PHYSICS

BOOKS - SAI PHYSICS (TELUGU ENGLISH)

SYSTEM OF PARTICLES AND ROTATIONAL MOTION

Mcq

1. Light with an energy flux of $9Wcm^{-2}$? falls on a nonreflecting surface at normal incidence. If the surface has an area of $20cm^2$. The total momentum delivered for complete absorption in one hour is

A. $2.16 \times 10^{-4}kgms^{-1}$

B. $1.16 \times 10^{-3}kgms^{-1}$

C. $2.16 \times 10^{-3}kgms^{-1}$

D. $3.16 \times 10^{-4}kgms^{-1}$

Answer: (c)

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2. A particle of mass m=5 units is moving with 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 units

Answer: (b)

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3. The kinetic energy of a circular disc rotating with a speed of 60 r.p.m. about an axis passing through a point on its circumference and perpendicular to its plane is (mass of circular disc = 5 kg, radius of disc = 1m) approximately.

A. 170 J

B. 160 J

C. 150 J

D. 140J

Answer: (c)

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4. The moment of inertia of a solid cylinder of mass M, length 2 R and radius about R an axis passing through the centre of mass and perpendicular to the axis of the cylinder is I and about an axis passing through one end of

the cylinder and perpendicular to the axis of cylinder is I_2,then

A. $I_2 < I_1$

B. $I_2 - I_1 = MR^2$

C. $\frac{I_2}{I_1} = \frac{19}{12}$

D. $\frac{I_2}{I_1} = \frac{7}{6}$

Answer: (b)

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5. A thin wire of length / having density p is bent into a circular loop with C as its centre, as shown in figure. The moment of inertia of the loop about the line AB is

A. $\frac{5pI^3}{16\pi^2}$

B. $\frac{pI^3}{16\pi^2}$

C. $\frac{pI^3}{8\pi^2}$

D. $\frac{3pI^3}{8\pi^2}$

Answer: (d)

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6. Moment of inertia of a body about an axis is $4kg - m^2$. The body is initially at rest and a torque of 8 N-m starts along the same axis. Work done by the R, about an axis which is a tangent and parallel to its torque in 20 s, in joules, is

A. 40

B. 640

C. 2560

D. 3200

Answer: (d)

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7. A uniform circular disc of radius R, lying on a frictionless horizontal plane is rotating with an angular velocity omega about is its own axis. Another identical circular disc is gently placed on the top of the first disc coaxially. The loss in rotational kinetic energy due to friction

between the two discs, as they acquire common angular velocity is (I is moment of inertia of the disc)

A. $\frac{1}{8}1\omega^2$

B. $\frac{1}{4}1\omega^2$

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

D. $1\omega^2$

Answer: (b)

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8. A magnetic needle lying parallel to a magnetic field is turned through 60°. The work done on it is W. The torque required to maintain the magnetic needle in the position mentioned above is

A. $\sqrt{3}w$

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

C. $\frac{W}{2}$

D. $2w$

Answer: (a)

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9. Two solid spheres A and B each of radius R are made of materials of densities P_A and P_B respectively. Their moments of inertia about a diameter are $I_A$and I_B respectively. The value of $I_A / I_B$is

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10. Two uniform circular discs having the same mass and the same thickness but different

radii are made from different materials. The disc with the smaller rotational inertia is

A. The one made from the more dense material

B. The one made from the less dense material

C. The disc with the larger angular velocity

D. The disc with the larger torque

Answer: (b)

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11. A thin hollow sphere of mass m is completely filled with a liquid of mass m. When the sphere rolls with a velocity v kinetic energy of the system is (neglect friction)

A. $\frac{1}{2}mv^2$

B. mv^2

C. $\frac{4}{3}mv^2$

D. $\frac{4}{5}mv^2$

Answer: (c)

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12. A bomb moving with velocity $\left(40\hat{i}+50\hat{j}-25\hat{k}\right)$ m/s explodes into two pieces of mass ratio 1 : 4. After explosion the smaller piece moves away with velocity $\left(200\hat{i}+70\hat{j}+15\hat{k}\right)m/s.$

A. $45\hat{j}-35\hat{k}$

B. $45\hat{i}-35\hat{j}$

C. $45\hat{k}-35\hat{j}$

D. $-35\hat{i}+45\hat{k}$

Answer: (a)

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13. The moment of inertia of a disc, of mass M and radius R, about an axis which is a tangent and parallel to its diameter is

A. $\frac{1}{2}MR^2$

B. $\frac{3}{4}MR^2$

C. $\frac{1}{4}MR^2$

D. $\frac{5}{4}MR^2$

Answer: (d)

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14. A fly-wheel of mass 25 kg has a radius of 0.2 m. It is making 240 rpm. What is the torque necessary to bring to rest in 20 s?

