CHEMWHIZ QUICK REFERENCE

TOPIC 03

Atomic Structure & Isotopes

Subatomic particles, atomic and mass number, isotopes, average atomic mass, shells, and Lewis dots.

01 Subatomic particles — CORE RULE

Proton: +1, in the nucleus. Neutron: 0 charge, in the nucleus. Electron: −1, outside the nucleus.

Proton ≈ neutron ≈ 1 amu; electron ≈ 0.00055 amu (far lighter).

02 Neutral atom — CORE RULE

In a neutral atom, electrons = protons. Nearly all the mass is in the nucleus.

03 Counting particles — METHOD

Z (atomic number) = number of protons; it identifies the element.

A (mass number) = protons + neutrons = Z + N.

Neutrons: N = A − Z.

Ion electrons = Z − charge (positive: lost electrons; negative: gained electrons).

04 Isotopes — CORE RULE

Isotopes: same element (same protons), different neutron count and mass number.

05 Isotope notation — CORE RULE

Symbol notation: mass number A as left superscript, atomic number Z as left subscript (e.g. $^{14}_{6}C$).

Name notation: element name + hyphen + mass number (carbon-14, uranium-235).

06 Average atomic mass — METHOD

Weighted average = Σ (isotopic mass × fractional abundance).

Convert % abundance to decimal first; fractional abundances sum to 1.00.

The more abundant isotope pulls the average toward its mass; that is why atomic masses are not whole numbers.

07 Electron shells (first 20 elements) — CORE RULE

Introductory fill pattern through calcium: 2, 8, 8, then up to 2 in shell 4 (not the full physical capacities).

Valence electrons (main group) = electrons in the outermost occupied shell.

08 Lewis dot symbols — CORE RULE

Element symbol surrounded by one dot per valence electron.

One dot on each side before pairing a second on any side. He is drawn with 2 (its first shell is full).

09 Common ion charges — REFERENCE

Group 1 → +1 · Group 2 → +2 · Al → +3 · Group 16 → −2 · Group 17 → −1 · N, P → −3. Introductory patterns, not universal.

10 Ionic formulas & naming — CORE RULE

Balance charge with the cross-over rule (each ion's charge magnitude becomes the other's subscript), then reduce to the smallest whole-number ratio.

Binary ionic name: metal + nonmetal root + -ide. $Na^{+} + Cl^{-} \rightarrow NaCl$; $Mg^{2+} + O^{2-} \rightarrow MgO$; $Li^{+} + S^{2-} \rightarrow Li_2S$; $Al^{3+} + N^{3-} \rightarrow AlN$.