Rotational Motion

1. Two particles *A* and *B* initially at rest move towards each other under a mutual force of attraction. At the instant when the speed of *A* is *v* and the speed of *B* is 2*v*, the speed of centre of mass of the system is

(a) Zero (b) *v* (c) 1.5*v* (d) 3*v*

2. A circular plate of uniform thickness has diameter 56 *cm*. A circular part of diameter 42 *cm* is removed from one edge. What is the position of the centre of mass of the remaining part

(a) 3 *cm* (b) 6 *cm* (c) 9 *cm* (d) 12 *cm*

3. A strap is passing over a wheel of radius 30 *cm*. During the time the wheel moving with initial constant velocity of 2 rev/sec. comes to rest the strap covers a distance of 25 *m*. The deceleration of the wheel in *rad*/s^2 is

(a) 0.94 (b) 1.2 (c) 2.0 (d) 2.5

4. A particle starts rotating from rest. Its angular displacement is expressed by the following equation $\theta = 0.025t^2 - 0.1t$ where θ is in radian and *t* is in seconds. The angular acceleration of the particle is

(a) 0.5 *rad*/*sec*^{2} at the end of 10 *sec* (b) 0.3 rad/sec^2 at the end of 2 *sec*

(c) 0.05 *rad*/*sec*^{2} at the end of 1 *sec* (d) Constant 0.05 *rad*/*sec*^{2}

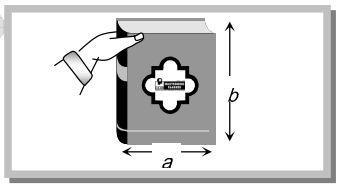
5. The planes of two rigid discs are perpendicular to each other. They are rotating about their axes. If their angular velocities are 3 *rad*/*sec* and 4 *rad*/*sec* respectively, then the resultant angular velocity of the system would be

(a) 1 *rad*/*sec* (b) 7 *rad*/*sec* (c) 5 *rad*/*sec* (d) $\sqrt{12}$ *rad*/*sec*

6. When a ceiling fan is switched off, its angular velocity falls to half while it makes 36 rotations. How many more rotations will it make before coming to rest (Assume uniform angular retardation)

(a) 36 (b) 24 (c) 18 (d) 12

7. A person supports a book between his finger and thumb as shown (the point of grip is assumed to be at the corner of the book). If the book has a weight of *W* then the person is producing a torque on the book of



(a) $W\frac{a}{2}$ anticlockwise

(b) $W\frac{b}{2}$ anticlockwise

(c) Wa anticlockwise

(d) Wa clockwise

8. Weights of $1g, 2g.....,100\,g$ are suspended from the 1 *cm*, 2 *cm*, ... 100 *cm*, marks respectively of a light *metre* scale. Where should it be supported for the system to be in equilibrium

(a) 55 *cm* mark (b) 60 *cm* mark (c) 66 *cm* mark (d) 72 *cm* mark

9. 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 *Q* 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 *r* or *nr*)

(a) 8 (b) 6 (c) 4 (d) 2

10. A circular disc *A* of radius *r* is made from an iron plate of thickness *t* and another circular disc *B* of radius 4*r* is made from an iron plate of thickness *t*/4. The relation between the moments of inertia I_A and I_B is

(a) $I_A > I_B$ (b) $I_A = I_B$

(c) $I_A < I_B$ (d) Depends on the actual values of *t* and *r*

11. The moment of inertia *I* of a solid sphere having fixed volume depends upon its volume *V* as

(a) $I \propto V$ (b) $I \propto V^{2/3}$ (c) $I \propto V^{5/3}$ (d) $I \propto V^{3/2}$

12. In a playground there is a merry-go-round of mass 120 *kg* and radius 4 *m*. The radius of gyration is 3*m*. A child of mass 30 *kg* runs at a speed of 5 *m*/*sec* tangent to the rim of the merry-go-round when it is at rest and then jumps on it. Neglect friction and find the angular velocity of the merry-go-round and child

(a) 0.2 *rad*/*sec* (b) 0.1 *rad*/*sec* (c) 0.4 *rad*/*sec* (d) 0.8 *rad*/*sec*

13. A uniform thin rod of length *l* is suspended from one of its ends and is rotated at *f* rotations per second. The rotational kinetic energy of the rod will be

(a) $\frac{2}{3}\pi^2 f^2 ml^2$ (b) $\frac{4}{3}f^2 ml^2$ (c) $4\pi^2 f^2 ml^2$ (d) Zero

14. A body rotating at 20 *rad*/*sec* is acted upon by a constant torque providing it a deceleration of 2 *rad*/*sec*^{2}. At what time will the body have kinetic energy same as the initial value if the torque continues to act

(a) 20 *secs* (b) 40 *secs* (c) 5 *secs* (d) 10 *secs*

15. The string of a simple pendulum is replaced by a uniform rod of length *L* and mass *M*. If the mass of the bob of the pendulum is *m*, then for small oscillations its time period would be (assume radius of bob *r* << *L*)

(a) $2\pi\sqrt{\frac{2(M+3m)L}{3(M+2m)g}}$ (b) $2\pi\sqrt{\frac{(M+2m)L}{3(M+3m)g}}$ (c) $2\pi\sqrt{\left(\frac{2M}{3m}\right)\frac{L}{g}}$ (d) $2\pi\sqrt{\left(\frac{M+m}{M+3m}\right)\frac{L}{g}}$