DEPARTMENT OF PHYSICS
Indian Institute of Technology Kharagpur
Classical Mechanics-I
Course: PH20007
Assignment-7: Assignment-7 (Rigid body dynamics-2)

1. Moment of inertia of a uniform square plate of length $x = y = a$ and mass M about x and y axes are
(a) $I_{xx} = \frac{1}{3}Ma^2$ and $I_{yy} = \frac{1}{3}Ma^2$
(b) $I_{xx} = \frac{2}{3}Ma^2$ and $I_{yy} = \frac{2}{3}Ma^2$
(c) $I_{xx} = \frac{1}{3}Ma^2$ and $I_{yy} = \frac{2}{3}Ma^2$
(d) $I_{xx} = \frac{2}{3}Ma^2$ and $I_{yy} = \frac{1}{3}Ma^2$

2. Moment of inertia of a uniform square plate of length $x = y = a$ and mass M about z axis is
(a) $I_{zz} = \frac{1}{3}Ma^2$
(a) $I_{zz} = \frac{3}{2}Ma^2$
(a) $I_{zz} = Ma^2$
(a) $I_{zz} = \frac{2}{3}Ma^2$

3. Product of inertia of a uniform square plate of length $x = y = a$ and mass M are
(a) $I_{xy} = I_{yx} = 0$, $I_{xz} = I_{zx} = 0$ and $I_{yz} = I_{zy} = 0$
(b) $I_{xy} = I_{yx} = -\frac{1}{4}Ma^2$, $I_{xz} = I_{zx} = 0$ and $I_{yz} = I_{zy} = 0$
(c) $I_{xy} = I_{yx} = 0$, $I_{xz} = I_{zx} = -\frac{1}{4}Ma^2$ and $I_{yz} = I_{zy} = -\frac{1}{4}Ma^2$
(d) $I_{xy} = I_{yx} = 0$, $I_{xz} = I_{zx} = -\frac{1}{4}Ma^2$ and $I_{yz} = I_{zy} = 0$

4. Principal moment of inertia of a uniform square plate of length $x = y = a$ and mass M are
(a) $I_1 = 0$, $I_2 = 0$ and $I_3 = 0$
(b) $I_1 = \frac{1}{12}Ma^2$, $I_2 = 0$ and $I_3 = \frac{7}{12}Ma^2$
(c) $I_1 = \frac{1}{12}Ma^2$, $I_2 = \frac{7}{12}Ma^2$ and $I_3 = 0$
(d) $I_1 = \frac{1}{12}Ma^2$, $I_2 = \frac{7}{12}Ma^2$ and $I_3 = \frac{2}{3}Ma^2$

5. Moment of inertia of a solid circular plate of radius a, height h and mass M about an axis on the surface of the cylinder and parallel to the axis of the cylinder
(a) Ma^2
(b) $\frac{2}{3}Ma^2$
(c) $\frac{3}{2}Ma^2$
(d) $\frac{1}{2}Ma^2$

6. Radius of gyration of a rectangular plate with sides a and b about an axis perpendicular to the plate and passing through a vertex is
(a) $\frac{1}{3}M(a^2 + b^2)$
(b) $\sqrt{\frac{1}{3}(a^2 + b^2)}$
(c) $\sqrt{\frac{1}{3}M(a^2 + b^2)}$

(d) $\frac{1}{3}(a^2 + b^2)$

7. Calculate the radius of gyration of a spherical shell of mass M and radius R with origin (fixed point) at its center
(a) $\sqrt{\frac{3}{8}}R$
(b) $\sqrt{\frac{2}{5}}R$
(c) $\sqrt{\frac{2}{3}}R$
(d) $\sqrt{\frac{3}{5}}R$

8. A solid cylinder of radius a and mass M rolls without slipping down an inclined plane of angle θ. The acceleration is
(a) $g \sin\theta$
(b) $\frac{1}{3}g \sin\theta$
(c) $\frac{2}{3}\sin\theta$
(d) $\frac{2}{3}g \sin\theta$

9. Equation for the ellipsoid of inertia corresponding to a square plate of length $x = y = a$ is
(a) $\rho_x^2 + \rho_y^2 + 2\rho_z^2 - \frac{3}{2}\rho_x\rho_y = \frac{3}{Ma^2}$
(b) $\rho_x^2 + \rho_y^2 + 2\rho_z^2 + \frac{3}{2}\rho_x\rho_y = \frac{3}{Ma^2}$
(c) $\rho_x^2 - \rho_y^2 - 2\rho_z^2 - \frac{3}{2}\rho_x\rho_y = \frac{3}{Ma^2}$
(d) $\rho_x^2 + \rho_y^2 + 2\rho_z^2 - \frac{3}{2}\rho_x\rho_y = -\frac{3}{Ma^2}$

10. If a rigid body with one point fixed rotates with angular velocity $\vec{\omega}$ and has angular momentum $\vec{\Omega}$, then kinetic energy can be written as
(a) $\frac{1}{2}(I_{xx}\omega_x^2 + I_{yy}\omega_y^2 + I_{zz}\omega_z^2$
(b) $2I_{xy}\omega_x\omega_y + 2I_{xz}\omega_x\omega_z + 2I_{yz}\omega_y\omega_z)$
(c) $\frac{1}{2}(I_{xx}\omega_x^2 + I_{yy}\omega_y^2 + I_{zz}\omega_z^2 - 2I_{xy}\omega_x\omega_y - 2I_{xz}\omega_x\omega_z - 2I_{yz}\omega_y\omega_z)$
(d) $\frac{1}{2}(I_{xx}\omega_x^2 + I_{yy}\omega_y^2 + I_{zz}\omega_z^2 + 2I_{xy}\omega_x\omega_y + 2I_{xz}\omega_x\omega_z + 2I_{yz}\omega_y\omega_z)$

End