Name: _____

[M2015E3P] 1. How much heat is gained or lost when a) 1 mole and b) 1kg (1000 g) of chlorine gas (Cl_2) reacts in the following equation? Show the correct sign number of significant figures for ΔH. Also state whether the reaction is exothermic or endothermic.

$$2\ Al\ (s)\ +\ 3\ Cl_2\ (g)\ \rightarrow\ 2\ AlCl_3\ +\ 337\ kcal$$

ΔH for 1 mol Cl_2 =_____

ΔH for 1 kg Cl_2 =_____

Exothermic or endothermic? _____

2. Draw 3 reaction diagrams (energy vs. time) side by side, using the same scale. Label the reactants, products, activation energy, enthalpy change, and both axes.

a) exothermic reaction releasing 100 J of energy with activation energy 50 J.

b) exothermic reaction releasing 100 J of energy with activation energy 100 J.

c) exothermic reaction releasing 50 J of energy with activation energy 200 J.

3. Convert the following units:

a) 4.184 J → cal

b) 4.184 kJ → kcal

c) 523 J → Cal (food calories)

d) 6.0 Cal → cal

e) 9000 cal → J

[131 E2P-1] 4. Calculate the heat, in Joules, required for the following

a) heating 25.0 g of water from 20.0 °C to 60.0 °C (c = 4.184 J/°C g for water)

b) heating 25.0 g water from 60.0 °C to 100.0 °C

c) heating 25.0 g of water from 20.0 °C to 100 °C

d) heating 25.0 g copper from 60.0 °C to 100.0 °C (c = 0.385 J/°C g for copper)

e) cooling 25.0 g copper from 20.0 °C to -20.0 °C

Name: _____

5. Use the below expression for Gibbs Free Energy ΔG to determine if water will spontaneously boil at 300K, 350 K, and 400 K. For water, ΔH_{vap} = 40.68 kJ/mol and ΔS_{vap} = 118.89 J/mol·K. Show 3 calculations for ΔG, and watch your units. Indicate as spontaneous or not at each temperature.

$$\Delta G = \Delta H - T\Delta S$$

ΔG(300 K) = _____ Spontaneous? _____

ΔG(350 K) = _____ Spontaneous? _____

ΔG(400 K) = _____ Spontaneous? _____

5. Use the Le Chatlier principle to predict the effects on the below equilibrium.

$$N_2(g) + O_2(g) \rightleftharpoons 2\,NO(g)\ \Delta H = +43\ \text{kcal/mol}\ (+180\ \text{kJ/mol})$$

a. Does the NO level increase, decrease, or stay the same when more O_2 is added?

b. What happens to N_2 when more O_2 is added?

c. What happens to NO when the total pressure is increased?

d. What happens to NO when the temperature is increased?

e. What happens to NO when a catalyst is added?

6. Write an equilibrium constant expression (capital K) for the above reaction in #5.