



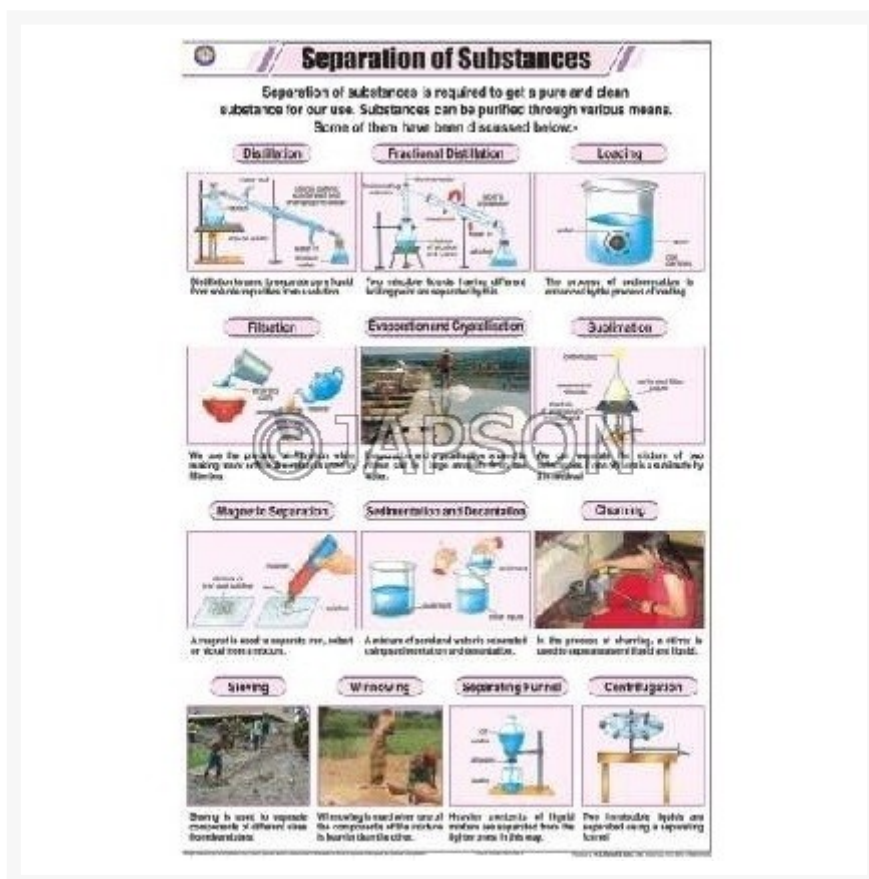
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Chemistry (I) Charts, School Education

Product Image



Description

Standard Size: 58x90cms

Language: English

Laminated Paper Charts with Plastic Rollers. These charts have technically accurate and detailed description in vivid colours.

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A . Charts, Composition of Water by Weight B. Charts, Chemical Reactivity of An Element

Composition of Water by Weight

Method used by Berzelius, Dulong and Dumas to find Composition of Water by Weight

Results
 Weight of water formed = 235.36 g
 Oxygen given up by the copper oxide = 212.04 g
 Weight of hydrogen present in water = 23.32 g

According to this experiment the ratio of hydrogen to oxygen by weight in water is 23.32 to 212.04 or 1 : 9.05

Berzelius's Method of Direct Synthesis to Find Composition of Water by Weight

Endo-therm for Demonstrating the Volume Composition of Steam

WELL WATER, SPRING WATER, SEA WATER, RAIN WATER, CLOUD, ICE, RIVER WATER

In accordance with Proust's Law of Definite Proportion, the composition of water by weight is always the same, regardless of how the water is made or where the water is found.

2 Hydrogen atoms combine with 1 Oxygen atom to form 1 molecule of Water.

$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$

Weight of Oxygen in 1 molecule of Water = 16.02
 Weight of Hydrogen in 1 molecule of Water = 4.04
 Total weight of 1 molecule of Water = 20.06

Thus, Oxygen makes up 80% of Weight of any sample of Pure Water, while Hydrogen makes up the remaining 20% of the Weight.

Chemical Reactivity of An Element

The more readily an element can lose electrons to form positive ions, the more reactive it is. The more readily an element can gain electrons to form negative ions, the more reactive it is. Gold is the least reactive metal.

