CLASS TEST

SECTION-I

Single Correct Answer Type **9 Q. [3 M (–1)]**

1. ABC is a triangular frame of three uniform rods each of mass m and length 2*l*. It is free to rotate in its own plane about a smooth horizontal axis through A which is perpendicular to ABC. If it is released from rest when AB is horizontal & C is above AB, find the maximum velocity of C in the subsequent motion.

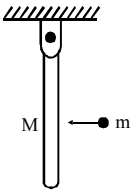
(A) $v = 2\ell\sqrt{\frac{g\sqrt{6}}{\ell}}$ (B) $v = \ell\sqrt{\frac{g\sqrt{7}}{\ell}}$ (C) $v = 2\ell\sqrt{\frac{g\sqrt{3}}{\ell}}$ (D) $v = \ell\sqrt{\frac{g\sqrt{3}}{\ell}}$

2. A particle is projected with some velocity at an acute angle to the horizontal. The graph between its angular momentum about the point of projection and time during flight is a/an-

(A) Straight line parallel to time axis (B) Straight line inclined to the time axis

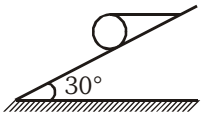
(C) Straight line perpendicular to time axis (D) Parabola

3. A uniform rod of mass M is hinged at its upper end. A particle of mass m moving horizontally strikes the rod at its mid point elastically. If the particle comes to rest after collision find the value of M/m =?



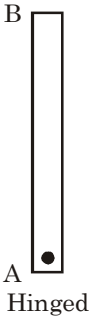
(A) 3/4 (B) 4/3 (C) 2/3 (D) 3/2

4. A spherical ball of mass 5kg is resting on a plane with angle of inclination 30° with respect to the horizontal as shown in the figure. The ball is held in place by a rope attached horizontally to the top of the ball and to the slope. What is the frictional force acting on the ball ?



(A) $\frac{50}{2-\sqrt{3}}$N (B) $\frac{50}{2+\sqrt{3}}$N (C) $\frac{50\sqrt{3}}{2+\sqrt{5}}$N (D) None of these

5. A uniform rod of mass m length ℓ is hinged at A. It is released from the given position so that it rotates about A in vertical plane. Which of the following represents the hinge force when rod becomes horizontal. (Rod is rotating clockwise) :-

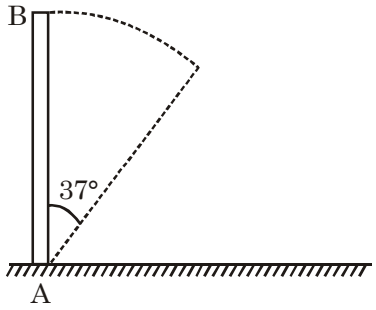


(A) ← (B) ↙ (C) ↑ (D) ↖

6. A generator's flywheel, which is a homogeneous cylinder of radius R and mass M, rotates about its longitudinal axis. The linear velocity of a point on the rim (side) of the flywheel is v. What is the kinetic energy of the flywheel ?

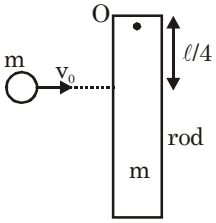
(A) $K = \frac{1}{2}Mv^2$ (B) $K = \frac{1}{4}Mv^2$ (C) $K = \frac{1}{2}Mv^2/R$ (D) $K = \frac{1}{2}Mv^2R$

7. A rod of mass m = 5kg and length L = 1.5m is held vertical on a table as shown. A gentle push is given to it and it starts falling. Friction is large enough to prevent end A from slipping on the table. When it rotates through an angle $\theta = 37°$, the angular velocity of the rod will be :



(A) $\frac{1}{6}$ rad/sec (B) 2 rad/sec (C) $\frac{3}{2}$ rad/sec (D) 3 rad/sec

8. Rod of mass m and length ℓ is free to rotate about point 'O' in vertical plane. A particle having same mass m moving horizontally with velocity v_0 hits the rod perpendicular at distance $\frac{\ell}{4}$ from the top end 'O' and stops. Find the magnitude of impulse due to hinge on the rod due to collision.



(A) $\frac{mv_0}{19}$ (B) $\frac{10mv_0}{19}$ (C) $\frac{mv_0}{8}$ (D) $\frac{5mv_0}{8}$

9. When a woman on a frictionless rotating turntable extends her arms out horizontally, her kinetic energy:

(A) must increase (B) must decrease

(C) must remain the same (D) changes into angular momentum

Multiple Correct Answer Type 4 Q. [4 M (–1)]

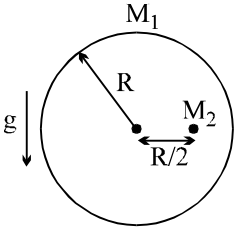
10. A uniform disc of mass $M_1 = 2$ kg and radius R = 1 m is pivoted on a frictionless horizontal axle through its center. A small mass $M_2 = 4$ kg is attached to the disc at radius R/2, at the same height as the axle. If this system is released from rest then :

(A) angular acceleration of the disc immediately after it is released 10 rad/s^2.

(B) magnitude of the maximum angular velocity of disc will be $2\sqrt{5}$ rad/s.

(C) angular acceleration of the disc immediately after it is released 5 rad/s^2.

(D) magnitude of the maximum angular velocity of disc will be 5 rad/s.