A. $2\pi NM$

B. $0.4\pi NM$

C. $\frac{2}{\pi}NM$

D. $4\pi NM$

Answer: (b)

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15. A rod of length / is held vertically stationary with its lower end located at a point P, on the horizontal plane. When the rod is released to topple about P, the velocity of

the upper end of the rod with which it hits the ground is

A. $\sqrt{\frac{g}{l}}$

B. $\sqrt{gl}$

C. $3\sqrt{\frac{g}{l}}$

D. $\sqrt{\frac{3g}{l}}$

Answer: (b)

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16. A wheel of radius 0.4 m can rotate freely about its axis as shown in the figure. A string is wrapped over its rim and a mass of 4 kg is hung. An angular acceleration of 8 $rad - s^{-2}$ produced in it due to the torque. Then, moment of inertia of the wheel is $(g = 10ms^{-2})$

A. $2kg - m^2$

B. $1kg - m^2$

C. $4kg^{-2}$

D. $8kg^2$

Answer: (a)

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17. Two particles A and B initially at rest, move towards each other, under mutual force of attraction. At an instance when the speed of A is v and speed of B is 2v, the speed of centre of mass (CM) is

A. Zero

B. v

C. 2.5

D. 4v

Answer: (a)

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18. Starting from rest, the time taken by a body sliding down on a rough inclined plane at 45° with the horizontal is, twice the time taken to travel on a smooth plane of same

inclination and same distance. Then, the coefficient of kinetic friction is a)

A. 0.25

B. 0.33

C. 0.5

D. 0.75

Answer: (d)

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19. The moment of inertial of a thin circular disc about an axis passing through its centre and perpendicular to its plane is I. Then, the moment of inertia of the disc about an axis parallel to its diameter and touching the edge of the rim is

A. I

B. 2I

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

D. $\frac{5}{2}I$

Answer: (d)

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20. Two bodies of 6 kg and 4 kg masses have their velocity $5\hat{i} - 2\hat{j} + 10\hat{j}$ and $10\hat{i} - 2\hat{j} + 5\hat{k}$ respectively. Then, the velocity of their centre of mass is

A. $5\hat{i} + 2\hat{j} - 8\hat{k}$

B. $7\hat{i} + 2\hat{j} - 8\hat{k}$

C. $7\hat{i} - 2\hat{j} + 8\hat{k}$

D. $5\hat{i} - 2\hat{j} + 8\hat{k}$

Answer: (c)

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21. Two solid spheres (A and B) are made of metals of different densities $P(A)$ and P_B respectively. If their masses are equal, the ratio of their moments of inertia $(I_A / I_B$ about their respective diameter is

A. $\left(\frac{P_B}{P_A}\right)^{2/3}$

B. $\left(\frac{P_A}{P_B}\right)^{2/3}$

C. $\frac{P_A}{P_B}$

D. $\frac{P_B}{P_A}$

Answer: (a)

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22. When the angle of inclination of an inclined plane is an object slides down with uniform velocity. If the same object is pushed up with a initial velocity u on the same

inclined plane, it goes up the plane and stops at a certain distance on the plane. Thereafter the body

A. Slides down the inclined plane and reaches the ground with velocity u.

B. Slides down the inclined plane and reaches the ground with velocity less than u.

C. Slides down the inclined pane an reaches the ground with velocity greater

than u.

