

## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

# Chapter 8

## Chemical Reactivity

### Section A

### Multiple Choice Questions (M.C.Qs)

Tick mark (✓) the correct answer:

01. Which one metal belongs to Alkaline earth metal?  
(a) B (b) Bi (c) Br (d) Ba
02. Which one is Barium?  
(a) Bi (b) Be (c) Ba (d) Br
03. Chlorine can be displaced by \_\_\_\_\_  
(a) F (b) Br (c) I (d) At
04. Which one is strong acid?  
(a) HF (b) HCl (c) HBr (d) HI
05. Which Halogen exists in liquid state?  
(a) F<sub>2</sub> (b) Cl<sub>2</sub> (c) Br<sub>2</sub> (d) I<sub>2</sub>
06. Non-metals of \_\_\_\_\_ group are gases:  
(a) VI-A (b) VII-A (c) VIII-A (d) VIII-B
07. Which one is Metalloid?  
(a) Br (b) Se (c) S (d) Sr.  
The metalloids; boron (B), silicon (Si), germanium (Ge), arsenic (As), antimony (Sb), tellurium (Te), polonium (Po) and astatine (At) are the elements found along the step-like line between metals and non-metals of the periodic table. Metalloids have properties of both metals and non-metals. Some of the metalloids, such as silicon and germanium, are useful in semiconductors. This property makes metalloids useful in electronic components.
08. Which one of the following act as oxidizing agent?  
(a) Be (b) Mg (c) Na (d) Cl
09. Which gas can turn lime water milky?  
(a) O<sub>2</sub> (b) NO<sub>2</sub> (c) CO<sub>2</sub> (d) N<sub>2</sub>
10. Which compound is known as lunar caustic?  
(a) KNO<sub>3</sub> (b) AgNO<sub>3</sub> (c) NaOH (d) NaNO<sub>3</sub>
11. The property of substance to undergo chemical reaction with any material is called:  
(a) electrochemistry (b) chemical reactivity  
(c) chemical bonding (d) chemical equilibrium
12. Reactivity of metals depends upon its tendency to:  
(a) lose electron (b) accept electron (c) lose proton (d) accept proton
13. Reactivity of non-metals depends upon its tendency to:  
(a) lose electron (b) accept electron (c) lose proton (d) accept proton
14. The most abundant element found in air is:  
(a) oxygen (b) argon (c) hydrogen (d) nitrogen

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15. Most abundant elements found in earth's crust are:  
 (a) Silicon, Aluminium, Oxygen (b) Oxygen, Aluminium, Silicon  
 (c) Oxygen, Silicon, Aluminium (d) Silicon, Aluminium, Oxygen
16. The most abundant element found in the universe is:  
 (a) helium (b) hydrogen (c) oxygen (d) carbon
17. Most abundant elements found in human body are:  
 (a) Oxygen, Carbon, Hydrogen (c) Carbon, Oxygen, Hydrogen  
 (c) Carbon, Hydrogen, Oxygen (d) Oxygen, Hydrogen, Carbon
18. The element which readily loses electron and easily form cation is termed as:  
 (a) non-metal (b) metal (c) gas (d) liquid
19. All B group elements are metals and known as:  
 (a) alkali metals (b) alkaline earth metals  
 (c) transition metals (d) rare metals
20. Elements of group IA are called:  
 (a) alkali metals (b) alkaline earth metals  
 (c) transition metals (d) rare metals
21. Elements of group IIA are called:  
 (a) alkali metals (b) alkaline earth metals  
 (c) transition metals (d) rare metals
22. It is a light, strong and highly toxic metal.  
 (a) Bi (b) Be (c) Ba (d) Br
23. The most abundant metal is:  
 (a) iron (b) gold (c) copper (d) aluminum
24. The most reactive metal is:  
 (a) Fe (b) Al (c) Cs (d) Li
25. The lightest metal is:  
 (a) Al (b) Cs (c) Os (d) Li
26. The heaviest metal is:  
 (a) Al (b) Cs (c) Os (d) Li
27. Due to this property metals easily lose their valance shell electrons.  
 (a) Electro positivity (b) Electronegativity (c) Electron affinity (d) Ionization energy
28. Positively charged ion is known as:  
 (a) cathode (b) anode (c) cation (d) anion
29. Electro positive character of metals:  
 (a) decreases down the group (b) increases down the group  
 (c) decreases up the group (d) None of these
30. They have large atomic size and low ionization potential values.  
 (a) Alkali metals (b) Alkaline earth metals  
 (c) Transition metals (d) Non-metals
31. The valence shell electronic configuration of alkali metals is.  
 (a)  $ns^1$  (b)  $np^1$  (c)  $ns^2$  (d)  $np^2$
32. Alkali earth metals form:  
 (a) monovalent anion (b) divalent anion  
 (c) monovalent cation (d) divalent cation
33. The valence shell electronic configuration of alkaline earth metals is:  
 (a)  $ns^1$  (b)  $np^1$  (c)  $ns^2$  (d)  $np^2$
34. The removal of electron from an element requires energy which is known as:  
 (a) Electro positivity (b) Electronegativity (c) Electron affinity (d) Ionization energy



