DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | Start Time : | End Time :

PHYSICS

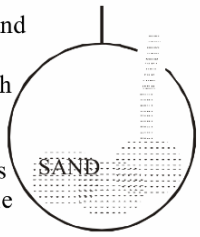
CP06

SYLLABUS : System of Particles and Rotational Motion

Max. Marks : 120 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. A hollow sphere is held suspended. Sand is now poured into it in stages.



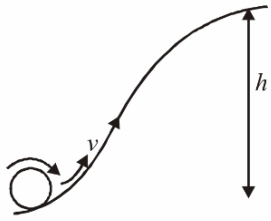
The centre of mass of the sphere with the sand

(a) rises continuously
(b) remains unchanged in the process
(c) first rises and then falls to the original position
(d) first falls and then rises to the original position

2. From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its center and perpendicular to one of its faces is :

(a) $\frac{4MR^2}{9\sqrt{3}\pi}$ (b) $\frac{4MR^2}{3\sqrt{3}\pi}$ (c) $\frac{MR^2}{32\sqrt{2}\pi}$ (d) $\frac{MR^2}{16\sqrt{2}\pi}$

3. A solid sphere is rolling on a surface as shown in figure, with a translational velocity v m s^{-1}. If it is to climb the inclined surface continuing to roll without slipping, then minimum velocity for this to happen is



(a) $\sqrt{2gh}$ (b) $\sqrt{\frac{7}{5}gh}$ (c) $\sqrt{\frac{7}{2}gh}$ (d) $\sqrt{\frac{10}{7}gh}$

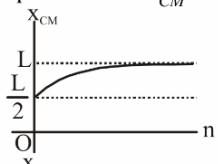
4. A loop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip?

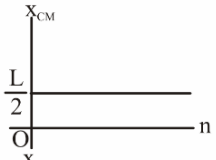
(a) $\frac{r\omega_0}{4}$ (b) $\frac{r\omega_0}{3}$ (c) $\frac{r\omega_0}{2}$ (d) $r\omega_0$

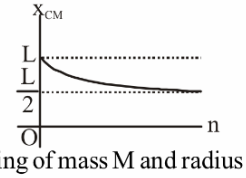
RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

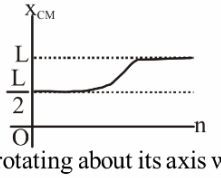
Space for Rough Work

5. A thin rod of length 'L' is lying along the x-axis with its ends at $x = 0$ and $x = L$. Its linear density (mass/length) varies with x as $k\left(\frac{x}{L}\right)^n$, where n can be zero or any positive number. If the position x_{CM} of the centre of mass of the rod is plotted against 'n', which of the following graphs best approximates the dependence of x_{CM} on n?

(a) 

(b) 

(c) 

(d) 

6. A ring of mass M and radius R is rotating about its axis with angular velocity ω. Two identical bodies each of mass m are now gently attached at the two ends of a diameter of the ring. Because of this, the kinetic energy loss will be :

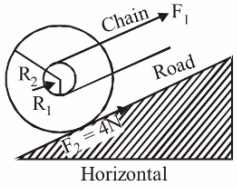
(a) $\frac{m(M+2m)}{M}\omega^2R^2$ (b) $\frac{Mm}{(M+m)}\omega^2R^2$

(c) $\frac{Mm}{(M+2m)}\omega^2R^2$ (d) $\frac{(M+m)M}{(M+2m)}\omega^2R^2$

7. A wooden cube is placed on a rough horizontal table, a force is applied to the cube. Gradually the force is increased. Whether the cube slides before toppling or topples before sliding is independent of :

(a) the position of point of application of the force
(b) the length of the edge of the cube
(c) mass of the cube
(d) Coefficient of friction between the cube and the table

8. Acertain bicycle can go up a gentle incline with constant speed when the frictional force of ground pushing the rear wheel is $F_2 = 4$ N. With what force F_1 must the chain pull on the sprocket wheel if R_1=5 cm and R_2 = 30 cm?



