AP CHEMISTRY WORKSHEET ON CALORIMETRY

NAME:_____DATE:_____PERIOD:_____

SHOW YOUR WORK! ! ! ! ! ! SHOW YOUR WORK! ! ! ! ! ! SHOW YOUR WORK! ! ! ! ! !

(1) The following substances undergo complete combustion in a bomb calorimeter. The bomb calorimeter assembly (including the water) has a heat capacity of 4.881 kJ/ ^{0}C. In each case, what is the final water temperature if the initial water temperature is 24.62 ^{0}C?

a. 0.5187 grams of cyclohexanol ($C_6H_{12}O_{(l)}$);
heat of combustion = – 3727 kJ/mol

b. 1.75 mL of ethyl acetate ($C_4H_8O_{2(l)}$, density = 0.901 g/mL);
heat of combustion = –2246 kJ/mol.

(2) A 0.50 gram sample of NH_4NO_3 is added to 35.0 grams of water in a "coffee cup" (constant pressure) calorimeter and stirred until it dissolves. The temperature of the solution drops from 22.7 ^{0}C to 21.6 ^{0}C. What is the HEAT OF SOLUTION of NH_4NO_3 expressed in kJ/mol NH_4NO_3?

(3) 0.5060 grams of liquid cyclohexanol undergo complete combustion in a bomb calorimeter. The calorimeter assembly has a heat capacity of 827.0 J/^{0}C and contains exactly 1000 grams of water. What is the final temperature if the initial water temperature is 24.98 ^{0}C? The heat of combustion of the cyclohexanol is –3727 kJ/mol.

(4) A coffee-cup calorimeter having a heat capacity of 472 J/^{0}C is used to measure the heat evolved when the following aqueous solutions, both initially at 22.6 ^{0}C, are mixed: 100 g of a solution containing 6.62 g of lead (II) nitrate, and 100 g of solution containing 6.00 g of sodium iodide. The final temperature is 24.2 ^{0}C. Assume that the specific heat of the mixture is the same as that for water (4.184 J/g $\cdot$ ^{0}C).

a. Write a balanced equation for the reaction that occurs

b. Calculate the heat evolved in the reaction

c. Calculate the ΔH for the reaction (per <u>mole</u> of lead (II) nitrate consumed) under the conditions of the experiment.

(5) The combustion of 1.048 g of benzene, $C_6H_{6\,(l)}$, in a bomb calorimeter compartment surrounded by 945 g of water raised the temperature of the water from 23.640 ^{0}C to 32.692 ^{0}C. The heat capacity of the calorimeter is 891 J/^{0}C.

a. Write a balanced equation for the combustion reaction that occurs, assuming that $CO_{2\,(g)}$ and $H_2O_{\,(l)}$ are the only products

b. Use the calorimetric data to calculate ΔE for benzene in kJ/g <u>and</u> kJ/mol.

(6) A 1.567 g sample of naphthalene, $C_{10}H_{8\,(s)}$, is completely combusted in a bomb calorimeter assembly and a temperature increase of 8.37 ^{0}C is observed. When a 1.227 g sample of thymol, $C_{10}H_{14}O_{\,(s)}$ (a preservative and a mold and mildew preventative), is burned in the same calorimeter assembly, the temperature increase is 6.12 ^{0}C. If the heat of combustion of naphthalene is 5153.9 kJ/mol $C_{10}H_8$, what is the heat of combustion of thymol, expressed in kJ/mol $C_{10}H_{14}O$?

KEY: WORKSHEET ON CALORIMETRY

(1) a. $T_F = 28.58\ ^0C$
b. $T_F = 32.86\ ^0C$

(2) 25.8 kJ/mol

(3) $28.74\ ^0C$

(4) a. $Pb(NO_3)_2 + 2NaI \longrightarrow 2NaNO_3 + PbI_2$
b. (–) 2.09 kJ
c. – 103.5 kJ/mol

(5) a. $2C_6H_6 + 15O_2 \longrightarrow 6H_2O + 12CO_2$
b. – 41.89 kJ/g
– 3.27×10^3 kJ/mol

(6) 5639.7 kJ/mol $C_{10}H_{14}O$