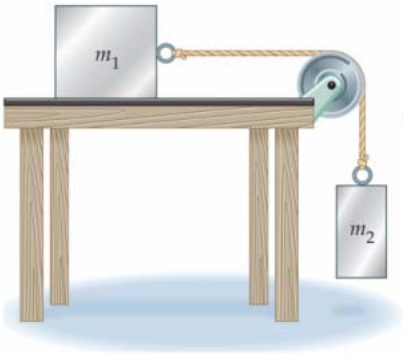
Physics 151 Class Exercise – Connected Objects w/Friction



1. Two masses are connected by a rope as shown in the figure to the right. The table is sufficiently smooth that friction can be ignored in this problem.

a) Indicate a coordinate system on the diagram. It should "follow the motion" of the string so that both masses accelerate in the positive direction with accelerations of equal magnitude.

b) Draw FBDs for each mass.

c) Write the relevant summation of force equations for both masses.

d) Combine the equations to determine an algebraic expression for the acceleration of the masses.

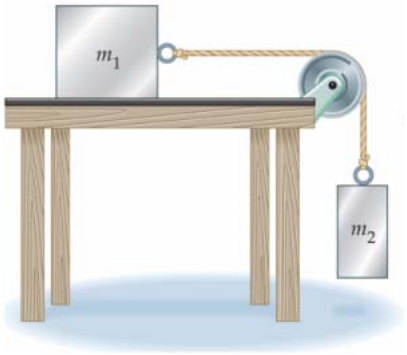
e) Determine an algebraic expression for the tension in the rope?

f) Is the tension greater than, equal to, or less than m_2g? Justify your answer with a common sense explanation and an algebraic expression for tension.

g) Determine the acceleration and tension if $m_1 = 7$ kg and $m_2 = 4$ kg.

2. . Two masses are connected by a rope as shown in the figure to the right. The table is rough and the coefficients of friction for the block/table interface are μ_s and μ_k with $\mu_s > \mu_k$.

a) Draw the new FBDs?



b) Write the relevant summation of force equations for both masses (assuming that they are accelerating).

c) Formulate a condition that will describe whether or not the masses accelerate.

d) Assuming that they do move, derive an algebraic expression for the acceleration.

e) Determine the acceleration if $m_1 = 7$ kg, $m_2 = 4$ kg, and $\mu_k = 0.20$.