SCIENCE

Current Curriculum Full Book

CONTENT

FORCE

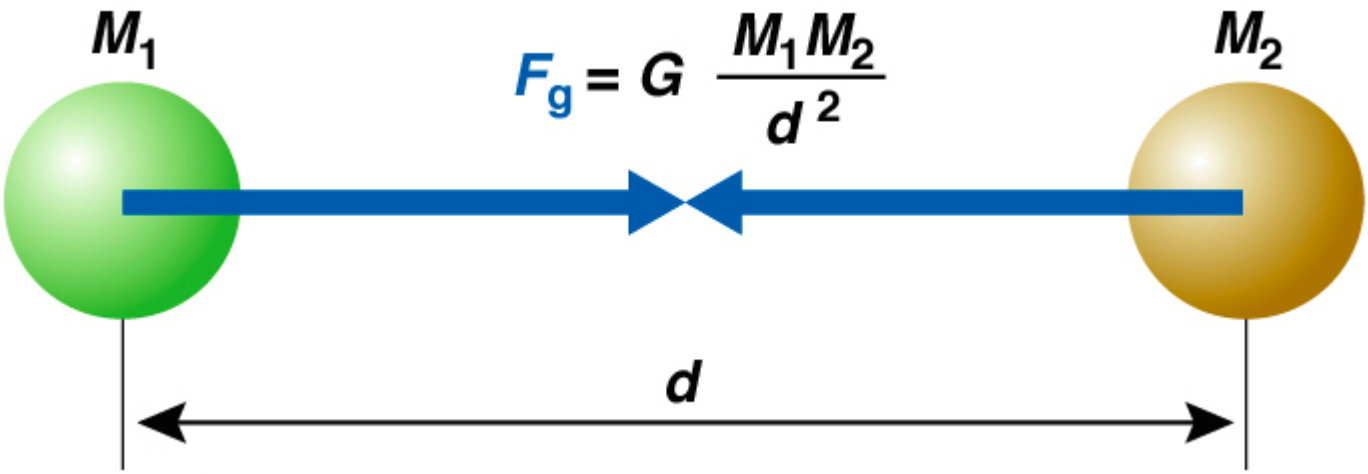
Force:

Force is defined as a push or pulls that change or tends to the state of the body whether it is at rest or in uniform motion along the straight line. Force is a vector quantity.

Newton law of gravitational: Newton's Law of Gravitation states that "The force of attraction between the two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. "Newton's law of the gravitation holds true or applicable for all the objects present in this universe whether the objects be terrestrial or celestial. The gravitational force exists everywhere in this universe. Therefore, Newton's law of gravitation is called universe law.

Verification of Newton's law:

Consider the two bodies of the mass M_1 and $M_2$with force F acting between them towards their center. If the distance between their centers is d then,



According to Newton's universal law of gravitation,

We have $F \propto M_1M_2$ ---- 1

$F \propto 1/d^2$

Combining 1 and 2 we get,

$F \propto M_1 M_2/d^2$

Removing the proportionality sign,

$F = GM_1M_2/d^2$

Where G is proportionality constant which is known as universal gravitational constant.

The numerical value of gravitational constant (G) is $6.67*10^{-11}$ and its unit is Nm^2/Kg^2

Properties of G:

Value of G is independent of the temperature, pressure, nature of the intervening medium and chemical composition of the masses of the bodies.

Gravity:

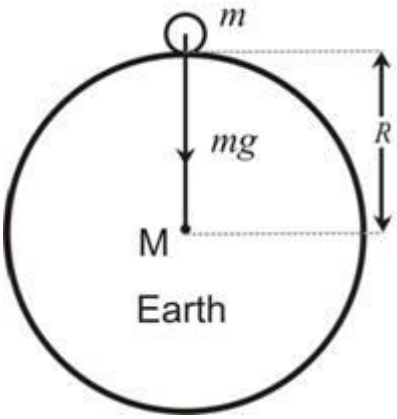
It is the force which pulls an object towards the center of the earth.

Acceleration due to gravity: The acceleration produced in a freely falling body due to the influence of gravity is called Acceleration due to gravity.

Its symbol is "g" and its SI unit is meter per second (m/s^2).

Relation between acceleration due to gravity and radius of the earth

Let 'M' be the mass and 'R' be the radius of the earth and 'm' be the mass of the body kept at the surface of the earth



According to the Newton's law of gravitation the force of attraction between them is given by

$F = G\,Mm/R^2$ ----------1

Also the body is attracted towards the center of the earth with a force given by

$F = mg$ ---------- 2

From 1 and 2,

$mg = G\,Mm / R^2$

$g = GM/R^2$ ----------3

G and M are constant whereas R varies because radius of the earth is more at the equator than at poles.

From 3

We can say that the acceleration due to the gravity is independent to the mass of the body but depends on the mass and radius of the earth.

Variation of the value of g:

a. Variation due to the shape of the earth: $g \propto 1/R^2$

Value of the g maximum at poles but minimum at equator

b. Variation due to the height from the surface of the earth:

$$g' = (R / (R + h))^2 g$$

If we increase the height from the surface of the earth the quantity in the bracket becomes less than 1.

And the acceleration due to the gravity decreases as height from the surface is increased.

c. Variation from the depth of earth surface: $g' = g(R-x)/R$ since the quantity

$(R-x)/R$ is less than 1 . The value of g inside the earth decreases with increase in depth.

At center of the earth x=R so gravity at the center of the earth is 0

Gravitational field and Gravitational field intensity:

The space around the mass where gravitational force of influence of the mass can be felt is called **gravitational field.**

Gravitational field intensity is the force experienced by the unit mass kept at that point.

It is given by

Gravitational Field intensity (I) = Forced experienced / mass

If the body of mass m is kept at the distance d from the center of the earth of mass M and radius R.

Them force experienced by the mass is given by

$F = G\,Mm/d^2$

To calculate the gravitational field intensity, we have to take a unit mass so m =1

Gravitational field intensity: $I = GM/d^2$

If the body is at the surface of the earth d = R, $I = G\ M/R^2$

This is numerically equal to the acceleration due to gravity.

Mass: It is the quantity of matter contained in the body. It is scalar quantity.

Weight: It is the force with which the object is attracted towards the center of the earth. It is vector quantity.

Weight=mass * gravity. Weight depends upon gravity and gravity depends on the distance.

E.g. As the stone is away from the earth surface the weight of the stone is less than the stone present in the bottom.

Free fall: When an object is falling towards the surface of the earth only under the influence of gravity without external resistance, the fall of the object is free fall.

Weightlessness: Weightlessness is the condition at which the apparent weight of a body is zero. Weightlessness is possible in the absence of gravity.

PRESSURE

Pressure is defined as the force acting per unit area surface.

Pressure = force/ area =F/A……1

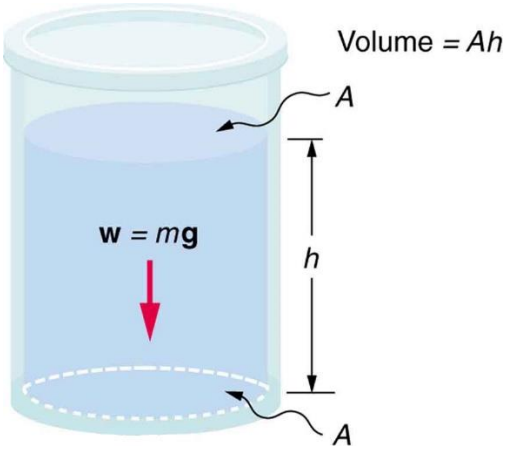
S.I unit is Nm^{-2} is also called 1Pascal (Pa). Pressure is scalar quantity.

Pressure is inversely proportional to the area. i.e. force acting on the small area exerts more pressure.

Pressure is directly proportional to the applied force i.e. more pressure is exerted if the force is increased and vice-versa.

Liquid pressure:

The pressure exerted by the liquid in a vessel is called liquid pressure. Consider a liquid with density d in a beaker of cross sectional area A and height of liquid column is h.



P=F/A

P=m g/A

P=d Vg/A

P=d A hg /A

P=d h g ----------1

The **factors affecting the liquid** pressure are:

Density of the liquid

Depth of liquid

Acceleration due to the gravity

Consequences of liquid pressure:

The pressure exerted by a liquid increases with depth.

A liquid finds its own level

The pressure at any point in a liquid acts in all direction.

Pascal's Law: Pascal's law of liquid pressure states that, "The pressure is equally exerted perpendicularly on all sides as pressure is applied on a liquid kept in a closed container."

Instruments based on Pascal's Law are: Hydraulic Brake and Pistons.

Up thrust: Up thrust is defined as the resultant thrust that a liquid uses to push up a body immersed in the liquid. Its SI unit is Newton.

Density: Density of the substance is defined as the mass per unit volume of that substance.

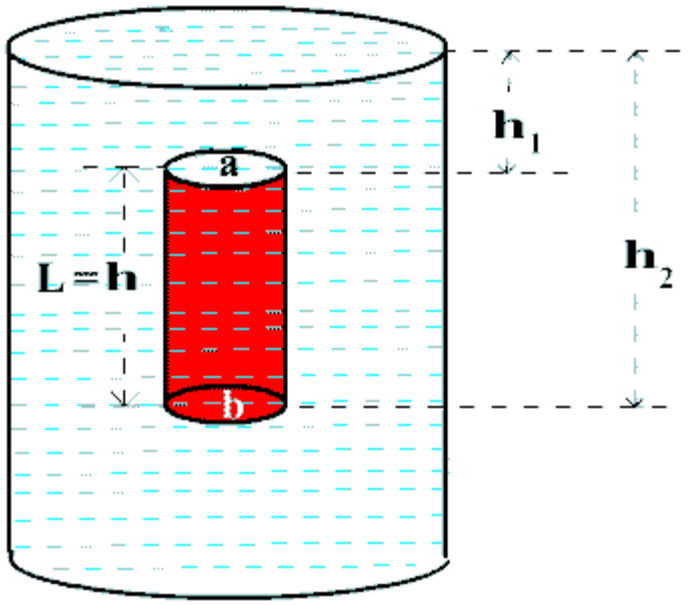
Density (d) = mass/volume

Density is measured in kg/m^3 .in S.I system. And in c.g.s. system it is measured in g/cm^3.

Relative density: The ratio of the density of the substance to the density of the substance at 4^0C is called relative density of the substance. It is unit less.

Archimedes Principle:

It states that," When a body is partially or wholly immersed in a liquid, it experiences an up thrust equal to the weight of the liquid displaced by it." This principle is used to calculate up thrust or apparent weight of an object.



Let us consider a cylinder of height h and cross-sectional area A completely immersed in a liquid as shown in figure.

