Practice Final Exam

1. A chemist needs a buffer with pH 4.35. How many milliliters of pure acetic acid (density = 1.049 g/mL) must be added to 465 mL of 0.0941 *M* NaOH solution to obtain such a buffer?

2. A study of the gas-phase oxidation of nitrogen monoxide at 25°C and 1.00 atm pressure gave the following results:

$$2\ NO_{(g)} + O_{2(g)} \rightarrow NO_{2(g)}$$

	Conc. NO, mol/L	***Conc. O_2,mol/L***	***Initial Rate***
Exp. 1	4.5×10^{-2}	2.2×10^{-2}	0.80×10^{-2} mol/(L·s)
Exp. 2	4.5×10^{-2}	4.5×10^{-2}	1.60×10^{-2} mol/(L·s)
Exp. 3	9.0×10^{-2}	9.0×10^{-2}	1.28×10^{-1} mol/(L·s)
Exp. 4	3.8×10^{-1}	4.6×10^{-3}	?

a. What is the experimental rate law for the reaction above?

b. What is the initial rate of the reaction in Experiment 4?

3. Consider the following cell reaction at 25°C.

$$2Cr_{(s)} + 3Fe^{2+}_{(aq)} \leftrightharpoons 2Cr^{3+}_{(aq)} + 3Fe_{(s)}$$

Calculate the standard cell potential of this cell from the standard electrode potentials, and from this obtain ΔG° for the cell reaction. Use data below to calculate ΔH°. Use these values of ΔH° and ΔG° to obtain ΔS° for the cell reaction.

Substance	ΔH_f° (kJ mol^{-1})
$Fe^{2+}_{(aq)}$	-89.1
$Cr^{3+}_{(aq)}$	-143.5

4. Crystals of AgBr can be removed from black-and-white photographic film by reacting the AgBr with sodium thiosulfate.

$$AgBr_{(s)} + 2\ S_2O_3^{2-}{}_{(aq)} \leftrightharpoons [Ag(S_2O_3)_2]^{3-}{}_{(aq)} + Br^-{}_{(aq)}$$

a. What is the equilibrium constant for this dissolving process?

b. In order to dissolve 2.5 g of AgBr in 1.0 L of solution how many moles of $Na_2S_2O_3$ must be added?

5. Tritium, or hydrogen-3, is formed in the upper atmosphere by cosmic rays, similar to the formation of carbon-14. Tritium has been used to determine the age of wines. A certain wine that has been aged in a bottle has a tritium content only 70% of that in a similar wine of the same mass that has just been bottled. How long has the aged wine been in the bottle? The half-life of tritium is 12.3 y.

6. 25.00 mL of a 0.1765 M solution of formic acid is titrated with a 0.2144 M solution of potassium hydroxide.

(a) What is the pH of the solution when 13.68 mL of the sodium hydroxide solution have been added?

(b) What is the pH of the solution at the equivalence point?

7. Phosphorus(V) chloride, PCl_5, dissociates on heating to give phosphorus(III) chloride, PCl_3, and chlorine.

$$PCl_{5(g)} \leftrightharpoons PCl_{3(g)} + Cl_{2(g)}$$

A closed 2.00-L vessel initially contains 0.0100 mol PCl_5. What is the total pressure at 250°C when equilibrium is achieved? The value of K_c at 250°C is 4.15×10^{-2}.

8. Answer the following questions about transition metal chemistry.

a. $[Fe(HOC_6H_4COO)_3]^{2-}$ is purple. The salicylate ion, $HOC_6H_4COO^-$, is a bidentate ligand. What hybridization is the iron ion using in the complex ion? Explain your reasoning.

b. $Cd(H_2O)_6^{2+}$ is colorless. Explain why this would be expected.

c. The fluoride ion is a weakly bonding ligand. What color would you expect to see in the FeF_6^{4-} ion? Explain.

d. Name $K_2[Cr(CO_3)_2(en)_2]$. What is the coordination number of the chromium ion?