#31.

Change in angular velocity is

$$\Delta\omega = 1.5 \text{ rad/s}$$

$$\Delta t = 8.0 \text{ s}$$

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{1.5 \text{ rad/s}}{8.0 \text{ s}} = 0.1875 \text{ rad/s}^2$$

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

$$\tau = I\alpha$$

$$I = \frac{1}{2}MR^2 = \frac{1}{2}(25{,}000 \text{ kg})(5.0 \text{ m})^2$$

$$= 312500 \text{ kg}\cdot\text{m}^2$$

$$\tau = (312500 \text{ kg}\cdot\text{m}^2)(0.1875 \text{ rad/s}^2)$$

$$= 58594 \text{ N}\cdot\text{m}$$

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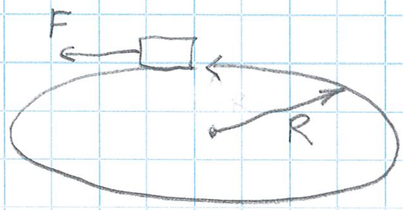
#32



Rotational acceleration, $\alpha = \frac{\sum \tau}{I}$

Point mass, $I = mR^2 = (0.8\,kg)(0.8\,m)^2$

$= 0.512\ kg \cdot m^2$

$\tau = F \cdot R = (2.0\ N)(0.8\ m)$

$= 1.6\ N \cdot m$

(a) $\alpha = \frac{1.6\ kg \cdot m^2/s^2}{0.512\ kg \cdot m^2} = 3.125\ s^{-2}$

(b) $\omega = \omega_0 + \alpha t$

Initially at rest, $\omega_0 = 0$.

$v = \omega R = \alpha t R$

$t = \frac{v}{\alpha R} = \frac{3.0\ m/s}{(3.125\ s^{-2})(0.8\,m)}$

$= 1.2\ s$

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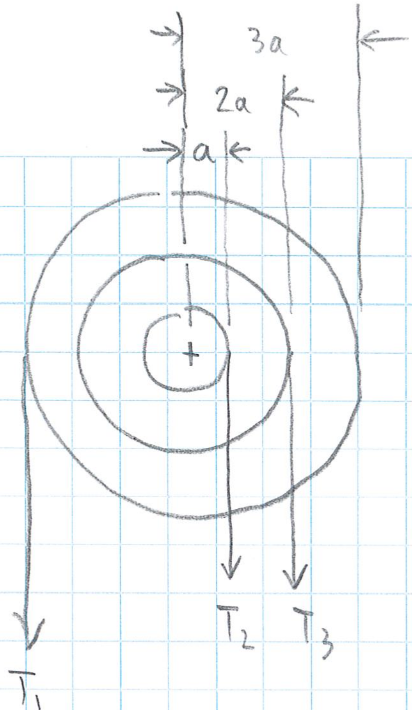

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Given

$I = 10\,kg \cdot m^2$

$T_1 = 80\,N$

$T_2 = 100\,N$

$T_3 = 50\,N$

$a = ?$

$I = \frac{1}{2}MR^2 = \frac{1}{2}M(3a)^2$

$$\sum \tau = \tau_1 + \tau_2 + \tau_3$$

$$= 3T_1 a - T_2 a - 2T_3 a$$

$$= a(3T_1 - T_2 - 2T_3) = a(40\,N)$$

$$\alpha = \frac{\sum \tau}{I} = \frac{(40N)\,a}{10\,kg \cdot m^2} = 4a$$

(a)

Can't evaluate this any further without knowing a.

(b) $\omega = \cancel{\omega_0}^{\,0} + \alpha t$

$= (4a)(4s)$

$= 16a$ (rad/s) when a is in meters.

#42 Rotational momentum,

$$L = I\omega$$

$$\omega = 320 \text{ rad/s}$$

$$I = \frac{1}{2}MR^2 \quad , \quad M = 10 \text{ kg}, \quad R = 9 \text{ cm} = 0.09 \text{ m}$$

$$L = \frac{1}{2}(10\text{kg})(0.09\text{ m})^2(320 \text{ rad/s})$$

(a) $$= 12.96 \text{ kg}\cdot\text{m}^2/\text{s}$$

(b) $$\omega' = \frac{L}{I'}$$

$$I' = \frac{2}{5}MR^2 =$$

$$\omega' = \frac{I\omega}{I'} = \left(\frac{1/2\, MR^2}{2/5\, MR^2}\right)(320 \text{ rad/s})$$

$$= \frac{5}{4}(320 \text{ rad/s})$$

$$= 400 \text{ rad/s}$$

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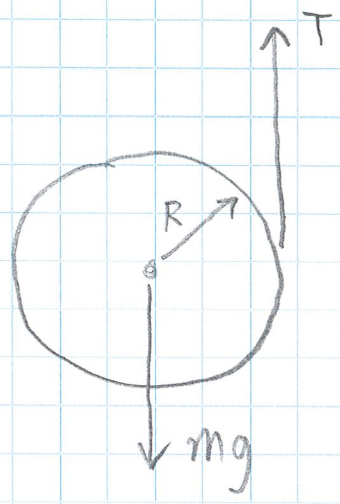
#38



$R = 0.040 \text{ m}$

$m = 0.2 \text{ kg}$

$I = \frac{1}{2} m R^2$ (solid cylinder)

$$a = \frac{2}{3} g = \frac{\sum F}{m} = \frac{mg - T}{m}$$

$$\frac{T}{m} = g - a$$

$$T = m(g - a)$$

$$= m\left(g - \frac{2}{3} g\right) = \frac{mg}{3}$$

$$= \frac{(0.2 \text{ kg})(9.8 \text{ N/kg})}{3}$$

(a) $= 0.653 \text{ N}$

(b) $I = \frac{1}{2} m R^2 = \frac{1}{2}(0.2 \text{ kg})(0.04 \text{ m})^2$

$$= 0.00016 \text{ kg}\cdot\text{m}^2$$

(c) $\alpha = \frac{\sum \tau}{I} = \frac{RT}{I} = \frac{(0.653 \text{ N})(0.04 \text{ m})}{.00016 \text{ kg}\cdot\text{m}^2}$

$$= 163.25 \text{ rad/s}^2$$

(d) $a = R\alpha = (.04 \text{ m})(163.25 \text{ rad/s}^2) = 6.53 \text{ m/s}^2$

$$= \frac{2}{3}(9.8 \text{ m/s})$$

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Probably an over estimate. More like $\frac{1}{2}$ m.

$R = 1\ \text{m}$

$\rho = 2750\ \text{kg}/\text{m}^3$

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

$I = \frac{2}{5}MR^2 = \frac{2}{5}\rho\pi R^5$

$\omega = \frac{2\pi}{2\,\text{s}}$

$K = \frac{1}{2}I\omega^2 = \frac{1}{5}\rho\pi^3 R^5$

$= \frac{1}{5}\left(2750\ \text{kg}\cdot\text{m}^{-3}\right)\left(\pi^3\right)\left(1\ \text{m}\right)^5$

$= 17.05\ \text{kJ}$

But if $R = \frac{1}{2}\ \text{m}$,

$K' = \frac{K}{2^5} = 533\ \text{J}$