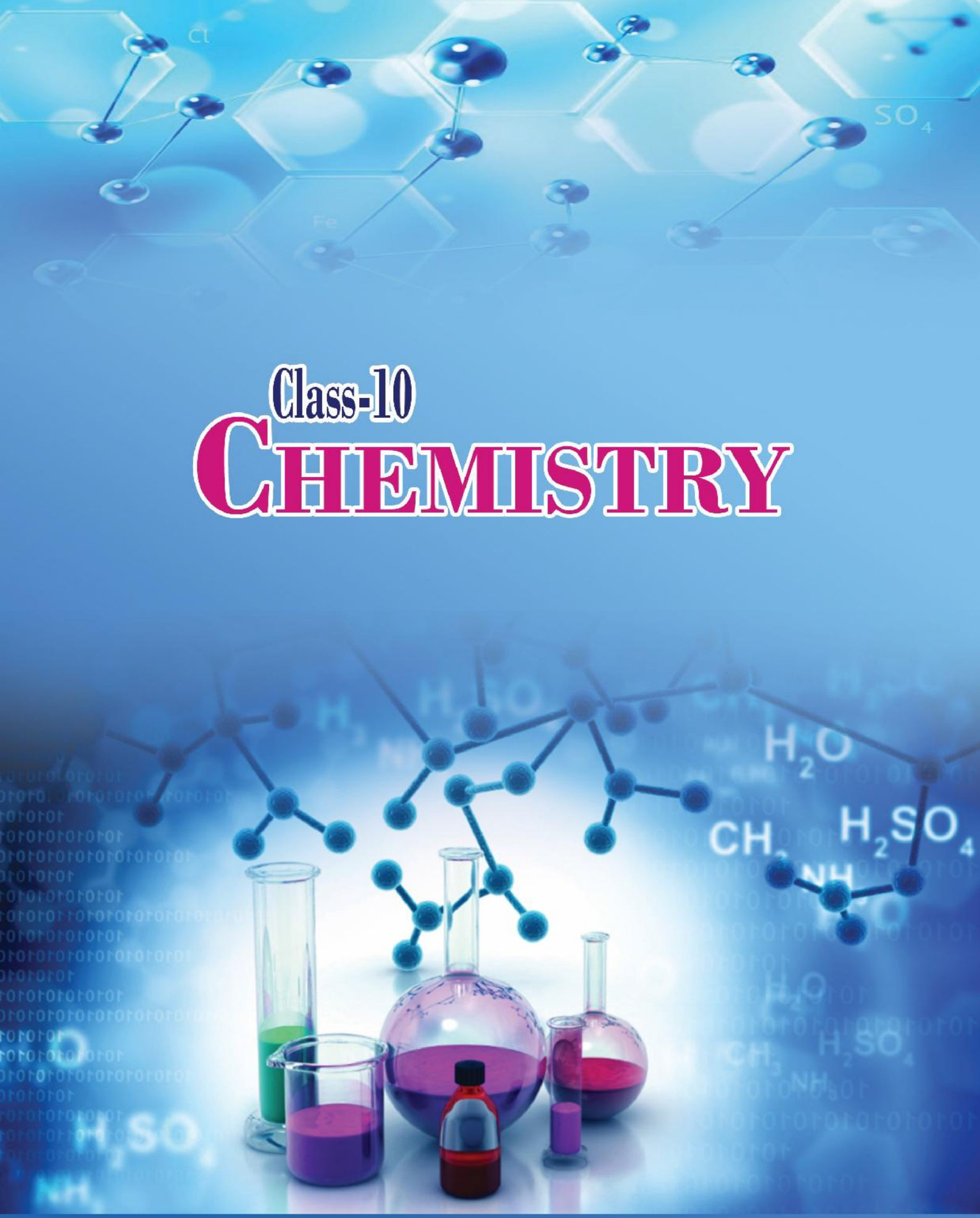
Class-10

CHEMISTRY



GENERAL EDUCATION DEPARTMENT

SAMAGRA SHIKSHA, KERALA

UNIT - 1

PERIODIC TABLE AND ELECTRONIC CONFIGURATION

FOCUS AREA

1. Shells and Sub shells.
2. The number of electrons in sub shells.
3. Filling of electrons in sub shells.
4. Peculiarity of the electronic configuration of Chromium (Cr) and Copper (Cu)
5. Sub shell electronic configuration and blocks.
6. The period and the group can be found out the basis of sub shell electronic configuration.
7. The group number of s block elements.
8. p block elements.
9. d block elements.
10. Characteristics of d block elements.

I Shells and Sub shells

Points to remember

- In an atom there are main energy level called shells and sub energy levels called sub shells.
- The number of sub shells in each energy level is equal to its shell number.

Shells	K	L	M	N
Shell Number (n)	1	2	3	4
Sub shells	s	s, p	s, p, d	s,p, d, f
Representation of Sub shells	1s	2s, 2p	3s, 3p, 3d	3s, 3p, 3d, 3f
Maximum number of electrons that can be accommodated in each Sub shell	2	2, 6	2, 6, 10	2, 6, 10, 14
Maximum number of electrons that can be accommodated in each Shell	2	8	18	32

Questions to Practice

1 Give the name of sub shell present in all shells.
2 Choose the correct representation of P sub shells in M shell.
(2p, 3p, 4p)
3 Maximum number of electrons accommodated in L shell is ----------
4 What are the sub shells in N shell?
5 How many sub shells are present in M shell?
(1, 2, 3, 4)

II The number of electrons in sub shells.

Points to remember

• s sub shells can accommodate 1 to 2 electrons
• p sub shells can accommodate 1 to 6 electrons
• d sub shells can accommodate 1 to 10 electrons
• f sub shells can accommodate 1 to 14 electrons

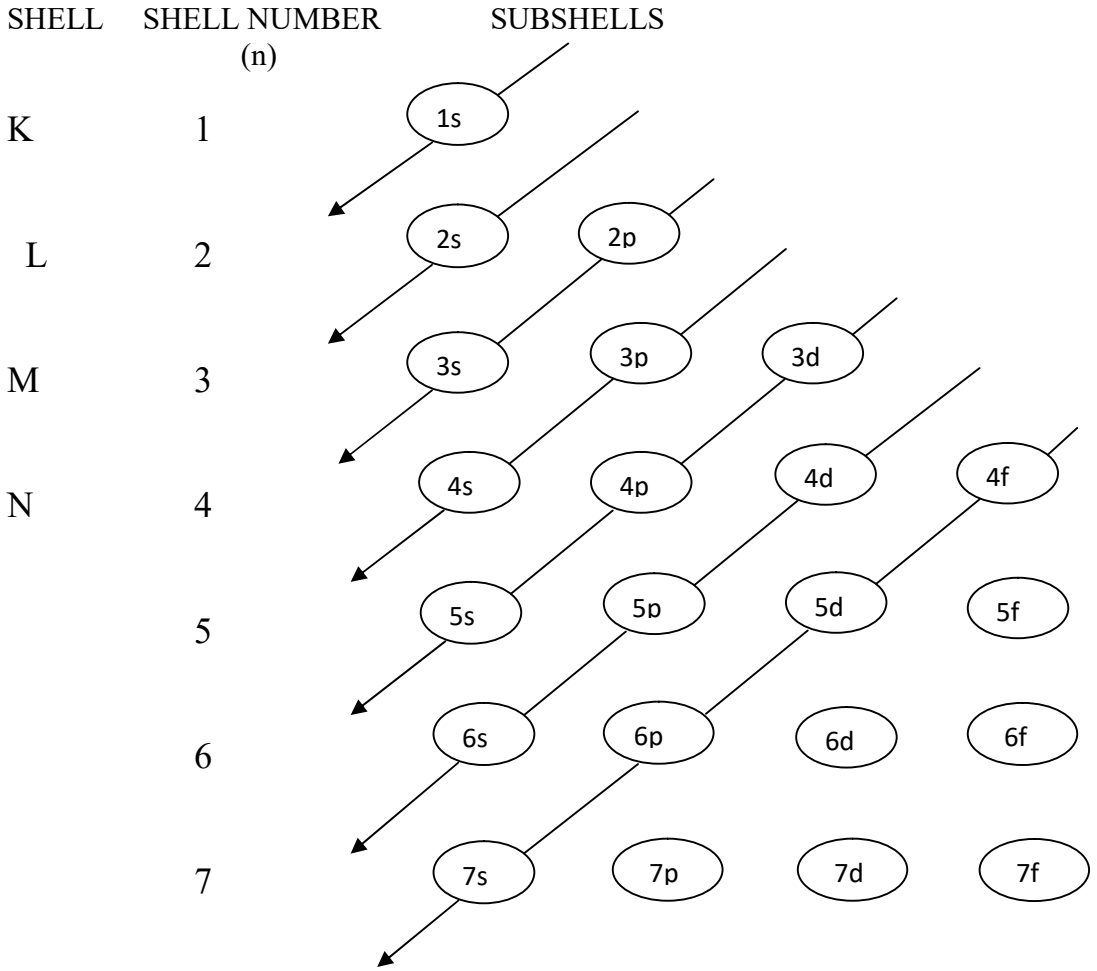
Questions to Practice

1. ***Complete the Table***

Sub shell	s	p	d	f
Maximum number of electrons accommodated in each sub shell	----------	----------	----------	----------

Filling of electrons in the sub shell

Points to remember



- 1s<2 s <2p<3s<3p<4s<3d<4p<5s<4d<5p<6s……
- 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s…….
- The electrons in an atom are distributed in the increasing order of the energies of sub shells. This is called sub shell electronic configuration.
- The maximum number of electrons accommodated in each sub shells s-2, p-6, d-10, f-14.

Example:

1. $_{3}Li$ $_{1}s^{2}$ $_{2}s^{1}$
2. $_{6}C$ $1s^{2}\ 2s^{2}\ 2p^{2}$
3. $_{8}O$ $1s^{2}\ 2s^{2}\ 2p^{4}$
4. $_{19}K$ $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{6}\ 4s^{1}$
5. $_{22}$ Ti

   Electron filling order

   $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{6}\ 4s^{2}\ 3d^{2}$

   Written as

   $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{6}\ 3d^{2}\ 4s^{2}$
6. $_{26}Fe$

   Electron filling order

   $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{6}\ 4s^{2}\ 3d^{6}$

   Written as

   $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{6}\ 3d^{6}\ 4s^{2}$

- While writing the sub shell electronic configuration of elements with higher atomic numbers, the symbol of the noble gas preceding that element may be shown with in square brackets followed by the electronic configuration of the remaining sub shells.

Example:

1 $_{18}$Ar $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

2 $_{10}$Ne $1s^2\ 2s^2\ 2p^6$

3 $_{19}$K $\underline{1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^{6)}}\ 4s^1$

[Ar]

4 $_{19}$K can written as [Ar] $4s^1$

5 $_{12}$Mg can written as $\underline{1s^2\ 2s^2\ 2p^6\ 3s^2}$

[Ne] $3s^2$

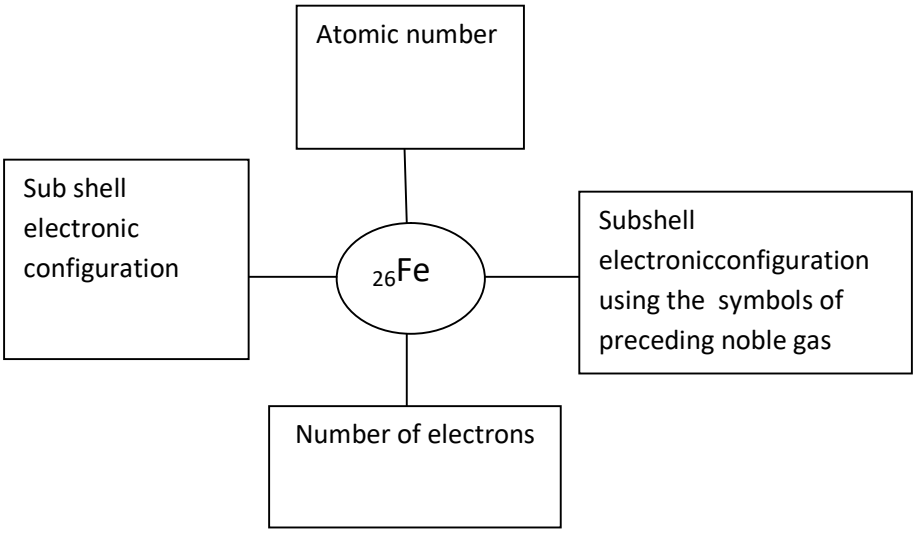
6 $_{12}$Mg can written as [Ne] $3s^2$

Questions to Practice

1. Complete the Table

Element	Atomic Number	Number of Electrons	Sub shell electronic configuration	Sub shell electronic configuration using the symbol of preceding noble gas
$_{11}$ Na	----------	11	$1s^2\ 2s^2\ 2p^6\ 3s^1$	----------
$_{12}$Mg	----------	----------	----------	----------
----------X	----------	----------	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$	----------
----------Y	----------	----------	----------	[Ar] $4s^1$
$_{20}$ Ca	----------	----------	----------	[Ar] $4s^2$
$_{21}$ Sc	----------	21	----------	----------
$_{27}$ Co	27	----------	----------	----------
$_{23}$V	----------	----------	----------	----------

2.



3 Among 1s and 2s which sub shell has less energy?

4 Arrange the given sub shells

[3s, 3p, 3d, 4s, 4p] in to increasing order of energy.

5 From the given sub shells

[2s, 2d, 3f, 4d, 3p, 1p] which are not possible.

