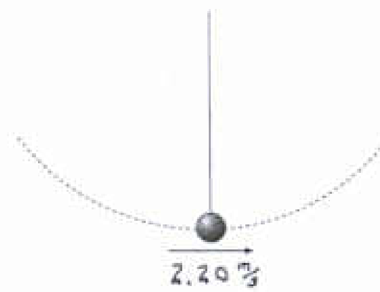
Units? Units?

Name______________________________

Phys 2010, Section 2
Quiz #3 — Fall 2003

1. A pendulum bob of mass 0.500 kg is at the end of a string of length 1.20 m. At the bottom of its swing it has a speed of 2.20$\frac{\text{m}}{\text{s}}$. Note, at this time the bob is on a *circular* path!



a) What is the magnitude and a direction of the acceleration of the bob at this time?

The acceleration of the mass has magnitude

$$a_c = \frac{v^2}{r} = \frac{(2.20\,\frac{\text{m}}{\text{s}})^2}{(1.20\,\text{m})} = \boxed{4.03\,\frac{\text{m}}{\text{s}^2}}$$

and its direction is toward the center of the circle; hence it is $\boxed{\text{upward}}$.

b) What the magnitude and direction of the net force on the bob at this time?

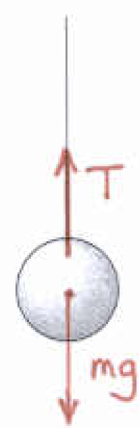
The net force has magnitude

$$F_c = \frac{mv^2}{r} = \frac{(0.500\,\text{kg})(2.20\,\frac{\text{m}}{\text{s}})^2}{(1.20\,\text{m})} = \boxed{2.02\ \text{N}}$$

and its direction is also toward the center of the circle, i.e. $\boxed{\text{upward}}$.

c) On the figure at the right, draw in and label the two forces acting on the bob at the bottom of the swing.

The forces are the (upward) tension force from the string and the downward force mg of gravity.



d) Find the tension in the string when the bob is at the bottom of the swing.

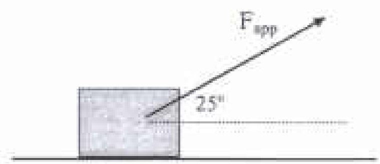
Using the answer in (b) and Newton's second law,

$$F_{net} = F_c = T - mg = 2.02\ \text{N}$$

$$\rightarrow \quad T = mg + 2.02\,\frac{\text{m}}{\text{s}^2} = (0.500\,\text{kg})(9.8\,\frac{\text{m}}{\text{s}^2}) + 2.02\ \text{N}$$

$$= \boxed{6.92\ \text{N}}$$

2. A force of 30.0 N is applied to a 2.00 kg mass at 25.0° above the horizontal to drag it over a horizontal surface a distance of 4.00 m.

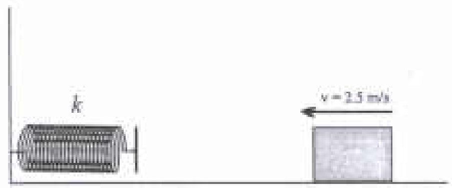


How much work is done on the mass by the applied force?

Work done is

$$W = Fs\cos\theta = (30.0\,N)(4.00\,m)\cos 25° = \boxed{109\,J}$$

3. A 0.600 kg mass with a speed of $2.50\frac{m}{s}$ slides on a frictionless flat surface to compress a horizontal spring; when it is brought to rest, the spring has been compressed by 5.20 cm.



a) What is the kinetic energy of the mass before it squishes the spring?

The kinetic energy is

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.600\,kg)(2.50\tfrac{m}{s})^2 = \boxed{1.88\,J}$$

b) What is the spring constant of the spring?

By energy conservation the energy in (a) equals the energy stored in the spring when it is fully squished:

$$\frac{1}{2}kx^2 = 1.88\,J$$

$$\rightarrow k = \frac{2(1.88\,J)}{x^2} = \frac{2(1.88\,J)}{(0.0520\,m)^2} = \boxed{1.39\times10^3\,\frac{N}{m}}$$

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

$\mathbf{F}_{\text{net}} = m\mathbf{a}$ $\quad g = 9.80\frac{m}{s^2}$ $\quad$ *sohcahtoa...sohcahtoa*...mmm-hmm-mm, *sohcahtoa*

$v = \dfrac{2\pi r}{T}$ $\quad a_c = \dfrac{mv^2}{r}$ $\quad F_c = \dfrac{mv^2}{r}$ $\quad \text{KE} = \frac{1}{2}mv^2$ $\quad \text{PE}_{\text{grav}} = mgy$ $\quad \text{PE}_{\text{spr}} = \frac{1}{2}kx^2$

$W = Fs\cos\theta$ $\quad \Delta E = \Delta\text{KE} + \Delta\text{PE} = W_{\text{non-cons}}$