DPP – 4

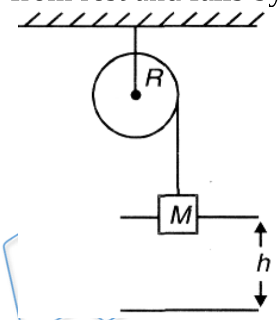
Video Solution on Website:- https://physicsaholics.com/home/courseDetails/81

Video Solution on YouTube:- https://youtu.be/tQX4BDTsGOQ

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/18

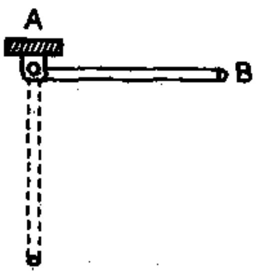
Q 1. A wheel of mass 2 kg having practically all the mass concentrated along the circumference of a circle of radius 20 cm, is rotating on its axis with an angular velocity of 100 rad/s. The rotational kinetic energy of the wheel is
(a) 4J (b) 70J
(c) 400 J (d) 800 J

Q 2. Pulley is rotating & frictionless and can be taken as solid cylinder as shown in figure. If block starts from rest and falls by distance h. Then speed of block is proportional to



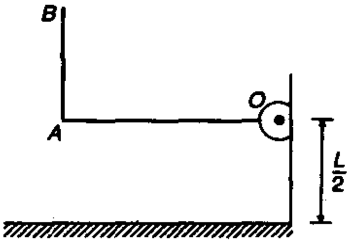
(a) R (b) 1/R (c) $1/R^2$ (d) R^0

Q 3. One end of a uniform rod of length l and mass m is hinged at A. It is released from rest from horizontal position AB as shown in figure. The force exerted by the rod on the hinge when it becomes vertical is:



(a) $\frac{3}{2}mg$ (b) $\frac{5}{2}mg$ (c) 3 mg (d) 5 mg

PASSAGE (Q.4 to Q.5)
An L shaped frame is free to rotate in a vertical plane about a horizontal axis passing through a smooth hinge 0. Each side of the frame has a length L and mass m. Frame is let to fall with one side horizontal and the other vertical.



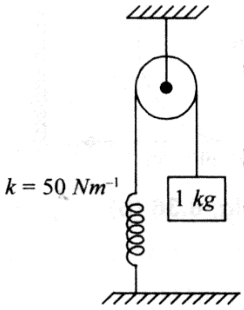
Q 4. Angular acceleration of the frame just after it is allowed to fall is

(a) $\frac{4g}{3L}$ (b) $\frac{9g}{10L}$ (c) $\frac{g}{2L}$ (d) $\frac{3g}{2L}$

Q 5. With what speed the end A will strike the ground?

(a) $1.1\sqrt{gL}$ (b) $2\sqrt{gL}$ (c) $3.2\sqrt{gL}$ (d) $\sqrt{gL}$

Q 6. The pulley shown in fig. has radius 20 cm and MOI 0.2 kg m^2. Spring used has force constant 50 Nm^{-1}. The system is released from rest when spring was in natural length. Find the velocity of 1kg block when it has descended 10 cm.



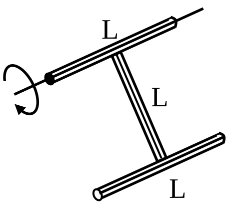
(a) 1/2 ms^{-1} (b) 1/√2 ms^{-1}
(c) 1/√3 ms^{-1} (d) none

Q 7. A uniform rod of length l is free to rotate in a vertical plane about a fixed horizontal axis through O. The rod is allowed to rotate from rest from its unstable vertical position. Then the angular velocity of the rod when it has turned through an angle θ is–

(a) $\sqrt{\frac{3g}{l}}$ sin (θ/2) (b) $\sqrt{\frac{6g}{l}}$ sin (θ/2)