Top face be at height of h_1 and bottom face be at height h_2

Thrust acted on the upper face of the cylinder due to liquid = pressure *area

$F_1 = p_1 * A$

$F_1 = dgh_1 * A$ ----------1

Similarly, upthrust acting on the bottom face

$F2 = p2 * A$

$F2 = dgh2 * A$

Total up thrust acting on the body = F2 – F1

$U = dgh_2 * A - dgh_1 * A$

$U = dgA(h_2 - h_1)$

$U = Vdg$

So the up thrust of the body immersed in a liquid is directly

Density of the liquid

Acceleration due gravity

Volume of the liquid

Also, the weight of the liquid displaced = Vdg, which is equal to the up thrust acting on the body.

Law of flotation:

Law of floatation states that, "The weight of the floating body is equal to the weight of the liquid displaced by the body."

The density of liquid is directly proportional to the floatation of the object. It means that if the density of liquid is more than the object, then the object floats whereas if the density of liquid is less than that of the object, then the object will sink. Hydrometer is a device which is based on the principle of flotation and used to measure the specific gravity and density of liquids.

ENERGY

Energy is defined as the ability or a capacity to perform a work.

On the basis of their form they are used. There are two types of energy sources:

The primary sources of energy are:

These are the sources of energy that are being used in their natural form. Wood, coal, crude oil, natural gas, solar energy.

The secondary sources of energy are:

They are derived from the secondary sources of energy. Coal gas, biogas, kerosene, petrol, diesel, charcoal are the examples of the secondary sources of energy.

On the basis of replacing period energy can be classified into two types:

Non-Renewable sources of energy: Non-renewable source of energy are found to be accumulated in the nature over a very long time and cannot be quickly replaced when exhausted at their origin place. For example: Coal, natural gas, petroleum, nuclear energy etc.

Renewable sources of energy:

The sources of energy that can be replaced if they are exhausted at their origin place are called renewable sources of energy. They are being produced continuously in nature and cannot be exhausted. They are:

1. Hydropower
2. Bio fuel
3. Tidal energy
4. Wind energy
5. Geo thermal energy
6. Solar energy

Sun as the ultimate source of energy

The sun is the ultimate source of almost all kinds of energy on earth, either directly or indirectly. Fossil fuels (coal, oil and gas) are the transformed forms of plants (and animals) which once lived

on the earth and grew capturing the energy of the sun. Biomass is a product of photosynthesis where the sun has the major role. Hydro-electricity depends upon the water cycle which again is dependent on solar radiation. Similarly, wind energy, tidal power, wave power all, in some way or other, and depends on the sun.

Energy /fuel crisis:

The future scarcity of the energy sources on the earth due to the over population, urbanization and industrialization is called energy crisis. Since the non-renewable resources of the energy will not last long and cannot be regained, the world is going to face the problem of energy crisis in near future. The only solution of energy crisis is energy saving. It can be done in following ways:

- By reducing the use of renewable sources of energy.
- By developing the alternative source of energy.
- By controlling the population growth.

Alternative source of energy:

The source of energy, which can be used instead of non- renewable sources of energy is called alternative source of energy. E.g. nuclear energy.

HEAT

Heat is defined as the sum of kinetic energy contained by the molecules of that object. The SI unit of heat is Joules. In c.g.s system it is measured calorie.

1calorie= 4.2joules

Heat depends on mass of the object and average kinetic energy of the molecules.

Heat is directly proportional to the mass of object and average kinetic energy.

Effects of heat are:

a. It changes the state of matter

b. It changes the temperature of an object.

c. It changes the solubility of a substance.

d. It changes the size of an object.

e. It changes the color of the body.

f. It changes the volume of the body

Temperature: Temperature is the degree of hotness or coldness of an object. Temperature is the thermal condition of the body that determines rate of flow of heat from one body to another. It is the average kinetic energy of the molecule.

Temperature scale

Centigrade scale:

Lower fixed point: $0^{o}C$

Upper fixed point: $100^{o}C$

Fahrenheit scale:

Lower fixed point: $32^{o}F$

Upper fixed point: $212^{o}F$

Kelvin scale:

Lower fixed point: 273K

Upper fixed point: 373K

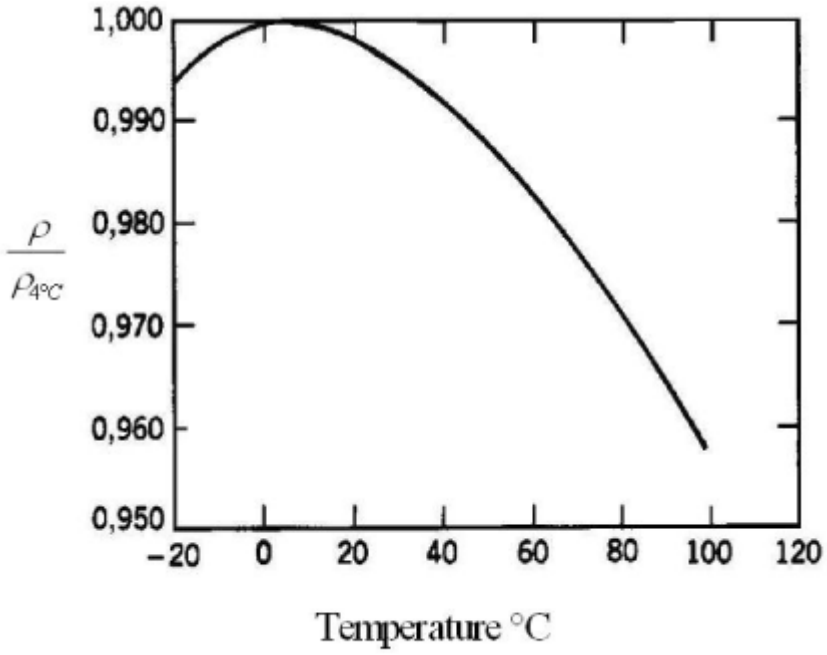
Relation between different temperature scales

C−0100C−0100 = F−32182F−32182 = K−100100K−100100

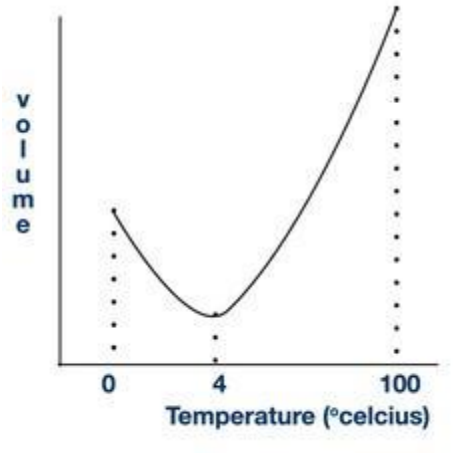
Anomalous expansion of water:

Generally, all substance expands on heating and contracts on cooling. But in case of water the behavior is different, when water at 0c is heated its volume decrease up to 4 and density increases. At 4c the density becomes maximum and beyond this temperature volume start to increase. This unusual expansion of water is called anomalous of water.

Graph between the volume and temperature



Graph between the density and temperature



Heat equation:

The amount of heat gained or lost by a body is equal to the product of the mass (m), the specific heat capacity (s) and the change in temperature (dt) of that body is called heat equation.

$Q = msdt$

Where s is proportionality constant called the specific heat capacity of the material of the body which is constant for the given material and independent of the shape size and mass of the body.

Principle of calorimetry:

When two body of different temperature are kept in thermal contact, heat transfers takes place from the hot body to cold body and the process continues until the equilibrium (same temperature) state is maintained. This principle works on the principle of the conservation of energy.

Heat lost = Heat gained

Specific heat Capacity:

The amount of heat required to change the temperature of a body of unit mass by 1°C is known as specific heat capacity of that body.

Or, $s = Q/mdt$

S.I unit of specific heat capacity is J/kg°C

Body having more heat capacity changes the temperature slowly then the body having less heat capacity.

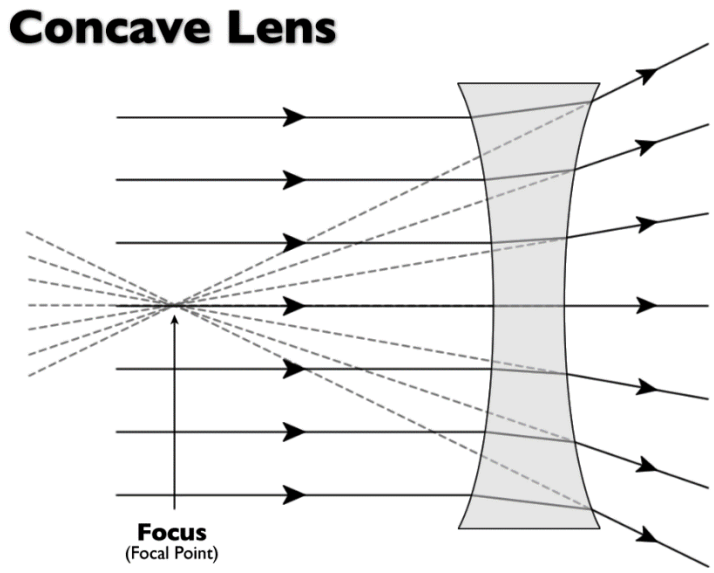
Specific heat capacity of water (s) = 4200 J/kg°C means 4200J of energy is needed to raise the temperature through $1^{o}C$

LIGHT

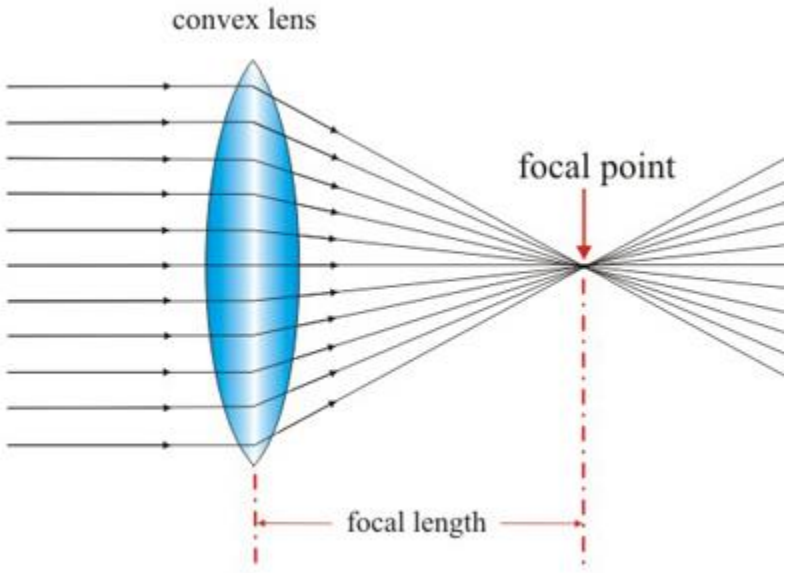
Light is the form of energy that can be found in nature from the sources like sun and other artificial sources.

