Chemistry OL Cie

INCAPSULE

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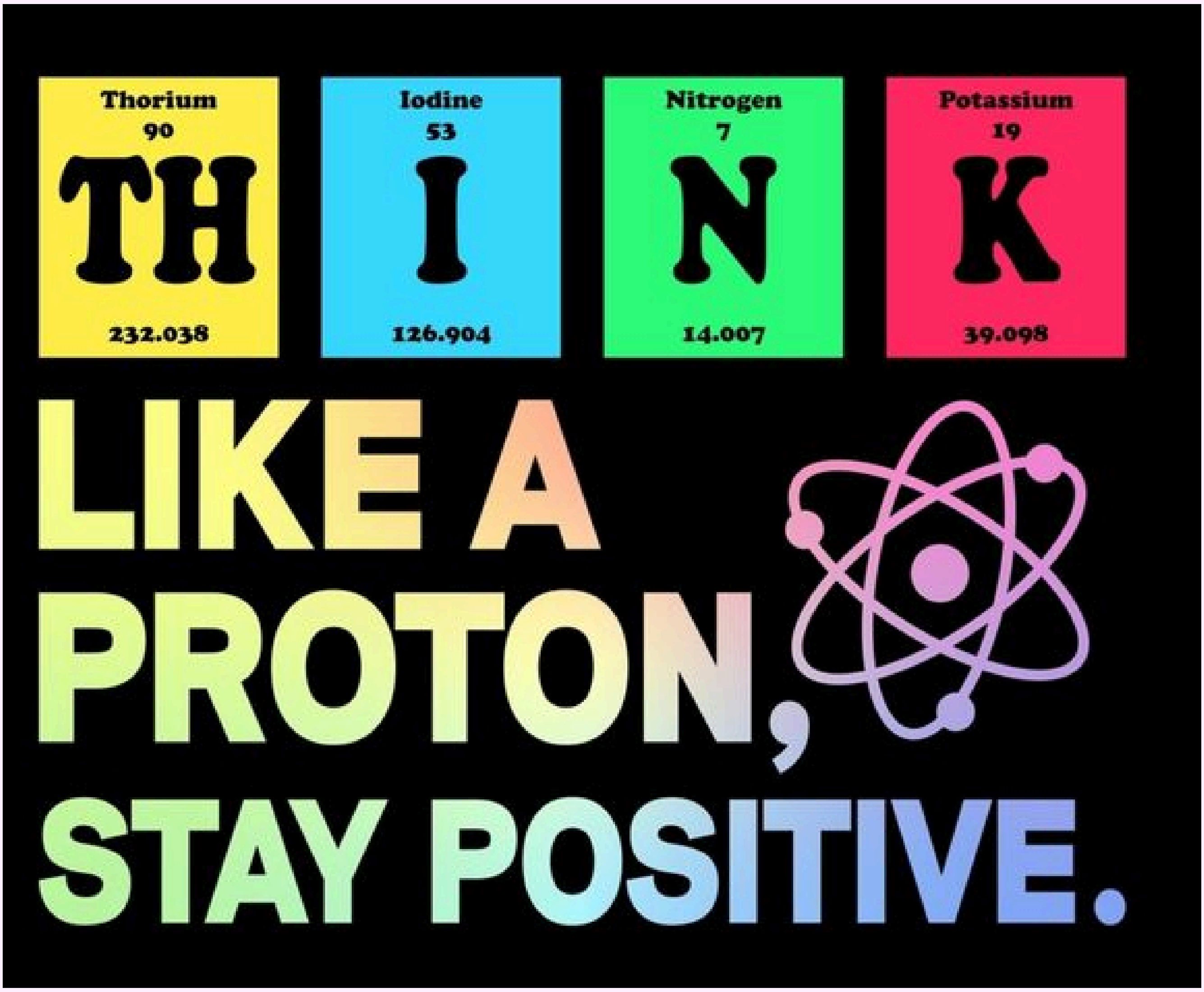
TOPIC 2

Atomic Structure



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TOPIC 2 Atomic Structure

Atom

Smallest Building Unit of an element.
Can **NOT** be **broken down** into anything simpler, by physical or chemical means.
It determines the **Chemical characteristics** of element.

