

Solution Composition:

Solution—one substance dissolved in another

2 parts:

1. solute—substance being dissolved
substance have smallest amount of
2. solvent—substance doing the dissolving
substance have most of
water—universal solvent

Concentration:

Molarity = $\frac{\text{moles of solute}}{\text{L of solution}}$

Symbol M

Changes slightly with temperature because of the volume.

$$\text{Mass percent} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

sometimes called weight percent or percent by weight

mass of solution = mass of solute + mass of solvent

* can be expressed as ppm (parts per million) or ppb (parts per billion)

ppm use 10^6 and ppb use 10^9 instead of 100

mole fraction (χ) = $\frac{\text{moles of solute}}{\text{total moles of solution}}$
 χ

total # moles = moles of solute + moles of solvent

χ = chi = symbol for mole fraction

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

Symbol m

not affected by temperature; depends on mass

if a solution is very dilute the molarity and molality are almost the same value.

Ex. 1

A solution is made by dissolving 13.5 g of glucose ($C_6H_{12}O_6$) in 0.100 kg of water.

- What is the mass percent of solute in this solution?
- What is the molality of the solution?
- What is the molarity of the solution?

$$\begin{aligned} \text{a) } \text{mass } \% &= \frac{\text{mass solute}}{\text{mass soln}} \times 100 \\ &= \frac{13.5 \text{ g}}{\cancel{.100 \text{ kg}} + 13.5 \text{ g}} \times 100 \\ &\quad \quad \quad 100 \text{ g} \\ &= \frac{13.5 \text{ g}}{113.5 \text{ g}} \times 100 \\ &= 11.9\% \end{aligned}$$

Ex. 2

A 2.5 g sample of groundwater was found to contain 5.4 μg of Zn^{2+} . What is the concentration of zinc ions in parts per million?

Ex. 3

Calculate the mass percentage of NaCl in a solution containing 1.50 g of NaCl in 50.0 g of water

Ex. 4

A commercial bleaching solution contains 3.62 mass percent sodium hypochlorite, NaOCl. What is the mass of NaOCl in a bottle containing 2500 g of bleaching solution?

Ex. 5

A solution is made by dissolving 4.35 g of glucose in 25.0 mL of water. Calculate the molality of glucose in the solution.

Ex. 6

A solution of hydrochloric acid contains 36 % HCl by mass.

(a) calculation the mole fraction of HCl in the solution.

(b) Calculate the molality of the solution.

Ex. 7

A commercial bleach solution contains 3.62 mass % NaOCl in water. Calculate

(a) the molality

(b) the mole fraction of NaOCl in the solution

Ex. 8

A solution contains 5.0 g of toluene (C_7H_8) and 225 g of benzene and has a density of 0.876 g/mL. Calculate the molarity of the solution.

Ex. 9

A solution containing equal masses of glycerol ($\text{C}_3\text{H}_8\text{O}_3$) and water has a density of 1.10 g/mL. Calculate

- (a) the molality of glycerol
- (b) the mole fraction of glycerol
- (c) the molarity of glycerol in the solution.