

CHAPTER -1

PERIODIC TABLE, PERIODIC PROPERTIES AND VARIATIONS OF PROPERTIES

1. Name

- (a) An alkali metal in period 3 and halogen in period 2
- (b) The noble gas with 3 shells
- (c) The non-metals present in period 2 and metals in period 3.
- (d) The element of period 3 with valency 4.
- (e) The element in period 3 which does not form an oxide.
- (f) The element of lower nuclear charge out of Be and Mg.
- (g) Which has higher E.A. Fluorine or Neon?
- (h) Which has maximum metallic character Na, Li or K?

Solution:

- (a) Na and F
- (b) Argon
- (c) The non-metals present in period 2 are C, N, O and F, and the metals present in period 3 are Na, Mg and Al
- (d) Silicon
- (e) Argon
- (f) Mg
- (g) Fluorine
- (h) K

2. Choose the most appropriate answer from

[SO₂, SiO₂, Al₂O₃, CO, MgO, Na₂O]

- (a) A covalent oxide of a metalloid.
- (b) An oxide which when dissolved in water forms acid.
- (c) A basic oxide.

(d) An amphoteric oxide.

Solution:

(a) A covalent oxide of a metalloid. – SiO_2 (where, Si is a metalloid)

(b) An oxide which when dissolved in water forms acid. – SO_2 ($\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$)

(c) A basic oxide. – Na_2O ($\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$)

(d) An amphoteric oxide. – Al_2O_3 (because it shows both acidic and basic properties)

3. Arrange the following as per instructions given in the brackets.

(a) Mg, Cl, Na, S, Si (increasing order of atomic size)

(b) Cs, Na, Li, K, Rb (increasing metallic character)

(c) Na, K, Cl, S, Si (increasing ionisation potential)

(d) Cl, F, Br, I (increasing electron affinity)

(e) Cs, Na, Li, K, Rb (decreasing electronegativity)

Solution:

(a) Mg, Cl, Na, S, Si (increasing order of atomic size) –

$\text{Cl} < \text{S} < \text{Si} < \text{Mg} < \text{Na}$

Below are the actual atomic sizes in increasing order:

$99 \text{ pm} < 104 \text{ pm} < 117 \text{ pm} < 160 \text{ pm} < 186 \text{ pm}$

(b) Cs, Na, Li, K, Rb (increasing metallic character) –

$\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$

(c) Na, K, Cl, S, Si (increasing ionisation potential) –

$\text{Cl} < \text{S} < \text{Si} < \text{Na} < \text{K}$

Below are the actual ionisation potentials (KJ mole^{-1}) of the elements arranged in increasing order:

$1256 < 999 < 786 < 496 < 419$

(d) Cl, F, Br, I (increasing electron affinity) –

$\text{I} < \text{Br} < \text{F} < \text{Cl}$

Below are the actual ionisation potentials of the given elements arranged in increasing order:

$-295 \text{ KJ mol}^{-1} < -324 \text{ KJ mol}^{-1} < -327.9 \text{ KJ mol}^{-1} < -349 \text{ KJ mol}^{-1}$

(e) Cs, Na, Li, K, Rb (decreasing electronegativity) –

Li > Na > K = Rb > Cs

Below are the actual electronegativity arranged in decreasing order:

1.0 > 0.9 > 0.8 = 0.8 > 0.7

4. Chlorine in the Periodic Table is surrounded by the elements with atomic number 9, 16, 18 and 35.

(a) Which of these have physical and chemical properties resembling chlorine?

(b) Which is more electronegative than chlorine?

Solution:

(a) Elements with atomic number 9 and 35 will have similar physical and chemical properties of chlorine.

(b) An element with atomic number 9 will be more electronegative than chlorine.

5. Arrange the following in order of increasing radii:

(a) Cl^- , Cl

(b) Mg^{2+} , Mg, Mg^+

(c) N, O, P

Solution:

(a) $\text{Cl} < \text{Cl}^-$

(b) $\text{Mg}^{2+} < \text{Mg}^+ < \text{Mg}$

(c) $\text{O} < \text{N} < \text{P}$

6. Which element from the following has the highest ionization energy?

Solution: (a) P, Na, Cl

(b) F, O, Ne

(c) Ne, He, Ar

Explain your choice.

(a) Cl

Generally, metals have low ionisation energy and non-metals have high ionisation energy. And, across the period, ionisation energy tends to increase. P, Na and Cl are elements belonging to the third period.

Na – Group 1, P – Group 15 and Cl – Group 17.

(b) Ne

The electron affinity of inert gases is zero due to their stable electronic configuration.

(c) He

Ionisation energy decreases with an increase in the atomic size, so it decreases as one moves down a group. Then in that case,

Ne, He and Ar are inert gases.

He – Period 1, Ne – Period 2 and Ar – Period 3.

7. The electronegativities (according to Pauling) of the elements in Period 3 of the Periodic Table are as follows with elements arranged in alphabetical order:

Al	Cl	Mg	Na	P	S	Si
1.5	3	1.2	0.9	2.1	2.5	1.8

Arrange the elements in the order in which they occur in the periodic table from left to right.

(The group 1 element first, followed by the group 2 element and so on, up to group 7).

Solution:

The correct order of arrangement is given as below:

Na, Mg, Al, Si, P, S, Cl

8. Choose the word or phrase from the brackets which correctly completes each of the following statements:

(a) The element below sodium in the same group would be expected to have a (lower/higher) electro-negativity than sodium, and the element above chlorine would be expected to have a (lower/higher) ionisation potential than chlorine.

(b) On moving from left to right in a given period, the number of shells (remains the same/increases decreases).

(c) On moving down a group, the number of valence electrons (remains the same/increases/decreases).

(d) Metals are good (oxidising agents/reducing agents) because they are electron (acceptors/donors).

Solution:

(a) The element below sodium in the same group would be expected to have a lower electro-negativity than sodium, and the element above chlorine would be expected to have a higher ionisation potential than chlorine.

(b) On moving from left to right in a given period, the number of shells remains the same.

(c) On moving down a group, the number of valence electrons remains the same.

(d) Metals are good reducing agents because they are electron donors.

9. Parts (a) to (e) refer to change in the properties of elements on moving from left to right across a period of the periodic table. For each property, choose the correct answer.