Ion

A **positively** or **negatively** charged body, produced by an atom **losing or gaining electrons** leading to **unequal** number of **electrons and protons.** **(Eg. Ca^{+2})**

Molecule:

Two or more atoms **chemically** joined together. Can be of **same or different** elements. **(Eg. Oxygen)**

Element:

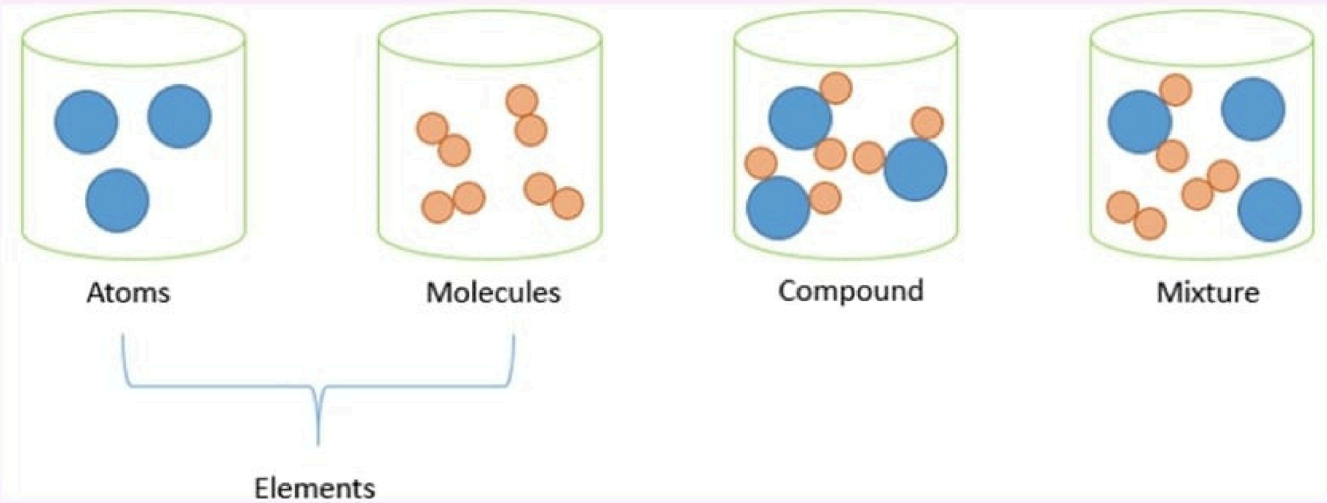
Substance made up of **many identical atoms**. It can **NOT** be broken down into simpler substances by **chemical or physical** means. **(Eg. Iron)**

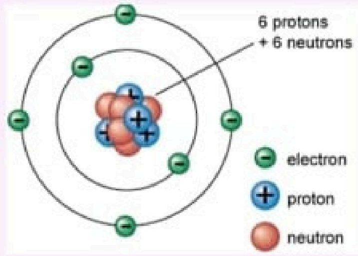
Mixture:

Two or more elements **physically** joined together, and can be separated by **physical** means. **(Eg. Water and Sand)**

Compound:

Two or more elements **chemically** joined together, and can **NOT** be separated by **physical** means. **(Eg. Water)**





Subatomic Particles

	Proton	Neutron	Electron
Charge	+1	0 (Neutral)	-1
Mass (amu)	1	1	0 (app 1/1840)
Location in Atom	Inside Nucleus	Inside Nucleus	Orbiting Nucleus in energy shells

