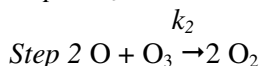
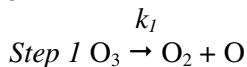


CHM 109 Exam III Study Guide F 09

Show logic and calculations for all problems. Remember to include units and be careful with sig. fig. Please put your name on the back of the last page and your initials on the back of the other pages

1. The following mechanism has been proposed:



- Write a balanced equation for the overall reaction.
- Write the predicted rate law for the overall reaction if k_2 is much larger than k_1 .
- Identify any reaction intermediates.

2. Given these data for the reaction of Fe^{3+} with I^- :

	Exp#	$[\text{Fe}^{3+}]$ (M)	$[\text{I}^-]$ (M)	Initial rate (M/s)
$2 \text{Fe}^{3+}(\text{aq}) + 2 \text{I}^-(\text{aq}) \rightarrow 2 \text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{aq})$	1	0.0400	0.0300	8.10×10^{-4}
	2	0.0800	0.0300	1.62×10^{-3}
	3	0.0400	0.0600	3.24×10^{-3}

Be sure to **explain** the logic for your answers.

- Write a general rate law for the reaction.
- Use the initial rate data to write the specific rate law consistent with the data. Make sure you solve to obtain a numerical value for k .
- Write a chemical rxn. for the reactant side of the rate limiting step in the rxn. mechanism.
- What is the initial rate of the rxn. with 0.090 M Fe^{3+} and 0.50 M I^- ?
- If I told you that the value of k that you obtained is relatively large, what height hill would you draw for this reaction on a reaction progress diagram (vertical axis = G°).

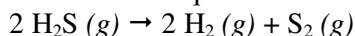
3. How does decreasing the temperature usually alter the rate of a chemical reaction? Explain your answer with reference to rate laws and collision theory.

4. Write equilibrium constant expressions for the following reactions:

- $2 \text{H}_2(\text{g}) + 2 \text{NO}(\text{g}) \rightarrow 2 \text{H}_2\text{O}(\text{g}) + \text{N}_2(\text{g})$
- $\text{Fe}(\text{s}) + \text{CO}_2(\text{g}) \rightarrow \text{FeO}(\text{s}) + \text{CO}(\text{g})$

5. What do all the symbols in the equation, $\Delta G =$

6. Shown below is a balanced equation for the decomposition of H_2S to form H_2 and S_2 .



- Write an equilibrium constant expression for the reaction.
- Given the equilibrium concentrations: $[\text{H}_2\text{S}] = 0.1007 \text{ M}$, $[\text{H}_2] = 0.0219 \text{ M}$, and $[\text{S}_2] = 3.30 \times 10^{-3} \text{ M}$, calculate the numerical value of K_{eq} .
- Assume the equilibrium is perturbed. When equilibrium is reestablished, the following concentrations are observed: $[\text{H}_2] = 0.00287 \text{ M}$ and $[\text{S}_2] = 0.171 \text{ M}$. Calculate $[\text{H}_2\text{S}]$ under these new conditions.
- What can you say about the forward and reverse reaction rates when the system is at equilibrium?
- What can you say about the forward and reverse rate constants, whether the system is at equilibrium or not?

7. Qualitatively, for the reaction shown #6, would the ΔG° value be positive or negative? Explain your logic. Calculate the ΔG° value if the experiment in problem #6 was carried out at 150.5°C .

8. Assuming I told you the reaction in #6, was relatively fast. Draw a reaction coordinate diagram that describes that system. Then draw another showing how the system would be changed in the presence of a catalyst. Be sure to clearly label all important quantities.

9. Why is it necessary to understand chemical kinetics if you want to understand the chemical basis of human health?

10. What is the definition of a Brønsted-Lowry acid?

11. Identify the acid and base on the reactant side of the equation shown below. Predict the products of the reaction and indicate the conjugate of each reactant.



12.(a) Write a balanced chemical reaction for the dissociation of acetic acid (CH_3COOH) in water, and then (b) write the K_a expression for that rxn. Acetic acid is a relatively weak acid. (c) What could you say about the strength of its conjugate base? Formic acid is a slightly stronger acid than acetic acid. (d) Would formic acid dissociate to a greater or lesser extent in water compared to acetic acid? (e) Which acid would have the larger pK_a ?

13.(a) Calculate the $[\text{H}_3\text{O}^+]$, $[\text{OH}^-]$, and pH of a 7.00×10^{-3} M solution of HNO_3 . (b) Is this solution acidic, basic or neutral? (c) Would the pH be the same for a 7.00×10^{-3} M solution of acetic acid? Explain.

14. How does a buffer function to keep the pH of a solution relatively constant when strong acid or base is added? Make sure your answer includes equations for chemical reactions.

15. What weak acid could be used to make a buffer that was effective around pH 4.25? You must explain your answer thoroughly to receive full credit.

16. Three coal miners are trapped in a closed space within the mine after a cave-in. Although they have oxygen tanks with enough O_2 to provide for their respiratory needs, they are still likely to incur health risks associated with gas exchange. Describe one risk that is likely to occur. Be sure to include chemical rxns. as necessary to support your answer.

17. How does a buffer function to keep the pH of a solution relatively constant when strong acid or base is added? Make sure your answer includes equations for chemical reactions.

18. Write a balanced chemical reaction for the dissociation of water, and then write the K_w expression for that rxn.

Supplemental information

Periodic Table

Electronegativity Table

$$K = ^\circ\text{C} + 273.15$$

$$\Delta G^\circ = -RT \ln K_{eq}$$

$$R = 0.0820578 \text{ (L}\cdot\text{atm}/(\text{K}\cdot\text{mol}))$$

$$R = 8.3145 \text{ J}/(\text{K}\cdot\text{mol})$$

$$K_{eq} = e^{(-\Delta G^\circ/RT)}$$

Acid Dissociation Constants as pK_a s From *Chemistry* by McMurray & Fay, 4th ed.

Acid	Formula	pK_{a1}	pK_{a2}	pK_{a3}
acetic	CH_3COOH	4.74		
acetylsalicylic	$\text{C}_8\text{H}_7\text{O}_2\text{COOH}$	3.52		
ascorbic	$\text{C}_6\text{H}_8\text{O}_6$	4.10		
benzoic	$\text{C}_6\text{H}_5\text{COOH}$	4.19		
boric	H_3BO_3	9.24		
carbonic	H_2CO_3	6.37	10.25	
chloroacetic	CH_2ClCOOH	2.85		
citric	$\text{C}_6\text{H}_8\text{O}_7$	3.15		
formic	HCOOH	3.74		
hydrocyanic	HCN	9.31		
hydrogen peroxide	H_2O_2	11.62		
hydrosulfuric	H_2S	7.00	~19	
hypobromous	HOBr	8.70		
hypochlorous	HOCl	7.46		
hypoiodous	HOI	10.64		
iodic	HIO_3	0.77		

