UNIT
8

Periodic Classification of Elements

POINTS TO REMEMBER

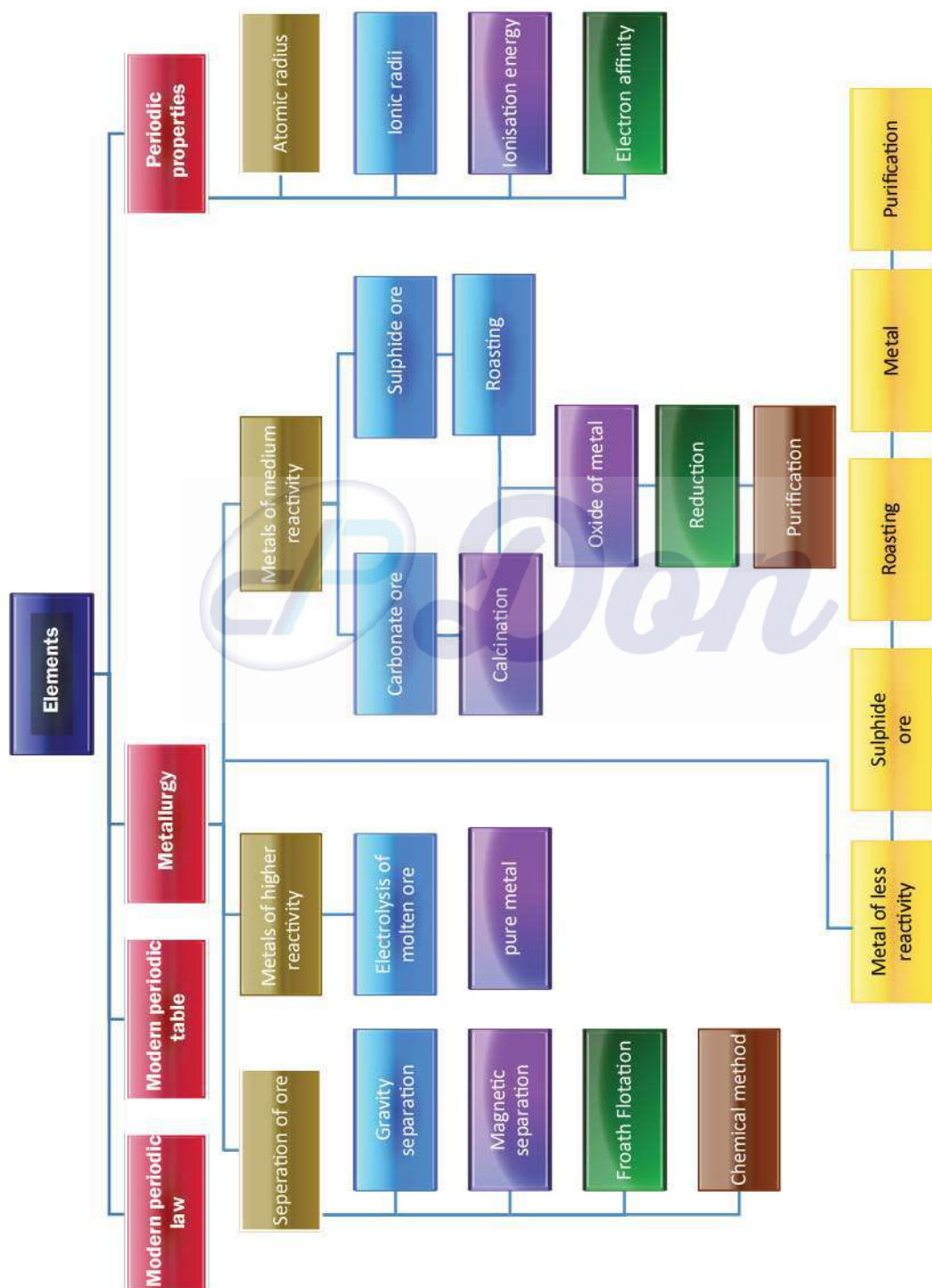|	
Modern periodic law	- The physical and chemical properties of the elements are the periodic functions of their atomic numbers.
Hendry Moseley	– Discovered atomic number of elements and formed modern periodic table.
Periods	– Horizontal rows in the periodic table.
Groups	– Vertical column in the periodic table
Inner transition elements	– Lanthanides and Actinides
Atomic radius	– Distance between centre of its nucleus and the outermost shell valence electron.
Metallic radius	– Half the distance between the nuclei of adjacent metal atoms.
Covalent radius	– Half the distance between the nuclei of two covalently bonded atoms of the same element in a molecule.
Ionic Radii	– The distance from the centre of the nucleus of the ion upto the point where it exerts its influence on the electron cloud of the ion.
Metallurgy	– Metallurgy is a science of extracting metals from their ores and modifying the metals into alloys for various uses, based on physical and chemical properties and their structural arrangement of atoms.
Ionisation energy	– Minimum energy required to remove an electron from gaseous atom.
Electron affinity	– Amount of energy released to gain an electron
Concentration	– Removal of impurities from the ore
Refining	– Purification of metal
Mineral	– A single compound or a complex mixture of various compounds of metals found in Earth.
Ore	– The mineral from which a metal can be readily and economically extracted in a large scale.
Mining	– Extracting the ore from the Earth's crust.
Gangue or matrix	– The rocky impurity associated with an ore.
Flux	– The substance added to the ore to reduce the fusion temperature
Slag	– The fusible product formed when a flux reacts with a gangue during the extraction of metals.

