Day 10: Combining Conservation of Energy with Momentum

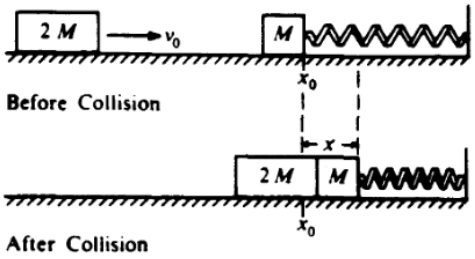
DO Now: The following is a conservation of energy problem from several months ago. Think back to what you learned during our energy unit, and attempt to solve it.

You grab a Y-shaped stick that you find on the ground as you walk from Building 3 to Building 5 to your physics class. You remove a few rubber bands from your old bungee cord and attach it to the stick to build a small slingshot. You put a small crumpled up piece of paper that weighs about 2 g into the slingshot and pull it back with a force of 2 N so that the rubber bands stretch 4 cm. How fast is the paper moving when it leaves the slingshot?

Class Activities: We will attempt independently and together, complex problems that combine both energy and momentum conservation.

1. A block of mass 2 kg is resting on a horizontal, frictionless table and is attached as shown above to a relaxed spring of spring constant k.

A second block of mass 4 kg and initial speed 5 m/s collides with and sticks to the first block. They move together against a spring with spring constant 40 N/m which compresses a distance x before coming to a stop.



a. v, the speed of the blocks immediately after impact

b. x, the maximum distance the spring is compressed

Before Collision Immediately After Collision

1985B1. A 2-kilogram block initially hangs at rest at the end of two 1-meter strings of negligible mass as shown on the left diagram above. A 0.003-kilogram bullet, moving horizontally with a speed of 1000 meters per second, strikes the block and becomes embedded in it. After the collision, the bullet/ block combination swings upward, but does not rotate.

a. Calculate the speed v of the bullet/ block combination just after the collision.
b. Calculate the ratio of the initial kinetic energy of the bullet to the kinetic energy of the bullet/ block combination immediately after the collision.
c. Calculate the maximum vertical height above the initial rest position reached by the bullet/block combination.