6 Pick out the wrong sub shell electronic configuration from those given below.

(a) $1s^2\ 2s^2\ 2p^7$ (b) $1s^2\ 2s^2\ 2p^4$ (c) $1s^2\ 2s^2\ 2p^5\ 3s^2$

(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^1$ (e) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$

7 The sub shell electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$. On the basis of this answer the questions below.

(a) Number of shells in the element.

(b) Name the sub shells in each shell

(c) Atomic Number

(d) Number of electrons

(e) Write the sub shell electronic configuration using the name of the preceding noble gas.

IV Peculiarity of the electronic configuration of Chromium (Cr) and Copper (Cu)

Questions to Practice

1 Identify the correct sub shell electronic configuration of $_{24}$ Cr from those given below. Justify your answer.
(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$
(b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

Ans. (b). $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

Reason : half filled d sub shells are more stable.

2 Write the correct sub shell electronic configuration of $_{29}$ Cu and explain the reason.

Ans. (Ar). $3d^{10}\ 4s^1$

Reason : Completely filled d sub shells are more stable.

V **<u>Sub shell electronic configuration and blocks points to remember</u>**

- Block of elements.
  = The sub shell to which the last electron is entered
- Half filled d sub shells are more stable.
- Completely filled d subsheel are more stable.

Example

(1) $_{11}$Na $1s^2 2s^2 2p^6\ 3(S)^1$ Block - s

(2) $_{7}$N $1s^2 2s^2 2(p)^3$ Block -p

(3) $_{21}$Sc $1s^2 2s^2 2p^6\ 3s^2 3P^6\ \ 3(d)^1 4s^2$ Block - d

(4) $_{29}$Cu $1s^2 2s^2 2p^6\ 3s^2 3P^6\ \ 3(d)^{10}\ 4s^1$ Block - d

Questions to practice

1. Complete the table

Element	Electronic Configuration	Block
$_{12}Mg$		
$_{1}H$		
$_{19}K$		
$_{8}O$		
$_{17}C1$		
$_{24}Cr$		
$_{26}Fe$		

2. The outermost sub shell electronic configuration of an element X (symbol is not real)is $3s^2\ 3p^2$.Write the complete subshell electronic configuration of X and find out number of electrons and block.

VI The period and the group can be found out on the basis of sub shell electronic Configuration.

Period Number – Highest shell Number

Electronic configuration	Period Number
$1s^2\ 2s^2\ 2p^6\ 3s^2$	3
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	4
$1s^2\ 2s^2$	2
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$	.....

Group Number

I. s block elements → No of electrons in the last s sub shell
II. p block elements → No of electrons in the last p sub shell +12
III. d block elements → No of electrons in the last s sub shell + No. of electrons in the inner d sub shell.

Elements	Electronic Configuration	Block	Group No.	Period
$_{11}$ Na	$1s^2\ 2s^2\ 2p^6\ 3s^2$	s	1	3
$_{13}$ Al	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$	p	1+12=13	3
$_{26}$ Fe	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$	d	2+6=8	4

Questions to Practice

1. Complete the table

Element	Subshell electronic Configuration	Period	Block	Group
$_{29}$Cu	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$	4	d	1+10=11
$_{19}$ K				
$_{12}$Mg				
$_{20}$ Ca				
$_{7}$N		2	P	3 +12 =15
$_{8}$O				
$_{9}$F				
$_{15}$P				
$_{21}$SC	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$			
$_{23}$ V				
$_{24}$Cr	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$			
$_{26}$ Fe				
$_{30}$zn				

2. The outermost sub shell electronic configuration of an element is $3s^2 3p^6$.Answer the question given below .

   (a) Complete sub shell electronic configuration

   (b) Atomic number

   (c) Number of electrons

   (d) Group number, Period number and block.

3. Group number of an element X is 17. It has 3 shells. Write the complete sub shell electronic configuration of the element X.

4. Sub shell electronic configuration of some elements are given below.

Based on this, answer the following questions.

(a) $1s^2\ 2s^2$ (b) $1s^2\ 2s^2\ 2p^4\ 3s^2\ 3p^6$ (c) $1s^2\ 2s^2\ 2p^5$

(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ (e) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$

(1) Write the sub shell electronic configuration of most stable element.

(2) s block elements

(3) Find the group number of element C

(4) Period of element E

(5) d block element

(6) Element which show valency -1

5.Complete the table

Element	Outermost sub shell Electronic configuration	Complete sub shell electronic configuration	Atomic Number	Period number	Block	Group Number
X	$3s^2$					
Y	$3s^2\ 3p^5$					
Z	$3d^3\ 4s^2$					

The group number of 'S' block elements.

Points to remember

- For 'S' block elements the number of electrons in the outermost 'S' subshell will be the group number.

a) $1s^1$ ---------- Group number 1

Outermost subshell electronic configuration

b) $4s^2$ ---------- Group number 2

Outermost subshell electronic configuration

Questions to practice

1. Write the subshell electronic configuration of $_{12}Mg$ and find out the group number ?

2. Subshell electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$. Find out the group number of this element?

3. The subshell electronic configuration of an element is $1s^2 2s^2$. Write the subshell electronic configuration of element just below the same group in the periodic table.

Points to remember

Element	Electronic Configuration	Group number
$_{1}H$	$1s^1$	1
$_{3}Li$	$Is^2\ 2s^1$	1
$_{11}Na$	$1s^2\ 2s^2 2p^6\ 3s^1$	1
$_{19}K$	$1s^2\ 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^1$	1
$_{4}Be$	$1s^2\ 2s^2$	2
$_{12}Mg$	$1s^2\ 2s^2 2p^6\ 3s^2$	2
$_{20}Ca$	$1s^2\ 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^2$	2

4. Subshell electronic configuration of some elements are given below.
   1) Find out the subshell electronic configuration of elements just below the element having subshell electronic configuration $1s^2\ 2s^2 2p^6\ 3s^1$
      a) $1s^2\ 2s^1$
      b) $1s^2\ 2s^2 2p^6\ 3s^2$
      c) $1s^2\ 2s^2 2p^6\ 3s^2\ 3p^6 3d^5\ 4s^1$
      d) $1s^2\ 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^1$
   2) Find the group number of these two elements

VIII p block elements

Points to remember

- 13 to 18 group elements are present in p Block
- 1 to 6 electrons are present in p subshell
- Elements in the solid, liquid and gaseous state at room temperature are included in this block
- In p block elements , less reactive elements(more stable elements) are present in the 18 th group (Noble gases)
- Elements with Positive and negative oxidation state are present in p block
- P block elements usually show higher ionization energy than the s block elements.
- In p block elements, the highly reactive elements are

present in 17 th group elements
Eg: Most reactive element in 17 th group is fluorine

- 13 th Group-Boron family ($2s^2\ 2p^1$)
  14 th Group – Carbon family($2s^2\ 2p^2$)
  15 th Group –Nitrogen family ($2s^2\ 2p^3$)
  16 th Group - Oxygen family ($2s^2\ 2p^4$)
  17 th Group - Halogen Family ($2s^2\ 2p^5$)
  18 th Group – Noble gases ($2s^2\ 2p^6$)
  (Rare gases)

Questions to practice

1 In p block, which group contains the elements having highest ionisation energy ?

(13 th group, 17 th group,18th group)

2 Name the element having the highest electronegativity in the p block

3 Find the block in which 17th group elements are presents (s,p,d,f)

4 From the given statements, which one is not the characteristic properties of p block elements
- Exist in solid, liquid and gaseous state
- Metals, Non metals, Metalloids and noble gases are presents
- Form coloured compounds
- They show +ve and –ve oxidation state

5 The outer most subshell electronic configuration of an element X is $3s^23p^2$
a) Find the group, period and block of the element 'X'
b) Write the outermost subshell electronic configuration of element Y which is present in the same group and just below the element 'X'.

IX d block elements

Points to remember

- Groups 3 to 12 belongs to 'd' block elements of periodic table
- From 4th period onwards the 'd' block elements beigns.
- 'd' block elements are called transition elements
- The last electron is filled in the penultimate shell
- The group number of the 'd' block elements will be the same as the sum of electron in the outer most ' s' subshell and inner 'd' sub shell

example

Elements	Outermost subshell electronic configuration	Group number
$_{21}Sc$	$3d^1 4s^2$	3
$_{24}Cr$	$3d^5 4s^1$	6
$_{26}Fe$	$3d^6 4s^2$	8

Questions to Practice

1 Find the block in which transition elements are present (s,p,d,f)
2 Find the group in which 'd' block elements are present (2^{nd} group, 15 thgroup, 10 th group)
3 From which period onwards does the 'd' block begin? (1^{st} period, 3^{rd} period, 4^{th} period)

X characteristic of 'd' block elements

Points to remember

- 'd' block elements are called transition elements
- They show different oxidation state
- They form coloured compounds
- The last electron is filled in the penultimate shell
- They show similarities in properties not only in group but also in period
- Most of them are metals

Questions to practice

1. 'd' block elements or transition elements show similarities in properties not only in group but also in periods. Why ?
   Answer: the outermost subshell electronic configuration of the transition elements are generally the same in a group and also along a period . Therefore they show similarities in properties not only in groups but also in periods

2. Complete the table

Element/compound	Oxidation state of Fe	Subshell electronic configuration of Fe and Fe ions
Fe	0	$_{26}Fe$- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
$FeCl_2$	+2	$_{26}Fe^{2+}$-$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$
$FeCl_3$	--------	--------Fe^{3+} ----------

3. **Fe show different oxidation state in $FeCl_2$and $FeCl_3$ why?**

OR

Transition elements or 'd' block elements show different oxidation states . why?

Answer: There is only a small difference of energy between the outermost 's' subshell and the penultimate 'd' subshell of transition elements. Hence under suitable conditions the electron in 'd' subshell also take part in chemical reactions along with s electrons. Hence transition elements show variable oxidation states.

4. The subshell electronic configuration of Mn-25 is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$. Based on this complete the following table

Compound	Oxidation state of Mn	Subshell electronic configuration of Mn ion
$MnCl_2$	----------	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
MnO_2	+4	----------
Mn_2O_3	----------	----------
Mn_2O_7	----------	----------

Points to remember

- Most of the coloured salts are compounds of transition elements.
- The colour is due to the presence of transition metals ions present in these compounds.

5. $CuSO_4$ is blue in colour. Why?

Unit -2

Gas Laws and Mole Concept

Focus Area Relation between Volume and Pressure

Boyle's Law

At a constant temperature, volume of a definite mass of gas is inversely proportional to its pressure. If P is the pressure and V the volume, then P x V is a constant.

Activity -1

Examine the data given in the table (Temperature and number of molecules of the gas are kept constant).

Pressure (P)	Volume (V)
1 atm	8 L
2 atm	4 L
4 atm	2 L

a) Calculate P x V.

b) Which is the gas law related to this?

a)

Pressure (P)	Volume (V)	P x V
1 atm	8 L	1 x 8 = 8
2 atm	4 L	2 x 4 = 8
4 atm	2 L	... x ... =....

b) **Boyle's Law**

Activity - 2

a) The size of the air bubbles rising from the bottom of an aquarium increases , Can you explain the reason .

Pressure decreases from bottom to top of an aquarium . Presuure and volume are inversiley proportional . It is boyle's law

II. Focus Area

Relation between Volume and Temperature

Charle's Law

At constant pressure, the volume of a definite mass of a gas is directly proportional to the temperature in Kelvin Scale. If V is volume and T the temperature, Then $\frac{V}{T}$ *will be a constant.*

Activity

Volume V	Temperature T (In Kelvin scale)	$\frac{V}{T}$
546mL	273 K	$\frac{546}{273}=2$
600mL	300 K	$\frac{600}{300}=2$
640mL	320 K	$\frac{640}{320}=2$
660mL	330 K	.....

III. Focus Area

Gram Atomic Mass

The mass of an element in grams equal to its atomic mass is called 1 Gram Atomic Mass (1 GAM) of the element. This may also be shortened as 1 Gram Atom.

Element	Atomic mass	Mass in grams	GAM	No. of atoms
Carbon	12	12g	1GAM	6.022×10^{23}
Oxygen	16	16g	1GAM	6.022×10^{23}
Nitrogen	14	...	1GAM	.....
Chlorium	35.5	...	...	6.022×10^{23}

1 Gram Atomic mass of any element contains 6.022×10^{23} atoms. The number is known as Avogadro Number. it is represented by N_A

Activity 1

No.of GAM in a means 23 g sodium. This contains 6.022×10^{23} atoms. If so, how many GAM will be there in 46 g sodium? What about the number of atoms in it?

46 g sodium = $\frac{46}{23}$ = 2 GAM

No.of atoms present in 46g of sodium

am Atomic mass = $\frac{\text{Given mass in grams}}{\text{GAM of the element}}$

It contains $2 \times 6.022 \times 10^{23}$ atoms

Activity 2

Calculate the number of atoms present in each of the sample?
(Atomic mass N = 14 O = 16)

1. 42 g Nitrogen
2. 80 g Oxygen

GAM of Nitrogen atom = 14g , GAM of Oxygen = 16 g

Number of GAM of nitrogen = 42 / 14 = 3

Number of nitrogen atom = 3 x 6.022 x 10^{23} atoms

Number of GAM of oxygen = 80 /16 = 5

Number of oxygen atom = 5x 6.022 x 10^{23} atoms

IV. Focus Area

One mole atom

We know that 1 gram hydrogen means 1 GAM hydrogen and it contains 6.022x10^{23} atoms. This is known as one mole of hydrogen atoms.