(a) The non-metallic character of the elements:

(i) Decreases

(ii) Increases

(iii) Remains the same

(iv) Depends on the period

(b) The electronegativity:

(i) Depends on the number of valence electrons

(ii) Remains the same

(iii) Decreases

(iv) Increases

(c) The ionization potential:

(i) goes up and down

(ii) Decreases

(iii) Increases

(iv) Remains the same

(d) The atomic size:

- (i) Decreases
- (ii) Increases
- (iii) Remains the same
- (iv) Sometimes increases and sometimes decreases

(e) The electron affinity of elements in group 1 to 7:

- (i) Goes up and then down
- (ii) Decreases and then increases
- (iii) Increases
- (iv) Decreases

Solution:

- (a) The non-metallic character increases from left to right across a period
- (b) The electronegativity of elements increases from left to right across a period
- (c) The ionisation potential of elements increases from left to right across a period
- (d) The atomic size of elements decreases from left to right across a period
- (e) The electron affinity of the elements in groups 1 to 7 increases

10. The elements of one short period of the periodic table are given below in order from left to right:

Li Be B C O F Ne

- (a) To which period do these elements belong?
- (b) One element of this period is missing. Which is the missing element and where should it be placed?
- (c) Place the three elements: Fluorine, Beryllium and nitrogen in the order of increasing electronegativity.
- (d) Which one of the above element belongs to the halogen series?

Solution:

- (a) Clearly, the elements belong to the 2nd period
- (b) Nitrogen (N), and it should be placed between carbon and oxygen
- (c) $Be < N < F$ is the correct order of increasing electronegativity
- (d) Fluorine belongs to the halogen family

11. Study the table and answer the following questions:

IA	IIA	IIIA	IVA	VA	VIA	VIIA	0
1	2	13	14	15	16	17	18
Li		D			O	J	Ne
A	Mg	E	Si		H	K	
B	C		F	G			L

Select from the table:

(i) Which is the most electronegative?

(ii) How many valence electrons are present in G?

(iii) Write the formula of the compound between B and H.

(iv) In the compound between F and J, what type of bond will be formed?

Solution:

(i) The most electronegative element of the table is J.

(ii) The number of valence electrons present in G are 5.

(iii) B has 1 valence electron and H has 6 valence electrons. Then, the valency of B is +1 and the valency of H is – 2.

Thus, the formula of the compound between B and H will be B_2H

(iv) In the compound between F and J, the type of bond formed will be covalent.

12.(a) The number of electrons in the valence shell of a halogen is

A – 1 B – 3 C – 5 D – 7.

(b) Electronegativity across the period [increases/decreases].

(c) Non-metallic character down the group [increases/decreases].

(d) Atomic number of an element is 16. State

(i) to which period it belongs

(ii) the number of valence electrons in the element

(iii) is the element metal or non-metal

Solution:

(a) The number of electrons in the valence shell of a halogen is 7.

(b) Electronegativity across the period increases.

(c) Non-metallic character down the group decreases.

(d) The atomic number of an element is 16

(i) It belongs to period 3

(ii) The number of valency electrons in the element is 6

(iii) The element is a non-metal

13. Give reasons –

(i) The oxidising power of elements increases from left to right along a period.

(ii) The ionisation potential of the element increases across a period.

(iii) Alkali metals are good reducing agents.

(a) **Solution**

(i) The tendency to gain electrons by elements is known as oxidising power and this increases from left to right along a period due to the increase in nuclear pull.

(ii) The atomic radius decreases across a period. Due to this, the attraction between the nucleus and the electron increases. Hence, it results in an increase in the ionisation potential.

(iii) Alkali metals have a greater tendency to lose electrons so, they are good reducing agents.

14. Select the correct answer from the choices A, B, C, D which are given. Write down only the letter corresponding to correct answer.

(i) With reference to the variation of properties in the Periodic table, which of the following is generally true?

- A. Atomic size increases from left to right across a period.
- B. Ionization potential increases from left to right across a period.
- C. Electron affinity increases going down a group.
- D. Electro-negativity increases going down a group.

Solution:

(b) Ionization potential increases from left to right across a period.

(ii) Among Period 2 elements A, B, C and D, the one which has high electron affinity is

- A. Lithium B. Carbon
- C. Fluorine D. Neon

Solution:

D. Lithium

(iii) An element in Period 3 whose electronic affinity is zero.

- A. Neon B. Sulphur
- C. Sodium D. Argon

Solution:

(a) D. Argon

(iv) Ionisation potential increases over a period from left to right because the

- A. Atomic radius and nuclear charge increase
- B. Atomic radius and nuclear charge decrease
- C. Atomic radius increases and nuclear charge decreases
- D. Atomic radius decreases and nuclear charge increases

Solution : B . Atomic radius and nuclear charge decrease

(v) An element A belonging to Period 3 and Group II will have

- A. 3 shells and 2 valence electrons
- B. 2 shells and 3 valence electrons
- C. 3 shells and 3 valence electrons
- D. 2 shells and 2 valence electrons

(vi) Among the elements given below, the element with the least electronegativity is

- A. Lithium B. Carbon C. Boron D. Fluorine

Solution : A. Lithium

(vii) The Modern Periodic Table is based on the:

- A. Atomic mass
- B. Atomic volume
- C. Atomic number
- D. Number of neutrons

Solution: C. Atomic number

(viii) Which of the following is a halogen?

- A. Potassium
- B. Iodine
- C. Calcium
- D. Neon

Solution : C .Iodine

(ix) On moving from left to right in a period, the atomic size:

- A. Increases
- B. Decreases
- C. Remains the same
- D. First increases then decreases

Solution : B. Decreases

(x) The element with the highest electronegativity is:

- A. Sodium
- B. Chlorine
- C. Fluorine
- D. Magnesium

Solution: C. Fluorine

(xi) Elements belonging to Group 18 are known as:

- A. Alkali metals
- B. Halogens
- C. Noble gases
- D. Alkaline earth metals

Solution: C. Noble gases

(xii) Which of the following is a liquid non-metal?

- A. Phosphorus
- B. Mercury
- C. Bromine
- D. Nitrogen

Solution: C. Bromine

(xiii) As you move down a group, the ionization potential:

- A. Increases
- B. Decreases
- C. Remains the same
- D. First increases then decreases

Solution: B. Decreases

(xiv). Which element has the highest metallic character?

- A. Sodium
- B. Caesium
- C. Calcium
- D Potassium

Solution : B. Caesium

(xv) The valency of elements in Group 2 is:

- A. 1
- B. 2
- C. 3
- D. 0

Solution : B.2

(xvi) Which of the following is a transition element?

- A. Sodium
- B. Calcium
- C. Iron
- D. Phosphorus

Solution: C. Iron

15.a. An atomic number of an element Z is 16. Answer the following:

(i) State the period and group to which Z belongs.

(ii) Is Z a metal or a non-metal?

(iii) State the formula of the compound between Z and hydrogen.

