CBSE

SYSTEM OF PARTICLES AND ROTATIONAL MOTION WS 10

Class 11 - Physics

Section A

1. Two bodies have their moments of inertia I and 2l respectively about their axis of rotation. If their kinetic energies of rotation are equal, their angular momenta will be in the ratio **[1]**

   a) $\sqrt{2}:1$ b) 2 : 1

   c) 1 : 2 d) $1:\sqrt{2}$

2. Two bodies with moments of inertia I_1 and I_2 ($I_1 > I_2$) have equal angular momenta. If K.E. of rotation is E_1 and E_2 then: **[1]**

   a) $E_1 < E_2$ b) $E_1 > E_2$

   c) $E_1 = E_2$ d) $E_1 \geq E_2$

3. Three objects, A: (a solid sphere), B: (a thin circular disc) and C: (a circular ring), each have the same mass M and radius R. They all spin with the same angular speed ω about their own symmetry axes. The amounts of work (W) required to bring them to rest, would satisfy the relation **[1]**

   a) $W_B > W_A > W_C$ b) $W_A > W_B > W_C$

   c) $W_A > W_C > W_B$ d) $W_C > W_B > W_A$

4. Circular disc of mass m and radius r is rolling forward on the horizontal table with a velocity v. Its total kinetic energy is **[1]**

   a) $\frac{1}{2}mv^2$ b) mv^2

   c) $\frac{1}{4}mv^2$ d) $\frac{3}{4}mv^2$

5. The earth circles around the sun once a year. The work which would have to be done on the earth to bring it: to rest relative to the sun is, (Ignore the rotation of earth about its own axis) given that the mass of the earth = 6×10^{24} kg and distance between sun and earth is 1.5×10^8 km: **[1]**

   a) -2.7×10^{33} J b) 2.7×10^{31} J

   c) 2.7×10^{30} J d) 2×10^{33} J

6. A sphere of radius r is rolling without sliding. What is ratio of rotational kinetic energy and total kinetic energy associated with the sphere? **[1]**

   a) $\frac{2}{7}$ b) 1

   c) $\frac{2}{5}$ d) $\frac{1}{2}$

7. A circular disk of moment of inertia I, is rotating in a horizontal plane, about its symmetry axis, with a constant angular speed ω_i Another disk of moment of inertia I_b is dropped coaxially onto the rotating disk. Initially the **[1]**

second disk has zero angular speed. Eventually both the disks rotate with a constant angular speed ω_f. The energy lost by the initially rotating disk due to friction is

a) $\frac{I_b - I_t}{(I_t + I_b)}\omega_i^2$

b) $\frac{1}{2(I_t + I_b)}\omega_i^2$

c) $\frac{1}{2(I_t + I_b)}\omega_i^2$

d) $\frac{1}{2}\frac{I_b^2}{(I_t + I_b)}\omega_i^2$

8. 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 **[1]**

a) $\frac{k^2}{k^2+R^2}$

b) $\frac{k^2}{k^2+R^2}$

c) $\frac{k^2}{R^2}$

d) $\frac{R^2}{k^2+R^2}$

9. A spherical solid ball of 1 kg. mass and radius 3 cm is rotating about an axis passing through its centre with an angular velocity of 50 radians/s. The kinetic energy of rotation is **[1]**

a) 910 J

b) $\frac{9}{20}$ J

c) 45000 J

d) 920 J

10. A rod of length 1.4 m and negligible mass has two masses of 0.3 kg and 0.7 kg tied to its two ends. Find the location of the point on this rod, where the rotational energy is minimum when the rod is rotated about the point. **[1]**

a) 0.7 m from 0.7 kg

b) 0.98 m from 0.3 kg

c) 0.7 m from 0.3 kg

d) 0.98 m from 0.7 kg

11. A coin of mass 4.8 kg and radius one metre is rolling on a horizontal surface without sliding with angular velocity 600 rotations/min. What is total kinetic energy of the coin? **[1]**

a) 360 J

b) 1440 π^2 J

c) $600\pi^2$ J

d) $4000\pi^2$ J

12. **Assertion:** A sphere rolling on a rough horizontal surface with constant velocity then it start going up on a smooth inclined plane. Rotational kinetic energy remains constant on inclined surface. **[1]**
Reason: Rotational kinetic energy decreases if torque due to friction opposes angular velocity of the sphere.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

13. When does a disc rotate with uniform angular velocity, which of the following is not true? **[1]**

a) The orientation of the axis of rotation remains same.

b) The sense of rotation remains same.

c) The speed of rotation is non-zero and remains same.