Lens: lens is transparent refracting medium bonded by two spherical surfaces. There are two types of lens:

Concave lens: This lens is thin at its centre than at edges. Diverging lens is also called concave lens. It is thinner in the middle and thicker at the edges and has virtual focus.



Convex lens: This lens is thick at its centre and thin at its edges. A convex lens is called converging lens because it converge rays of light passing through it at a point after refraction.



Principal axis:

It is the straight line passing through the two centre of curvature.

Optical centre:

The geometrical centre of lens is called optical centre.

Focal length:

It is the distance between the optical centre and principal focus.

Principal focus:

When rays parallel to the principal axis of a concave (or convex) lens appear to diverge (or converge) from a point then it is called principal focus.

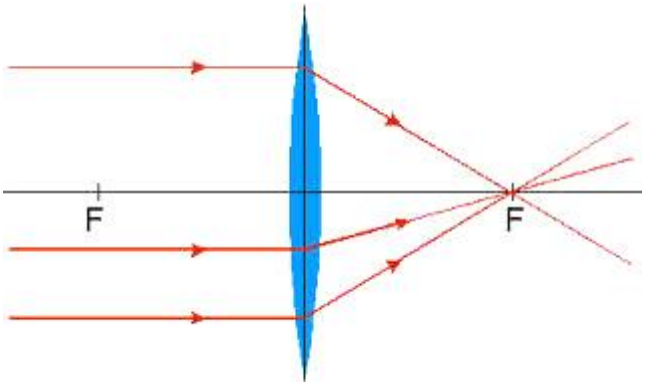
Real image and virtual image:

Image that are formed on the screen are the real image.eg image formed by the convex lens.

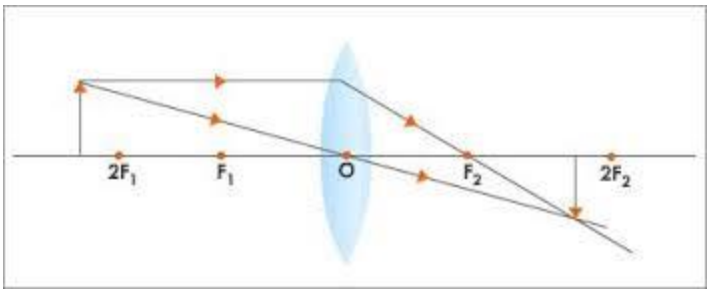
Image that are not formed on the screen are the virtual image formed by concave lens.

Ray diagram of the convex lens:

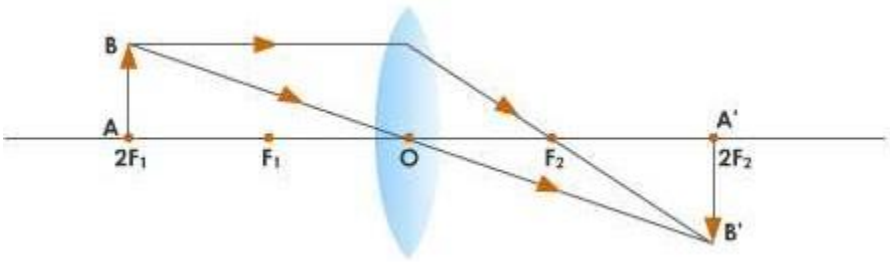
a. Parallel rays coming from the infinity meet at the focus after refraction by convex lens. The nature of image is real inverted and diminished.



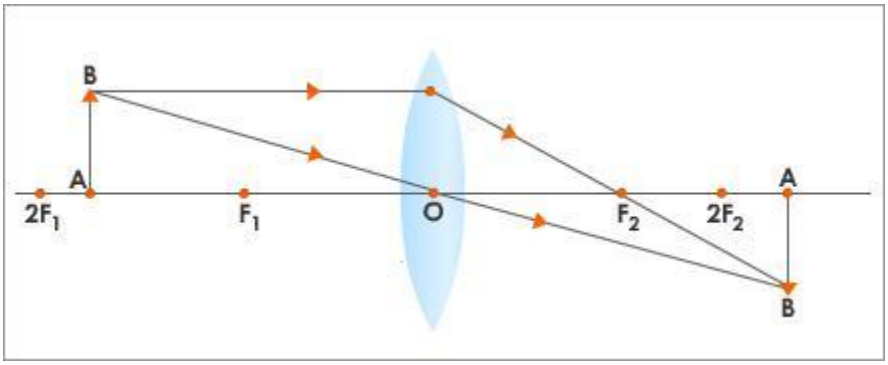
b. When the object is placed beyond the 2F, real inverted and diminished image is formed between F and 2F



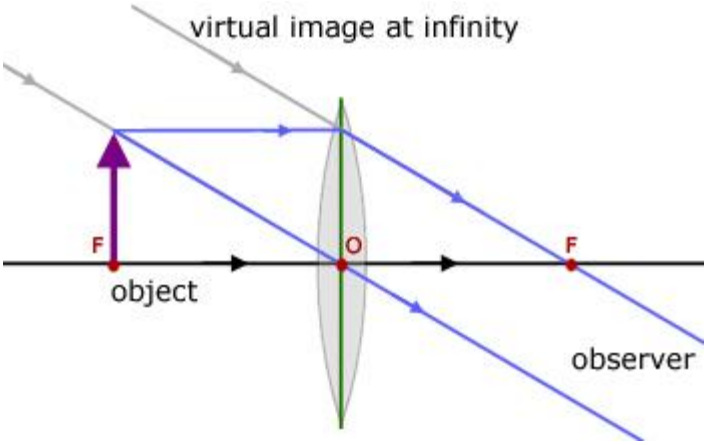
c. When the object is placed at 2F, the nature of the image is real, inverted and of the same size.



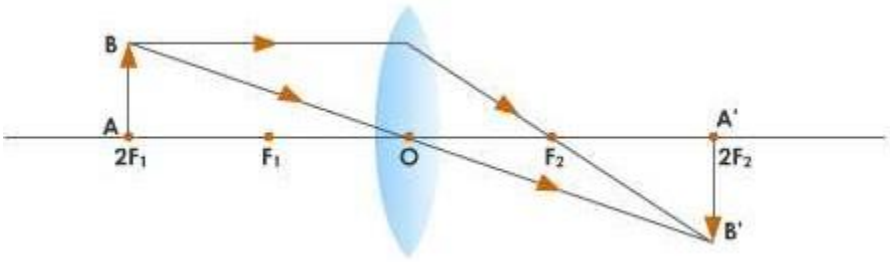
d. When the object is placed between 2F and F the image is formed beyond the 2F which is real, inverted and magnified.



e. When the object is placed at focus the image is formed at infinity which is real inverted and magnified.

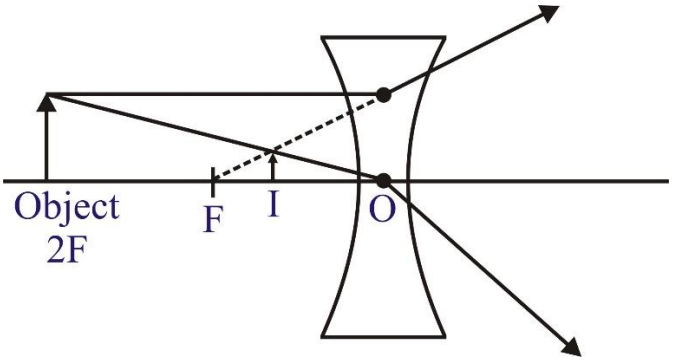


f.When the object is kept at optical centre and focus, virtual magnified and erect is formed.

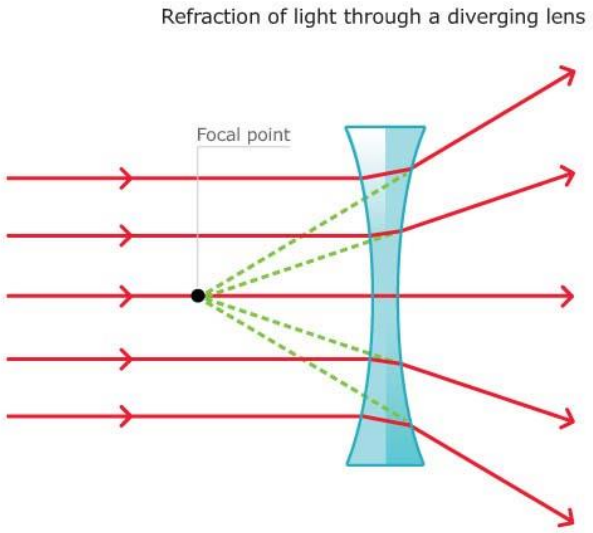


Ray diagram of the concave lens:

When the object is kept between infinity and focus, virtual erect and diminished image is formed between the focus and optical centre on the same side of the object in the lens.



When the object is kept infinity, virtual erect and highly diminished image is formed at focus.



Magnification:

The ratio of the size of the image to the size of the object is called magnification.

M = I/O = (height of image) height of object= Image distance (v)/object distance (u)

Relation between focal length, object distance and image distance:

The formula for lens is:
1/focal length(f) = 1/object distance(u)+1/image distance(v)

Power of lens:

The power of lens is defined as the ability of a lens to converge or diverge light rays falling on it.

Power(P) = 1/f

The S.I unit of the power is dioptre.

Optical instruments:

Those instruments which use lenses, prism, and mirror are called optical instruments.

Power of accommodation:

The ability of eye to change the focal length so that image is always formed at retina is called power of accommodation.

The nearest point which eye can see is called near point and it is 25cm.

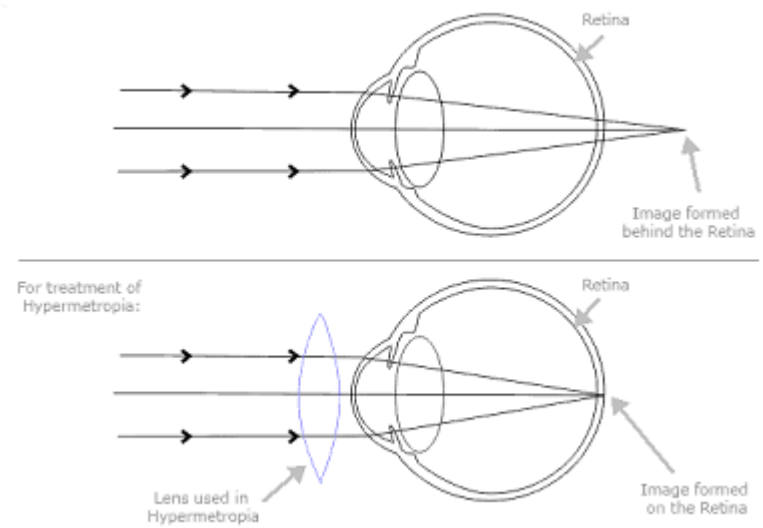
The farthest point which eye can see is called far point and it is infinity.