D. Stays at rest on the inclined plane and will not slide down

Answer: (d)

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23. A uniform rod of length 8 a and mass 6 m lies on a smooth horizontal surface. Two point masses m and 2 m moving in the same plane with speed 2 v and v respectively strike the rod

perpendicular at distances a and 2a from the mid point of the rod in the opposite directions and stick to the rod. The angular velocity of the system immediately after the collision is

A. $\frac{6v}{32a}$

B. $\frac{6v}{33a}$

C. $\frac{6v}{40a}$

D. $\frac{6v}{41a}$

Answer: (d)

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24. Assume the earth's orbit around the sun as circular and the distance between their centres as D. Mass of the earth is M and its radius is R. If earth has an angular velocity with respect to its centre and with respect to the centre of the sun, the total kinetic energy of earth is

A. $\frac{MR^2}{5}\omega_0^2\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

B. $\frac{MR^2}{5}\omega_0^2\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

C. $\frac{2}{3}MR^2\omega_0^2\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

D. $\frac{2}{5}MR^2\omega_0^2\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

Answer: (b)

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25. The centre of mass of three particles of masses 1 kg, 2 kg and 3 kg is at (2,2, 2). The position of the fourth mass of 4 kg to be placed in the system as that the new centre of mass is at (0, 0, 0) is

A. (-3, -3, -3)

B. (-3, 3, -3)

C. (2, 3, -3)

D. (2, -2,3)

Answer: (a)

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26. The minimum force required to move a body up an inclined plane is three times the minimum force required to prevent it from sliding down the plane. If the coefficient of

friction between the body and the inclined plane $\frac{1}{2\sqrt{3}}$,is the angle of the inclined plane is

A. 60°

B. 45°

C. 30°

D. 15°

Answer: (c)

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27. The instantaneous velocity of a point B of the given rod of length 0.5 m is $3ms^{-1}$ in the represented direction. The angular velocity of the rod for minimum velocity of end A is

A. $1.5rads^{-1}$

B. $5.2rads^{-1}$

C. $2.5rads^{-1}$

D. None of these

Answer: (b)

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28. Identify the increasing order of the angular velocities of the following

1. Earth rotating about its own axis

2. Hour's hand of a clock

3. Second's hand of a clock

4. Flywheel of radius 2 m making 300 rpm

A. 1,2,3,4

B. 2, 3, 4, 1

C. 3,4, 1,2

D. 4, 1,2,3

Answer: (a)

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29. Two particles of equal mass have velocities $\vec{V}_1 = 4\hat{i}ms^{-1}$ and $\vec{V}_2 = 4\hat{j}ms^{-1}$ First particle has an acceleration $\vec{a}_1 = \left(5\hat{i} + 5\hat{j}\right)ms^{-1}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of

A. Straight line

B. Parabola

C. Circle

D. Ellipse

Answer: (a)

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30. A thin uniform square lamina of side a is placed in the xy plane with its sides parallel to x and y-axes and with its centre coinciding

with origin. Its moment of inertia about an axis passing through a point on the y-axis at a distance y - 2a and parallel to x-axis is equal to its moment of inertia about an axis passing through a point on the x-axis at a distance x d and perpendicular to xy-plane. Then, value of d is

A. $\frac{7}{3}a$

B. $\sqrt{\frac{47}{12}}a$

C. $\frac{9}{5}a$

D. $\sqrt{\frac{51}{12}}a$

Answer: (b)

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31. A particle of mass 1 kg is projected with all initial velocity $10ms^{-1}$ at an angle of projection 45° with the horizontal. The average torque acting on the projectile, between the time at which its is projected and the time at which it strikes the ground, about the point of projection in newton-metre is

A. 25

B. 50

C. 75

D. 100

Answer: (b)

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32. Two objects of masses 200 g and 500 g possess velocities $10\hat{i}ms^{-1}$ and

$3\hat{i} + 5\hat{j} ms^{-1}$ respectively. The velocity of their centre of mass in ms^{-1} is

A. $5\hat{i} - 25\hat{j}$

B. $\frac{5}{7}\hat{i} - 25\hat{j}$

C. $5\hat{i} + \frac{25}{7}\hat{j}$

D. $25\hat{i} - \frac{5}{7}\hat{j}$

Answer: (c)

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33. The moment of inertia of meter scale of mass 0.6 kg about an axis perpendicular to the scale and located at the 20 cm position on the scale in $kg - m^2$ is (Breadth of the scale is negligible)

A. 0.078

B. 0.104

C. 0.148

D. 0.208

Answer: (a)

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34. A circular disc of radius R and thickness $\frac{R}{6}$ has moment of inertia about an axis passing through its centre and perpendicular to its plane. It is melted and recasted into a solid sphere. The moment of inertia of the sphere about its diameter as axis of rotation is

A. I

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

C. $\frac{I}{5}$

D. $\frac{I}{10}$

Answer: (c)

