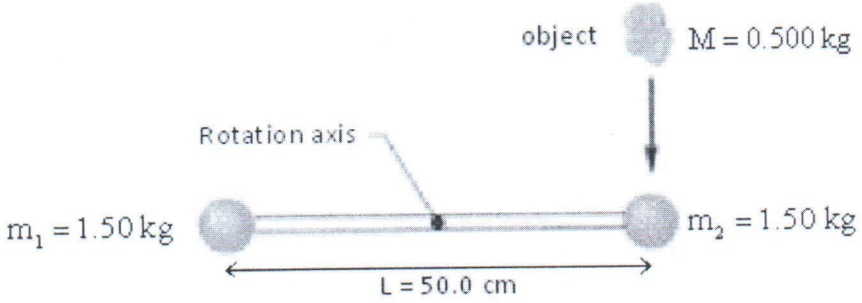
QUIZ#10- CHAPTER 11
DATE: 18/11/19

Name: Key Id#: Sect.#:

Two equal masses m1 = m2 = 1.50 kg are joined with a massless rod with length L= 50.0 cm. The rod is free to rotate in a horizontal plane without friction about a vertical axis through its center. With the rod initially at rest, an object with mass M = 0.500 kg is moving horizontally towards m2 with a velocity 4.50 m/s , as shown in the figure (top view). Finally, the object collides with m2 and sticks to it and the rod rotates. Calculate the angular speed of the rod-masses system just after the collision.



$L_i = L_f$

$L_i = L_{object} + L_{rod} = M v r \sin 90^\circ = M v \frac{L}{2} = 0.5 \times 4.5 \times 0.25$

$= 0.5625 \ kg \cdot \frac{m}{s^2}$

$L_f = L_{object} + L_{rod} = I_{system} \omega_f$

$I_{system} = I_m + I_M = 2 m r^2 + M r^2 = 2 \times 1.5 \times (0.25)^2 + 0.5 \times (0.25)^2$

$I_{system} = 0.21875 \ kg \cdot m^2$

$0.5625 = 0.21875 \ \omega_f$

$\boxed{\omega_f = 2.57 \ rad/s}$

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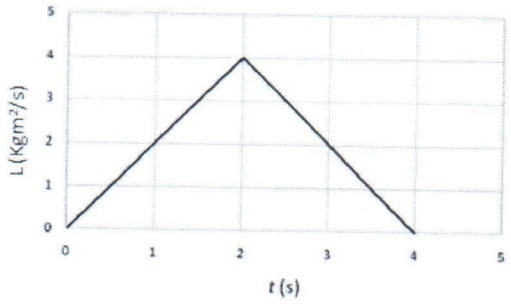
A circular disc of mass 4.0 kg and radius 10 cm rotates about a vertical axis passing through its center. The variation of its angular momentum with time is given in the figure. Find the angular acceleration of the disc at t = 3.0 s?



$\tau = \frac{dl}{dt}$ = slope

Slope at $t = 3.0$ sec

$$\tau = \frac{0-4}{4-2} = -\frac{4}{2} = -2 \text{ N.m}$$

$$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I}$$

$$I = \frac{1}{2}mR^2 = \frac{1}{2} \times 4 \times (0.1)^2 = 0.02 \text{ Kg.m}^2$$

$$\alpha = -\frac{2}{0.02} = \boxed{-100 \text{ rad/s}^2}$$

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A uniform solid disk of radius 0.10 m rolls smoothly across a horizontal table at a speed 2.0 m/s with total kinetic energy of 3.0 J.

(a) Calculate the mass of the disk.

$$K = \frac{1}{2} I_{cm} \omega^2 + \frac{1}{2} m v_{cm}^2 \qquad \omega_{cm} = \frac{v_{cm}}{R}$$

$$= \frac{1}{2} \frac{I_{cm}}{R^2} v^2 + \frac{1}{2} m v_{cm}^2 \qquad I_{cm} = \frac{1}{2} m R^2$$

$$\Rightarrow K = \frac{1}{4} m v_{cm}^2 + \frac{1}{2} m v_{cm}^2 = \frac{3}{4} m v_{cm}^2$$

$$m = \frac{4K}{3 v_{cm}^2} = \frac{4 \times 3}{3 \times (2)^2} = \boxed{1\ kg}$$

(b) What is the speed of the point on the rim of the disk farther away from the contact point?