

Chapter 14 : Periodic Table

No.

Date

The Periodic Table

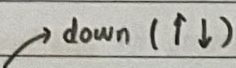
- ★ The Periodic Table is the arrangement of elements in the orders of **increasing proton (or atomic) number**.
- ★ Advantages of arranging elements in the Periodic Table:
 - Allows us to study & understand the **relationship between various elements**
 - Allows us to identify the **characteristics of the elements easily**
 - Allows us to **predict the characteristics of an element for application purposes**
- ★ Elements in the Periodic Table can be classified into two main classes:
 - **Metals**
 - **Non-metals**
- ★ Elements tend to develop **more metallic characteristics from right to left**.
- ★ Properties of metallic & non-metallic elements (**physical**):
 - **Metals**
 - ↳ **High melting points and boiling points**
 - ↳ **Good conductor of electricity and heat**
 - ↳ **Malleable and ductile**
 - ↳ **Silvery appearance**
 - **Non-metals**
 - ↳ **Low melting points and boiling points**
 - ↳ **Good insulator of electricity and heat**
 - ↳ **Brittle in solid state**
 - ↳ **Variety of colours**
- ★ Properties of metallic & non-metallic elements (**chemical**):
 - **Metals**
 - ↳ Form **basic oxides** generally which **reacts with acids to form salt and water**
 - ↳ Form **positive ions** by **losing electrons**
 - ↳ Form **ionic compounds** when combined with **non-metallic elements**
 - **Non-metals**
 - ↳ Form **acidic oxides** generally which **reacts with alkalis to form salt and water**

↳ Form **negative ions** by **gaining electrons**

↳ Form **covalent compounds** by **sharing electrons** with **non-metallic elements**

★ Main structure of Periodic Table:

- **Group** → Vertical columns of elements
- **Period** → Horizontal rows of elements

Groups 

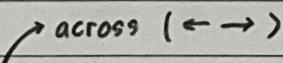
★ Groups are **vertical columns of elements** in the Periodic Table.

★ The elements in a group have **similar chemical properties** due to the **same number of valence electrons** in the valence shell.

- All group 1 elements lose 1 electron to form **positive ions of +1**.
- All group 2 elements lose 2 electrons to form **positive ions of +2**.
- All group 17 elements gain 1 electron to form **negative ions of -1**.
- All group 18 elements are **unreactive**.

★ Going down the group, there is an **increase in metallic properties** and a **decrease in non-metallic properties** because they are **more and more likely to lose electrons than gain electrons**.

- As the **size of the atoms get larger** going down a group, the **outermost electrons** will also be further away from the attractive force of the nucleus.
- An element further down a group will lose its outermost electrons more easily.

Periods 

★ Periods are the **horizontal rows of elements** in the Periodic Table.

★ Across a period from left to right, elements change from metals to non-metals. Hence, there is a **decrease in metallic properties** and an **increase in non-metallic properties** because elements become **more and more likely to gain electrons than lose electrons** from left to right across a group.

★ A period starts with an element with 1 valence electron and ends with the element with a full valence shell. Therefore, the number of valence electrons increases across the period.

★ All the elements in the same period have the same number of electron shells.

- Period 1: Elements with 1 electron shell
- Period 2: Elements with 2 electron shells
- Period 3: Elements with 3 electron shells

→ basically your explosive metals
Group 1: Alkali metals

★ Group 1 elements are metallic. They are known as the alkali metals.

★ They are stored under oil to prevent them from coming into contact with water. This is because they can react spontaneously with moist and the reaction is highly exothermic and violent.

★ Elements in Group 1:

- Lithium (Li)
- Sodium (Na)
- Potassium (K)
- Rubidium (Rb)
- Caesium (Cs)
- Francium (Fr)

★ These metals react with water to form alkaline solutions.

Group 1 metal + water $\longrightarrow$ alkali + hydrogen

★ Similar physical properties:

- Shiny
- Soft and can be cut by knife
- Good conductor of electricity
- Good conductor of heat

- Ductile
- Malleable
- Low density
- Low melting points and boiling points

★ Similar chemical properties:

- Have 1 valence electron
- Lose 1 electron to form positive ions of +1
- React vigorously with water to produce alkalis and hydrogen gas.
- React with non-metals to form ionic compounds
- React with acid to produce salt and water

★ When ^(down the group) atomic number increases:

- Melting and boiling point decreases
- Density increases
- Elements become more reactive *

★ Elements become more reactive:

- Down the group, elements of group 1 are more readily to lose its valence electron to form a cation.
- Valence electron is easier to lose when the size of atomic radius increases. It means that the atom has a greater tendency to lose its valence electrons to form cations.
- Valence electrons of bigger atomic radius is attracted less strongly by the protons in the nucleus.
- More electron shells also shield the attractive force from the nucleus, so the valence electrons are attracted less strongly.
- The more readily the atoms of an element to lose the valence electrons, the more reactive the element will be.

