Chemical Composition

Equation Sheet

Moles **(mol)**	**Atoms, molecules, formula units, particles**
	Avogadro's Number **6.022×10^{23} particles / mole**

Molar Mass **Sum of the masses of all elements in a compound (g/mol)**	**Mass (grams, g)**
	Moles (mol)

Molar Mass: sum of all the masses of the elements in a compound.

Ex. H_2O

H = 2 x 1.01 = 2.02

O = 1 x 16.0 = 16.00

18.02 g/mol

Percent Composition

$$\text{\% composition} = \frac{\text{Mass of element}}{\text{Mass of compound}} \times 100$$

H = 2 x 1.01 = 2.02

O = 1 x 16.0 = 16.00

18.02 g/mol

% H = (2.02 / 18.02) x 100 = 11.20 %

% O = (16.00 / 18.02) x 100 = 88.79 %

Chemical Composition

Equation Sheet

Empirical Formula:

1. **Convert percentage to grams (change unit)**
2. **Divide grams by the atomic mass of the element**
3. **Divide each # of moles by the smallest number of moles**
4. ****Special numbers: To get a whole number...**
    a. **0.25 multiply all values by 4**
    b. **0.50 multiply all values by 2**
    c. **0.67 or 0.33 multiply all values by 3**
5. **To find the Molecular formula, divide the molecular mass (must be given in the problem) by the empirical mass to find the ratio.**
6. **Multiply all subscripts in the empirical formula by the ratio to get the molecular formula**

Example: What is the empirical formula of a compound that has 25.18% hydrogen and 74.81 % carbon?

25.18 % H 74.81 % C

25.18 g H / 1.01 = 24.93 mol H / 6.23 = 4 CH_4

74.81 g C / 12.01 = 6.23 mol C / 6.23 = 1

Example: What is the molecular formula of a compound that has 25.18% hydrogen and 74.81 % carbon, the molecular mass of the compound is 64.0 g/mol?

Empirical formula is CH_4. The empirical mass is (C = 12.0) + H =(4 x 1.01) = 16.0 g/mol

$$\text{Ratio} = \frac{\text{molecular mass}}{\text{empirical mass}} = \frac{64.0\ \text{g/mol}}{16.0\ \text{g/mol}} = 4$$

Molecular formula = C_4H_{16}

Chemical Composition

Equation Sheet

Concentration Units

Solution: solvent (largest quantity: it does the dissolving) + solute (smallest quantity it gets dissolved)

Molar Volume **22.414 L/mol**	**Volume (liters)**
	Moles (mol)

Molar Volume **22.414 L/mol**	**Molar Mass (g/mol)**
	Density **(g/L)**

Moles (mol)	
Molarity **Moles solute / L solution**	**Volume of solution** **Liters (L)** **1000 ml = 1 L**

Moles **(mol)**	
Molality **Moles solute / kg solvent**	**Mass of solvent** **Kilograms (kg)** **1000 g = 1 kg**

Chemical Composition

Equation Sheet

Percent by mass (m/m) =	Mass of solute / Mass of solvent	X 100

Percent by volume (v/v) =	Volume of solute / Volume of solvent	X 100

$M_1 \times V_1$	=	$M_2 \times V_2$

Percent by mass (m/m) =	Mass of solute / Mass of solvent	X 100

Moles (mol)	
Molarity Moles solute / L solution	Volume of solution Liters (L) 1000 ml = 1 L

Moles

Chemical Composition

Equation Sheet

(mol)	
Molality **Moles solute / kg solvent**	**Mass of solvent** **Kilograms (kg)** **1000 g = 1 kg**

Percent by mass (m/m) =	**Mass of solute** **Mass of solvent**	**X 100**

Percent by volume (v/v) =	**Volume of solute** **Volume of solvent**	**X 100**

$M_1 \times V_1$	=	$M_2 \times V_2$

Percent by mass (m/m) =	**Mass of solute** **Mass of solvent**	**X 100**