MIND MAP

Elements

Periodic properties
- Atomic radius
- Ionic radii
- Ionisation energy
- Electron affinity

Metallurgy

Metals of medium reactivity
- Sulphide ore → Roasting
- Carbonate ore → Calcination
- Oxide of metal → Reduction → Purification

Metals of higher reactivity
- Electrolysis of molten ore → pure metal

Seperation of ore
- Gravity separation
- Magnetic separation
- Froath Flotation
- Chemical method

Metal of less reactivity
- Sulphide ore → Roasting → Metal → Purification

Modern periodic table

Modern periodic law

Smelting	– Reducing the roasted metallic oxide from the metal in its molten condition
Concentration methods	– Hydraulic, magnetic, froth floatation, chemical method.
Bauxite	– Chief ore of Aluminium
Fluorspar	– Lowers the fusion temperature of electrolyte
Copper pyrite	– Chief ore of copper
Roasting	– Concentrated ore is roasted in excess of air
Haematite	– Chief ore of Iron
Calcination	– Concentrated ore is heated with limited supply of air
Amalgam	– Alloy of mercury with another metal
Alloy	– A homogeneous mixture of two or more methods
Galvanization	– Coating zinc on iron sheets by using electric current.

Formulae

Metallic radius	$\dfrac{\text{Distance between the nuclei of adjacent metal atoms}}{2}$
Covalent radius	$\dfrac{\text{Distance between the nuclei of two covalently bonded atoms of the same element in a molecule}}{2}$

Textbook Evaluation

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. The number of periods and groups in the periodic table are_____. ✶ ✶
   a) 6,16   b) 7,17   c) 8,18   d) 7,18

2. The basis of modern periodic law is_____.
   a) atomic number   b) atomic mass
   c) isotopic mass   d) number of neutrons

3. _____ group contains the member of halogen family.
   a) 17th b) 15th c) 18th d) 16th

4. _____ is a relative periodic property.
   a) Atomic radii   b) Ionic radii
   c) Electron affinity   d) Electronegativity

5. Chemical formula of rust is _____. ✶ ✶ ✶
   a) $FeO.xH_2O$ b) $FeO_4.xH_2O$
   c) $Fe_2O_3.xH_2O$ d) FeO

Don

6. In the alumino thermic process the role of Al is _____.
   a) oxidizing agent   b) reducing agent
   c) hydrogenating agent   d) sulphurising agent

7. The process of coating the surface of metal with a thin layer of zinc is called_____.
   a) painting   b) thinning
   c) galvanization   d) electroplating

8. Which of the following inert gases have 2 electrons in the outermost shell?
   a) He   b) Ne
   c) Ar   d) Kr

9. Neon shows zero electron affinity due to _____.
   a) stable arrangement of neutrons
   b) stable configuration of electrons
   c) reduced size
   d) increased density

10. _____ is an important metal to form amalgam.
    a) Ag   b) Hg
    c) Mg   d) Al

Ans:						
1)	d)	7, 18	6)	b)	reducing agent	
2)	a)	atomic number	7)	c)	galvanization	
3)	a)	17th	8)	a)	He	
4)	d)	electron negativity	9)	b)	stable configuration of electrons	
5)	c)	$Fe_2O_3 \cdot xH_2O$	10)	b)	Hg	

II. Fill in the blanks

1. If the electronegativity difference between two bonded atoms in a molecule is greater than 1.7, the nature of bonding is _____.

2. _____ is the longest period in the periodic table.

3. _____ forms the basis of modern periodic table. ✸ ✸ ✸

4. If the distance between two Cl atoms in Cl_2 molecule is 1.98Å, then the radius of Cl atom is _____.

5. Among the given species A^-, A^+, and A, the smallest one in size is _____.

6. The scientist who propounded the modern periodic law is _____.

7. Across the period, ionic radii _____.

8. _____ and _____ are called inner transition elements. ✸ ✸

9. The chief ore of Aluminium is _____. ✸

10. The chemical name of rust is _____.

Ans:

1)	ionic	6)	Hendry Moseley
2)	6th period	7)	decreases
3)	Atomic number	8)	Lanthanides, and actinides
4)	0.99Å	9)	Bauxite
5)	A^+	10)	hydrated ferric oxide

III. Match the following

1. i)   Galvanisation   – a) Noble gas elements   (b)

    ii) Calcination   – b) coating with Zn   (e)

    iii) Redox reaction   – c) Silver – tin amalgam   (d)

    iv) Dental filling   – d) Aluminium thermic process   (c)

    v) Group 18 elements   – e) Heating in the absence of air   (a)

IV. True or False (If false give the correct statement)

1. **Moseley's periodic table is based on atomic mass.**   **False**
    Moseley's periodic table is based on atomic number.

