Homework #8

Due Friday, Apr. 8

1. Two toy cars A and B are propelled by fans pointing backward. The fans are identical, and supply the same constant force F to both cars. Car A is more massive than cart B, and therefore accelerates less quickly. Neglect friction.

(a) Both cars start at rest on a horizontal surface, and the fans are turned on for a fixed time t. At the end of the time t, which car has more kinetic energy? Which car has more momentum? Which car is going faster?

(b) Both cars again start at rest, but this time the fans are turned on for each car as long as it is one meter away from where it started. (This means that the fan is on longer for car A.) After both fans are off, which car has more kinetic energy? Which car has more momentum? Which car is going faster?

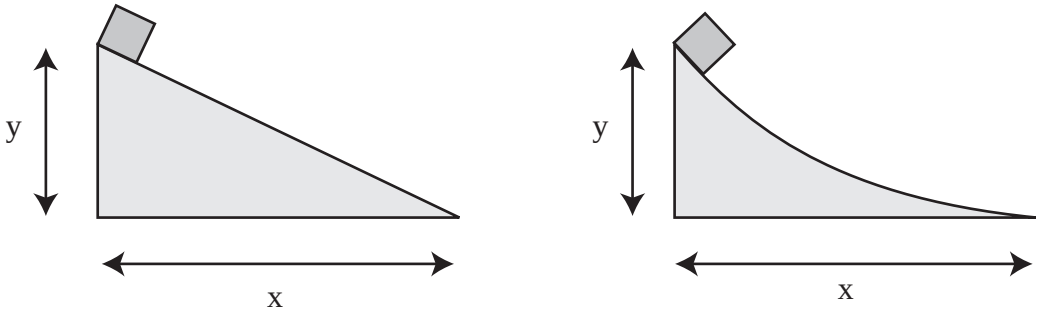
2. A block of mass 0.23 kg is thrown downward with initial speed 1.5 m/s from a height 1.5 m above a spring with spring constant 550 N/m.

(a) What is the speed of the block just before it hits the spring?

(b) What is the maximum compression of the spring?

(c) The spring now re-launches the ball straight upward. What is the maximum height attained by the block?

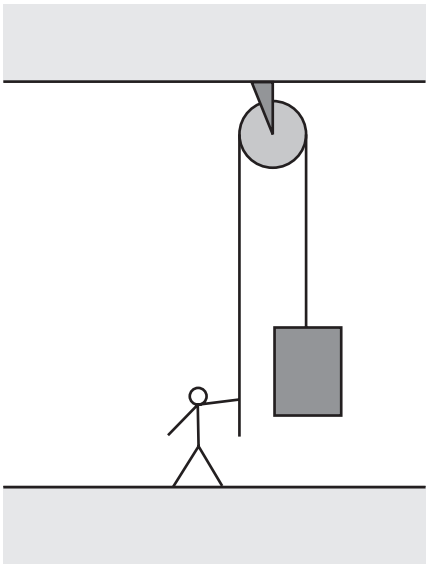
3. (a) Find a formula for the work done by friction on a block of mass m sliding down a straight inclined plane with length x and height y, as shown below left. The coefficient of friction between the block and the plane is μ.

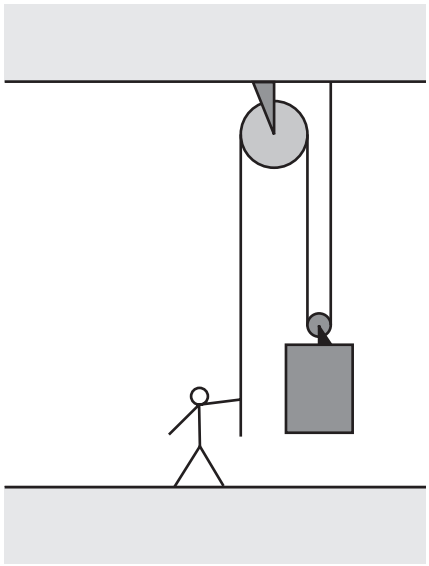


(b) Can you use the result above to find a simple expression for the work done by friction along a ramp of shaped like part of a circle, as shown above

right? Think carefully about the fact that the block is moving in a circle. Does this affect the frictional force?

4. **(a)** A man is hoisting a box into the air using the pulley arrangement shown at left. The box has a mass of 15 kg and the pulley is frictionless. What force must the man apply to move the package upward at a constant speed? How much work does the man have to do in order to lift the package by 2.0 m?





(b) The man now uses the fancier pulley arrangement shown at right. (Neglect the mass of the pulley attached to the block.) What force must the man apply to move the package upward at a constant speed? How much work does the man have to do in order to lift the package by 2.0 m?

5. A block of mass m_1 is initially moving toward a block of mass m_2 with speed v. The blocks stick together and move off together. Find the fraction of the initial kinetic energy that is lost in the collision. What happens to this fraction when $m_1 \to 0$ or $m_2 \to 0$?