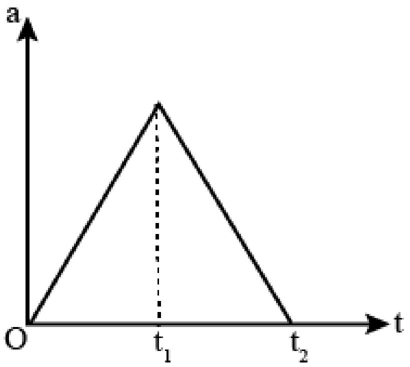
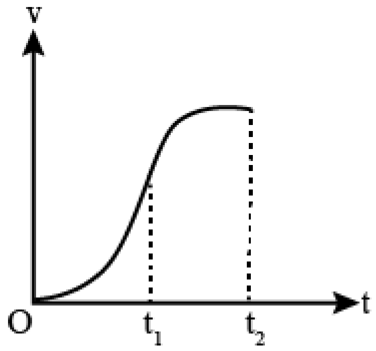
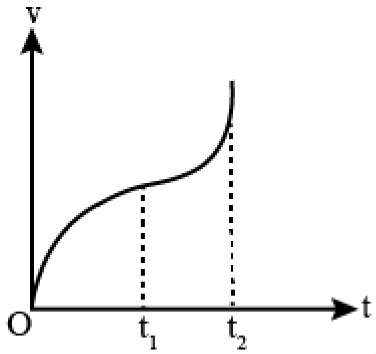
JEE Main Part Test 1

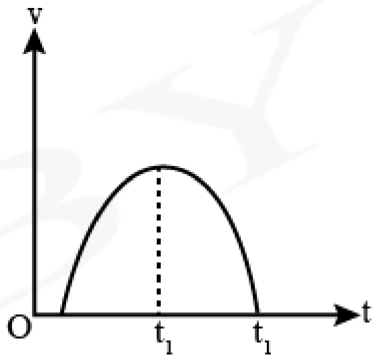
Subject: Physics   Class: Standard XII

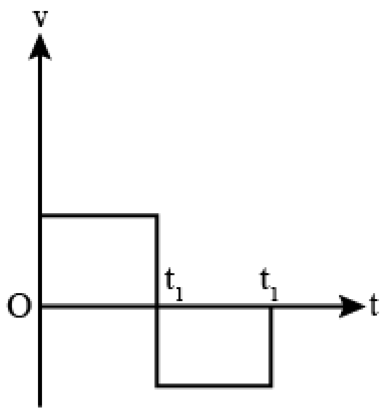
1. The acceleration-time graph of a particle is shown in figure. The respective $v-t$ graph of the particle is



A. 

B. 

C. 

D. 

2. A particle is projected at an angle with the horizontal such that it follows a trajectory given by the equation $y = 6x - 2x^2$. Find the maximum height attained by it.

