ROTATIONAL MOTION, ANGULAR MOMENTUM AND ITS CONSERVATION

1. A wheel whose moment of inertia is 5 kgm^2 has an initial angular velocity of 40 rad/s. A constant torque of 20 N m acts on the wheel. The time in which the wheel is accelerated to 60 rad/s is:
   (a) 5 s (b) 6 s (c) 8 s (d) 13 s
2. A cord is wound over the rim of a flywheel of mass 20 kg and radius 25 cm. A mass 2.5 kg attached to the cord is allowed to fall under gravity. The angular acceleration of the flywheel is:
   (a) 25 rad/s^2 (b) 20 rad/s^2 **(c)** 10 rad/s^2 (d) 5 rad/s^2
3. A hollow cylinder of mass M and radius R is rotating about its axis of symmetry and a solid sphere of same mass and radius is rotating about an axis passing through its centre. If torques of equal magnitude are applied to them, then the ratio of angular accelerations produced is:
   (a) 4/5 **(b)** 2/5 (c) 3/5 (d) 7/5
4. A string is wound round the rim of a mounted flywheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord. Neglecting friction and mass of the string, the angular acceleration of the wheel is:
   (a) 25 rad/s^2 (b) 20 rad/s^2 **(c)** 12.5 rad/s^2 (d) 8.25 rad/s^2
5. When a ceiling fan is switched on, it makes 5 revolutions in the first 4 seconds. Assuming a uniform angular acceleration, how many rotations it will make in the next 4 seconds?
   (a) 15 (b) 20 (c) 25 (d) 30
6. A flywheel rotates with a uniform angular acceleration. Its angular velocity increases from 20π rad/s to 40π rad/s in 10 seconds. How many rotations did it make in this period?
   (a) 150 (b) 120 (c) 100 (d) 60
7. A rigid body rotates about a fixed axis with variable angular velocity equal to $(\alpha - \beta t)$ at time t where α and β are constants. The angle through which it rotates before it comes to rest is:
   (a) $2\alpha^2/\beta$ (b) α^2/β **(c)** $\alpha^2/2\beta$ (d) $\alpha^2/4\beta$
8. If 2 kg mass is rotating on a circular path of radius 0.8 m with angular velocity of 44 rad/sec. If radius of the path becomes 1 m, then what will be the value of angular velocity?
   (a) 18.16 rad/sec **(b)** 28.16 rad/sec (c) 38.21 rad/sec (d) 5.26 rad/sec
9. A rigid horizontal smooth rod XY of mass 0.75 kg and length 40 cm can rotate freely about a fixed vertical axis through its midpoint 0. Two rings each of mass 1 kg initially at rest are placed at a distance of 10 cm from 0 on either side of the rod. The rod is set in rotation with an angular velocity of 30 rad/s and when the rings reach the ends of the rod, the angular velocity in rad/sec is:
   (a) 25 (b) 20 (c) 15 **(d)** 10
10. A rotating body has angular momentum L. If its frequency is doubled and kinetic energy is halved, its angular momentum becomes:
    (a) L/4 (b) L/2 (c) 4L (d) L/3
11. A thin uniform circular disc of mass M and radius R is rotating in a horizontal plane about an axis passing through its centre and perpendicular to its plane with an angular velocity ω. Another disc of same dimensions but of mass M/4 is placed gently on the first disc coaxially. The angular velocity of the system now is:
    (a) ω (b) $5\omega/4$ **(c)** $4\omega/5$ (d) $\omega/4$
12. A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system becomes doubled. The kinetic energy of the system now is:

(a) K/2 (b) 2K (c) K/4 (d) 4K

13. A particle of mass 5 kg is moving along the line y = x + 2 (here x and y are in metres) with speed 4 m/s. The magnitude of angular momentum of particle about origin is:
    (a) 4 kgm^2/s **(b)** $20\sqrt{2}$ kgm^2/s (c) 4 kgm^2/s (d) 4 kgm^2/s
14. A particle performing uniform circular motion has angular momentum L. If its angular frequency is halved and its kinetic energy is doubled, then the new angular momentum is:
    (a) 4L (b) 2L (c) L/4 (d) L
15. The moment of inertia of a uniform disc about an axis passing through its centre and perpendicular to its plane is 1 kgm^2. It is rotating with an angular velocity 100 rad/s. Another identical disc is gently placed on it so that their centres coincide. Now these two discs together continue to rotate about the same axis. Then the loss in kinetic energy in kilo joules is:
    (a) 2.5 (b) 3.0 (c) 3.5 (d) 4.0
16. Consider a body shown in figure consisting two identical balls, each of mass M connected by a light rigid rod. If an impulse J = Mv is imparted to the body at one of its ends, what would be its angular velocity?
    (a) $\frac{2v}{L}$ (b) $\frac{v}{4L}$ **(c)** $\frac{v}{L}$ (d) $\frac{v}{2L}$

17. A ballet dancer, dancing on a smooth floor is spinning about a vertical axis with her arms folded with an angular velocity of 20 rad/s. When she stretches her arms fully, the spinning speed decreases to 10 rad/s. If I is the initial moment of inertia of the dancer, the new moment of inertia is:
    (a) 6*I* (b) 8*I* (c) *I* **(d)** 2*I*
18. If I is the moment of inertia and K is the kinetic energy of rotation of a body, then its angular momentum will be:
    (a) $\sqrt{2KI}$ (b) $\sqrt{KI/2}$ (c) $\sqrt{KI}$ (d) $2KI$
19. If the angular momentum of a rotating body about a fixed axis is increased by 10%. Its kinetic energy will be increased by:
    (a) 10% (b) 16% **(c)** 21% (d) 20%
20. A billiard ball of mass m and radius r, when hit in a horizontal direction by a cue at a height h above its centre, acquired a linear velocity v_o. The angular velocity acquired by the ball is:
    (a) $\frac{5v_0h}{2r^2}$ (b) $\frac{5v_0r}{2h^2}$ (c) $\frac{3v_0h}{2r^2}$ (d) $\frac{v_0h}{2r^2}$