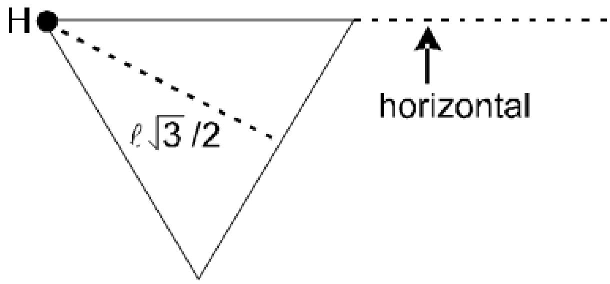
(c) $\sqrt{\frac{3g}{l}}$ Cos (θ/2) (d) $\sqrt{\frac{6g}{l}}$ Cos (θ/2)

Q 8. A rigid body is made of three identical thin rods fastened together in the form of a letter H. The body is free to rotate about a horizontal axis that passes through one of the legs of H. The body is allowed to fall from rest from a position in which the plane of the H is horizontal. Then the angular speed of the body when the plane of the H is vertical is -



(a) $\sqrt{9g/4L}$ (b) $\sqrt{3g/4L}$
(c) $\sqrt{3g/L}$ (d) None of these

Q 9. A rigid equilateral triangular frame made of three identical thin rods (mass = 1kg & length = $\sqrt{3}$ meter) is free to rotate smoothly in vertical plane. Frame is hinged at one of its vertices H. Frame is released from rest from the position shown in figure. Maximum angular velocity of frame in subsequent motion is

