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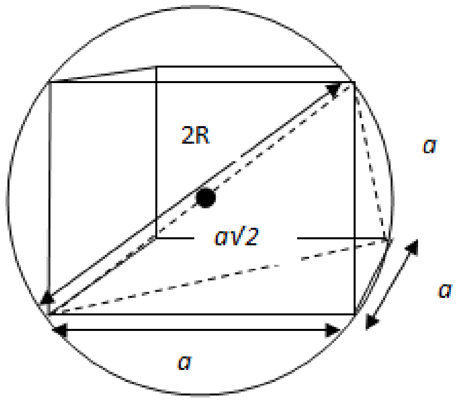
6. From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is

1. $\frac{MR^2}{32\sqrt{2}\,\pi}$ 2. $\frac{MR^2}{16\sqrt{2}\,\pi}$ 3. $\frac{4MR^2}{9\sqrt{3}\,\pi}$ 4. $\frac{4MR^2}{3\sqrt{3}\,\pi}$



Cube of maximum volume will have diagonal passing through centre of sphere and diagonal length=2R

Let *a*= edge of cube, from the figure we find

$$(2R)^2 = \left(a\sqrt{2}\right)^2 + a^2$$

$$or\ 3a^2 = 4R^2$$

$$or\ a = \frac{2}{\sqrt{3}}R$$

Moment of inertia of the cube=$\frac{mass \times edge^2}{6}$

Mass of the cube = Volume X density

$$== a^3 \times \frac{M}{\frac{4}{3}\pi R^3} = \frac{3Ma^3}{4\pi R^3}$$

Moment of Inertia = $\frac{\frac{3Ma^3}{4\pi R^3} \times a^2}{6} = \frac{Ma^5}{8\pi R^3}$

$$= \frac{M \times 32R^5}{8\pi R^3 \times 9\sqrt{3}} = \frac{4MR^2}{9\sqrt{3}\pi}$$

Correct answer is option (3) $\frac{4MR^2}{9\sqrt{3}\pi}$