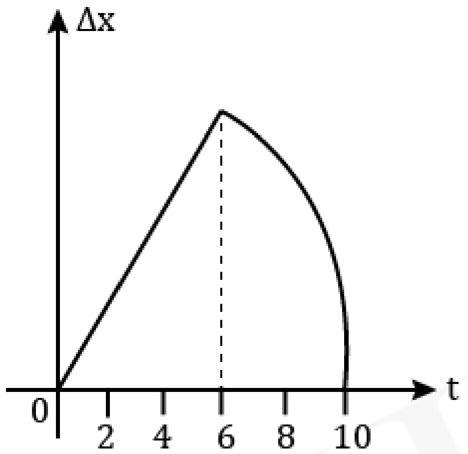
   A. $2.5\ m$

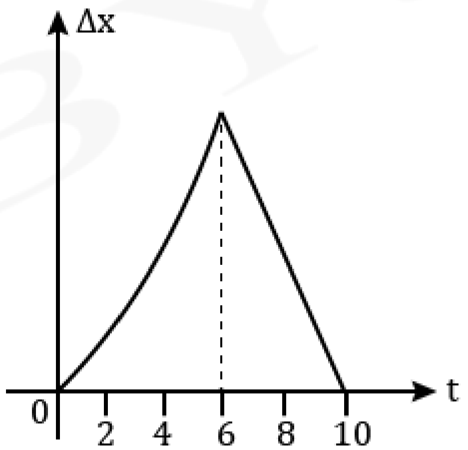
   B. $5.2\ m$

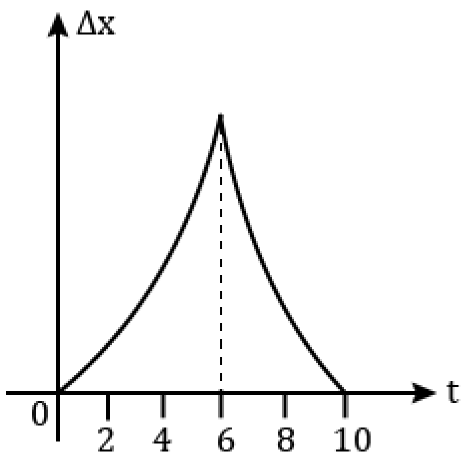
   C. $4.5\ m$

   D. $6\ m$

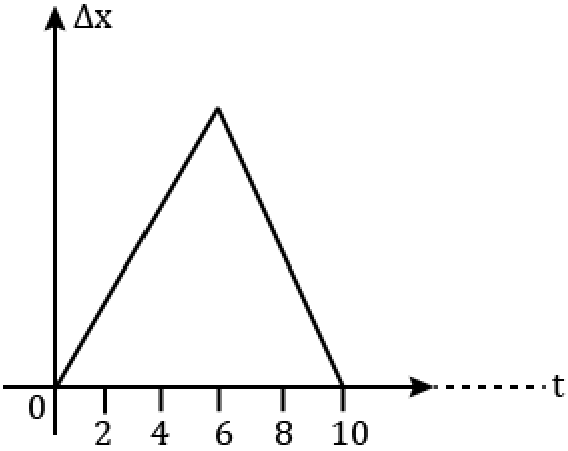
3. Two stones are thrown up simultaneously with initial speeds u_1 and $u_2 (u_2 > u_1)$. They hit the ground after 6 s and 10 s respectively. Which graph correctly represents the time variation of, $\Delta x = (x_2 - x_1)$, the relative position of the second stone with respect to the first upto $t = 10 \text{ s}$? Assume that the stones do not rebound after hitting the ground.

A. 

B. 

C. 

D.



4. In a lift moving up with an acceleration of $5 \mathrm{~ms}^{-2}$, a ball is dropped from a height of $1.25 \mathrm{~m}$. The time taken by the ball to reach the floor of the lift is approximately $\left(g=10 \mathrm{~ms}^{-2}\right)$

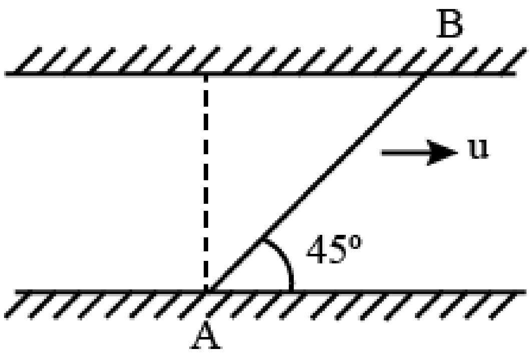
A. 0.3 second

B. 0.2 second

C. 0.16 second

D. 0.4 second

5. A man wants to reach point B on the opposite bank of a river flowing at a speed u as shown. What minimum velocity relative to water should the man have so that he can reach directly to point B?



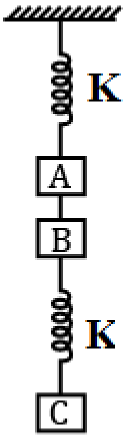
A. $\frac{u}{\sqrt{2}}$, in the upstream at an angle 45° with the vertical

B. $\sqrt{2}u$, in the upstream at an angle 45° with the vertical

C. $\frac{u}{\sqrt{2}}$, in the downstream at an angle 45° with the vertical

D. $\sqrt{2}u$, in the downstream at an angle 45° with the vertical

6. The system shown is in equilibrium. Find the accelerations of the blocks A, B and C just after the spring between B and C is cut. All blocks are of equal masses 'm' each and springs are of equal stiffness. (Assume springs to be ideal and take downward acceleration to be positive).



