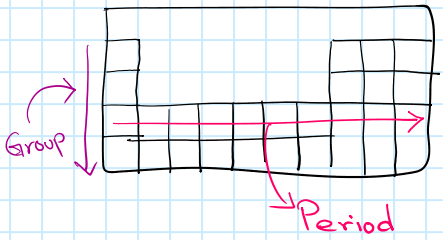
- Vertical column is called group.
- Horizontal column is called period.
- In the periodic table, columns are arranged according to increasing atomic number (proton number).
- Electronic configuration can be used to identify group numbers, period numbers, metal or non-metal.
- Group number indicate number of electrons in the outermost shell.
- Period number indicate number of energy shells.
- In the periodic table, left to right atomic radius decreases.
- Group 1, 2 &3 elements are metallic.
- Group 4,5 &6 elements are non-metallic.
- Metallic elements donate electrons to make positively charged ions called cations.
- Non-metallic elements gain or share electrons.
- Non-metallic elements gain electron to make negatively charged ions called anions.
- Elements between group 2 and 3 are called transition elements.

How to identify charge from group number:



Group 1 ⟶ +1
Group 2 ⟶ +2
Group 3 ⟶ +3
Group 4 ⟶ +4
Group 5 ⟶ −3
Group 6 ⟶ −2
Group 7 ⟶ −1

- Group 1 metals are called alkaline metal.
- Group 2 metals are called alkaline earth metals.
- Group 7 elements are called halogen.
- Group 8 elements are called noble gas.

Oxides

- Oxides are binary compound.
- Binary compounds contain two types of elements.
- One of the element is oxygen.
- The other element is a metal or a non-metal or a metalloid.

Basic oxide

- Metallic oxides are called basic oxide.
- Basic oxides react with acid only.

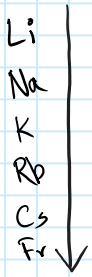
Amphoteric oxide

- ZnO, Al_2O_3 and PbO are amphoteric oxides.

Acidic oxides

- Non-metallic oxides which can react with bases are called acidic oxides.
- Non-metallic which cannot react with base are called neutral oxides.
- Non-metallic oxides cannot react with water to make acidic solution.
- Acidic oxides react with water to make acidic solution.

Alkaline metals



1. Metallic character increases
2. Melting point decreases
3. Reactivity increases
4. Density increases
5. Atomic radius increases
6. Reducing power increases

- Group I elements are called alkaline metals.
- Group I elements react with water to make alkaline solution.
- They react with water to make metal hydroxide solution and hydrogen gas.
- Alkaline solutions contain hydroxide ions.

Reactions:

1. Lithium

$$2Li_{(s)} + 2H_2O_{(l)} \longrightarrow 2LiOH_{(aq)} + H_{2(g)}$$

Observations:

- Bubbles of colorless gas are formed.
- The metal floats on the surface of water.
- Red color flame is observed.
- Lithium melts.
- Lithium dissolves in water.

2. Sodium

$$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH + H_{2(g)}$$

Observations:

- Bubbles of colorless gas are formed
- The metal floats on the surface of water.
- Yellow flame is produced(orange or golden yellow flame).
- Sodium melts
- Sodium dissolves in water.

3. Potassium

$$2K_{(s)} + H_2O_{(l)} \longrightarrow KOH_{(aq)} + H_{2(g)}$$

Observations:

- Bubbles of colorless gas are formed.
- The meatal floats on the surface of water.
- Lilac color flame is observed.
- Potassium melts.
- Potassium dissolves after reacting.

From lithium to francium atomic radius increases

- Electrons are added to the new energy shell
- Distance between the nucleus and the outermost shell increases

From lithium to francium reactivity increases

- Reactivity of Group One elements depend on how easily they can donate electrons
- Electrons are added to the new energy shells
- The distance between the nucleus and the outermost electron decreases.
- It becomes easier to donate electrons

From lithium to francium melting point decreases

- Charge on the ions is +1.
- Number of delocalized electrons is identical.
- From Li^+ to Fr^+ ionic radius decreases.
- The strength of electrostatic force of attraction between metal ions and delocalized electrons decreases.
- Metallic bond becomes weaker.
- Less amount of heat energy is needed to break the metallic bond.

