## Answer on Question #63869, Physics / Mechanics | Relativity

Derive moment of inertia of a solid sphere.

**Answer:**

Direct calculation of the moment of inertia of the body about the axis reduced to the evaluation of the integral

$$J = \int r^2 dm$$

Where *r* is the distance of elemental mass *dm* to the axis of rotation.

Calculate the moment of inertia of the sphere (in spherical coordinate's r, θ, φ)

$$dm = \frac{m}{V} dV = \frac{m}{V} r^2 \sin\theta \cdot dr \cdot d\theta \cdot d\varphi$$

Here *m* is the mass of bullet, *V* is its volume.

Since

$$\rho = r \sin\theta$$

Then

$$dJ = \rho^2 \cdot dm = \frac{m}{V} r^4 \sin^3\theta \cdot dr \cdot d\theta \cdot d\varphi$$

So

$$J = \frac{m}{V} \int_o^R r^4 \, dr \int_0^{2\pi} d\varphi \int_0^{\pi} \sin^3\theta \cdot d\theta = \frac{m}{V} \cdot \frac{R^5}{5} \cdot 2\pi \cdot \frac{4}{3}$$

Since

$$V = \frac{4}{3}\pi R^3$$

Finally

$$J = \frac{2}{5} m R^2$$