Group 17: Halogens ^{↗ colourful elements}

- ★ Group 17 elements are non-metallic. They are known as the halogens which means 'salt formers'.

★ Elements in group 17:

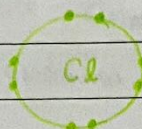
↳ Fluorine (F)

- Pale yellow gas
- Most reactive
- Pale yellow in g state



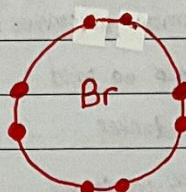
↳ Chlorine (Cl)

- Yellow-green gas
- Green in g state



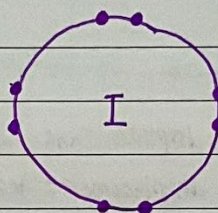
↳ Bromine (Br)

- Reddish brown liquid
- Brown in g state



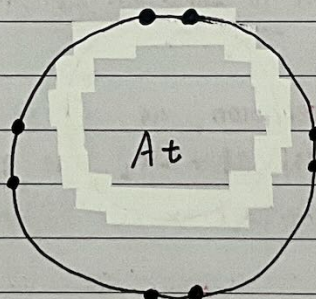
↳ Iodine (I)

- Purple-black solid
- Purple in g state



↳ Astatine (At)

- Black solid
- Least reactive
- Black in g state



Usually not tested, but good to remember!

★ Halogens exist as diatomic molecules because they can achieve a stable electronic configuration.

★ Halogens react with metals to form salts called halides.

E.g. Magnesium + Chlorine → Magnesium chloride

★ Similar physical properties:

- Poor conductor of electricity
- Poor conductor of heat
- Brittle in solid state
- Coloured molecules

• Low melting and boiling points

★ Similar chemical properties:

- Have 7 valence electrons
- Gain 1 electron to form negative ions of -1.
- Form ionic compounds with metals
- Form covalent compounds with non-metals

★ Down the group when atomic number increases:

- Physical state changes from gas to solid
- Colour changes from lighter to darker
- Melting point and boiling point increases
- Reactivity decreases

* If displacement takes place, the solution takes the colour of the less reactive halogen

★ The more reactive halogen can displace the less reactive halide ion from its solution. This reaction is called the displacement reaction.

• A displacement reaction in which one element takes the place of another element in the compound

E.g. • $\text{Cl}_2 + \text{NaF} \rightarrow \text{No reaction}$, as Cl is less reactive than F.

E.g. • $\text{Cl}_2 + 2\text{NaBr} \rightarrow 2\text{NaCl} + \text{Br}_2$, as Cl is more reactive than Br.
[Ionic eqn: $\text{Cl}_2(\text{aq}) + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\text{aq})$]

Group 18: noble gases $\rightarrow$ no reaction

★ They are known as noble gases.

★ Members of group 18:

- Helium (He)
- Neon (Ne)
- Argon (Ar)
- Krypton (Kr)
- Xenon (Xe)
- Radon (Rn)

★ They are unreactive because they have maximum number of electrons in their

valence shell. So they exist as monoatomic elements. Monoatomic elements are elements existing as single atoms only.

★ The applications of noble gases:

- Helium in balloons
- Neon in light bulbs for neon store signs
- Argon in light bulbs and the manufacture of steel

Transition metals

→ everything in between groups 2 and 13

★ Transition metals occupying the central block of the Periodic Table without any group.

★ They have typical metallic properties such as:

- High melting and boiling points
- High density
- Can conduct electricity and heat
- Ductile and malleable

★ They are different from Group 1 or Group 2 metals in the following ways:

- Have variable oxidation states
- Form coloured compounds
- Less reactive → do not explode (easily)

★ Transition metals or their compounds are often used as catalysts in the industrial processes / chemical reactions due to:

- Higher melting points than Group 1 and Group 2 metals generally
- Ability to have variable oxidation states