12g C = 1GAM Carbon = 6.022 x10^{23} carbon atoms = 1 mole carbon atom

14g N = 1 GAM Nitrogen = 6.022x10^{23} nitrogen atoms = 1 mole nitrogen atom

1 mole of atom means 6.022x10^{23} atoms

Activity- 1

Find the number of moles of oxygen atoms present in 640 g oxygen

1GAM of oxygen = 16 g = 6.022×10^{23} atoms = 1 mole

$$\text{No. of Gram Atomic mass} = \frac{\text{Given mass in grams}}{\text{GAM of the element}}$$

Number of GAM = 640 / 16 =40

Number of moles = 40

Number of atoms = 40 x 6.022 x 10^{23} atoms

Activity- 2

Find the number of moles of hydrogen atoms present in 10 g hydrogen

1GAM of hydrogen = 1g = 6.022×10^{23} atoms = 1 mole

Number of GAM = 10 / 1 =10

Number of moles = 10

Number of atoms = 10 x 6.022 x 10^{23} atoms

Activity - 3

Find the number of moles of nitrogen atoms present in 140 g nitrogen

1GAM of nitrogen = 14g = 6.022×10^{23} atoms = 1 mole

Number of GAM = 140 / 14 =10 GAM

Number of moles = 10 GAM

Number of atoms = $10 \times 6.022 \times 10^{23}$ atoms

Activity - 4

Find the mass of 4 mole nitrogen atom

$$\text{Number of mole} = \frac{\text{Given mass in grams}}{\text{GAM of the element}}$$

Mass = Number of moles x GAM of the element

1GAM of nitrogen = 14g = 6.022×10^{23} atoms = 1 mole

Mass = 4x 14 =56 g

Activity - 5

Find the mass of 10 mole oxygen atom

V. Focus Area

Molecular mass and Gram molecular mass

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

Element / Compound	Chemical formula	Molecular mass
Hydrogen	H_2	
Oxygen	O_2	
Nitrogen	N_2	
Water	H_2O	
Ammonia	NH_3	

H_2	**1 x 2 = 2**
O_2	16 x 2 = 32
N_2	14 x 2 = 28
H_2O	1 x2+ 16 x 1 = 18
NH_3	14 x 1 + 1 x 3 =17

Activity - 1

Calculate the molecular mass of glucose ($C_6H_{12}O_6$) and sulphuric acid (H_2SO_4) (Atomic mass C = 12, H = 1, O = 16, S = 32).

$C_6H_{22}O_6$ - 12 x 6 + 1 x 12 + 16 x 6 = 72 + 12 + 96 = 180

H_2SO_4 - 1 x 2 +32 x1 + 16 x 4 = 2 + 32 + 64 = 98

VI. Focus Area

Number of Molecules

Element/ Compound	Molecular Mass	Mass in grams	GMM	No. of molecules
Hydrogen H_2	2	2g	1GMM	6.022×10^{23} H_2 molecules
Oxygen O_2	32	32g	1GMM	6.022×10^{23} O_2 molecules
Nitrogen N_2	28	28g	.....	.....
Water H_2O	18	18g	1GMM	6.022×10^{23} H_2O molecules
Ammonia NH_3	17	17g	.....	.....

- The amount of a substance in grams equal to its molecular mass is called Gram Molecular Mass.
- One gram molecular mass of any substance contains Avagadro number of molecules.

One GMM oxygen is 32g Oxygen, isn't it? This contains 6.022×10^{23} oxygen molecules. How many GMM are there in 64g oxygen? How many molecules are present in it?

$$64 \text{ g } O_2 = \frac{64}{32} = 2 \text{ GMM}$$

This contains $2 \times 6.022 \times 10^{23}$ molecules.

Activity - 1

How many GMM are present in each of the given samples?

Calculate the number of molecules present in each sample?

1. 360 g glucose (Molecular mass = 180)
2. 90 g water (Molecular mass = 18)

$$\text{No. of Gram Molecular Mass} = \frac{\text{Given mass in grams}}{\text{Grams Molecular Mass (GMM)}}$$

1) **No. of GMM**
in 360 g of glucose = 360 /180 = 2

Number of molecules = 2 x 6.022 x 10^{23} molecules

2) **No. of GMM**
in 90 g of water = 90 / 18 = 4

Number of molecules = 4x 6.022 x 10^{23} molecules

6.022×10^{23} molecules are called one mole molecule.

1 GMM = 1 Mole = 6.022×10^{23} molecules.

Activity- 2

Find the mass of 4 mole N_2 molecules (GMM= 28)

Number of mole = Given mass in grams / GMM

Mass = Number of moles x GMM

= 4 x 28 = 112 g

Find the mass of 4 mole CO_2 molecules (C-12, O-16)

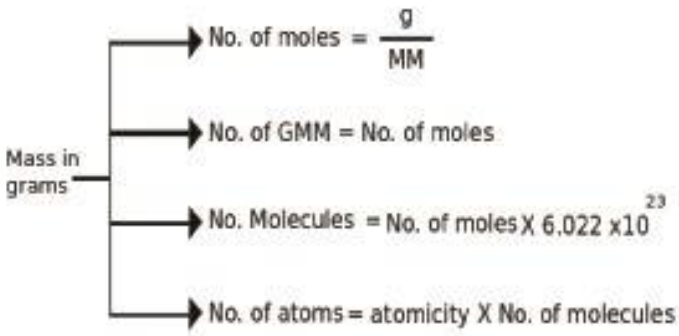
GMM of CO_2 = 1 x 12 + 2x 16 =12 +32 = 44g

Mass = Number of moles x GMM

= 4 x 44 = 176 g

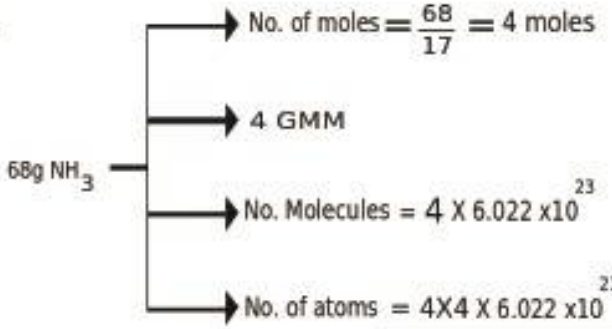
Tips for Mole Concept

I.



1. You are given 68g of NH_3. Find out the following.
   (a) No of GMM (b) No of mole (c) No of molecules

Ans.



Molecular mass of NH_3
N - 1 x 14 = 14
H - 3 x 1 = 3
MM of NH_3 = 17

Atomicity of NH_3 = Sum of atoms = 1+3 = 4

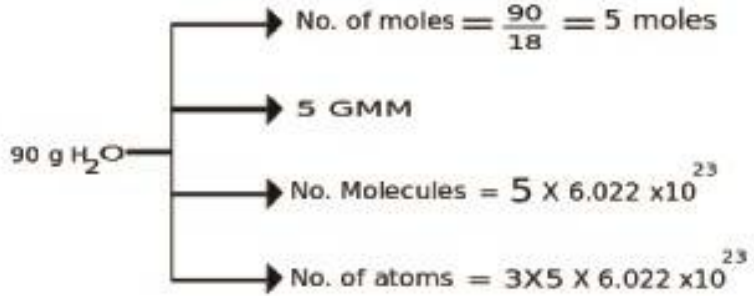
II. No of moles ⟶ Mass

Mass = No of moles X Molecular mass

2. Find out the mass of 2 mole NH_3
   Mass = No of moles x Molecular mass

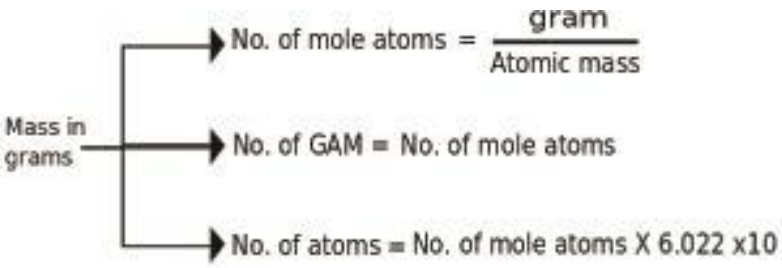
   Mass of 2 mole NH3 = 2 x 17 = 34 gram

3. Find out the following in 90 g water.
   Number of moles, Number of GMM, Number of molecules, Number of atoms



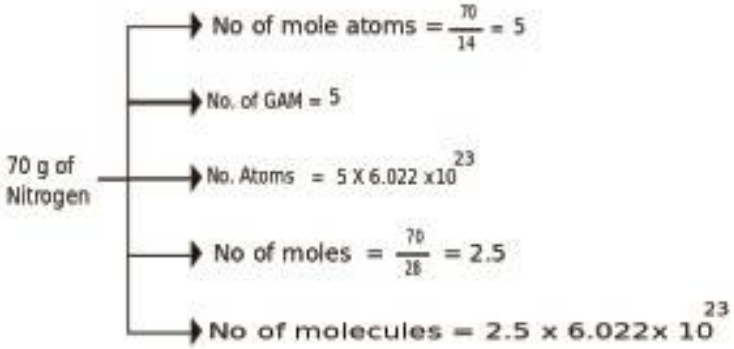
Molecular mass of H_2O
H - 2 x 1 = 2
O - 1 x 16 = 16
MM of H_2O 18

III.



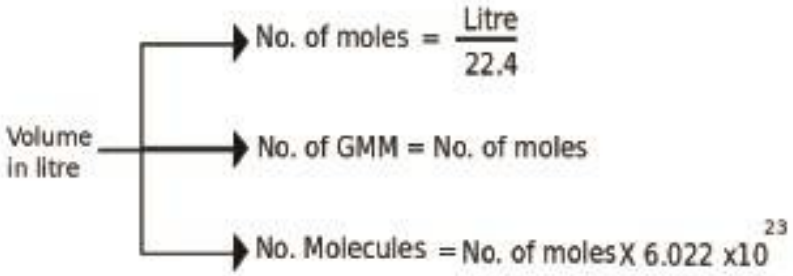
4. Find out the following in 70 g of Nitrogen

No of mole atoms, No of GAM, No of atoms, No of moles , No of molecules



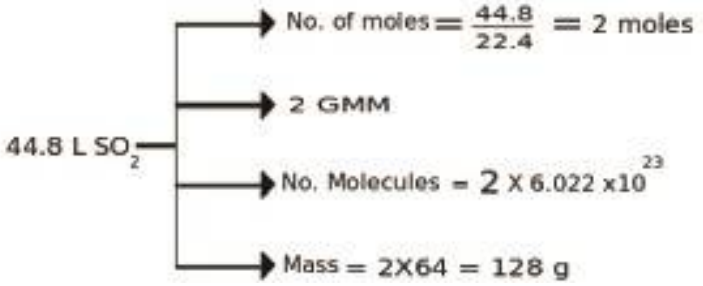
Nitrogen
Atomic mass = 14
Molecular mass = 28

IV



5. Find out the following in 44.8 litre of SO_2 at STP

No of moles, No of GMM, No of molecules, Mass



Molecular mass of SO_2
S - 1 x 32 = 32
O - 2 x 16 = 32
MM of SO_2 = 64

Unit – 3

Reactivity series and Electrochemistry

Focus Area

(I) Reactivity series and displacement reaction

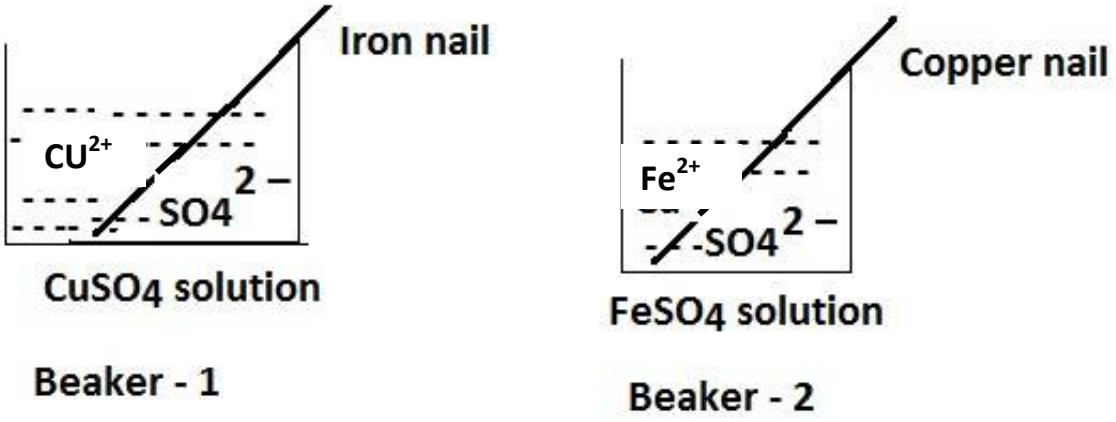
(II) Galvanic cell

(III) Electrolytic cell

(IV) Electrolysis of molten sodium chloride

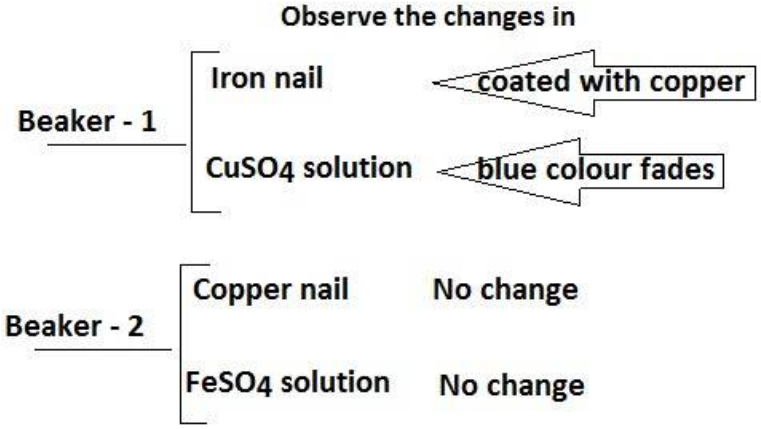
1. Reactivity series and displacement reaction

Observe the diagram given below



CuSO4 solution contains Cu^{2+} & $SO4^{2-}$ ions

Cu^{2+} ions gains 2 electrons from Fe nail and get coated on it .



