Module-Test(Physics)

Section-A
(One Options Correct Type)

This section contains 20 multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE option is correct.

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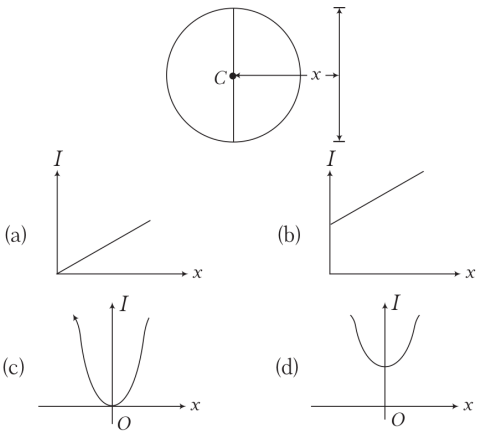
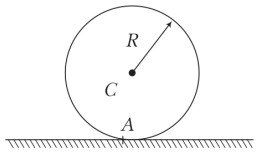
01. Figure represents the moment of inertia of the solid sphere about an axis parallel to the diameter of the solid sphere and at a distance x from it. Which one of the following represents the variations of I with x?



02. Two uniform, thin identical rods each of mass M and length l are joined together to form a cross. What will be the moment of inertia of the cross about an axis passing through the point at which the two rods are joined and perpendicular to the plane of the cross?

(a) $\frac{Ml^2}{12}$ (b) $\frac{Ml^2}{6}$ (c) $\frac{Ml^2}{4}$ (d) $\frac{Ml^2}{3}$

03. A disc of radius R rolls on a rough horizontal surface. The distance covered by the point A in one revolution is



(a) $2\pi R$ (b) $2R$ (c) $8R$ (d) πR

04. When a body is projected at an angle with the horizontal in a uniform gravitational field of the earth, the angular momentum of the body about the point of projection, as it proceeds along its path
(a) remains constant
(b) increases
(c) decreases
(d) initially decreases and after its highest point increases

05. A particle of mass $m = 5$ units is moving with a uniform speed $v = 3\sqrt{2}$ units in the XY-plane along the line $y = x + 4$. The magnitude of the angular momentum about origin is

(a) zero (b) 60 units (c) 7.5 units (d) $40\sqrt{2}$ units

06. A sphere rolls without slipping on a rough horizontal surface with centre of mass speed v_0. If mass of the sphere is M and its radius is R, then what is the angular momentum of the sphere about the point of contact?

(a) $\frac{5}{2}Mv_0R$ (b) $\frac{7}{5}Mv_0R$ (c) $\frac{3}{5}Mv_0R$ (d) $\frac{1}{2}Mv_0R$

07. The ratio of the radii of gyration of a circular disc and a circular ring of the same radii about a tangential axis perpendicular to plane of disc or ring is

(a) 1 : 2 (b) $\sqrt{5}:\sqrt{6}$ (c) 2 : 3 (d) $\sqrt{3}:2$

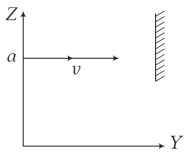
08. The ratio of the radii of gyration of a circular disc and a circular ring of the same radius about a tangential axis in the plane is

(a) $\sqrt{3}:\sqrt{4}$ (b) $\sqrt{5}:\sqrt{6}$
(c) $\sqrt{6}:\sqrt{5}$ (d) $\sqrt{4}:\sqrt{3}$

09. A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of angular momentum of projectile about the point of projection when the particle is at its maximum height h is

(a) zero (b) $\frac{mvh}{\sqrt{2}}$ (c) mvh (d) $\sqrt{2}\,mvh$

10. A particle of mass m is moving in YZ-plane with a uniform velocity v with its trajectory running parallel to + ve Y-axis and intersecting Z-axis at $z = a$ as shown in figure. The change in its angular momentum about the origin as it bounces elastically from a wall at y = constant is



[NCERT Exemplar]

(a) $mva\,\hat{\mathbf{e}}_x$ (b) $2\,mva\,\hat{\mathbf{e}}_x$ (c) $ymv\hat{\mathbf{e}}_x$ (d) $2\,ymv\hat{\mathbf{e}}_x$

11. A ring is kept on a rough inclined surface. But the coefficient of friction is less than the minimum value required for pure rolling. At any instant of time, let K_T and K_R be the translational and rotational kinetic energies of the ring respectively, then

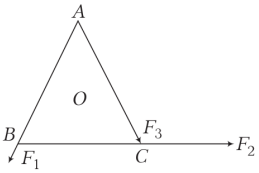
(a) $K_R = K_T$ (b) $K_R > K_T$ (c) $K_T > K_R$ (d) $K_R = 0$

12. A ring and a disc of different masses are rotating with the same kinetic energy. If we apply a retarding torque τ on the ring, it stops after making n revolutions. After how many revolutions will the disc stop, if the retarding torque on it is also τ?

(a) $\frac{n}{2}$ (b) n
(c) $2n$ (d) Data insufficient

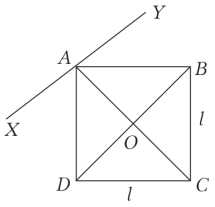
13. O is the centre of an equilateral triangle ABC. F_1, F_2 and F_3 are three forces acting along the sides AB, BC and AC respectively as shown in figure.

What should be the magnitude of F_3, so that the total torque about O is zero?



