The problems on this practice exam are representative of the types of problems that will be on the actual exam. These problems do not necessarily cover all of the topics that the exam will cover. You should study the ideas and problems associated with all of the chapters that the exam will cover. The practice exam is slightly longer than the actual exam will be (to give you more practice).

Physics 161 - General Physics Practice Exam 1

Short answers [5 pts each]

1. Briefly explain what momentum and impulse each are, and how they are related to each other. (You may write down an equation, but if you do, describe its meaning with words as well.)

2. State in words the meaning of the equation for momentum requirement: $dK_{cm} = \vec{F}_{ext} \cdot d\vec{r}_{cm}$. Also describe how this equation applies to two example situations: one in which the interaction does not change the kinetic energy and one in which the interaction does change the kinetic energy of the object.

3. The Hubble space telescope orbits earth outside its atmosphere and is used to take images of deeps space objects. The Hubble orbits at 600 km above the surface of the earth, and has a mass of 11,110 kg. How much was the gravitational potential energy of the earth-Hubble system changed when the Hubble was launched from the surface of earth to its orbital position?

4. A spring-loaded dart gun has a spring with a spring constant of 15 J/m^2. If the dart is loaded so that the spring is compressed by 4 cm, what is the potential energy stored in the spring?

5. 4. A 75 kg person pushes a cart which is carrying a 125 kg refrigerator, increasing the speed of the refrigerator from rest to 3.5 m/s in 6 seconds. During this time period, how much momentum does the refrigerator transfer to the person? Does the person move in the direction of the momentum transfer from the refrigerator? Why or why not?

6. Two hockey pucks travel on ice (without friction). The first, with a mass of 5 kg, moves north at a speed of 3 m/s. The second, with a mass of 4 kg, moves southwest at a speed of 6 m/s. What is the velocity of the center of mass of this system? (give the magnitude and direction)

7. A 1500 kg car travels at a constant speed of 35 mph (15.6 m/s) down an incline that makes a 5 degree angle with horizontal. During the time the car travels 145 meters, how much work does gravity do on the car?

For each of the following 6 questions, do all of the following:

a) Identify the constituents of the system and all of the interactions both within the system and external to the system.

b) Identify the principle that can be used to model the situation and answer the question and justify the use of the principle in this situation. In order for energy or momentum to be conserved, all external interactions must equal zero. Since that is almost never the case, explain why you can use the conservation law even with the presence of external interactions. If there are internal interactions that you can ignore, explain the reasons that you can ignore them. Once you have explained in detail the reasons that you can ignore a type of external interaction for one of these questions, you don't have to explain the reason you can ignore that type of external interaction for another question.

c) Write down the master equation for that conservation law.

d) Write down a second expression, based on the master equation, which has all the terms necessary to solve the problem. Identify any terms that are equal to zero, specify the values of terms that are known, and circle the terms that are unknown.

DO NOT SOLVE THESE PROBLEMS. DO NOT CARRY OUT ANY ALGEBRA. DO NOT PLUG ANY NUMBERS INTO ANY EQUATIONS. [10 pts each]

8. An object is projected upward from the surface of the Moon at an initial speed of 4 km/s. Find the maximum height it reaches. (Ignore air resistance.) **Remember, answer questions a)-d) above, but do not do algebra or find the numerical answer to this question.**

9. The long ski jump hill at the Olympics has a height drop of 120 m between the gate and the jump-off point. If a ski jumper starts from rest at the gate, how fast will he be going when he reaches the jump-off point at the bottom of the hill, if the friction between his skis and the snow and air drag are both negligible? **Remember, answer questions a)-d) above, but do not do algebra or find the numerical answer to this question.**

10. Two children, Dan (45 kg) and Mary (38 kg), are ice skating on a frozen lake. They can essentially slide without friction on their skates. They decide to toss a 6 kg medicine ball between them. When Dan is standing directly south of Mary, Mary pushes the medicine ball directly towards Dan. With what velocity does Mary move after she tosses? **Remember, answer questions a)-d) above, but do not do algebra or find the numerical answer to this question.**

11. Two ultimate Frisbee players, one running directly east at 5 m/s, the other running 30 degrees north of east at 3 m/s, both jump to grab the Frisbee. As the two players collide in mid-air, one player holds onto the other. How fast are they going after they collide? **Remember, answer questions a)-d) above, but do not do algebra or find the numerical answer to this question.**

12. Buckyballs are molecules which are made of 60 carbon atoms and are approximately spherical. In a physics experiment, two buckyballs each have one electron removed, so that they are positively charged. The molecules start out at a distance of 20 micrometers. How fast are they moving when they are 1 meter apart? **Remember, answer questions a)-d) above, but do not do algebra or find the numerical answer to this question.**

Solve the following problems. You must write out the equations you are using before plugging in numbers. I suggest that you solve for the unknown variable algebraically and then plug in the numbers. You do not need to justify the use of any conservation law.

13. [15 pts] A penny is dropped from a height of 4×10^6 m above the surface of the earth. Ignoring air resistance, use conservation of energy to determine the speed of the penny when it hits the earth.

14. [15 pts] A 5.0 kg ball with speed 3 m/s collides with a 10 kg ball at rest. The final velocity of the 5.0 kg ball is 2.24 m/s at an angle of 63.4 degrees with its original direction. Find the final speed and direction of the 10 kg ball using conservation of momentum. **[note for practice exam – use vectors!]**