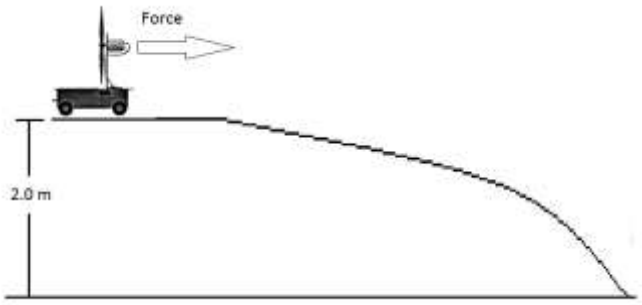
PHYS 250, Sample Chapters 6-8 Test

NOTE: this sample test is a lot longer than the actual test will be: I wanted to give you all lots of problems to practice on!

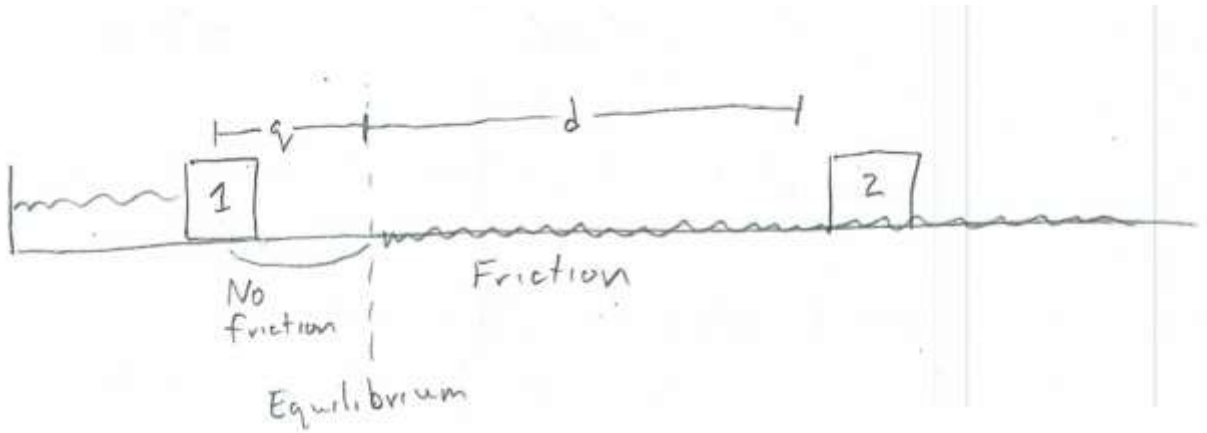
1. Cart B is twice as massive as cart A. Identical fans exert the same force on both of them. Both are propelled by their fans, starting from rest, along a 5 m long track.
    a. Which cart reaches the end of the track with more kinetic energy? Explain using **words.**
    b. Which cart reaches the end of the track more quickly? Explain using **words.**
    c. Which cart has a greater magnitude of momentum when it reaches the end of the track? Explain using **words.**

2. A 2.0 kg fan carts sits on top of the slope shown. The slope is 2.0 m in elevation. The fan is turned on and exerts a constant 3.0 N force on the cart. The fan force is always parallel to the motion of the cart. The cart goes down the slope, travelling a total distance of 6.0 m. Drag and frictional forces are negligible. What is the speed of the cart when it reaches the bottom of the slope? Show all your work and explain your reasoning.



3. A bullet of mass 10 g strikes a pendulum bob of mass 1.5 kg horizontally with speed v, and then becomes embedded in the bob. The bob is initially at rest, and is suspended by a stiff rod of length 0.60 m and negligible mass. The bob is free to rotate in the vertical direction. What is the minimum value of v which causes the bob to execute a complete vertical circle? Hint: treat the collision and the swinging upwards of the bob after the collision as two separate processes.

4.

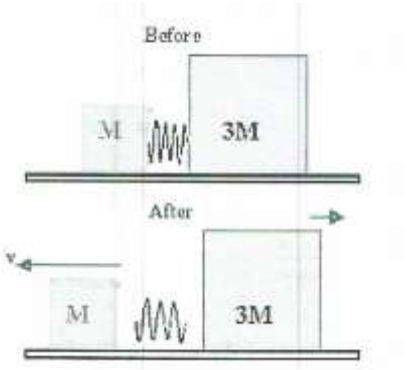


A block, mass $m_1 = 2.0\ kg$, is pressed up against a spring with $k = 300\ N/m$ compressed $q = 0.40\ m$ from its equilibrium position. The block slides frictionlessly forwards until it reaches the equilibrium point of the spring. The block then loses contact with the spring and slides over a surface with $\mu_k = 0.20$ for a distance of $d = 2.0\ m$. It then collides inelastically (but NOT perfectly inelastically) with a second block which has mass $m_2 = 6\ kg$. Immediately after the collision, the first block is moving to the left with a speed of $0.5\ m/s$.

a. Label all of the key moments in time during this process and draw a picture of each moment in time. Note that a collision, while fast, does not happen instantaneously! Do NOT use "initial" and "final" to label the moments in time since there are more than two key moments in time here.

b. Find the velocity of the second block immediately after the collision. Show all your work and explain your reasoning. Use the subscripts corresponding to the moments in time you labeled in part a.

5. Two boxes are placed on a frictionless surface and a spring of negligible mass is placed between them. They are then pressed together. Finally, they are released, and the spring pressed them apart. As they separate, the spring will exert equal magnitude forces on both of them for equal amounts of time. One box has mass M, one box has mass 3M.



a. Which box has more momentum after they separate? Explain.
b. Which box will have more energy after they separate? Explain.

6. Which consumes more energy, a 1.2 kW hair drier used for 10 minutes or a 10 W night light used for 24 hours? Show your work.

7. A pendulum of mass 0.20 kg and length 0.50 m is brought to an initial position of 90 degrees from vertical and then released from rest. As it swings, a constant 0.5 N force of air resistance opposes the motion. (This is unrealistic, but let's ignore that for now). How fast is the pendulum moving when it reaches the bottom of its swing? Show all your work.