(b) M is a metal above hydrogen in the activity series and its oxide has the formula M_2O . This oxide, when dissolved in water, forms the corresponding hydroxide which is a good conductor of electricity. In the above context, answer the following:

(i) What kind of combination exists between M and O?

(ii) State the number of electrons in the outermost shell of M.

(iii) Name the group to which M belongs.

(c) Give one word or phrase for: The amount of energy released when an atom in the gaseous state accepts an electron to form an anion.

Solution:

a.(i) It belongs to Period 3 and Group 16 of the Periodic Table

(ii) Z is a non-metal

(iii) H_2Z

b (i) An ionic bond exists between M and O.

(ii) The number of electrons in the outermost shell of M is 1.

(iii) M belongs to Group 1(Alkali metals) in the Periodic Table.

(c) Electron affinity

16. The metals of Group 2 from top to bottom are Be, Mg, Ca, Sr and Ba.

(i) Which of these elements will form ions most readily and why?

(ii) State the common feature in the electronic configuration of all these elements.

Solution:

(i) Ba metal will form ions readily since the ionisation energy of elements down the group decreases as the size increases.

(ii) The number of electrons in the outermost shell remains the same on moving down the group. Hence, the valency in a group remains the same, i.e. for Group 2 – valency is 2.

17.(a) Metals are good _____ (oxidising agents/reducing agents) because they are electron _____ (acceptors/donors).

(b) An element with the atomic number 19 will most likely combine chemically with the element whose atomic number is:

(i) 17 (ii) 11 (iii) 18 (iv) 20

(c) Rewrite the following sentences by using the correct symbol > (greater than) or < (less than) in the blanks given:

1. The ionization potential of potassium is _____ that of sodium.

2. The electronegativity of Iodine is _____ that of Chlorine.

(d) Fill in the blanks by selecting the correct word from the brackets:

(i) If an element has a low ionization energy then it is likely to be _____ (metallic / non-metallic).

(ii) If an element has seven electrons in its outermost shell then it is likely to have the _____ (largest / smallest) atomic size among all the elements in the same period.

Solution:

(a) Metals are good reducing agents because they are electron donors.

(b) (i) 17

Element with atomic number 19 will have valency 1 (lose 1 electron to achieve the noble gas configuration) which can be accepted by the element with atomic number 17 whose valency is 1.

(c) 1. less than, I.P of K < I.P of Na

2. less than, electronegativity (I) < electronegativity (Cl)

(d) (i) If an element has low ionization energy then it is likely to be metallic.

(ii) If an element has seven electrons in its outermost shell then it is likely to have the smallest atomic size among all the elements in the same period.

18.(a) In Period 3 of the Periodic table, element B is placed to the left of element A. On the basis of this information, choose the correct word from the brackets to complete the following statements:

(i) The element B would have (lower / higher) metallic character than A.

(ii) The element A would probably have (lesser / higher) electron affinity than B.

(iii) The element A would have (greater / smaller) atomic size than B.

Solution:

- (i) The element B would have a higher metallic character than A.
- (ii) The element A would probably have higher electron affinity than B.
- (iii) The element A would have a smaller atomic size than B.

This question refers to the elements of the Periodic Table with atomic numbers from 3 to 18. Some of the elements are shown by letters, but the letters are not the usual symbols of the elements.

3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H
11	12	13	14	15	16	17	18
I	J	K	L	M	N	O	P

Which of these :

- (a) is the most electronegative element ?
- (b) is a halogen ?
- (c) is an alkali metal ?
- (d) is an element with valency 4 ?
- (e) has the least Ionisation Energy ?
- (f) has the least atomic size in period 3 ?

Answer

- (a) The most electronegative elements are **G**
- (b) **G & O** are halogens.
- (c) **A / I** are alkali metals.
- (d) **D / L** are elements with valency 4.
- (e) **I** have least Ionisation Energy.
- (f) **O** have least atomic size in period 3.

19.ASSERTION -REASON

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.

3. A is true but R is false.

4. A is false but R is true.

a. Assertion (A): Smaller the size of an atom greater is its electronegativity.

Reason (R): Electronegativity is the tendency of an atom to attract shared pair of electrons towards itself in a molecule.

Answer Both A and R are true but R is not the correct explanation of A.

Explanation — Assertion (A) is true because smaller atoms attract electrons more strongly. Reason (R) correctly defines electronegativity but does not explain why smaller atoms have higher electronegativity.

b. Assertion (A): Hydrogen is placed in group I.

Reason (R): Hydrogen can gain an electron to achieve noble gas configuration.

Answer Both A and R are true but R is not the correct explanation of A.

Explanation — Hydrogen is placed in Group I with alkali metals because, like them, it has one electron in its outermost shell and forms (H^+) ions by losing this electron. Although hydrogen can also gain an electron to form the hydride ion (H^-) similar to halogens. Hence, Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

c. Assertion (A): Atomic size increases along a period.

Reason (R): Effective nuclear charge increases with atomic number.

Answer A is false but R is true.

Explanation — Atomic size decreases across a period (from left to right) in the periodic table. This is because, although electrons are being added, they are added to the same shell, and the increasing effective nuclear charge pulls the electrons closer to the nucleus. Hence, Assertion (A) is false.

As atomic number increases, the number of protons increases, which increases the effective nuclear charge. Hence, Reason (R) is true.

c. Assertion (A): Elements in the same vertical column have similar properties.

Reason (R): Properties depend upon the number of electrons in the valence shell.

Answer Both A and R are true and R is the correct explanation of A.

Explanation — Elements in the same vertical column i.e., a group in the periodic table, have the same number of valence electrons. Since chemical properties of elements depend upon the number of valence electrons, thus elements in the same group have similar properties. Hence, Reason (R) correctly explains the Assertion (A).

d. Assertion (A): Alkali metals do not form dipositive ions.

Reason (R): After loss of one electron, alkali metals achieve a stable electronic configuration of noble gases.

Answer Both A and R are true and R is the correct explanation of A.

Explanation — Alkali metals (such as lithium, sodium, and potassium) do not form dipositive ions. Instead, they form monovalent cations by losing one electron. This is because they have a single electron in their outermost shell, and losing this one electron achieves the stable noble gas configuration.

