Physics 113 - Fall 2012 – Problems for workshop 7

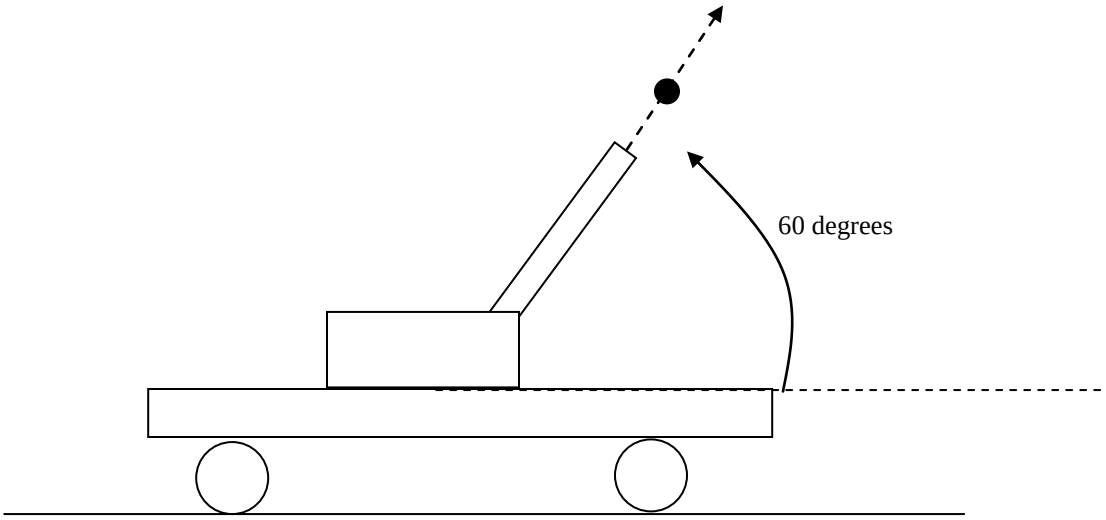
1. A machine gun is fired at a steel plate. Is the force on the plate from the bullet impact greater if the bullets bounce off or if they are squashed and stick to the plate? Why?

2. At the big basketball arena, a maintenance man tried out a new type of floor wax that rendered the floor of the court *completely frictionless*. Shaquille O'Neal was standing in the middle of the court dreaming of another NBA championship during the waxing process, and became stranded there. Luckily, he was carrying his NBA Most Valuable Player trophy, which weighs 50 pounds. If O'Neal, who weighs 300 pounds, hurled the trophy away from himself at 6 m/s, how long did it take him to reach the unwaxed edge of the court, 30 meters away?

3. A 5.00 g bullet is shot through a 1.00 kg wood block suspended on a string 2.000 m long. The center of mass of the block rises a distance of 0.45 cm. Find the speed of the bullet as it emerges from the block if its initial speed is 400 m/s.

4. An important thing to learn in the process of becoming a physicist is how to be spacey. Let's get spacey. In a zero-gravity environment, can a rocket-propelled spaceship ever attain a speed greater than the relative speed with which the burnt fuel is exhausted?

5. A cannon is situated on a railcar as shown in the sketch below. The cannon fires a shell (or cannonball) with a mass of 50 kg with a velocity of 400 m/s at an angle of 60 degrees with the horizontal. Assume the cannon and railcar combination has a mass of 11000 kg both before and after the cannon is fired. What is the recoil velocity of the railcar+cannon immediately after it is fired. Ignore friction and air resistance in this problem.



6. An astronaut floats in a long spaceship with a uniform linear mass density (say what?). If the back end of the spaceship is sitting at x=0, the front end is measured to reach x=25 meters. The spaceship has a mass of 2000 kg (built with very light materials!). If the astronaut, whose mass is 70 kg, is floating at x=4 meters, where is the center-of-mass of the astronaut-spaceship system?