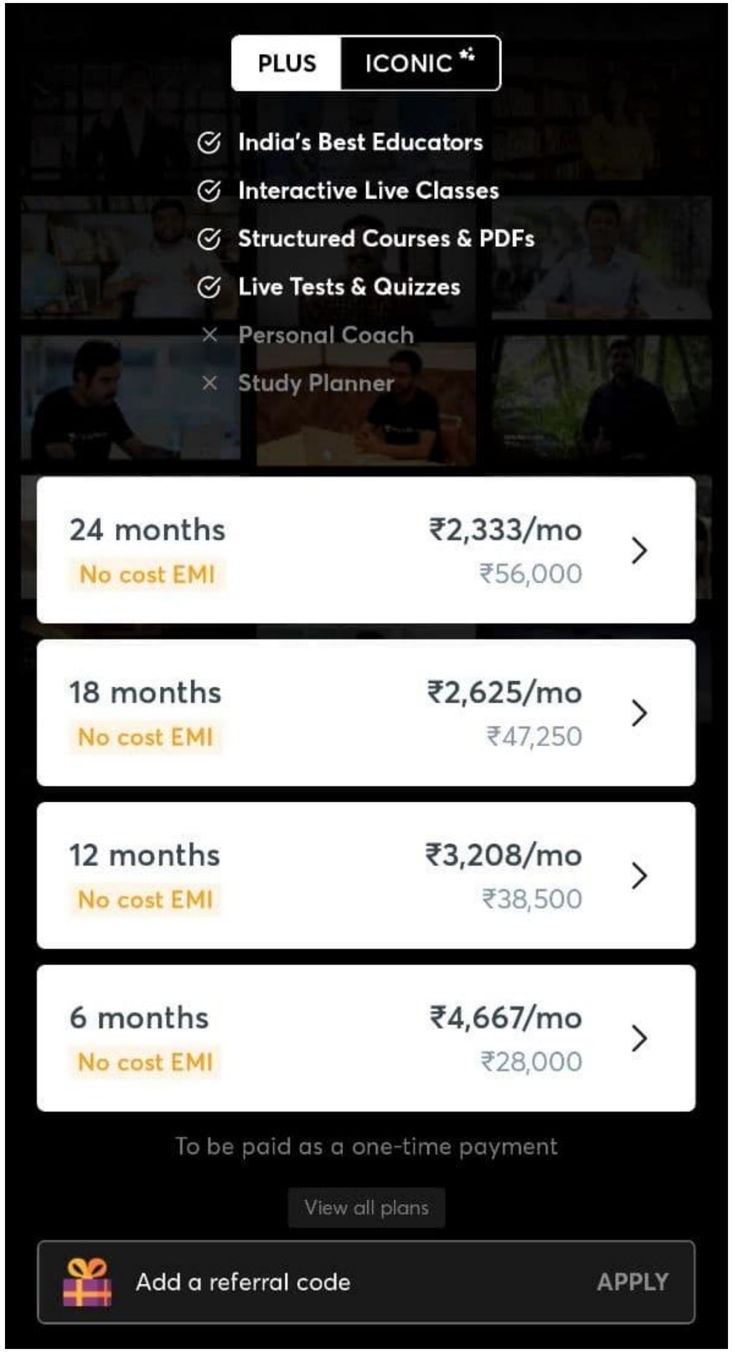


(a) $\sqrt{\frac{g}{3}}$ (b) $\sqrt{\frac{2g}{3}}$
(c) $\sqrt{\frac{4g}{3}}$ (d) $\sqrt{\frac{g}{2}}$

Q 10. A particle of mass 1 kg is moving along the line y = x + 2 (here, x and y are in metres) with speed 2 m/s. The magnitude of angular momentum of particle about origin is:
(a) 4 kg – m^2/s (b) $2\sqrt{2}$kg – m^2/s
(c) $4\sqrt{2}$kg – m^2/s (d) 2gk – m^2/s