CHAPTER -2

CHEMICAL BONDING

I. Select the correct answer from the choices A, B, C, D which are given.

1. Chemical bond is formed due to:

- A. Loss of neutrons
- B. Gain, loss or sharing of electrons
- C. Change in nucleus
- D. Change in protons

Answer: B. Gain, loss or sharing of electrons

2. Which particle participates in chemical bonding?

- A. Proton
- B. Neutron
- C. Electron
- D. Nucleus

Answer: C. Electron

3. Sodium chloride is formed by:

- A. Covalent bonding
- B. Ionic bonding
- C. Metallic bonding

D. Hydrogen bonding

Answer: B. Ionic bonding

4. Which of the following is a covalent compound?

A. NaCl

B. MgO

C. H₂O

D. CaCl₂

Answer: C .H₂O

5. In ionic bonding, electrons are:

A. Shared

B. Transferred

C. Destroyed

D. Created

Answer: B. Transferred

6. In covalent bonding, electrons are:

A. Lost

B. Gained

C. Shared

D. Transferred

Answer: C. Shared

7. Which element tends to lose electrons easily?

A. Chlorine

B. Oxygen

C. Sodium

D. Nitrogen

Answer: C .Sodium

8. The valency of oxygen is:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B.2

9. The electronic configuration of chlorine is:

- A. 2,8,7
- B. 2,8,8
- C. 2,7
- D. 2,8,1

Answer: A. 2,8,7

10. Which of the following contains ionic bond?

- A. HCl
- B. CO₂
- C. KBr
- D. NH₃

Answer: C. KBr

11. Which compound has a double covalent bond?

- A. H₂
- B. O₂
- C. Cl₂
- D. NaCl

Answer: B. O₂

12. Which compound has a triple covalent bond?

- A. N₂

- B. O₂
- C. H₂
- D. CO₂

Answer: A. N₂

13. Noble gases are chemically stable because they have:

- A. Incomplete outer shell
- B. Completely filled outer shell
- C. More protons
- D. More neutrons

Answer: B. Completely filled outer shell

14. Electrovalent compounds generally:

- A. Have low melting points
- B. Conduct electricity in molten state
- C. Are gases
- D. Are insoluble in water

Answer: B. Conduct electricity in molten state

15. Covalent compounds usually:

- A. Conduct electricity
- B. Have high melting points
- C. Do not conduct electricity
- D. Form ions in solid state

Answer: C. Do not conduct electricity

16. Magnesium chloride is represented as:

- A. MgCl
- B. MgCl₂

C. Mg_2Cl

D. Mg_2Cl_2

Answer: B. MgCl_2

17. Which bond is present in hydrogen molecule?

A. Ionic bond

B. Single covalent bond

C. Double bond

D. Triple bond

Answer: B. Single covalent bond

18. The valency of nitrogen in ammonia is:

A. 1

B. 2

C. 3

D. 4

Answer: C.3

19. Calcium oxide is formed between:

A. Two non-metals

B. Two metals

C. A metal and a non-metal

D. Noble gases

Answer: C. A metal and a non-metal

20. C consists of oppositely charged ions even in the solid state.

What could be C?

X. C is an ionic compound.

Y. C is a polar covalent compound.

- A. X is correct but not Y.
- B. Y is correct but not X
- C. X and Y are correct.
- D. Neither X nor Y are correct.

21. An atom X donates one electron, and another atom Y accepts that electron. Which statements are true for the compound XY?

- A. An ionic bond exists between XY.
- B. The compound XY is soluble in water.
- C. The compound XY is a non-volatile solid.
- D. XY ionizes in water.

21. Which statements are true to form a coordinate covalent bond?

- P. A lone pair is shared during bonding.
- Q. H^+ ion accepts the lone pair electrons to be stable.
- R. The bond is formed between the central atom of a polar compound with an H^+ ion.
- S. It is not a mutual sharing case.

(a) P, Q, R & S

(b) Q, R & S

(c) S, P & Q

(d) R, S & P

22. Which one is the true statement for a covalent bond?

- K. A covalent bond is formed due to the mutual sharing of electrons, shared by each atom.

- L. A covalent bond is always formed between two or more non-metal atoms.
- M. The number of electrons a non-metal atom shares is 8 – its valency electrons.
- N. The number of non-participating electrons in the valency shell is an even number.

- A. Only K
- B. K & L
- C. K, L & M
- D. K, L, M & N

23. Read the following and find out the correct sequence.

- (i) E contains more electrons than its protons.
- (ii) F contains fewer electrons than its protons.
- (iii) G contains the same number of protons and electrons.

Based on the statements (i), (ii), and (iii), choose the correct statement only.

	E	F	G
P	A cation	An anion	An atom
Q	An anion	A cation	An atom
R	An atom	An anion	A cation
S	A cation	An atom	An anion

- A. P
- B. Q
- C. R
- D. S

24. Ionic compounds have a high melting point. Which statements are true?

- K. Molecules are attracted with strong forces of attraction.
- L. Oppositely charged ions are attracted with strong forces of attraction.
- M. Molecules of the compound are made up of oppositely charged ions.

N. Oppositely charged ions are attracted with weak forces of attraction.

A. K

B. K & L

C. L & M

D. M & N

25. Hydrogen chloride can be termed as a polar covalent compound. Which statements are incorrect about the statement?

P. The lone pairs of electrons are distributed unequally between the combining atoms.

Q. The bond pairs of electrons are distributed unequally between the combining atoms.

R. The electronegativity difference between hydrogen and chlorine is negligible.

S. The nucleus of chlorine pulls the bond pair more effectively than that of the nucleus of hydrogen.

A. P

B. Q,R,S

C. P,Q,R,S

D. None of these

II. Give reasons.

- a. Ammonia does not conduct electricity in gaseous state but its aqueous solution does.-No ions in gaseous state- polar covalent compound- forms ions in water.**
- b. The ionization of a metal is an oxidation reaction.-Metals lose electrons- loss of electrons is oxidation.**
- c. Non- metals can exhibit both covalency and electro valency. -covalency in covalent compounds as they react with non-metals-electro valency in ionic compounds as they react with metals.**
- d. Sodium chloride undergoes dissociation in its solution whereas hydrogen chloride undergoes ionization.-Sodium chloride is ionic in nature -constituent particles are ions- hydrogen chloride is polar covalent compound – ionise in polar solvents.**
- e. Sodium chloride does not conduct electricity in its solid state. -absence of free mobile ions- strong electrostatic force of attraction between the constituent particles.**
- f. Carbon tetrachloride is insoluble in water.-non- polar in nature -does not dissolve in polar solvent.**

III. Choose the appropriate answer from the given:

NaCl, NH₃, NH₄NO₃, H₂O, N₂, HCl

(i) The compound containing a lone pair of electrons.

NH₃

(ii) The compound is a non-conductor of electricity but conducts in its aqueous state.

HCl

(iii) The substance formed due to the transfer of the electron.

NaCl

(iv) A neutral gas.

N₂

(v) The compound containing two lone pairs of electrons.

H₂O

(vi) The molecule containing all three types of bond.