Defect of vision:

The inability of the eye to form a image on retina of the object lying between the far and near point is called defect of vision.

Long sightedness (hypermetropia):

The defects of eye in which a person can see object at farther distance but cannot see the object at close distance is known as long sightedness.



Causes:

Shortening of eye ball

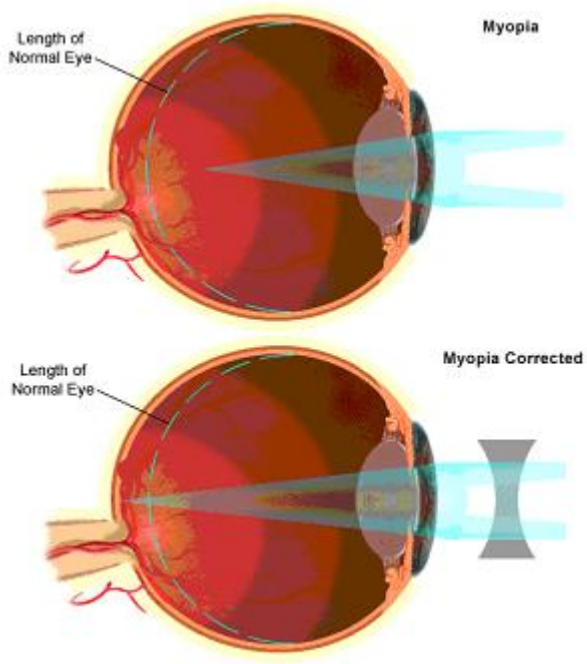
Inability of ciliary muscles of the eyes press for the required thickness, when the eye lens becomes thin

Remedy:

By using the convex lens of suitable focal length.

Short sightedness (myopia):

Short sightedness is the defect in which the person has the ability to see the object at near distance but has weakness in seeing the object at farther distance.



Causes:

Inability of ciliary muscles of the eye to press for the required thickness when the eye lens becomes thick

Elongation of eyeball

Remedy:

By using the concave lens of suitable focal length.

Microscope:

Microscope is the optical instrument which is used to view image of the small object in a magnified form. There are two types of microscope:

1. Simple microscope
2. Compound microscope

Telescope:

Telescope is the optical instrument, which is used to view the distant object. There are two types telescope:

1. Astronomical telescope
2. Terrestrial telescope

ELECTRICITY AND MAGNETISM

Electric circuit: Electric circuit is the combination of source of current, conducting wires, and loads. They are of two types:

Closed circuit:

The circuit in which switch is closed and the electric current passes in the circuit is called closed circuit.

Open circuit:

The circuit in which switch is open and the electric current does not flow in the circuit is called open circuit.

Combination of cells

Arrangement of the cells which is designed to get the maximum potential difference and current supply is called combination of cells. In general, they can be grouped as:

Series combination of cells:

In this combination the positive terminal of one cell is connected to the negative terminal of the other cell.

Total potential in this case (V) = sum of the individual p.d. of the cell.

The current in the external resistance is the number of times the current due to t e single cell

Parallel combination of cells:

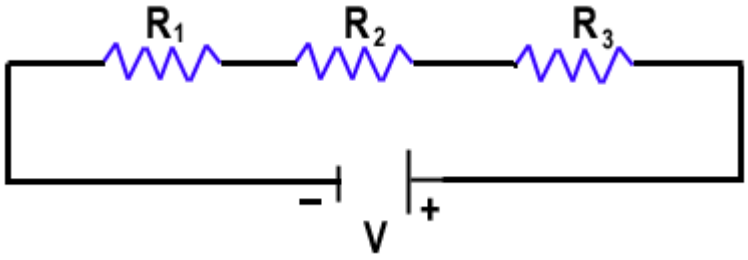
The cells are said to be parallel if the positive terminal of all cells are connected at one common point and the negative terminal are connected to one common point.

In parallel combination of cells, the total voltage between any two points is always constant this is equal to the voltage of one cell.

Combination of the resistors:

Series combination

When the resistors are connected end to end then it is called series combination of resistor.



If R_1 R_2 R_3 R_4 are connected as shown in the figure, then

$R = R_1 + R_2 + R_3$ and if V_1 V_2 V_3 are the voltage across resistors respectively.

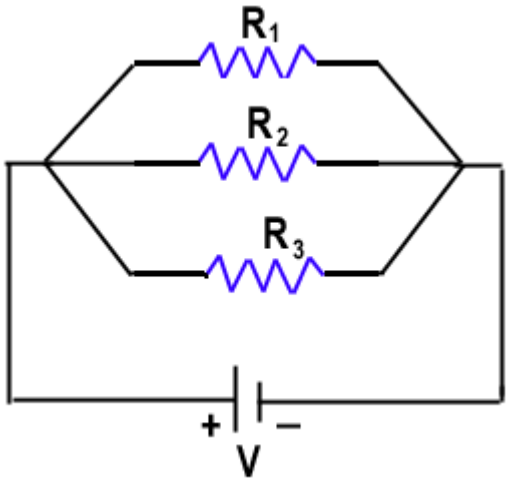
$V = V_1 + V_2 + V_3$

Characteristics

The value of the current is same in each resistor but the p. d is different. If the one of the resistor do not work, then it effects the whole combination.

Parallel combination:

When the resistors in the circuit are connected between the two common points, then the combination is called parallel combination. The voltage in each branch is same.



In this case total current $(I) = I_1 + I_2 + I_3$ ----------1

From the ohm law

$I_1 = V/R_1$

$I_2 = V/R_2$

$I_3 = V/R_3$

Putting the value in 1

V/R = V/R1 + V/R2 + V/R3

1/R = 1/R1 + 1/R2 + 1/R3

We get, the reciprocal of effective resistance in parallel combination is equal to the sum of the reciprocal of each resistance.

Electric power:

Electric power of the device is defined as the rate at which electrical energy is converted into other form of energy.

The electrical power of device is the product of the current (I) and voltage (V) across.

P = VI

P = V*V/R from ohm's law V = IR

$P = V^2/R$

$P = RI^2$

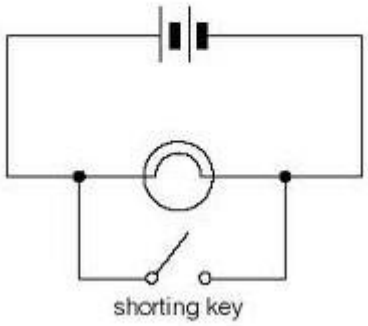
Fuse:

Fuse is a safety device to protect a circuit from excessive heating. A fuse wire is a short metal wire having low melting point made of an alloy of tin and lead. It is connected in series with a circuit.

Short –circuiting:

The overflow of the current due to the low reactance path in the circuit is called short-circuiting.

SHORT CIRCUIT



Transformer:

A transformer is a device which is used to convert low ac voltage into the high ac voltage or vice –versa.

A **step - up transformer** is used to convert low a-c voltage to high ac voltage

A **step - down transformer** is used to convert high a-c voltage to low ac voltage

Principle of transformer:

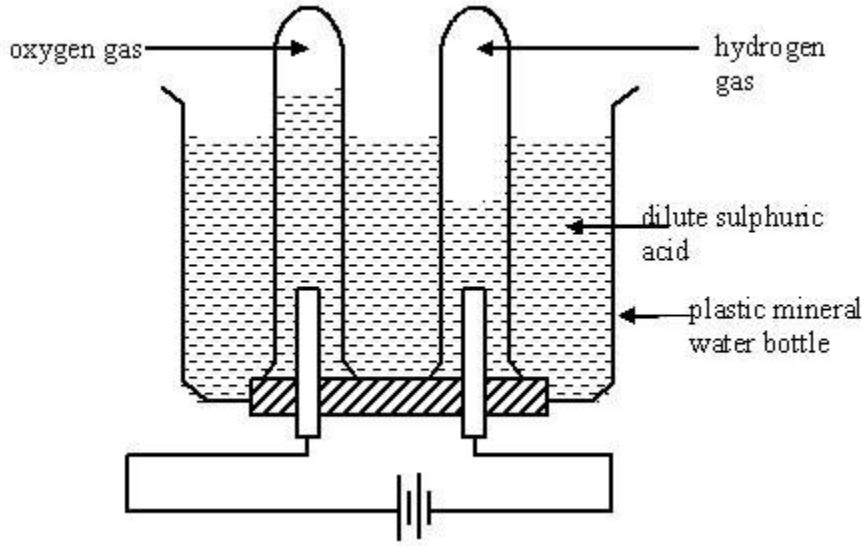
When an alternating emf is applied to the primary coil, a changing current flowing in it produces an alternating magnetic flux in it. This causes to change the magnetic flux linked with the secondary coil. An alternating emf is then induced in the secondary coil. It is called the principle of mutual inductance on which transformers are based.

Uses:

Transformers are used in computer, television, air condition, doorbells etc.

Electrolysis of water:

The process of the decomposition of the electrolytic solution into constituent when the electric current is passed through it is called **Electrolysis of water.**



When dil. H_2SO_4 is mixed with water

H_2O (HOH) $H^+ + OH^-$

At anode

$OH^- \rightarrow OH + e^-$

$4O \rightarrow 2H_2O + O_2$

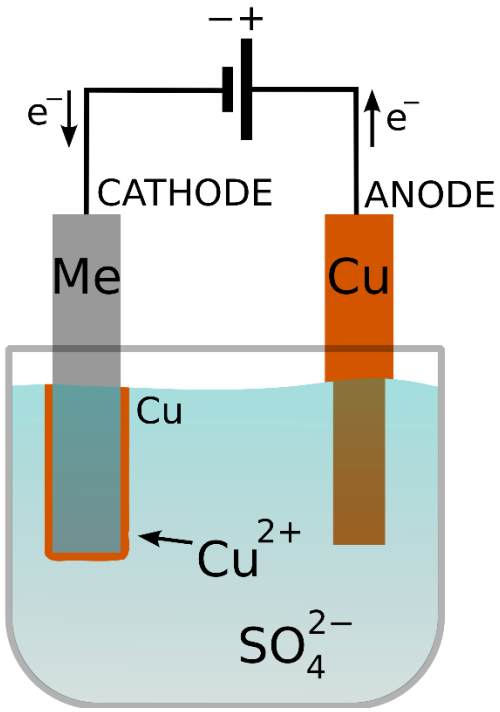
At cathode

$H^+ + e^- \rightarrow H$

$4H \rightarrow 2H_2$

Electroplating:

The process of depositing a thin layer of a metal over a conducting surface by the process of electrolysis is called electroplating. The metal to be electroplated is connected to the negative terminal of the battery and the metal which is deposited over is connected to the positive terminal of the battery.



