Patterns in the Periodic Table

The periodic table is an arrangement of all the known elements in order of increasing atomic number. The reason why the elements are arranged as they are in the periodic table is to fit them all, with their widely diverse physical and chemical properties, into a logical pattern. If sodium is placed beneath lithium and not next door to fluorine, and potassium is placed beneath sodium to begin another row - and so on - it is found that the vertical lines of elements are chemically similar. These vertical lines are called GROUPS.

Horizontal lines of elements are called PERIODS. A set of D-BLOCK ELEMENTS, sometimes called the transition metals, occurs between Groups 2 and 13; these are also chemically similar to each other. Some Groups exhibit striking similarity between their elements, such as Group 1, and in other Groups the elements are less similar to each other, such as Group 4, but each Group has a common set of characteristics.

The periodic table is divided into BLOCKS.

The s-block elements have valence configuration s^1 or s^2.

The p-block elements have valence configuration s^2p^1 to s^2p^6.

The d-block elements have valence configurations in which d-subshells are being filled.

Hydrogen occupies a unique position at the top of the periodic table. It does not fit naturally into any Group.

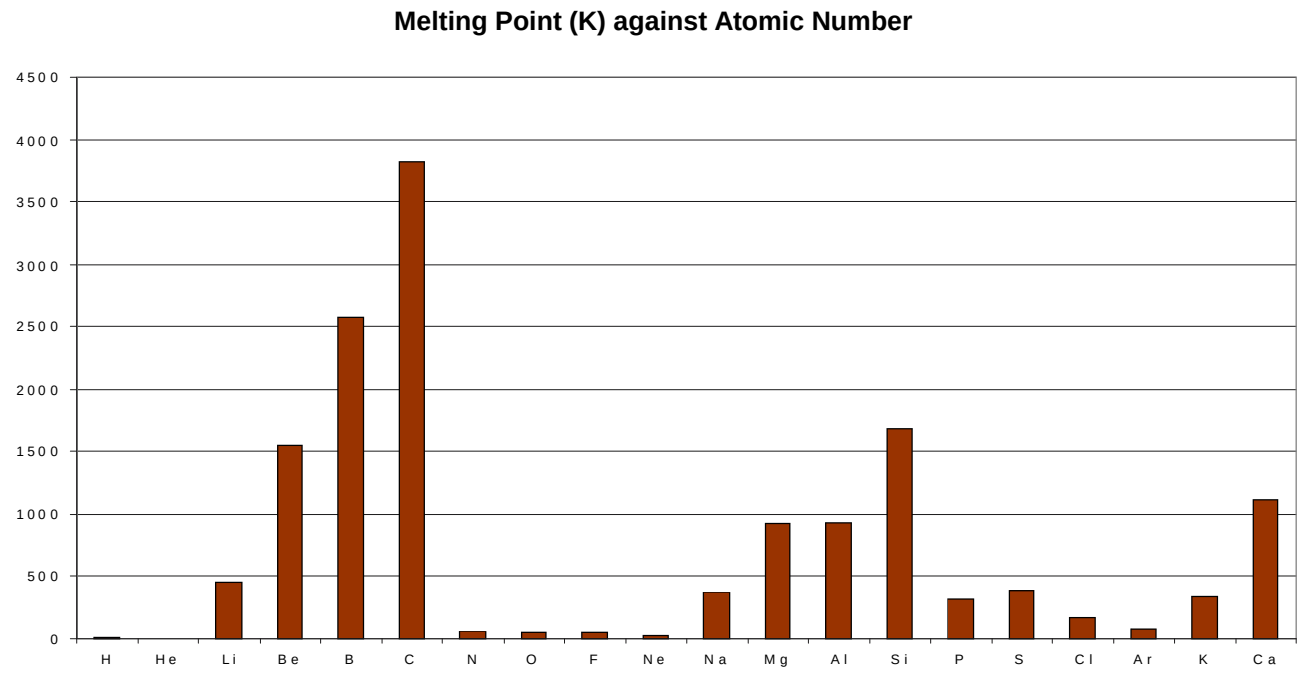
All the members of a Group have the same valence configuration but different principal quantum numbers. The number of valence electrons equals the Group number. The period number equals the principal quantum number of the valence shell.

Chemically, elements in the same block exhibit the same general characteristics. This is most apparent for the s-block elements which are all metals with low electronegativity. The p-block elements are more varied with some metals such as aluminium on the left and non-metals on the right. Between them, indicating the gradual change in character going across the Periodic Table, are the metalloids (or semi-metals), which lie roughly in a diagonal line from silicon to tellurium. The d-block elements are often called the transition metals, but some of them, such as zinc, do not fit this description well. They are usually considered together as differences between Groups are much less apparent in this block.

