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CLASS 6TH

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LANGUAGE CHEMISTRY

SYNOPSIS - 1

SYMBOL & FORMULAE

"A symbol represents short form of an element.The scientist who suggested a method of representing elements using the english letters (Capitals as well as small) is J.J. Berzelius".

A symbol is defined as an abbreviation or short hand sign for the full name of an element.

Significance of a symbol:

Qualitative meaning: A symbol represents a specific element.A symbol represents one atom of an element. For example O stands for oxygen, N stands for nitrogen.

Quantitative meaning: A symbol represents the mass of element, equal to its atomic mass of that element.

Quantitatively it represents,

i) One atom of an element.

ii) The number of parts by weight (Atomic weight) of an element.

iii) One gram atom of an element.

For example the symbol O represents

i) One atom of oxygen.

ii) 16 parts by weight of oxygen.

iii) One gram atom of oxygen i.e., 16 grams.

Guidelines to write the symbols

1. For some of the elements the first letter of its English name is used as symbol to represent that element in short form. Only capital letters are used.

2. When the names of the two elements start with the same letter, the second letter or a prominent letter is added to the first letter. When two letters are used the first letter is in capital and the second letter is always a small one.

3. For some elements, the symbols are taken from their latin names.

Tables showing the symbols of all elements

Atomic number	Name of the element	Symbol		Atomic number	Name of the element	Symbol
1	Hydrogen	H		21	Scandium	Sc
2	Helium	He		22	Titanium	Ti
3	Lithium	Li		23	Vanadium	V
4	Beryllium	Be		24	Chromium	Cr
5	Boron	B		25	Manganese	Mn
6	Carbon	C		26	Iron	Fe
7	Nitrogen	N		27	Cobalt	Co
8	Oxygen	O		28	Nickel	Ni
9	Fluorine	F		29	Copper	Cu
10	Neon	Ne		30	Zinc	Zn
11	Sodium	Na		31	Gallium	Ga
12	Magnesium	Mg		32	Germanium	Ge
13	Aluminium	A*l*		33	Arsenic	As
14	Silicon	Si		34	Selenium	Se
15	Phosphorus	P		35	Bromine	Br
16	Sulphur	S		36	Krypton	Kr
17	Chlorine	C*l*		37	Rubidium	Rb
18	Argon	Ar		38	Strontium	Sr
19	Potassium	K		39	Yttrium	Y
20	Calcium	Ca		40	Zirconium	Zr

FORMULA

Definition : The representation of a molecule of a substance (element or compound) in terms of symbols and subscript numbers is known as the formula.

Example: H_2 is the formula of hydrogen.

HC*l* is the formula of hydrochloric acid.

SIGNIFICANCE OF A FORMULA

Like the symbols, a formula has also qualitative as well as quantitative significance.

Qualitative significance:

Qualitatively, it represents:

The number of the substance.

The names of the various elements present in the substance.

Quantitative significance:

Quantitatively, it represents:

One molecule of the substance.

The actual number of atoms of each element present in one molecule of the substance.

The number of parts by weight of the substance (molecular weight).

The number of parts by weight of each element.

For example : The formula of $CaCO_3$ has two significances.

a) Qualitative significance : Qualitatively, it represents.

i) Calcium carbonate.

ii) It contains calcium, Carbon and Oxygen as the elements.

b) Quantitative significance : Quantitatively it represents.

i) One molecule of calcium carbonate

ii) One molecule of calcium carbonate is made up of one atom of calcium, one atom of carbon and three atoms of oxygens.

iii) One mole of calcium carbonate.

iv) 100 parts by weight of calcium carbonate (atomic weights:Ca-40, C-12, O-16)

v) 40 parts by weight of calcium, 12 parts by weight of carbon and 48 parts by weight of oxygen.

SYMBOLS AND FORMULAE

Symbols for elements :

For some of the elements the first letter of its English name is used as symbol to represent that element in short form. Only capital letters are used.

Example :

S. No.	*Name*	*Symbol*
1.	Hydrogen	H
2.	Carbon	C
3.	Nitrogen	N
4.	Oxygen	O
5.	Fluorine	F
6.	Sulphur	S
7.	Boron	B
8.	Phosphorus	P
9.	Iodine	I

When the names of the two elements start with the same letter, the second letter or a prominent letter is added to the first letter. When two letters are used the first letter is in capital and the second letter is always a small one.

WORK SHEET - 1

Single Answer Type

1. The scientist who suggested a method of representing elements using the English letters (Capital as well as small) is:
   1) Lavoisier 2) J. J. Berzelius
   3) Robert Boyle 4) Rutherford
2. Symbol 'S' stands for the element:
   1) Strontium 2) Silicon 3) Sulphur 4) Selenium
3. The symbols for the elements selenium and silicon respectively are:
   1) Si and Se 2) S and Si 3) Se and Si 4) S and Sl
4. The symbol for Aluminium is:
   1) At 2) Am 3) A*l* 4) As
5. The symbol for Fluorine is
   1) F 2) Fe 3) Fr 4) Fr
6. Which of the following is correct for 'O' element?
   1) The symbol 'O' represents 8 parts by weight
   2) It represents one atom of carbon
   3) One gram atom of oxygen is 16 grams
   4) The atomic number of oxygen is 16
7. Identify the name of the element from the following given symbols.
   (i) Cu (ii) Au (iii) Sb (iv) Hg (v) Fe

	(i)	(ii)	(iii)	(iv)	(v)
1)	Ferrum	Cuprum	Stibium	Hydrargyrum	Ferrum
2)	Cuprum	Aurum	Stibium	Hydrargyrum	Ferrum
3)	Ferrum	Cuprum	Aurum	Stibium	Hydrargyrum
4)	Aurum	Ferrum	Stibium	Hydrargyrum	Cuprum

8. The Latin names for the elements Tungsten, Potassium and Sodium are:
   1) Wolfram, Kalium and Argentum 2) Kalium, Wolfram and Natrium
   3) Wolfram, Stannum and Natrium 4) Wolfram, Kalium and Natrium
9. They symbol for Einsteinium is:
   1) Cm 2) Es 3) Fm 4) Md
10. A formula has :
    1) Qualitative significance only 2) Quantitative significance only
    3) Both qualitative and quantitative significance.
    4) None of these
11. What is the formula of hydrochloric acid
    1) H*Cl* 2) H_2 3) Cl_2 4) H_2SO_4
12. The symbolic representation of actual number of atoms in molecule is called
    1) Valency 2) Formula 3) Both 1 & 2 4) Ion

13. The chemical formula of water is:
1) H_2O_2 2) H_2O 3) O_2 4) H_2

14. Chemical formula for calcium sulphate is $CaSO_4$. The formula for ferric sulphate will be:
1) $Fe_2(P_2O_7)_3$ 2) $Fe_4P_3O_{14}$ 3) $Fe_2(SO_4)_3$ 4) Fe_3PO_4

15. The chemical formula of Epsom's salt is:
1) $MgSO_4.10H_2O$ 2) $MgSO_4.7H_2O$
3) $2CaSO_4.H_2O$ 4) $Na_2SO_4.10H_2O$

16. Which of the following is not the correct formula?
1) H_2S 2) $NaHSO_4$ 3) SiO_2 4) $NaCl_2$

17. Sodium phosphate has the chemical formula
1) $Na_2P_2O_7$ 2) Na_3PO_4 3) $Na_4P_2O_7$ 4) Na_3PO_3

Multi Answer Type

18. Identify the correct statements.
1) The symbol for an element represents the element either in pure state or in combined state.
2) A symbol represents one atom of that element.
3) An atom is the smallest particle of an element.
4) None are correct.

19. The element/s named after the scientist name(s) is/are:
1) Mendelevium 2) Fermium 3) Nobelium 4) Curium

20. The element/s named after the names of the countries and laboratories is/are:
1) Germinium 2) Americium 3) Berkelium 4) Polonium

21. Identify the correct statement/s:
1) The representation of a molecule of a substance (element or compound) in terms of symbols and subscript numbers is known as the formula.
2) Atoms of different elements combine in certain fixed ratio to form a compound.
3) All chemical compounds are represented by their respective formulae.
4) None of the above.

22. Which of the following formula is having 2 atoms?
1) HCl 2) $HgCl_2$ 3) CaO 4) $CaCO_3$

Reasoning Answer Type

23. *Statement I :* Symbol of cobalt is Co but not CO, CO represents a molecule of carbon monoxide.
Statement II : The first letter of the symbol is always capital while the second one is always small for certain elements symbols.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

24. *Statement I :* For some elements, the first letter of its English name is used as symbol to represent that element in short form in capital letter as symbol.
Statement II : When two letters are used, the first letter is in capital form and the second letter is always a small one.
1) Both statement I and II are correct 2) Both statement I and II are incorrect
3) Statement I is correct and statement II is incorrect
4) Statement I is incorrect and statement II is correct

25. Statement I: The symbol for potassium is K
Statement II: The symbol for yttrium is Y
1) Both statement I and II are correct 2) Both statement I and II are incorrect
3) Statement I is correct and statement II is incorrect
4) Statement I is incorrect and statement II is correct

26. *Statement I :* The latin name of Antimony is Stibium.
Statement II : The latin name of Tin is Plumbum.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

27. *Statement I :* A formula has qualitative as well as quantitative significance.
Statement II : Quantitatively it represents the actual number of atoms of each element present in one molecule of the substance.
1. Both Statements I and II are correct
2. Both Statement I and II are incorrect
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

28. *Statement I :* The formula of calcium carbonate is $CuCO_3$.
Statement II : The formula of Sodium chloride is NaCl.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Writeup-1

The symbols of some elements are derived from their Latin names.

29. The element/s named after the names of the countries and laboratories is/ are:
1) Ruthenium 2) Americium 3) Berkelium 4) All the above

30. The elements named after the names of the planets are:
1) Uranium 2) Neptunium 3) Plutonium 4) All the above

31. The element Nobelium named after the name of the scientist is:
1) Madam Curie 2) Mendeleev 3) Alfred Nobel 4) Enrico Fermi

Writeup-2

32. The formula of washing soda is:
1) $Na_2CO_3.7H_2O$ 2) $Na_2CO_3.H_2O$ 3) $Na_2CO_3.10H_2O$ 4) Na_2CO_3

33. Molecular formula of Glauber's salt is:
1) $MgSO_4.7H_2O$ 2) $FeSO_4.7H_2O$ 3) $CuSO_4.5H_2O$ 4) $Na_2SO_4.10H_2O$

34. The formula of Baking powder is:
1) $NaHCO_3$ 2) Na_2CO_3 3) $KHCO_3$ 4) K_2CO_3

Writeup-3

35. A student has written the folowing symbols
Symbol - 1 : MN
Symbol - 2 : Ca
Symbol - 3 : PB
Symbol - 4 : Cr
Symbol - 5 : AL
Identify the correct option/s
1) Symbol - 1 is correct 2) Symbol - 2 and 3 are incorrect
3) Symbol - 2 and 4 are correct 4) Symbol - 5 is correct

36. Identify the symbols for the following element.

	i) Sodium	ii) Cadmium	iii) Calcium
	(i)	(ii)	(iii)
1)	Ca	Na	Cd
2)	Ca	Cd	Na
3)	Al	Mg	Si
4)	Na	Cd	Ca

37. Give the symbols for the following elements

	A) Boron	B) Silicon	C) Aluminium	D) Scandium
	(A)	(B)	(C)	(D)
1)	Si	Sc	B	Al
2)	Si	B	Al	Sc
3)	B	Si	Sc	Al
4)	B	Si	Al	Sc

Matrix Matching Type

38.

Column - I	Column - II
a) Selenium	1) V
b) Zinc	2) Al
c) Aluminium	3) Se
d) Vanadium	4) Zn
	5) P

39.

Column-I	Column-II
a) Californium	1) Bk
b) Neptunium	2) Cm
c) Berkelium	3) Np
d) Curium	4) Cf
	5) Pu

40.

Column-I	Column-II
a) Hg_2Cl_2	1) Manganous sulphate
b) $Ca(OH)_2$	2) Sodium dichromate
c) $MnSO_4$	3) Calcium hydroxide
d) $Na_2Cr_2O_7$	4) Mercurous chloride
	5) Nickel bisulphate

SYNOPSIS - 2

Valency

"The combining capacity of an element is called its valency"

Significance of valency

1. It is given by the number of hydrogen (or chlorine) atoms that combine with or displaced from a compound by one atom of the element.
2. When an element exhibits more than one valency, it is said to exhibit variable valency.
3. The reason for variable valency in certain metals is that, depending upon the experimental conditions, an atom of the metal loses more electrons that are present in its outermost shell (valence shell), i.e., it loses some electrons from the shell next to outermost shell. Thus, it exhibits variable valency.
4. If an element exhibits two different positive valencies, then suffix-**ous** is attached at the end of the name of the metal for **lower valency** and suffix **–ic** is attached at the end of the name of the metal for **higher valency**.

Some examples:

Metal	Name and lower valency	Name and higher valency
Iron (Ferrum)	Ferrous Fe^{2+} or Fe(II)	Ferric Fe^{3+} or Fe(III)
Copper (Cuprum)	Cuprous Cu^{+} or Cu(I)	Cupric Cu^{2+} or Cu(II)
Silver (Argentum)	Argentous Ag^{+} or Ag(I)	Argentic (Ag^{2+} or Ag(II)
Mercury	Mercurous Hg^{+} or Hg(I)	Mercuric Hg^{2+} or Hg(II)

Method to write a formula from the knowledge of valency

To write a formula, follow the steps given below. This method of writing formula is called criss-cross method.

Step-1: Write the symbol of positive ion or the radical to the left and for the negative ion or radical to the right.

Step-2: Put the valency number of each radical or the ion on its top right. Divide the valency numbers by highest common factor, if any, to get simple ratio. Now ignore the (+) and (–) symbols. Interchange the valency numbers of radicals or ions.

Step-3: Shift the valency numbers to lower right side of radical or ion. If the radical receives a number more than 1, enclose it within brackets. Do not enclose ions within brackets.

Examples:

1. Write the formula of aluminium sulphate.

Step-1: Writing the symbols of ions. Al SO_4

Step-2: Al (SO_4)

Step-3: Al^3 $(SO_4)^2$

Steps 4 and 5:

$= Al_2(SO_4)_3$

The formula is $Al_2(SO_4)_3$

2. Formula of calcium chloride:

Step-1: Ca^2 Cl^1

Step-1: Ca Cl_2

The formula is $CaCl_2$.

3. Formula of sodium chloride:

Step-1: Na^1 Cl^1

Step-1: Na_1 Cl_1

The formula of sodium chloride is $NaCl$

WORK SHEET - 2

Single Answer Type

1. The symbol for the element Astatine is:
   1) As 2) At 3) Ai 4) An
2. The valency of inert gas is :
   1) Zero 2) One 3) Three 4) Two
3. The number of electrons, lost, gained or shared with one atom of the element in order to acquire stable configuration of nearest noble gas element is called:
   1) Valency 2) Atomicity 3) Molecularity 4) None of these
4. An atom (or) a group of atoms which can exist independently with charge(s) is called:
   1) Ion 2) Molecule 3) Compound 4) Substance
5. Radicals are formed by the loss of electron (or) electrons, such radicals are called
   1) Anions 2) Cations 3) Compounds 4) Molecules
6. Radicals are formed by the gain of electrons, such radicals are called.
   1) Anions 2) Cations 3) Compounds 4) Molecules
7. The valency A*l* is:
   1) 3 2) 2 3) 1 4) 0
8. The valency of Berylium is
   1) 1 2) 2 3) 3 4) 4

Multi Answer Type

9. Which of the following form tetravalent ions?
   1) Platinum 2) Lead 3) Tin 4) Barium

Reasoning Answer Type

10. *Statement I* : Iron and chlorine combine to form $FeCl_2$, $FeCl_3$.
    Statement II : The valency of iron in these compounds are respectively 2 ans 3.
    1) Both statement I and II are correct
    2) Both statement I and II are incorrect
    3) Statement I is correct and statement II is incorrect
    4) Statement I is incorrect and statement II is correct

Comprehension Type

The combining capacity of an element is called its valency. It is given by the number of hydrogen or chlorine atoms that combine with or displaced from a compound by one atom of the element. If an element exhibits two different positive valencies, then suffix-ous is attached at the end of the name of the metal for lower valency and suffix-ix is attached at the end of the name of the metal for higher valency.

11. i) The name of the element with lower valency in a compound ends with suffix _____.

ii) The name of the element with higher valency ends with suffix _____.

	(i)	*(ii)*
1)	ous	ous
2)	ic	ous
3)	ous	ic
4)	ic	ic

12. Identify tetravalent ion from the following.

A) Chromus B) Stannic C) Auric D) Mercurous

1) Only A 2) Only B 3) Only C 4) Only D

13. Which of the following statement is correct?

1) The combining capacity of an element is called its valency

2) The valency of sodium is 2

3) Oxygen valency and charge is +2 4) None

Matrix Matching Type

14.

Column-I	**Column-II**
a) Antimony	1) Bi and trivalent
b) Iron	2) Penta and trivalent
c) Ammonium	3) Trivalent
d) Boron	4) Monovalent
	5) Hexavalent

SYNOPSIS - 3

Ions

If an atom lose of an electron it forms positive ion is called cation.

If an atom gain of an electron it forms negative ion is called anion.

Ions are two types depending upon the nature of the charge carried by them. They are Electro positive ions or cations and Electronegative ions or anions.

Electro positive ions : The ion having positive charge on it is known as electrpositive and it is also known as cations. Ex: Ca^{+2}, K^{+}, Na^{+}

Monovalent electropositive ions

Name of the cation	Symbol of the cation	Charge
Hydrogen	H+	+1
Lithium	Li+	+1
Sodium	Na+	+1
Potassium	K+	+1
Rubidium	Rb+	+1
Copper	Cu+ Cuprous or Copper (I)	+1
Silver	Ag+	+1
Gold	Au+ Aurous or gold (I)	+1
Mercury	Hg^{+1} Mercurous or Mercury (I)	+1
Ammonium	NH_4^+	+1
Phosphonium	PH_4^+	+1

Divalent electropositive ions

Name of the cation	Symbol of the cation	Charge
Beryllium	Be^{2+}	+2
Magnesium	Mg^{2+}	+2
Calcium	Ca^{2+}	+2
Strontium	Sr^{2+}	+2
Barium	Ba^{2+}	+2
Radium	Ra^{2+}	+2
Copper	Cu^{2+} Cupric or Copper (II)	+2
Mercury	Hg^{2+} Mercuric or Mercury (II)	+2
Iron	Fe^{2+} Ferrous or Iron (II)	+2
Chromium	Cr^{2+} Chromous	+2
Cobalt	Co^{2+} Cobaltous of Cobalt (II)	+2
Nickel	Ni^{2+}	+2
Manganese	Mn^{2+} Manganous or Manganese (II)	+2
Cadmium	Cd^{2+}	+2
Zinc	Zn^{2+}	+2
Lead	Pb^{2+} Plumbous or lead (II)	+2
Tin	Sn^{2+} Stannous or Tin (II)	+2

Trivalent electropositive ions

Name of the cation	Symbol of the cation	Charge
Iron	Fe^{3+} Ferric or Iron (III)	+3
Manganese	Mn^{3+} Manganic or Manganese (III)	+3
Aluminium	Al^{3+}	+3
Gold	Au^{3+} Auric or gold (III)	+3
Antimony	Sb^{3+} Antimonous or Antimony (III)	+3
Arsenic	As^{3+} Arsenous or Arsenic (III)	+3
Chromium	Cr^{3+}	+3
Cobalt	Co^{3+} Cobaltic or Cobalt (III)	+3
Boron	B^{3+}	+3

Tetravalent electropositive ions

Name of the cation	Symbol of the cation	Charge
Platinum	Pt^{4+} Platinic or Platinum (IV)	+4
Lead	Pb^{4+} Plumbic or Lead (IV)	+4
Tin	Sn^{4+} Stannic or Tin (IV)	+4

Pentavalent electropositive ions

Name of the cation	Symbol of the cation	Charge
Arsenic	As^{5+} Arsenic (V)	+5
Antimony	Sb^{5+} Antimonic or Antimony (V)	+5

WORK SHEET - 3

Single Answer Type

1. Arrange the following into monovalent,bivalent trivalent,tetravalent cations.
   A) Phosphonium B) Stannic C) Cobaltous D) Antimonous
   1) A, B, D, C 2) A, C, D, B 3) A, B, C, D 4) D, B, C, A
2. The tetravalent ion from the following is:
   1) Platinum 2) Tin 3) Lead 4) All the above
3. Cations are called _____.
   1) Acidic radicals 2) Basic radicals
   3) Neutral 4) None
4. Name the cation which is having the valency 5
   1) Platinum 2) Arsenic 3) Lead 4) Cobalt

5. The valency of Zn is
1) 4 2) 3 3) 2 4) 1

Multi Answer Type

6. Identify the following trivalent positive ions.
1) Cr^{+3} 2) Al^{+3} 3) Fe^{+3} 4)H^{+}
7. Nickel ion is :
1) Monovalent 2) Bivalent 3) Trivalent 4) Tetravalent
8. Correct formula of a trivalent metal nitride is: 1) M_3N_2
2) M_3N_3 3) MN 4) Both 2 and 3

Reasoning Answer Type

9. *Statement I :* $Al^{+3}$is a trivalent positive ion
Statement II : The metallic ion is formed by the donating three electrons from its outermost orbit is called trivalent electropositive ions.
1) Both statement I and II are correct
2) Both statement I and II are incorrect
3) Statement I is correct and statement II is incorrect
4) Statement I is incorrect and statement II is correct
10. *Statement I :* The higher valency of antimony is 5.
Statement II : The higher valency of tin is 4.
1) Both statement I and II are correct
2) Both statement I and II are incorrect
3) Statement I is correct and statement II is incorrect
4) Statement I is incorrect and statement II is correct

Comprehension Type

Writeup-1

Metal have one to three electrons in their outermost orbit (valence shell) which they tend to donate to the other element.

11. Mg^{+2} is :
1) Monovalent positive ion 2) Bivalent positive ion
3) Trivalent positive ion 4) Tetravalent positive ion
12. Which of the following is trivalent positive ion?
1) Boron 2) Cromium 3) Calcium 4) Both 1 and 2
13. If Fe is lose two electrons which type of positive ion is formed?
1) Fe^{+} 2) Fe^{+2} 3) Fe^{+3} 4) Fe

Writeup-2

The ion having a positive charge on it is known as electro-positive ion.

14. The oxidation states of lead are
1) +2 2) +4 3) +3 4) Both 1 and 2
15. Which of the following exhibit more than one oxidation state?
1) Na 2) Mg 3) Al 4) Au
16. Iron and chlorine combine to form $FeCl_2, FeCl_3$.
The valency of iron in these compounds are respectively
1) 2, 3 2) 3, 4 3) 1, 2 4) 3, 4

Matrix Matching Type

17.

Column-I	Column-II
a) Fe^{+2}	1) Argentous ion
b) Ag^{+}	2) Mercuric ion
c) Hg^{+2}	3) Ferrous ion
d) Cu^{+}	4) Cuprous ion
	5) Hydrogen

SYNOPSIS - 4

Electronegative ions: The ion having a negative charge on it is knwon as electro negative and also knwon as anion. Ex: Cl^{-}, O^{2-}, SO_4^{2-}

Divalent electronegative ions		
Name of the anion	**Symbol**	**Charge**
Iodate	IO_3^-	– 1
Nitrite	NO_2^-	– 1
Nitrate	NO_3^-	– 1
Hypophosphite or Dihydrogen phosphite	$H_2PO_2^-$	– 1
Cyanide	CN^-	– 1
Thiocyanate	SCN^- Sulphocyanide	– 1
Permanganate	MnO_4^-	– 1
Hydride	H^-	– 1
Hydroxide	OH^-	– 1
Superoxide	O_2^-	– 1
Hydrogen peroxide	HO_2^-	– 1
Carbonate	CO_3^{2-}	– 2
Chromate	CrO_4^{2-}	– 2
Dichromate	$Cr_2O_7^{2-}$	– 2
Manganate	MnO_4^{2-}	– 2
Sulphide	S^{2-}	– 2
Sulphite	SO_3^{2-}	– 2
Sulphate	SO_4^{2-}	– 2
Oxide	O^{2-}	– 2
Peroxide	O_2^{2-}	– 2
Oxalate	$C_2O_4^{2-}$ or $\begin{matrix}COO^-\\ \vert \\ COO^-\end{matrix}$ or $\left[(COO)_2\right]^{2-}$	– 2
Zincate	ZnO_2^{2-}	– 2

Trivalent electronegative ions		
Name of the anion	**Symbol**	**Charge**
Trivalent Aluminate	$A\ell O_3^{3-}$	– 3
Arsenate	AsO_4^{3-}	– 3
Boride	B^{3-}	– 3
Borate	BO_3^{3-}	– 3
Nitride	N^{3-}	– 3
Phosphide	P^{3-}	– 3
Phosphite	PO_3^{3-}	– 3
Phosphate	PO_4^{3-}	– 3
Ferricyanide	$[Fe(CN)_6]^{3-}$ Iron(III)	– 3

Tetravalent electronegative ions		
Name of the anion	**Symbol**	**Charge**
Tetravalent Ferrocyanide	$[Fe(CN)_6]^{4-}$ Iron(III)	– 4
Carbide	C^{4-}	– 4

WORK SHEET - 4

Single Answer Type

1. Identify phosphide ion:
   1) PO_4^{-3} 2) P^{4-} 3) P^{3-} 4) PO_3^{4-}
2. Super oxide ion is:
   1) O_2^{2-} 2) O^{-2} 3) O_2^- 4) O_2
3. Choose the trivalent anions from the following:
   i) Aluminate ii) Dichromate iii) Bromide iv) Boride
   1) i, ii, iii 2) (i), (iv) 3) i, iii 4) i, ii, iii, iv
4. Cyanide ion is represented as:
   1) CN^- 2) SNC^- 3) SN^- 4) None
5. Carbonate and bicarbonate ions are respectively:
   1) CO_2^{3-} and HCO_2^- 2) HCO_2^- and CO_2^{3-}
   3) HCO_3^- and CO_3^{2-} 4) CO_3^{2-} and HCO_3^-
6. Which of the following is hydroxide ion?
   1) H^+ 2) OH^- 3) OH^+ 4) H^-

7. The Chloride and Nitrate ions are respectively:
   1) Cl^- and NO_3^- 2) Cl^{2-} and NO_4^- 3) Cl^+ and NO_3^- 4) Cl^- and NO_3^+
8. Sulphite and sulphate ions are respectively :
   1) SO_3^- and SO_4^- 2) SO_4^- and SO_3^- 3) SO_3^{2-} and SO_4^{2-} 4) SO_4^{2-} and SO_3^{2-}
9. The valency of PO_4^{-3} ion is :
   1) 2 2) 3 3) 4 4) 0
10. Choose the correct order of formula for the given radicals:

	a) Nitrite	b) Nitride	c) Nitrate
	a	*b*	*c*
1)	N^{3-}	NO_3^-	NO_2^-
2)	NO_2^-	NO_3^-	N^{3-}
3)	NO_2^-	N^{3-}	NO_3^-
4)	N^{3-}	NO_2^-	NO_3^-

11. Choose the correct order of formulae for the given radicals:

	(a) Permanganate	(b) Chlorite	(c) Phosphite
	(a)	*(b)*	*(c)*
1)	MnO^{2-}	$C\ell O_3^-$	HPO_3^{3-}
2)	MnO_4^{2-}	$C\ell O_4^-$	PO_2^{3-}
3)	MnO_4^-	$C\ell O_2^-$	PO_3^{3-}
4)	MnO^-	$C\ell O_2^-$	$H_2PO_3^{3-}$

Multi Answer Type

12. Which of the following is trivalent electronegative ions?
    1) Nitride 2) Phosphide 3) Phosphite 4) Phosphate
13. The monovalent ion/radical among the following is :
    1) Sodium 2) Carbonate 3) Chromate 4) Bicarbonate

Reasoning Answer Type

14. *Statement I* : An ion or radical formed by the acceptance of 3 electrons is called trivalent electronegative ion.

    Statement II : SO_4^{2-} is a trivalent radical.

    1. Both Statements I and II are correct
    2. Both statement I and II are incorrect
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

15. *Statement I :* PO_3^{-3} is a trivalent electronegative ion.

Statement II : An ion or a radical formed by the acceptance of one electron is called monovalent electronegative ion.

1. Both Statements I and II are correct
2. Both statement I and II are incorrect
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

16. *Statement I :* NO_3^- is a trivalent electronegative ion.

Statement II : An ion or a radical formed by the acceptance of one electron is called monovalent electronegative ion.

1. Both Statements I and II are correct
2. Both statement I and II are incorrect
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Writeup-1

An ion or radical formed by the acceptance of 2 electrons is called bivalent electronegative ion or radical.

17. Sulphate ion is a
    1) Monovalent negative ion 2) Bivalent negative ion
    3) Bivalent positive ion 4) Monovalent positive ion
18. The number of electrons accepted by an atom of an element is called
    1) Its electronegative valency 2) Its electropositive valency
    3) Its outermost shell 4) Both 1 and 2
19. Cl^-, O^{-2}, N^{-3} are respectively called as:
    1) mono, di, trivalent ions 2) mono, tetra, divalent ions
    3) mono, tri, divalent ions 4) All the above

Writeup-2

The ion having a negative charge on it is known as electro-netative ion.

20. Phosphide and phosphate ions are respectively:
    1) PO_4^{3-} and P^{3-} 2) P^{3-} and PO_4^{3-} 3) PO_3^{4-} and P^{4-} 4) P^{4-} and PO_3^{4-}
21. The trivalent ion/radical among the following is :
    1) Zinc 2) Boride 3) Barium 4) Oxide
22. The bivalent ion/radical among the following is :
    1) Nitride 2) Phosphide 3) Antimony 4) Sulphate

Matrix Matching Type

23.

Column-I	**Column-II**
a) SO_4^{2-}	1) Oxide
b) O_2^{2-}	2) Sulphite
c) SO_3^{2-}	3) Sulphate
d) S^{2-}	4) Sulphide
	5) Peroxide

24.

Column-I	**Column-II**
a) Acetate ion	1) H^-
b) Hydride ion	2) CH_3COO^-
c) Bromide ion	3) I^-
d) Iodide ion	4) Br^-
	5) Mn^{+2}

KEY

WORK SHEET – 1 (KEY)				
1) 2	**2)** 3	**3)** 3	**4)** 3	**5)** 1
6) 1	**7)** 2	**8)** 4	**9)** 2	**10)** 3
11) 1	**12)** 2	**13)** 2	**14)** 3	**15)** 2
16) 4	**17)** 2	**18)** 1,2,3	**19)** 1,2,3,4	**20)** 1,2,3,4
21) 1,2,3	**22)** 3	**23)** 1	**24)** 1	**25)** 1
26) 3	**27)** 1	**28)** 4	**29)** 4	**30)** 4
31) 3	**32)** 3	**33)** 4	**34)** 1	**35)** 3
36) 4	**37)** 4	**38)** A-3 B-4 C-2 D-1	**39)** A-4 B-3 C-1 D-2	**40)** A-4 B-3 C-1 D-2

WORK SHEET – 2 (KEY)				
1) 2	**2)** 1	**3)** 1	**4)** 1	**5)** 2
6) 1	**7)** 1	**8)** 2	**9)** 1,2,3	**10)** 1
11) 3	**12)** 2	**13)** 3	**14)** A-2 B-1 C-4 D-3	

WORK SHEET – 3 (KEY)				
1) 2	**2)** 4	**3)** 2	**4)** 2	**5)** 3
6) 1,2,3	**7)** 2	**8)** 4	**9)** 1	**10)** 1
11) 2	**12)** 4	**13)** 2	**14)** 4	**15)** 4
16) 1	**17)** **A-3** **B-1** **C-2** **D-4**			

WORK SHEET – 4 (KEY)				
1) 3	**2)** 3	**3)** 2	**4)** 1	**5)** 4
6) 2	**7)** 1	**8)** 3	**9)** 2	**10)** 3
11) 3	**12)** 1,2,3,4	**13)** 1,4	**14)** 3	**15)** 1
16) 4	**17)** 2	**18)** 1	**19)** 1	**20)** 2
21) 2	**22)** 4	**23)** A-3 B-5 C-2 D-4	**24)** **A-2** **B-1** **C-4** **D-3**	

HYDROGEN

SYNOPSIS - 1

INTRODUCTION:

1. Hydrogen is the first and the lightest element in the periodic table.
2. It is the most abundant element (92%) in the universe.
3. It accounts for 15.4% of all atoms in the earth's crust.
4. It does not occur in the form of free element in nature except in volcanic gases.
5. It's electronic configuration is $1s^1$.

Symbol	:	H
Atomic weight	:	1.008
Atomic number	:	1
Valency	:	1

Discovery of hydrogen:

Robert Boyle prepared hydrogen in 1672, by treating iron with sulphuric acid, but was unable to establish its elementary character.

The credit of discovery of hydrogen goes to Henry Cavendish, who prepared it by the action of dilute hydrochloric acid, with zinc in 1766. He not only established its elementary character, but also proved that, when hydrogen is burnt in air it forms water.

Lavoisier named this gas "Hydrogen", because of its property of water formations. in Greek language hydrogen means "water former" hydra-water, gennas-maker. Hydrogen is a diatomic molecule and commonly known as dihydrogen. The reaction of hydrogen with oxygen to form water. Hydrogen forms more compounds than any other element. These include the organic compounds, biologically important compounds acids and bases.

Occurrence of hydrogen:

Hydrogen occurs in free as well as in combined state:

(a) Free state:

(i) Hydrogen does not occur in the free state on planet Earth.

(ii) It is found in minute traces in the earth's crust and the earth's atmosphere, in volcanic gases and to a higher extent around the sun and the stars.

(b) Combined state:

(i) In plant and animal tissues - which are made of compounds of hydrogen along with carbon, oxygen and nitrogen.

(ii) In water – about one ninth by mass of water is Hydrogen.

(iii) As a constituent of - acids, alkalis, petroleum products and organic substances.

Ex: Proteins.

WORK SHEET - 1

Single Answer Type

1. The stars, including sun are mainly composed of:
   1) Oxygen 2) Hydrogen 3) Carbon dioxide 4) Nitrogen dioxide
2. The most abundant element in the universe is:
   1) Potassium 2) Oxygen 3) Hydrogen 4) Nitrogen
3. (i) prepared hydrogen by the action of hydrochloric acid on zinc metal.
   1) Lavoisier 2) Joseph Priestly 3) Henry Cavendish 4) Henry Clark
4. Identify the element by reading the following.
   (i) It is the lightest known element.
   (ii) It means water forms and one of the element in plant and animal tissue.
   1) Nitrogen 2) Carbondioxide 3) Argon 4) Hydrogen
5. In Greek, hydrogen means:
   1) Salt maker 2) Water maker 3) Acid maker 4) Oxygen maker
6. Choose the correct statement:
   1) Hydrogen exists freely in the atmosphere.
   2) In combined state, hydrogen occurs as water.
   3) The chief constituent of sun and stars is hydrogen.
   4) All of these
7. Hydrogen can be prepared by the action of dilute HCl or dilute H_2SO_4 on active metals. Which of the following metal is exceptional?
   1) Zn 2) Fe 3) Mg 4) Pb
8. An element 'A' reacts with a compound 'B' forms a lightest gas 'C'.
   A is an element with atomic number 26, with variable valency +2 its "ous" state, +3 to its 'ic state.
   'B' is a compound formed by a lightest element and poisonous gas used for purification of water.
   Identify A, B and C

	A	B	C
1)	Mg	NO_2	O_2
2)	Fe	HCl	H_2
3)	Na	HCl	NO_2
4)	Al	NO_2	HCl

Multi Answer Type

9. Identify the correct options related to hydrogen:
   1) Atomic weight is 1.008 2) Valency is one
   3) It is the lightest element
   4) Hydrogen is the element that makes the sun shine.

10. Which of the following is / are correct statement(s).
    1) The sun, rest of the stars are made of free hydrogen.
    2) Hydrogen is present in mineral products such as petroleum natural gas coal etc.
    3) In combined state 1/3 part of water by weight consists of hydrogen
    4) Hydrogen was discovered by Henry Cavendish.

Reasoning Answer Type

11. *Statement I:* The process of combination of two nuclei of hydrogen to form a bigger nucleus of helium is called nuclear fusion.
    Statement II: Nuclear fusion is not accompanied by the release of heat.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.
12. *Statement I:* Hydrogen burns in air and forms water.
    Statement II: Hydrogen means water former in Greek language.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

Comprehension Type

Hydrogen is a lightest element. It is colourless, odourless and tasteless gas. It's valency is one.

13. Robert Boyle prepared hydrogen by treating iron with:
    1) Hydrochloric acid 2) Sulphuric acid
    3) Sulphurous acid 4) Nitric acid
14. Who discovered hydrogen?
    1) Robert Boyle 2) Lavoisier
    3) Henry Cavendish 4) Joseph Priestley
15. Hydrogen was named by:
    1) Lavoisier 2) Henry Cavendish 3) Robert Boyle 4) Antoine Chaptal

Matrix Matching Type

16.

Column-I	**Column-II**
a) Hydrochloric acid	1) H_2SO_4
b) Sulphuric acid	2) Fe
c) Iron	3) HCl
d) Zinc	4) Zn
	5) N_2

17. **Column-I**

a) Meaning of hydrogen
b) Hydrogen does not occur
c) Hydrogen is found in traces
d) A compound, one ninth by mass of which is hydrogen in the combined state is

Column-II

1) Earth's crust
2) Water
3) 'Water producer'.
4) Free state on earth.

SYNOPSIS - 2

PREPARATION OF HYDROGEN:

General methods:

(i) (a) from cold water (b) boiling water/steam
(ii) From acids
(iii) From alkalis (bases when dissolved in water known as alkalies)

From cold water:

When metals reacts with cold water to form metal hydroxide and Hydrogen.

$2K + 2H_2O \rightarrow 2KOH + H_2$

(This reaction is violant and exothermic. The liberated heat ignites the hydrogen)

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

(This reaction is violent but comparatively less than potassium. Hydrogen is difficult to collect)

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

(The reaction is slightly vigorous but calcium is comparatively more expensive)

From acids:

When metals reacts with dilute acids to form solts and liberation of hydrogen.

Metal	Acid [dil.]	Salt	Hydrogen	Observations
1) Mg +	$2HCl \rightarrow$	$MgCl_2$ +	H_2	K, Na and Ca react with dil. H_2SO_4 or dil. HCl but the reaction is highly explosive and practically not feasible.
2) $2Al$ +	$3H_2SO_4 \rightarrow$	$Al_2(SO_4)_3$ +	$3H_2$	
3) Zn +	$H_2SO_4 \rightarrow$	$ZnSO_4$ +	H_2	Mg, Al, Zn and Fe react with dil. HCl liberating hydrogen and forming respective salt.
4) Fe +	$2HCl \rightarrow$	$FeCl_2$ +	H_2	

Note:

1) **Nitric acid in the dilute form is not used in the preparation of hydrogen from metals.**

HNO_3 is a powerful oxidizing agent and the nascent oxygen formed on its decomposition oxidises the hydrogen to water. Magnesium and Manganese however, react with very dil. HNO_3 at low temperatures liberating hydrogen. Since, the oxidising action of the acid is much reduced due to dilution.

2) Lead cannot be used in the preparation of hydrogen using dilute acids.

Lead reacts with dil. HCl and dil. H_2SO_4 forming an insoluble coating of lead chloride ($PbCl_2$) and lead sulphate ($PbSO_4$) respectively and hence further reaction comes to a stop.

From alkalis:

Metal (Powdered)	Acid [dil.] (conc.sol.)	Salt	Hydrogen	Observations
1) $Zn + 2NaOH \xrightarrow{\Delta} Na_2ZnO_2 + H_2$				Zn, Pb and Al on boiling with conc. alkali solutions, i.e., NaOH or KOH react to form their soluble salts and liberate H_2.
2) $Zn + 2KOH \xrightarrow{\Delta} K_2ZnO_2 + H_2$				
3) $Pb + 2NaOH \xrightarrow{\Delta} Na_2PbO_2 + H_2$				
4) $2Al + 2NaOH + 2H_2O \xrightarrow{\Delta} 2NaAlO_2 + 3H_2$				
5) $2Al + 2KOH + 2H_2O \xrightarrow{\Delta} 2KAlO_2 + 3H_2$				

WORK SHEET - 2

Single Answer Type

1. Reaction of iron with steam is:
   1) Endothermic 2) Reversible 3) Irreversible 4) None

2. The reactive metals like sodium, magnesium, zinc or iron displace __I__ from __II__.

I	II
1) Carbondioxide	Distilled water
2) Oxygen	Salt water
3) Hydrogen	Water
4) Nitrogen	Saline water

3. $2K + 2H_2O \longrightarrow A + H_2$

   $Mg + B \longrightarrow MgO + H_2$

   A, B represents?

   1) $A \longrightarrow 2KOH$, $B \longrightarrow H_2O$ 2) $A \longrightarrow KOH$, $B \longrightarrow H_2$

   3) $A \longrightarrow K_2O$, $B \longrightarrow 2H_2$ 4) $A \longrightarrow K_2$, $B \longrightarrow H$

4. Which of the following reaction is exothermic?

   1) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$ 2) $Ca + H_2O \longrightarrow Ca(OH)_2 + H_2$

   3) $K + H_2O \longrightarrow KOH + H_2$ 4) $Mg + H_2O \longrightarrow MgO + H_2$

5. $Mg + I \rightarrow MgO + II$
$Zn + III \rightarrow IV + H_2$
Identify I, II, III, and IV from the above equations

	I	II	III	IV
1)	H_2O	H_2	H_2O	ZnO
2)	H_2	H_2O	H_2	H_2O
3)	H_2O	H_2O	H_2	H_2
4)	H_2	H_2	H_2O	H_2O

6. Which of the following is /are correct statement?
1) Mg, A*l*, Zn and Fe react with dil.HC*l* or H_2SO_4 to liberate hydrogen gas.
2) The reaction of iron and steam is irriversible.
3) Mg reacts with boiling water to liberate hydrogen.
4) Both 1 and 3

7. i) $Na + \underline{(a)} \longrightarrow NaOH + H_2$
ii) $Fe + H_2O \longrightarrow \underline{(b)} + H_2$
iii) $(c) + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + H_2$
iv) $Al + \underline{(d)} + H_2O \longrightarrow 2KAlO_2 + 3H_2$
Identify a, b, c and d

	a	b	c	d
1)	KOH	H_2O	A*l*	Fe_3O_4
2)	H_2O	Fe_3O_4	A*l*	KOH
3)	A*l*	H_2O	KOH	Fe_3O_4
4)	Fe_3O_4	KOH	H_2O	A*l*

Solution :
I) $2Na + 2H_2O \longrightarrow 2NaOH + H_2O$ II) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + H_2O$
III) $2\ Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$
IV) $2\ Al + 2KOH + 2H_2O \longrightarrow 2KAlO_2 + 3H_2$

Multi Answer Type

8. Which of the following metals reacts with dil.HC*l* to liberate hydrogen?
1) Mg 2) Al 3) Zn 4) Fe

9. What are the products formed when zinc metal reacts with caustic potash?
1) Potassium zincate 2) Hydrogen
3) Potassium aluminate 4) Oxygen

Reasoning Answer Type

10. *Statement I:* The reaction between potassium and water is violent and exothermic.
Statement II: The reaction between calcium and water is slightly vigorus.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

11. *Statement I:* Nitric acid is not used for preparing hydrogen from metals.
Statement II: Nitric acid is a strong oxidising agent and forms oxides of nitrogen rather than hydrogen.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Metals like sodium, potassium and calcium react with cold water to form their respective metallic hydroxide and hydrogen gas.

12. Choose the correct statement:
1) The reaction with potassium and cold water is violent
2) Potassium is added to cold water heat energy released.
3) Potassium is added to cold water heat energy absorbed.
4) Both 1 and 2

13. Which of the following reaction is very difficult to collect the hydrogen gas?
1) $2K + 2H_2O \longrightarrow 2KOH + H_2$
2) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$
3) $Ca + 2H_2O \longrightarrow 2Ca(OH)_2 + H_2$
4) None

14. Calcium reacts with cold water to form:
1) Potassium hydroxide
2) Sodium hydroxide
3) Calcium hydroxide
4) Magnesium hydroxide

Matrix Matching Type

15.

Column-I	**Column-II**
a) Do not react with cold water	1) Reaction between potassium and water
b) The reaction is violent	2) Aluminium
c) HNO_3	3) Strong oxidising agent
d) Reacts with boiling water or steam	4) Magnesium

16.

Column-I	**Column-II**
a) Sodium zincate	1) Na_2ZnO_2
b) Sodium plumbate	2) K_2ZnO_2
c) Sodium aluminate	3) $NaPbO_2$
d) Potassium zincate	4) $NaAlO_2$
	5) Na_2AlO_2

SYNOPSIS - 3

LABORATORY METHODS OF PREPARATION OF HYDROGEN:

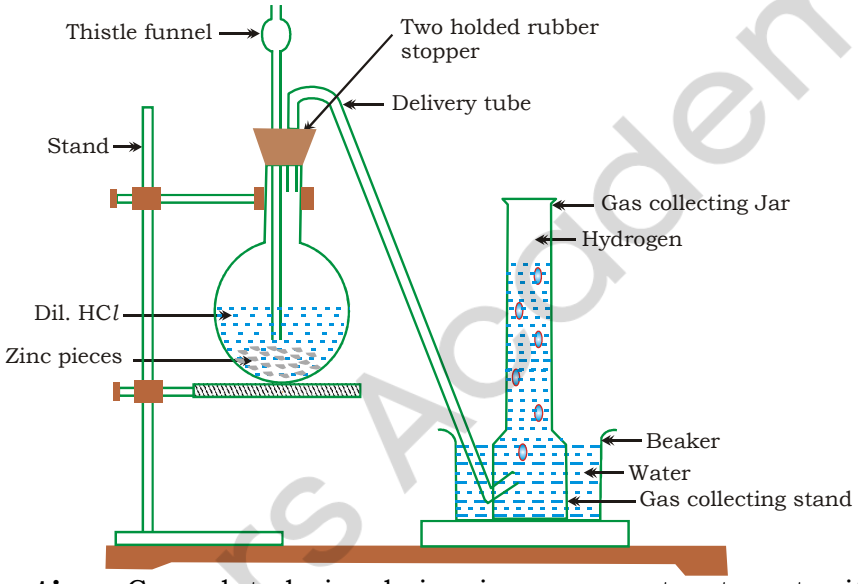
Laboratory method:

Hydrogen is prepared in the laboratory by the action of dilute acid on Zinc. Reaction equation:

$$Zn + 2HCl(dil.) \longrightarrow ZnCl_2 + H_2(g)$$

Reactants: Granulated Zinc in round bottom flask and dilute hydrochloric acid is added through thistle funnel.

Procedure: Granulated zinc is placed in the round bottom flask and hydrochloric acid is added slowly from the thistle funnel. A brisk effervescence is seen with the evolution of hydrogen gas.



Purification: Granulated zinc being impure, on treatment with dil. HCl evolves in traces of gaseous impurities. These impurities may be further removed by passage of the impure gas through three washer bottles and a U- tube.

Washer bottle 1- contains $AgNO_3$ solution which absorbs impurity - Arsine (AsH_3) and Phosphine (PH_3).

Washer bottle 2 – contains Pb $(NO_3)_2$ solution which absorbs - impurity - H_2S.

Washer bottle 3– contains KOH solution which absorbs - impurity - NO_2, CO_2, SO_2.

U - tube 4 - contains anhydrous $CaCl_2$ which absorbs - impurity - moisture.

Precautions:

(1) No leakage of gas should take place and no flame must be near the apparatus.

(2) Hydrogen is collected after all the air in the apparatus is allowed to escape.

(3) The end of the thistle funnel should dip below the level of the dil. acid in the flask or the hydrogen gas may escape out through the thistle funnel.

Collection: Hydrogen gas is collected by the downward displacement of water.

WORK SHEET - 3

Single Answer Type

1. Zn + 2 HCl (dil) ⟶ $ZnCl_2$ + "X" (gas). In the above reaction "X" is:
   1) Zinc 2) Hydrogen 3) Zinc chloride 4) Chlorine
2. The chemical name of $AgNO_3$:
   1) Silver nitrate 2) Silver nitrite 3) Silver oxide 4) Silver chloride
3. Which is a phosphine gas?
   1) AsH_3 2) H_2S 3) PH_3 4) NO_2
4. Which of the following is Arsine gas?
   1) PH_3 2) $AgNO_3$ 3) AsH_3 4) KOH
5. Which is a poisonous gas?
   1) O_2 2) CO_2 3) H_2 4) PH_3

Multi Answer Type

6. KOH solution which absorbs impurity as:
   1) NO_2 2) CO_2 3) SO_2 4) None

Reasoning Answer Type

7. *Statement I:* Zn + 2HCl (dil) ⟶ $ZnCl_2$ + H_2 (g)

   Statement II: Hydrogen gas is collected by the downward displacement of water.

   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

8. *Statement I:* Granulated zinc is placed in the round bottomed flask and Hydrochloric acid is added slowly from the thistle funnel.

   Statement II: A brisk effoverscence is seen with the evolution of hydrogen gas.

   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

9. *Statement I:* Granulated zinc being impure on treatment with dil. hydrochloric acid evolves gaseous impurities.

Statement II: NO_2, CO_2 and SO_2 gases are impurities.

1. Both Statements are true, Statement II is the correct explanation of Statement I.

2. Both Statements are true, Statement II is not correct explanation of Statement I.

3. Statement I is true, Statement II is false.

4. Statement I is false, Statement II is true.

Comprehension Type

Hydrogen is prepared in the laboratory by the action of dilute acid on zinc.

10. Which of the following impurity absorbs $AgNO_3$ solution?

1) Arsine 2) Phosphine 3) Both 1 and 2 4) Hydrazine

11. Hydrogen gas is collected by:

1) Upward displacement of water 2) Downward displacement of alcohol

3) Downward displacement of water 4) Upward displacement of alcohol

12. In washer bottle 4-contains anhydrous $CaCl_2$:

Which absorbs impurity as:

1) NO_2 2) CO_2 3) SO_2 4) Moisture

Matrix Matching Type

13.

Column-I	**Column-II**
a) $AgNO_3$ absorbs	1) PH_3
b) KOH absorbs	2) H_2S
c) $CaCl_2$ absorbs	3) NO_2, CO_2 and SO_2
d) $Pb(NO_3)_2$	4) Moisture

14.

Column-I	**Column-II**
a) KOH	1) Silver nitrate
b) $CaCl_2$	2) Lead nitrate
c) $AgNO_3$	3) Calcium chloride
d) $Pb(NO_3)_2$	4) Potassium hydroxide
	5) Potassium chloride

SYNOPSIS - 4

PHYSICAL PROPERTIES OF HYDROGEN:

1) Nature: (i) Pure hydrogen is (a) colourless (b) odourless (c) tasteless gas

(ii) Impure hydrogen has fishy smell, because of phosphine and arsine gases present as impurities.

(iii) Nonpoisonous.

2) Density:

Hydrogen is lightest element. = 0.08987 gl^{-} (vapour density of hydrogenis 1)

3) Solubility: Hydrogen is practically insoluble in water.

4) Boiling point: Liquid hydrogen boils at – 253^{0}C. (20.5K)

5) Melting point: Solid hydrogen melts at – 259.4^{0}C. (14.0 K)

6) Liquefaction: Hydrogen is a difficult gas to liquefy. It liquefies at a temperature of – 243^{0}C at a pressure of 20 atm.

7) Adsorption or occlusion: The property by virtue of which certain substances adsorb gases on their outer surface is called adsorption.

Ex: Palladium, gold, nickel, platinum.

CHEMICAL PROPERTIES OF HYDROGEN:

1. **Combustibility:** Hydrogen is a combustible gas, but it does not support combustion. In air or oxygen, it burns silently, with a very pale blue flame. However, if hydrogen is premixed with air or oxygen, it explodes with a pop sound, because of spontaneous combustion.
2. **Action with litmus:** Hydrogen is neutral towards litmus solution.
3. **Action with non-metals:**

(i) Oxygen: Hydrogen burns silently in oxygen with a pale blue flame.

$2H_2 + O_2 \longrightarrow 2H_2O$

(ii) Chlorine: Equal volumes of H_2 and Cl_2 react slowly in diffused sunlight and explosively in direct sunlight. $H_2 + Cl_2 \longrightarrow 2HCl$

(iii) Nitrogen: Nitrogen reacts with hydrogen to form ammonia.

$N_2 + 3H_2 \longrightarrow 2NH_3$; Temp - 450 - 500^{0}C, pressure: 200 – 900 atm, catalyst – finely divided iron and promoter is molybdenum.

(iv) Sulphur: $H_2 + S \longrightarrow H_2S$

4. **Action with metals:** Most of the metals do not react with hydrogen. However, when dry hydrogen gas is passed over heated Na, K or Ca, they react to form their respective hydrides.

$2K + H_2 \xrightarrow{\Delta} 2KH$

$2Na + H_2 \xrightarrow{\Delta} 2NaH$

$Ca + H_2 \xrightarrow{\Delta} CaH_2$

The hydrides further react with cold water forming hydrogen.

$CaH_2 + 2H_2O \longrightarrow Ca(OH)_2 + 2H_2$

5. **Reducing properties of hydrogen:** When hydrogen gas is passed over heated oxides of the less active metals such as zinc, iron, lead and copper, it reduces them to free metals and forms water.

Metal oxide	+	**Hydrogen**	$\xrightarrow{\Delta}$	**Free metal**	+	**Water**
ZnO	+	H_2	$\xrightarrow{\Delta}$	Zn	+	H_2O
Fe_2O_3	+	$3H_2$	$\xrightarrow{\Delta}$	$2Fe$	+	$3H_2O$
PbO	+	H_2	$\xrightarrow{\Delta}$	Pb	+	H_2O
CuO	+	H_2	$\xrightarrow{\Delta}$	Cu	+	H_2O

Note: i) In the above reactions, hydrogen is a reducing agent and hence, is oxidized to water.

ii) In the above reactions, the metallic oxides are oxidizing agents and hence are reduced to free metals.

Hydrogenation – involves addition of hydrogen to organic compounds:

Addition of hydrogen to organic compounds in the presence of a catalysts like platinum or nickel is called hydrogenation.

$$H_2C = CH_2 + H_2 \longrightarrow C_2H_6$$

TEST FOR HYDROGEN:

Test	**Observation**
Colour, odour, nature	Colourless, odourless, neutral gas, lighter than air and density
Combustibility of	
a) Pure hydrogen forming	Burns quietly in air with a pale blue flame water as the only product.
b) Hydrogen - air moisture	Burns with a characteristic 'pop sound' $[2H_2 + O_2 \rightarrow 2H_2O + \Delta]$

Uses of hydrogen:

(1) As a fuel: It is present in coal gas (45 %) and water gas (50%) by volume. It produces a large amount of energy with the formation of water only and no other gases. It is an excellent non- polluting fuel.

(2) For cutting and welding purposes: The flame of hydrogen and oxygen can produce a temperature of 2800°C. This flame is used for cutting and welding metals.

(3) For meteorological purposes: To study weather conditions.

(4) For the manufacture of industrial chemicals: Used extensively in the manufacture of NH_3 and HC*l*.

(5) In hydrogenation reactions: Used in hydrogenation of oil [ghee preparation] and hydrogenation of coal.

(6) In extraction of metals: Hydrogen acts as a reducing agent and reduces metallic oxides to metals.

(7) For making artificial petroleum: The artificial petroleum can be fractionally distilled so as to obtain various useful fractions like petrol, kerosene oil, diesel, etc.

