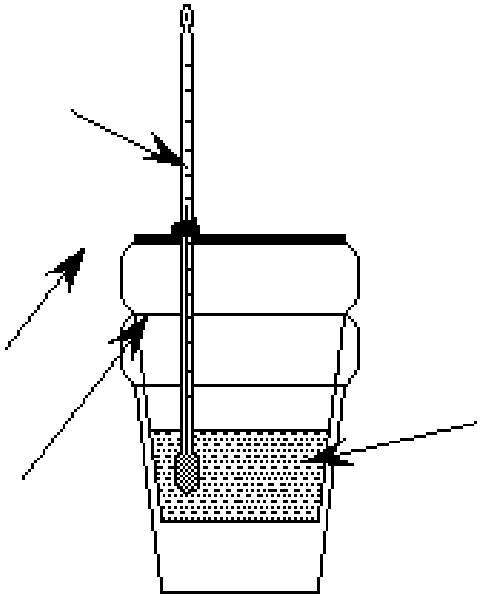
Name: _____

THERMODYNAMICS
HONORS CHEMISTRY 2005.1.0
TEXTBOOK PG 145–173

1. How much heat must be added to change the temperature of 250 g of water from 25 ˚C to 60 ˚C? (2points)

2. If 2.09 joules are required to change the temperature of 15.0 g of mercury by 1.00 ˚C, calculate the specific heat of mercury. (specific heat table in textbook 159) (2points)

3. Label the important components of the coffee-cup calorimeter shown below. What property of a chemical reaction does a coffee-cup calorimeter measure? What type of reactions are studied? (2points)



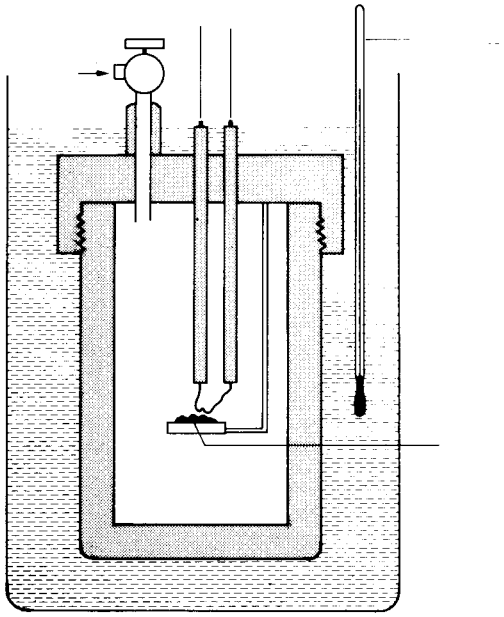
4. Write the mathematical equation that relates the heat released by the chemical reaction to the heat absorbed by the water and the coffee-cup calorimeter. (2points)

5. When 1.095 g of NaOH is dissolved in 150.0 g of water initially at 23.50 ˚C in a coffee-cup calorimeter, the final temperature is found to be 25.32 ˚C. Calculate the heat liberated when NaOH dissolves in water. (Assume the specific heat of the solution is the same as that of water and no heat is absorbed by the calorimeter.) (2points)

MAD SCIENCE CHALLENGE QUESTION

6. A 50.00 g sample of 0.200 M NaBr*(aq)* at 23.65 ˚C is added to a coffee-cup calorimeter containing 50.00 g of 0.200 M $AgNO_3$*(aq)* at 23.65 ˚C. If the heat capacity of the calorimeter is 65.0 $\frac{J}{^\circ C}$ and the specific heat of the solution is 4.20 $\frac{J}{g \cdot ^\circ C}$ and the final temperature of the solution in the calorimeter is 25.40 ˚C, calculate the heat released in the reaction. (4 points)

7. Label the important components of a bomb calorimeter shown below. What property of a chemical reaction does a bomb calorimeter measure? What type of reaction is studied? (2points)



8. Write the mathematical equation that relates the heat released by the chemical reaction to the heat absorbed by the water and the bomb calorimeter. (2 points)

9. Sucrose, $C_{12}H_{22}O_{11}$ reacts with oxygen according to the reaction,

$$C_{12}H_{22}O_{11(s)} + 12O_{2(g)} \rightarrow 12CO_{2(g)} + 11H_2O_{(l)}$$

Calculate the heat produced per mole of sucrose when 2.75 g of $C_{12}H_{22}O_{11}$ are combusted with excess oxygen in a bomb calorimeter containing 4.80 kg of water. The temperature change measured is 2.01 ˚C. The heat capacity of the calorimeter is 2540 $\frac{J}{^\circ C}$.(3 points)

10. A 28.4 g sample of an unknown metal was heated to 110.0 ˚C and plunged into a 100 g sample of water initially at a temperature of 24.60 ˚C. The final temperature of the mixture was 25.34 ˚C. Calculate the specific heat of the metal. Identify the metal. (Specific Heat table in textbook pg 159) (2 points)

11. Define *Hess' Law*. (2 points)

12. Given the enthalpy change for the two reactions below,

$$C_{(s)} + \frac{1}{2} O_{2(g)} \rightarrow CO_{(g)} \qquad \Delta H^\circ = -111 \text{ kJ}$$
$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \qquad \Delta H^\circ = -394 \text{ kJ}$$

Calculate the enthalpy change for the reaction, **Show reactions** (3 points)

$$CO_{(g)} + \frac{1}{2} O_{2(g)} \rightarrow CO_{2(g)}$$

13. Using the following standard enthalpy of reaction data,

$$2C_{(s)} + 3H_{2(g)} \rightarrow C_2H_{6(g)} \qquad \Delta H^\circ = -84.68 \text{ kJ}$$
$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \Delta H^\circ = -394 \text{ kJ}$$
$$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)} \qquad \Delta H^\circ = -286 \text{ kJ}$$

Calculate the heat of reaction for the combustion of 1 mol of ethane (C_2H_6). **Show reactions** (3 points)

14. Define the term *heat of reaction* and write the mathematical equation used to calculate the heat of a chemical reaction. (2 points)

For the following problems refer to Table 5.3: Standard Enthalpies of Formation, ΔH°_{f}, at 298K in your textbook pg 166

15. Calculate the ΔH° for the following reaction, (2 points)

$$C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$$

MAD SCIENCE CHALLENGE QUESTION

16. Calculate the ΔH° for the following reaction, **Show reactions** (4 points)

$$3NO_{2(g)} + H_2O_{(l)} \rightarrow 2HNO_{3(aq)} + NO_{(g)}$$

MAD SCIENCE CHALLENGE QUESTION

17. The standard enthalpy of combustion to $CO_{2(g)}$ and $H_2O_{(l)}$ at 25 $^{\circ}$C of cyclohexane, $C_6H_{12(l)}$, is -3924 $\frac{kJ}{mol}$. Calculate the standard heat of formation, ΔH°_{f}, of cyclohexane. **Show reactions** (4 points)

$$C_6H_{12(l)} + 9O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)}$$