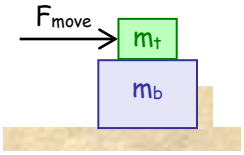
Homework Set 4: More Fun with NSL
Due Monday, September 11, 2023

Treat each block separately! Separate FBDs, applications of NSL, and motions. Equate where appropriate, but start out treating each independently … include all normal forces (yes, they should cancel out, but show them for each block and write them in the equations).

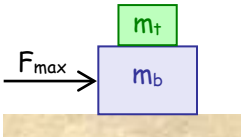


1) A small block rests on a large one. When the bottom one is held fixed, a force, F_{move} must be applied to the top block in order for it to slip. If these block are placed on a frictionless table,

a) what is the maximum force that can be applied to the lower block so that the blocks move together (the top one does not slip)?

b) Evaluate this for m_t = 4.0 kg, m_b = 5.0 kg and F_{move} = 12N

c) What is the resulting acceleration of the two blocks?



This problem requires you to draw four (4) FBDs! One for the initial situation and one for the second. Don't skip any.

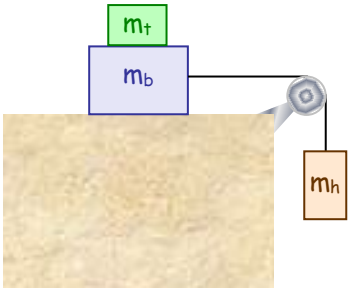
Answers: F_{max} = 27 N (Hint: $a_{Horiz} \neq 0$ when they move together, even though m_t does not slip!), a = 3.0 m/s^2

2) A railroad flatcar is loaded with crates having a coefficient of static friction 0.25 with the floor. If the train is moving at v_0 = 48 km/h, in what distance can it be stopped without the crates sliding?

You are interested in the crates, not the flatcar. Draw the FBD for a crate then write an expression for x_{MIN} in ***symbols*** as a function of g, μ_s and v_0, then evaluate it in the last step.

Answer: x_{min} = 36.3 m

3) A block, m_b = 6 kg, on a table with a coefficient of friction, μ_s = 0.40, is attached to a hanging block, m_h = 3 kg, by a rope that passes over a friction-less, massless pulley.



a) What must the mass of another block, m_t, placed on top so that the system does not move?

b) If the top block is suddenly lifted off, what will the acceleration of the system be if μ_k = 0.2?

Draw FBDs for all three blocks, write expressions for m_T and a_{sys} in ***symbols*** then evaluate them numerically in the last step.

Answers: m_t = 1.5 kg, a_{sys} = 1.96 m/s^2