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35. With increasing atomic size, ionization energy values:  
 (a) increases (b) decreases (c) remains the same (d) becomes zero
36. It is sixth most abundant element and constitutes 2.87% of earth's crust.  
 (a) Sodium (b) Silicon (c) Carbon (d) Hydrogen
37. It is silvery white alkali metal which is so soft that it can be cut with knife.  
 (a) Lithium (b) Cesium (c) Sodium (d) Barium
38. Chemical formula of baking soda is:  
 (a)  $\text{Na}_2\text{CO}_3$  (b)  $\text{NaNO}_3$  (c)  $\text{NaCl}$  (d)  $\text{NaHCO}_3$
39. It is 8th most abundant element found in earth's crust.  
 (a) Sodium (b) Magnesium (c) Carbon (d) Calcium
40. Magnesium belongs to:  
 (a) I A group (b) II A group (c) III A group (d) IV A group
41. It is used in flares and photographic flash bulbs.  
 (a) Magnesium (b) Sodium (c) Calcium (d) Iridium
42. It is 5th abundant metal in earth's crust. It belongs to IIA group and 4th period.  
 (a) Magnesium (b) Sodium (c) Calcium (d) Lithium
43. It is essential for healthy teeth and bones.  
 (a) Sodium (b) Magnesium (c) Potassium (d) Calcium
44. Chemical formula of gypsum is:  
 (a)  $\text{Ca(OH)}_2$  (b)  $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$  (c)  $\text{CaOCl}_2$  (d)  $\text{CaCO}_3$
45.  $\text{CaCO}_3$  is the chemical formula of:  
 (a) slaked lime (b) calcium tungstate (c) Soda ash (d) Limestone
46. Noble metals are difficult to oxidize because they are:  
 (a) less electropositive (b) more electropositive  
 (c) less electronegative (d) more electronegative
47. It is the only metal found in a liquid state.  
 (a) Platinum (b) Osmium (c) Mercury (d) Palladium
48. Which of the following forms alloys with other metals which are known as amalgam?  
 (a) Platinum (b) Mercury (c) Sodium (d) Silver
49. The only non-metal found in liquid state is:  
 (a) Xenon (b) Selenium (c) Mercury (d) Bromine
50. Halogen belongs to group:  
 (a) V A (b) VI A (c) VII A (d) VIII A

### Answers

01. (d)	09. (c)	17. (a)	25. (d)	33. (c)	41. (a)	49. (d)
02. (c)	10. (b)	18. (b)	26. (c)	34. (d)	42. (c)	50. (c)
03. (a)	11. (b)	19. (c)	27. (a)	35. (b)	43. (d)	
04. (d)	12. (a)	20. (a)	28. (c)	36. (a)	44. (b)	
05. (c)	13. (b)	21. (b)	29. (b)	37. (c)	45. (d)	
06. (c)	14. (d)	22. (b)	30. (a)	38. (d)	46. (a)	
07. (x)	15. (c)	23. (d)	31. (a)	39. (b)	47. (c)	
08. (d)	16. (b)	24. (c)	32. (c)	40. (b)	48. (b)	

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### Section B&C

### Short & Detailed Answer Questions

#### Q.1 Define chemical reactivity.

**Ans:** **Chemical Reactivity:** The property of a substance to undergo a chemical reaction with any material is called chemical reactivity.

Medicines, plastics, glass, detergents etc. are the products of chemical reactivity. Matter which undergoes chemical reactivity may be an element, compound or mixture.

An element is always composed of like atoms. Elements are further divided into metals, non metals and metalloids.

#### Q.2 On which factors reactivity of metals and non-metals depend?

**Ans:** Reactivity of metals depends upon its tendency to lose an electron and that of non-metals depends upon its tendency to accept an electron.



#### DO YOU KNOW?

- The most abundant elements found in the air are:  
(i) nitrogen (ii) oxygen (iii) argon
- The most abundant elements found in the earth's crust are:  
(i) oxygen (ii) silicon (iii) aluminum
- The most abundant elements found in the universe are:  
(i) hydrogen (ii) helium (iii) oxygen
- The most abundant elements found in the human body are:  
(i) oxygen (ii) carbon (iii) hydrogen

#### Q.3 Define metal.

**Ans:** **Metal:** The element which readily loses an electron and easily forms cation is termed metal. A the metal structure consists of metal ions joined by metallic bonds.

#### Q.4 From which group do transition metals, alkali metals and alkaline earth metals belong?

**Ans:** All B group elements are metals and known as Transition Metals.  
Some elements of the A group are also metals. Elements of group I A are called Alkali metals. Elements of group II A are called Alkaline earth metals. Metals of the A-Group family are shown in the given table.

IA	IIA	IIIA	IVA	VA
Li	Be			
Na	Mg	Al		
K	Ca	Ga		
Rb	Sr	In	Sn	
Cs	Ba	Tl	Pb	Bi
Fr	Ra			



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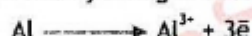


### DO YOU KNOW?

- Beryllium (Be) is a light strong and highly toxic metal. Its small grain of 0.25 mg can kill a rat.
- The most abundant metal is aluminium (Al).
- The most useable metal is iron (Fe).
- The most reactive metal is caesium (Cs).
- The lightest metal is lithium (Li).
- The heaviest metal is osmium (Os).
- Most malleable, ductile metals are gold (Au) and silver (Ag).

### Q.5 Describe electropositive character OR cation formation in/of metals.

**Ans:** Electropositive Character (Cation Formation): Metals are highly electropositive, due to this property they easily lose their valence shell electrons. When an atom or a molecule loses an electron then it changes into a positively charged ion known as a cation.



The electropositive character of metals increases down the group with increasing atomic size. Alkali metals have a large atomic size and low ionization potential values. The nucleus force on the valence shell is very weak so they can lose their valence electron easily. Hence they are highly reactive, highly electropositive, powerful reducing agents and cannot exist free in nature.

The valence shell electronic configuration of alkali metals is  $ns^1$ .

Alkali earth metals lose one electron and form a monovalent cation. Example  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$

The valence shell electronic configuration of alkaline earth metals is  $ns^2$ .

### Q.6 Define ionization energy and describe the ionization energy of alkali and alkaline earth metals.

**Ans:** Ionization Energy: The removal of an electron from an element requires energy which is known as ionization energy.



