CHEM 1212K Reading Day Problems

Ch. 14: Chemical Kinetics

1. True/false questions
    a. T/F: The activated complex of a chemical reaction is an observable species.
    b. T/F: Catalysts speed up reactions by increasing the frequency of collisions.
    c. T/F: The slow step of a mechanism matches the rate law.
    d. T/F: The overall reaction can match the rate law.
    e. T/F: Catalysts can either appear as a product or as a reactant in a reaction mechanism.
    f. T/F: Intermediates are allowed to be in a rate law.
    g. T/F: Catalysts can appear in the rate law.
    h. T/F: The forward and reverse rate constants are equal when a system is in equilibrium.
    i. T/F: There is only one equilibrium position for every reaction at a given temperature. (Position meaning the concentrations of all the species).
    j. T/F: A reaction stops when equilibrium is reached.
2. Express the units for rate constants when the concentrations are in moles per liter (M) and time is in seconds for (a) zero-order reactions; (b) first-order reactions; (c) second-order reactions.
3. In the reaction $CH_3Br(aq) + OH^-(aq) \rightarrow CH3OH(aq) + Br^-(aq)$, when the OH^- concentration alone was doubled, the rate doubled; when the CH_3Br concentration alone was increased by a factor of 1.2, the rate increased by a factor of 1.2. Write the rate law for the reaction.
4. The following data were collected for the reaction $2A(g) + 2B(g) + C(g) \rightarrow 3G(g) + 4F(g)$:

	Initial concentration ($mmol \cdot L^{-1}$)			Initial rate
Experiment	$[A]_0$	$[B]_0$	$[C]_0$	$((mmol\ G) \cdot L^{-1} \cdot s^{-1})$
1	10.	100.	700.	2.0
2	20.	100.	300.	4.0
3	20.	200.	200.	16
4	10.	100.	400.	2.0
5	4.62	0.177	12.4	?

    a. What is the order for each reactant and the overall order of the reaction?
    b. Write the rate law for the reaction.
    c. Determine the reaction rate constant.
    d. Predict the initial rate for Experiment 5.

5. The biological half-life of a medication is the time required for the drug to lose half of its pharmacologic activity. The biological half-life of a new medication is 6.0 hours and its decay follows first-order kinetics. How long does it take for medication to lose 75% of is pharmacologic activity?

A) 0.0479 hours
B) 0.0834 hours
C) 2.31 hours
D) 2.49 hours
E) 12.0 hours

5. Given the data below, which of the following best represents the rate law for the overall reaction?

$$2A(g) + 3B(g) \rightarrow \text{products}$$

Experiment	$[A]_0$ (M)	$[B]_0$ (M)	Initial rate (mol/L·s)
1	0.50	1.00	28.0
2	0.25	1.00	14.0
3	0.50	0.10	2.80

A) rate = k $[A]^2[B]^3$
B) rate = k $[B]^3$
C) rate = k $[A]^3[B]^2$
D) rate = k [A][B]
E) rate = k [A]

6. Which statement or statements explain why collision rate is greater than reaction rate for a given chemical reaction?

I. Most collisions occur with an energy that is less than energy required to begin breaking bonds in reactants.
II. Collisions don't occur that frequently because there are no attractions between molecules of a gas.
III. Some collisions occur with orientations that are not conducive to product formation.

A) I only
B) II only
C) Both II and III
D) Both I and III
E) All of I, II, and III

7. What is the initial concentration of oxalate in experiment 4?

Experiment	Initial $[HgCl_2]$	Initial $[C_2O_4^{2-}]$	Initial Rate of Formation of Cl^- ($mol \cdot L^{-1} \cdot min^{-1}$)
1	0.0836	0.202	0.52×10^{-4}
2	0.0836	0.404	2.08×10^{-4}
3	0.0418	0.404	1.06×10^{-4}
4	0.0316	?	1.27×10^{-4}

Ch. 17 Aqueous Equilibrium (Titrations, buffers, Ksp)

1. Which compound has the greatest molar solubility in pure water?

   A) $Al(OH)_3$, $K_{sp} = 3 \times 10^{-34}$
   B) PbS, $K_{sp} = 9.04 \times 10^{-29}$
   C) ZnS, $K_{sp} = 1.6 \times 10^{-24}$
   D) Ag_2S , $K_{sp} = 8 \times 10^{-48}$
   E) CuS, $K_{sp} = 1.27 \times 10^{-36}$

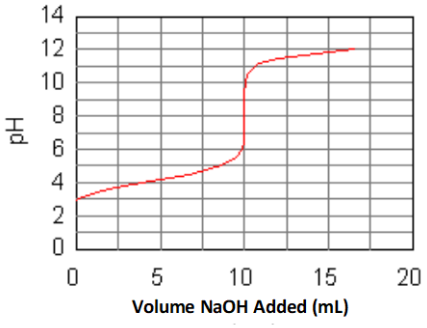
2. Which solution is a buffer?

   A) A solution that is 0.100 *M* in HNO_3 and 0.100 *M* in KNO_3
   B) A solution that is 0.100 *M* NaCl and 0.100 *M* in $NaNO_3$
   C) A solution that is 0.100 *M* in NH_3 and 0.100 *M* in KOH
   D) A solution that is 0.100 *M* in NaOH and 0.100 *M* in CH_3COOH
   E) A solution that is 0.100 *M* in $NaNO_2$ and 0.100 *M* in HNO_2

3. Which statement is true at the equivalence point of *any* acid/base titration?

   A) The pH is 7.00
   B) Moles of OH^- = moles of H_3O^+
   C) Moles of HA = moles of A^-
   D) Moles of analyte = moles of titrant
   E) More than one of these statements is true

4. The curve for the titration of 50.0 mL of 0.0200 M C_6H_5COOH(aq) with 0.100 M NaOH(aq) is given below. What are the main species in the solution after 7.5 mL of base have been added?



A) $C_6H_5COOH(aq)$ and $C_6H_5COO^-(aq)$
B) $C_6H_5COOH(aq)$ and $NaOH(aq)$
C) $NaOH$ and and $C_6H_5COO^-(aq)$
D) $C_6H_5COOH(aq)$ only
E) $NaOH(aq)$ only

5. A buffer solution contains 0.0200 M acetic acid and 0.0200 M sodium acetate. What is the pH after 0.0020 mol of HCl are added to 1.00 L of this buffer? $pK_a = 4.75$ for acetic acid. Assume no change in volume.

A) 4.75
B) 4.70
C) 4.80
D) 4.84
E) 4.66

6. A 10.00 mL sample of HCl was titrated with 0.150 *M* KOH. If 15.00 mL of KOH was required to reach the equivalence point (stoichiometric point), then what was the concentration of the HCl?

A) 0.100 *M*
B) 0.150 *M*
C) 0.200 *M*
D) 0.225 *M*
E) 0.250 *M*

7. A buffer solution of 100mL volume is 0.1 M CH3CO2H (aq) and 0.1 M NaCH3CO2 (aq).
   a. What is the initial pH of the buffer?
   b. What is the pH after the addition of 10 ml of 0.95 M NaOH (aq)

8. Suppose that 4.25 g of an unknown weak monoprotic acid is dissolved in water. Titration of the solution with 0.35 M NaOH (aq) required 52ml to reach the stoichiometric point. After the addition of 26ml, the pH of the solution was found to be 3.82.
    a. What is the pKa for the acid?
    b. What is the molar mass of the acid?

The molarity of $CrO4^{2-}$ in a saturated Tl2CrO4 solution is 6.3e(-5) mol/L. What is the Ksp of Tl2CrO4?