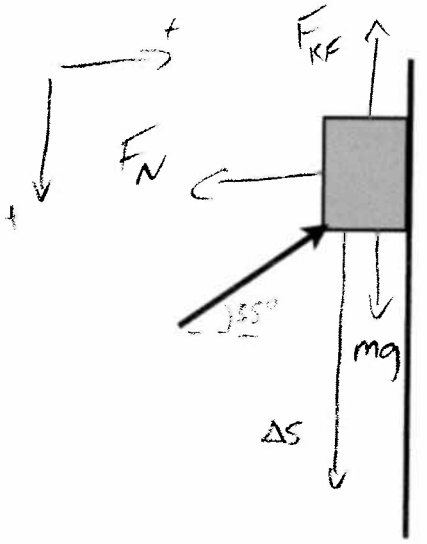
Physics 10154 - Summer 2013 - Exam #2B

Instructions: Be sure to SHOW ALL WORK and clearly indicate your answers. I will not give full credit if I cannot logically follow how you got your answer, even if the answer is correct. Partial credit will be given provided you are solving parts of the problem correctly. Clearly indicate your final answer, including correct units and significant figures.

1. (30 pts) A 28 kg block is sliding down a wall, despite being pushed upward by an applied force of 280 N applied force directed 35° above the horizontal. The coefficient of kinetic friction between the block and the wall is 0.32. If the block begins at rest, how fast is it moving after it has fallen through a distance of 1.5 meters?



$\Sigma F_x = F_{App}\cos 35° - F_N = 0$

$F_N = 280\cos 35° = 229.4\,N$

$\Sigma F_y = mg - F_{App}\sin 35° - \mu_k F_N = ma$

$(28)(9.8) - (280)\sin 35° - (.32)(229.4) = 28a$

$274.4 - 160.6 - 73.4 = 28a$

$40.4 = 28a$

$a = 1.44\ m/s^2$

$v^2 = v_0^2 + 2a\Delta x$

$v^2 = 0 + 2(1.44)(1.5)$

$v = 2.1\ m/s$

Alt:

$W_{KF} + W_N + W_{App} + W_g = \frac{1}{2}mv^2 - 0$

$W_{KF} = -\mu_k F_N \Delta s = -(.32)(229.4)(1.5) = -110.1$

$W_N = 0$

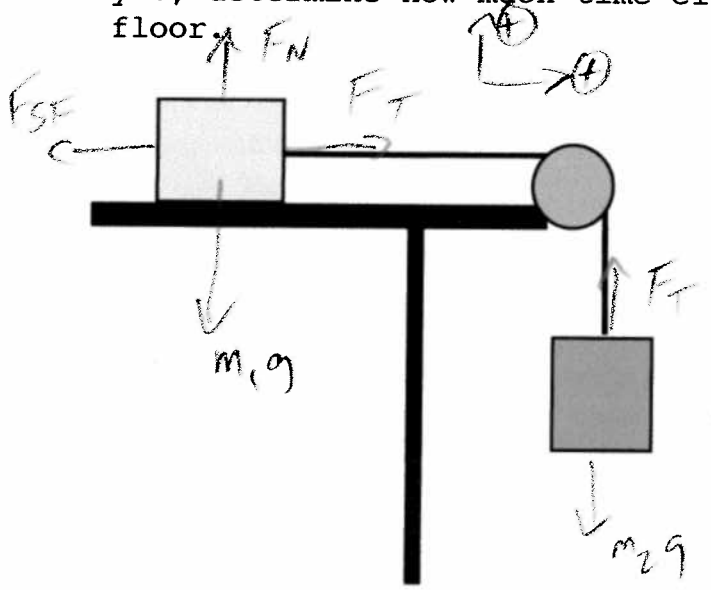
$W_{App} = (280)(1.5)\cos 125° = -240.9$

$W_g = +mgh = (28)(9.8)(1.5) = 411.6$

$\Sigma W_F = 60.6 = \frac{1}{2}(28)v^2$

$v = 2.1\ m/s$

2. (30 pts) Mass 1 (15 kg) is initially at rest on a table. The coefficient of static friction between the mass and the table is 0.45. Coefficient of kinetic friction is 0.25. Mass 2 (5.0 kg) is attached to mass 1 by a thin string over a frictionless pulley, and it is initially at rest 75 cm above the ground. If the system is initially at rest, does mass 1 move? Justify your answer mathematically. ALSO, if the answer is no, determine the magnitude and direction of the force of static friction acting on mass 1. If the answer is yes, determine how much time elapses before mass 2 hits the floor.



Assume $a = 0$, find F_{SF}

For m_1:

$\Sigma F_x : F_T - F_{SF} = 0$

For m_2:

$\Sigma F_y : m_2 g - F_T = 0$

$F_T = m_2 g = 49\ N$

so $F_T = F_{SF} = 49\ N$

$\Sigma F_y = -m_1 g + F_N = 0$

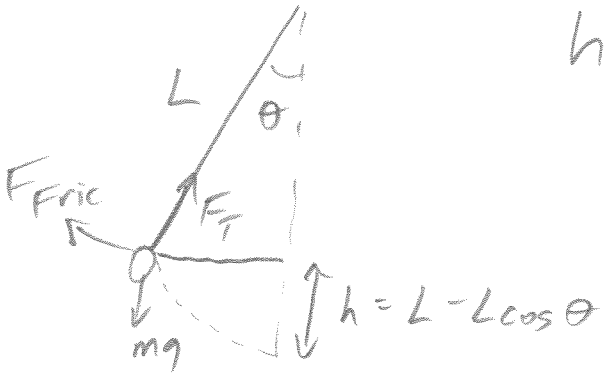
$F_N = m_1 g = 147\ N$

$F_{SF,MAX} = \mu_S F_N = (.45)(147) = 66$

Since $F_{SF} < F_{SF,MAX}$, m_1 doesn't move

$F_{SF} = 49\ N$, $-x$ dir

3. (40 pts) A 4.50 kg mass acts as a pendulum bob. The pendulum has a length of 7.20 meters and is initially 38.0° away from the vertical direction when released from rest. If the mass is moving at a speed of 4.90 m/s when it passes through the lowest point of its motion, how much work was done by frictional forces in the system?



$h = 7.20 - 7.20\cos 38°$

$= 1.526\ m$

$W_T = 0$ since $\Delta s, F_T$ are always 90° apart

$\Sigma W_F = W_T + W_{grav} + W_{Fric} = \Delta K$

$0 + mgh + W_{Fric} = \frac{1}{2}mv^2 - 0$

$(4.50)(9.8)(1.526) + W_{Fric} = \frac{1}{2}(4.50)(4.90)^2$

$67.297 + W_{Fric} = 54.023$

$W_{Fric} = -13.3\ J$