Ionization energies values decrease with increasing atomic size and vice versa.

Ionization Energy of Alkali and Alkaline Earth Metal: The Alkali metals and Alkaline earth metals show an increasing trend of reactivity down the group because their atomic size increases down the group.

Since Alkali metals have low ionization energy values than alkaline earth metals, so alkali metals are highly reactive than alkaline earth metals.

Alkali metals and alkaline earth metals have low values of ionization energies due to which they easily lose their valence electron and form a cation. Thus they are highly reactive.

Ionization Potential Valence is KJ/mole

I-A	II-A
Li = 520	Be = 899
Na = 495	Mg = 738
K = 419	Ca = 520
Rb = 403	Sr = 549
Cs = 376	Ba = 309

Reactivity Increases ↓

Reactivity Increases ↓

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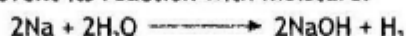
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The position of Alkali metals and Alkaline earth metals in the periodic table is also useful to explain their reactivity.

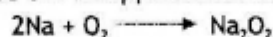
#### Q.7 Describe position, properties and uses of sodium (Na).

**Ans:** Position of Sodium (Na): It is the sixth most abundant element and constitutes 2.87% of the earth's crust. It belongs to the IA group, 3rd period of the periodic table.

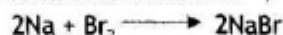
Properties of Sodium (Na): Sodium is a silvery-white alkali metal. It melts at 97.8°C and boils at 881.4°C. It is soft and can be cut with a knife due to weak metallic bonding between its atoms. It violently reacts with H<sub>2</sub>O water and form sodium hydroxide and hydrogen gas, so it is kept in kerosene oil to prevent its reaction with moisture.



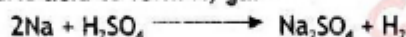
Sodium metal has a shiny surface but its appearance becomes dull due to the action of air.



Sodium reacts with halogens to form sodium halide.



Sodium reacts with sulphuric acid to form H<sub>2</sub> gas



Uses of Sodium (Na):

- (i) It is an excellent heat transfer fluid so it is used as a coolant in nuclear reactors.
- (ii) It is used in detergent preparation.
- (iii) It is used as street lights and gives yellow colour.
- (iv) It is used as a reducing agent in the extraction of calcium, zirconium and titanium.

#### Q.8 Name some common compounds of sodium.

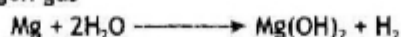
**Ans:** Common Compounds of Sodium: Some common compounds of Sodium and their uses are mentioned below:

Soda Ash	Na <sub>2</sub> CO <sub>3</sub>	Used as a water softener
Baking Soda	NaHCO <sub>3</sub>	Used in baking powder, health salt, beverages
Table Salt	NaCl	Food Items
Sodium Nitrate	NaNO <sub>3</sub>	Used as fertilizer and in dynamite

#### Q.9 Describe position, properties and uses of magnesium (Mg).

**Ans:** Position of Magnesium (Mg): It is the 8th most abundant element found in the earth's crust. Magnesium belongs to the II-A group and 3rd period of the periodic table.

Properties of Magnesium (Mg): It is a grey-white metal. Its name is derived from Magnesia, a district in Greece. It melts at 650°C and boils at 1090°C. Magnesium reacts violently with water and releases Hydrogen gas



Magnesium fire cannot be extinguished with water because H<sub>2</sub> gas is highly flammable and intensifies the fire. Magnesium fire can be extinguished by using dry sand.

Uses of Magnesium (Mg):

- (i) It is used in flares and photographic flashbulbs because it burns to produce brilliant white light.
- (ii) Magnesium hydroxide is used as an antacid.



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- (iii) It is used for manufacturing of mobile phones, laptop and tablet computers because of lightweight and electrical properties.
- (iv) The use of magnesium reduces the weight of a vehicle by replacing steel components of a vehicle. Magnesium alloys are used in the aviation industry, space crafts and missile because they are lightweight and remain stable at high temperature.
- (v) Magnesium can be changed into intricate (twisters, knotty) shapes, so it is used in tennis rackets and handles of archery bows.

### Q.10 Describe position, properties and uses of calcium (Ca).

**Ans:** Position of Calcium (Ca): It is 5th abundant metal in the earth's crust. It belongs to the IIA group and 4th period.

Properties of Calcium (Ca): It is a silvery-white soft metal. It melts at 851°C and boils at 1484°C.

Uses of Calcium (Ca): Calcium is essential for healthy teeth and bones.

### Q.11 Name some common compounds of calcium (Ca).

**Ans:** Some Common Compounds of Calcium (Ca): Calcium forms useful compounds which are mentioned below:

Slaked lime	$\text{Ca(OH)}_2$	As soil conditioner, used in water treatment to reduce acidity. Used in steel industry to remove impurities from iron ore.
Gypsum	$2\text{CaSO}_4 \cdot \text{H}_2\text{O}$	It is used as component in construction of buildings. It is used medically in plaster for setting broken bones.
Calcium hypochlorite	$\text{CaClO}_2$	It is used for sterilization of water in swimming pool.
Calcium tungstate	$\text{CaWO}_4$	It is used in Luminous paints.
Limestone	$\text{CaCO}_3$	As source of $\text{CO}_2$ in cement industry.



### DO YOU KNOW?

#### Calcium Light:

When a popular personality becomes the centre of public attention then it is said to be in the limelight. Previously musical halls, theatres, stages were lit by a chemical called lime ( $\text{CaO}$ ), using an oxyhydrogen flame. As a result, bright light was produced also known as calcium light. This light increases the visibility of the audience to enjoy the performance of the actor on stage.