CuSO4 solution contains
Cu^{2+} & $SO4^{2-}$ ions
Cu^{2+} ion gains 2 electrons from Fe nail and get coated on it .

- $FeSO_4$ solution contains
- Fe^{2+} & $SO4^{2-}$ ions
- Fe^{2+} ions will not get electrons from Cu
- Cu is less reactive than Fe

- Fe is more reactive than Cu
- More reactive metal donate electrons to less reactive metal
- More reactive metal undergo oxidation
- Less reactive metal ion gains electrons
  Less reactive metal undergo reduction

Equations

Beaker – 1

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

Beaker – 2

$Cu + FeSO_4 \rightarrow$ No reaction

Write the oxidation and reduction reaction

$Fe \rightarrow Fe^{2+} + 2e^-$ (Oxidation)

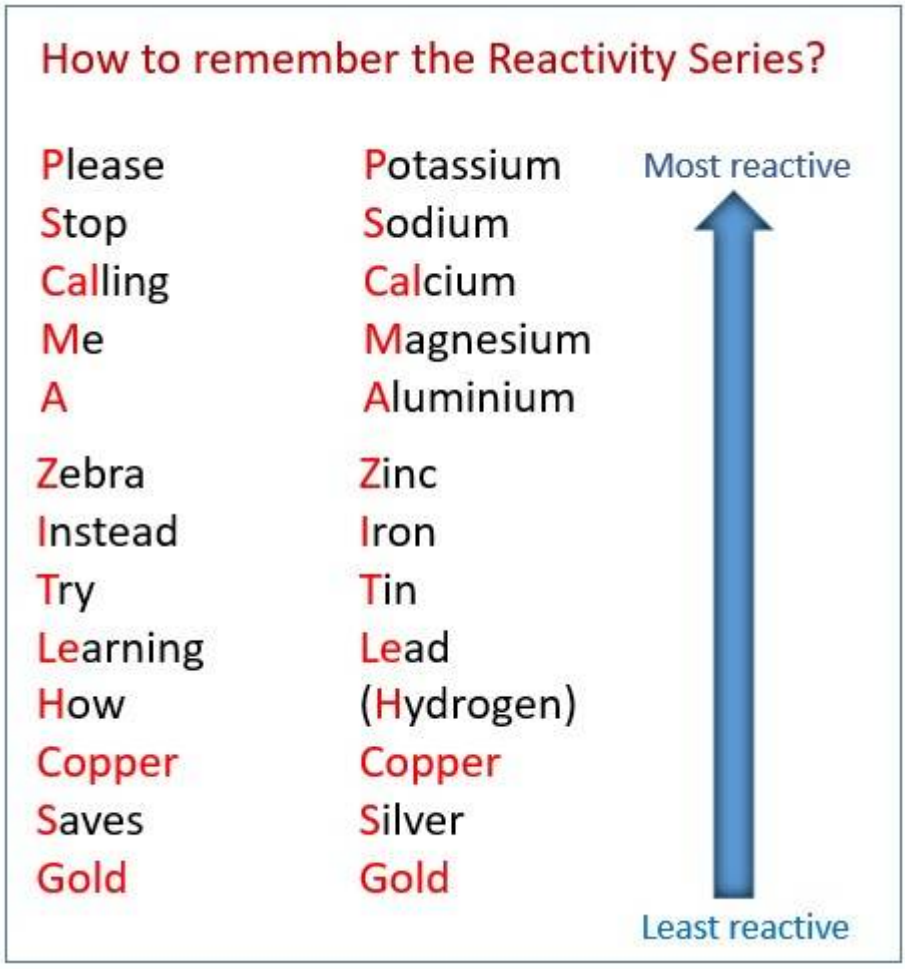
$Cu^{2+} + 2e^- \rightarrow Cu$ (Reduction)

Why does the colour of copper sulphate solution in Beaker – 1 fades?

Cu^{2+} ion gains two electrons from Fe and get coated on iron nail . Hence the concentration of Cu^{2+} ions decreases .

Reactivity series

Metals are arranged in the decreasing order of their reactivity.
This series is known as reactivity series .



Q. Arrange the following elements in the increasing order of reactivity
Magnessium (Mg) , Copper (Cu) , Zinc (Zn) , Silver (Ag)

Ans:- Silver (Ag) < Copper (Cu) < Zinc (Zn) < Magnessium (Mg)

More reactive metal displaces less reactive metal from its salt solution . Such reactions are called displacement reactions.

Q. Which of the following reaction is not possible?

(i) $Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$

(ii) $2Ag + Cu(NO_3)_2 \rightarrow Cu + 2\ AgNO_3$

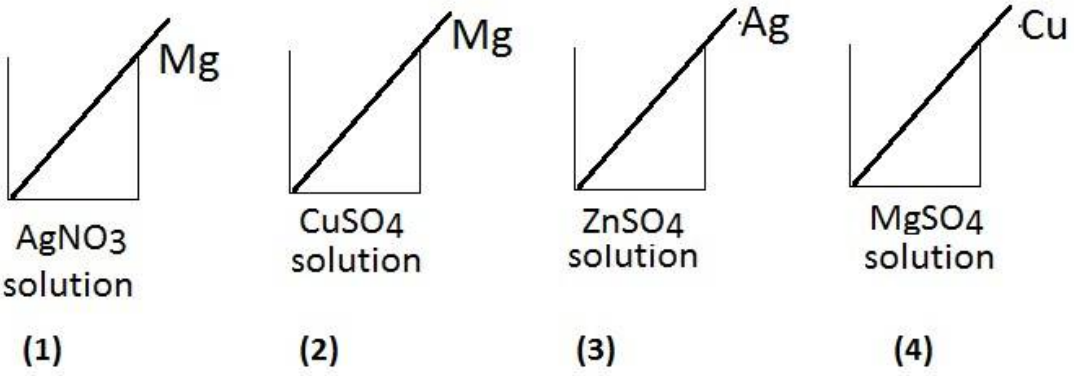
(iii) $Fe + 3AgNO_3 \rightarrow 3\ Ag + Fe(NO_3)_3$

(iv) $3Ag + Fe(NO_3)_3 \rightarrow Fe + 3\ AgNO_3$

Ans:- (ii) & (iv)

Reason (ii) Ag is less reactive than Cu . Ag cannot displace Cu from $Cu(NO_3)_2$ solution .

(iv) Ag is less reactive than Fe . Ag cannot displace Fe from $Fe(NO_3)_3$ solution .



Which among them undergo displacement reaction? Write the answer based on reactivity series

Ans:- In Beaker (1) and (2)

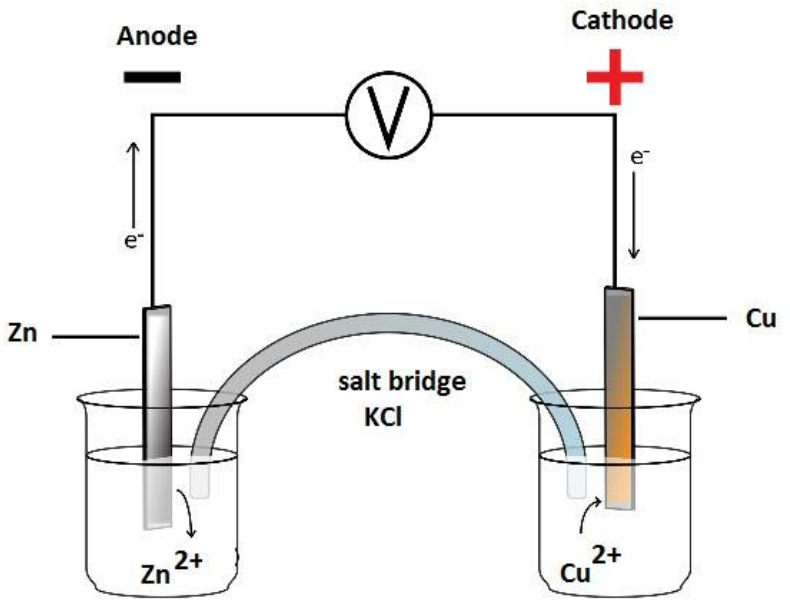
(1) Mg is more reactive than Ag

(2) Mg is more reactive than Cu

(II) Galvanic cell (Voltaic cell)

- Chemical energy → Electrical energy
- Make use of redox reaction
- Metal should be immersed in solution containing its own ions
- More reactive metal acts as anode

- Oxidation take place at anode (lose of electron)
  Anode carries negative charge
- Less reactive metal acts as cathode
- Reduction take place at cathode (gain of electron)
  Cathode carries positive charge
- Salt bridge – connect two solutions – helps current to flow continuously – make the solution electrically neutral .Filled with inert electrolyte KCl
- Electron flows from more reactive metal to less reactive metal.
  (Anode to Cathode)
- Current flows from less reactive metal to more reactive metal
  (Cathode to Anode)



Reaction at Anode :- $Zn \rightarrow Zn^{2+} + 2e^{-}$ (Oxidation)

Reaction at Cathode :- $Cu^{2+} + 2e^{-} \rightarrow Cu$ (Reduction)

Redox reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

Direction of electron flow :- From Zinc to Copper

Direction of current Flow :- From Copper to Zinc

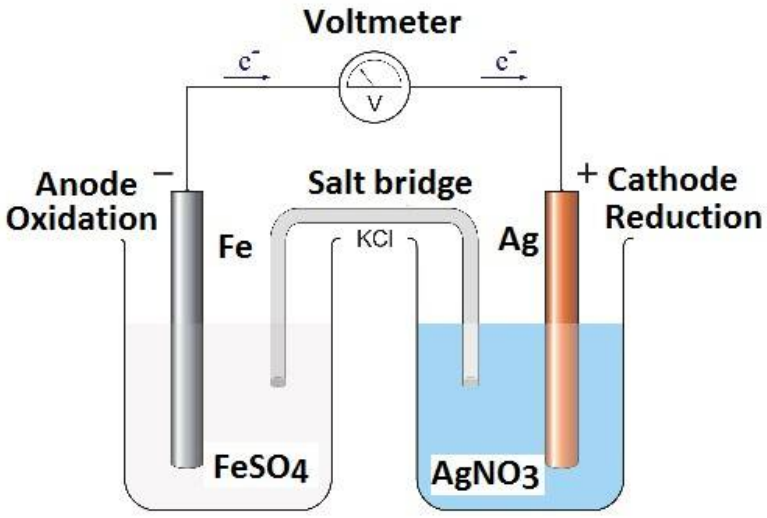
Q. Select suitable materials for making galvanic cells .Then complete the table

Fe rod , Ag rod , Mg rod , Cu rod $CuSO_4$, $FeSO_4$, $MgSO_4$,$AgNO_3$

No	Cell	Anode (Oxidation)	Cathode (Reduction)
1	Fe – Ag	Fe $Fe \rightarrow Fe^{2+} + 2e^-$	Ag $Ag^+ + e^- \rightarrow Ag$
2	Mg – Fe	Mg $Mg \rightarrow Mg^{2+} + 2e^-$	Fe $Fe^{2+} + 2e^- \rightarrow Fe$
3	Mg – Ag	Mg $Mg \rightarrow Mg^{2+} + 2e^-$	Ag $Ag^+ + e^- \rightarrow Ag$
4	Mg – Cu	Mg $Mg \rightarrow Mg^{2+} + 2e^-$	Cu $Cu^{2+} + 2e^- \rightarrow Cu$
5	Fe – Cu	Fe $Fe \rightarrow Fe^{2+} + 2e^-$	Cu $Cu^{2+} + 2e^- \rightarrow Cu$
6.	Cu – Ag	Cu $Cu \rightarrow Cu^{2+} + 2e^-$	Ag $Ag^+ + e^- \rightarrow Ag$

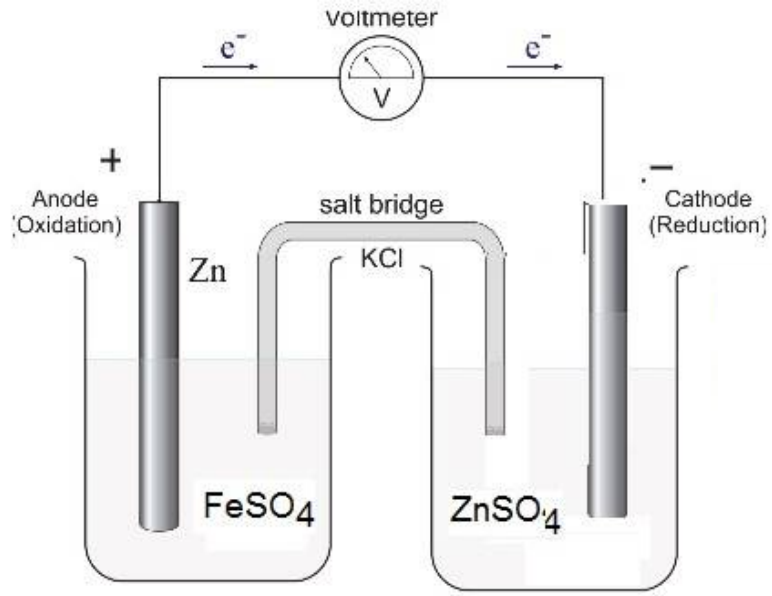
Draw the diagram of galvanic cell by using suitable materials from the box.

