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CHEMISTRY

REVISION NOTES

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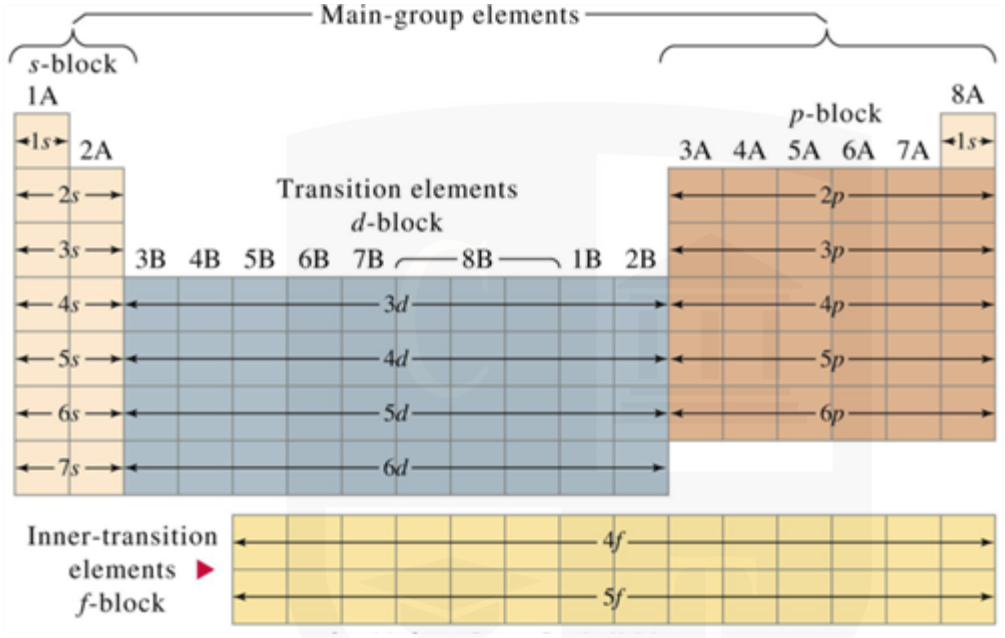
Periodicity

Classification of elements in s, p, d and f block.

Elements are classified as s, p, or d blocks depending on the highest energy electrons' orbitals.



Atomic radius

Period 2:

- Atomic radius generally decreases across Period 2.
- Electrons are added to the same energy level, leading to increased effective nuclear charge.
- Lithium has the largest atomic radius, and fluorine has the smallest.

Period 3:

- Atomic radius generally decreases across Period 3.
- The increase in effective nuclear charge outweighs the shielding effect.
- Sodium has the largest atomic radius, and chlorine has the smallest.

In both periods, there's a general trend of decreasing atomic radius from left to right.

1st ionisation energy

The first ionisation energy generally increases across a period. This is because, as you move from left to right, the atomic number increases, leading to a higher number of protons in the nucleus. The greater positive charge in the nucleus attracts electrons more strongly, making it harder to remove them.

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Now, let's focus on the dip between magnesium (Mg) and aluminium (Al) and further between phosphorus (P) and sulfur (S):

Magnesium to Aluminum:

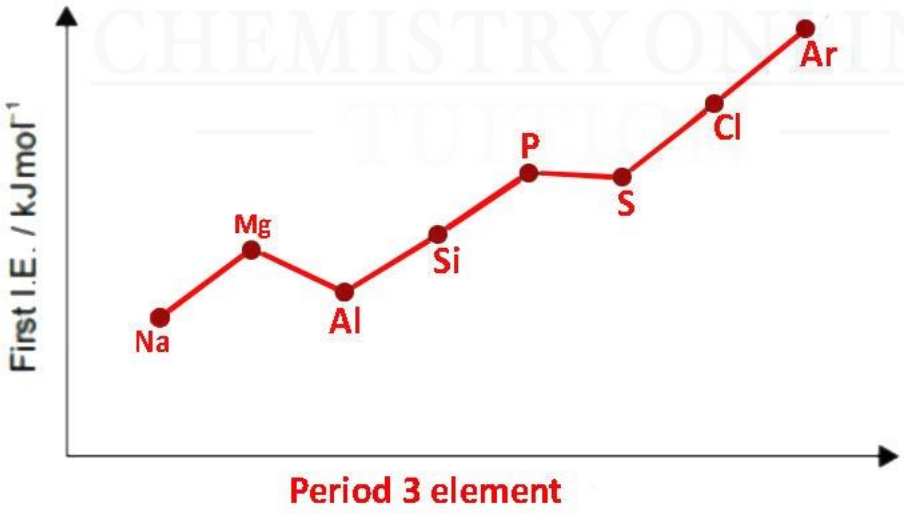
- Magnesium (Mg) has an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2$. The electrons being removed are in the 3s subshell.
- Aluminum (Al) has a configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$. The extra electron is in a p orbital.
- The dip in ionisation energy occurs because removing an electron from the 3p orbital in aluminium requires breaking into a new subshell, which involves a higher energy cost. The 3p orbital is slightly higher in energy than the 3s orbital, leading to a dip in ionisation energy between Mg and Al.

Phosphorus to Sulfur:

- Phosphorus (P) has a configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$.
- Sulfur (S) has a configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$.
- The dip occurs because, in sulfur, you have pairs of electrons in the 3p orbitals. Electrons in paired orbitals repel each other, making it easier to remove one electron compared to phosphorus, where all three p electrons are unpaired. This repulsion lowers the energy required to remove an electron in sulfur compared to phosphorus.

