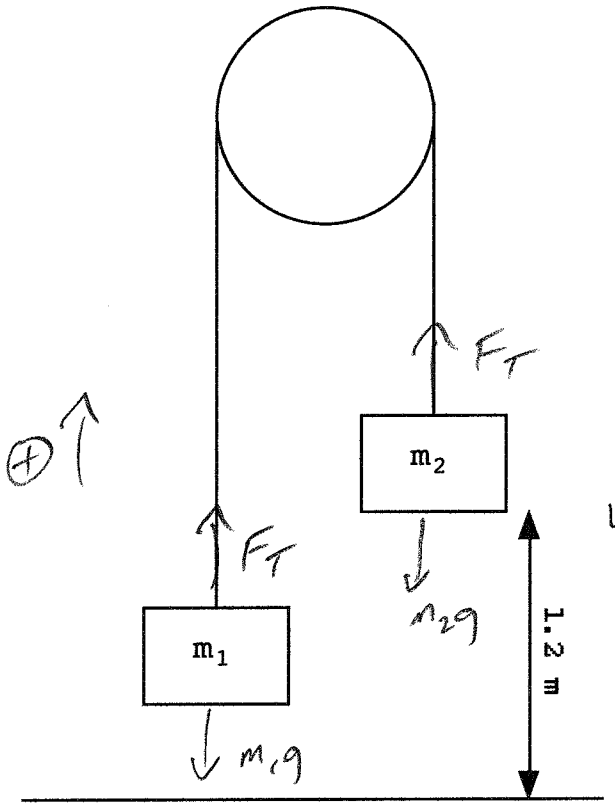
Quiz #4A

Clearly indicate (with a box) your answers to the following questions. SHOW ALL WORK.

1. Two blocks are connected by a thin rope over a frictionless pulley as shown below. The masses are m_1 = 1.5 kg and m_2 = 2.5 kg. How much time does it take for m_2 to hit the ground if the system starts from rest?



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

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

From m_1: $F_T = m_1 a + m_1 g$

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

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

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

$$a = \frac{2.5 - 1.5}{2.5 + 1.5}(9.8)$$

$$= 2.45 \text{ m/s}^2$$

$\Delta y = 1.2$ m

$v_0 = 0$

$v = ?$

$a = 2.45$ m/s^2

$t = ?$

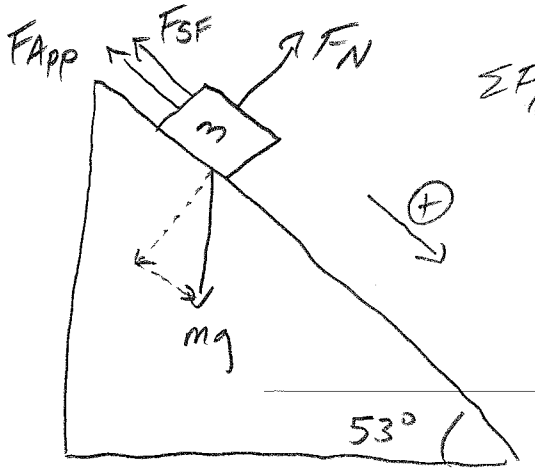
$\Delta y = v_0 t + \frac{1}{2} a t^2$

$1.2 = 0 + 1.225 t^2$

$\boxed{t = 0.99 \text{ s}}$

2. A 3.5 kg block is at rest on a hill inclined at 53° above the horizontal. In order to prevent the block from sliding down the hill, a force is applied parallel to the hill (up the hill) with a magnitude of 15 N.

The coefficient of static friction between the block and the hill is 0.30. Determine whether or not the block begins moving down the hill. Justify your answer.



$$\Sigma F_{\parallel} = mg\sin 53 - F_{App} - F_{SF} = 0$$

$$F_{SF} = mg\sin 53 - F_{App}$$

$$= 27.4 - 15 = \underline{12.4\,N}$$

$$\Sigma F_{\perp} = F_N - mg\cos 53^\circ = 0$$

$$F_N = mg\cos 53^\circ = 20.6\,N$$

$$F_{SF,MAX} = \mu_S F_N = \underline{6.2\,N}$$

Since $F_{SF} > F_{SF,MAX}$, the block moves.