Chemistry 20
Lessons 1 to 34 Review

A Mixture of Problems

Within this problem set are solutions problems, gas laws problems, stoichiometry problems, etc. all mixed together. The key difference between stoichiometry problems and other problems is that stoichiometry problems involve a reaction of compounds while the others generally do not.

1. Calculate the concentration of a solution that contains 2.8 mol of nitric acid in 4.0 L of solution. (0.70 mol/L)

2. Calculate the concentration of a solution that contains 25.0 g of magnesium bromide in 500.0 mL of solution. (0.272 mol/L)

3. What is the concentration if 2.25 g of copper (II) sulfate pentahydrate is used to prepare 50.0 mL of solution? (0.180 mol/L)

4. 78.9 g of ethene undergoes combustion. How many moles of water are formed? (5.62 mol)

5. Determine the mass of sulfuric acid required to react with 78.9 kmol of calcium phosphate. (23.2 Mg)

6. Calculate the number of moles in 50.0 mL of a 2.50 mol/L solution of silver nitrate? (0.125 mol)

7. Calculate the mass of barium hydroxide required to prepare 2.75 L of a 0.125 mol/L solution. (58.9 g)

8. Hydrofluoric acid may be produced in the lab and used to etch glass. How many grams of hydrofluoric acid may be produced by the addition of sufficient sulfuric acid to 6.78 g of calcium fluoride? (3.47 g)

9. What mass of aluminum chloride is required to prepare 750.0 mL of a 0.30 mol/L solution? (30 g)

10. Milk of magnesia (magnesium hydroxide) is used to neutralize excess stomach acid (HCl). 9.89 g of milk of magnesia will neutralize how many moles of stomach acid?

11. An excess of barium chloride solution was added to 300 mL of silver nitrate solution and 5.60 g of precipitate formed. What is the concentration of the silver nitrate solution?

12. Calculate the volume of solution that would contain 0.592 mol of hydrosulfuric acid from a 0.75 mol/L solution. (790 mL)

13. A piece of aluminum is placed in a beaker containing 600 mL of a sulfuric acid solution. Using the data table below, calculate the concentration of the sulfuric acid. (0.50 mol/L)
initial mass of Al ..... 15.14 g
final mass of Al ..... 9.74 g

14. What is the percent error if 10.5 g of copper are extracted when 3.45 g of aluminum are reacted with an excess of copper (II) sulfate solution? (13.9%)

15. A weather balloon with a volume of 5.00 L at a pressure of 100.5 kPa and a temperature of 20.0°C is released into the atmosphere. What will the volume be when it reaches a level in the atmosphere with a pressure of 50.0 kPa and a temperature of –20.0°C? (8.68 L)

16. The volume of oxygen consumed at STP by the combustion of 9.1 kg of propane. (23 kL)

17. When 200 mL of 0.100 mol/l silver nitrate reacts with copper, 1.84 g of silver metal is produced. What is the percent error? (14.8%)

18. In pure form methanol has a concentration of 24.7 mol/L. What volume of methanol is necessary to prepare 12.0 L of a 5.0 mol/L solution? (2.43 L)

19. In an experiment, 0.25 g of hydrogen gas is provided at 92 kPa and 30°C. What is the volume of the gas? (3.4 L)

20. 12.45 g of hydrogen gas was reacted with 96.0 g of oxygen gas. 94.0 g of water was collected in the lab. What is the percent error? (13.0%)

21. What is the molar concentration if 1.0 L of concentrated caustic soda solution (19.1 mol/L) is diluted to 50.0 L? (0.38 mol/L)

22. Concentrated ammonia ($NH_{3\,(aq)}$) is 14.8 mol/L. What volume is required to prepare 0.750 L of a 0.070 mol/L solution? (35 mL)

23. A scientist isolates 2.367 g of an unreactive gas. The sample occupies a volume of 800 mL at 78°C and 103 kPa. Calculate the molar mass and identify the gas. (Kr)

24. 7.00 L of hydrogen reacts with 14.00 L of oxygen at SATP. What mass of water is collected?