WORK SHEET - 4

Single Answer Type

1. Melting point of hydrogen is _____
   1) –259.4^{0}C 2) 259.4^{0}C 3) 25.94^{0}C 4) –25.94^{0}C
2. The property by virtue of which certain substance adsorb gases on their outer surface is called _____
   1) Absorption 2) Occlusion 3) Desorption 4) None
3. Hydrogen is _____
   1) Support combustion 2) Combustible gas
   3) Non combustible gas 4) All
4. $ZnO + H_2 \xrightarrow{\Delta} Zn + H_2O$
   In the above reaction, which element is act as a reducing agent?
   1) H_2 2) ZnO 3) Zn 4) None
5. Hydrogen burns in air (or oxygen) with a _____ flame.
   1) Pale - blue 2) Blue 3) Red 4) Pale green
6. Hydrogen reacts with chlorine in the presence of _____, to form hydrogen chloride gas.
   1) Diffused sunlight 2) Electric current
   3) Catalyst 4) None
7. When hydrogen reacts with chlorine in the presence of direct sunlight, the result is:
   1) Reaction is explosive 2) Hydrogen chloride is formed
   3) Both 1 and 2 4) Only 1 is correct, 2 is not possible
8. A reaction in which a metallic oxide loses its oxygen to form pure metal is called:
   1) Reduction reaction 2) Oxidation reaction
   3) Redox reaction 4) None
9. Hydrogen act as a _____
   1) Oxidising agent 2) Reducing agent
   3) Neither oxidising nor reducing agent 4) None

10. Which one of the following shows practically insolubility of hydrogen?
    1) 100 volumes of water can absorbs only 50 volumes of hydrogen gas
    2) 100 volumes of water can absorbs only 30 volumes of hydrogen gas
    3) 100 volumes of water can absorbs only 2 volumes of hydrogen gas
    4) 100 volumes of water can absorbs only 10 volumes of hydrogen gas
11. Vegetable oils are the complex compounds of:
    1) Carbon, hydrogen and oxygen 2) Carbon, nitrogen and oxygen
    3) Carbon, hydrogen and nitrogen 4) Hydrogen, nitrogen and oxygen
12. Which one of the following is correct statement(s) regarding hydrogen?
    1) Pure hydrogen burns silently in air
    2) A mixture of hydrogen and air explodes with a pop sound
    3) Hydrogen burns in air, produces pop sound due to spontaneous combustion.
    4) All the above
13. In hydrogenation of oils catalyst used is:
    1) Nickel 2) Platinum 3) Asbestos 4) Both 1 and 2

Multi Answer Type

14. Hydrogen is used in the manufacture of ?
    1) Ammonia gas 2) Hydrogen chloride
    3) Sodium chloride 4) Magnesium
15. Boiling point of liquid hydrogen is _____
    1) -253^0C 2) 253^0C 3) 20.5K 4) –20.5K
16. Which of the following is correct statement for Hydrogen?
    1) Hydrogen is colourless 2) Hydrogen is odourless
    3) Hydrogen is tasteless 4) Hydrogen is lightest element
17. Which of the following is correct statement:
    1) Hydrogen flame is used for cutting and welding purposes
    2) Hydrogen used in hydrogenation of oil.
    3) Hydrogen used in making artificial petroleum.
    4) Density of hydrogen is 0.008987 gram lit^{-1}.
18. Hydrogen is used for the extraction of metals like _____ from their oxides.
    1) Tungsten 2) Copper 3) Lead 4) Tin

Reasoning Answer Type

19. *Statement I:* Working with large volumes of hydrogen gas is dangerous.
    Statement II: When a small flame is brought nearer explodes like a bomb.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

20. *Statement-I :* Nitrogen reacts with hydrogen to form ammonia.
Statement-II: Hydrogen is used for the manufacture of industrial chemicals.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

21. *Statement-I:* Most of the metals doesn't react with hydrogen.
Statement-II: $2K + H_2 \xrightarrow{\Delta} 2KH$
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

22. *Statement I:* The balloon filled with equal volumes of hydrogen and helium gases do not cause accidental fires.
Statement II: A mixture of hydrogen and oxygen burns with a characteristic of pop sound is test for hydrogen
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Hydrogen is lightest gas which is colourless, odourless and tasteless. Hydrogen is practically insoluble in water.

23. Which gas is neutral towards litmus?
1) Sulphur dioxide 2) Hydrogen 3) Carbon dioxide 4) None of these

24. Identify the element for which atomic number is one, vapour density is one, number of protons is one.
1) Nitrogen 2) Hydrogen 3) Helium 4) Oxygen

25. Hydrogen liquifies at temperature:
1) –253°C 2) –259.4°C 3) –243°C 4) –150°C

Matrix Matching Type

26. **Column-I** **Column-II**

a) $Fe_2O_3 + H_2$ 1) $Pb + H_2O$

b) $CaH_2 + H_2O$ 2) $Fe + H_2O$

c) $CH_2 = CH_2 + H_2$ 3) C_2H_6

d) $PbO + H_2$ 4) $Ca(OH)_2 + H_2$

27. **Column - I** **Column - II**

a) Boiling point of hydrogen 1) 450 - 500^{0}C

b) $N_2 + 3H_2 \rightarrow NH_3$ 2) 0.08987 g L^{-1}

c) Density of hydrogen 3) 20.5 kelvin

d) Melting point of hydrogen 4) 200 - 900 atm.

5) 14.0 kelvin

28. **Column-I** **Column-II**

a) The property by virtue of which certain substances adsorb gases un their outer surface 1) Catalyst in preparation of ammonia

b) Pale blue flame 2) Hydrogenation

c) Finely divided iron 3) Hydrogen

d) Addition of hydrogen to organic compounds in the presence of catalyst like platinum or Nickel is 4) Adsorption

KEY

WORK SHEET – 1 (KEY)				
1) 2	**2)** 3	**3)** 3	**4)** 4	**5)** 2
6) 4	**7)** 1	**8)** 2	**9)** 1,2,3,4	**10)** 1,2,3,4
11) 3	**12)** 2	**13)** 2	**14)** 3	**15)** 1
16) A-3 B-1 C-2 D-4	**17)** A-3 B-4 C-1 D-2			

WORK SHEET – 2 (KEY)				
1) 2	**2)** 3	**3)** 1	**4)** 3	**5)** 4
6) 2	**7)** 1,2,3,4	**8)** 1,2	**9)** 2	**10)** 1
11) 4	**12)** 2	**13)** 3	**14)** A-4,2 B-1 C-3 D-2,4	**15)** A-1 B-3 C-4 D-2

WORK SHEET – 3 (KEY)				
1) 2	**2)** 1	**3)** 3	**4)** 3	**5)** 4
6) 1,2,3	**7)** 2	**8)** 2	**9)** 2	**10)** 3
11) 3	**12)** 4	**13)** A-1 B-3 C-4 D-2	**14)** A-4 B-3 C-1 D-2	

WORK SHEET – 4 (KEY)				
1) 1	**2)** 2	**3)** 2	**4)** 1	**5)** 1
6) 1	**7)** 3	**8)** 1	**9)** 2	**10)** 3
11) 1	**12)** 4	**13)** 4	**14)** 1,2	**15)** 1,3
16) 1,2,3,4	**17)** 1,2,3,4	**18)** 2,3	**19)** 1	**20)** 2
21) 2	**22)** 2	**23)** 2	**24)** 2	**25)** 3
26) A-2 B-4 C-3 D-1	**27)** A-3 B-1 C-2 D-5	**28)** A-4 B-3 C-1 D-2		

OXYGEN

SYNOPSIS - 1

INTRODUCTION:

Oxygen forms 21 % of the air by volume and is very vital for our existence and the existence of all forms of animals and vegetable life. It is due to absorption of oxygen, that our respiratory system burns food materials at controlled rate, to produce heat energy which not only maintains our body temperature at 37°C, but also helps us to perform various life activities.

Discovery:

Oxygen was discovered by a British chemist **Joseph Priestley** in 1774. He heated mercury (II) oxide [HgO by concentrating rays of the sun. He found out that gas evolved is colourless and odourless, but is chemically active. A glowing splint gets rekindled when introduced in the gas. Priestly named this gas **"active air"**.

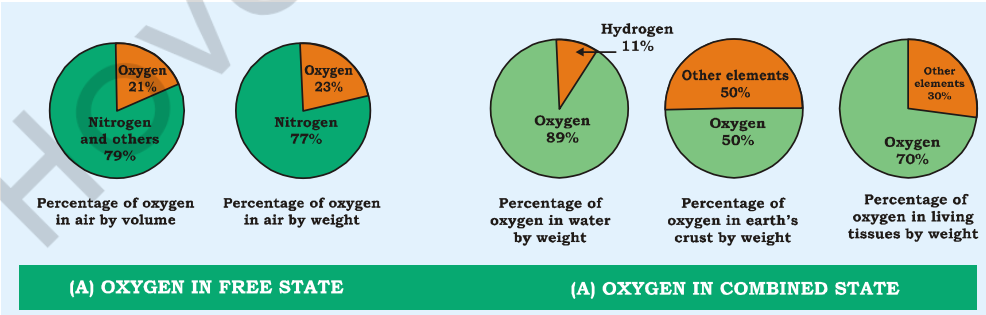
Carl Wilhelm Scheele (1777) obtained the Oxygen gas by strongly heating compounds, such as nitre [KNO_3, or mercury (II) oxide in a hard glass test tube. He named this gas as **dephlogisticated air or fire air,** as it supported combustion but itself does not burn.

Lavoisier proved later on, that oxygen is an element. As a matter of fact, it was Lavoisier who named this gas as oxygen, meaning acid former, because he believed that oxygen is the constituent of all acids.

Occurrence of Oxygen:

1. Oxygen is the most abundant element occurring on the earth, both in free, as well as in combined state. As a matter of fact the total weight of element oxygen on the crust of earth, is as much as the total weight of all the elements taken together.
2. It occurs both in free state as well as combined state.

Oxygen in Free state:



a) **In air :** It constitutes 21% by volume of air. It constitutes 23% by weight of air.

b) **In water :** Oxygen dissolves in large water bodies such as lakes, rivers, seas and oceans. Though the percentage of dissolved oxygen in water small, it is very important for the respiration of water animals and plants.

Oxygen in combined state:

i) **In water :** 8/9th part by weight of water (89%) contains oxygen in combined state.

ii) **In minerals:** Solid crust of earth is made of minerals like oxides; carbonates and phosphates of metals. It is estimated, that approximately [50% of earth's crust is made of oxygen in combined state.

iii) **In the tissues of plants and animals:** Roughly 50% - 70% by weight of living plants or animal cells, contain oxygen in combined state.

WORK SHEET - 1

Single Answer Type

1. Name the scientist who named oxygen gas as dephlogisticated air or fire air:
   1) Lavoisier 2) Joseph Priestly
   3) Dalton 4) Carl Wilhelm scheele
2. The scientist who proved oxygen to be an element is:
   1) Carl wilhelm 2) Landsteiner 3) Cavendish 4) Lavoisier
3. Choose the false statement.
   1) Oxygen is also known to be active air.
   2) Oxygen is also known to be water maker.
   3) Oxygen is also known to be fire air.
   4) Oxygen is also known to be acid former.
4. Study the following statements and identify the element.
   (i) The most abundant element occurring on the earth, both in free as well as in combined state.
   (ii) It constitutes 21% by volume of air.
   1) O_2 2) N_2 3) CO_2 4) SO_2
5. Oxygen was discovered by a British chemist __I__ in __II__. He heated __III__ by concentrating rays of the sun. He found out that gas evolved is colourless, odorless but is chemically active.

	I	II	III
1)	Lavoisier	1890	Potassium nitrate
2)	C.W. Scheele	1800	Potassium chlorate
3)	Joseph Priestly	1774	Mercury(II) oxide
4)	James clark	1722	Mercury

6. Give the scientist names for the following statements?
   i) When mercury oxide is heated a colourless and odourless gas evolved is active.
   ii) The gas obtained by strong heating of KNO_3 and HgO in hard glass test tube is dephlogisticated air.

iii) Oxygen is an element.

	(i)	(ii)	(iii)
1)	Joseph priestley	Lavoisier	Carl wilhelm scheele
2)	Joseph priestley	Carl wilhelm scheele	Lavoisier
3)	Carl wilhelm scheele	Joseph priestley	Lavoisier
4)	Daniel Rutherford	Joseph priestley	Carl wilhelm scheele

Multi Answer Type

7. Oxygen gas is also called as:
   1) Active air
   2) Fire air
   3) Dephlogisticated air
   4) Inactive air

8. Which of the following is/are correct statement(s)?
   1) Oxygen was discovered by British chemist Joseph Priestley.
   2) The percentage of oxygen in water by weight is 50%.
   3) The percentage of oxygen is living tissues by weight is 70%.
   4) The percentage of oxygen in air by volume is 21%.

Reasoning Answer Type

9. *Statement I:* Lavoisier named the oxygen, means acid former.
   Statement II: Oxygen is the constituent of all acids.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

10. *Statement I*:Oxygen dissolves in large water bodies such as lakes, rivers, seas and oceans.
   Statement II:$8/9^{th}$ part by weight of water (89%) contains oxygen in combined state.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

11. **Statement I:** Oxygen is available in the tissues of plants and animals.
   Statement II: Oxygen is most abundant element on the earth.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

Comprehension Type

Oxygen is the most abundant element occurring on the earth, both in free, as well as in combined state.

12. Oxygen gas named as active air by:
1) Joseph Priestley 2) Scheele 3) Lavoisier 4) Cavendish

13. What is the valency of oxygen?
1) 3 2) 1 3) 2 4) 4

14. The percentage of oxygen in air by volume is:
1) 30% 2) 89% 3) 21% 4) 78%

Matrix Matching Type

15.

Column-I	**Column-II**
a) Percentage of oxygen in air by volume	1) 50%
b) Percentage of oxygen in air by weight	2) 70%
c) Percentage of oxygen in water by weight	3) 23%
d) Percentage of oxygen in earth's crust by weight	4) 89%
	5) 21%

16.

Column-I	**Column-II**
a) Dephlogisticated air	1) Obtained by strongly heating compounds nitre or mercury oxide
b) Percentage of oxygen in earth crust by weight	2) 89%
c) Percentage of oxygen in water by weight	3) Lavoisier
d) Potassium nitrate	4) KNO_3
	5) 50%

SYNOPSIS - 2

GENERAL METHODS OF PREPARATION OF OXYGEN:

1. By heating oxides of mercury and silver:

Heating of mercuric oxide [HgO: When mercuric oxide is heated strongly, it decomposes to form mercury and free oxygen gas.

$$2HgO(s) \xrightarrow{\Delta} 2Hg(l) + O_2(g) - \Delta t$$

Observations:

Mercuric oxide is red in colour.

On heating, it blackens and gives off colourless vapours.

A mirror like surface is formed near the cooler parts of the test tube.

A glowing wooden splint bursts into flame, when held in the test tube. It shows that gas evolved is oxygen.

Heating of silver (I) oxide [Ag_2O: When silver (I) oxide is heated strongly, it decomposes to form silver metal and oxygen gas.

$$2Ag_2O(s) \xrightarrow{\Delta} 4Ag(s) + O_2(g) - \Delta t$$

Observations:

Silver (I) oxide is brown in colour.

On heating, it leaves behind globules which are silvery in colour.

A glowing wooden splint bursts into flame, when held in the test tube. It shows, that gas evolved is oxygen.

2. By heating higher oxides of lead:

Heating of red lead oxide (tri lead tetraoxide) [Pb_3O_4: On strong heating red lead oxide decomposes to form lead monoxide [PbO and oxygen gas.

$$2Pb_3O_4(s) \xrightarrow{\Delta} 6PbO(s) + O_2(g) - \Delta t$$

Observations:

Red lead is orange red in colour.

The residue is reddish brown when hot and yellow when cold.

If a glowing wooden splint is held in the test tube, it bursts into flame, thereby showing that gas evolved is oxygen.

A part of residue fuses in glass test tube and stains it yellow.

Heating of lead (IV) oxide (lead dioxide) [PbO_2: On strong heating lead (IV) oxide decomposes to form lead monoxide [PbO and oxygen gas.

$$2PbO_2(s) \xrightarrow{\Delta} 2PbO(s) + O_2(g)$$

Observations: Same as in case of red lead oxide, except that, it is chocolate brown in colour, before heating.

3. Preparation of Oxygen from hydrogen peroxide: Hydrogen peroxide is a colourless liquid having 20% of hydrogen peroxide and 80% of water. When hydrogen peroxide is allowed to trickle over manganese dioxide, it rapidly decomposes to form water and oxygen gas.

$$2H_2O_2(l) \xrightarrow[\text{Catalyst}]{MnO_2} 2H_2O(l) + O_2(g)$$

From Sodium Peroxide:

When water is allowed to trickle drop by drop on sodium peroxide a vigorous reaction takes place in the cold, forming sodium hydroxide solution and oxygen gas.

$$2Na_2O_2(s) + 2H_2O(l) \longrightarrow 4NaOH(aq) + O_2(g)$$

From Potassium Chlorate:

When four parts of potassium chlorate ($KClO_3$) and **one part** of manganese dioxide is heated strongly, then chemical decomposition takes place with the formation of potassium chloride and oxygen gas. **Manganese dioxide does not take part in the chemical reaction,** but only helps in accelerating the rate of decomposition of potassium chlorate and hence, is a catalyst.

$$2KClO_3(s) \xrightarrow[\text{Heat}]{MnO_2} 2KCl(s) + 3O_2(g).$$

From Water:

This method is followed only at those places, where electricity is very cheap. In addition to the formation of oxygen, hydrogen is also formed as a by-product, which is collected separately.

The tank is used for the decomposition of water. When heavy current is passed through acidulated water (water containing sulphuric acid, so as to make it good conductor of electricity), it decomposes to form hydrogen gas, which is liberated at cathode (negative pole) and oxygen gas, which is liberated at anode (positive pole).

$$2H_2O(l) \xrightarrow[\text{current}]{\text{Electric}} 2H_2(g) + O_2(g)$$

FROM AIR:

(i) Purification of air:

Air generally contains carbon dioxide gas, hydrogen sulphide gas and sulphur dioxide gas as impurities. In addition to it there are dust particles.

Air is first of all washed by passing it through water, when dust particles are removed.

The washed air is then passed through dilute caustic soda solution, where gases like carbon dioxide, sulphur dioxide and hydrogen sulphide are removed.

The purified air, however, contains moisture. The moist air is passed through pipes, maintained at a temperature below –20°C, where water vapour present in it freezes and hence, air becomes dry.

The air leaving the cooling pipes, is free from all impurities.

(ii) Liquefaction of air:

The cool air, free from all impurities is compressed to a pressure, 200 times more than atmospheric pressure. The compression raises the temperature of air.

The hot compressed air is then passed through cooling tank in which cold water enters from one end and warm water leaves from other end.

The compressed and cooled air is then passed through a spiral pipe, placed in a vacuum flask. The end of spiral pipe is provided with a fine jet.

When compressed, air suddenly escapes from jet, its pressure suddenly falls. Thus, its molecules move wide apart. When the molecules move wide apart, they need energy. This energy is taken by the molecules from themselves and hence, their temperature drops.

The air so cooled, is now at a pressure equal to that of atmosphere. This cooled air rises up and in the process, further cools the incoming compressed air in spiral tube.

The air is then sucked again by the compression pump and the cycle is repeated. With every cycle, the temperature of air drops, till it liquefies.

(iii) Fractional distillation of air:

The liquid air mainly consists of nitrogen and oxygen, and is at a temperature of –200°C.

The boiling point of liquid nitrogen is –195.8°C and that of liquid oxygen is –183°C.

The liquid is gradually warmed to –195°C, when nitrogen starts boiling off from the liquid air. The nitrogen gas so formed, is compressed and filled in steel cylinders.

The liquefied oxygen left behind, is also changed to gas and then filled in compressed state in steel cylinders.

WORK SHEET - 2

Single Answer Type

1. Which of the following is the test for oxygen?
   1) Turns lime water milky.
   2) A glowing wooden splint burns into flame.
   3) Copper blue sulphate crystals turn white in colour
   4) White dense fumes are observed in the test tube containing $NH_4Cl(s)$ in the presence of oxygen.

2. $2KClO_3(s) \xrightarrow[\text{Heat}]{MnO_2} 2KCl(s) + 3O_2(g)$

   The chemical that does not take part in the above reaction but helps in accelerating the rate of reaction is:
   1) $KClO_3$ 2) MnO_2
   3) Both $KClO_3$ and MnO_2 4) Neither KCl nor MnO_2

3. When hydrogen peroxide is allowed to trickle over manganese dioxide, it rapidly decomposes to form:
   1) Carbon dioxide and Hydrogen. 2) Water and Oxygen gas
   3) Carbon monoxide and Hydrogen. 4) Carbon and Oxygen.

4. _____ solution is used in removal of impurities present in air:
   1) Dil. Caustic soda solution 2) Con. Caustic soda solution
   3) Dil. Hydrochloric acid 4) Con. Hydrochloric acid

5. Liquid air is mainly consists of:
   1) Nitrogen and oxygen 2) Carbon dioxide and nitrogen
   3) Carbon dioxide and oxygen 4) Carbon dioxide and hydrogen

6. The boiling point of liquid nitrogen is:
   1) -183^0C 2) -195.8^0C 3) 183^0C 4) 195^0C

7. The boiling point of liquid oxygen is:
   1) -183^0C 2) -195.8^0C 3) 183^0C 4) 195^0C

8. Hydrogen peroxide is a ___(P)___ liquid have ___(O)___ of hydrogen peroxide and ___T___ of water.

	P	O	T
1)	Black	80%	20%
2)	Colourless	20%	80%
3)	Red	50%	50%
4)	White	60%	40%

9. The liquid air mainly consists of (H) & (A), & is at a temperature of (T).

H	A	T
1) Carbon	Chlorine	–100°C
2) Argon	Carbon	–1000°C
3) Nitrogen	Oxygen	–200°C
4) Helium	Chlorine	–500°C

10. $2Na_2O_2(s) + 2H_2O(l) \longrightarrow A + B$

A	B
1) 2NaOH	$H_2\uparrow$
2) 3NaOH	$2O_2\uparrow$
3) 4NaOH	$O_2\uparrow$
4) NaOH	$2O_2\uparrow$

11. When water is allowed to trickle drop by drop on sodium peroxide a vigorous reaction takes place in the cold, forming sodium hydroxide solution and oxygen gas.
The balanced chemical equation for the above reaction is:
1) $NaO_2(s) + H_2O(l) \longrightarrow NaOH + O_2$. 2) $2NaO_2 + H_2 \longrightarrow Na_2O_2 + O_2$.
3) $2Na_2O_2(s) + 2H_2O(l) \longrightarrow 4NaOH(aq) + O_2(g)$.
4) $Na_2O_2(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + O_2(g)$.

Multi Answer Type

12. A teacher performed the following experiment in the laboratory. He took red lead and heated strongly:
Choose the possible observations that can be made from the following:
1) Red lead oxide decomposes to form lead monoxide and oxygen gas.
2) The residue is reddish brown when hot and yellow when cold.
3) If a glowing wooden splint is held in the test tube, if busts into flame, there by showing that gas evolved is oxygen.
4) A part of residue fuses in glass test tube and stains it yellow.

13. $2H_2O_2(l) \xrightarrow{MnO_2} 2H_2O(l) + O_2(g)$
Which of the following is/are correct for the above reaction?
1) It is a rapid decomposition.
2) Oxygen gas liberated can be collected by downward displacement of water.
3) Hydrogen peroxide is a colourless liquid.
4) A brisk reaction occurs with the liberation of oxygen gas.

14. Which of the following gas is/are impurities present in air?
1) Carbon dioxide gas 2) Hydrogen sulphide gas
3) Sulphur dioxide gas 4) None of these

15. Which of the following is correct for heating of red lead oxide?
    1) Red lead is orange in colour
    2) PbO_2 is a chacolate brown colour before heating.
    3) The residue is yellowish brown in colour when hot.
    4) A glowing wooden splint is held in the test tube it bursts into flame.
16. Which of the following is the correct option, in the steps of purification of air?
    a) Dust particles are removed, washing air by passing through water.
    b) In the purified air, moisture is removed by maintaining the temperature below -20^0C.
    c) When air is passed through dil. caustic soda solution impurities like CO_2, SO_2 and H_2S are removed.
    1) c, a and b 2) a,c and b 3) a,b,c 4) b,c,a
17. In the liquefaction of air, compression of air require the pressure of:
    1) 20 times more than atmospheric pressure
    2) 200 times less than atmospheric pressure
    3) 200 times more than atmospheric pressure
    4) 40 times more than atmospheric pressure

Reasoning Answer Type

18. *Statement I:* Pb_3O_4 is orange red in colour.
    Statement II: PbO_2 is chocolate brown in colour.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.
19. *Statement I:* Air contains gaseous substances as impurities.
    Statement II: The liquid air mainly consists of nitrogen and oxygen, and is at a temperature of -200^0C.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.
20. *Statement I:* When mercuric oxide is heated strongly, it decomposes to form mercury and free oxygen gas.
    Statement II: Silver oxide is red in colour.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

21. *Statement I:* Water decomposes into hydrogen and oxygen by electrolysis.
Statement II: Nitrogen and oxygen present in liquid air are separated by fractional distillation process.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Writeup-1:

Hydrogen peroxide is a colour less liquid having 20% of hydrogen peroxide and 80% of water.

When water is allowed to trickle drop by dron on sodium peroxide a vigorous reaction takes place in the cold.

22. The catalyst used in decomposition of hydrogen peroxide is:
1) Nickel 2) Platinum
3) Manganese dioxide 4) Palladium

23. The chemical formula of sodium peroxide is:
1) NaO 2) NaO_2 3) Na_2CO_3 4) Na_2O_2

24. What are the two compounds formed when sodium peroxide with water?
1) NaOH 2) O_2 3) H_2O_2 4) Both 1 and 2

Writeup-2:

When mercuric oxide is heated strongly it, decomposes to form mercury and free oxygen gas. In the same way silver oxide is heated strongly it decomposes to form silver metal and oxygen gas.

25. Name a liquid that can be used for the preparation of oxygen in laboratory.
1) NaC*l* 2) Pb_3O_4 3) H_2O_2 4) Ag_2O

26. Name a solid which on coming in contact with water produces oxygen gas.
1) H_2O_2 2) Na_2O_2 3) $KClO_3$ 4) PbO_2

27. On strong heating lead (IV) oxide decomposes to form lead monoxide and oxygen gas
Which of the following is a balanced chemical equation for the above reaction?
1) $2Pb_3O_4(s) \xrightarrow{\Delta} 6PbO(s) + O_2(g) - \Delta$ 2) $Pb_3O_4(s) \xrightarrow{\Delta} 6PbO(s) + H_2(g)\ \Delta t$
3) $2PbO_2(s) \xrightarrow{\Delta} 2PbO(s) + O_2(g)$ 4) $2Pb(s) + O_2 \xrightarrow{\Delta} PbO(s) + O_2(g)$

Matrix Matching Type

28.

Column - I	**Column - II**
a) HgO	1) $PbO + O_2$
b) Ag_2O	2) KC*l* + O_2
c) Pb_3O_4	3) Hg + O_2
d) $KClO_3$	4) Ag + O_2

29. **Column-I**

a) Tri lead tetraoxide
b) Lead dioxide
c) Silver(I) oxide
d) Mercuric oxide

Column-II

1) Ag_2O
2) Pb_3O_4
3) HgO
4) PbO_2

SYNOPSIS - 3

PHYSICAL PROPERTIES OF OXYGEN:

Nature: It is colourless, odourless and tasteless gas.

Vapour density: It is slightly heavier than air. Its vapour density is 16, whereas that of air is 14.4. It is because of its higher vapour density, that amount of oxygen on higher altitudes decreases.

Solubility: Under laboratory conditions, oxygen is practically insoluble in water, e.g., 100 cm^3 of water will dissolve only 4 cm^3 of oxygen after a prolonged interval of time.

Liquefaction: Under high pressure and low temperature, oxygen can be liquefied. The liquid oxygen is slightly blue in colour and has a boiling point –183°C.

CHEMICAL PROPERTIES OF OXYGEN:

Combustibility: Oxygen is an incombustible gas, but it supports combustion. When a glowing splinter is taken in the jar of oxygen, it rekindles.

Action with litmus: Oxygen neither turns moist blue litmus red, nor red litmus blue and hence, is neutral towards litmus i.e., it is neither acidic nor basic in character.

Oxidising properties: Oxygen is a very active element. It reacts with most of the metals (exception is gold, silver and platinum), non-metals and compounds containing carbon to form their respective oxides.

Oxidation of Non-metals:

Action with hydrogen: When two volumes of hydrogen and one volume of oxygen are electrically sparked, they react with blinding flash and loud explosion, to form water.

However, if a mixture of two volumes of hydrogen and one volume of oxygen, under pressure are passed through a pipe with a very small hole and the mixture is ignited, it burns with intense hot blue flame, commonly called **oxy-hydrogen flame**.

$$2H_2(g) + O_2(g) \xrightarrow[\text{Spark}]{\text{Electric}} 2H_2O(l) + \Delta t$$

Products : only water

Colour of flame : Very pale blue

Effect on litmus solution : Neutral.

Self-oxidation: Normally an element never reacts with itself. When silent electric discharge is passed through oxygen, about 2% of it reacts with itself, to form ozone.

$$3O_2(g) \xrightarrow[\text{Discharge}]{\text{Silent electric}} \underset{\text{(Ozone)}}{2O_3(g)} - \Delta t$$

Action with nitrogen: When equal volumes of nitrogen and oxygen are electrically sparked, they react to form nitric oxide gas. However, reaction is reversible and only 2% gases react.

$$N_2(g) + O_2(g) \xrightarrow[300^\circ C]{\text{Electric spark}} 2NO(g) - \Delta t$$

Action with carbon: When red hot charcoal is taken in the jar containing oxygen, it starts glowing with a yellowish glow and gives off bright sparkles to form carbon dioxide gas.

$$C(s) + O_2(g) \xrightarrow{\Delta} CO_2(g) + \Delta t$$

Products: Carbon dioxide gas

Colour of flame: Bright yellow

Effect on litmus solution: Blue to red.

The reaction is exothermic. The presence of carbon dioxide can be shown by adding a few drops of limewater to gas jar, where it turns milky.

Action with sulphur: When burning sulphur (in deflagrating spoon) is introduced in the jar of oxygen, it burns with beautiful blue flame forming a mixture of sulphur dioxide and sulphur trioxide.

$$2S\ (s) + 3O_2\ (g) \xrightarrow{\Delta} 2SO_3\ (g) + \Delta t \quad \text{(In traces)}$$

$$S\ (s) + O_2\ (g) \xrightarrow{\Delta} SO_2(g) + \Delta t \quad \text{(Main reaction)}$$

Products: Sulphur dioxide and traces of sulphur trioxide.

Colour of flame: Brilliant blue

Effect on litmus solution: Blue to red and then gets bleached.

Effect on dichromate solution: Orange to green.

The presence of sulphur dioxide can be shown, by adding a few drops of acidified potassium **dichromate solution** ($K_2Cr_2O_7$ solution) to the gas, where it turns green.

Action with phosphorus: When burning phosphorus (in deflagrating spoon) is introduced in the jar of oxygen, it burns with brilliant white flame, forming dense white fumes of phosphorus pentoxide.

$$4P(s) + 5O_2(g) \xrightarrow{\Delta} 2P_2O_5(s) + \Delta t$$

Products: Phosphorus pentoxide

Colour of flame: Bright white and dense white fumes.

Effect on litmus solution: Blue to red.

OXIDATION OF METALS:

Action with potassium: When slightly warm potassium is taken in a jar of oxygen (by means of deflagrating spoon), it catches fire and burns with lilac flame to form potassium oxide.

$$4K(s) + O_2(g) \xrightarrow{\Delta} 2K_2O(s) + \Delta t$$

Products: Potassium oxide

Colour of flame: Lilac flame.

Action on litmus solution: Red to blue

Potassium oxide is basic in nature.

Action with sodium: When slightly warm sodium is taken in a jar of oxygen (by means of deflagrating spoon), it catches fire and burns with a brilliant golden yellow flame.

$$4Na(s) + O_2(g) \xrightarrow{\Delta} 2Na_2O(s) + \Delta t$$

Products: Sodium oxide

Colour of flame: Golden yellow

Action on litmus solution: Red to blue

Sodium oxide is basic in nature.

Action with calcium: When burning calcium is taken in the jar of oxygen (by means of deflagrating spoon), it catches fire and burns with a brick red flame.

$$2Ca(s) + O_2(g) \xrightarrow{\Delta} 2CaO(s) + \Delta t$$

Products: Calcium oxide

Colour of flame: Brick red

Action on litmus solution: Red to blue

Calcium oxide is basic in nature.

Action with magnesium: When burning magnesium wire is introduced in jar of oxygen, it burns vigorously with a dazzling white flame to form white powdery magnesium oxide.

$$2Mg(s) + O_2(g) \xrightarrow{\Delta} 2MgO(s) + \Delta t$$

Products: Magnesium oxide

Colour of flame: Dazzling white.

Action on litmus solution: Red to light blue.

Magnesium oxide is weakly basic in nature.

Action with iron: When red hot tip of an iron wire is introduced in the jar of oxygen, it starts glowing to form white hot tip, but no flame is formed. It gives off white sparks, with crackling noise and forms a reddish brown powder of triferric tetraoxide.

$$3Fe(s) + 2O_2(g) \xrightarrow{\Delta} Fe_3O_4(s) + \Delta t$$

Products: Triferric tetraoxide

Colour of flame: No flame but white sparks fly off

Action on litmus solution: No effect. Triferric tetraoxide is insoluble in water.

Action with copper: When red hot tip of a copper wire is introduced in the jar of oxygen it starts glowing, to form white hot tip, but no flame is formed. It gives off green sparks, with crackling noise, and forms a black powder, of copper (II) oxide.

$$2Cu(s) + O_2(g) \xrightarrow{\Delta} 2CuO(s) + \Delta t$$

Products: Copper (II) oxide

Colour of flame: No flame, but green sparks fly off

Action on litmus solution: No effect

Copper (II) oxide is insoluble in water.

OXIDATION OF COMPOUNDS:

Action with carbon monoxide: Carbon monoxide burns with pale blue non-luminous flame, producing intense heat in the atmosphere of oxygen, to form carbon dioxide gas.

$$2CO\ (g) + O_2\ (g) \longrightarrow 2CO_2\ (g) + \Delta t$$

WORK SHEET - 3

Single Answer Type

1. The vapour density of oxygen gas is:
   1) 16 2) 12 3) 10 4) 18
2. Oxygen can be liquefied under:
   1) Low pressure, High temperature 2) Low pressure, Low temperature
   3) High pressure, Low temperature 4) High pressure, High temperature
3. Oxygen is:
   1) Acidic 2) Basic 3) Neither acidic or basic 4) None
4. Which of the following metal react with oxygen?
   1) Gold 2) Silver 3) Platinum 4) Mercury
5. $2H_2 + O_2 \longrightarrow 2H_2O\ (l) + \Delta t$
   In the above reaction product is:
   1) Oxygen 2) Hydrogen 3) Hydrogen peroxide 4) Water
6. $3O_2\ (g) \xrightarrow[\text{discharge}]{\text{Silent electric}} 2O_3\ (g) - \Delta t$
   In the above reaction ozone is:
   1) Reactant 2) Product
   3) Neither reactant nor product 4) None of these
7. If a mixture of two volumes of hydrogen and one volume of oxygen, under pressure are passed through a pipe with a very small hole and the mixture is ignited, it burns with intense hot blue flame, commonly called:
   1) Hydroxy flame 2) Carboxy flame
   3) Oxygen flame 4) Oxyhydrogen flame
8. $2S(s) + 3O_2(g) \xrightarrow{\Delta} A + \Delta t$

   $S(s) + O_2(g) \xrightarrow{\Delta} B + \Delta t$

	A	B
1)	SO_2	SO_3
2)	SO_2	SO_2
3)	SO_3	SO_3
4)	$2SO_3$	SO_2

9. Which of the following reaction occurs in self oxidation?

1) $3\ O_2 \xrightarrow[\text{discharge}]{\text{Silent electric}} 2\ O_3 - \Delta t$ 2) $4\ P + 5O_2 \longrightarrow 2\ P_2O_5 + \Delta t$

3) $S + O_2 \longrightarrow SO_2 - \Delta t$ 4) $C + O_2 \longrightarrow CO_2 + \Delta t$

10. $2H_2(g) + O_2(g) \xrightarrow[\text{spark}]{\text{Electric}} 2H_2O(l) + \Delta t$

The products is / are ___(M)___.

The Colour of the flame is ___(E)___.

(M)	**(E)**
1) Hydrogen and oxygen	Red
2) Only water	Very pale blue
3) Only hydrogen	Yellow
4) Only oxygen	Orange red

11. $S + O_2 \xrightarrow{\Delta} SO_3 + \Delta t$

The presence of sulphur dioxide can be shown, by adding a few drops of:

1) Copper sulphate crystals turns blue.
2) Acidified potassium dichromate solution it turns green.
3) Lime water turns milky.
4) Hydrochloric acid forms brown vapours.

12. The molecular formula of Potassium di-chromate is:

1) $KMnO_4$ 2) KMn_2O_7 3) $K_2Cr_2O_7$ 4) All

13. When burning sulphur is introduced in the jar of oxygen, it burns with beautiful blue flame forming a mixture of:

1) H_2SO_4,	O_2
2) H_2SO_3	O_2
3) SO_3	SO_2
4) H_2SO_4	H_2O

14. $4P(s) + 5O_2(g) \xrightarrow{\Delta} 2P_2O_5(s) + \Delta t$

(i) Colour of flame: Bright white and dense white fames.

(ii) Effect on litmus solution: Blue to red.

(i)	**(ii)**
1) False	True
2) True	False
3) False	False
4) True	True

15. The flame colour of potassium metal is:

1) Golden yellow 2) Lilac 3) Brick red 4) Dazzling white

16. When slightly warm sodium is taken in a jar of oxygen it catches fire and burns with a _____ flame.

1) Red 2) Green 3) Golden yellow 4) brilliant blue

17. Element 'A' is silvery white metal which burns with golden yellow flame. The oxide is basic in nature. Element 'A' is:
1) Carbon 2) Nitrogen 3) Sodium 4) Oxygen

18. Carbon monoxide burns with _____ producing intense heat in the atmosphere of Oxygen, to form CO_2 gas.
1) Red luminous flame 2) Pale blue non-luminous
3) Yellow flame 4) No flame

19. The chemical formula of Tri-ferric tetraoxide is:
1) Fe_2O_3 2) Fe_3O_4 3) $Fe(OH)_2$ 4) $Fe(OH)_3$

20. 3 Fe (s) + 2 O_2 (g) $\xrightarrow{\Delta}$ 'X' . What is 'X"?
1) CuO 2) Fe_3O_4 3) $Fe(OH)_2$ 4) MgO

21. 2 Cu (s) + O_2 (g) $\xrightarrow{\Delta}$ "A" + Δt
In the above reaction product "A" is:
1) Copper (I) oxide 2) Copper (II) oxide
3) Copper (III) oxide 4) Copper (IV) oxide

22. Which of the following metal form a peroxide?
1) Potassium 2) Sodium 3) Calcium 4) Magnesium

Multi Answer Type

23. $C(s) + O_2(g) \xrightarrow{\Delta} CO_2(g) + \Delta t$.
Which of the following statements is/are false for the above reaction?
1) The reaction endothermic.
2) Only carbondioxide is formed as a product.
3) The colour of the flame is bright yellow.
4) Effect on litmus solution is red to blue.

24. Which of the following is correct statement?
1) Oxygen is neutral towards litmus.
2) Oxygen reacts with itself to form ozone in the presence of electric discharge.
3) The presence of carbon dioxide can be adding lime water, turns milky.
4) The amount of oxygen in higher attitudes increases.

25. $4K(s) + O_2(g) \xrightarrow{\Delta} 2K_2O(s) + \Delta t$
Choose the correct statements for the above reaction.
1) Products: Potassium peroxide 2) Colour of flame: lilac flame
3) Action on litmus solution : Red to blue
4) Potassium oxide is acidic in nature

26. Choose the false statements:
1) Sodium oxide is basic in nature
2) Magnesium oxide is weakly basic in nature.
3) Calcium oxide is acidic in nature. 4) Potassium oxide is acidic in nature.

27. If burning calcium is taken in a jar of oxygen (by means of deflagrating spoon),
What are the possible observations you can make.
1) Product is Calcium oxide 2) Colour of flame is Pale blue
3) Action on litmus solution is blue to red
4) Calcium oxide is basic in nature

28. $2Mg\ (s) + O_2\ (g) \xrightarrow{\Delta} 2\ MgO\ (s) + \Delta t$
Choose the correct statement for the above reaction:
1) Exothermic reaction 2) Colour of flame is dazzling white
3) Action on litmus solution blue to red
4) MgO is amphoteric

Reasoning Answer Type

29. *Statement I:* When phosphorus reacts with oxygen, phosphorus pentoxide is formed with white dense fumes.
Statement II: Reaction of nitrogen with oxygen is reversible.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

30. **Statement I:** Oxygen is an incombustible gas, but it supports combustion.
Statement II: When a glowing splinter is taken in the jar of oxygen, it rekindles.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

31. *Statement I:* Triferric tetroxide is insoluble in water.
Statement II: Triferric tetroxide is no change in litmus test.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

32. *Statement I:* Calcium monoxide is golden yellow colour.
Statement II: Calcium monoxide is basic in nature.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

33. *Statement I:* Generally oxides of metals are basic in nature.
Statement II: Hyroxides of potassium, sodium, magnesium and calcium are acidic in nature.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Writeup-1:

Oxygen is colourless, odourless and taste less gas.

34. The valency of oxygen is:
1) 4 2) 1 3) 3 4)2

35 The boiling point of liquid oxygen is:
1) 183°C 2) –183°C 3) 180°C 4) 120°C

36. The amount of oxygen on higher attitudes is:
1) Increases 2) Decreases
3) Increases and decreases 4) Neither decreases nor increases

Writeup-2:

In oxidation of metals, when warm potassium is taken in a jar of oxygen, it catches fire and burns with lilac flame to form potassium oxide

37. Potassium oxide _____ in nature.
1) Acidic 2) Basic 3) Neutral 4) None

38. The colour of flame of sodium metal is:
1) Golden yellow flame 2) Dazzling white
3) Lilac flame 4) Brick flame

39. What is product formed when iron reacts with oxygen?
1) Ferrous oxide 2) Triferric tetroxide
3) Diferric tetroxide 4) None

Matrix Matching Type

40.

Column - I	**Column - II**
a) $N_2 + O_2$	1) SO_2
b) $C + O_2$	2) $2P_2O_5$
c) $S + O_2$	3) 2NO
d) $4P + 5\ O_2$	4) CO_2
	5) NO_2

41.

Column - I **Action with non-metal**	**Column - II** **Colour of flame**
a) Hydrogen	1) Bright yellow
b) Sulphur	2) Pale blue
c) Carbon	3) Blue flame
d) Nitrogen	4) White
	5) Red

42. **Column - I**
a) Na + O_2
b) Mg + O_2
c) K + O_2
d) Cu + O_2

Column - II
1) MgO
2) K_2O
3) Na_2O
4) CuO
5) KO_2

43. **Column-I**
Colour
a) Lilac flame
b) Golden yellow
c) Dazzling white
d) White spaks

Column-II
Compound
1) Fe_3O_4
2) MgO
3) Na_2O
4) K_2O
5) CuO

SYNOPSIS - 4

OXIDATION PROPERTIES OF OXYGEN:

Action with sulphur dioxide: When two volumes of sulphur dioxide gas and one volume of oxygen are passed over heated platinized asbestos or vanadium pentoxide at 450°C they react to form sulphur trioxide.

$$2SO_2\,(g) + O_2\,(g) \xrightarrow[450°C]{\text{Platinised asbestos}} 2SO_3\,(g) + \Delta t$$

Action with nitric oxide: When nitric oxide gas (colourless), comes in contact with oxygen it reacts to form reddish brown fumes of nitrogen dioxide.

$$2NO\,(g) + O_2\,(g) \longrightarrow 2NO_2\,(g)\ \text{(Reddish brown gas)}$$

Action with ammonia gas: When 4 volumes of ammonia gas and 5 volumes of oxygen gas are passed over platinum gauze, maintained at 800°C, they react to form nitric oxide gas and steam.

$$4NH_3\,(g) + 5O_2\,(g) \xrightarrow[800°C]{\text{Pt. gauze}} 4NO(g) + 6H_2O\,(l) + \Delta t$$

However, if ammonia gas is burnt in the atmosphere of oxygen, it burns with a pale blue flame, forming nitrogen gas and steam.

$$4NH_3\,(g) + 3O_2\,(g) \xrightarrow{\text{Burning}} 2N_2\,(g) + 6H_2O\,(l) + \Delta t$$

Action with hydrocarbons: All hydrocarbons burn in oxygen, to form carbon dioxide gas and steam. The reactions are exothermic and a lot of heat and lightis liberated.

$$\underset{\text{(Methane)}}{CH_4(g)} + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l) + \Delta t$$

$$\underset{\text{(Butane)}}{2C_4H_{10}(g)} + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(l) + \Delta t$$

$$\underset{\text{(Ethylene)}}{C_2H_4(g)} + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l) + \Delta t$$

$$\underset{\text{(Acetylene)}}{2C_2H_2(g)} + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(l) + \Delta t$$

Action with non-metallic sulphides: Hydrogen sulphide (gas) and carbon disulphide (liquid), burn in oxygen, to form sulphur dioxide gas. The reaction is exothermic and a large amount of heat is liberated.

$$2H_2S(g) + 3O_2(g) \longrightarrow 2H_2O(l) + 2SO_2(g) + \Delta t$$

$$CS_2(l) + 3O_2(g) \longrightarrow CO_2(g) + 2SO_2(g) + \Delta t$$

Action with metallic sulphides: Sulphides of zinc, iron, lead, copper, mercury, silver catch fire, when heated in oxygen, to form their respective metallic oxides and sulphur dioxide gas.

$$2ZnS(s) + 3O_2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO_2(g) + \Delta t$$

$$2FeS(s) + 3O_2(g) \xrightarrow{\Delta} 2FeO(s) + 2SO_2(g) + \Delta t$$

$$\underset{\text{(Iron pyrites)}}{4FeS_2(s)} + 11O_2(g) \xrightarrow{\Delta} 2Fe_2O_3(s) + 8SO_2(g) + \Delta t$$

Note: The sulphides of **potassium, sodium, calcium, magnesium and aluminium, do not react** with oxygen.

WORK SHEET - 4

Single Answer Type

1. Two volumes of sulphur dioxide gas and one volume of oxygen react with in the presence of platinised asbestos and vanadium pentoxide at 450^{0}C to gives a ____
   1) Sulphur dioxide 2) Sulphur trioxide
   3) Hydrogen sulphide 4) Hydrogen sulphate
2. Colour of nitric oxide gas is _____
   1) Colourless 2) Yellow colour
   3) Brick red colour 4) Reddish brown colour
3. The chemical formula of ammonia is:
   1) N_2H_4 2) NH_3 3) N_2H_5 4) NO_2
4. Hydrocarbons mainly consists of:
   1) Carbon and Hydrogen 2) Oxygen and hydrogen
   3) Nitrogen and hydrogen 4) None
5. The physical state of H_2S and Cl_2 respectively are:

	H_2S	Cl_2
1)	Liquid	gas
2)	Solid	liquid
3)	Gas	Gas
4)	Liquid	gas

6. $2\ ZnS(s) + 3O_2(g) \xrightarrow{\Delta} A + B + \Delta t$

	A	B
1)	ZnO	SO_3
2)	ZnO_2	SO_2
3)	2ZnO	SO_3
4)	2ZnO(s)	$2SO_2$

7. All hydrocarbons burn in oxygen, to form __(P)__ gas and __(Q)__.

(P)	(Q)
1) CO_2	Steam
2) O_2	H_2
3) SO_2	O_2
4) H_2S	H_2

8. $A + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l) + \Delta t$

$B + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O + \Delta t$

A	B
1) Ethylene	Acetylene
2) Methane	Butane
3) Propane	Butane
4) Acetylene	Propane

9. $4FeS_2(s) + 11O_2(g) \xrightarrow{\Delta} A + B + \Delta t$; A and B are

A	B
1) $2Fe_2O_3(s)$	$5SO_2(g)$
2) $2FeSO_4(s)$	$6SO_2(g)$
3) $Fe(OH)_2(s)$	$7SO_2(g)$
4) 2FeS(s)	$10SO_2$

10. $2SO_2(g) + O_2(g) \xrightarrow[450°C]{I} 2SO_3(g) + \Delta t$

$4NH_3(g) + 5O_2(g) \xrightarrow[800°C]{II} 4NO(g) + 6H_2O(l) + \Delta t$. Identify I and II

I	II
1) Manganese dioxide	Nickel
2) Platinum gauze	Manganese dioxide
3) Nickel	Platinised asbestos
4) Platinised asbestos	Platinum gauze.

11. 4 volumes of __I__ gas and 5 volumes of __II__ gas are passed over __III__ maintained at 800°C to form __IV__ gas and steam.

I	II	III	IV
1) Nitrogen gas	Hydrogen	Asbestos	Nitrous oxide gas
2) Ammonia gas	Oxygen	Platinum gauze	Nitric oxide gas
3) Nitric oxide gas	Carbon	Iron	Nitrogen gas
4) Nitrous oxide	Oxygen	Iron	Nitric dioxide gas

Multi Answer Type

12. Which of the following is/are hydrocarbons?
1) CH_4 2) C_4H_{10} 3) C_2H_4 4) C_2H_2

13. Which of the following sulphides (metal & non-metal) burn with oxygen to gives a sulphur dioxide gas?
1) H_2S 2) CS_2 3) ZnS 4) FeS

14. Which of the following sulphides doesn't react with oxygen:
1) Potassium 2) Sodium 3) Magnesium 4) Aluminium

Reasoning Answer Type

15. *Statement I:* $2\ H_2S\ (g) + 3\ O_2\ (g) \longrightarrow 2\ H_2O\ (l) + 2\ SO_2\ (g) + \Delta t$

Statement II: Hydrocarbons burn in oxygen to form carbondioxide and steam.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

16. *Statement I:* Potassium sulphide react with oxygen to form potassium oxide.

Statement II: The sulphides of potassium does not react with oxygen.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

17. *Statement I:* The sulphides of zinc, iron, lead, copper catch fire when heated in oxygen, by forming their oxides.

Statement II: The sulphides of potassium, sodium, calcium, magnesium and aluminium, react vigorously with oxygen.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

Writeup-1:

All hydrocarbons burn in oxygen, to form carbon dioxide gas steam. The reactions are exothermic and a lot of heat and light is liberated.

18. Methane gas reacts with oxygen gas to form a:
    1) Carbon dioxide gas 2) Hydrogen gas
    3) Oxygen gas 4) Carbon monoxide gas

19. $2C_4H_{10}\ (g) + 13\ O_2\ (g) \longrightarrow 8\ CO_2\ (g)\ 10H_2O\ (g) + \Delta t$

In the above reaction is:
    1) Exothermic reaction 2) Endothermic reaction
    3) Heat liberation 4) Both 1 and 3

20. Hydrogen sulphide gas burns in oxygen to form:
    1) Sulphur trioxide 2) Sulphur dioxide
    3) Carbon disulphide 4) Hydroxide

Writeup-2:

Hydrocarbons burn in oxygen to form carbon dioxide gas and steam.

21. The chemical formula of ethylene is:
1) CH_4 2) C_2H_6 3) C_2H_2 4) C_2H_4

22. The chemical formula of butane is:
1) C_4H_8 2) C_4H_9 3) C_4H_{10} 4) C_6H_6

23. What are the two products formed when carbon disulphide burns in oxygen?
1) Carbon dioxide 2) Sulphur dioxide
3) Carbon monoxide 4) Both 1 and 2

Matrix Matching Type

24.

Column-I	**Column-II**
a) Hydrogen sulphide	1) C_2H_2
b) Methane	2) CS_2
c) Acetylene	3) H_2S
d) Carbon disulphide	4) CH_4

25.

Column-I	**Column-II**
a) $FeS_2 + O_2$	1) SO_3
b) $C_2H_2 + O_2$	2) $N_2 + H_2O$
c) $SO_2 + O_2$	3) $CO_2 + H_2O$
d) $NH_3 + O_2$	4) $Fe_2O_3 + SO_2$
	5) $FeO + SO_2$

SYNOPSIS - 5

TESTS FOR OXYGEN:

It turns alkaline pyrogallol solution brown.

It rekindles glowing wooden splinter.

When mixed with nitric oxide, it forms **reddish brown colour** of nitrogen dioxide.

USES OF OXYGEN:

General Uses:

21% of the air by volume is oxygen. It is absolutely essential for the respiration of all living beings.

Artificial respiration is resorted to only when there is not sufficient supply of oxygen in air, such as at high altitudes; during fire fighting; under sea or in space. Thus, oxygen is used for artificial respiration by:

Firemen during fire fighting
Aviators during high altitude flying
Astronauts in space ships
Divers and submariners under water
Miners during deep mining
Climbers during high altitude climbing

Liquid oxygen, under the trade name LOX, is used to burn rocket fuel in space.

MEDICAL USES:

Carbogen: It is a mixture of 5% carbon dioxide and 95% oxygen. It stimulates natural breathing. It is given to the patients suffering from asthma or for reviving patients from drowning or gas poisoning.

Anaesthesia: A mixture of nitrous oxide (N_2O) and oxygen is used in surgical operations.

INDUSTRIAL USES:

For cutting and welding purposes: When oxygen and hydrogen are made to burn in a specially designed torch, they form a flame, having a temperature of 2800°C. However, if instead of hydrogen, acetylene gas is used, the temperature is 3300°C.

The oxy-hydrogen flame or oxy-acetylene can easily melt most of metals and hence, are used for welding purposes.

In the iron and steel industry: Instead of air, the oxygen is used in blast furnace for the manufacture of iron, because it can produce more heat than oxygen, diluted by nitrogen. Moreover, it saves heat energy, which is otherwise carried by non-reacting nitrogen. Similarly, in the manufacture of steel we use oxygen for removing impurity of carbon present in cast iron, in the form of carbon dioxide.

In explosives: In mining industry large amount of explosives are required. Cartridges made of one part of coal dust, one part of petroleum jelly and eight parts of liquid oxygen are used for blasting rocks.

In chemical industry: Oxygen is extensively used in the manufacture of sulphuric acid from sulphur dioxide and nitric acid from ammonia.