### Q.12 Define moh scale.

**Ans:** Moh Scale: The hardness of the metal is the resistance of metal to be scratched. It is measured on a moh scale. It is devised by Frederick Mohs in 1812. It is based on scratch resistance of different metals and other materials. The hardness of plastics, lead pencil, is 1 and that of a diamond is 10 on Moh scale.

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### Values of the hardness of few metals on Moh scale

Li	Na	K	Rb	Cs	Ni	Fe	W
0.8	0.5	0.4	0.3	0.2	4	4.5	7.5

**Q.13** Define soft and hard metals with examples.

**Ans:** Metals may be soft or hard.

**Soft Metals:** The metals which are scratched easily are called soft metals. Alkali metals like sodium (Na), potassium (K) and rubidium (Rb) are soft metals.

**Hard Metals:** Metals that show strong resistance towards scratching are called hard metals. Nickel (Ni), iron (Fe), tungsten (W) are hard metals.

**Q.14** What do you know about the inertness of noble metals?

**Ans:** **Inertness of Noble Metal:** Noble metals include Gold (Au), Silver (Ag), Platinum (Pt), Iridium (Ir), Osmium (Os), Rhodium (Rh), Ruthenium (Ru), Palladium (Pd).

Noble metals are less electropositive so they are difficult to oxidize. Therefore they show no reaction with atmospheric gases and resist corrosion. This helps noble metals to maintain their appearance so noble metals like Ag, Au, Pt are used to make ornaments.

**Q.15** Write a note on the commercial value of silver, gold and platinum.

**Ans:** **Commercial Value of Silver (Ag):** It is widely used in society. It is used in jewellery, decorative items and silver tableware because it does not tarnish and maintain its silvery shiny appearance. It is used to make a mirror because it is the best reflector of visible light. Silver forms compounds of significant importance.

Silver Nitrate ( $\text{AgNO}_3$ ) or lunar caustic is used in the detection of halogen. Light sensitive material  $\text{AgBr}$  and  $\text{AgI}$  are used in photographic films.

**Commercial Value of Gold (Au):** Gold has Importance in our society. It is used in jewellery because it has very high lustre, yellow colour and tarnishes resistance.

Gold is used in electronic components because it is a highly efficient conductor of current and cannot corrode.

Gold is used in connecting wires, connection strips, switches and relay contacts to make electronic devices highly reliable. Therefore, gold is used in cellphones, global positioning systems, calculators etc. Gold is used in laptop computers for the rapid and accurate transmission of digital information. It is used in dentistry because it is chemically inert, non allergic and easy for a dentist to work. Gold-coated polyester films are used in space vehicles to reflect infrared radiation and stabilize the temperature of a space vehicle. The helmet of astronauts is coated with a thin film of gold which reflects intense solar radiation and protects the eyes, skin of astronaut. Glass surface coated with gold will reflect solar radiations outward and keep the buildings cool in summer. It also reflects internal heat inward and keeps the building warm in winter. Gold symbolizes purity, beauty and stability so it is used in making medals, trophies awards etc.

**Commercial Value of Platinum (Pt):** It is a silvery-white corrosion resistance metal. It is a paramagnetic transition metal. It is used in chemical reactions as a catalyst. It is used as a catalytic converter in vehicles. It helps the complete combustion of hydrocarbons and reduces the emission of air pollutants. The price of precious metal is fixed according to its weight. Its density is more than gold. So it is more expensive than gold.



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### Q.16 Describe position, properties and uses of mercury.

**Ans:** Position of Mercury: Mercury is the only metal found in a liquid state. It belongs to the sixth period and III B group of the modern periodic table.

Properties of Mercury: It has the lowest melting point among all metals. It forms alloys with other metals which are known as amalgam. For example, tin amalgam is an alloy of tin and mercury.

Uses of Mercury:

- (i) Its alloy with silver and tin is used as a dental filling.
- (ii) Mercury is used in thermometers and barometers.
- (iii) Gaseous mercury is used in street light and fluorescence lamps.

### Q.17 Describe the position and properties of non-metals.

**Ans:** Position of Non-metals: Non-metals are the elements that have a greater tendency to accept an electron. Non-metals are placed at the upper right portion of the periodic table as shown in the following table.

*Non-Metal of Periodic Table*

IA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.00797					2 He Helium 4.0026
	6 C Carbon 12.01115	7 N Nitrogen 14.067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.180
		15 P Phosphorus 30.9738	16 S Sulphur 32.064	17 Cl Chlorine 35.453	18 Ar Argon 39.948
			34 Se Selenium 78.98	35 Br Bromine 79.904	36 Kr Krypton 83.80
				53 I Iodine 126.9044	54 Xe Xenon 131.30
					86 Rn Radon (222)

Properties of Non-metals: Non-metals are non-malleable; non-ductile, dull in appearance, non-sonorous, poor or non-conductors of heat and electricity.

Most of the non-metals are gases

For example, H, N, O, F, Cl and VIII A group non-metals are gases.

Bromine (Br) is the only non-metal found in a liquid state.

Some non-metals like S, P, Se, I are solids.

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**Q.18** Identify the VIII A group elements from the following:  
 N, Na, Ni, Ne, Ar, At, He

**Ans:** VIII A group elements: Ne, Ar, He

**Q.19** Write names and symbol of non-metals of VA group elements.

**Ans:** Nitrogen N Phosphorus P

**Q.20** Which group contains non-metals in gaseous state only?

**Ans:** 1A



### DO YOU KNOW?

- Fluorine gas is a yellow colour non-metal.
- Chlorine gas is a green non-metal.
- Iodine is a lustrous purple colour non-metal.
- Diamond is the hardest non-metal.

