Chemistry 220 • Lab Quizzam #1

Name: _____

Directions: Answer the following questions in the spaces provided. Show all work and units to receive credit.

Integrated Rate Equations:

Zero-order reaction: $\mathbf{[A] = -kt + [A]_0}$

First-order reaction: $\mathbf{\ln[A] = -kt + \ln[A]_0}$

Second-order reaction: $\mathbf{1/[A] = kt + 1/[A]_0}$

Acids and Bases: K_a & K_b

Conjugate Acid	K_a	Conjugate Base	K_b
HCl	Very large	Cl^-	Very small
H_2CO_3	4.2×10^{-7}	HCO_3^-	2.4×10^{-8}
HCO_3^-	4.8×10^{-11}	CO_3^{2-}	2.1×10^{-4}

1. What is the expected pH of a 0.25 *M* HCl solution?

2. What is the expected pH of a solution prepared by diluting 1.00 mL of the solution in question #1 to a total volume of 1.00 L?

3. A) What is the expected pH of a 0.25 M solution of $NaHCO_3$?

   B) The observed pH of the system is 0.32 pH units less than expected. Suggest a possible reason.

4. A weak acid, "HA", is found to be 3.2 % dissociated in 10.0 mL of solution and the solution has a pH of 4.82. The 10.0-mL solution is then diluted to 100.0 mL.

   A) Will the pH of the new solution be higher or lower?

   B) Will the acid have a higher percent dissociation or a lower percent dissociation. Explain your reasoning in terms of LeChatlier's Principle.

5. Consider the complex ion formation: $Ni^{2+}_{(aq)} + 6\ NH_{3(aq)} \Leftrightarrow Ni(NH_3)_6{}^{2+}_{(aq)}$ $K = 1 \times 10^4$

   Nickel (II) and ammonia are colorless, but the complex is a deep green color. A mixture of 0.05 M nickel (II) and 0.05M ammonia is prepared and is found to be a moderate green color, still transparent. Heating the solution causes it to become a pale green color.

   A) Is the reaction endothermic or exothermic? Explain.

   B) Does K increase, decrease or stay the same?

   Nickel (II) ions react with carbonate: $Ni^{2+}_{(aq)} + CO_3{}^{2-}_{(aq)} \rightarrow NiCO_{3(s)}$ $K = 1 \times 10^{12}$

   C) If carbonate ion is added to the solution containing the complex ion, what would you expect to be the effect on the solution? Explain.

6. The dimerization of cyclohexadiene, C_6H_8, is believed to be a concerted (one-elementary step) reaction:

$$2\ C_6H_8 \rightarrow C_{12}H_{16}$$

A) With the data given below, determine the order of the reaction. Provide graphical support.

Time (s)	$[C_6H_8]$ in *M*		
0	0.1000		
120	0.0739		
240	0.0586		
360	0.0486		
480	0.0415		
600	0.0362		
720	0.0321		
840	0.0288		
960	0.0262		
1080	0.0240		

(Graph paper provided.)

B) The order of the reaction is:

C) What is k for the reaction?

D) Does the experimental order determination support the idea of a one-step mechanism written above? ***Explain briefly***.

7. (20 points) *The reaction of iron (III) and thoicyanate follows the equation below.*

$$Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \Leftrightarrow [FeNCS^{2+}]_{(aq)}$$

The data to the right is gathered for the $[FeNCS^{2+}]$ vs. Absorbance.

Absorbance	$[FeNCS^{2+}]$ in mol/L
0	0
0.115	2.5×10^{-4}
0.232	5.0×10^{-4}
0.340	7.5×10^{-4}
0.462	1.0×10^{-3}

A) Make a Beer's law plot of the data (follow the rules of good graphing):

(Graph paper provided.)

A solution is then prepared by mixing 5.00 mL of a 0.0030 M Fe^{3+} solution with 3.00 mL of a 0.0030 M SCN^{-} solution and 2.00 mL of DI water. The absorbance of the solution is measured to be 0.311 (at the same wavelength as the data above).

B) Determine the equilibrium $[FeNCS^{2+}]$ from the graph.

C) Calculate K_c for this trial.