25. If 600 L of a 2.50 mol/L toxic substance were dumped into a pond to give a final volume of 8.00×10^4 L, what would be the final concentration? (0.0188 mol/L)

26. 10.00 mL of sodium hydroxide is titrated with 0.752 mol/l $HCl_{(aq)}$. The concentration of the hydroxide solution is? Which indicator should be used? (1.70 mol/L)
final volume of acid ..... 26.2 mL
initial volume of acid ..... 3.6 mL

27. In a 0.65 mol/L solution of $Ga_2(CO_3)_3$, what is the molar concentration of each ion? (1.30 mol/L, 1.95 mol/L)

28. In a potassium dichromate solution where the concentration of the potassium ion is 0.360 mol/L, what is the concentration of the solute? (0.180 mol/L)

29. What volume of oxygen at SATP is needed to completely burn 15 g of ethanol? (24.2 L)

30. A solution contains 4.80 g of sodium carbonate dissolved in water to form 600 mL of solution. What is the concentration of sodium ions in the solution? (0.151 mol/L)

31. 20.0 g of $KCl_{(s)}$ will dissolve in 100.0 mL of solution at 40°C. What is the solubility of KCl at 40°C? (2.68 mol/L)

32. To make concentrated hydrochloric acid requires that 90.4 g of $HCl_{(g)}$ be dissolved to make 200 mL of solution at 25°C. What is the molar solubility of hydrogen chloride at 25°C? (12.4 mol/L)

Acid and Bases

1. What is the difference between a *conceptual definition* and an *operational definition*?

2. What are the Arrhenius conceptual definitions for:
   An acid?
   A base?

3. What are operational definitions for:
   An acid?
   A base?

4. What is the difference between ionization and dissociation?

5. For the following compounds, write the appropriate dissociation or ionization equations and state whether the compound is an acid, base, neutral ionic, or neutral molecular compound.
   A. HBr

   B. CsOH

   C. H_2SO_3

   D. $Ba(NO_3)_2$

   E. C_5H_{12}

   F. hydrosulfuric acid

   G. ammonium hydroxide

   H. boric acid

I. ethanol

J. sodium acetate

6. A compound was found to have $[H_3O^+_{aq}] = 1.85 \times 10^{-5}$ mol/L. What is the pH and is this an acid, base, or neutral compound?

7. How much of a 0.0050 mol/L solution of hydrochloric acid is required to prepare 2.5 L of a solution with a pH of 3.75?

8. How many times more $[H_3O^+_{aq}]$ is found in a solution with a pH of 2 than in a solution with a pH of 5?

9. A lab technician requires 4.0 L of a pH 2.45 solution of hydrofluoric acid. What mass of hydrogen iodide is required to prepare this solution?

Gas Law Problems

1. A flask containing 90.0 cm^3 of hydrogen was collected under a pressure of 97.5 kPa. Assuming the temperature is kept constant, at what pressure would the volume be 70.0 cm^3? (125 kPa)

2. A gas has a volume of 275 mL when measured at a pressure of 98 kPa. If the temperature is constant, what would be the volume at **STP**? (266 mL)

3. A gas is confined in a container with a movable piston at one end. When the volume of the cylinder is 760 mL the pressure is 1.25 atm. When the cylinder is reduced in volume to 450 mL, what is the pressure? (2.11 atm)

4. A gas occupies a volume of 560 cm^3 at 100°C. Assuming constant pressure, to what temperature must the gas be lowered if it is to occupy 400 cm^3? (–7°C or 266 K)

5. A gas has a volume of 10.0 m^3 at **STP**. Assuming no pressure change, what volume will the gas occupy
   a. if the temperature is doubled? (20.0 m^3)
   b. if the temperature is halved? (5.00 m^3)

6. Convert the following gas volumes to their new conditions.
   a. 500 mL hydrogen at 20°C and 120 kPa to **STP**. (552 cm^3)
   b. 100 cm^3 chlorine at **STP** to 20°C and 98 kPa. (111 mL)
   c. 140 mL carbon dioxide at 15°C and 110.0 kPa to 40°C and 94.5 kPa. (177 cm^3)

7. A gas occupied 550 mL at a pressure of 99.5 kPa and a temperature of 21°C. Several days later it was measured at a pressure of 97.8 kPa and a temperature of 15°C. What was the new volume? (548 mL)

8. The volume of nitrogen gas collected at a temperature of 18°C and a pressure of 98.5 kPa measures 47.0 mL. What volume will the gas occupy at **STP**? (41.9 mL)

9. An automobile tire has a pressure of 300.0 kPa at 20^{o}C. What will be the tire pressure after driving, if the tire temperature rises to 50^{o}C? (331 kPa)

10. If the absolute temperature of a given gas is doubled, while the pressure is halved, what is the volume change? (4 times)

11. What volume of gas at **STP** is required to have 0.75 mol of oxygen? What is the mass of this amount of gas? (17 L, 24 g)

12. How many moles are found in 100 L of nitrogen gas at **SATP**? (4.03 mol)

13. If an experiment calls for 40.0 g of carbon dioxide at **SATP**, what volume of gas is required? (22.5 L)