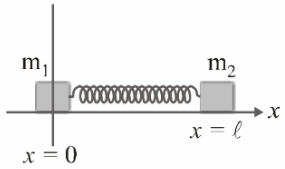
(a) 4 N (b) 24 N (c) 140 N (d) $\frac{35}{4}$ N

9. A ball rolls without slipping. The radius of gyration of the ball about an axis passing through its centre of mass is K. If radius of the ball be R, then the fraction of total energy associated with its rotational energy will be

(a) $\frac{K^2}{R^2}$ (b) $\frac{K^2}{K^2+R^2}$ (c) $\frac{R^2}{K^2+R^2}$ (d) $\frac{K^2+R^2}{R^2}$

10. Two masses m_1 and m_2 are connected by a massless spring of spring constant k and unstretched length ℓ. The masses are placed on a frictionless straight channel, which are consider our x-axis. They are initially at $x = 0$ and $x = \ell$ respectively. At $t = 0$, a velocity v_0 is suddenly imparted to the first particle. At a later time t, the centre of mass of the two masses is at :

(a) $x = \frac{m_2\ell}{m_1+m_2}$



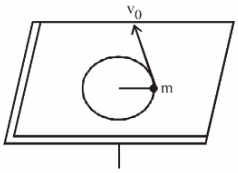
(b) $x = \frac{m_1\ell}{m_1+m_2} + \frac{m_2v_0t}{m_1+m_2}$

(c) $x = \frac{m_2\ell}{m_1+m_1} + \frac{m_2v_0t}{m_1+m_2}$ (d) $x = \frac{m_2\ell}{m_1+m_2} + \frac{m_1v_0t}{m_1+m_2}$

11. From a circular ring of mass M and radius R, an arc corresponding to a 90° sector is removed. The moment of inertia of the ramaining part of the ring about an axis passing through the centre of the ring and perpendicular to the plane of the ring is k times MR^2. Then the value of k is

(a) 3/4 (b) 7/8 (c) 1/4 (d) 1

12. A mass m moves in a circle on a smooth horizontal plane with velocity v_0 at a radius R_0. The mass is attached to string which passes through a smooth hole in the plane as shown.



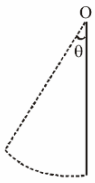
The tension in the string is increased gradually and finally m moves in a circle of radius $\frac{R_0}{2}$. The final value of the kinetic energy is

(a) $\frac{1}{4}mv_0^2$ (b) $2mv_0^2$ (c) $\frac{1}{2}mv_0^2$ (d) mv_0^2

RESPONSE GRID					
5. ⓐⓑⓒⓓ	**6.** ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ
10. ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ		

Space for Rough Work

13. A uniform rod of length l is free to rotate in a vertical plane about a fixed horizontal axis through O. The rod begins rotating from rest from its unstable equilibrium position. When it has turned through an angle θ, its angular velocity ω is given as



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

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

14. A rod PQ of length L revolves in a horizontal plane about the axis YY′. The angular velocity of the rod is ω. If A is the area of cross-section of the rod and ρ be its density, its rotational kinetic energy is

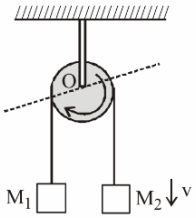
(a) $\frac{1}{3}AL^3\rho\omega^2$ (b) $\frac{1}{2}AL^3\rho\omega^2$

(c) $\frac{1}{24}AL^3\rho\omega^2$ (d) $\frac{1}{18}AL^3\rho\omega^2$

15. A solid sphere of mass 2 kg rolls on a smooth horizontal surface at 10 m/s. It then rolls up a smooth inclined plane of inclination 30° with the horizontal. The height attained by the sphere before it stops is

(a) 700 cm (b) 701 cm (c) 7.1 m (d) 70 m

16. A pulley is in the form of a disc of mass M and radius R. In following figure two masses M_1 and M_2 are connected by a light inextensible string which passes over the pulley. Assuming that the string does not slip over the pulley, the angular momentum of system at the instant shown, about axis of rotation of pulley is



$\left[M_2 + M_1 + \frac{1}{k}M\right]$ vR then

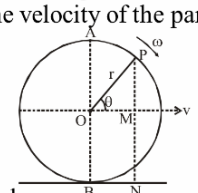
find the value of k.

(a) 1 (b) 2 (c) 4 (d) 5

17. A couple produces

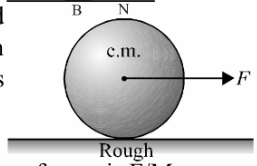
(a) purely linear motion
(b) purely rotational motion
(c) linear and rotational motion
(d) no motion

18. Fig. shows a disc rolling on a horizontal plane with linear velocity v. Its linear velocity is v and angular velocity is ω. Which of the following gives the velocity of the particle P on the rim of the disc ?



(a) v (1 + cos θ)
(b) v (1 – cos θ)
(c) v (1 + sin θ)
(d) v (1 – sin θ)

19. A solid sphere of mass M and radius R is pulled horizontally on a sufficiently rough surface as shown in the figure.



Choose the correct alternative.

