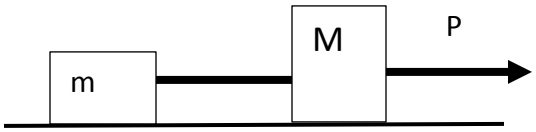
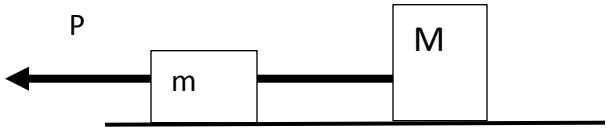
Physics 1135 Homework for Recitation 6: Newton's 3rd law, coupled objects

1. Two crates with treasure, a small one with mass m=100kg and a large one with mass *M*=300kg are connected by a massless rope and are on a frozen lake which you may assume to be frictionless. A rope is attached to the front of the heavy crate, and a band of dwarves, which stand at the shore and dig their heels into the soil so they do not slip, are pulling with a horizontal force that causes the crates to accelerate with an acceleration of 2 m/s^2.



a) Determine the magnitude of the pulling force and the tension in the rope that connects the crates.

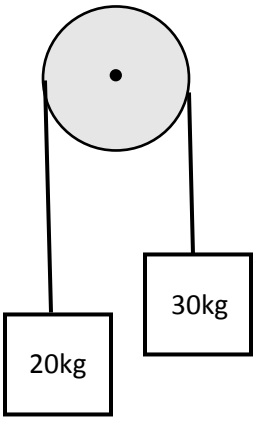
b) What would the tension in the rope connecting the crates be if the rope were attached to the front of the *small* crate, and the dwarves pulled with the same force as you found in part a?



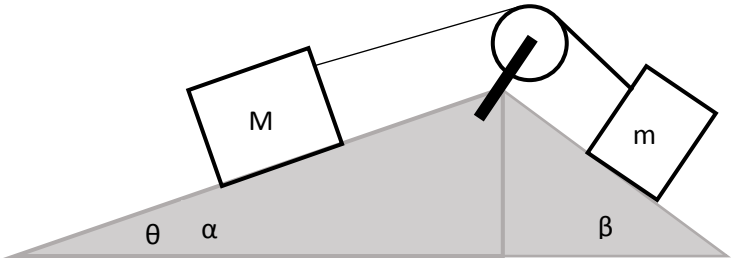
2. Atwood machine. A 20kg box and a 30kg crate are attached to the two ends of a massless string that passes over a massless frictionless pulley. The system is released from rest.

Without performing a calculation, rate, smallest to largest, the magnitudes of the tension in the string and the weights of box and crate, respectively.

Calculate the acceleration of the system and the tension in the string.



3. Two blocks are connected by a massless string that is passing over a massless frictionless pulley. Block 1 of mass *M*=10kg is on a frictionless surface that makes an angle α= 30° with the horizontal. Block 2 of mass *m*=5kg is on a frictionless surface that makes an angle β= 45° with the horizontal. Calculate the tension in the string and the acceleration of the blocks.



4. A small block of mass *m* is on the inclined side of a wedge shaped block of mass *M* which makes an angle θ with the horizontal. The wedge is on a horizontal surface. All surfaces are frictionless.
Find the magnitude *P* of the horizontal force that must be applied to the wedge so that the block m does not slide up or down the incline.