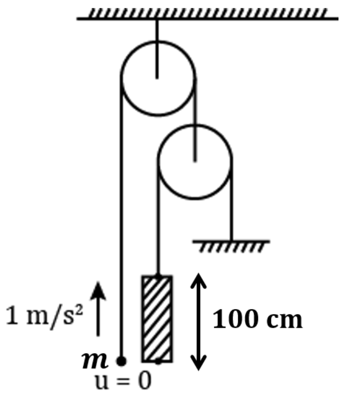
A. $+g, +g, -g$

B. $-\frac{g}{2}, -\frac{g}{2}, +g$

C. $+g, -\frac{g}{2}, -g$

D. $0, -\frac{g}{2}, -g$

7. In the arrangement shown in the figure, the mass 'm' is going upward with an acceleration of $1\ m/s^2$. The length of the rod is $100\ cm$. Pulley is frictionless and threads are massless . If the mass is set at the level of the lower end of the rod and released, how much time it will take for ball to reach the level of the upper end?



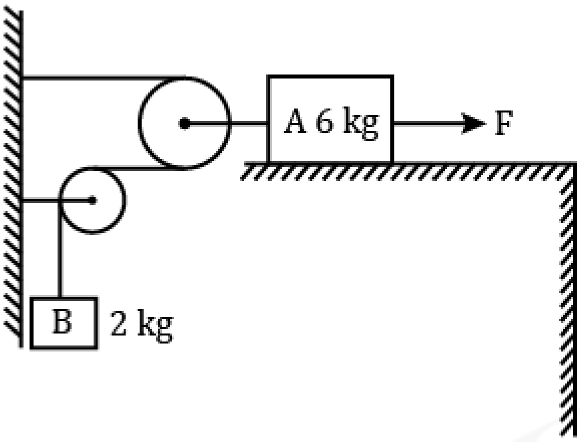
A. $\sqrt{\frac{1}{3}}s$

B. $\sqrt{\frac{2}{3}}s$

C. $\frac{2}{3}s$

D. $\frac{1}{3}s$

8. The system starts from rest and block A attains a velocity of $5 \mathrm{~m/s}$ after it has moved $5 \mathrm{~m}$ towards the right. Assuming the arrangement to be frictionless everywhere and pulley & strings to be light, find the value of the constant force F applied on block A. (Take $g = 10\ m/s^2$)



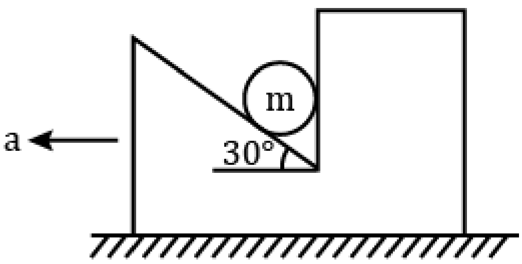
A. $50 \mathrm{~N}$

B. $75 \mathrm{~N}$

C. $100 \mathrm{~N}$

D. $96 \mathrm{~N}$

9. In the figure shown, if a ball of mass m is at rest relative to the wedge moving to the left with an acceleration $a = g\sqrt{3}$, find the force exerted by the vertical face of the wedge on mass m.



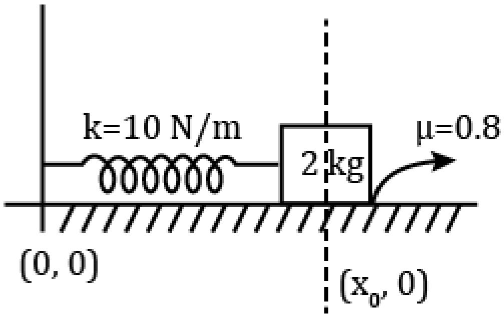
A. $\frac{2mg}{\sqrt{3}}$

B. $mg\sqrt{3}$

C. $\frac{4mg}{\sqrt{3}}$

D. $\frac{\sqrt{3}mg}{4}$

10. A block of mass $2\ \mathrm{kg}$ is attached to a spring of force constant $k = 10\ \mathrm{N/m}$ as shown in the figure. Find the range in which the block can be kept without slipping when the block is pulled or pushed towards the spring (spring is elongated or compressed). Take $g = 10\ \mathrm{m/s^2}$.



