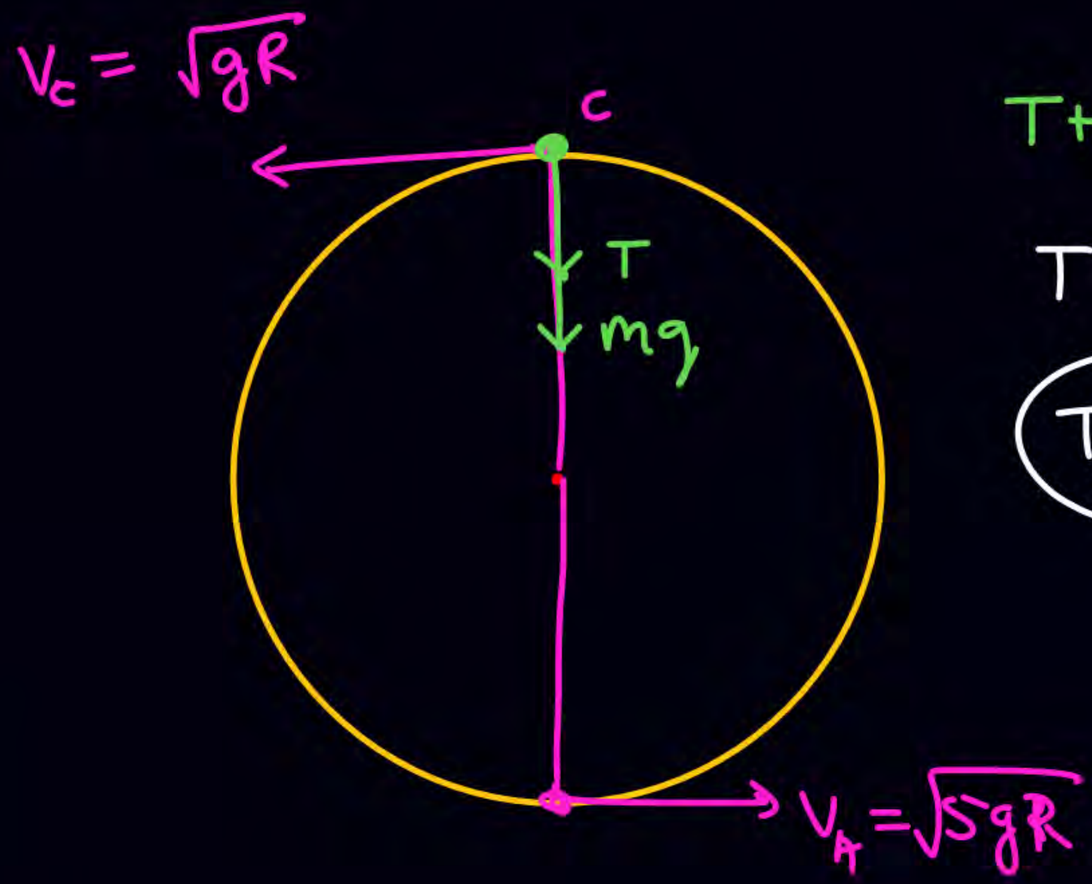
$$T - mg = \frac{m(5gR)}{R}$$

$$\boxed{T = 6mg}$$



$$T_B = \frac{mV_B^2}{R} = \frac{m\,3gR}{R}$$

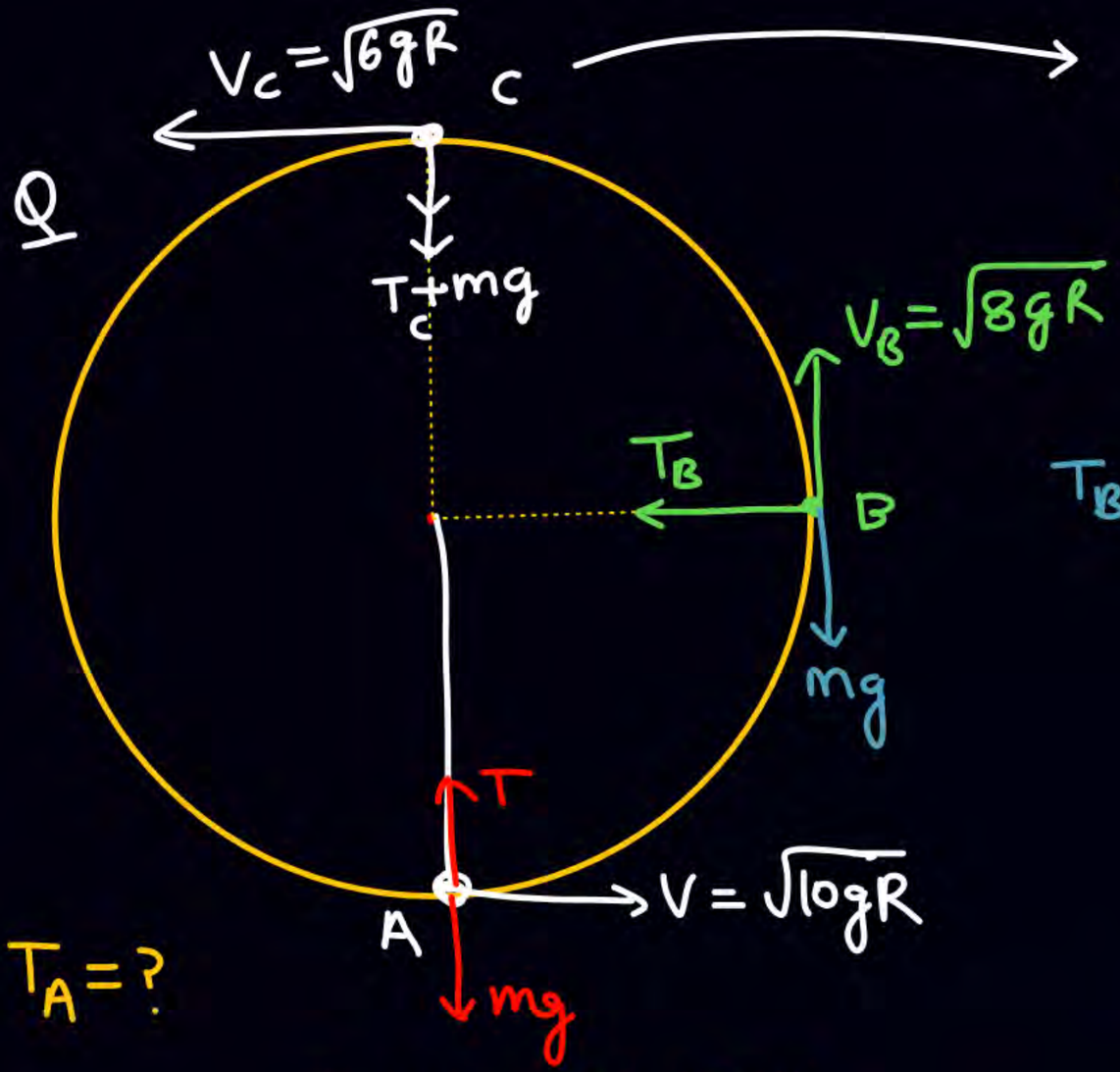
$$\boxed{T_B = 3mg}$$



$$T + mg = \frac{mV_c^2}{R}$$

$$T + mg = \frac{mgR}{R}$$

$$T_c = 0$$



$T_A = ?$

