

INSTRUCTIONS: Use a soft, #2 pencil. Your marks must be dark to be counted correctly.

Write your perm number and **bubble in your perm number**. Correct perm = 2 points!

Bring a **CALCULATOR**

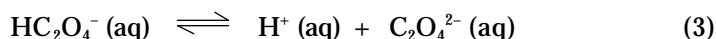
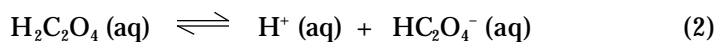
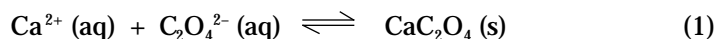
1. Predict how the following reaction at equilibrium will shift by the affect of an increase in volume.



- a) left
- b) right
- c) no shift

Answers are included at the end of the quiz.

2. Consider the following three equilibria occurring simultaneously in solution.



If NaOH is added to the solution, will the amount of $\text{CaC}_2\text{O}_4 (\text{s})$ precipitate increase or decrease or stay the same

- a) Increase
- b) Decrease
- c) Stay the same

3. A solution is prepared by adding 20.0 mL of 0.10 M HCl to 30.0 mL of 0.20 M HNO_3 . Calculate the concentration of H^+ in this solution. Both HCl and HNO_3 are strong acids.

- a) 0.04 M
- b) 0.12 M
- c) 0.16 M
- d) 0.30 M
- e) 0.14 M

4. Calculate the pH of a 0.10 M HNO_2 solution. ($K_a = 4.6 \times 10^{-4}$ for HNO_2)

- a) 5.3
- b) 1.0
- c) 1.7
- d) 2.2
- e) 8.7

5. A 0.1 M aqueous solution of the salt NaNO_2 is made. Will the solution be acidic, basic or neutral?

- a) acidic
- b) basic
- c) neutral

6. A 0.1 M aqueous solution of the salt NaHCO_3 is made. Will the solution be acidic, basic or neutral?
- acidic
 - basic
 - neutral
7. A 0.1 M aqueous solution of the salt NH_4NO_3 is made. Will the solution be acidic, basic or neutral?
- acidic
 - basic
 - neutral
8. Consider a 0.1 M NaNO_2 solution and a 0.1 M NaCN solution. Which solution will have the lower pH?
- 0.1 M NaNO_2
 - 0.1 M NaCN
 - Neither; the solutions have the same pH
9. List the **major species** present in a 0.25 M solution of CH_3COOH .
- CH_3COOH , CH_3COO^- , H^+ , H_2O
 - CH_3COO^- , H^+ , H_2O
 - CH_3COO^- , H^+ , OH^- , H_2O
 - CH_3COOH , H_2O
 - CH_3COOH , CH_3COO^- , H^+ , OH^- , H_2O

| Acid | HA | A^- | K_a | $\text{p} K_a$ |
|----------------------|--------------------------|---------------------------|---|----------------|
| Hydrochloric | HCl | Cl^- | | |
| Nitric | HNO_3 | NO_3^- | | |
| Hydronium ion | H_3O^+ | H_2O | 1 | 0.0 |
| Hydrofluoric | HF | F^- | 6.6×10^{-4} | 3.18 |
| Nitrous | HNO_2 | NO_2^- | 4.6×10^{-4} | 3.34 |
| Acetic | CH_3COOH | CH_3COO^- | 1.76×10^{-5} | 4.75 |
| Carbonic (1) | H_2CO_3 | HCO_3^- | 4.3×10^{-7} | 6.37 |
| Hydrocyanic | HCN | CN^- | 6.17×10^{-10} | 9.21 |
| Ammonium ion | NH_4^+ | NH_3 | 5.6×10^{-10} | 9.25 |
| Carbonic (2) | HCO_3^- | CO_3^{2-} | 4.8×10^{-11} | 10.32 |
| Water | H_2O | OH^- | 1.0×10^{-14} | 14.00 |

$$\text{pH} = -\log [\text{H}^+] \quad [\text{H}^+] = 10^{-\text{pH}}$$

$$K_w = 1 \times 10^{-14} \quad \text{at } 25^\circ\text{C} \quad K_w = [\text{OH}^-][\text{H}^+] \quad K_w = K_a K_b$$

ANSWERS: 1. b 2. a 3. c 4. d $[\text{HCl}] = 0.04 \text{ M}$, $[\text{HNO}_3] = 0.12 \text{ M}$, \Rightarrow Total $[\text{H}^+] = 0.16 \text{ M}$

5. b 6. b Why basic? HCO_3^- is amphoteric. Compare the value of K_b to K_a 7. a 8. a

9. d Compare the value of K_b for NO_2^- to the value of K_b for CN^- . Smaller $K_b \Rightarrow$ less $\text{OH}^- \Rightarrow$ lower pH