CHEMISTRY ONLINE
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CHEMISTRY

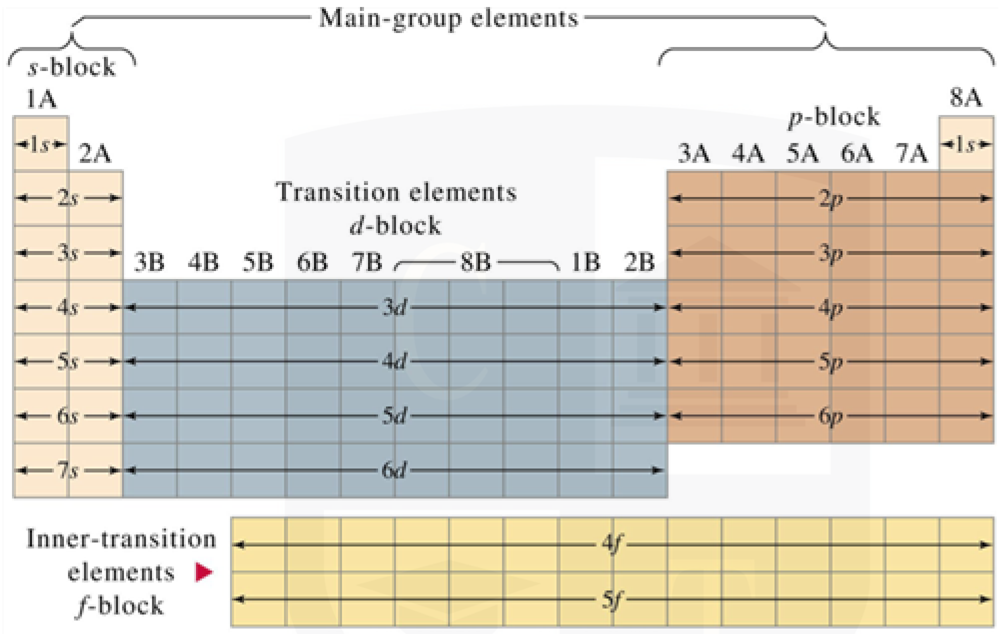
REVISION NOTES

PERIODICITY

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.

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

Magnesium to Aluminum:

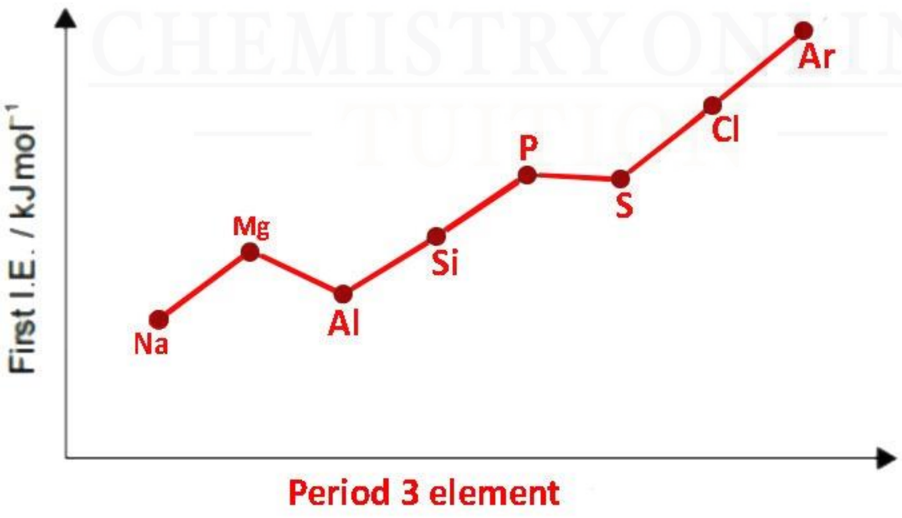
- Magnesium (Mg) has an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2$. The electrons being removed are in the 3s subshell.
- Aluminum (Al) has a configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$. The extra electron is in a p orbital.
- The dip in ionisation energy occurs because removing an electron 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.