In summary, the dip in ionisation energy between magnesium and aluminium is due to the transition from a 3s to a 3p orbital, and the dip between phosphorus and sulfur is influenced by the electron-electron repulsion in the paired p orbitals of sulfur.

Please find below the graph which represents 1st ionisation energy.



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Melting and boiling points

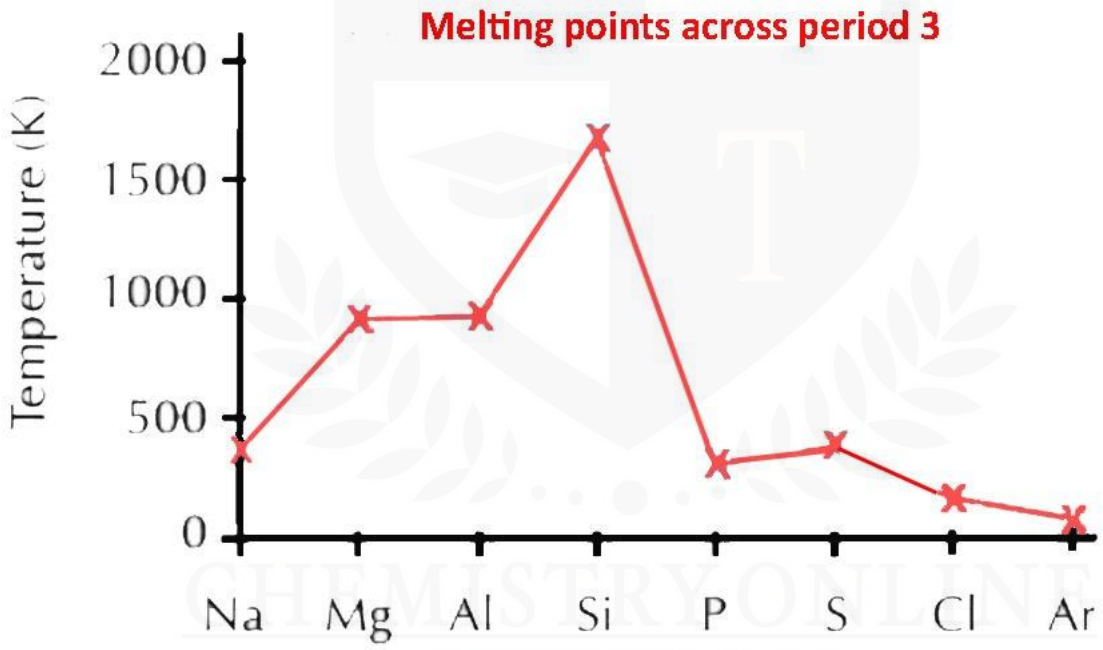
Na, Mg, and Al, the strong metallic bonding occurs due to the presence of more electrons in the outer shell that are released into a sea of electrons. A smaller positive centre also strengthens the bonding, and it takes higher energy to break these bonds.

Si has a Macromolecular structure with many strong covalent bonds between atoms. The energy required to break these covalent bonds is very high, which results in a very high melting point.

On the other hand, Cl_2 (g), S_8 (s), and P_4 (s) have simple molecular structures. The weak van der Waals forces between molecules result in low melting and boiling points since little energy is needed to break them.

S_8 has a higher melting point than P_4 because it has more electrons, resulting in stronger van der Waals forces between molecules.

Finally, Ar is a monoatomic element with weak van der Waals forces between atoms.



Exam Questions

There is a general trend for an increase in ionisation energy across Period 3. Give **one** example of an element that deviates from this trend.

Explain why this deviation occurs.

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Explain why the atomic radii of the elements decrease across Period 3 from sodium to chlorine.

Explain why the melting point of sulfur (S_8) is greater than that of phosphorus (P_4).

Which represents the correct order of increasing radius of the ions?

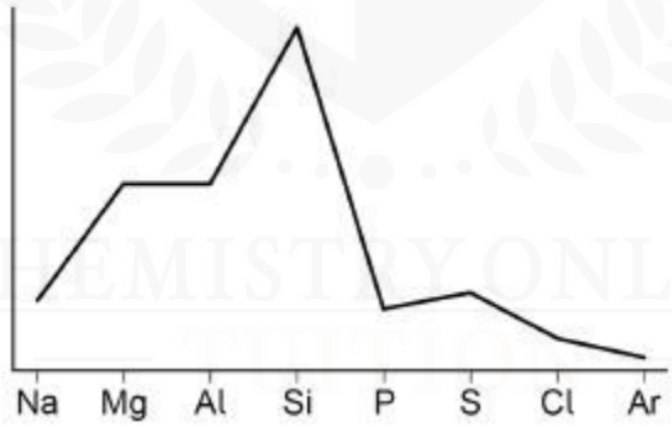
A F^- O^{2-} Li^+ Be^{2+} ⬭

B Li^+ Be^{2+} O^{2-} F^- ⬭

C Be^{2+} Li^+ F^- O^{2-} ⬭

D O^{2-} F^- Li^+ Be^{2+} ⬭

The diagram shows how a property of Period 3 elements varies across the period.



What is the property?

A Atomic radius ⬭

B Electronegativity ⬭

C First ionisation energy ⬭

D Melting point ⬭

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