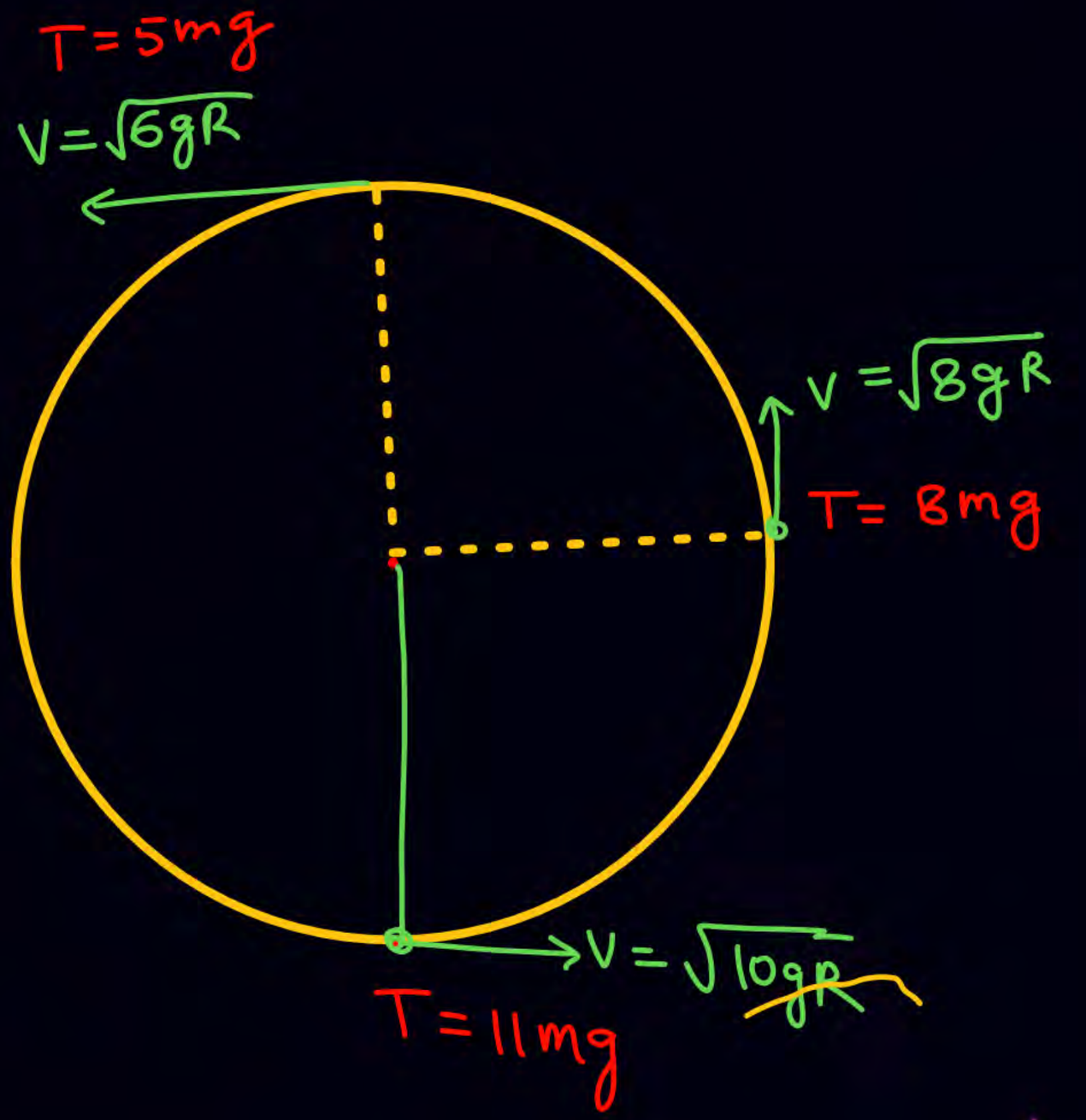
$$T + mg = \frac{mV_C^2}{R}$$

$$T + mg = \frac{m6gR}{R} \Rightarrow \boxed{T_C = 5mg}$$

$$T_B = \frac{mV_B^2}{R} = \frac{m \times 8gR}{R} \Rightarrow \boxed{T_B = 8mg}$$

$$T - mg = \frac{m \times 10gR}{R}$$

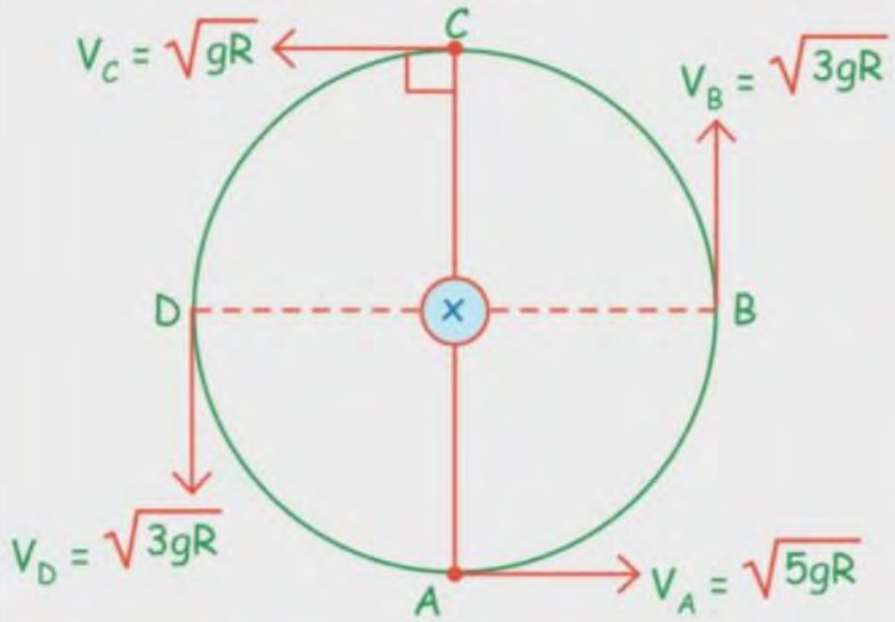
$$\boxed{T = 11mg}$$



Velocity के लिए
2 कण
T के 3 कण

This is Very Important Part

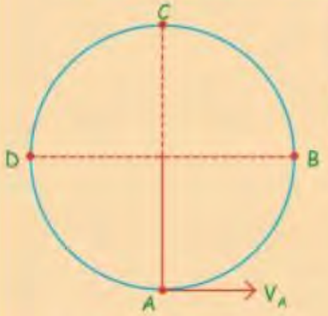
Minimum velocity at A to complete vertical circular motion is $\sqrt{5gR}$, इस case मे remember हमने at highest point $T_c = 0$ किया, mg ने इज्जत बचाई, $V_b = \sqrt{3gR}$ और $V_c = \sqrt{gR}$



