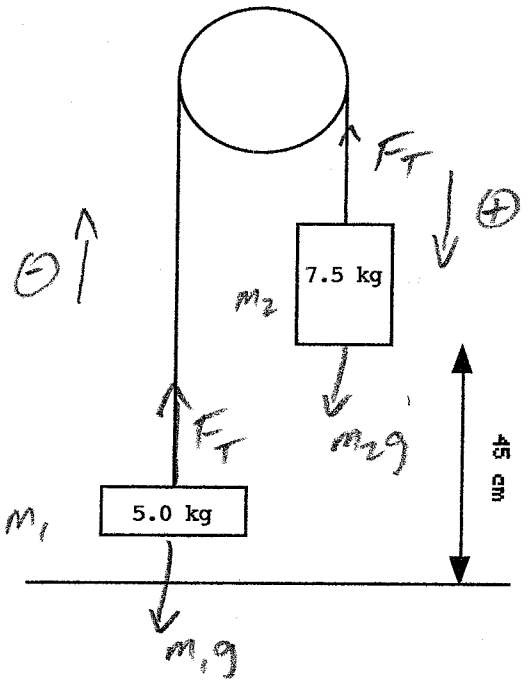
Phys 10154 - Fall 2006 - Exam #4A

Be sure to answer with the proper units and significant figures. Indicate your answers clearly with boxes. SHOW ALL WORK. Even if your answer is correct, I will deduct points if I can't see how you solved the problem. Both problems are worth 50 points.

1. Two masses are hanging vertically from a frictionless pulley, initially at rest. Find the tension in the string connecting the two masses, and determine how much time it will take for the 7.5 kg mass to reach the ground from its initial location.



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

m_1: $\Sigma F_y = -m_1 g + F_T = m_1 a$

$F_T = m_1 a + m_1 g$

$m_2 g - m_1 a - m_1 g = m_2 a$

$(m_2 - m_1) g = (m_1 + m_2) a$

$$a = \frac{m_2 - m_1}{m_1 + m_2} g$$

$$= \frac{2.5}{12.5}(9.8) = 1.96 \text{ m/s}^2$$

$\Delta y = 0.45$

$v_0 = 0$

$v = ?$

$a = 1.96 \text{ m/s}^2$

$t = ?$

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

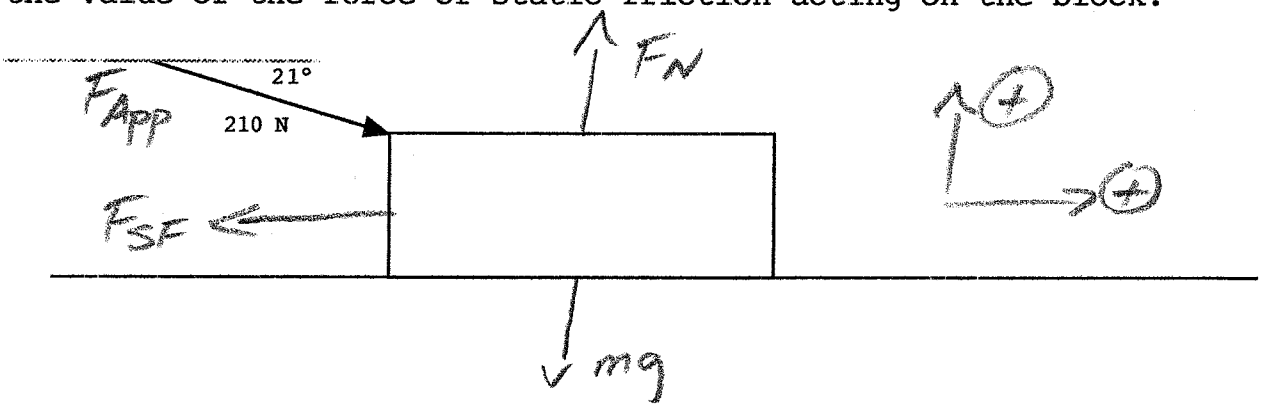
$0.45 = 0 + 0.98 t^2$

$t = \sqrt{\frac{0.45}{0.98}} = \boxed{0.68 \text{ s}}$

$F_T = (5.0)(1.96) + (5.0)(9.8) = \boxed{59 \text{ N}}$

2. A 320-N block is at rest on a rough floor. The coefficient of static friction between the block and the floor is 0.60. The coefficient of kinetic friction between the block and the floor is 0.40. In an attempt to move the block, a 210 Newton applied force is directed 21° below the horizontal as shown. Does the block move?

If yes, determine the acceleration of the block. If no, calculate the value of the force of static friction acting on the block.



$$\Sigma F_x = F_{App}\cos 21^\circ - F_{SF} = 0$$

$$\Sigma F_y = F_N - mg - F_{App}\sin 21^\circ = 0$$

$$F_N = mg + F_{App}\sin 21^\circ$$

$$= 320 + 210\sin 21^\circ$$

$$= 395\ N$$

$$F_{SF} = F_{App}\cos 21^\circ = 196\ N$$

$$F_{SF,MAX} = \mu_S F_N$$

$$= (0.60)(395) = 237$$

Since $F_{SF} < F_{SF,MAX}$, the block does not move.

$$\boxed{F_{SF} = 200\ N}$$