Review Questions   ---   Solutions and Solubility
Use : Chemistry Today, Whitman, Zinck and Nalepa

Questions: p.370 pp#11-29, 11-30, 11-31

Read section 10.1, pp 308 – 309, pp 368 - 372

11-29 How many grams of formaldehyde, CH_2O, are contained in 500mL of a 13.0 mol/L aqueous solution of formaldehyde?

11-30 What volume of 6.0 mol/L KBr would be required to make 3.0L of 0.20 mol/L KBr?

11-31 If 25.0mL of 6.0 mol/L KBr is diluted to final volume of 2.0L, what is the new concentration of the KBr?

Read pp 367 - 372
Questions: p.380 #47-55

47. **What is the concentration in moles per liter of a solution that contains 39.2g of H_3PO_4 in 500mL of solution?**

48. **What is the concentration in moles per liters of a solution that contains 100g of Na_2SO_4 in 10.0L of solution.**

49. **How many grams of $C_6H_{12}O_6$ are contained in 250mL of 0.050 mol/L solution of $C_6H_{12}O_6$ in water?**

50. **How many grams of $CuSO_4 . 5H_2O$ are required to prepare 2.0L of a 3.0mol/L copper sulfate solution?**

51. **Sodium phosphate, Na_3PO_4 (known commercially as TSP), is used for cleaning grease and oil spills.   Describe precisely how you would prepare 250mL of 0.320 mol/L solution of Na_3PO_4.**

52. **What volume of 0.14 mol/L hydrochloric acid would contain 5.0g of HCl?**

53. **What volume of 0.95 mol/L Na_2SO_4 would be required to prepare 200 mL of 0.15 mol/L Na_2SO_4?**

54. **If 55.0 mL of 0.55 mol/L Na_2SO_4 are diluted to a final volume of 250mL, what is the new concentration of the Na_2SO_4 in moles per litre?**

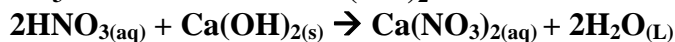55. **To what final volume would 50.0 mL of 1.50 mol/L HNO_3 have to be diluted to prepare 0.45 mol/L HNO_3?**

Questions: p.381 #56-60

56. How many grams of $Ca(NO_3)_2$ can be prepared by reacting 125mL of 5.00 mol/L HNO_3 with an excess of $Ca(OH)_2$?

$$2HNO_{3(aq)} + Ca(OH)_{2(s)} \rightarrow Ca(NO_3)_{2(aq)} + 2H_2O_{(L)}$$

57. If 0.0200 g of Na_2CO_3 completely reacts with 30.0 mL of HCl, what is the concentration of the HCl in moles per litre?

$$Na_2CO_{3(aq)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_2O_{(L)} + CO_{2(g)}$$

58. If 50.0 mL of H_2SO_4 yields 0.300 g of $BaSO_4$ when reacted with excess $BaCl_2$, what is the concentration of the H_2SO_4 in moles per litre?

$$BaCl_{2(aq)} + H_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2HCl_{(aq)}$$
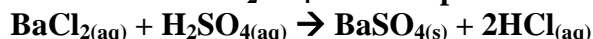
59. How many grams of Fe^{2+} are required to react with 30.1 mL of 0.0165 mol/L $K_2Cr_2O_7$ solution?

$$14H^+_{(aq)} + 6Fe^{2+}_{(aq)} + K_2Cr_2O_{7(aq)} \rightarrow 6Fe^{3+}_{(aq)} + 2Cr^{3+}_{(aq)} + 2K^+_{(aq)} + 7H_2O_{(L)}$$

60. What is the maximum number of grams of NaCl that can be produced when 50.0 mL of 0.120 mol/L NaOH reacts with 39.4 mL of 0.165 mol/L HCl?

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(L)}$$
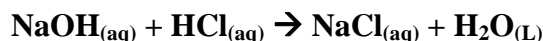
Questions: p.381 (apply understanding)#1-3,5

1. One method of analyzing for arsenic in a pesticide is to treat the sample chemically to convert the arsenic into soluble sodium arsenate (Na_3AsO_4). Then a solution of silver nitrate is added until a precipitate of Ag_3AsO_4 is no longer formed. If a 1.10 g sample of a pesticide required 23.7 mL of 0.0968 mol/L $AgNO_3$ in a given analysis, what was the percentage of arsenic present in the pesticide?

2. Aspirin ($C_9H_8O_4$) is produced commercially from salicylic acid ($C_7H_6O_3$) and acetic acid anhydride ($C_4H_6O_3$) according to the equation

$$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + HC_2H_3O_2$$

   a) If all the salicylic acid is converted to aspirin, how much salicylic acid is required to prepare 175 Kg of aspirin?
   b) If only 75.0% of the salicylic acid is converted to aspirin, how much salicylic acid would be required?
   c) If salicylic acid costs $11.00/kg and acetic acid anhydride costs $13.00/kg, which compound would you choose as the limiting reagent in order to have the most economical process?
   d) What is the theoretical yield of aspirin if 205 kg of salicylic acid are allowed to react with 140kg of acetic anhydride?
   e) If the actual yield of aspirin from part (d) is 202 kg, what is the percent yield?

f) What would you have to charge for a kilogram of aspirin to cover the costs of the raw materials? (Ignore the cost of labour, electricity, machinery, taxes, etc.)

3. Iron (III) chloride can be prepared by reacting iron metal with hydrochloric acid. The other product is hydrogen.
a) What is the balance equation for this reaction?
b) How many grams of iron are required to make 2.25L of an aqueous solution containing 8.00% iron(III) chloride? The density of the solution is 1.067 g/mL.