Here CUSO4 solution is taken as electrolyte. When the electric current passes through the circuit, thin layer of the copper is deposited over the metal.

Chemical reaction involved

'When $CuSO_4$ dissolves in water

$CuSO_4 \rightarrow Cu^{++} + SO_4^{--}$

At anode: $Cu + SO_4 \rightarrow CuSO_4 + 2e^{--}$

At cathode: $Cu^{++} + 2e \rightarrow Cu$

Application of electrolysis

- Purification of metal
- Electroplating
- Extraction of metal
- Production of hydrogen and oxygen gas

Lighting effect of current:

Some electrical devices converts electrical energy into the light energy this is called lighting effect of electric current

Lighting effect of current is used in:

Florescent lamp:

A florescent lamp consists glass tube filled the mercury vapor and coated with florescent powder. It converts 30% of the electrical energy to the light energy and very useful for the household purposes.

Filament lamp:

Filament lamp has tungsten filament with inert gases filled inside the bulb. These inert gases prevent from the oxidation and evaporation of tungsten metal at high temperature. It converts 10% of the electrical energy into light energy.

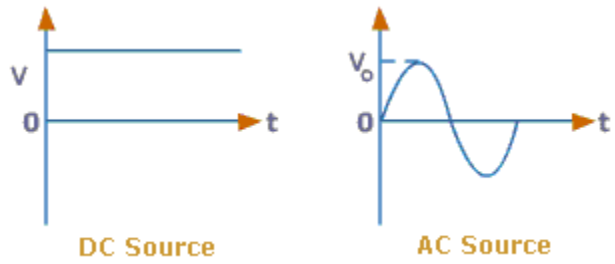
Fleming right hand rule:

Fleming's right hand rule states that "If the first three fingers of the right hand are held mutually perpendicular to each other, with the index finger in the direction of the magnetic flux and the thumb in the direction of motion of coil, the middle finger points to the direction of the induced current."

Fleming's right hand rule is used to determine the direction of the induced current in a generator.

Ac and Dc circuit:

Alternating current is one which changes its magnitude continuously and reverses its direction periodically and if the polarity of an electrical source does not change with time it is called direct current.



Graph of ac and dc circuit

Electromagnetic induction

The phenomenon of inducing the emf in a closed circuit whenever there is change in the magnetic flux is called electromagnetic induction. The resulting current is called induced current.

Faraday laws of electromagnetic induction

Faradays laws of electromagnetic induction are:

1. Whenever magnetic flux linked with a closed circuit changes, an emf is induced in the circuit.

2. The induced emf lasts as long as the change in the magnetic flux is taking place.

3. The magnitude of the induced emf is directly proportional to the rate of change of the magnetic flux.

CLASSIFICTION OF ELEMENTS

Mendeleev's periodic table

Mendeleev's periodic rule states, "The physical and the chemical properties of elements are a periodic function of their atomic weights."

The merits of Mendeleev's periodic table are:

1. Incorrect atomic weights of some of the arranged elements were corrected.
2. Existence of some undiscovered elements was predicted and Mendeleev left gaps for them.

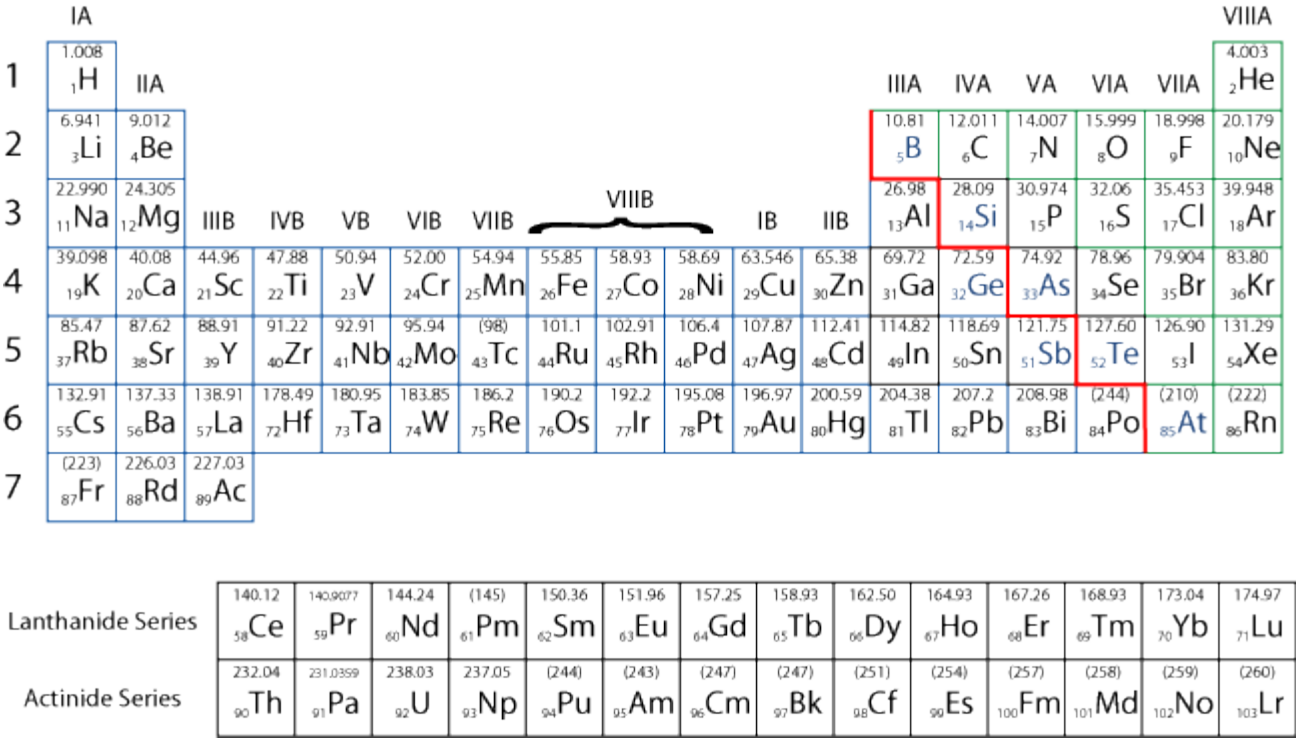
The defects of Mendeleev's periodic table are:

1. Hydrogen was placed in the group I with alkali metals like Li, Na etc but it could be also placed in the position of halogens.
2. The position of isotopes should be separated according to Mendeleev's periodic rule but they were kept within the same group.
3. There were no suitable places for Lanthanides and Actinides series.

Modern periodic table

Modern periodic rule states that "The physical and the chemical properties of elements are a periodic function of their atomic number."

Modern Periodic Table has many advantages like Elements are arranged in 4 different blocks, they are arranged in the increasing number of atomic number, position of alkali metals, alkali earth metals, halogens, inert gases etc. are separated. So it is superior than Mendeleev's periodic table.



The features of Modern Periodic Table are:

1. The wrong position of some elements like Argon and Potassium, Cobalt and Nickel were rearranged by their atomic number.
2. Isotopes of the same element can be placed within the same group due to the same atomic number.
3. The controversy of Hydrogen was explained.
4. Elements have been classified into 4 different blocks.

Periods are the horizontal rows of elements in the periodic table. There are seven periods.

Characteristics of periods

- The number of electron in the valance shell increases as we move from the left to right.
- The valency of the electron increases from 1 to 4 then decreases to 0.
- Atomic size of an atom decreases from left to right due to increase in nuclear charge as extra electron is added.
- Ionization energy and electro positivity decreases as we move from left to right in periodic table.
- Electro negativity and metallic character increases as we move from left to right.

Groups are the vertical columns of elements in periodic table. There are 18 groups arranged vertically.

Characteristics of groups

- Atoms of the element in the group have the same number of the electron in the outermost shell.
- Elements in the group have same valency except for the group 0, which do not take part in the chemical reaction.ar
- Atomic size increases as we move down as one new shell is added.
- Ionization increases as we move down the group.
- Metallic character, chemical reactivity of metals increases but not metallic character and chemical reactivity decreases as we move down the group.

Sub-shells

Each shells consists number of sub-shells in which electrons are distributed.

s-block

It includes alkali and alkali earth metals which forms positive ions by losing one or two electron of the outermost shells.eg Ca, Mg

p-block

It includes metals, metalloids non-metals and inert gases. They may have 1 to 6 valence electrons in the outermost shells. The completely filled p-orbital are noble gases.

d-block

It includes the transition element which lies in between s and p block elements. E.g. Ag

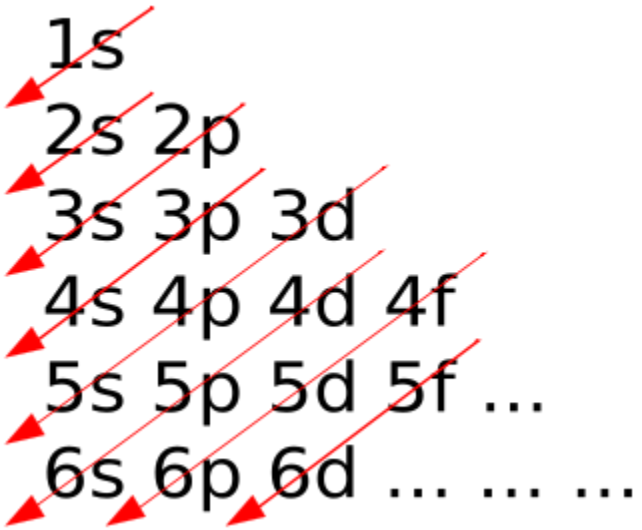
The valance electron lies in the d sub shells.

f- block

It includes the elements of lanthanide and actinide.

Aufbau principle

This principle explains how the atoms are being arranged in orbital. According to this principle, the sub shells of lowest energy is filled first then higher energy level are filled so on.



Valency

The total number of the electrons in the outermost shell of an atom, either shared or gained or lost in chemical combination is called valency. The outermost electron determines the chemical reactivity of the element.eg sodium has one valence electron that it transfers to the shell of other atom and becomes positively charged. So the valency of sodium is 1.

CHEMICAL REACTIONS

Chemical reaction is the change in both physical and chemical properties brought about by the addition, decomposition or displacement of an atoms or group of atoms.

Chemical equation is the symbolic and short representation of chemical reaction.