NH₄NO₃

IV. Classify the following as Oxidation, reduction, Redox reaction, ionisation:

(i) $X^{2+} + 2e^{-} \rightarrow X$

Reduction

(ii) $X^{2-} - 2e^{-} \rightarrow X$

Oxidation

(iii) $X + 2e^{-} \rightarrow X^{2-}$

Reduction

(iv) $XY \rightarrow X^{2+} + Y^{2-}$

Ionisation

V. Draw the electron dot structure of the following molecules:

a. Sodium chloride

b. Water

c. Calcium oxide

d. Magnesium chloride a

e. Ammonia

f. Hydrogen chloride

g. Methane

h. Carbon tetrachloride

i. Nitrogen

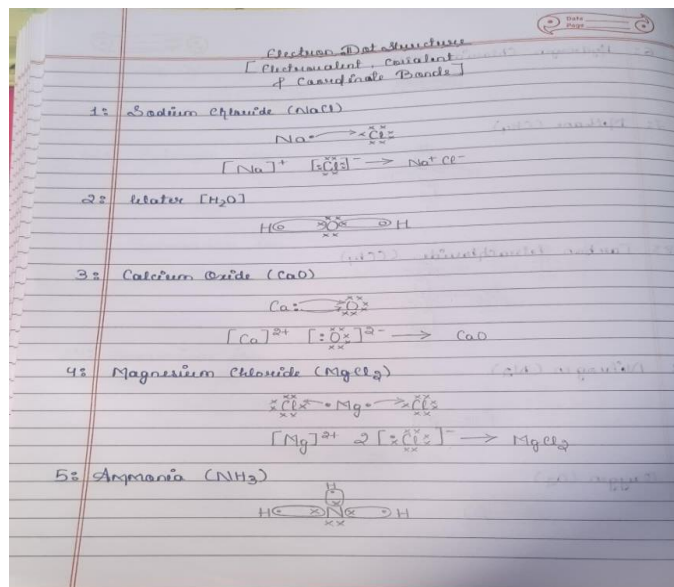
j. Oxygen

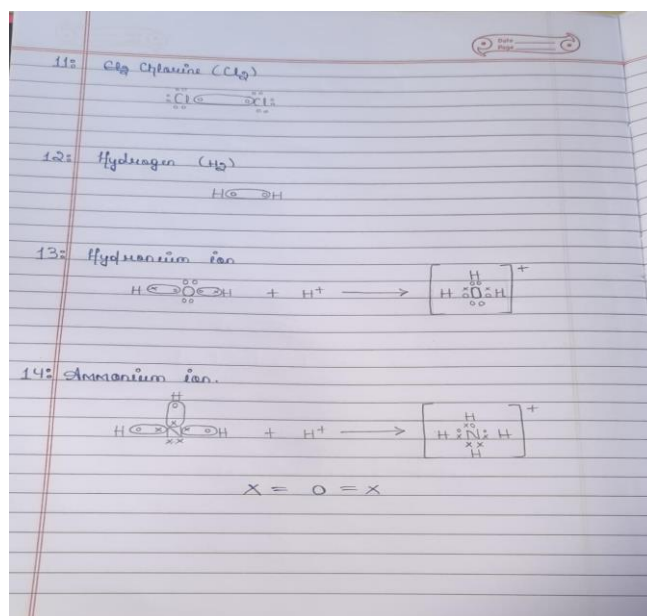
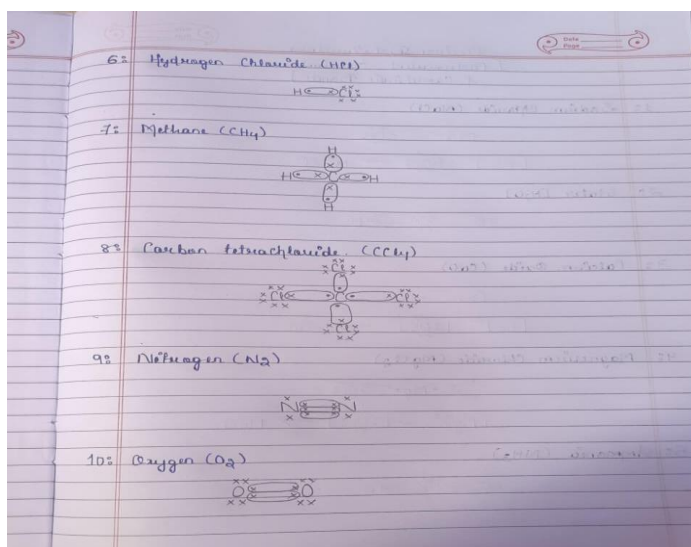
k. Chlorine

l. Hydrogen

m. Hydronium ion

n. Ammonium ion





VI. ASSERTION – REASON TYPE QUESTIONS

These questions consist of two statements each, printed as assertion and reason, while answering these questions you are required to choose any one of the following responses.

(A) If both assertion and reason are true and reason is the correct explanation of assertion.

(B) If both assertion and reason are true and reason is not the correct explanation of assertion.

(C) If the assertion is true but the reason is false.

(D) If the assertion is false but the reason is true.

01.Assertion: Ionic compounds have a high melting point.

Reason: Ionic compounds are made up of cation and anion.

Ans- B

02.Assertion: Inert gases do not form ions.

Reason: Inert gases have a stable electronic configuration so they do not lose or gain electrons to form ions.

Ans-A

03.Assertion: Carbon tetrachloride does not conduct electricity.

Reason: It is a non-polar covalent compound and does not dissociate to give ions.

Ans- A

04.Assertion: Covalent compounds generally exist as solids.

Reason: Weak Vander Wall's force of attraction exists between their molecules.

Ans- D

05.Assertion: Hydrogen chloride can be termed as a non-polar covalent compound.

Reason: Chlorine is more electronegative than hydrogen and the bond pair electrons shifted towards the chlorine.

Ans- D

06.Assertion: Carbon tetrachloride does not dissolve in water.

Reason: Carbon tetrachloride is a non-polar compound.

Ans- A

07.Assertion: Ammonia does not conduct electricity but its aqueous solution does.

Reason: Ammonia is a gas non-polar hence does not conduct electricity.

Ans- C

08.Assertion: The ionization of a metal is an oxidation reaction.

Reason: Ionization of a metal means to convert it into a cation by losing an electron(s).

Ans- A

09.Assertion: Ionization may be an oxidation process or may be a reduction process.

Reason: Ionization means the conversion of a neutral atom to an ion.

Ans - B

10.Assertion: Non-metals can exhibit both covalence and electrovalence.

Reason: A non-metal exhibits electrovalence when it combines with a metal, by accepting electrons and covalence when it combines with non-metals by sharing electrons.