NOTES

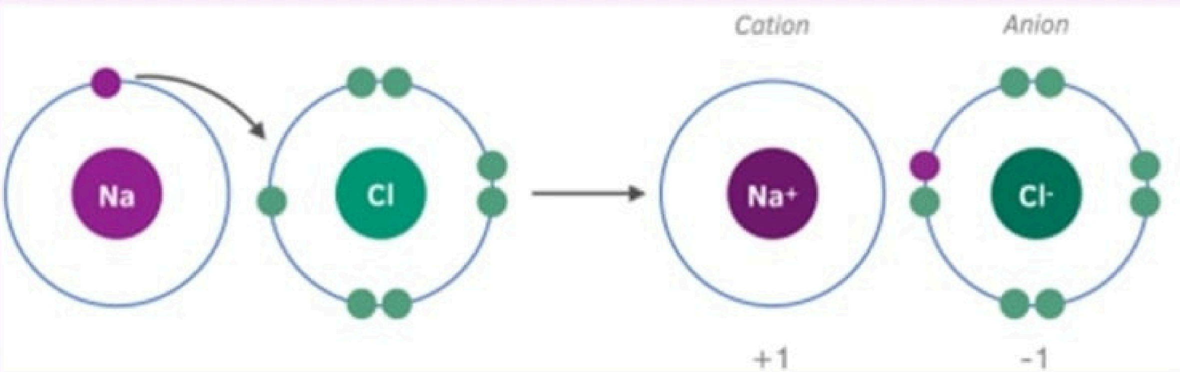
- Nucleus has an **overall positive** charge.
- The atom has **negatively charged electrons** orbiting it in energy shells// energy levels.
- **Energy levels** are attracted to **nucleus** by electrostatic forces between **positively charged protons** and **negatively charged electrons.**
- An atom has an **equal** number of **protons** and **electrons**, making it **neutrally charged.**
- If **proton number** is **larger** or **smaller** than **electron** number, the atom forms either a **positively** or **negatively charged ion**.

Metals

- **Lose** electrons
- **Protons > Electrons**
- **Positive** charges **>** **Negative** charges
- **Positive** Ions (**Cations**)

NON Metals

- **Gain** electrons
- **Protons < Electrons**
- **Positive** charges **<Negative** charges
- **Negative** Ions (**Anions**)

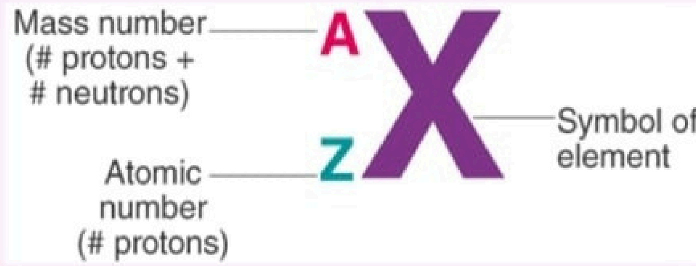


NOTES

- **Group** number represents the **number** of **Electrons** in the **outermost shell (Valency electrons)**.
- **Period** number represents the **number** of **Electronic shells**.
- So, If **Calcium** has the **electronic Configuration** of **2,8,8,2**
  - → **Group Number: 2**
  - → **Period Number: 4**

NOTES

- **Proton number (Atomic number):** Number of **protons** in the nucleus of an atom.
- **Nucleon number (Mass number):** Number of **protons and neutrons** in the nucleus of an atom. **(Protons + Neutrons)** .
- **Neutron Number: Mass Number – Atomic// Proton Number.**

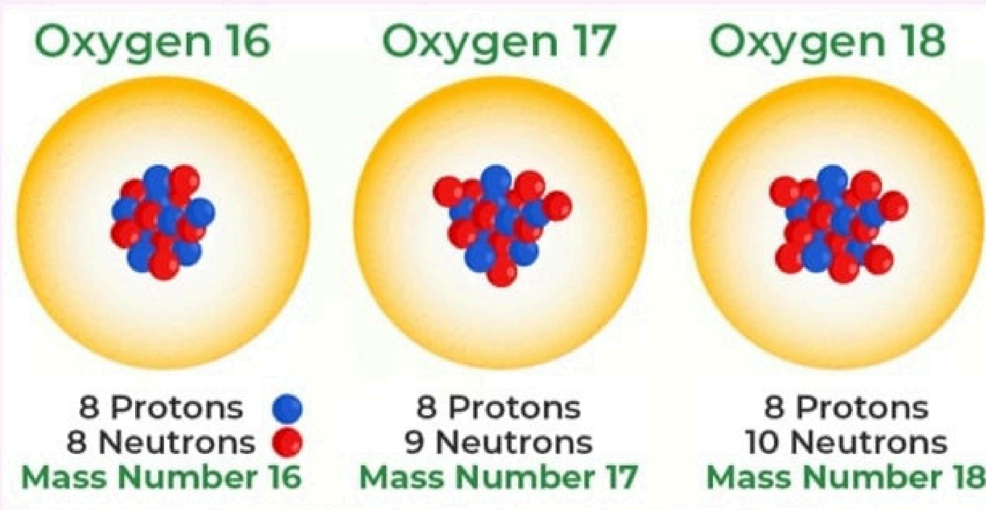


Isotopes

Atoms of **same element** that have **SAME** number of **protons and electrons** BUT **different mass // nucleon number // number of neutrons.**

Explain why isotopes have Same Chemical properties?

