Chapter 13 Study Questions

Mass percent

1. What is the mass percentage of $KMnO_4$ in a solution containing 1.00 mole of $KMnO_4$ and 158 g of water?

2. How many moles of $KMnO_4$ are needed to prepare 335 g of a 22.0% solution?

Molarity

3. How many moles of NaCl are in 275 mL of 0.500 M NaCl?

4. What mass of NaCl is needed to prepare 250. mL of a 2.00 M NaCl solution?

5. What volume of a 2.00 M NaCl solution is needed to make 125 mL of a 0.350 M NaCl solution?

6. What is the molarity of a solution made by dissolving 90.0 grams of glucose ($C_6H_{12}O_6$; molar mass = 180. g/mole) in enough water to yield 200. mL of solution?

7. What mass of potassium chloride is needed to prepare 150. mL of a 0.300 M potassium chloride solution?

8. When 1.00 mol of potassium nitrate is mixed with 100. g of water at 40°C, 63 g potassium nitrate dissolves.
   a) Is the solution saturated, unsaturated or supersaturated?
   b) Calculate the mass percent of potassium nitrate in this solution.

9. What is the molarity of an HCl solution if 25.0 mL of a 6.00 M HCl solution are diluted to 1.50 liters?

10. How many grams of sodium hydroxide are in 250. g of a 20.0% solution?

Summary of Chapter 13: Solutions

Definition of solutions
Like dissolves like (polarity)
Solubility
Electrolytes, nonelectrolyes
Strong and weak electrolytes
Unsaturated, saturated and supersaturated solutions
Mass percent
Molarity (M)
Dilution

Answers to Chapter 13 Study Questions

1. mass percent = $\frac{mass\ KMnO_4}{mass\ solution} x\ 100\%$;

   mass $KMnO_4$ = 1.00 mole = 158 g; mass solution = 158 g $KMnO_4$ + 158 g H_2O = 316 g

   mass percent = $\frac{158\ g\ KMnO_4}{316\ g\ solution}$ = 50.0 %

2. 335 g solution $x\ \frac{22.0\ g\ KMnO_4}{100\ g\ solution} x\ \frac{1\ mol\ KMnO_4}{158\ g\ KMnO_4}$ = 0.466 moles

3. 275 mL solution x $\frac{0.500\ mol\ NaCl}{1000\ mL\ solution}$ = 0.138 moles

4. 250 mL solution x $\frac{2.00\ mol\ NaCl}{1000\ mL\ solution} x\ \frac{58.5\ g\ NaCl}{1\ mol\ NaCl}$ = 29.2 g

5. V_1 x M_1 = V_2 x M_2; V_1 x 2.00 M = 125 mL x 0.350 M

   V_1 = 125 mL x 0.350 M/2.00 M = 21.9 mL

6. molarity = $\frac{moles\ solute}{L\ solution}$; $\frac{90.0\ g\ glucose}{200\ mL\ solution} x \frac{1000\ mL}{1\ liter} x \frac{1\ mol\ glucose}{180\ g\ glucose}$ = 2.50 M

7. (Molarity as a conversion factor)

   150 mL $\times \frac{0.300\ mol\ KCl}{1000\ mL} \times \frac{74.6\ g}{1\ mol\ KCl}$ = 3.36 g

8. (Solubility; Mass Percent)
   a) Saturated. 1 mole KNO_3 = 101g; since 101 g > 63 g, only 63 g dissolve and the solution is saturated.
   b) mass percent = $\frac{\text{mass solute}}{\text{mass solution}}$ x 100% = $\frac{63\ g\ KNO_3}{163\ g\ solution}$ × 100% = 39%

9. (Molarity; Dilution) $V_1 \times M_1 = V_2 \times M_2$; 1.50 L = 1500 mL

   25.0 mL × 6.00 M = 1500 m L × M_2; $M_2 = \frac{25.0\ mL \times 6.00\ M}{1500\ mL}$ = 0.100 M

10. (Mass percent as a conversion factor)

    250. g solution x $\frac{20.0\ g\ NaOH}{100\ g\ solution}$ = 50.0 g NaOH