Practice Exam 3

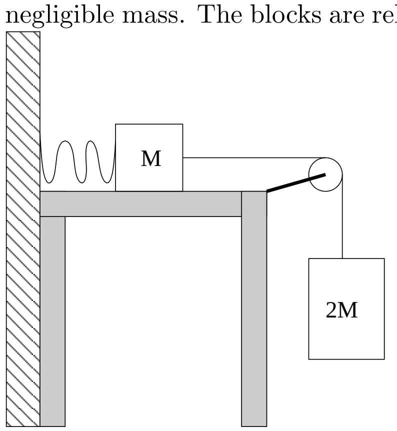
1. Explain why the center of mass of a system is important.

2. Ben has two identical cars. Each are frictionless and have a mass of $20g$.

   (a) He takes a $50g$ wad of silly putty and throws it directly at the back of the car with a speed of $10m/s$. It sticks to the car and the whole mess rolls away. What is the speed of the car?

   (b) Next he takes $50g$ steel marble and throws it straight at the back of the second little car. It collides with the car totally elastically and the car rolls away. What is the speed of the second car?

3. Two blocks of masses M=3kg and 2M are connected to a spring whose spring constant is 100N/m that has one end fixed, as shown in the figure. The horizontal surface and the pulley are frictionless, and the pulley has negligible mass. The blocks are released from rest with the spring relaxed.



   (a) What is the combined kinetic energy of the two blocks when the hanging block has fallen 0.08m?

   (b) What is the kinetic energy of the hanging block when it has fallen 0.08m?

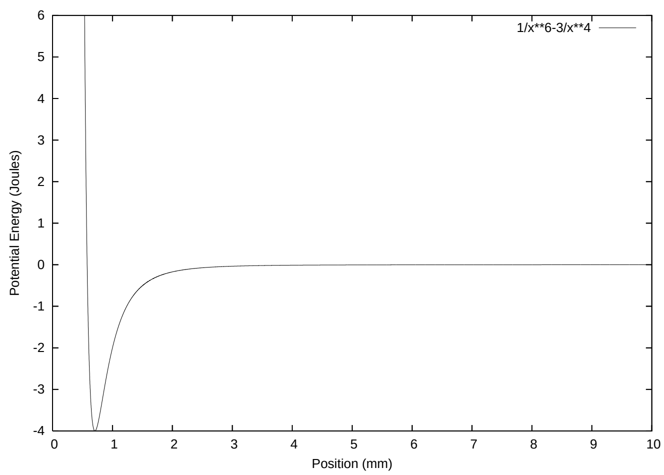
   (c) What maximum distance does the hanging block fall before momentarily stopping?

4. A person drops a penny from the 101st floor of the Empire State building. The penny has a mass of 1.5g.

(a) Using the energy argument of your choice what is the velocity of the penny when it hits the ground? (Assume no drag and that each story is 3m tall)

(b) The actual velocity of the penny just before impact is 70m/s. Calculate the work done by drag on the penny.

5. An object with a mass of 1.5 grams is part of a system that has the following potential energy graph (there are no external forces, no friction and thermal energy is not relevant).



(a) If the total energy of the system is -1.0Joules identify the turning points of the system on the graph.

(b) Estimate the kinetic energy of the object at the turning points.

(c) Estimate the speed of the object at position 1.0mm.

(d) If the system now has total energy +1.0Joules object is initially moving with a negative velocity where will the object eventually wind-up? Assume the potential energy continues the same trend in the regions not shown.