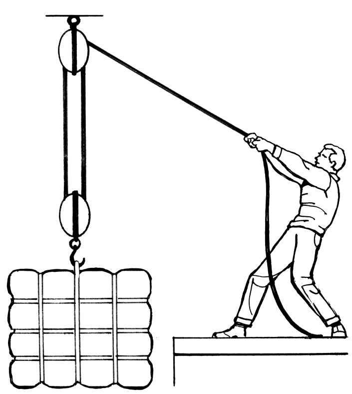
Homework 6

Due Friday, 24 March

1. We saw in class that in a pendulum the string does no work. We also saw that the normal force does no work on an object sliding down a ramp.
   (a) Explain why the tension in the string of a pendulum does no work.
   (b) Explain why the normal force does no work on an object sliding down a ramp.
   (c) Give an example of a situation where tension *does* do work on an object.
   (d) Give an example of a situation where friction does positive work on something.
2. A lazy penguin slides down a snow-covered slope on its chest. Suppose that the diagonal length of the slope is 12 m, and it is inclined at an angle of $10°$ above the horizontal. If the penguin is traveling at 4 m/s when it reaches the bottom of the slope, what is the coefficient of friction between the penguin and the slope? Do this problem twice: once with Newton's second law and kinematics, and once with energy methods. Write a few sentences comparing the approaches.
3. A person uses a block-and-tackle system as shown below (from Wikimedia Commons) to lift a heavy load. This works similarly to the double pulley on Homework 4: the string is wrapped around the lifting pulley twice (shown in the picture), but the person only pulls on one strand of the rope.

   Suppose the load has a weight of 1250 N.
   (a) Suppose our person lifts this load two meters slowly (at constant velocity). What force must they exert on the rope to do so?
   (b) It seems they are getting something for nothing – that they're able to lift a larger weight with a smaller force. But are they? Calculate the work done by the rope on the load, and calculate the work the person does on the rope.

(c) If they lift this load 2m and then hold it there, clearly its change in kinetic energy is zero: it started at rest and ended at rest. However, the rope did positive work on the load; the work-energy theorem thus says that its kinetic energy should increase unless some other force did an equal amount of negative work on it. What force was this?

(d) Explain why, using the definition of work $W = \vec{F} \cdot d\vec{s}$, that force does negative work.