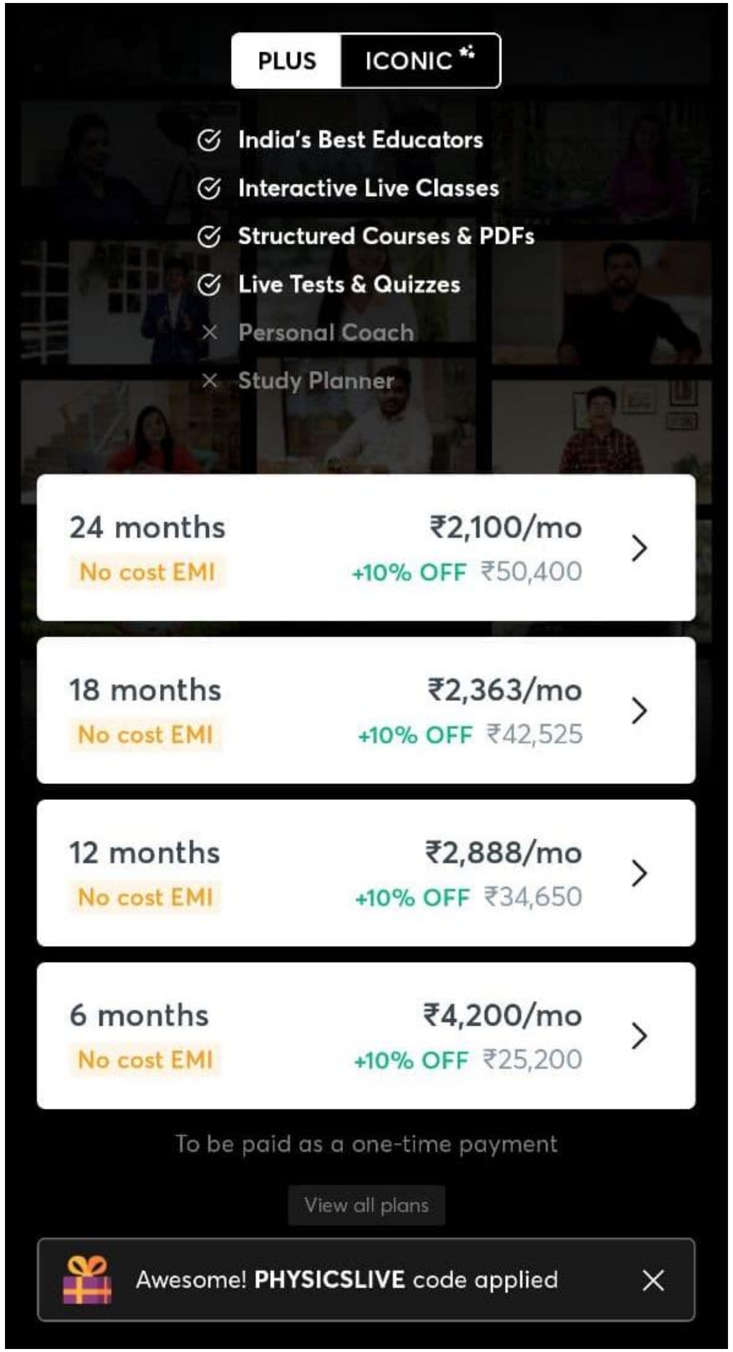
Answer Key

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



PHYSICSLIVE

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



Written Solution

JEE Main & Advanced, NSEP, INPhO, IPhO

Physics DPP

DPP- 4 Rotation: Rotational Kinetic Energy & Angular Momentum

By Physicsaholics Team

Q1) A wheel of mass 2 kg having practically all the mass concentrated along the circumference of a circle of radius 20 cm, is rotating on its axis with an angular velocity of 100 rad/s. The rotational kinetic energy of the wheel is

$I = mR^2$

$KE = \frac{1}{2} I \omega^2 = \frac{1}{2} m R^2 \omega^2$

$= \frac{1}{2} \times 2 \times .2 \times .2 \times 100 \times 100$

$= 400 J$

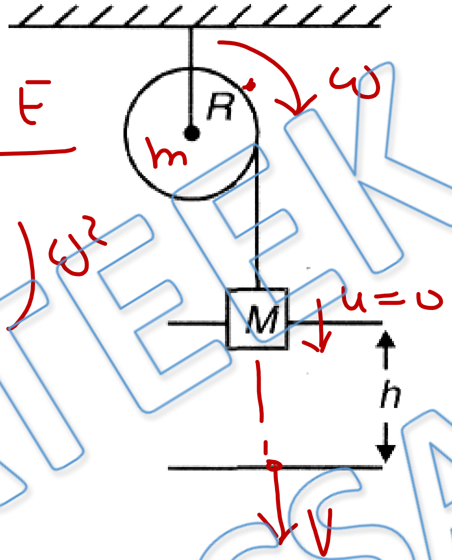
(a) 4J

(b) 70J

(c) 400 J

(d) 800 J

Q2) Pulley is rotating & frictionless and can be taken as solid cylinder as shown in figure. If block starts from rest and falls by distance h. Then speed of block is proportional to



by Conservation of ME

$v = \omega R$

$$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}\left(\frac{mR^2}{2}\right)\omega^2$$

$$Mgh = \frac{Mv^2}{2} + \frac{mv^2}{4}$$

(a) R

(b) 1/R

(c) $1/R^2$

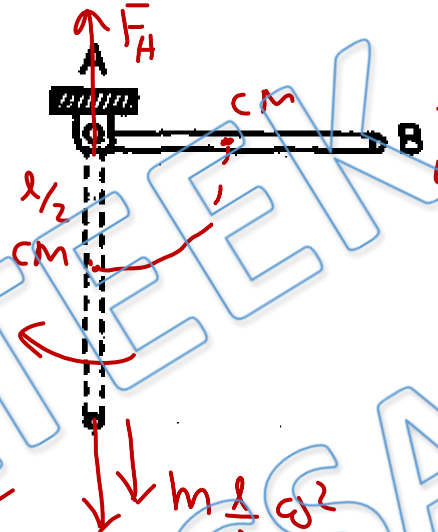
(d) R^0 ✓

Q3) One end of a uniform rod of length l and mass m is hinged at A. It is released from rest from horizontal position AB as shown in figure. The force exerted by the rod on the hinge when it becomes vertical is:

by COME!