11. A rigid body of mass 0.5 kg at $\vec{r} = 2\hat{i} - \hat{j} + \hat{k}$ is acted on by the forces $\vec{F}_1 = \hat{i} + \hat{j} - 2\hat{k}$ and $\vec{F}_2 = 2\hat{i} + 3\hat{j} - \hat{k}$. Then

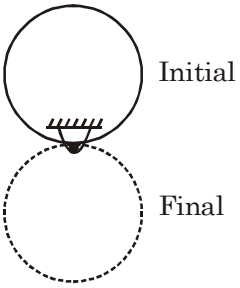
(A) Acceleration of body is given by $6\hat{i} + 8\hat{j} - 6\hat{k}$

(B) Vector perpendicular to $\vec{r}$ and $\vec{F}_1$ is $\hat{i} + 5\hat{j} + 3\hat{k}$

(C) Torque acting on the body due to forces about the origin is $-\hat{i} + 9\hat{j} + 11\hat{k}$

(D) Force required to make the body at equilibrium is $-3\hat{i} - 4\hat{j} + 3\hat{k}$

12. A ring of mass M and radius R rotates in a vertical plane about an axle at the edge of the ring. The ring starts at its highest position and is given a very small push to start it rotating. At its lowest position,



(A) The angular acceleration is zero

(B) The angular velocity is $\sqrt{\frac{g}{R}}$

(C) The force exerted by the axle on the ring is vertical

(D) The force exerted by the axle on the ring is 3Mg.

13. Suppose you are standing on the edge of a spinning plant form and step off at right angles to the edge (radially outward). Now consider it the other way. You are standing on the ground next to a spinning carousel and you step onto the platform at right angles to the edge (radially inward).

(A) There is no change in rotational speed of the carousel in either situation.

(B) There is a change in rotational speed in the first situation but not the second.

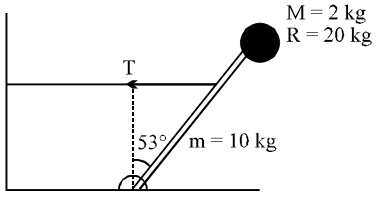
(C) There is a change in rotational speed in the second situation but not the first.

(D) There is a change in rotational speed in both instances.

Linked Comprehension Type (1 Para × 3Q.) [3 M (-1)]
(Single Correct Answer Type)

Paragraph for Question 14 to 16

A uniform, thin, cylindrical beam of length 3m and mass 10 kg is connected to the ground by a frictionless hinge as shown in the fig. The beam has a sphere of radius 20 cm and mass 2 kg attached to its end and is supported by a horizontal cable attached to the wall and to the midpoint of the beam. The beam is initially at rest at an angle of 53° with respect to the vertical.



14. If rod is in equilibrium then tension in the cable :

(A) $\frac{560}{3}$ N (B) $\frac{500}{3}$ N (C) $\frac{580}{3}$ N (D) $\frac{250}{3}$ N

15. If cable is cut then angular acceleration of the beam with sphere attached to it just after cutting of cable.

(A) 2.5 rad/s^2 (B) 3 rad/s^2 (C) 3.5 rad/s^2 (D) 4.5 rad/s^2

16. The angular velocity of the beam when it reaches a horizontal position.
(Take sin 37° = 0.6)

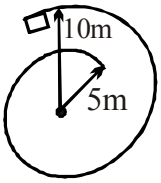
(A) 5 rad/s (B) 5.25 rad/s (C) 3.25 rad/s (D) 6 rad/s

SECTION-II

Numerical Answer Type Question **1Q.[3(0)]**

(upto second decimal place)

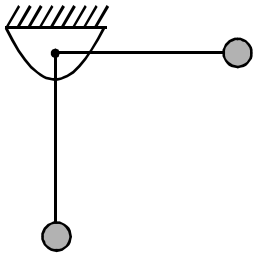
1. A block enters a horizontal smooth spiral track in which the radius of the track decreases from 10 m to 5m. If the block enters the spiral at a speed of 10 m/s, what is it's speed (in m/s) at the end of the spiral?



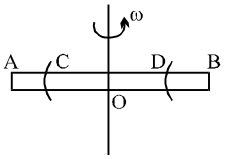
SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **2 Q. [4 M (0)]**

1. Two light rods of length 1m each are joined rigidly to form a L. Two particles of mass m each are joined at the ends and the rod is hinged at the corner so that it swings freely in a vertical plane. If the system is released from the position shown. The initial reaction force is 10α N at the hinge. Write the value of α in your OMR sheet. Take m = $\sqrt{\frac{8}{5}}$kg..



2. A rigid horizontal smooth rod AB of mass 0.75 kg and length 40 cm can rotate freely about a fixed vertical axis through its mid point O. Two rings each of mass 1 kg are initially at rest at a distance of 10 cm from O on either side of the rod. The rod is set in rotation with an angular velocity of 30 radians per second. The velocity of each ring along the length of the rod (in m/s) when they reach the ends of the rod is :



SPECIAL CLASS TEST # 08 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **9 Q. [3 M (–1)]**

1. Ans. (C) **2. Ans. (D)** **3. Ans. (A)** **4. Ans. (B)**
5. Ans. (D) **6. Ans. (B)** **7. Ans. (B)** **8. Ans. (D)**
9. Ans. (C)

Multiple Correct Answer Type **4 Q. [4 M (–1)]**

10. Ans. (A,B) **11. Ans. (A,B,C,D)** **12. Ans. (A,C,D)** **13. Ans. (C)**

Linked Comprehension Type **(1 Para × 3Q.) [3 M (-1)]**
(Single Correct Answer Type)

14. Ans. (A) **15. Ans. (C)** **16. Ans. (B)**

SECTION-II

Numerical Answer Type Question **1Q.[3(0)]**
(upto second decimal place)

1. Ans. 10.00

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **2 Q. [4 M (0)]**

1. Ans. 2 **2. Ans. 3**