Because they have **SAME** number of **protons** and **SAME electronic configuration**



Relative Atomic Mass

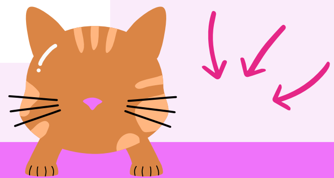
- **Average mass** of **naturally occuring atoms** of an **element** on a scale where a **Carbon 12** atom has exactly **12 units.**
- To calculate it we need:
  - → **Mass number** of isotopes
  - → **Relative Abundance** of Isotopes

$$A_r = \frac{(\% \text{ of isotope } a \times \text{mass of isotope } a) + (\% \text{ of isotope } b \times \text{mass of isotope } b)}{100}$$

Isotope	Relative Mass	Abundance
^{35}Cl	34.969	75.80%
^{37}Cl	36.966	24.20%

$$A_r(Cl) = \frac{34.969 \times 75.8 + 36.966 \times 24.2}{100}$$

$A_r(Cl) = 35.45$

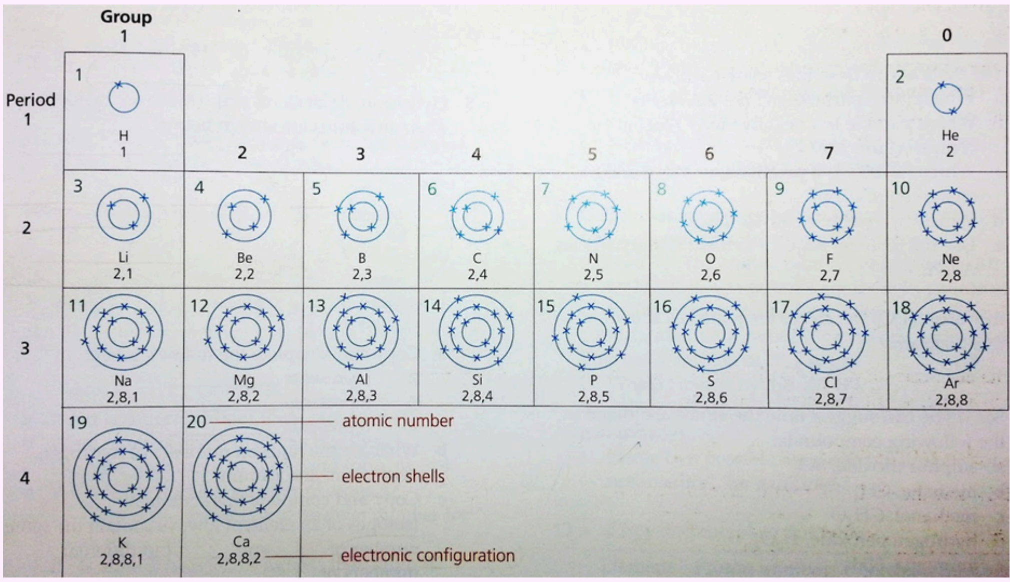


Why is **relative atomic mass** of **Chlorine NOT** a **whole number?**

- Because it has **more** than **1 Isotope**

Elements from 1 - 20

- **1st shell:** Carries **maximum 2** electrons
- **2nd shell:** Carries **maximum 8** electrons
- **3rd Shell:** Carries **maximum 8** electrons
- **4th Shell:** Carries **maximum 2** electrons
- Each shell should be **COMPLETELY** filled, **before starting** the **next** shell.



What if the Element has more than 20 electrons?

- **STEP 1:** Fill the **1st** shell with **2** electrons, and the **2nd** with **8** electrons. (Now we have a total of **10**)
- **STEP 2:** Skip the **3rd** electronic shell for now.
- **STEP 3:** Fill the **4th** shell with **2** electrons. (Now we have **12** electrons)
- **STEP 4:** Put the **remaining** electrons in the **3rd** energy shell.

The **3rd** shell can hold up to **18** electrons.

