Quiz II General Chemistry II Lecture I Summer 13 Dr. Hahn 25 pts 6/3 M quiz #

Name Key (print name) Name NA = not attempted (sign name)

NW = no work NG = not graded

Please **show all work** for full credit.

1. If a system loses energy, the surrounding will [(gain) or (lose)] (circle one) energy. (3 pts) According to the first law of thermodynamics, energy [(can) or (cannot)] (circle one) be destroyed. (3 pts) An exothermic reaction (system is reaction) will have a [(negative) or (positive)] (circle one) ΔH(2 pts)

2. For the following reaction & enthalpy, what is the enthalpy for the 2nd reaction shown. Do either (a) or (b). (You won't have time for both. Show work) (7 pts)

a. $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

$CO_2(g) \rightarrow C(s) + O_2(g)$ $\Delta H =$ +393.5 kJ

reaction is reversed sign of ΔH is reversed

b. $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$ $\Delta H = -163.2$ kJ

$6N_2O(g) \rightarrow 6N_2(g) + 3O_2(g)$ $\Delta H =$ -489.6 kJ

×3 multiply 1st reaction by 3 & then must multiply ΔH by 3 $3(-163.2\ kJ) = -489.6\ kJ$

3. For the following reaction what is the ΔH. Use Hess's Law. (10 pts)

*$C_2H_4(g) + Cl_2(g) \rightarrow C_2H_4Cl_2(l)$ $\Delta H_{reaction} =$ -217.5 kJ ← final 2pt

3pt 2pt

Given the following reactions and enthalpy.

$4\ HCl(g) + O_2(g) \rightarrow 2\ Cl_2(g) + 2\ H_2O(l)$ $\Delta H = -202.4$ kJ ⓐ

$2\ HCl(g) + C_2H_4(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_4Cl_2(l) + H_2O(l)$ $\Delta H = -318.7$ kJ ⓑ

reversed RXN & take ½

$Cl_2 + H_2O \rightarrow 2\ HCl + \frac{1}{2}O_2$ $\Delta H = +\frac{202.4}{2}$ kJ ⓐ

$2\ HCl + C_2H_4 + \frac{1}{2}O_2 \rightarrow C_2H_4Cl_2 + H_2O$ $\Delta H = -318.7$ kJ ⓑ

$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$ $\Delta H = \frac{+202.4}{2} - 318.7$

$\Delta H = -217.5$ kJ

same as * RXN sum @ + ⓑ RXN did not show RXN -3

4. Extra Credit 3 pts [Do either (a), (b) or (c). (You won't have time to do more than one.)

a. For the following reaction use the following enthalpies of formation to calculate the enthalpy of the reaction. $\{\Delta H^\circ_{RXN} = \Sigma n_{product} \Delta H^\circ_f(\text{product}) - \Sigma n_{reactant} \Delta H^\circ_f(\text{reactant})\}$

$Mg(OH)_2(s) + 2\,NH_4^+(aq) \rightarrow Mg^{2+}(aq) + 2\,H_2O(l) + 2\,NH_3(g)$

reactant product

$\Delta H^\circ_f [Mg(OH)_2(s)] = -924.5$ kJ/mol $\Delta H^\circ_f [NH_4^+(aq)] = -132.5$ kJ/mol $\Delta H^\circ_f [Mg^{2+}(aq)] = -466.9$ kJ/mol $\Delta H^\circ_f [H_2O(l)] = -187.8$ kJ/mol $\Delta H^\circ_f [NH_3(g)] = -46.11$ kJ/mol

$$\Delta H^\circ_{RXN} = \{1\,mol\,\Delta H_f^\circ[Mg^{2+}(aq)] + 2\,mol\,\Delta H_f^\circ[H_2O(l)] + 2\,mol\,\Delta H_f^\circ[NH_3(g)]\} - \{1\,mol\,\Delta H_f^\circ[Mg(OH)_2(s)] + 2\,mol\,\Delta H_f^\circ[NH_4^+(aq)]\}$$

products reactants

$$\Delta H^\circ_{RXN} = \{1\,mol(-466.9\,kJ/mol) + 2\,mol\left(-187.8\,\tfrac{kJ}{mol}\right) + 2\,mol(-46.11\,kJ/mol)\} - \{1\,mol(-924.5\,kJ/mol) + 2\,mol(-132.5\,kJ/mol)\} = 254.78\,kJ$$

b. A reaction using one mole of HCl with one mole of NaOH is carried out in a water solution in a coffee cup. (Note: If I did not say the reaction occurs for one mole, you would have to figure out how many moles and then divide the final enthalpy by the number of moles. Note: I made up these numbers so the value may not fit experimental reality.) $HCl + NaOH \rightarrow NaCl + H_2O$

As the reaction occurs, the temperature of the water rises from 25.2°C to 35.7 °C. The reaction occurs in 10.5 mL of water. Assume that the heat lost to the coffee cup, thermometer, and air surrounding the cup are negligible. What is the $q_{water\ solution}$? ($q_{water\ solution} = q_{universe}$ when we assume that everything other than the water in which the reaction is occurring is negligible). What is the $q_{reaction}$? ($q_{system} = q_{reaction}$) What is the enthalpy for the reaction ($\Delta H_{reaction}$)? ($q = m\,C\,\Delta T$, $C_{water} = 4.18$ J / g °C, for density (water) = 1 gram / mL)

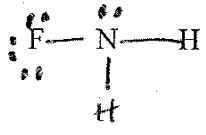
$q = mC\Delta T$, $C = 4.18\,J/g^\circ C$ $m = 10.5\,mL \times \frac{1\,g}{1\,mL} =$

$m = 10.5\,g$ $\Delta T = T_f - T_i = 35.7^\circ C - 25.2^\circ C$

$\Delta T = 10.5^\circ C$

$q_{water} = (10.5\,g)(4.18\,J/g^\circ C)(10.5^\circ C) = +460.8\,J$

$q_{RXN} = -460.8\,J$, $\Delta H_{RXN} = -460.8\,J$

c.  For the molecule shown (VSEPRT molecular shape = trigonal pyramidal) the intermolecular force is [(London force) or (dipole-dipole) or (hydrogen bonding)] (circle one) H directly attached to F, O, N

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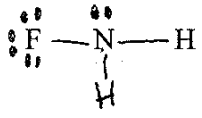
c.  For the molecule shown (VSEPRT molecular shape = trigonal pyramidal) the intermolecular force is [(London force) or (dipole-dipole) or (hydrogen bonding)] (circle one)