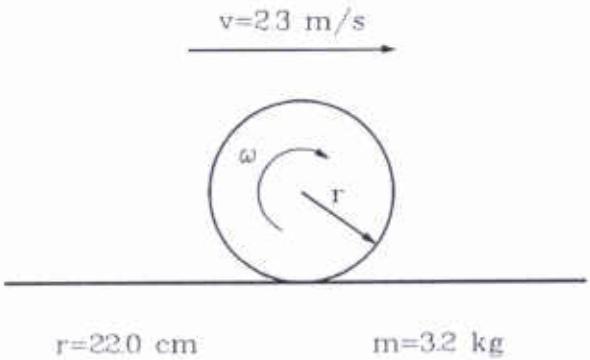
Name _____

Physics 121, Section 1 .....Quiz #5

1. A ball of radius 22.0cm and mass 3.2kg rolls on a flat surface without slipping; the speed of the ball's center of mass is 2.3 $\frac{m}{s}$.



a) Find the angular velocity ω of the ball.

v and ω are related by $v = \omega r$.

So $\omega = \frac{v}{r} = \frac{2.3\ \frac{m}{s}}{0.220\ m} = \boxed{10.5\ \frac{[rad]}{s}}$

b) Find the moment of inertia of the ball (about the axis of rotation.)

For a ball (sphere), $I = \frac{2}{5}MR^2$.

$I = \frac{2}{5}(3.2\ kg)(0.22\ m)^2 = \boxed{6.20 \times 10^{-2}\ kg\ m^2}$

c) Find the *total* kinetic energy of the rolling ball.

$KE_{rolling} = \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$

$= \frac{1}{2}(3.2\ kg)(2.3\ \frac{m}{s})^2 + \frac{1}{2}(6.20 \times 10^{-2}\ kg\ m^2)(10.5/s)^2$

$= \boxed{11.9\ J}$

2. a) A harmonic traveling wave has wavelength 0.65m and speed 450 $\frac{m}{s}$. Find the frequency of the wave.

$f = \frac{v}{\lambda} = \frac{450\ \frac{m}{s}}{0.650\ m} = 692/s = \boxed{692\ Hz}$

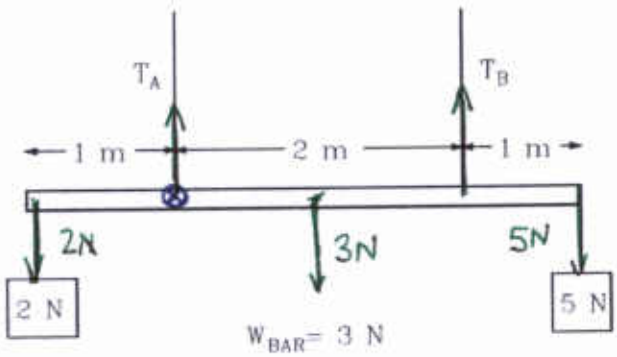
b) Explain what is meant by the *frequency* of a traveling wave.

"Frequency" counts the oscillations per time made by a single small piece of the medium.

Alternately, it counts the number of wave crests (troughs) which pass by a fixed point per time

3. A uniform bar having a weight of 3.0 N and a length of 4.0 m has weights 2.0 N and 5.0 N hanging from the left and right ends; the bar is suspended by two vertical cords attached at .0 m from each end. (See figure.)

Find the tensions T_A and T_B.



The forces acting on the bar are as shown.

Consider torques about the indicated axis. We get:

$$+2N(1m) - 3N(1m) + T_B(2m) - 5N(3m) = 0$$

$$T_B(2m) - 16\ N\cdot m = 0 \rightarrow \boxed{T_B = 8\ N}$$

Sum of forces is zero:

$$-2N + T_A - 3N + \underbrace{8N}_{=T_B} - 5N = 0 \Rightarrow \boxed{T_A = 2N}$$

$\theta r = \ell \quad \pi \text{ rad} = 180^\circ \quad v = \omega r \quad a_T = \alpha r$

$I_{\text{disk}} = \frac{1}{2}MR^2 \quad I_{\text{sphere}} = \frac{2}{5}MR^2 \quad I_{\text{rod, middle}} = \frac{1}{12}ML^2 \quad \tau = rF\sin\theta \quad \tau = I\alpha$

$\text{KE}_{\text{rot}} = \frac{1}{2}I\omega^2 \quad L = I\omega \quad \text{KE}_{\text{roll}} = \frac{1}{2}Mv_{\text{cm}}^2 + \frac{1}{2}I\omega^2$

For static equilibrium, $\sum \mathbf{F} = 0$ and $\sum \tau = 0$

$\lambda f = v$

REMEMBER TO SHOW YOUR WORK!