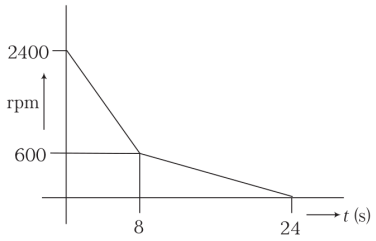
(a) $\frac{F_1 + F_2}{2}$ (b) $F_1 - F_2$ (c) $F_1 + F_2$ (d) $2(F_1 + F_2)$

14. Four point masses each of mass m are placed at the corners of a square $ABCD$ of side l. The moment of inertia of the system about an axis passing through A and parallel to BD is



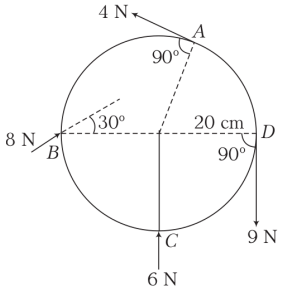
(a) $\sqrt{3}\,ml^2$ (b) $3\,ml^2$ (c) ml^2 (d) $2\,ml^2$

15. A table fan rotating at a speed of 2400 rpm, is switched OFF and the resulting variation of the rpm with time as shown in the figure. The total number of revolutions of the fan before it comes to rest is



(a) 420 (b) 190 (c) 280 (d) 380

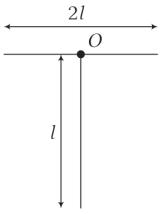
16. Forces are applied on a wheel of radius 20 cm as shown in the figure. The torque produced by the forces 4 N at A, 8 N at B, 6 N at C and 9 N at D at angles indicated is



(a) 5.4 N-m anti-clockwise (b) 1.80 N-m clockwise
(c) 2.0 N-m clockwise (d) 3.6 N-m clockwise

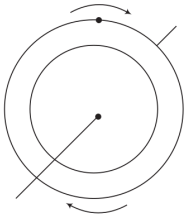
17. A uniform rod of mass 2 kg and length 1 m lies on a smooth horizontal plane. A particle of mass 1 kg moving at a speed of 2 ms^{-1} perpendicular to the length of the rod strikes it at a distance $\frac{1}{4}$ m from the centre and stops. What is the angular velocity of the rod about its centre just after the collision?
(a) 3 rad s^{-1} (b) 4 rad s^{-1} (c) 1 rad s^{-1} (d) 2 rad s^{-1}

18. For the uniform T shaped structure with mass $3M$, moment of inertia about an axis normal to the plane and passing through O would be



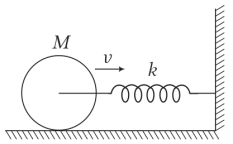
(a) $\frac{2}{3}Ml^2$ (b) Ml^2
(c) $\frac{Ml^2}{3}$ (d) None of these

19. A disc is free to rotate about a smooth horizontal axis passing through its centre of mass. A particle is fixed at the top of the disc. A slight push is given to the disc and it starts rotating. During the process,



(a) only mechanical energy is conserved
(b) only angular momentum (about the axis of rotation) is conserved
(c) Both mechanical energy and angular momentum are conserved
(d) Neither the mechanical energy nor the angular momentum are conserved

20. A solid sphere rolls without slipping and presses a spring of spring constant k as shown in figure. Then, the compression in the spring will be



(a) $v\sqrt{\frac{2M}{3k}}$ (b) $v\sqrt{\frac{2M}{5k}}$ (c) $v\sqrt{\frac{5k}{7M}}$ (d) $v\sqrt{\frac{7M}{5k}}$

Section-B
(Numerical Answer Type)

This section contains 10 questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place).
Do any 5 questions out of 10 Questions.

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21. If the rotational kinetic energy of a body is increased by 300%, then determine percentage increase in its angular momentum.

22. If the radius of the earth contracts to half of its present value without change in its mass, what will be the new duration of the day?

23. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its centre of mass has speed of $0.2\,\mathrm{m\,s^{-1}}$. How much work is needed to stop it?

24. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of $2\mathrm{rad/\,s^{-2}}$. Its net acceleration (in $\mathrm{m\,s^{-2}}$) at the end of 2 s is approximately

25. An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part of mass 1 kg moves with a speed of $12\,\mathrm{m\,s^{-1}}$ and the second part of mass 2 kg moves with speed of $8\,\mathrm{m\,s^{-1}}$. If the third part flies off with speed of $4\,\mathrm{m\,s^{-1}}$, then its mass is

26. A body of mass 4 kg moving with velocity $12\,\mathrm{m\,s^{-1}}$ collides with another body of mass 6 kg at rest. If two bodies stick together after collision, then the loss of kinetic energy of system is k then $10k$ is

27. Body A of mass 4 m moving with speed u collides with another body B of mass 2 m at rest. The collision is head on and elastic in nature. After the collision, the fraction of energy lost by the colliding body A is k, then $9k$ is

28. Two particles of masses 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass. The centre of mass of the system from the 5 kg particle is nearly at a distance in cm is

29. A moving block having mass m, collides with another stationary block having mass $4m$. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v, then the value of coefficient of restitution (e) multiplied by 100 will be

30. Body of mass M is much heavier than the other body of mass m. The heavier body with speed v collides with the lighter body which was at rest initially elastically. The speed of lighter body after collision is kv then k is

Module-Test-12
Physics(Answer)

1. (d)
2. (b)
3. (c)
4. (b)
5. (b)
6. (b)
7. (d)
8. (b)
9. (b)
10. (b)
11. (c)
12. (b)
13. (c)
14. (b)
15. (c)
16. (b)
17. (a)
18. (b)
19. (a)
20. (d)
21. 100
22. 6
23. 3
24. 8
25. 5
26. 1728
27. 1
28. 67
29. 25
30. 2