Eg. Cobalt (Atomic no. 27)

- **STEP 1:** Fill the **1st** shell with **2** electrons, and the **2nd** with **8** electrons. (Now we have a total of **10**)

2,8

- **STEP 2:** Skip the **3rd** electronic shell for now.

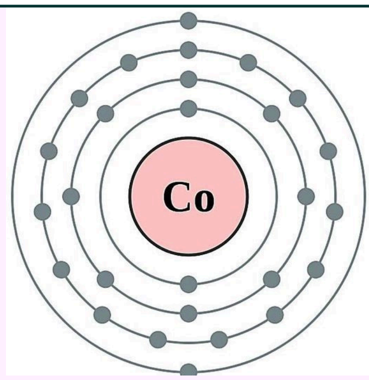
2,8,X

- **STEP 3:** Fill the **4th** shell with **2 electrons.** (Now we have **12 electrons**)

2,8,X,2

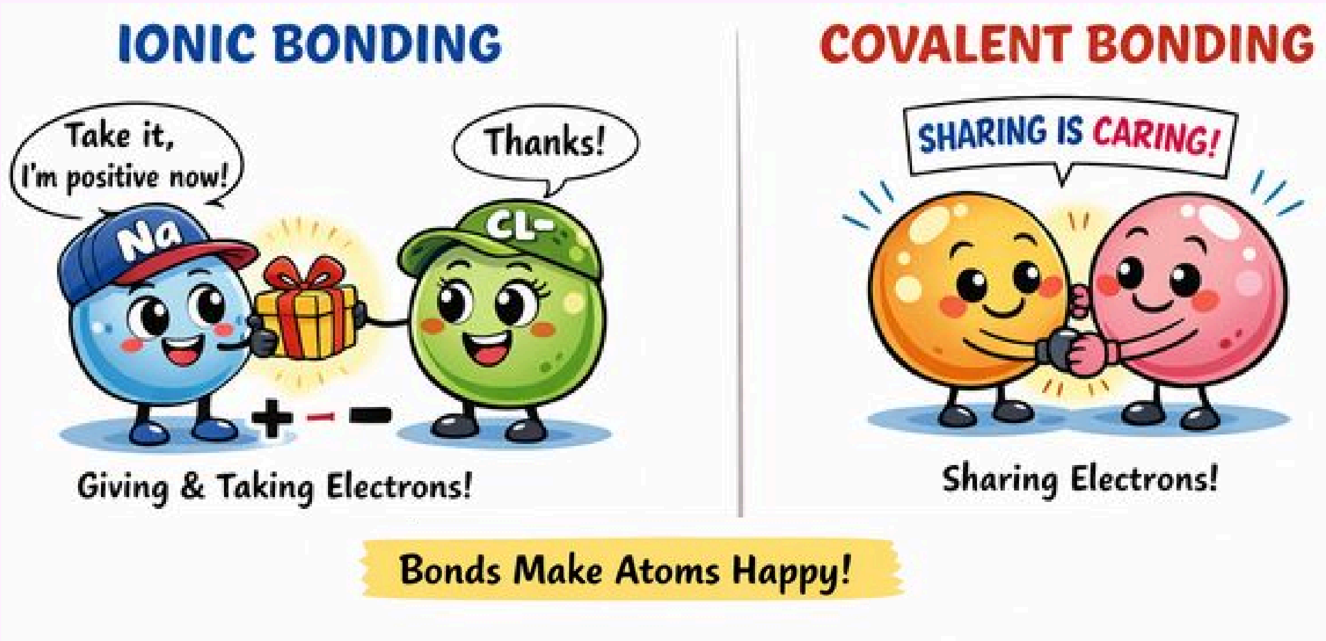
- **STEP 4:** Put the **remaining** electrons in the 3rd energy shell.

So, X = 27 - 12 = 15
Then, 2,8,15,2



IN CAPSULE

TOPIC 3 **Chemical Bonding**



IN CAPSULE

TOPIC 3 Chemical Bonding

Why do atoms lose, gain or share electrons?

To have a **stable outermost shell** of **electrons.**
To achieve the **electronic configuration** of the **nearest noble** gas.

Group 8 (Noble Gases) are inert or unreactive?

Because they have a **full outermost shell** of **electrons** **(Eg. Helium)**.

