Physical Science 101 Name:_____
Homework #5

1. A 2 kg ball is thrown straight upward with an initial speed of 12 m/s. Assume air resistance is negligible. (Note: you may want to refer to HW #4 problem 9.) Show all work or justify your answers.
   a. When the ball is at its peak, what is its kinetic energy?

   b. When the ball is at its peak, what is its potential energy?

   c. When the ball is halfway down from its peak to the ground, what is its potential energy?

   d. When the ball is halfway down from its peak to the ground, what is its kinetic energy?

2. John argues that an object can have energy without having any momentum while Jeff argues that an object must have momentum if it is to have energy.

   Who do you agree with? JOHN JEFF

   Why?

3. A car with a mass of 1000 kg is moving with a constant speed of 10 m/s.
   a. If the car's speed is doubled by what factor does its momentum change?

   b. By what factor does its kinetic energy change?

4. A car drives 55 mph to the east. A second identical car travels 55 mph to the west.
   a. Do they have the same momentum? Explain.

   b. Do they have the same kinetic energy? Explain.

5. Kenny, who has a mass of 15 kg, slides down a frictionless slide that is 3.4 meters tall. Cartman, who has a mass of 85 kg, slides down the same slide. (Remember to show all work and justify all answers.)

   a. What speed does Kenny reach at the bottom of the slide?

   b. What speed does Cartman reach at the bottom of the slide?

   c. Kyle slides down the same slide. What speed does Kyle reach at the bottom of the slide? Explain.

Problems 6 & 7 will require some measurements and some calculations. Measuring devices will be available in the lab and in your instructor's office. Be sure to describe all quantities that you measure and how you measured them, as well as to show all of your calculations. You will choose some object to drop that will bounce (such as a tennis or golf ball).
Identify the object you used: _____

6. Hold the object up about at the height of your eyes.
   a. What quantities do you need to determine the potential energy of the object at this location? How will you determine each of them?

   b. Record any quantities that you measure.

   c. Calculate the potential energy of the object when you hold it up to drop it.

   d. Drop the object. Assuming negligible air resistance, what is the kinetic energy of the object just before it hits the ground? Justify your answer with physical principles.

7. Drop the object again and carefully observe its motion after it hits the ground (it should bounce).
   a. What do you need to measure to determine the total energy of the object after it hits the ground? (Consider only the first bounce and do NOT assume it is the same as before it hits the ground.) Record your measurements and describe how you measured them.

   b. Calculate the energy of the object after it hit the ground.

   c. Determine whether or not the object' energy was conserved when it hit the ground. If it was not conserved, explain where the energy went.

8. A container of hydrogen gas is at the same temperature as a separate container of oxygen gas. (An oxygen molecule is about 16 times more massive than a hydrogen molecule.) Does this mean that all the oxygen and hydrogen molecules are moving at the same speed?

YES **NO**

Explain your answer.

9. Your 150 kg bath water is at 55 °C and you add 50 kg of water at 35 °C. Will the temperature of the mixed water be 45 °C or at a higher or a lower temperature?

45 °C **Higher than 45 °C** **Lower than 45 °C**

Explain your answer with a one sentence justification.

10. Place a cold spoon into a cup of hot coffee and the spoon becomes warm.
    a. Describe the warming of the spoon from the nanoscale.

    b. From where does the energy that warms the spoon come?

    c. What happens to the temperature of the coffee?
    Increases **Stays the Same** **Decreases**

    Why?