Ans - A

11.Assertion: Water is a polar compound.

Reason: Water is a polar compound due to unequal distributions of the bond pair of electrons among oxygen and hydrogen atoms.

Ans - A

12.Assertion: Electrovalent compounds are generally liquids or soft solids.

Reason: Electrovalent compounds are made up of cations and anions. The strong electrostatic forces of attraction bind these cations and anions strongly.

Ans - D

13.Assertion: Ionic compounds are the good conductor of electricity in their molten state.

Reason: The strong ionic bond breaks in a molten state. So it dissociates into ions.

Ans - A

14.Assertion: Covalent compounds undergo rapid reactions.

Reason: Covalent molecules are first broken and new bonds are slowly established.

Ans – D

CHAPTER – 5

MOLE CONCEPT AND STOICHIOMETRY

I. Select the correct answer from the choices A, B, C, D which are given.

1. Which of the following would occupy 22.4 litres at S.T.P?

(Atomic weights: O = 16, H = 1, N = 14)

1.32 g of oxygen gas

2.2 moles of hydrogen

$3.6.022 \times 10^{23}$ molecules of ammonia

(A) 1 & 2

(B) 1 & 3

(C) 2 & 3

(D) 1, 2 & 3

Ans - B

2. If relative molecular mass of Butane (C_4H_{10}) is 58, then its vapour density will be:

(A) 58

(B) 29

(C) 32

(D) 16

Ans - B

3. The percentage of hydrogen present in NaOH is:

(Relative Molecular Mass of NaOH = 40)

(At. Wt. of H = 1)

(A) 2.5

(B) 25

(C) 0.25

(D) 0.025

Ans - A

4. If the empirical mass of the formula PQ_2 is 10 and the relative molecular mass is 30, then the molecular formula will be:

(A) PQ_2

(B) P_3Q_2

(C) P_6Q_3

(D) P_3Q_6

Ans - D

5.If the empirical formula of a compound is CH and its vapour density is 13, then its molecular formula will be:

(At. Wt. C = 12, H = 1)

(A) CH

(B) C_2H_2

(C) C_4H_4

(D) C_3H_3

Ans - B

6.The ratio between the numbers of molecules in 2 g of hydrogen and 32 g of oxygen is:

(A) 1 : 2

(B) 1 : 0.01

(C) 1 : 1

(D) 0.01 : 1

Ans - C

7.The vapour density of carbon dioxide [C = 12, O = 16] is:

(A) 32

(B) 16

(C) 44

(D) 22

Ans - D

8.A gas cylinder of the capacity of 20 dm^3 is filled with gas X, the mass of which is 10 g. When the same cylinder is filled with hydrogen gas at the same temperature and pressure, the mass of the hydrogen is 2 g. Hence the relative molecular mass of the gas is:

(A) 5

(B) 10

(C) 15

(D) 20

Ans - B

9. The gas law which relates the volume of a gas to the number of molecules of the gas is:

(A) Avogadro's law

(B) Gay-Lussac's law

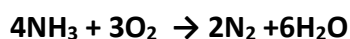
(C) Boyle's law

(D) Charles's law

Ans - A

II. PROBLEMS BASED ON GAY LUSSAC'S LAW:

01. Ammonia burns in oxygen as shown below:



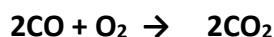
If 240 cc of ammonia is burnt in 300 cc of oxygen, find out the composition of the resultant gaseous mixture at room temperature.

02. Ethane burns in oxygen according to the equation:



If 80 ml of ethane is burnt in 300 ml of oxygen, find the composition of the mixture when measured at room temperature.

03. Calculate the amount of each required to produce 750 ml of carbon dioxide, when two volumes of carbon monoxide combine with one volume of oxygen to produce two volumes of carbon dioxide.



04. Ethane burns in oxygen to form CO_2 and H_2O according to the equation:

If 1250 cc of oxygen is burnt with 300 cc of ethane, calculate:



(i) The volume of CO_2 formed.

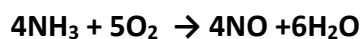
(ii) The volume of unused O_2 .

05. Propane burns in air according to the following equation:



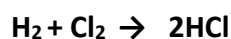
What volume of propane is consumed on using 1000 cc of air, considering only 20% of air contains oxygen?

06. The equation



If 100 cm³ of ammonia is used, calculate the volume of oxygen required to oxidise the ammonia completely.

07. If 6 litres of hydrogen and 4 litres of chlorine are mixed and exploded and if water is added to the gases formed, find the volume of the residual gas.



08. Oxygen oxidizes ethyne to carbon dioxide and water as shown by the equation:



What volume of ethyne gas at S.T.P. is required to produce 8.4 dm³ of carbon dioxide at S.T.P.?

III. PROBLEMS BASED ON VAPOUR DENSITY AND MOLECULAR MASS

1. State the volume occupied by 40 gm of methane at STP, if its vapour density is 8.
2. The mass of 11.2 litres of a certain gas at STP is 24 gm. Find the molecular mass of the gas.
3. A gas of mass 32 gm has a volume of 20 litres at STP, calculate the gram molecular mass of the gas.
4. The vapour density of a gas is 8. What would be the volume occupied by 24 gm of the gas at STP ?
5. The mass of 5.6 litres of a gas at STP is 12 gm. Calculate the gram molecular mass of the gas.
6. A certain gas X occupies a volume of 100 litres at STP and weighs 0.5 gm. Find its relative molecular mass.

IV. PROBLEMS BASED ON AVOGADRO'S NUMBER

1. (i) Calculate the volume occupied by 80 gm of carbon dioxide at STP.

ii) Calculate the number of molecules in 4.4 g of CO_2 . [Atomic mass of C = 12, O =16] —

2. Calculate the number of mole present in 160 g of NaOH.

[Atomic mass: Na = 23, H = 1, O =16]

3. Calculate:

(i) The number of moles in 12 g of oxygen gas. [O = 16]

(ii) The weight of 10^{22} atoms of carbon. [C = 12, Avogadro's No. = 6×10^{23}]

4. A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure:

(i) Find the number of moles of hydrogen present.

(ii) What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure? (H = 1, C = 12, O =16)

5. Calculate the number of gram atoms in 4.6 g of sodium. (Na = 23)

6. A gas cylinder contains 12×10^{24} molecules of oxygen. If Avogadro's number is 6×10^{23} , calculate:

(i) The mass of oxygen present in the cylinder.

(ii) The volume of oxygen at S.T.P. present in the cylinder. [O =16]

7. Calculate the mass of calcium that will contain the same number of atoms as are present in 3.2 g of sulphur.

[Atomic masses: S = 32, Ca = 40]

8. A cylinder contains 68 g of ammonia at S.T.P.

(i) What is the volume occupied by the gas?

