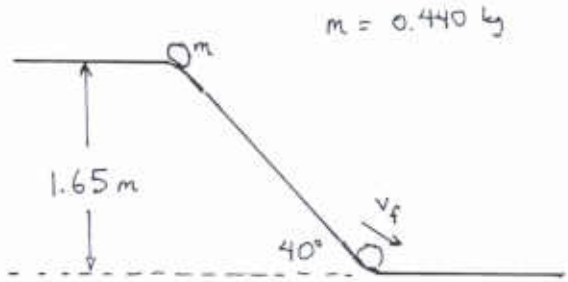
Name_____

Phys 121 — Section 2
Quiz #4

1. A 0.440 kg mass slides down a rough 40.0° slope, starting from rest at a height of 1.65 m. Its speed at the bottom of the slope is 4.70 $\frac{m}{s}$.



Find the work done by friction during the mass's slide down the slope

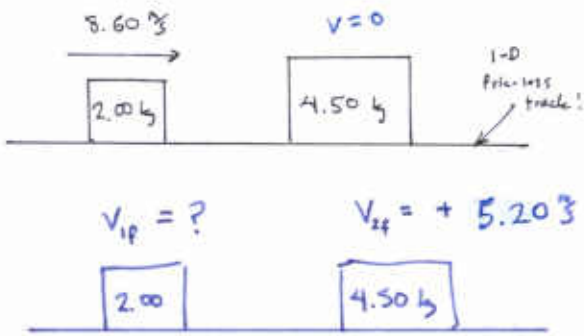
With $y = 0$ at bottom of slope,

$E_0 = KE_0 + PE_0 = 0 + (0.440\,kg)(9.80\,m/s^2)(1.65\,m) = 7.11\ J$

$E_f = KE_f + PE_f = \frac{1}{2}(0.440\,kg)(4.70\,m/s)^2 + 0 = 4.86\ J$

$W_{non\text{-}cons\ (fric)} = \Delta E = E_f - E_0 = \boxed{-2.26\ J}$

2. On a frictionless track a 2.00 kg mass moves to the right at 8.60 $\frac{m}{s}$. It collides with a stationary 4.50 kg mass. After the collision, the 4.50 kg mass moves to the right with speed 5.20 $\frac{m}{s}$.



a) What is the final *velocity* of the 2.00 kg mass?

Linear momentum is conserved

$P_{0x} = (2.00\,kg)(8.60\,m/s) = 17.2\ kg\,m/s$

$P_{fx} = (2.00\,kg)\,v_{1f} + (4.50\,kg)(5.20\,m/s)$

These are equal. Solve for v_{1f}.

$v_{1f} = \frac{1}{(2.00\,kg)}\left[17.2\,kg\,m/s - (4.50\,kg)(5.20\,m/s)\right] = \boxed{-3.10\,m/s}$

i.e. block moves to left w/ speed 3.10 m/s

b) How much kinetic energy was lost (or gained) in the collision?

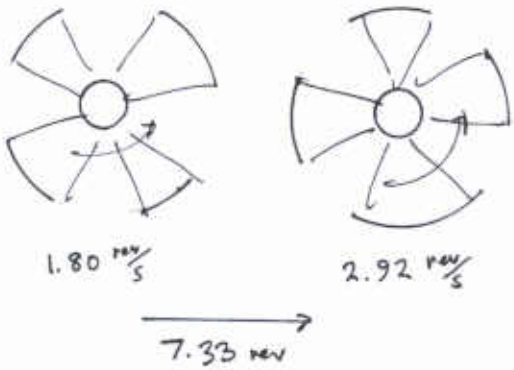
$K_0 = \frac{1}{2}(2.00\,kg)(8.60\,m/s)^2 = 74.0\ J$

$K_f = \frac{1}{2}(2.00\,kg)(3.10\,m/s)^2 + \frac{1}{2}(4.50\,kg)(5.20\,m/s)^2 = 70.9\ J$

$K_f - K_0 = -3.5\ J$

3.5 J of KE was lost

3. A fan is rotating at 1.80 $\frac{\text{rev}}{\text{s}}$ on the LOW speed. I push the HIGH button and after making 7.33 revolutions it achieves a final angular velocity of 2.92 $\frac{\text{rev}}{\text{s}}$. We'll assume that during the speed–up the angular acceleration α was constant.



(a) Express the initial and final angular velocities of the fan in units of $\frac{\text{rad}}{\text{s}}$ and also the angular displacement during the speed-up in radians.

$\omega_0 = 1.80 \frac{\text{rev}}{\text{s}} \left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right) = 11.3 \frac{\text{rad}}{\text{s}}$

$\omega_f = 2.92 \frac{\text{rev}}{\text{s}} \left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right) = 18.3 \frac{\text{rad}}{\text{s}}$

$\theta = 7.33 \text{ rev} \left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right) = 46.1 \text{ rad}$

(b) Find the angular acceleration of the fan in $\frac{\text{rad}}{\text{s}^2}$.

$\omega_f^2 = \omega_0^2 + 2\alpha\theta \longrightarrow \alpha = \frac{\omega_f^2 - \omega_0^2}{2\theta}$

$\alpha = \frac{(18.3 \frac{\text{rad}}{\text{s}})^2 - (11.3 \frac{\text{rad}}{\text{s}})^2}{2(46.1 \text{ rad})} = 2.26 \frac{\text{rad}}{\text{s}^2}$

(c) Find the time that elapsed during the period that the fan was speeding up.

$\omega_f = \omega_0 + \alpha t$

$t = \frac{\omega_f - \omega_0}{\alpha} = 3.09 \text{ s}$

You must show all your work!

$\text{PE}_{\text{grav}} = mgy \qquad E = \text{PE} + \text{KE} \qquad \Delta E = \Delta\text{PE} + \Delta\text{KE} = W_{\text{non-cons}}$

$\text{KE} = \frac{1}{2}mv^2 \qquad \mathbf{p} = m\mathbf{v} \qquad \mathbf{I} = \mathbf{p}_f - \mathbf{p}_0 = \Delta\mathbf{p} \qquad \overline{\mathbf{F}} = \frac{\Delta\mathbf{p}}{\Delta t}$

$x_{\text{CM}} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$ etc. for $y \qquad v_{\text{CM},x} = \frac{m_1 v_{x1} + m_2 v_{x2}}{m_1 + m_2}$

$180 \text{ deg} = \pi \text{ rad} \qquad s = r\theta \qquad \omega = \frac{\Delta\theta}{\Delta t} \quad t \Rightarrow 0 \qquad \alpha = \frac{\Delta\omega}{\Delta t} \quad t \Rightarrow 0$

$\omega = \omega_0 + \alpha t \quad \theta = \omega_0 t + \frac{1}{2}\alpha t^2 \quad \omega^2 = \omega_0^2 + 2\alpha\theta \quad \theta = \frac{1}{2}(\omega_0 + \omega)t \quad v_T = r\omega \quad a_T = r\alpha \quad a_c = r\omega^2$