

Solution Properties, Kinetics

Name _____

Slayter Box _____

Hour Examination 2

February 7, 2003

General Chemistry (CHEM 122-01)

Solution Properties, Kinetics

Dr. Bennett

Please do not open until instructed

*Solution Properties, Kinetics*Notes:

* This exam consists of **5 questions on 6 pages** (including this cover page). Please check to make sure that you have a complete copy of the exam.

* *Please do not simply give me answers. Give me well-supported answers. Numerical answers that are not backed by supporting calculations will receive minimal credit.*

* Please write clearly; if I can't read your answer, I can't give you credit for your answer.

* Please note that different questions are worth different numbers of points. Plan your time accordingly.

* Remember to include units and significant figures where appropriate.

* No books or notes are to be used on this exam.

* Please do NOT share calculators; if you need a calculator but do not have one, please let me know!

* *If you feel that you would be better able to answer **any** question if you had additional information, please do not hesitate to ask for it. I will happily provide any information that I feel will help you answer the question without compromising the efficacy and fairness of the test.*

Question	Possible	Score
1	15	
2	10	
3	15	
4	15	
5	15	
TOTAL	70	
	percent:	

The Quadratic Equation

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Some equations you *might* use:

$$S = k_H \times P$$

$$P_A = P_A^\circ \times X_A$$

$$\Delta T_b = i K_b \times m$$

$$\Delta T_f = i K_f \times m$$

Arrhenius equation:

$$k = Ae^{-E_a/RT}$$

Integrated rate laws:

zero-order

$$[A]_t = -kt + [A]_0$$

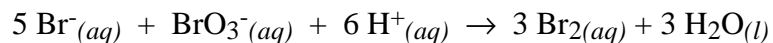
first-order

$$\ln [A]_t = -kt + \ln [A]_0$$

second-order

$$1/[A]_t = kt + 1/[A]_0$$

15. For the reaction given below, answer the following questions:



- (a) Based on the stoichiometry of the equation what are the relative rates of disappearance and appearance ($\Delta[X]/\Delta t$) of the reactants and products, respectively?

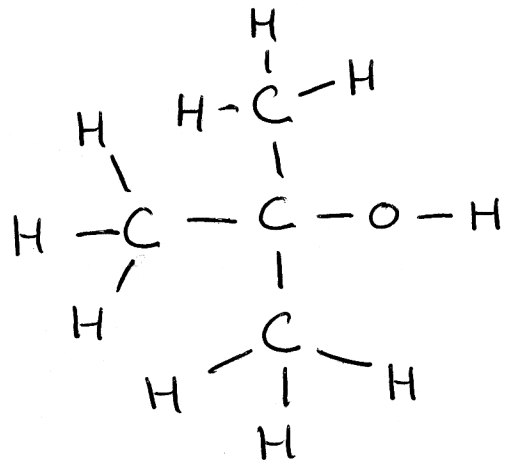
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- (b) In words describe how the rate of formation of Br_2 is related to the rate of disappearance of H^+ .

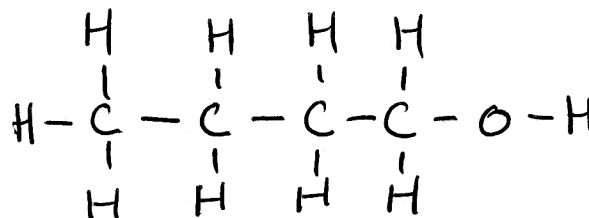
- c) If the rate of appearance of Br_2 is $6.33 \times 10^{-4} \text{ M/sec}$, what is the rate of disappearance of BrO_3^- ?

10.2. Consider the compounds *tertiary*-butanol and *normal*-butanol (also called 1-butanol). Lewis structures are shown below. You should expect that the boiling point of *tertiary*-butanol is lower than that of *normal*-butanol (the explanation would be similar to that you gave for question 2(c) above).

What you might not expect is that the solubilities of these two compounds in water is vastly different. The *tertiary*-butanol is miscible with water while the *normal*-butanol is immiscible.



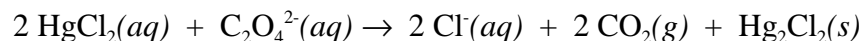
tertiary-butanol
(C_4H_9OH)



normal-butanol
(C_4H_9OH)

Consider what you know about solubility and intermolecular forces and please provide a thoughtful explanation for the different behaviors of these two compounds with water.

153. For the chemical reaction given below:



The following initial rates of reactions were determined for the reactant concentrations given:

Experiment #	[HgCl ₂]	[C ₂ O ₄ ²⁻]	Initial rate (M/sec)
1	0.100	0.20	3.1 × 10 ⁻⁵
2	0.100	0.40	1.2 × 10 ⁻⁴
3	0.050	0.40	6.2 × 10 ⁻⁵

- (a) Find the order of the reaction with respect to HgCl₂.
- (b) Find the order of the reaction with respect to C₂O₄²⁻.
- (c) Write the rate law for this reaction.
- (d) Calculate the value for the rate constant based on the data for experiment #1 and provide the proper units.
- (e) In another experiment, experiment 4, it was found at t=0 that $\Delta[\text{C}_2\text{O}_4^{2-}]/\Delta t = -5.34 \times 10^{-2} \text{ M/sec}$. What is $\Delta[\text{HgCl}_2]/\Delta t$ under those conditions?

- 15.4. (a) Consider four beakers, one contains pure water, and the other three are 0.1 *m* solutions of MgCl₂, glucose, and NaCl. Rank these four solutions in order from lowest boiling point to highest boiling point.

Lowest b.p.

Highest b.p.

- (b) The Henry's law constant (k_H) for helium is 3.7×10^{-4} M/atm. Calculate the molarity of He_(g) in water when the pressure of helium above the water is 236 torr.

- (c) A solution is prepared by mixing 0.50 mol propylene glycol (C₃H₈O₂) with 8.50 mol H₂O. The normal vapor pressure of pure water at 25 °C is 23.8 torr. Assuming ideal solution behavior, what is the vapor pressure of water above the propylene glycol/water solution? (Propylene glycol is a non-volatile non-electrolyte.)

15. On a winter day when the temperature is $23\text{ }^{\circ}\text{F}$ ($-5\text{ }^{\circ}\text{C}$), three identical test patches of 1.00 kg of ice are treated with potential de-icing agents. The first patch is sprinkled with rock salt (NaCl), the second patch with automotive antifreeze (ethylene glycol, $\text{CH}_2\text{OHCH}_2\text{OH}$, a non-electrolyte), and the third with a product billed as “the ultimate driveway icebreaker” (the label indicates that it is CaCl_2). If 100.0 grams of each de-icing agent is used, which (if any) of the test patches will completely melt? Be sure to justify your answer with equations or written explanations as appropriate. The freezing point constant for water is $k_f = 1.86\text{ }^{\circ}\text{C/m}$.