Units?
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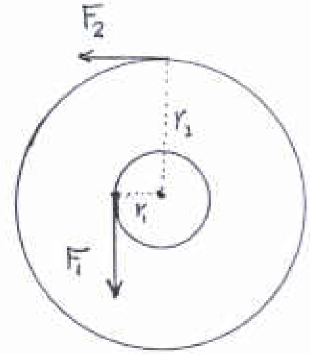
Name____________________________

Phys 121, Section 2
Quiz #5 — Fall 2000



1. Two forces pull on the axle and the outer rim of a wheel in tangential directions, as shown. The forces have magnitudes 4.00 N and 0.900 N (respectively) and the rim and axle have radii 0.150 m and 0.590 m, respectively.

a) Find the net torque on the wheel.

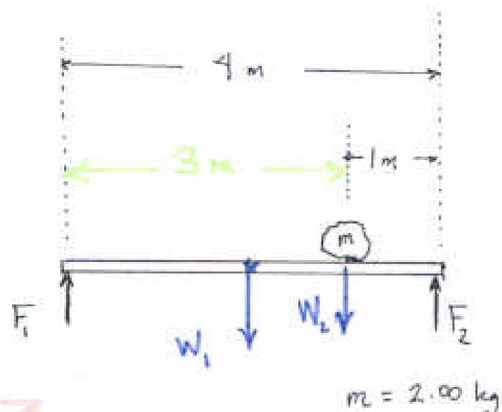
Both forces act to rotate the wheel counter clockwise (+).
Net torque is (add up $rF\sin\phi$):

$$\tau_{net} = (4.00\ N)(0.150\ m)(1) + (0.900\ N)(0.590\ m) = \boxed{1.13\ N\cdot m}$$

b) If, with these forces, the wheel is given an angular acceleration of $11.3\,\frac{\text{rad}}{\text{s}^2}$, what is the wheel's moment of inertia?

$\tau_{net} = I\alpha$

$$\rightarrow \quad I = \frac{\tau_{net}}{\alpha} = \frac{1.13\ N\cdot m}{11.3\ \text{rad}/s^2} = \boxed{0.100\ kg\cdot m^2}$$



2. A *uniform* board of length 4.00 m and having mass 3.00 kg is supported on both ends so that it is in static equilibrium.

There is a rock of mass 2.00 kg resting on the board at a distance of 1.00 m from the right end.

Find the magnitudes of the supporting forces. *(Hint: You can choose either end of the board as the "pivot point".)*

Forces acting on the board are as shown

W_1 = wt of board $= (3.00\ kg)(9.80\ \frac{m}{s^2}) = 29.4\ N$

W_2 = Force from rock $= mg = (2.00\ kg)(9.80\ \frac{m}{s^2}) = 19.6\ N$

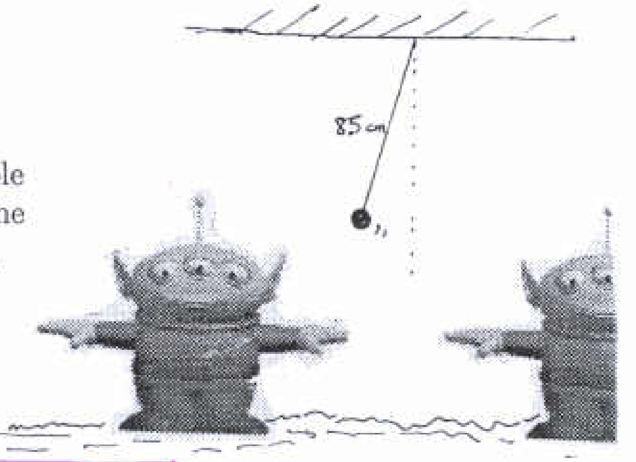
Put "pivot" at left end; sum of torques is zero:

$$\Sigma\tau = -(29.4\ N)(2.00\ m) - (19.6\ N)(3.00\ m) + F_2(4.00\ m) = 0$$

Gives: $F_2 = \dfrac{117.6\ N\cdot m}{(4.00\ m)} = \boxed{29.4\ N}$

Sum of forces is zero. We know F_2 so this gives

$$\Sigma F_y = F_1 - 29.4\ N - 19.6\ N + 29.4\ N = 0 \qquad \text{So} \quad \boxed{F_1 = 19.6\ N}$$



3. The inhabitants of a far–off planet construct a simple pendulum which has a length of 85.0 cm. The value of the gravitational acceleration on the planet's surface is 11.3 $\frac{\text{m}}{\text{s}^2}$.

a) What is the frequency of the pendulum's oscillations?

$L = 0.850\,\text{m}$ $\quad g_{\text{plan}} = 11.3\,\text{m/s}^2$

Freq of pendulum is

$$f = \frac{1}{2\pi}\sqrt{\frac{g_{pl}}{L}} = \frac{1}{2\pi}\sqrt{\frac{11.3\,\text{m/s}^2}{0.850\,\text{m}}} = \boxed{0.580\,\frac{[\text{cycle}]}{\text{sec}}}$$

b) How long does it take the pendulum to make one oscillation?

This is the period of the pendulum, T:

$$T = \frac{1}{f} = \frac{1}{0.580\,\text{s}^{-1}} = \boxed{1.72\,\text{s}}$$

You must show all your work!

$$g = 9.80\,\frac{\text{m}}{\text{s}^2} \qquad 180\text{ deg} = \pi\text{ rad} \qquad 1\text{ min} = 60\text{ s}$$

$$\tau = rF\sin\phi \qquad \tau_{\text{net}} = I\alpha \qquad I_{\text{disk}} = \tfrac{1}{2}MR^2 \qquad I_{\text{sph}} = \tfrac{2}{5}MR^2 \qquad I_{\text{rod, mid}} = \tfrac{1}{12}ML^2$$

$$\text{KE}_{\text{trans}} = \tfrac{1}{2}Mv^2 \qquad \text{KE}_{\text{rot'n}} = \tfrac{1}{2}I\omega^2 \qquad \text{KE}_{\text{roll}} = \tfrac{1}{2}Mv^2 + \tfrac{1}{2}I\omega^2 = \text{KE}_{\text{trans}} + \text{KE}_{\text{rot'n}}$$

$$\text{Static Equil.:} \qquad \sum F_x = 0 \qquad \sum F_y = 0 \qquad \sum \tau = 0$$

$$F_x = -kx \qquad T = \frac{1}{f} \qquad \omega = 2\pi f \qquad f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \qquad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$