Cell- 1



Model Questions

1. **Identify the mistakes in the diagram of galvanic cell.**



Mistakes

i) Zinc rod should be immersed in a solution contain Zn^{2+} ions (eg $ZnSO_4$)

ii) Iron rod should be immersed in a solution contain Fe^{2+} ions (eg $FeSO_4$)

iii) Anode of galvanic cell carries negative charge an cathode carries +ve charge.

2. which among the diagram represent galvanic cell ? Why

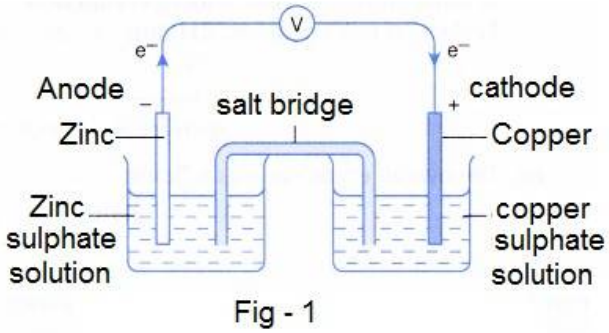


Fig - 1

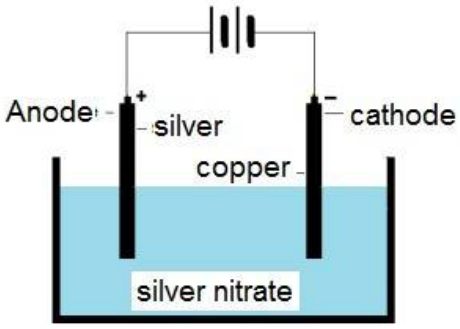


Fig -2

Fig -1 Because salt bridge is connected

Electrodes are immersed in their own salt solution

(III) Electrolytic cell

Electrolytes :- Substances which conduct electricity in molten states or the aqueous solutions and undergo chemical change

Scienctist :- Michael Faraday

Electrodes :- Substances which pass electricity to the electrolyte.

Anode :- Electrode at which oxidation take place (connected to positive terminal of a battery)

Cathode : Electrode at which reduction take place (connected to negative terminal of a battery)

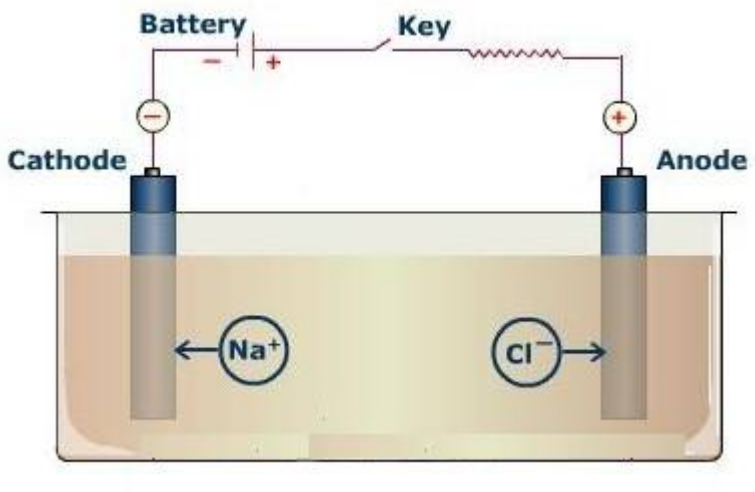
Cations :- Ions move towards cathode (Positively charged ions)

Anoios :- Ions move towards anode (Negatively charged ions)

Comparison - Galvanic cell and Electrolytic cell

	Galvanic cell	Electrolytic cell
Energy change	Chemicalenergy →Electrical energy	Electrical energy→ Chemical energy
Anode	Negative charge	Positive charge
Cathode	Positive charge	Negative charge

(IV) Electrolysis of molten sodium chloride



- Which are the ions present in molten sodium chloride ?

Sodium chloride in solid state is not a conductor of electricity because its ions have no freedom of movement.

- Identify the cations and anions

.....

Reaction take place at Cathode

$Na^{+} + e^{-} \rightarrow Na$

Reaction take place at Anode

$Cl^- \rightarrow Cl + e^-$

$Cl + Cl \rightarrow Cl_2$

Which is the gas liberated at the anode ?

.....

Which is the metal deposited at the cathode ?

.....

Unit 4
Production of Metals

Focus Area

1. Minerals and Ores
2. Concentration of ores
3. Extraction of metal from Concentred or
4. Refining of metals
5. Industrial production of iron

I) Minerals and Ores

- **Minerals:** The metallic compounds found in the earth crust are called minerals
- **Ores**: A mineral from which a metal is economically, easily and quickly extracted, is called the ore
- Characteristics possessed by minerals that are used for the extraction of metals.

  i) Abundance

  ii) Easily and cheaply separable

  iii)High metal content

Metals	Ores
Aluminium	Bauxite
Iron	Haematite, Magnetite
Copper	Copper pyrites, Cuprite
Zinc	Zinc blend, Calamine
Tin	Tin stone

Activities

1. Which is not a mineral of iron ?

   (bauxite, iron pyrites, haematite, magnetite)

2. Which among the following metals exists in the elemental state in nature?

   (Gold, Magnesium, Sodium, Platinum, Aluminium, Copper)

3. Identify the relation and fill up suitably

   Calamine : Zinc; Bauxite : ----------

4. Clay, bauxite and precious stone are some minerals of aluminium.

   a) Which among these is the ore of aluminium?

   b) Write any two characteristics of an ore

5. Give the name of any two sulphide ores.

6. Which is the metal present in the clay?

II) Concentration of ores

•The process of removing the impurities (gangue) from the ore obtained from the earth's crust is termed ***concentration of the ore.***

•Different methods of concentration.

1) Levigation or hydraulic washing

2) Froth floatation

3) Magnetic separation

4) Leaching

Activities

1. Which is the method of concentration of gold ore?

2. Match the following

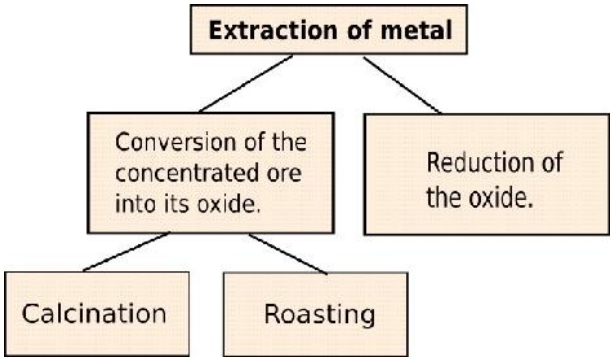
Ore	Method of concentration
Tin stone	Froth floatation
Bauxite	Levigation/ Hydraulic washing
Zinc blende	Magnetic separation
Ore of Gold	Leaching

3. Which is oil used for making froth in froth floatation process?

4. Which method is used to remove iron tungstate from tin stone?

5. Name the process used to concentrate Copper Pyrites ore.

III) Extraction of metal from concentrated ore



- Calcination is the process of heating the concentrated ore in the *absence of air*
- Roasting is the process of heating the concentrated ore *in the presence of air*
- Calcination and Roasting taking place at a temperature below its melting point
- Reduction of the oxide : The process of extraction of metal from its oxide is by reduction.

Activities

1. Different methods are used to convert the ores $ZnCO_3$ and Cu_2S into oxides.

   a) Write the appropriate methods to convert these ores into their oxides.

   b) What method is employed to convert hydroxide ore into its oxide?

   c) What is the product obtained during the roasting of Cu_2S?

2. Equation related with the conversion oxide of two ores of Zn are given.

   i. $ZnCO_3 + Heat \longrightarrow ZnO + CO_2$

   ii. $ZnS + O_2 + Heat \longrightarrow ZnO + SO_2$

   a) Which of these equation represent roasting?

   b) How does roasting differ from calcination ?

3. Metals can be extracted by using suitable reducing agents.

a) On what basis the reducing agent is selected for the production of metals?

b) Give the name of any three reducing agents which are commonly used.

c) Which is the reducing agent used in the production of highly reactive metals like sodium, potassium, calcium and aluminium?

IV) Refining of metals

•The process of removal of impurities from newly extracted metal to get the pure metal is called ***refining of metal.***

•There are different methods used for the refining of metals based on the nature of metal and impurities

Method	Characteristics	Example
Liquation	**Melting point** of the metal is less than the impurities	Tin (Sn) Lead (Pb)
Distillation	**Boiling point** of the metal is less than the impurities	Zinc (Zn), Cadmium (Cd) Mercury (Hg)
Electrolytic refining	Electrolysis of the salt solution of the metal.	Copper (Cu), Silver (Ag) Gold (Au)

•Anode (+ve electrode): Impure metal

•Cathode (–ve electrode) : A small piece of pure metal

•Electrolyte: Aqueous solution of metal to be refined.

Activities

1. The table given below is incomplete

Metal	Method of refining
Tin	**A**
Zinc	**B**

(a) Identify A and B

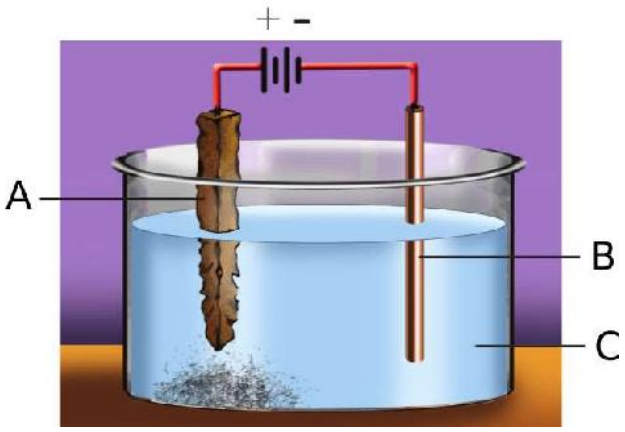
(b) Which property of the above metals are made use of in their refining?

2. What are the methods used to refine the following metals?

a) i) Lead ii) Cadmium

b) Why those methods are employed?

3. The electrolytic refining of copper is shown in the figure. A,B and C are anode, cathode and electrolyte respectively.



a) What are the anode, cathode and electrolyte ?

b) Write the equation of the chemical reaction taking place at anode and cathode.

c) At which electrode the pure metal is deposited?

V) Industrial production of iron

- **Minerals of iron :** Haematite, magnetite, iron pyrites etc
- **Fool's gold:** iron pyrites
- **Chief ore of iron:** Haematite (Fe_2O_3)
- **Concentration of haematite :** Washing and magnetic separation.
- **Furnace used:** Blast furnace

- **Raw materials:** Haematite (Fe_2O_3), coke (carbon), limestone ($CaCO_3$)
- **Gangue :** The impurities present in the ore.
- Two types of gangue – Acidic and Basic (SiO_2 -Acidic and CaO - Basic)
- **Flux :** The material used to remove gangue
- Two types of flux – Acidic and Basic (SiO_2 -Acidic and CaO - Basic)
- **Slag :** Gangue and flux combines to form Slag. (Flux +Gangue →Slag)
- At high temperature limestone decompose. ($CaCO_3$ +Heat ⟶ CaO + CO_2)
- CaO (quick lime) is formed and combines with silicon dioxide (SiO_2) the main impurity of the ore.

$CaO + SiO_2 \longrightarrow CaSiO_3$

Flux + Gangue ⟶ Slag

- The coke combines with oxygen in the hot air.

$C + O_2 \longrightarrow CO_2 + Heat$

$CO_2 + C + Heat \longrightarrow 2\,CO$ (Reducing agent)

- The Carbon monoxide (CO) in the furnace reacts with iron oxide to produce iron.

$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

- **Pig iron :** The molten iron obtained from the blast furnace.

(Contains impurities like 4% carbon, silicon, manganese, phosphorous etc)

Activities

1. Equations of chemical reaction occurring in blast furnace during the production of iron are given.

$CaCO_3 \rightarrow CaO + CO_2$

$Fe_2O_3 + 3\,CO \rightarrow 2\,Fe + 3\,CO_2$

$CaO + SiO_2 \rightarrow CaSiO_3$

(a) Which of these represent slag formation reaction ?

(b) Which is the substance acting as reducing agent in blast furnace?

(c) Which is the flux used in the blast furnace.

(d) Which is the gas formed during the reduction of iron oxide.

2. Iron is commercially produced in blast furnace

(a) Which is the iron ore used?

(b) Coke is added along with the ore to the blast furnace. Why ?

(c) What is the role of limestone in blast furnace?

(d) By which name the molten iron obtained from the blast furnaceos known?

3. What are the raw materials used in the industrial production of iron?

4. Mach the following.

Haematite	Gangue
Carbon monoxide	Calcium silicate ($CaSiO_3$)
Silica (SiO_2) in the iron ore	Iron ore
Calcium oxide	Iron obtained from blast furnace
Pig iron	Reducing agent
Slag	flux

Answer key

I) Minerals and Ores

1) bauxite
2) Gold, Platinum
3) Aluminium
4) a. bauxite b. i) Abundance ii) Easily separable iii) High metal content
5) copper pyrites, Zinc blende
6) Aluminium
7) Zinc and Copper

II) Concentration of ores

1) **Levigation/ Hydraulic washing**
2)

Ore	Method of concentration
Tin stone	Magnetic separation
Bauxite	Leaching
Zinc blende	Froth floatation
Ore of Gold	Levigation/ Hydraulic washing

3) Pine oil
4) Magnetic separation
5) Froth floatation

III) Extraction of metal from concentrated ore

1) a. $ZnCO_3$ – Calcination, Cu_2S – Roasting

   b. Roasting

   c. CuO

2) a. ii. $ZnS + O_2 + Heat \longrightarrow ZnO + SO_2$

   b. Calcination is carried out in the absence /limited supply of air where as roasting is carried out with the presence of excess air.