A. $3.2\ \mathrm{m}$

B. $1.6\ \mathrm{m}$

C. $2.4\ \mathrm{m}$

D. $4.8\ \mathrm{m}$

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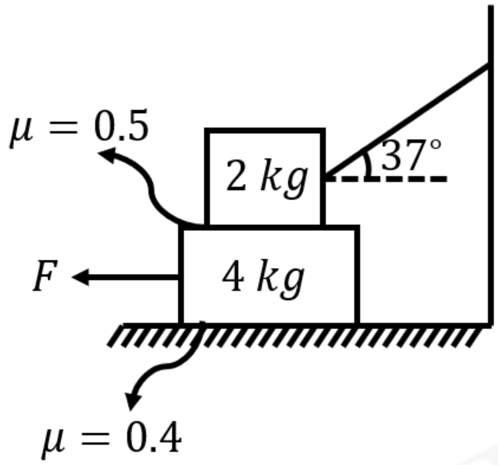
11. In the figure shown below, a horizontal force F is applied on $4\ \mathrm{kg}$ block towards left. If the coefficient of friction between the surfaces are 0.5 and 0.4 as shown in the figure. The value of Tension in the rope and force required just to slide the $4\ \mathrm{kg}$ block under $2\ \mathrm{kg}$ block is
(rope is massless and inextensible)



A. $T = 90.9\ \mathrm{N}$ and $F = 29\ \mathrm{N}$

B. $T = 9.09\ \mathrm{N}$ and $F = 14.5\ \mathrm{N}$

C. $T = 9.09\ \mathrm{N}$ and $F = 29\ \mathrm{N}$

D. $T = 90.9\ \mathrm{N}$ and $F = 14.5\ \mathrm{N}$

12. A block of mass m is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is

A. $\frac{1}{6} m$

B. $\frac{2}{3} m$

C. $\frac{1}{3} m$

D. $\frac{1}{2} m$

13. At certain place on railway track, the radius of curvature of railway track is $200\ \mathrm{m}$. If the distance between the rails is $1.6\ \mathrm{m}$, and the outer rail is raised by $0.08\ \mathrm{m}$ above the inner rail, find the speed of train for which there is no side pressure of the rails.
(Take $g = 10\ \mathrm{m/s^2}$)

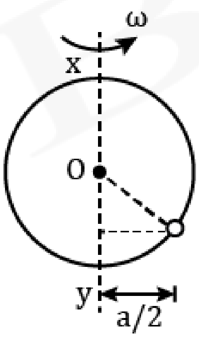
A. $5\ \mathrm{m/s}$

B. $10\ \mathrm{m/s}$

C. $15\ \mathrm{m/s}$

D. $20\ \mathrm{m/s}$

14. A small ring P is threaded on a smooth wire bent in the form of a circle of radius a and center O. The wire is rotating with constant angular speed ω about a vertical diameter xy, while the ring remains at rest relative to the wire at a distance $\frac{a}{2}$ from xy. Then ω^2 is equal to



A. $\frac{2g}{a}$

B. $\frac{g}{2a}$

C. $\frac{2g}{a\sqrt{3}}$

D. $\frac{g\sqrt{3}}{2a}$

15. A force F acting on a body depends on its displacement x as $F \propto x^{\frac{-1}{3}}$. The power delivered by F will depend on displacement as

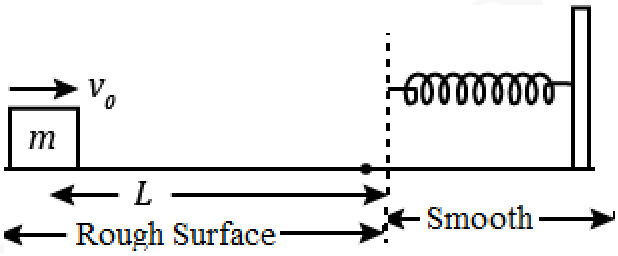
A. $x^{\frac{2}{3}}$

B. $x^{\frac{5}{3}}$

C. $x^{\frac{1}{2}}$

D. x^{0}

16. A block of mass m starts moving with an initial velocity v_0 at a distance L towards a stationary spring of stiffness K attached to the wall as shown in the figure.



