CHM 161-A
 Name______

 Exam II – 145 pts
 Signature______

Answer questions in the space provided and be sure to show your work on problems that require a numerical answer. Pay attention to significant figures.

1.(15) Consider the equilibrium reaction shown below:

 $Fe(s) + H_2O(g) \longrightarrow Fe_2O_3(s) + H_2(g)$

Balance the reaction. Using LeChatelier's Principle, predict the impact of the following on the direction of the equilibrium (moves to the **right**, to the **left**, or **no change**)

- a) Remove H_2 as it forms.
- b) Add water.
- c) Add a catalyst.
- d) Increase the pressure.
- e) Add Fe₂O₃.

2.(20) When organic compounds are burned in O_2 , they react to form CO_2 and H_2O . The combustion of pentane is shown below.



- a) Balance the above reaction.
- b) According to the balanced reaction, how many moles of O_2 are needed to burn 10 mol of C_5H_{12} ?
- c) If 1.4 mol of C_5H_{12} reacts with excess O_2 , how many moles of water will form?
- d) If I use 8.0 moles of C₅H₁₂ and 8.0 moles of O₂ in this reaction, which reactant will have some remaining *unreacted* (which reactant is used in excess)? How many moles of this compound will be left over unreacted?

3.(10) Complete the following Lewis structures by filling in the remaining bonds and lone pairs of electrons. Be sure to count the electrons and check for octets.



4.(15) For the following oxidation-reduction reactions, determine what was oxidized, what was reduced, the oxidizing agent and the reducing agent.



5.(10) In the following reactions, predict which product, *if any* will precipitate (form a solid). Use the solubility guidelines attached.

a) $\text{Li}_2\text{SO}_4(\text{aq}) + \text{PbCl}_2(\text{aq}) \longrightarrow 2 \text{LiCl} + \text{PbSO}_4$

b)
$$NH_4Cl(aq) + AgNO_3(aq) \longrightarrow NH_4NO_3 + AgCl$$

6.(10) Write a balanced equation for a reaction of aqueous Na_2CO_3 with aqueous H_2SO_4 to yield aqueous Na_2SO_4 , gaseous carbon dioxide and liquid water.

7.(25) The following questions refer to the chemical equation below.

$$I_2 + Cl_2 \longrightarrow ICl_5$$

- a) Balance the equation.
- b) Assuming excess Cl₂ is available, how many moles iodine pentachloride will form from 2.5 moles of iodine?
- c) How many molecules iodine pentachloride is this?
- d) How many moles of chlorine are needed to react with 0.250 moles of iodine?
- e) What mass (grams) of Cl₂ is needed to react with 0.250 moles of iodine?

8.(15) For the reaction shown below...

 $Br_2 + Cl_2 \implies 2 BrCl$

- a) Write the equilibrium (Keq = ...) equation for this reaction using [] to indicate concentration in mol/L.
- b) Keq = 58.0 for this reaction. The equilibrium concentrations at $25^{\circ}C$ are $[Cl_2] = 0.0200 \text{ mol/L}$; [BrCl] = 0.110 mol/L. Determine the concentration of Br₂ in mol/L at equilibrium (hint, first solve your equation in part a) for [Br₂], then put numbers in).

- 9.(15) Use the following information in part c): $\Delta G = \Delta H T\Delta S$ The reaction of H₂ with Br₂ to yield HBr has a $\Delta H = -17$ kcal/mol and $\Delta S = +27.2$ cal/mol⁻K.
 - a) Write and balance the chemical equation.

b) Is the reaction exothermic or endothermic? _____

- c) At 298 K, what is the value of ΔG (**kcal/mol**)? Be careful with units for entropy.
- d) Is the reaction spontaneous at 25°C?

10.(10) Draw a Lewis structure of CH₂O using lines for covalent bonds. Show all lone pairs of electrons.

- a) How many total valence electrons should be in your Lewis structure?
- b) What is the shape or geometry of this molecule?

Useful Info:

Avogadro's number 6.02×10^{23}

Keq = [products]/[reactants] each raised to a power = to coefficient in balanced equation