Relative Reactivity of Metals

K	Potassium	Most reactive
Na	Sodium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	
Fe	Iron	
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

When 10 ml of dilute HCl is added to each piece of magnesium, aluminium, zinc, iron and copper, the rate of bubble formation decreases in the order: Mg > Al > Zn > Fe > Cu

Chemical Equations:

$$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$$

$$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$$

$$2\text{Al} + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2$$

$$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$$

$$\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$$

No reaction takes place when a piece of copper is placed in the zinc sulphate solution.

No reaction takes place. Therefore there is no bubble formation in the case of copper.


C. Charts, Occurrence, and Forms of Carbon D. Charts, Carbon Dioxide & Carbon Monoxide

Occurrence and Forms of Carbon

Occurrence of Carbon


In Fuel Oils

Carbon is present in various forms in petroleum, graphite and coal.




In Fossil Fuels

In fossil fuels, carbon is found in coal, petroleum and natural gas.




In Charcoal Form

In the charcoal form, carbon is found in charcoal, wood and graphite in the form of carbon dioxide (CO₂).




In Atmosphere

In the atmosphere, carbon is found in carbon dioxide.



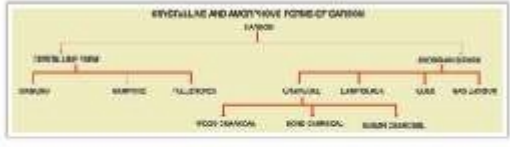
In Liquid Form

Carbon forms a liquid in molten iron, steel and cast iron.




Different Forms of Carbon

DIFFERENT AND IMPORTANT FORMS OF CARBON




Graphite

Graphite is a form of carbon that is soft and slippery. It is used in pencils and as a lubricant.




Diamond

Diamond is a form of carbon that is very hard. It is used in jewelry and as a cutting tool.



Carbon Dioxide and Carbon Monoxide

CARBON DIOXIDE (CO₂)



Release of CO₂ in Atmosphere

- Respiration by living beings.
- Burning of fossil fuels.
- Decomposition of animal and plant wastes.
- Volcanic eruptions.
- Acid rain falling on water bodies and soils.

Properties of CO₂

- Colorless and odorless gas.
- Slightly soluble in water.
- Turns limewater (calcium hydroxide) into milky white.
- It is a greenhouse gas.

Mass of CO₂

Relative atomic mass of C = 12, O = 16

$$\text{C}_x\text{O}_y = x \times 12 + y \times 16$$

For CO₂: $1 \times 12 + 2 \times 16 = 44$

Laboratory Preparation of CO₂

In the laboratory, carbon dioxide is prepared by the reaction of dilute hydrochloric acid and calcium carbonate.

$$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$$


CARBON MONOXIDE (CO)

Carbon monoxide is a poisonous gas, which is formed when carbon is oxidized in a limited supply of air.

$$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$$

Use of CO

Carbon monoxide is used in the extraction of iron from its ores. This process is called as blast furnace.

Laboratory Preparation of CO

In the laboratory, carbon monoxide is prepared by heating formic acid with concentrated H₂SO₄.

$$\text{HCOOH} + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{O} + \text{CO}$$


Properties of CO

- Colorless and odorless gas.
- It is a poisonous gas.
- It is a reducing agent.
- It is a neutral oxide.

E. Charts, Carbonates & Bicarbonates

Carbonates & Bicarbonates

Carbonates and bicarbonates are the salts of carbonic acid.

CARBONATES

Sodium Carbonate (Na₂CO₃)

Sodium carbonate is commonly known as washing soda. It is used in the manufacture of glass, paper, soap, and in the treatment of water.



Calcium Carbonate (CaCO₃)

Calcium carbonate is found in nature in the form of limestone, marble, and chalk.



BICARBONATES

Sodium Bicarbonate (NaHCO₃)

Sodium bicarbonate is commonly known as baking soda. It is used in the manufacture of glass, paper, soap, and in the treatment of water.



F. Charts, Valencies of Elements

Valencies of Elements

Valency :- Capacity of a single atom or radical to combine with other atoms or radicals to form a stable molecule. Valency of an element depends on the number of valence electrons.



Hydrogen has 1 valence electron.



Carbon has 4 valence electrons.



Nitrogen has 5 valence electrons.



Oxygen has 6 valence electrons.



Aluminum has 3 valence electrons.

