

Pre-AP Chemistry – Unit 11 – Aqueous Systems

Objective 1: Students will understand and explain the composition and formation of solutions, including the concept of solubility. [S.15.C.1]

Objective 2: Students will calculate solution concentrations in various units (molarity (M), molality (m)) and quantify the effects of dilution on solutions.

Objective 3: Students will identify the types of common heterogeneous mixtures. [S.15.C.2]

Objective 1

1. Define the terms solvent, solute, solvation, solubility, Henry's Law.
2. Explain why some solutes do not dissolve in some solvents. Site Examples....
3. Explain the solvation process with sodium chloride and water.
4. Explain how the following factors affect the solution process:
 - (a) Agitation
 - (b) Temperature
 - (c) Pressure
 - (d) Surface Area
5. The solubility of Nitrogen gas at 101.9 kpa is 1.9g/L at 37 degrees Celsius. What would be the new solubility if the pressure was increased to 120.7 kpa at the same temperature?

Objective 2

1. (a) Calculate the molarity of a solution that contains 10g of NH_4Cl in exactly 400mL of solution. (b) How many moles of HNO_3 are present in 35.0mL of a 2.20M solution of nitric acid? (c) How many milliliters of a 1.50M KOH solution is needed to obtain 25.0g of KOH?
2. Calculate the molality of each of the following solutions: (a) 8.66g benzene (C_6H_6) dissolved in 23.6g of carbon tetrachloride (CCl_4); (b) 4.80g of NaCl dissolved in 0.350L of water ($d_{\text{water}} = 1.0\text{g/mL}$).
3. (a) Determine the concentration of a solution produced when 7.50 mL of 1.56M KOH is mixed with 450.0mL of deionized water. (b) What volume of 0.53 molar lithium chloride is needed to make 900.0mL of a 0.25 molar solution of the same material?

Objective 3

1. Define the following: colloid, emulsion, suspension.
2. List three types of colloids.
3. What helps to hold an emulsion together? Cite a specific example.

Molarity & Molality Notes and Practice

Answer the questions below. SHOW ALL WORK, including units!!

Molarity

Just a reminder, molarity is one of the many ways to measure concentration or the strength of a solution. When using molarity to measure concentration you must follow the formula below and then put a capital M to represent mol / L

$$M = \frac{\text{moles of solute}}{\text{Liters of solvent}}$$

Liters of solvent

1. Calculate the molarity of a solution which contains 0.40 mol of a substance dissolved in 1.6 L of a solution.
2. What is the molarity of a solution containing 325 g of NaCl dissolved in 750. mL of solution?
3. 140 g of KCl is dissolved in 600. mL of water. What is the molarity?
4. 724.4 g of ammonium phosphate in 4500 mL of alcohol. What is the molarity of the solution?
5. You are making 2.2 L of 3.1 M AgNO_3 solution. How many moles of solute are there?
6. How many grams of MgCl_2 are needed to make 700.mL of a 1.4 M solution?
7. 93.2 g of copper (II) sulfate is mixed into 290. mL of water. What is the molarity?
8. What will the volume in mL of a 0.50 M solution be if it contains 25 grams of sodium hydroxide?

Molality

Molality is an additional way to measure the strength or concentration of a solution. It is abbreviated with a little m and is calculated only slightly differently than molarity. Here is the formula.

$$m = \frac{\text{moles of solute}}{\text{kg of solvent}}$$

- ♣ You will be given two mass measurements and you must decide which is the solute and which is the solvent.
- ♣ Look for the phrases "dissolved in," "placed in," or "mixed with" to identify the two parts. The solute comes before the phrase and the solvent comes after.

- ♣ Change the solute into moles (factor label)

- ♣ Change solvent into kg (KHDBdcm)

- ♣ Molality and molarity can be very close if water is the solvent.

Example:

190 g of CuSO_4 are placed in 3500 g of water. Determine the molality.

$$\text{Solute: } \frac{190 \text{ g CuSO}_4}{159.9 \text{ g}} \cdot 1 \text{ mole} = 1.2 \text{ mole CuSO}_4$$

$$\text{Solvent: } 3500 \text{ g} = 3.5 \text{ kg water}$$

$$\text{Molality} = \frac{1.2 \text{ moles}}{3.5 \text{ kg}} = 0.30\text{m}$$

Mixed Problems

Decide if the problem is molarity or molality so you know which formula to use.

9. What mass of Ca(OH)_2 must dissolve in 850 mL of water to make a 2.4 M solution?

10. 326g of C_6H_6 dissolve in 820. g of acetone. What is the molality?

11. What mass of NaCl must dissolve in 400. g of ethanol to make a 1.6 m solution?

12. What volume of water must be added to 325 g of chromium (III) carbonate to make a 0.90 M solution?

13. How many grams of BeCl_2 would you need to add to 125 mL of water to make a 0.050 molal solution?

14. What mass of ethanol is 360. g of $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, sucrose, dissolved in to make a 1.6 m solution? If the density of ethanol is 0.89 g/mL, determine the volume of ethanol used.

Dilutions Worksheet

- 1) If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?
- 2) If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?
- 3) How much 0.05 M HCl solution can be made by diluting 250 mL of 10 M HCl?
- 4) I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?
- 5) How much water would I need to add to 500 mL of a 2.4 M KCl solution to make a 1.0 M solution?