

Unit #3: Chemistry and the Environment

Solvent: the pure substance in solution that _____ the other components, usually the substance in _____ quantity

Solute: the pure substance in a solution that is _____ by the solvent, usually the substance in _____ quantity

Concentration

Concentration: the amount of _____ per quantity of solvent

Dilute Versus Concentrated: _____ versus _____ quantity of solute in the solvent.

When is knowing the concentration of a solution important?

- _____
- _____
- _____
- _____
- _____

A. Percentage Concentrations

1. volume/volume (V/V) percent =

e.g. vinegar is 5% V/V acetic acid, which means that in a 100 mL solution of vinegar, there are _____ mL of acetic acid.

2. Weight/weight (W/W) percent =

e.g. In a 200 g tube of toothpaste, there are 0.486 g of dissolved sodium fluoride.
W/W concentration of NaF =

3. Weight/volume (W/V) percent =

e.g. A salt solution has 12.8 g of salt in 1 L of solution. .
W/V concentration of NaCl =

B. Parts per Million

- concentrations of very small quantities can be expressed in parts per million (ppm)

ppm =

e.g. In a 0.25 L sample of pond water, 2.2 mg of dissolved oxygen are measured.
Concentration of O₂ in ppm =

C. Molar Concentration (Molarity) – the number of _____ of solute that is dissolved in _____ of solution (mol/L or M)

Molarity =

c =

Ex. 1 A solution contains 5.85 g of sodium chloride dissolved in 5000 mL of water. What is the concentration of the sodium chloride in mol/L?

Ex. 2 What is the concentration in mol/L of a solution that contains 49 g of sulfuric acid, H₂SO₄, in 3.0 L of solution.

Ex. 3 What mass of potassium hydroxide (KOH) is required to prepare 600 mL of a 0.225 mol/L solution?

Ex. 4 A solution containing 0.125 mol/L of magnesium chloride, MgCl_2 , is required for an experiment. If 87.8 g of solid MgCl_2 is available, what is the maximum volume of solution that can be prepared?

Concentration Worksheet

Equations:

% V/V

% W/W

% W/V

ppm

mol/L

mass \longleftrightarrow mole

- The perfect cup of hot chocolate contains 28g of hot chocolate powder in 175 mL of steaming hot water.
 - Calculate the percent concentration of hot chocolate (W/V).
 - A styrofoam cup holds 140 mL of hot chocolate. Based on the perfect concentration you found in part a), how many grams of powder are dissolved in this cup of hot chocolate?
 - OPTIONAL: If you would like a cup of hot chocolate, measure out the correct mass of powder directly into a Styrofoam cup (tare the balance with a paper towel on top). Fill the cup with hot water to get 140 mL (that's to just below the rim). Stir and enjoy while you finish these problems! Add a marshmallow if you like.
- The maximum acceptable concentration of fluoride ions in municipal water supplies is 1.5 ppm. What is the maximum mass of fluoride ions you would get from a 0.25 L glass of water?
- Determine the molar concentration of these solutions:
 - 4.67 moles of Li_2SO_3 dissolved to make 2.04 L of solution
 - 0.629 moles of Al_2O_3 to make 1.500 L of solution
 - 4.783 g of Na_2CO_3 to make 10.00 L of solution
- Seawater contains roughly 28.0 g of NaCl per litre. What is the molar concentration of sodium chloride in sea water?
- Seawater also contains magnesium chloride MgCl_2 , at a concentration of 0.055 mol/L. What volume of seawater contains 4.1 mol of magnesium chloride?
- What is the molar concentration of 5.30 g of sodium carbonate, Na_2CO_3 , dissolved in a 400 mL solution?
- How many moles of sodium carbonate, Na_2CO_3 , are there in 10.0 L of 2.0 mol/L solution?
- How many moles of NaCl are contained in 100.0 mL of a 0.20 mol/L solution?
 - What mass (in g) of NaCl would be contained in this solution?
- What mass (in g) of sulfuric acid, H_2SO_4 , would be needed to make 750.0 mL of 2.00 mol/L solution?
- What volume of 7.6 mol/L hydrochloric acid, HCl, must be poured into a flask to obtain 0.050 mol of hydrochloric acid? Give your answer in litres and millilitres.

Answers:

1. a) 16% W/V solution b) 22.4 g 2. 0.375 mg 3. a) 2.3 mol/L b) 0.4 mol / L
c) 0.0045 mol / L 4. 0.48 mol / L 5. 75 L 6. 0.125 mol / L 7. 20 mol
8 a) 0.02mol b) 1.17g 9. 147 g 10. 0.0066 L or 6.6 mL