Z	Element	Sym.	Valency
1	Hydrogen	H	+1, -1
2	Helium	He	0
3	Lithium	Li	+1
4	Beryllium	Be	+2
5	Boron	B	+3, -3
6	Carbon	C	+2, +4
7	Nitrogen	N	+3, -2, -1, +1, +2, +3, +4, -3
8	Oxygen	O	-2
9	Fluorine	F	-1, +1
10	Neon	Ne	0
11	Sodium	Na	+1
12	Magnesium	Mg	+2
13	Aluminium	Al	+3
14	Silicon	Si	+2, +4
15	Phosphorus	P	+3, +5
16	Sulphur	S	+2, +4, +6
17	Chlorine	Cl	+1, +3, +5, +7
18	Argon	Ar	0
19	Potassium	K	+1
20	Calcium	Ca	+2
21	Scandium	Sc	+3
22	Titanium	Ti	+2, +3, +4
23	Vanadium	V	+2, +3, +4, +5
24	Chromium	Cr	+2, +3, +6
25	Manganese	Mn	+2, +3, +4, +6, +7
26	Iron	Fe	+2, +3, +6
27	Cobalt	Co	+2, +3, +4
28	Nickel	Ni	+2, +3, +4
29	Copper	Cu	+1, +2, +3
30	Zinc	Zn	+2
31	Gallium	Ga	+3
32	Germanium	Ge	+2, +4
33	Arsenic	As	+3, +5
34	Selenium	Se	+2, +4, +6
35	Bromine	Br	+1, +3, +4, +5
36	Krypton	Kr	0
37	Rubidium	Rb	+1
38	Strontium	Sr	+2
39	Yttrium	Y	+3
40	Zirconium	Zr	+2, +3, +4
41	Niobium	Nb	+2, +3, +4, +5
42	Molybdenum	Mo	+2, +3, +4, +5, +6
43	Technetium	Tc	+3, +4, +5, +6, +7
44	Ruthenium	Ru	+2, +3, +4, +5, +6, +7, +8
45	Rhodium	Rh	+3, +4, +5, +6
46	Palladium	Pd	+2, +3, +4, +5, +6
47	Silver	Ag	+1, +2, +3
48	Cadmium	Cd	+1, +2
49	Indium	In	+1, +2, +3
50	Tin	Sn	+2, +4
51	Antimony	Sb	+3, +5, +6, +7
52	Tellurium	Te	+2, +3, +4, +5, +6, +7
53	Iodine	I	+1, +3, +5, +6, +7
54	Xenon	Xe	0
55	Cesium	Cs	+1
56	Barium	Ba	+2
57	Lanthanum	La	+3
58	Cerium	Ce	+3, +4
59	Praseodymium	Pr	+3
60	Neodymium	Nd	+2, +3
61	Europium	Eu	+2, +3
62	Gadolinium	Gd	+2, +3
63	Terbium	Tb	+3, +4
64	Dysprosium	Dy	+2, +3
65	Ho	+2, +3	
66	Erbium	Er	+2, +3
67	Thulium	Tm	+2, +3
68	Ytterbium	Yb	+2, +3
69	Lutetium	Lu	+3
70	Hafnium	Hf	+4
71	Tantalum	Ta	+3, +4, +5
72	Tungsten	W	+2, +3, +4, +5, +6
73	Rhenium	Re	+2, +3, +4, +5, +6, +7
74	Osmium	Os	+2, +3, +4, +5, +6, +7
75	Iridium	Ir	+2, +3, +4, +5, +6, +7
76	Platinum	Pt	+2, +3, +4, +5, +6
77	Gold	Au	+1, +2, +3
78	Mercury	Hg	+1, +2
79	Thallium	Tl	+1, +2, +3
80	Lead	Pb	+2, +4
81	Bismuth	Bi	+2, +3, +4, +5
82	Polonium	Po	+2, +4, +6
83	Astatine	At	+1, +2, +3, +5, +7
84	Radium	Ra	+2
85	Francium	Fr	+1
86	Radium	Ra	+2
87	Actinium	Ac	+3
88	Thorium	Th	+2, +3, +4
89	Protactinium	Pa	+3, +4, +5
90	Uranium	U	+3, +4, +5, +6

Valence Mechanism

The way by which the elements combine with each other to obtain a stable electronic configuration.

- By forming ionic bond.
- By forming covalent bond.
- By forming co-ordinate bond.

