PHYS-1800 **Homework 9** **Due: 2 April, 2010**

Name:_____ **(show all workings)**

1. The first law of thermodynamics is an extension of the principle of conservation of _____ that we first met in mechanics. (1 point)

2. In an experiment a certain amount of heat is transferred into a system. The system then performs some work on its surroundings but the amount of work done is less than the heat added. The experimenter concludes that: (1 point)
   A. the internal energy of the system increased.
   B. the internal energy of the system decreased.
   C. there must have been a phase change.

3. A box of graham crackers is labeled "120 calories per serving". Assuming this means 120 kcal, the energy of a serving of the graham crackers is about: (1 point)
   A. 120 J.
   B. 4200 J.
   C. 50000 J.
   D. 500000 J.

4. A student uses a new thermometer calibrated in Kelvin units to measure the temperature of various substances. Calculate the temperature (a) at which mercury freezes (234 K), and (b) at which lead melts (600 K) in degrees Centigrade and Fahrenheit for each metal (to nearest deg). (2 points)

5. Sixty grams each of four different materials is used in a heat experiment: steel, lead, alcohol and glass. When 120 calories of heat is added to each body, each initially at 18°C, the final temperatures of each are, 39.6°C for steel, 87.2°C for lead, 24.1°C for alcohol and 33.0°C for glass. The material with the largest specific heat capacity is which of the following? (2 points)
   A. Steel
   B. Lead
   C. Alcohol
   D. Glass

6. You are given a mixture of 60 g of ice and 40 g of liquid water, both at 0°C. The amount of heat which must be added to melt all of the ice is about: (latent heat of fusion of ice = 80 cal/g, and specific heat capacity of water = 1.0 cal/g ºC). (2 points)
   A. 3200 cal.
   B. 4000 cal.
   C. 4800 cal.
   D. 8000 cal.

Name:_____ **(show all workings)**

7. The temperature of 50 gram sample of aluminum is raised from 20º C to 90º C when 770 calories of heat is added. The specific heat capacity of the metal is: (2 points)

A. 0.11 cal/g ºC
B. 15.4 cal/g ºC
C. 0.22 cal/g ºC
D. 0.91 cal/g ºC

8. Suppose water is boiled in a vessel open to the atmosphere. Compare the internal energy of 1 gram of steam at the boiling point to 1 gram of water at the same temperature: (3 points)

A. The internal energy of the water and steam are the same
B. The internal energy of the water will be higher
C. The internal energy of the steam will be higher.

Explain your answer:

9. 1500 J of work is done by stirring an insulated beaker containing 220 g of water at 15º C. Using a specific heat capacity for water = 1.0 cal/g ºC, determine: (3 points)

(a) The change in the internal energy of the system?
(b) The new temperature of the water?

10. Explain what we mean when we say that "freezing is a warming process while melting is a cooling process". (3 points)

Name:_____ **(show all workings)**

Two additional questions worth up to a total of 10 extra points:

1. (a) Determine how much heat must be added to a 1.5 kg mass of water ice at -14º C (at atmospheric pressure) in order to transform it into superheated steam at 125º C. (Assume: specific heat of ice = 2.1 kJ/kg.K, specific heat of water = 4.2 kJ/kg.K, specific heat of steam = 2.0 kJ/kg.K, and the latent heat of fusion of ice = 334 kJ/kg and latent heat of vaporization of water = 2.3 x 10^3 kJ/kg.)

(b) State how much and at which stage most of the energy is used. (5 points)

Please turn over..

Name:_____ **(show all workings)**

2. A 200-gram quantity of an unknown metal, initially at 110º C, is dropped into an insulated beaker containing 100 grams of water at 20º C. The final temperature of the metal and water in the beaker is measured to be 38º C. If no heat is transferred to the beaker, determine: (5 points)

(a) How much heat is transferred from the metal to the water?

(b) The specific heat capacity of the metal?

(c) If in a new experiment the final temperature of the water and metal was 70º C, what quantity of metal (initially at 110º C) was dropped into the beaker of water?