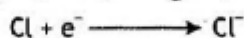
**Q.21** Describe electronegative characteristics.

**Ans:** **Electronegative Characteristics:** A non-metal has a property to accept electron easily and form an anion. It is called the electronegative character.

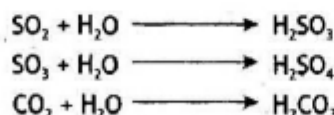


Negative ions move towards the anode during electrolysis so they are termed anions. The number of negative charges on an anion shows the excess number of electrons as compared to the number of protons.

Electronegative character increases across the period because atomic size decreases and nuclear charge density increases. It decreases down the group due to increasing atomic size. Halogens accept electrons easily due to their high electronegative character.



Non-metals form acidic oxides which react with water vapours of the atmosphere and cause acid rain.

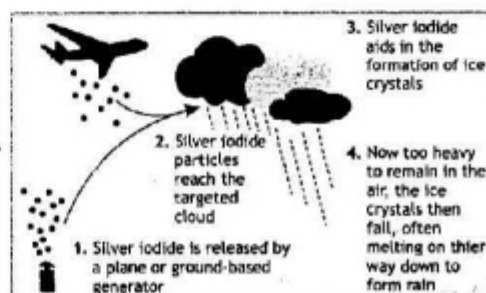


Sulphurous Acid  
 Sulphuric Acid  
 Carbonic Acid

**Q.22** What do you know about artificial rain?

**Ans:** **Artificial Rain:** Dr Vincent J. Schaefer in 1946 successfully created artificial clouds in a chilled chamber.

Artificial rain can occur through cloud seeding. In this process chemicals like silver iodide (AgI) or dry ice (solid CO<sub>2</sub>) are spread over clouds. As a result, a supercooled water molecule condenses





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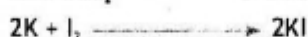
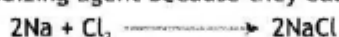
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rapidly around these chemicals and forms ice crystals. When these ice crystals grow big and become too heavy then they fell downward and change into the rain.

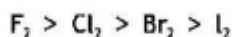
### Q.23 Compare the reactivity of the halogen.

**Ans:** **Comparison of Reactivity of the Halogen:** Halogen belongs to the VII-A group and consists of fluorine (F), chlorine (Cl), bromine (Br), iodine (I) and astatine (At). Halogens exist in molecular form. The reactivity of halogens - decreases down the group because atomic size increases and electronegativity decreases down the group.

(i) Halogens act as an oxidizing agent because they easily accept an electron.



Power of halogens as oxidizing agent decreases in the following order:



It means Fluorine can displace other halogens due to its highest oxidizing power.

(ii) More reactive halogen can displace less reactive halogen from a solution of its salt. For example,

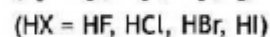
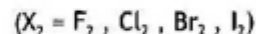


Chlorine is a more reactive halogen than iodine so chlorine displaces iodine. The mixture turns reddish-brown due to liberation of iodine.

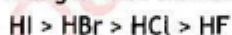
(iii)  $2\text{KCl} + \text{F}_2 \longrightarrow 2\text{KF} + \text{Cl}_2$



(iv) Reaction of hydrogen with halogen form halogen acid.



The acidic strength of halogen acid decreases in the following order:



HI is a very strong acid because HI easily breaks up and forms an  $\text{H}^+$  ion in water due to weak covalent bonding.

HF is a very weak acid because it has strong covalent bonding so it does not break up easily to form  $\text{H}^+$  ion in water,  $\text{H}^+$  ions react with a water molecule to form hydronium ( $\text{H}_3\text{O}^+$ ) ion.



**DO YOU  
KNOW?**

Enamel is the outer layer of our teeth it is mainly composed of calcium carbonate ( $\text{CaCO}_3$ ) and hydroxylapatite [ $\text{Ca}_5(\text{PO}_4)_3\text{OH}$ ]. Fluoride (F) ions of toothpaste replace hydroxide ( $\text{OH}^-$ ) ions of hydroxylapatite and form fluoroapatite. This replacement makes it more resistant to tooth decay.

## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

Chapter-8

Chemical Reactivity

### Differences

1. Differentiate between metals, non-metals and metalloids.

Ans:

Metals	Non-Metals	Metalloids
<ul style="list-style-type: none"> <li>Tend to lose electrons in reactions.</li> <li>Good conductors of heat and electricity.</li> <li>Ductile</li> <li>Lustrous</li> <li>Strong</li> <li>Malleable</li> <li>Sonorous</li> <li>Oxides are basic in nature e.g. (<math>\text{Li}_2\text{O}</math>, <math>\text{Na}_2\text{O}</math>, <math>\text{K}_2\text{O}</math>, <math>\text{MgO}</math>)</li> </ul>	<ul style="list-style-type: none"> <li>Tend to gain electrons in reactions with metals.</li> <li>Poor-conductors of heat and electricity.</li> <li>Not ductile</li> <li>Often have dull appearance.</li> <li>Oxides are acidic in nature (<math>\text{CO}_2</math>, <math>\text{SO}_2</math>, <math>\text{NO}_2</math>)</li> </ul>	<ul style="list-style-type: none"> <li>Intermediate properties of metals and non-metals.</li> <li>Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb), Tellurium (Te), Polonium (Po) and Astatine (At) are metalloids.</li> <li>Oxides may be acidic (<math>\text{B}_2\text{O}_3</math>, <math>\text{SiO}_2</math>) or amphoteric (<math>\text{As}_2\text{O}_3</math>).</li> </ul>

2. What are the differences between alkali and alkaline earth metals?

Ans:

Alkali Metals (IA)	Alkaline Earth Metals (IIA)
They are highly reactive than (IIA) group elements due to low ionization energy.	They are less reactive than (IA) group elements due to high ionization energy.
They form monovalent cation ( $\text{M}^+$ ).	They form divalent cation ( $\text{M}^{2+}$ ).
They immediately tarnish in air and form metal oxide. $\text{K} + \text{O}_2 \rightarrow \text{KO}_2$	They react with oxygen on heating. $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
They react violently with halogens $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$	They react slowly with halogens $\text{Ca} + \text{Cl}_2 \rightarrow \text{CaCl}_2$
They react with water vigorously at room temperature and form strong alkaline solution. $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$	They react with water less vigorously and form alkaline solution. $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$ $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2$
Their oxides and hydroxides are more basic than those of IIA group elements.	Their oxides and hydroxides are less basic than those of IA group elements.
They do not form metal carbides.	They form metal carbides on heating. $\text{Ca} + 2\text{C} \rightarrow \text{CaC}_2$

3. Differentiate soft and hard metals.

Ans: Soft and hard metals can be differentiated with reference to sodium (Na) and iron (Fe) as follows:

Sodium	Iron
It is a soft metal of group IA.	It is a hard metal VIIIIB.
It has large atomic size.	It has smaller ionic radii.
It has low value (0.5) on moh scale.	It has high value (4.5) on moh scale.



## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

Chapter-8 Chemical Reactivity

It has weak metallic bonding so it is a soft metal.

It can be cut easily with knife.

It is light due to its low density ( $0.971 \text{ g/cm}^3$ ).

It has low melting and boiling point values

(melting point =  $98^\circ\text{C}$ , boiling point =  $890^\circ\text{C}$ )

It has strong metallic bonding so it is hard metal.

It is hammered to form sheets and wires.

It is heavier metal due to its high density ( $7.87 \text{ g/cm}^3$ ).

It has high melting and boiling point values

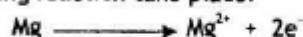
(melting point =  $1535^\circ\text{C}$ , boiling point =  $2450^\circ\text{C}$ )

### Reasons

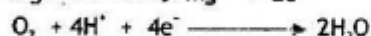
- (1. **Magnesium is used in cathodic protection (CP). Give its reason.**

**Ans:** Magnesium is easily oxidized as compared to iron so magnesium is used as anode and underground metallic pipelines become cathode to protect from corrosion.

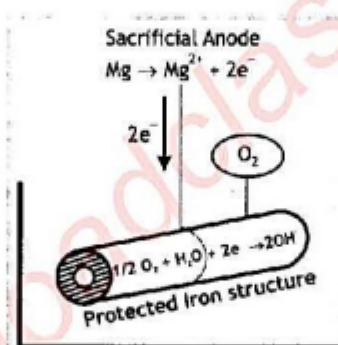
Following reaction take place:



(oxidation at anode)



(reduction at cathode)



- (2. **Two pieces of pure uncoated metals permanently stuck together in space. Why?**

**Ans:** Two pieces of pure uncoated metals permanently stuck together in space because there is no oxygen in space and hence no oxidation reaction occurs. The oxidized layer on metals serves as a barrier and prevent adherence to metals.

- (3. **Why helmets of astronauts are coated with a thin film of gold?**

**Ans:** The helmet of astronauts is coated with a thin film of gold which reflects intense solar radiation and protects the eyes, the skin of astronaut.

- (4. **Why glass surface is coated with gold?**

**Ans:** Glass surface coated with gold will reflect solar radiations outward and keep the buildings cool in summer. It also reflects internal heat inward and keeps the building warm in winter.

- (5. **Why gold is used in jewellery?**

**Ans:** Gold is used in jewellery because it has very high lustre, yellow colour and tarnishes resistance.

- (6. **Why platinum is used as a catalytic converter in vehicles?**

**Ans:** Platinum is used as a catalytic converter in vehicles because it helps the complete combustion of hydrocarbons and reduces the emission of air pollutants.

- (7. **Explain why alkali metals do not exist free in nature.**

**Ans:** The alkali metals readily lose an electron to give monovalent  $\text{M}^+$  ions, hence they are highly reactive and therefore they are never found in a free state in nature.

## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

Chapter-8 Chemical Reactivity

### Skills

#### Qualitative analysis of

Cations like  $Zn^{2+}$ ,  $Mg^{2+}$ ,  $NH_4^+$ ,  $Ca^{2+}$  and  $Ba^{2+}$  can be identified by following test.

#### Experiment

<b>Test for <math>Zn^{2+}</math></b> <b>Experiment</b> Salt Solution + $NH_4OH$ solution. White ppt + excess $NH_4OH$ or $NaOH$ solution.	<b>Observation</b> White ppt  White ppt is dissolved and form clear solution	<b>Result</b> $Zn^{2+}$ may be present  $Zn^{2+}$ Ion is present
<b>Test for <math>Mg^{2+}</math></b> <b>Experiment</b> Salt Solution + $NaOH$ or $NH_4OH$ solution. White ppt + $NaOH/NH_4OH$ solution.	<b>Observation</b> White ppt  White ppt insoluble in excess of $NaOH$ or $NH_4OH$	<b>Result</b> $Mg^{2+}$ may be present  $Mg^{2+}$ is present
<b>Test for <math>NH_4^+</math></b> <b>Experiment</b> Portion of Aqueous solution of salt + $NaOH$ solution warm	<b>Observation</b> Pungent of $NH_3$ Gas release	<b>Result</b> $NH_4^+$ Ion is present
<b>Test for <math>Ca^{2+}</math> &amp; <math>Ba^{2+}</math></b> <b>Experiment</b> Heat Nichrome wire until flame is no longer coloured.  Dip the loop of wire into water and then in unknown salt. Heat the wire on flame.	<b>Observation</b> Apple Green colour flame  Brick Red colour flame	<b>Result</b> $Ba^{2+}$ is present  $Ca^{2+}$ is present

#### Qualitative analysis of

Anions like  $CO_3^{2-}$ ,  $Cl^-$ ,  $I^-$ ,  $SO_4^{2-}$  and  $NO_3^-$  can be identified by following test.