WORK SHEET - 5

Single Answer Type

1. Carbogen is a mixture of:
   1) 5% CO_2 and 95% O_2 2) 95% CO_2 and 5% O_2
   3) 25% CO_2 and 75% O_2 4) 50% CO_2 and 50% O_2
2. Which of the following is a true statement?
   1) Carbogen is used in natural breathing.
   2) Cartridze is used for blosting rocks.
   3) Anaesthesia is used in surgical operations. 4) All
3. Which of the following is used as a rocket fuel?
   1) HOX 2) COX 3) LOX 4) POX
4. Oxygen is obtained from water:
   1) Distillation 2) Electrolysis
   3) Combination 4) Displacement

5. The method of separating liquid nitrogen from liquid oxygen is:
   1) Electrolysis 2) Liquefaction
   3) Fractional evaporation 4) Sedimentation
6. Which of the following compound burns in Oxygen to give a coloured acidic gas:
   1) CO 2) SO_2 3) NO 4) CH_4
7. Prevents rusting of pots and stoves.
   1) Greasing 2) Galvanizing 3) Enamelling 4) Electroplating
8. Oxygen burns in an atmosphere of hydrogen and in an atmosphere of acetylene to produce respectively:
   1) Oxy-hydrogen flame Oxy-acetylene flame.
   2) Carbory - hydrogen flame Carbory acetylene flame
   3) Hydrogen flame Acetylene flame
   4) Hydroxy flame Acetylene flame

Multi Answer Type

9. Which of the following flame can easily melts the metals?
   1) Oxy-hydrogen flame 2) Oxy-acetylene flame
   3) Golden yellow flame 4) Lilac flame
10. Which of the following is correct statement?
   1) Liquid oxygen is used to burn rocket fuel in space.
   2) A mixture of nitrous oxide and oxygen is used in surgical operations.
   3) When oxygen mixed with nitric oxide it forms yellowish brown colour nitrogen dioxide.
   4) Oxygen is used for artificial respiration by fireman during fire fighting.

Reasoning Answer Type

11. *Statement I:* Oxygen rekindles glowing wooden splinter.
   Statement II: Oxygen when mixed with nitric oxide forms reddish brown nitrogen dioxide.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.
12. **Statement I:** Rusting is observed in the test tube containing tap water.
   Statement II: Rusting can be removed by coating with red lead oxide paint.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

Comprehension Type

Oxygen is used in blast furnace for the manufacture of iron, because it can produce more heat than diluted by nitrogen

13. The chemical name of rust is:
    1) Iron oxide 2) Iron II oxide
    3) Hydrated Iron III oxide 4) Iron
14. Which of the following is not essential condition for burning but essential for rusting?
    1) Oxygen 2) Moisture 3) Heat 4) Pressure
15. Prevents rusting of lower parts of a ship or bridges:
    1) Greasing 2) Tar 3) Plastic coating 4) Tin-plating

Matrix Matching Type

16.

Column-I	**Column-II**
a) Oxy-acetylene flame	1) Mixture of N_2O and O_2
b) Anaesthesia	2) $Fe_2O_3.H_2O$
c) Carbogen	3) Oxygen and acetylene
d) Rust	4) Mixture of CO_2 and O_2
	5) Mixture of CO_2 and NO_2

17.

Column-I **Oxides**	**Column-II** **Nature**
a) CO_2	1) Basic
b) K_2O	2) Amphoteric
c) ZnO	3) Acidic

WORK SHEET – 1 (KEY)

1) 4	**2)** 4	**3)** 2	**4)** 1	**5)** 3
6) 2	**7)** 1,2,3	**8)** 1,3,4	**9)** 1	**10)** 2
11) 2	**12)** 1	**13)** 3	**14)** 3	**15)** A-5 B-3 C-4 D-1
16) A-1 B-5 C-2 D-4				

WORK SHEET – 2 (KEY)				
1) 2	**2)** 2	**3)** 2	**4)** 1	**5)** 1
6) 2	**7)** 1	**8)** 2	**9)** 3	**10)** 3
11) 3	**12)** 1,2,3,4	**13)** 1,2,3,4	**14)** 1,2,3	**15)** 1,2,3,4
16) 2	**17)** 3	**18)** 2	**19)** 2	**20)** 3
21) 2	**22)** 3	**23)** 4	**24)** 4	**25)** 3
26) 2	**27)** 3	**28)** A-3 B-4 C-1 D-2	**29)** A-2 B-4 C-1 D-3	

WORK SHEET – 3 (KEY)				
1) 1	**2)** 3	**3)** 3	**4)** 4	**5)** 4
6) 2	**7)** 4	**8)** 4	**9)** 1	**10)** 2
11) 2	**12)** 3	**13)** 3	**14)** 4	**15)** 2
16) 3	**17)** 3	**18)** 2	**19)** 2	**20)** 2
21) 2	**22)** 2	**23)** 1,2	**24)** 1,2,3	**25)** 1,2,3
26) 3,4	**27)** 1,4	**28)** 1,2	**29)** 2	**30)** 2
31) 2	**32)** 4	**33)** 3	**34)** 4	**35)** 2
36) 2	**37)** 2	**38)** 1	**39)** 2	**40)** A-3 B-4 C-1 D-2
41) A-2 B-3 C-1 D-4	**42)** A-3 B-1 C-2 D-4	**43)** A-4 B-3 C-2 D-1		

WORK SHEET – 4 (KEY)				
1) 2	**2)** 1	**3)** 2	**4)** 1	**5)** 3
6) 4	**7)** 1	**8)** 2	**9)** 1	**10)** 4
11) 2	**12)** 1,2,3,4	**13)** 1,2,3,4	**14)** 1,2,3,4	**15)** 2
16) 4	**17)** 2	**18)** 1	**19)** 4	**20)** 2
21) 4	**22)** 3	**23)** 4	**24)** A-3 B-4 C-1 D-2	**25)** A-4 B-3 C-1 D-2

WORK SHEET – 5 (KEY)				
1) 1	**2)** 4	**3)** 3	**4)** 2	**5)** 3
6) 3	**7)** 3	**8)** 1	**9)** 1,2	**10)** 1,2,4
11) 2	**12)** 2	**13)** 3	**14)** 2	**15)** 2
16) A-3 B-1 C-4 D-2	**17)** A-3 B-1 C-2 D-4			

NATURE OF MATTER

SYNOPSIS - 1

Any material which has mass and occupies space is called matter.

Characteristics of matter

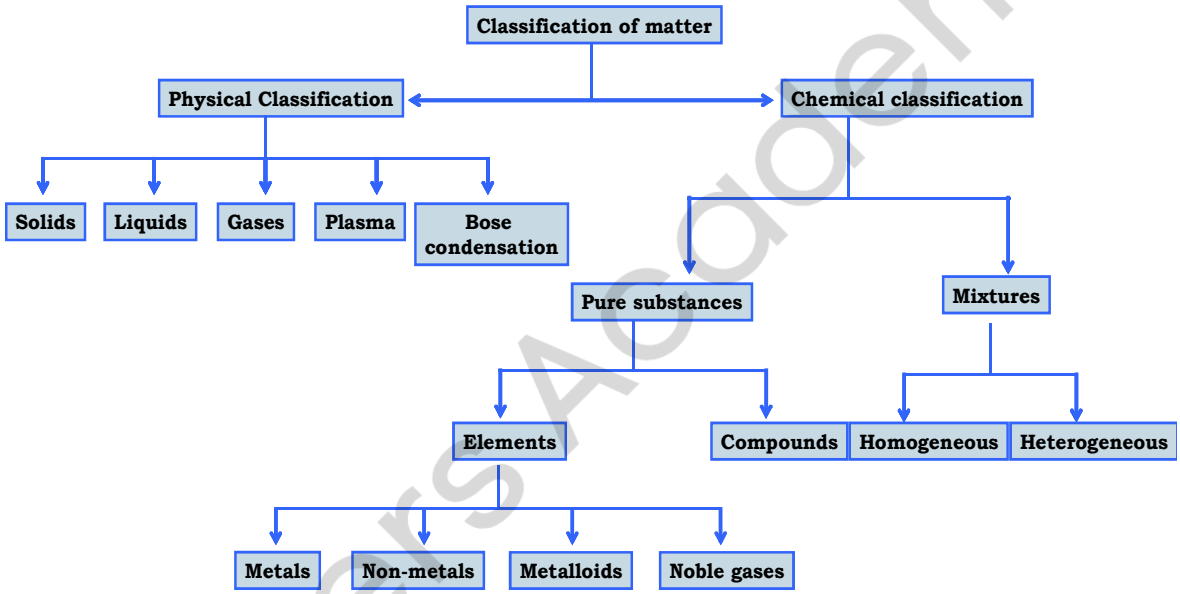
i) All matter is composed of particles.

ii) All material bodies have weight and hence have mass.

iii) All material bodies occupy space.

These particles have intermolecular spaces between them and attract each other with a force and are in continuous random motion.

Classification of matter



Matter exists in five states :

(1) Solids: Ex: Wood, Stone, Sand, Iron, Ice etc.,

(2) Liquids: Ex: Water, Milk, Fruit juice....etc.,

(3) Gases: Ex: Oxygen, Nitrogen, CO_2.... etc.,

(4) Plasma: Plasma is ionised gas, a gas to which sufficient energy is provided to get free electrons from atoms (or) molecules to allow both the species, ions and electrons to co-exist.

Ex: The gases in the sun and stars exist in plasma state.

(5) Bose-Einstein: Bose - Einstein is a condensate super fluid phase formed by atoms, cooled very near to absolute zero temperature. It is opposite to plasma state.

Ex: First condensate was produced by using Ru atoms cooling to 170 nano kelvin.

Differences between solids, liquids and gases at room temperature			
S.No.	Solids	Liquids	Gases
1	They have definite shape and definite volume	They have no definite shape, but have a definite volume	They have neither definite shape no definite volume
2	Solids cannot be compressed	Liquids can be very slightly compressed	Gases can be easily compressed
3	Solids do not need a vessel to contain them	Liquids flow from higher to lower level	Gases can flow in all directions
4	Solids do not need a vessel to contain them	Liquids need a vessel to contain them	Gases need a vessel to contain them
5	Solids have very small intermolecular spaces	Liquids have small inter-molecular spaces, which is more than the solids	Gases have very large intermolecular spaces
6	Solids have very strong intermolecular forces of attraction	Liquids have less intermolecular forces of attraction than the solids	Gases have negligible intermolecular forces of attraction.

Based on the properties , elements are classified into:

(i) Metals (ii) Non metals (iii) Metalloids (iv) Noble gases

Metals		Non Metals	
1	Solids at room temperature	1	Gases, liquids & solids at room temperature
2	They are lustrous (means having shining surface)	2	Non lustrous
3	Good conductors of heat and electricity	3	Poor conductors of heat and electricity
4	They are ductile (can be drawn into wires without breaking and losing their characters)	4	Non ductile
5	They are malleable (extensible in all dimensions without losing their character by hammering rolling.	5	Non malleable
6	Ex : Iron, gold, silver, copper, sodium, potassium etc.	6	Ex : Hydrogen, Nitrogen, Oxygen, Chlorine etc.

Metalloids: Elements which exhibit the properties of both metals and non-metals are called metalloids

Ex: Germanium, Arsenic, Antimony, Selenium, Tellurium.

NOBLE GASES AND RADIO ACTIVE ELEMENTS

1) Noble gases occur in small traces in gaseous state
2) Chemically inactive i.e. inert, hence called as **INERT GASES**.
3) They are generally mono atomic.

Ex: Helium(He), Neon(Ne), Argon(Ar), Krypton(Kr), Xenon(Xe), Radon(Rn)

As these elements are found in small traces, they are also called as **RARE GASES**.

Noble gases also known as **Aerogens**.

Radio Active Elements:

The elements which emit α, β and γ radiations are called RADIOACTIVE ELEMENTS.

Ex: Uranium, Polonium, Radium, Radon etc.

Metals:

Exceptions: Mercury and Gallium are liquid metals at 30°C. Zinc is not malleable and ductile at room temperature. Sodium, Potassium, Calcium, Lead do not have high melting points.

Non-metals

Exceptions: Graphite (an allotrope of carbon) has a lustre and is a good conductor of heat and electricity.

Bromine is a liquid non-metal.

Exceptions:

Metalloids: Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb) Tellurium (Te) and Polonium (Po)

A compound is a substance composed of two or more different elements chemically combined with one another in a fixed proportion by weight.

Example: H_2O, CO, SO_2 et.

Each compound is represented by a **FORMULA**

Characteristics of a compound :

(i) Pure substance are homogeneous in nature.
(ii) Composed of two or more elements.
(iii) Combined chemically in a fixed proportion.
(iv) Properties of compound differ from the properties of constituent elements.
(v) Formation involves energy changes.
(vi) Mechanical separation of constituents is impossible.

Example: Water-H_2O.

(i) Composed of two elements : Hydrogen & Oxygen.
(ii) Hydrogen and oxygen combined in fixed proportion by weight i.e 1:8.
(iii) Properties of water differ from those of Hydrogen and Oxygen.
Hydrogen - Combustible.
Oxygen - Supporter of Combustion ; Water - Extinguisher of flame.

S.No	Name of the compound	Formula
1.	Hydrochloric acid	HCl
2.	Nitric acid	HNO_3
3.	Sulphuric acid	H_2SO_4
4.	Sodium hydroxide	NaOH
5.	Calcium oxide	CaO
6.	Sodium carbonate (Washing soda)	$Na_2CO_3.10H_2O$
7.	Calcium carbonate	$CaCO_3$
8.	Sodium	$NaHCO_3$
9.	Ferrous sulphide (Iron sulphide)	FeS
10.	Sodium chloride (Common salt)	$NaCl$
11.	Potassium nitrate	KNO_3
12.	Aluminium chloride	$AlCl_3$
13.	Silver nitrate	$AgNO_3$
14.	Copper sulphate (Blue vitriol)	$CuSO_4.5H_2O$

Formulae of some common gaseous compounds :

S.No	Gas	Formula
1.	Carbon dioxide	CO_2
2.	Sulphur dioxide	SO_2
3.	Hydrochloric acid gas	HCl
4.	Methane	CH_4
5.	Carbon monoxide	CO
6.	Sulphur trioxide	SO_3
7.	Nitrogen dioxide	NO_2
8.	Steam (Gaseous form of water)	H_2O

Formulae of some common metal oxides

The compounds of metals with oxygen are called metal oxides.

S.No	Metallic oxides	Formula
1.	Magnesium oxide	MgO
2.	Zinc oxide	ZnO
3.	Lead oxide	PbO
4.	Mercury oxide	HgO
5.	Calcium oxide	CaO
6.	Iron Oxide	FeO
7.	Copper oxide	CuO

If two ore more substances (elements or compounds or both) are mixed together in any proportion, such that they do not undergo any chemical change, but retain their individual properties, then the resulting mass is called MIXTURE.

Kinds of Mixtures :

(A) Heterogeneous mixtures:

A mixture in which its constituents are not distributed uniformly is called **HETEROGENEOUS MIXTURE**.

Ex: Soil: It is a mixture of several elements and compounds. It's composition changes from place to place.

(B) Homogeneous mixtures:

A mixture in which its constituents are mixed uniformly is called **HOMOGENEOUS MIXTURE**.

Ex: Brass - Copper + Zinc (Alloy)
Sugar solution - Sugar + water.

Characteristics of a mixture :

(i) The constituents of a mixture are present in any ratio i.e. variable composition.
Ex: Mixture of salt and powdered charcoal can be prepared by mixing them in any proportion.

(ii) Constituents of a mixture do not bind to each other by any chemical force.
Ex: Mixture of common salt and charcoal powder.

(iii) Properties of a mixture are average of the properties of the constituents.
Ex: Mixture of common salt and charcoal salt is white and soluble in water but coal is black and insoluble in water.

(iv) A mixture can be homogeneous or heterogeneous .

(v) Constituents of a mixture can be separated by physical means.
Ex: Mixture of charcoal and common salt can be separated by dissolving it in water and then filtering the solution.

(vi) No energy is released during the formation of a mixture.
Ex: If we mix charcoal and common salt no energy is released.

DIFFERENCES BETWEEN A MIXTURE AND A COMPOUND

	Mixture	Compound
1.	**Nature** When two or more elements or compounds or both are mixed together, such that they do not combine chemically, a mixture is formed.	**Nature** When two or more elements unite chemically, a compound is formed.
2.	**Structure** Mixtures are generally heterogeneous, e.g., mixture of sand and salt or iron and sulphur.However, some mixtures can be homogeneous	**Structure** Compounds are always homogeneous.
3.	**Composition** In case of mixtures their constituents can be present in any ratio, i.e., mixtures have variable composition.	**Composition** In case of compounds, the constituents are present in a fixed ratio by weight.
4.	**Properties** The constituents of a mixture retain their individual chemical and physical properties.	**Properties** The properties of a compound are entirely different from the properties of its constituents.
5.	**Separation of Constituents** The constituents of a mixture can be separated by applying physical methods like solubility, filtration, evaporation, distillation, use of magnet etc,	**Energy Changes** During the formation of a compound either the energy is absorbed or given out.

WORK SHEET - 1

SINGLE ANSWER TYPE

1. The state of matter with no definite shape but have definite volume is:
   1) Gas 2) Liquid 3) Solid 4) All the above
2. Choose the correct order of physical states for the following:
   a) Iodine b) Bromine c) Fluorine
   1) a - Solid, b - Liquid, c – Gas 2) a - Liquid, b - Solid, c - Gas
   3) a - Gas, b - Solid, c - Liquid 4) a - Solid, b - Gas, c – Liquid
3. The materials, with negligible intermolecular forces is:
   1) Milk 2) Stone 3) CO_2 4) Iron
4. Which of the following is a metal?
   1) Flourine 2) Sodium 3) Oxygen 4) Hydrogen
5. A liquid metal at room temperature is:
   1) Bromine 2) Mercury 3) Iodine 4) Water
6. Antimony is a _____
   1) Metal 2) Metalloid 3) Non Metal 4) Inert gas
7. Which of the following is a compound?
   1) Hydrogen 2) Water 3) Chlorine 4) Helium

8. Which one of the following is the chemical formula of washing soda?
   1) $Na_2CO_3.10H_2O$ 2) $Na_2SO_4.10H_2O$
   3) $NaCl$ 4) $NaNO_3$
9. Identify the hetero geneous mixture from the following:
   1) Sodium chloride 2) Pure water
   3) Soil 4) Both 1 and 2
10. Mixtures are the substances obtained by mixing two or more substances in _____ proportion
   1) Fixed 2) Any 3) Definite 4) Percentage
11. Which one of the following statement is correct regarding mixture
   1) Constituent of a mixture do not bind to each other by any chemical force.
   2) Constituent of a mixture can be repeated by physical means.
   3) No energy is released during the formation of a mixture.
   4) All the above.
12. $MgSO_4$ is _____.
   1) Element 2) Mixture 3) Compound 4) Atom
13. Which one of the following is the charateristics of a compound?
   A) Compound is a pure substance, homogeneous in nature.
   B) Composed of two or more elements.
   C) Properties of a compound differ from the properties of the constituent elements
   D) Mechanical separation of constituents is impossible
   1) Only A and B 2) Only B and C
   3) Only C and D 4) A, B, C and D
14. Identify which of the following is/ are compounds :
   1) H_2SO_4 2) $AlCl_3$ 3) HgS 4) All the above
15. Which of the following statement is correct about mixture?
   1) Syrrup is a mixture of sugar in water.
   2) Milk is a mixture of protein, fat and water.
   3) Sea water is a mixture of mineral salts in big quantity.
   4) All the above

MULTI ANSWER TYPE

16. Matter has the following character/s:
   1) Mass 2) Volume
   3) Occupies space 4) Made up of particles
17. Among the following, the monoatomic element is/are
   1) Helium 2) Oxygen 3) Nitrogen 4) Xenon
18. Among the following, compounds are
   1) SO_2 2) O_2 3) S_8 4) CO_2
19. Which of the following are mixtures?
   1) Soil 2) Common Salt 3) Brass 4) Water

REASONING ANSWER TYPE

20. *Statement I :* Solids have definite shape and volume.
Statement II : They have strong intermolecular force of attraction.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

21. *Statement I :* Chlorine is a non metal
Statement II : It is non lustrous, non ductile and non malleable
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

22. *Statement I :* Water is a compound.
Statement II : The properties of compound differ from the properties of constituent elements.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

23. *Statement I :* The constituents of mixture retain their individual properties.
Statement II : The constituents do not undergo chemical change.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Elements are divided into three types. Some non metals are very rare in atmosphere which are chemically inert. Some elements show both metal and non-metal characters.

24. Which of the following is not chemically inert:
1) Na 2) Ar 3) Ne 4) He

25. Tellurium is a:
1) Metal 2) Non - metal 3) Metalloid 4) Inert gas

26. The basic form of matter is:
1) Solid 2) Liquid 3) Element 4) Gas

Writeup:2

Elements are made up of tiny particles called Atoms.

Each element is characterized by the mass of its atoms. Atoms of the same element have the same mass, but atoms of different elements have different masses.

Chemical combination of elements to make different substances occurs when atoms join together in small whole - number ratios.

27. The distinguishing feature between atoms of different elements is:
    1) Number of proton 2) Volume
    3) Atomicity 4) All the above
28. During the chemical reaction mass of an atom of the element is:
    1) Increases 2) Decreases
    3) Remains unchanged 4) Doubled.
29. The most abundant element by mass in the universe is:
    1) H 2) O 3) Si 4) C

Writeup:3

The compounds are always composed by two or more elements and combined in a fixed proportion. The formation of compound involves energy change.

30. Which of the following is not a compound?
    1) Cl_2 2) H_2O 3) CO_2 4) SO_2
31. In CO_2, how many types of elements are present?
    1) 2 2) 3 3) 4 4) 5
32. Which of the following is true about mixture?
    1) No energy is released during the formation of a mixture
    2) A mixture can be Homogeneous or Heterogeneous
    3) Mixture may not have fixed proportion
    4) All the above.

Writeup:4

A symbolic representation of one molecule of a compound representing the number of atoms of various elements present in it, is called formula of compound.

33. The chemical formula of blue vitriol is:
    1) $CuSO_4.2H_2O$ 2) $Na_2CO_3.10H_2O$
    3) $CuSO_4.5H_2O$ 4) $CuSO_3.5H_2O$
34. The chemical formula of aluminium sulphate is:
    1) $Al_3(SO_4)_3$ 2) $Al(SO_4)$ 3) $Al_2(SO_4)$ 4) $Al_2(SO_4)_3$
35. Identify the chemical formula of following compounds.
    i) Potassium hydrogen carbonate
    ii) Dinitrogen trioxide
    iii) Sodium hydrogen sulphate
    iv) Sodium hydrogen sulphide

	(i)	(ii)	(iii)	(iv)
1)	N_2O_3	$NaHSO_4$	$KHCO_3$	NaHS
2)	$NaHSO_4$	NaHS	$KHCO_3$	N_2O_3
3)	$KHCO_3$	N_2O_3	$NaHSO_4$	NaHS
4)	$KHCO_3$	NaHS	N_2O_3	$NaHSO_4$

MATRIX MATCHING TYPE

36.

Column-I	**Column-II**
a) Metal	1) Bromine
b) Non metal	2) Iodine
c) Liquid non metal	3) Graphite
d) Lustrous non metal	4) Potassium
	5) Hydrogen

37.

Column-I	**Column-II**
a) Germenium is	1) Metal
b) Zinc is	2) Not malleable
c) Plasma is	3) Metalloid
d) A condensate super fluid is	4) Bos Einstein
	5) Ionised gas

38.

Column-I	**Column-II**
a) Homogeneous mixture	1) Soil
b) heterogenous mixture	2) Copper + zinc
c) Alloy	3) 22 carat gold
d) Pure metal	4) Sodium
	5) Sugar + water

39.

Column-I	**Column-II**
a) Compound	1) Heterogeneous
b) Salt and Charcoal	2) Homogeneous
c) Brass	3) The constituents are present in a fixed ratio by weight
d) Lead oxide	4) Alloy
	5) Metallic oxide

INTEGER ANSWER TYPE

40. How many magnesium atoms are present in chlorophyll molecule?

41. Total number of components present in salt solution are _____.

SYNOPSIS - 2

Separation of mixtures

Introduction: Mixture is said to be pure when its components are known and they are put together in a desired quantity.

Need for separation: Some times it happens that an unwanted substances gets mixed up with the required substances. Things are thus rendered impure. To remove impurity we need separation of the components of a mixtures.

Principles involved in the separation of components of a mixture:

The method(s) necessary to separate the components of a mixture depends upon:

1. The physical state of the constituents of the mixture
2. The difference in one or more physical properties of the constituents of the mixture.

TECHNIQUES FOR THE SEPARATION OF SOLID-SOLID MIXTURES

Technique employed for the separation of a mixture	Physical property involved in separation	Examples
Magnetic separation	One of the components of the mixture is a magnetic substance (iron, cobalt; nickel and steel or their oxides are magnetic in nature).	i) Separation of iron ore from rocky material (gangue) ii) Separation of nickel from mixture of nickel and lead.
Using gravity	One of the components is heavier than water, whereas the other components are either lighter or soluble in water.	i) A mixture of saw dust and sand ii) A mixture of common salt and sand.
Using solvents	One of the components is soluble, but the other is insoluble in a specific solvent.	i) Sulphur and sand (sulphur dissolves in carbon disulphide) ii) Ammonium chloride and iodine [ammonium chloride dissolves in water].
Fractional crystallization	Both the components are soluble in water, but their solubilities are different, i.e., one is more soluble than the other. Furthermore, they do not sublime.	i) Potassium nitrate and sodium chloride. ii) Potassium chlorate and potassium chloride.
Sublimation	Both the components are soluble in water, but one of them can sublime but not the other, or both the omponents are insoluble in water.	i) Ammonium chloride and common salt. ii) Iodine and sand

SEPARATION OF SOLID-SOLID MIXTURES

A. MAGNETIC SEPARATION

The method of separation of mixtures where one of the components is magnetic in nature, i.e., it consists of iron, steel, cobalt, nickel or their compounds is called magnetic separation.

Let us consider a mixture is of iron fillings and sulphur.

Method :

1. Spread the mixture evenly in the form of a thin layer over a piece of paper.
2. Place another sheet of paper over the mixture.
3. Place a powerful horse shoe magnet over the paper and then lift. Some iron fillings will cling to paper.
4. Remove the magnet from the paper. The iron fillings will fall down.
5. Repeat the process a number of times, till all the iron fillings are removed.

BY USING GRAVITY METHOD:

The method of separation of the components mixture when either lighter than the other or is soluble in water. This method is suitable for mixtures given in table.

Solid-Solid Mixture	Heavier component	Lighter component or soluble component
i) Sand and saw dust	Sand	Saw dust (lighter)
ii) Salt and sand	Sand	Salt (soluble)
iii) Charcoal and limestone	Limestone	Charcoal (lighter)

Method :

1. Stir the mixture in water or any other suitable solvent.
2. Allow the mixture to stand, so that the heavier components settles down.
3. Decant off or filter the water along with lighter or soluble component.

USING SOLVENTS:

This method is suitable for such mixtures in which one of the components is soluble in some particular solvent. Table 8 shows some mixtures which can be separated by this process.

Solid-Solid Mixture	Solvent	Soluble Component	Insoluble Component
Sand and sulphur	Carbon disulphide	Sulphur	Sand
Charcoal and sulphur	Carbon disulphide	Sulphur	Charcoal
Sand and wax	Turpentine oil	Wax	Sand
Common salt and marble powder	Water	Common salt	Marble powder
Nitre and charcoal	Water	Nitre	Charcoal
Gun powder (nitre carbon and sulphur)	i) Water ii) Carbon disulphide	i) Nitre ii) Sulphur	i) Sulphur and carbon ii) Carbon

LIST OF IMPORTANT SOLVENTS

Substance	Solvent
Chlorophyll	Methylated spirit
Grease	Petrol
Iodine	Ethyl alcohol
Nail polish	Acetone
Nitre	Water
Oil	Petrol
Paraffin wax	Turpentine oil
Phosphorus	Carbon disulphide
Rust	Oxalic acid
Rubber	Benzene
Sulphur	Carbon disulphide
Shellac	Ethyl alcohol
Paint	Turpentine oil

Method :

1. Choose the solvent, such that only one particular component of the mixture is soluble in it, and other component is insoluble.
2. Dissolve the mixture is a good amount of solvent such that the soluble component of the mixture completely dissolves.
3. The above solution is filtered. The insoluble component of the mixture is left on the filter paper. The soluble content collects as filtrate.

Recovery of the components :

1. The insoluble component is left on filter paper. It is dried either in hot air or the folds of filter paper.
2. The filtrate is evaporated either on slow heat or in the sunlight. The solvent evaporates, leaving behind soluble component.

FRACTIONAL CRYSTALLISATION

The process of separation of two different soluble substances from their solution by by crystallisation at controlled temperature, such that one of the solid crystallises is called **fractional crystallisation.**

Fractional crystallisation is based on the principle that different solids have different solubilities at a given temperature.

This method is suitable for mixtures mentioned in Table.

Solid-Solid Mixture	More soluble component	Less soluble component
Potassium nitrate and sodium chloride	Potassium nitrate	Sodium chloride
Potassium chloride and potassium chlorate	Potassium chlorate	Potassium chloride
Sodium nitrate and sodium chloride	Sodium nitrate	Sodium chloride

Method :

1. Choose the solvent (generally water) and warm it to around 60^0 C.
2. Add the mixture in solvent, till it stops dissolving.
3. Allow the mixture to cool. Large amount of **more soluble solid crystallises out** along with **some amount of less soluble solid.**
4. Filter the crystals and redissolve them in minimum amount of warm solvent.
5. Recrystallise the crystals, when large amount of more soluble salt crystallises out.
6. **Concentrate the filtrate** containing **less soluble** solid. On cooling, the crystals of less soluble solid separate out.

BY SUBLIMATION

This method is used in separation of such mixtures, where one of the components of the mixture sublimes on heating. It is useful for mixture mentioned in Table. However, care should be taken that the components of mixture do not react chemically on heating.

Solid-Solid mixture	Sublimable solid
Ammonium chloride and common salt	Ammonium chloride
Iodine and sand	Iodine
Iodine and common salt	Iodine
Sodium sulphate and Benzoic acid	Benzoic acid
Napthalene and iron filling	Napthalene

Method :

1. The mixture is placed in a china dish and heated by a low flame.
2. An inverted dry funnel is placed over the china dish and its stem is closed with cotton wool.
3. The sublimable component of the mixture sublimes and its vapours condense on the sides of the funnel to form fine powder.
4. The fine powder (sublimable component) is scrapped from the sides of funnel.
5. The residue left behind is non-sublimable component.

WORK SHEET - 2

SINGLE ANSWER TYPE

1. Which one of the following substances is soluble in Acetone?
   1) Iodine 2) Chlorophyll 3) Nail polish 4) Oil
2. Choose the correct statement:
   1) Grease is soluble in petrol 2) Nitre is soluble in ethyl alcohol
   3) Paraffin wax is soluble in benzne 4) Phosphorous is soluble in water
3. What is the soluble component in the mixture of Nitre and charcoal?
   1) Charcoal 2) Nitre
   3) Both charcoal and Nitre 4) Neither charcoal nor nitre

4. Oil is soluble in:
   1) Benzene 2) Oxalic acid
   3) Carbondisulphide 4) Petrol
5. Identify insoluble component in separating the follwoing mixtures by useing solvents.
   a) Sand and sulphur b) Charcoal and sulphur
   c) Sand and wax d) Nitre and charcoal

	a	b	c	d
1)	Sand	Charcoal	Sand	Charcoal
2)	Sand	Charcoal	Sand	Nitre
3)	Sulphur	Sulphur	Wax	Nitre
4)	Sulphur	Sulphur	Wax	Charcoal

6. Given below are a few substances:
   a) Chlorophyll b) Grease c) Nitre
   Choose the suitable solvents.

	a	***b***	***c***
1)	Water	Methylated spirit	Petrol
2)	Petrol	Water	Methylated spirit
3)	Methylated spirit	Petrol	Water
4)	Ethyl alcohol	Water	Petrol

7. Choose the solvent that separates common salt and marble powder.
   1) Turpentine oil 2) Water
   3) Carbon disulphide 4) Benzene
8. The process of separation of two different soluble substances from their solution by crystallisation at controlled temperature, such that one of the solid crystallises, is called _____
   1) Crystallisation 2) Filtration
   3) Distillation 4) Fractional Crystallisation
9. A solid - solid mixture of sodium nitrate and sodium chloride can be separated through the method of:
   1) Dissolution 2) Fractional crystallisation
   3) Magnetic separation 4) Fusion
10. Rearrange the jumbled steps of one of the separation technique by choosing the right option.
   A) Dissolve the mixture in good amount of solvent such that the soluble component of the mixture completely dissolves.
   B) The above solution is filtered. The insoluble component of the mixture is left on the filter paper. The soluble content collects as filtrate.
   C) Choose the solvent, such that only one particular component of the mixture is soluble in it, and other component is insoluble.
   1) A, C, B 2) B, C, A 3) A, B, C 4) C, A, B

MULTI ANSWER TYPE

11. Gun powder is soluble in:
   1) Carbon disulphide 2) Water
   3) Benzene 4) Ethyl alcohol

12. We can separate certain solid-solid mixtures by using solvents. The principle behind this method of separation is:
    1) One of the components is soluble in specific solvent.
    2) One of the components is not soluble in specific solvent.
    3) Both the components should be soluble be in specific solvents.
    4) None of the components should be soluble in specific/solvents.

REASONING ANSWER TYPE

13. *Statement I :* A solid - solid mixture can be separated through fractional crystallisation.
    Statement I : Potassium Chlorate and Potassium Chloride can be separated through fractional crystallisation.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.
14. *Statement I :* Potassium nitrate and Sodium chloride can be separated through fractional crystallisation.
    Statement II : Fractional crystallisation is based on the principle that different solids have different solubilities at a given temperature.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup: 1

A mixture contains two components, one of which can form a sublimate whereas the other does not, the two can be separated by method of sublimation.

15. We can separate sodium sulphate and benzoic acid through the method of sublimation, beacause:
    1) Sodium sulphate is sublimable.
    2) Benzoic acid is sublimable.
    3) Sodium sulphate and Benzoic acid are both sublimable.
    4) Neither sodium sulphate nor benzoic acid are sublimable.
16. Iodine can be dissolved in:
    1) Petrol 2) Ethyl alcohol
    3) Carbon disulphide 4) Oxalic acid
17. Which of the follwoing is sublimable solid in given mixtures.
    A) Iodine and sand B) Ammonium chloride and common salt

	A	B
1)	Iodine	Common salt
2)	Iodine	Ammonium chloride
3)	Sand	Ammonium chloride
4)	Sand	Common salt

Writeup:2

In a mixture contains two components, one of which can form a sublimate whereas the other does not, the two can be separated by method of sublimation.

18. Study the following statements and arrange the statements in correct order.
A) The residue left behind is non-sublimable component.
B) The fine powder (sublimable component) is scrapped from the sides of funnel.
C) An inverted dry funnel is placed over the china dish and its stem is closed with cotton wool.
D) The sublimable component of the mixture sublimes and its vapours condense on the sides of the funnel to form fine powder.
E) The mixture is placed in a china dish and heated by a low flame.
1) A, D, C, B, E 2) C, E, A, D, B
3) E, A, C, B, D 4) E, C, D, B, A

19. Which is sublimate in benzoic acid and sodium chloride?
1) Sodium chloride 2) Benzoic acid
3) Both 1 and 2 4) None

20. The separation technique used in separating iodine and sand is:
1) Evaporation 2) Distillation 3) Sublimation 4) Decantation

MATRIX MATCHING TYPE

21.

Column-I	**Column-II**
a) Oxalic acid	1) Shellac
b) Benzene	2) Rust
c) Ethyl alcohol	3) Paint
d) Turpentine oil	4) Rubber
	5) Wax

22.

Column-I	**Column-II**
a) Separation charcoal and limestone	1) Using solvents
b) Separation of gunpowder	2) Sublimation
c) Separation of sodium nitrate and sodium chloride	3) Magnetic separation
d) Separation of napthalene and iron filling	4) Fractional crystallisation
	5) Using gravity method

INTEGER ANSWER TYPE

23. i) Potassium nitrate and sodium chloride ii) Sand and sulphur
iii) Common salt and marble powder iv) Gunpowder
v) Nitre and charcoal vi) Iodine and sand
How many from the above mixtures are examples of solid-solid mixture?

SYNOPSIS - 3

SEPARATION OF SOLID-LIQUID MIXTURES:

The solid-liquid mixtures can be separated by the techniques given in table, depending upon the physical properties of the components of the mixtures.

Technique employed for separation of mixture	Physical property involved in separation	Examples
Sedimentation and Decantation	One of the components is **heavier than** the liquid and is insoluble	Muddy water, water containing sand.
Filtration	One of the components is a **solid** and is **insoluble in the liquid.**	Silver chloride precipitates in water. Barium sulphate precipitates in water.
Evaporation	One of the components is non-volatile. It may or may not be soluble in water.	Common salt solution, sodium sulphate solution.
Distillation	One of the components is soluble solid in the liquid	Iodine in chloroform.

SEPARATION BY SEDIMENTATION AND DECANTATION :

Sedimentation: The process in which a suspension of insoluble fine particles suspended in a liquid are allowed to stand undisturbed, such that solid particles settle down, leaving the clear liquid above is called **sedimentation.**

Sediment: The insoluble solid material which settles down when a suspension is allowed to stand undisturbed is called **sediment.**

Separation liquid: The clear liquid above the sediment, when a suspension is allowed to stand undisturbed is called **supernanant liquid.**

Decantation: The process of pouring out the clear supernatant liquid above the sediment, thus helping the separation of solid particles from liquid is called **decantation.**

Figures illustrate the technique of sedimentation and decantation. It is useful in the separation of the clay and sand particles from the muddy water.

Drawbacks of Decantation

i) The constitution of the mixture of a solid and a liquid do not get separated completely.

ii) The constituents of a solid lighter than liquid cannot be separated as they float on the surface of liquid, rather than settling down

SEPARATION BY FILTRATION :

Filtration: The process of separation of insoluble solid constituent of a mixture from its liquid constituent by passing it through some porous material is called **filtration.**

Filtrate: The clear liquid obtained from a mixture of a solid and a liquid by the process of filteration is called **filtrate.**

Residue: The insoluble solid constituent left on the filter paper when a mixture of an insoluble solid and a liquid a filtered is called **residue.**

The method of filtration is employed for the following solid-liquid mixtures as shown in table.

Solid-Liquid mixture	Residue	Filtrate
Silver chloride and water	Silver Chloride	Water
Barium sulphate and water	Barium sulphate	Water
Chalk and water	Chalk	Water

Method:

1. Filter paper is generally available in the form of a circular disc. It is folded to form a cone .
2. A glass funnel is moistened with water. The filter paper cone is inserted in the cavity of the funnel and is pressed on the sides. This expels out the air and the filter paper cone sticks tightly to the walls of the funnel.
3. The funnel is clamped in an iron stand and under its stem is placed a beaker, such that the wall of beaker is in contact with the stem of the funnel.
4. The suspension of the solid-liquid is poured in the funnel slowly with the help of glass rod.
5. The filtrate collects in the beaker. The residue is left on filter paper. The residue is dried either in hot air or in the folds of filter paper.

Advantages of Filtration over Sedimentation and Decantation :

1. It is a quicker process than sedimentation and decantation.
2. The insoluble solid is completely removed, which is not possible in case of decantation.

SEPARATION BY EVAPORATION :

The process of changing a liquid into a gaseous state, below its boiling point by the supply of external heat, is called **evaporation.**

The process of evaporation is suitable for the separation of **non-volatile soluble solid** from its **liquid solvent.** Table shows the solid liquid mixtures which can be separated by evaporation.

Solid-Liquid mixture	Non-volatile solid	Liquid
Common salt and water	Common salt	Water
Sodium sulphate and water	Sodium sulphate	Water
Carbon disulphide and sulphur	Sulphur	Carbon disulphide

Method :

1. Heat the sand in an iron vessel by placing it over a tripod stand. This arrangement is called sand bath.
2. Take the clear solution of soluble non-volatile substance in the china dish. Place the china dish on the sand bath.
3. Heat gently, such that water (liquid) evaporates, but does not boil, continue heating till liquid completely evaporates.

4. When almost dry solid is left, reduce the flame, but go on heating for another five minutes. This helps in forming (i) completely dry solid (ii) will prevent the spurting (jumping out) of solid from the china dish due to excessive heat.

SEPARATION BY DISTILLATION :

The process of conversion of a liquid into gaseous state on boiling and then recondensing the gas so formed into liquid by condensation in another vessel, is called **distillation.**

It is used in the situations where the **liquid component** of solid-liquid mixture is required in pure state. Table shows some of the solid-liquid mixtures which can be separated by distillation.

Solid-Liquid mixture	Liquid	Non-volatile solid
Salt and water (sea water)	Pure water	Salt
Iodine and methyl alcohol	Methyl alcohol	Iodine
Iodine and chloroform	Chloroform	Iodine

Method :

1. The solid-liquid mixture is placed in a distillation flask. The distillation flask is connected to Liebig's condenser, at the end of which is placed a receiver to collect distilled liquid (distillate) .
2. When the distillation flask is heated, the liquid starts boiling. The vapour of liquid passes through the Liebig condenser, where they condense to form liquid. The liquid so formed trickles into the receiver.
3. The solid component of mixture forms residue in the flask.

WORK SHEET - 3

SINGLE ANSWER TYPE

1. Barium sulphate and water can be separated by filtration. Which of the following is left as a residue from the above mixture?
   1) Water
   2) Barium sulphate
   3) Both water and barium sulphate
   4) Neither water nor barium sulphate
2. The process of separation of insoluble solid constituent of a mixture from its liquid constituent by passing it through some porous material is called _____.
   1) Evaporation 2) Crystallization
   3) Filtration 4) Decantation
3. The separation technique involved in separating sand from water is:
   1) Sedimentation 2) Sublimation
   3) Gravity separation 4) All the above
4. The clear liquid obtained from a mixture of a solid and liquid by the process of filtration is called:
   1) Redidue 2) Supernatant
   3) Filltrate 4) Sedimate

5. The clear liquid above the sediment, when a suspension is allowed to stand undisturbed is called
   1) Redidue 2) Supernatant
   3) Filltrate 4) Sedimate
6. The evaporation process is suitable for the separation of (i) solid from its (ii) .
   1) (i) → Volatile soluble solid, (ii) → Solute
   2) (i) → Insoluble solid, (ii) → Solution
   3) (i) → Non-volatile solid, (ii) → Liquid solvent
   4) (i) → Sublimate, (ii) → Filtrate
7. Chalk precipitate in water can be separated by the method of filtration. The principle behind the filtration technique is:
   1) One of the components is heavier than the liquid and is insoluble.
   2) One of the components is a solid and is insoluble in the liquid.
   3) One of the components is soluble in the liquid.
   4) One of the components is non-volatile.
8. Certain solid - liquid mixtures can be seperated by using filtration technique: The priniciple behind the filtration technique is.
   1) Insoluble component is removed from the liquid mixtures by passing through porous material.
   2) Removal of insoluble lighter solids
   3) Liquid changes into vapour state on gentle heating
   4) Cooling the gaseous mixture to obtain components in the liquid
9. The clear liquid above the sediment, when a suspension is allowed to stand undisturbed is called (A) and the insoluble solid material is called (B)
   1) A→ Supernatant liquid, B → Sediment
   2) A → Filtrate, B → Residue
   3) A → Decantate, B → Sediment
   4) A → Residue, B → Filtrate
10. Choose the correct order of arrangement of steps involved in the method of evaporation:
   a) Heat the sand in an iron vessel by placing it over a tripod stand. This arrangement is called sand bath.
   b) Heat gently, such that water (liquid) evaporates, but does not boil. Continue heating till liquid completely evaporates.
   c) When almost dry solid is left, reduce the flame, but go on heating for another five minutes. This helps in forming (i) completely dry solid (ii) will prevent the spurting (jumping out) of solid from the china dish due to excessive heat.
   d) Take the clear solution of soluble non-volatile substance in the china dish. Place the china dish on the sand bath.

   1) b, a, d, c 2) c, a, d, b 3) a, d, b, c 4) b, a, d, c

11. Rearrange the steps involved in the method of seperation by studying the following steps:
    a) A glass funnel is moistened with water. The filter paper cone is inserted in the cavity of the funnel and is pressed on the sides. This expels out the air and the filter paper cone sticks tightly to the walls of the funnel.
    b) The suspension of the solid-liquid is poured in the funnel slowly with the help of glass rod.
    c) Filter paper is generally available in the form of a circular disc. It is folded to form a cone.
    d) The funnel is clamped in an iron stand and under its stem is placed a beaker, such that the wall of beaker is in contact with the stem of the funnel.
    e) The filtrate collects in the beaker. The residue is left on filter paper. The residue is dried either in hot air or in the folds of filter paper.

    1) b, d, a, c, e 2) e, b, a, c, d 3) c, a, d, b, e 4) d, a, c, b, e

MULTI ANSWER TYPE

12. Which of the following is/are non-volatile in nature?
    1) Water 2) Common salt
    3) Iodine 4) Sulphur
13. Choose the correct statement:
    1) Sulphur is a non-volatile solid
    2) Sodium sulphate is a non-volatile solid
    3) Carbondisulphide is non-volatile
    4) Common salt is a volatile solid.
14. Identify the correct statement :
    1) The insoluble solid material which settles down when a suspension is allowed to stand undisturbed is called sediment.
    2) The process of conversion of a liquid into gaseous state on boiling and the recondensing the gas is callded distillation.
    3) Iodine in chloroform is separated by distillation.
    4) The constituent of a mixture of a solid and liquid dust get separated completely by decantation method.

REASONING ANSWER TYPE

15. *Statement I :* We should not heat the mixture of sulphur and Carbon disulphide.
    Statement II : Carbon disulphide is highly inflammable.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

16. *Statement I :* The solid - liquid mixture can be separated by the technical, depending upon the physical property of the compound of a mixture.
Statement II : In sedimentation of the components is heavier than the liquid and is insoluble.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

The process of separation of insoluble solid constituent of a mixture from its liquid constituent by passing it through some porous material is called **filtration.**

17. The process of changing a liquid into a gaseous state, below its boiling point by the supply of external heat, is called_____.

1) Distillation 2) Evaporation
3) Fractional crystallisation 4) Filtration

18. Which of the following separation techniques will you suggest to seperate silver chloride and water?

1) Decantation 2) Sedimentation
3) Evaporation 4) Filtration

19. The insoluble solid obtained from a mixture of a solid and a liquid by the process of filltration is called_____ .

1) Filtrate 2) Decantate 3) Residue 4) Sediment

Writeup:2

The process of changing a liquid into a gaseous state, below its boiling point by the supply of external heat, is called **evaporation.**

20. Why do you think filltration is more beneficial than sedimentation and decantation?
1) The constituents of the mixture of a solid and a liquid can be separated completely.
2) The consitituents of a solid are lighter than liquid and can be separated as they float on the surface of liquid, rather than settling down.
3) The process is suitable for the separation of non-volatile soluble solid from its liquid solvent.
4) The insoluble solid is completely removed, which is not possible in case of decantation.

21. Carbon disulphide and Sulphur can be separated by the method of evaporation because:
    1) Sulphur is non-volatile solid and Carbon disulphide is liquid.
    2) Carbon disulphide is non volatile solid and Sulphur is a solvent.
    3) Both Sulphur and Carbon disulphide are solvents.
    4) Neither Sulphur is solvent nor Carbon disulphide.
22. The Non volatile solid in common salt and water is:
    1) Common salt 2) Water 3) Both 1 and 2 4) None

MATRIX MATCHING TYPE

23.

Column-I	**Column-II**
a) Muddy water	1) Filtration
b) Common salt solution	2) Evaporation
c) Iodine in chloroform	3) Decantation
d) Silver chloride pricipitate in water	4) Distillation
	5) Using solvents

24.

Column-I	**Column-II**
a) A clear liquid above the sediment when a suspension is allowed to stand undisturbed	1) Evaporation
b) A clear liquid obtained from a mixture of a solid and a liquid in filtration	2) Filtrate
c) The process changing a liquid into a gaseous state is	
d) The convertion of a liquid into gaseous state on boiling and recondensing the gas so formed into liquid by condensation another vessel is	3) Distillation
	4) Supernant liquid
	5) Residue

INTEGER ANSWER TYPE

25. Identify how many mixtures from the following are separated by filtration?
    i) Muddy water ii) Iodine in chloroform
    iii) Silver chloride in water iv) Water containing sand

SYNOPSIS - 4

SEPARATION OF LIQUID-LIQUID MIXTURES

The liquid-liquid mixtures can be separated by the techniques given in Table, depending upon the physical properties of the components of the mixture.

TECHNIQUES OF SEPARATION OF LIQUID-LIQUID MIXTURES

Technique employed for separation of mixture	Physical property involved in separation	Examples
1. Separating funnel	The liquid components i) do not dissolve in one another (immiscible) ii) have different densities	1. Kerosene oil and water. 2. Carbon disulphide and water.
2. Fractional distillation	The liquid components i) dissolve in each other (miscible) ii) have different boiling points	1. Ethyl alcohol (b.p. 78^0 C) and water (b.p. 100^0 C) 2. Methyl alcohol (64.5 ^{0}C) and acetone (b.p. 56.5^0C)

SEPARATION OF LIQUID-LIQUID MIXTURES BY SEPARATING FUNNEL:

Separating funnel is a long glass tube provided with a tap. The liquid-liquid mixture of immiscible components is poured into the funnel and allowed to stand. The liquids separate out on account of difference in their densities. Table shows various immiscible liquids which can be separated by the separate funnel.

Immiscible liquid-liquid mixtures	Heavier liquid	Lighter liquid
Benzene and water	Water	Benzene
Kerosene oil and water	Water	Kerosene oil
Turpentine oil and water	Water	Turpentine oil
Carbon disulphide and water	Water	Carbon disulphide
Chloroform and water	Chloroform	Water
Mercury and alcohol	Mercury	Alcohol

Method:

1. The top of the separting funnel is closed. The separating funnel is clamped in the vertical positions in an iron stand.
2. The immiscible liquid-liquid mixture is poured into the **separating funnel.** The mixture is allowed to stand for half an hour or more.
3. The immiscible components of the mixture separate out into two distinct layers. the heavier and denser liquid forms the lower layer. The lighter and less denser liquid forms the upper layer.
4. A conical flask is placed under the nozzle of separating funnel. The tap is gently opened so that the heavier liquid trickles in flask drop by drop. Once the denser liquid is drained out, the tap is closed.
5. Another conical flask is placed under the nozzle of separating funnel. The tap is opened to drain the lighter liquid.

SEPARATION OF LIQUID-LIQUID MIXTURE BY FRACTIONAL DISTILLATION:

In case two liquids have very close boilding points, both the liquids tend to distil over in different proportions. It means lesser the boiling point of a liquid, more is the proportion of it distilling over.

The above problem can be avoided by using a fractionating column. It gives the effect of **repeated distillation** by offering resistance to the message of vapours.

The process of separation of two miscible liquids by the process of distillation, making use of their difference in boiling points, is called **fractional distillation.**

This process is useful only, if the difference in the boiling points of the two miscible liquids is between 10 ^{0}C to 20^0 C or more.

Table shows various miscible liquids, which can be separated by fractional distillation

Miscible liquid-liquid mixture			Component which distills over
Ethyl alcohol (b.p 78^{0}C)	+	Water 100° C	Ethyl alcohol
Methyl alcohol (b.p. 64.5^{0}C)	+	Ethyl alcohol (b.p. 78^{0}C)	Methyl alcohol
Ethyl alcohol (b.p 78^{0}C)	+	Chloroform (b.p. 61^0 C)	Chloroform
Acetone (b.p 56.5^{0}C)	+	Water (b.p 100^0 C)	Acetone
Acetone (b.p 56.5^{0}C)	+	Ethyl alcohol (b.p 78^0 C)	Acetone

Method:

1. The process of fractional distillation is similar to the process of distillation.
2. The design of a fractionating column is such that the vapour of one liquid (with a higher boiling point) are preferentially condensed as compared to the vapour of the other liquid (with lower boiling point)
3. Thus, the vapours of the liquid with low boiling point, pass on to Liebig's condenser where they condense. The liquid so formed is collected in receiver.
4. The thermometer shows a constant reading as long as the vapour of one liquid are passing to Liebig's condenser. As soon as the temperature starts rising, the receiver is replaced by another receiver to collect second liquid.

Chromatography :

The process of separation of different constituents of a mixture by absorbing them over an appropriate absorbent material is called **chromatography.**

The absorbent medium is generally **magnesium oxide, alumina or filter paper.**

The **solvent** generally used for dissolving a mixture of two or more constituents in **water or alcohol.**

The different constituents of a mixture get **adsorbed** differently on the same absorbent material, because they have **different rates of movement.** The rate of movement of each adsorbed material depends upon :

i) The relative solubility of the constituent of mixture in a given solvent.

ii) The relative affinity of the constituents of mixture for the adsorbed medium

If a filter paper is used as an adsorbent material for the separation of various constituents of a mixture, then this method of separation of mixture is called **paper chromatography.**

Paper chromatography is very useful in separating various constituents of coloured solutes present in a mixture like ink, dyes, etc.,

SEPARATION OF COLOURED CONSTITUENTS PRESENT IN A MIXTURE OF INK AND WATER :

Method :

1. Take a filter paper 22 cm long, 5 cm broad and stick its smaller end to a glass rod with the help of gum. On the other end, measure a distance of 7 cm from lower end and mark a small point. On this point pour a drop or two of the ink.
2. Suspended this filter paper in a wide and tall cylinder . Gradually, pour water into the cylinder till the lower end of filter paper slightly dips in the water. Cover the cylinder with a glass lid to prevent any evaporation and leave the apparatus undisturbed for an hour. The water rises up the filter paper and reaches the ink mark. This water then dissolves various constituents of the ink in it. These constituents of the ink get adsorbed by the filter paper in different amounts. More a constituent gets adsorbed the lesser it moves upward and vice versa.
3. When the solvent (water) reaches near the top of filter paper, the filter paper is removed from water and dried. On the filter paper will be seen a hand of colours, of various constituents.
4. A filter paper with separated hands of various constituents of a coloured substance is called **chromatograph.**

Advantages of Paper Chromatography

1. It can be carried out by a very small amount of material.
2. The substances under investigation do not get wasted in chromatographic separation.

WORK SHEET - 4

SINGLE ANSWER TYPE

1. The boiling point of acetone is:
   1) 56.5°C 2) 78°C 3) 64.5°C 4) 100°C
2. Which method of separation do you suggest to separate ethyl alcohol and acetone?
   1) Fractional Crystallisation
   2) Fractional distillation
   3) Sedimentation followed by Decantation
   4) Seperating funnel
3. The process of separation of different constituents of a mixture by absorbing them over an appropriate absorbent material is:
   1) Filtration 2) Evaporation 3) Chromatography 4) Sublimation
4. Turpentine oil and water can be separated by using a separating funnel. On what principle does a separating funnel work?
   1) Difference in melting points
   2) Difference in boiling points
   3) Difference in solubilities
   4) Difference in their densities.
5. Out of the liquid – liquid mixture of methyl alcohol and ethyl alcohol the component that distills first is:
   1) Methyl alcohol 2) Ethyl alcohol
   3) Neither methyl alcohol nor ethyl alcohol
   4) Both ethyl alcohol and methyl al
6. Mercury and alcohol can be separated by:
   1) Fractional distillation 2) Filtration
   3) Separating funnel 4) Sublimation
7. You are given a mixture of sand, water and mustard oil. How will you separate the components of this mixture?
   1) Evaporation followed by using separating funnel.
   2) Filtration followed by using separating funnel.
   3) Distillation followed by using separating funnel.
   4) Crystallisation followed by using separating funnel.
8. Rearrange the jumbled steps given below pertaining to a separation technique:
   (a) The design of a fractionating column is such that the vapour of one liquid (with a higher boiling point) are preferentially condensed as compared to the vapour of the other liquid (with lower boiling point)
   (b) Thus, the vapours of the liquid with low boiling point, pass on to Liebig's condenser where they condense. The liquid so formed is collected in receiver.
   (c) The process of fractional distillation is similar to the process of distillation, except that a fractionating column is attached.
   (d) The thermometer shows a constant reading as long as the vapour of one liquid are passing to Liebig's condenser. As soon as the temperature

starts rising, the receiver is replaced by another receiver to collect second liquid.