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35. If A is the areal velocity of a planet of mass M, its angular momentum is

A. $\frac{M}{A}$

B. 2MA

C. A^2M

D. AM^2

Answer: (b)

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36. Moment of inertial of a uniform horizontal solid cylinder of mass M about an axis passing through its edge and perpendicular to the axis of the cylinder when its length is 6 times its radius R is

A. $\frac{39MR^2}{4}$

B. $\frac{30MR^2}{4}$

C. $\frac{49MR}{4}$

D. $\frac{49MR^2}{4}$

Answer: (d)

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37. A body is sliding down a rough inclined plane. The coefficient of friction between the body and the plane is 0.5. The ratio of the net force required for the body to slide down and

the normal reaction on the body is 1:2. Then, the angle of the inclined plane is

A. 15°

B. 30°

C. 45°

D. 60°

Answer: (c)

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38. Particles of masses m, 2m, 3m ... nm gram are placed on the same line at distance l, 2l, 3l, ..., nl cm from a fixed point. The distance of centre of mass of the particles from the fixed point in cm is

A. $\frac{(2n+1)1}{3}$

B. $\frac{1}{n+1}$

C. $\frac{n\left(n^2+1\right)I}{2}$

D. $\frac{2I}{n(n^2+I)}$

Answer: (a)

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39. The diameter of a flywheel is 1 m. It has a mass of 20 kg. It is rotating about its axis with a speed of 120 rotations in 1 min. Its angular momentum in `kg-m^(2)s^(-1)is

A. 13.4

B. 31.4

C. 41.4

D. 43.4

Answer: (b)

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40. The velocities of three particles of masses 20 g, 30 g and 50 g are $10\hat{}$i, $10\hat{j}$ and $10\hat{k}$ respectively. The velocity of the centre of mass of the three particles is

A. $2\hat{i} + 3\hat{j} + 5\hat{k}$

B. $10\left(\hat{i} + \hat{j} + \hat{k}\right)$

C. $20\hat{i} + 30\hat{j} + 5\hat{k}$

D. $2\hat{i} + 30\hat{j} + 50\hat{k}$

Answer: (a)

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41. . A particle is projected up along a rough inclined plane of inclination 45° with the horizontal. If the coefficient of friction is 0.5, the acceleration is

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

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

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

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

Answer: (c)

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42. A uniform metal rod of length L and mass M is rotating about an axis passing through one of the ends and perpendicular to the rod with angular speed omega. If th temperature

increases by $t^{\circ}C$, then the change in its angular velocity is proportional to which of the following? (Coefficient of linear expansion of rod = a)

A. $\sqrt{\omega}$

B. ω

C. ω^2

D. $\frac{1}{\omega}$

Answer: (b)

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43. From a uniform wire, two circular loops are made (i) P of radius r and (ii) Q of radius nr. If the moment of inertia of about an axis passing through its centre and perpendicular to its plane is 8 times that of P about a similar axis, the value of n is (diameter of the wire is very much smaller than i or nr)

A. $8\sqrt{2}$

B. $6\sqrt{2}$

C. $4\sqrt{2}$

D. $2\sqrt{2}$

Answer: (d)

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44. A body is sliding down an inclined plane having coefficient of friction 0.5. If the normal reaction is twice that of the resultant downward force along the inclination the angle between the inclined plane and the horizontal is

A. 15°

B. 30°

C. 45°

D. 60°

Answer: (c)

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45. The radius of gyration of a sphere of mass M and radius R about the axis parallel to the

axis passing through its centre and tangent to the sphere is

A. $\frac{7}{5}R$

B. $\frac{3}{5}R$

C. $\left(\sqrt{\frac{7}{5}}\right)R$

D. $\left(\sqrt{\frac{3}{5}}\right)R$

Answer: (c)

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46. A wheel has a speed of 1200 rev/min and is made to slow down at a rate of $4rads^{-2}$. The number of revolutions it makes before coming to rest is

A. 143

B. 272

C. 314

D. 722

Answer: (c)

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47. Two particles of mass 1 kg and 3 kg have position vectors $2\hat{i}+3\hat{j}+4\hat{k}$ and $-2\hat{i}+3\hat{j}-4\hat{k}$ respectively. The centre of mass, has a position vector