अब आपको हर point पर V, T, a_t, a_c निकालना आना चाहिए मै मस्त तरीके से हर एक-एक चीज को solve करके represent कर दे रहा हुँ plz इन्हे खुद से जरूर solve

काम का डब्बा

Particle given horizontal velocity at A

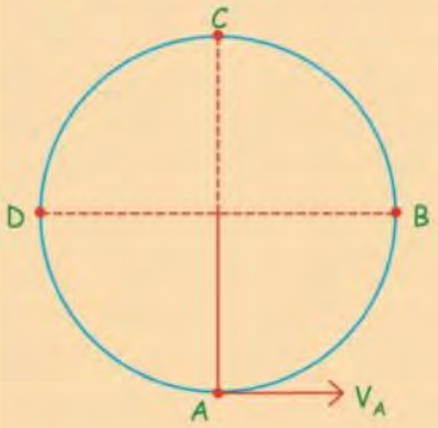


ये result जरूर याद कर लेना bcz इसके बाद आपको पहले से पता होगा की particle का motion क्या होगा।

- ★ $V_A < \sqrt{2gR}$ = particle comes to rest before 'B' (v = 0 between A & B)
- ★ $V_A = \sqrt{2gR}$ = particle comes to rest at 'B'
- ★ $V_A = \sqrt{5gR}$ = vertical circular motion just completed ($T_C = 0$, $V_C = \sqrt{gR}$)
- ★ $V_A > \sqrt{5gR}$ ⇒ चमचमाता vertical circular motion चमचमाता $T_C \neq 0$
- ★ $\sqrt{2gR} < V_A < \sqrt{5gR}$ ⇒ somewhere between B & C, T will zero and subsequently motion will be projectile.

काम का डब्बा

Particle given horizontal velocity at A



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- ★ $\sqrt{2gR} < V_A < \sqrt{5gR}$ ⇒ somewhere between B & C, T will zero and subsequently motion will be projectile.

53. The bob of a pendulum at rest is given a sharp hit to impart a horizontal velocity $\sqrt{10\,gl}$, where l is the length of the pendulum. Find the tension in the string when (a) the string is horizontal, (b) the bob is at its highest point and (c) the string makes an angle of 60° with the upward vertical.

56. The bob of a stationary pendulum is given a sharp hit to impart it a horizontal speed of $\sqrt{3\,gl}$. Find the angle rotated by the string before it becomes slack.

HCV

easy

$$-mg(R+R\cos\theta) = \frac{1}{2}mV_c^2 - \frac{1}{2}m(3gR)$$

$$mg\cos\theta = \frac{mV_c^2}{R}$$

57. A heavy particle is suspended by a 1·5 m long string. It is given a horizontal velocity of $\sqrt{57}$ m/s. (a) Find the angle made by the string with the upward vertical, when it becomes slack. (b) Find the speed of the particle at this instant. (c) Find the maximum height reached by the particle over the point of suspension. Take $g = 10\ m/s^2$.

$\sqrt{2gR} = \sqrt{2 \times 10 \times 1.5} = \sqrt{30}$

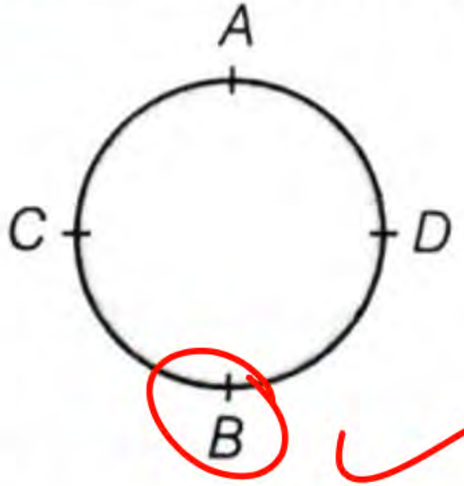
$\sqrt{5gR} = \sqrt{5 \times 10 \times 1.5} = \sqrt{75}$

