The Periodic Table

- In the periodic table elements are placed in order of increasing atomic number
- Elements are arranged into four blocks associated with the four sub-levels - s, p, d and f.
- The period number is the outer energy level that is occupied by electrons
- Elements in the same vertical group contain the same number of electrons in the outer energy level.
- The number of the principlal energy level and the number of the valence electrons in an atom can be deduced from its position on the periodic table.
- Shows the position of metals, non-metals and metalloids

Elements in the same group tend to have similar chemical and physical properties.

- Atomic radius
  - Is the distance from the nucleus to the outermost electron.
  - Atomic radius increases down the group (as the number of shells increases down the group)
  - Atomic radius decreases across the period (as the nuclear charge increases with no significant change in sheilding).

- Ionic Radius

The ionic radii of positive ions are smaller than their atomic radii, and the ionic radii of negatively charged ions are greater than their atomic radii.

Mg^{2+} has a smaller ionic radii than Na^+. As both have same number of electrons but magnesium have more number of protons so higher nuclear charge and the electrons pulled more closer.

- First ionisation Energy

The first ionisation energy is the energy required to remove one electron from each atom in one mole of gaseous atoms under standard conditions.

- Decreases down the group

The size of the atoms increases down the group, thus outer electrons are strongly attracted by nucleus, therefore less energy is required.

- Increases across the period

As the nucleur charge increases with no significat increase in shielding, therefore strongly attracted by nucleus and requires more energy.

- Electron Affinity

The first electron affinity involves the energy change when one electron is added to a gaseous atom.
It is also the enthalpy change when one electron is added to each atom in one mole of gaseous atoms under standard conditions.

- becomes more exothermic across the period
- becomes less exothermic down the group.

- Electronegativity
Is a measure of the attraction of an atom in a molecule for the electron pair in the covalent bond of which it is a part.

- Decrease down the group - as the size increases the less strongly attracts and further the electron repulsion also increasing.

- Increases accoss the period - as the nucleur charge increases with no significant increase in shielding

- Group 1 elements - Alkali metals
• Reactive, sloft, low melting point metals.

- Melting point decreases down the group - as the size increases and the attraction between positive ions and delocalised electrons becomes weaker.

- Reactivity increases down the group - as less energy required to lose the outer electron (due to increase in size of atom)

- Density increases down the group.

- Group 17 elements - Halogens

- Melting point increases down the group - as the london forces between molecules get stronger.

- Reactivity decreases down the group - as the bond strength increases down the group. Or decrease in electron affinity down the group.

- Oxides of period 2 and period 3

	Sodium	Magnesium	Aluminium	Silicon	Phosphorus	Su
Formula	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO SO
Nature of element	metal			non-metal		
Nature of oxide	basic		amphoteric	acidic		
Reaction water	soluble, reacts	sparingly soluble, some reaction	insoluble		soluble, reacts	
Solution	alkaline	slightly alkaline	-		acidic	

Amphoteric

$$Al_2O_3 + 6H^+ \longrightarrow 2Al^{3+} + 3H_2O$$

$$Al_2O_3 + 2OH^- + 3H_2O \longrightarrow 2Al(OH)_4^-$$

- Transition Metals

A transition metal is an element the forms at least one stable ion with a partially filled d subshell

- They have high melting points and densities
- Have more than one oxidation number
- Forms complex ions
- forms coloured compounds
- Exhibit magnetic properties

- Variable Oxidation States

As 4s and 3d subshells are close in energy, and there are no big jumps in the successive ionisation energies. Thus the number of electrons lost are dependent on factors such as lattice enthalpy, ionisation energy, etc.

- Magnetic Properties

Paramagnetism is caused by unpaired electrons - paramagnetic substances are attracted by a magnetic field.

Diamagnetism is caused by paired electrons - diamagnetic substances are repelled slightly by a magnetic field.

Diamagnetic effect is much smaller than the paramagnetic effect.

- Catalytic Behaviour

Iron in Haber process (ammonia)
Vanadium(V)oxide in Contact process (H_2SO_4)

They increase the rate of reaction and they have varying oxidation numbers and also being able to coordinate to other molecules to form complex ions.

Platinium in catalytic converter

- Complex Ion

Consists of a central metal ion surrounded by ligands.

Ligands are negative ions or neutral molecules that have lone pairs of electrons. The lone pairs are donated to metal ions and form a complex ion with coordinate covalent bonds (dative bonds). Ligands are lewis base.

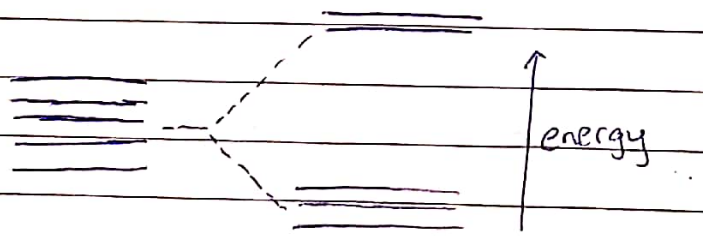
Coordination number is the number of lone pairs to electrons central metal is bonded to.

- Coloured Complexes

When the metal ion is surrounded by the ligands in a complex ion, due to the repulsion between electrons of metal ion and lone pair of electrons which split d orbital into two (2 orbitals in the upper group and 3 in the lower group.

When white light passes through the complex it absorbs energy and the electron is promoted to the higher set of d orbitals. Therefore the complementary colour to colour whose frequency is absorbed

* Formation of coloured compounds need partially filled d orbital.



- Factors affecting colour of ligand

- Identity of metal
  - as different number of protons, thus different nuclear charge. Thus d orbital pulled more closer of ~~with~~ metal with higher nuclear charge. Thus greater repulsion and greater splitting

- Oxidation number

- Nature of ligand

$I^- < Br^- < Cl^- < F^- < OH^- < H_2O < NH_3 < CO \approx CN^-$

larger the energy gap the shorter wavelength would be absorbed.