

You have mastered this topic when you can:

- 1) determine the *concentration* of various *solutions*.
 - 2) determine the *mass* of *solute* mixed a given *volume* of *solvent* to create a given *concentration* of *solution*.
 - 3) determine the *volume* of *solvent* to which a given *mass* of *solute* to create a given *concentration* of *solution*.
-

CONCENTRATION

- I) When a solute is mixed with a solvent a solution is created. The amount of solute dissolved in a given amount of solvent is described by the term **CONCENTRATION**. The more solute dissolved in a given volume of solvent the greater the concentration of the solution. The less solute dissolved in a given volume of solvent the lower the concentration of the solution. The **concentration** of a solution is measured with the units called **MOLARITY**.

Molarity is defined here:

$$\text{MOLARITY} = \frac{\text{moles of solute}}{\text{volume of solvent in L}} = \text{M solute}$$

- A) **Molarity** is written with two possible sets of units that are given below. Be sure you remember each and that they are interchangeable. Square brackets around the formula of the solute mean ‘**the concentration**’ of the formula within the brackets. **i.e.** [CaS] means the concentration of CaS.

$$\frac{\# \text{ mol solute}}{\text{L}} = \# \text{ M solute}$$

- 1) **Molarity** means a given number of moles of solute is dissolved in exactly 1 L of water.

i.e. 1.25 M NaCl =

B) Sample Problems 1

1. Calculate the concentration of the solution created by dissolving 0.250 mol of NaCl_(s) in 0.200 L of water.
2. Calculate the concentration of the solution created by dissolving 55 g of NaCl_(s) in 0.250 L of water.
3. Calculate the concentration of the solution created by dissolving 0.050 mol of NaCl_(s) in 400.0 mL of water.
4. Calculate the concentration of the solution created by dissolving 38.5 g of NaCl_(s) in 375 mL of water.

C) Required Practice 1 {Answers are on page 3 of these notes.}

1. A dropper bottle for a chemical analysis contains 0.11 mol of calcium chloride in 60.0 mL of solution. Calculate the molar concentration of calcium chloride.
2. Brine is a solution of sodium chloride. 235 g of pure sodium chloride is dissolved in 3.00 L of water. Determine the concentration of sodium chloride.
3. Calculate the concentration of solute created when 0.35 mol of copper(II) nitrate is dissolved in 500.0 mL of water.
4. 10.0 g of sodium hydroxide is mixed with water to make a 2.00 L solution. Calculate the concentration of the solution created.

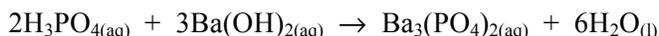
II) CALCULATIONS INVOLVING CONCENTRATION

A) Sample Problems 2

1. 2.00 L of 0.025 M NaCl reacts with excess AgNO₃. What mass of silver chloride is produced?

2. What mass of water is produced when 225 mL of 0.15 M Sr(OH)₂ reacts with excess HCl?

B) **Required Practice 2:** Use the balanced equation given below to answer the questions that follow. **{Answers are on page 3 of these notes.}**



1. The solute found in 0.550 L of 0.20 molar barium hydroxide reacts completely. Calculate the mass of barium phosphate produced.
2. What mass of water is produced when 155 mL of 0.200 M of Ba(OH)₂ reacts with excess H₃PO₄?
3. During an experiment investigating the chemical reaction described by the equation given above, Annie determined that a 500.0 mL solution contained a 0.100 M concentration of barium phosphate. What mass of barium hydroxide was used?
4. Determine the minimum mass of barium hydroxide required to react all of the solute in 150.0 mL of 0.06552 M phosphoric acid.

C) Sample Problems 3

1. Calculate the number of moles of solute required to create 0.500 L of 0.30 M NaCl.

2. Calculate the mass of calcium hydroxide required to create 0.250 L of a solution having a concentration of 1.2×10^{-3} M.

D) **Required Practice 3:** Answer these questions. **{Answers are on page 3 of these notes.}**

1. Calculate the number of moles of solute required to create 1.500 L of 0.040 M NaOH.
2. How many moles of solute are required to make 0.050 L of 1.305 M aluminum nitrate?
3. Calculate the mass of Cu(C₂H₃O₂)₂ that must be added to 0.6500 L to create a solution having a concentration of 0.12 M.
4. What mass of solute required to create 750.0 mL of 0.125 M Pb(NO₃)₂?
5. A beaker contains 50.0 mL of 5.0 M hydrochloric acid. How many moles of solute are in the beaker?

E) Sample Problems 4

1. 12.5 g of NaCl was added to what volume of water in order to create a 0.100 M solution of NaCl?

2. A 6.255×10^{-2} M $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ was created by adding 20.00 g of $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ to what volume of water?

F) Required Practice 4: Answer these questions. {Answers are on page 3 of these notes.}

1. Calculate the volume of water required to create a 0.455 M NaOH solution from 15.00 g of NaOH.

2. A 1.005 M aluminum nitrate was created by adding 12.25 g of aluminum nitrate to what volume of water?

3. Calculate the volume of water that 22 g of $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ was added to in order to create a solution having a concentration of 1.250 M $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$.

4. A 0.155 M $\text{Pb}(\text{NO}_3)_2$ solution was created by adding 6.5 g of the solute to what volume of water?

5. A solution of household ammonia has a concentration of 1.24 M NH_3 . What volume of this solution would contain 0.500 mol of ammonia?

6. A student wants to make a 2.6 mol/L solution using 0.14 mol of sodium sulphate. What volume of water will she need?

ANSWERS TO THE REQUIRED PRACTICE**Required Practice 1 from page 1**

1. 1.80 M CaCl_2 2. 1.34 mol/L NaCl 3. 0.70 M $\text{Cu}(\text{NO}_3)_2$ 4. 0.125 M NaOH

Required Practice 2 from page 2

1. 22 g $\text{Ba}_3(\text{PO}_4)_2$ 2. 1.12 g H_2O 3. 25.7 g $\text{Ba}(\text{OH})_2$ 4. 2.526 g $\text{Ba}(\text{OH})_2$
6. 0.403 L 7. 0.25 mol HCl

Required Practice 3 from page 2

1. 0.060 mol NaOH 2. 0.065 mol $\text{Al}(\text{NO}_3)_3$ 3. 14 g $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ 4. 31.1 g $\text{Pb}(\text{NO}_3)_2$ 5. 0.25 mol HCl

Required Practice 4 from page 3

1. 0.824 L 2. 0.05722 L or 57.22 mL 3. 0.097 L 4. 0.13 L 5. 0.403 L 6. 54 mL

BE SURE YOU PREPARE FOR MEMORY CHALLENGE-7 ON T44 – T52!!