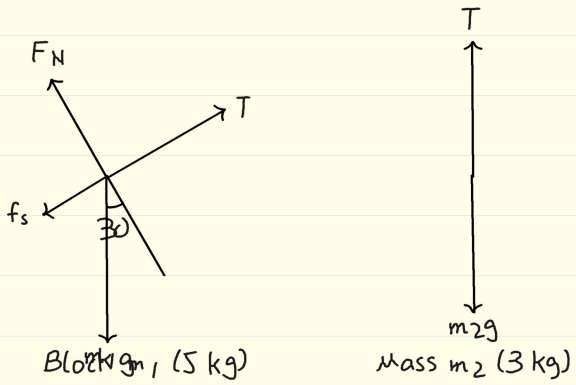
Assignment: sample_mechanics

1a) Free Body Diagrams:



1b) We first calculate the relevant force components for $m_1 = 5$ kg and $m_2 = 3$ kg with $g = 9.8$ m/s^2.

Normal force $F_N = m_1 g \cos 30 = (5)(9.8)(0.866) = 42.44$ N. Max static friction $f_{s,max} = \mu_s F_N = (0.4)(42.44) = 16.98$ N.

Driving force from hanging mass: $W_2 = m_2 g = (3)(9.8) = 29.4$ N. Gravity component down incline for m_1: $F_{gx} = m_1 g \sin 30 = (5)(9.8)(0.5) = 24.5$ N.

Net driving force (without friction) is $F_{net} = 29.4 - 24.5 = 4.9$ N up the incline. Since 4.9 N $< f_{s,max}$ (16.98 N), static friction prevents movement.

So, the system does not move. Acceleration $a = 0$ m/s^2.

1c) Since the system is stationary, the forces on the hanging mass must sum to zero:

$$\sum F_y = T - m_2 g = 0$$

$$T = m_2 g = (3)(9.8) = 29.4 \text{ N}$$

Checking the block on the incline: $T - F_{gx} - f_s = 0$ $29.4 - 24.5 - f_s = 0$ $f_s = 4.9$ N, which is valid since it is less than 16.98 N.