$\sqrt{2gR} < v < \sqrt{5gR}$

01 A point mass m is moved in a vertical circle of radius r with the help of a string. The velocity of the mass is $\sqrt{7\,gr}$ at the lowest point. The tension in the string at the lowest point is *[NEET (Oct.) 2020]*

(a) $6mg$ (b) $7mg$ (c) $8mg$ (d) $1mg$

02 A stone is attached to one end of a string and rotated in a vertical circle. If string breaks at the position of maximum tension, it will break at *[AIPMT 2000]*



(a) A (b) B (c) C (d) D

05 A body of mass 1 kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining a height of 18 m.

How much energy is lost due to air friction?
(Take, $g = 10\ ms^{-2}$)

[NCERT (New) Pg. 74, AIPMT 2009]

(a) 20 J (b) 30 J (c) 40 J (d) 10 J

06 A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be

[NCERT (New) Pg. 78, AIPMT 2009]

(a) Mg/k (b) $2\ Mg/k$ (c) $4\ Mg/k$ (d) $Mg/2k$

JEE'25

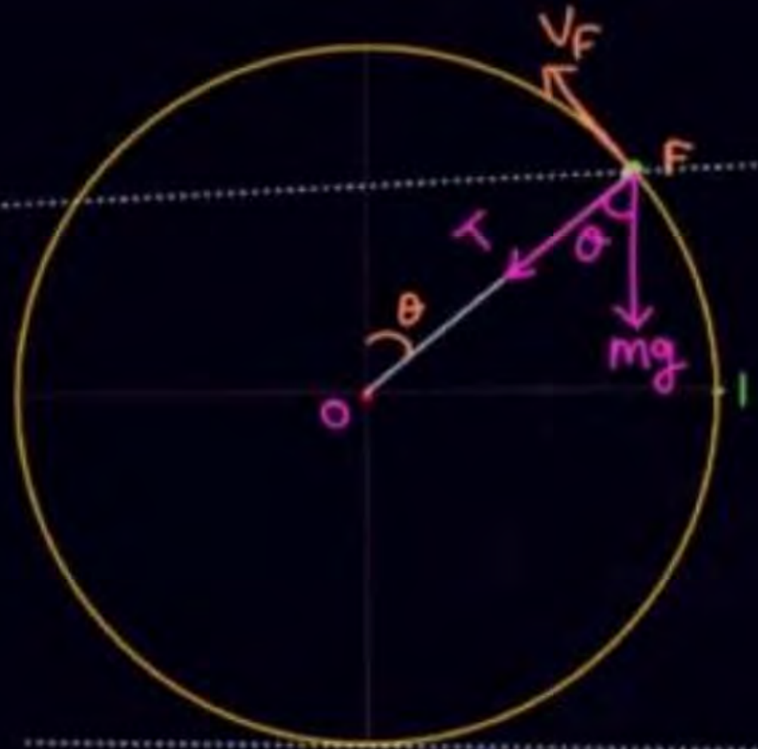
Q

① where T becomes zero.
where string slack

④ h_{max} from A

* ② Find min speed of particle in entire motion

③ a_t & a_c where $T = 0$



(W.E.T)

$W_g + W_T = \Delta KE = K_f - K_i$

$-mg(R + R\cos\theta) + 0 = \frac{1}{2}mV_f^2 - \frac{1}{2}m(3.5gR)$ ——— ①

Circular motion equation $\Rightarrow$ $T + mg\cos\theta = \frac{mv_f^2}{R}$ ——— ②

Solve ——— ① & ② $\Rightarrow$ $\theta = 60^\circ$; $V_f = \sqrt{\frac{gR}{2}}$

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$v < \sqrt{2gR}$ ⇒ particle will not reach at B comes to at rest before B & oscillate
B से पहले कहीं पर $v=0$, $T \neq 0$

$V_A = \sqrt{2gR}$ ⇒ particle reaches at B
s.t $v_B = 0$

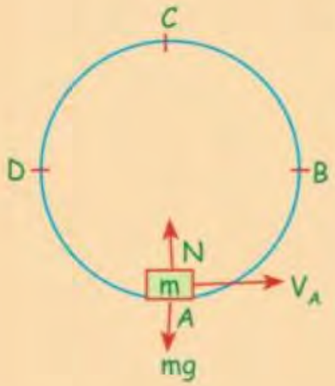
$\sqrt{2gR} < v_A < \sqrt{5gR}$ ⇒ V.C.M. doesnot Complete
particle cross point B
and between B & C
Somewhere $T=0$
↓
इसके बाद projectile motion

$v_A = \sqrt{5gR}$ सबसे वाला Circle
particle just complete (V.C.M.)
$T_c = 0$, $v_B = \sqrt{3gR}$, $v_C = \sqrt{gR}$

$v_A > \sqrt{5gR}$ चमचमाता V.C.M.