Find the distance travelled by block on smooth surface before coming to rest.
Given that surface is rough only for distance L and friction coefficient μ is such that $\left(\frac{1}{2}mv_0^2 > \mu mgL\right)$.

A. $v_0\sqrt{\frac{m}{K}}$

B. $\sqrt{\frac{\frac{1}{2}mv_0 - \mu mL}{K}}$

C. $\sqrt{\frac{\frac{1}{2}mv_0 - \mu mL}{2K}}$

D. $\sqrt{\frac{mv_0^2 - 2\mu mgL}{K}}$

17. A stone of mass $1\ \mathrm{kg}$ tied to a light string of length $\frac{10}{3}\mathrm{m}$ is whirled in a vertical circle. If the ratio of the maximum tension to minimum tension is 4 and $g = 10\ \mathrm{m/s^2}$, then the speed of the stone at the highest point of the circle is

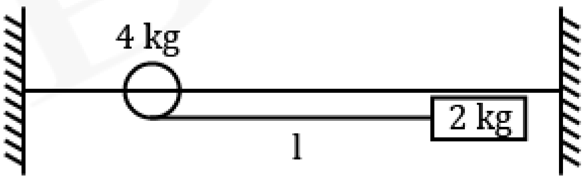
A. $0\ \mathrm{m/s}$

B. $20\ \mathrm{m/s}$

C. $10\ \mathrm{m/s}$

D. $5\ \mathrm{m/s}$

18. As shown in figure, a particle of mass $2\ \mathrm{kg}$ is attached to a bead. The bead can slide on a smooth straight wire. Length of the string which connect the particle and the bead is l. Initially, the particle is held in contact with the wire with the string taut as shown in figure, and then it is let to fall. If the bead has a mass $4\ \mathrm{kg}$, then, when the string makes an angle $\theta = 60^\circ$ with the wire, find the distance it slides upto this instant.



A. $\frac{l}{6}$ towards left

B. $\frac{l}{6}$ towards right

C. $\frac{l}{2}$ towards left

D. $\frac{l}{2}$ towards right

19. Two boys A and B of mass $60\ \mathrm{kg}$ and $40\ \mathrm{kg}$ are standing on a platform. Both start walking towards each other with the same velocity $5\ \mathrm{m/s}$. Find the velocity of the platform if mass of the platform is $100\ \mathrm{kg}$.

A. $0.5\ \mathrm{m/s}$

B. $2\ \mathrm{m/s}$

C. $1\ \mathrm{m/s}$

D. $5\ \mathrm{m/s}$

20. A solid cylinder is released from rest from the top of an inclined plane of inclination θ and length $'l'$. If the cylinder rolls without slipping, then find it's speed when it reaches the bottom of inclined plane.

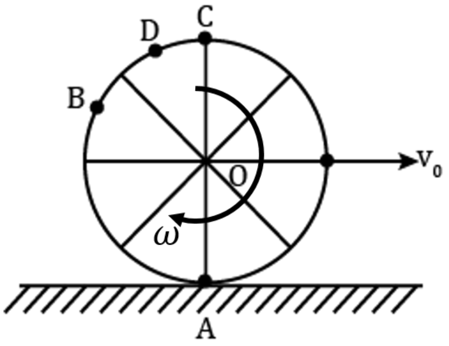
A. $\sqrt{\dfrac{4gl\sin\theta}{3}}$

B. $\sqrt{\dfrac{3gl\sin\theta}{2}}$

C. $\sqrt{\dfrac{4gl}{3\sin\theta}}$

D. $\sqrt{\dfrac{4g\sin\theta}{3l}}$

21. Consider a bicycle tyre rolling without slipping on a smooth horizontal surface with a linear velocity v_0 as shown in figure. Then, which of the following statement is incorrect?