#### Experiment

<b>Test for <math>CO_3^{2-}</math></b> <b>Experiment</b> Sample of Solid + Dilute Mineral Acid	<b>Observation</b> Bubbles comes out which turns lime water milky	<b>Result</b> $CO_3^{2-}$ is present
<b>Test for <math>Cl^-</math></b> <b>Experiment</b> Few ml of salt solution + dilute $HNO_3$ + $AgNO_3$  White ppt + $NH_4OH$ solution	<b>Observation</b> White ppt  White ppt solution in $NH_4CH$	<b>Result</b> $Cl^-$ may be present  $Cl^-$ Ion is present
<b>Test for <math>I^-</math></b> <b>Experiment</b> Few ml of salt solution + few drops of dilute $HNO_3$ + few drops of $AgNO_3$  Yellow ppt + $NH_4OH$ solution	<b>Observation</b> Yellow ppt  Yellow ppt insoluble in excess $NH_4CH$	<b>Result</b> $I^-$ may be present  $I^-$ Ion is present

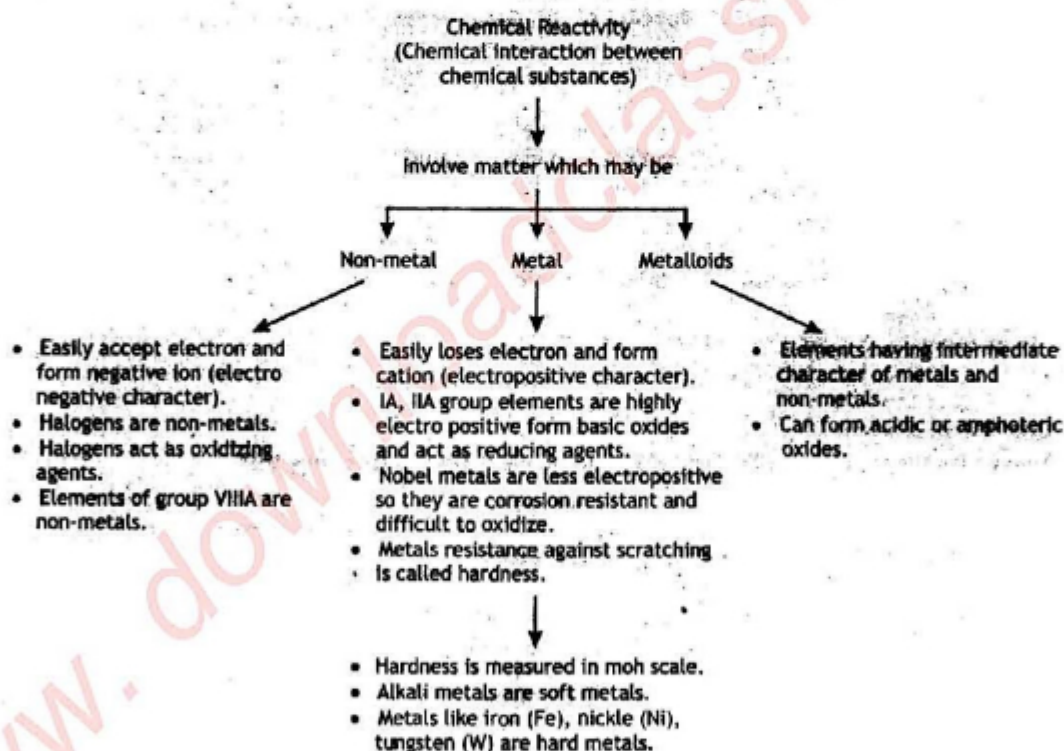


## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

Chapter-8 Chemical Reactivity

<b>Test for <math>\text{SO}_4^{2-}</math></b> <b>Experiment</b> Few ml of Sample + dilute HCl + few drops of $\text{BaCl}_2$ or Few drops of Sample of dilute HCl + few drops of lead nitrate $\text{Pb}(\text{NO}_3)_2$ solution  White ppt + dilute HCl	<b>Observation</b>  White ppt   White ppt insoluble in excess HCl	<b>Result</b>  $\text{SO}_4^{2-}$ ion may be present   $\text{SO}_4^{2-}$ ion is present
<b>Test for <math>\text{NO}_3^-</math></b> <b>Experiment</b> Small amount of salt + few drops of dilute $\text{H}_2\text{SO}_4$ solution	<b>Observation</b> Reddish Brown vapours evolve	<b>Result</b> $\text{NO}_3^-$ ion is present

### Concept Map



### Summary

- ♦ Metals have a greater tendency to lose electrons.
- ♦ Non-metals have a greater tendency to accept an electron.
- ♦ Oxides of metals are basic because they produce a basic solution with water.
- ♦ Oxides of non-metals are acidic because they form an acidic solution with water.
- ♦ Ionization energy decreases and electro positivity increases down the group.
- ♦ Group I-A elements are called alkali metals.

## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

### Chapter-8 Chemical Reactivity

- Group II-A elements are called alkaline earth metals.
- Metals of group I-A, II-A are powerful reducing agent.
- Noble metals like platinum, silver, gold etc. are difficult to oxidize.
- VII-A group elements are non-metals and act as oxidizing agents.
- VII-A group elements are known as halogens.
- Halogen reacts with metals and forms salt.
- Elements of group VIIA are non-metals and consist of gases.
- Metalloids are elements that have properties intermediate between metals and non-metal elements.  
 For example, B, Si, Ge, As, Sb, Te are metalloids.