(ii) How many moles and how many molecules of ammonia are present in the cylinder?

(N =14, H =1)

9. Calculate the volume occupied by 0.01 mole of CO_2 at S.T.P.

10. Calculate the mass of:

(i) 10^{22} atoms of sulphur.

(ii) 0.1 mole of carbon dioxide.

[Atomic mass: S = 32, C = 12 and O =16, Avogadro's number = 6×10^{23}]

11. Calculate the volume of 320 g of SO_2 at S.T.P. (Atomic mass: S = 32 and O =16)

12. 4.5 moles of calcium carbonate are reacted with dilute hydrochloric acid.

(i) Write the equation for the reaction.

(ii) What is the mass of 4.5 moles of calcium carbonate?

(Relative molecular mass of calcium carbonate is 100)

(iii) What is the volume of carbon dioxide liberated at S.T.P.?

(iv) What mass of calcium chloride is formed?

(Relative molecular mass of calcium chloride is 111)

(v) How many moles of HCl are used in this reaction?

13. A gas cylinder contains 24×10^{24} molecules of nitrogen gas. If Avogadro's number is 6×10^{23} and the relative atomic mass of nitrogen is 14, calculate:

(i) Mass of nitrogen gas in the cylinder.

(ii) The volume of nitrogen at S.T.P. in dm^3 .

14. The equation for the burning of octane is:



(i) How many moles of carbon dioxide are produced in one mole of octane burns.

(ii) What volume at STP is occupied by the number of moles determined in (i).

(iii) If the relative molecular mass of carbon dioxide is 44. what is the mass of carbon dioxide produced by burning two moles of octane?

V. PROBLEMS BASED ON EMPIRICAL AND MOLECULAR FORMULA:

1. The empirical formula of an organic compound is CHCl_2 . If its relative molecular mass is 168, what is its molecular formula?

[At. wt. C = 12, H = 1, Cl = 35.5] — 2023

2. What is the empirical formula of octane/ C_8H_{18} ?

3. Find the empirical formula and the molecular formula of an organic compound from the data given below:

C = 75.92%, H = 6.32% and N = 17.76%

The vapour density of the compound is 39.5. [C = 12, H = 1, N = 14]

4. The percentage composition of the gas is: Nitrogen 82.35%, Hydrogen 17.64%. Find the empirical formula of the gas. [N = 14, H = 1]

5. A compound of 'X' and 'Y' has the empirical formula XY_2 . Its vapour density is equal to its empirical formula weight. Determine its molecular formula.

6. A gaseous hydrocarbon contains 82.76% carbon, given that its vapour density is 29. Find the molecular formula. [C = 12, H = 1]

7. If the empirical formula of a compound is CH and it has a vapour density of 13, find the molecular formula of the compound.

8. A compound made up of two elements 'X' and 'Y' has an empirical formula X_2Y . If the atomic weight of 'X' is 10 and that of 'Y' is 5 and the compound has a vapour density of 25, find its molecular formula.

9. An organic compound with vapour density 94 contains C = 12.67%, H = 2.13% and Br = 85.11%. Find the molecular formula. [At. Mass C = 12, H = 1, Br = 80]

10. A gaseous compound of nitrogen and hydrogen contains 12.5% hydrogen by mass. Find the molecular formula of the compound if its molecular mass is 37.

11. (i) A compound has the following percentage composition by mass:

Carbon 14.4%, hydrogen 1.2% and chlorine 84.5%. Determine the empirical formula of this compound. Work correctly to 2 decimal place. (H = 1, C = 12, Cl = 35.5)

(ii) The relative molecular mass of this compound is 168. So what is the molecular formula?

(iii) By what type of reaction could this compound be obtained from ethyne?

VI. PROBLEMS BASED ON PERCENTAGE COMPOSITION

1. Calculate the percentage of phosphorus in fertilizer superphosphate $Ca(H_2PO_4)_2$.

(Correct to 2 decimal place) [H = 1, P = 31, O = 16, Ca = 40]

2. Calculate the percentage of:

(i) Fluorine (ii) Sodium and (iii) Aluminium in sodium aluminium fluoride $[\text{Na}_3\text{AlF}_6]$, to the nearest whole number. [At. mass: Na = 23, Al = 27, F = 19]

3. Calculate the percentage composition of the water of crystallization in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

[Cu = 64, S = 32, O = 16, H = 1] — 2017

4. Find the total percentage of magnesium in magnesium nitrate crystals, $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

[Mg = 24, N = 14, O = 16 and H = 1] — 2012

5. Calculate the percentage of nitrogen and oxygen in ammonium nitrate.

(O = 16, H = 1, N = 14)

6. Calculate the percentage of nitrogen in aluminium nitride. (Al = 27, N = 14)

7. Calculate the percentage of platinum in ammonium chloroplatinate $(\text{NH}_4)_2\text{PtCl}_6$.

(Give your answer to the nearest whole number)

8. Calculate the percentage of phosphorus in fertilizer superphosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$.

(Correct to 2 decimal place) (H = 1, P = 31, O = 16, Ca = 40)

VII. PROBLEMS BASED ON AVOGADRO'S LAW:

1. (i) If 150 cc of gas 'A' contains X molecules, how many molecules of gas B will be present in 75 cc of 'B' under the same conditions of temperature and pressure?

(ii) Name the law on which the problem is based.

2. (i) If the number of the molecules of hydrogen in the cylinder is 'X', calculate the number of CO_2 molecules in the cylinder under the same conditions of temperature and pressure.

(ii) State the law that helped you to arrive at the above result.

3. A vessel contains 'X' number of molecules of hydrogen gas at a certain temperature and pressure. How many molecules of nitrogen gas would be present in the same vessel under the same conditions of temperature and pressure?

4. The volume of gases, 'A', 'B', 'C', and 'D' are in the ratio of 1:2:2:4 under the same conditions of temperature and pressure.

(i) Which sample of gas contains the maximum number of molecules?

(ii) If the temperature and the pressure of gas A are kept constant, then what will happen to the volume of A when the number of molecules is doubled?

(iii) If the ratio of gas volumes refers to the reactants and products of a reaction, which gas law is being observed?

(iv) If the volume of 'A' is 5.6 dm³ at S.T.P., calculate the number of molecules in the actual volume of 'D' at S.T.P. (Avogadro's number is 6×10^{23})

(v) Using your answer from (iv), state the mass of 'D' if the gas is dinitrogen oxide (N₂O).

