# Physics 113 – Fall 2012 - workshop module 3
## Newton's Laws

1. A dog musher asks his dogs to pull the sled. The dogs refuse, referring to Newton's 3rd Law in their defense. They feel that since the sled will pull on them with the same force that they exert on it, they won't be able to go anywhere. They say, "If we can never exert a forward force on the sled which is greater than the backward force it exerts on us, how can we ever get the sled moving?" Discuss the validity of this defense with your group, and construct a counter-argument using Newton's Laws.

2. If a mosquito hits your windshield, which is greater, the force of your car on the mosquito, or the force of the mosquito on your car? Which accelerates more during the collision, the car or the mosquito? Justify your answers carefully!

3. A heavy lifting crane is being used to stack cargo containers on the deck of a ship. The heaviest container weighs 10 tons (= 20,000 pounds = 89,000 Newtons). How much force should the crane's cable support if it lifts this container (straight up) with an upward acceleration of 1 m/s^2? How would this answer change if the crane were sliding the heaviest container up an inclined plane (frictionless) making an angle of 30 degrees with the horizontal. Please assume the crate lies flat on the plane and that the cable pulling it is parallel to the surface of the plane.
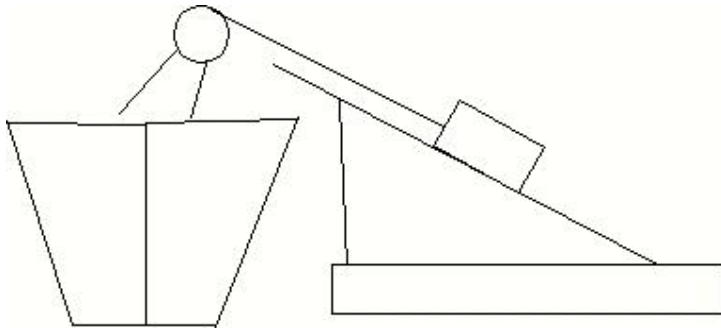
4. Which of the following situations results in a greater tension in the string? In both cases, the strings can be considered massless and the pulleys frictionless. Prove your answer using Newton's Laws.
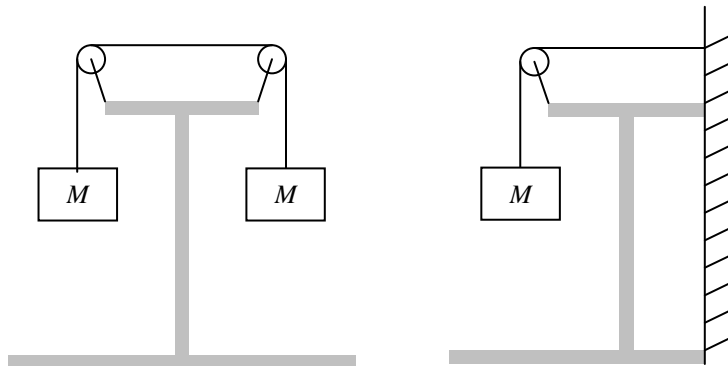
5. Two identical twins of mass 30 kg have identical ropes. One twin ties his rope to the branch of a tree and hangs (without swinging) from the end of the rope. The other twin ties his rope tightly between two trees and hangs (without swinging) from the rope in the center (such that the two sides of the rope each make a 10 degree angle with the horizontal). Which rope is more likely to break? Explain your answer. What is the tension in each rope?
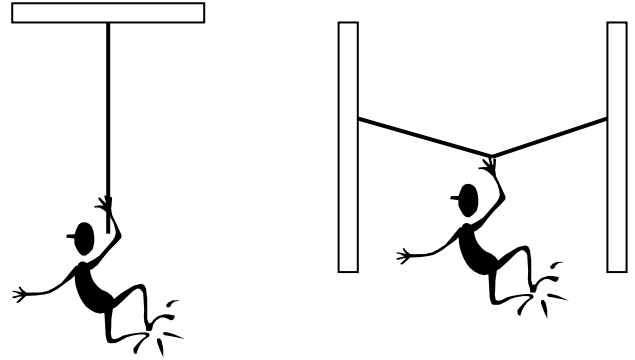
6. Some wacked physics professor does a demo for his class that involves three masses in the configuration sketched below. The professor pulls upward on mass M1 with a force F causing M1 to move upward with an acceleration of 0.5 m/s^2. Let the masses of M1, M2 and M3 be 2 kg, 3 kg and 4 kg, respectively. The frictionless inclined plane on which M3 slides is at an angle of 30 degrees with the horizontal. Determine the magnitude of the force F exerted by the professor on M1 and the tension in each rope. *Assume M2 slides on the table without friction and M3 slides on the inclined plane without friction and that the ropes are massless. Ignore air resistance. Assume the physics class is taking place on the Earth's surface.*

F

M1

Massless and frictionless pulleys

Rope 1

M2

Rope 2

30°

Table (with frictionless surface)

M3