Non Sibi High School

Andover's Chem 550/580: Advanced Chemistry

Chapter 17, Review Quiz 1

1

A 65 mL sample of HBr gas, measured at 35°C and 722 mmHg, was dissolved in water to yield 275 mL of solution. Calculate the molarity of hydrogen ion, the molarity of hydroxide ion, pH, and pOH in this solution.

2

A 0.086 gram sample of strontium hydroxide was dissolved in water to create 58 mL of solution. Calculate the molarity of hydroxide ion, the molarity of hydrogen ion, pOH, and pH in this solution.

3

Write the acid ionization equation and calculate the pH and percent ionization of 0.63 M hypobromous acid, HBrO ($K_a = 2.5 \times 10^{-9}$).

4

A 0.85 M lactic acid solution has a pH of 1.97. Write the acid ionization equation and calculate K_a for lactic acid, $HC_3H_5O_3$.

5

A 0.017 M solution of propanoic acid is 2.7% ionized. Write the acid ionization equation and calculate the pH of the solution and K_a for propanoic acid, $HC_3H_5O_2$.

6

A cyanic acid, HCNO, solution has a pH of 2.25. Given that $K_a = 3.5 \times 10^{-4}$ for cyanic acid, write the acid ionization equation and calculate the initial molarity of the cyanic acid solution.

7

Write the stepwise acid ionization equations and calculate the pH of 0.23 M selenous acid, H_2SeO_3, which has the following acid ionization constants:

$$Ka_1 = 2.3 \times 10^{-3}$$

$$Ka_2 = 5.3 \times 10^{-9}$$

8

Identify the Bronsted acids and bases in the forward and reverse directions for the reaction below:

$$H_2C_6H_5O_7{}^-(aq) + HC_3H_2O_4{}^-(aq) \rightleftharpoons HC_6H_5O_7{}^{2-}(aq) + H_2C_3H_2O_4(aq)$$

9

Write the formula for:

a. the conjugate acid of $HC_2O_4{}^-$
b. the conjugate base of $HAsO_4{}^{2-}$

10

Write the base ionization equation and calculate the pH and percent ionization of 0.44 M dimethylamine, $(CH_3)_2NH$ ($K_b = 5.4 \times 10^{-4}$).

11

A 0.084 M codeine solution has a pH of 10.46. Write the base ionization equation and calculate K_b for codeine, $C_{18}H_{21}O_3N$.

12

A 0.077 M solution of piperidine is 12% ionized. Write the base ionization equation and calculate the pH of the solution and K_b for piperidine, $C_5H_{11}N$.

13

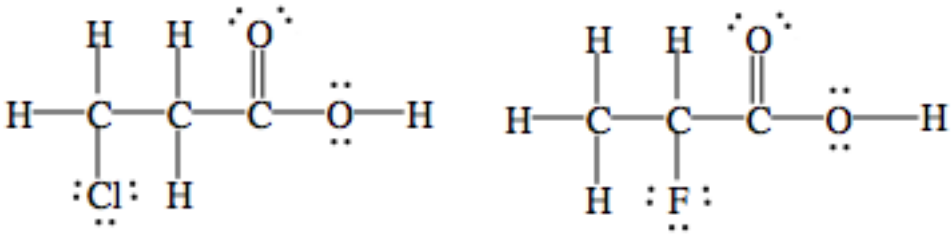
A quinoline, C_9H_7N, solution has a pH of 9.00. Given that $K_b = 6.3 \times 10^{-10}$ for quinoline, write the base ionization equation and calculate the initial molarity of the quinoline solution.

14

Draw Lewis structures for chloric acid, $HClO_3$, and selenous acid, H_2SeO_3. Which is the stronger acid? Give two reasons to justify your answer.

15

Which of the two acids shown below is the stronger acid? Give two reasons to justify your answer.



16

Predict whether a solution of each compound below will be acidic, basic, or neutral. For solutions that are not neutral, show all relevant hydrolysis reactions that affect the pH and also calculate the equilibrium constant for each reaction you write using information from the following data tables:

Acid	K_a
HCN	4.9×10^{-10}
HIO	2.3×10^{-11}

Base	K_b
$(CH_3)_3N$	6.4×10^{-5}
NH_3	1.8×10^{-5}

a. $(CH_3)_3NHCl$ [composed of $(CH_3)_3NH^+$ and Cl^-]
b. KCN
c. NaI
d. NH_4IO

17

For each solution below, show any relevant hydrolysis reactions and calculate the pH.

a. 0.31 M $C_6H_5NH_3Br$ [composed of $C_6H_5NH_3^+$ and Br^-]
b. 1.2 M $KC_3H_5O_3$

$K_b = 4.3 \times 10^{-10}$ for $C_6H_5NH_2$
$K_a = 1.4 \times 10^{-4}$ for $HC_3H_5O_3$

18

Predict whether a solution of sodium hydrogen arsenate, NaH_2AsO_4, will be acidic or basic. Show all relevant reactions that affect the pH and also give the value of the equilibrium constant for each reaction you write. For arsenic acid, H_3AsO_4:

$$Ka_1 = 5.6 \times 10^{-3}$$

$$Ka_2 = 1.0 \times 10^{-7}$$

$$Ka_3 = 3.0 \times 10^{-12}$$

19

Will the reaction of P_4O_{10} and water produce H_3PO_3 or H_3PO_4? Write a balanced equation for the reaction.

