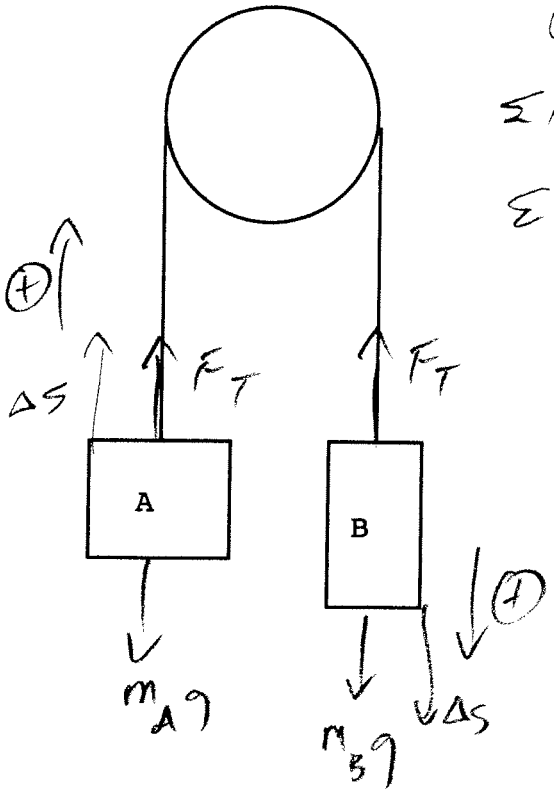
Physics 10154 - Exam #2a b

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) Two masses are hung over a light, frictionless pulley as shown below. Mass A is 5.0 kg. Mass B is 8.0 kg. If the system is released from rest, how long does it take for mass B to move a distance of 65 cm?



Using Newton's laws:

$\Sigma F_A: F_T - m_A g = m_A a$

$\Sigma F_B: -F_T + m_B g = m_B a$

$m_B g - m_A g = (m_A + m_B) a$

$(8)(9.8) - (5)(9.8) = (13) a$

$a = 2.26\ m/s^2$

$v_0 = 0$

$\Delta s = .65\ m$

$\Delta s = v_0 t + \frac{1}{2} a t^2$

$0.65 = 0 + \frac{1}{2}(2.26) t^2$ $\quad \boxed{t = 0.76\ s}$

Using work-energy $\Sigma W_F = W_{grav,A} + W_{T,A} + W_{T,B} + W_{grav,B} = \Delta K$

$-m_A g h + F_T \Delta s - F_T \Delta s + m_B g h = \frac{1}{2}(m_A + m_B) v^2 - 0$

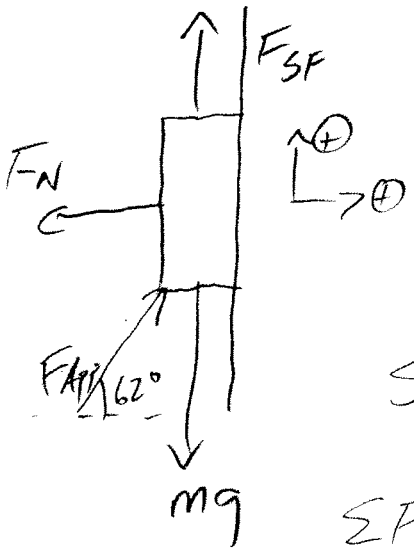
$-(5)(9.8)(.65) + (8)(9.8)(.65) = \frac{1}{2}(13) v^2$

$19.11 = 6.5 v^2 \quad v = 1.71$

$\Delta s = \frac{1}{2}(v + v_0) t \quad 0.65 = \frac{1}{2}(0 + 1.71) t$ $\quad \boxed{t = 0.76\ s}$

2. (40 pts) A 6.5-kg book is held at rest against a vertical wall by an applied force of 120 Newtons directed 62° above the horizontal. The coefficient of static friction between the book and the wall is 0.86. The coefficient of kinetic friction is 0.45.

Does the book move?
If yes, what is the magnitude and direction of the acceleration?
If no, what is the magnitude and direction of the force of static friction?



$$\Sigma F_\perp = F_{App}\cos 62^\circ - F_N = 0$$

$$F_N = 56.3\ N$$

$$F_{SF,MAX} = \mu_s F_N = 48.4\ N$$

Set $a = 0$, find F_{SF}, compare to

$$\Sigma F_{//} = F_{SF} + F_{App}\sin 62^\circ - mg = 0$$

$$F_{SF} + (120)\sin 62 - (6.5)(9.8) = 0$$

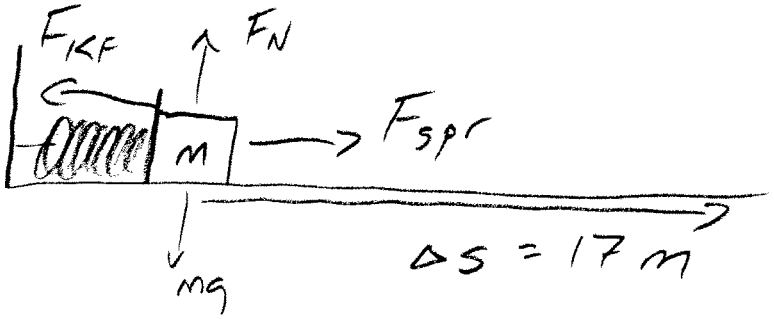
$$F_{SF} + 106.0 - 63.7$$

$$F_{SF} = -42.3\ N$$

$\overline{\uparrow}$ means it points in opposite direction indicated in my diagram

$|F_{SF}| < |F_{SF,MAX}|$, so book doesn't move and $F_{SF} = 42\ N$, downward

3. (30 pts) A 12-kg mass is initially at rest on a rough. horizontal surface. The mass compresses a horizontal spring (k = 1200 N/m) by 35 cm. Once the mass is released from rest, it slides a total distance of 17 meters across the surface, as measured from the point of release. What is the coefficient of kinetic friction between the mass and the surface?



$W_N = 0$

$W_{grav} = 0$

$W_{spr} = +\frac{1}{2}kx^2 = \frac{1}{2}(1200)(.35)^2 = 73.5\ J$

$W_{KF} = -\mu_K F_N \Delta s = -\mu_K mg \Delta s$

$= -\mu_K (12)(9.8)(17) = -1999 \Delta s\ J$

$0 + 0 + 73.5 - 1999\mu_K = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$ (the v^2 and v_0^2 terms are 0)

$\mu_K = \frac{73.5}{1999} = \boxed{.037}$