1) d, b, a, c 2) c, a, b, d 3) a, c, b, d 4) d, b, a, c

MULTI ANSWER TYPE

9. Which of the following statements is true for the given mixture?
Carbondisulphide and water
1) Water is a heavier liquid
2) Carbondisulphide is a lighter liquid
3) It is an immiscible liquid-liquid mixture
4) The mixture can be separated by using a separating funnel

10. Which of the following is example for separation of liquid-liquid mixture?
1) Benzene and water 2) Turpentine oil and water
3) Ethyl alcohol and chloroform 4) Common salt and water

REASONING ANSWER TYPE

11. *Statement I :* Methyl alcohol and acetone can be separated by fractional distillation.
Statement II : Methyl alcohol completely dissolves in acetone.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

12. *Statement I :* A separating funnel is used to separate immiscible liquids.
Statement II : We can separate ammonium chloride and iodine by using separating funnel.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

13. *Statement I :* Potassium nitrate and Sodium chloride can be separated through fractional crystallisation.
Statement II : Fractional crystallisation is based on the principle that different solids have different solubilities at a given temperature.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

The process of separation of two miscible liquids by the process of distillation, making use of their difference in boiling points, is called **fractional distillation.**

14. Choose the correct statement(s):
    1) Benzene and water form a miscible liquid-liquid mixture.
    2) Compared to benzene water is a heavier liquid.
    3) Benzene and water can be separated by using separating funnel.
    4) All the above
15. The process of separation of two miscible liquids by the process of distillation, making use of their difference in boiling points is called:
    1) Fractional distillation 2) Fractional crystallization
    3) Chromatography 4) Boiling
16. The mixture of acetone and water can be separated by the method of:
    1) Evaporation 2) Sublimation
    3) Fractional distillation 4) Heating

Writeup:2

The process of separation of different dissolved constituents of a mixture by adsorbing them over an appropriate adsorbent material is called chromatography.

17. The adsorbent media used generally in chromatography is:
    1) Magnesium oxide 2) Alumina
    3) Filter paper 4) All the above
. When a filter paper is used as an adsorbent material for separation of a mixture, this separation technique is called:
    1) Column chromatography 2) Paper chromatography
    3) Gas chromatography 4) All the above
18. Which solvent is generally used for dissolving a mixture of two are more constituents?
    1) Alcohol 2) Water 3) Both 1 and 2 4) Petrol

MATRIX MATCHING TYPE

19.

Column-I	**Column-II**
a) Ethyl alcohol	1) 100°C
b) Chloroform	2) 78°C
c) Water	3) 61°C
d) Acetone	4) 64.5°C
	5) 56.5°C

20.

Column-I **Immiscible liquid-liquid mixture**	**Column-II** **Lighter liquid**
a) Benzene and water	1) Water
b) Kerosene oil and water	2) Alcohol
c) Mercury and alcohol	3) Kerosene oil
d) Chloroform and water	4) Chloroform
	5) Benzene

INTEGER ANSWER TYPE

21. The boiling point of methyl alcohol is _____.

WORK SHEET – 1 (KEY)				
1) 2	**2)** 1	**3)** 3	**4)** 2	**5)** 2
6) 2	**7)** 2	**8)** 1	**9)** 3	**10)** 2
11) 4	**12)** 3	**13)** 4	**14)** 4	**15)** 4
16) 1,2,3,4	**17)** 1,4	**18)** 1,4	**19)** 1,3	**20)** 1
21) 1	**22)** 1	**23)** 2	**24)** 1	**25)** 3
26) 1	**27)** 1	**28)** 3	**29)** 1	**30)** 1
31) 1	**32)** 4	**33)** 3	**34)** 4	**35)** 3
36) 4,(1,2,3,5), 1,3	**37)** 3,(1,2), 5,4	**38)** (1,2,5), 1,(2,3), 4	**39)** (2,3), 1, (2,4), 5	**40)** 1
41) 2				

WORK SHEET – 2 (KEY)				
1) 3	**2)** 1	**3)** 2	**4)** 1	**5)** 3
6) 2	**7)** 4	**8)** 2	**9)** 4	**10)** 1,2
11) 1,4	**12)** 1,2	**13)** 2	**14)** 1	**15)** 2
16) 2	**17)** 2	**18)** 4	**19)** 2	**20)** 3
21) 2,4,1,(3,5)	**22)** 5,1,4,(2,3)	**23)** 6		

WORK SHEET – 3 (KEY)				
1) 2	**2)** 3	**3)** 1	**4)** 3	**5)** 2
6) 3	**7)** 2	**8)** 1	**9)** 1	**10)** 3
11) 3	**12)** 2,3,4	**13)** 1,2	**14)** 1,2,3,4	**15)** 1
16) 2	**17)** 2	**18)** 4	**19)** 3	**20)** 2
21) 1	**22)** 1	**23)** 3,2,4,1	**24)** 4,2,1,3	**25)** 1

WORK SHEET – 4 (KEY)				
1) 1	**2)** 2	**3)** 3	**4)** 4	**5)** 1
6) 3	**7)** 2	**8)** 2	**9)** 1,2	**10)** 1,2,3
11) 3	**12)** 3	**13)** 1	**14)** 4	**15)** 1
16) 3	**17)** 4	**18)** 2	**19)** 3	**20)** 2,3,1,5
21) 5,3,2,1	**22)** 64.5^{0}C			

AIR AND ITS CONSTITUENTS

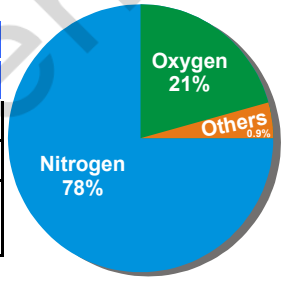
SYNOPSIS - 1

Introduction, composition and properties of air

The air cover of the earth extends even upto 1000 kms from its surface. This air cover is known as atmosphere. You have already learnt in lower classes that at its surface the atmosphere consists mainly oxygen and nitrogen in the ratio of 1:4. Apart from these gases, the atmosphere contains small amounts of carbon dioxide, helium, neon and water vapour.

The above constituents of air lie side by side in atmosphere without losing their properties.We cannot say that the proportion of the constituents of air remain the same but they may vary according to altitude and season. That is why air is called a mixture.

The composition of air	
Component	**Percentage by volume**
Nitrogen	78.1
Oxygen	21
Carbon dioxide, Water vapour and other gases	0.9



When fuel is ignited Carbon dioxide is evolved. A large quantity of Carbon dioxide is found in the atmosphere where more industries are established. Carbon dioxide also evolves from the surface of the earth like the Death Valley in Java and Grotodel Cave in Naples. Dense forests contribute even distribution of Carbon dioxide in atmosphere, plants prepare food by photosynthesis using Carbon dioxide and water in the presence of sunlight. That is why the amount of Carbon dioxide is less in dense forests.

The proportion of Nitrogen in air is found to be less where the leguminous plants are in abundance. These plants have nodules in their root system. Some kind of bacteria is found in these nodules. These bacteria change the nitrogen in the air into nitrate and supply it to the plants. Human and animal excreta and dead bodies on earth surface are purified by a kind of bacteria. As a result of these reactions the nitrogen present in those compounds get released and reaches air in the atmosphere. The volume of water vapour present in the air varies from place to place. It is high in the sea coastal areas. It is low in the plateau regions. In the same way the temperature shows its effect on water vapour in air. When the temperature is high the volume of water vapour increases in air. In winter season mist and fog are formed due to the presence of water vapour in air in excess.

WORK SHEET - 1

SINGLE ANSWER TYPE

1. The air cover the earth's surface up to:
   1) 2000 km 2) 3000 km 3) 1000 km 4) 500 km
2. The thick blanket of air, on the earth's surface is called:
   1) Atmosphere 2) Hydrosphere
   3) Lithosphere 4) Ionosphere
3. Atmosphere consists of oxygen and nitrogen in the ratio of _____ respectively.
   1) 4 :1 2) 1 : 4 3) 2 : 3 4) 3 : 1
4. Which gas is evolved, when fuel is ignited?
   1) Oxygen 2) Chlorine
   3) Carbon dioxide 4) Nitrogen
5. _____ is found in the atmosphere in large quantity in industrial areas. 1) LPG 2) CNG 3) TNT 4) CO_2
6. Which of the following statement(s) is/are not true?
   1) Nitrogen is the major constituent of air present in large quantity.
   2) Air is a mixture of several gases.
   3) The amount of carbondioxide is less in dense forests.
   4) The thick blanket of air on the surface of air is hydrosphere.
7. The Rhizobium bacteria present in root nodules:
   1) Changes the nitrogen in the air into nitrates.
   2) It supply the nitrates to the plants.
   3) It prevents the growth of plants.
   4) Both 1 and 2
8. Identify the correct statements:
   1) The volume of water vapour present in the air is high in the plateau regions.
   2) The amount of carbon dioxide is more in dense forests.
   3) When the temperature is high the volume of water vapour increases in air.
   4) Due to excess presence of water vapour in air, mist and fog are formed in winter seasons.

MULTI ANSWER TYPE

9. Identify inertgas(es) in the atmosphere?
   1) Carbon dioxide 2) Helium
   3) Neon 4) Water vapour
10. The plants prepare food by the photosynthesis process using:
    1) Carbon dixoide 2) Water
    3) Sun light 4) Carbon tetrachloride
11. In which of the following plants root nodules are present?
    1) Peas 2) Beans 3) Cannabinus 4) Leguminous

REASONING ANSWER TYPE

12. *Statement I* :Air is a mixture.
    Statement II: The constituents of air lie side by side in atmosphere without losing their properties..
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

13. *Statement I* :The amount of CO_2 is less in industrial areas.
Statement II : The volume of water vapour present in the air is high in the sea coastal areas.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Air is a mixture of several gases.

14. Air is one state of matter, because:
1) Air occupies space 2) Air has weight
3) Air is in solid state 4) Both 1 and 2
15. Air exerts pressure:
1) Side ward 2) Upward 3) Downward 4) All the above
16. Air is/are
1) Colourless gas 2) Weight
3) Several gaseous 4) All the above

Writeup:2

The air cover of the earth extends even upto 1000 kws from its surface. The air cover is known as atmosphere

17. The atmosphere consists mainly _____
1) Oxygen and Nitrogen 2) Nitrogen and Hydrogen
3) Hydrogen and Oxygen 4) None of the above
18. What is the ratio of oxygen and nitrogen in the atomosphere respectively?
1) 2:4 2) 4:2 3) 4:1 4) 1:4
19. The air is called:
1) Element 2) Compound 3) Mixture 4) Alloy

MATRIX MATCHING TYPE

20.

Column-I		**Column-II**
a)	Oxygen	1) 0.9%
b)	Nitrogen	2) 0.09%
c)	Carbondioxide	3) 0.03%
d)	Inert gases	4) 21%
		5) 78%

21.

Column-I		**Column-II**
a)	Volume of water vapour is high	1) 32 : 14 respectively
b)	Leguminous plants are more	2) 1 : 4 respectively
c)	Oxygen : Nitrogen in air	3) Nitrogen presence in air is less
d)	Even distribution of CO_2	4) Dense forests
		5) In the sea coastal areas

INTEGER ANSWER TYPE

22. How many number of gaseous substances are present in air from the following?
1) Carbon dioxide 2) Nitrogen 3) Oxygen
4) Helium 5) Argon 6) Water vapour

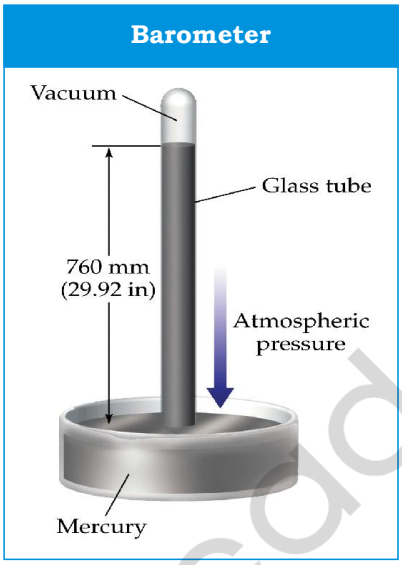
SYNOPSIS - 2

AIR PRESSURE:

Air has weight. So, it exerts pressure on earth's surface. This pressure is called 'Atmospheric Pressure.'

Torricelli designed the Cistern Barometer. It is mainly used to measure the atmospheric pressure.

Cistern barometer



Parts: 1) Thick walled glass tube
2) Mercury

The construction of a Cistern barometer:

1) Take a thick walled glass tube of length one meter and diameter 1 c.m. which is closed at one end.
2) Mercury is poured into this tube without any air bubbles.
3) Close the open end of the tube with your thumb and invert it. Place the open end of the tube in a trough of mercury and remove the thumb.
4) A portion of mercury in the tube falls down into the trough. Mercury in the tube stands still at a certain height of centimeters. This is called Mercury column.
5) Vacuum is developed above the surface of mercury column. This is called Torricellian vacuum.
6) The height of the level of mercury column in the tube from the level of mercury in the trough is measured. This is nearly 76 cms.
7) Usually this will be 76 cms near the sea level. This is called normal atmospheric pressure.
8) The pressure exerted by the atmosphere at a point on the surface of the mercury in the trough is equal to the pressure exerted at any point in the tube which is in the same horizontal line.
9) It means, the weight of 76 cm height of mercury column exerts the same pressure in the tube as exerted by the atmosphere outside the tube.
10) This is the reason that height of mercury is used in measuring the atmospheric pressure.

The information we can get by using a barometer:

1) At any place, atmospheric pressure is known with a barometer.
2) The height of any place from the sea level can be found with a barometer.
3) Forecast of storms, rains can be made with the help of barometer.
4) For every height of 272.7 meters from the sea level, a decrease of 2.54 cms. of pressure takes place.
5) For every depth of 272.7 meters from the sea level, an increase of 2.54 cms of pressure occurs.
6) Gradual decrease in the height of the mercury column in the barometer indicates the rainfall.
7) Sudden fall in the height of the mercury column in the barometer forecasts occurrence of storms.

WORK SHEET - 2

SINGLE ANSWER TYPE

1. The height of mercury column will be high below the _____ areas.
   1) Sea-level 2) Moon level 3) Sun level 4) None
2. Air has weight so it exerts pressure on earth's surface, the pressure is called_____.
   1) Atmospheric pressure 2) Atmospheric volume
   3) Atmospheric energy 4) None of the above
3. The mercury column is called_____.
   1) Atmospheric pressure 2) Atmospheric volume
   3) Atmospheric energy 4) Atmospheric weight
4. This is used to find the atmospheric pressure:
   1) Barometer 2) Spherometer
   3) Speedometer 4) Gravitymeter

12. Normal atmospheric pressure is..... of mercury column.
    1) 76m.m. 2) 76 m 3) 760 mm 4) 76 km
13. Vacuum in the barometer is called:
    1) Volt vacuum 2) Torricellian vacuum
    3) Ampere vacuum 4) Edison's vacuum
15. _____ is the normal atmospheric pressure:
    1) 76 cm of mercury column 2) 56 cm of mercury
    3) 86 cm of mercury column 4) 46 cm of mercury column
16. Rain, Storm can be forecasted with the help of _____.
    1) Atmospheric pressure 2) Water pressure
    3) Vapour pressure 4) None
18. _____ shows atmospheric pressure of a particular place.
    1) Barometer 2) Spherometer
    3) Gravitymeter 4) Manometre
20. The liquid used in the barometer is:
    1) KOH solution 2) Hydrochloric acid
    3) Mercury 4) All the above

MULTI ANSWER TYPE

5. Identify the correct statement:

1) Air has weight
2) Air exerts pressrure as earth surface.
3) Torricelli a scientist designed cistern barometer.
4) Barometer is used to measure the weight of air.

14. Which of the following is correct statement?
1) The vaccum formed above the surface of mercury column is Torricellian vaccum.
2) Rain storm can be forecasted with the help of atmospheric pressure.
3) The height of a particular place from seal level is known with the help of barometer.
4) For every 272.7 metres the height from the seal level 2.54 centimeters of pressure increases.

REASONING ANSWER TYPE

6. *Statement I :* Barometer is used to measure atmospheric pressure.
Statement II : The height of mercury column near the sea level will be 76cm.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

17. *Statement I :* The height of mercury column near the sea level will be 76cm.
Statement II : This is called normal atmospheric pressure.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

19. *Statement I :* The height of mercury column shows the pressure of atmosphere at a particular place.
Statement II : It also denotes the mean sealevel of a particular place.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Barometer is used to measure the atmospheric pressure. Those are many kinds of barometers in usage. Cistern barometer is one among them

7. Cistern barometer is designed by:
1) Boyle 2) Torricelli 3) Charles 4) Graham

8. Normal atmospheric pressure is _____ of mercury column.
1) 76 cm 2) 76 km 3) 76 mm 4) 76 m

9. Sudden fall in mercury barometer forecasts:

1) Wind blow 2) Rain 3) Storm 4) Cool weather

Writeup:2

Air has weight. So, it exerts pressure on earth's surface. This pressure is called 'Atmospheric Pressure.'

Torricelli designed the Cistern Barometer. It is mainly used to measure the atmospheric pressure.

21. _____ is formed above the surface of the mercury column
    1) Vacuume 2) Pressure 3) Volume 4) All the above
22. Gradual decrease in mercury column in the Barometer forecasts:
    1) Storm 2) Rainfall
    3) Cool weather 4) Dry weather
23. The sudden fall in mercury Barometer forecasts:
    1) Dry weather 2) Rain
    3) Wind blow 4) Storm

MATRIX MATCHING TYPE

10.

Column-I	**Column-II**
a) Decrease in the height of the mercury column	1) 76cms
b) The height of any place from the sea level	2) Rain fall
c) Sudden fall in the height of the mercury column	3) Occurence of storms
d) Normal atmorspheric pressure	4) 272.7 meters
	5) Manometer

INTEGER ANSWER TYPE

11. The height of mercury column near the sea level is _____.

SYNOPSIS - 3

AIR POLLUTION

When the air contains harmful or undesirable substances, generated by the activities of man or nature, such that their concentration interferes with human health or is injurious to plants or animals, it is said to be polluted air, and the undesirable substances are called pollutants.

How air gets polluted in nature?

1. When wind blows hard, it carries dust particles and sand particles in large amount from one place to another place. When the forest fires take place, large amount of carbon particles (smoke) and carbon monoxide enters the air as pollutants.
2. When volcanoes erupt, huge amount of ash and sulphur dioxide is added in the air as pollutants.
3. During the pollination of crops and trees, a significant amount of pollens enter in the atmosphere. The air polluted with pollens causes allergy in some persons and creates problems like sneezing and asthma.

How air gets polluted by the activities of the human beings?

Most of the pollution is caused by the activities of human beings :

1. Large amount of coal is burnt in thermal plants for the generation of electricity. These plants throw out huge amount of smoke and ash in the atmosphere, which can be detected in the radius of 20 km or more from the location of power plant.
2. Vehicles using petrol or diesel produce large amount of smoke and carbon monoxide. In the big cities, such as Delhi, Mumbai, etc., vehicular pollution is causing lot of problems. The vehicles emit hydrocarbons, carbon monoxide, lead, nitrogen oxides and paniculate matter.
3. Burning of wood or coal or kerosene oil in not properly designed 'Chulha' or stoves produce large amount of smoke, ash, carbon monoxide, sulphur dioxide and nitrogen oxide.
4. Burning of refuse in big cities, especially the plastic bags, etc., causes lot of pollution due to the formation of carbon monoxide, sulphur dioxide and nitrogen dioxide.
5. Pesticides spread in the fields also cause air pollution.

How to reduce pollution of air due to human activities?

1. In the houses, we must use improved 'chulha', if we use wood or coal as fuel. In case kerosene oil is used as fuel, we must use improved stoves, so that the production of smoke and carbon monoxide is minimised.
2. In the thermal power plants; cement plants; steel plants, etc., we must provide electric precipitators, so that smoke and ash entering the atmosphere are minimised.

   The sulphur dioxide gas; nitrogen dioxide gas formed in above plants should be removed. This can be done by passing the gases through water, before letting them into atmosphere. The sulphur dioxide and nitrogen dioxide dissolve in water.
3. We must use efficient internal combustion engines in our vehicles, so that petrol or diesel burns completely without emitting any smoke. The harmful gases present in the exhaust should be removed by using catalytic converter.
4. We must grow more trees as they are capable of removing harmful gases.

Table showing the effects of air pollution.

S.No.	Source	Polluted substances	Effect
1.	Homes	Carbon dioxide	Carbon dioxide causes Difficulty in breathing. Increase in the temperature of earth. Certain changes in atmosphere.
2.	Combustion of fuels	Carbon dioxide, Sulphur dioxide.	Since it is poisonous, it causes headache, mental disorder, and lethargy and also leads to death.
3.	Transport	Carbon monoxide Sulphur dioxide	Sulphur dioxide causes breathlessness in human beings and animals. It also destroys plants chlorophyll. It checks the growth of plants.
4.	Industries	Sulphur dioxide, Nitric oxide, Carbon monoxide, Zinc, Chromium, Nickel, Lead, Soot particles	Smoke containing the particles of zinc, chromium, lead cause diseases of skin, lungs, asthma and other allergies.
5.	Atomic explosions	Strontium 90	Cancer: hazardous to plants and animals.
6.	Aero plane Jet plane	Carbon compounds Fluoro carbons	Destroys the Ozone layer. It causes diseases related to lungs, eyes, skin, and digestive system.
7.	Sound pollution	Sound above audible range	Causes deafness and affects central nervous system leading to mental disability.

(a) Greenhouse effect

The trapping of solar heat energy in earth's atmosphere is called greenhouse effect.

It has been found that wavelength of infra-red rays (heat rays) is inversely proportional to the temperature of the object emitting these rays. It means, lower the temperature of a hot object, the longer is wavelength of infra-red rays emitted by it.

The solar heat radiations consist of infra-red radiations of very short wavelength, as the Sun is at extremely high temperature. These radiations easily pass through atmosphere. On reaching the surface of the Earth, these radiations are absorbed, with the result the temperature of the Earth rises during the day time. However, at night the Earth radiates out the heat radiations at a temperature far below the temperature of the Sun. Thus, heat radiations are of very long wavelength.

WORK SHEET - 3

SINGLE ANSWER TYPE

1. Atmosphere is polluted by:
   1) Nitrogen dioxide 2) Sulphur dioxide
   3) Carbon dioxide 4) All the above
2. Solid, liquid and gaseous substances are present in higher volumes in air it is called:
   1) Water pollution 2) Air pollution
   3) Sound pollution 4) None
3. Decrease in the area of forests causes decrease in:
   1) Volume of oxygen 2) Volume of carbon dioxide
   3) Volume of O_2 and CO_2 4) None
10. _____ causes breathlessness in human beings and animals
   1) Carbon dioxide 2) Carbon monoxide
   3) Sulphur dioxide 4) All the above
11. Burning of plastic bags causes air pollution due to the formation of:
   1) Carbon monoxide 2) Suphur dioxide
   3) Nitrogen dioxide 4) All the above
13. The controlling method for air pollution is:
   1) By checking or controlling the emission of smoke from factories.
   2) By checking the emission of smoke from motor vehicles.
   3) By using the devises which can filter the agents causing the pollution.
   4) All the above
14. Which pollution causes deafness and affects central nervous system?
   1) Air pollution 2) Sound pollution
   3) Water pollution 4) None
16. The trapping of solar heat energy in earth's atmosphere is called:
   1) John Thomson effect 2) Green house effect
   3) Zeeman effect 4) All the above
17. In houses if we use wood or coal as fuel, we must use:
   1) Kerosene oil 2) Chulha
   3) Both 1and 2 4) None
19. The gases is/are released by factories :
   1) Dust 2) Smoke 3) Soot 4) All the above
20. The percentage of carbon dioxide in air is:
   1) 0.03% to 0.04% 2) 0.02% to 0.04%
   3) 0.03% 4) 0.05%

MULTI ANSWER TYPE

4. Air is polluted by combustion of:
   1) Charcoal 2) Kerosene 3) Diesel 4) Petrol
12. What are the factors causing air pollution?
   1) Air is polluted by the combustion of fuels.
   2) Air is polluted by emission of gases by vehicles.
   3) Air is polluted by industrialisation.
   4) Using fertilizers and pesticides in large quantities.

REASONING ANSWER TYPE

5. *Statement I :* Air is polluted by gases produced during of fire wood in

the houses.

Statement II : Decreases in the area of forests causes decreases in the volume of oxygen

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

15. *Statement I :* The temperature in big cities is higher than in the country side.

Statement II : The heat radiations are reflected back in the cities due to the presence of CO_2

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Every organism require air, water and food for living. The substences exists in an impoper ratio in atmosphere. If solid, liquid and gaseous substances are present in higher volumes than required in air, it is harmful to air. It is called air pollution.

6. _____ is used for preventive against pest.
   1) Pesticides 2) Fungisides 3) Herbisides 4) None
7. _____ are used for more yield of crops.
   1) Synthetic fertilizers 2) Manure
   3) Biomass 4) None
8. The sounds above the audible range causes:
   1) Green house effect 2) Water pollution
   3) Radiation 4) Sound pollution

Writeup:2

The trapping of solar heat energy in earth atmosphere is called gree house effect.

21. What is/are the green house gases?
   1) Carbon dioxide 2) Water vapour
   3) Methane 4) All the above
22. _____ will result in submerging of coastal regions and islands.
   1) Thermal power station 2) Steel plants
   3) Wind mills 4) Global warming
23. _____ is/are act as reflecters, during greenhouse effect.
   1) CO_2 molecules 2) Clouds
   3) Both 1 and 2 4) None

MATRIX MATCHING TYPE

9.

	Column-I	Column-II
a)	Breathness in human beings	1)Asthma

and animals
b) Smoke containing particles of zinc, chromium and lead
c) Cancer
d) Causes deafness and effects central norvous system

2)Stronium 90
3)Sulphur dioxide
4)Sound above audible range
5)Carbon compounds

18. **Column-I**
a) Atomic explosions
b) Combustion of fuels
c) Sound pollution
d) Aeroplane and Jet plane

Column-II
1) Mental disability
2) Destroys the ozone layer
3) Hazardous to plants and animals
4) Head ache
5) Diseases of skin

WORK SHEET – 1 (KEY)				
1) 3	**2)** 1	**3)** 2	**4)** 3	**5)** 4
6) 4	**7)** 4	**8)** 3	**9)** 2,3	**10)** 1,2,3
11) 4	**12)** 1	**13)** 4	**14)** 4	**15)** 4
16) 4	**17)** 1	**18)** 4	**19)** 3	**20)** 4,5,3,1
21) 5,3,2,4	**22)** 6			

WORK SHEET – 2 (KEY)				
1) 1	**2)** 1	**3)** 1	**4)** 1	**5)** 3
6) 2	**7)** 1	**8)** 1	**9)** 1	**10)** 3
11) 1,2,3	**12)** 1,2,3	**13)** 2	**14)** 2	**15)** 2
16) 2	**17)** 1	**18)** 3	**19)** 1	**20)** 2
21) 4	**22)** 2,4,3,1	**23)** 76cm		

WORK SHEET – 3 (KEY)				
1) 4	**2)** 2	**3)** 1	**4)** 3	**5)** 4
6) 4	**7)** 2	**8)** 2	**9)** 2	**10)** 4
11) 3	**12)** 1,2,3,4	**13)** 1,2,3,4	**14)** 2	**15)** 1
16) 1	**17)** 1	**18)** 4	**19)** 4	**20)** 4
21) 3	**22)** 3,1,2,4	**23)** 3,4,1,2		

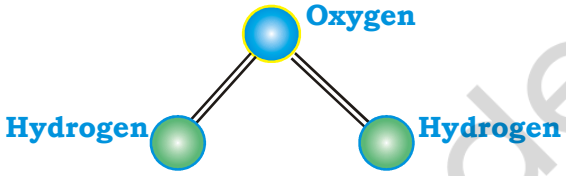
WATER AND ITS CONTITUENTS

SYNOPSIS - 1

INTRODUCTION

Water is a colourless, odourless and tasteless liquid that covers over 70% of the Earth's surface. It is present in rain, clouds and the seas. Water is not only all around us, but it is inside us as well. On an average, the human body contains almost 65% water. Some foods are almost all water. For example, a ripe tomato consists of nearly 95% water.

In 1781, Henry Cavendish showed that water could be prepared by introducing an electric spark through a mixture of two volumes of hydrogen and one volume of oxygen.



Cavendish was a strong believer of phlogiston theory. He thought that, water pre-existed in the two gases as hydrogen and oxygen.

Occurrence of Water

Water is widely distributed in nature in all the physical states. It is found in the combined states in certain minerals and crystalline substances.

In solid state: It occurs as ice, snow and hailstones in Polar regions and mountainers areas of the Earth. As the temperature rises during summer, some amount of these forms melt down.

In liquid state: Water in the liquid state covers about three-fourth of the surface of the Earth. The volume of water in ocean is estimated to be 3×10^{18} cubic metres.

In gaseous state: A large amount of water is present in the form of vapours in the atmosphere. This water plays a vital role in sustaining life in plants and animals. A dry weather (without moisture) is injurious to plant and animal tissues.

Note: Water is the only substance that can exist in all three states (solid, liquid, gas), at ordinary temperature and pressure.

Combined state of water: In combined state, water is an important constituent of all living beings. It is present in carbohydrates, proteins, etc. It is also present in salts containing water of crystallisation, such as $CuSO_4.5H_2O$, $FeSO_4.7H_2O$.

Hydrated salts and anhydrous salts: Compounds containing water of crystallization are called hydrated salts. If the water of crystallization is removed, then the compound is said to be anhydrous.

Hydrated salts on strong heating lose water of crystallization and give rise to anhydrous salts.

For example, $Na_2CO_3.2H_2O$ is hydrated sodium carbonate. On heating, it changes to Na_2CO_3 (anhydrous sodium carbonate).

Note: All crystalline compounds do not contain water of crystallization, e.g., sodium chloride (NaCl), potassium nitrate (KNO_3).

Importance of water

Role of Water in the Human Body:

1. Water is a medium of transport of chemicals to and from cells.
2. Metabolic reactions occur in water.
3. Water regulates the temperature of the body by the process of sweating and evaporation.
4. Blood is a colloidal solution of many compounds such as salts, proteins, enzymes, glucose etc, in water.

Role of water in plants:

1. **Germination of seeds:** Water helps in the germination of seeds.
2. **Photosynthesis:** Along with carbon dioxide, plants use water for manufacturing food.
3. **Transport of minerals:** Minerals present in the soil dissolve in the water and form a solution. This solution is then absorbed by the roots and conducted upwards through the plant tissues.

The mystery of dead sea:

The dead sea is a terminal lake with no outlet, meaning water can only leave through evaporation. Water from its surrounding tributaries flow in to the dead sea. Bringing with them all sorts of minerals, including salts. Since, there is no outlet, the water evaporates depositing minerals and salts. This is the basic reason why dead sea has such high concentration and thus life cannot sustain in it

Composition of water:

1. Ancient philosophers believed that water is an element.
2. Henry Cavendish (1786) showed that water can be prepared by igniting two volumes of hydrogen with one volume of oxygen.
3. A. L. Lavoisier(1783) showed that water is a compound of hydrogen and oxygen atoms combined together in the ratio of 2 : 1.

Reasons to regard water as a compound:

1. **A compound has some elements, combined together in a fixed proportion by weight:** As the water molecule consists of hydrogen and oxygen atoms combined together in the ratio of 1 : 8 by weight, water is a compound.
2. **A compound has properties different from constituting elements:** Hydriogen is a combustible gas, the oxygen is supporter of combustion, but water is a liquid which extinguishes fire. Therfore, its properties are different from constituting elements and, hence, it is a compound.
3. **The components of a compound cannot be separated by any physical means. However, they can be separarted by chemical means:** In case of water it is just not possible to separate hydrogen from oxygen by any physical means. However, the constituents of water can be separated by electro-chemical means, i.e., electrolysis of water.

WORK SHEET - 1

SINGLE ANSWER TYPE

1. The amount of water content in the human body is :
   1) 40% 2) 10% 3) 70% 4) 50%
2. Who proved that water can be prepared by igniting two volumes of hydrogen with one volume of oxygen?
   1) Robert Boyle 2) Henry Cavendish
   3) Avogadro 4) W. Ostwald
3. Who showed that water is a compound of hydrogen and oxygen atoms combined together in the ratio of 2 : 1?
   1) A. L. Lavoisier 2) Avogadro
   3) Henry Cavendish 4) Robert Boyle
4. Choose the property given below to state that "water is a liquid".
   1) Water has a definite mass and volume.
   2) Water has a definite shape.
   3) Water has more density.
   4) Water has no definite shape.
5. The ratio of hydrogen and oxygen atoms in water molecule respectively is:
   1) 3 : 1 2) 4 : 1 3) 2 : 1 4) 1 : 3
13. Which one of the following is a liquid state of water?
   1) Mist 2) Dew 3) Frost 4) Fog
15. Which of the following is extingishes fire?
   1) Oxygen 2) Nitrogen 3) Water 4) Hydrogen
17. Which of the following is correct statement?
   1) Hydroelectric and thermoelectric stations use large amounts of water.
   2) Bulk transport of goods to other countries is carried through sea water.
   3) Water occurs in free as well as combined state.
   4) All the above
19. The constituents of water can be separated by:
   1) Electrolysis 2) Photosynthesis
   3) Resipiration 4) Photolysis

MULTI ANSWER TYPE

6. The solid state of water is:
   1) Frost 2) Mist 3) Fog 4) Hoar frost
14. Water is needed for:
   1) Growing and cooking food
   2) Cleaning our body externally
   3) Clean our body internally and regulate various life process
   4) None

REASONING ANSWER TYPE

7. *Statement I :* Water present in salts containing water of crystallisation such as $CuSO_4.5H_2O$.

   Statement II : Water can be prepared by igniting two volumes of hydrogen with one volume of oxygen.

   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

16. *Statement I :* Water is a compound.

   Statement II : Water molecule consists of hydrogen and oxygen atoms combined together in the ratio of 1 : 8 by weight.

   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Water occurs in free as well as combined state. In free state water occurs in solid liquid and gaseous state.

8. The example for water in gaseous state is:
   1) Mist 2) Dew 3) Hoar frost 4) All the above
9. The ratio of hydrogen and oxygen by weight is respectively.
   1) 2 : 1 2) 3 : 1 3) 1 : 8 4) 1 : 4
10. Which of the following is correct?
   1) Soil contains water in the form of moisture.
   2) Water is a compound of hydrogen and oxygen atoms in present the ratio of 1 : 8 by weight respectively.
   3) 70% of our body is constituted by water.
   4) All the above.

Writeup:2

Water occurs in free as well as combined state. However, a very large percentage of it occurs in free state. In free state, water occurs in solid, liquid and gaseous state.

20. Fresh water is found in the form of:
   1) Snow 2) Ice
   3) Both 1 and 2 4) None
21. Soil contains some amount of water in the form of:
   1) Moisture 2) Ice 3) Mist 4) Frost
22. What are the other forms of solid state of water?
   1) Frost 2) Hoar frost 3) Mist 4) Both 1 and 2

MATRIX MATCHING TYPE

11.

Column-I		Column-II	
a)	Solid state of water	1)	Mist, fog
b)	Liquid state of water	2)	Dew
c)	Gaseous state of water	3)	Froast
d)	In solid state large amount of fresh water found in the form of	4)	Snow or ice
		5)	Hoar frost

18.

Column-I		Column-II	
a)	Water is a compound of hydrogen and oxygen atoms combined together in the ratio of 2 : 1	1)	$CuSO_4.5H_2O$ & $FeSO_4.7H_2O$
b)	Water can be prepared by igniting two volumes of hydrogen with one volume of oxygen	2)	Lavoisier
c)	Potassium nitrate	3)	Cavendish
d)	Salts containing water of crystallisation	4)	KNO_3
		5)	$NaNO_3$

INTEGER ANSWER TYPE

12. The moleculat weight of water is _____.

SYNOPSIS - 2

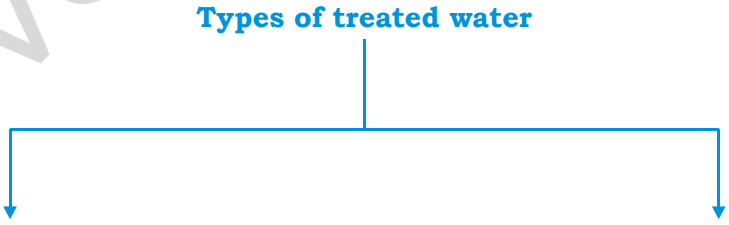
NATURAL WATER AND TREATED WATER

Water which occurs in nature in free state is called natural water.

Examples: River water, Well water, Rain water, Spring water etc.

Treated water: The natural water that obtained after the treatment by some man made process/es and which can be used for some purposes.

Types of treated water:



(i) (Used for preparing soluble injectables

(ii) Used in qualitative analysis

Distilled water: Water obtained by the distillation of natural water, such that it contains no dissolved salts or gaseous impurities, is called distilled water.

The distilled water is purest form of water. It is used for preparing soluble injectables as well as qualitative analysis.

Potable water: Potable water (drinking water) contains dissolved salts. Every 1 litre of potable water contains from 1 g to 2 g of dissolved salts, the chief amongst them being common salt.

Every 1 litre of sea water contains 24 g of dissolved salts, the chief amongst them being common salt. If we drink sea water, we may start vomiting due to excessive salt.

The saline water is distilled to obtain pure distilled water. To this distilled water is added about 2 g of common salt per litre

If we drink distilled water, it will dissolve essential salts present in our body. This may lead to deficiency of vital salts which in turn can make us sick

Any sample of natural water which contains more than 2% of dissolved salts, especially the common salt, is called saline water.

Physical characteristics of water

Colour, odour and taste:

Water is a colourless, odourless and tasteless liquid. Deep water bodies like ponds, lakes, rivers and appear greenish blue due to the scattering of light.

Melting point of ice or freezing point of water:

Ice melts and water freezes at 0°C at 1 atm. The melting point decreases with increase in pressure, and rises with decrease in pressure.

Boiling point:

Water boils at 100°C at 1 atm.

As is the case with other liquids, the boiling point of water rises as the pressure is raised and decreases as the pressure is lowered.

In a pressure cooker, food is cooked better and quicker because the temperature of the boiling water inside the cooker, i.e., under pressure, is higher than 100°C, say 110°C or so. Surgical instruments are sterilized in an autoclave, which works on the same principle as a pressure cooker. At temperatures higher than 100°C, the bacteria are killed.

The atmospheric pressure decreases and the boiling point of water is reduced at higher altitudes. For example, water boils at around 70°C at Mount Everest. Hence, cooking food at high altitudes becomes difficult. Using a pressure cooker, however, solves the problem.

Freezing point: Pure water freezes at 0°C at 760 mm of mercury pressure.

a. Presence of impurities lowers the freezing point, i.e., the water freezes at temperature lower than 0°C.

b. At higher pressure, the freezing point is slightly less than 0°C.

Conduction: Pure water is a bad conductor of heat and electricity.

Change in state on heating: When water is boiled, it changes to gaseous state. 1 cm^3 of water changes to approximately 1760 cm^3 of steam, at 100^0C.

The amount of heat required, to change one gm of water, at 100^0C in to one gm of steam, at 100^0C, is called specific latent of vaporisation that steam causes far more serious burns than water at 100^0C .

Change in state on cooling: When water is cooled, it freezes to form ice. It has been found that 92 cm^3 of water, on freezing, forms 100 cm^3 of ice. Thus, volume of water increase on freezing. It is on account of this expansion that ice floats on the surface of water.

The amount of heat energy liberated by 1 gm of water, at 0^0C, to form 1 gm of ice, at $0\ ^0C$ is called specific latent heat of solidification of water. Its value is 336J/g or 80 cal/g. It is on account of high specific latent heat of solidification that lakes and rivers do not freeze suddenly.

Absorption of a fixed amount of heat: It has been found that 1 gm of water, when heated through 1^0C, always absorbs 4.2 J (or 1 calorie) of heat energy. The fixed amount of heat absorbed by 1 gm of water, when heated through 1^0C, is called specific heat capacity. The specific heat capacity of pure water is 4.2 J/g^0C.

Density the anomalous behaviour of water:

A behaviour that goes against a general rule is said to be anomalous.

Usually, the density of a substance in the solid state is higher than that in the liquid state. Also, the density of a liquid decreases as the temperature rises. However, water shows a peculiar behaviour below 4°C.

The density of water is maximum (1 g/mL) at 4°C, and lower at greater and lower temperatures. Thus ice is lighter than water and floats on it.

Solvent properties: Water is polar covalent compound. It has uniqe property to break the electrostatic forces, holding the ionic compounds. Thus, ionic compounds rapidly dissolve anything and everything in it. It is for this reason that water is called universal solvent.

WORK SHEET - 2

SINGLE ANSWER TYPE

1. What type of water is used for preparing soluble injectables?
   1) Natural water 2) Potable water
   3) Distilled water 4) All of these
2. Well water is an example of:
   1) Rain water 2) River water
   3) Surface water 4) Underground water
3. The water fit for human consumption is called:
   1) Impotable water 2) Pure water
   3) Potable water 4) Saline water
4. Water which occurs in free state is:
   1) River water 2) Well water 3) Rain water 4) All the above
5. Potable water is sterilised by passing:
   1) Hydrogen gas 2) Chlorine gas
   3) Bromine gas 4) Nitrogen gas

13. At 0°C, water can exist in:
   1) Gaseous state 2) Liquid state
   3) Solid state 4) All

14. Water has maximum density at:
1) 100°C 2) 0°C 3) 4°C 4) 10°C

16. When atmospheric pressure is more than 76 cm of mercury, then freezing point of water is:
1) Above 4°C 2) Above 0°C 3) Above 100°C 4) Below 0°C

18. At what temperature pure water boils?
1) 100°C 2) 0°C 3) –4°C 4) 70°C

19. The amount of heat energy liberated by 1gm of water, at 0°C to form 1 gm of ice, at 0°C is called:
1) Specific heat capacity
2) Specific latent heat of vaporisation
3) Specific latent heat of solidification
4) None.

21. i) The amount of heat required to change one gram of water at 100°C into one gram of steam at 100°C is called_____.
ii) The amount of heat liberated by 1 gram of water at 0°C to form 1 gram of ice, at 0°C is called_____.
iii) The fixed amount of heat absorbed by 1 gram of water, when heated through 1°C is called_____.

	(i)	*(ii)*	*(iii)*
1)	Specific heat capacity	Latent heat of solidification	Latent heat of vaporisation
2)	Latent heat of vaporisation	Latent heat of solidification	Specific heat capacity
3)	Latent heat of solidification	Latent heat of vaporisation	Specific heat capacity
4)	Specific heat capacity	Latent heat of vaporisation	Latent heat of solidification

MULTI ANSWER TYPE

6. Choose the false statements.
1) Water boils at 50°C at 2 atm.
2) The density of water is minimum at 4°C.
3) Water shows a peculiar behaviour below 4°C.
4) None of the above.

15. The value of specific latent heat of vaporisation of steam is:
1) 2260 J/g 2) 540 cal/g 3) 1260J/g 4) 640 cal/g

REASONING ANSWER TYPE

7. *Statement I :* Distilled water is purest form of water.
Statement II : Water contains no dissolved salts or gaseous impurities is called natural water.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

17. *Statement I :* The amount of heat energy liberated by 1 gm of water at 0°C to form 1 gm of ice at 0°C is called specific latent heat solidification of water.
Statement II : The value of specific latent heat of solidification of water is 336J/g or 80 cal/g.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Water is a colourless, transparent and clear liquid.

8. Which of the following is correct statement?
1) Boiling point of water increases with increases in atmospheric pressure.
2) Boiling point of water decreases with the decrease in atmospheric pressure.
3) Boiling point of water increases due to the presence of dissolved impurities.
4) All the above.

9. Pure water:
1) Boils at 100°C at a pressure of 76 cm of mercury.
2) Bad conductor of heat as well as electricity.
3) Freezes at 0°C at a pressure of 76 cm of mercury.
4) All the above

10. The heat absorbed by 1gm of water, when heated through 1°C is called:
1) Latent 2) Specific heat capacity
3) Specific conductivity 4) Specific gravity

Writeup:2

Water is a colourless, transparent, clear liquid. Pure water has flat, insipid taste, which may be called tasteless. However, drinking water generally has some taste, because it contains some dissolved salts in it. Pure water has no smell. However, if a particular sample of water smells, it is on account of the dissolved gases or volatile liquids.

22. The fixed amount of heat absorbed by 1gm of water, when heated through 1^0C, is called:
1) Specific rotation 2) Specific heat capacity
3) Specific temperature 4) All the above

23. Specific heat capacity of pure water is:
1) 4.2 J/g°C 2) 5.2 J/g°C 3) 4.2 K/g°C 4) None

24. 1 cm^3 of water changes to approximately _____ of steam at 100^0C.
1) 760 cm^3 2) 76 cm^3 3) 1760 cm^3 4) 760 cm^2

MATRIX MATCHING TYPE

11.

Column-I	Column-II
a) Specific heat capacity	1) 2260 J/g
b) Specific heat latent of solidification	2) Bad conductor of electricity
c) Specific heat latent of vaporisation	3) 336 J/g
d) Pure water	4) 4.2 J/g°C
	5) 330 J/g

20.

Column-I	Column-II
a) Distilled water	1) Natural water which contain 2% of dissolved salts
b) Potable water	2) Qualitative analysis
c) Saline water	3) Natural water that obtained after the treatment by man made process
d) Treated water	4) Human consuption
	5) Obtained by distillation of natural water

INTEGER ANSWER TYPE

12. The relative density water is _____.

SYNOPSIS - 3

Experiment showing dissovled solids in tap water:

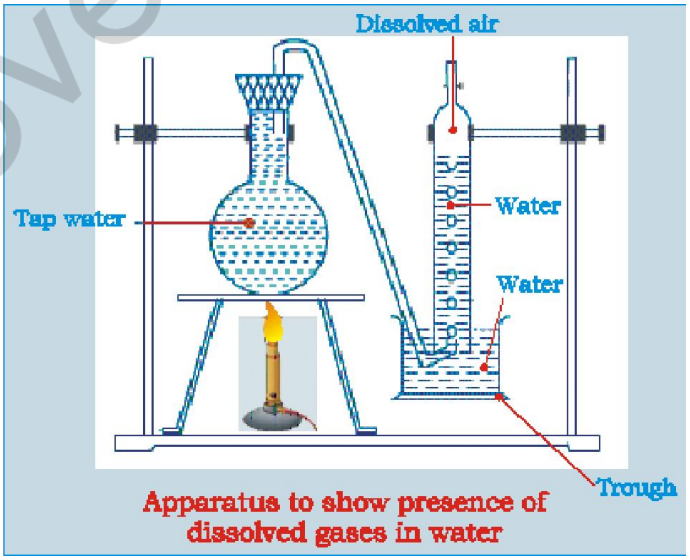
Tap water is placed in a watch glass and placed over a beaker containing water as shown below.

When the water in the beaker is boiled, the heat evolved causes the water in the watch glass to evaporate slowly.

After all the water has evaporated in the watch glass, hold the watch glass against the light.

A number of concentric rings of solid matter are observed.

The concentric rings are deposits of the dissolved solids left behind after evaporation.



Importance of dissolved salts in water:

Dissolved salts provide a specific taste to water. It is for the same reason that water at different places tastes differently.

Dissolved salts act as micro-nutrients for plants and help in their growth and development.

Dissolved gases in water:

Large water surfaces are in direct contact with atmospheric air. Since, the forces of attraction between gas molecules are small, the gases present in air dissolve to some extent in the water.

Air is a mixture. Hence, the solubility of air in water is actually the solubility of each of the constituents of air i.e., oxygen, nitrogen and carbon dioxide. Oxygen being more soluble in water than nitrogen, air dissolved in water contains a higher percentage of oxygen (30-35%) than ordinary air (21%).

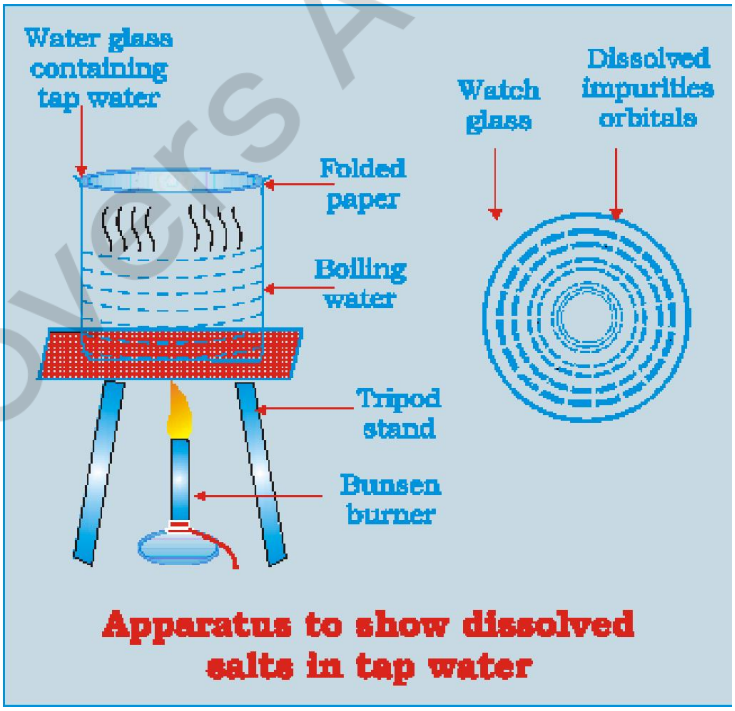
Experiment showing dissolved air in tap water:

One litre round bottom flask and delivery tube are completely filled with tap water.

A graduated tube filled with water, is inverted and clamped over the end of the delivery tube.

Gas bubbles evolved on heating the flask, travel through the delivery tube and collect in the inverted graduated tube. The heating is stopped, when no more of the gas is given off.

The volume of the gas collected is a measure of the volume of air dissolved in one litre of tap water.



The solubility of gases in water decreases with the increase in temperature. Hence, dissolved gases can be removed by boiling.

Importance of dissolved air in water:

The survival of aquatic organisms depends on the gases dissolved in water.

Significance of oxygen dissolved in water: Aquatic plants and animals use oxygen dissolved in water to respire.

Importance of Dissolved Gases (Air) in Water

Dissolved oxygen and dissolved carbon dioxide gas play an important role in the life processes of water animals and water plants.

(A) Importance of Dissolved Oxygen in Water

1. **Respiration:** It has been found that 1 cm^3 of naturally occurring water contains approximately 40 cm^3 of dissolved oxygen. Water animals (fishes, tortoise, etc.) can extract out this oxygen with the help of their gills and, hence, dissolved oxygen is a source of the respiration for them.

$$\underset{\text{Glucose}}{C_6H_{12}O_6(s)} + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(\ell) + \text{Heat}$$

2. **Water Purifier:** The dissolved oxygen kills the germs and bacteria and, hence, keeps water fresh.

(B) Importance of Dissolved Carbon Dioxide in Water

1. **Photosynthesis by water plants:** Dissolved carbon dioxide is utilised by the water plants during photosynthesis and, hence, helps them to manufacture food for themselves as well as for fishes.

$$6CO_2(g) + 6H_2O(\ell) \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6(s) + 6O_2(g)$$

2. **Formation of shells by water animals:** Dissolved carbon dioxide reacts with limestone bearing rocks to form a soluble salt of calcium (calcium bicarbonate), which is used by shell bearing animals (like snails), to form hard shells, for the protection of their soft bodies.

$$\underset{\text{Limestone}}{CaCO_3(s)} + H_2O(\ell) + CO_2(g) \longrightarrow \underset{\text{Cal. bicarbonate}}{Ca(HCO_3)_2(aq)}$$

Effect of Temperature on the Solubility of Air (Gases) in Water

The 'solubility of gases in water decreases with the rise in temperature. It is because of the decrease in solubility that the dissolved air is expelled out from tap water. The solubility of gases in water is contrary to the solubility of solids in water, which increases with the rise in temperature.

1. It is the expulsion of air from boiled water that it tastes flat. However, if same water is shaken with air, the taste returns because of the dissolution of air.
2. It is for the same reason that a chilled soda water bottle does not produce large effervesence on opening, as compared to another soda water bottle at room temperature, because the solubility of gases increases with the fall in temperature.

Effect of Pressure on the Solubility of Air (Gases) in Water

An increase of pressure on the surface of water increases the solubility of gases in it and vice versa. The solubility of gases in water at a fixed temperature can be stated by Henry's law as under :

At any given temperature, the mass of gas dissolved by a fixed volume of liquid is directly proportional to the pressure on the surface of liquid.

It is for the same reason that carbon dioxide gas rapidly bubbles out when soda water bottle is opened. It is because the pressure on the surface of water suddenly decreases and so does the solubility of the carbon dioxide.

WORK SHEET - 3

SINGLE ANSWER TYPE

1. 1 cm^3 of naturally occuring water contains approximately 40 cm^3 of:
   1) Carbon dioxide 2) Carbon monoxide
   3) Dissloved oxygen 4) All the above
2. Which is source of the respiration for water animals?
   1) Dissolved oxygen 2) Carbon dioxide
   3) Hydrogen 4) Carbon monoxide
3. _____ kills the germs and bacteria.
   1) Dissolved chlorine 2) Dissolved oxygen
   3) Dissolved flourine 4) Dissolved sodium
4. The chemical formula of lime stone is:
   1) $CaCl_2$ 2) $Ca(OH)_2$ 3) $CaCO_3$ 4) None

12. Calcium bicarbonate is used by:
   1) Shell bearing animals 2) Skin bearing animals
   3) Bones bearing animalss 4) Muscle bearing animals

13. $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{sunlight}} \_\_\_\_\_ + 6O_2$
   1) $C_6H_{18}O_6$ 2) $C_6H_{18}O_{16}$ 3) $C_6H_{18}O_8$ 4) $C_6H_{12}O_6$

15. $CaCO_3 + H_2O + CO_2 \longrightarrow$ ____A____ Identify A.
   1) $CaHCO_3$ 2) $Ca(H_2CO_3)$ 3) $Ca(H_2CO)_3$ 4) $Ca(HCO_3)_2$

16. The use of shells by water animals is:
   1) To give attraction
   2) It is an additional growths
   3) For the protection of their soft bodies
   4) None

17. The use of dissolved oxygen in water is:
   1) It kills the germs 2) It kills the bacteria
   3) It keeps the water fresh 4) All the above

19. The solubility of gases in water at a fixed temperature can be stated by:
   1) Joule's law 2) Henry's law 3) Raoult's law 4) Avagadro's law

20. The solubility of gases in water decreases with:
   1) Constant in temperature 2) Decrease in temperature
   3) No change 4) Rise in temperature

22. $C_6H_{12}O_6 + 6O_2 \rightarrow \underset{i}{\_\_(i)\_\_} + 6H_2O + \underset{ii}{(ii)}$ Identify (i) and (ii).

1) 6CO Heat
2) $6CO_2$ H_2
3) $6CO_2$ Heat
4) $6CO_2$ O_3

MULTI ANSWER TYPE

5. Which of the following is/are an example(s) of water animal(s)?
1) Fishes 2) Tortoise 3) Frog 4) Crocodile

14. Identify the correct statement from the following:
1) The dissolved oxygen kills the germs and bacteria.
2) Dissolved carbon dioxide is utilised by water plants, during photosynthesis.
3) Dissolved carbon dioxide reacts with limestone to form calcium bicarbonate which is used by shells in water animals.
4) The solubility of gases in water decreases with increases in temperature.