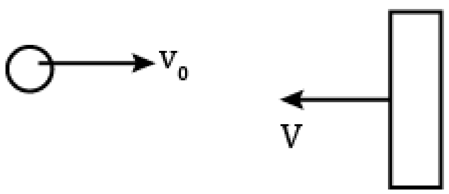
A. Speed of point A is zero

B. Speed of point B, C and D are equal to v_0

C. Speed of point $B >$ speed of point O

D. Speed of point $C = 2v_0$

22. A prticle of mass m moves with velocity $v_0 = 20 \mathrm{~m/s}$ towards a large wall that is moving with velocity $v = 5 \mathrm{~m/s}$ towards the particle as shown. If the particle collides with the wall elastically, then find the speed of the particle just after collision. (Assume collision with the wall is elastic)



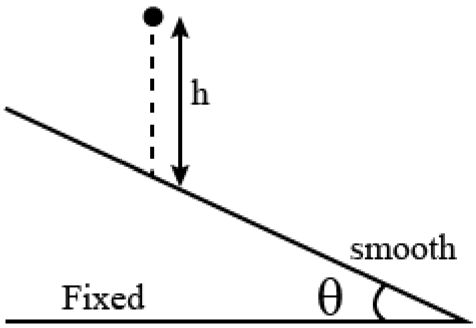
A. $30 \mathrm{~m/s}$

B. $20 \mathrm{~m/s}$

C. $25 \mathrm{~m/s}$

D. $22 \mathrm{~m/s}$

23. A ball of mass m strikes the fixed inclined plane after falling through a height h. If it rebounds elastically, the impulse imparted on the ball is



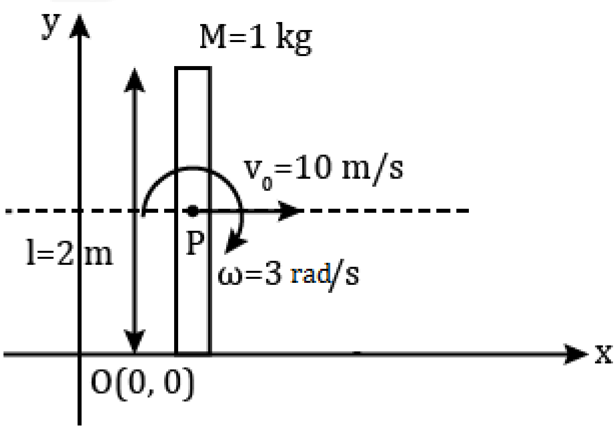
A. $2m\sqrt{2gh}\cos\theta$

B. $2m\sqrt{gh}\cos\theta$

C. $2m\sqrt{2gh}\sin\theta$

D. $2m\sqrt{2gh}$

24. A rod of mass $1\ \mathrm{kg}$ and length $2\ \mathrm{m}$ is performing combined translational and rotational motion as shown in figure. Find the magnitude of total angular momentum about the origin.



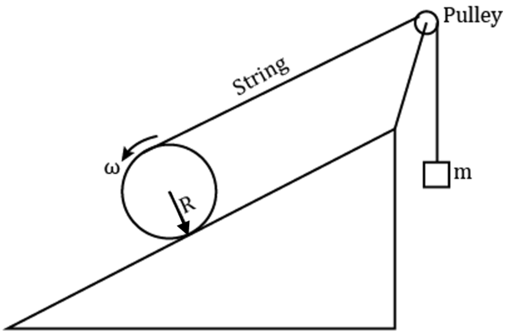
A. $10\ \mathrm{kgm^2/s}$

B. $1\ \mathrm{kgm^2/s}$

C. $11\ \mathrm{kgm^2/s}$

D. $20\ \mathrm{kgm^2/s}$

25. A uniform disc of mass M and radius R is attached to a block of mass m by means of a light string and a light pulley fixed at the top of an inclined plane of inclination θ. The string is wrapped around the disc. The disc rolls down the incline. If $M = 6\ \mathrm{m}$ and $\theta = 30^{\circ}$, the acceleration of the centre of mass of the disc is: (Assume no slipping at any contact point)



A. $\frac{g}{6}$

B. $\frac{g}{13}$

C. $\frac{g}{16}$

D. g

26. At some instant $\vec{v} = 4\hat{i} - 3\hat{j}\ \mathrm{m/s}$ and $\vec{a} = 2\hat{i} + \hat{j}\ \mathrm{m/s^2}$. Find the radius of curvature at that instant.