$mg\frac{l}{2} = \frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2$

$\omega^2 = 3g/l$



$F_A = mg + m\frac{l}{2}\omega^2$

$= mg + \frac{ml}{2} \times \frac{3g}{l}$

$= \frac{5}{2}mg$

(a) $\frac{3}{2}mg$ (b) $\frac{5}{2}mg$ (c) 3 mg (d) 5 mg

PASSAGE

An L shaped frame is free to rotate in a vertical plane about a horizontal axis passing through a smooth hinge 0. Each side of the frame has a length L and mass m. Frame is let to fall with one side horizontal and the other vertical.

by Conservation of mechanical energy →

$\sin\theta = \frac{L/2}{L}$

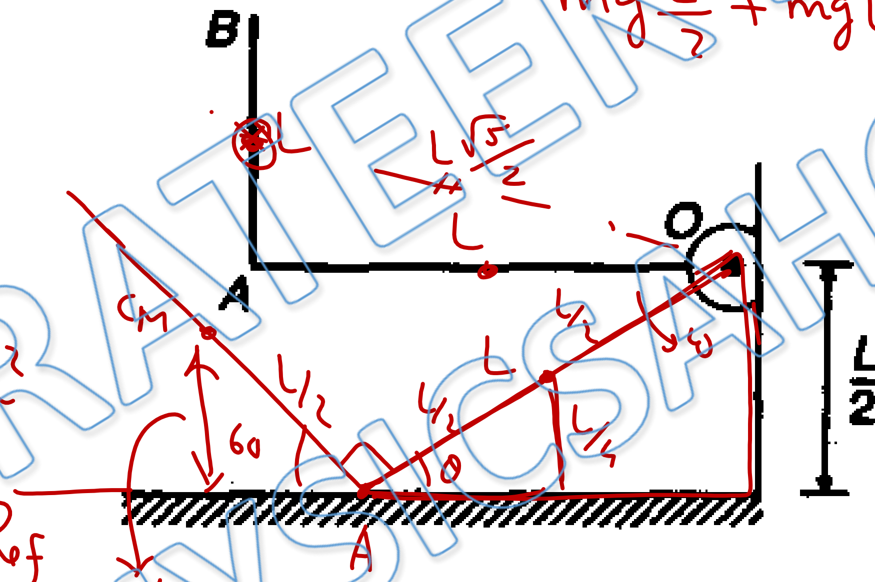
$\theta = 30^\circ$

$I = \frac{mL^2}{3} + \frac{mL^2}{12} + \frac{5mL^2}{4}$

$= \frac{4mL^2 + mL^2 + 15mL^2}{12}$

$= \frac{20mL^2}{12}$

$= \frac{5mL^2}{3}$



$\frac{L}{2}\sin 60 = \frac{L\sqrt{3}}{4}$

$mg\frac{L}{2} + mgL = mg\frac{L}{4} + mg\frac{L\sqrt{3}}{4} + \frac{1}{2} \times \frac{5mL^2}{3}\omega^2$

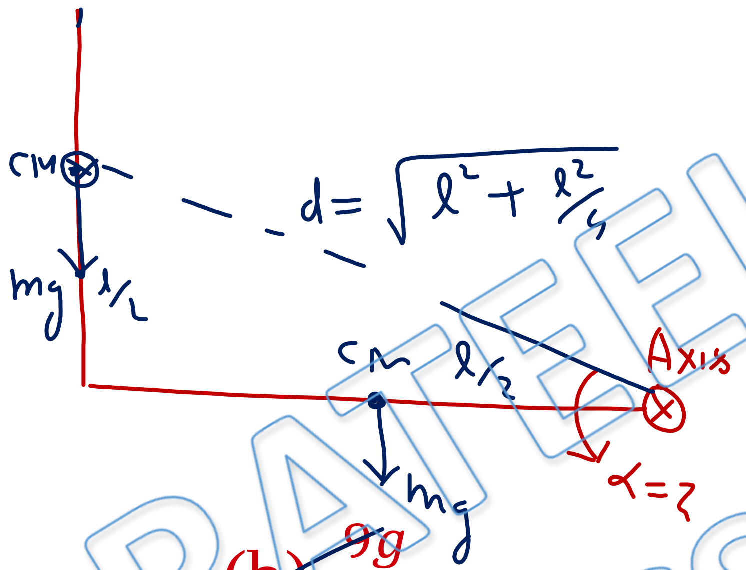
$\frac{5}{4}mgL - mgL\frac{\sqrt{3}}{4} = \frac{5}{6}mL^2\omega^2$