G. Charts, Different Kinds of Cells

H. Charts, Sulphur

Different Kinds of Cells

Galvanic Cell
Copper (Cathode) | Zinc (Anode)
 $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$
 $Cu^{2+} + 2e^- \rightarrow Cu$ | $Zn \rightarrow Zn^{2+} + 2e^-$
 $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$

Dry Cell
Zinc shell as a container terminal
Cathode of manganese dioxide
Anode of zinc powder mixed with electrolyte paste
Neutral salt bridge
Porous rubber cap

Car Battery
Positive terminal
Negative terminal
Sulfuric acid
Lead plates

Rechargeable Cell
Positive terminal
Steel top plate
Positive electrode
Separator
Negative electrode

Sodium Sulphur Battery
Carbon anode
Sulphur anode
Aluminum
Sulfur
Sulfur Layer
Sulfur Layer Core
Outer Ring of Sulphur
Electrolyte

Solar Cell
Transparent film
Silicon
A photon gives its energy to an electron in a silicon atom. The electron flies out, and the gap left behind is made up by another electron.

Fuel Cell
Proton flow
Hydrogen
Oxygen
Proton Exchange Membrane
Catalyst
Positive Electrode
Negative Electrode
Electrolyte

Mercury-Zinc Button Cell
Zinc shell as a container terminal
Zinc powder
Mercuric oxide
Electrolyte
Steel shell as a positive terminal

Sulphur

Extraction of Sulphur (Frasch Process)
Sulphur is mined from underground deposits using super-heated water and compressed air in Frasch Process.

Structure of Sulphur Molecule
S₈ Ring | S₈ Ring

Rhombic Sulphur
1. Stable at room temperature
2. Density 2.07 g/cm³
3. Specific Gravity 2.08
4. Melts to liquid
5. Insoluble in water
6. Stable below 95.5°C
7. Stable below 100°C

Monoclinic Sulphur
1. Stable at 119°C or higher
2. Density 1.96 g/cm³
3. Specific Gravity 1.96
4. Single lattice in liquid
5. Insoluble in water
6. Stable between 119°C and 160°C

Effect of Heat on Sulphur
Sulphur molecules are linked together in a zig-zag chain. On heating, the chains break and the molecules become smaller. Further heating breaks the long chains into single rings.

Vulcanisation of Rubber
Vulcanisation is invented by Charles Goodyear in 1839. By heating the mixture of raw rubber, sulphur and natural rubber, sulphur cross-links are formed between the rubber molecules. This hardens the rubber.

I. Charts, Classification of Chemical Reactions
J. Charts, Chemical Bonding

Classification of Chemical Reactions

Combination Reaction
In a combination reaction two or more substances combine to give a single substance.
 $Mg + O_2 \rightarrow MgO$

Decomposition Reaction
A compound splits up into two or more substances in a single step.
 $CaCO_3 \rightarrow CaO + CO_2$

Displacement Reaction
In a displacement reaction, the more reactive element displaces the less reactive element.
 $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Double Decomposition Reaction
In a double decomposition reaction, two compounds exchange their ions to give new compounds.
 $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

Redox Reaction
In a redox reaction, both oxidation and reduction take place at the same time.
 $C + O_2 \rightarrow CO_2$

Exothermic Reaction
The reaction of acids with metals and hydrogen is an exothermic reaction, as it releases heat.
 $Mg + HCl \rightarrow MgCl_2 + H_2$

Endothermic Reaction
The reaction of acids with carbonates and bicarbonates is an endothermic reaction, as it absorbs heat.
 $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Photochemical Reaction
Photochemical reactions are those in which light is used as a source of energy to drive a chemical reaction.
 $2AgCl \xrightarrow{h\nu} 2Ag + Cl_2$

Chemical Bonding

The attractive force which holds various constituents (atoms, ions etc.) together to different chemical species is a chemical bond.

COVALENT BONDING
In covalent bonding, atoms share their electrons with other atoms. When only one electron pair is shared, a single covalent bond is formed. Similarly a double bond or triple bond is formed when two pairs or three pairs of electrons are shared respectively.

IONIC BONDING
When an atom loses or gains electron, it becomes electrically charged ion. An ionic bond is formed when ions with opposite charges are held together by electrical attraction and form an ionic lattice. In common salt (NaCl), sodium atom loses an electron to form an positive ion, while the chlorine atom gain an electron to form a negative ion.

METALLIC BONDING
Metal atoms have relatively free electrons in their outer shells. In metallic bonding, a lattice is formed when all the metal atoms share their outer electrons to form a sea of delocalised mobile electrons.

HYDROGEN BONDING
In polar covalent molecules involving hydrogen, the slightly positive hydrogen atom of one molecule tends to attract the slightly negative atom of the other molecule. This type of attraction is hydrogen bonding. It is a very weak sort of chemical bond.

