Solutions

1. In what ways does a solution differ from a compound?

2. Why isn't a mixture of sand in water considered a solution?

3. Describe the concept of dynamic equilibrium as it applies to a saturated solution.

4. There is much public concern about oil spills. Why doesn't most of the oil just dissolve in the ocean?

5. Why does a nonpolar solvent not dissolve in a polar solvent?

6. Why does an ionic substance not dissolve in a nonpolar solvent?

7. Solid naphthalene will dissolve in nonpolar octane. What can we conclude about the nature of naphthalene?

8. A compound, X, dissolves readily in water. Can we conclude that X is an electrolyte? Explain.

9. Is it possible for a solution to be both saturated and dilute? Explain.

10. What test could you perform to determine whether a solution is unsaturated, saturated, or supersaturated?

11. Originally Arrhenius believed that there must be the same number of positive and negative ions in a solution. However, the modern theory of electrolytes states that the total positive ionic charge must equal the total negative ionic charge. Is there a difference between these two statements? If so, why did Arrhenius' original theory have to be modified?

12. Will we ever find a chemical that will dissolve all substance? (a universal solvent)? Give reasons for your answer.

13. What volume of 0.140 mol/L hydrochloric acid would contain 5.00 g of the acid?

14. Calculate the volume of concentrated phosphoric acid (14.6 mol/L) that must be diluted to prepare 500.0 mL of a 1.25 mol/L solution.

15. How many grams of calcium nitrate can be prepared by reacting 125 mL of 5.00 mol/L nitric acid with an excess of calcium hydroxide?

16. If 0.200 g of sodium carbonate completely reacts with 30.0 mL of hydrochloric acid, what is the concentration of the hydrochloric acid?

17. If 50.0 mL of sulfuric acid yields 0.300 g of barium sulfate when reacted with excess barium chloride, what is the concentration of the sulfuric acid?

18. What is the maximum number of grams of sodium chloride that can be produced when 50.0 mL of 0.120 mol/L sodium hydroxide reacts with 39.4 mL of 0.165 mol/L hydrochloric acid?

19. Silver plated tableware is popular because it is less expensive than sterling silver. Silver nitrate solution is used by an electroplating business to replate silver tableware for their customers. To test the purity of the solution, a technician observes 10.00 mL of 0.500 mol/L silver nitrate reacting with an excess quantity of 0.480 mol/L sodium hydroxide solution. Calculate the mass of precipitate that forms.

20. Some antacid products contain aluminum hydroxide to neutralize excess stomach acid. Determine the volume of 0.100 mol/L hydrochloric acid that can be neutralized by 912 mg of aluminum hydroxide in an antacid tablet.

21. Sulfuric acid is produced on a large scale from readily available raw materials. One step in the industrial production of sulfuric acid is the reaction of sulfur trioxide with water. Calculate the molar concentration of sulfuric acid produced by the reaction of 10.0 Mg of sulfur trioxide with an excess quantity of water to produce 7.00 kL of acid.

22. Analysis shows that 9.44 mL of 50.6 mmol/L potassium hydroxide is needed for the titration of 10.00 mL of water from an acidic lake. Determine the molar concentration of acid in the lake water, assuming that it is sulfuric acid.

23. A convenient source of oxygen in a laboratory is the decomposition of aqueous hydrogen peroxide to produce water and oxygen. What volume of 0.880 mol/L hydrogen peroxide is required to produce 500.0 mL of oxygen gas at STP?

24. A 10.00 mL sample of oxalic acid is boiled until dry to crystallize the oxalic acid. Use the following evidence to calculate the molar concentration of the oxalic acid solution.

    Mass of empty evaporating dish = 84.56 g   Mass of dish plus solid oxalic acid = 85.97 g

25. What volume of hydrogen gas at STP is produced by the reaction of a 25.0 g strip of zinc with 1000.0 mL of a 0.197 mol/L nitric acid solution?

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

27. One method of analyzing gold ores is to convert the sold to soluble gold(III) chloride and treat the solution with an excess of a solution of potassium iodide. The reaction that occurs is:

    $$AuCl_3(aq) \ + \ 3\ KI(aq) \ \rightarrow \ AuI(s) \ + \ I_2(aq) \ + \ 3\ KCl(aq)$$

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

    $$2\ Na_2S_2O_3(aq) \ + \ I_2(aq) \ \rightarrow \ Na_2S_4O_6(aq) \ + \ 2\ NaI(aq)$$

    If 28.8 mL of 1.00×10^{-4} mol/L sodium thiosulfate 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?

28. A sample of solid zinc hydroxide is added slowly to 228 mL of 0.609 mol/L hydrobromic acid. The resulting solution contains unreacted hydrobromic acid. A 0.450 mol/L solution of sodium hydroxide is added, and 155 mL is required to react with all of the remaining hydrobromic acid. What is the mass of the sample of zinc hydroxide?