$L\omega^2 = \frac{g}{4}(5-\sqrt{3}) \times \frac{6}{5}$

$\omega = \sqrt{\frac{3g(5-\sqrt{3})}{10L}}$

$V_A = \omega L = \sqrt{\frac{3gL(5-\sqrt{3})}{10}}$

Q4) Angular acceleration of the frame just after it is allowed to fall is



$$\tau = I\alpha$$

$$mg\frac{l}{2} + mgl = \left[\frac{ml^2}{3} + \frac{ml^2}{12} + \frac{5ml^2}{4}\right]\alpha$$

$$\frac{3}{2}mgl = ml^2\alpha\left[\frac{4+1+15}{12}\right]$$

$$\alpha = \frac{18}{20}\frac{g}{l}$$

(a) $\frac{4g}{3L}$ (b) $\frac{9g}{10L}$ (c) $\frac{g}{2L}$ (d) $\frac{3g}{2L}$

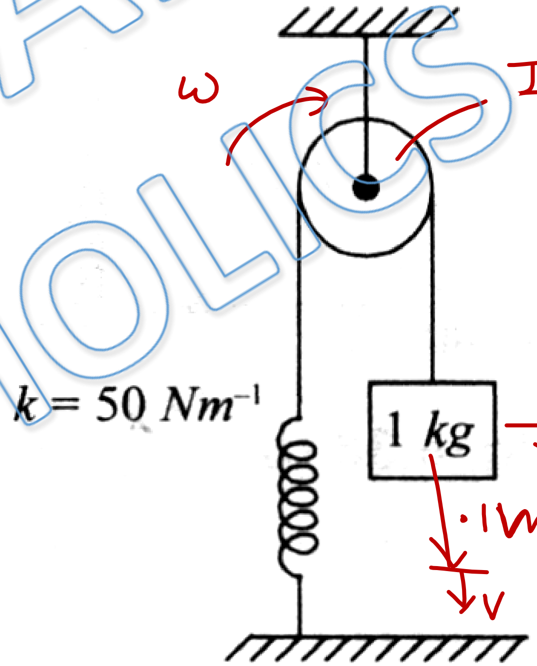
$$\alpha = \frac{9g}{10l}$$

Q5) With what speed the end A will strike the ground?

$$V_A = \sqrt{\frac{3gL(5-\sqrt{3})}{10}}$$

(a) $1.1\sqrt{gL}$ (b) $2\sqrt{gL}$ (c) $3.2\sqrt{gL}$ (d) $\sqrt{gL}$

Q6) The pulley shown in fig. has radius 20 cm and MOI 0.2 kg m^2. Spring used has force constant 50 Nm^{-1}. The system is released from rest when spring was in natural length. Find the velocity of 1kg block when it has descended 10 cm.