REASONING ANSWER TYPE

6. *Statement I :* Water animals can extract out dissolved oxygen with the help of their gills.
Statement II : Carbon dioxide is a source of the respiration for water animals.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

18. *Statement I :* When soda water bottle is opened carbon dioxide gas rapidly bubbles out.
Statement II : The pressure on the surface of water suddenly decreases and so the solubility of the carbon dioxide also decreases.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

Water is an universal solvent which can dissolve many substances in it. The dissolved gases in water is very useful for the aquatic animals and plants.

7. Which one of the following play an important role in the life processes of water animals and water plants?
   1) Dissolved oxygen 2) Dissolved carbon dioxide
   3) Dissolved flourine 4) Both 1 and 2
8. 1 cm^3 of naturally occuring water contains approximately:
   1) 40 cm^3 of dissolved oxygen 2) 40 cm^3 of hydrogen
   3) 40 cm^3 of nitrogen 4) 40 cm^3 of carbogen
9. Aquatic animals use dissolved carbon dioxide for the photosynthesis, which is useful for:
   1) The manufacture of food 2) For fishes
   3) Both 1 and 2 4) None

Writeup:2

Dissolved oxygen and carbon dioxide play an important role in the life processes of water animals and water plants

23. $\underline{\quad A \quad} + 6O_2 \longrightarrow 6CO_2 + B + \text{Heat}$

Identify 'A' and 'B' respectively:
   1) $C_6H_{12}O_6$, H_2 2) $C_{12}H_{22}O_{11}$, H_2O
   3) $C_6H_{12}O_6$, O_2 4) $C_6H_{12}O_6$, H_2O

24. Which one of the following protect the body of water animals?
   1) Gills 2) Eyes 3) Shells 4) None

MATRIX MATCHING TYPE

10.

Column-I	**Column-II**
a) Boiled water	1) 40 cm^3 of dissolved oxygen
b) Solubility of gases	2) The pressure on the surface of a liquid
c) The mass of gas dissolved by fixed volume of liquid is directly proportional to	3) Tastes flat
d) 1 cubic cm of water contains	4) Increases with decreases in temperature
	5) 40cm^3 of dissolved carbon dioxide

21.

Column-I	**Column-II**
a) Water animals extract out oxygen with the help of	1) Manufacture food in plants
b) Photosynthesis	2) Gills
c) Calcium carbonate reacts with	3) $Ca(HCO_3)_2$
d) Calcium bicarbonate	4) To form hard shells in shell bearing animals
	5) Dissolved carbon dioxide

INTEGER ANSWER TYPE

11. The hydrogen atoms present in glucose molecule is _____.

SYNOPSIS - 4

CHEMICAL PROPERTIES OF WATER

1. **Nature:** Pure water is neutral towards litmus.
2. **Stability:** Water is very stable compound. It does not decompose into elements, when heated to ordinary temperatures.

   However, if it is heated to 2000 °C, 0.6% of it decomposes to form hydrogen and oxygen.

$$2H_2O(\ell) \xrightarrow{2000^\circ C} 2H_2(g) + O_2(g)$$

3. **Catalytic nature:** Water acts as a catalyst in a number of reactions. A few of the reactions are listed below.

   (i) Perfectly dry hydrogen and chlorine gas do not react in the presence of sunlight unless a few traces of water are introduced.

$$2H_2(g) + Cl_2(g) \xrightarrow[\text{Sunlight}]{\text{Moisture}} 2HCl(g)$$

   (ii) White phosphorus does not catch fire, on heating in the atmosphere of perfectly dry air. However, in the presence of moist air it burns to form dense white fumes of phosphorus pentoxide.

ACTION WITH METALS

Action with metals can be studied under two heads:

(a) Action with very active metals like sodium, potassium and calcium.

(b) Action with slightly less active metals like magnesium, aluminium, zinc and iron. These metals react when water is boiling or is in the form of steam. Water does not react when treated with metals like copper, silver, lead or mercury.

Action with Sodium or Potassium

When a small piece of sodium or potassium is dropped into a trough of cold water, it reacts violently to form their respective hydroxides and hydrogen gas.

$$2Na(s) + 2H_2O(\ell) \longrightarrow 2NaOH(aq) + H_2(g) + \Delta T$$

$$2K(s) + 2H_2O(\ell) \longrightarrow 2KOH(aq) + H_2(g) + \Delta T$$

Action with Calcium Metal

When whitish grey calcium metal is treated with cold water, it reacts briskly with the formation of calcium hydroxide and hydrogen gas.

$$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g) + \Delta T$$

Observations when calcium is dissolved in water :

(i) When whitish grey calcium metal is dropped in water, it sinks down.

(ii) It rapidly reacts with water to liberate tiny bubbles of hydrogen gas.

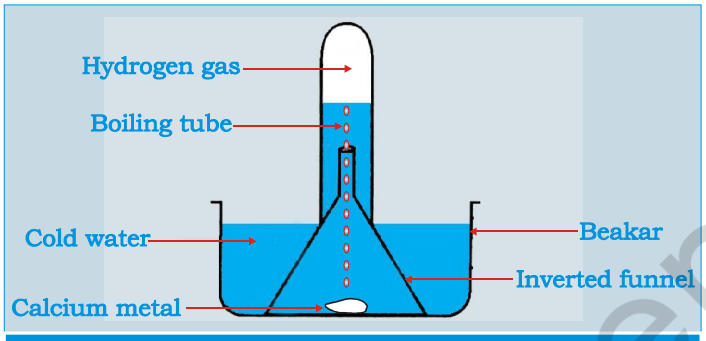
(iii) The area around the metal gets somewhat milky, because the calcium hydroxide formed, is sparingly soluble in water.

(iv) The temperature of water rises slightly.

(v) Red litmus paper turns blue, when placed in the above solution. This proves that solution formed is alkaline in nature.

To collect hydrogen gas from water using calcium metal

Experiment: Place an inverted funnel in a 500 cm^3 beaker, filled with water and over the neck of funnel, invert a boiling tube completely filled with water, so that water does not flow down, as shown in figure.



Collection of hydrogen gas from calcium

By gently tilting the funnel introduce a piece of calcium (about 5 gm) in the funnel, with the help of tongs. At once the reaction takes place, with the evolution of hydrogen gas, which collects in the boiling tube, by the downward displacement of water.

The gas evolved can be shown as hydrogen, by bringing a burning candle near the mouth of boiling tube, when the gas catches fire and burns with a pop sound.

Action with Magnesium

Magnesium, if placed in cold water, does not react with it.

If magnesium powder is boiled with water, a very slow reaction takes place. However, if burning magnesium is plunged into steam, it burns for a few moments to produce hydrogen gas, but then the reaction stops. The production of hydrogen gas can be demonstrated by the following experiment:

$$Mg\ (s) + H_2O\ (g) \xrightarrow{\Delta} MgO\ (s) + H_2(g)$$

WORK SHEET - 4

SINGLE ANSWER TYPE

1. The products formed when sodium reacts with cold water are:
   1) Sodium hydroxide 2) Hydrogen
   3) Sodium oxide 4) Both 1 and 2
2. Which metals react with water to form steam?
   1) Magnesium 2) Aluminium 3) Zinc 4) All of these
3. Which reaction take place in the presence of sunlight with moisture from the following reactions?
   1) $P_4 + 5O_2 \longrightarrow 2P_2O_5$ 2) $H_2O \longrightarrow 2H_2 + O_2$
   3) $Na + 2H_2O \longrightarrow 2NaOH + H_2$ 4) $H_2 + C\ell_2 \longrightarrow 2HC\ell$

11. Calcium reacts _____ with cold water in comparison to sodium.
1) Less vigorously 2) More vigorously
3) Mildly 4) None of these

12. What is the observation when calcium metal dissolved in water?
1) Blue litmus paper turns to red.
2) It rapidly reacts with water to liberate bubbles of hydrogen gas.
3) The temperature of water decreases slightly.
4) The product calcium hydroxide formed is insoluble in water.

14. i) Pure water is _____ towards litmus.

ii) $2H_2(g) + C\ell_2(g) \xrightarrow[\text{Sunlight}]{?} 2HC\ell(g)$

	(i)	***(ii)***
1)	Basic	Pressure
2)	Neutral	Moisture
3)	Acidic	Moisture
4)	Neutral	Heat

16. A VIII class student of Narayana IIT Olympiad school was given an experiment, to collect hydrogen gas from the reaction of calcium metal and cold water. He conducted the experiment and collected the hydrogen gas in boiling tube. Which process is involved in collection of hydrogen gas?
1) Upward displacement of water
2) Steam distillation
3) Fractional distillation
4) Downward displacement of water

18. Identify X, Y and Z in the following equations
(Note: X, Y and Z are very active metals).
i) $X + H_2O \rightarrow XOH + H_2$
ii) $Y + H_2O \rightarrow YOH + H_2$
iii) $Z + H_2O \rightarrow Z(OH)_2 + H_2$
1) X = Mg, Y = A*l* and Z = Fe 2) X = K, Y = Na and Z = Ca
3) X = A*l*, Y = Na and Z = Ca 4) X = Mg, Y = Ca and Z = Na

MULTI ANSWER TYPE

4. Less active metals are:
1) Magnesium 2) Aluminium 3) Zinc 4) Iron

13. With which of the following metals water does not react?
1) Copper 2) Silver 3) Lead 4) Mercury

REASONING ANSWER TYPE

5. *Statement I :* Less active metals react with water when water is boiling or in the form of steam.
Statement II : Hydrogen and chlorine gas react in the presence of sunlight.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

15. *Statement I :* Water acts as catalyst in some reactions
Statement II : White phosphorus burns to form dense white fumes of phosphorus pentoxide in the presence of moist air.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

When a small piece of sodium or potassium is dropped into a trough of cold water, it reacts violently to form their respective hydroxides and hydrogen gas.

6. When water is heated to 2000^{0}C, _____ of it decomposes to form hydrogen and oxyygen.
1) 0.4% 2) 0.6% 3) 1.6% 4) 2.6%

7. When a small piece of sodium or potassium is dropped in to cold water, it reacts violently to form their respective:
1) Hydroxides 2) Hydrogen gas
3) Oxides 4) Both 1 and 2

8. Sodium, Potassium and calcium are:
1) Less active metals 2) Very active metals
3) Less active non- metals 4) None

MATRIX MATCHING TYPE

9.

	Column-I		**Column-II**
a)	Less active metals	1)	$Ca(OH)_2$
b)	Very active metals	2)	Calcium
c)	Whitish grey metal	3)	Magnesium
d)	Calcium hydroxide	4)	Sodium
		5)	Hydrogen

17.

	Column-I		**Column-II**
a)	$P_4 + 5O_2$	1)	$2H_2 + O_2$
b)	$2H_2O$	2)	$Ca(OH)_2 + H_2$
c)	$2Na + 2H_2O$	3)	$2NaOH + H_2$
d)	$Ca + 2H_2O$	4)	$2P_2O_5$
		5)	$2HCl$

INTEGER ANSWER TYPE

10. The percentage of water decomposes to hydrogen and oxygen when heated to 2000°C is _____.

SYNOPSIS - 5

Action of Water with Non-metals

Action with carbon

When super-heated steam (at 170°C) is passed through white hot coke or charcoal, an endothermic reaction takes place with the formation of a mixture of equal volumes of hydrogen and carbon monoxide gas, commonly called water gas.

$$\underset{\text{(White hot)}}{C(s)} + \underset{\text{(Steam)}}{H_2O(g)} \longrightarrow \underbrace{CO(g) + H_2(g)}_{\text{Water gas}}$$

Action with chlorine gas

When chlorine gas is passed through water in dark, it dissolves to form a greenish yellow solution, commonly called chlorine water.

When chlorine water is exposed to diffused sunlight, it forms a mixture of hydrochloric acid and hypochlorous acid.

$$C\ell_2(g) + H_2O(\ell) \xrightarrow[\text{Light}]{\text{Diffused}} HC\ell(aq) + HC\ell O(aq)$$

However, if chlorine water is exposed to direct sunlight, it forms a colourless solution of hydrochloric acid and gives off tiny bubbles of oxygen gas.

$$2C\ell_2(g) + 2H_2O(\ell) \xrightarrow[\text{Sunlight}]{\text{Direct}} 4HC\ell(aq) + O_2(g)$$

Action of Water with Metallic Oxides

Oxides of sodium, potassium and calcium react with cold water to form their respective hydroxides. The reactions are exothermic in nature. All other oxides are insoluble in water.

$$Na_2O\ (s) + H_2O\ (l) \rightarrow 2NaOH(aq)$$
$$K_2O\ (s) + H_2O\ (l) \rightarrow 2KOH(aq)$$
$$CaO\ (s) + H_20\ (l) \rightarrow Ca(OH)_2(aq)$$

Action of Water with Non-metallic Oxides

(i) **Sulphur dioxide** dissolves in cold water, to form sulphurous acid.

$$SO_2(g) + H_20(l) \rightarrow \underset{\text{Sulphurous acid}}{H_2SO_3(aq)}$$

(ii) **Sulphur trioxide** dissolves in cold water, to form sulphuric acid.

$$SO_3(g) + H_20(l) \rightarrow \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} + \Delta T$$

(iii) **Nitrogen dioxide** dissolves in cold water, to form a mixture of nitrous acid and nitric acid.

$$2NO_2(g) + H_2O(\ell) \longrightarrow \underset{\text{Nitrous acid}}{HNO_2(aq)} + \underset{\text{Nitric acid}}{HNO_3(aq)}$$

(iv) **Phosphorus pentoxide** dissolves in cold water, to form phosphoric acid.

$$P_2O_5 + 3H_2O(\ell) \longrightarrow \underset{\text{Phosphoric acid}}{2H_3PO_4(aq)}$$

(v) **Carbon dioxide** dissolves in cold water to form carbonic acid.

$$CO_2(g) + H_2O(\ell) \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3\ (aq)}$$

WORK SHEET - 5

SINGLE ANSWER TYPE

1. The metals do not react with steam when red hot are:
   1) Copper 2) Mercury 3) Silver 4) All the above
2. The metals which are placed in the decreasing order of their chemical activity is:
   1) Non-reactivity series 2) Reactivity series
   3) Conductivity series 4) None
3. The reactivity series of the elements in decreasing order is:
   1) K > Na > Mg > Ca > Fe > Zn > Pb > H > Sn > Cu > Ag > Au
   2) Au > Na > Ca > Zn > Mg > Fe > Pb > H > Sn > Ag > Cu > k
   3) K > Na > Ca > Mg > Zn > Fe > Pb > Sn > H > Cu > Hg > Ag > Au
   4) Au > Na > Ca > Mg > Zn > Fe > Pb > Sn > H > Ag > Cu > k
11. The reaction takes place in formation of water gas is:
   1) Exothermic reaction 2) Endothermic reaction
   3) Precipitation reaction 4) Photochemical reaction
12. The chlorine gas is passed through water to form greenish yellow solution is called:
   1) Distilled water 2) Muddy water
   3) Chlorine water 4) Saline water
14. When chlorine water is exposed to direct sunlight to form:
   1) Hydrochlorous acid 2) Hydrochloric acid
   3) Both 1 and 2 4) None
16. The gas evolved when chlorine water is exposed to direct sunlight
   1) Oxygen 2) Hydrogen 3) Chlorine 4) None
18. Sulphur dioxide dissolves in cold water to form:
   1) Sulphuric acid 2) Sulphur trioxide
   3) Sulphurous acid 4) Sulphur
19. Which of the following is react with water to form sulphuric acid?
   1) Sulphur dioxide 2) Sulphur trioxide
   3) Sulphur 4) Oxygen

MULTI ANSWER TYPE

4. The products formed when nitrogen dioxide dissolves in cold water are:
   1) Nitrous acid 2) Nitric acid 3) Water 4) Oxygen
13. Which of the following is correct statement?
   1) The rate of reaction of sodium and potassium with water is extremely high as they react explosively to liberate hydrogen gas.
   2) The rate of reaction of magnesium with water is slower than sodium, potassium and calcium.
   3) The rate of reaction of iron with water is slowest compared to sodium, potassium and calcium.
   4) The rate of reaction of calcium with water is slower than sodium and potassium.

20. The products formed when chlorine water is exposed to diffused sunlight
    1) Hypochlric acid 2) Hydrochloric acid
    3) Oxygen 4) Both 2 and 3

REASONING ANSWER TYPE

5. *Statement I :* The rate of reaction of iron with water is slowest as compared to sodium, potassium, calcium and magnesium.
   Statement II : The reaction of red hot iron with steam is reversible reaction.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

15. *Statement I :* The reaction of water with white hot cake or charcoal is endothermic reaction.
    Statement II : The mixture of equal volumes of hydrogen and carbon monoxide is water gas.
    1. Both Statements are true, Statement II is the correct explanation of Statement I.
    2. Both Statements are true, Statement II is not correct explanation of Statement I.
    3. Statement I is true, Statement II is false.
    4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

A series in which the metal are place in the decreasing order of their chemical activity is called reactivity series or metal reactivity series.

6. The mixture of equal volumes hydrogen and carbonmonoxide gas is called:
   1) Natural gas 2) Producer gas
   3) Water gas 4) Gobar gas
7. What happens when chlorine water is exposed to direct sunlight?
   1) A colourless solution of hydrochloric acid is formed
   2) A colourless solution hypochlorous acid is formed.
   3) A colourless solution hypochloric acid is formed.
   4) All the above
8. What happens when super heated steam is passed through white hot coke?
   1) A mixture of carbondioxide and hydrogen is formed.
   2) A mixture of carbon monoxide and oxygen is formed.
   3) A mixture of carbon monoxide and hydrogen is formed.
   4) Carbon dioxide is formed.

MATRIX MATCHING TYPE

9.

Column-I		Column-II	
a)	H_3PO_4	1)	Carbonic acid
b)	H_2CO_3	2)	Sulphuric acid
c)	H_2SO_4	3)	Nitrous acid
d)	HNO_2	4)	Phosphoric acid
		5)	Nitric acid

17.

Column-I		Column-II	
a)	$SO_2 + H_2O$	1)	H_2SO_4
b)	$P_2O_5 + H_2O$	2)	H_2CO_3
c)	$CO_2 + H_2O$	3)	$HNO_2 + HNO_3$
d)	$NO_2 + H_2O$	4)	H_3PO_4
		5)	H_2SO_3

INTEGER ANSWER TYPE

10. How many products are formed when nitrogen dioxide dissolves in cold water?

SYNOPSIS - 6

VOLUMETRIC COMPOSITION OF WATER

We learnt that when a substance is heated, it decomposes. Energy is needed fo decomposing the substance. This energy may be either heat, electricity or light.

Electrolysis of Water:

If electricity is used for decomposing a substance, it is called 'Electrolysis'. When electricity is passed through acidic water, it decomposes into oxygen and hydrogen gases. But water is a bad conductor of electricity. Therefore a little salt or a little alkali is added to water for easy conduction of electricity.

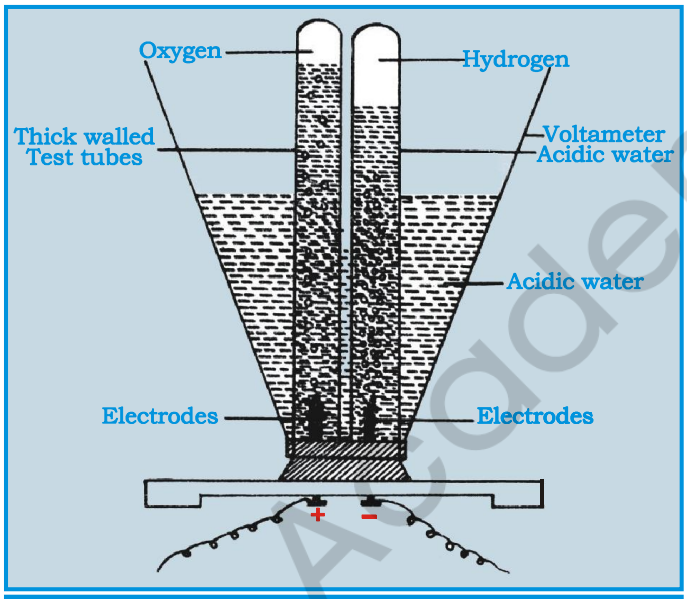
Dissolve a little quantity of acid in water. Pour this solution in an apparatus as shown in the figure. Fill two test tubes with solution and see that no air bubbles are present. Invert these test tubes over the iron nails. These are called electrodes. Connect these outer electrodes to the positive and negative terminals of a battery. You can see that gases are produced in the two test tubes. After 30 minutes examine the volume of each gas formed in the test tubes. Are the volumes of gases equal?

Introduce a glowing splinter into the test-tube in which less amount of gas is formed. The splinter burns brilliantly. Therefore we can say that this gas is oxygen. Introduce another glowing splinter into the test-tube in which more volume of gas is formed and observe it. The splinter is put out with a pop sound. But the gas burns with blue flame. Hydrogen posseses this property. Therefore we can say that the gas present in this test tube is Hydrogen.

In this way sending electricity through water and decomposing into oxygen and hydrogen is called electrolysis.

Composition of Water:

Water is formed through combination of hydrogen and oxygen. This combination occurs in a certain ratio. This is 'called composition of water. Composition of elements in certain volumes is known as volumetric composition. We have observed in the previous experiment that when the water is electro-lysed hydrogen and oxygen are evolved. When we observe volumetrically water decomposes into two volumes of hydrogen and one volume of oxygen. This shows that the volumetric composition of water contains hydrogen and oxygen in the ratio 2:1



Electrolysis of water

Important Points:

1) Water is not an element. Butitisacompound with a composition of two elements i.e., Hydrogen and Oxygen.
2) Water is formed by the constant ratio of Hydrogen and Oxygen.
3) Two volumes of Hydrogen and one volume of oxygen compose two volumes of water.

WORK SHEET - 6

SINGLE ANSWER TYPE

1. What is added to make a good conductor?
   1) Salt 2) Base 3) Acid 4) None
2. The colour of air when hydrogen burns in air:
   1) Green 2) Blue 3) Red 4) Yellow
3. What is needed for decomposing a substance?
   1) Alcohol 2) Magnetic current
   3) Electric current 4) None

11. The volumetric composition of water contains hydrogen and oxygen respectively in the ratio of:
    1) 1 : 2 2) 2 : 3 3) 3 : 4 4) 2 : 1
12. _____ is needed for decomposing the substance .
    1) Energy 2) Work 3) Force 4) Mass
14. If electricity is used for decomposing a substance, it is called:
    1) Photolysis 2) Electrolysis 3) Ozonlolysis 4) None of the above
16. Which one of the follwoing is true statement?
    1) Acidic water decomposes on electrolysis.
    2) Acidic water decomposes into oxygen and hydrogen gases.
    3) For easy conductor of electricity in water a little salt or a little alkali is added.
    4) All the above

MULTI ANSWER TYPE

4. The products formed when water is electrolysed
    1) Hydrogen 2) Oxygen 3) Nitrogen 4) All the above
13. Energy which is needed for decomposing the substance is in the form of:
    1) Heat 2) Electricity 3) Light. 4) None of the above

REASONING ANSWER TYPE

5. *Statement I :* When electricity is passed through acidic water it decomposes into oxygen and hydrogen.
   Statement II : Water is a bad conductor of electricity.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.
15. *Statement I :* *A glowing splinter introduced in to the test-tube containing gas, butns with blue flame and put's off with pop sound..*
   Statement II : The gas formed in the test tube during electrolusis of water is of less amount.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.
18. Statement I : The composition of elements in certain volumes is known as volumetric composition.
   Statement II : During electrolysis of water, the test tube in which more amount of gas formed is hydrogen.
   1. Both Statements are true, Statement II is the correct explanation of Statement I.
   2. Both Statements are true, Statement II is not correct explanation of Statement I.
   3. Statement I is true, Statement II is false.
   4. Statement I is false, Statement II is true.

COMPREHENSION TYPE

6. Composition of elements in certain volumes is known as:
   1) Chemical composition 2) Physical composition
   3) Volumetric compostion 4) Gravimetric composition

7. The atoms present in water molecules are:
   1) Hydrogen 2) Oxygen 3) Nitrogen 4) Both 1 and 2

8. $H_2 + O_2 \longrightarrow$
   1) H_2O 2) H_2O_2 3) OH 4) HO_2

MATRIX MATCHING TYPE

9.

Column-I	**Column-II**
a) Pure water	1) Puts of burning splint with pop sound
b) On electrolysis water decomposes into	2) Bad conductor of electricity
c) Hydrogen	3) Burns brightly
d) Oxygen	4) Oxygen, Carbon dioxide
	5) Hydrogen, Oxygen

17.

Column-I	**Column-II**
a) The combination of H_2 and O_2 is	1) Electro chemical reaction
b) Water is	2) Hydrogen
c) Electricity is used in	3) Water
d) Burns with blue flame	4) A compound
	5) Electrolysis

INTEGER ANSWER TYPE

10. _____ volumes of hydrogen reacts with _____ volume of oxygen to form water.

WORK SHEET – 1 (KEY)				
1) 3	**2)** 2	**3)** 1	**4)** 4	**5)** 3
6) 2	**7)** 3	**8)** 4	**9)** 1	**10)** 1,4
11) 1,2,3	**12)** 2	**13)** 1	**14)** 1	**15)** 3
16) 4	**17)** 3	**18)** 1	**19)** 4	**20)** (3,5),2,1,4
21) 2,3,4,1	**22)** 18			

WORK SHEET – 2 (KEY)				
1) 3	**2)** 4	**3)** 3	**4)** 4	**5)** 2
6) 4	**7)** 3	**8)** 4	**9)** 1	**10)** 3
11) 2	**12)** 1,2	**13)** 1,2	**14)** 3	**15)** 2
16) 4	**17)** 4	**18)** 2	**19)** 2	**20)** 1
21) 3	**22)** 4,3,1,2	**23)** (2,5),4,1,3	**24)** 336J/g	

WORK SHEET – 3 (KEY)				
1) 3	**2)** 1	**3)** 2	**4)** 3	**5)** 1
6) 4	**7)** 4	**8)** 3	**9)** 1	**10)** 2
11) 4	**12)** 3	**13)** 1,2,3,4	**14)** 1,2,3,4	**15)** 3
16) 1	**17)** 4	**18)** 1	**19)** 3	**20)** 4
21) 1	**22)** 3,4,2,1	**23)** 2,1,5,(3,4)	**24)** 12	

WORK SHEET – 4 (KEY)				
1) 4	**2)** 4	**3)** 4	**4)** 2	**5)** 2
6) 2	**7)** 4	**8)** 2	**9)** 1,2,3,4	**10)** 1,2,3,4
11) 2	**12)** 2	**13)** 2	**14)** 4	**15)** 2
16) 3,(2,4)2,1	**17)** 2,1,3,2	**18)** 0.60		

WORK SHEET – 5 (KEY)				
1) 4	**2)** 2	**3)** 3	**4)** 2	**5)** 3
6) 2	**7)** 1	**8)** 1	**9)** 1	**10)** 1,2
11) 1,2,3,4	**12)** 4	**13)** 1	**14)** 2	**15)** 3
16) 1	**17)** 3	**18)** 4,1,2,3	**19)** 1,4,2,3	**20)** 2

WORK SHEET – 6 (KEY)				
1) 3	**2)** 2	**3)** 3	**4)** 4	**5)** 1
6) 2	**7)** 4	**8)** 1,2	**9)** 2	**10)** 2
11) 3	**12)** 2	**13)** 3	**14)** 4	**15)** 1
16) 2,5,1,3	**17)** 3,4,(1,5),2	**18)** 2,1		

ATOMIC STRUCTURE

SYNOPSIS - 1

INTRODUCTION

1. Matter is made up of small particles.
2. These small particles can be atoms, molecules (or) ions.
3. The words anu and paramany stand for small and very small particles.
4. The idea of finiest unit of matter was proposed by Maharshi Kannada in Vedic period in our country.
5. John Dalton is 1808 published them of atom assuming that atom are the ultimate indivisible particles of matter.

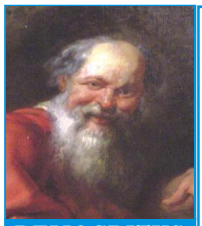
The views of Kanad

Way back as the sixth century BC, the Indian philosopher Maharshi Kanad came forward with the following idea.

Matter is not continuous, and made up of tiny particles, named paramanus.

(In Sanskrit, 'param' means 'final' or 'ultimate', 'and' anu means 'particle'.)

Kanad further said that two or more paramanus combine to form bigger particles.



DEMOCRITUS

The Views of Democritus and Leucippus
In the fifth century BC, the Greek philosophers Democritus and Leucippus came up with a similar idea.
They thought that on dividing a piece of a substance, one would ultimately get a particle that could not be divided further.
They gave the name atomos (in Greek, atomos means indivisible) to these ultimate particles.

Dalton's Theory

The theories of Kanad as well as of Democritus and Leucippus remained forgotten for more than two thousand years.

JOHN DALTON

But when experimental chemistry developed, it became necessary to explain the observed facts.

In this connection, in 1803, an English chemist, John Dalton, put forward his atomic theory, which can be summarised as follows.

1. **Composition of matter:** Elements are made up of very small particles of matter, called atoms (derived from the Greek word atoms).
2. **Indivisibility of atoms:** Atoms are indivisible. They cannot be further broken down.
3. **Atoms of similar elements:** The atoms of an element are alike in all the respects.
4. **Indivisibility of atoms:** Atoms can be neither be created nor be destroyed in a chemical reaction, cannot be converted to that of another element.
5. The atoms of different elements are different in all the respects.
6. **Combination of atoms:** Atoms combine in small whole numbers to form compound (molecules).
7. **Role of atom in a chemical reaction:** An atom is defined as the smallest part of an element that takes part in a chemical reaction.

Fundamental Particles

Discovery of Electron, Protons & Neutrons

Discovered by J.J. Thomson.

Electron was discovered by cathode ray experiment.

Cathode rays

A discharge tube is a long glass tube, at the two ends of which are sealed two metal plates.

These plates can be connected to a high-voltage source and are called electrodes.

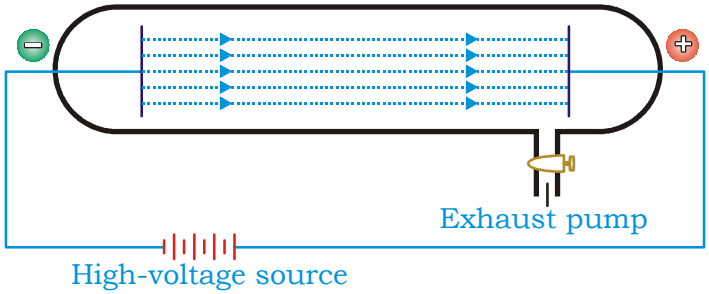
The electrode connected to the negative terminal of the source is called the cathode, and the one connected to the positive terminal is called the anode.

There is also a side tube which can be connected to an exhaust pump, used for lowering the pressure of the gas inside the discharge tube.

When a high voltage is applied across the terminals, and the pressure inside the tube is 0.01-0.001 mm of mercury, the end of the tube opposite the cathode starts glowing.

This phenomenon is called fluorescence. Investigations have shown that some invisible rays, starting from the cathode, fall on the opposite wall of the tube, causing fluorescence.

These rays were named as cathode rays.



Cathode rays produced in a discharge tube

The characteristics of cathode rays

Sir J.J.Thomson and others found that cathode rays have the following characteristics.

Cathode rays was disovered by Crooks

Cathode rays are the stream of electrons

Cathode rays travel in straight lines.

Cathode rays are deflected towards anode

Positive rays have one or more units of +ve charge.

Ex: H^{+} the charge is +1

H^{+2} the charge is +2

The charge and mass of an electron

1. The charge to mass ratio (e/m) of an electron was determined by J.J.Thomson to be 1.78×10^{8} C/g (coulomb per gram).
2. In 1908, R.A.Millikan determined the charge of an electron to be 1.6×10^{-19} C.or -4.802×10^{-10} esu.
3. THe e/m value of the electron is called its specific charge.
4. Electron has a mass of $\frac{1}{1836}$ of that of the hydrogen atom.
5. Absolute mass of the electron = 9.11×10^{-28} grams or 9.11×10^{-31} kg or 0.0005486 amu.

The Proton

An atom is electrically neutral. But the electrons present in it are negatively charged particles.

Hence, the atom must also contain some positively charged particles so that the overall charge on it becomes zero.

These particles should be found in the discharge tube itself, when cathode rays are formed.

Anode rays

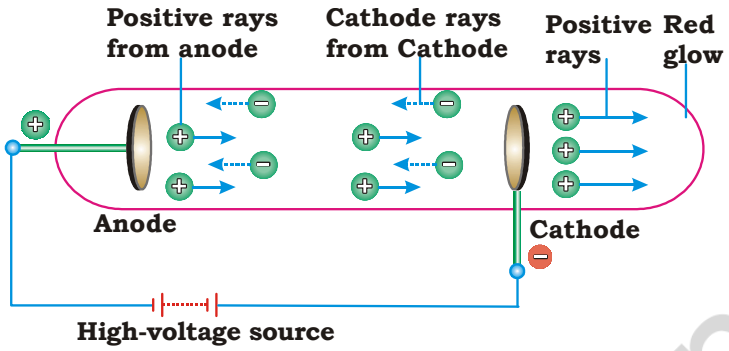
Goldstein repeated the cathode-ray experiment using a perforated cathode.

He observed that there was a glow on the wall opposite the anode.

So, some rays must be travelling in the direction opposite that of the cathode rays, i.e., from the anode towards the cathode.

These rays were called anode rays or canal rays (as they moved through the perforations, or canals, in the cathode).

It was found that these rays contained positively charged particles, and so, J.J.Thomson called them positive rays.



Anode rays

The characteristics of anode rays

- Ø Goldstein discovered the protons in an anode ray experiment.
- Ø Anode rays are also called as canal rays or positive rays.
- Ø They travel in straight lines.
- Ø Cause mechanical motion.
- Ø Anode rays cause heating effect.
- Ø They get deflected both in electric and magnetic filed but in opposite direction to that deflections caused by cathode ray.
- Ø The $\frac{e}{m}$ value of anode rays is not constant and depends on the nature of gas inside the discharge tube.

The charge and mass of a proton

Charge

The charge on a proton is the same ($1.6 \times 10^{-19}3$) as that on an electron, but with opposite sign. It is taken as a unit of positive charge. So, a proton has a unit positive charge, i.e., +1.

Mass

The mass of a proton is the same as that of a hydrogen atom, i.e., 1 amu.

A proton is about 1840 times heavier than an electron. Its absolute mass is 1.67×10^{-24} g (or) 1.67×10^{-27} kg.

The Neutron:

- Ø Neutron was discovered by Chadwick.
- Ø Neutron is lightly heavier than (about 0.18%) proton.
- Ø The $\frac{e}{m}$ value of neutron is zero as it does not possess any charge.
- Ø The discovery of neutrons became late as it does not possess any charge.

Properties of Electrons, Protons and neutrons:

Name	Symbol	Absolute charge/C	Relative charge	Mass/kg	Mass/u	Approx. mass/u
Electron	e	-1.6023×10^{-19}	-1	9.10939×10^{-31}	0.00054	0
Proton	p	$+1.6023 \times 10^{-19}$	+1	1.67262×10^{-27}	1.00727	1
Neutron	n	0	0	1.67493×10^{-27}	1.00867	1

WORK SHEET - 1

Single Answer Type

1. The term 'atom' was given by:
   1) Democritus 2) John Dalton
   3) William Crookes 4) Maharishi Kanada
2. Dalton proposed:
   1) Atomic model 2) Atomic theory
   3) Both 1 and 2 4) None
3. Who among the following scientists, proved that, atom consists of small indivisible particles called atoms:
   1) John Dalton 2) William Crookes 3) J.J. Thomson 4) Goldstein
4. The idea of tiniest unit of matter (anu and paramanu) was propounded by
   1) Demoerius 2) John Dalton
   3) Widliam Crookes 4) Maharshi kanada
5. Atom is electriccally neutral because of:
   1) The presence of protons 2) The presence of neutrons
   3) The presence of equal number of protons and electrons
   4) The presence of equal number of protons and neutrons
6. The electron is:
   1) α-ray particle 2) β-ray particle
   3) Hydrogen ion 4) Positron
7. Cathode rays are:
   1) Protons 2) Electrons 3) Neutrons 4) α - particles
8. Cathode rays are made up of:
   1) Positively charged particles 2) Negatively charged particles
   3) Neutral particles 4) None of these
9. The e/m ratio is zero for:
   1) Electron 2) Proton 3) Neutron 4) All
10. The mass of electron in amu is:
    1) 5.4×10^{-8} 2) 5.4×10^{-4} 3) 5.4×10^{-3} 4) 5.4×10^{-5}
11. The mass of the electron is:
    1) 1.76×10^{-23} kg 2) 1.67×10^{-24} kg
    3) 9.11×10^{-28} kg 4) 9.11×10^{-31} kg

12. The lightest sub-atomic particle is:
1) Neutron 2) Meson 3) Electron 4) Proton

13. Which of the following are the characteristics of cathode rays?
R) Cathode rays caste shadow.
A) The characteristics of cathode rays depend upon the nature of electrodes.
Y) Cathode rays effected by electricc field.
S) The ratio of charge to mass i.e., charge/mass is different for different gases.
1) R, S 2) R, A, Y 3) R, A, Y, S 4) R, Y

14. Protons are denoted by the symbol:
1) P^0 2) P^{-2} 3) $_{+1}p^1$ 4) P

15. Thomson atomic model can explain only:
1) Existence of Nucleus 2) Electrical neutrality
3) Orbital concept 4) All the these

16. The nature of anode rays depends upon.
1) Nature of electrode 2) Nature of residual gas
3) Nature of discharge tube 4) All the above

17. The ratio of specific charge (e/m) of an electron to that of a hydrogen ion is:
1) 1 : 1 2) 1840 : 1 3) 1 : 1840 4) 2 : 1

18. The fundamental particles present in the nucleus of an atom are:
1) Alpha particles and electrons 2) Neutrons and protons
3) Neutrons and electrons 4) Electrons, neutrons and protons

Multi Answer Type

19. Which of the following is true according to Dalton's atomic theory?
1) Matter consists of small indivisible particles called atoms.
2) Atoms of same element are alike in all respects.
3) Atoms combine in small whole numbers to form compound atoms (molecules).
4) Atom is the smallest unit of matter which takes part in a chemical reaction.

20. Which one of the following is/are incorrect statement(s) about proton?
1) Proton is nucleus of deuterium
2) Proton is ionized hydrogen molecule
3) Proton is ionized hydrogen atom
4) Proton is α -particle

21. Select the correct statement(s):
    1) Cathode rays have only charge but no mass.
    2) Anode rays are deflected by electricc and magnetic field.
    3) Canal rays is name for beam of electrons.
    4) Anode rays do not originate from the anode.

Reasoning Answer Type

22. ***Statement I:*** Elements are made up of very small particles of matter called atoms.
    Statement II: Atoms combine in small whole number to form compound (molecule).
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.
23. ***Statement I:*** The first atomic theory was given by Dalton.
    Statement II: According to Dalton, Atom is not the smallest particle that takes part in chemical reaction.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.
24. ***Statement I:*** Cathode rays do not travel in straight lines.
    Statement II: Cathode rays penetrate through thick sheetc.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.

Comprehension Type

Writeup-1

Atom is no longer indivisible, but consists of neutrons, protons and electrons.

25. The first atomic theory was proposed by:
    1) Democritus 2) John Dalton 3) William crookes 4) J.J. Thomson
26. As the number of protons is equal to number of electrons in an atom, there for it is:
    1) Electrically positive 2) Electrically negative
    3) Electrically neutral 4) None

27. who proposed that matter is made up of extremely small particles called atoms?
1) Democritus 2) John Dalton 3) Maharshi kanada 4) Neil Bohr

Writeup-2

Cathode rays consists of negatively charged material particles called electrons. These electrons are fundamental sub atomic particles carrying negative charge and having mass 9.1×10^{-31} kg. Discovered by J.J Thomson. Charge to mass (e/m) ratio of an electron is 1.76×10^{8} C/g. Charge to mass (e/m) ratio for an proton is 9.55×10^{4} C/g.

28. Particles in cathode rays have same charge to mass ratio as:
1) α - particles 2) β - particles
3) γ - rays 4) Protons

29. The e/m ratio for proton is:
1) 1.76×10^{8} C/g 2) 9.1×10^{-31} kg 3) 9.55×10^{4} C/g 4) 9.55×10^{4} kg

30. Which of the following particles has maximum charge to mass ratio?
1) Electrons 2) Protons
3) α - particles 4) Neutrons

Matrix Matching Type

31.

Column-I	**Column-II**
a) The idea of tiniest unit of matter	1) Nucleus
b) Nucleus consists of	2) Negative changed particles
c) Revolves around the nucleus	3) Maharshi kanada
d) Atom consists of	4) Protons and neutrons
	5) Electron

32.

Column-I	**Column-II**
a) e/m ratio of electron	1) G. J. Stoney
b) The charge of electron	2) William crooke
c) Cathode rays	3) J. J. Thomson
d) Cathode rays are named as electrons	4) R. A. Millikan

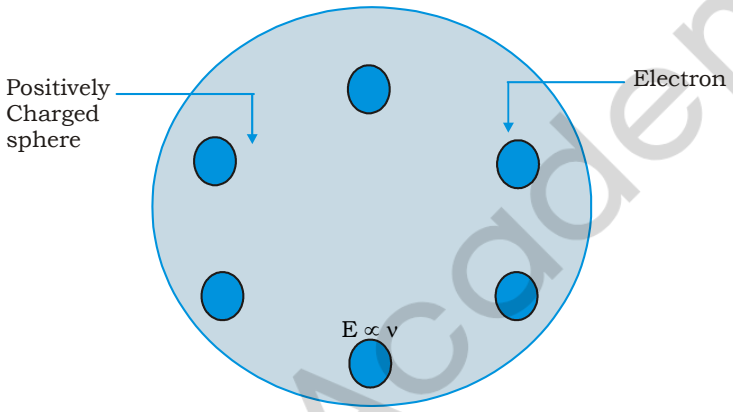
33.

Column I	**Column II**
a) Electron	1) Atom is electriccally neutral
b) Proton	2) Negative charge
c) Thomson model of atom	3) Positive charge
d) Mullikan's oil drops experiment	4) Quantization of charge

SYNOPSIS - 2

Atomic model: Atomic model depects the systematic arrangement of fundamental particles in the atom.

Thomsons atomic model: Thomson was the first to propose a detailed model of the atom.He proposed that an atom consists of a uniform sphere of positive electricity in which electrons are distributed more or less uniformly.This model of an atom is known as the ***'plum-pudding model' or 'raisin pudding model' or 'water melon model'.This model*** assumed that mass of the atom is evently spread over the entire atom.This model could explain the electrical neutrality of an atom but failed to explain the observations of Rutherfords α-particle scattering experiment.

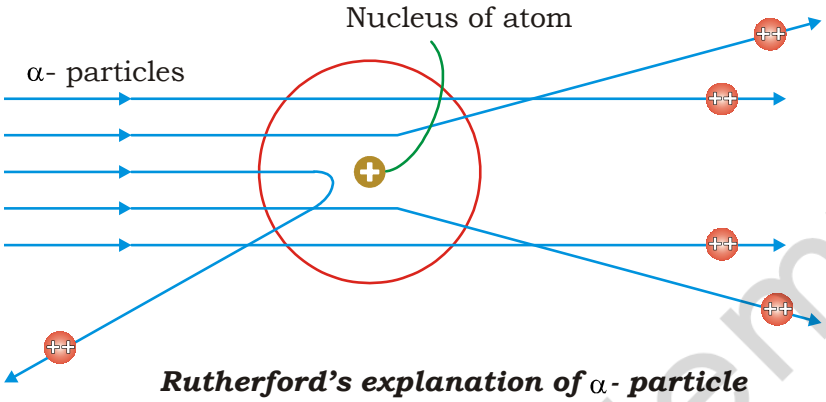


Rutherford's model of an atom or Rutherford α–ray scattering experiment

- Ø Rutherford proposed atom model based on α–ray scattering experiment
- Ø According to rutherford scattering of a narrow beam of α–particles as they passed through a thin gold foil and it is covered with fluorescent Zns (Zinc sulphide) screen.
- Ø When α–particles struck the screen then a tiny flash of lights was produced at that point.
- Ø During the experiment most of α–particles passes through the foil undeflected.
- Ø A small fraction of α–particles were deflected by small angles.
- Ø Some of these particles deviated slightly from their path. They were repelled to a small extent by a positive charge. Very few of the particles, the ones at the centre, almost retraced their path. This meant that they were strongly repelled by a small positively charged body at the centre of the atom. This positively charged body is called the **nucleus**.
- Ø Since the electron has negligible mass, the mass of the atom is concentrated in the nucleus.

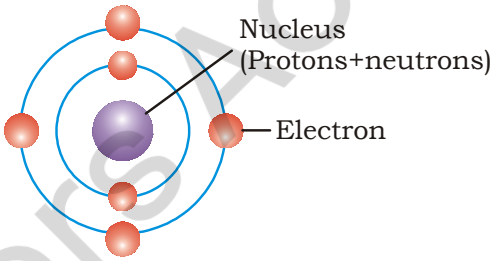
Ø Rutherford also theorised that electrons revolve round the nucleus at large distances from it.

Ø Rutherford estimated the diameter of the nucleus to be of the order of 10^{-13} cm and that of the atom to be of the order of 10^{-8} cm. Thus, the diameter of the nucleus is about 10^5(= 1,00,000) times smaller than that of the atom.



Rutherford's explanation of α- particle scattering on the basis of his nuclear model

The electrons revolve round the nucleus in their own orbits, just like planets around the sun in solar system. Hence this theory is also called Rutherford's planitary theory of an atom.



Main points of this model are:

1. Most of the mass and all the positive charge of an atom is concentrated in a very small region called nucleus. Size of the nucleus is extremely small as compared with the size of the atom. Radius of the nucleus is of the order of 10^{-5} m, whereas radius of atom is of the order of 10^{-10} m.
2. The positive charge on the nucleus is due to protons. The magnitude of the charge on the nucleus is different for atoms of different elements.
3. The nucleus is surrounded by electrons which are revolving around it at very high speeds. The electrostatic force of attraction between electrons and the nucleus is balanced by the centrifugal force acting on the revolving electrons.
4. Total negative charge on the electrons is equal to the total positive charge on the nucleus so that atom on the whole is electrically neutral.

5. Most of the space inside an atom is empty.

Nuclear model of atom can be compared with the solar system. In an atom electrons revolve around the nucleus in just the same way as the planets revolve around the sun. Due to this comparison revolving electrons are sometimes called planetary electrons and Rutherford's nuclear model of atom is known planetary model of atom.

Failure's of Rutherford's model:

Thus, Rutherford's model failed to explain stability of atoms. It does not explain the distribution of electrons around the nucleus and does not tell us anything about their energies. Rutherford's model also failed to explain the existence of certain definite lines in the hydrogen spectrum.

WORK SHEET - 2

Single Answer Type

1. Mulliken's oil drop experiment is used to find.

1) e/m ratio of an electron 2) Mass of an electron

3) Velocity of an electron 4) Charge of an electron

2. Rutherford's atomic model of an atom is also called as:

1) Planetary 2) Solar model 3) Nuclear model 4) All of these

3. Rutherford identified the existence of protons at the centre of the atom in his experiment by:

1) The deflection of alpha particle 2) The absorption of alpha rays

3) The retention of alpha rays 4) None

4. Rutherford's experiment on scattering of alpha particles showed that the atom has:

1) Nucleus 2) Largely empty space

3) Both 1 and 2 4) None

Multi Answer Type

5. Which one of the following is true for Thomson's model of the atom?

1) The radius of an electron can be calculated using this model.

2) In an undisturbed atom, the electrons will be at their equilibrium positions, where the attraction between the cloud of positive charge and the electrons balances their mutual repulsion.

3) When the electrons are disturbed by collision, they will vibrate around their equilibrium positions and emit electromagnetic radiation. The frequency of this radiation is of the order of magnitude of the frequency of electromagnetic radiation, typical of these electrons.

4) It can explain the existence of protons.

6. The defects of Rutherford's atomic model are:
   1) Does not explain the stability of an atom
   2) Does not explain the distribution of electron around the nucleus
   3) It could not explain the line spectrum
   4) None
7. Which of the following statement is/are correct for Rutherford experiment?
   1) Electrons revolve around the nucleus at large distances from it.
   2) Electron revolve around nucleus
   3) The positively charged body is called nucleus
   4) Rutherford model is also known as nuclear model of an atom.

Reasoning Answer Type

8. ***Statement I:*** The charge to mass ratio (e/m) of an electron was determined by J.J.Thomson to be 1.78×10^{8} C/g.
   Statement II: R.A.Millikan determined the charge of an electron to be 1.6×10^{-19} C.
   1) Both Statements are true, Statement II is the correct explanation of Statement I.
   2) Both Statements are true, Statement II is not correct explanation of Statement I.
   3) Statement I is true, Statement II is false.
   4) Statement I is false, Statement II is true.
9. ***Statement I:*** J.J. Thomson's atomic model is water melon atomic model or plum pudding model.
   Statement II: By conducting alpha ray scattering experiment he gave his atomic model.
   1) Both Statements are true, Statement II is the correct explanation of Statement I.
   2) Both Statements are true, Statement II is not correct explanation of Statement I.
   3) Statement I is true, Statement II is false.
   4) Statement I is false, Statement II is true.
10. ***Statement I:*** α -particles are emitted by radioactive elements.
    Statement II: The mass of neutron is slightly more than that of proton.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.
11. ***Statement I:*** Alpha particle is the nuclei of helium atom.
    Statement II: Helium nucleus consists of two protons and two neutrons.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.

Comprehension Type

Writeup-1:

According to the classical laws of mechanics or dynamics of physics, any charged particle revolving around another charged particle should lose energy continuously.

Hence electron revolving round the nucleus should lose energy and fall inside the nucleus. But nucleus is found to be stable. Thus Rutherford's atomic model does not explain the stability of an atom. It could not explain the distribution of electrons around the nucleus and does not tell us anything about their energies. If the electron loses energy continuously, then the atomic spectra should be continuous but it is discontinuous. Hence It could not explain the line spectrum.

12. Rutherford atomic model does not obey:
    1) Classical laws of electrodynamics. 2) Laws of electrolysis
    3) Both 1 and 2 4) None of these
13. Rutherford's atomic model could not explain.
    1) Gaps present in the spectrum 2) Stability of the atom
    3) Both 1 and 2 4) None of these
14. In Rutherford's atomic model one of the defect is:
    1) Comparison of atomic model with Solar system.
    2) Comparision of atomic model with water melon.
    3) Comparision of atomic model with Custard apple.
    4) None of these.

Writeup-2:

The first concrete attempt to study the structure of an atom was made by Rutherford
through his "alpha ray scattering experiment".

15. Rutherford's scattering experiments led to the discovery of :
    1) Nucleus 2) Presence of neutrons in the nucleus
    3) Both 1 and 2 4) Revolving nature of electrons around the nucleus
16. In Rutherford's α-ray scattering experiment, which of the following does not happen?
    1) Most of the α-rays passed through without deflection.
    2) A few α-particles pass through the nucleus.
    3) A few α-particles are deflected back.
    4) α-particles going near the nucleus are slightly deflected.
17. Deflection back of a few particles on hitting thin foil of gold shows that:
    1) Nucleus is heavy
    2) Nucleus is small
    3) Both 1 and 2
    4) Electrons create hindrance in the movement of α-particles.

Matrix Matching Type

18.

Column-I	Column-II
a) Nucleus	1) $(1.33 \times 10^{-13})\ A^{1/3}$
b) Neutron	2) p + n
c) Radius of the nucleus	3) Chadwick
d) Atomic weight	4) Rutherford
	5) Goldstein

SYNOPSIS - 3

Atomic number:

In 1913, H.G.J. Moseley devised an experiment to find out positive change on the nucleus of an atom. The number of unit positive charges on the nucleus of an atom of the element is called atomic number of the element. Atomic number is also equal to the number of electrons in an atom of the element. Thus atomic number of an element is equal to the number of protons in the nucleus of its atom or the number of extra nuclear electrons. Generally, it is denoted by the letter Z.

Atomic number (Z) = Number of protons
= Number of electrons.

Mass number:

Protons and neutrons are collectively called nucleons. Total number of protons and neutrons in the nucleus is called mass number of the atom. It is generally represented by the letter A.

Mass number (A) = Number of protons + Number of neutrons
= Number of nucleons.

Isotopes, Isobars and Isotones:

Isotopes of an element are the atoms of the element with same atomic number but different mass numbers. For example, hydrogen has three isotopes, protium (H), deuterium (D) and tritium (T). All the three isotopes have atomic number 1, however, their mass numbers are 1,2 and 3 respectively. The three isotopes of carbon are represented as ${}^{12}_{6}C$, ${}^{13}_{6}C$ and ${}^{14}_{6}C$.

The atoms of different elements which have same mass number are called isobars. For example, ${}^{14}_{6}C$ and ${}^{14}_{7}N$ are isobars.

Isotones may be defined as the atoms of different elements containing same number of neutrons.

For example, ${}^{13}_{6}C$ and ${}^{14}_{7}N$. For isotones, the difference of mass number and atomic number is same.

Isodiaphers: The atoms of the different elements which contain same number of A–2Z are Isodiaphers.

Examples: ${}_{9}F^{19}$ and ${}_{11}Na^{23}$

Calculation of number of electrons, protons and neutrons:

For example, atomic number and mass number of aluminium are 13 and 27 respectively. Number of electrons, protons and neutrons in an atom of it can be calculated as under:

Number of protons =Atomic number = 13

Number of electrons =Atomic number = 13

Number of neutrons = Mass numbert - Atomic number

= 27-13 = 14.

For example, Mg^{2+} ion is formed by the removal of two electrons from Mg atom.

$Mg - 2e^- \longrightarrow Mg^{2+}$

Therefore, Mg^{2+} ion has two electrons less than the number of electrons in Mg atom. Knowing that the atomic number and mass number of Mg are 12 and 24, respectively , the number of electrons, protons and neutrons in Mg^{2+} ions may be calculated as under:

Number of protons =Atomic number = 12

Number of electrons =Atomic number - 2 = 10

Number of neutrons = Mass numbert - Atomic number

= 24 - 12 = 12.

$P + 3e^- \longrightarrow P^{3-}$

Knowing that atomic number of phosphorus is 15 and mass number is 31, the number of electrons, protons and neutrons in phosphide ion may be calculated as under:

Number of protons =Atomic number = 15

Number of electrons =Atomic number + 3 = 18

Number of neutrons = Mass numbert - Atomic number

= 31-15 = 16.

SHELLS OF AN ATOM

The electrons revolve around the nucleus of the atom. The actual path the electron takes while revolving around the nucleus is called its orbit or shell.

The orbit of an electron is the region around the nucleus in which it revolves.

1. The shells closest to the atom in the first shell called K-shell and can have a maximum of 2 electrons.
2. The shell next to the K-shell is the second shell called the L-shell and can have a maximum of 8 electrons.
3. The shell next to the L-shell is the third shell called the M-shell and can have a maximum of 18 electrons.
4. The shell next to the M-shell is the fourth shell called the N-shell and can have a maximum of 32 electrons.

The maximum number of electrons in an orbit is fixed and is given by the formula $2n^2$, where n is the number of the shell.

Orbit	Shell name	Maximum number number (n) Of electrons $(2n^2)$
1	K-shell	2
2	L-shell	8
3	M-shell	18
4	N-shell	32
5	O-shell	50

The first shell is closest to the nucleus and can hold a maximum of 2 electrons. The second shell is the next shell and can hold a maximum of 8 electrons. The third shell is the next shell and can hold a maximum of 18 electrons.