3) a. On the basis of reactivity of the metal

   b. Electricity, Carbon and Carbon monoxide

   c. Electricity

IV) Refining of metals

1) a. A- Liquation B – Distillation

(b) Melting point of tin is lower than impurities.

Boiling point of zinc is lower than impurities .

2) (a) i) Lead - Liquation ii) Cadmium - Distillation

(b) Because they have low **melting point** and **boiling point**

3) (a) Anode - Impure copper

Cathode - Pure copper

Electrolyte - Copper sulphate solution with H_2SO_4

(b) At anode $Cu \longrightarrow Cu^{2+} + 2e^-$

At cathode. $Cu^{2+} + 2e^- \longrightarrow Cu$ (atom)

(c) At cathode.

V) Industrial production of iron

1) (a) $CaO + SiO_2 \rightarrow CaSiO_3$

(b) Carbon monoxide (CO)

(c) Calcium oxide - CaO (Quick lime)

(d) Carbon dioxide - CO_2

2) (a) Haematite

(b) For the reduction of ore / For the formation of CO.

(c) To remove the gangue

(d) Pig iron

3) Haematite, coke and limestone

4)

Haematite	Iron ore
Carbon monoxide	Reducing agent
Silica (SiO_2) in the iron ore	Gangue
Calcium oxide	Flux
Pig iron	Iron obtained from blast furnace
Slag	Calcium silicate ($CaSiO_3$)

Unit - 5

NON METALLIC COMPOUNDS

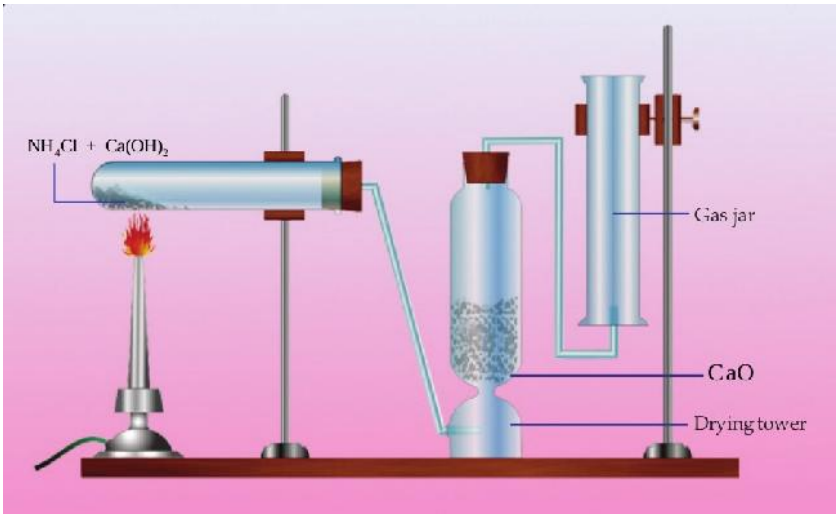
Focus area – 1 Ammonia

Ammonia chemical formula – NH_3

Physical properties

- Basic in nature
- Have pungent smell
- Lighter than air
- Highly soluble in water

Activity – 1



The arrangement of apparatus to prepare ammonia in the laboratory is shown in the figure. Analyse the figure and answer the following questions.

1. What are the chemicals required to prepare ammonia in the laboratory
2. Why ammonia gas is passed through a drying tower?
3. Which substance is used to remove moisture from ammonia?
4. Can conc. sulphuric acid be used to remove moisture from ammonia? Why?
5. Ammonia gas is collected by the down ward displacement (keeping the gas jar upside down) of air. Why?
6. Write the balanced chemical equation of the reaction.

Explanations

1. Ammonium chloride (NH_4Cl)
   Calcium hydroxide ($Ca(OH)_2$)
2. To remove moisture from ammonia gas

3. Quick lime (calcium oxide, CaO)
4. No.
   Ammonia is basic in nature. So it reacts with sulphuric acid and forms ammonium sulphate salt.
5. Ammonia is lighter than air.
6. $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3$

Activity – 2

What are liquor ammonia and liquid ammonia?

Explanation :

Ammonia gas is highly soluble in water. The concentrated solution of ammonia in water is called liquor ammonia.

Ammonia can be liquified by applying pressure. The product thus obtained is called liquid ammonia.

Activity – 3

List the various uses of ammonia

Explanation :

- used for the manufacture of fertilizers
- used as a refrigerant/ cooling agent in ice plants
- used to clean tiles and glass window panes

Activity – 4

If ammonia gas leaked water is sprayed to avoid causalties. The reason behind this is,

a) Ammonia is basic in nature
b) Ammonia is lighter than air
c) Ammonia is highly soluble in water
d) Ammonia has strong pungent smell

Explanation – C

Activity – 5

Ammonium chloride (NH_4Cl) is strongly heated in a boiling tube. A wet red litmus paper is shown at the month of the boiling tube.

1. What will be the observations?

2. What is the reason for it?
3. Write the equations of the chemical reactions
4. What is the white substance deposited on the inner wall of the boiling tube? How is it formed?

Explanation

1. Red litmus paper turns to blue. After sometime it turns back to red. A white precipitate is formed on the inner wall of the boiling tube.
2. On strong heating ammonium chloride decomposes into NH_3 and HCl
   $NH_4Cl \rightarrow NH_3 + HCl$

Ammonia being lighter first rises up and turns red litmus into blue. Later acidic HCl gas reaches the mouth of the boiling tube and turns it to red again.

3. $NH_4Cl \rightleftharpoons NH_3 + HCl$

4. Ammonium chloride (NH_4Cl)

   At the top of the boiling tube NH_3 and HCl combines together to form NH_4Cl

5. $NH_3 + HCl \rightarrow NH_4Cl$

Activity – 6

What is the peculiarity of the thermal decomposition of ammonium chloride?

Explanation :

1. Reactants changes into products and the products react back to form the reactants again.

   $NH_4Cl \rightarrow NH_3 + HCl$

   $NH_3 + HCl \rightarrow NH_4Cl$

2. By which name chemical reactions taking place to both sides are known.

Explanation

Reversible reactions

3. By which name the reactants changes into products in a reversible reaction is known?

Explanation

Forward reaction

4. By which name the products react back into the reactants in a reversible reaction is known?

Explanation

Backward reaction

5. What will happen if the speed of forward and backward reactions becomes equal in a reversible reaction?

Explanation

The system will attain equilibrium. This stage is called chemical equilibrium.

6. At what name the state at which the rate of forward reaction and backward reaction become equal.

Explanation

Chemical equilibrium

Activity – 7

1. What are the peculiarities of chemical equilibrium.

Explanation

- Chemical equilibrium is dynamic at molecular level.
- Reversible reactions never stops.
- Only the speed of forward and backward reactions becomes equal. At equilibrium state both forward and backward reactions proceed.

2. Which are the factors that can change the equilibrium state?

Explanation

- Concentration
- Temperature
- Pressure (In gaseous systems)
- Presence of catalyst

6. What will happen if one of the factors change in a system at equilibrium?

Explanation

The system will readjust itself to nullify the effect of that change. So a new equilibrium will be attained.

This is known as Le-Chatelier principle.

Activity – 8

A glass rod dipped in conc. HCl is shown at the mouth of a gas jar filled with ammonia gas.

1. What will be the observation?
2. What is the reason?
3. Write the equation of the chemical reaction.

Explanation

1. Dense white fumes will be formed
2. Basic NH_3 gas combines with HCl and forms NH_4Cl
3. $NH_3 + HCl \rightarrow NH_4Cl$

Activity – 9

1. Equations of certain reversible reactions are given below. Identify the forward and backward reactions and list them in a table.

   $NH_4Cl \rightleftharpoons NH_3 + HCl$

   $N_2 + 3H_2 \rightleftharpoons 2NH_3$

   $2SO_2 + O_2 \rightleftharpoons 2SO_3$

   $H_2 + I_2 \rightleftharpoons 2HI$

Explanation

Forward reaction	Backward reaction
$NH_3 + HCl \rightarrow NH_4Cl$	$NH_4Cl \rightarrow NH_3 + HCl$
$N_2 + 3H_2 \rightarrow 2NH_3$	$2NH_3 \rightarrow N_2 + 3H_2$
$2SO_2 + O_2 \rightarrow 2SO_3$	$2SO_3 \rightarrow 2SO_2 + O_2$
$H_2 + I_2 \rightarrow 2HI$	$2HI \rightarrow H_2 + I_2$

2. What is an irreversible reaction? Give examples for irreversible reactions.

Explanation

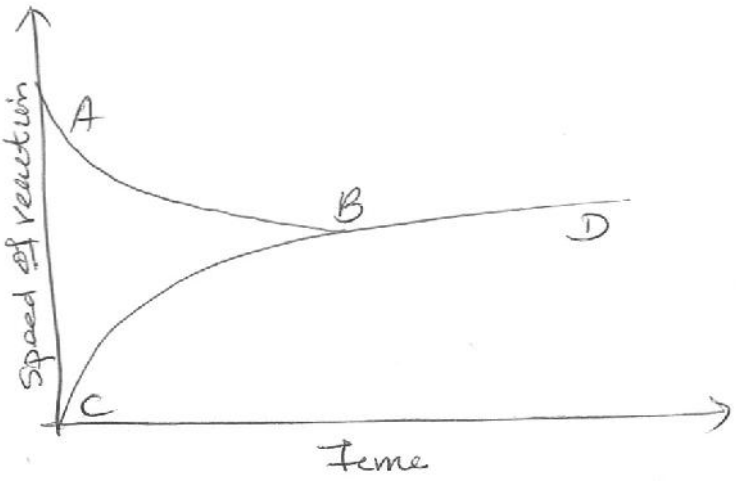
Chemical reactions in which the reactants changes into the products and the products do not react back into the reactants are called irreversible reactions.

Give example for irreversible reactions.

- Acid base neutralization reaction
- Combustion of fuels
- Displacement reactions

Activity – 10

Graphical representation of a reversible reaction is given below. Analyze it and answer the questions given below.



1. Which part of the graph shows the forward reaction ? (AB, BD, CB, AC)
2. The speed of which reaction increases as time passes?
   (Forward reaction, Backward reaction)
3. Why the part of graph BD appears to be straight?
4. What is the peculiarity of the part BD?

Explanation

1. CB
2. Speed of backward reaction
3. The speed of both forward and backward reactions becomes equal.
4. The reactants and products coexist at this stage.

Activity – 11

Two chemical reactions are given below

I $N_2 + 3H_2 \rightarrow 2NH_3 + Heat$

II $NH_4Cl + Heat \rightarrow NH_3 + HCl$

- Which one of this is endothermic? Which is exothermic?

Explanation

Reaction I – exothermic

Reaction II – endothermic

Activity – 12

The equation of a reversible chemical reaction is given below.

$N_2 + 3H_2 \rightleftharpoons 2NH_3 + Heat$

1. In this, which reaction is endothermic?
   (Forward reaction, Backward reaction)
2. Which reaction will be favored by rise in temperature?

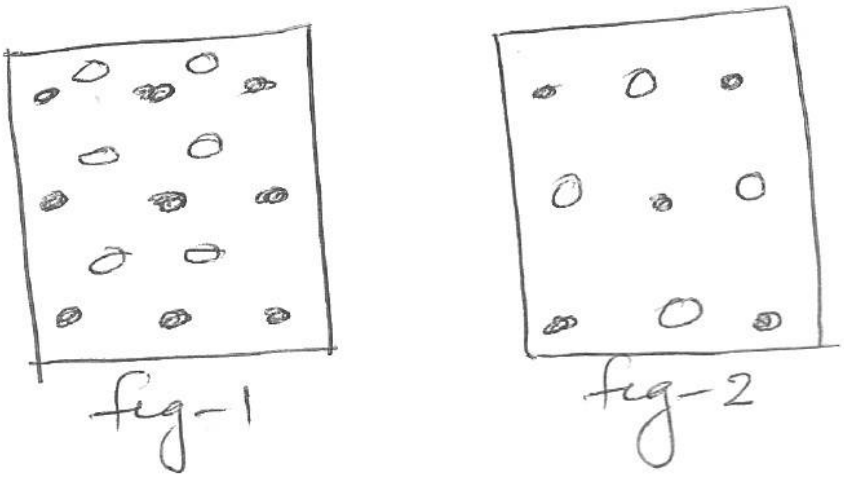
Explanation

In this reaction backward reaction is endothermic and forward reaction is exothermic.

Rise in temperature is favorable to backward reaction.

Activity – 13

The reactant molecules in two systems are shown below.



1. In which number of molecules is greater?
2. Molecules per unit area is greater (concentration) in Fig 3/ Fig 2)
3. Chemical reactions take place due to the effective collision of molecules. Rate of collision is greater in Fig 3/ Fig 2)
4. What is the relation between concentration and speed of chemical reactions?

Explanation

1. In figure 1
2. In figure 1
3. In figure 1
4. When concentration increases speed of reaction also increases because rate of collision increases.

