

\* While I prefer you turn in a hard copy of the worksheet, I will accept scanned copies sent to my email address, joensj@fiu.edu

Section: (circle one) M,W,F

Tu,Tr

For problems involving calculations you must show your work for credit. Unless otherwise stated, you may assume  $T = 25.0\text{ }^{\circ}\text{C}$ .

1) The data below are given at  $T = 25.0\text{ }^{\circ}\text{C}$ , and may be of use in doing the following problem.

substance	$\Delta H^{\circ}_f$ (kJ/mol)	$\Delta G^{\circ}_f$ (kJ/mol)	$S^{\circ}$ (J/mol·K)
CO(g)	- 110.5	- 137.3	197.9
CO <sub>2</sub> (g)	- 393.5	- 394.4	213.6
O <sub>2</sub> (g)	0.0	0.0	205.0

Consider the reaction

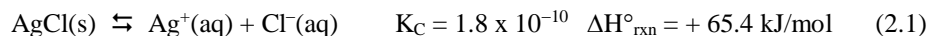


a) Give the expression for  $K$ , the thermodynamic equilibrium constant, for the above reaction.

b) Using the thermochemical data above, find the numerical value for  $K$  at  $T = 25.0\text{ }^{\circ}\text{C}$ .

c) Typical partial pressures of CO, CO<sub>2</sub>, and O<sub>2</sub> in the lower atmosphere are  $p_{\text{CO}} = 1.0 \times 10^{-7}$  atm,  $p_{\text{CO}_2} = 4.1 \times 10^{-4}$  atm, and  $p_{\text{O}_2} = 0.21$  atm. Based on your answer in b, are CO, CO<sub>2</sub> and O<sub>2</sub> in equilibrium in the lower atmosphere? Justify your answer.

2) For nominally insoluble ionic compounds a small amount of the compound will usually dissolve in water. As an example, consider the solubility reaction for silver chloride (AgCl).



Consider 1.000 of an aqueous solution of silver chloride in equilibrium with solid silver chloride. For each of the following changes, indicate whether the number of moles of  $\text{Ag}^+(\text{aq})$  will increase, stay the same, or decrease (circle your answer).

a) Add 0.100 moles of  $\text{NaCl(s)}$ , a soluble ionic compound, to the solution.

moles  $\text{Ag}^+(\text{aq})$  increases                      moles  $\text{Ag}^+(\text{aq})$  stays the same                      moles  $\text{Ag}^+(\text{aq})$  decreases

b) Add 2.00 g of solid silver chloride to the solution.

moles  $\text{Ag}^+(\text{aq})$  increases                      moles  $\text{Ag}^+(\text{aq})$  stays the same                      moles  $\text{Ag}^+(\text{aq})$  decreases

c) Change the temperature of the solution from  $T = 25.0 \text{ }^\circ\text{C}$  to  $T = 50.0 \text{ }^\circ\text{C}$ .

moles  $\text{Ag}^+(\text{aq})$  increases                      moles  $\text{Ag}^+(\text{aq})$  stays the same                      moles  $\text{Ag}^+(\text{aq})$  decreases

3) The major industrial source of hydrogen gas is from the chemical reaction of methane with water.



A system initially has the following partial pressures of gases:  $p_{\text{CH}_4} = 2.00 \text{ atm}$  and  $p_{\text{H}_2\text{O}} = 0.0100 \text{ atm}$ . There is initially no  $\text{CO}$  or  $\text{H}_2$  in the system.

a) What is the partial pressure of  $\text{H}_2(\text{g})$  in the system when equilibrium is reached?

b) Based on your answer in a, is it likely that this reaction for producing  $\text{H}_2(\text{g})$  is carried out at  $T = 25.0 \text{ }^\circ\text{C}$ ? Justify your answer.