

- The Periodic Table as arranged by Mendeleev allows us to make predictions about the behaviours of elements based on those around them. Briefly describe why the Periodic Table works?

Marks
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The Periodic Table groups atoms into:

- **Groups (columns) based on the number of valence electrons they have and on the occupation of these electrons in *s*, *p*, *d* and *f* sub-shells, and**
- **Periods (rows) based on the shell and sub-shell.**

Chemical reactivity is based on the number of valence electrons and the size of the element. Elements in the same group have similar chemical properties as they have the same number of valence electrons. Differences in the reactivity of elements in the same group are due to their size – elements get larger down each group leading to decreased electronegativity.

- Identify one property used by Mendeleev to organise elements in his periodic table.

One from: atomic volume, stoichiometry of oxides, hydroxides, chloride and other compounds, melting points of elements and compounds, chemical reactivity and atomic mass

Provide a brief explanation of the origin of the periodicity of this property in terms of the quantum theory of atomic structure.

For atomic volume: atomic volume increases going down the groups of the table as new valence shells are filled.

For stoichiometry of compounds: compounds of elements in the same group show the same stoichiometry because they have the same configuration of valence electrons and therefore combine with the same number of atoms of another element to form a stable electronic configuration. Moving across a period, the stoichiometry changes as the number of valence electrons changes.

For melting points of elements and compounds: the type of bonding found in an element (metallic, covalent, dispersion) and in compounds (ionic, covalent, intermolecular) depends on the number of electrons in the outer shell. Elements on the left hand side of the periodic table have few valence electrons and relatively low nuclear charges favouring formation of metallic bonds in the element and ionic bonds in compounds. Elements on the right hand side have configurations just short of stable ones and tend to form covalent bonds with each other and ionic bonds with the metals.