**Midterm Prep Worksheet**

1. A 245.7g sample of a metal at 75.2 degrees Celsius was placed in 115.43g of water at $22.6^oC$. The final temperature of the water was $34.6^oC$. Assuming no heat was lost to the surroundings, calculate the specific heat of the metal.

0.581 J/g $^oC$

2. A bowl containing 56 grams of ice cream is sitting out in the sun. The heat from the sun completely melts the ice cream and raises its temperature to $30^oC$. Assuming that the ice cream was initially a solid with a freezing point at $0^oC$, how much energy was supplied to the ice cream? ($\Delta H_{fusion}$ of ice cream is 210 J/g and the specific heat capacity of liquid ice cream is 3.1 J/g $^oC$)

1.7 x 10^4 J

3. Determine the reaction enthalpy for the hydrogenation of ethyne to ethane:

$$C_2H_{2\,(g)} + 2\,H_{2\,(g)} \rightarrow C_2H_{6\,(g)}$$

$\Delta H^o_{combustion}$ $C_2H_{2\,(g)}$ = -1300 kJ/mol
$\Delta H^o_{combustion}$ $C_2H_{6\,(g)}$ = -1560 kJ/mol
$\Delta H^o_{combustion}$ $H_{2\,(g)}$ = -286 kJ/mol

-312 kJ/mol

4. Under what conditions is the work done by the system equal to heat absorbed by the same system? Also state relevant equations.

T must be 0

5. 1.00 mol of an ideal gas is compressed reversibly at a constant temperature (T=500 K) and w = 1000J. Find the following quantities for this process:

    a. $\Delta U$

    0

    b. q

    -1000 J

c. $\frac{V_f}{V_i}$

0.786

d. $\Delta S_{gas}$

-2.00 J/K

e. $\Delta S_{surrounding}$

+2.00 J/K

6. The reaction between gaseous iodoethane and water vapor generates ethanol and HI:

$$CH_3CH_2I_{(g)} + H_2O_{(g)} \rightarrow CH_3CH_2OH_{(g)} + HI_{(g)}$$

36.00 g of $H_2O_{(g)}$ is converted to ethanol and HI gas completely. The initial volume of the system is 20 L. The internal energy change of the reaction is 84.00 kJ. The reaction occurs under constant pressure (1 atm) and room temperature ($25^oC$).

$\Delta H_f^o\ H_2O_{(g)}$ = -241.82/mol
$\Delta H_f^o\ CH_3CH_2I_{(g)}$ = -51.39 kJ/mol
$\Delta H_f^o\ CH_3CH_2OH_{(g)}$ = -277.69kJ/mol

Bond enthalpies:
H—-O 463 kJ/mol
C—-C 348 kJ/mol
H—-I 299 kJ/mol
C—-I 238 kJ/mol

a. Calculate work and heat of the reaction process.

w=0
q= 84.00 kJ

b. Is the reaction endothermic or exothermic?

endothermic

c. What is the enthalpy of the reaction for 1 mol of $H_2O_{(g)}$ ?

42.00 kJ/mol

d. What is $\Delta H_f^o$ $HI_{(g)}$ ?

+26.48 kJ/mol

e. Answer the following regarding bond enthalpies:
   i. Only two bonds are formed during the reaction. Which bond is formed during the reaction besides H-I?

   C—-O

   ii. What is its bond enthalpy?

   360 kJ/mol

7. Which of the following processes lead to an increase in entropy? Circle all that apply.
   a. The pressure of 1 mole of $O_2$ doubles isothermally.
   b. $CO_2$ expands isothermally to 10 times its original volume.
   c. The temperature of 1 mol of He is increased to $25^oC$ at constant pressure.
   d. $N_{2\,(g)}$ is compressed isothermally to half its original volume.
   e. A glass of water loses 100J of energy reversibly at $30^oC$.

8. A crystal formed from 8 identical molecules can have 3 possible equal energy orientations. What is the minimum entropy for this system?

1.21 x 10^-22 J/K

9. What is the standard molar entropy of vaporization of water at 373K given that the standard molar enthalpy of vaporization is 40.7kJ/mol?

109 J/mol • K

10. A balloon filled with 0.150 moles of He gas expands isothermally from 3.3L to 5.7L. What is $\Delta S$?

0.682 J/K

11. Another balloon expands from 3.3L at 298K to $9.2\ x\ 10^5$ L at 333K. What is $\Delta S$?

15.8 J/K