Answer on Question #60516-Physics-Astronomy-Astrophysics

Three particles of mass 10 g are placed at the vertices of an equilateral triangle of side 30 cm. find distance of its center of mass from any of its vertex and moment of inertia of the system of particles about an axis passing through the center of mass of the system and perpendicular to the plane containing them

Solution

From symmetry, it comes that the center of mass located at the center of circumcircle of triangle, so the quantity we are looking for in part (i) is nothing else, but radius of the circumcircle.

There is simple formula of circumradius for equilateral triangle:

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

Where R − circumradius, a − side length.

Plug in numbers: (30 cm = 0.3 m)

$$R = \frac{\sqrt{3}}{3}0.3 = \frac{\sqrt{3}}{10} \approx 0.173\ m$$

As far as we know location of the center of mass and axis, we can calculate moment of inertia:

$$I = \sum_i m_i r_i^2$$

Where m_i − mass of the ith particle, r_i − length of perpendicular from the ith particle to the axis passing through the center of mass.

In our case all masses and all distances are equal, that's why we can make simplification:

$$I = \sum_i m_i r_i^2 = mr^2 \sum_i 1 = 3mr^2$$

Plug in numbers: (10 g = 0.01 kg)

$$I = 3 \cdot 0.01 \cdot \left(\frac{\sqrt{3}}{10}\right)^2 = 9 \cdot 10^{-4}\ kg \cdot m^2.$$