काम का डब्बा

Particle given horizontal velocity at A



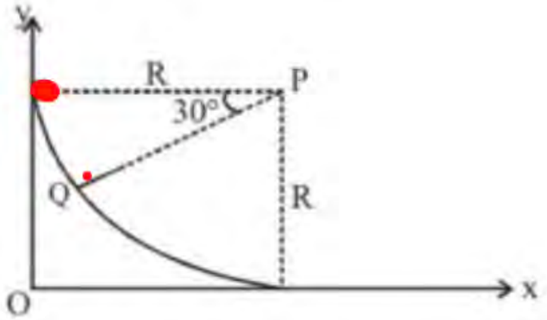
ये result बिल्कुल पहले जैसे है बस tension की जगह अब normal आगया और भाई ये VCM है horizontal नही be carefull

- ★ $V_A < \sqrt{2gR}$ = particle comes to rest before 'B' (v = 0 between A & B)
- ★ $V_A = \sqrt{2gR}$ = particle comes to rest at 'B'
- ★ $V_A = \sqrt{5gR}$ = vertical circular motion just completed ($N_C = 0$, $V_C = \sqrt{gR}$)
- ★ $V_A > \sqrt{5gR}$ ⇒ चमचमाता vertical circular motion

  चमचमाता $N_C \neq 0$
- ★ $\sqrt{2gR} < V_A < \sqrt{5gR}$ ⇒ somewhere between B & C, N will zero and subsequently motion will be projectile.

A small block of mass 1 kg is released from rest at the top of a rough track. The track is a circular arc of radius 40 m. The block slides along the track without toppling and a frictional force acts on it in the direction opposite to the instantaneous velocity. The work done in overcoming the friction up to the point Q, as shown in the figure below, is 150 J. (Take the acceleration due to gravity, $g = 10\ m\ s^{-2}$) **[IIT-JEE-2013]**

एक रूक्ष पथ के उच्चतम बिन्दु से एक 1 kg द्रव्यमान के गुटके को विरामावस्था से छोड़ा जाता है। यह पथ 40 m त्रिज्या का वृत्तीय चाप है। गुटका अपने पथ पर बिना लुढ़के हुए सरकता है। इस गुटके पर एक घर्षण बल तात्क्षणिक वेग की विपरीत दिशा में लगता है। चित्र में दर्शाये अनुसार, बिन्दु Q तक आने के लिए घर्षण को अतिकम करने के लिए 150 J कार्य करना पड़ता है। (गुरूत्वीय त्वरण $g = 10\ m\ s^{-2}$ लीजिए)