K. Charts, Separation of Substances L. Charts, Atoms and Atomic Structure

Separation of Substances

Separation of substances is required to get a pure and clean substance for our use. Substances can be purified through various means. Some of them have been discussed below.

Distillation <p>Distillation is used to separate a liquid from a mixture of liquids.</p>	Fractional Distillation <p>The mixture is heated and the vapors are condensed and collected.</p>	Leaching <p>The process of extraction is carried out by the process of leaching.</p>	
Filtration <p>We use the process of filtration to separate a solid from a liquid.</p>	Evaporation and Crystallization <p>The process of crystallization is used to separate a solid from a liquid.</p>	Sublimation <p>The process of sublimation is used to separate a solid from a liquid.</p>	
Magnetic Separation <p>A magnet is used to separate iron, nickel or cobalt from a mixture.</p>	Sedimentation and Decantation <p>A mixture of insoluble solids is allowed to settle and the liquid is decanted.</p>	Churning <p>In the process of churning, a mixture is used to separate butter and curd.</p>	
Sieving <p>Sieving is used to separate a mixture of different sized particles.</p>	Winnowing <p>Winnowing is used to separate a mixture of different sized particles.</p>	Separating funnel <p>Heavier particles of a liquid are separated from the lighter ones in this way.</p>	Centrifugation <p>The centrifuge helps to separate a mixture of different sized particles.</p>

Atoms and Atomic Structure

Atoms are the building blocks of matter.

Dr. J.J. Thomson was the first to discover the presence of electrons in 1897. He performed the Cathode Ray Experiment.

An atom has a positively charged centre called nucleus. The nucleus has positively charged protons. Proton is positively charged and neutron has no charge. Electrons revolve around the nucleus. The number of electrons in an atom is equal to the number of protons in the nucleus.

Rutherford's Gold Foil Experiment led him to suggest the presence of positively charged nucleus deep inside the atom where probably the entire mass of atom is concentrated.

In 1932, James Chadwick discovered the presence of neutrons in an atom. Goldstein shows the existence of protons in an atom.

According to classical electromagnetic theory, electrons will lose energy continuously while revolving around the nucleus. This, however, does not happen.

Bohr's Atomic Model suggested that electrons revolve around the nucleus in different energy levels or shells. Energy levels or shells are represented by letters K, L, M, N, O and P. The electrons do not lose their energy as long as they keep moving in their energy levels.

The electrons orbiting the nucleus of an atom can absorb energy and move from a normal orbit to a higher one.

Mass number = protons + neutrons. It is represented by A.

Atomic mass is the average of mass number of naturally occurring isotopes of an atom. In 1913, Mosley introduced atomic number collectively number. It is equal to the number of protons present inside the nucleus of an atom. It is represented by Z.

The mass number and atomic number are shown as superscript and subscript respectively on the left side of the symbol of that element.

Example: $^{23}_{11}\text{Na}$

M. Charts, Atmosphere and Composition of Air

N. Charts, Chemical Reaction and its Characteristics

Atmosphere and Composition of Air

The atmosphere is a thick layer of air over the Earth's surface. It is made up of different gases.

Composition of Air

Nitrogen 78.08% It is a colorless, odorless gas. It is the most abundant gas in the atmosphere.	Oxygen 20.95% It is a colorless, odorless gas. It is essential for the survival of most living organisms.
Carbon Dioxide 0.04% It is a colorless, odorless gas. It is essential for the growth of plants.	Water Vapor 1-4% It is a colorless, odorless gas. It is essential for the survival of most living organisms.
Other Gases 0.93% These include neon, argon, helium, krypton, and xenon.	Dust Particles 0.01% These are small particles of solid and liquid matter.

Chemical Reaction and its Characteristics

A chemical reaction is a phenomenon of formation of new substances.

For example: $\text{CuSO}_4 + \text{NaOH} \rightarrow \text{Cu(OH)}_2 + \text{Na}_2\text{SO}_4$

- Evolution of Gas**

When a substance reacts with water, it produces a gas.
- Change of Colour**

Colours change due to the formation of new products.
- Change of Temperature**

When a reaction is exothermic, it releases heat. When a reaction is endothermic, it absorbs heat.
- Formation of a Precipitate**

A white substance (precipitate) is formed in an aqueous solution.
- Release of Heat**

Reactions which involve the release of heat are called exothermic reactions.
- Absorption of Heat**

Reactions which involve absorption of heat are called endothermic reactions.