2. **Ionic radius increases across the period from left to right.**   **False**
    Ionic radius decreases across the period from left to right.

3. **All ores are minerals; but all minerals cannot be called as ores;**   **True**

4. **Al wires are used as electric cables due to their silvery white colour.**   **False**
    Al wires are used as electric cables as they are good conductor of electricity

5. **An alloy is a heterogenous mixture of metals.**   **False**
    An alloy is a homogeneous mixture of metals.

V. Assertion and Reason

Answer the following questions using the data given below:
   i)   A and R are correct, R explains the A.
   ii) A is correct, R is wrong.
   iii) A is wrong, R is correct.
   iv) A and R are correct, R doesn't explains A.

1. **Assertion :** The nature of bond in HF molecule is ionic.
    Reason : The electronegativity difference between H and F is 1.9.
    Ans : i) A and R are correct R explains the A

2. **Assertion :** Magnesium is used to protect steel from rusting.
    Reason : Magnesium is more reactive than iron.
    Ans : ii) A is wrong R is correct

3. **Assertion :** An uncleaned copper vessel is covered with greenish layer.
    Reason : Copper is not attacked by alkali.
    Ans : iv) A and R are correct R does not explains A

Don

VI. Short answer questions:

1. **A is a reddish brown metal, which combines with O_2 at < 1370 K gives B, a black coloured compound. At a temperature > 1370 K, A gives C which is red in colour. Find A, B and C with reaction.** ✶ ✶ ✶

   • A - reddish brown metal - **Copper**

   • When copper is heated at < 1370 K in the presence of oxygen, copper forms black colour **Copper II oxide** (CuO).

   • $2Cu + O_2 \xrightarrow{\text{below 1370 K}} \underset{\text{(copper II oxide)}}{2CuO}$

   • When copper is heated at > 1370 K in the presence of oxygen, copper forms red colour **Copper I oxide** (Cu_2O)

   • $4Cu + O_2 \xrightarrow{\text{above 1370 K}} \underset{\text{(Copper-I-oxide)}}{2Cu_2O}$

   • **A – copper (Cu)**

   • **B – copper II oxide (CuO)** – Black coloured

   • **C – copper-I-oxide (Cu_2O)** – Red coloured

2. **A is a silvery white metal. A combines with O_2 to form B at 800ºC, the alloy of A is used in making the aircraft. Find A and B.**

   • $4Al + 3O_2 \to 2Al_2O_3$ (Aluminium oxide)

   • A is Aluminium (Al)

   • B is Aluminium oxide (Al_2O_3)

3. **What is rust? Give the equation for formation of rust.** ✶ ✶ ✶

   • Rust is the formation of scaling reddish brown **hydrated ferric oxide** on the surface of iron containing materials.

   • This compound os known as rust and the phenomenon of formation of rust in know as rusting.

   • $4Fe + 3O_2 + xH_2O \to \underset{\substack{\text{(Rust)} \\ \text{(Hydrated ferric oxide)}}}{2Fe_2O_3.xH_2O}$

4. **State two conditions necessary for rusting of iron.**

   Conditions necessary for rusting of iron.

   • Iron is exposed to moist air.

   • Presence of water droplets in the atmosphere.

   • Presence of Oxygen.

VII. Long answer questions:

1. a) **State the reason for addition of caustic alkali to bauxite ore during purification of bauxite.** ✶ ✶

   b) **Along with cryolite and alumina, another substance is added to the electrolyte.**

   Addition of caustic alkali to bauxite ore:

   • Bauxite ore is finely ground and heated under pressure with a solution of concentrated caustic soda solution at 150ºC to obtain sodium meta aluminate.

- On diluting sodium meta aluminate with water, a precipitate of aluminium hydroxide is formed.
- The precipitate is filtered, washed, dried and ignited at 1000ºC to get alumina.
- $2Al(OH)_3 \xrightarrow{1000ºC} Al_2O_3 + 3H_2O$
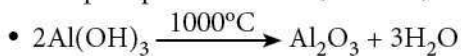
b)

- Fluorspar.
- It **lowers** the **fusion temperature** of electrolyte.

2. **The electronic configuration of metal A is 2, 8, 18, 1. The metal A when exposed to air and moisture forms B a green layered compound. A with con. H_2SO_4 forms C and D along with water. D is a gaseous compound. Find A, B, C and D.**

- Copper gets covered with a green layer of basic **copper carbonate** in the presence of CO_2 and moisture.
- $2 Cu + O_2 + CO_2 + H_2O \rightarrow CuCO_3.Cu(OH)_2$
- Copper reacts with dil H_2SO_4 to from **copper sulphate** and SO_2
- $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 \uparrow + 2H_2O$
- So,   A is – **Copper** (Cu)

      B is – $CuCO_3. Cu(OH)_2$ Basic **copper carbonate.**
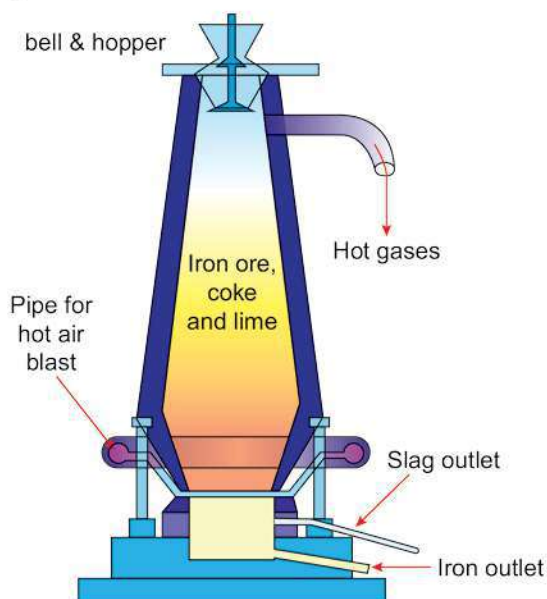
      C is – $CuSO_4$ **(copper sulphate)**

      D is – SO_2 **(Sulphur oxide)**

3. **Explain smelting process.** ★ ★ ★

   Smelting (in a Blast Furnace):

- The charge consisting of **roasted ore, coke** and **limestone** in the ratio **8:4:1** is smelted in a blast furnace by introducing it through the cup and cone arrangement at the top.
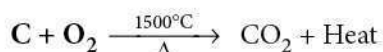- There are **three** important regions in the furnace.


Blast Farnance

a) The Lower Region (Combustion Zone):

- The temperature is at **1500°C**.
- In this region, **coke** burns with **oxygen** to form **CO_2** when the charge comes in contact with a hot blast of air.
- It is an **exothermic reaction** since heat is liberated.

$$C + O_2 \xrightarrow[\Delta]{1500°C} CO_2 + Heat$$

b) The Middle Region (Fusion Zone):

- The temperature prevails at **1000°C**.
- In this region, CO_2 is reduced to **CO.**

$$CO_2 + C \xrightarrow[\Delta]{1000°C} 2CO - Heat$$
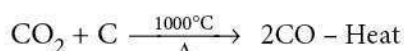
- Limestone decomposes to **calcium oxide** and **CO_2.**

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2 - Heat$$

- These two reactions are endothermic due to absorption of heat.
- Calcium oxide combines with **silica** to form **calcium silicate** slag.

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

c) The Upper Region (Reduction Zone):

- The temperature prevails at **400°C**.
- In this region carbon monoxide **reduces ferric oxide** to form a fairly pure spongy iron.

$$Fe_2O_3 + 3CO \xrightarrow{400°C} 2Fe + 3CO_2$$

- The molten iron is collected at the bottom of the furnace after removing the slag.
- The iron thus formed is called **pig iron.**
- It is remelted and cast into different moulds.
- This iron is called **cast iron.**

VIII. Higher Order Thinking Skill (HOTS)

1. **Metal A belongs to period 3 and group 13. A in red hot condition reacts with steam to form B. A with strong alkali forms C. Find A,B and C with reactions**

- When steam is passed over red hot aluminium, **Aluminium oxide** and Hydrogen is produced.

$$2Al + 3H_2O \longrightarrow Al_2O_3 + 3H_2 \uparrow$$
$$\text{(steam)} \qquad \text{(Aluminium oxide)}$$
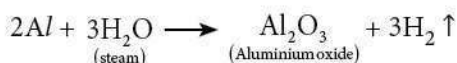
- When Aluminium react with strong caustic alkalis forming aluminate.

$$2 Al + 2 NaOH + 2H_2O \longrightarrow 2Na AlO_2 + 3H_2 \uparrow$$
$$\text{(Sodium meta Aluminate)}$$
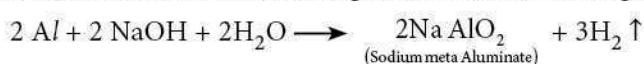
- A is **Aluminium** (Al)
- B is **Aluminium oxide** (Al_2O_3)
- C is **Sodium meta aluminate** (Na AlO_2)

2. **Name the acid that renders aluminium passive. Why?**

- **Dilute or concentrated nitric acid** renders aluminum passive
- It does not attack aluminium but it forms **oxide film** on its surface.

3. a) Identify the bond between H and F in HF molecule.
   b) What property forms the basis of identification?
   c) How does the property vary in periods and in groups?
   a) Ionic bond.
   b) Electronegativity property.
   c)

   • **Along the period** from left to right in the periodic table the electronegativity **increases**, because of the increase in the nuclear charge which in turn attracts the electrons more strongly.

   • On moving down a **group** the electronegativity of the element **decreases** because of the increased number of energy levels.

Additional Questions

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. The atomic mass of inert gas Argon is _____ amu.
   a) 39.10   b) 39.95
   c) 39.98   d) 35.45

2. The vertical columns in the periodic table starting from the top to bottom are called _____
   a) groups   b) periods
   c) levels   d) families

3. Ionisation energy is measured in _____. ★
   a) kJ   b) J/kg   c) kJ/mol   d) kg/mol

4. The rocky impurity associated with an ore is called _____.
   a) mining   b) matrix   c) flux   d) slag

5. Fluorspar is a _____ore.
   a) oxide   b) carbonate   c) Halide   d) sulphide

6. _____ is a chemical formula of cuprite.
   a) $CaCO_3$ b) CaF_2 c) PbS d) Cu_2O

7. The _____ is a less reactive metals.
   a) mercury   b) sodium   c) Aluminium   d) Calcium

8. Metals are usually malleable except _____.
   a) sodium   b) aluminium
   c) mercury   d) gold

9. The melting point of Aluminium is _____. ★
   a) 660°C   b) 800°C   c) 150°C   e) 1370°C

10. _____ is used in making aeroplanes and other industrial machine parts.
    a) Copper   b) Iron
    c) Silver   d) Aluminium

11. When copper reacts with dil HNO_3 _____ gas is liberated
    a) Nitric oxide   b) sulphur oxide
    c) copper oxide   d) carbon di oxide

12. An Amalgam is an alloy of _____ with another metal.
    a) metal   b) non metal   c) mercury   d) Gold

13. _____ is used in making an electromagnets.
    a) pig iron   b) wrought iron
    c) steel iron   d) none of these

14. When fusing the metal by melting of zinc and copper _____ alloy is collected.
    a) brass   b) bronze   c) magnalium   d) duralumin

15. _____ alloy is used to make propeller. ✴
    a) Stainless steel   b) Duralumin   c) Nickel steel   d) Magnalium

Ans:

1)	b)	39.95	9)	a)	660°C
2)	a)	groups	10)	d)	Aluminium
3)	c)	kJ/mol	11)	a)	Nitric oxide
4)	b)	matrix	12)	c)	mercury
5)	c)	Halide	13)	b)	wrought iron
6)	d)	Cu_2O	14)	a)	Brass
7)	a)	mercury	15)	c)	Nickel steel
8)	c)	mercury			

II. Fill in the blanks

1. The horizontal rows are called _____ and vertical columns are called _____.

2. The largest period of periodic table contains _____ elements.

3. The _____ is the last element of periodic table.

4. The 16th group is called as _____.

5. _____ is the process of removal of impurities from the ore. ✴

6. _____ are less hard metals.

7. _____ is a silvery white metal.

8. The chief ore of copper is _____.

9. The _____ is used for making calorimeters.

10. The chief ore of iron is hematite and its molecular formula is _____.

11. The pig iron contains _____ % of carbon. ✴

12. _____ alloy is used to make pressure cookers.

13. Pamban bridge was opened in _____.

Don

Ans:

1)	periods, groups	8)	copper pyrite
2)	32	9)	copper
3)	oganesson	10)	Fe_2O_3
4)	chalcogen family	11)	2 – 4.5
5)	concentration (or) separation	12)	Duralumin
6)	sodium and potassium	13)	1914
7)	Aluminium		

III. Match the following

1. i) Shortest period – a) 32 elements (c)
    ii) Long period – b) 8 elements (d)
    iii) Longest period – c) 2 elements (a)
    iv) Short period – d) 18 elements (b)

2. i) Boran family – a) phosphorus (d)
    ii) Carbon family – b) Iodine (e)
    iii) Nitrogen family – c) sulphur (a)
    iv) Chalcogen family – d) Aluminium (c)
    v) Halogens – e) silicon (b)

3. i) Removal of impurities from ore – a) Mining ✴ (b)
    ii) Convertion of ore into metal – c) Concentration (d)
    iii) Purification of metal – d) Smelting (e)
    iv) Extracting the ore from earth's crust – d) Production (a)
    v) Reducing the roasted metallic oxide
       from metal in molten condition – e) Refining (c)

4. i) Brass – a) Aircrafts (d)
    ii) Bronze – b) Scientific instruments (f)
    iii) Duralumin – c) Automobile parts (a)
    iv) Magnalium – d) Medal (b)
    v) Stainless steel – e) Propeller (c)
    vi) Nickel steel – f) Statues (e)

IV. True or False (If false give the correct statement)

1. The shortest period contains only eight elements.
   The shortest period contains only two elements (or)
   The short period contains only eight elements.   **False**

2. In the periodic table 18th group is called as Halogens. ✴
   In the periodic table 18th group is called as Noble gases.   **False**

3. The ionisation energy decreases down the group in the periodic table.   **True**

4. **The process of extracting the ores from the Earth crust is called smelting.**
   The process of extracting the ores from the Earth's crust is called <u>mining</u>. **False**

5. **The lighter ores are concentrated by froth floatation method.** **True**

6. **Metals high density except sodium and potassium.** **True**

7. **Blister copper contains 2% of pure copper 98% of impurities.** ✦
   Blister copper contains <u>98%</u> of pure copper and <u>2%</u> of impurities. **False**

8. **Copper is a reddish brown metal with low melting point of 100°C .**
   Copper is a reddish brown metal with high melting point of 1356°C **False**

V. Assertion and Reason

Answer the following questions using the data given below:
   i) A and R are correct, R explains the A.
   ii) A is correct, R is wrong.
   iii) A is wrong, R is correct.
   iv) A and R are correct, R doesn't explains A.

1. **Assertion :** In the modern periodic table sixth period is the longest period.
   Reason : It contains 32 elements from Caesium to Radon.

   Ans : iv) A and R are correct R explains the A

2. **Assertion :** The lanthanides and actinides are called inner transition elements.
   Reason : In the modern periodic table lanthanam to lutinum elements are called as lanthanides.

   Ans : iv) A and R are correct, R doesn't explains A.

3. **Assertion :** The process of extracting the ores from the earth's crust is called mining. ✦
   Reason : The rocky impurity associated with an ore is called slag.

   Ans : ii) A is correct, R is wrong.

4. **Assertion :** Cryolite is an oxide ore.
   Reason : Cryolite molecular formula is Na_2AlF_6.

   Ans : iii) A is wrong, R is correct.

5. **Assertion :** Metals are usually malleable. ✦
   Reason : They can be beaten into thin sheets without cracking.

   Ans : i) A and R are correct, R doesn't explains A.

6. **Assertion :** Iron is a lustrous metal, greyish white in colour.
   Reason : Iron can be magnetized.

   Ans : iv) A and R are correct, R doesn't explains A.

VI. Find the Odd one out:

1. a) **Helium, Neon, Silicon, Argon.**
   b) **Magnesium, Aluminium, Copper, Carbon.**
      Ans: a) Silicon
           b) Carbon.

2. a) Bauxite, Cryolite, Cuprite, Haematite
   b) Fluorspar, Galena, Iron pyrite, Zinc blende
   Ans: a) Cryolite
   b) Fluorspar

3. a) Brass, Bronze, Nickel, Magnalium
   b) Galvanisation, Froth floatation, Electroplating, Anodizing
   Ans: a) Nickel
   b) Froth floatation

VII. Short answer questions

1. **Define – atomic radius.**

   Atomic radius is defined as the distance between the centre of its nucleus and the outermost shell containing the valence electron.

2. **Define – Covalent radius.**

   It is defined as half the distance between the nuclei of two covalently bonded atoms of the same element in a molecule.

3. **Define – Ionisation Energy.** ✶ ✶

   Ionisation energy is the **minimum energy** required to remove an electron from a gaseous atom in its ground state to or a cation. It is otherwise called as **ionisation enthalpy**.

4. **What is electron affinity?** ✶ ✶

   Electron affinity is the amount of **energy released** when a gaseous atom gains an electron to form its anion. It is represented by
   $$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)} + energy$$
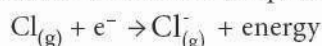
5. **Define – Metallurgy.**

   Metallurgy is a science of **extracting metals** from their ores and modifying the metals into alloys for various uses based on their physical and chemical properties and their structural arrangement of atoms.

6. **Name the metallurgical process.**

   • Concentration or separation of the ore
   • Production of the metal
   • Refining of the metal

7. **Define – Ore.**

   The mineral from which a metal can be readily and economically extracted on a large scale is said to be an ore
   Ex: Clay ($Al_2O_3. 2SiO_2. 2H_2O$)

8. **Give the principle of froth floatation.**

   • This process depends on the **preferential wettability** of the ore with oil and the gangue particles by water.
   • Lighter ores such as sulphide ores are separated by this method.

9. **Give any four physical properties of Aluminium.**
   - It is a **silvery white metal.**
   - It is a **good conductor** of heat and electricity.
   - It is **malleable** and **ductile**.
   - It is **low density** and it is light.

10. **What is aluminothermic process?** ✴
    - Mixture of **Aluminium powder** and **iron oxide** when ignited ,the latter is reduced to metal
    - This process is known as aluminothermic process.

11. **List out the uses of Aluminium.**
    - It is used in household utensils.
    - It is used in electrical cable industry.
    - It is used in making aeroplanes.
    - It is used in industrial machine parts.

12. **List the physical properties of Iron.**
    - It is a lustrous metal.
    - It is of greyish white in colour.
    - It has high tensility, malleability and ductility.
    - It can be magnetized.

VIII. Long answer questions:

1. **Give the features of periods in the modern periodic table.**
   - The **horizontal rows are called periods**. There are **seven** periods in the periodic table.
   - **First period** (Atomic number 1 and 2): This is the shortest period. It contains only two elements (Hydrogen and Helium).
   - **Second period** (Atomic number 3 to 10): This is a short period. It contains eight elements (Lithium to Neon).
   - **Third period** (Atomic number 11 to 18): This is also a short period. It contains eight elements (Sodium to Argon).
   - **Fourth period** (Atomic number 19 to 36): This is a long period. It contains eighteen elements (Potassium to Krypton). This includes 8 normal elements and 10 transition elements.
   - **Fifth period** (Atomic number 37 to 54): This is also a long period. It contains 18 elements (Rubidium to Xenon). This includes 8 normal elements and 10 transition elements.
   - **Sixth period** (Atomic number 55 to 86): This is the longest period. It contains 32 elements (Caesium to Radon). This includes 8 normal elements, 10 transition elements and 14 inner transition elements (Lanthanides).
   - **Seventh period** (Atomic number 87 to 118): Like the sixth period, this period also accommodates 32 elements. Recently 4 elements have been included by IUPAC.

2. Give the features of groups in the modern periodic table.

- The vertical columns in the periodic table starting from top to bottom are called **groups.** There are **18 groups** in the periodic table.
- Based on the common characteristics of elements in each group, they can be grouped as various families.

Group Number	Family
1	Alkali Metals
2	Alkaline earth metals
3 to 12	Transition metals
13	Boron Family
14	Carbon Family
15	Nitrogen Family
16	Oxygen Family (or) Chalcogen family
17	Halogens
18	Noble gases

- The Lanthanides and Actinides, which form part of Group 3 are called **inner transition elements**.
- **Except 'group 0'**, all the elements present in each group have the same number of electrons in their valence shell and thus have the same valency.
- For example, all the elements of **group 1** have one electron in their valence shells ($1s^1$). So, the valency of all the alkali metal is '1'.
- As the elements present in a group have **identical** valence shell electronic configurations, they possess similar chemical properties.
- The physical properties of the elements in a group such as melting point, boiling point and density vary gradually.
- The atoms of the **'group 0'** elements have stable electronic configuration in their valence shells and hence they are unreactive

3. List any five physical properties of metal

Physical state:

- All metals are solids at room temperature except mercury and gallium.

Lustre:

- Metals possess a high lustre (called metallic lustre).

Hardness:

- Most of the metals are hard and strong (exceptions: sodium and potassium can be cut with a knife)

Melting point and Boiling point:

- Usually, metals possess high melting and boiling points and vaporize only at high temperatures (exceptions: gallium, mercury, sodium and potassium).

Density:

- Metals have a high density (exceptions: sodium and potassium are less dense than water).

Ductility:

- Metals are usually ductile. In other words, they can be drawn into thin wires without breaking.

4. How Aluminium extracted from Bauxite? ✵ ✵

- Bauxite is the chief ore of aluminium. The extraction of aluminium from bauxite involves two steps:

Conversion of bauxite into alumina – Baeyer's Process:

- The conversion of Bauxite into Alumina involves the following steps:
- Bauxite ore is finely ground and heated under pressure with a solution of concentrated caustic soda solution at **150° C** to obtain sodium meta aluminate.
- On diluting sodium meta aluminate with water, a precipitate of **aluminium hydroxide** is formed.
- The precipitate is filtered, washed, dried and ignited at **1000°C** to get alumina.

Electrolytic reduction of alumina – Hall's Process:

- Aluminium is produced by the electrolytic reduction of fused alumina (Al_2O_3) in the electrolytic cell.

Cathode::

- Iron tank lined with **graphite**.

Anode:

- A bunch of **graphite rods** suspended in molten electrolyte.

Electrolyte:

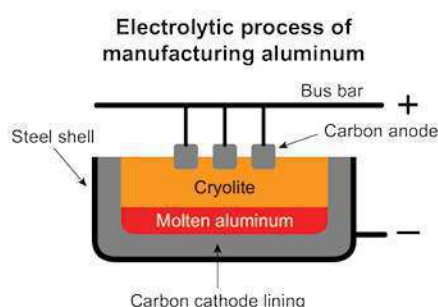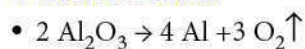- Pure alumina+ molten cryolite + fluorspar (fluorspar lowers the fusion temperature of electrolyte)

$$2Al(OH)_3 \xrightarrow{1000°C} Al_2O_3 + 3H_2O$$
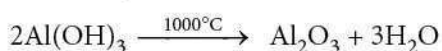
Temperature:

- 900 - 950 °C

Voltage used:

- 5-6 V

Overall reaction:

- $2\ Al_2O_3 \rightarrow 4\ Al + 3\ O_2 \uparrow$

Electrolytic process of manufacturing aluminum

- **Aluminium** is deposited at the **cathode** and **oxygen** gas is liberated at the **anode**.
- Oxygen combines with graphite to form CO_2.

5. **Explain the methods of copper extracted from copper pyrite.** ✴

- The chief ore of copper is copper pyrite.
- It yields nearly **76%** of the world production of copper. Extraction of copper from copper pyrites involves the following steps.

Concentration of ore:

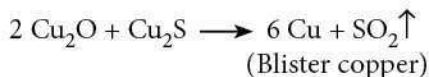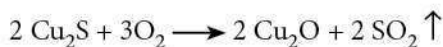- The ore is crushed and then concentrated by **froth floatation process.**
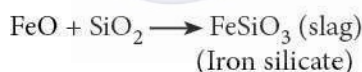
Roasting:

- The concentrated ore is roasted in excess of air.
- During the process of roasting, the moisture and volatile **impurities** are removed.
- Sulphur, phosphorus, arsenic and antimony are removed as oxides.
- Copper pyrite is partly converted into sulphides of copper and iron.
- $2\,CuFeS_2 + O_2 \longrightarrow Cu_2S + 2\,FeS + SO_2 \uparrow$

Smelting:

- The roasted ore is mixed with powdered coke and sand and is heated in a blast furnace to obtain matte **(Cu_2S + FeS)** and slag.
- The slag is removed as **waste.**

Bessemerisation:

- The molten matte is transferred to **Bessemer converter** in order to obtain blister copper.
- Ferrous sulphide from matte is oxidized to ferrous oxide, which is removed as slag using silica.

$$2\,FeS + 3\,O_2 \longrightarrow 2\,FeO + 2\,SO_2 \uparrow$$

$$FeO + SiO_2 \longrightarrow FeSiO_3 \text{ (slag)}$$
$$\text{(Iron silicate)}$$

$$2\,Cu_2S + 3O_2 \longrightarrow 2\,Cu_2O + 2\,SO_2 \uparrow$$

$$2\,Cu_2O + Cu_2S \longrightarrow 6\,Cu + SO_2 \uparrow$$
$$\text{(Blister copper)}$$

Refining:

- Blister copper contains **98%** of pure copper and **2%** of impurities and is purified by **electrolytic refining.**
- This method is used to get metal of a high degree of purity.
- For electrolytic refining of copper, we use:

Cathode:

- A thin plate of **pure copper metal.**

Anode:

- A block of **impure copper metal.**

Electrolyte:

- Copper sulphate solution **acidified** with sulphuric acid.
- When electric current is passed through the electrolytic solution, **pure copper** gets deposited at the **cathode** and the **impurities** settle at the bottom of the **anode** in the form of **sludge** called **anode mud.**

IX. Higher Order Thinking Skill (HOTS)

1. **The element (A) has the melting point is 660°C . It reacts with dilute acid (B) and liberates hydrogen gas. When concentrated Sulphuric acid is combined with (A), it gives C and D with sulphur di oxide. Find A, B, C, D and write the equation.**

   - A is Aluminium (Al)
   - B is dilute sulphuric acid (H_2SO_4)
   - C is Aluminium sulphate ($Al_2(SO_4)_3$)
   - D is water (H_2O)

   Equation:

   - $2\,Al + 6\,H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6\,H_2O + 3SO_2 \uparrow$
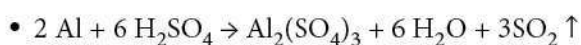
2. **The following Elements A, B, C, D are combine to form alloy E. It is used to make aircrafts and pressure cooker. Find A, B, C, D, E.**

   - A is Aluminium (Al)
   - B is Magnesium (Mg)
   - C is Manganese (Mn)
   - D is Copper (Cu)
   - E is Duralumin, Alloy

Unit Test -8

Periodic Classification of Elements

Time : 1 hr   **Marks : 30**

I. Choose the most suitable answer and write the code with the corresponding answer.   5 × 1 = 5

1. The number of periods and groups in the periodic table are_____.
   a) 6,16   b) 7,17   c) 8,18   d) 7,18

2. _____ group contains the member of halogen family.
   a) 17th   b) 15th   c) 18th   d) 16th

3. Chemical formula of rust is _____.
   a) $FeO.xH_2O$ b) $FeO_4.xH_2O$ c) $Fe_2O_3.xH_2O$ d) FeO

4. The process of coating the surface of metal with a thin layer of zinc is called_____.
   a) painting   b) thinning   c) galvanization   d) electroplating

5. The vertical columns in the periodic table starting from the top to bottom are called _____.
   a) groups   b) periods   c) levels   d) families

II. Answer the following questions in one or two lines.   5 × 2 = 10

1. List out the periodic properties.
2. Define – atomic radius.
3. Define – Covalent radius.
4. What is electron affinity?
5. Give the uses of Copper.

III. Answer the following questions in brief.   2 × 4 = 8

1. Give the features of periods in the modern periodic table.
2. i) Give the types of ore with an example.
   ii) Name the acid that renders aluminium passive. Why?

IV. Answer the following questions in detail.   1 × 7 = 7

1. Metal A belongs to period 3 and group 13. A in red hot condition reacts with steam to form B. A with strong alkali forms C. Find A,B and C with reactions