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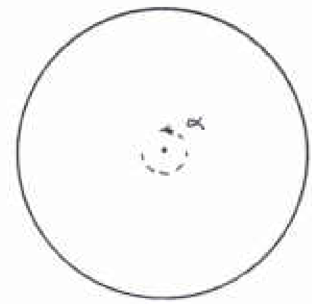
Phys 121
Quiz #4



At $t = 4.0s$
ang vel $= 27.0 \frac{rad}{s}$

1. A wheel rotates about a fixed axis; it starts from rest and undergoes a constant angular acceleration. After 4.0 s, its angular velocity is $27.0 \,\frac{\text{rad}}{\text{s}}$.

a) Find the angular acceleration of the wheel.

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{\omega - \omega_0}{t} = \frac{27.0 \frac{rad}{s} - 0}{4.0s} = \boxed{6.75 \frac{rad}{s^2}}$$

b) Find the angular displacement of the wheel at $t = 4.0$ s.

$$\theta = \frac{1}{2}(\omega_0 + \omega)t = \frac{1}{2}(0 + 27.0 \frac{rad}{s})(4.0s) = \boxed{54.0 \text{ rad}}$$

c) Find the *number of revolutions* through which the wheel has turned at $t = 4.0$ s.

Ang. disp of 54.0 rad corresponds to

$$(54.0 \text{ rad})\left(\frac{1 \text{ rev.}}{2\pi \text{ rad}}\right) = \boxed{8.59 \text{ revolutions}}$$

d Find the linear speed of a point on the wheel at $t = 4.0$ s if the point is at a distance of 8.0 cm from the axis.

$$v_T = r\omega = (8.0\times10^{-2} m)(27.0/s) = \boxed{2.16 \frac{m}{s}}$$

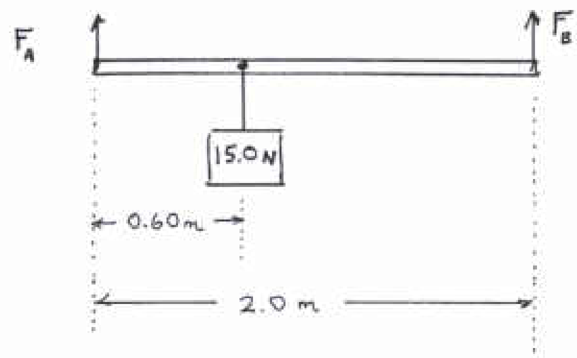
e) If the net torque acting on the wheel during its acceleration is $6.20 \text{ N}\cdot\text{m}$, find the moment of inertia of the wheel.

$$\tau = I\alpha$$

$$\rightarrow \quad I = \frac{\tau}{\alpha} = \frac{6.20 \text{ N}\cdot\text{m}}{6.75 /s^2} = \boxed{0.92 \text{ kg m}^2}$$

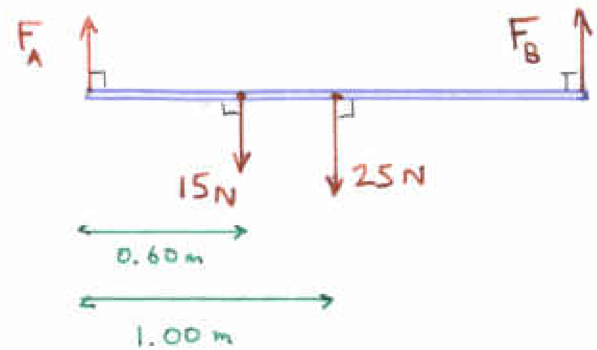
2. A uniform rod of length 2.0 m and weight 25.0 N is supported on its left and right ends by forces $\mathbf{F}_A$ and $\mathbf{F}_B$, respectively. In addition, there is a 15.0 N weight hanging 0.60 m from the left end.

Find the magnitudes of the forces $\mathbf{F}_A$ and $\mathbf{F}_B$.



Rod is uniform and has weight 25.0 N

The free-body-diagram for the rod is drawn here. [The weight of the rod "acts at" its center since it is uniform.]



Putting the axis at the left end,

$\Sigma \tau = 0$ gives:

$$-(15\,N)(0.60\,m) - (25\,N)(1.00\,m) + F_B(2.00\,m) = 0$$

Solve for F_B,

$$\boxed{F_B = 17\ N}$$

Since $\Sigma F_y = 0$ we have

$$F_A - 15\,N - 25\,N + 17\,N = 0$$

Using $F_B = 17\ N$

Solve for F_A,

$$\boxed{F_A = 23\ N}$$

(Both forces point upward!)

You must show all your work!

$$\omega = \omega_0 + \alpha t \qquad \theta = \omega_0 t + \tfrac{1}{2}\alpha t^2 \qquad \omega^2 = \omega_0^2 + 2\alpha\theta \qquad \theta = \tfrac{1}{2}(\omega_0 + \omega)t$$

$$360^\circ = 2\pi \text{ radians} \qquad s = r\theta \qquad v_T = r\omega \qquad a_T = r\alpha \qquad a_c = r\omega^2$$

$$\tau = rF\sin\theta \qquad \text{For equilibrium,} \quad \sum \mathbf{F} = 0 \quad \text{and} \quad \sum \tau = 0$$

$$I = \sum m_i r_i^2 \qquad I_{\text{disk}} = \tfrac{1}{2}MR^2 \quad I_{\text{stick,mid}} = \tfrac{1}{12}ML^2 \quad I_{\text{stick,end}} = \tfrac{1}{3}ML^2 \quad I_{\text{sphere}} = \tfrac{2}{5}MR^2$$

$$\tau_{\text{net}} = I\alpha \qquad \text{KE}_{\text{rot}} = \tfrac{1}{2}I\omega^2 \qquad \text{KE}_{\text{roll}} = \tfrac{1}{2}I\omega^2 + \tfrac{1}{2}Mv^2$$