Qualitative and quantitative analysis, empirical and molecular formulae

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Percentage of carbon (Liebig)	%C = (12 / 44) x (mass CO2 / mass compound) x 100 Valid when: all carbon converted to CO2 and fully absorbed (Liebig method)	percent by mass
Percentage of hydrogen (Liebig)	%H = (2 / 18) x (mass H2O / mass compound) x 100 Valid when: all hydrogen converted to H2O and fully absorbed (Liebig method)	percent by mass
Percentage of nitrogen (Dumas)	%N = (28 x V(STP) / 22 400) / mass x 100; dry pressure = total pressure - aqueous tension Valid when: all N released as N2, volume at STP, dry gas (Dumas method)	V in mL; percent by mass
Percentage of nitrogen (Kjeldahl)	%N = 1.4 x (normality x volume of acid used by NH3 in mL) / mass of compound in g Valid when: N converted to NH3 (not for nitro, azo or ring N); acid in mL, normality	percent by mass
Percentage of halogen (Carius)	%Cl = (35.5 / 143.5) x (mass AgCl / mass) x 100; %Br = (80 / 188) x (mass AgBr / mass) x 100 Valid when: halogen fully precipitated as silver halide (Carius method)	percent by mass
Percentage of sulphur (Carius)	%S = (32 / 233) x (mass BaSO4 / mass) x 100 Valid when: sulphur fully oxidised and precipitated as BaSO4 (Carius method)	percent by mass
Percentage of phosphorus	%P = (62 / 222) x (mass Mg2P2O7 / mass) x 100 Valid when: phosphorus fully precipitated as Mg2P2O7	percent by mass
Empirical formula	ratio of (percentage / atomic mass), divided by the smallest; oxygen % = 100 - sum of the others Valid when: percentages by mass add to 100; oxygen found by difference	whole-number ratio
Molecular formula	n = molar mass / empirical mass; molar mass = 2 x vapour density (relative to H2) Valid when: empirical formula and molar mass known; molar mass = 2 x vapour density	g mol^-1

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/purification-and-characterisation-of-organic-compounds/qualitative-an

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