General Chemistry II

RR # 10

Summer 2022

1. **Circle the best acid to combine with its sodium salt to make a solution buffered at pH 4.25. For the best choice, calculate the ratio of the conjugate base to the acid required to attain the desired pH**

Chlorous acid $HClO_2$	Formic acid HCOOH	Hypochlorous acid HClO
$pK_a = 1.95$	$pK_a = 3.74$	$pK_a = 7.54$

2. **Calculate the pH of an aqueous buffer solution made from 0.15 M NH_4Cl and 0.100 M NH_3. K_a for $NH_4^+ = 5.61 \times 10^{-10}$**

3. **A 1.0 L buffer solution contains 0.100 mol acetic acid (CH_3COOH) and 0.100 mol sodium acetate (CH_3COONa). Calculate the new pH after adding 0.010 mol of solid NaOH to the buffer. For comparison, calculate the pH after adding 0.010 mol of solid NaOH to 1.0 L pure water. K_a of acetic acid = 1.8×10^{-5}.**

4. **A chemist has synthesized a monoprotic weak acid and wants to determine its K_a value. She dissolves 2.00 millimoles of the solid acid in 100.0 mL of water. Assume negligible dissociation at this point. She titrates the resulting solution with 0.0500 M NaOH. After 20.0 mL NaOH has been added, the pH is 6.00. What is the K_a value for the acid?**

5. **A 20.0 mL sample of 0.115 M sulfurous acid (H_2SO_3) solution is titrated with 0.1014 M KOH. At what added volume of base solution does each equivalence point occur?**

6. **Find the pH of each of the following points in the titration of 25.0 mL of 0.30 M HF with 0.30 M NaOH. The K_a of HF is $7.2 * 10^{!4}$**

    a. **Before adding NaOH. "X" is negligible.**

b. After adding 10.00 mL of NaOH

c. At the ½ equivalence point

d. At the equivalence point. "X" is negligible.

e. After adding 28.00 mL of NaOH

MCAT Style Question

7.0 Researchers wish to mimic the conditions of the medial Golgi (pH ≈ 6.3. Which of these buffers would be best suited for this experiment?

a. Acetic acid, $K_a = 1.7 \times 10^{-5}$
b. MES, $K_a = 7.1 \times 10^{-7}$
c. HEPES, $K_a = 2.8 \times 10^{-8}$
d. Tris, $K_a = 6.3 \times 10^{-9}$

7.1 A buffer solution was prepared by adding 4.82 g of sodium acetate, $NaCH_3COO$, to 2.50×10^2 mL of 0.160 M acetic acid, CH_3COOH. What is the pH of the buffer? The K_a of acetic acid is 1.8×10^{-5}. The volume of solution doesn't change.

MCAT-Style Questions

8. Methanethiol, CH_3SH, has a pK_a of 10.3 and methanol, CH_3OH, has a pKa of 15.5. Which is a stronger acid? Which is a stronger base, CH_3S^- or CH_3O^-?

    a. Methanethiol is the stronger acid; its conjugate base is the stronger base
    b. Methanol is the stronger acid; its conjugate base is the stronger base
    c. Methanethiol is the stronger acid; methanol's conjugate base is the stronger base
    d. Methanol is the stronger acid; methanethiol's conjugate base is the stronger base

9. Which of the following structural features may affect the pK_a of an acid?
    I. Electronegativity
    II. The length of the bond to the acidic hydrogen atom
    III. Inductive effects
    IV. Resonance delocalization

    a. I only
    b. III only
    c. II and IV
    d. I, II, and IV
    e. I, II, III, and IV

10. Based on the acid comparison in Table 1, which of the following organic acids will give a 0.10 M aqueous solution with the lowest pH?

    a. Acetic acid
    b. Carbonic acid
    c. Citric acid
    d. Lactic acid

Acid	Acid Formula (HA)	Conjugate Base (A^-)	K_a
Hydrochloric	HCl	Cl^-	1.3×10^{6}
Carbonic	H_2CO_3	HCO_3^-	4.3×10^{-7}
Formic	HCO_2H	CO_2H^-	1.8×10^{-4}
Acetic	$HC_2H_3O_2$	$C_2H_3O_2^-$	1.8×10^{-5}
Lactic	$H_2C_3H_5O_3$	$HC_3H_5O_3^-$	1.4×10^{-4}
Ascorbic	$H_2C_6H_6O_6$	$HC_6H_6O_6^-$	7.9×10^{-5}
Citric	$H_3C_6H_5O_7$	$H_2C_6H_5O_7^-$	8.4×10^{-4}

11. Gastric acid has a pH of 1.0. How many millimoles of hydrogen ions are present in 10.0 mL of gastric acid? Assume gastric acid comprises solely HCl.

    a. 100 mmol
    b. 10 mmol
    c. 1.0 mmol
    d. 0.10 mmol

12. In metal coordination complexes, the coordination number refers to:

    a. The number of ligands that form the complex
    b. The number of coordinate bonds formed
    c. The number of electrons involved in the coordinate bonding
    d. The oxidation number of the metal ion