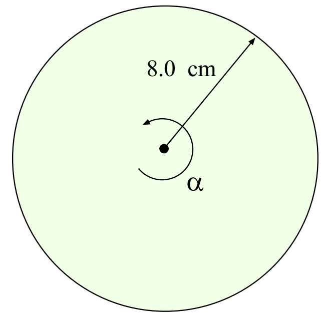
Name______________________________

Nov. 26, 2007

Quiz #3 — Fall 2007

Phys 2010 – NSCC



1. A circular wheel of radius 8.0 cm rotating about its center starts from rest and undergoes a constant angular acceleration. In 3.80 s it makes 8.50 rotations.

a) Through what angle has the wheel turned in this time?

Convert revolutions to radians:

$$8.50\ \text{rev} = (8.50\ \text{rev})\left(\frac{2\pi\ \text{rad}}{1\ \text{rev}}\right) = 53.4\ \text{rad}$$

b) Find the angular acceleration of the wheel.

Since the wheel starts from the equation relating θ, α and t gives:

$$\theta = \tfrac{1}{2}\alpha t^2 \qquad \Longrightarrow \qquad \alpha = \frac{2\theta}{t^2} = \frac{2(53.4\ \text{rad})}{(3.80\ \text{s})} = 7.40\ \tfrac{\text{rad}}{\text{s}^2}$$

c) What is the angular speed of the wheel at the end of this time period?

Again, the wheel starts from rest so we have

$$\omega = \alpha t = (7.40\ \tfrac{\text{rad}}{\text{s}^2})(3.80\ \text{s}) = 28.1\ \tfrac{\text{rad}}{\text{s}}$$

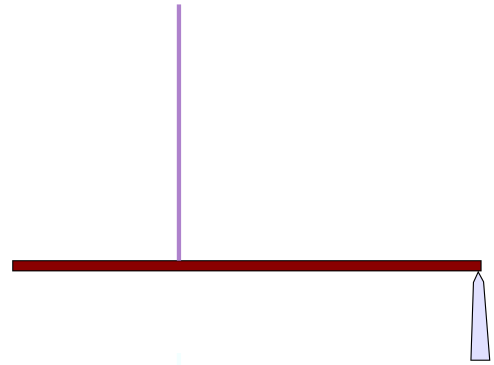
d) What is the speed of a point on the rim of the wheel at the end of this time period?

Speed of a point on the rim at the end of the $3.80\ \text{s}$ period is

$$v = r\omega = (0.080\ \text{m})(28.1\ \tfrac{\text{rad}}{\text{s}}) = 2.25\tfrac{\text{m}}{\text{s}}$$

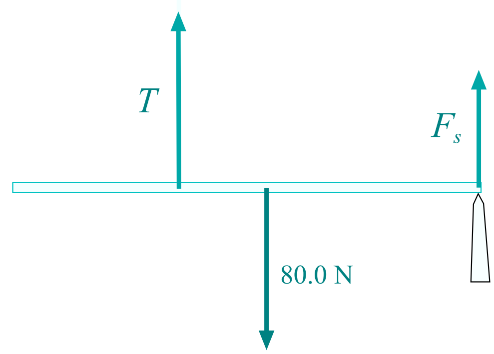
2. A bar of length 2.0 m and weight 80.0 N is supported 0.60 m from the left end by a cable and at the right end by a support (which exerts an upward force).

Find the tension in the cable and the force of the support. (At very least, you should draw the forces acting on the bar.)



Forces on the bar are shown at the right. The total force must be zero, so

$$T + F_s - 80.0\ \mathrm{N} = 0$$



and the total torque must be zero. Take the rotation axis to be at the right end, then we have

$$\sum \tau = -(1.40\ \mathrm{m})T + (1.0\ \mathrm{m})(80.0\ \mathrm{N}) = 0$$

This gives

$$T = 57.1\ \mathrm{N}$$

and putting this into the first equation gives

$$F_s = 22.9\ \mathrm{N}$$

You must show all your work and include the right units with your answers!

$$A_x = A\cos\theta \qquad A_y = A\sin\theta \qquad A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = A_y/A_x$$

$$g = 9.80\tfrac{\mathrm{m}}{\mathrm{s}^2} \qquad \mathbf{F}_{\mathrm{net}} = m\mathbf{a} \qquad f_s^{\mathrm{Max}} = \mu_s F_N \qquad f_k = \mu_k F_N \qquad a_c = \frac{v^2}{r} \qquad F_c = \frac{mv^2}{r}$$

$$W = Fs\cos\theta \qquad \mathrm{KE} = \tfrac{1}{2}mv^2 \qquad \mathrm{PE}_{\mathrm{grav}} = mgy \qquad \Delta E = \Delta\mathrm{KE} + \Delta\mathrm{PE} = W_{\mathrm{nc}}$$

$$2\pi\ \mathrm{rad} = 360\ \mathrm{deg} = 1\ \mathrm{rev} \qquad s = \theta r \qquad \omega = \omega_0 + \alpha t \qquad \theta = \omega_0 t + \tfrac{1}{2}\alpha t^2 \qquad \omega^2 = \omega_0^2 + 2\alpha\theta \qquad \theta = \tfrac{1}{2}(\omega_0 + \omega)t$$

$$v = v_t = \omega r \qquad a_c = \frac{v^2}{r} = \omega^2 r \qquad a_t = r\alpha \qquad \tau = rF\sin\phi \qquad \tau = I\alpha \qquad I = \sum_i m_i r_i^2$$

$$I_{\mathrm{cyl}} = \tfrac{1}{2}MR^2 \qquad I_{\mathrm{rod,\,ctr}} = \tfrac{1}{12}ML^2 \qquad I_{\mathrm{rod,\,end}} = \tfrac{1}{3}ML^2 \qquad I_{\mathrm{sph,\,sol}} = \tfrac{2}{5}MR^2 \qquad I_{\mathrm{sph,\,sh}} = \tfrac{2}{3}MR^2$$

$$\text{Statics:} \quad \sum \mathbf{F} = 0 \quad \sum \tau = 0 \qquad \mathrm{KE}_{\mathrm{rot}} = \tfrac{1}{2}I\omega^2 \qquad \mathrm{KE}_{\mathrm{roll}} = \mathrm{KE}_{\mathrm{trans}} + \mathrm{KE}_{\mathrm{rot}} = \tfrac{1}{2}mv^2 + \tfrac{1}{2}I\omega^2$$

$$v_c = r\omega \qquad a_c = r\alpha \qquad L = I\omega \qquad f = \frac{1}{T} = \frac{\omega}{2\pi} \qquad \omega = \sqrt{\frac{k}{m}} \qquad \omega = \sqrt{\frac{g}{L}}$$