20

a. An unknown monoprotic weak acid was found to be 30.60% carbon, 45.16% chlorine, and 3.85% hydrogen by mass, with the remainder being oxygen. Determine the empirical formula of the acid.

b. In a separate experiment, 3.75 grams of the acid was dissolved in 45 mL of water and then titrated with 0.164 M barium hydroxide. The volume of base required to reach the equivalence point was 72.8 mL. Calculate the molar mass and determine the molecular formula of the acid.

21

Calculate the initial molarity of a sodium fluoride, NaF, solution that has a pH of 8.17 given that $K_a = 6.8 \times 10^{-4}$ for hydrofluoric acid, HF.

22

Calculate the initial molarity of a $C_5H_5NHNO_3$ [composed of $C_5H_5NH^+$ and $NO_3{}^-$] solution that has a pH of 2.83 given that $K_b = 1.7 \times 10^{-9}$ for C_5H_5N.

23

Given that a 0.72 M KIO solution has a pH of 12.24, calculate K_a and pK_a for HIO.

24

Given that a 0.066 M $C_6H_{15}O_3NHCl$ [composed of $C_6H_{15}O_3NH^+$ and Cl^-] solution has a pH of 4.48, calculate K_b and pK_b for $C_6H_{15}O_3N$.

25

Calculate the pH of a solution containing 4.2 grams of $NaC_7H_5O_2$ in 75 mL of 0.27 M $HC_7H_5O_2$ ($K_a = 6.3 \times 10^{-5}$).

26

Calculate the pH of a solution containing 2.4 grams of $(CH_3)_2NH_2I$ [composed of $(CH_3)_2NH_2{}^+$ and I^-] in 84 mL of 0.18 M $(CH_3)_2NH$ ($K_b = 5.4 \times 10^{-4}$).

27

Write the net ionic equation for the neutralization reaction that occurs and calculate the pH when:

a. 0.002 mol NaOH is added to the solution in Question 25
b. 0.002 mol HBr is added to the solution in Question 25
c. 0.002 mol NaOH is added to the solution in Question 26
d. 0.002 mol HBr is added to the solution in Question 26

28

Write the net ionic equation for the neutralization reaction that occurs in each aqueous mixture below. Which one of the four reactions creates a buffer solution? For each mixture, describe the method of calculating the pH of the resulting solution after the neutralization reaction is complete.

a. 0.15 mol HNO_3 + 0.15 mol NaCN
b. 0.25 mol HIO + 0.25 mol KOH
c. 0.15 mol NH_4Br + 0.25 mol NaOH
d. 0.15 mol HI + 0.25 mol $C_6H_5NH_2$ (a weak base)

29

a. Write the net ionic equation for the neutralization reaction that occurs during the titration of 22 mL of 0.40 M HNO_3 with 0.20 M NaOH and calculate the volume of base needed to reach the equivalence point.

b. Calculate the following:

i. the initial pH
ii. the pH after 31 mL of base has been added
iii. the pH at the equivalence point
iv. the pH after 49 mL of base has been added

30

a. Write the net ionic equation for the neutralization reaction that occurs during the titration of 24 mL of 0.30 M $HC_3H_5O_2$ ($K_a = 1.3 \times 10^{-5}$) with 0.20 M KOH and calculate the volume of base needed to reach the equivalence point.

b. Calculate the following:

i. the initial pH
ii. the pH after 23 mL of base has been added
iii. the pH at the equivalence point
iv. the pH after 43 mL of base has been added

31

a. Write the net ionic equation for the neutralization reaction that occurs during the titration of 48 mL of 0.10 M C_5H_5N ($K_b = 1.7 \times 10^{-9}$) with 0.30 M HI and calculate the volume of acid needed to reach the equivalence point.

b. Calculate the following:

i. the initial pH
ii. the pH after 12 mL of acid has been added
iii. the pH at the equivalence point
iv. the pH after 27 mL of acid has been added

32

Which indicator, bromphenol blue ($K_a = 1 \times 10^{-4}$) or phenolphthalein ($K_a = 5 \times 10^{-10}$), would be the better choice for the titration in Question 30?