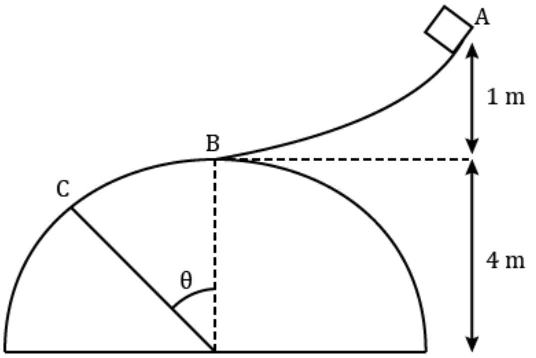
A. $12.5\ \mathrm{m}$

B. $25\ \mathrm{m}$

C. $15\ \mathrm{m}$

D. $20\ \mathrm{m}$

27. An object at rest at point A slides down on a smooth surface ending at point B at a fixed hemisphere as shown in the figure. Determine the angle θ at which the object will leave the hemisphere.



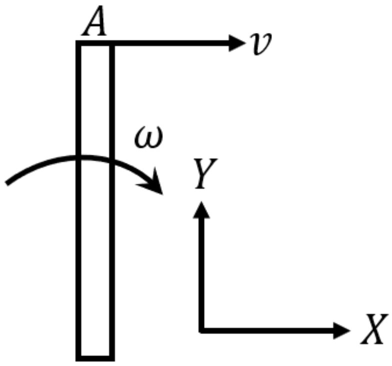
A. $\cos^{-1}\left(\frac{4}{7}\right)$

B. $\cos^{-1}\left(\frac{5}{6}\right)$

C. $\cos^{-1}\left(\frac{1}{2}\right)$

D. $\cos^{-1}\left(\frac{1}{3}\right)$

28. Find the instantaneous axis of rotation of a rod of length l from the end A when it moves with a velocity $\overrightarrow{v_A} = v\hat{i}$ and the rod rotates with an angular velocity $\vec{\omega} = -\frac{v}{2l}\hat{k}$, shown in the figure.



A. $\frac{l}{2}$

B. l

C. $2l$

D. $\sqrt{2}l$

29. A physical quantity $'y'$ is represented by the formula $y = m^2 r^{-4} g^x l^{-3/2}$. If the relative errors found in y, m, r, l and g are $18, 1, 0.5, 4$ and p respectively, then which of the following combination satisfy value of x and p

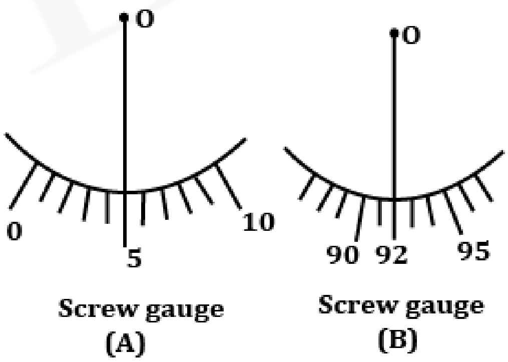
A. 5 and 2

B. 4 and 3

C. $\frac{16}{3}$ and $\frac{3}{2}$

D. 8 and 2

30. Student A and Student B used two screw gauges of equal pitch and 100 circular divisions each, to measure the radius of a given wire. The actual value of the radius of the wire is $0.322\ \mathrm{cm}$. The absolute value of the difference between the final circular scale readings observed by the students A and B is.
[Figure shows position of reference $'O'$ when jaws of screw gauge are closed]
Given pitch = $0.1\ \mathrm{cm}$.



A. 31

B. 13

C. 21

D. 15