A. $\hat{i}+3\hat{j}-2\hat{k}$

B. $-\hat{i}-3\hat{j}-2\hat{k}$

C. $-\hat{i}+3\hat{j}+2\hat{k}$

D. $-\hat{i}+3\hat{j}-2\hat{k}$

Answer: (d)

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48. A stone is projected vertically up to reach maximum height h. The ratio of its kinetic energy to its potential energy, at a height $\frac{4}{5}$, will be

A. $5:4$

B. $4:5$

C. $1:4$

D. $4:1$

Answer: (c)

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49. A body takes $1\frac{1}{3}$ times as much time to slide down a rough inclined plane as it takes to slide down an identical but smooth inclined plane. If the angle of inclined plane is 45°, the coefficient of friction is

A. $\frac{7}{16}$

B. $\frac{9}{16}$

C. $\frac{7}{9}$

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

Answer: (a)

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50. The moment of inertia of a thin uniform rod of mass M and length L about an axis perpendicular to the rod, through its centre is I. The moment of inertia of the rod about axis

perpendicular to the rod through its end point is

A. $\frac{I}{4}$

B. $\frac{I}{2}$

C. 2I

D. 4I

Answer: (d)

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51. The position of a particle is given by $\overrightarrow{r} = \left(\hat{i} + 2\hat{j} - \hat{k}\right)$ momentum $\overrightarrow{p} = \left(3\hat{i} + 4\hat{j} - 2\hat{k}\right)$ The angular momentum is perpendicular to

A. x-axis

B. y-axis

C. z-axis

D. Line at equal to all the three axes

Answer: (a)

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52. A thin metal disc of radius 0.25 m and mass 2 kg starts from rest and rolls down an inclined plane. If its rotational kinetic energy is 4 J at the foot of the inclined plane, then its linear velocity at the same point is

A. $1.2ms^{-1}$

B. $2\sqrt{2}ms^{-1}$

C. $20ms^{-1}$

D. $2ms^{-1}$

Answer: (b)

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53. A constant torque of 1000 N-m, turns á wheel of moment of inertia 200 $kg - m^2$ about an axis through its centre. Its angular velocity after 3 s is, (in rad/s)

A. 1

B. 5

C. 15

D. 10

Answer: (c)

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54. A wheel of mass 10 kg has a moment of inertial of $160kg - m^2$ about its own axis. The radius of gyration is

A. 10m

B. 4m

C. 5m

D. 6m

Answer: (b)

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55. The moment of inertia of a solid sphere of mass M and radius R about the tangent is

A. $\frac{2}{5}MR^2$

B. $\frac{7}{5}MR^2$

C. $\frac{2}{3}MR^2$

D. $\frac{-5}{3}MR^2$

Answer: (b)

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56. A bomb travelling in a parabolic path under the effect of gravity, explodes in mid-air. The centre of mass of the fragments will

A. Move vertically upwards and then vertically downwards

B. Move vertically downwards

C. Move in irregular path

D. Move in the parabolic path the unexploded bomb would have travelled

Answer: (d)

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57. A solid cylinder at rest at top of an inclined plane of height 2.7 m, rolls down without slipping. If the same cylinder has to slide down a frictionless inclined plane and acquire the same velocity as that acquired by centre of mass of rolling cylinder, at the bottom of inclined plane, the height of the inclined plane should be

A. $5m^{-1}, 1.5m$

B. $7m^{-1}, 2.5m$

C. $6m^{-1}, 1.8m$

D. $3m^{-1}, 1.2m$

Answer: (c)

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58. The moment of inertia of thin uniform circular disc about one of the diameter is I. Its moment of inertia about an axis perpendicular to the circular surface and passing through its centre is

A. $\sqrt{2}I$

B. 2I

C. $\frac{I}{2}$

D. $\frac{I}{\sqrt{2}}$

Answer: (b)

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59. Two particles P and Q located at distancer, andr, respectively from the centre of a rotating disc such that $r_P > r_Q$

A. Both P and Q have the same acceleration

B. Both P and Q do not have any acceleration

C. P has greater acceleration than Q

D. Q has greater acceleration than P

Answer: (c)

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60. A ball of 1 g released down an inclined plane describes a circle of radius 10 cm in the vertical plane on reaching the bottom. The minimum height of the inclined plane is

A. 10cm

B. 15cm

C. 20cm

D. 25cm

Answer: (d)

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