Nitrogen + Hydrogen Ammonia

N_2 + H2- NH_3 ↑

Here, N_2 and H_2 are reactants and NH_3 isthe product.

If the total number of atoms in the reactants and products are same then the chemical reaction is said to be **balanced chemical equation.**

For example:

$4Al + 3O_2 \rightarrow 2Al_2O_3$

$H_2 + O_2 \rightarrow H_2O$

Here, the number of oxygen in the reactant is not equal to the oxygen in product side. So, to balance the equation we have to balance the numbers on the reactant as well as product side.

$2H_2 + 0_2 \rightarrow 2H_20$

Here, all the elements in the product side are equal to the elements in the reactant side.

Factors influencing the chemical reaction

a. Simple Contact: When two elements are brought in contact they react. This is the simple condition under which chemical reaction takes place.

$2Na + Cl_2 \rightarrow 2NaCl$

b. Light: Light simulates the reactants for chemical reaction. When hydrogen react violently with chlorine in presence of diffused sunlight hydrogen chloride is produced.

$H_2 + Cl_2 \rightarrow$Sunlight 2HCl

c. Temperature: Increase in temperature increases the rate of almost all chemical reactions while decrease in temperature decreases the reaction rate. The increase in temperature increases the kinetic energy of molecules. It causes the breaking of bonds n the reactant molecules and reaction takes place at a high speed.

d. Concentration: The rate of reaction increases with the increase in the concentration of reactants. This means that the rate of reaction is directly proportional to the concentration of the reactants. For e.g. when dilute HCl is poured into a piece of calcium carbonate there is effervescence with the evolution of CO_2.The effervescence is brisk when concentrated HCl is added. So it increases the rate of chemical reaction between $CaCO_3$ and HCl.

e. Pressure: Pressure is another important factor influencing the chemical reaction. With the application of high pressure nitrogen and hydrogen combined to form ammonia.

N_{2+} H2- NH_3

f. Catalyst: A catalyst is defined as a chemical substance that changes the rate of chemical reaction itself without undergoing any permanent chemical change during the course of chemical reaction. They are of two types; they are positive catalyst and negative catalyst.

Manganese dioxide acts as a **positive catalyst** in the decomposition of hydrogen peroxide without heating. This is because it increases the decomposition rate of hydrogen peroxide. Also glycerin acts as a **negative catalyst** as it decreases the rate of reaction during the decomposition of hydrogen peroxide into water and oxygen.

$2H_2O_2 \rightarrow$MnO2 $2H_2O + O_2$

Types of chemical reaction

There are 4 types of chemical reaction mainly. They are as follows:

a. Addition or Combination reaction.

Examples:
Sodium combines with chlorine to form sodium chloride.
$2Na + Cl_2 \rightarrow 2NaCl$
When iron fillings are heated with Sulphur, Ferrous Sulphide is produced.
$Fe + S \rightarrow Fes$

b. Decomposition or dissociation reaction.

Examples:
When lead oxide is heated, it decomposes into lead and oxygen.
$2PbO \rightarrow 2Pb + O_2$
When sodium chloride is electrolyzed at a high temperature, it forms sodium and chlorine.
$2NaCl \rightarrow 2Na + Cl_2$

c. Displacement Reaction

Examples:
Single Displacement
$Zn + H_2SO4 \rightarrow ZnSO4 + H_2$
In this reaction, H_2 is replaced by Zn.
Double Displacement
$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
In this reaction, Na is replaced by Ag and NO_3 is replaced by Cl.

Neutralization or Acid Base Reaction

Examples:
When NaOH is reacted with HCl, then there is formation of NaCl and H_2O
$NaOH + HCl \rightarrow NaCl + H_2O$
When copper oxide reacts with hydrochloric acid then copper chloride is formed.
$CuO + 2HCl \rightarrow CuCl_2 + H_2O$

The sum of atomic weights of all the atoms of the same or different elements present in the molecule is called **molecular weight.**

The **molecular weight** of a substance (elements or compounds) is expressed in term of gram, which is called its gram molecular weight. It is also called gram mole or only mole.

One mole of a substance is defined as a collection of $6.023*10^{23}$ particles of that substance.

$6.023*10^{23}$ = 1 Avogadro's number

ACID, BASE AND SALT

An **acid** is a substance which gives hydrogen ions or proton (H+) when dissolved in an aqueous solution.
Examples: - Hydrochloric acid (HCl), sulphuric acid (H_2SO_4) , nitric acid (HNO_3), carbonic acid (H_2CO_3)

$HCl\ H^+ + Cl^-$

Properties of acids

a) Acid is sour in taste.
b) Acid reacts with base to give salt and water.
   For example:
   $HCl + NaOH \rightarrow NaCl + H_2O$
   (acid) (base) (salt) (water)
c) It gives hydrogen ion (H+) when dissolved in water.
   For example:
   $HCl \rightarrow H^+ + Cl^-$
d) Acid turns blue litmus paper to red, light yellow color of methyl orange to red and phenolphthalein to colorless.
e) When acid reacts with carbonates and bicarbonates, carbon dioxide is produced.

   $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Uses

- Carbonic acid is used in soft drinks.
- Sulphuric acid is used in fertilizers
- Hydrochloric acid is used for bleaching purpose.
- Carbolic acid is used as germ killer.

Bases are the substance, which gives hydroxyl ion when dissolved in aqueous solution.
For example: Sodium oxide (NaO), Potassium hydroxide (KOH) etc.

Properties of base

- Base turns red litmus paper into red, phenolphthalein into pink and methyl orange in to yellow.
- Alkalis are water-soluble bases. They give hydroxyl ions when dissolved in water.

  For E.g.: NaOH, KOH and $Ca(OH)_2$.

- Alkali reacts with carbon dioxide to produce in the presence of heat.

  $NaOH + CO_2Na_2CO_3 + H_2O$

- Acid reacts with base to give salt and water.
  For example:
  $HCl + NaOH \rightarrow NaCl + H_2O$
  (acid) (base) (salt) (water)

Salts are the neutral compounds, which are formed by the reaction between acid and base. Example: NaCl, $CaCL_2$ etc.

The salt formed by the complete displacement of hydrogen atoms by a metal or electropositive radical is called normal salt. Normal salt are neutral in nature.

For e.g.: NaCl, KNO_3 etc

The salt formed by strong acids and weak base are strong salt.

E.g. CuSO4

The salt formed by weak acid and strong base are called basic salt.

E.g. $Ca(HCO_3)_2$

Methods of preparation of salts are as follows:
Neutralization of acid and base
$NaOH + HCl \rightarrow NaCl + H_2O$

Reaction of acid on metallic oxides
$FeO + 2HCl \rightarrow FeCl_2 + H_2O$

Action of acids on metal
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

The characteristics of salt are:

Common salt (NaCl) is an essential constituent of our diet.

Most salts are insoluble in water but few are soluble in water.

The solution during the formation of salt the radical derives from an acid is called acid radical and the radical obtained from a base is called basic radical.

For E.g.:

$NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

In the salt Na_2SO_4, sodium radical (Na^+) is obtained from the base (NaOH) and SO_4^{--}radical is obtained from the acid H_2SO_4. So Na^+ and $SO_4^{--}$are called **basic radical** and **acid radical** respectively.

I**ndicators** are the chemical substance used to identify acidic or basic nature of the substance.

Indicators	Litmus	Phenolphthalein	Methyl Orange
Acid	Blue to Red	Colorless	Red color
Base	Red to Blue	Pink Color	Yellow color
Salt	No change	Neutral	No change

A **universal indicator** is a special kind of indicator which is used to measure the strength of acidity or alkalinity. It is prepared by several organic indicators of different of different colors. It is found in green blue solution or in the form of yellow litmus paper.

pH Scale is the scale which shows the quantity of hydrogen ions in acid or base.
If the concentration of hydrogen ion is less than 7, then it shows acidity of the substance and if the concentration is more than 7 then it shows the basicity of the substance.

When we add alkali on acid, the pH value of the acid goes from its acidic value to value 7 where it acts as a neutral compound as the pH value of neutral compound is 7.

SOME GASES

Carbon dioxide

General **methods of preparation:**

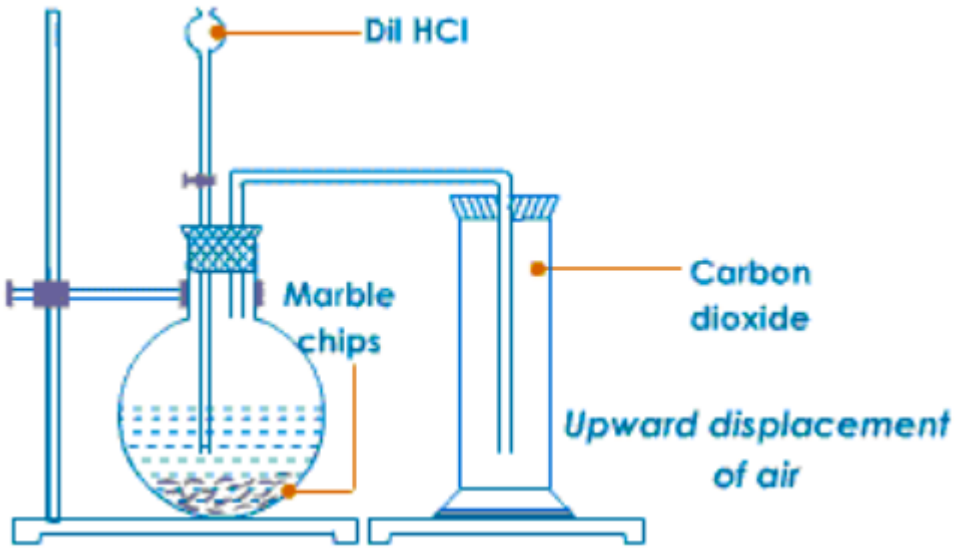
By burning carbon in excess air

$C + O_2 \rightarrow CO_2$

By burning organic compounds.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy

Laboratory preparation of carbon dioxide



Carbon dioxide is prepared in the laboratory by reacting calcium carbonate with dil. hydrochloric acid.

Chemical Reaction:

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

First of all, pieces of limestone are taken in Wolfe's bottle and dil HCl is poured from the thistle funnel. When limestone and HCl comes in contact, the reaction occurs and CO_2 gas is formed.

The formed gas passes through the delivery tube to the gas jar. Since, the gas is heavier than air, it is collected by upward displacement of air.

Physical properties of Carbon dioxide are:

1. It is colorless, odourless and tasteless gas.
2. It is heavier than air.
3. It dissolves in water.
4. It turns wet blue litmus paper into red.

