CHEMWHIZ QUICK REFERENCE

TOPIC 13

Periodic Properties & Trends

Effective nuclear charge and the radius, ionization energy, electron affinity, electronegativity, and ionic-size trends.

01 Effective nuclear charge — CORE RULE

Z_eff = protons minus shielding by core and same-shell electrons (core shields well, same-shell poorly). It rises left-to-right across a period and drives the radius and IE trends.

02 Atomic radius — CORE RULE

Radius increases down a group (higher n shell) and decreases across a period (higher Z_eff pulls the same-shell valence electrons in tighter).

03 Ionization energy — CORE RULE

IE_1 rises across a period, falls down a group. Two dips: Be → B (B loses a higher-energy 2p) and N → O (O loses a paired 2p, restoring half-filled stability).

04 Successive IE jump — CORE RULE

$IE_1 < IE_2 < IE_3$ … always. A sharp jump appears when the next electron removed is a core electron: a jump after IE_n means n valence electrons.

05 Electron affinity — CORE RULE

EA generally becomes more negative across a period. Exceptions: groups 2, 15, 18. Cl has the most negative EA (adding an electron to tiny F is destabilized by repulsion).

06 Electronegativity — CORE RULE

Electronegativity (Pauling) increases up and to the right; F is highest (χ = 3.98). Use it qualitatively, for ranking and comparison.

07 Ionic radius — CORE RULE

A cation is smaller than its atom (fewer electrons, higher Z_eff each; main-group cations expose the inner shell).

An anion is larger than its atom (added electrons raise repulsion, lower Z_eff each). S: 104 → S^{2-} 170 pm.

08 Isoelectronic series — CORE RULE

Same electron count = isoelectronic. Radius shrinks as Z rises. 10-e^- set: $N^{3-} > O^{2-} > F^- > Ne > Na^+ > Mg^{2+} > Al^{3+}$.

09 Bond character from ΔEN — REFERENCE

ΔEN	Bond type
< ~0.4	nonpolar covalent
~0.4 to <~1.7	polar covalent
≥ ~1.7	ionic

Rough guide only: the thresholds are heuristic, and some borderline cases go by chemistry (e.g. NaH, ΔEN ≈ 1.2, is treated as ionic).

10 Group similarity — CORE RULE

Same-group elements share a valence configuration (Ca, Sr, Ba are ns^2) so they share reactivity, oxidation states, and bonding. Diagonal likenesses (Be↔Al, Li↔Mg) are secondary.