QUIZ#9- CHAPTER10
DATE: 12/11/18

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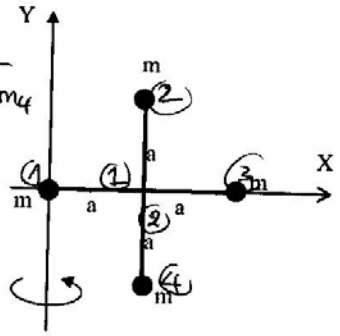
Four identical particles, each with mass m, are arranged in the x, y plane as shown in the figure. They are connected by 2 rods, each of mass M = 4.0 kg and length 2a to form a rigid body. The mass m =2.0 kg and the length a =1.0 m.
Calculate the rotational inertia of this array about the y-axis (rotation axis).




$$I_{System} = I_{rod1} + I_{rod2} + I_{m_1} + I_{m_2} + I_{m_3} + I_{m_4}$$

$$I_{rod1} = \frac{1}{3} M(2a)^2 \quad (= I_{cm} + m h^2) = \frac{4}{3} M a^2$$

$$I_{rod2} = I_{cm} + M h^2 = 0 + M a^2$$

$$I_{m_1} = 0$$

$$I_{m_2} = I_{m_4} = m a^2$$

$$I_{m_3} = m (2a)^2 = 4 m a^2$$

$$I_{System} = \frac{4}{3} M a^2 + M a^2 + 2 m a^2 + 4 m a^2$$

$$= \frac{7}{3} M a^2 + 6 m a^2 = 9.3 + 12 = \boxed{21.3 \ Kg.m^2}$$

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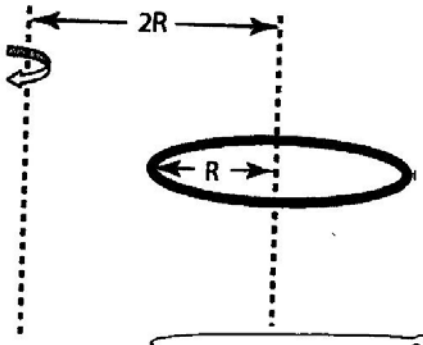
(a) Calculate the moment of inertia of a uniform ring of radius R = 50 cm and mass M = 1.0 kg about an axis 2R from the center of the ring as shown in the figure.




$I_{new} = I_{cm} + m h^2 \qquad h = 2R$

$I_{cm} = MR^2$

$I_{new} = MR^2 + M(2R)^2$

$= 5MR^2 = 5(1.0)(0.5)^2 = \boxed{1.25\ kg.m^2}$

(b) Calculate the kinetic energy of the disk if it is rotating at a constant angular speed of 100 rev/min.

$K = \frac{1}{2} I_{new} \omega^2$

$\omega = 100 \frac{rev}{min} \frac{2\pi\ rad}{rev} \left(\frac{1\ min}{60\ s}\right) = 10.5\ rad/s$

$K = \frac{1}{2}(1.25)(10.5)^2 = \boxed{68.5\ J}$

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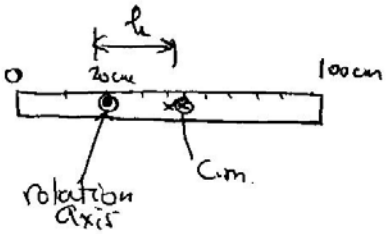
A thin rod of mass 0.23 *kg* and length 1.00 *m* is rotated in a horizontal circle about a fixed axis passing through a point 20.0 *cm* from one of the edges of the rod. If it has a constant angular acceleration of 3.0 $rad/s^2$, find the net torque acting on the rod?




(a) $I = I_{cm} + m h^2$

$= \frac{1}{12} m L^2 + m h^2$ $\quad h = 30\ cm = 0.3\ m$

$I = \frac{1}{12}(0.23)(1)^2 + (0.23)(0.3)^2 = 0.04\ Kg.m^2$

(b) $\tau = I \alpha \Rightarrow \alpha = 3\ rad/s^2$

$\tau = 0.04 \times 3 = \boxed{0.12\ N.m}$