Chemical properties of carbon dioxide are:

i. When CO_2 gas reacts with lime water, then it forms calcium carbonate and the solution turns lime water milky.
$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

ii. When carbon dioxide is passed into lime water for a long time, then the milky solution turns into colorless.
$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$

iii. The process by which plants make the food with the help of sunlight is called photosynthesis.
$6CO_2 + 6H_20 \rightarrow$ Sunlight + $C_6H_{12}O_6 + 6O_2$

Uses

1. Carbon dioxide is used by all green plants during photosynthesis.
2. It is used as fire extinguishers.
3. It is used for making dry ice to preserve meat, fruits etc
4. It is also used in the process of carbonation in industries.
5. It is used for making soft drinks like beer, coca cola, soda etc.

Ammonia

General methods of preparation:

Heating ammonium salts

$(NH_4)2SO_4$ 2 $NH_3 + H_2SO_4$

Heating ammonium salts with strong base

When the mixture of sodium hydroxide and ammonium sulphate is heated, then there is the formation of ammonia gas. $(NH_4)_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O + NH_3$

Laboratory preparation of ammonia gas.

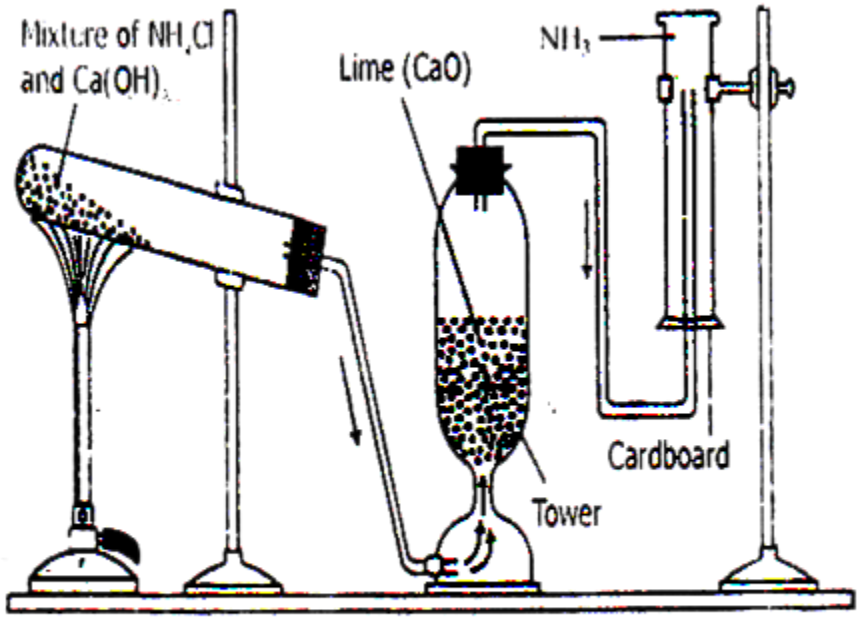


Fig: Preparation of Ammonia in Laboratory

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When a crushed mixture of ammonium chloride is heated with calcium hydroxide, then ammonia produced.

$2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3$

For the preparation of ammonia gas, first of all a mixture of ammonium chloride and slaked lime is taken in a hard glass tube. The test tube is hold by a stand in inclined position. The delivery tube is fixed on the opening of the test tube which is connected to lime tower. Above lime tower inverted delivery tube is kept. When the mixture is heated, ammonia gas is liberated which passes through lime tower inside the delivery tube. Since ammonia is lighter than air, it is collected by downward displacement of air.

The test of ammonia gas can be done in following ways:

I. It changes red litmus into blue.

II. It can be identified by its pungent smell.

III. When it is reacted with HCl, it forms ammonium chloride.

Manufacture of ammonia (Haber's synthesis process)

In the industrial sector, ammonia is manufactured at the Haber's synthesis process. In this process, nitrogen and hydrogen are heated in the ratio of 1:3 in the presence of iron as catalyst and molybdenum as promoter at temperature of about 500oC, under high pressure of about 200 - 900 atmospheric pressure. $N_2 + 3H_2 \leftrightarrow 2NH_3$ It is essential for production of ammonia at large quantity because it is a reversible process. Since it is reversible, after a certain time product will form the reactants itself, so less reactant is consumed. Along with that it is an exothermic reaction, so less heat is required.

Uses

- It is used in preparation of chemical fertilizers.
- It is also used for the production of nylons and rayon.

METALS

Metal is a solid material that is typically hard, shiny, malleable, fusible, and ductile, with good electrical and thermal conductivity (e.g., iron, gold, silver, copper, and aluminum, and alloys such as brass and steel).

The **physical properties** of metal are:

1. They are good conductor of heat and electricity.
2. They have high specific gravity.
3. They have high melting and boiling point.
4. They are malleable and ductile in nature.
5. They have metallic luster.

Iron is called metal because it shows metallic property.

Chemical properties of metal are:

i. Metals like zinc, iron reacts with sulphuric acids to produce the hydrogen gas.
$Fe + dil.\ H_2SO_4 \rightarrow FeSO_4 + H_2$

ii. Some metals Mg, Ca combine with oxygen to produce oxides
$2Mg + O_2 \rightarrow 2MgO$

Metallurgy

The process of extraction of metal from its ores is called **metallurgy.**

Metallurgical processes are:

Crushing of the ores

Pulverization of the crushed ore

Concentration of the ore

Calcinations and roasting

Extraction of the metals

Refining

Iron

Symbol:Fe

Atomic weight:26amu

Atomic no:55.84

Valency: 3 and 2

Iron is transition element and known as d block element. It belongs to group VII of the periodic table. The electronic configuration of iron is: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$,$3d^6$

Occurrence: Iron is very rarely found in free state but it occurs in a combined form. It is found in the body of living organisms. Ores of iron are Hematite and Magnetite

Properties

i. When iron is immersed in copper sulphate solution, copper is liberated.
$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

ii. When iron and chlorine is heated, it forms ferric chloride.
$2Fe + 3Cl_2 \rightarrow 2FeCl_3$

iii. Reaction of iron with acids
$Fe + dil.\ H_2SO_4 \rightarrow FeSO_4 + H_2$
$Fe + dil.\ 2HCl \rightarrow FeCl_2 + H_2$
$4Fe + dil.\ 10HNO_3 \rightarrow 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$

When iron is exposed to moist air, a brown scale of rust is formed and rusting takes place in iron. The chemical formula of rust is ($2Fe_2O_3.H_2O$)

Uses

1. It is used as making rods, pipes
2. It is used in the manufacture of steel
3. It is used in making household utensils
4. It is used as a catalyst in chemical reaction.

Aluminum

Symbol: Al

Atomic weight: 27amu

Atomic no: 13

Valency: 3

Ores: bauxite, feldspar, caryolite.

The electronic configuration of iron is: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $2p^1$,

Properties

i. Reaction of Aluminum with acids
$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$
$2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$
$2Al + \text{conc. } 6H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3SO_2 + 6H_2O$

ii. When aluminum is heated with nitrogen, then aluminum nitride is formed.
$2Al + N_2 \rightarrow 2AlN$

iii. When aluminum is heated with chloride, then aluminum chloride is formed.
$2Al + 3Cl_2 \rightarrow 2AlCl_3$
$2Al + 3Cl_2 \rightarrow 2AlCl_3$
$2Al + 3Br_2 \rightarrow 2AlBr_3$
$2Al + 3I_2 \rightarrow 2AlI_3$

Uses

The uses of aluminum are as follows:

I. It is used in making coins.
II. It is used in electric cables.
III. Aluminum foil is used in wrapping.

Copper

Symbol: Cu

Atomic weight: 67.57amu

Atomic no: 29

Valency: 1 and 2

The electronic configuration of iron is: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^1$,$3d^{10}$

Properties

i. With concentrated Nitric acid,
$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

ii. With dilute nitric acid
$4Cu + 10HNO_3 \rightarrow Cu(NO_3)_2 + 2N_2O + 4H_2O$

iii. Reaction of copper with acids
$Cu + \text{conc. } H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$
$2Cu + \text{conc. } HCl \rightarrow 2CuCl + H_2$
$Cu + \text{conc. } 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

Uses

1. It is used for making electrical goods and cables
2. It is used for making coins, pieces of jewelers.
3. It is used for electroplating
4. It is used in electrolytic process.

Silver

Symbol: Ag

Atomic weight: 107.88amu

Atomic no:47

Valency: 1

Ores: Argentite, Horn silver, pyrolite

The electronic configuration of silver is: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$ $4p^6$, $5s^1$, $4d^{10}$

Properties

i. When silver is heated with bromine, then there is formation of silver bromide.
$2Ag + Br_2 \rightarrow 2AgBr$ silver

ii. Action with Sulphur:
$2Ag + S \rightarrow Ag_2S$ (Silver Sulphide)

iii. Action with halogen:
$2Ag + Cl \rightarrow 2AgCl$ (Silver Chloride)

iv. Action with nitric acid:
$Ag + \text{conc. } 2HNO_3 \rightarrow 3AgNO_3 + 2H_2O + NO$
(Silver Nitrate)
The mixture is called Aqua Regia.
$2Ag + \text{conc. } H_2SO_4 \rightarrow Ag_2SO_4 + H_2O + SO_2$
$4Ag + \text{conc. } 4HCl + O_2 \rightarrow 4AgCl + 2H_2O$
(Silver Chloride)

v. $3Ag + \text{dil. } 4HNO_3 \rightarrow 3AgNO_3 + 2H_20 + NO$
$Ag + \text{conc. } 2HNO_3 \rightarrow AgNO_3 + H_2O + NO_2$

Uses

1. It is used for making coins, pieces of jewelers.
2. Silver bromide is used in photography.
3. It is used in the preparation of silver salts and medicine.
4. It is used for silvering mirror.

Gold

Symbol: Au

Atomic weight:197.2amu

Atomic no:79

Valency: 1 and 3

The electronic configuration of silver is: $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}4p^6, 5s^2, 4d^{10}, 5p^6, 6s^1, 4f^{14}, 5d^{10}$

Gold is called noble metal. Gold is found in native state because it does not react with other elements in ordinary conditions.

Properties

Action with Acid:

$2Au + 3HNO_3 + 9HCl \rightarrow 3NOCl + H_2O + 2AUCl_3$

(Aqua Regia) (Nitrosyl Chloride)

Action with Halogens:

$2Au + 3Cl_2 \rightarrow 2AuCl_3$

Action with alkali Cyanide:

$4Au + 8KCN + 2H_2O \rightarrow 4K[Au(CN)_2] + 4KOH$

(Potassium aurocyanide)

Uses

1. It is used for electroplating
2. It is used to prepare alloys.
3. It is used for making pieces of jewelers.
4. It is used as ornaments.

HYDROCARBON AND THEIR DERIVATIVES

Hydrocarbons and their derivatives

Hydrocarbons are the chemical compounds made by the composition of hydrogen and carbon. Example: Methane (CH_4), Ethane (C_2H_6), Propene (C_3H_6), acetylene (C_2H_2) etc.

