

Answer all questions in the blue notebook provided. Show all your work and indicate your reasoning in order to receive most credit.

1. Romeo (75 kg) entertains Juliet (50 kg) by playing his guitar from the rear of their boat at rest in still water, 5.0 m away from Juliet who is in the front of the boat. After the serenade, Juliet carefully moves to the rear of the boat (away from shore) to plant a kiss on Romeo's cheek. How far does the 125 kg boat move toward the shore it is facing?
2. Assume that you attend a state university that started out as an agricultural college. Close to the center of the campus is a tall silo topped with a hemispherical cap. Someone has somehow balanced a tennis ball at the highest point. While you happen to be standing nearby, a breath of wind makes the ball start rolling without sliding downward from rest. The ball loses contact with the cap when the line from the center of the hemisphere to the ball makes a certain angle with the vertical. What is this angle? Consider the ball as a hollow sphere with the moment of inertia $I = \frac{2}{3}mr^2$.
3. A meter stick is supported on a fulcrum at the 20 cm mark. A 1.50 kg object is hung from the zero end of the meter stick, and the stick is balanced horizontally. What is the mass of the meter stick?
4. A rubber cylinder is rotating without friction about a its axis. The frequency of the cylinder's rotations is 63 rpm, the radius of the cylinder is 10 cm, the mass of the cylinder is 1 kg. A dart of mass 0.1 kg flying parallel the axis hits the cylinder and sticks a distance of 5 cm from the rotation axis. What is the subsequent frequency of rotations of the cylinder?
5. A hollow basketball rolls down a 30° incline. If it starts from rest, what is its speed after it has gone 10 m along the incline? (Assume $g = 10.0 \text{ m/s}^2$.)

6. A 4 kg load hangs from the massless bracket, 40 cm from the wall, as shown in the figure below. A single screw located 20 cm from the bracket's corner holds the bracket to the wall. Find the horizontal tension force in the screw. Hint: Imagine that the bracket is slightly loose and pivoting about its bottom end. Assume the wall is frictionless. Assume $g = 10.0 \text{ m/s}^2$.