Melting and boiling points

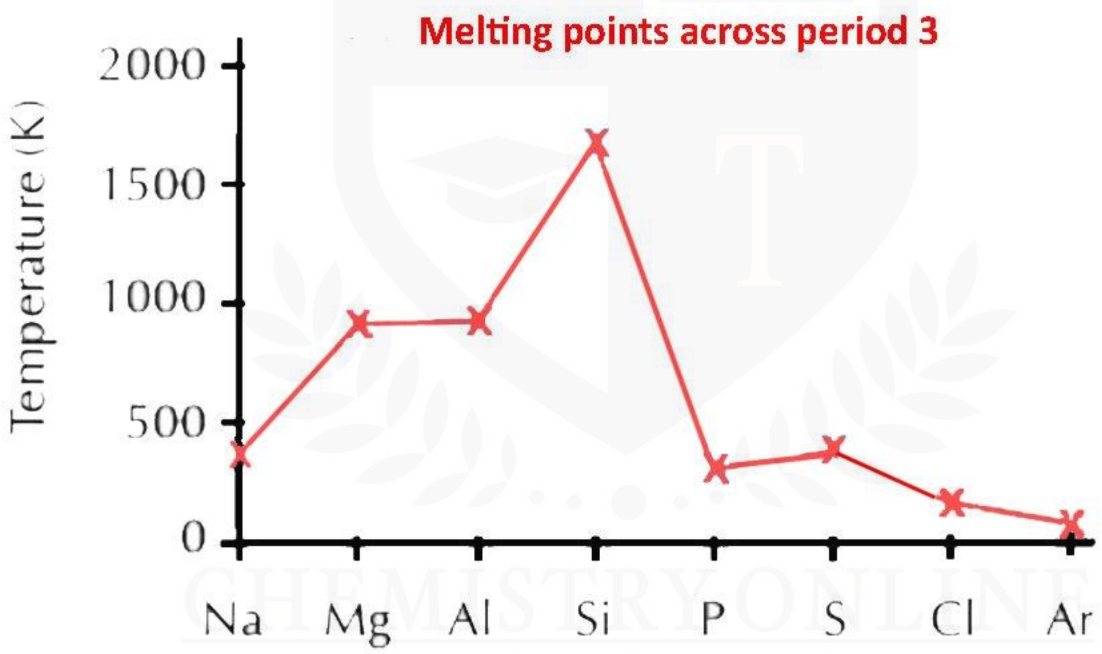
Na, Mg, and Al, the strong metallic bonding occurs due to the presence of more electrons in the outer shell that are released into a sea of electrons. A smaller positive centre also strengthens the bonding, and it takes higher energy to break these bonds.

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

Give the meaning of the term 'periodicity'.
Illustrate your answer by referring to the atomic radii of the Period 2 and Period 3 elements.
Specific values of atomic radii are not required.

(3)

Ionisation energies provide information about the number of electrons and the arrangement of the electrons in an atom of an element.

Estimate a value for the first ionisation energy of oxygen given the data in the table.

(1)

Element	First ionisation energy / $kJ\,mol^{-1}$
carbon	1086
nitrogen	1402
oxygen	....

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* The melting temperatures of the Period 2 elements are shown.

Symbol of the element	Li	Be	B	$C_{(diamond)}$	N	O	F	Ne
Melting temperature / K	454	1551	2573	3970	63	55	53	25

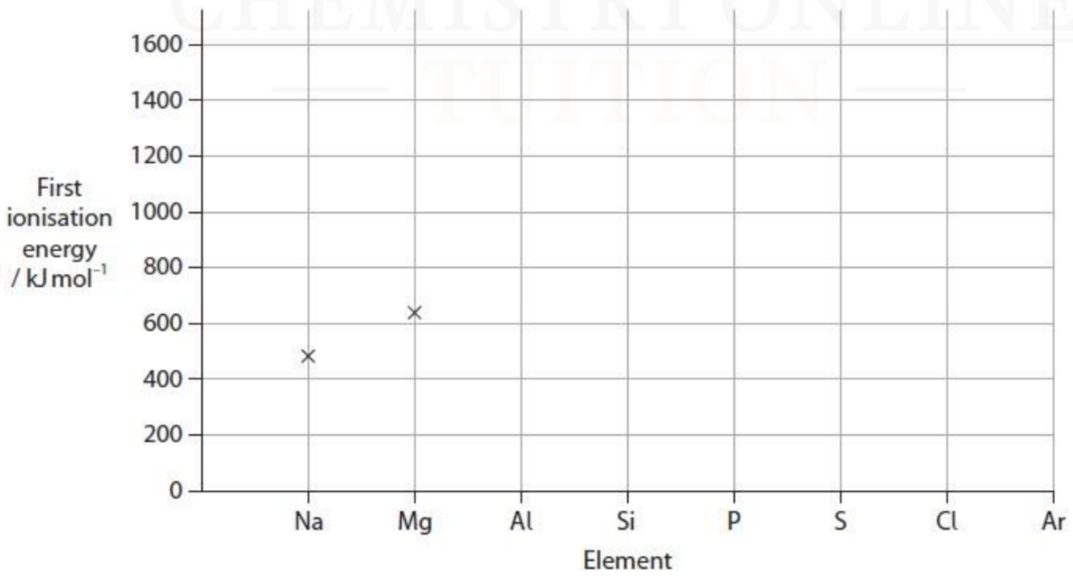
Explain the trend in melting temperatures across the elements of Period 2 in terms of their structure and bonding.

(6)

This question is about ionisation energies.
(i) Complete the graph to show how the first ionisation energies of the Period 3 elements change across the period. Precise figures are not required.

(3)

First ionisation energies of the Period 3 elements



This question is about hydrogen, the element with atomic number Z = 1.

(i) Write an equation to represent the first ionisation energy of hydrogen. Include state symbols.