WORK SHEET - 3

Single Answer Type

1. The atoms of an element which have the same atomic number but different mass numbers are called:
   1) Isobars 2) Isotopes 3) Isodiaphers 4) Isotones
2. Number of neutrons in the three isotopes of hydrogen (H, D, T) respectively are:
   1) 0, 1, 2 2) 1, 2, 3 3) 1, 1, 1 4) 0, 0, 0
3. Choose the correct representation of carbon isotopes.
   1) ${}^{1}_{4}C$, ${}^{14}_{6}C$, ${}^{12}_{5}C$ 2) ${}^{12}_{6}C$, ${}^{13}_{6}C$, ${}^{14}_{6}C$
   3) ${}^{11}_{3}C$, ${}^{14}_{4}C$, ${}^{12}_{7}C$ 4) ${}^{10}_{2}C$, ${}^{16}_{2}C$, ${}^{14}_{7}C$
4. If the atomic weight of an element is 23 times that of the lightest element and it has 11 protons, then it contains:
   1) 11 protons, 23 neutrons, 11 electrons
   2) 11 protons, 11 neutrons, 11 electrons
   3) 11 protons, 12 neutrons, 11 electrons
   4) 11 protons, 11 neutrons, 23 electrons
5. The mass number of an atom A is 16 and its atomic number is 8. Find the number of neutrons?
   1) 16 2) 32 3) 8 4) 2
6. The atomic number of sodium element is:
   1) 12 2) 14 3) 23 4) 11
7. W, X, Y, Z are 4 elements. Which among them are related to each other as isotopes.
   ${}^{230}_{91}W$; ${}^{235}_{92}X$; ${}^{236}_{93}Y$; ${}^{238}_{92}Z$.
   1) ${}^{235}_{92}X$, ${}^{238}_{92}Z$ 2) ${}^{230}_{91}W$, ${}^{238}_{92}Z$ 3) ${}^{238}_{92}Z$, ${}^{230}_{93}Y$ 4) ${}^{230}_{91}W$, ${}^{238}_{92}Z$

Multi Answer Type

8. Choose the correct statement/s:
   1) The number of protons in all the isotopes of an element is the same.
   2) The nuclide symbol is expressed as ${}^{A}_{Z}X$
   3) The isotopes of an element have same number of neutrons
   4) The electronic configuration of all the isotopes of same element is same.
9. Which of the following is correct statement?
   1) The atoms of the different elements which contain same number of A – 2Z are isodiaphers
   2) The atoms of different elements containing same number of neutrons is isotones.
   3) ${}_{8}O^{16}$, ${}_{8}O^{17}$, ${}_{8}O^{18}$ are isotones.
   4) The electronic configuration of carbon is 2, 4.

Reasoning Answer Type

10. ***Statement I:*** The two defining characteristics of an element are its atomic number and its mass number.
    Statement II: The mass number of all the atoms of an element is always the same.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.
11. ***Statement I:*** The atoms of different elements containing same mass number are known as isobars.
    Statement II: $C\ell^{35}_{17}$ represents atomic number is 17 and mass number is 35.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.
12. ***Statement I:*** The neutrons present in aluminium atom are 14.
    Statement II: The mass number of potassium is 40.
    1) Both Statements are true, Statement II is the correct explanation of Statement I.
    2) Both Statements are true, Statement II is not correct explanation of Statement I.
    3) Statement I is true, Statement II is false.
    4) Statement I is false, Statement II is true.

Comprehension Type

The atoms of same element having different number of neutrons or the atoms of same element having same atomic number but different mass number are Isotopes.

The atoms of different elements containing same mass number are known as isobars.

The atoms of different elements containing same number of neutrons are Isotones.

The atoms of the different elements which contain same number of A–2Z are Isodiaphers.

13. Identify the correct example for Isodiaphers:
    1) $_{9}F^{19}$ and $_{11}Na^{23}$ 2) $_{9}F^{19}$ and $_{19}K^{39}$
    3) $_{19}K^{39}$ and $_{11}Na^{23}$ 4) All of these
14. Identify the correct set of an example for Isotopes:
    1) $_{1}H^{1}$, $_{1}H^{2}$, $_{1}H^{3}$ 2) $_{8}O^{16}$, $_{8}O^{17}$, $_{9}O^{18}$
    3) $_{8}C^{12}$, $_{6}C^{14}$ 4) $_{92}U^{235}$, $_{93}U^{236}$
15. Isotones have same:
    1) Atomic number 2) Mass number
    3) Number of neutrons 4) Number of electrons

Matrix Matching Type

16.

Column-I	Column-II
a) Isotopes	1) Proton + Neutrons
b) Isobars	2) Same mass number different atomic number
c) Nucleons	3) Same atomic number different mass number
d) Isotones	4) Differ in number of electrons and proton but same no.of neutrons
	5) Proton or electron

SYNOPSIS - 4

VALENCY ELECTRONS

The electrons in an atom are distributed in the shell sof an atom. The last shell electrons play an important role while combining with other atoms.

The last shell of an atom is called its valency shell.

The electrons in the valence shell are called valence electrons.

The valence electrons take part in chemical reactions.

The number of valence electrons determines the chemical reactivity of the element.

NUCLEONS

Nucleons are all the particles present in the nucleus of an atom. The most important nucleons are the protons and neutrons as they are responsible for the mass of the atom. There are several other particles like mesons in the nucleus.

REPRESENTING AN ELEMENT

The Atomic number and Mass number of an element are very important physical quantities that are referred to frequently. To make it easier they are written using special notations.

An element is represented using its symbol with Atomic number as a subscript and Mass number as superscript.

$_zX^A$ where X denotes the element,

Z its Atomic number

and A its mass number.

Example: $_{17}Cl^{35}$

ELECTRONIC CONFIGURATION OF ELEMENTS (BOHR-BURY RULES)

Electronic configuration of an atom shows the actual way in which the electrons are distributed in the shells.

Bohr-Bury rules of electronic configuration

a) The electrons revolve in orbits around the nucleus of the atom.

b) The centre of the atom consists of the nucleus with the nucleons (protons and neutrons) in it.

c) The orbits are numbered from the centre outward. The first orbit closest to the nucleus is numbered as 1 and is denoted as the K-shell. The next is numbered as 1 and is denoted as the K-shell. The next is numbered as 2 and is denoted as the L-shell. The next with number 4 is denoted as the N-shell and so on.

d) The maximum number of electrons in an orbit is given by $2n^2$ where n is the number of the orbit. The first orbit can have a maximum of 2 electrons, the second orbit a maximum of 8 electrons, the third a maximum of 18 electrons and so on. The last orbit however irrespective of its number cannot have more than 8 electrons.

e) The maximum number of electrons in the outermost shell cannot exceed 8 and in the second last shell 18, irrespective of the shell number.

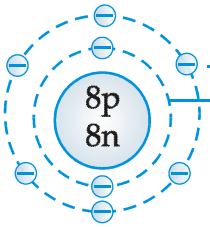
f) It is not necessary that the last orbit should be filled with electrons for the next orbit to start filling - a new orbit starts filling as soon as the last orbit gets 8 electrons. (For example the maximum number of electrons in the 3rd shell is 18. But the fourth shell starts filling as soon as the 3rd shell has 8 electrons.

The number of electrons, protons and neutrons in some atoms

Element	Symbol	Atomic number (Z)	Mass number (A)	Number of particles		
				Electrons (Z)	Protons (Z)	Neutrons (A - Z)
Hydrogen	H	1	1	1	1	0
Helium	He	2	4	2	2	2
Lithium	Li	3	7	3	3	4
Beryllium	Be	4	9	4	4	5
Boron	B	5	11	5	5	6
Carbon	C	6	12	6	6	6
Nitrogen	N	7	14	7	7	7
Oxygen	O	8	16	8	8	8
Fluorine	F	9	19	9	9	10
Neon	Ne	10	20	10	10	10
Sodium	Na	11	23	11	11	12
Magnesium	Mg	12	24	12	12	12
Aluminium	Al	13	27	13	13	14
Silicon	Si	14	28	14	14	14
Phosphorus	P	15	31	15	15	16
Sulphur	S	16	32	16	16	16
Chlorine	Cl	17	35	17	17	18
Argon	Ar	18	40	18	18	22
Potassium	K	19	39	19	19	20
Calcium	Ca	20	40	20	20	20

Geometric representation of oxygen atom [$_8O^{16}$]

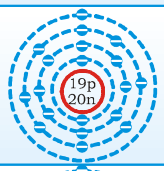
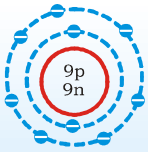
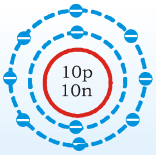
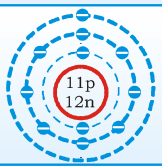
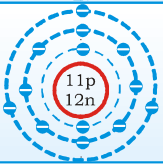
Mass number of oxygen (A) = 16
Atomic number of oxygen (Z) = 8
$\therefore$ Number of protons = Z = 8
$\therefore$ Number of electrons = No. of protons = 8
$\therefore$ Number of neutrons = A – Z = 16 – 8 = 8
And the electrons in the first shell = 2 [K-shell]
Remaining electrons in second shell = (8 – 2) = 6 [L - shell]
So, the geometric structure of oxygen atom is:

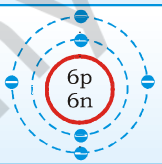
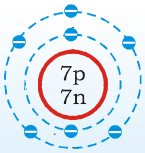
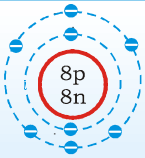


L-Shell six electrons
K-Shell two electrons

∴ The number of electrons = 8

GEOMETRIC REPRESENTATION OF SOME ELEMENTS

Element	No.of neutrons A – Z	No. of protons - Z	No. of electrons	Electronic configuration	Geometric representation of atomic structure
Sulphur $^{32}_{16}S$	32 – 16 = 16	16	16	2, 8, 6, ...	
Chlorine $^{32}_{17}C\lambda$	35 – 17 = 18	17	17	2, 8, 7, ...	
Potassium $^{39}_{19}K$	39 – 19 = 20	19	19	2, 8, 8, 1	
Calcium $^{40}_{20}Ca$	40 – 20 = 20	20	20	2, 8, 8, 2	
Flourine $^{19}_{9}F$	19 – 9 = 10	9	9	2, 7	
Neon $^{20}_{10}Ne$	20 – 10 = 10	10	10	2, 8....	
Sodium $^{23}_{11}Na$	23 – 11 = 12	11	11	2, 8, 1....	
Aluminium $^{27}_{13}A\lambda$	27 – 13 = 14	13	13	2, 8, 3....	

Element	No.of neutrons A – Z	No. of protons - Z	No. of electrons	Electronic configuration	Geometric representation of atomic structure
Hydrogen $^{1}_{1}H$	1 – 1 = 0	1	1	1, ...	
Helium $^{4}_{2}He$	4 – 2 = 2	2	2	2,...	
Carbon $^{12}_{6}C$	12 – 6 = 6	6	6	2, 4,....	
Nitrogen $^{14}_{7}N$	14 – 7 = 7	7	7	2, 5,....	
Oxygen $^{16}_{8}O$	16 – 8 = 8	8	8	2, 6,....	

WORK SHEET - 4

Single Answer Type

1. Nucleus of an atom consists of:
   1) Proton and electron 2) Electron and neutron
   3) Protons and Neutrons 4) Electrons protons neutrons
2. If Pauli's exclusion principle is not known, the electronic arrangement of lithium atom is:
   1) $1s^2\ 2s^1$ 2) $1s^1\ 2s^2$ 3) $1s^3$ 4) $1s^2\ 2s^1\ 2p^1$
3. The electronic configuration of Li atom is:
   1) $1s^2\ 2s^2$ 2) $1s^2$ 3) $1s^2\ 2s^1$ 4) $1s^2\ 2s^1\ 2p^1$
4. Electronic configuration of H atom is:
   1) $1s^1$ 2) $1s^2$ 3) $1s^2\ 2s^1$ 4) $1s^2\ 2s^2$
5. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6$. Identify the element.
   1) O 2) B 3) Ne 4) Mg
6. The correct electronic configuration of chromium (atomic number - 24) is:
   1) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$ 2) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6$
   3) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6, 4s^2$ 4) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5, 3d^5, 4s^2$

7. The electronic configuration of zinc is:
   1) $1s^2\ 2s^2\ 2p^6\ 3p^6\ 4s^2\ 3d^5$ 2) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^9$
   3) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$ 4) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
8. The element whose electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2$ is:
   1) Metal 2) Metalloid 3) Inert gas 4) Non-metal
9. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$. What is the atomic number of that element?
   1) 27 2) 26 3) 30 4) 28

Multi Answer Type

10. Which of the following is correct statement?
   1) F – electronic configuration is $1s^2\ 2s^2\ 2p^5$
   2) Si – electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
   3) C*l* – electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
   4) Co – electronic configuration is [Ar] $4s^2 3d^7$

Reasoning Answer Type

11. ***Statement I:*** The electronic configuration of carbon can be written as $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$.

   Statement II: The electronic configuration of nitrogen is $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$.
   1) Both Statements are true, Statement II is the correct explanation of Statement I.
   2) Both Statements are true, Statement II is not correct explanation of Statement I.
   3) Statement I is true, Statement II is false.
   4) Statement I is false, Statement II is true.
12. ***Statement I:*** The electronic configuration of aluminium is [Ne] $3s^2\ 3p^1$.
   Statement II: The electronic configuration of vanadium is [Ar] $4s^2\ 3d^3$.
   1) Both Statements are true, Statement II is the correct explanation of Statement I.
   2) Both Statements are true, Statement II is not correct explanation of Statement I.
   3) Statement I is true, Statement II is false.
   4) Statement I is false, Statement II is true.
13. ***Statement I:*** The atomic of Cr is 24.
   Statement II: Electronic configuration of Cu is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
   1) Both Statements are true, Statement II is the correct explanation of Statement I.
   2) Both Statements are true, Statement II is not correct explanation of Statement I.
   3) Statement I is true, Statement II is false.
   4) Statement I is false, Statement II is true.

Comprehension Type

Knowing the mass and atomic number of an element we can easily represents its geometric structure.

14. The number of protons present in $^{24}_{12}Mg$ is:

1) 12 2) 24 3) 36 4) 26

15. The number of neutrons in magnesium is:

1) 24 2) 12 3) 36 4) 20

16. The electrons present in first shell

1) 2 2) 8 3) 16 4) 32

Matrix Matching Type

17.

Column-I	**Column-II**
a) K shell	1) 3s, 3p
b) L shell	2) 4s 4p
c) M shell	3) 2s 2p
d) N shell	4) 1s

18.

Column-I **Element**	**Column-II** **Electronic**
a) Fe	1) [Ne] $3s^2\ 3p^5$
b) C*l*	2) [Ne] $3s^2\ 3p^4$
c) S	3) [Ne] $3s^2\ 3p^3$
d) P	4) [Ar] $4s^2\ 3d^6$
	5) [Ar] $4s^2\ 3d^4$

19.

Column-I **Element**	**Column-II** **Atomic number**
a) K	1) 26
b) V	2) 25
c) Mn	3) 19
d) Fe	4) 23
	5) 28

20.

Column-I **Electronic configuration**	**Column-II** **Number of valance electrons**
a) $1s^2\ 2s^2\ 2p^3$	p) 7
b) $1s^2\ 2s^2\ 2p^5$	q) 5
c) $1s^2\ 2s^2\ 2p^6\ 3s^1$	r) 6
d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$	s) 1

SYNOPSIS - 5

PAULI'S EXCLUSION PRINCIPLE

- No two electrons in the same atom can have the same values for all the four quantum numbers.
- Each electron in an atom is designated by a set of four quantum numbers.
- An orbital accommodates two electrons with opposite spin: These two electrons have same values of principal, azimuthal and magnetic quantum number but the forth, i.e., spin quantum number will be different.

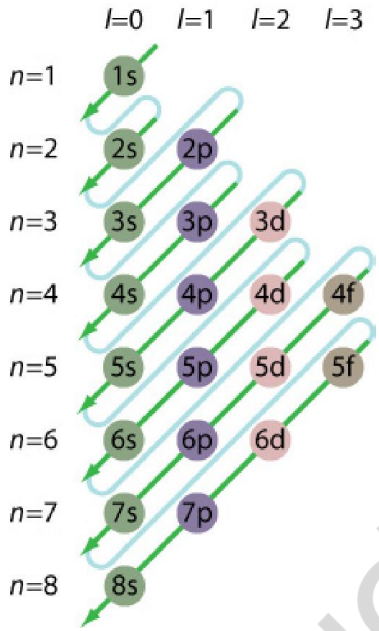
  Example:

$$N(z=7) = 1s^2 \quad 2s^2 \quad 2p^3$$
$$= 1s^2 \quad 2s^2 \quad 2p_x^1 2p_y^1 2p_z^1$$
$$= \boxed{\uparrow\downarrow} \quad \boxed{\uparrow\downarrow} \quad \boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}$$

Principal quantum number (n)	= 1	2	2	2	2
Azimutal quantum number (l)	= 0	0	1	1	1
Magnetic quantum number (m)	= 0	0	+1	-1	0
Spin quantum number (s)	= $+\frac{1}{2}$ $-\frac{1}{2}$	$+\frac{1}{2}$ $-\frac{1}{2}$	$+\frac{1}{2}$	$+\frac{1}{2}$	$+\frac{1}{2}$

AUFBAU PRINCIPLE :

- The subshell with minimum energy is filled up first and when this obtains maximum quota of electrons, then thenext subshell of higher energy starts filling".
- Electron filling follows energy ranking.
- The energy value of an orbital increases as its $(n+l)$ value increases.
- If two orbitals have the same value for $(n+l)$, the orbital having lower n value is first filled.
- The sequence in which the various subshells are filled in the following

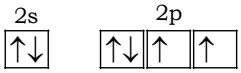


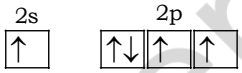
HUND'S RULE:

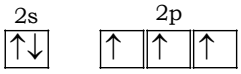
- Orbitals of the same kind should be half filled before electron pairing takes place.
- Orbitals having the same values for n and l are called degenerate orbitals.
- Unpaired electrons have parallel spin.
- Half filled and completely filled degenerate orbitals give greater stability to atoms.
- Chromium (Z = 24) and copper (Z = 29) have anomalous electronic configuration due to this reason.
- Electronic configuration of chromium atom is $1s^2\ 2s^2\ 2p^6\ 3s^2 3p^6\ 3d^5\ 4s^1$ but not $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$.

WORK SHEET - 5

Single Answer Type

1. Any p-orbital can accommodate upto:
   1) Four electrons
   2) Two electrons with parallel spins
   3) Six electrons
   4) Two electrons with opposite spins
2. The order of filling various sublevels with electrons is the order of their energies. This is:
   1) Auf-bau principle
   2) Pauli's principle
   3) Hund's rule
   4) nl^x principle
3. The orbital diagram in which the aufbau principle is violated is:
   1) 

   2) 

   3) 

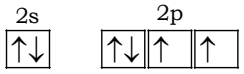
   4) 

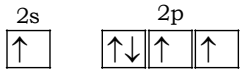
4. The electronic configuration of nitrogen is $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2P_z^1$. This is in accordance with
   1) Aufbau principle
   2) Pauli's rule
   3) Hund's rule
   4) Bohr Bury principle
5. The presence of five unpaired electrons in 3d orbitals of manganese atom is according to
   1) Pauli's principle 2) Hund's rule 3) Aufbau principle 4) de-Broglie's theory
6. The fact that the two electrons in an orbital must have opposite spins is deduced from?
   1) Hund's rule of maximum multiplicity
   2) Pauli's exclusion principle
   3) Aufbau's rule
   4) Heisenberg's uncertainty principle
7. The principle which excludes the possibility of presence of a third electron in an orbital is:
   1) Aufbau rule
   2) Hund's rule
   3) Pauli's exclusion principle
   4) None of these
8. Any p-orbital can accommodate upto:
   1) Four electrons
   2) Two electrons with parallel spins
   3) Six electrons
   4) Two electrons with opposite spins
9. The order of filling various sublevels with electrons is the order of their energies. This is:
   1) Auf-bau principle
   2) Pauli's principle
   3) Hund's rule
   4) nl^x principle

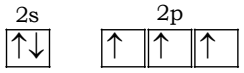
10. The increasing order of energy of the orbitals 1s, 2s and 2p is:

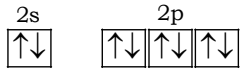
1) 2p < 2s < 1s 2) 2s < 2p < 1s 3) 1s < 2s < 2p 4) 2p > 3d > 4s

11. The orbital diagram in which the aufbau principle is violated is:

1) 

2) 

3) 

4) 

12. Aufbau principle fails to explain the configuration of element with atomic number.

1) 18 2) 21 3) 24 4) 27

13. According to Aufbau's principle, which of the three 4d, 5p and 5s orbitals will be filled with electrons first?

1) 4d 2) 5p

3) 5s 4) 4d and 5s will be filled simultaneously

14. The atomic orbitals are progressively filled in the order of the increasing energy'. This statement is known as:

1) Hund's rule 2) Exclusion principle

3) Aufbau rule 4) de-Broglie rule

15. The electronic configuration of nitrogen is $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2P_z^1$. This is in accordance with

1) Aufbau principle 2) Pauli's rule

3) Hund's rule 4) Bohr Bury principle

16. The presence of five unpaired electrons in 3d orbitals of manganese atom is according to

1) Pauli's principle 2) Hund's rule

3) Aufbau principle 4) de-Broglie's theory

17. If Pauli's exclusion principle is not known, the electronic arrangement of lithium atom is:

1) $1s^2\ 2s^1$ 2) $1s^1\ 2s^2$ 3) $1s^3$ 4) $1s^2\ 2s^1\ 2p^1$

18. Nitrogen, phosphorus, Arsenic, Antimony and Bismuth atoms have s unpaired electrons in their p-orbitals because of:

1) Pauli's principle 2) Hund's rule

3) Aufbau principle 4) All the above

19. Nitrogen has the electronic configuration $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ and not $1s^2\ 2s^2\ 2p_x^2\ 2p_y^1\ 2p_z^0$. This is determined by:

1) Aufbau principle 2) Pauli exclusion principle

3) Hund's rule 4) Uncertainty principle

20. The fact that the two electrons in an orbital must have opposite spins is deduced from?

1) Hund's rule of maximum multiplicity

2) Pauli's exclusion principle

3) Aufbau's rule

4) Heisenberg's uncertainty principle

21. The principle which excludes the possibility of presence of a third electron in an orbital is:

1) Aufbau rule 2) Hund's rule

3) Pauli's exclusion principle 4) None of these

22. Which of the following is the correct statement?

1) In pauli's principle, there is room for only two electrons in an orbital and they should have opposite spins.

2) In an atom if electrons have same n, l and m values they must differ in spin quantum number.

3) The order of filling the different orbitals in 9 sub energy level is governed by Hund's rule.

4) Pairing of electrons take place in a sub-shell only after all the orbitals are singly filled.

23. Which of the following is correct statement

1) K-shell can accommodate 2 electrons

2) Maximum number of electrons in L-shell is 6 electrons

3) Maximum number of electrons, accommodated in N-shell is 32 electrons

4) Maximum number of electrons, accommodated in M-shell is 18 electrons

24. Based on what principle(s), the electronic configuration of any atom depends?

1) Pauli's exclusion 2) Hunds rule

3) Aufbau's principle 4) None of these

Multi Answer Type

25. Which of the following is correct statement?

1) Electronic configuration of atoms is based on certain rules like (n + l) values.

2) Among 3d and 4s electrons occupy 4s first

3) When two or more sub-levels with same (n + l) value are available, electrons enter that sub-level which has least 'n' value.

4) Among 3d, 4p and 5s; electrons enter 3d first followed by 4p, than 5s.

26. The orbital with relative energy 5

1) 5p 2) 5s 3) 4p 4) 3d

27. Which of the following is correct statement

1) K-shell can accommodate 2 electrons

2) Maximum number of electrons in L-shell is 6 electrons

3) Maximum number of electrons, accommodated in N-shell is 32 electrons

4) Maximum number of electrons, accommodated in M-shell is 18 electrons

Reasoning Answer Type

28. ***Statement I:*** 1s orbital possesses lower energy than 2s orbital.
Statement II: Pauli's exclusion principle states that an orbital can have maximum of two electrons and these must have opposite spins.

1) Both Statements are true, Statement II is the correct explanation of Statement I.
2) Both Statements are true, Statement II is not correct explanation of Statement I.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

29. ***Statement I:*** The increasing order of energy of the orbitals is 1s<2s<2p.
Statement II: Electrons occupy orbitals with high energy first.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

30. ***Statement I:*** The arrangement of electrons in the atomic orbitals is based on the increasing order of their energy
Statement II: Moeller's diagram is necessary to write electronic configuration.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

31. ***Statement I:*** When two or more sub-levels with same $(n + l)$ value are available, electrons enter the sub level which has least n values.
Statement II: Among 3d and 4s electrons, electron occupy 4s level first.

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

32. ***Statement I:*** 1s orbital possesses lower energy than 2s orbital.
Statement II: Pauli's exclusion principle states that an orbital can have maximum of two electrons and these must have opposite spins.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

33. ***Statement I:*** The electronic configuration of carbon can be written as $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$.
Statement II: The electronic configuration of nitrogen is $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$.
1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

Comprehension Type

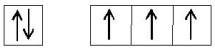
Writeup-1

Pairing of electrons take place in a sub - shell only after all the orbitals are singly filled.

In p sub - level pairing of electrons take place with 4^{th} electron according to Hund's rule.

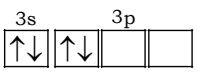
Similarly pairing of electrons starts with 6^{th} electron and 8^{th} electron in d and f sub - levels respectively.

34. The orbital diagram, in which both Pauli's exclusion principle and Hund's rule are violated?

1)  2)  3)  4) 

35. Quantum numbers of an atom can be defined on the basis of
1) Hund's rule 2) Aufbau's principle
3) Pauli's exclusion principle 4) Heisenberg's uncertainty principle

36. The electronic configuration in the valence shell of silicon is:



The rule violated is:
1) Auf-bau principle 2) Paul's rule 3) Hund's rule 4) All

Writeup-2

Electrons occupy orbitals with lower energy first. Electronic Configuration is a representation of the occupation of electrons in the orbitals in the increasing order of their energies.

37. Which of the following represent the energy of the orbital?

1) n + l 2) n – l 3) l + m 4) n + s

38. Which of the following has more energy?

1) 1s 2) 2s 3) 3p 4) 3d

39. No two electrons in an atom can have:

1) The same principal quantum numbers only .
2) The azimuthal quantum numbers only .
3) The same magnetic quantum numbers only .
4) An identical set of four quantum numbers.

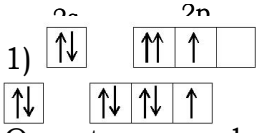
Writeup-3

Pairing of electrons take place in a sub - shell only after all the orbitals are singly filled.

In p sub - level pairing of electrons take place with 4th electron according to Hund's rule.

Similarly pairing of electrons starts with 6th electron and 8th electron in d and f sub - levels respectively.

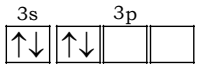
40. The orbital diagram, in which both Pauli's exclusion principle and Hund's rule are violated?

1)  2)  3)  4)

41. Quantum numbers of an atom can be defined on the basis of

1) Hund's rule 2) Aufbau's principle
3) Pauli's exclusion principle 4) Heisenberg's uncertainty principle

42. The electronic configuration in the valence shell of silicon is:



The rule violated is:

1) Auf-bau principle 2) Paul's rule 3) Hund's rule
4) All

Matrix Matching Type

43.

Column-I	**Column-II**
Element	**Electronic configuration**
a) Calcium	1) 2, 8, 6
b) Sodium	2) 2, 8, 3
c) Sulphur	3) 2, 8, 8, 2
d) Aluminium	4) 2, 8, 1
	5) 2, 7

44. **Column-I** **Column-II**

a) The electrons of same orbital differ is s value — 1) Aufbau principle

b) Order of orbitals is 2s, 2p, 3s, 3p, 4s filled sub level — 2) 32 electrons

c) Electronic configuration $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1$ — 3) Pauli's exclusion principle

d) Maximum number of electrons in N=shell — 4) Hund's rule

5) 16 electrons

45. **Column-I** **Column-II**

a) s — 1) Number of electrons

b) p — 2) 14 electrons

c) d — 3) 2 electrons

d) f — 4) 10 electrons

5) 6 electrons

46. **Column-I** **Column-II**

a) K shell — 1) 3s, 3p

b) L shell — 2) 4s 4p

c) M shell — 3) 2s 2p

d) N shell — 4) 1s

5) 4d

47. **Column-I** **Column-II (n + *l* value)**

a) $l = 0$ — 1) 2s = 2 + 0 = 2; 2p = 2 + 1 = 3

b) $\ell = 0$, $\ell = 1$ — 2) 1s = 1 + 0 = 1

c) $\ell = 0$, $\ell = 1$, $\ell = 2$ — 3) 4s = 4 + 0 = 4; 4p = 4 + 1 = 5; 4d = 4 + 2 = 6; 4f = 4 + 3 = 7

d) $\ell = 0$, $\ell = 1$, $\ell = 2$, $\ell = 3$ — 4) 3s = 3 + 0 = 3; 3p = 3 + 1 = 4; 3d = 3 + 2 = 5

5) 1s = 1 + 1 = 2

WORK SHEET – 1 (KEY)				
1) 1	**2)** 2	**3)** 1	**4)** 4	**5)** 3
6) 2	**7)** 2	**8)** 2	**9)** 3	**10)** 2
11) 4	**12)** 3	**13)** 4	**14)** 3	**15)** 2
16) 2	**17)** 2	**18)** 2	**19)** 1,2,3,4	**20)** 1,2,3
21) 2,3	**22)** 2	**23)** 3	**24)** 4	**25)** 2
26) 3	**27)** 2	**28)** 2	**29)** 3	**30)** 3
31) A-3 B-1,4 C-2,5 D-1,2,4,5	**32)** A-2 B-4 C-3 D-1	**33)** A-2 B-3 C-1 D-4		

WORK SHEET – 2 (KEY)				
1) 4	**2)** 4	**3)** 1	**4)** 3	**5)** 1,3
6) 1,2,3	**7)** 1,2,3,4	**8)** 2	**9)** 3	**10)** 2
11) 1	**12)** 1	**13)** 3	**14)** 1	**15)** 1
16) 2	**17)** 3	**18)** A-4,2 B-3 C-1,4 D-2		

WORK SHEET – 3 (KEY)				
1) 2	**2)** 1	**3)** 2	**4)** 3	**5)** 3
6) 4	**7)** 1	**8)** 1,2,4	**9)** 1,2,4	**10)** 3
11) 2	**12)** 4	**13)** 1	**14)** 1	**15)** 3
16) A-3 B-2 C-1 D-4				

WORK SHEET – 4 (KEY)				
1) 2	**2)** 3	**3)** 3	**4)** 1	**5)** 3
6) 1	**7)** 3	**8)** 1	**9)** 4	**10)** 1,2,3,4
11) 2	**12)** 2	**13)** 2	**14)** 1	**15)** 2
16) 1	**17)** A-4 B-3 C-1 D-2,5	**18)** A-4 B-1 C-2 D-3	**19)** A-3 B-4 C-2 D-1	**20)** A-2 B-1 C-4 D-3

WORK SHEET – 5 (KEY)				
1) 1	**2)** 3	**3)** 2	**4)** 3	**5)** 2
6) 2	**7)** 3	**8)** 4	**9)** 1	**10)** 3
11) 2	**12)** 3	**13)** 3	**14)** 3	**15)** 3
16) 2	**17)** 3	**18)** 2	**19)** 3	**20)** 2
21) 3	**22)** 1,2,3,4	**23)** 1,3,4	**24)** 1,2,3	**25)** 1,2,3
26) 2,3,4	**27)** 1,2,3,4	**28)** 2	**29)** 3	**30)** 2
31) 2	**32)** 2	**33)** 2	**34)** 1	**35)** 3
36) 3	**37)** 1	**38)** 4	**39)** 4	**40)** 1
41) 3	**42)** 3	**43)** A-3 B-4 C-1 D-2	**44)** A-3 B-1 C-4 D-2	**45)** A-3 B-5 C-4 D-2
46) A-4 B-3 C-1 D-2,5	**47)** A-2 B-1 C-4 D-3			

CHEMICAL BONDING

SYNOPSIS - 1

INTRODUCTION

Elements form compounds and it is a universal law that any particle (molecule, atom or ion), will tend to be in the minimum state of energy, if it gets chance to do so. As the atoms of all elements (with the exception of noble gases) have one to seven electrons in their valence shell, therefore, they are not in the minimum state of energy. Thus, to attain or octet structure in their valence shell, the participating atoms of the elements redistribute their electrons in such a way that each atom has a stable electronic configuration of the nearest noble gas.

1 Electronic configuration of Noble Gases:

Noble gases ar7e monoatomic in nature. They do not form molecules either with their own atoms or react chemically with any other element. Why?

In order to answer the above, question, let us study electronic configuration of the noble gases as illustrated in a given table:

Noble Gas	Symbol	Atomic number	Electronic configuration K L M N O P
Helium	He	2	2
Neon	Ne	10	2, 8
Argon	Ar	18	2, 8, 8
Krypton	Kr	36	2, 8, 18, 8
Xenon	Xe	54	2, 8, 18, 18, 8
Radon	Rn	86	2, 8, 18, 32, 18, 8

Notice that with the exception of helium, which has two electrons in its valence shell, all other noble gases have eight electrons in their valency shells. Thus, we can say that helium has duplet configuration in its valence shell, whereas all other noble gases have octet configuration in their valence shells.

2 As all noble gases are chemically inactive, following conclusions can be drawn:

(i) Duplet configuration of valence shell makes an element inactive.

(ii) Octet configuration of valence shell makes an element inactive.

3. The above conclusions were drawn by Kossel and Lewis independently in 1916. They further stated that a duplet or an octet configuration of electrons in the valence shell is most stable and any atom having this configuration will be in the minimum state of energy.

4. **Why do atoms combine?**

   We know that, noble gases do not enter into any chemical action due to their stable duplet (or) octet configuration in their outermost shell. Hence, they are chemically inactive. This assumption was made by Kossel and Lewis independently in 1916.

5. With the exception of noble gases, atoms of all elements have 1-7 electrons in their outermost shell. Thus, the electronic configuration of outermost shell of these elements is incomplete. Hence, they are unstable and have a tendency to attain stability by attaining stable configuration. In other words, atoms of the same element or different elements combine with one another, so that they attain duplet (or) octet configuration.

6. Consider sodium (2, 8, 1) and chlorine (2, 8, 7) atoms. Both are unstable in their atomic state. When sodium and chlorine are brought together, Sodium loses an electron, which is gained by chlorine atom. As a result Na^+ (2, 8) and Cl^- (2, 8, 8) are formed, thus making themselves stable.

7. Further, stability is co-related to energy. A system with less energy is more stable. During a chemical reaction, the reactants lose energy and the resulting product has less energy. As the product has less energy, it is more stable. So, during a chemical reaction, stability can also be achieved by lowering the energy.

8. We can thus conclude that, the cause of a chemical reaction is to attain stability.

9. **How do atoms acquire stable octet configuration?**

   Atoms can complete the valence shell by acquiring octet configuration in two ways.

   1. By transfer of one or more electrons, from one atom to another. Generally, electropositive elements lose electrons and electronegative elements gain electrons.
   2. By sharing one or more electrons between two or more atoms.

10. Thus, we can conclude that, atoms tend to acquire 8 electrons in their outermost shell (except hydrogen, lithium and beryllium which tend to acquire 2 electrons), in order to attain stable state. This is called 'octet rule'.

THE ELEMENTS OF THE FIRST THREE PERIODS OF THE PERIODIC TABLE

PERIODS	GROUP 1 IA	GROUP 2 IIA	GROUP 13 IIIA	GROUP 14 IVA	GROUP 15 VA	GROUP 16 VIA	GROUP 17 VIIA	GROUP 18 0
1	1 H HYDROGEN 1 p=1, n=0 Elec. conf. 1	2 He Helium 4 — ***Atomic number*** *[= no. of electrons = no. of protons]*; ***Mass number*** *[relative atomic mass] [= no. of neutrons + no. of protons]*						2 He HELIUM 4 p=2, n=2 Elec. conf. 2
2	3 Li LITHIUM 7 p=3, n=4 Elec. conf. 2,1	4 Be BERYLLIUM 9 p=4, n=5 Elec. conf. 2,2	5 B BORON 11 p=5, n=6 Elec. conf. 2,3	6 C CARBON 12 p=6, n=6 Elec. conf. 2,4	7 N NITROGEN 14 p=7 n=7 Elec. conf. 2,5	8 O OXYGEN 16 p=8, n=8 Elec. conf. 2,6	9 F FLUORINE 19 p=9, n=10 Elec. conf. 2,7	10 Ne NEON 20 p=10, n=10 Elec. conf. 2,8
3	11 Na SODIUM 23 p=11, n=12 Elec. conf. 2,8,1	12 Mg MAGNESIUM 24 p=12, n=12 Elec. conf. 2,8,2	13 Al ALUMINIUM 27 p=13, n=14 Elec. conf. 2,8,3	14 Si SILICON 28 p=14, n=14 Elec. conf. 2,8,4	15 P PHOSPHOROUS 31 p=15, n=16 Elec. conf. 2,8,5	16 S SULPHUR 32 p=16, n=16 Elec. conf. 2,8,6	17 Cl CHLORINE 35.5 p=17, n=18 Elec. conf. 2,8,7	18 Ar ARGON 40 p=18, n=22 Elec. conf. 2,8,8
4	19 K POTASSIUM 39 p=19, n=20 Elec. conf. 2,8,8,1	20 Ca CALCIUM 40 p=20, n=20 Elec. conf. 2,8,8,2						

WORK SHEET - 1

SINGLE ANSWER TYPE

1. Duplet configuration is not found in:
   1) Hydride ion 2) Hydrogen molecule
   3) Lithium cation 4) Be^{+}
2. Chemical bond implies:
   1) Repulsion 2) Attraction
   3) Attraction and repulsion balanced at a particular distance
   4) Attraction and repulsion
3. Which inert gas has a duplet configuration in its valence shell?
   1) Helium 2) Neon 3) Argon 4) Krypton

11. $Cl + Cl \rightarrow Cl_2$ This is an example for:
   1) Endothermic reaction 2) Exothermic reaction
   3) Either exothermic or endothermic 4) Neither exothermic nor endothermic
12. "The duplet and octet configuration of electrons in the valence shell is most stable and any atom having this configuration will be in minimum state of energy". This statement was given by:
   1) Kossel and Lewis 2) Lewis and Debye
   3) Kossel and London 4) Lewis and London
13. Chemical reactivity of an elements depends on:
   1) Outer shell electronic configuration. 2) Reactivity of the nucleus.
   3) Core electrons. 4) None of these
15. During bond formation potential energy of the system:
   1) Increases 2) Decreases
   3) Remain same 4) Cannot be predicted
17. Example of super octate molecule:
   1) F_3Cl 2) PCl_5 3) IF_7 4) All of these
19. The electronic configuration of Na+ is:
   1) 2,8,1 2) 2,8 3) 2,8,2 4) 2,8,7

MULTI ANSWER TYPE

4. Which of the following statement is/are incorrect?
   1) Products of endothermic reactions are more stable.
   2) Products of exothermic reactions are more stable.
   3) Products of both exothermic and endothermic reactions are equally stable.
   4) None of the above.
16. Atoms attain the octet configuration:
   (i) by transfer of one or more electrons from one atom to another.
   (ii) by sharing of one or more electrons between two or more atoms.
   1) 'i' is correct 2) 'ii' is correct
   3) Both i and ii are incorrect 4) None of these
20. It was found that atoms having atomic numbers of 2, 10, 18, 36, 54, 86 are very stable and do not show any chemical reactivity, these elements were found to be gases and are called:
   1) Inert gases 2) Diatomic gases
   3) Monoatomic gases 4) Noble gases

21. Which of the following element(s) do not form molecules?
1) Helium 2) Oxygen 3) Nitrogen 4) Argon

REASONING ANSWER TYPE

5. *Statement I*: Duplet configuration implies that a given atom has 2 electrons in its valence shell.
Statement II: Elements with octet configuration in their valence shell are stable.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

14. *Statement I*: Less energy species are more stable.
Statement II: When energy is less, the velocity of the vibrating particles decreases, thereby increases the stability.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

18. *Statement I*: Pure metal is more stable than its ore.
Statement II: Ore of metal is more stable than pure metals.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

Atoms can complete the valence shell by acquiring octet configuration in two ways.
1. By transfer of one or more electrons, from one atom to another. Generally, electropositive elements lose electrons and electronegative elements gain electrons.
2. By sharing one or more electrons between two or more atoms.

6. To attain a _____ participating atoms redistribute their electrons to get a electronic configuration of the nearest noble gas either octet or duplet.
1) State of maximum energy 2) State of minimum energy
3) Stability 4) None

7. By doing which of the following, an atom can attain stability?
1) Transfer of electrons 2) Sharing of electrons
3) Lowering energy 4) All of these

8. The chemical stability is more for [Excepting inert gases]
1) The parent atom 2) Their ions 3) Both 1 and 2 4) None

MATRIX MATCHING TYPE

9.

Column-I	**Column-II**
a) Sodium	1) 2, 8, 8
b) Duplet configuration	2) Stable (or) inactive
c) Xe	3) Makes an element inactive
d) Ar	4) Unstable (or) active
	5) 2, 8, 18

INTEGER ANSWER TYPE

10. In Argon atom _____ number of electrons present in L shell.

SYNOPSIS - 2

ELECTRON THEORY OF VALENCY

A number of attempts were made to explain formation of chemical bonds in terms of electrons, but it was only in 1916, Kossel and Lewis' succeeded independently in giving a satisfactory explanation. They proposed a theory, based on electronic concept of atoms, known as "Electron theory of valency".

The main postulates of this theory are:

1. **The secret of stability of atoms:** Atoms with eight electrons in the outermost shell (two in the case of Hydrogen, Helium, Lithium and Beryllium) are chemically more stable.
2. **Cause of chemical reaction:** The cause for chemical reaction is to attain stability. An atom achieves this by acquiring the octet configuration (inert gas configuration) in its outermost shell.
3. **Type of electrons taking part in a chemical reaction (or) chemical bonding:** The electrons present in the outermost shell of an atom are responsible for chemical reaction.

The outer most shell is called valency shell and hence the electrons present in it are called valence electrons. The number of electrons taking part in a chemical reaction is called valence of that element.

4. **Attainment of nearest inert gas configuration:** The atoms of various elements achieve the nearest inert gas configuration, either by transfer (losing or gaining) or by sharing of electrons with another atom.

   This transfer or sharing of electrons results in the development of an attractive force between the atoms, which holds the atoms together by a bond.

Electron Dot structure of atoms - Lewis' Symbols:

i) In the formation of any molecule or formula unit, only the electrons present in the outermost shell are shown.

ii) The reason for not showing the inner shell electrons is that, they are well protected and do not involve in chemical reaction.

iii) Therefore, valence electrons are considered for the formation of the chemical bonds.

G.N. Lewis' introduced simple symbols called *Lewis' symbols* to denote the valence electrons in an atom.

Lewis' symbols: The symbol of the element, surrounded by the valence electrons of its atom, represented in the form of dots around it, is known as Lewis' symbol or electron dot symbol.

Examples:

S.No	Element	Symbol	Atomic Number	E.G.	Lewis' Symbol	Number of electrons in valence shell
1.	Lithium	Li	3	2, 1	Li·	1
2.	Carbon	C	6	2, 4	:C:	4
3.	Nitrogen	N	7	2,5	:N:	5
4.	Chlorine	Cl	17	2, 8, 7	:Cl:	7
5.	Calcium	Ca	20	2, 8, 8, 2	:Ca	2

Note : Practice from 1 to 20 Lewis symbol of elements.

Significance of Lewis' Symbols

(i) The number of dots present around the symbol, gives the number of electrons present in the outermost shell i.e., number of valence electrons.

(ii) The number of electrons present in the outermost shell is the common valency of the element.

The common valency of the element is equal to the number of dots around the symbol **(if the dots are $\leq$ 4, then the valency is equal to the number of dots and if the number of dots $\geq$ 5, then the valency is 8 – number of dots.)**

For example: Li, Be, B and C have valencies 1, 2, 3 and 4 respectively and N, O and F have 3, 2, 1 respectively (i.e. 8 – number of dots).

WORK SHEET - 2

SINGLE ANSWER TYPE

1. The maximum valency of an element with atomic number 7 is:
   1) 2 2) 5 3) 4 4) 3
2. Chemical bond formation takes place when:
   1) Energy is absorbed
   2) Force of attraction overcome force of repulsion.
   3) Force of repulsion overcome force of attraction.
   4) Force of attraction equal to force of repulsion.
3. The force of attraction that holds the atoms or ions or molecules together is known as:
   1) Chemical bond 2) Gravitational pull
   3) Nuclear pull 4) Magnetic pull
4. Atoms experience the following when they are brought closer.
   1) Attractive forces 2) Repulsive forces
   3) Both 1 and 2 4) None of these

5. The dots in Lewis symbols represents:
1) Valence electrons in an atom 2) Low energy state of an atom
3) Octet and duplet of an atom 4) Nearest noble gas configuration

13. The maximum number of valence electrons possible for atoms in the second period of the periodic table is :
1) 2 2) 8 3) 18 4) 32

14 A, B, C are the elements of group IA, IIA, IIIA respectively.
Identify the correct Lewis dot diagram of A, B and C in the following:

	(A)	*(B)*	*(C)*
1)	:A•	•B•	•C•
2)	A•	•B•	•C•
3)	:A•	•B•	•C•
4)	:A:	•B•	•C•

16. Nucleus of an element has 9 protons, its valency would be:
1) 1 2) 3 3) 2 4) 5

17. The Lewis' symbols of three unknown elements are as follows : •R• :A: •M•

Predict the general valency of each element and groups to which they belong:

	(R)	***(A)***	***(M)***
1)	2, IIA	1, VII A	3, VA
2)	2, IIA	7, VIIA	5, VA
3)	1, IA	3, VIIA	1, VA
4)	2, IIA	4, IVA	3, VIA

19. The Lewis' symbols of three unknown elements are as following.

(i) •X• (ii) •Y• (iii) :Z:

Write their respective general valencies and the groups to which they belong.

	(i)	*(ii)*	*(iii)*
1)	3, IIIA	6, VI A	8, VIIIA
2)	2, IIA	2, IIA	8, VIIIA
3)	3, IIIA	2, VIA	0, VIIIA
4)	3, IIA	6, VIA	0, VIIIA

21. The Lewis' symbols of three unknown elements are as follows:

(i) •A• (ii) :B: (iii) :C:

Write the formula of the different compounds formed by their combination.
1) A_3B_2, AC, A_2, B_2, BC, B_2C, BC_2, C_2 2) A_2B_3, AC_2, B_2, $B_{-2}C$, B_2C_2, C_2, BC_2, AC
3) A_2B_4, A_2C_2, B_2, BC, BC_2, C_2, B_2C 4) A_3B_2, AC, B_2, BC, B_2C, BC_2, C_2

MULTI ANSWER TYPE

6. Which of the following will try to achieve helium configuration?
   1) Hydrogen 2) Lithium 3) Beryllium 4) None of these

18. Which of the following statements are correct?
   1) Valency of an atom depends mainly on the number of electrons present in the outer most orbit.
   2) Kossel and Lewis formulated a comprehensive statement which has completed by Langmuir and called electronic theory of valency.
   3) The Lewis symbol for sodium is .Na.
   4) Sulphur has six valency electrons.

22. The common or group valency is equal to:
   1) No. of valence electrons till group number 4.
   2) 8 no. of valence electrons after group number 4.
   3) Only no. of electrons present in the valence shell.
   4) None of the above.

REASONING ANSWER TYPE

7. *Statement I*: If the magnitude of attractive forces is more than those of repulsive forces, then potential energy of the system increase.
   Statement II: With the decrease in potential energy, system gains stability and a chemical bond is formed.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

15. *Statement I*: Number of valency electrons in nitrogen atom = 5.
   Statement II: The electrons in the outermost orbit of an atom are called valency electrons.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

20. *Statement I*: Electronic theory of valency is also known as chemical bond theory.
   Statement II: Electronic theory of valency was proposed to explain the electronic rearrangements that occur during the formation of chemical bond.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

Electron theory of valency - Kossel and Lewis' approach of bonding:

A number of attempts were made to explain formation of chemical bonds in terms of electrons, but it was only in 1916, Kossel and Lewis' succeeded independently in giving a satisfactory explanation. They proposed a theory, based on electronic concept of atoms, known as electron theory of valency.

8. "Highly electronegative halogens & highly electropositive alkali metals are separated by noble gases.This fact in relation to chemical bonding was given by:
   1) Kossel 2) Langmuir 3) Lewis 4) Debye
9. Inert nature of noble gases can be explained by _____ theory.
   1) Valence bond theory 2) Octet
   3) Valence shell electron pair repulsion 4) None of the above
10. Electrons involved in bond formation are commonly called as_____.
   1) Valence electrons 2) Core electrons
   3) Both 1 and 2 4) None of these

MATRIX MATCHING TYPE

11.

Column-I	**Column-II**
a) NH_3	1) 4 bond pairs and no lone pairs on the central atom
b) H_2O	2) 2 bond pairs and 2 lone pairs
c) O_2	3) 3 bond pairs and 1 lone pair
d) CCl_4	4) 2 bond pairs and 4 lone pairs

INTEGER ANSWER TYPE

12. No. of valence electrons present in calcium atom is _____

SYNOPSIS - 3

IONIC BOND AND ITS FORMATION:

Definition: The strong electrostatic attraction between two oppositely charged ions which are formed due to transfer of electrons one atom to another is called ionic bond.

Electron transfer and the formation of ionic bonds:

Electron transfer from one atom to another results in the formation of charged species, called ions. On losing electron(s), an atom has more protons than electrons. So it forms a positively charged ion, called a cation.

$$X \qquad -1e^- \longrightarrow \qquad X^{1+}$$

Metallic atom (2,8,1) Cation (positive ion 2,8)

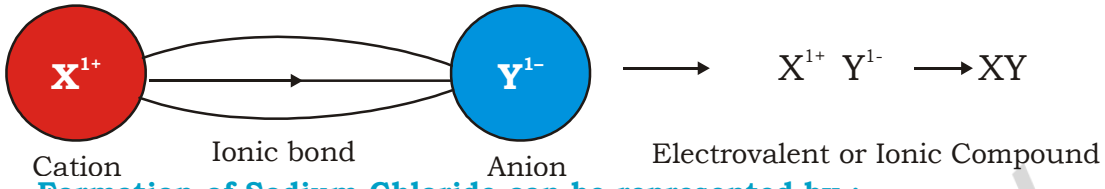
On gaining electron(s), an atom has more electrons than protons, so it forms a negatively charged ion, called an anion.

$$Y \qquad +1e^- \longrightarrow \qquad Y^{1-}$$

Non-metallic atom (2,8,7 Anion (negative ion 2,8,8)

Elements which lose electrons are called electropositive elements and those which gain electrons are called electronegative elements.

The cations and anions formed as a result of electron transfer are drawn towards each other due to the electrostatic force (coulomb force) of attraction. "Thus oppositely charged ions are bonded by an attractive force. (electrostatic force) is called ionic bond or electrovalent bond". They form an ionic bond or an electrovalent bond.



Formation of Sodium Chloride can be represented by :

Ionic Equation :

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

(Atom) (2,8,1) **(Cation) (2,8)**

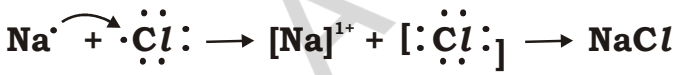
$$Cl + 1e^- \longrightarrow Cl^-$$

(Atom) (2,8,7) **(Anion) (2,8,8)**

$$Na + Cl \rightarrow Na^+Cl^- \rightarrow NaCl$$

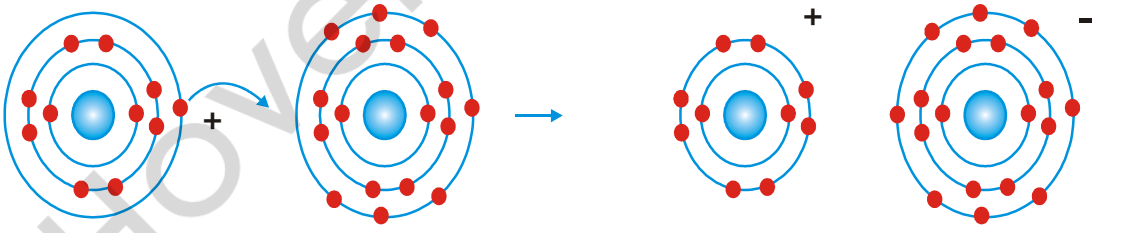
Ionic compound

Electron dot structural diagram:



Sodium atom 2,8,1 **Chlorine atom 2,8,7** **Sodium Chloride**

Atomic or orbit structural diagram:



Na-atom Ele.Con. : 2,8,1 **Cl-atom Ele.Con. : 2,8,7** **Na^+ Ele.Con. : 2,8** **Cl^- Ele.Con. : 2,8,8**

Before Combination **After Combination**

Formation of Magnesium chloride can be represented by:

Ionic Equation:

$$Mg - 2e^- \longrightarrow Mg^{2+}$$

(Atom) (2,8,2) **(Cation) (2,8)**

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

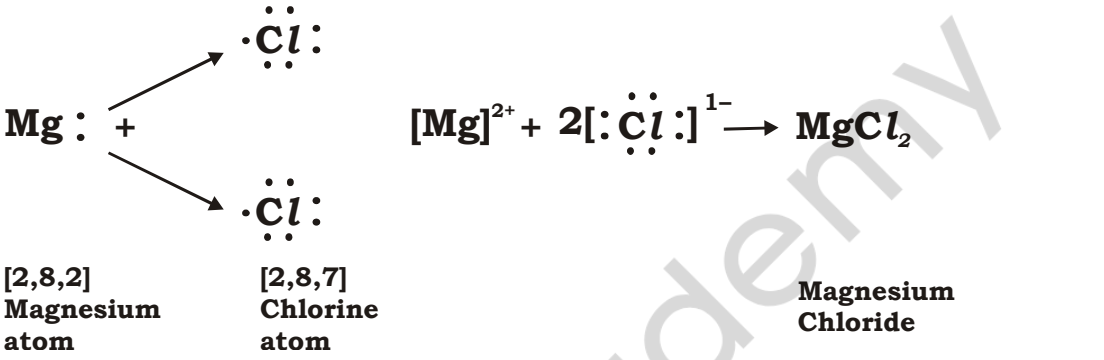
(Atom) (Anion)

(2,8,7) (2,8,8)

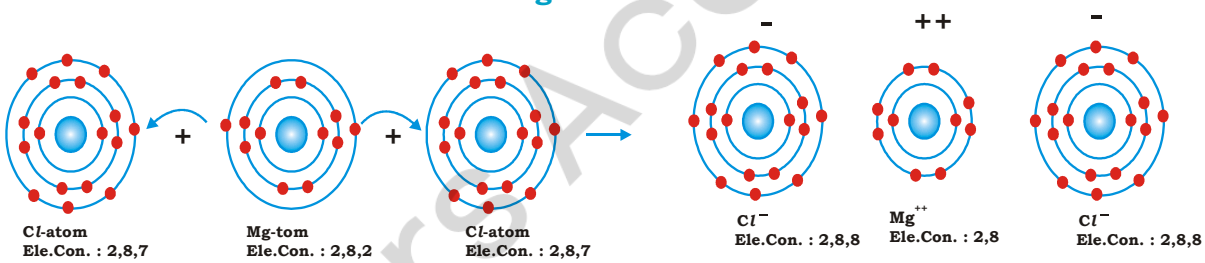
$Mg + 2Cl \rightarrow Mg^{2+}2Cl^{1-} \rightarrow MgCl_2$

Ionic compound

Electron Dot Structure Diagram



Atomic or orbit structural diagram:



Some more examples:

CaO, NaCl, MgCl, $CaCl_2$, MgO, Na_2S

Properties of ionic compounds:

1. Physical state:

Generally, ionic solids are relatively hard. It is because of the close packing due to strong inter-ionic force of attraction present between oppositely charged ions.