Activity – 14

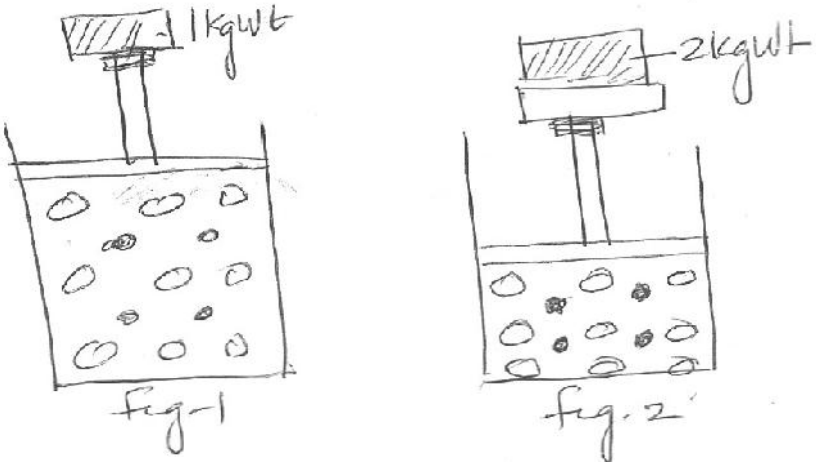
1. What will be the effect of increase in concentration of the reactants in a reversible reaction?
2. What will happen if the concentration of the products increases in a reversible reaction?
3. What will happen if the products are removed from the system at regular intervals of time?

Explanation

1. Speed of forward reaction will increase/ More product will be formed.
2. Speed of backward reaction will decrease/ Amount of products decreases
3. Rate of forward reaction will increase/ More product will be formed.

Activity – 15

Same number of molecules in a system at two circumstances are shown below.



1. Which is system where volume is less and which it the system where volume is high?
2. In which system pressure is high?
3. What is the relationship between pressure and volume?

4. In which the rate of collision will be greater?
5. Which system does have greater speed of reaction? Why
6. What is the relationship between pressure and speed of chemical reaction?

Explanation

1. Volume is greater in fig – 1
   Volume is less in fig – 2
2. In fig – 2
   Volume is less so distance between the molecules is less.
3. When pressure increases volume decreases/ when volume increases pressure decreases.
4. In fig – 2
   Volume is less/ pressure is high
   Rate of collision increases
5. In fig – 2 (Rate of collision high)
6. In gaseous systems when pressure increases rate of reaction increases.

Activity – 16

The equation of a reversible reaction is given below.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

1. What is the total number of reactant molecules? What is the total number of product molecules?
2. What happens to the number of molecules due to forward reaction?
3. What will happen to the volume if the number of molecules decreases?
4. Suggest a method to decrease volume.
5. What will happen in this system if pressure is increased?
6. What will be the effect of change in pressure in a reversible reaction.

Explanation

1. Number of reactant molecules = 1+3 = 4
   Number of product molecules = 2
2. Number of molecules decreases from 4 to 2
3. Volume decreases
4. Increase pressure
5. Forward reaction
6. The reaction in which the number of molecules decreases will speed up.

Activity – 17

Chemical equation of a reversible reaction is given below.

$A + B \rightleftharpoons C + D + Heat$

1. Write the number molecules of both reactants and products
2. What is the effect of change in pressure in this reaction. Why?
3. Which reaction will be favoured by rise in temperature?

Explanation

1. Number of molecules of reactants – 2
   Number of molecules of products - 2
2. Pressure change has no effect in this reaction. Because there is no change in the number of molecules due to forward and backward reactions.
3. Rise in temperature is favorable to backward reaction in this reaction. (Because it is endothermic).

Activity – 18

The change of various factors and its effect in the system given in table.

Complete the table.

Change in the factor	Effect of the change
Concentration of the reactants increases	Speed of forward reaction increases/ more product will be formed
Concentration of the products increases	Speed of backward reaction increases/ Amount of the product decreases.
Product is removed at regular intervals from the system	(1) ……
Temperature increases	Speed of endothermic reaction increases
Temperature decreases	(2) ……
Pressure increases	Reaction in which number of molecules decreases speeds up
Pressure decreases	(3) ……

Explanation

1. Speed of forward reaction increases/ More product will be formed.
2. Exothermic reaction speeds up
3. Reaction in which number of molecules increases speeds up.

Activity – 19

The equation of a reversible reaction at equilibrium is given below.

$2SO_2 + O_2 \rightleftharpoons 2SO_3 + Heat$

Write the influence of the following factors in this system.

1. Increase in Concentration of the reactants.
2. Pressure increases
3. Temperature increases
4. SO_3 is removed from the system at regular intervals

Explanation

1. Speed of forward reaction increases/ Amount of products increases
2. Speed of forward reaction increases. Because due to forward reaction number of molecules reduces from 3 to 2.
3. Speed of backward reaction increases. Because backward reaction is endothermic.
4. Speed of forward reaction increases/ Amount of products increases.

Unit 6
Nomenclature of organic compounds and isomerism

Focus Area

1. Alkane, Alkene and Alkyne
2. Homologous series
3. Nomenclature of Unbranched Hydrocarbon
4. Nomenclature of hydrocarbons with one branch
5. Nomenclature of unsaturated Hydrocarbons
6. Functional Group – hydroxyl, alkoxy

I) Alkane, Alkene and Alkyne

- Hydrocarbons are classified into Alkane ,Alkene and Alkyne.
- Alkanes are Single bonded saturated hydrocarbons.

Alk**ane** C_nH_{2n+2}			
No. of carbon	Name of Compound	Molecular Formula	Condensed formula
1	Meth**ane**	CH_4	CH_4
2	Eth**ane**	C_2H_6	$CH_3{-}CH_3$
3	Prop**ane**	C_3H_8	$CH_3{-}CH_2{-}CH_3$
4	But**ane**	C_4H_{10}	$CH_3{-}CH_2{-}CH_2{-}CH_3$
5	Pent**ane**	C_5H_{12}	$CH_3{-}CH_2{-}CH_2{-}CH_2{-}CH_3$
6	Hex**ane**	C_6H_{14}	$CH_3{-}CH_2{-}CH_2{-}CH_2{-}CH_2{-}CH_3$

- Alkenes are Double bonded unsaturated hydrocarbons.(**ene**) - C_nH_{2n}

No. of carbon	Name alk**ene**	Molecular Formula
2	Eth**ene**	C_2H_4
3	Prop**ene**	C_3H_6
4	But**ene**	C_4H_8
5	Pent**ene**	C_5H_{10}
6	Hex**ene**	C_6H_{12}

- Alkynes are Triple bonded unsaturated hydrocarbons. (**yne**) – C_nH_{2n-2}

No. of carbon	Name alk**yne**	Molecular Formula
2	Eth**yne**	C_2H_2
3	Prop**yne**	C_3H_6
4	But**yne**	C_4H_8
5	Pent**yne**	C_5H_{10}
6	Hex**yne**	C_6H_{12}

Activities

1. Choose the odd one out. Give reason

   (CH_4 , C_3H_4 , C_2H_2 , C_2H_4)

2. Complete the table

C_2H_4	C_3H_6	C_4H_8	.....a.....
CH_4	C_2H_6	.....b.....	C_4H_{10}
C_2H_2	..... c.....	C_4H_6	C_5H_8

3. To which category does CH_3- CH_2- CH_3 belong?

   (Alkane, Alkene, Alkyne, Cyclo alkane)

4. Write the structure of C_3H_8

5. Some hydrocarbons are given in the box

   (C_3H_4 , C_2H_6 , C_2H_2 , C_4H_8, C_5H_{10} , C_3H_8)

   a) Which belong to the family with the general formula C_nH_{2n+2}

   b) Which compounds have a triple bond?

   c) Select the alkenes from the box ?

II) Homologous series

- A series of compound with similar properties, in which members differ from one another by same group, is called homologous series
- The members can be represented by a general formula.
- Successive members differ by a CH_2 group.
- Members show similarity in chemical properties
- There is a regular gradation in their physical properties.

Activities

1. What is the difference between the number of carbon atoms and hydrogen atoms in CH_4 and C_2H_6 ?

2. Given below is a homologous series

C_2H_2	....A....	C_4H_6	....B....

a) What are A and B?

b) To which family do this belong?

(Alkane, Alkene, Alkyne)

3. The formulae given below are a homologous series

CH_4	C_2H_6	C_3H_8

a) To which category does this belong?

(Alkane, Alkene, Alkyne)

b) Write the general formula of this family

c) Write the structure of C_2H_6

III) Nomenclature of Unbranched Hydrocarbon

- IUPAC has put forward some rules for the naming of hydrocarbons.
- IUPAC - International Union of Pure and Applied Chemistry
- Find the number of carbon atoms
- Nature of the chemical bond between the carbon atoms (single /double/triple)
- Word roots are selected based on the number of carbon atoms.

No. of carbon atom	Word root	No. of carbon atom	Word root
1	Meth	6	Hex
2	Eth	7	Hept
3	Prop	8	Oct
4	But	9	Non
5	Pent	10	Dec

•Word root + Suffix (ane/ene/yne)

•Eg.

Word root	Suffix	IUPAC name of hydrocarbon
Meth	ane	Meth**ane**
Eth	ane	Eth**ane**
Eth	ene	Eth**ene**
Prop	ene	Prop**ene**
Eth	yne	Eth**yne**
Prop	yne	Prop**yne**

Activities

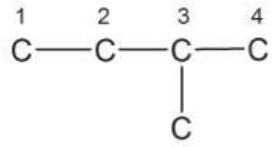
1. Write the IUPAC name of CH_4
2. Write the IUPAC name of C_3H_4
3. The molecular formula of a hydrocarbon is C_2H_4
   a) In which homologous series does this compound belong?
   b) Write the molecular formula of the Fifth member
   c) Write the structure of C_2H_4 and give its IUPAC name
4. Complete the table given below.

Molecular formula	Condensed formula	IUPAC name
CH_4	**A**	Methane
C_2H_6	CH_3-CH_3	**B**
C_3H_8	**C**	Propane
D	CH_3-CH_2-CH_2-CH_3	**E**
F	**G**	Hexane

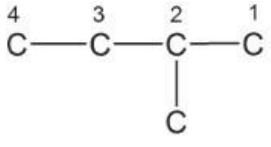
IV) Nomenclature of hydrocarbons with one branch

- Identify the longest continuous carbon chain.

- The longest chain should be considered as the main chain.
- The remaining carbon atoms are treated as branches.
- The position of the branches can be found out by numbering carbon atoms
- The two ways in which the carbon chain can be numbered.



(1)

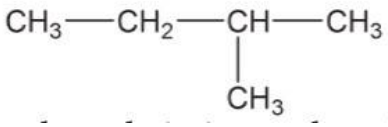


(2)

- The lowest number for the carbon atom carrying the branch should be taken for naming the compound.

  Eg.Second one is the correct method among the above. So the branch number is 2

- Position number of branch + hyphen + branch (radical name) + word root + suffix
- IUPAC name for the compound given below is **2-Methylbutane.**

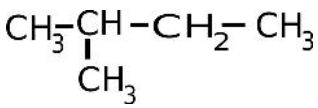


- Alk**yl** radicals (Alk**ane** – 1 Hydrogen atom)

Alkane	Formula	Condensedformula	Alkyl radical		Formula
Methane	CH_4	CH_4	Methyl	$-CH_3$	CH_3-
Ethane	C_2H_6	CH_3-CH_3	Ethyl	$-C_2H_5$	CH_3-CH_2-
Propane	C_3H_8	$CH_3-CH_2-CH_3$	Propyl	$-C_3H_7$	$CH_3-CH_2-CH_2-$
Butane	C_4H_{10}	$CH_3-CH_2-CH_2-CH_3$	Butyl	$-C_4H_9$	$CH_3-CH_2-CH_2-CH_2-$

Activities

1. The structure of a hydrocarbon is given below.

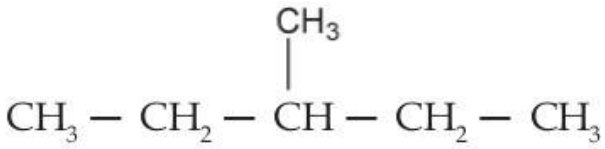


a) How many C – atoms are there in the main chain? Which is the word root?

b) Identify the branch and its position number.

c) Write the IUPAC name of the compound.

2. The structure of a hydrocarbon is given below. Analyse and answer the following questions.



a) How many carbon atoms are present in this compound?

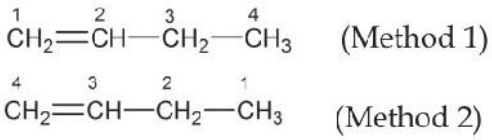
b) Name of the alkyl radical coming as branch is .....

c) What is the position of the branch?

d) Write IUPAC name of this compound.

V) Nomenclature of unsaturated Hydrocarbons

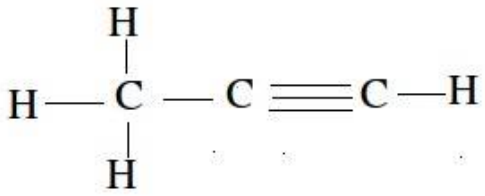
- The position number is given in two methods



- Give the lowest position number to the carbon atoms linked by double/ triple bond.
- In method (1) , the lowest position numbers are given to the double bonded carbon atoms.
- The IUPAC name of the compound CH_2= CH – CH_2 - CH_3 is **But-1-ene**
- If the compound is CH ≡ CH – CH_2 _ CH_3, the IUPAC name is **But-1-yne**

Activities

1. **Analyse the below given structure and answer the following question.**



a) Write the condensed formula

b) Write its molecular formula

c) Write the structure and IUPAC name of the first member of homologous series to which the above compound belongs

VI) Functional group – hydroxyl, alkoxy

- **Functional group :** The presence of certain atoms or groups imparts certain characteristic properties to organic compounds.

Functional group	Name of the functional Group	Name of the compounds formed	Suffix	Example
-OH	Hydroxyl	Alcohol	ol	Methanol
R-O-	Alkoxy	Ether	oxy	Methoxy ethane

- Hydroxyl group is the functional group of alcohols.
- The IUPAC naming of alcohols is done by replacing 'e' from the name of the corresponding alkane with 'ol'.