(a) The acceleration of the centre of mass is F/M
(b) The acceleration of the centre of mass is $\frac{2}{3}\frac{F}{M}$
(c) The friction force on the sphere acts forward
(d) The magnitude of the friction force is F/3

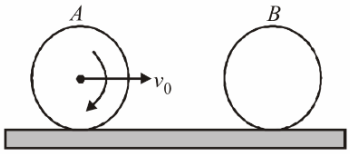
20. Point masses 1, 2, 3 and 4 kg are lying at the point (0, 0, 0), (2, 0, 0), (0, 3, 0) and (–2, –2, 0) respectively. The moment of inertia of this system about x-axis will be

(a) 43 kgm^2 (b) 34 kgm^2 (c) 27 kgm^2 (d) 72 kgm^2

21. A circular disc of radius R rolls without slipping along the horizontal surface with constant velocity v_0. We consider a point A on the surface of the disc, then the acceleration of the point A is

(a) constant in magnitude as well as direction.
(b) constant in direction
(c) constant in magnitude
(d) cannot say

22. A hollow smooth uniform sphere *A* of mass m rolls without sliding on a smooth horizontal surface. It collides head on elastically with another stationary smooth solid sphere *B* of the same mass m and same radius. The ratio of kinetic energy of *B* to that of *A* just after the collision is



(a) 1 : 1
(b) 2 : 3
(c) 3 : 2
(d) None of these

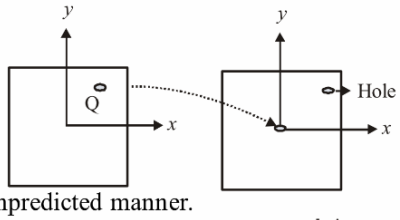
RESPONSE GRID					
	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ

Space for Rough Work

23. The moment of inertia of a body about a given axis is 1.2 kg m^2. Initially, the body is at rest. In order to produce a rotational kinetic energy of 1500 joule, an angular acceleration of 25 radian/sec^2 must be applied about that axis for a duration of
(a) 4 seconds (b) 2 seconds
(c) 8 seconds (d) 10 seconds

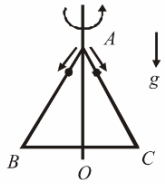
24. A pulley of radius 2 m is rotated about its axis by a force $F = (20t - 5t^2)$ newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is 10 kg-m^2 the number of rotations made by the pulley before its direction of motion is reversed, is:
(a) more than 3 but less than 6
(b) more than 6 but less than 9
(c) more than 9 (d) less than 3

25. A uniform square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind. Then the moment of inertia about the z-axis



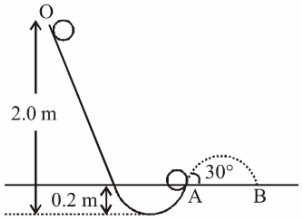
(a) increases
(b) decreases
(c) remains same
(d) changed in unpredicted manner.

26. An equilateral triangle ABC formed from a uniform wire has two small identical beads initially located at A. The triangle is set rotating about the vertical axis AO. Then the beads are released from rest simultaneously and allowed to slide down, one along AB and the other along AC as shown. Neglecting frictional effects, the quantities that are conserved as the beads slide down, are



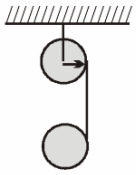
(a) angular velocity and total energy (kinetic and potential)
(b) total angular momentum and total energy
(c) angular velocity and moment of inertia about the axis of rotation
(d) total angular momentum and moment of inertia about the axis of rotation

27. A tennis ball (treated as hollow spherical shell) starting from O rolls down a hill. At point A the ball becomes air borne leaving at an angle of 30° with the horizontal. The ball strikes the ground at B. What is the value of the distance AB ? (Moment of inertia of a spherical shell of mass m and radius R about its diameter $= \frac{2}{3}mR^2$)



(a) 1.87m (b) 2.08m
(c) 1.57m (d) 1.77m

28. Two identical discs of mass m and radius r are arranged as shown in the figure. If α is the angular acceleration of the lower disc and a_{cm} is acceleration of centre of mass of the lower disc, then relation between a_{cm}, α and r is



(a) $a_{cm} = \alpha/r$ (b) $a_{cm} = 2\alpha r$
(c) $a_{cm} = \alpha r$ (d) None of these

29. A gymnast takes turns with her arms and legs stretched. When she pulls her arms and legs in
(a) the angular velocity decreases
(b) the moment of inertia decreases
(c) the angular velocity stays constant
(d) the angular momentum increases

30. The moment of inertia of a uniform semicircular wire of mass m and radius r, about an axis passing through its centre of mass and perpendicular to its plane is $mr^2\left(1-\frac{k}{\pi^2}\right)$. Find the value of k.
(a) 2 (b) 3 (c) 4 (d) 5

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ		

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP06 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	50
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work