17. The magnitude of the normal reaction that acts on the block at the point Q is

बिन्दु Q पर, गुटके पर लगने वाले अभिलंब बल का परिमाण है :-

(A) 7.5 N (B) 8.6 N (C) 11.5 N (D) 22.5 N

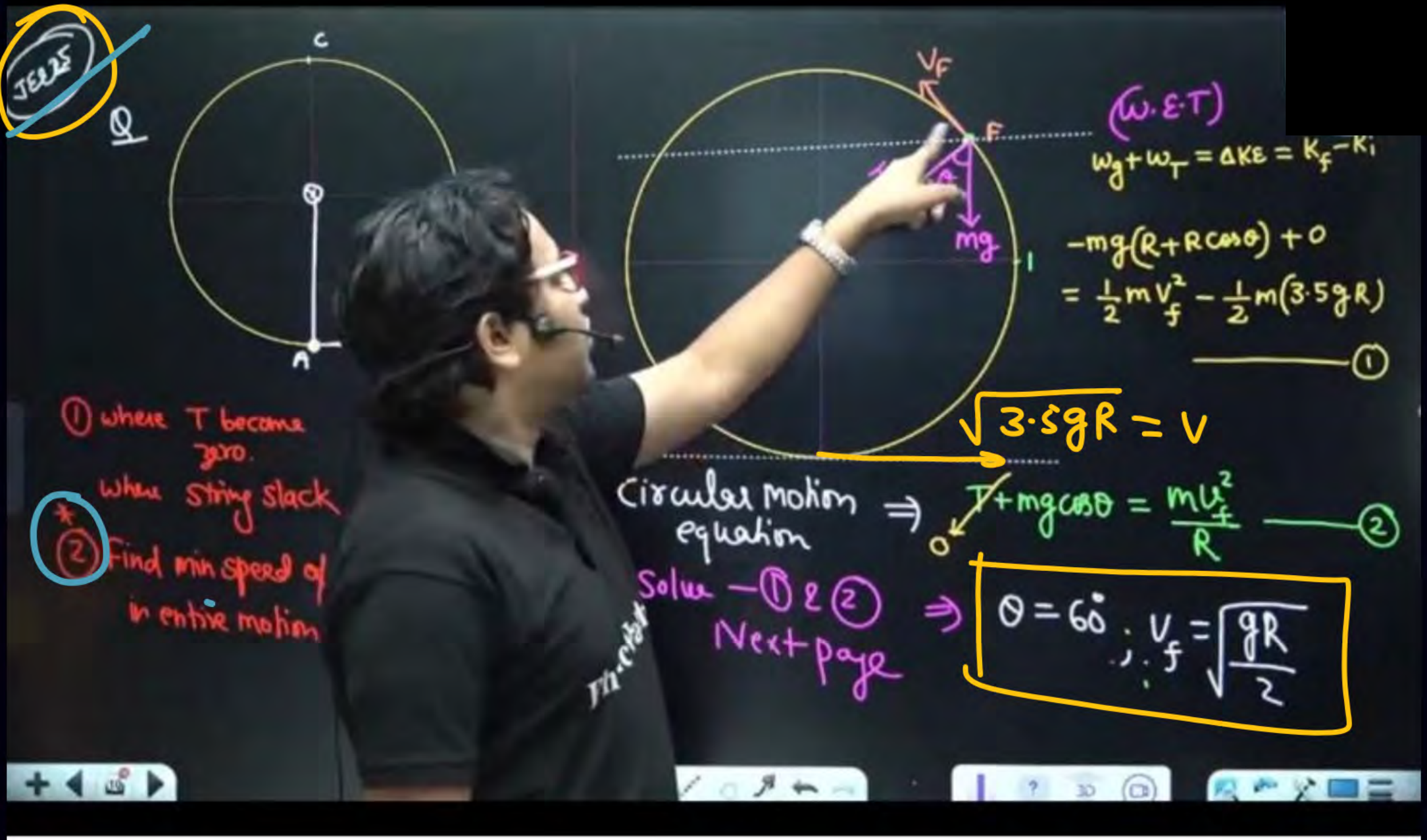
Ans. (A)

18. The speed of the block when it reaches the point Q is

जब गुटका बिन्दु Q पर पहुँचता है, इसकी गति है :-

(A) $5\ ms^{-1}$ (B) $10\ ms^{-1}$ (C) $10\sqrt{3} ms^{-1}$ (D) $20\ ms^{-1}$

Ans. (B)


JEE25
Q
C
A
O
V_F
F
mg
(W.E.T)
$W_g + W_T = \Delta KE = K_f - K_i$
$-mg(R+R\cos\theta) + 0 = \frac{1}{2}mV_f^2 - \frac{1}{2}m(3.5gR)$ ——— (1)
$\sqrt{3.5gR} = V$
① where T becomes zero.
where String slack
* (2) Find min speed of in entire motion
Circular motion equation ⇒
$T + mg\cos\theta = \frac{mv_f^2}{R}$ ——— (2)
Solve — (1) & (2)
Next page
⇒
$\theta = 60°$; $V_f = \sqrt{\frac{gR}{2}}$

QUESTION

A force F = 20 + 10y acts on a particle in y-direction where F is in newton and y in meter. Work done by this force to move the particle from y = 0 to y = 1 m is:

[NEET - 2019]

$$\int_0^1 (20 + 10y)\, dy = \checkmark$$

1. 20 J
2. 30 J
3. 5 J
4. 25 J

Ans: (4)

QUESTION

What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop? [NEET-I, 2016]

1. $\sqrt{3gR}$
2. $\sqrt{5gR}$
3. $\sqrt{gR}$
4. $\sqrt{2gR}$

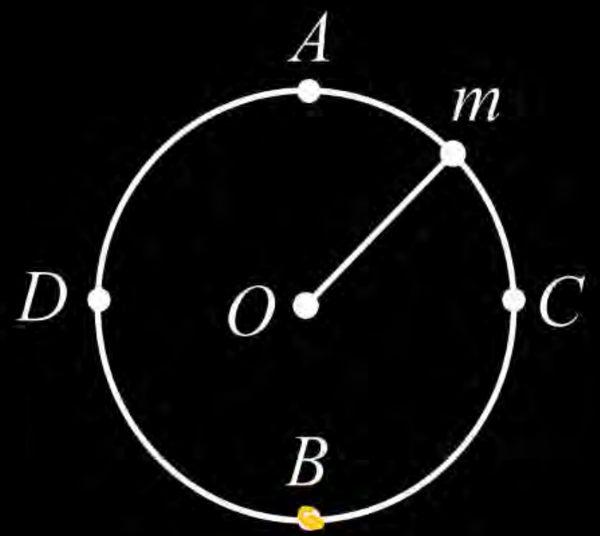
Ans: (2)

QUESTION

As shown in the figure, a mass is performing vertical circular motion. The average velocity of the particle is increased, then at which point will the string break?

