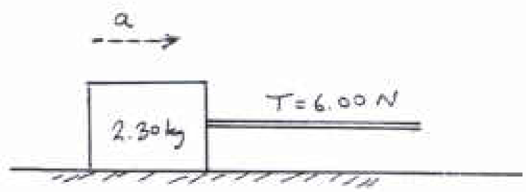
Name____________________________

Phys 121 — Section 2
Quiz #3

1. A 2.30 kg block is dragged over a *rough* horizontal surface by a rope pulling horizontally. The tension in the rope is 6.00 N.



a) Starting from rest, the mass travels 2.96 m in 2.00 s. What is the net force acting on the mass? (Hint: Find its acceleration...)

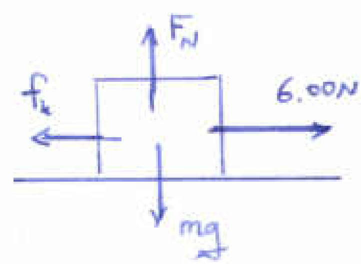
$x = v_0 t + \frac{1}{2} a_x t^2 \rightarrow (2.96\,m) = 0 + \frac{1}{2} a_x (2.00\,s)^2$

Solve for a_x: $a_x = \frac{2(2.96\,m)}{(2.00\,s)^2} = 1.48\,m/s^2$ $\quad F_{net} = m a_x = (2.30\,kg)(1.48\,m/s^2) = \boxed{3.40\,N}$

(b) What is the (magnitude of) the force of kinetic friction which acts on the mass?

Individual forces acting on block are as shown. Using (a) we know:

DDP:



$F_{x,net} = 6.00\,N - f_k = 3.40\,N$

Then $f_k = 6.00\,N - 3.40\,N = \boxed{2.60\,N}$

c) What is normal force (of the surface) on the mass?

Vertical forces on mass must sum to zero. So we know:

$F_N = mg = (2.30\,kg)(9.80\,m/s^2) = \boxed{22.5\,N}$

d) What is coefficient of kinetic friction for the surface and this mass?

Since $f_k = \mu_k F_N$, we have

$\mu_k = f_k / F_N = \frac{(2.60\,N)}{(22.5\,N)} = \boxed{0.115}$

2. A 0.440 kg hockey puck is attached to a string and moves in a circular path on a frictionless horizontal table. The radius of the circle is 0.650 m; it makes one revolution in 3.13 s

$r = 0.650\,\text{m}$
$m = 0.440\,\text{kg}$

a) What is the speed of the hockey puck?

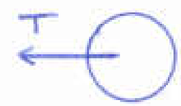
Distance around the circle is $C = 2\pi r = 2\pi(0.650\,\text{m}) = 4.08\,\text{m}$

Puck travels this distance in 3.13 s, so

$$v = \frac{(4.08\,\text{m})}{(3.13\,\text{s})} = \boxed{1.30\,\tfrac{\text{m}}{\text{s}}}$$

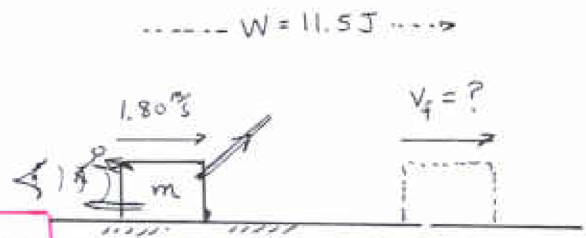
b) What is the tension in the string?

The only horizontal force on the puck is the string tension so it must be equal to the centripetal force:



$$F_{\text{cent}} = T = \frac{mv^2}{r} = \frac{(0.440\,\text{kg})(1.30\,\tfrac{\text{m}}{\text{s}})^2}{(0.650\,\text{m})} = \boxed{1.15\,\text{N}}$$

3. Another object is dragged on a table! Its mass is 2.50 kg and its initial speed is 1.80 $\frac{\text{m}}{\text{s}}$.



(a) What is its initial kinetic energy?

$$K_0 = \tfrac{1}{2}mv_0^2 = \tfrac{1}{2}(2.50\,\text{kg})(1.80\,\tfrac{\text{m}}{\text{s}})^2 = \boxed{4.05\,\text{J}}$$

$m = 2.50\,\text{kg}$

(b) As it is dragged along the surface, the forces acting on the mass do a total of 11.5 J of work. What is the final speed of the mass?

$$W_{\text{net}} = K_f - K_0 \implies 11.5\,\text{J} = K_f - (4.05\,\text{J}) \rightarrow K_f = 15.6\,\text{J}$$

But

$$K_f = \tfrac{1}{2}mv_f^2 \quad \text{So} \quad v_f^2 = \frac{2K_f}{m} = \frac{2(15.6\,\text{J})}{(2.5\,\text{kg})} = 12.4\,\tfrac{\text{m}^2}{\text{s}^2} \rightarrow \boxed{v_f = 3.53\,\tfrac{\text{m}}{\text{s}}}$$

You must show all your work!

$$v = v_0 + at \qquad x = v_0t + \tfrac{1}{2}at^2 \qquad v^2 = v_0^2 + 2ax$$

$$\mathbf{F} = m\mathbf{a} \qquad F = G\frac{m_1m_2}{r^2} \qquad G = 6.67\times10^{-11}\,\tfrac{\text{N}\cdot\text{kg}^2}{\text{m}^2} \qquad g = 9.80\,\tfrac{\text{m}}{\text{s}^2}$$

$$f_s \le \mu_s F_N \qquad f_k = \mu_k F_N \qquad a_{\text{cent}} = \frac{v^2}{r} \qquad F_{\text{cent}} = \frac{mv^2}{r}$$

$$W = Fs\cos\theta \qquad \text{KE} = \tfrac{1}{2}mv^2 \qquad W_{\text{net}} = \Delta\text{KE} = \text{KE}_f - \text{KE}_0$$