$v = \omega R$

by COME :-

$1 \times 10 \times .1 = \frac{1}{2} \times 1 v^2 + \frac{1}{2} \times .2\, \omega^2 + \frac{1}{2} \times 50 \times .1 \times .1$

$1 = \frac{v^2}{2} + .1 \times \frac{v^2}{.2 \times .2} + .25$

$.75 = \frac{v^2}{2} + \frac{5}{2} v^2$

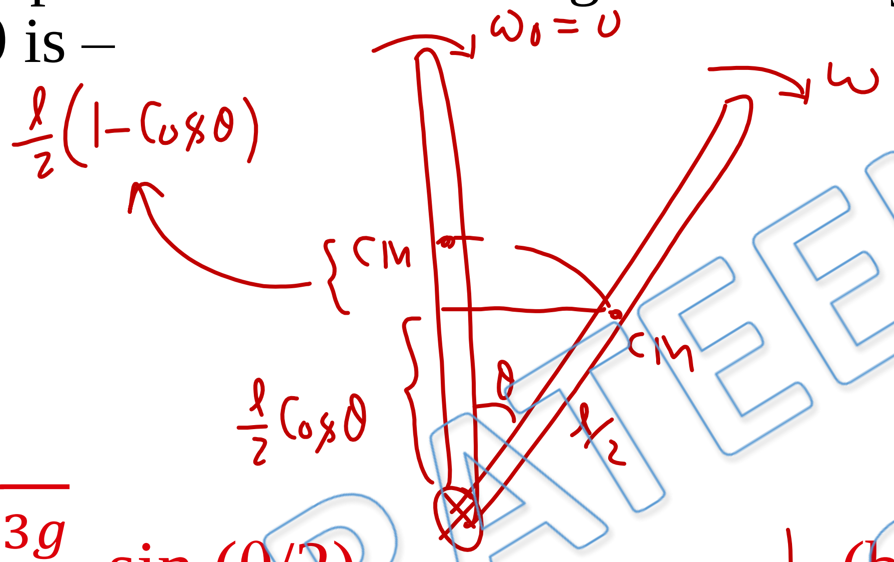
$3v^2 = .75 \Rightarrow v^2 = .25$

$v = .5 = \frac{1}{2}$

(a) 1/2 ms^{-1} (b) 1/√2 ms^{-1}

(c) 1/√3 ms^{-1} (d) none

Q7) A uniform rod of length l is free to rotate in a vertical plane about a fixed horizontal axis through O. The rod is allowed to rotate from rest from its unstable vertical position. Then the angular velocity of the rod when it has turned through an angle θ is –



(a) $\sqrt{\frac{3g}{l}}\ \sin(\theta/2)$

(b) $\sqrt{\frac{6g}{l}}\ \sin(\theta/2)$

(c) $\sqrt{\frac{3g}{l}}\ \cos(\theta/2)$

(d) $\sqrt{\frac{6g}{l}}\ \cos(\theta/2)$

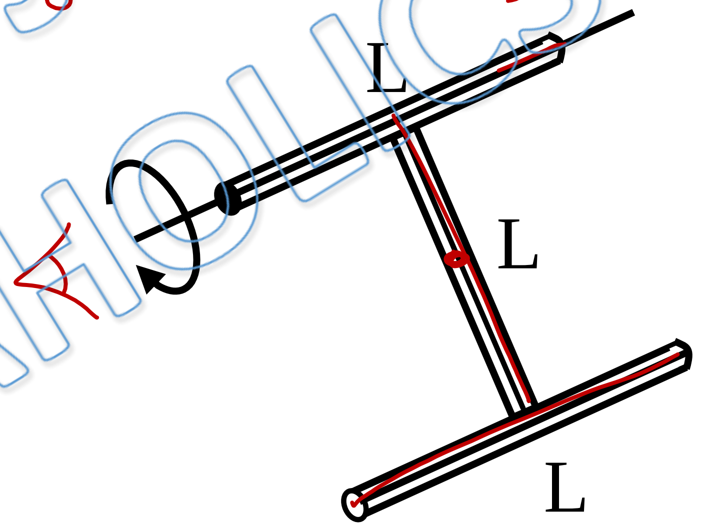
by COME !

