**EXTRA CREDIT**
**Due Wednesday November 17, 2010**

1. When 1.35 g of benzoic acid ($C_7H_6O_2$) burns completely in excess $O_2$ gas at constant volume and 289 K, it releases 35.61 kJ of energy.

   a. What is the balanced chemical equation for this reaction?
   b. What is the molar energy of combustion of benzoic acid?
   c. What is the energy released per mole of $O_2$ consumed?

2. Solid urea, burns to give $CO_2$, $N_2$, and liquid $H_2O$. Its heat of combustion is -632.2 kJ/mol.
   a. Write the balanced combustion equation.
   b. Calculate the heat generated per mole of $H_2O$ formed.
   c. Using this heat of formation and the appropriate thermodynamic data, determine the heat of formation of urea.

3. When 1.00 g of $KClO_3$, dissolves in 50.0 g of water in a coffer-cup calorimeter, the temperature drops fro 298.00 K to 296.36 K. Calculate the molar heat of solution of $KClO_3$.

4. Explain what will happen to any living organism if we try to make it an isolated thermodynamic system

5. Some chemists classify sodium chloride dissolving in water as a chemical change that is described by the equation: $NaCl_{(s)}$ ---> $Na^+_{(aq)} + Cl^-_{(aq)}$. Others classify this as a physical change because NaCl is an ionic solid whose species are unchanged when it dissolves. Which classification do you prefer? Defend your choice using your understanding of "chemical" and "physical."

6. A 9.50 g copper block, initially at 200°C, is dropped into a thermos flask containing 200 mL of water initially at 5.00°C. What is the final temperature of the system?

7. One way to cool a hot beverage is with a cold spoon. A silver spoon weighing 99 g is placed in a Styrofoam cup containing 200 mL of hot coffee at 350 K. Find the final temperature of the coffee, assuming that the initial temperature of the spoon is 280 K and that the coffee has the same heat capacity as water. Would an aluminum spoon of the same mass cool the coffee more or less effectively?

8. A coin dealer, offered a rare silver coin, suspected that it might be a counterfeit nickel copy. The dealer heated the coin, which weighed 15.5 g to 100.0°C in boiling water and then dropped the hot coin into 21.5 g of water at T = 15.5°C in a coffee-cup calorimeter. The temperature of the water rose to 21.5°C. Was the coin made of silver or nickel?

9. A 44.0 g sample of an unknown metal at 100.0°C is placed in a constant pressure calorimeter containing 80.0 g of water at 24.8°C. Assume the heat capacity of the calorimeter is negligible. The final temperature is 28.4°C. Calculate the heat capacity of the metal and use the result to identify the metal: Al - 0.903 J/g K; Cr = 0.616 J/g k; Co = 0.421 J/g k; or Cu = 0.385 J/g K.

10. In liquid-fuel rockets, such as the lunar lander module of the Apollo moon missions, the fuels are liquid hydrazine ($N_2H_4$) and dinitrogentetroxide gas ($N_2O_4$). The two chemicals ignite on contact to release very large amounts of energy:

    $2N_2H_{4(l)} + N_2O_{4(g)}$ ----------> $3N_{2(g)} + 4H_2O_{(g)}$

    a. Calculate the enthalpy change that occurs when 1 mol of hydrazine is burned in a lunar lander.
    b. If $O_2$ was used in the lander instead of $N_2O_4$, would the reaction give off more heat per mole of hydrazine or less heat per mole of hydrazine? Explain.