NOTES

When the question asks about **ANY structure** we will talk about:

- **Type** of **particles**.
- **Arrangement** of **particles**.
- **Forces holding particles** together.
- **Shape** of **whole structure**.

Types of Bonding

METALLIC

- Between **Metal** atoms
- **Metal** atoms **lose** electrons.
- They become **positively** charged **ions**.
- **The metallic structure consists of:**

  Type & arrangement of particles:

  → **Giant lattice** (**Regular** arrangement) of **positive** ions.

  → Surrounded by a **sea** of **delocalized negatively** charged **electrons**.

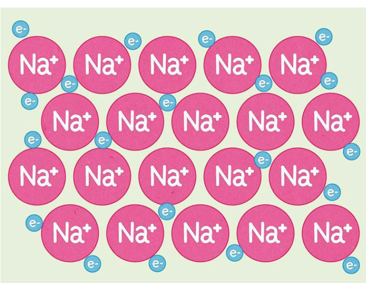
  Forces holding particles:

  → Held together by **strong electrostatic forces**.
- **Their structure gives them the following properties:**

  → **Malleable & Ductile** → **Layers slide** over each other.

  → **Conduct electricity** → **delocalized negatively charged electrons** carry the **charge**.

  → **High melting & boiling points** → **strong electrostatic high** energy to break them.



IONIC

- Between **positive Metal** ions and **negative Non-metal ions**
- **Metal** atoms **lose** electrons.
- They become **positively** charged **ions**.
- **Nonmetal** atoms **gain** electrons.
- They become **negatively** charged **ions**.
- **The ionic structure consists of:**

  Type & arrangement of particles:

  → **Giant lattice** (**Regular** arrangement) of **alternating positive** and **negative ions.**

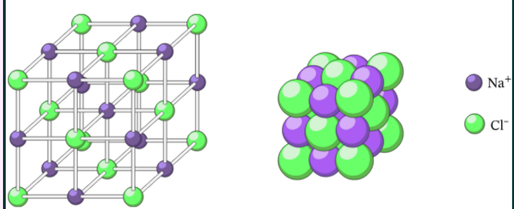
  Forces holding particles:

  → Held together by **strong electrostatic forces**.
- **Their structure gives them the following properties:**

  → **Mostly soluble** in **water**

  → **Conduct electricity** when **molten** or **aqueous ONLY**
  → charged **ions are free,** so carry the **charge**.

  → **High melting & boiling points** → **strong electrostatic forces** need **high** energy to break them.



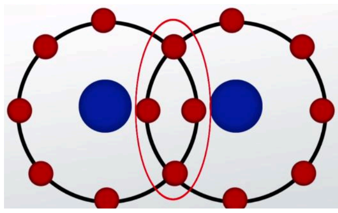
COVALENT

- **Sharing** of **pairs** of **electrons** between **Nonmetal** atoms.
- **Their structure gives them the following properties:**

  → **Mostly INsoluble** in **water**, but **soluble** in **organic solvents** eg. **ethanol**.

  → Do **NOT conduct electricity**
  → **NO free moving ions** or **electrons to** carry the charge.

  → **Low melting & boiling points** → **weak intermolecular forces** need **low** energy to break them.



NOTES

When the question asks about **properties** we will talk about:

- **Melting** & **Boiling** points.
- **Electrical Conductivity.**
- **Texture** or **Solubility** (If mentioned).

Electrostatic forces

Strong force attracting **oppositely charged particles** to each other.

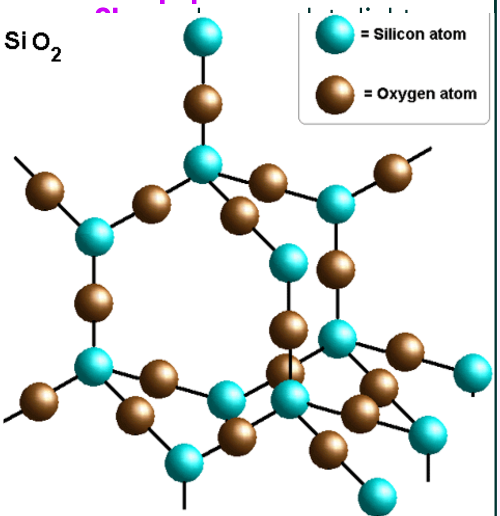
Lattice

Giant structure formed of **regular arrangement** of **particles**.