Physical properties of Group I metals

- They are ductile.
- They are malleable.
- They are soft and can be easily cut with a knife.
- They have low density.
- They have a low melting and boiling point.
- They conduct electricity and heat.

Chemical properties of Group 1 metals

- React with water to make alkaline solution
- Cannot make colored compounds
- Fixed oxidation state.
- Cannot be used as catalyst.
- Cannot make complex ions.

Transition metals

Physical properties of transition metals

- Ductile
- Malleable
- Hard
- Have high density
- High melting and boiling point
- They conduct heat and electricity

Chemical properties of transition metals

- Cannot react with water to make alkaline solution
- Cannot make colored compounds
- They have a variable oxidation state
- They can be used as catalysts
- They can make complex ions.

Name of process	Name of catalyst
Haber process (making of ammonia)	Iron (Fe)
Contact process (making of sulfuric acid)	V_2O_5 / vanadium peroxide/ vanadium(V) oxide
Decomposition of hydrogen peroxide	Manganese (IV)oxide/ MnO_2
Hydration of alkene	Phosphoric acid
Hydrogenation of alkene	Nickel

Color of compounds / ions

$K_2Cr_2O_7$ ⟶ Orange

$Cr_2O_7^{2-}$ ⟶ Orange

Cr_2^{6+} ⟶ Orange

$KMnO_4$ ⟶ Purple

MnO_4^- ⟶ Purple

$Cu(OH)_2$ ⟶ Blue

Cu^{2+} ⟶ Blue

$CuSO_4.5H_2O$ ⟶ Blue

$Fe(OH)_2$ ⟶ Pale green

$Cr(OH)_3$ ⟶ Green

$Fe(OH)_3$ ⟶ Red Brown

$CuCO_3$ ⟶ Green

CuO ⟶ Black

Ions that have variable oxidation state

① Fe^{2+}, Fe^{3+}

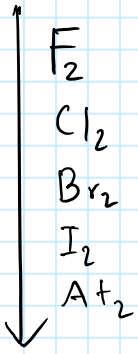
② Cr^{3+}, Cr^{6+}

③ Mn^{2+}, Mn^{7+}

④ V^{3+}, V^{5+}

Halogens

Name of halogen	Molecular formula	Physical state	Color
Fluorine	F_2	Gas	Yellow
Chlorine	Cl_2	Guess	Green
Bromine	Br_2	Liquid	Red/brown/orange
Iodine	I_2	Solid	Black
Astatine	At_2	Solid	Shiny black



- Melting and boiling point increases
- Color becomes darker
- Reactivity decreases
- Density increases
- Oxidation power decreases

From Fluorine to Astatine melting and boiling point increases

- Number of electrons increase
- Strength of Van der Waal's force of attraction increases/ intermolecular force becomes stronger
- More heat energy is required to break the intermolecular force of attraction.

From fluorine to astatine color becomes darker

- Number of electrons increases
- Strength of intermolecular force of attraction increases
- Molecule gets closer together

From fluorine to Astatine reactivity decreases

- Reactivity of group 7 elements depends on how easily they can gain electrons.
- Atomic radius increases
- Attraction towards the incoming electron decreases

Displacement reaction

A more reactive halogen can displace a less reactive halogen from a compound. These reactions are called displacement reaction,

① $Cl_{2(g)} + KBr_{(aq)} \longrightarrow KCl_{(aq)} + Br_{2(aq)}$

Observation: colorless solution turns red brown

② $Br_{2(g)} + KCl_{(aq)} \longrightarrow$ No reaction

As bromine is less reactive than chlorine it cannot replace chlorine.

③ $Cl_{2(g)} + 2KI \longrightarrow 2KCl_{(aq)} + I_{2(aq)}$

Observation: colorless solution turns brown.