Periodicity of some properties

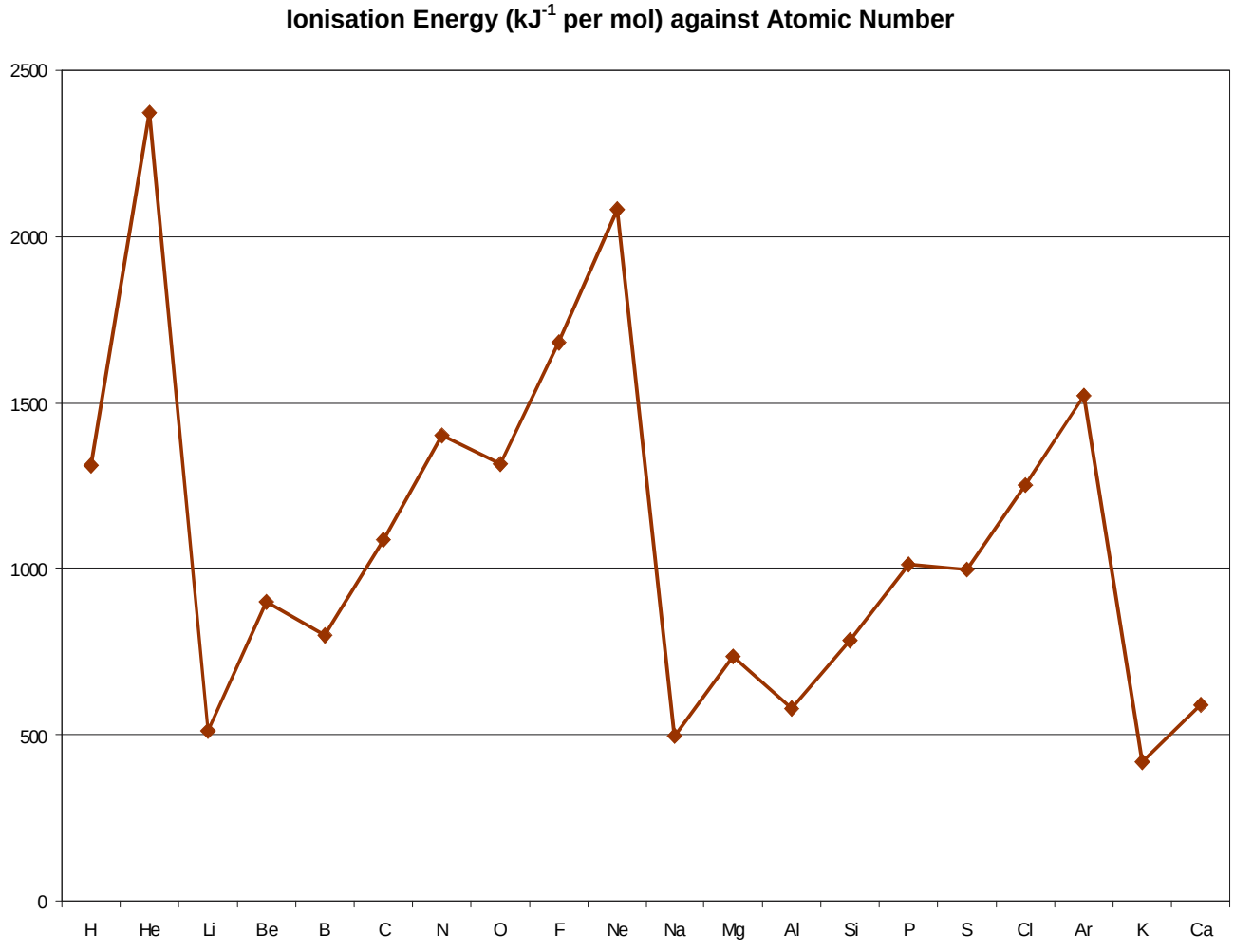
Periodicity is the name given to regularly-occurring similarities in physical and chemical properties of the elements. Periodicity reflects the periodic repetition of similar electron configurations. Very many properties of the elements show periodicity. The most obvious of these is the continuing change from metal on the left to non-metal on the right.

This is reflected in the graph of melting points for the first 20 elements:



For each period the melting point rises from Group 1 to Group 14, then falls to the lowest value at Group 18. If the d-block elements are also included periodicity can be seen between rows of these elements, but as periodicity becomes less apparent with increasing atomic number this is less obvious than for the s- and p-block elements.

Variation of first ionisation energy with atomic number also shows striking periodicity. The relative position of each Group in relation to the others follows the same pattern in each period.



Periodicity is also seen for atomic radius and can be summarised by indicating the main trends:

decreasing radius

increasing radius

Some chemical properties of the elements also follow trends and can be summarised in the same way. These include bonding, oxidising properties, acid-base properties of the oxides and electronegativity.

more covalent
less reducing
more acidic oxides
more electronegative

more ionic
more reducing
more basic oxides
less electronegative