Chemistry Lab: Acids/Bases and Aqueous Solutions

Test
Part 1- Acids and Bases (36 pts)

1. What is the conjugate base of the following acids: HClO₄, H₂S, PH₄⁺, H₂O (_/1)

2. What is the conjugate acid of the following bases: CN⁻, SO₄²⁻, H₂O, HCO₃⁻ (_/1)

3. Label the acid, base, conjugate acid, and conjugate base in the equation (_/1)

\[ \text{HCl (g) + H}_2\text{O (l)} \rightarrow \text{H}_3\text{O}^+ (aq) + \text{Cl}^- \]

4. Predict whether equilibrium lies predominantly to the left or the right (_/1)
   a. HSO₄ (aq) + CO₃²⁻ (aq) → SO₄²⁻ (aq) + HCO₃⁻ (aq)
   b. PO₄³⁻ (aq) + H₂O (l) → HPO₄²⁻ (aq) + OH⁻ (aq)

5. A solution made by adding solid sodium hypochlorite (NaClO) to enough water to make 2.00 L of solution has a pH of 10.50. Using the equation below calculate the number of moles of NaClO that were added to the water. (_/4)

\[ \text{ClO}^- (aq) + \text{H}_2\text{O (l)} \rightarrow \text{HClO (aq)} + \text{OH}^- (aq) \quad \text{K}_b = 3.3 \times 10^{-7} \]

6. In each of the following pairs choose the compound that creates a more acidic solution and briefly explain why (_/2)
   a. HBr, HF
b. \( \text{PH}_3, \text{H}_2\text{S} \)

c. \( \text{HNO}_2, \text{HNO}_3 \)

d. \( \text{H}_2\text{SO}_3, \text{H}_2\text{SeO}_3 \)

7. Calculate the pH of a solution containing 0.085 M nitrous acid and 0.10 M potassium nitrite. 
\( (K_a = 4.5 \times 10^{-4}) (/_4) \)

8. Calculate the formate concentration and the pH of a solution that is 0.05 M in formic acid, 
\( \text{HCHO}_2 \) \( (K_a = 1.8 \times 10^{-4}) \) and 0.10 M in \( \text{HNO}_3 \) (/_4)

9. Calculate the pH of a buffer composed of 0.12 M benzoic acid and 0.20 M sodium benzoate 
\( (K_a = 6.34 \times 10^{-5}) (/_3) \)
10. 50.0 mL of 0.10 M acetic acid ($K_a = 1.8 \times 10^{-5}$) is titrated with 0.10 M NaOH. Calculate the pH when the following volumes of base are added:
   a. 10.0 mL (_,/3)

   b. 50.0 mL (_,/3)

   c. 75.0 mL (_,/3)

11. A solution is predicted to have a pH of 3.5. Give two indicators that can be used and explain how these indicators are used to verify the test results. (_,/3)

12. Give three uses for $H_2SO_4$ (sulfuric acid). (_,/3)
Part 2- Aqueous solutions (23 pts)

1. A solution is prepared by mixing 1.00 g ethanol (C₆H₁₂O) with 100.0 g of water to give a final volume of 101 mL. Calculate the molarity, mass percent, mole fraction, and molality of ethanol (__/2)

2. A 2.5 g sample to groundwater has 5.4 μg of Zn²⁺. What is the concentration of Zn²⁺ in parts per million? (__/2)

3. Calculate the molality and mole fraction of a 36% by mass HCl solution (__/2)

4. Glycerin (C₃H₈O₃) is a nonvolatile nonelectrolyte with a density of 1.26 g/mL at 25°C. Calculate the vapor pressure at 25°C of a solution made by adding 50.0 mL of glycerin to 500.0 mL of water. The vapor pressure of pure water at 25°C is 23.8 torr, and its density is 1.00 g/mL (__/3)

5. Calculate the total vapor pressure of a solution containing 1.0 mol benzene (C₆H₆) and 2.0 mol toluene (C₇H₈). At 20°C the vapor pressure of benzene is 75 torr and toluene is 22 torr. (__/2)
6. List the following aqueous solutions in order of decreasing freezing point: 0.050 m CaCl$_2$, 0.15 m NaCl, 0.10 m C$_{12}$H$_{22}$O$_{11}$

7. Calculate the concentration of CO$_2$ in a soft drink that is bottled with a partial pressure of CO$_2$ of 4 atm over the liquid at 25°C. The Henry’s law constant for CO$_2$ in water at this temperature is 3.1 x 10$^{-2}$ M/atm

8. A sample of 2.05 g of polystyrene was dissolved in enough toluene to create 100.0 mL of solution. The osmotic pressure of this solution is 1.21 kPa at 25°C. Calculate the molar mass of polystyrene

9. Fill out the following table

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Part 1: __/36
Part 2: __/22
Total: __/58