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Class: XI
Subject: Physics
Topic: Systems of Particles and Rotational motion
No. of Questions: 20

Q1. A shell fired from a gun at an angle to the horizontal explodes in mid-air. Then the centre of mass of the shell fragments will move
a. vertically down
b. horizontally
c. along the same parabolic path along which the 'intact' shell, was moving
d. along tangent to the parabolic path of the 'intact' shell, at the point of explosion

Q2. A child is standing at one end of a long trolley moving with a speed v on a smooth horizontal track. If the child starts running towards the other end of the trolley with a speed u, the centre of mass of the system (trolley + child) will move with a speed

a. zero
b. (v + u)
c. (v – u)
d. V

Q3. Choose the only incorrect statement from the following
a. The position of the centre of mass of a system of particles does not depend upon the internal forces between particles.
b. The centre of mass of a solid may lie outside the body of the solid.
c. A body tied to a string is whirled in a circle with a uniform speed. If the string is suddenly cut, the angular momentum of the body will change from its initial value.
d. The angular momentum of a comet revolving around a massive star, remains constant over the entire orbit.

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Q4. A carpet of mass M, made of an inextensible material, is rolled along its length in the form of a cylinder of radius R and kept on a rough floor. If the carpet is unrolled (without sliding) to a radius R/2, the decrease in potential energy will be

a. $\frac{1}{2}MgR$
b. $\frac{5}{8}MgR$
c. $\frac{3}{4}MgR$
d. $\frac{7}{8}MgR$

Q5. A molecule consists of two atoms, each of mass m, separated by a distance a. The moment of inertia of the molecule about its centre of mass is

a. $2\ ma^2$
b. ma^2
c. $\frac{1}{2}\ ma^2$
d. $\frac{1}{4}\ ma^2$

Q6. The moment of inertia of a solid sphere of mass M and radius R, about an axis through its centre is $\frac{2}{5}MR^2$. The moment of inertia about an axis tangential to the surface of the sphere will be

a. $\frac{4}{5}MR^2$
b. MR^2
c. $\frac{6}{5}MR^2$
d. $\frac{7}{5}\ MR^2$

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Q7. When W joules of work is done on a flywheel, its frequency of rotation increases from ν_1 Hz to ν_2 Hz. The moment of inertia of the flywheel about its axis of rotation is given by

a. $\frac{W}{2\pi^2(v_2^2 - v_1^2)}$
b. $\frac{W}{2\pi^2(v_2^2 + v_1^2)}$
c. $\frac{W}{4\pi^2(v_2^2 - v_1^2)}$
d. $\frac{W}{4\pi^2(v_2^2 + v_1^{2)}}$

Q8. If the earth were to suddenly contract to half its present size, without any change in its mass, the duration of the new day will be

a. 6 hours
b. 12 hours
c. 18 hours
d. 30 hours

Q9. A solid sphere rolls down from the top of an inclined plane. Its velocity on reaching the bottom of the plane is v. When the same sphere slides down from the top of the plane, its velocity on reaching the bottom is v'. The ratio v'/v is equal to

a. $\sqrt{\frac{3}{5}}$
b. 1
c. $\sqrt{\frac{7}{5}}$
d. $\frac{3}{\sqrt{5}}$

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Q10. A circular disc rolls down an inclined plane without slipping. What fraction of its total energy is translational?

a. $\frac{1}{\sqrt{2}}$
b. $\frac{1}{2}$
c. $\frac{1}{3}$
d. $\frac{2}{3}$

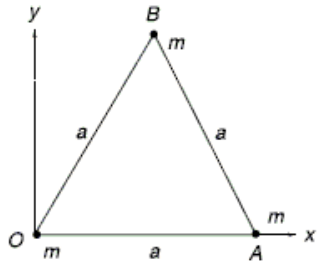
Q11. A circular disc is rolling down an inclined plane without slipping. If the angle of inclination is 30°, the acceleration of the disc down the inclined plane is

a. g
b. $\frac{g}{2}$
c. $\frac{g}{3}$
d. $\frac{\sqrt{2}}{3}$ g

Q12. Two circular loops A and B are made of the same wire and their radii are in the ratio 1 : n. Their moments of inertia about the axis passing through the centre and perpendicular to their plane are in the ratio 1 : m. The relation between m and n is

a. $m = n$
b. $m = n^2$
c. $m = n^3$
d. $m = n^4$

Q13. Three particles, each of mass m, are placed at the corners of an equilateral triangle of side a, as shown in the figure. The position vector of the centre of mass is



a. $\frac{a}{2}(i + j/\sqrt{3})$

b. $\frac{a}{2}(3\,i + j)$

c. $\frac{a}{2}(3\,i + \sqrt{3}\,j)$

d. $\frac{a}{2}(3\,i + j/\sqrt{3})$

Q14. A circular disc of mass m and radius r is rolling on a horizontal surface with a constant speed v. Its kinetic energy is

a. $\frac{1}{4}mv^2$

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

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

d. mv^2

Q15. A cylinder, released from the top of an inclined plane, rolls without sliding and reaches the bottom with speed v_r. Another identical cylinder, released from the top of the same inclined plane, slides without rolling and reaches the bottom with speed v_s. Then

a. $v_r > v_s$

b. $v_r < v_s$

c. $v_r = v_s$

d. $v_r = v_s = 0$

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Q16. Three thin metal rods, each of mass M and length L are welded to form an equilateral triangle. The moment of inertia of the composite structure about an axis passing through the centre of mass of the structure and perpendicular to its plane is

a. $\frac{ML^2}{2}$
b. $\frac{ML^2}{4}$
c. $\frac{ML^2}{8}$
d. $\frac{ML^2}{12}$

Q17. A solid sphere is rotating about its diameter. Due to increase in room temperature, its volume increases by 0.5%. If no external torque acts, the angular speed of the sphere will

a. increase by nearly $\frac{1}{3}\%$
b. decrease by nearly $\frac{1}{3}\%$
c. increase by nearly $\frac{1}{2}\%$
d. decrease by nearly $\frac{2}{3}\%$

Q18. A uniform rod of length L is suspended from one end such that it is free to rotate about an axis passing through that end and perpendicular to the length. What minimum speed must be imparted to the lower end, so that the rod completes one full revolution?

a. $\sqrt{2gL}$
b. $\sqrt{gL}$
c. $\sqrt{6gL}$
d. $2\sqrt{2gL}$

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Q19. A thin uniform rod AB of mass M and length L is hinged at one end A to the horizontal floor. Initially, it stands vertically. It is allowed to fall freely on the floor in the vertical plane. The angular velocity of the rod when its end B strikes the floor is

a. $\sqrt{\frac{g}{L}}$
b. $\sqrt{\frac{2g}{L}}$
c. $\sqrt{\frac{3g}{L}}$
d. $2\sqrt{\frac{g}{L}}$

Q20. The moment of inertia of a thin rod of mass M and length L about an axis passing through the point at a distance L/4 from one of its ends and perpendicular to the rod is

a. $\frac{7ML^2}{48}$
b. $\frac{ML^2}{12}$
c. $\frac{ML^2}{9}$
d. $\frac{ML^2}{3}$