AP Chemistry Work, Energy & Calorimetry CW Name: _____

1. Calculate the change in energy for a system undergoing an endothermic process in which 15.6kJ of heat flows and where 1.4 kJ of work is done on the system.

↑(+)

$\Delta E = q + w$

$\Delta E = 15.6\,kJ + 1.4\,kJ = 17.0\,kJ$

2. A gas absorbs 45kJ of heat and does -29kJ of work. Calculate the change in internal energy.

(+) (−)

$\Delta E = 45\,kJ + -29\,kJ = 16\,kJ$

3. A system releases 125 kJ of heat and does 29 kJ of work. Calculate the change in internal energy.

(−) (+)

$\Delta E = -125 + -29\,kJ = -154\,kJ$

4. A 0.150 g sample of octane (liquid) was burned in a bomb calorimeter causing the temperature to change from 25.246°C to 26.386°C. If the heat capacity of the calorimeter was 7.15 kJ/°C, calculate ΔH_{comb} for octane.

$q_c = (7.15\,kJ/°C)(26.386°C - 25.246°C)$

$q = 8.151\,kJ$ per 0.150g octane (C_8H_{18})

$\Delta H = 8.151\,kJ \Big/ \left(.150g\ octane \Big| \frac{1\ mol}{114.23\ g}\right) = 6210\ kJ/mol$

↑ kJ/mol

5. Calcium oxide (lime) reacts with water to give calcium hydroxide. A 5.40 g sample of calcium oxide was added to 500. mL of water in a calorimeter of heat capacity 350. J/°C. The observed temperature increase was 2.60°C. What is the standard enthalpy change for the reaction of one mole of calcium oxide? (Surroundings = calorimeter & solution) Assume that the resulting solution has the same specific heat as water.

Need to take into account the calorimeter and the solution

500 mL H_2O = 500 g H_2O (Density = 1 g/mL)

$q_c = (350\,J/°C)(2.60°C)$

$q_c = 910\,J$

$q_{solution} = (500 + 5.40)(4.184\,J/g°C)(2.6°C)$

$q_{soln} = 5498\,J$

$q_{rxn} = 910\,J + 5498\,J = 6408\,J$

$\left(6408\,J \Big| \text{per } 5.40\,g\ CaO \Big/ \left(5.40 \Big| \frac{1\ mol}{56.08}\right)\right) = 6.65 \times 10^4\ J/mol$

6. A 50.0 mL sample of 0.20 M HCl was mixed with 50.0 mL of 0.20 M NaOH in a coffee cup calorimeter. Use the equation below to predict the temperature change that should be observed.

$H_3O^+ + OH^- \rightarrow 2\,H_2O\,(l) \qquad \Delta H = -54\,kJ$

↳ -54000 J

assume density is 1 g/mL

mass = 50 + 50 = 100.0g

$-54000J = (100.0g)(4.184\,J/g°C)(\Delta T)$

$\Delta T = -129°C$

7. Propane gas is often used as a home fuel in areas where natural gas is not available. When 3.00 g of propane is burned in a calorimeter whose heat capacity is 32.7 kJ/°C, the temperature increases by 4.25°C. Write the thermochemical equation for the combustion of ~~octane.~~ propane

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O \quad \Delta H = 2040\ kJ/mol$

$q_c = (32.7\ kJ/°C)(4.25°C)$

$q_c = 139\ kJ$

$\Delta H = 139\ kJ \Big/ \left(3.00\ g \Big/ \frac{1\ mol}{44.094\ g}\right) = 2040\ kJ/mol$

* thermochemical means balanced reaction and $\Delta H =$ — *

8. When 1.00 g of oxalic acid, $H_2C_2O_4$, is burned in a calorimeter, the temperature increases 0.312°C. If the ΔH_{comb} of oxalic acid is - 246 kJ/mol, determine the heat capacity of the calorimeter.

$\Delta H = -246\ \frac{kJ}{mol} = \frac{q_c}{1.00\ g/(90.036)}$

$q_c = -2.73\ kJ$

$-2.73 = (C)(.312°C)$

$C = 8.75\ kJ/°C$

9. A sample of potassium chloride is dissolved in water in a coffee cup calorimeter. Use the data shown below to determine the enthalpy change for the dissolving process.

mass of KCl	2.80 g
volume of water	100.0 mL
initial temperature of water	22.6°C
final temperature of solution	19.9°C

> add together

$\Delta H = (102.8\ g)(4.184\ J/g°C)(19.9 - 22.6)$

$\Delta H = -1160\ J$