O. Charts, Mole Concept

Mole Concept

The word 'mole' is derived from the latin word moles, which means pile, heap or mass.
Every mole of any element has the same number of atoms in it.
One mole is the amount of a substance that contains as many particles or entities as there are atoms in exactly 12 gm (or 0.012kg) of the ¹²C isotope. Mole of a substance always contain some number of entities no matter what the substance may be.

AVOGADRO NUMBER: Knowing that 1 mole of carbon weighs 12g, the number of atoms in it is equal to

$$= 6.0221415 \times 10^{23}$$

This number is known as Avogadro Constant and is denoted by **N_A**.

THE AVOGADRO NUMBER, N_A

$N_A = 6.0221415 \times 10^{23}$ or 602,214,150,000,000,000,000,000
To 3 significant figures $N_A = 6.02 \times 10^{23}$

The number of units represented by the Avogadro Number, N_A is 6.02×10^{23} .

ELEMENT	ATOMIC MASS (amu)	1 MOLE = 1 GRAM ATOM (masses 6.02×10^{23} atoms)
Al	27.3	27.3 g
O	16.0	16.0 g
C	12.0	12.0 g
H	1.008	1.008 g

One mole of an element is a gram-atom of the element. It contains 6.02×10^{23} atoms.

AVOGADRO'S HYPOTHESIS

Equal volumes of all gases, under the same conditions of temperature and pressure, contain the same number of molecules.

1 MOLE (Gram-molecular mass)	MOLECULAR MASS (amu)	
H ₂	2.016 g	2.016
O ₂	32.0 g	32.0
CO ₂	44.0 g	44.0

The determination of the mass of a molecule also serves to determine the gram-molecular mass of a substance.

CHARGE ON AN ELECTRON

$e = 9.62 \times 10^{18}$ electrons $F = 96,500$ coulombs

Charge on one electron = $\frac{96,500 \text{ coulombs}}{6.02 \times 10^{23} \text{ electrons}} = 1.60 \times 10^{19}$ coulombs

A mole of electrons is 6.02×10^{23} electrons and is called the Faraday (F). In electrical units one Faraday is equal to 96,500 coulombs of charge.

MOLECULAR VOLUME OR GRAM-MOLECULAR VOLUME = 22.4 L AT S.T.P.

For all gases, the volume occupied by the Avogadro Number, N_A of molecules is approximately 22.4 liters at S.T.P. (standard temperature and pressure).

P. Charts, Combustion

Combustion

Combustion is the process of burning of a substance in the presence of oxygen to liberate energy in the form of heat and light. A substance which helps in burning of combustible substances is known as supporter of combustion. Oxygen is a supporter of combustion while nitrogen is a non-supporter.

Wood

Paper

Substances which burn in air to produce heat and light are called **Combustible Substances**.

Candle

Iron

Substances that do not burn easily are called **Non Combustible Substances**.

Types of Combustion

Combustion of coke to yield carbon dioxide, heat and light.

$$C + O_2 \rightarrow CO_2 + \text{heat} + \text{light}$$

The chemical reaction of combustion of a substance containing carbon is as follows.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + \text{heat} + \text{light}$$

When magnesium burns in air, magnesium oxide is produced.

$$2Mg + O_2 \rightarrow 2MgO + \text{heat} + \text{light}$$

When hydrogen burns in air, water is produced.

$$2H_2 + O_2 \rightarrow 2H_2O + \text{heat} + \text{light}$$

Ignition Temperature

A combustible substance starts burning only when it is heated to a certain minimum temperature called the ignition temperature. Three requirements for ignition take place as:

1. A combustible substance.
2. A supporter of combustion such as oxygen.
3. Heat to raise the temperature of the combustible substance to the ignition temperature.

1. Rapid Combustion

Combustion in which a large amount of heat and light are produced for a short time is called Rapid Combustion.

2. Slow Combustion

When a substance burns in air, a very slow combustion is called Slow Combustion.

3. Explosion

Combustion, in which a very large amount of energy is released in the form of heat, light and sound in a very short period of time is called an Explosion.

4. Complete Combustion

Combustion in the presence of excess oxygen to burn the highest carbon of the substance is called complete combustion. e.g. burning of carbon to form carbon dioxide.

$$C + O_2 \rightarrow CO_2$$

5. Incomplete Combustion

Combustion in the presence of insufficient supply of oxygen is called incomplete combustion. e.g. incomplete combustion of carbon produces carbon monoxide.

$$2C + O_2 \rightarrow 2CO$$

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