2. Melting and boiling points:

Ionic compounds possess high melting and boiling points.

Reason : Melting and boiling points of ionic compounds involves breaking of the lattice structure and setting the ions free. In a lattice, there are strong electrostatic forces between oppositely charged ions. To break these strong electrostatic forces, considerable amount of energy is required. Hence, the melting point and boiling points are high.

3. Solubility:

Ionic compounds are soluble in water.

Reason : Dissolve in an ionic solid involves the setting of opposite ions free from the lattice into the solvent. This can happen when the strong electrostatic force of attraction between the opposite ions is weakened. Therefore, solvents having oppositely charged ions, called polar solvents should be used. The best polar solvent is water. Therefore all ionic compounds are dissolved in water.

4. Electrical conductivity:

Even though ionic solids consist of opposite ions, they are bad conductors of electricity. In ionic solids, a strong electrostatic force of attraction, making the ions immobile, holds the oppositely charged ions together. Hence, conductivity is not possible.

However, in their fused or aqueous state, ionic compounds are good conductors of electricity owing to the presence of mobile ions.

For instance, NaCl in its fused state or in its aqueous solution, has free Na^+ and Cl^- ions. The mobility of Na^+ and Cl^- results in conduction.

5. High reactivity:

Ionic compounds react instantaneously in fused state. This is because of easy formation of free ions, rapid union of these ions in solutions, form new compounds.

For example, the reaction between NaCl and $AgNO_3$ is very rapid in solution state, resulting in the formation of AgCl, a precipitate and $NaNO_3$.

WORK SHEET - 3

SINGLE ANSWER TYPE

1. Which of the following conducts electricity?
   1) Crystalline NaCl 2) Fused NaCl 3) Molten sulphur 4) Diamond
2. When a metal atom becomes an ion:
   1) It loses electrons and is oxidised. 2) It gains electrons and is oxidised.
   3) It gains electrons and is reduced 4) It loses electrons and is reduced
3. In a NaCl crystal, cations and anions held together by:
   1) Electrons 2) Electrostatic forces
   3) Nuclear forces 4) Covalent bonds
4. Number of electrons transferred from one atom to another during bond formation in Aluminium Nitride:
   1) 1 2) 2 3) 3 4) 4

12. Which of the following is not an ionic compound?
   1) BaC_2 2) Al_2O_3 3) CaH_2 4) $AlCl_3$
13. Many ionic crystals dissolve in water because,
   1) Water is an amphoteric solvent.
   2) Water is a high boiling liquid, which has no taste and no odour.
   3) The process is accompanied by a positive heat of solution.
   4) Water decreases the inter ionic attraction in the crystal lattice due to solvation.

15. Most of the ionic substances:
    1) Are non-electrolytes in molten state
    2) Have directional character
    3) Are soluble in polar solvents like water
    4) Conduct electricity in solid state

17. Fused ionic compounds:
    1) Are insulators 2) Are used as semiconductors
    3) Conduct electricity 4) Don't conduct electricity

18. Sodium fluoride contains:
    1) Sodium, fluorine atoms 2) Sodium fluoride molecules
    3) Sodium ions and fluoride ions 4) Sodium ions, fluorine atoms

20. The electronegativities of two elements are 1.0 and 3.5. Bond formed between the would be:
    1) Electrovalent 2) Polar covalent 3) Pure covalent 4) Metallic

21. An aqueous solution of silver nitrate gives a white precipitate with:
    1) C_2H_5Cl 2) $CHCl_3$ 3) HCl 4) None of these

MULTI ANSWER TYPE

5. Atoms can lose or gain _____ number of electrons.
    1) 1 2) 2 3) 3 4)4

14. Which of the following true for ionic compounds?
    1) They are hard solids
    2) They can be broken down into pieces very easily
    3) They are soluble in non-polar solvents
    4) None of the above

22. Which of the following are true?
    1) Ionic compounds exists as solid.
    2) Ionic compounds have high melting point and high boiling point.
    3) Ionic compounds undergo chemical reactions quickly in aqueous solutions.
    4) None of these.

REASONING ANSWER TYPE

6. *Statement I*: Elements which lose electrons are called electropositive elements.
    Statement II: Elements which gain electrons are called electronegative elements.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.

16. *Statement I*: Ionic compound tend to be non-volatile.
    Statement II: Inter molecular forces in these compounds are weak.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.

19. *Statement I*: Ionic compounds possess high melting and boiling points.
Statement II: The reaction between NaCl and $AgNO_3$ is very fast in solution state.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

The cations and anions formed as a result of electron transfer are drawn towards each other due to the electrostatic force (coulomb force) of attraction. They form an ionic bond or an electrovalent bond. The bond between two elements is ionic if the EN difference between them is greater than 1.7
The number of electrons transferred during an ionic bond formation is known as an electrovalency. Compounds containing ionic bonds are called ionic compounds. Examples of ionic compounds are NaCl(Na^+Cl^-), CaO($Ca^{2+}O^{2-}$), MgO($Mg^{2+}O^{2-}$) and $MgCl_2$ ($Cl^-Mg^{++}Cl$).

7. The atomic number of 3 elements A,B & C are a, a^{+1} and a^{+2} C is an alkali metal. In a compound of A and C the nature of bonding is:

1) Coordinate 2) Covalent 3) Ionic 4) Metallic

8. An element with atomic number 11 will form a strong ionic compound with an element of atomic number.

1) 10 2) 34 3) 35 4) 37

9. During the formation of an ionic bond, the atom that receives electrons is the atom with.

1) Higher electronegativity 2) Lower oxidation number
3) Higher ionisation energy 4) Lower electronegativity

MATRIX MATCHING TYPE

10.

Column-I	**Column-II**
a) Ionic compounds in aqueous	1) Good conductor of electricity
b) Ionic compounds in solid state	2) Bad conductor of electricity
c) Ionic compounds insoluble in	3) Water
d) Best polar solvent	4) $CHCl_3$

INTEGER ANSWER TYPE

11 Number of electrons transferred from sodium atom to chlorine atom is _____.

SYNOPSIS - 4

COVALENT BOND

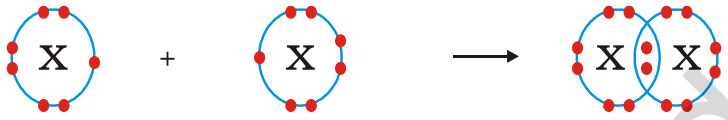
As the electronegativity difference between two hydrogen atoms, in a hydrogen molecule is zero, transfer of electrons is not possible. Hence, the two hydrogen atoms combine due to the electrostatic force of attraction, developed by the sharing of electrons.

Definition:

A bond formed by the equal contribution and equal sharing of electrons between two atoms or more atoms is known as covalent bond (co-sharing, valence → valence electron).

Since, the formation of a covalent bond results in the formation of a molecule, it is also called **molecular bond**.

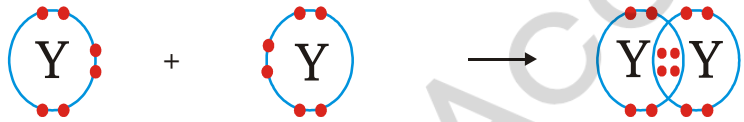
a) Non-metallic atoms - having 7 valence electrons [or 1] - share - ***one pair of electron.***



Non-metallic atom [2,7] | Non-metallic atom [2,7] | One shared pair [2,8][2,8]

Covalent compound [Single covalent bond]

b) Non-metallic atoms - having 6 valence electrons - share - ***two pairs of electrons.***



Non-metallic atom [2,6] | Non-metallic atom [2,6] | Two shared pairs [2,8][2,8]

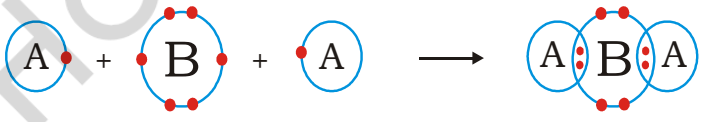
Covalent compound [Double covalent bond]

c) Non-metallic atoms - having 5 valence electrons - share - ***three pairs of electrons.***

Non-metallic atom [2,5] | Non-metallic atom [2,5] | Three shared pairs [2,8][2,8]

Covalent compound [Triple covalent bond]

d) Dissimilar non metallic atoms - form covalent molecules - ***by sharing electron pairs***



[1] [2,6] [1] [2] [2,8] [2]

Covalent compound [Two single covalent bonds]

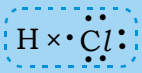
G.N. Lewis did the study of covalent bond. He explained covalent bond formation by the electron dot structure called Lewis Structure.

When is the bond between two atoms covalent?

When non-metallic atoms come together, the tendency to donate or accept the electrons is not possible due to the less electronegativity (EN) difference. Thus, in order to acquire stable configuration (an octet or duplet) of a noble gas, sharing takes place between them, resulting in formation of covalent bond.

Generally if the electro-negativity difference between two non metals is less than 1.7, a covalent bond is formed between them due to their combination.

Electronegativity : It is the tendency of an atom - to attract electrons to itself when combined in a compound. For example :



Covalent bond formed

(H and Cl show small difference in electronegativity)

Representation of covalent bond: The covalent bond between a pair of two atoms is represented by a small line[–].

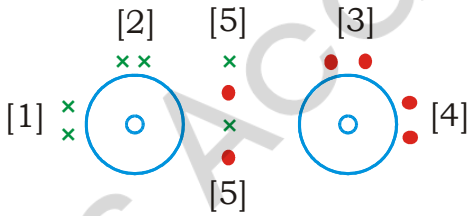
For example, H_2 can be represented as H–H.

Covalency : The number of electron pairs shared between two atoms of the same element or different elements during the formation of a molecule is known as co-valency.

Ex: Covalency of hydrogen molecule is equal to 1 and that of oxygen molecule is 2.

Bond pairs and lone pairs:

Have a look at the Lewis dot structure of oxygen molecules.



There are six electron pairs (1), (2), (3), (4), (5) and (6).

Out of them, the electron pairs (5) and (6) are involved in bonding and they are called bond pairs. The remaining electron pairs (1), (2), (3) and (4) present in the valence shell of the atom but not involved in the bonding are called lone pairs.

Bond pair of electrons: The shared pair of electrons, which result in the formation of a bond, is called the "bonded pair".

Lone pair of electrons: The pair of electrons, present in the valence shell but not involved in the bonding is called the "non-bonded pair" or "lone pair."

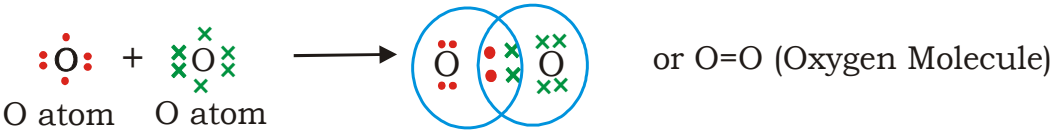
Examples of covalent compounds:

F_2, Cl_2, I_2, O_2, N_2, H_2, HCl, H_2O, NH_3 etc.

Note:

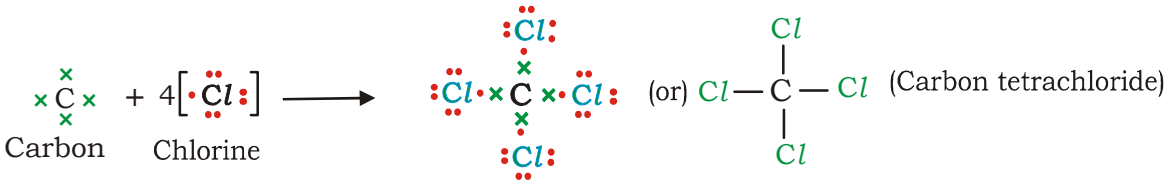
The force of attraction present between the molecules of inert gases is the Vander Waal's forces.

a) Formation of oxygen molecule:



or O=O (Oxygen Molecule)

b) Formation of carbon tetrachloride – CCl_4:



TYPES OF COVALENT BONDS AND THEIR FORMATION:

Covalent bonds are classified into different types based on:

The type of atoms involved in bonding

Covalent bonds based on the type of atoms involved in bonding:

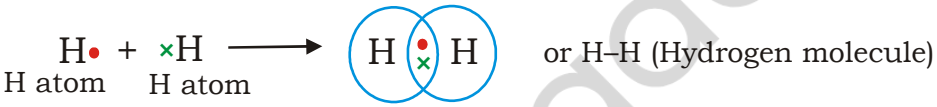
Based on the types of atoms involved in bonding, covalent bonds are classified into homogeneous and heterogeneous covalent bonds.

1. Homogeneous covalent bond:

It is a covalent bond formed between the atoms of similar type.

Examples:

(a) Formation of hydrogen molecule:



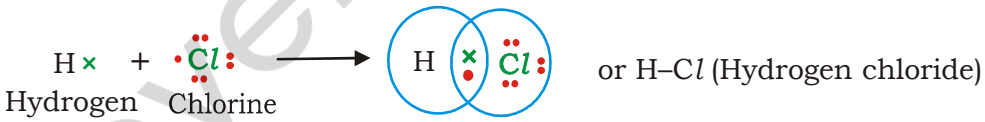
(b) Formation of chlorine molecule:

2. Heterogeneous covalent bond:

It is a covalent bond formed between the atoms of different types.

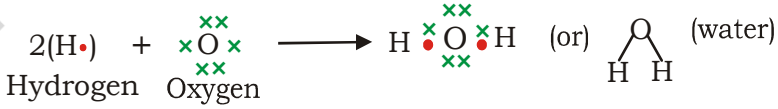
Examples:

(a) Formation of Hydrogen Chloride HCl:

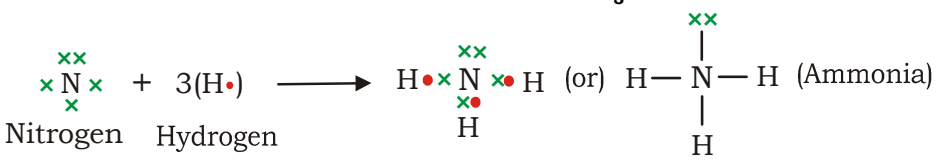


After formation of a covalent bond, hydrogen has stable duplet configuration, and chlorine has stable octet configuration.

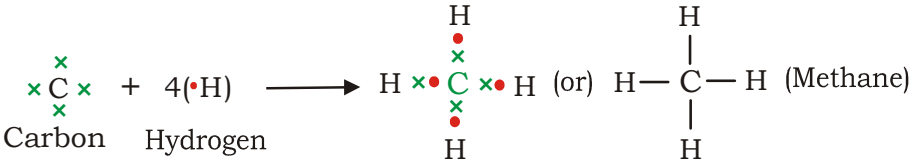
(b) Formation of water molecule – H_2O:



(c) Formation of Ammonia molecule – NH_3:



(d) Formation of methane molecule – CH_4:



(f) Formation of Carbondioxide molecule – CO_2:

PROPERTIES OF COVALENT COMPOUNDS :

i) Physical state:

Under the normal conditions of temperature and pressure, these exist as gases or liquids of low boiling points.

Reason : This is due to the fact that very weak forces of attraction (Van der Waals' forces) exist between discrete molecules. Some exist as soft solids if their molecular masses are high. Sulphur, phosphorous, iodine are soft solids.

ii) Melting and boiling points:

Generally covalent compounds have relatively low melting and boiling points.

Reason : This is due to the presence of weak attractive force between the molecules. On supplying heat energy, the molecules are readily pulled out from these forces and move freely having high kinetic energy.

iii) Crystal structure: These are of three types.

a) First type : These are the crystals in which the unit is molecules. These are readily fusible and volatile. Examples are sulphur, iodine, phosphorous pentoxide, etc.

b) Second type : This includes crystals which have separate lattice layers. The best example of this type is graphite.These layers can slide on one another. This accounts for the softness of graphite.

c) Third type : This includes crystals in which every atom is bonded to four other atoms by single covalent bonds resulting in the formation of giant structure. Example is diamond, these crystals are very hard and possess high melting points.

iv) Electrical conductivity:

a) In general, covalent substances are bad conductors of electricity.

b) Substances which have polar character like HC*l* in solution, can conduct electricity.

c) Covalent solids having giant molecules, are bad conductors since they do not contain charged particles or free electrons.

d) The graphite can conduct electricity since electrons can pass from one layer to the other.

v) Solubility:

a) In general, covalent substances are insoluble in polar solvents like water but soluble in non-polar solvents like benzene, carbon tetrachloride, ether etc.

b) This is based on the principle, "Like dissolves like" one of the covalent compounds like alcohols, amines dissolve in water due to hydrogen bonding. Covalent solids having giant molecules are practically insoluble in all solvents.

WORK SHEET - 4

SINGLE ANSWER TYPE

1. A covalent bond is possible between:
   1) Similar atoms 2) Dissimilar atoms
   3) Similar and dissimilar atoms 4) Similar molecules
2. In covalency:
   1) Transfer of electrons take place 2) Sharing of electrons takes place
   3) Sharing of electrons by one atom only
   4) None of these takes place
3. Covalent compounds are bad conductors due to:
   1) Free ion 2) No free electrons
   3) No free ions 4) Both 2 and 3

11. Number of electrons present in sulphuric acid molecule
   1) 30 2) 28 3) 50 4) 38

14. An atom with atomic number 20 is most likely to combine chemically with the atom whose atomic number is?
   1) 11 2) 16 3) 18 4) 10

17. Covalent compounds are soluble in:
   1) Polar solvents 2) Non-polar solvents
   3) Concentrated acids 4) All solvents

20) Valency of the metal atom with respect to oxygen is maximum in:
   1) MnO_2 2) OsO_4 3) MnO_2 4) CrO_3

MULTI ANSWER TYPE

4. Which of the following statements are true about covalent compounds
   1) They have low melting point and boiling point
   2) They show molecular reaction
   3) Bad conductor of heat and electricity
   4) They exist in solid, liquid and gaseous state.

12. Identify the following atoms of the elements, formed covalent bond:
   1) Hydrogen 2) Oxygen 3) Chloride 4) Bromine

15. Which of the following covalent molecule is exhibit a octet rule?
   1) $BeCl_2$ 2) CO_2 3) H_2O 4) CH_4

18. Which of the following is not a property of covalent compounds?
   1) They have low melting points
   2) They are not electrical conductors
   3) They exhibit space isomerism
   4) They undergo chemical reaction quickly

REASONING ANSWER TYPE

5. *Statement I:* Covalent compounds are soluble in non polar-solvents
   Statement II: Covalent compounds are directional in nature
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

13. *Statement I:* Generally all non metal elements are covalent compounds
Statement II: Covalent compounds exist only gas at room temp.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

16. *Statement I:* A Covalent bond is represent by single dash '____'.
Statement II: A covalent bond is formed by a pair of electrons
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

19. *Statement I:* A covalent bond in which electrons are equally(or) un equally shared between atoms
Statement II: In this covalent bond, atoms do not acquire any charge
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

A bond formed by the equal contribution and equal sharing of electrons between two atoms or more atoms is known as covalent bond (co-sharing $\rightarrow$valence electron)

6. Covalent bond is formed by _____
1) Sharing of valency shell electrons
2) Loss of valency shell electrons
3) Gain of valency shell electrons
4) Both 2 and 3

7. Which of the following has a tendency to form covalent compounds?
1) Ba 2) Be 3) Na 4) Ca

8. The combination of two different non-metals are _____ in nature
1) Ionic bond 2) Covalent 3) Metalic 4) Co-ordinated

MATRIX MATCHING TYPE

9.

Column-I Element	**Column-II Valency**
a) Sodium	1) 4
b) Aluminium	2) 2
c) Carbon	3) 1
d) Sulphur	4) 3

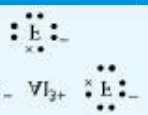
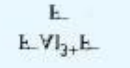
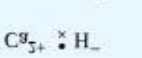
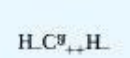
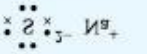
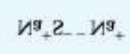
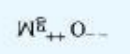
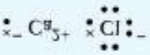
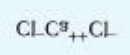
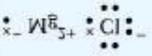
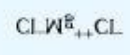
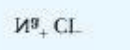
INTEGER ANSWER TYPE

10. Number of atoms in sulphur molecule is _____.

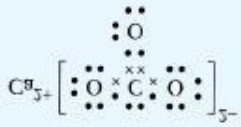
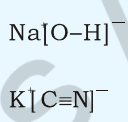
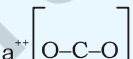
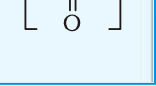
SYNOPSIS - 5

DIFFERENT EXAMPLES OF IONIC AND COVALENT COMPOUNDS

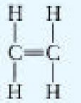
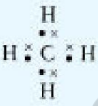
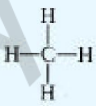
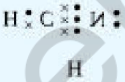
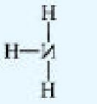
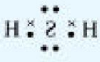
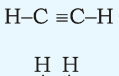
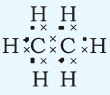
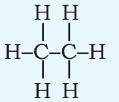
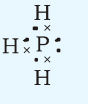
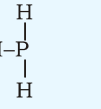
Ionic Compounds

Molecular Formula	Electron dot Formula	Dash Formula or Bond Formula
AlF_3		
CaH_2		
Na_2S		
MgO		
$CaCl_2$		
$MgCl_2$		
$NaCl$		

BOTH IONIC AND COVALENT COMPOUNDS

Molecular Formula	Electron dot Formula	Dash Formula or Bond Formula
$CaCO_3$		
KCN		
$NaOH$		

Covalent Compounds

Molecular Formula	Electron dot Formula	Dash Formula or Bond Formula
C_2H_4		
CH_4		
HCN		
NH_3		
H_2S		
H_2O		
HCl		
C_2H_2		
C_2H_6		
PH_3		
PCl_3		

WORK SHEET - 5

SINGLE ANSWER TYPE

1. Which of the following is a covalent compound:
   1) H_2 2) CaO 3) KCl 4) Na_2S
2. Identify the following compounds are Ionic:
   1) NaCl 2) Magnesium chloride
   3) Potassium chloride 4) All of these

3. Molecule having maximum number of covalent bonds is:
1) NH_4OH 2) NH_4Cl 3) $CO(NH_2)_2$ 4) CH_3OH

11. An element X is strongly electropositive and element Y is strongly electronegative. Both are univalent. The compound formed by their combination contains:
1) X^+, Y^- 2) X^-, Y^+ 3) XY molecule 4) X^{2+}, Y^{2+}

14. Identify the following covalent molecule having same number of electrons
1) CH_4 2) NH_3 3) H_2O 4) All of these

17. Identify the elements, having single covalent bond:
1) H_2 2) Cl_2 3) Br_2 4) All of these

20. Which of the following is not an ionic compound?
1) CSe_2 2) NaH 3) $BeCl_2$ 4) BF_3

MULTI ANSWER TYPE

4. Which of the following substance, not having covalent bond.
1) Potassium oxide 2) Sodium sulphide
3) Calcium oxide 4) Hydrogen molecule

12. Electron deficient compound among the following is:
1) ICl 2) CH_4 3) BCl_3 4) PCl_3

15. Electrovalent bond present in:
1) Na_2O 2) MgO 3) H_2O 4) NH_3

18. Which of the following compound exhibits ionic properties?
1) They are solids 2) They have high melting points
3) They are conductors of molten state 4) They exhibit space isom

REASONING ANSWER TYPE

5. *Statement I:* A covalent bond is likely to be formed between two same or different non metalic elements.
Statement II: Covalent bond is formed by sharing of electrons.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

13. *Statement I:* Sulphur of poly atomic molecule
Statement II: Calicium chloride is ionic compound
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

16. *Statement I:* Ionic bond is also called electrovalent bond
Statement II: Ionic bond formed by sharing of electron
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

Ionic Bond is formed by transfer of electrons from one atom to another atom.Covalent Bond formed by sharing of electrons between two atoms

6. Sodium Bromide is formed by _____
   1) Sharing of electrons with one another
   2) Transfer of electrons from sodium to bromine
   3) Both 1 and 2
   4) None of these

7. Identify the covalent compounds from following:
   1) Br_2 2) Cl_2 3) N_2 4) All of these

8. Iodine is:
   1) Covalent solid
   2) Ionic solid
   3) Molecular solid
   4) Covalent solid having metalic lustre

MATRIX MATCHING TYPE

9.

Column-I	**Column-II**
a) F_2	1) Covalent compound
b) Cl_2	2) Triple covalent bond
c) N_2	3) Double bond
d) O_2	4) Single bond

19.

Column-I	**Column-II**
a) Sharing of electrons	1) 2
b) Transfer of electrons	2) 3
c) Covalency of oxygen	3) ionic bond
d) Electro valency of nitrogen	4) covalent bond

INTEGER ANSWER TYPE

10. Covalency of nitrogen in ammonium ion is _____

SYNOPSIS - 6

COMPARISON BETWEEN IONIC AND COVALENT COMPOUNDS:

	Electrovalent (Ionic) Compounds		Covalent Compounds
1.	**STATE** – Bonding – Electrovalent **Existence** – crystalline hard solid (room temp) **Constituent Units** – Ions (metallic, non-metallic) **Force of attraction** – Strong Electrostatic force exists between ions. **Reason:** Ions (charged particles which attract one another to form electrovalent compounds) are closely packed with strong force of attraction existing between them, hence electrovalent compounds are hard solids.	1.	**STATE** – Bonding – Covalent **Existence** – Gases, liquids or soft solids. **Constituent Units** – Molecules **Force of attraction** – Weak Vander Waal's forces exist between molecules. **Reason:** Molecules have weak force of attraction between them and hence covalent compounds are gaseous (if molecules are less) and liquid or soft solids (if molecules are more).
2.	**VOLATILITY:** Non-volatile	2.	**VOLATILITY:** Volatile
3.	**MELTING & BOILING POINT :** High melting point and high boiling point. **Reason:** Strong electrostatic force of attraction between ions. Large amount of energy is required to break the force of attraction.	3.	**MELTING & BOILING POINT** Low melting point and low boiling point. **Reason:** Weak Vander Waals force of attraction between molecules. Less amount of energy is required to break the force of attraction.
4.	**CONDUCTION OF HEAT :** Good conductors of heat	4.	**CONDUCTION OF HEAT :** Bad or non-conductors of heat
5.	**CONDUCTION OF ELECTRICITY** **Solid state –** Non-conductors **Molten or aq. solution state** : Good conductors **Reason :** Strong electrostatic force keeps ions in fixed position in the solid state. The force is weakened in the molten state and disappears in soln, state, hence free ions formed migrate to oppositely charged electrodes.	5.	**CONDUCTION OF ELECTRICITY** **Gaseous or liquid state:** Non-conductors. **Soft solid state :** Non conductors **Reason:** Non-polar covalent compounds contain molecules and not free ions, hence are non-conductors. Polar covalent compounds eg. HCl, NH_3 show charge separation and dissociate in water which is a polar solvent.
6.	**ELECTROLYSIS : Can –** be electrolysed in molten or aq. Solution state. On electrolysis the ions being charged are attracted towards the respective electrodes.	6.	**ELECTROLYSIS : Cannot –** be electrolysed in normal state. In solution state, polar covalent compounds undergo electrolysis. e.g HCl & NH_3 gas.
7.	**SOLUBILITY : Soluble –** in water **Insoluble –** in organic solvents. **Reason:** Water (Polar solvent) has a high dielectric constant i.e. capacity to weaken the force of attraction thus resulting in free ions. Organic solvents [non-polar] have low dielectric constants and do not cause dissolution.	7.	**SOLUBILITY : Soluble –** in organic solvents [non-polar] **Insoluble –** insoluble in water.[polar] **Reason :** Organic solvents [non-polar] eg., Benzene, alcohol, dissolve non-polar covalent compounds [like dissolves like]. Water [polar solvent] cannot dissolve non-polar covalent compounds, but dissolves polar.
8.	**REACTIONS : Undergo** – high speed ionic reactions. **Reason :** Free ions easily formed in solution, rapidly regroup in solution.	8.	**REACTIONS :Undergo** – slow speed molecular reactions. **Reason :** Covalent molecules are first broken and new bonds are then slowly established.
9.	**DISSOCIATION :** Undergo electrolytic dissociation on passage of electric current. Process involves separation of ions already present in the electrovalent or ionic compound. Eg. $NaCl \rightleftharpoons Na^{1+} + Cl^{1-}$ [in molten state]	9.	**IONISATION :** Undergoes ionization in solution state on passage of electric current. Process involves formation of ions from molecules which are not in the ionic state. Eg. $HCl \rightleftharpoons H^{1+} + Cl^{1-}$ [in molten state]

WORK SHEET - 6

SINGLE ANSWER TYPE

1. Compared with covalent compounds, electrovalent compounds, generally have:
   1) Low melting points and low boiling points.
   2) Low melting point and high boiling point.
   3) High melting point and high boiling point.
   4) High melting point and low boiling point.
2. Which of the following is not a property of ionic compounds.
   1) They are solids
   2) They have high melting points
   3) They are conductors in solid state.
   4) They are conductors in molten state.
3. Which of the following is correct statement about an ionic compound.
   1) Higher the temperature, more the solubility.
   2) High the dielectric constant of the solvent, more the solubility.
   3) Lower the temperature, more solubility
   4) Both 2 and 3
11. Identify the element having covalent bond, but good conductor of electricity
   1) Diamond 2) Graphite 3) NH_3 4) H_2S
15. The bond between two identical non-metal atom and metal atom as a pair of electrons:
   1) Unequally shared between them
   2) Transferred fully from one atom to other atom.
   3) With identical spins
   4) Equally shared between them.
18. Pure covalent bond is present in:
   1) H–Cl 2) Cl–Cl 3) C-Cl 4) NaCl

MULTI ANSWER TYPE

4. Identify the correct statements
   1) Ionic bond is stronger than covalent bond
   2) Ionic compounds are soluble in water
   3) Covalent compounds are insoluble in water
   4) Ionic compounds good conductors in solid state.
12. Identify the false statements
   1) Covalent compounds are good conductors except graphite
   2) Generally covalent compound are soluble in water
   3) Ionic compounds are insoluble in water
   4) CH_4 is ionic compound.
16. Which of the following statement is correct for $CsBr_3$
   1) It is a covalent compound
   2) It contains Cs^{3+} and Br^- ions
   3) It contains Cs^+ and Br_3^-
   4) None of these
20. KF combines with HF to form KHF_2. The compound contains species:
   1) K^+, F^- and HF 2) K^+ and $[HF_2]^-$ 3) K^+, F^- and HF 4) $[KHF]^+$ and F_2

REASONING ANSWER TYPE

5. *Statement I:* Ionic compounds are good conductor of heat and electricity infused and solution state.
   Statement II: In solution form, their electrostastic force weakers, compound split into ions.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

13. *Statement I:* The solubility of ionic compounds decreases with increases in covalent character of ionic compound.
   Statement II: Only unpaird electrons present in the atom involve in covalent bond.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

17. *Statement I:* Covalent bond is present in $AlCl_3$
   Statement II: The maximum electrovalency in the formation of ionic bond is 3.
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

19. *Statement I:* Neon molecule (Ne_2)is not possible.
   Statement II: Due to Neon last shell having '8' electrons
   1) Both Statements I and statement II are correct.
   2) Both Statements I and statement II are incorrect.
   3) Statement I is correct and statement II is incorrect.
   4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

There are two ways by which the atoms can acquire noble gas configuration(or) electrons in the outer most energy level.
(a) By losing (or) accepting electrons (b) By sharing of electrons

6. Potassium, its electronic configuration. 2,8,8,1 By loss of:
   one electron potassium, achieve nearest noble gas configuration.
   1) Neon 2) Argon 3) Krypton 4) Xenon

7. Chlorine, its electronic configuration, 2,5,7 By share one electron with another chlorine atom, resulting bond
   1) Ionic 2) Coordinate 3) Covalent 4) All

8. Ionic bond is also called as:
   1) Dative bond 2) Electrovalent 3) Covalent 4) Coordinate bond

MATRIX MATCHING TYPE

9.

Column-I	**Column-II**
a) HCl	1) Ionic bond
b) MgCl_2	2) Covalent bond
c) KCl	3) Hard and brittle
d) Na_2SO_4	4) Soft

14.

Column-I	**Column-II**
a) Sodium chloride	1)Covalent compound
b) Methane	2) Ionic compound
c) Potassium chloride	3) Soluble in water
d) Water	4) Soluble in non polar solvents

INTEGER ANSWER TYPE

10. _____ electron pairs present in oxygen molecule.

WORK SHEET – 1 (KEY)				
1) 4	**2)** 3	**3)** 1	**4)** 2	**5)** 1
6) 1	**7)** 2	**8)** 4	**9)** 2	**10)** 2
11) 1,2	**12)** 1,3,4	**13)** 1,4	**14)** 1	**15)** 1
16) 4	**17)** 3	**18)** 4	**19)** 2	**20)** 4,(2,3), 2, (1,2)
21) 8				

WORK SHEET – 2 (KEY)				
1) 2	**2)** 4	**3)** 1	**4)** 3	**5)** 1
6) 1	**7)** 2	**8)** 1	**9)** 1	**10)** 1
11) 4	**12)** 1,2,3	**13)** 1,2,4	**14)** 1,2	**15)** 4
16) 1	**17)** 1	**18)** 1	**19)** 2	**20)** 1
21) 3,2,4,1	**22)** 2			

WORK SHEET – 3 (KEY)				
1) 2	**2)** 1	**3)** 2	**4)** 3	**5)** 4
6) 4	**7)** 3	**8)** 3	**9)** 3	**10)** 3
11) 1	**12)** 1,2,3	**13)** 1,2,3	**14)** 1,2,3	**15)** 1
16) 3	**17)** 1	**18)** 3	**19)** 2	**20)** 1
21) 1,2,4,3	**22)** 1			

WORK SHEET – 4 (KEY)				
1) 3	**2)** 2	**3)** 3	**4)** 3	**5)** 2
6) 2	**7)** 2	**8)** 1,2,3,4	**9)** 1,2,3,4	**10)** 2,3,4
11) 4	**12)** 1	**13)** 3	**14)** 2	**15)** 2
16) 1	**17)** 2	**18)** 2	**19)** 1,4,1,2	**20)** 8

WORK SHEET – 5 (KEY)				
1) 1	**2)** 4	**3)** 3	**4)** 1	**5)** 4
6) 4	**7)** 4	**8)** 1,2,3	**9)** 3	**10)** 4
11) 1,2,3,4	**12)** 1	**13)** 1	**14)** 3	**15)** 2
16) 4	**17)** 4	**18)** (1,4), (1,4), (1,2), (1,3)	**19)** 4,3,1,2	**20)** 4

WORK SHEET – 6 (KEY)				
1) 3	**2)** 3	**3)** 4	**4)** 2	**5)** 4
6) 2	**7)** 1,2,3	**8)** 1,2,3,4	**9)** 3	**10)** 2
11) 1	**12)** 1	**13)** 1	**14)** 1	**15)** 2
16) 3	**17)** 2	**18)** (2,4), (1,3), (1,2,3), (1,3)	**19)** (2,3), (1,4), (2,3), 1	**20)** 6

MOLE CONCEPT

SYNOPSIS - 1

INTRODUCTION

Atom: The term atom was introduced by Dalton. Atom is the smallest particle of matter that takes part in a chemical reaction. Atom is also defined as the smallest particle of an element that retains all the properties of an element.

Atomic mass unit (a.m.u.): It is the smallest unit of mass and is used to measure the masses of atoms and subatomic particles. The mass of one a.m.u. is equal to the mass of $\frac{1}{12}$th the mass of C–12 atom. The other names of a.m.u. are Aston, Dalton and Avogram.

Note: 1 a.m.u. = 1.66×10^{-24} g or 1.66×10^{-27} kg.

Atomic weight: The atomic weight is defined by total number of protons and neutrons in an atom.

Where the mass of proton is nearly equal to mass of neutron.

For example Carbon atom has 6 electrons, 6 protons, 6 neutrons, therefore Carbon atomic weight is 12.

The atomic weight or the relative atomic mass (RAM) of an element is defined as the number of times an atom of an element is heavier than the mass of $\frac{1}{12}$th of C–12 isotope's atom.

$$\text{Relative atomic mass of an element } (\text{RAM}) = \frac{\text{Mass of 1 atom of that element}}{\frac{1}{12} \times (\text{Mass of C}-12 \text{ atom})}$$

Atomic weight has no units.

The relative atomic mass of an element indicates the number of times one atom of that element is heavier than $\frac{1}{12}$th of mass of C – 12 isotopes atom.

For example, the atomic weight of calcium is 40. This means that an atom of calcium is on average is 40 times the mass of 1/12 the mass of C – 12 isotope's atom.

Atomic weights of many elements are not whole numbers due to the presence of stable isotopes.

The number of atoms of a particular isotope present in 100 atoms of a natural sample of that element is called its relative abundance which always remains constant for a given element.

Natural chlorine is a mixture of two isotopes with relative abundances 75% (Cl – 35) and 25% (Cl – 37) approximately.

Then, the atomic weight of chlorine is $\frac{(75\times35)+(25\times37)}{100}=35.5$

Mass of one atom of an element = Relative atomic mass × mass of $\frac{1}{12}$th the mass of C- 12

THE ATOMIC NUMBER AND MASS NUMBER FOR 1 TO 30 ELEMENTS							
Z	**Name**	**Symbol**	**Mass Number**	**Z**	**Name**	**Symbol**	**Mass Number**
1	**Hydrogen**	H	1.00794	**16**	**Sulphur**	S	32.065
2	**Helium**	He	4.002602	**17**	**Chlorine**	*Cl*	35.453
3	**Lithium**	Li	6.941	**18**	**Argon**	Ar	39.948
4	**Beryllium**	Be	9.012182	**19**	**Potassium**	K	39.0983
5	**Boron**	B	10.811	**20**	**Calcium**	Ca	40.078
6	**Carbon**	C	12.0107	**21**	**Scandium**	Sc	44.955912
7	**Nitrogen**	N	14.0067	**22**	**Titanium**	Ti	47.867
8	**Oxygen**	O	15.9994	**23**	**Vanadium**	V	50.9415
9	**Fluorine**	F	18.998403	**24**	**Chromium**	Cr	51.9961
10	**Neon**	Ne	20.1797	**25**	**Manganese**	Mn	54.938045
11	**Sodium**	Na	22.989769	**26**	**Iron**	Fe	55.845
12	**Magnesium**	Mg	24.3050	**27**	**Cobalt**	Co	58.933195
13	**Aluminium**	*Al*	26.9815386	**28**	**Nickel**	Ni	58.6934
14	**Silicon**	Si	28.0855	**29**	**Copper**	Cu	63.546
15	**Phosphorus**	P	30.973762	**30**	**Zinc**	Zn	65.38

PRACTICE ATOMIC WEIGHTS

Element	Symbol	Atomic number	Atomic Mass	Element	Symbol	Atomic number	Atomic Mass
Hydrogen	H	1	1,0079	Nickel	Ni	28	58.693
Helium	He	2	4.0026	Copper	Cu	29	63.546
Lithium	Li	3	6.941	Zinc	Zn	30	65409
Beryllium	Be	4	9,0122	Gallium	Ga	31	69.723
Boron	B	5	10.811	Germanium	Ge	32	72.64
Carbon	C	6	12.011	Arsenic	As	33	74.922
Nitrogen	N	7	14.007	Selenium	Se	34	78.96
Oxygen	O	8	15.999	Bromine	Br	35	79.904
Fluorine	F	9	18.998	Krypton	Kr	36	83.798
Neon	Ne	10	20.180	Rubidium	Rb	37	85.468
Sodium	Na	11	22.990	Strontium	Sr	38	87.62
Magnesium	Mg	12	24.305	Palladium	Pd	46	106.42
Aluminium	Al	13	26.982	Silver	Ag	47	107.87
Silicon	SI	14	28.086	Cadmium	Cd	48	112 41
Phosphorus	P	15	30.974	Tin	Sn	50	118.71
Sulphur	S	16	32.065	Antimony	Sb	51	121.76
Chlorine	Cl	17	35.453	Tellurium	Te	52	127.60
Argon	Ar	18	39.948	Iodine	I	53	126.90
Potassium	K	19	39.098	Xenon	Xe	54	131.29
Calcium	Ca	20	40.078	Caesium	Cs	55	132.91
Scandium	Sc	21	44.956	Barium	Ba	56	137.33
Titanium	Ti	22	47.867	Gold	Au	79	196.97
Vanadium	V	23	50.942	Mercury	Hg	80	200.59
Chromium	Cr	24	51.996	Lead	Pb	82	207.20
Manganese	Mn	25	54.938	Bismuth	Bi	83	208.98
Iron	Fe	26	55.845	Radium	Ra	88	226.00
Cobalt	Co	27	58.933	Thorium	Th	90	232.04

WORK SHEET - 1

SINGLE ANSWER TYPE

1. Which property of an element is always a whole number?
   1) Atomic weight 2) Equivalent weight
   3) Atomic number 4) Atomic volume
2. Which one of the following properties of an element is not variable?
   1) Valency 2) Atomic weight
   3) Equivalent weight 4) All of these
3. The modern atomic weight scale is based on:
   1) C^{12} 2) O^{16} 3) H^{1} 4) C^{13}
4. The symbol of carbon is C. It means that:
   1) 'C' represents one atom of carbon.
   2) 'C' also represents 1 mole of carbon atoms.
   3) 'C' also represents 12g of C. 4) All

5. What are the units of atomic weight?
   1) No units 2) amu 3) gram 4) ev
6. What is atomic weight of an elementary gas whose molecular weight and atomicity are x and y respectively?
   1) x/y 2) y/x 3) xy 4) x^2y
7. Atomic mass unit is also called:
   1) Avogram 2) Dalton 3) Aston 4) All
8. The ratio of weight of one atom of an element to its atomic weight is equal to:
   1) 1 amu 2) mass of $\frac{1}{12}$th of C – 12 isotopic atom
   3) 12 amu 4) Both 1 and 2
9. Energy equivalent to one electron = ____ MeV.
   1) 0.0055 2) 0.055 3) 0.55 4) 5.5
10. The weight of Helium atom in grams is:
    1) 2 2) 4 3) 6.64×10^{-24} 4) 1.66×10^{-24}
11. Atomic weight of an element is x. It means that weight of one atom of that element is:
    1) 'x' g 2) $\frac{1}{12} \times x$ g 3) 12 × x g 4) $1.66x \times 10^{-24}$g
12. The approximate number of electrons that are required to make 1 smallest unit of mass is:
    1) 6.023×10^{23} 2) 1.66×10^{24} 3) 1852 4) 2500
13. The mass of one atom of an element is $40 \times 1.66 \times 10^{-24}$g. The number of protons in its nucleus is:
    1) 40 2) 20 3) 10 4) 5

MULTI ANSWER TYPE

14. Which of the following are monoatomic gases?
    1) He 2) Ne 3) Ar 4) Kr
15. 1 amu is equal to the mass of:
    1) $\frac{1}{12}$th of C - 12 atom 2) $\frac{1}{14}$th of O-16 atom
    3) 1g of H_2 4) 1.66×10^{-23} kg
16. 1 atomic mass unit =
    1) $\frac{1}{12}^{th}$ mass of a carbon - 12 atom 2) 1.66×10^{-24}g
    3) 6.023×10^{23}g] 4) None of these
17. The mass of one atom of an unknown element is $4 \times 1.66 \times 10^{-24}$g. The element is:
    1) Hydrogen 2) Helium 3) Oxygen 4) Sulphur

REASONING ANSWER TYPE

18. *Statement I:* 1 a.m.u. = 1.66×10^{-24} g or 1.66×10^{-27} kg.
    Statement II: Atomic weight has no units.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.

19. *Statement I*: The relative atomic mass of an element indicates the number of times one atom of that element is heavier than $\frac{1}{12}^{th}$ of mass of C- 12 isotopes atom.
Statement II: Atomic weight of oxygen is 14.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct..

COMPREHENSION TYPE

Relative atomic mass of an element $(\text{RAM}) = \frac{\text{Mass of 1 atom of that element}}{\frac{1}{12} \times (\text{Mass of C}-12 \text{ atom})}$

20. The total mass of 100 atoms of silicon is:
1) 2800 2) 2800 amu 3) $28 \times 1.66 \times 10^{-22}$g 4) Both 2 and 3

21. If the atomic weight of oxygen were taken as 100, then what would be molecular weight of water:
1) 18 2) 102 3) 112.5 4) 142.5

22. Natural Boron is a mixture of $_5B^{10}$, $_5B^{11}$ with relative abundance of 20 % and 80 %. Find the atomic weight of boron:
1) 10 2) 11 3) 10.8 4) 11.2

MATRIX MATCHING TYPE

23.

Column-I	**Column-II**
a) Dalton equals	1) 1 a.m.u
b) Chlorine	2) 35.453 a.m.u
c) Hydrogen	3) 1.008 a.m.u
d) The actual mass of an atom of an element	4) Atomic mass of an element in a.m.u × 1.66×10^{-24} gm

24.

Column-I	**Column-II**
a) 1 a.m.u. equal to	1) $\frac{1.9924 \times 10^{-23}}{12}$
b) Smallest particle of matter	2) Sodium
c) 22.989 a.m.u	3) Avogram
d) a.m.u. also called	4) Atom

INTEGER ANSWER TYPE

25. 1 a.m.u. = _____ MeV.

SYNOPSIS - 2

Gram Atomic Weight (GAW):

(a) Atomic weight of an element expressed in grams is known as its gram atomic weight. For example, the atomic weight of hydrogen is 1.008. So, the gram-atomic weight of hydrogen is 1.008 g.

(b) Gram atomic weight of any substance is also called its gram atom. For example, 1 gram atom of carbon weighs 12 gram and 1 gram atom of nitrogen weighs 14 grams.

(c) Number of gram atoms $= \frac{\text{Given weight}}{\text{Gram atomic weight}}$.

For example, the number of gram atoms in 5 g of hydrogen =5/1 = 5.

(d) Weight of x gram atoms = x × Gram atomic weight.

(e) 1 gram atom or gram atomic weight of an element contain = 6.023×10^{23} atoms.

(f) Number of atoms in a given substance (given element) = Number of gram atoms × 6.023×10^{23}.

(g) Number of atoms in 1 gram of an element = $\frac{6.023 \times 10^{23}}{\text{Atomic weight}}$.

Gram Molecular Weight (GMW):

(a) It is the molecular weight of an element or compound expressed in grams. For example, the molecular weight of hydrogen gas is 2. So, the gram molecular weight of hydrogen is 2 g.

(b) Gram molecular weight of a substance is also called its gram molecule or mole molecule. For example, the weight of 1 gram molecule or mole molecule of H_2O is 18 grams and the weight of 1 gram molecule of N_2O is 44 grams.

(c) Number of moles $= \frac{\text{Given weight}}{\text{Gram Molecular weight}}$.

(d) Weight of x moles of any compound = x × Gram molecular weight.

(e) Number of molecules in a given substance = Number of gram molecules $\times 6.023 \times 10^{23}$.

(f) Weight of substance in grams = Number of gram molecules × GMW.

S.No.	Substance	Molecular formula	Gram-molecular Relative molecular mass		Gram molecular mass
1.	Hydrogen	H_2	2×1	= 2	2g
2.	Nitrogen	N_2	2×14	= 28	28 g
3.	Oxygen	0_2	2×16	= 32	32g
4.	Ozone	0_3	3×16	= 48	48 g
5.	Chlorine	Cl_2	2×35.5	= 71	71 g
6.	Helium	He	1×4	= 4	4g
7.	Neon	Ne	1×20	= 20	20 g
8.	Water	H_2O	H_20 ↙ ↘ 2×1+16=18	=	18 g
9.	Hydrogen chloride	HC*l*	1+ 35.5	= 36.5	36.5 g
10.	Carbon dioxide	CO_2	12+2×16	= 44	44 g
11.	Methane	CH_4	12+4x1	= 16	16 g
12.	Carbon tetrachloride	CCl_4	12+4×35.5	= 154	154g
13.	Nitric acid	HNO_3	1+14+3×16	= 63	63g
14.	Sulphuric acid	H_2SO_4	2×1+32+4×16	= 98	98 g
15.	Ethanol	C_2H_5OH	2×12+5×1+16+1	= 46	46 g

Note:

a) Gram atomic mass of an element and Molar mass of an element are just the same.

(b) Gram molecular weight of a substance and Molar mass of a substance are also just the same.

Gram molecular volume (GMV):

The volume occupied by 1 gram molecule of a dry gas at S.T.P. is called Gram Molecular Volume.

STP is Standard Temperature and Pressure. T = 273 K, Pressure = 760 mm of Hg or 76 cm.

The experimental value of 1gram molecular volume of a gas is 22.4 litre at S.T.P or 22.4 dm^2 at S.T.P or 22400 cm^3 at S.T.P.

Avogadro's number:

The number of atoms present in 12 g (Gram Atomic Mass) of carbon $^{12}_{6}C$ is called

Avagadro's number. It is denoted by letter N_A or L.

Its value is 6.023×10^{23}.

Vapour density is the density of a vapour in relation to that of hydrogen. It may be defined as mass of a certain volume of a substance divided by mass of same volume of hydrogen.

vapour density = mass of *n* molecules of gas/mass of *n* molecules of hydrogen

(By definition, the molar mass of a gas is the ratio of the mass of one molecule of gas to that of an hydrogen atom under similar conditions.)

Therefore:

vapour density = molar mass of gas/molar mass of H_2

vapour density = molar mass of gas/2

vapour density = ½ × molar mass

(and thus: molar mass = 2 × vapour density)

MOLECULE: The term molecule was introduced by Avogadro. Molecule is the smallest particle of matter that exists independently and is formed by the combination of atoms. Molecule is also defined as the smallest particle of matter that can exist and retains all the properties of that substance.

Note: A molecule splits into atoms first before taking part in a chemical reaction.

Relative Molecular Weight (RMM):

Relative molecular mass or molecular weight is defined as the number of times a molecule is heavier than $\frac{1}{12}$th the mass of C – 12 isotope's atom.

$$\text{RMM} = \frac{\text{Average mass of one molecule}}{\text{Weight of } 1/12^{\text{th}} \text{ of C}-12 \text{ atom}}.$$

Relative molecular mass or molecular weight has no units.

The molecular weight of an element or compound indicates the number of times a molecule is heavier than $\frac{1}{12}$th the mass of C – 12 isotope's atom. For example, the molecular weight of calcium carbonate is 100, it implies that mass of one molecule of calcium carbonate is 100 times heavier than $\frac{1}{12}$th the mass of C – 12 isotope's atom.

If the relative molecular mass or molecular weight of any compound is M, then its molecular mass is 'M' a.m.u. = Molecular weight $\times \frac{1}{12}^{\text{th}}$ the mass of C – 12 atom.

Steps to calculate the molecular weight:

1. Write the formula of the compound or the molecule.
2. Identify the different types of elements present in it and write their symbols along with the number of atoms.
3. Now multiply the number of atoms with the atomic weights of the respective elements
4. Finally add them to get molecular weight.

WORK SHEET - 2

SINGLE ANSWER TYPE

1. Atoms of which of the following elements exist independently:
   1) Helium 2) Sodium 3) Argon 4) Both 1 and 3
2. Which of the following exist independently?
   1) Atoms 2) Molecules 3) Ions 4) Both 2 and 3
3. Which of the following is the smallest particle of matter that exist independently?
   1) Atom 2) Molecule 3) element 4) compound
4. A: H_2O, CH_4, NH_3 ; B: H_2, N_2, O_2, F_2
   1) 'A' contains homogeneous molecules.
   2) 'B' contains hetereogeneous molecules.
   3) 'A' contains hetereogeneous molecules.
   4) All
5. In which of the following, the smallest particles exists in diatomic form?
   1) Hydrogen gas 2) Nitrogen gas 3) Oxygen gas 4) All
6. The number of atoms present in a molecule is called its atomicity. Then, the atomicity of phosphorus and sulphur is_____and _____respectively.
   1) 1, 2 2) 3, 6 3) 2, 4 4) 4, 8
7. Which of the following exists in mono-atomic form?
   1) He 2) Ne 3) Ar 4) All
8. Which among the following takes part actively in a chemical reaction?
   1) He 2) Ne 3) Ar 4) None
9. 2.5 gram -atoms of carbon is required for a particular reaction. How many grams of carbon would you take. (atomic weight of carbon is 12)?
   1) 10 gms 2) 20 gms 3) 30 gms 4) 40 gms.
10. The gram atomic weight of nitrogen is:
    1) 14 amu 2) 14 g 3) 28 a.m.u 4) 28 g
11. Gram atom of any element contains:
    1) 6.023×10^{23} atoms 2) 3.0115×10^{23} atoms
    3) 1.505×10^{23} atoms 4) 12.0×10^{23} atoms
12. Among all the naturally occurring elements, one gram atom of which element contains the maximum amount of it?
    1) Hydrogen 2) Uranium 3) Calcium 4) Mercury
13. Gram atomic weight of C and N is _____ and _____ respectively.
    1) 6, 7 2) 12, 14 3) 7, 6 4) 14, 12
14. Find the number of gram atoms present in 16 g of S:
    1) 1 2) 2 3) 0.5 4) 0.25
15. Find the weight of 5 gram molecules of oxygen:
    1) 40 g 2) 80 g 3) 160 g 4) 320 g
16. Find the number of gram atoms present in 10 g of Ca:
    1) 1 2) 2 3) 0.5 4) 0.25
17. 1 gram atom of which of the following elements weigh more?
    1) Hydrogen 2) Nitrogen 3) Oxygen 4) Calcium

18. The ratio of number of molecules present in 1 gram mole of O_2 to one gram mole of SO_2 is:
1) 1 : 4 2) 1 : 2 3) 1 : 8 4) 1 : 1

19. 1 gram molecule of which of the following compounds weigh more?
1) Marble stone 2) Laughing gas 3) Soda ash 4) Sugar

20. What is the weight of 5 gram atoms of phosphorus?
1) 100 g 2) 155 g 3) 106 g 4) 62 g

21. Find the number of gram atoms present in the following:
(i) 4g of hydrogen (ii) 1 g of helium

(i)	(ii)
1) 2	1
2) 0.25	4
3) 1	4
4) 4	0.25

MULTI ANSWER TYPE

22. The weight of ammonia molecule in grams is:
1) 17a.m.u 2) 17×10^{-3}
3) $17 \times 1.66 \times 10^{-24}$ g 4) $17 \times 1.66 \times 10^{-27}$ Kg

23. The mass of one molecule of a compound is 1.66×10^{-22} g. The molecular weight of the compound is:
1) 166 2) 1.66 3) 100 4) 1000

24. Which of the following is correct?
1) Molecular weight of oxygen is 32.
2) Gram molecular mass of sulphur (S_8) is 256 g.
3) The weight of one molecule of O_3 is 48 amu.
4) None of these

25. Identify the element whose 2 gram atoms weigh 8g.
1) Hydrogen 2) Helium 3) Oxygen 4) Sulphur

REASONING ANSWER TYPE

26. *Statement I:* The number of atoms present in gram atomic weight of different elements are equal.
Statement II: The number of molecules present in gram molecular weight of different substances is equal.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

27. *Statement I:* A chemical formula represents the composition of a molecule of the substance in terms of the symbols of the elements present in a molecule.
Statement II: The chemical formula of methane is CH_4.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

28. *Statement I:* Gram atomic mass of an element and molar mass of an element are just the same.
Statement II: Gram molecular mass of a substance and molar mass of a substance are also just the same.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

29. *Statement I:* Relative molecular mass or molecular weight has no units.
Statement II: The volume occupied by 1 gram molecule of a dry gas at S.T.P. is called Gram Molecular Volume..
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

Writeup:1

$$\text{Number of gram atoms} = \frac{\text{Given weight}}{\text{Gram atomic weight}}.$$

$$\text{Number of atoms in 1 gram of an element} = \frac{6.023\times10^{23}}{\text{Atomic weight}}$$

30. $\frac{\text{weight of one atom of an element}}{\text{Its atomic weight}} = x.$

$\frac{\text{weight of one molecule of a compound}}{\text{Its molecular weight}} = y.$ Then, x : y is:

1) $1:\frac{1}{12}$ 2) 2 : 1 3) 1 : 2 4) 1 : 1

31. The units of molecular mass (or) molecular weight is:
1) amu 2) grams 3) Both '1' and '2 4) None

32. What is the weight of one carbon dioxide molecule?
1) 44g 2) 44 amu 3) 44 kg 4) 44 mg

Writeup:2

Relative molecular mass or molecular weight is defined as the number of times a molecule is heavier than $\frac{1}{12}^{th}$ the mass of C-12 isotope's atom.

$$\text{RMM} = \frac{\text{Average mass of one molecule}}{\text{Weight of } 1/12^{th} \text{ of C}-12 \text{ atom}}$$

33. Find the number of gram molecules of hydrogen present in 1 gram molecule of methane gas.
1) 1 2) 2 3) 4 4) 8

34. 100 g of which gas contains of the maximum number of gram molecules?
1) SO_2 2) O_2 3) He 4) H_2

35. How many gram molecules of methane are present in 'x' g of it, where 'x' is equal to the weight of 1 gram molecule of SO_2?
1) 4 2) 8 3) 16 4) 32

MATRIX MATCHING TYPE

36.