Alkane - e + ol -----> Alkanol

Methane - e + ol → Methanol

Ethane - e + ol -------> Ethanol

Eg. i) CH_3-CH_2- OH Ethanol

ii) CH_3- CH_2- CH_2- OH Propanol

iii) CH_3-CH_2- CH_2-CH_2- OH Butanol

- Ethers are compounds with alkoxy group.
- In alkoxy compounds alkyl radicals on either side of the – O -

- The longest alkyl group is taken as alkane and the other as alkoxy group.

Eg. i) CH_3-CH_2- O-CH_2-CH_3 Ethoxy ethane

ii) CH_3- O-CH_2-CH_3 Methoxy ethane

iii) CH_3-CH_2- CH_2- O-CH_2-CH_3 Ethoxy propane

Activities

1. Name the functional group present in the compound CH_3-CH_2-CH_2-OH
2. The structural formula of an organic compound is given below.

CH_3- O-CH_2-CH_3

a) Identify the functional group present in this compound.

b) What are the compounds with given functional group commonly called?

VII) Isomerism

- Compounds having same molecular formula and different chemical and physical properties are called Isomers.
- This phenomenon is called Isomerism
- There are **three** types of Isomers.

i) Chain isomer ii) Functional isomer iii) Position isomer

- **Chain isomer :** Compounds with the same molecular formula but possess a difference in the chain structures.

Example.

$CH_3-CH_2-CH_2-CH_3$	C_4H_{10}
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$	

•**Functional isomer :** Compounds having same molecular formula, but having a difference in their functional groups

CH_3-CH_2-OH	C_2H_6O
CH_3-O-CH_3	

•**Position isomer :** If the position of the same functional group is different in two compounds having the same molecular formula

$CH_3–CH_2–CH_2–OH$	C_3H_8O
$CH_3–\underset{\displaystyle OH}{\underset{\vert}{CH}}–CH_3$	

Activities

1. The structure of two organic compounds are given below.

   (i) $CH_3–CH_2–CH_2–CH_2–CH_2–OH$

   (ii) $CH_3–CH_2–CH_2–O–CH_2–CH_3$

   a) Write the molecular formula of these compound.

   b) Which type of isomerism do they exhibit?

   c) Explain this isomerism.

   d) Write structural formula of a position isomer of compound (i)

2. Structural formula of certain compounds are given below.

   A) CH_3- O-CH_2- CH_2 -CH_3

   B) CH_3-CH_2-COOH

   C) CH_3-CH_2.CH_2-CH_2-OH

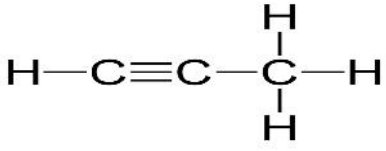
   a) Select the pair of isomers from these.

   b) Identify the type of isomer shown by this pair.

   c) Write down the structural formula and IUPAC name of the position isomer of

   CH_3-CH_2.CH_2-CH_2-OH

3. The structure of a hydrocarbon is given



   a) What is the molecular formula of this compound?

   b) Write its IUPAC name

   c) To which homologous series does this compound belong?

4. The structural formula of an organic compound is given below.

CH_3- O-CH_2-CH_3

Write down the structural formula of its functional isomer and its IUPAC name.

5. Complete the table

	Srtucture	**Molecular formula**	**Isomer pair**	**Isomer type**
A	CH_3— CH_2— CH_2— CH — CH_3 | CH_3			
B	CH_3— CH_2— CH_2— OH			
C	CH_3— CH_2— CH_2— CH_2—OH			
D	CH_3— CH_2 — CH — CH_2— CH_3 | CH_3			
E	CH_3— CH_2— CH— CH_3 | OH			
F	CH_3— O — CH_2— CH_3			

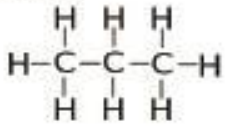
Answer key

I) Alkane, Alkene and Alkyne

1) CH_4

2) (a) C_5H_{10} (b) C_3H_8 (c) C_3H_4

3) Alkane

4) 

5) a) C_2H_6 , C_3H_8
b) C_3H_4 , C_2H_2
c) C_4H_8 , C_5H_{10}

II) Homologous series

1) Difference of CH_2 group

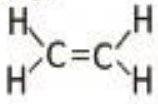
2) (a) A - C_3H_4 B - C_5H_8
(b) Alkyne

3) (a) Alkyne
(b) C_nH_{2n+2}
(c) $CH \equiv CH$

III) Nomenclature of Unbranched Hydrocarbon

1) Methane

2) Propyne

3) a. Alkene
b. C_7H_{14}
c.  Ethene

4) A- CH_4 B – Ethane C - CH_3-CH_2- CH_3 D - C_4H_{10}
E – Butane F – C_6H_{14} G - CH_3-CH_2-CH_2-CH_2 - CH_3

IV) Nomenclature of hydrocarbons with one branch

1) a. 4 , But

(b) Methyl, 2

(c) 2-Methyl Butane

2) (a) 6

(b) Methyl

(c) 3

(d) 3-Methyl Pentane

V) Nomenclature of unsaturated Hydrocarbons

1) (a) CH_3-C ≡ C-H
(b) C_3H_4

(c) H-C ≡ C-H Ethyne

VI) Functional group – hydroxyl, alkoxy

1) Hydroxyl group -OH
2) (a) Alkoxy group -O-

(b) Ethers

VII) Isomerism

1) (a) i) $C_5H_{12}O$ ii) $C_5H_{12}O$
(b) Functional isomerism
(c) These compounds having same molecular formula and different functional group.

(d) CH_3-CH_2-CH_2-$\underset{\underset{OH}{|}}{CH}$-$CH_3$ Pentan-2-ol

or

CH_3-CH_2-$\underset{\underset{OH}{|}}{CH}$-$CH_2$-$CH_3$ Pentan-3-ol

2) (a) A and C
(b) Functional isomer

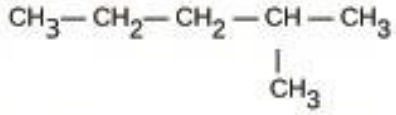
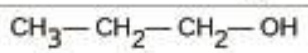
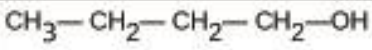
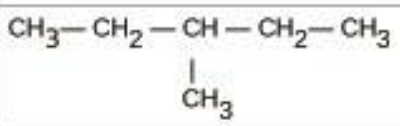
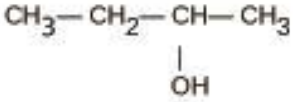
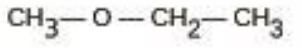
(c) CH_3-CH_2-$\underset{\underset{OH}{|}}{CH}$-$CH_3$ Butan-2-Ol

3) (a) C_3H_4
(b) Prop-1-yne
(c) Alkyne

4) CH_3-CH_2- CH_2-OH Propan-1-ol

5)

	Structure	Molecular	Isomer	Isomer type

		formula
A		C_6H_{14}
B		C_3H_8O
C		$C_4H_{10}O$
D		C_6H_{14}
E		$C_4H_{10}O$
F		C_3H_8O

pair	
D	Chain Isomer
F	Functional Isomer
E	Position Isomer
A	Chain Isomer
C	Position Isomer
B	Functional Isomer

Unit – 7

Chemical reactions of Organic Compounds

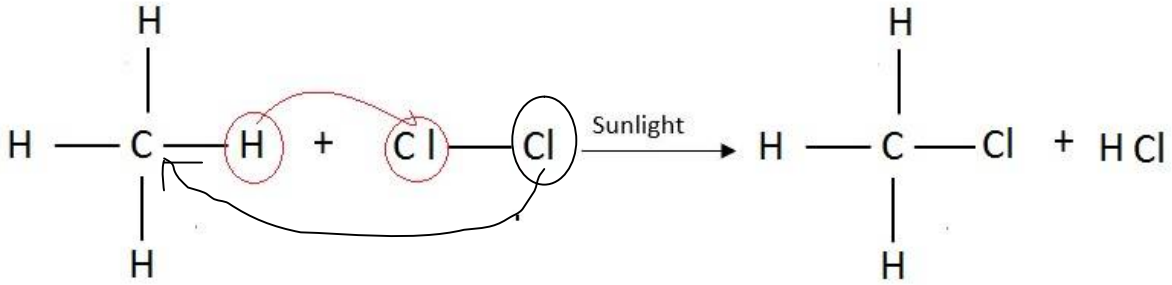
Focus Area

(I) Substitution Reactions
(II) Addition reactions
(III) Polymerisation
(IV) Combustion
(V) Thermal cracking

(I) Substitution Reactions

An atom or a group in a compound is replaced by another atom or group .

Reaction of methane with chlorine in the presence of sunlight is an example of substitution reaction .



Or

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

Methane Chloromethane

(II) Addition reaction

Unsaturated hydrocarbons (double bond / triple bond) react with other molecules (H_2 ,Cl_2 ,HCl , HBr -----) to form saturated compounds

Double bond changes to single bond

i) $CH_2 = CH_2 + Cl_2 \rightarrow CH_2Cl - CH_2Cl$

Ethene 1,2- Dichloroethane

ii) $CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$ Ehthane

iii) $CH_3 - CH = CH_2 + Cl_2 \rightarrow CH_3 - CHCl - CH_2Cl$

1,2- dichloropropane

(iii) Polymerisation

Large number of simple molecules Combine together to form complex molecules.

Simple molecules are called monomer

Complex molecules are called polymer

Examples of polymerisation

i) $n\,CH_2 = CH_2 \longrightarrow [\,CH_2 - CH_2\,]_n$

ii) $n\,CH_2 = CHCl \longrightarrow -[-CH_2 - \underset{\displaystyle Cl}{\underset{|}{CH}} -]-_n$

Vinylchloride

Polyvinylchloride (PVC)

iii) $n\,CF_2 = CF_2 \longrightarrow -[-CF_2 - CF_2 -]-_n$

Tetrafluoroethene Polytetrafluoroethene (Teflon)

Monomer	Polymer	Uses
Tetrafluoroethene	Teflon	Nonstick vessels
Vinylchloride	PVC	Pipes, Footwears
Ethene	Polythene	Carry bags
Isoprene	Polyisoprene (Natural rubber)	Tyre,Tubes, Footwears

(IV) Combustion

Combines with oxygen liberating heat ,CO_2 &H_2O

Or Substance + O_2 → CO_2 + H_2O + heat

Examples of combustion

(i) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat

Methane

CO_2 carbondioxide
H_2O water

ii) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ + Heat

Ethane

iii) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ + Heat

Ethene

iv) $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$ + Heat

Ethyne

v) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ + Heat

Butane

(LPG)

Model questions

a) Why do hydrocarbons are used as fuels ?

Burning of hydrocarbons produce heat energy

b) Complete the reaction given below .

$2\ C_4H_{10} + 13\ O_2 \rightarrow$ ------ + ------- + Heat

Butane
(LPG)

$2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$ + Heat

(V) Thermal cracking

Hydrocarbons with higher molecular mass on heating in the absence of air decomposes into hydrocarbons with lower molecular mass.

The product formed depend on the nature of the hydrocarbons , temperature and pressure.

Examples for thermal cracking

$CH_3 - CH_2 - CH_3 \xrightarrow{Heat} CH_4 + CH_2 = CH_2$

Propane methane ethene

$C_7H_{16} \xrightarrow{Heat} C_5H_{12} + C_2H_4$

Heptane Pentane Ethene

Model questions

1.

$CH \equiv CH + H_2 \rightarrow A$

$A + H_2 \rightarrow B$

Identify A and B

Ans:- A) $CH_2 = CH_2$, B) $CH_3 - CH_3$

2.

$CH \equiv CH + Cl_2 \rightarrow A$

$A + Cl_2 \rightarrow B$

Identify A and B

Ans:- A) CHCl = CHCl B) $CHCl_2 – CHCl_2$

3.

$CH \equiv CH + HCl \rightarrow A$

$A + HCl \rightarrow B$

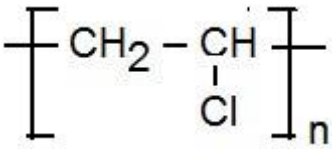
Identify A and B

3 . Ans:- A) $CH_2 = CHCl$ B) $CH_3 – CHCl_2$

4. Match the following suitably

Reactant	Products	Name of reaction
$CH_2 = CH_2 + O_2$	$\left[CH_2 – \underset{\displaystyle Cl}{\underset{\vert}{CH}} \right]_n$	Addition
$CH_3 – CH_3 + Cl_2$	$CH_3 – CH_2Cl$	Combustion
$CH_2 = CH_2 + HCl$	$CO_2 + H_2O$	Polymerisation
$nCH_2 = CHCl$	$C_2H_5Cl + HCl$	Substitution

Ans:-

Reactant	Products	Name of reaction
$CH_2 = CH_2 + O_2$	$CO_2 + H_2O$	Combustion
$CH_3 – CH_3 + Cl_2$	$C_2H_5Cl + HCl$	Substitution
$CH_2 = CH_2 + HCl$	$CH_3 – CH_2Cl$	Addition
$nCH_2 = CHCl$		Polymerisation

5 $CH \equiv CH + \xrightarrow{HCl} A \xrightarrow{H_2} B$

a) Which are the substances likely to be A and B

b) Complete the reaction

Ans:- a) A $CH_2 = CHCl$

B $CH_3 – CH_2Cl$

b) $CH \equiv CH + \xrightarrow{HCl} CH_2 = CHCl \xrightarrow{H_2} CH_3 – CH_2Cl$