$$mg\frac{l}{2}(1-\cos\theta) = \frac{1}{2}\frac{ml^2}{3}\omega^2$$

$$\omega^2 = \frac{3g}{l}(1-\cos\theta) = \frac{3g}{l}\left(1-1+2\sin^2\theta/2\right)$$

$$\omega = \sqrt{\frac{6g}{l}}\ \sin\theta/2$$

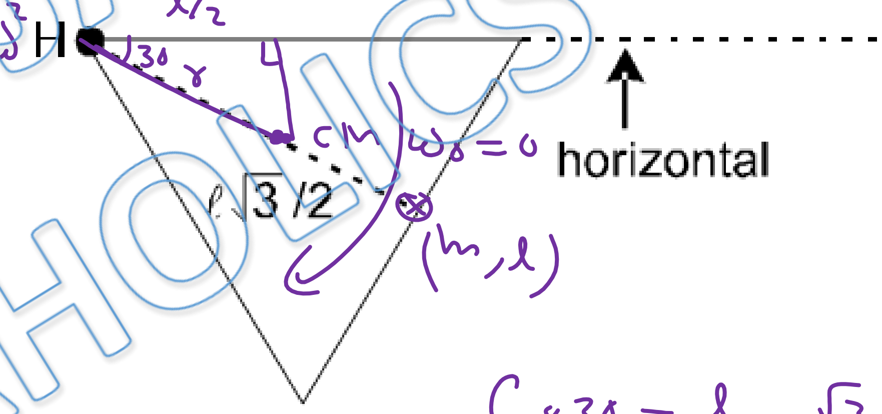
Q8) A rigid body is made of three identical thin rods fastened together in the form of a letter H. The body is free to rotate about a horizontal axis that passes through one of the legs of H. The body is allowed to fall from rest from a position in which the plane of the H is horizontal. Then the angular speed of the body when the plane of the H is vertical is -



(a) $\sqrt{9g/4L}$ (b) $\sqrt{3g/4L}$

(c) $\sqrt{3g/L}$ (d) None of these

(Q9) A rigid equilateral triangular frame made of three identical thin rods (mass = 1kg & length = $\sqrt{3}$ meter) is free to rotate smoothly in vertical plane. Frame is hinged at one of its vertices H. Frame is released from rest from the position shown in figure. Maximum angular velocity of frame in subsequent motion is



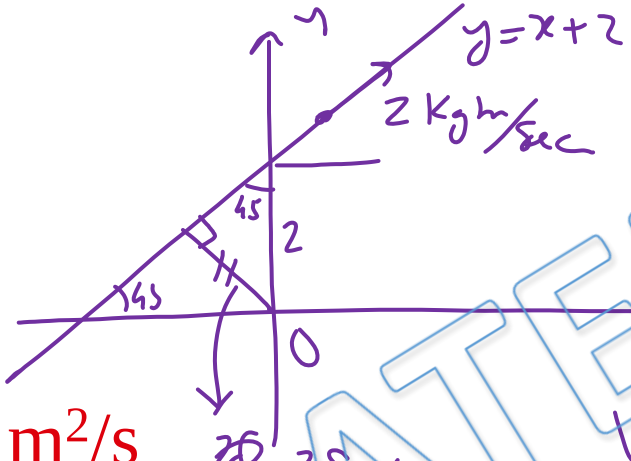
(a) $\sqrt{\frac{g}{3}}$

(b) $\sqrt{\frac{2g}{3}}$

(c) $\sqrt{\frac{4g}{3}}$

(d) $\sqrt{\frac{g}{2}}$

Q10) A particle of mass 1 kg is moving along the line y = x + 2 (here, x and y are in metres) with speed 2 m/s. The magnitude of angular momentum of particle about origin is:



(a) 4 kg – m^2/s

(b) $2\sqrt{2}$kg – m^2/s

(c) $4\sqrt{2}$kg – m^2/s

(d) 2gk – m^2/s

2 Sin 45 = $\sqrt{2}$

L = $2\sqrt{2}$

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/81

Video Solution on YouTube:- https://youtu.be/tQX4BDTsGOQ

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/18

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo