Topic 1: Periodic Table

Periodic Table: A table in which the elements are arranged in terms of proton number (atomic number)

- Vertical columns – "Groups"
  - Elements in the same group:
    - Same number of electrons in valence shell (therefore, similar chemical properties)
- Horizontal rows – "Periods"
  - When going across (left to right), atomic radius decreases
    - Same number of valence shells
    - More protons and electrons
    - Attractive forces stronger → smaller radius
  - Period number = number of shells

Metals VS Non Metals

- Staircase can be drawn to distinguish → start from left of Boron

Metals	Non Metals
Usually solids at rtp (except Hg, mercury)	Usually gases at rtp (except carbon, sulfur, silicon)
High melting and boiling points	Low melting and boiling points
Good conductors of heat and electricity	Poor conductors of heat and electricity (except graphite, an allotrope of carbon)
Shiny, ductile, malleable, great tensile strength	Dull and soft
Oxides are basic or amphoteric	Oxides are acidic or neutral
Positive ions (cations)	Negative ions (anions)

Trends in the Periodic Table

Nuclear charge:

- Defined as the "sum of all the protons in the nucleus of the atom"
- Same as proton number/atomic number

Shielding electrons:

- The electrons which are not in the valence shell
- As a result, they shield the valence electrons from the attractive force of the nuclear charge
- Shielding electron number increases down a group, and stays the same across the period

Atomic Radius:

- Increases down a group
  - Number of electron shells increases, shells go further away from nucleus → radius increases
- Decreases across a period
  - Nuclear charge increases (attractive force increases due to increased number of protons and electrons)
  - Number of shielding electrons remains the same
  - Overall effect → atomic radius decreases

Ionization Energy:

- The first ionization energy of element X is a measure of the energy required to remove one electron each from one mole of gaseous atoms X
- Decreases down a group:
    - With more electron shells, the valence electrons become further away from the nucleus
    - The forces of attraction between nucleus and valence electron decreases
    - Lesser energy required to remove first electron
- Increases across a period
    - Nuclear charge increases across period, but number of shielding electrons remains constant
    - Each element across a period will have a stronger force of attraction between the valence electron and the nucleus
    - More energy is required to remove first electron

Melting point (metals):
- Determined by forces of attraction between positive nuclei and sea of delocalized electrons
- Decreases down the group:
    - The larger atoms have electrons that are further away from the nuclei
    - Force of attraction between electrons and nuclei decreases
    - Lower melting and boiling point (as lesser energy is required to break the weaker bonds)

Melting point (non-metals):
- Determined by forces of attraction between molecules
- Increases down the group:
    - Non metals with larger molecules have larger surfaces for interaction
    - Intermolecular forces of attraction are stronger
    - Higher melting and boiling point (more energy is required to break the stronger bonds)

Note:
- Metal → "electrostatic forces of attraction between positive metal ions and sea of delocalized electrons"
- Covalent compound → "intermolecular forces"
- Ionic compound → "electrostatic forces of attraction between anions and cations"

Note:
- Density generally increases down a group and across a period (because of increasing mass)

Group 7 elements (halogens):
- Going down the group:
    - Color becomes darker
    - State changes from gas → solid
    - Reactivity decreases (note: a more reactive halogen displaces a less reactive halogen from its salt solution)

Group 0 elements (noble gases):
- Form colored compounds
- High melting points, boiling points, densities and hardness (due to atomic radius which is smaller and shielding electrons which are the same) compared to Group I metals
- Catalysts for biological/industrial reactions