

1. Atomic Radius (Size)**General trend**

- Increases down a group
- Decreases across a period (left → right)

Usual order (same period)

Group 1 > Group 2 > Group 13 > Group 14 > Group 15 > Group 16 > Group 17

Key exceptions

- N > O > F**
Due to strong electron–electron repulsion in compact p-orbitals
- Ga < Al**
Because of **d-block contraction**
- Pb ≈ Sn** (sometimes Pb smaller)
Due to **lanthanide contraction**

2. Ionic Radius**General trend**

- Cations < neutral atom
- Anions > neutral atom
- Increases down a group

Isoelectronic series order

Greater nuclear charge → smaller ion

$N^{3-} > O^{2-} > F^- > Ne > Na^+ > Mg^{2+} > Al^{3+}$

3. Ionization Energy (IE)**General trend**

- Increases across a period
- Decreases down a group

Usual order (period 2)

$Li < Be < B < C < N < O < F < Ne$

Important exceptions

- Be > B**
(filled 2s orbital is more stable)
- N > O**
(half-filled p^3 is more stable than p^4)
- Al < Mg**
- S < P**

4. Electron Affinity (EA)**General trend**

- Becomes **more negative across a period**
- Less negative down a group

Expected order

$Cl > F > Br > I$

Exceptions

- Cl > F**
(small size of F causes e^-e^- repulsion)
- N, Be, Mg, noble gases ≈ zero or positive EA**
 - N: half-filled p^3
 - Be/Mg: filled s^2
 - Noble gases: complete octet

5. Electronegativity (EN)**General trend**

- Increases across a period
- Decreases down a group

Highest to lowest (common)

$F > O > N > Cl > Br > I > S > C > P$

Exceptions / notes

- N > Cl** (sometimes surprises students)
- Noble gases usually **excluded**
- F is the most electronegative element**

6. Metallic Character**General trend**

- Increases down a group
- Decreases across a period

Order (period 3)

$Na > Mg > Al > Si > P > S > Cl$

Exception

- Al > Mg** in some chemical reactions (due to high charge density)

7. Oxidizing & Reducing Power**Oxidizing power (non-metals)**

$F_2 > Cl_2 > Br_2 > I_2$

Reducing power (metals)

$Cs > Rb > K > Na > Li$

Exception

- Li is strongest reducing agent in aqueous solution**
(high hydration enthalpy)

8. Shielding Effect**General trend**

- Increases down a group
- Almost constant across a period

Exception

- d and f electrons shield poorly**
→ causes:
 - Lanthanide contraction**
 - High density & high IE in transition metals

9. Inert Pair Effect**Observed in**

- Heavier p-block elements (Group 13–16)**

Effect

Lower oxidation states become more stable down the group

Example

Group 13: $+3 \rightarrow +1$ (Tl^+ most stable)

Group 14: $+4 \rightarrow +2$ (Pb^{2+} stable)

10. Diagonal Relationship

Elements diagonally adjacent show similar properties:

$Li \leftrightarrow Mg$

$Be \leftrightarrow Al$

$B \leftrightarrow Si$

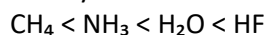
Reason: similar **charge density and size**

11. Lanthanide Contraction**What it is**

1. Acidic strength of hydrides (H–X)

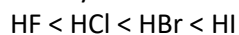
Across a period (left → right)

Acidity **increases** with electronegativity:



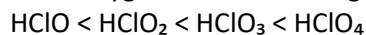
Down a group (top → bottom)

Acidity **increases** with size (weaker H–X bond):



2. Acidic strength of oxoacids (same central atom)

More oxygen atoms → stronger acid



Reason: greater **–I effect** and better resonance stabilization.

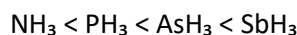
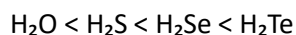
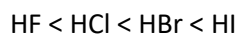
3. Oxoacids with different central atoms (same oxidation state)

Higher electronegativity → stronger acid



4. Acidic strength of binary acids of non-metals

General order:



Key idea: **bond strength decreases down the group**

Gradual decrease in atomic & ionic radii from La → Lu Consequences

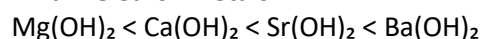
- Zr ≈ Hf in size
- High density & melting point of 5d elements
- Ga < Al (size anomaly)

5. Acidic strength of metal hydroxides

Alkali metals



Alkaline earth metals



(As metallic character increases, basicity increases → acidity decreases)

6. Acidic strength of oxides

Period 3 oxides

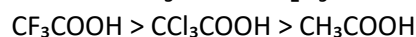


- Metal oxides → basic
- Non-metal oxides → acidic
- **Al₂O₃ is amphoteric**

7. Acidic strength of organic acids

Carboxylic acids

Electron-withdrawing groups increase acidity:

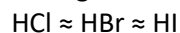


Phenols (substituent effect)



8. Acidic nature of hydrogen halides in water

Strong acids:



Weak acid:



Exception reason: **very strong H–F bond**

9. Acidic strength of polyprotic acids (same acid)

Successive ionization:

