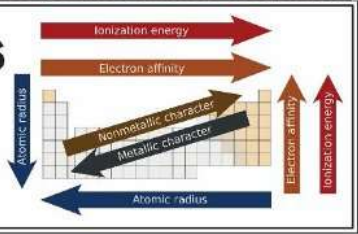
9 CHAPTER

GROUP PROPERTIES AND ELEMENTS



Students Learning Outcomes

After studying this chapter, students will be able to:

- Define group 1 Alkali metals as relatively soft metals with general trends down the group limited to decreasing melting point, increasing density and increasing reactivity.
- Predict properties of other elements in group 1, given information about the elements.
- Predict properties of elements in group 1 in order of reactivity given relevant information.
- Define group 17 halogens as diatomic non-metals with general trends limited to increasing density, and decreasing reactivity.
- Identify the appearance of halogens at ftp as fluorine as pale-yellow gas, chlorine as yellow - green gas, bromine as red -brown liquid, iodine as grey- black solid
- Explain the displacement reactions of halogens with other halide ions and also as reducing agents
- Predict the properties of elements in group 17, given information about the elements.
- Analyse the relative thermal stabilities of the hydrogen halides and explain these in terms of bond strengths Transition elements
- Describe the transition elements as metals that: have high densities, high melting points, variable oxidation numbers, form coloured compounds and act as catalysts for industrial purposes. (Some examples include catalysts being used are the Haber process, catalytic converters, Contact process and manufacturing of margarine) Define the Group 1 8 noble gases as unreactive, monatomic gases
- Explain this in terms of electronic configuration properties of metals.
- Compare the general physical properties of metals and non-metals (Specifically in terms of:

a. thermal conductivity
b. electrical conductivity
c. malleability and ductility
d. melting points and boiling points)

9.1 PROPERTIES OF GROUP 1 ELEMENTS

LONG QUESTIONS

Q.1 What are Group 1 elements? Describe general properties of group I elements.

Ans:

GROUP 1 ELEMENTS

Definition

The elements of group I (H, Li, Na, K, Rb, Cs, Fr) form alkaline solution with water thus are called alkali metals except hydrogen.

Properties of element in a group

(a) Similar Properties of elements

Elements present in a group of the periodic table show similar chemical properties owning to the presence of same number of electrons in their outermost shells.

(b) Small variation in the chemical properties

However, a small variation in the chemical properties of elements is expected because the atomic size increases down the g roup.

GENERAL PROPERTIES OF GROUP I ELEMENTS

i. Outer Shell Electronic Configuration

All the elements present in group 1 have ns^1 configuration in their outer shells.

ii. Other Name

They are also called alkali metals.

iii. Formation of Positive Ion

This single electron can be removed easily and form positive ion. It makes these metals very reactive except the first element hydrogen which is a gas and a non-metal.

iv. Atomic Size

When we move from top to bottom in this group, the atomic size increases.

v. Reactivity

Owing to the increase in atomic size from top to bottom, it becomes easier for elements to lose electron down the group which is reflected in the increased reactivities of the lower members of the group.

Example

(a) Reaction with water

Lithium reacts with water steadily giving hydrogen and lithium hydroxide. Sodium reacts vigorously while potassium reacts violently with water giving their respective water soluble hydroxides.

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

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

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

(b) Reaction with chlorine

Similarly, reaction of these metals with chlorine becomes more vigorous as we go down the group.

$$2Li_{(s)} + Cl_{2(g)} \xrightarrow{Heat} 2LiCl_{(s)}$$

$$2Na_{(s)} + Cl_{2(g)} \xrightarrow[vigorous\ reaction]{Heat} 2NaCl_{(s)}$$

$$2K_{(s)} + Cl_{2(g)} \xrightarrow[violent\ reaction]{Heat} 2KCl_{(s)}$$

vi. Interatomic attraction and softness and melting point

Increase in the atomic size down the group also weakens the interatomic attraction of the

atomic metals. This fact makes them softer down the group and their melting points decrease.

vii. Size of volume of atoms

As we go down the first group, both the size and volume of the atoms increase as the number of electrons and protons increases.

Increase in mass and volume

But the increase in mass of the elements is greater than the increase in volume.

viii. Trends in density

The density which is defined as the mass per unit volume increases gradually down the group.

Density

Definition

Mass per unit volume of a substance is called density.

Formula

$$d = \frac{m}{v}$$

Table (9.1) Physical Properties of First Group Metals

Metal	Li	Na	K	Rb	Cs
Melting point ^{o}C	180	98	64	39	28
Density g/cm ^{3}	0.53	0.97	0.86	1.53	1.87

EXERCISE

Q. Keeping in view the trends of reactivity in first group element how would they react with oxygen?

Ans: **REACTION WITH WATER**

- They **immediately tarnish in air** giving their oxides which form strong alkalies in water.
- Their reactivity increases down the group. Cesium explodes in contact with water, possibly shattering the container.

$$4Na + O_2 \longrightarrow 2Na_2O$$

$$Na_2O + H_2O \longrightarrow 2NaOH$$

INTERESTING INFORMATION

PROPERTIES OF ALKALI METALS

Li, Na, and K are lighter than water but rubidium sinks in water. Cesium explodes in contact with water, possibly shattering the container.

SHORT QUESTIONS

Q.1 Describe reactivities of alkaline earth metals. (RWP 2016)*(U.B+K.B)*

Ans: ALKALINE EARTH METALS

They are also reactive elements because of **ns^2 valence shell electronic** configuration but **less reactive than alkali metals** because of **small size** and **more nuclear charge**.

Q.2 What are Group 1 elements? What do you know about properties of elements?

Ans: GROUP 1 ELEMENTS

Definition

The elements of group I (H, Li, Na, K, Rb, Cs, Fr) form alkaline solution with water thus are called alkali metals except hydrogen.

Properties

Elements present in a group of the periodic table show similar chemical properties owning to the presence of same number of electrons in their outermost shells.

Q.3 How do Group I elements react with oxygen?

Ans: **REACTION WITH WATER**

- They **immediately tarnish in air** giving their oxides which form strong alkalies in water.
- Their reactivity increases down the group. Cesium explodes in contact with water, possibly shattering the container.

$$4Na + O_2 \longrightarrow 2Na_2O$$

$$Na_2O + H_2O \longrightarrow 2NaOH$$

Q.4 How do Group I elements react with chlorine?

Ans:

REACTION WITH CHLORINE

Similarly, reaction of these metals with chlorine becomes more vigorous as we go down the group.

$$2Li_{(s)} + Cl_{2(g)} \xrightarrow{\text{Heat}} 2LiCl_{(s)}$$

$$2Na_{(s)} + Cl_{2(g)} \xrightarrow[\text{vigorous reaction}]{\text{Heat}} 2NaCl_{(s)}$$

$$2K_{(s)} + Cl_{2(g)} \xrightarrow[\text{violent reaction}]{\text{Heat}} 2KCl_{(s)}$$

MULTIPLE CHOICE QUESTIONS

9. Alkali metals have valence shell electronic configuration: ***(K.B)***

- (A) ns^2 (B) np^6 (C) np^1 (D) ns^1

10. All metals are solid except: ***(K.B)***

- (A) Na (B) Mg (C) Hg (D) Au

11. How many series of d-block elements are there in the periodic table? ***(K.B)***

- (A) Three (B) Four (C) Five (D) Two

12. Three transition elements, Cu, Ag and Au constitute group number: ***(K.B)***

- (A) 9 (B) 10 (C) 11 (D) 12

13. Which one of the following reacts with water vigorously? ***(K.B)***

- (A) Alkaline earth metal (B) Alkali metals
- (C) Halogens (D) Noble gases

9.2 PROPERTIES OF GROUP 17 ELEMENTS

LONG QUESTIONS

Q.1 What are Group 17 elements? Describe general properties of group I7 elements.

Ans:

GROUP 17 ELEMENTS

Definition

The elements of group 17 (F, Cl, Br, I, At) form salts with metals and thus are called halogens.

GENERAL PROPERTIES OF GROUP 17 ELEMENTS

i. **Number of Valence Electrons**

All the elements in the group 17 have seven electrons in their outermost shells (ns^2, np^5).

ii. **Electronegative Non-metals**

They are electronegative non-metals because they have strong tendency to accept one electron to become an anion.

iii. **Diatomic Molecules**

They exist as diatomic molecules and behave as very reactive non-metals.

iv. **Atomic radii, melting and boiling points**
Atomic radii, melting and boiling points of halogens **increase** when you go down the group. This is because the atoms get larger as they have more electrons.

v. **Stronger Intermolecular Forces**
Because of their larger size they experience stronger intermolecular forces between molecules.

vi. **Melting and Boiling Points**
Because of they require more heat energy to overcome their intermolecular forces and so their melting and boiling points are **increased**.

vii. **Why called halogen?**
They react with alkali and alkaline earth metals to give salts. These elements are thus named as Halogens which means salt-forming elements.

viii. **Reactivity of halogens**
Unlike metals, the reactivity of halogens decreases from top to bottom in the group.

ix. **Decrease in reactivity down the group**
This is due to the fact that atomic size increases down the group and tendency to accept electron from other atoms decreases making them less reactive.

x. **Density**
The attractive forces present between the halogen molecules increase down the group so as we go down the group, the halogens become more dense.

xi. **Colours of halogens**
Fluorine gas is very pale yellow, chlorine gas yellowish green while bromine is fuming red-brown liquid. Iodine exists as shiny grey crystals which easily turns into dark purple vapours when they are warmed up.

Table: Physical Properties of Halogens

Element	Physical State	Colour	Atomic No.	Electronic Configuration	Melting Point (K)	Boiling Point (K)	Electro negativities
F	Gas	Pale Yellow	9	$[He]2s^2 2p^5$	53	85	4.0
CI	Gas	Yellowish Green	17	$[Ne]3s^2 3p^5$	172	238	3.2
Br	Liquid	Fuming Red brown	35	$[Ar]4s^2 4p^5$	266	332	3.0
I	Solid	Shiny grey	53	$[Kr]5s^2 5p^5$	387	457	2.7

Q.2 Give the chemical properties of halogens. ***(U.B+K.B)***

OR

Describe important reactions of halogens. ***(U.B+K.B)***

Ans: **CHEMICAL PROPERTIES OF GROUP 17 ELEMENTS (HALOGENS)**

Order of reactivity of halogens is as follows:

F > Cl > Br > I

(i) **Reaction with alkali or alkaline earth metal**
Metal halides are formed when halogens react directly with alkali and alkaline earth metals. Metal halides behave usually as ionic compounds.

$$2Li_{(s)} + Cl_{2(g)} \xrightarrow{\text{Heat}} 2LiCl_{(s)}$$

$$2Na_{(s)} + Cl_{2(g)} \xrightarrow[\text{vigorous reaction}]{\text{Heat}} 2NaCl_{(s)}$$

$$2K_{(s)} + Cl_{2(g)} \xrightarrow[\text{violent reaction}]{\text{Heat}} 2KCl_{(s)}$$

(ii) **Oxidizing agent**
All halogens are oxidizing agent. **Fluorine** is the **strongest oxidizing element** while **iodine** is the **least** i.e. **mild oxidizing agent**.

Definition

Reduction is a process in which an electron is gained and the substance which accepts the electron is called an oxidizing agent.

OR

The substance which oxidizes a substance by taking a electron from it is called oxidizing agent.

$$Cl_2 + 2e \longrightarrow 2Cl^-$$

Oxidation

Oxidation is a process in which an electron is lost.

Reducing agent

Definition

The substance which loses an electron is called a reducing agent.

OR

The substance which reduces a substance by giving electron to it is called reducing agent.

Example

- Metal
- Carbon
- CO

$$Na_{(s)} \longrightarrow Na^+ + e$$

Oxidation-reduction are simultaneous reactions

Oxidation-reduction are simultaneous reactions. In other words, an electron is lost only when there is a substance to accept it.

(iii) Halogens as reducing agent

Halogens are reducing agents and their reducing power decreases down the group.

$$Cl_2 > Br_2 > I_2$$

Principle

A more reactive halogen displaces less reactive halogen from its salt.

Importance of reducing agent

This fact gives a unique property to halogens when a halogen having more reducing power displaces an ion of another halogen from its compound.

$$Cl_{2(aq)} + 2NaBr_{(aq)} \longrightarrow 2NaCl_{(aq)} + Br_{2(g)}$$

$$Cl_{2(aq)} + 2NaI_{(aq)} \longrightarrow 2NaCl_{(aq)} + I_{2(v)}$$

$$Br_{2(aq)} + 2NaI_{(aq)} \longrightarrow 2NaBr_{(aq)} + I_{2(v)}$$

(iv) Reaction with hydrogen

Halogens react with hydrogen to give hydrogen halides. Hydrogen halides behave as strong acids in water.

$$H_2 + X_2 \longrightarrow 2HX$$

$$H_2 + F_2 \xrightarrow[\text{state}]{\text{dark and cold}} 2HF$$

$$H_2 + Cl_2 \xrightarrow{\text{sunlight}} 2HCl$$

$$H_2 + Br_2 \xrightarrow{\text{only on headting}} 2HBr$$

$$H_2 + I_2 \xrightarrow[\text{and catalyst}]{\text{heating}} 2HI$$

Properties of halides

(a) Physical state

All halides exist in gaseous state at ordinary temperature except hydrogen fluoride which is a liquid.

(b) Thermal stability

Bond length between hydrogen and halogen increases down the group because as the halogen atom gets bigger the bonding pairs of electron get further away from the halogen nucleus. The bond between hydrogen and halogen therefore gets weaker. The weaker the bond, the less heat energy it will need to break it. Hence the thermal stability of hydrogen halides decreases down the group

HF > HCl > HBr > HI

EXERCISE

Q. How do halogens react with water?

Ans:

REACTION OF HALOGENS WITH WATER

Fluorine (F_2) decomposes water in cold state and in dark. Chlorine decomposes water in presence of sunlight. Bromine only reacts with water under special conditions. Iodine does not give this reaction.

$$2F_2 + 2H_2O \xrightarrow[\text{Cold state}]{\text{Dark and}} 4HF + O_2$$

$$Cl_2 + H_2O \xrightarrow{\text{sunlight}} HCl + HOCl$$

$$Br_2 + H_2O \xrightarrow{\text{heat}} HBr + BOBr$$

$$I_2 + H_2O \longrightarrow \text{No reaction}$$

INTERESTING INFORMATION

Water in swimming pool is sterilized with chlorine.

SHORT QUESTIONS

Q.1 Define halogen. ***(K.B)***

Ans: Answer given on page # 235

Q.2 How halogens react with hydrogen? ***(U.B)***

Ans: Answer given on page # 237

Q.3 Write two chemical properties of halogens. **(LHR 2016 G-II, 2017 G-I)** ***(U.B+K.B)***

Ans: **CHEMICAL PROPERTIES OF HALOGENS**

(i) Reaction with Hydrogen: All **halogens (X_2)** combine with hydrogen to give hydrogen halides (HX).

$$H_2 + F_2 \xrightarrow[\text{state}]{\text{dark and cold}} 2HF$$

$$H_2 + Cl_2 \xrightarrow{\text{sunlight}} 2HCl$$

$$H_2 + Br_2 \xrightarrow{\text{only on headting}} 2HBr$$

$$H_2 + I_2 \xrightarrow[\text{and catalyst}]{\text{heating}} 2HI$$

(ii) Reaction with Water: Fluorine (F_2) decomposes water in cold state and in dark. Chlorine decomposes water in presence of sunlight. Bromine only reacts with water under special conditions. Iodine does not give this reaction.

$$2F_2 + 2H_2O \xrightarrow[\text{Cold state}]{\text{Dark and}} 4HF + O_2$$

$$Cl_2 + H_2O \xrightarrow{\text{sunlight}} HCl + HOCl$$

$$Br_2 + H_2O \xrightarrow{\text{heat}} HBr + HOBr$$

$$I_2 + H_2O \longrightarrow \text{No reaction}$$

Q.4 Why valency of chlorine is 1? ***(U.B)***

Ans: **VALENCY OF CHLORINE**

Valency of chlorine is one because chlorine has seven electrons in its valence shell and it can accept only one electron to complete its valence shell or octet.

Q.5 Which factor controls the non-metallic character of the elements? ***(U.B)***

Ans: **FACTORS CONTROLLING NON-METALLIC CHARACTER**

The non-metallic character of elements is controlled by electron affinity and electronegativity of atoms. Greater the electron affinity and electronegativity, more non-metallic character of elements will be.

Q.6 Why fluorine is more non-metallic than chlorine? ***(U.B)***

Ans: **NON-METALLIC CHARACTER**

Fluorine is more non-metallic than chlorine because it has smaller size and more nuclear attraction to valance electrons. Non-metallic depends upon electronegativity and Fluorine electronegativity is more than Chlorine, therefore Fluorine is more non-metallic than Chlorine.

Q.7 Iodine exists in solid state, can it be beaten with hammer to form sheets? ***(U.B)***

Ans: **IODINE A NON-METAL**

No, only solid things or metals have the characteristics to be beaten with hammer to form sheets. Iodine is a non-metal and brittle.

Q.8 Can liquids and gases be brittle? ***(U.B)***

Ans: **BRITTLENESS OF LIQUIDS AND GASES**

Liquid and gases cannot be brittle because it is only the property of solids especially ionic solids.

Q.9 **Why the oxygen is called non-metal?** *(U.B)*

Ans: **OXYGEN IS CALLED NON-METAL**

Oxygen is non-metal because it form negative ion by gaining electrons like other non-metals.

Q.10 **Name two non-metals which are both brittle and non-ductile.** *(K.B)*

Ans: **BRITTLE AND NON-DUCTILE NON-METAL**

Graphite and iodine are two non-metals which are brittle and non-ductile in nature.

Q.11 **Name the most abundant non-metal in the Earth's crust.** *(K.B)*

Ans: **ABUNDANT NON-METAL IN THE EARTH**

The most abundant non-mental in the Earth's crust is oxygen. It is 47 % of Earth's crust.

Q.12 **Give the non-metallic trend in halogens.** **(RWP 2016)** *(U.B)*

Ans: **NON-METALLIC TREND IN HALOGENS**

The non-metallic trend in halogens decreases from top to bottom because of increasing atomic sizes.

$$F > Cl > Br > I$$

Q.13 **Why do the non-metals accept electrons readily?** *(U.B)*

Ans: **ACCEPTANCE OF ELECTRON**

Non-metals accept electrons readily because they are more electronegative and are usually electron deficient in nature. So they form anions by gaining electrons.

$$Cl + 1e^- \longrightarrow Cl^-$$

MULTIPLE CHOICE QUESTIONS

1. **The least electronegative element among the halogens is:** *(K.B)*

(A) Fluorine (B) Chlorine (C) Bromine (D) Iodine

2. **The most electronegative element among the halogens is** *(K.B)*

(A) Fluorine (B) Chlorine (C) Bromine (D) Iodine

3. **Atomic number of iodine is:** *(K.B)*

(A) 35 (B) 53 (C) 52 (D) 54

4. **At room temperature F and Cl exist as:** *(K.B)*

(A) Monoatomic (B) Diatomic (C) Triatomic (D) Polyatomic

5. **Br exist as:** *(K.B)*

(A) Liquid (B) Gas (C) Solid (D) Both A and C

6. **Colour of iodine is:** *(K.B)*

(A) Pale yellow (B) Purple (C) Red (D) Black

7. **Noble gas electronic configuration of F is:** *(U.B)*

(A) $[He]2s^2, 2p^5$ (B) $[Ne]\ 3s^2, 3p^5$ (C) $[Ar]4s^2, 4p^5$ (D) $[Kr]5s^2, 5p^5$

8. **Which one of the following makes covalent bond with halogens?** *(U.B)*

(A) Na (B) K (C) O (D) Mg

9. **Which one among the halogens has least affinity with hydrogen?** *(K.B)*

(A) F_2 (B) Cl_2 (C) Br_2 (D) I_2

10. **In diffused sunlight chlorine reacts with methane to form:** *(K.B)*

(A) CH_3Cl (B) CH_2Cl_2 (C) CCl_4 (D) All of these

11. **Which halogen react with water in dark and cold state?** *(K.B)*

(A) F_2 (B) Cl_2 (C) Br_2 (D) I_2

12. **Which one of the following is strongest oxidizing agent?** *(K.B)*

(A) Chlorine (B) Fluorine (C) Bromine (D) Iodine

13. **Which halogen does not react with water?** *(K.B)*

(A) Chlorine (B) Bromine (C) Fluorine (D) Iodine

9.3 GROUP PROPERTIES OF TRANSITION ELEMENTS

LONG QUESTIONS

Q.1 Give the group properties of transition elements. ***(U.B+K.B)***

Ans:

GROUP PROPERTIES OF TRANSITION ELEMENTS

Transition elements

Definition

Elements present at the centre of the modern periodic table from group 3 to group 12 are called d block elements or transition elements.

GROUP PROPERTIES

(i) Metals

All transition elements are metals having the similar properties.

(ii) Hard and high density

Transition elements are often hard with higher densities.

(iii) Melting and Boiling Points

Their melting and boiling points are also high.

(iv) Variable Oxidation States

These metals show variable oxidation states.

(v) Coloured Compounds

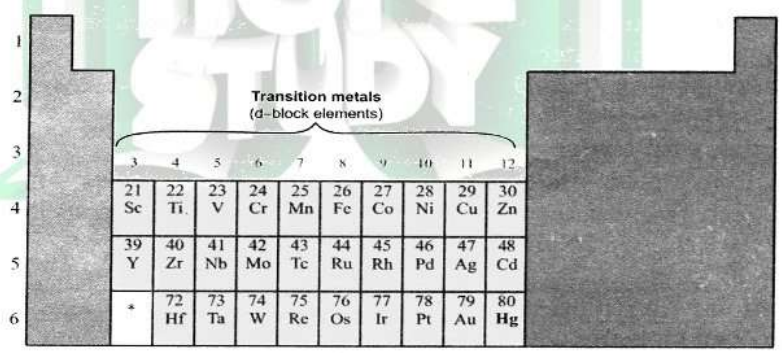
The compounds, the transition elements form are often coloured.

(vi) Malleable and ductile

They are malleable and ductile.

(vii) As Catalyst

Transition metals and their compounds function as catalysts in many important chemical reactions.



Q.2 How transition elements act as catalysts? ***(U.B+K.B)***

Ans:

TRANSITION ELEMENTS AS CATALYST

Transition metals and their compounds function as catalysts in many important chemical reactions.

Mechanism of Action as Catalyst

Metals often absorb other substances on their surface and activate them in this process.

Example

i. Iron as catalyst in Haber process

Iron, a transition metal, is used as a catalyst in one of the most important industrial reactions which gives **ammonia.** It is called Haber process. This ammonia is used to prepare urea fertilizer.

$$N_2 + 3H_{2(g)} \xrightarrow{Fe} 2NH_{3(g)}$$

ii. Platinum as catalyst in contact process

Platinum was originally used as a catalyst in the contact process for the **manufacture of sulphuric acid.**

Inactivation or poisoning of a catalyst

This expensive catalyst is, however, rendered inactive due to the presence of arsenic as impurity in sulphur dioxide.

iii. Vanadium pentoxide as a catalyst in contact process

Vanadium pentoxide (V_2O_5) is now preferred as a catalyst in contact process.

$$SO_{2(g)} + O_{2(g)} \xrightarrow{V_2O_5} SO_{3(g)}$$

$$SO_{3(g)} + H_2O_{(l)} \longrightarrow H_2SO_{4(aq)}$$

iv. Catalyst used in catalytic converter

Platinum, palladium and rhodium are the catalysts used in catalytic converters.

Catalytic converter

Definition

A catalytic converter is a device used in the exhaust of an automobile which converts more harmful gases produced in the engine to such gases which do not pollute the atmosphere.

v. Nickel as a catalyst in catalytic converter

A transition metal nickel is used as a catalyst for the hydrogenation of oils to give solid margarine. Margarine is less likely to spoil than butter.

THINGS TO KNOW

Q. Transition metals have high tensile strength. What does it mean?

Ans: **TENSILE STRENGTH**

Tensile strength is the maximum amount of stress a material can withstand before it breaks when it is stretched or pulled.

It iss an important property of materials e.g metals, polymers etc.

SHORT QUESTIONS

Q.1 How platinum is used as a catalyst in automobiles and what are the advantages of this use?

(RWP 2017, SGD 17)*(U.B)*

- **Ans:** **PLATINUM AS CATALYST**

- Platinum alloyed with palladium and rhodium is used as catalyst in automobiles as catalytic converter. They convert most of the toxic harmful gases (NO_2, CO) emitted by the vehicles into less harmful CO_2, N_2 and H_2O vapours.

MULTIPLE CHOICE QUESTIO

1. All are solid except: ***(K.B)***

(A) Na (B) Mg (C) Br (D) Au

2. Which metal is used for making mirrors? ***(K.B)***

(A) Lead (B) Iron (C) Silver (D) Lithium

3. Gold is always alloyed with one among the following metals: ***(K.B)***

(A) Sodium (B) Mercury (C) Copper (D) Calcium

4. How many series of f-block elements are there in the periodic table? ***(K.B)***

(A) Three (B) Four (C) Five (D) Two

5. Platinum is used in manufacturing of: ***(K.B)***
(A) LCD (B) Photographic film (C) Dental preparation (D) Mirror

6. Thin layer of oxide makes silver relatively: ***(K.B)***
(A) Reactive (B) Stable (C) Unreactive (D) Inert

7. Which one is used in dental preparations? ***(K.B)***
(A) Gold (B) Silver (C) Platinum (D) All of these

8. Ornamental metal is: ***(K.B)***
(A) Sodium (B) Potassium (C) Calcium (D) Gold

9.4 PROPERTIES OF NOBLE GASES

LONG QUESTIONS

Q.1 What are Noble gases? Describe the properties of noble gases (group I8 elements).

Ans:

NOBLE GASES

Definition

Elements present in group 18 (He, Ne, Ar, Kr, Xe, Ra) *of the modern periodic table are called Noble elements.*

PROPERTIES OF NOBLE GASES

Following are general properties of noble gases:

(i) Monoatomic gases
All noble elements are monoatomic gases.

(ii) Boiling point
Having very low boiling points, Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenone (Xe) and Radon (Ra).

(iii) No of valence shell
All these gases have eight electrons (s^2 p^6) in their outermost shells except He which has s^2 electronic configuration.

(iv) Reactivity
Since their outer shells are complete, they show very little chemical reactivity.

(v) Density
Noble gases have low density. Which increases down the group.

(vi) Ionization energy
Noble gases have very high ionization energy which decreases down the group due to increase in atomic size.

SHORT QUESTIONS

Q.1 What are Noble gases? Describe the properties of noble gases (group I8 elements).

Ans:

NOBLE GASES

Definition

Elements present in group 18 (He, Ne, Ar, Kr, Xe, Ra) *of the modern periodic table are called Noble elements.*

Q.2 Describe any three properties of noble gases (group I8 elements).

Ans:

NOBLE GASES

Definition

PROPERTIES OF NOBLE GASES

Following are general properties of noble gases:

(j) Monoatomic gases
All noble elements are monoatomic gases.

(ii) Boiling point
Having very low boiling points, Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenone (Xe) and Radon (Ra).

(iii) No of valence shell
All these gases have eight electrons (s^2 p^6) in their outermost shells except He which has s^2 electronic configuration.

MULTIPLE CHOICE QUESTIONS

7. **Which one of the following non-metals is lustrous?** **(GRW 2017 G-I)** ***(K.B)***
(A) Sulphur (B) Phosphorus (C) Iodine (D) Carbon

8. **Non-metals are generally soft but which one of the following is extremely hard?** ***(K.B)***
(A) Graphite (B) Phosphorous (C) Iodine (D) Diamond

9. **In the group metallic character:** ***(U.B)***
(A) Increases (B) Decreases (C) Remains same (D) None of these

10. **Non-metals react with:** ***(K.B)***
(A) Dilute acids (B) Concentrated acids (C) Water (D) Both B and C

9. **Noble gases have valence shell electronic configuration:** ***(K.B)***
(A) ns^2 (B) np^6 (C) np^1 (D) ns^1

9.5 PHYSICAL PROPERTIES OF METALS AND NON METALS

LONG QUESTIONS

Q.1 Describe the physical properties of metals and non-metals.

Ans: **PHYSICAL PROPERTIES OF METALS AND NON METALS**

Metals and non-metals can be distinguished based on their physical and chemical properties.

(A) METALS

Definition

Metals are defined as the elements which can generally form cations easily.

OR

*"The elements which are **electropositive** and form **cations** by **losing electrons** are called metals".*

Examples:

Iron, gold, silver, copper etc.

PHYSICAL PROPERTIES OF METALS

(i) They also tend to form **metallic bond**.
(ii) Metals can be **hammered into thin sheets**. This property is called **malleability**.
(iii) Metals can also be **drawn into wires** and this property is named as **ductility.**
(iv) Metallic bond in metals allows metals to be the **best conductor of heat and electricity**.
(v) Metals are lustrous which means that they have a **shiny appearance**.
(vi) Due to high tensile strength metals can hold **heavy weights**.
(vii)When metals are hit by an object, they make a **ringing sound**.
(viii)Metals **cannot be cut easily** because they are hard substances.
(ix) Due to the presence of strong metallic bond metals generally have **high melting and boiling points.**
(x).Their **densities** are also **very high**.
(xi)Alkali metals **being soft metals** are treated as exceptions.

Examples

- Copper
- Silver
- Iron
- Lead
- Aluminium
- Gold
- Platinum
- Zinc etc.

(B) NON METALS

Definition

Non-metals generally gain electrons easily.

OR

*"The elements which are **electronegative** and form **anions** by **gaining electrons** are called non-metals".*

Examples:

Carbon, nitrogen, sulphur, phosphorous etc.

PHYSICAL PROPERTIES OF NON METALS

(i) Colours And Physical States

Non-metals show a greater variety of colours and physical states compared to metals.

(ii) Not beaten into sheets

Non-metals cannot be beaten into thin sheets because being brittle they break into pieces when hammered. Sulphur and phosphorous exist in powdered forms and cannot be made into sheets.

(iii) Not drawn into wires

Non-metals cannot be melted and drawn into wires.

(iv) Brittle

Nonmetals do not have free electrons due to which the bonds between their atoms are weak and they break down when stretched.

(v) Non-conductor of heat and electricity

As there are no free electrons so non-metals cannot conduct heat and electricity.

Exception of non-metals towards electrical conductivity

Graphite is the only exception. It conducts electricity because of its special crystalline arrangements. The electrons which are present between the layers of graphite crystal are loosely held and hence they can become mobile. The conduction of electricity of graphite is due to the mobility of these electrons.

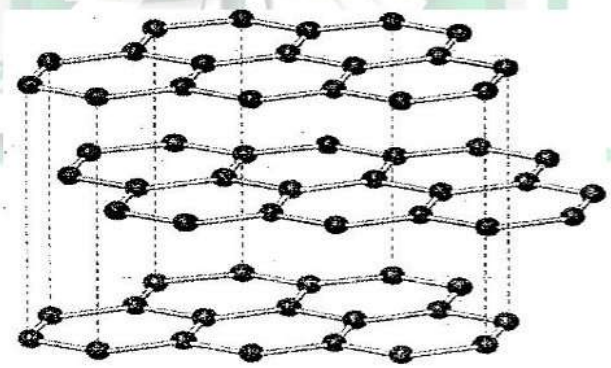


Fig (9.1): Graphite structure

(vi) Dull surface

Non-metals cannot be polished because they either exist in •powder or gaseous form.

Most of the powders are dull in texture.

(vii). Breaking of non-metals

Due to non-ductile and non-malleable properties, non-metals are not strong at all. Their bonds being weak break easily.

(viii).Melting and Boiling Points

All non-metals have low melting and boiling points. The melting point of sulphur is 115 ^{0}C.

Exceptions

Graphite and diamond have high melting points and these are exceptions.

(ix). Low Density

Non-metals have low densities as compared to metals. This means that in non-metals atoms are not strongly bound with each other.

Examples of non-metals

Oxygen, nitrogen, chlorine, sulphur, carbon, bromine, etc.

COMPARISON OF THE PHYSICAL PROPERTIES OF METALS AND NON-METALS	
Metals	Non metals
Meting and boiling point	
1. Metals usually have high melting and boiling points	1. Non-metals may be solids, liquids or gases at room temperature. They show wide range of melting and boiling points.
Electrical conductivity	
2. Metals are good conductors of heat and electricity.	2. Non-metals are bad conductors of heat and electricity (except graphite).
Malleable and ductile	
3. Metals can be made into different shapes by applying pressure. Metals can therefore be easily drawn into wires and sheets.	3. Non-metals are brittle.
Lustre	
4. Metals are usually lustrous solids (except mercury).	4. Non-metals are dull and cannot be polished (except iodine).
Hardness	
5. Metals are generally tough and strong.	5. Non-metals are neither tough nor strong

INTERESTING INFORMATION

NUMBER OF METALS AND NON-METALS

About 75% of all element in the periodic table are metals. There are total 20 non-metals which exist in solids or liquid or gaseous state at room temperature

INTERESTING INFORMATION

ELEMENTS FACING THREAT OF EXTINCTION

According to one report nine elements are facing serious threat of extinction. Some of those elements are arsenic, gallium, gold, helium and zinc.

SHORT QUESTIONS

Q.7 What type of elements are metals? **(FSD 2017)*(K.B)***

Ans: **METAL ELEMENTS**

Definition:

*"The elements which are **electropositive** and form **cations** by losing electrons are metals".* They **form basic oxides** with oxygen, are good conductor of heat and electricity and are usually hard.

Examples:

(vi) Sodium
(vii) Potassium
(viii) Calcium
(ix) Magnesium
(x) Aluminum

Q.8 Name a metal which exists in liquid form? ***(K.B)***

Ans:

METAL IN LIQUID FORM

The only metal which exist in liquid form at room temperature is **mercury (Hg)**.

Q.9 What is the nature of a metal oxide? ***(U.B+K.B)***

Ans:

NATURE OF METAL OXIDE

Metal oxides are basic in nature because they change red litmus paper to blue.

Examples:

Na_2O, CaO, K_2O, MgO

Q.10 Which group of metal is highly reactive? ***(K.B)***

Ans:

HIGHLY REACTIVE METAL

Alkali metals of group I **(Li, Na, K, Rb, Cs, Fr)** of the periodic table are **highly reactive** because they are **highly electropositive** in nature.

Q.11 Why Sodium metal is more reactive than magnesium metal? ***(U.B)***

Ans:

REACTIVITY OF SODIUM AND MAGNESIUM

Sodium metal is more reactive than magnesium metal because **sodium has larger size,** low ionization energy than magnesium and thus can **lose electrons more easily** than magnesium.

Q.12 Name a metal which can be cut with knife? ***(K.B)***

Ans:

METAL CAN CUT WITH KNIFE

Sodium metal can be cut with knife, because it is soft due to **weak metallic bonding**.

Q.13 Name the best ductile and malleable metal? **(RWP 2017)** ***(K.B)***

Ans:

DUCTILE AND MALLEABLE METAL

The best ductile and malleable metal is **gold**.

Q.14 Name the metal which is the poorest conductor of heat? ***(K.B)***

Ans:

POOREST CONDUCTOR METAL

The poorest conductor of heat is lead **(Pb)**.

Q.15 What do you mean by malleable and ductile? ***(K.B)***

Ans:

MALLEABLE AND DUCTILE

Malleable:

*"Malleability is the property of metals due to which they can be **beaten/hammered into sheets**".*

Ductile:

*"Ductility is the property of the metals due to which they can be **drawn into wires**".*

Q.16 Why alkali metals are more reactive than alkaline earth metals? ***(U.B)***

Ans:

REACTIVITY OF ALKALI AND ALKALINE EARTH METALS

Alkali metals are more reactive than alkaline earth metals because **alkali metals have the largest size** and the lowest ionization energy in their respective periods therefore alkali metals have highest metallic character, so these are more reactive than alkaline earth metals.

Q.17 What do you mean by metallic character? **(SGD 2017)** ***(U.B+K.B)***

OR

Define electropositivity. **(SWL 2016, BWP 2016)** ***(U.B+K.B)***

Ans:

ELECTROPOSITIVE CHARACTER / METALLIC CHARACTER

*"Metals have the tendency to **lose** their **valance electrons**. This property of a metal is termed as **electropositivity** or **metallic character***

Q.18 Why metallic character decreases along a period and increases in a group? ***(U.B)***

Ans:

METALLIC CHARACTER

Metallic character in a period because size of atom decreases and increases in a group because size of atom increases.

Q.19 What is the trend of electronegativity of non-metals? (FSD 2016)*(U.B)*

Ans:

TREND OF ELECTRONEGATIVITY

Electro negativity of first member of group 14, 15, 16 and 17 are higher than that of other members of the group decreasing their electronegativity.

The **decreasing order** of electronegativity is as under.

F > O > Cl > N > Br > S > C > I > P

Q.20 What is non-metallic character? (RWP 2016)*(U.B)*

Ans:

NON-METALLIC CHARACTER

"*The tendency of an element to gain electrons and form negative ions is called non-metallic character or electronegative character*".

Trends in Periodic Table:

Non-metallic character decreases in a group and increases in a period

Q.21 Which factors affect the nonmetallic character? (RWP 2017 G-I)*(U.B)*

Ans:

FACTORS AFFECTING NONMETALLIC CHARACTER

The non-metallic character depends upon the electron affinity and electronegativity of the atom. Small sized elements having high nuclear charge are electronegative in nature. They have high electron affinity. Therefore, they possess non-metallic nature.

Non-metallic character × Electronegativity

MULTIPLE CHOICE QUESTIONS

1. Which one of the following is non-metal? *(K.B)*

(A) Carbon (B) Oxygen (C) Sulphur (D) All of these

2. Non-metals occupy the position in periodic table: *(K.B)*

(A) Upper left (B) Lower left (C) Upper right (D) Lower right

3. Metals lose their electron easily because: (Ex-7)*(U.B)*

(A) They are electronegative (B) They have electron affinity

(C) They are electropositive (D) Good conductor of heat

4. Metals have generally: (LHR 2015)*(U.B)*

(A) High ionization energy values (B) Low ionization energy values

(C) High electron affinity values (D) High electronegativity values

5. In the group non-metallic character: *(U.B)*

(A) Increases (B) Decreases (C) Remains same (D) None of these

6. Small sized atoms have: *(U.B)*

(A) High nuclear charge (B) Low nuclear charge

(C) Low ionization energy (D) All of these

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

9.1 PROPERTIES OF GROUP 1 ELEMENTS

1	D	**2**	C	**3**	B	**4**	C	**5**	D

9.2 PROPERTIES OF GROUP 17 ELEMENTS

1	D	**2**	A	**3**	B	**4**	B	5	A
6	D	**7**	A	**8**	D	**9**	B	10	
11	C	**12**	B	**13**	D				

9.3 GROUP PROPERTIES OF TRANSITION ELEMENTS

1	C	**2**	C	**3**	C	4	D	5	A
6	C	**7**	A	**8**	D				

9.4 PROPERTIES OF NOBLE GASES

1	C	2	D	3	A	4	D	5	A

9.5 PHYSICAL PROPERTIES OF METALS AND NON-METALS

1	D	2	C	3	C	4	B
5	B	6	A				

EXERCISE SOLUTION

MULTIPLE CHOICE QUESTIONS

1. Tick (v) the correct answer.

1. Which halogen will have the least reactivity with alkaline earth metals?
(A) Chlorine
(B) Iodine
(C) Bromine
(D) Fluorine

2. Which compound do you expect to be coloured?
(A) KCI
(B) $BaCl_2$
(C) $AICl_3$
(D) $NiCl_2$

3. In which element there exists the strongest forces of attraction between atoms?
(A) Mg
(B) Ca
(C) Sr
(D) Ba

4. Elements of which group are all coloured?
(A) Second group
(B) Sixth group
(C) Fourth group
(D) Fifth group

5. Which halogen acid is unstable at room temperature?
(A) HBr
(B) HI
(C) HCI
(D) HF

6. Which oxide is the most basic oxide?
(A) Na_2O
(B) Li_2O
(C) MgO
(D) CO

7. Which group elements are the most reactive elements?

(A) Transition metal Group
(B) First group
(C) Second group
(D) Third group

8. The following solutions of a halogen and a sodium halide are mixed together. Which solution will turn dark because of a reaction?
(A) Br_2 and NaCl
(B) Br_2 and NaF
(C) Cl_2 and NaF
(D) Cl_2 and NaI

9. X is a mono atomic gas, which statement about this is correct?
(A) X burns in air
(B) X is coloured
(C) X is unreactive
(D) X will displace iodine from it

10. Which property is correct for group 1 elements?
(A) Low catalytic activity
(B) High density
(C) Low electrical conductivity
(D) High melting point

ANSWER KEY

1	B	2	D	3	A	4	D	5	B
6	A	7	B	8	A	9	C	10	A

QUESTIONS FOR SHORT ANSWERS

2. Questions for Short Answers.

Q.1 Why does it become easier to cut an alkali metal when we move from top to bottom in a group I?

Ans: **CUTTING OF ALKALI METAL DOWN THE GROUP 1**

It becomes easier to cut an alkali metal when we move from top to bottom in a group I because the atomic size increases which results in a decrease in nuclear attraction. Thus metallic bond between atoms becomes weaker which makes the metals softer and easier to cut.

Q.2 Predict the reactivity of potassium towards halogens.

Ans: **REACTIVITY OF POTASSIUM TOWARDS HALOGENS**

Potassium metal reacts vigorously with all the halogens to form potassium halides. Its reactivity decreases from fluorine to iodine. It reacts with fluorine, F_2, chlorine, Cl_2, bromine, I_2, and iodine, I_2, to form respective halides i.e. potassium fluoride, KF, potassium chloride, KCl, potassium bromide, KBr, and potassium iodide, KI, respectively.

Q.3 In the following reaction, chlorine acts as an oxidizing agent. What is the reducing agent?

$$Cl_{2(aq)} + 2NaBr_{(aq)} \longrightarrow 2NaCl_{(aq)} + Br_{2(g)}$$

Ans: **OXIDIZING AGENT**

The reducing agent in this reaction is Br^{1-} because it gives electrons to $Cl_{2(g)}$.

Q.4 Why does iodine exist in the solid state at room temperature?

Ans: **IODINE IN SOLID STATE AT R.T.P.**

Iodine exists in the solid at room temperature because of its larger atomic size, high polarizability and comparatively strong intermolecular forces of attraction, called London dispersion force.

Q.5 How does Ni catalyse the reaction involving hydrogenation of oil?

Ans: **Ni AS CATALYST IN HYDROGENATION OF OIL**

Ni catalyses the reaction involving hydrogenation of oil by decreasing the energy of activation of the reactants. The path of the reaction changes and the reaction occurs at a faster rate.

CONSTRUCTED RESPONSE QUESTIONS

3. Constructed Response Questions

Q.1 Which noble gas should have the lowest boiling point and why?

Ans: **NOBLE GAS WITH LOWEST BOILING POINT**

Helium has the lowest boiling point among all noble gases.

Reason

Helium is the smallest atom which results in the weakest intermolecular forces (London dispersion forces) between its atoms and thus helium will have lowest boiling point.

Q.2 Compare the reactions of alkali metals with chlorine.

Ans: **COMPARISON**

The comparison between reactions of alkali metals with chlorine are as follows:

Order of reactivity of halogens is as follows:

F > Cl > Br > I

Reaction with alkali metals

Metal chlorides are formed when halogens react directly with alkali metals. Metal chlorides behave usually as ionic compounds.

$$2Li_{(s)} + Cl_{2(g)} \xrightarrow{\text{Heat}} 2LiCl_{(s)}$$

$$2Na_{(s)} + Cl_{2(g)} \xrightarrow[\text{vigorous reaction}]{\text{Heat}} 2NaCl_{(s)}$$

$$2K_{(s)} + Cl_{2(g)} \xrightarrow[\text{violent reaction}]{\text{Heat}} 2KCl_{(s)}$$

Q.3 Why are almost all the metals solids while non-metals generally exist as gases and solids?

Ans: **METALS AS SOLIDS & NON-METALS AS GASES AND LIQUIDS**

Almost all the metals are solids at room temperature because of the strong metallic bonds between their atoms. Due to strong metallic bond metals have a tightly packed structure. Non-metals exist as gases and low boiling solids due to weaker intermolecular forces of attraction.

Q.4 Name any three elements in the periodic table which exist as liquids.

Ans: **LIQUID ELEMENTS**

Liquid at room temperature

- Mercury (Hg)
- Bromine (Br)

Liquid at slightly higher temperature

- Caesium (Cs)
- Rubidium (Rb)
- Francium (Fr)
- Gallium (Ga)

Q.5 Why are transition elements different from normal elements?

Ans: **REASON FOR DIFFERRENCE**

Transition elements are different from "normal" elements because they have partially filled d-orbitals in their electron configuration which allows them to show multiple oxidation states, to form colored compounds and different properties as compared to the normal elements.

Q.6 Compare the reactivity of chlorine and bromine as reducing agent.

Ans: **COMPARISON OF EACTIVITY**

Chlorine is more reactive than bromine due to its smaller size and greater tendency to accept electrons. Thus chlorine takes up electron and thus acts as stronger oxidizing agent as compared to the bromine, as shown in the reaction.

$$Cl^{o}_{2} + Na^{+1}Br^{-1} \longrightarrow Na^{+1}Cl^{-1} + Br^{o}_{2}$$

Q.7 Which element is the most reactive and which is the least reactive among halogens? Give two reasons to explain your answer.

Ans: **MOST REACTIVE AND LEAST REACTIVE HALOGEN**

Most Reactive element

Fluorine

Least Reactive element

Iodine

Reason

The reactivity of halogens decreases down the group due to increase in atomic size and thus decreases tendency to gain electrons which is the reactivity of halogens.

DESCRIPTIVE QUESTIONS

4. Descriptive Questions

Q.1 Explain the role of catalytic converter in an automobile.

Ans: **ROLE OF CATALYTIC CONVERTER**

: **WORKING OF CATALYTIC CONVERTERS**

When hot gases pass through the converters, harmful pollutants are converted to harmless substances.

Examples:

- Carbon monoxide is oxidized to carbon dioxide.
- Unburnt hydrocarbons are oxidized to carbon dioxide and water, while oxides of nitrogen are reduced to nitrogen.

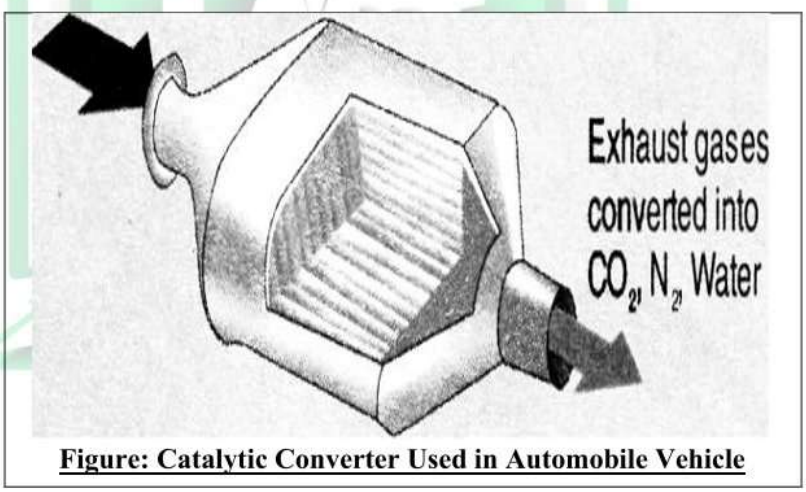


Figure: Catalytic Converter Used in Automobile Vehicle

Q.2 Why do the chemical reactivities of alkali metals increase down the group whereas they decrease down the group in case of halogens?

Ans: **TREND IN REACTIVITIES**

Alkali Metals

The chemical reactivities of alkali metals increase down the group due to increase in size of the atoms and decrease in nuclear attraction on valence electrons. Thus down the group tendency to lose electrons increases which in turn increases the reactivity of Alkali metals down the group.

Halogens

The reactivity of halogens decreases down the group due to their decreases tendency to gain electron as reactivity of non-metals is directly proportional to their electronegativity.

Q.3 Why are metals generally tough and strong whereas non-metals are neither tough nor strong?

Ans: **TOUGHNESS OF METALS AND NON-METALS**

Metals are generally tough and strong because of their unique atomic structure, where electrons are delocalized and can move freely throughout the metal lattice. It creates a strong "sea of electrons" that holds the metal ions together strongly.

Non-metals are neither tough nor strong due to the absence of mobile electrons and weaker intermolecular forces of attraction between molecules.

Q.4 Both alkali metals and halogens are very reactive elements with roles opposite to each other. Explain.

Ans: **REACTIVITY AND ROLE OF ALKALI METALS AND HALOGENS**

Alkali Metals	Halogens
• Their reactivity depends on the tendency to lose electron. More tendency to lose electron, more reactive the element will be.	• Their reactivity depends on the tendency to gain electron. More tendency to gain electron, more reactive the element will be.
Key Difference	
• These are metals and form cations.	• These are non-metals and forms anion.
•	•
• Alkali metals from strong alkali with water.	• Halogens forms different compounds on reaction with water.

Q.5 Why hydrogen bromide is thermally unstable as compared to hydrogen chloride?

Ans: **THERMAL UNSATBILITY OF HBr AND HCl**

Hydrogen bromide is thermally unstable as compared to hydrogen chloride due to the difference in the energies of some of the covalent bonds, involved in the decomposition.

Q.6 Compare the properties of metals and non-metals.

Ans: Answer given on page #

Q.7 V_2O_5 catalyst is preferred over platinum in the oxidation of sulphur dioxide. Give reasons.

Ans: **PREFERENCE OF V_2O_5 CATALYST OVER PLATINUM**

Vanadium pentoxide (V_2O_5) is preferred over platinum in the oxidation of sulphur dioxide. Vanadium pentoxide (V_2O_5) is cheaper, more readily available, and less susceptible to poisoning by impurities.

INVESTIGATIVE QUESTIONS

5. Investigative Questions

Q.1 Explain the role of sodium as heat transfer agent in the atomic nuclear power plant. Which property of sodium is utilized in this role?

Ans: **ROLE OF SODIUM AS HEAT TRANSFER**

Sodium is an excellent heat transfer agent in the atomic nuclear power plant due to its high thermal conductivity, high heat capacity, and a large liquid temperature range (98–883°C). Sodium permits high power density with a low coolant volume fraction because sodium is a good reactor coolant in a sodium-cooled fast reactor (SFR).

Q.2 Why and how does lithium behave differently from the rest of the alkali metals?

Ans: **LITHIUM AND OTHER ALKALI METALS**

Lithium behaves differently from the rest of the alkali metals because of its smaller atomic size. Due to smaller atomic size it has higher charge density and greater polarizing power which results in higher melting and boiling points, stronger covalent character in its compounds.

Q.3 Why aluminium metal is used in the manufacture of cooking utensils whereas magnesium is not considered useful for this purpose

Ans: **USE OF Al AND NOT USE OF Mg IN COOKING UTENSILS**

Aluminium metal is used in the manufacture of cooking utensils whereas magnesium is not considered useful for this purpose because aluminum is a relatively good conductor of heat, light in weight, fairly strong and relatively inert as compared to magnesium.

TERMS TO KNOW

Terms	Definitions
Atomic size of group I element	Atomic size increases from top to bottom for elements of group-I. It becomes easier for elements to lose their single electron.
Chemical reactivity	Chemical reactivity of the elements in group-I increases down the group.
Interatomic attraction of first group of element	Due to increase in their atomic sizes, the interatomic attraction decrease down the first group elements. This makes them softer and their melting points decrease down the group.
Densities of alkali metals	Due to increase in the- size and volume of atoms, the densities of alkali metals increases down the group.
Group-17 elements	Group -17 elements or-halogens exist as diatomic molecules. They are very reactive non-metals and react With alkali and alkaline earth metals
Halogens as reducing agent	Halogens are reducing agents and their reducing power decreases down the group.
Thermal stability of hydrogen halides	hydrogen halides the bond between hydrogen and halogen gets weaker as we go down the group, Hence the thermal stability of hydrogen halides decreases down the group.
D-block or transition element	D-block elements or transition elements are alt-metals. They are often have higher densities. These elements: and their compounds are used as catalysts an important industrial reactions.
Un-reactivity of noble gases	Noble gases are all unreactive gases because their outermost shells are complete.
Physical properties of metals and non-metals	Metals and non-metals have very different physical properties.