[NEET - 2000]

1. A
2. B
3. C
4. D



Ans: (2)

QUESTION

The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applies by the breaks on car A and B, respectively, then the ratio F_A / F_B is

[NEET-2025]

A: $K = 100$, $x = 1000$ B: $K = 225$, $x = 1500$

$-fx = 0 - K_i$

$fx = K$

$f = \frac{K}{x}$

$\frac{f_1}{f_2} = \frac{K_1}{K_2} \cdot \frac{x_2}{x_1}$

$= \frac{100}{225} \times \frac{1500}{1000}$

$= \frac{150}{225} = \frac{6}{9} = \frac{2}{3}$

1. 3/2
2. 2/3
3. 1/3
4. 1/2

Ans: (2)

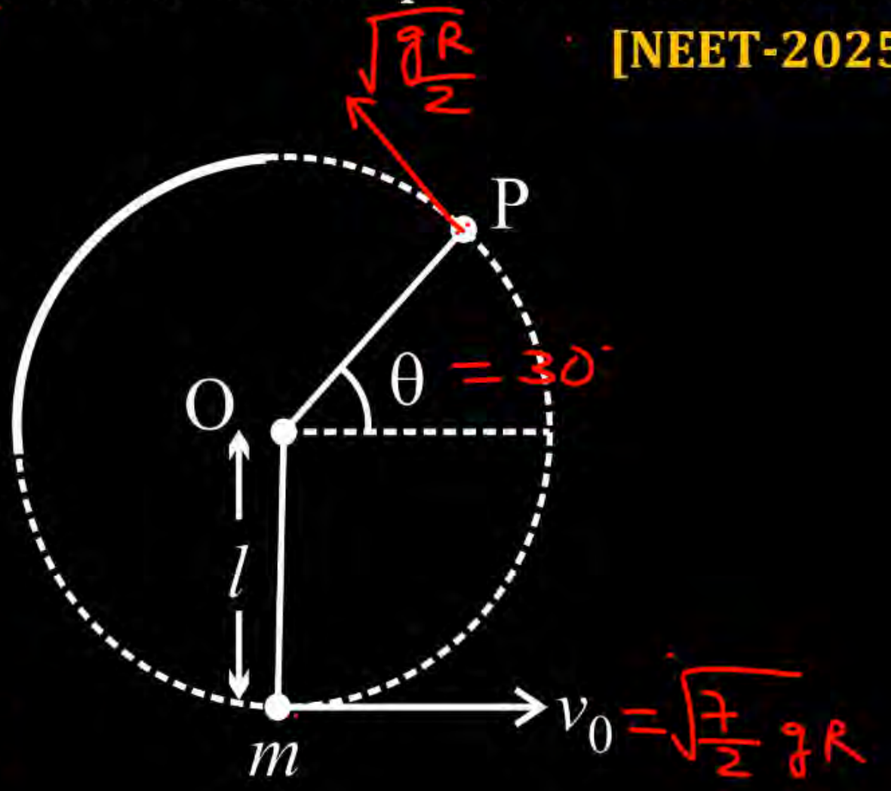
QUESTION

A bob of heave mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is: [NEET-2025]

1. $(\sin\theta)^{1/2}$
2. $\left(\frac{1}{1+3\sin\theta}\right)^{1/2}$
3. $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{1/2}$
4. $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$

$\sqrt{\frac{\frac{gR}{2}}{\frac{7}{2}gR}} = \frac{1}{7}$

$\frac{\frac{1}{2}}{2+\frac{3}{2}} = \sqrt{\frac{\frac{1}{2}}{\frac{7}{2}}} = \sqrt{\frac{1}{7}}$



Ans: (4)

Home Work

- KPP next 2, HCV circular complete
- HCV WPE complete...

"ha...ha...ha.... ye kuch Nahi kaana hai..... just enjoy.

No. Homework till monday...
Be relax & stressfree...

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THANK YOU