

NAME _____

DATE:

INSTRUCTOR (circle): Voloshchuk Zhang

SHOW ALL WORK USE CORRECT UNITS AND SIGNIFICANT DIGITS
YOU MAY SHOW YOUR WORK ON THE BACK OF THE SHEET, BUT INDICATE
YOUR ANSWER ON THE FRONT

1. (5 points) Indicate whether each of the following statements is true or false:

T F

- A catalyst can change the equilibrium constant of a reaction.
- A catalyst can change the activation energy of a reaction.
- Chemical equilibrium occurs when opposing reactions proceed at equal rates.
- A system is always at equilibrium when the reaction quotient equals the equilibrium constant.
- A Lewis acid can never act as a Bronsted-Lowry acid.
- Increasing the concentration of a weak acid increases its percent ionization
- The equivalence point of a weak acid titrated against a strong base is basic.
- All indicators change color when a solution is at neutrality.
- Ammonia and ammonium chloride can be used to construct a buffer solution.
- Titration of an acid requires a base solution with a known concentration.

2. (5 points) Briefly define each of the following terms:

Half-life

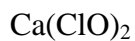
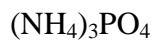
Instantaneous rate

Reaction intermediate

Amphoteric

Buffer solution

3. (10 points) State whether an aqueous solution of each of the following compounds would be acidic, basic or neutral.



4. (10 points) Consider the reaction



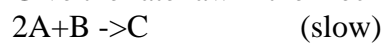
The following rate data were collected:

Experiment	$[\text{ClO}_2]$	$[\text{OH}^-]$	initial rate
1	0.060 M	0.030 M	0.0248 M/s
2	0.020 M	0.030 M	0.00276 M/s
3	0.020 M	0.090 M	0.00828 M/s

Write the rate law and give the rate constant for this reaction.

5. (10 points) For the reaction
 $A+2B \rightarrow E$

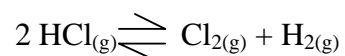
A. Give the rate law if the mechanism is:



B. Give the rate law if the mechanism is:



6. (10 points) Consider the reaction



A. What is the equilibrium constant expression for this reaction?

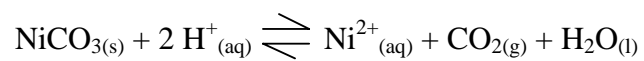
B. If a flask at equilibrium contains 0.0114M HCl, 0.0931M Cl₂ and 0.0154M H₂, what is the numerical value of K_c?

C. For the conditions above, what is the numerical value of K_p?

D. Give the numerical value of K_c for the reaction $\text{Cl}_{2(g)} + \text{H}_{2(g)} \rightleftharpoons 2 \text{HCl}_{(g)}$.

7. (10 points)

A. Write the equilibrium constant expression for the following reaction:



B. How will the addition of a solution of hydrochloric acid to the system affect the pressure of $\text{CO}_{2(g)}$ above the sample? Explain your answer.

8. (10 points) Calculate the pH of the following solutions:

A. A 0.10M solution of potassium hydroxide:

B. A 0.10 M solution of acetic acid:

C. The solution formed by the addition of 10.0 mL of 0.10M potassium hydroxide to a 50.0 mL sample of 0.10M acetic acid:

9. (15 points)

- A. You want to make a buffer solution of $\text{pH}=3.5$. How many grams of sodium nitrite should be added to a 0.500L sample of 0.10M nitrous acid? You may neglect the volume of solid acid added

B. The pH of a sample of hydrochloric acid is 0.0. What is the pH of the system if 5.00mL of this acid is added to 0.500L the buffer you prepared in part A of this problem? Account for the volume of the acid in this problem.

10. (15 points) Aliens from the planet Zarkox are found to have a circulatory fluid analogous to blood. Experiments detect a 1.13M concentration of HF in its unionized form, and a 0.82M concentration of the fluoride ion.

A. Calculate the pH of Zarkox blood.

B. State in words the significance of the observed concentrations with respect to Zarkox biochemistry. (Hint: How does this system resemble human blood?)