d) The angular acceleration is non-zero and remains same

14. A constant torque of 120 N-m rotates its point of action by an angle of 30°. What is the work done by the torque? **[1]**

15. To maintain a rotor at a uniform angular speed of 200 rads^{-1}, an engine needs to transmit a torque of 180 Nm. What is the power required by the engine? **[1]**

16. If angular momentum is conserved in a system whose moment of inertia is decreased, will its rotational kinetic energy be conserved? **[1]**

17. Fill in the blank: A tangential force F acting along the ring of radius R causes it to rotate through an angle θ. The work done on the ring is _____. **[1]**

Section B

18. A flywheel of mass 500 kg and diameter 1 m makes 500 rpm. Assuming the mass to be concentrated along the rim, calculate **[2]**

    i. angular velocity

    ii. moment of inertia and

    iii. rotational K.E. of the flywheel.

19. Calculate the kinetic energy of rotation of a circular disc of mass 1 kg and radius 0.2 m rotating about an axis passing through its centre and perpendicular to its plane. The disc is making $\frac{30}{\pi}$ rotations per minute. **[2]**

20. A thin hollow cylinder open at both ends and weighing 5 kg, **[2]**

    i. slides with a speed of 5 m/s without rotating and

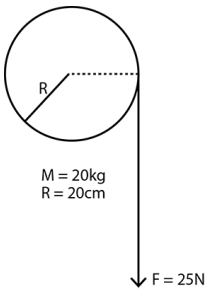
    ii. rolls with the same speed without slipping.

    Compare the K.E. of the cylinder in the two cases.

21. On applying a constant torque, a wheel is turned from rest through 400 rad in 10 s. What is its angular acceleration? If the same torque continues to act, what will be the angular velocity of wheel after further 10 s? **[2]**

Section C

22. A cord of negligible mass is wound round the rim of a flywheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord as shown in the figure. The flywheel is mounted on a horizontal axle with frictionless bearings. **[3]**



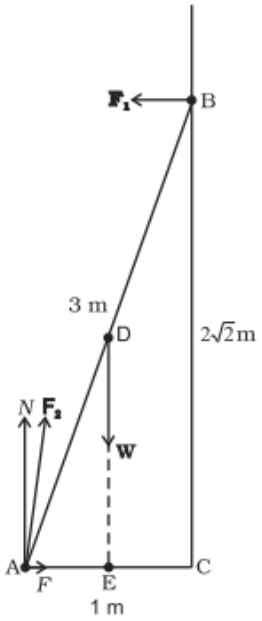
    a. Compute angular acceleration of the flywheel.

    b. Find the work done by the pull, when 2 m of the cord is unwound.

    c. Find also the KE of the flywheel at this point. Assume that the flywheel starts from rest.

    d. Compare the answers of parts (b) and (c).

23. A 3m long ladder weighing 20 kg leans on a frictionless wall. Its feet rest on the floor 1 m from the wall as shown in Fig. Find the reaction forces of the wall and the floor. **[3]**



Section D

24. **Fill in the blanks:** **[4]**

(a) Power delivered by a torque = Torque × _____. **[1]**

(b) Work done by a torque = Torque × _____. **[1]**

(c) Moment of inertia of a rigid body is equal to _____ the rotational kinetic energy of the body rotating with unit angular velocity about the given axis. **[1]**

(d) A body whose constituent particles retain their relative positions even when they move under the action of an external force is called a _____. **[1]**

Section E

25. A man stands on a rotating platform, with his arms stretched horizontally holding a 5 kg weight in each hand. The angular speed of the platform is 30 revolutions per minute. The man then brings his arms close to his body with the distance of each weight from the axis changing from 90cm to 20cm. The moment of inertia of the man together with the platform may be taken to be constant and equal to 7.6 kg m^2. **[5]**

a. What is his new angular speed? (Neglect friction.)

b. Is kinetic energy conserved in the process? If not, from where does the change come about?

26. a. A child stands at the centre of a turntable with his two arms outstretched. The turntable is set rotating with an angular speed of 40 rev/min. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to 2/5 times the initial value? Assume that the turntable rotates without friction. **[5]**

b. Show that the child's new kinetic energy of rotation is more than the initial kinetic energy of rotation. How do you account for this increase in kinetic energy?

27. A solid disc and a ring, both of radius 10 cm are placed on a horizontal table simultaneously, with initial angular speed equal to 10π rad s^{-1}. Which of the two will start to roll earlier? The co-efficient of kinetic friction is μ_k = 0.2. **[5]**