### Solution of Textbook Exercise

#### SECTION-A: MULTIPLE CHOICE QUESTIONS

Tick Mark (✓) the correct answer:

See "Multiple Choice Questions (M.C.Qs)" - (1) to (10)

#### SECTION-B: SHORT QUESTIONS:

1. Identify the elements as Metals, Non-metals and Metalloids from the following elements:

Ans:	Elements	Metals	Non-Metals	Metalloids
	C, Ca, Sb, S, Sr, Si, K, P, Ba, Ge	Ca, Sr, K, Ba	C, S, P	Sb, Si, Ge

2. What are Alkali metals? Write names and symbols of alkali metals.

Ans: Alkali metal, any of the six chemical elements that make up Group 1 (I-A) of the periodic table—namely, lithium (Li), sodium (Na), potassium (K), rubidium (Rb), caesium (Cs), and francium (Fr). The alkali metals are so-called because reaction with water forms alkalies (i.e., strong bases capable of neutralizing acids).

All alkali metals have their outermost electron in an s-orbital: this shared electron configuration results in their having very similar characteristic properties.

3. What are Alkaline Earth Metals? Write names and symbols of Alkaline earth metals.

Ans: Alkaline-earth metal, any of the six chemical elements that comprise Group 2 (II-A) of the periodic table. The elements are beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra).

The elements have very similar properties: they are all shiny, silvery-white, somewhat reactive metals at standard temperature and pressure.

4. What are Halogens? Write names and symbols of Halogens.

Ans: Halogen, any of the six nonmetallic elements that constitute Group 17 (Group VIIA) of the periodic table. The halogen elements are fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At), and tennessine (Ts). They were given the name halogen, from the Greek roots hal- ("salt") and -gen ("to produce"), because they all produce sodium salts of similar properties, of which sodium chloride—table salt, or halite—is best known.

5. Write names and symbols of any three metalloids.

Ans: Metalloids have properties that are intermediate between metals and non-metals. They have properties that are difficult to characterize. Following are the elements that are considered to be metalloids:

- (i) Boron (B)                      (ii) Silicon (Si)                      (iii) Germanium (Ge)                      (iv) Arsenic (As)  
 (v) Antimony (Sb)                      (vi) Tellurium (Te)                      (vii) Polonium (Po)

6. Define following with examples: - (i) Cation                      (ii) Anion

Ans: (i) Cation: A cation has more protons than electrons, consequently giving it a net positive charge. For a cation to form, one or more electrons must be lost, typically pulled away by atoms with a stronger affinity for them. The number of electrons lost, and so the charge of the ion is indicated after the chemical symbol, e.g. silver (Ag) loses one electron to become Ag<sup>+</sup>, whilst zinc (Zn) loses two electrons to become Zn<sup>2+</sup>.



## CHEMISTRY (EM) NOTES FOR CLASS 9<sup>TH</sup> (FOR SINDH)

### Chapter-8 Chemical Reactivity

(II) **Anion:** An anion has more electrons than protons, consequently giving it a net negative charge. For an anion to form, one or more electrons must be gained, typically pulled away from other atoms with a weaker affinity for them. The number of electrons gained, and so the charge of the ion is indicated after the chemical symbol, e.g. chlorine (Cl) gains one electron to become  $\text{Cl}^-$ , whilst oxygen (O) gains two electrons to become  $\text{O}^{2-}$ .

7. **Explain why alkali metals do not exist free in nature.**

Ans: See "Reasons" - Q.7

8. **Explain the inertness of noble metals.**

Ans: See "Short & Detailed Questions" - Q.14

9. **Write names and symbols of some noble metals.**

Ans: Noble metals include Gold (Au), Silver (Ag), Platinum (Pt), Iridium (Ir), Osmium (Os), Rhodium (Rh), Ruthenium (Ru), Palladium (Pd).

10. **Explain the electronegative character of non-metals.**

Ans: See "Short & Detailed Questions" - Q.21

### SECTION - C: DETAILED QUESTIONS:

1. **Explain the importance of Silver.**

Ans: See "Short & Detailed Questions" - Q.15

2. **Explain the importance of Gold.**

Ans: See "Short & Detailed Questions" - Q.15

3. **Explain the experiment to test  $\text{Cl}^-$  and  $\text{I}^-$  ions.**

Ans: This test is carried out in a solution of halide ions. The solution is acidified by adding dilute nitric acid. The nitric acid reacts with, and removes, other ions that might also form precipitates with silver nitrate. Silver nitrate solution is then added, and the halide can be identified from the following products:

$\text{Cl}^-$	white precipitate	$\text{I}^-$	very pale yellow precipitate
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4. **Explain the electropositive character of metals.**

Ans: See "Short & Detailed Questions" - Q.5

5. **Explain the position of Magnesium in the periodic table and its importance.**

Ans: See "Short & Detailed Questions" - Q.9

6. **Explain the position of Sodium in the periodic table and its importance.**

Ans: See "Short & Detailed Questions" - Q.7

7. **Arrange the following Halogen Acids in increasing order of their Acidic strength:  $\text{HBr}$ ,  $\text{HCl}$ ,  $\text{HI}$ ,  $\text{HF}$ .**

Ans:  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$

8. **Explain the electronegative character of non-metals.**

Ans: See "Short & Detailed Questions" - Q.21

9. **Differentiate between sodium and iron as soft and hard metal.**

Ans: See "Differences" - Q.3

10. **Discuss the reactivity of Halogens.**

Ans: See "Short & Detailed Questions" - Q.23