Column - I	**Column - II**
a) Sodium	1) Monoatomic
b) Helium	2) Diatomic
c) Oxygen	3) Triatomic
d) Ozone	4) Poly atomic

37.

Column-I **Element**	**Column-II** **Atomic weight**
a) Fluorine	1) 9
b) Calcium	2) 32
c) Beryllium	3) 19
d) Sulphur	4) 40

38.

Column-I **Molecule**	**Column-II** **Gram molecular mass**
a) Chlorine	1) 71 gms
b) Ozone	2) 48 gms
c) Neon	3) 18 gms
d) Water	4) 20 gms

39.

Column-I	**Column-II**
a) 1 mole of Cl_2 gas at STP conditions occupied volume.	1) 22.4 L
b) 1/4 mole of Cl_2 gas at STP conditions occupied volume.	2) 5.6 L
c) No. of moles present in 17.7 gms of Cl_2	3) 0.25 moles
d) The relative mass of Cl_2	4) 71 gms

INTEGER ANSWER TYPE

40. The atomic weight of calcium is _____

41. The number of atoms present in 12 grams of carbon $^{12}_{6}C$ _____

SYNOPSIS - 3

Mole: This is unit used to express the quantity of matter in chemistry.

(a) It is defined as "the amount of a substance which contains the same number of chemical units (atoms, molecules or ions) as there are atoms in exactly 12 grams of pure carbon".

(b) 12 g of carbon-12 is found to contain 6.023×10^{23} atoms of carbon-12. Thus, a mole represents a collection of 6.023×10^{23} chemical units (atoms, molecules or ions).

(c) The number 6.023×10^{23} is called the Avogadro's number. The Avogadro's number is denoted by N_A or L. Most commonly the symbol N_A is used. Thus, a mole represents the quantity of material which contains one Avogadro's number (6.023×10^{23}) of chemical units (atoms, molecules, or ions) of any substance.

(d) It is important to note that while using the unit mole, it is necessary to specify the chemical unit also. For example,

1 mole of hydrogen atom =	**6.023×10^{23} atoms of hydrogen**
1 mole of hydrogen molecule =	**6.023×10^{23} molecules of hydrogen**
1 mole of carbon dioxide =	**6.023×10^{23} molecules of carbon dioxide**
1 mole of electrons =	**6.023×10^{23} electrons**
1 mole of sodium ions (Na+) =	**6.023×10^{23} Na^+ ions**

Symbol of the mole unit: The unit of mole is given a symbol mol. So, if you want to express one mole, you may write it as 1 mol.

Important relations related to mole:

(a) 1 mole of particles = 6.023×10^{23} particles (atoms/ molecules/ions/ electrons/protons/neutrons/nucleons).

(b) The weight of 1 mole atoms of an element = gram atomic weight of the element.

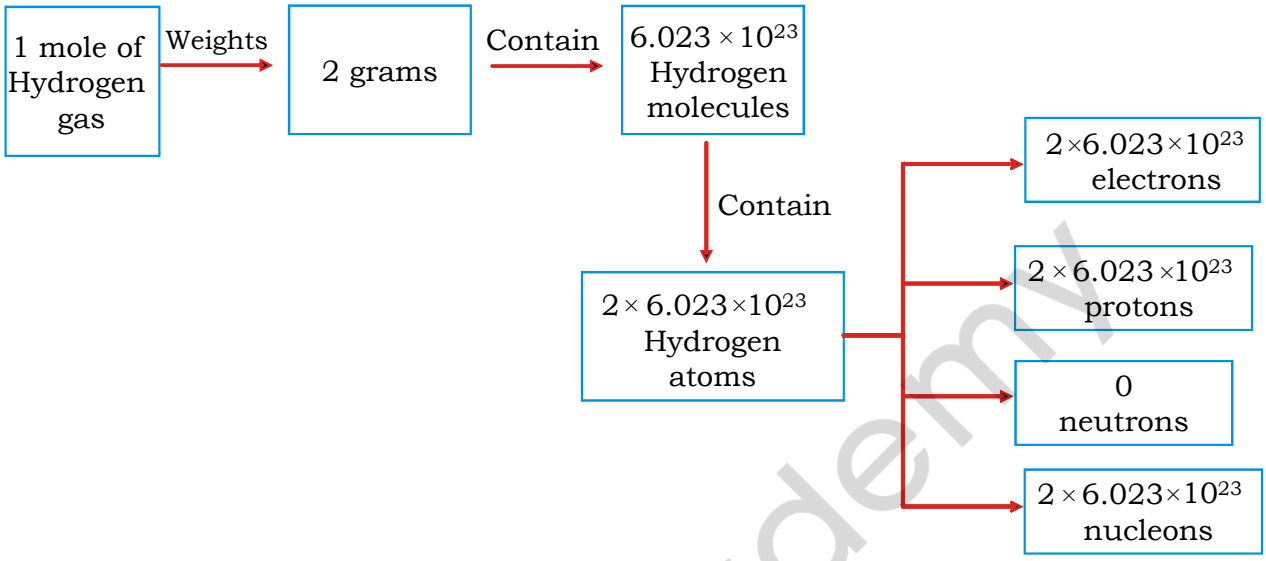
(c) The weight of 6.023×10^{23} atoms of an element = gram atomic weight of the element.

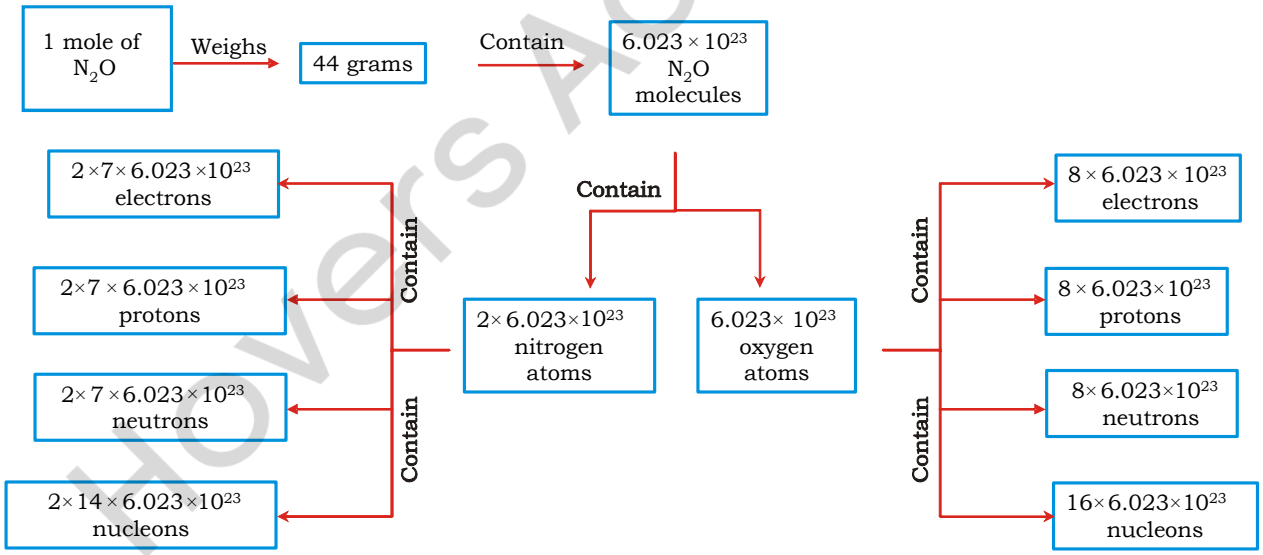
(d) The weight of 1 mole molecules of a compound = gram molecular weight of a compound.

(e) The weight of 6.023×10^{23} molecules of a compound = gram molecular weight of the compound.

(f) The weight of 1 mole of formula units of a salt = gram formula weight of the salt.

UNDERSTANDING OF A MOLE





We can easily arrive at the following important relationship :

1. 1 mole of atom of an element = number of atoms in gram-atom of the element
$= 6.022 \times 10^{23}$ atoms.

2. The absolute mass of 1 atom of an element $= \frac{\text{gram} - \text{atomic mass}}{6.022 \times 10^{23}}$
= relative atomic mass $\times 1.66 \times 10^{-24}$ g

3. In a given mass of an element,

(a) the number of moles of atoms = the number of gram atoms

$$= \frac{\text{mass of the element in grams}}{\text{gram} - \text{atomic mass}}, \text{and}$$

(b) the total number of atoms = the number of moles $\times N_A$

$$= \frac{\text{mass of the element in grams}}{\text{gram} - \text{atomic mass}} \times 6.022 \times 10^{23}$$

1. 1 mole of molecules of a substance
= number of molecules in 1 mole of the substance
$= 6.022 \times 10^{23}$ molecules

2. The absolute mass of 1 molecule of a substance

$$= \frac{\text{gram} - \text{molecular mass of the substance}}{6.022 \times 10^{23}} \text{ (in grams)}$$

3. In a given mass of a substance,

(a) the number of moles $= \frac{\text{mass of the substance in grams}}{\text{gram} - \text{molecular mass}}$

(b) The total number of molecules = the number of moles $\times 6.022 \times 10^{23}$

$$= \frac{\text{mass of the substance in grams}}{\text{gram} - \text{molecular mass}} \times 6.022 \times 10^{23}$$

(c) the number of atoms of a given element constituting the substance
= the number of moles of the substance × the number of atoms of the element in 1 molecule of the substance × 6.022×10^{23}

(d) the total number of atoms
= the number of gram-molecules of the substance × the total number of atoms in a molecule of the substance × 6.022×10^{23}

WORK SHEET - 3

SINGLE ANSWER TYPE

1. 1 mole of atoms = _____ atoms.
   1)6.023×10^{23} 2) 3.0115×10^{23} 3) 1.505×10^{23} 4) 12.046×10^{23}
2. What is Avogadro's number?
   1)12.046×10^{23} 2) 6.023×10^{23} 3) 3.0115×10^{2} 4) 1.505×10^{23}
3. The weight of 1 mole of atoms of an element = _____.
   1)1.66×10^{-24} g 2) Gram molecular weight
   3)Gram atomic weight 4) 6.023×10^{23} g
4. The weight of 1 mole of calcium atoms of an element = _____ grams.
   1) 40 g 2) 20 g 3) 10 g 4) 5 g
5. 6 grams of carbon = _____ mole.
   1) 0.25 2) 0.5 3) 1 4) 2
6. The weight of 6.023×10^{23} atoms of an nitrogen= _____.
   1) 3.5 g 2) 7 g 3) 14 g 4) 28 g
7. Gram atomic weight of an element contain _____ number of atoms.
   1)6.023×10^{23} 2) 3.0115×10^{23} 3) 1.505×10^{23} 4) 12.046×10^{23}
8. Find the respective number of gram moles present in
   (a) 4 g of O_2 (b) 25 g of $CaCO_3$ (c) 10 g of NaOH (d) 5.5 g CO_2
   1) $\frac{1}{4},\frac{1}{4},\frac{1}{4},\frac{1}{4}$ 2) $\frac{1}{4},\frac{1}{2},\frac{1}{2},\frac{1}{4}$ 3) $\frac{1}{8},\frac{1}{8},\frac{1}{4},\frac{1}{4}$ 4) $\frac{1}{8},\frac{1}{4},\frac{1}{4},\frac{1}{8}$
9. How many number of atoms are present in 2.4 gram atoms of sulphur? (Where N= avogadro number)
   1) 2.4 N 2) 1.2 N 3) 0.075N 4) 0.25 N
10. How many number of molecules are present 3.2 gram moles of NH_3?
    1) 2.4 N 2) 3.2 N 3) 0.075N 4) 0.25 N
11. The weight of 1/4 mole of atom of an element is 5 grams. Identify the substance
    1) Boron 2) Neon 3) Phosphorus 4) Calcium

MULTI ANSWER TYPE

12. 49 grams of H_2SO_4 contain _____ number of molecules.(N = Avogadro number)
    1) 4N 2) 2 N 3) N 4) 0.5 N
13. The weight of 6.023×10^{23} molecules of glucose is _____ grams.
    1) 98 g 2) 180 g 3) 342 g 4) 246 g

REASONING ANSWER TYPE

14. *Statement I:* One mole of hydrogen atom contains 6.023×10^{23} atoms of hydrogen.
    Statement II: One mole of sodium ions contains 6.023×10^{23} Na^+ ions.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct

15. *Statement I:* The number 6.023×10^{23} is called the Avogadro's number.
Statement II: The experimental value of 1gram molecular volume of a gas is 22.4 dm^2 at S.T.P or 22400 cm^3 at S.T.P.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

Writeup:1

1 mole of particles = 6.023×10^{23} particles (atoms/ molecules/ions/ electrons/protons/neutrons/nucleons). The weight of 1 mole atoms of an element = gram atomic weight of the element. The weight of 6.023×10^{23} atoms of an element = gram atomic weight of the element.

16. Which of the following weigh more?
1) 1 GAW of Ca 2) 1 mole of SO_2
3) 6.023×10^{23} atoms of He 4) 6.023×10^{23} molecules of methane.

17. Which of the following pairs contain equal number of particles?
1) 1 g He, 1g H_2 2) 1 g He, 2 g H_2 3) 4 g He, 2 g H_2 4) 4 g He, 4 g H_2

18. $$\frac{1 \text{ cgs unit of mass}}{1 \text{ smallest unit of mass}} = \frac{\text{Gram atomic weight of carbon}}{\text{Mass of one atom of carbon}}$$

$$= \frac{1}{\text{Avogram}} = \text{No. of molecules present in 18g of water} = x$$

X = ...
1)6.023×10^{23} 2) 3.0115×10^{23} 3) 1.505×10^{23} 4) 12.046×10^{23}

Writeup:2

1 mole of hydrogen atom =	**6.023×10^{23} atoms of hydrogen**
1 mole of hydrogen molecule =	**6.023×10^{23} molecules of hydrogen**
1 mole of carbon dioxide =	**6.023×10^{23} molecules of carbon dioxide**
1 mole of electrons =	**6.023×10^{23} electrons**
1 mole of sodium ions (Na+) =	**6.023×10^{23} Na^+ ions**

19. Which of the following contains equal number of atoms as 12g of Magnesium? (At . wts : Mg = 24, C = 12, Ca = 40)
1) 12 g of Carbon 2) 20 g of Calcium
3) 24 g of Carbon 4) 40 g of Calcium

20. The number of atoms in 8g of Sulphur is:
1) 6.02×10^{23} 2) 3.01×10^{23} 3) 12.04×10^{24} 4) 1.505×10^{23}

21. 12 g of Carbon contains equal number of atoms as:
1) 12 grams of Mg 2) 40 grams of Calcium
3) 32 grams of Oxygen 4) 7 grams of nitrogen

MATRIX MATCHING TYPE

22.

Column-I	Column-II
a) 92 gms of NO_2	1) 3 moles
b) 51 gms of NH_3	2) 2 moles
c) 112 gms of CO	3) 5 moles
d) 80 gms of CH_4	4) 4 moles

INTEGER ANSWER TYPE

23. 1 mole of N_2O _____ N_2O molecules

SYNOPSIS - 4

Relation between GMM, GMV, Number of moles and Avogadro's number for common gases

Gas	Molecular formula	Gram molecular mass	Gram molecular volume in dm^3 at S.T.P.	Number of moles	Number of molecules in one mole (Avogadro's number)
Hydrogen	H_2	2 g	22.4	1	6.023×10^{23}
Oxygen	O_2	32 g	22.4	1	6.023×10^{23}
Chlorine	Cl_2	71 g	22.4	1	6.023×10^{23}
Sulphur dioxide	SO_2	64 g	22.4	1	6.023×10^{23}
Nitrogen dioxide	NO_2	46 g	22.4	1	6.023×10^{23}
Ammonia	NH_3	17 g	22.4	1	6.023×10^{23}
Carbon monoxide	CO	28 g	22.4	1	6.023×10^{23}
Methane	CH_4	16 g	22.4	1	6.023×10^{23}

APPLICATIONS OF AVOGADRO'S LAW

1. It helps in the determination of atomicity of gases which occur as elements.
2. It explains Gay Lussac's law of combining volumes of gases.
3. It establishes relation between gram molecular mass and gram molecular volume.
4. It establishes relation between molecular mass and vapour density.
5. It helps in establishing molecular formula of gases.

1. Determination of Atomicity of a gas:

Atomicity: The number of atoms present in one molecule of an element is called its **atomicity**.

Examples

Monatomic: The elements which have only one atom in their molecule. For example, helium, neon, krypton, argon, xenon, etc.

Diatomic: The elements which have two atoms in their molecule. For example, hydrogen, nitrogen, oxygen; fluorine, chlorine etc.

Triatomic: The elements which have three atoms in their molecule. For example, ozone (O.,)

Polyatomic: The elements which have more than three atoms in their molecule are called polyatomic.

For example,

(i) Sulphur molecule (S_8). (ii) Phosphorus molecule (P_4)

(iii) Carbon molecule (C_{60})

WORK SHEET - 4

SINGLE ANSWER TYPE

1. Which one of the following pairs of gases contain the same number of molecules?
   1) 16 g of O_2 and 14 g of N_2 2) 8 g of O_2 and 22 g of CO_2
   3) 28 g of N_2 and 22 g of CO_2 4) 32 g of O_2 and 32 g of N_2
2. How much amount of oxygen in (grams) is present in 32.2 g $Na_2SO_4.10H_2O$?
   1) 20.8 2) 22.4 3) 2.24 4) 2.08
3. The number of oxygen atoms in 4.4 g of CO_2 is approximately is:
   1) 1.2×10^{23} 2) 6×10^{22} 3) 6×10^{23} 4) 12×10^{23}
4. The number of water molecules present in a drop of water (volume 0.0018ml) at room temperature is:
   1) 6.023×10^{19} 2) 1.084×10^{18} 3) 4.84×10^{17} 4) 6.023×10^{23}
5. 19.7 kg of gold was recovered from a smuggler. How many atoms of gold were recovered (At. wt of gold = 197)?
   1) 100 2) 6.02×10^{23} 3) 6.02×10^{24} 4) 6.02×10^{25}
6. The total number of protons in 10 g of calcium carbonate is ($N_0 = 6.02 \times 10^{23}$)
   1) 1.5057×10^{24} 2) 2.0478×10^{24}
   3) 3.0115×10^{24} 4) 4.0956×10^{24}
7. The number of molecules in 16 g of methane is:
   1) 3.0×10^{23} 2) 6.02×10^{23} 3) $\frac{16}{6.02} \times 10^{23}$ 4) $\frac{16}{3.0} \times 10^{23}$
8. The molecular weight of hydrogen peroxide is 34. The weight of 1 mole of H_2O_2 is:
   1) 34 a.m.u 2) 34 mg 3) 34 g 4) 34 kg
9. The number of electrons in a mole of hydrogen molecule is:
   1) 6.02×10^{23} 2) 12.046×10^{23} 3) 3.0115×10^{23} 4) Indefinite

MULTI ANSWER TYPE

10. The total number of gm-molecules of SO_2Cl_2 in 13.5g of sulphuryl chloride is:
    1) 0.1 2) 0.2 3) 0.3 4) 0.4
11. How many atoms are contained in one mole of sucrose ($C_{12}H_{22}O_{11}$)?
    1) $45 \times 6.02 \times 10^{23}$ atoms/mole 2) $5 \times 6.62 \times 10^{23}$ atoms/mole
    3) $5 \times 6.02 \times 10^{23}$ atoms/mole 4) None of these

REASONING ANSWER TYPE

12. *Statement I:* Avogadro's law helps in the determination of atomicity of gases which occur as elements.
    Statement II: It helps in establishing molecular formula of gases.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.

13. *Statement I:* Avogadro's law explains Gay Lussac's law of combining volumes of gases.
Statement II: The mass of 1.4 litres of CO_2 at STP is 2.75 gms.
1) Both Statements I and statement II are correct.
2) Both Statements I and statement II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

The number of atoms present in one molecule of an element is called its atomicity.

Equal volumes of gases, under similar conditions of temperature and pressure, contain equal number of molecules, explains Gay Lussac's law of combining volume of gases.1 mole of particles = 6.023×10^{23} particles (atoms/ molecules/ions/electrons/protons/neutrons/nucleons).

14. A sample of phosphorus trichloride (PCl_3) contains 1.4 moles of the substance. How many atoms are there in the sample?
1) 4 2) 5.6 3) 8.431×10^{23} 4) 3.372×10^{24}

15. The number of water molecules in 1 litre of water is (N_A = Avogadro number)
1) 18 2) 18×1000 3) N_A 4) $55.55N_A$

16. The largest number of molecules are present in:
1) 34g of water 2) 28g of CO_2 3) 46g of CH_3OH 4) 54g of N_2O_5

MATRIX MATCHING TYPE

17.

Column-I	**Column-II**
a) 1 mole of H_2 occupies volume at STP	a) 22.4 dm^3
b) The volume of 2 moles of CO_2 at STP	b) 44.8 L
c) The volume of 1/2 mole of Cl_2 at STP	c) 11.2 L
d) The volume of 1/4 mole of Cl_2 at STP	d) 5.6 L

18.

Column-I	**Column-II**
a) Mass of 1.4 Lts of CO_2 at STP	1) 2.75 gms
b) Mass of 2.0 Lts of O_2 at STP	2) 2.85 gms
c) Mass of 3.5 Lts of Cl_2 at STP	3) 11.09 gms
d) Mass of 4.0 Lts of SO_2 at STP	4) 11.39 gms

INTEGER ANSWER TYPE

19. _____ Number of moles of sodium oxide in 620 grams

SYNOPSIS - 5

NUMERICAL PROBLEMS ON MOLECULAR WEIGHT (RMM)

Numerical Problem 1

Calculate molecular weight of lead nitrate. [Pb = 207; N = 14; O = 16]

Solution:

Molecular weight of lead nitrate $Pb(NO_3)_2$ = 1 (Pb) + 2(N) + 6(O)
= 1(207) + 2 (14) + 6 (16)
= 207 + 28 + 96 = **331 amu.**

Numerical Problem 2

Calculate molecular weight of $Na_2CO_3.10H_2O$.
[Na = 23; C = 12; O = 16; H = 1]

Solution:

Molecular weight of $Na_2CO_3.10H_2O$ = 2(Na) + 1 (C) + 3 (O) + 10 [2(H) + 1 (O)]
= 2(23) + (12) + 3 (16) + 10 [2 (1) + 1 (16)]
= 46 + 12 + 48 + 180 = 286 amu.

Practice Problem 1

1. Calculate the molecular weights of the following substances:
   (i) Aluminium hydroxide [$Al(OH)_3$] **[78 amu]**
   (ii) Potassium dichromate [$K_2Cr_2O_7$] **[294 amu]**
   (iii) Ammonium nitrate [NH_4NO_3] **[80 amu]**
   [O = 16; H = 1; Al = 27; K = 39; Cr = 52; N = 14]

Practice Problem 2

Calculate molecular weights of the following :
(i) Hydrated copper sulphate [$CuSO_4.5H_2O$] **[250 amu]**
(ii) Hydrated sodium sulphate [$Na_2SO_4 10H_2O$] **[322 amu]**
[Na = 23; Cu = 64; S = 32; O = 16; H = 1]

Practice Problems 1

1. Calculate the number of molecules in 12.8 g of sulphur dioxide gas. Take Avogadro's number as 6×10^{23}. [S = 32; O = 16] **[1.2×10^{23}]**
2. Calculate the number of molecules in 0.71 g of chlorine gas. Take Avogadro's number as 6×10^{23}. [Cl = 35.5] **[6×10^{21}]**

Practice Problems 2

1. Calculate the weight in grams of 2.8×10^{24} molecules of nitrogen gas. Take Avogadro's number as 6×10^{23}. [N = 14]. **[130.67g]**
2. Calculate the weight in grams of 2×10^{22} molecules of copper sulphate. Take Avogadro's number as 6×10^{23}. [Cu = 64; S = 32; O = 16] **[5.33 g]**

Practice Problems 3

1. Calculate the weight of one molecule of oxygen. Take Avogadro's number as 6×10^{23}. [O = 16] **[5.33×10^{-23}g]**
2. Calculate the weight of one molecule of ozone (O_3). Take Avogadro's number as
   6×10^{23}. [O = 16]. **[8×10^{-23}g]**

NUMERICAL PROBLEMS ON AVOGADRO'S NUMBER

Numerical Problem 1

Calculate the number of molecules in 3.65 g of HCl gas. Take Avogadro's number as 6×10^{23}. [H = I; Cl = 35.5]

Solution:

Molecular weight of HCl = 1 + 35.5 = 36.5 amu

∴ Gram molecular weight of HCl = 36.5 g

Now, one gram molecular wt. of any substance contains 6×10^{23} molecules

∴ 36.5 g of HCl contain number of HCl molecules = 6×10^{23}

∴ 3.65 g of HCl contain number of HCl molecules $\frac{6\times10^{23}\times365}{365} = \mathbf{6\times10^{22}}$ **molecules.**

Numerical Problem 2

Calculate the weight in grams of 4×10^{24} molecules of SO_3. Take Avogadro's number as 6×10^{23}. [S = 32; O = 16]

Solution:

Gram molecular weight of SO_3 = 1 (S) + 3(O)

= 1 (32) + 3 (16) = 80 g

Now, 6×10^{23} molecules of SO_3 = 80 g

∴ 4×10^{24} molecules of $SO_3 = \frac{80\times4\times10^{24}}{6\times10^{23}} = \mathbf{53.33\ g.}$

Numerical Problem 3

Calculate the weight of one molecule of nitrogen (N_2). Take Avogadro's number as 6×10^{23}. [N = 14]

Solution:

Molecular weight of nitrogen (N_2) = 2 × 14 = 28 amu.

∴ Gram molecular weight of nitrogen = 28 g.

Now, 6×10^{23} molecules of nitrogen weigh = 28 g.

∴ 1 molecule of nitrogen weighs $= \frac{28}{6\times10^{23}} = \mathbf{4.67\times10^{-23}\ g.}$

WORK SHEET - 5

SINGLE ANSWER TYPE

1. 1 gram molecule of which of the following compounds weigh more?
   1) Marble stone 2) Laughing gas 3) Soda ash 4) Sugar
2. Find the weight of 5 gram molecules of oxygen:
   1) 40 g 2) 80 g 3) 160 g 4) 320 g
3. How many number of atoms are present in 2.4 gram atoms of sulphur? (Where N= avogadro number)
   1) 2.4 N 2) 1.2 N 3) 0.075N 4) 0.25 N
4. How many number of molecules are present 3.2 gram moles of NH_3?
   1) 2.4 N 2) 3.2 N 3) 0.075N 4) 0.25 N

5. Calculate the mass of nitrogen supplied to the soil by 5 kg of urea $[CO(NH_2)_2]$ [N = 14, C = 12, O = 16, H = 1]
   1) 3033.3 g 2) 4330.3 g 3) 1303.3 g 4) 2333.3 g
6. How much H_2SO_4 can be produced from 500 kg of sulphur?
   1) 1053 2) 1530 3) 1350 4) 1203
7. If two moles of ethyl alcohol are burnt the amount of carbon dioxide formed will be:
   1) 44 g 2) 88 g 3) 132 g 4) 176 g
8. The weight of Na_2CO_3 would be needed to react with 0.1 mole HCl according to the equation.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$$

   1) 5.3 g 2) 53 g 3) 0.53 g 4) 0.053 g
9. What quantity of limestone ($CaCO_3$) on heating will give 56 kg of CaO?
   1) 1000 kg 2) 56 kg 3) 44 kg 4) 100 kg
10. 56 g of CaO has been mixed with 63 g of HNO_3; the amount of $Ca(NO_3)_2$ formed is:
    1) 4 gm 2) 3.28 gm 3) 164 gm 4) 82 gm
11. Insulin contains 3.4 % sulphur. Calculate minimum mol. wt. of insulin.
    1) 614.27 2) 941.17 3) 841.27 4) 714.17

MULTI ANSWER TYPE

12. An astronaut receives the energy required per hour by the combustion of 34 g of sucrose present in his body. How much oxygen should he carry along with him for his energy requirement in a day?
    1) 761.12 2) 861.21 3) 916.21 4) 1016.12
13. When 0.5 mole of $CaCO_3$ undergoes thermal decomposition the amount of CO_2 formed is:
    1) 1 mole 2) 22 g 3) 44 g 4) 2 moles

REASONING ANSWER TYPE

14. *Statement I:* One gram molecular weight of any substance contains 6×10^{23} molecules.
    Statement II: 36.5 g of HCl contain number of 6×10^{23} HCl molecules..
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.
15. *Statement I:* 1 mole of Copper sulphate contains 6×10^{23} molecules.
    Statement II: 0.005 moles of copper sulphate contains 3×10^{21} molecules.
    1) Both Statements I and statement II are correct.
    2) Both Statements I and statement II are incorrect.
    3) Statement I is correct and statement II is incorrect.
    4) Statement I is incorrect and statement II is correct.

COMPREHENSION TYPE

A chemical formula which gives the actual number of atoms of the different elements present in one molecule of a compound is called molecular formula. One gram molecular weight of any substance contains 6×10^{23} molecules.

16. A sample of potato starch was ground in a ball mill to give a starch-like molecule of lower molecular weight. The product analyzed 0.086% phosphorus. If each molecule is assumed to contain one atom of phosphorus, what is the average molecular weight of the material?
    1) 24606.5 2) 36046.5 3) 48460.5 4) 55640.5
17. How many atoms of hydrogen are liberated when 6.5 g of zinc is treated with excess of dilute HC1? (atomic weight of zinc is 65)
    1) 3.046×10^{23} 2) 6.023×10^{23} 3) 12.046×10^{22} 4) 18.022×10^{23}
18. Most of the commercial hydrochloric acid is prepared by heating NaCl with concentrated H_2SO_4. How many grams of sulphuric acid containing 90.0% H_2SO_4 by weight are needed for the production of 1000 g of concentrated hydrochloric acid containing 42.0% HC1 by weight?
    1) 862.47 2) 426.74 3) 626.47 4) 562.74

MATRIX MATCHING TYPE

1120 cm^3 volume of nitrogen gas at STP conditions calculate Column-I.

19.

Column-I	**Column-II**
a) Weight in grams	1) 1.4 g
b) No. of moles	2) 0.05 moles
c) No. of molecules	3) 0.3×10^{23} molecule
	4) 0.7 g
	5) 3×10^{23} molecules

INTEGER ANSWER TYPE

20. The weight of 6.023×10^{23} molecules of glucose is _____ grams.

KEY & HINTS

WORK SHEET – 1 (KEY)				
1) 3	**2)** 2	**3)** 1	**4)** 3	**5)** 1
6) 1	**7)** 4	**8)** 4	**9)** 3	**10)** 3
11) 4	**12)** 3	**13)** 2	**14)** 1,2,3,4	**15)** 1
16) 1,2	**17)** 2	**18)** 1	**19)** 3	**20)** 4
21) 3	**22)** 3	**23)** 1,2,3,4	**24)** 1,3,2, (3,4)	**25)** 931.5

11. Weight of one atom of an element = Atomic weight × amu.
12. Smallest unit of mass = amu
    Mass of one electron = 0.00054 amu

No. of electrons = $\frac{1\text{amu}}{0.00054\text{amu}}$ = 1852.

15. $\frac{1}{12}$th of C–12.

16. 1 amu = mass of $\frac{1}{12}$th of C – 12 isotopic atom.

17. Atomic weight $= \frac{4\times1.66\times10^{-24}}{1.66\times10^{-24}} = 4 \Rightarrow$ He.

20. 20. Atomic weight of silicon = 28
$\Rightarrow$ weight of one atom of silicon = 28amu $\Rightarrow$ Weight of 100 atoms of silicon
= 28 × 100 = 2800 amu.

21. $\frac{AW_O}{AW_H} = K \Rightarrow \frac{16}{1} = \frac{100}{x} \Rightarrow x = \frac{100}{16} = 6.25$.
Mol. wt of water = 112.5

22. $\text{At.wt} = \frac{xA_1 + yA_2}{100}$, where x and y are the relative abundances of isotopes.

24. 19. Atomic weight $= \frac{40\times1.66\times10^{-24}}{1.66\times10^{-24}} = 40$
$\Rightarrow$ Mass number = 40 and the element is either calcium or Argon.
$\therefore$ Number of protons = 20 (or) 18.

WORK SHEET – 2 (KEY)

1) 1	**2)** 4	**3)** 2	**4)** 3	**5)** 4
6) 4	**7)** 4	**8)** 4	**9)** 3	**10)** 4
11) 1	**12)** 2	**13)** 2	**14)** 3	**15)** 3
16) 4	**17)** 4	**18)** 4	**19)** 4	**20)** 2
21) 1	**22)** 1,3,4	**23)** 3	**24)** 1,2,3	**25)** 2
26) 1	**27)** 1	**28)** 1	**29)** 1	**30)** 4
31) 4	**32)** 2	**33)** 2	**34)** 4	**35)** 1
36) 1,1,2,3	**37)** 3,4,1,2	**38)** 1,2,4,3	**39)** 1,2,3,4	**40)** 40.078
41) $6x10^{23}$				

6. $P_4 \Rightarrow$ Atomicity is 4.
   $S_8 \Rightarrow$ Atomicity is 8.
7.
8. None of them take part actively in a chemical reaction as they are inert.
9. The relative atomic mass of carbon = 12
   $\therefore$ 1 gm atomic mass of carbon = 12 gms
   $\therefore$ 2.5 gms. of atoms of carbon = 2.5 × 12 gms. = 30 gms
   So, the amount of carbon to be taken = 30 gms.
13. 12 grams and 14 grams.
14. We know that ,

    Number of gram atoms = $\frac{\text{Given weight}}{\text{Gram atomic weight}}$ ...(1)

    Applying (1), we get, Number of gram atoms of S = $\frac{16}{32} = \frac{1}{2}$
15. We know that, weight = Number of gram molecules $\times$ Gram molecular weight = 5 $\times$ 32 = 160 grams.
16. Number of gram atoms = $\frac{10}{40} = 0.25$
17. We know that, number of gram atoms = $\frac{\text{Given weight}}{\text{Gram atomic weight}}$ .....(1)

    As number of gram atoms are same, weight of the element $\propto$ atomic weight
    Therefore, 1 gram atom of calcium weigh more.
18. 1gram mole of O_2 contains 6.023×10^{23} molecules.
    1 gram mole of SO_2 contains 6.023×10^{23} molecules.
19. We know that, number of gram molecules = $\frac{\text{Given weight}}{\text{Gram Molecular weight}}$ .....(1)

    Weight of the compound $\propto$ Gram molecular weight ($\because$ Number of gram molecules of all the compounds is same) .
    Let us now check the molecular weights of given compounds.
    (a) Marble stone $\Rightarrow CaCO_3$ $\Rightarrow$ MW = 100
    (b) Laughing gas $\Rightarrow N_2O$ $\Rightarrow$ MW = 44
    (c) Soda ash $\Rightarrow Na_2CO_3$ $\Rightarrow$ MW = 106
    (d) Sugar $\Rightarrow C_{12}H_{22}O_{11}$ $\Rightarrow$ MW = 342
    From the above, it is clear that the MW of sugar is more , 342 and hence 1gram molecule of it weigh more.
20. We know that, weight = Number of gm. atoms $\times$ Gram atomic weight= 5 $\times$ 31 = 155 grams.
22. The weight of ammonia molecule = 17 amu.
    = 17 × 1.66 × 10^{-24}g

23. To find out the molecular weight, we need to find the weight of one molecule in terms of amu.

$\therefore$ Weight of one molecule in terms of amu

$= \frac{\text{weight in grams}}{1.66\times10^{-24}} = \frac{1.66\times10^{-22}}{1.66\times10^{-24}} = 100$ amu.

$\therefore$ molecular weight of the compound = 100.

25. Any element can be identified from its atomic weight or atomic number.

We know, number of gram atoms $(n_a) = \frac{m}{GAW}$

$\therefore GAW = \frac{m}{\text{Number of gram atoms}}$ ------(1)

Applying (1) to the case, we get,

$GAW = \frac{8}{2} = 4g \Rightarrow$ Atomic weight = 4 $\Rightarrow$ The element is helium

26. Let us consider two elements, A and B, whose atomic weights are 'x' and 'y' respectively. $\Rightarrow$ Gram atomic weight of A = 'x' g ; Gram atomic weight of B = 'y' g

weight of one atom of A = 'x' amu = $x \times 1.66 \times 10^{-24}$g

weight of one atom of B = 'y' amu = $y \times 1.66 \times 10^{-24}$g

$\therefore$ Number of atoms of A $= \frac{xg}{x\times1.66\times10^{-24}\,g} = \frac{10^{24}}{1.66} \approx 6.023\times10^{23}$

$\therefore$ Number of atoms of B $= \frac{yg}{y\times1.66\times10^{-24}\,g} = \frac{10^{24}}{1.66} \approx 6.023\times10^{23}$

$\therefore$ Number of atoms of A = Number of atom of B.

$\therefore$ Similarly, the number of atom of any element in its gram atomic weight $= 6.023 \times 10^{23}$.

Now, consider any two compounds, say 'C' and 'D', whose molecular weight are 'p' and 'q' respectively.

$\Rightarrow$ Gram molecular weight of C = 'p' g ; Gram molecular weight of D = 'q' g

weight of one molecule of C = 'p' amu ; = $p \times 1.66 \times 10^{-24}$g

weight of one molecule of D = 'q' amu ; = $q \times 1.66 \times 10^{-24}$g

Number of molecules of C $= \frac{'p'g}{'p'\times1.66\times10^{-24}\,g} = \frac{10^{24}}{1.66} \approx 6.023\times10^{23}$

Number of molecules of D $= \frac{'q'g}{'q'\times1.66\times10^{-24}\,g} = \frac{10^{24}}{1.66} \approx 6.023\times10^{23}$

30. Atomic weight $= \frac{\text{weight of one atom}}{\text{weight of } \frac{1}{12}\text{th of C}-12\text{ atom}} \Rightarrow \frac{\text{weight of one atom}}{\text{Its atomic weight}}$

= weight of $\frac{1}{12}$th of C – 12 atom = x

Molecular weight = $\frac{\text{Weight of one molecule}}{\text{Weight of } \frac{1}{12}\text{th of C-12 atom}} \Rightarrow \frac{\text{Weight of one molecule}}{\text{Its molecular weight}}$

= Weight of $\frac{1}{12}th$ of C - 12 atoms = y $\Rightarrow$ x = y.

$\Rightarrow$ weight of one molecule of CO_2 44 amu

32. Weight of one molecule = (molecular weight) amu
Molecular weight of CO_2 = 12 + (2 × 16) = 44.

33. 1 gram mole of methane weight 16g.
$\Rightarrow$ Weight of methane = 1 × 16 = 16g
$\Rightarrow$ Weight of hydrogen in 16g of methane = 4 g (as 4 hydrogen atoms are present)
We know,

Number of gram molecules of hydrogen = $\frac{\text{Weight of the substance (m)}}{\text{Gram molecular weight (GMW)}} = \frac{4}{2} = 2$

34. Given that the weight of the gas is 100 g
We know,

Number of gram molecules (n_m)

$= \frac{\text{Given weight (m)}}{\text{Gram molecular weight (GWM)}}$

$\Rightarrow n_m \propto \frac{1}{GMW}$ ($\because$ mass is same for all the gases)

From the above equation, it is clear that the gas with the least molecular weight contains the maximum number of gram molecules.
The gas with the least molecular weight is hydrogen. Therefore, it contains the maximum number of gram molecules.

35. Given that the weight of methane (x) is equal to the weight 1 gram mole of SO_2 and the weight of 1 gram molecule of SO_2 is 64g
$\therefore$ Weight of methane = m = 64 g
Gram molecular weight of methane = GMW = 16g
We know, number of gram molecules

$(n_m) = \frac{m}{GMW} = \frac{64}{16} = 4$

Therefore, the number of gram molecules of methane are 4.

36. a) Sodium $\rightarrow$ monoatomic (Na)
b) Helium $\rightarrow$ monoatomic (He)
c) Oxygen $\rightarrow$ diatomic (O_2)

d) Ozone → triatomic (O_3)

39. a) 1 mole of Cl_2 gas occupied volume at STP conditions = 22.4 lts.
b) 0.25 moles Cl_2 gas occupied volume at STP conditions = 0.25 × 22.4 = 5.6 Lts.
c) No. of moles =

$$\frac{\text{Weight of the substance}}{\text{Weight of the molecular substance}} = \frac{17.7\,\text{g.}}{71\,\text{g.}} = 0.25 \text{ moles}$$

22. We know,

Number of gram molecules $(n_m) = \frac{\text{Given weight (m)}}{\text{Gram molecular weight (GMW)}}$ ——(1)

Applying (1) to the cases, we get,

i) Number of gram molecules of Neon (Ne) = $\frac{5}{20} = \frac{1}{4} = 0.25$ $(\because \text{GMW of Ne} = 20)$

ii) Number of gram molecules of nitrogen

$(N_2) = \frac{7}{28} = \frac{1}{4} = 0.25$ $(\because \text{GMW of } N_2 = 28)$

WORK SHEET – 3 (KEY)				
1) 1	**2)** 2	**3)** 3	**4)** 1	**5)** 2
6) 3	**7)** 1	**8)** 4	**9)** 1	**10)** 2
11) 2	**12)** 4	**13)** 2	**14)** 1	**15)** 1
16) 2	**17)** 3	**18)** 1	**19)** 2	**20)** 4
21) 2	**22)** 2,1,4,3	**23)** $6x10^{23}$		

4. 40.
5. 1/2 mole
6. 14 g
9. We know that,
number of atoms present in x gram atoms of any element = $x \times 6.023 \times 10^{23}$.
Therefore, the number of atoms present in 2.4 gram atoms of sulphur
= $2.4 \times 6.023 \times 10^{23}$.
10. We know that,
number of molecules present in x gram moles of any element/compound
= $x \times 6.023 \times 10^{23}$.
Therefore, the number of molecules present in 3.2 gram atoms of sulphur
11. Number of moles

$= \frac{\text{weight}}{\text{GAW}} \Rightarrow \text{GAW} \frac{\text{weight}}{\text{number of moles}} = \frac{5}{¼} = 20\text{g} \Rightarrow$ Element is Neon.

12. We know that ,
number of molecules = Number of moles $\times 6.023 \times 10^{23}$
$= \frac{49}{98} \times 6.023 \times 10^{23} = 3.0115 \times 10^{23}$.
$= 3.2 \times 6.023 \times 10^{23}$

13. We know that,
weight of 6.023×10^{23} molecules of any compound is equal to its gram molecular weight.
Therefore, the weight of 6.023×10^{23} molecules of glucose ($C_6H_{12}O_6$) is equal 180 grams.

Therefore, total number of ions in 1 gram formula weight of NaCl = 2 $\times$ 6.023 $\times 10^{23}$ = 12.046×10^{23} ions.16.

We know that , Number of gram moles = $\frac{\text{Given weight}}{\text{Gram Molecular weight}}$ .....(1)

Applying (1), we get

(a) Number of gram moles of O_2 = $\frac{4}{32} = \frac{1}{8}$

(b) Number of gram moles of $CaCO_3$ = $\frac{25}{100} = \frac{1}{4}$

(c) Number of gram moles of NaOH = $\frac{10}{40} = \frac{1}{4}$

(d) Number of gram moles of CO_2= $\frac{5.5}{44} = \frac{1}{8}$

16. 1) 1 GAW of Ca = 40 g
2) 1 mole of SO_2 = 64 g
3) 6.023×10^{23} atoms of He = 4 g
4) 6.023×10^{23} molecules of methane= 16 g

17. 4 g He = 1 mole of He and 2 g H_2 = 1 mole of H_2

18. No. of molecules in 18 gm or 1 mole of water = 6.023×10^{23}

19. Number of atoms = $\frac{\text{weight}}{\text{GAW}} \times N$; Number of atoms in 12 g of Mg = $\frac{12}{24} \times N = 0.5N$
Now, let us check the number of atoms in each of elements given.

1) $\frac{12}{12} \times N$ atoms of C = N ; 2) $\frac{20}{40} \times N$ atoms of Ca = 0.5 N

3) $\frac{24}{12}\times N$ atoms of C= 2N ; 4) $\frac{40}{40}\times N$ atoms of Ca = N

20. Number of atoms $=\frac{8}{32}\times N=\frac{6.023\times10^{23}}{4}$ = 1.505 × 10^{23}

21. Number of atoms of carbon $=\frac{12}{12}\times N=$ N

1) Number of atoms of Mg = $\frac{12}{24}\times N$;

2) Number of atoms of Ca = $\frac{40}{40}\times N=$ N

3) Number of atoms of O_2 = $\frac{32}{16}\times N=$ 0.5N ;

4) Number of atoms of $=\frac{7}{14}\times N=$ 0.25N

WORK SHEET – 4 (KEY)				
1) 1	**2)** 2	**3)** 1	**4)** 1	**5)** 4
6) 3	**7)** 2	**8)** 3	**9)** 1	**10)** 1
11) 1	**12)** 1	**13)** 1	**14)** 4	**15)** 4
16) 1	**17)** 1,2,3,4	**18)** 1,2,3,4	**19)** 10	

1. 16g O_2 has number of moles = $\frac{16}{32}=\frac{1}{2}$; 14g N_2 has number of moles = $\frac{14}{28}=\frac{1}{2}$

Number of moles are same, so number of molecules are same.

2. $Na_2SO_4.10H_2O$= 2 × 23 + 32 + 4 × 16 + 10 × 18 = 46 + 32 + 64 + 180 = 322 gm
322gm $Na_2SO_4.10H_2O$ contains =224 gm oxygen;
32.2 gm $Na_2SO_4.10H_2O$ contains

$=\frac{32.2\times224}{322}=22.4\,gm$

3. No. of moles of CO_2 = $\frac{44}{44}=1$

1 mole of CO_2 contain 1 mole of 'C' atoms and 2 moles of oxygen atoms.

$\Rightarrow$ 44g of CO_2 has $2 \times 6 \times 10^{23}$ atoms of oxygen.

4.4g of CO_2 has $= \frac{12 \times 10^{23}}{44} \times 4.4 = 1.2 \times 10^{23}$ atoms.

4. (1) Density $= \frac{\text{Mass}}{\text{Volume}}$; Density of water = 1 gm/ml $\Rightarrow$ 1 ml of water weighs 1 gm

$\therefore$ 0.0018 ml = 0.0018gm; Number of moles $= \frac{\text{weight}}{\text{Molecular weight}} = \frac{0.0018}{18} = 1 \times 10^{-4}$

$\therefore$ Number of water molecules $= 6.023 \times 10^{23} \times 1 \times 10^{-4} = 6.023 \times 10^{19}$

5. Amount of gold = 19.7 kg = 19.7 × 1000gm = 19700gm

Number of moles $= \frac{19700}{197} = 100$ $\therefore$ Number of atoms $= 100 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{25}$ atoms.

6. Total no. of protons in given amount of $CaCO_3$
= No. of molecules in the given amount of $CaCO_3$ (N_m) × No. of protons in 1 molecule of $CaCO_3$.
In 1 molecule of $CaCO_3$, the no. of protons = 20 + 6 + 24 = 50
$\Rightarrow$ Total no. of protons $= 50 \times N_m$
Let us find the no. of molecules.
We know, 1 mole of $CaCO_3$ contains 6.023×10^{23} molecules.
The weight of 1 mole of $CaCO_3$ = 100 gm
$\Rightarrow$ 100gm $CaCO_3 = 6.023 \times 10^{23}$ molecules

$\therefore$ 10gm $CaCO_3 = \frac{6.023 \times 10^{23}}{100} \times 10 = 6.023 \times 10^{22}$ molecules

$\therefore$ 6.023×10^{22} molecules of $CaCO_3 = 50 \times 6.023 \times 10^{22} = 3.0115 \times 10^{24}$.

7. 16gm of CH_4 = 1 mole = 6.023×10^{23} molecules.

9. 1 molecule of hydrogen contains 2 electrons.
$\therefore$ Total no. of electrons = 2× no. of molecules
No. of molecules in 1 mole of
$H_2 = 6.023 \times 10^{23}$ $\Rightarrow$ Total no. of electrons = $2 \times 6.023 \times 10^{23} = 12.046 \times 10^{23}$

10. Molecular weight of SO_2Cl_2 = 32 + 32 + 2 × 35.5 = 135 gm
$\because$ 135 gm of SO_2Cl_2 = 1gm molecule

$\therefore$ 13.5 gm of $SO_2Cl_2 = \frac{1}{135} \times 13.5 = 0.1$.

11. 1 mole of sucrose contains 6.023×10^{23} molecules
$\because$ 1 molecule of sucrose has 45 atoms
$\therefore$ 6.023×10^{23} molecules of sucrose has $45 \times 6.023 \times 10^{23}$ atom/mole.

12. Total no. of atoms in PCl_3 = No. of atoms in one molecule of PCl_3 × No. of

molecules in 1.4 moles of PCl_3. = $4\times1.4\times6.023\times10^{23} = 3.372\times10^{24}$

13. Statement : II
The relative molecular mass of CO_2 = 12 + 2 × 16 = 44
The mass of 22.4 litres of CO_2 at STP = 44 g.

$\therefore$ The mass of 1.4 litres of CO_2 at STP = $\frac{1.4\,L}{22.4\,L}\times44g$

$\frac{11}{4g} = 2.75\,g$

14. Density of water = 1gm/ml $\Rightarrow$ 1 ml of water weighs 1 gm $\Rightarrow$ 1 litre (1000ml) of water weighs 1000g

$\therefore$ No. of moles = $\frac{1000}{18}$ = 55.55

No. of molecules = No. of moles $\times6.023\times10^{23} = 55.55\times6.023\times10^{23} = 55.55\ N_A$

15. More is the no. of moles, more is the number of molecules.

No. of moles = $\frac{Wt}{GMW}$ ---- (1)

(1) $\frac{34}{18}$ = 1.8 (2) $\frac{28}{44}$ = 0.63 (3) $\frac{46}{32}$ = 1.437 (4) $\frac{54}{108}$ = 0.5

16. Sodium oxide $\rightarrow$ Na_2O ; Molecular weight = 46 + 16 = 62
62gm of Na_2O = 1 mole ; 620gm of Na_2O = 10 mole.

WORK SHEET – 5 (KEY)				
1) 4	**2)** 3	**3)** 1	**4)** 2	**5)** 4
6) 2	**7)** 4	**8)** 1	**9)** 4	**10)** 4
11) 2	**12)** 3	**13)** 2	**14)** 1	**15)** 1
16) 2	**17)** 3	**18)** 3	**19)** 1,2,3	**20)** 180

7. $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
1 mole of C_2H_5OH gives 88 g of CO_2
2 moles of C_2H_5OH gives 176 g of CO_2

8. $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$
2 moles of HCl react with 1 mole of Na_2CO_3
0.1 mole of HCl react with 0.05 mole of Na_2CO_3
$\therefore$ 0.05 mole of Na_2CO_3 = 0.05×106 = 5.3 g.

9. $CaCO_3 \rightarrow CaO + CO_2$

100 g 56 g 44 g

56 g CaO is obtained from 100 g of $CaCO_3$ 56 kg of CaO will be obtained from 100 kg of $CaCO_3$.

10. $CaO + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$

56 2×63 164

So 126 g of HNO_3 can give 164 g of $Ca(NO_3)_2$

63 g of HNO_3 can give 82 g of $Ca(NO_3)_2$

12. Amount of sucrose required for one hour = 34 g.

$\therefore$ Amount of sucrose required for one day = 24 × 34 = 816 g

Gram molecular weight of sucrose = 342 g

Gram molecular weight of oxygen = 32 g

Amount of oxygen required for the combustion of 816 g of sucrose = ?

Balanced chemical equation	$C_{12}H_{22}O_{11}(s) + 12\ O_2(g) \rightarrow 12CO_2(g) + 11H_2O(l)$
Terms	Weight of O_2 required and weight of sucrose.
Standard relation	342 g (1 mole) $C_{12}H_{22}O_{11} \xrightarrow{\text{requires}} 12 \times 32$ g (12 moles) of O_2 $\therefore$ 816 g $C_{12}H_{22}O_{11} \xrightarrow{\text{requires}} \frac{816 \times 12 \times 32}{342} = 916.21$ g

Therefore, 916. 21 g of oxygen is required for the combustion of sucrose required per day.X

13. $CaCO_3 \longrightarrow CaO + CO_2$

1 mole of $CaCO_3$ gives 1 mole or 22.4 lit at STP or 44 g of CO_2

$\therefore$ 0.5 mole of $CaCO_3$ gives 0.5 mole or 11.2 lit at STP or 22 g of CO_2.

15. 1 mole of copper sulphate contains a molecule = 6×10^{23}

0.005 moles of copper sulphate contains a molecule = $0.005 \times 6 \times 10^{23}$

$= 3 \times 10^{21}$ molecule

19. a) 1 mole of N_2 molecular weight = 28 gms

Now 22,400 Cm^3 of nitrogen at STP weigh = 28 gms.

1120 Cm^3 of nitrogen at STP weigh = $\frac{28 \times 1120\ Cm^3}{22400\ Cm^3}$ = 1.4 gms.

b) No. of moles

28 gms of N_2 = 1 mole

1.4 gms of nitrogen = $\frac{1.4}{28} = 0.05$ moles

c) No. of molecules

1 mole of nitrogen contains a molecule = 6×10^{23}

0.05 moles of nitrogen contains a molecule = $0.05 \times 6 \times 10^{23}$

= 0.3×10^{23} molecules

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