5. One method of analyzing gold ores is to convert the gold to soluble $AuCl_3$ and treat the solution with an excess of a solution of KI. The reaction that occurs is:

$$AuCl_{3(aq)} + 3KI_{(aq)} \rightarrow AuI_{(s)} + I_{2(aq)} + 2KCl_{(aq)}$$

The liberated iodine is then reacted with a solution of sodium thiosulfate $(Na_2S_2O_3)$ until all the iodine has disappeared. The equation for this reaction is

$$2Na_2S_2O_{3(aq)} + I_{2(aq)} \rightarrow Na_2S_4O_{6(aq)} + 2NaI_{(aq)}$$
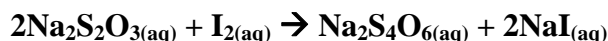
If 28.8 mL of 1.00×10^{-4} mol/L $Na_2S_2O_3$ are required to react with the iodine generated by a 0.945 g sample of gold ore, what is the percentage of gold in the ore.

Reading: p.387-392

Questions: p.393 #12-1, 12-2

12-1   Write (a) the balanced chemical equation; (b) the ionic equation; and (c) the net ionic equation for the neutralization of hydrochloric acid, $HCl_{(aq)}$, by rubidium hydroxide, $RbOH_{(aq)}$.

12-2   Write (a) the balanced chemical equation; (b) the ionic equation; and (c) the net ionic equation for the neutralization of sulfuric acid, $H_2SO_{4(aq)}$, by magnesium hydroxide, $Mg(OH)_{2(aq)}$.

Questions: p.400 part 1 review #1-10

1-   One useful operational definition of an acid describes an acid as a substance which turns blue litmus red. What is another useful definition of an acid?

2-   Acids cause certain indicators to change color. Why is this statement although true, not a useful operational definition of an acid?

3- **What are the Arrhenius definitions of acids and bases?**

4- **Explain the meaning of the terms *strong acid* and *weak acid*. Give an example of each.**

5- **Write the balance chemical equation, the ionic equation, and the net ionic equation for each of the following acid-base neutralization reactions:**
   A. NaOH and H_2SO_4

   B. NaOH and HNO_3

6- **What are the usual products of an acid-base neutralization reaction?**

7- **What is an acid-base titration?**

8- **Why is an indicator used during a titration?**

9- **List three uses for each of the following:**

10- **Give three examples of acids and three examples of bases found in the household.**

Questions: p.412 (Test Your Understanding) #1-11

1- **Which of the following is not a property of acids?**
   C) Acids turn red litmus blue.

2- **Which of the following is not a property of bases?**
   B) Basic solutions react with metallic carbonates to generate carbon dioxide gas.

3- **According to Arrhenius, an acid is**
   A) A substance that produces hydrogen ions in water.

4- **Which of the following is not a strong acid?**
   C) Acetic Acid

5- **The products of an acid-base neutralization are**
   A) A salt and a water.

6- **Which of the following does not occur in an acid-base neutralization?**
   B) The concentration of both the H_3O^+ and the OH^- ions increases.

7- **The volume of 0.10 mol/L NaOH that is required to neutralize 20mL of 0.20 mol/L HCl is**
   B) 40 mL

8- **What is the concentration of HCl if 25.0 mL of the acid are needed to neutralize 15.0 mL of 0.300 mol/L KOH?**
    D) 0.180 mol/L

9- **What is the concentration of H_2SO_4 if 20.0mL of the acid are needed to neutralize 10.0 mL of 0.400 mol/L NaOH?**
    C) 0.200 mol/L

10- **Which of the following statements concerning acid-base titrations is incorrect?**
    A) There is never any difference between the theoretical endpoint and the experimental endpoint.

Questions: p.414 (Review Your Understanding) #1-11

1- **Why would you expect acids and bases to be electrolytes?**

2- **Why is pure water neither acidic nor basic?**

3- **What are the equilibrium processes occurring in**
    A. An aqueous solution of acetic acid
    B. An aqueous solution of ammonia

4- **Explain why HNO_3 is considered an Arrhenius acid. Why is KOH an Arrhenius base?**

5- **What is the difference between a weak acid and a dilute solution of a strong acid?**

6- **Equal volumes of acid A and acid B, both at the came concentration, were tested with a conductivity apparatus. The light bulb glowed brightly with acid B and only dimly for acid A. Comment on the relative strength of these two acids. Explain the observations.**

7- **Draw the Lewis structures for sulphuric acid and nitric acid.**
    A. Sulfuric Acid
    B. Nitric Acid

8- **What property of bases are you taking advantage of when you use antacid tablets?**

9- **Which of the following hypothetical definitions of a carbonate compound is an operational definition? What is a conceptual definition? Explain.**
    A. Carbonate compounds produce carbon dioxide gas, a salt, and water when in contact with hydrochloric acid.
    B. Carbonate compounds are compounds which contain the CO_3^{2-} ion.

10- Explain by a chemical equation how milk of magnesia, $Mg(OH)_{2(s)}$, is used to neutralize excess stomach acid, $HCl_{(aq)}$.   Why isn't $NaOH_{(aq)}$ used for this purpose?

11- Write the balanced chemical equation, the ionic equation, and the net ionic equation when each of the following acid-base neutralization reactions goes to completion:

   A. $KOH_{(aq)}$ and $HCl_{(aq)}$_

   B. $H_2SO_{4(aq)}$ and $Sr(OH)_{2(aq)}$

   C. $HI_{(aq)}$ and $NaOH_{(aq)}$

   D. $Ba(OH)_{2(aq)}$ and $HBr_{(aq)}$

Read section 12.4 pp 394 – 398. Pp 397 –398: Practice Problem 12-3, 12-4, 12-5
Answer pp 414 – 415 # 14 –19, # 21-24, # 26