(N = 14, O = 16)

5. The gases, hydrogen, oxygen, carbon dioxide, sulphur dioxide, and chlorine are arranged in order of their increasing relative molecular mass, given 8 g of each gas at S.T.P. Which gas will contain the least number of molecules and which gas is the most?

VIII. PROBLEMS BASED ON EQUATION:

1. Calcium carbonate reacts with dilute hydrochloric acid as given below:



(i) What is the mass of 5 moles of calcium carbonate? (RMM of CaCO₃ = 100)

(ii) How many moles of HCl will react with 5 moles of calcium carbonate?

(iii) What is the volume of carbon dioxide liberated at the S.T.P. at the same time?

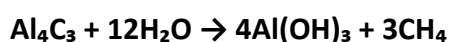
2. Copper sulphate solution reacts with sodium hydroxide solution to form a precipitate of copper hydroxide according to the equation: $2\text{NaOH} + \text{CuSO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{Cu}(\text{OH})_2 \downarrow$

(i) What mass of copper hydroxide is precipitated by using 200 g of sodium hydroxide?

[H = 1, O = 16, Na = 23, S = 32, Cu = 64]

(ii) What is the colour of the precipitate formed?

3. Aluminium carbide reacts with water according to the following equation:

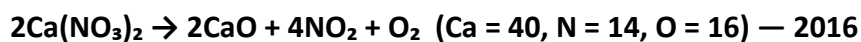


(i) What mass of aluminium hydroxide is formed from 12 g of aluminium carbide?

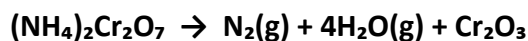
(ii) What volume of methane at S.T.P. is obtained from 12 g of aluminium carbide?

[Relative molecular weight of Al₄C₃ = 144; Al(OH)₃ = 78]

4. How much calcium oxide is formed when 82 g of calcium nitrate is heated? Also, find the volume of nitrogen dioxide evolved:



5. Consider the following reaction and based on the reaction the questions that follow:



- (i) the quantity in moles of $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ if 63 g of $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ is heated.
- (ii) the quantity in moles of N_2 formed.
- (iii) the volume in litres of N_2 evolved at S.T.P.
- (iv) the mass of Cr_2O_3 formed at the same time.

[H=1, Cr=52, N=14, O=16]

SOLUTION

II. PROBLEMS BASED ON GAY LUSSAC'S LAW:

- 01. 120 cc. of nitrogen and 120 cc of oxygen
- 02. Composition: 160 ml. CO_2 + 20 ml. unused O_2
- 03. $\text{CO}=750$ ml., $\text{O}_2=375$ ml.
- 04. 1. 600 cc. 2. 200 cc.
- 05. 40 cm^3
- 06. 125 cm^3
- 07. 2 liters of H_2
- 08. 4.2 dm^3

III. PROBLEMS BASED ON VAPOUR DENSITY AND MOLECULAR WEIGHT

- 01. 56 litres
- 02. 48 gm.
- 03. 35.84 gm.
- 04. 33.6 litres
- 05. 48 gm.
- 06. 112 gm.

IV .PROBLEMS BASED ON AVOGADRO'S NUMBER

01. (i) moles=1.82, volume=40.32 liters.
(ii) moles=0.1, molecules= 6.023×10^{22}
02. moles=4
03. (i) moles=0.375
(ii) 0.2gm.
04. (i) moles=500
(ii) Weight=22000 g.
05. Gram atoms=0.2, atoms= $0.2 \times 6.023 \times 10^{23}$
06. (i) Mass=640g.
(ii) Volume=448 liters
07. 4 gm.
08. (i) Volume=89.6 liters
(ii) molecules= $4 \times 6.023 \times 10^{23}$
09. Volume=0.224 liters
10. (i) Mass=0.53 gm.
(ii) Mass=4.4 g.
11. Volume=112 liters
12. (i) $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
(ii) Mass=450 g.
(iii) Volume=100.8 liters
(iv) mass=499.5 g.
(v) 9 moles.
13. (i) mass=1120 g.
(ii) volume=896 liters
14. (i) 8 moles of CO_2 .
(ii) volume=179.2 liters
(iii) mass=704 g.

V. PROBLEMS BASED ON EMPIRICAL AND MOLECULAR FORMULA:

01. $C_2H_2Cl_4$
02. C_4H_9
03. C_5H_5N
04. NH_3
05. X_2Y_4
06. C_4H_{10}
07. C_2H_2
08. X_4Y_2
09. C_2H_4Br
10. N_2H_4
11. (i) $CHCl_2$
(ii) $C_2H_2Cl_4$
(iii) addition reaction

VI. PROBLEMS BASED ON PERCENTAGE COMPOSITION

01. 26.5%
02. (i) F=54%
(ii) Na=33%
03. 36%
04. 9.375%
05. N=35% O=60%
06. 60%
07. 34.14%
08. 44%

VII. PROBLEMS BASED ON AVOGADRO'S LAW:

01. (i) $X/2$ molecules,

(ii) Avogadro's law

02. (i) X

(ii) Avogadro's law: Under the same conditions of temperature and pressure, equal volumes of all gases contain the same number of molecules.

03. X

04. (i) D

(ii) Volume will be doubled

(iii) Gay Lussac's law.

(iv) 5.6 dm^3 moles (A)=0.25 moles (D)=1 molecules= 6×10^{23}

(v) Mass of D = 44 gm.

05. Chlorine has the least molecules and hydrogen has the higher number of molecules.

(d) PROBLEMS BASED ON PERCENTAGE COMPOSITION

- 01. 26.5%
- 02. * (i) F=54%
 - (ii) Na=33%
- 03. 36%
- 04. 9.375%
- 05. N=35% O=60%
- 06. 60%
- 07. 34.14%
- 08. 44%

(e) PROBLEMS BASED ON EMPIRICAL AND MOLECULAR FORMULA:

- 01. $\text{C}_2\text{H}_2\text{Cl}_4$
- 02. C_4H_9

- 03. C₅H₅N
- 04. NH₃
- 05. X₂Y₄
- 06. C₄H₁₀
- 07. C₂H₂
- 08. X₄Y₂
- 09. C₂H₄Br
- 10. N₂H₄
- 11. * (i) CHCl₂
 - (ii) C₂H₂Cl₄
 - (iii) addition reaction

VIII. PROBLEMS BASED ON EQUATIONS:

01. (i) 500 gm.
 (ii) 10 moles
 (iii) 112 litres
02. (i) 245 gm.
 (ii) Blue ppt.
03. (i) 26 gm.
 (ii) 5.6 litres
04. (i) 28 gm.
 (ii) 22.4 litres
05. (i) 0.25
 (ii) 0.25
 (iii) 5.6 litres
 (iv) 38 gm.