Giant Covalent

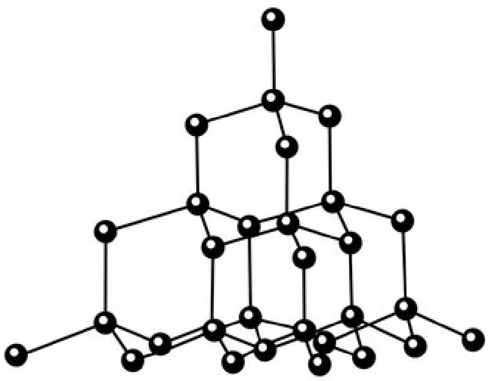
SILICON DIOXIDE (Sand)

- **Type & arrangement of particles:**
  → Each **Silicon** atom bonded to **4 Oxygen** atoms.
  → Each **Oxygen** atom bonded to **2 Silicon** atoms.
- **Forces holding particles:**
  → By **strong covalent** bonds.
- **Shape of whole structure.**
  → Forming **tetrahedral** structure.
- **Properties:**
  → **Hard**
  → Do **NOT conduct electricity**
  → **NO free moving ions** or **electrons** to carry the **charge.**
  → **High melting & boiling** points → **many strong covalent** bonds need **high** energy to break them.
- **Uses:**
  → **Sandpaper** → because **hard**



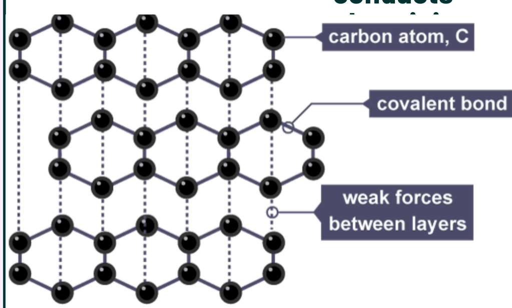
DIAMOND

- **Type & arrangement of particles:**
  → Each **Carbon** atom bonded to **4 Carbon** atoms.
- **Forces holding particles:**
  → By **strong covalent** bonds.
- **Shape of whole structure.**
  → Forming **tetrahedral** structure.
- **Properties:**
  → **Hard**
  → Do **NOT conduct electricity**
  → **NO free moving ions** or **electrons** to carry the **charge.**
  → **High melting & boiling** points → **many strong covalent** bonds need **high** energy to break them.
- **Uses:**
  → **Cutting tools** → because **hard**
  → **Jewelry** → because **shiny**



GRAPHITE

- **Type & arrangement of particles:**
  → Each **Carbon** atom bonded to **3 Carbon** atoms.
  → Remaining **4th electron freely moves** between **layers.**
- **Forces holding particles:**
  → By **strong covalent** bonds.
- **Shape of whole structure.**
  → Forming **hexagonal rings.**
  → **Arranged** in **layers.**
  → **Layers** held by **weak forces,** therefore, **slide over each other.**
- **Properties:**
  → **Soft**
  → **Conduct electricity** → **delocalized negatively** charged **electrons between layers** carry the charge.
  → **High melting & boiling** points → **many strong covalent** bonds need **high** energy to break them.
- **Uses:**
  → **Lubricant** → because **soft**
  → **Electrodes** → because **conducts**



ALLOTROPES

Different forms of the **same element,** which have **different properties,** due to the different **arrangement** of their **atoms.** **eg. Diamond** and **graphite** are **allotropes** of **Carbon.**

NOTES

- **Anything** that **conducts electricity** has either **free moving electrons (Metals & Graphite)**, or **free moving ions (ionic compounds)**.
- The **stronger** the **attraction forces**, the **higher** the **melting** and **boiling** points.
- **Solid ionic compounds** can **NOT conduct electricity**, while **molten** or **aqueous** ones do.
- **Silicon Dioxide** has a **similar structure** to that of **diamond**, therefore, **same properties**.
- **Single, double**, and **triple covalent** bonds are according to the **number** of **electron pairs shared**.
- **Metals** and **ionic** compounds are arranged into a **lattice**, so pay attention, which **lattice** is the question asking you to **define**.
- A **giant covalent compound** is **ONLY Silicon Dioxide** (**Graphite** and **Diamond** are **elements**.)