There are two types of hydro carbons. They are:

1. **Saturated Hydrocarbons**
2. **Unsaturated Hydrocarbons**

The hydrocarbons with single bonded carbon atoms are known as **saturated hydrocarbons.**

It consists of only one group i.e. alkane group.

Example: Methane, Ethane, etc.

The hydrocarbons with double bonded or triple bonded carbon atoms are known as **unsaturated hydrocarbons.**

It consists of alkene and alkyne group.

Example: Propene, Propyne, etc.

An **alkene** is an unsaturated hydrocarbon in which the two carbon atoms are connected by a double bond. The double bond is formed by the sharing of two pairs of electrons. For eg: Methane, Propane etc

Alkynes are an unsaturated hydrocarbon in which the two carbon atoms are connected by a triple bond. The triple bond is formed by the sharing of three pairs of electrons. For Eg: Acetylene, Methyl acetylene etc.

Homologous series is defined as a group of organic compounds having similar structures and chemical properties in which the successive compounds differ by CH_2 group.

The **characteristics of homologous series** are:

1. All the members of the same series can be represented by the same formula.
2. All members of the series show similar chemical properties.
3. Each excessive member of a homologous series differs by CH_2.
4. All the members of the same series have the same functional group like alcohol (-OH), ether (-O-) etc.

Example. C_2H_6,C_3H_8

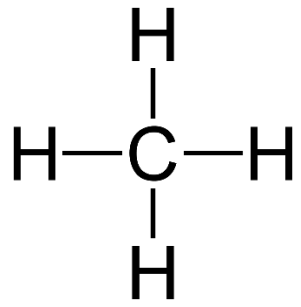
Functional group is defined as an atom of group of atoms which determines the chemical behavior of organic compounds.

The hydrocarbon unit derived by the removal of one hydrogen atom from alkane is called alkyl group.

Methane

Molecular formula: CH_4

Structural formula:



First member of alkane

Uses

The five uses of Methane are:

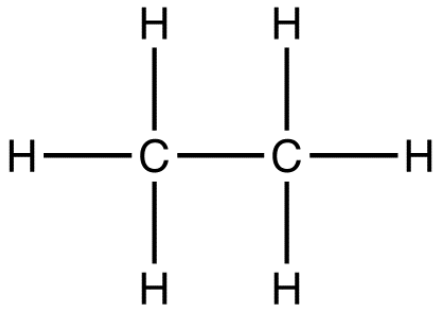
1. It is used to manufacture water gas or hydrogen gas.
2. It is used in the form of LPG for domestic use.
3. It is used for making printing ink.

4. It is used for making Carbon Black needed for paints and in rubber industries.
5. It is used as a gaseous fuel in industries and household works.

Ethane

Molecular formula: C_2H_6

Structural formula:



Second member of alkane family

Uses

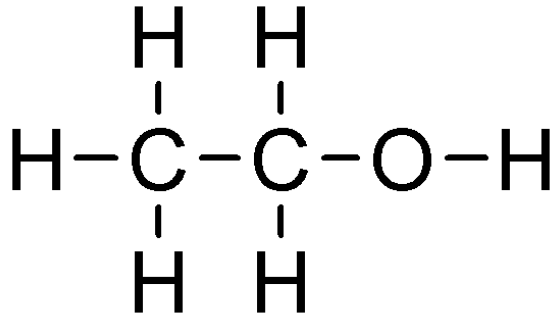
- Used as gases fuel
- Preparing the organic compounds

Alcohol

Organic compounds containing the hydroxyl group attached to saturated carbon atoms or hydrocarbon radicals are known as **alcohol.**

Ethyl –alcohol (C_2H_5OH)

Structural formula:



Preparation

By oxidation of glucose in the presence of yeast

$C_2H_{12}O_6 \rightarrow C_2H_5OH + 2CO_2$

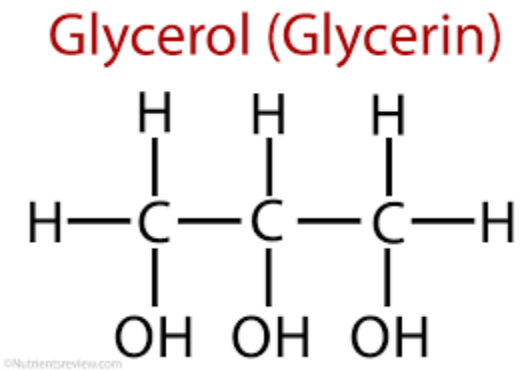
Physical properties of alcohol

1. It is colorless liquid but has taste
2. It is soluble in water.
3. Its boiling point is 78^0C and freezing point is -114^0C.

The **uses** of alcohol are as follows:

I. It is used for dry cleaning.
II. It is used as alcoholic beverage.
III. It is used in making paint, varnish, medicine, synthetic rubber etc.

Glycerol ($C_3H_5(OH)_3$)



Glycerol is the simplest trihydric alcohol. It occurs in almost all the natural animal fats and vegetable oils. It is proposed by hydrolysis of fat or oil in presence of alkali.

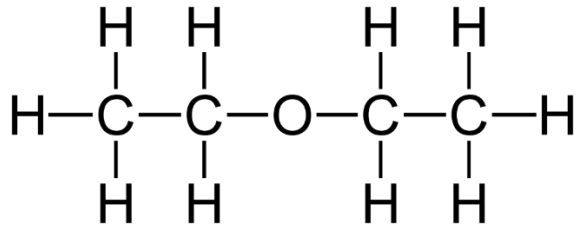
Physical properties

- Soluble in water
- Colorless viscous liquid
- Sweat taste

The **uses of glycerol** are as follows:

I. It is used to make toilet soaps and cosmetic goods.
II. It is used to make printing inks and stamp pad inks.
III. It is used for the preservation of tobacco, fruits and other edible substances.

Diethyl ether (C_2H_5–O - C_2H_5)



Preparation: By heating the ethyl alcohol in the presence of conc. H_2SO_4 at 270^0C

$2C_2H_5OH$ C_2H_5–O - C_2H_5 + H_2O

The **physical properties of ether** are:

1. It is colorless volatile liquid with pleasant smell.
2. It is slightly soluble in water but readily soluble in alcohol.
3. Its freezing point is -116^0C and boiling point is 35^0C

The **uses of ether** are:

1. It is used as a solvent.
2. It is used as cooling agent.
3. It is used as purifying compounds by extracting.

MATERIALS USED IN DAILY LIFE

Cement

The mixture of calcium silicate (fine grey) and calcium aluminate is called cement.

Cement is prepared by heating calcium carbonate ($CaCO_3$) and special kind of clay ($Al_2O_3.SiO_2$) at a temperature of 1600°C.

Uses

Plastering of walls, between the bricks

Used for roofing and flooring

Glass

Glass is the **transparent** homogeneous mixture of the silicates of alkaline and alkali metals.

Ordinary glass is made from a mixture of 50% Silica, 15% Sodium Carbonate, 10% Calcium Carbonate and 25% glass pieces.
It's **useful properties** are as follows:

- It is used in light bulbs and other objects.
- It is used in laboratory apparatus, windowpanes, glass sheets etc.

Hard glass is made by heating silica with potassium carbonate and calcium carbonate at 1500°C.

Soft glass is made by the mixture of 50% Silica, 15% sodium carbonate, 10% calcium carbonate and 25% glass pieces.

Hard glass is used in making hard glass laboratory apparatus like test tubes, beakers and tube lightest.

Soft glass is used in making windowpanes, light bulbs and other objects.

Ceramics

Ceramics is a special type of clay containing compounds of silica, nitrogen and oxygen. It is the clay made up of clay, feldspar, silicates.
For the production of ceramics, clay is crushed, grinded and sieved to get fine clay. Then it is mixed in water to make a paste known as slip. The slip formed is molded into different shapes and dried. The hardened shapes are put into furnace and little salt is added to make it shiny. This

makes porcelain non porous, smooth and shiny. Colors are added to make the ceramics objects attractive.

Fibers

Fibers are the extremely long sand thin hair-like strands.

Natural fibers are the fibers which are obtained from natural sources. Example: Animal fibers, Cotton fibers etc.
Artificial fibers are the fibers which are made artificially. Example: Rayon, Nylon etc.

Plastics

Plastic is widely used than any other materials because of its properties like transparency, lightness, less brittleness, non-decaying, harmless effect in body, colorfulness, flexibility, hardness, insulating heat and electricity etc.

Soap and detergents

Sodium and potassium salt of fatty acid is called **soap**. It is the sodium salt of long chain fatty acids that has cleansing property in water.

Detergents are the soap less soaps because they have cleansing property in water like soap but their chemical nature is different from soap. In other words, any substance which removes dirt is known as detergents. They are sodium salts of long chain benzene sulphonic acids. Example: Sodium n-dodecyl benzene sulphonate, Sodium n-dodecyl sulphate.

Pesticides

Insecticides are used in killing insects that destroy the crops and eat the fruits. If not used properly it degrades the crops as well as the fertility of the soil and causes pollution. So, we should be careful while using insecticides.
There are two types of insecticides.

They are:

1. Organic Insecticides
2. Inorganic Insecticides

Organic Insecticides: They are the synthetic compounds made up of carbon, hydrogen, and oxygen. There are three kinds of organic insecticides. They are chlorinated hydrocarbon, organic phosphate and carbamates. Example: BHC (Benzene hexachloride), DDT (DichloroDiphenylTrichloro ethane) etc.

Inorganic insecticides: Inorganic insecticides are made from minerals. They include calcium arsenate, lead arsenate, fluoride and lime sulphur. They are used in order to protect cotton, fruits vegetables etc. Example: Baygon, Temik etc.

Fertilizers

A good fertilizer not only supplies the essential nutrients required by the plant but also nourishes the micro-organisms, which helps to maintain the fertility of the soil. It also improves the physical condition of the soil. So fertilizers are necessary for the maintaining the quality of the soil.

There are two types of fertilizers.

They are

1. Organic fertilizers
2. Chemical fertilizers

Organic fertilizers: Organic fertilizers are the substance obtained from the decay of animals and plants or the waste products of animals. They provide necessary nutrients to plants. It can be further categorized into two types: I. Green manure II. Compost manure

Chemical fertilizers: Chemical fertilizers are the fertilizers, which are prepared artificially using inorganic compounds that are used in order to overcome the deficiencies of the plant nutrients. It can be further sub divided into three parts:
a. Nitrogen fertilizers b. Phosphorous fertilizers c. Potassium fertilizers

CLASSIFICATION OF PLANTS AND ANIMALS

Classification is the process of grouping the living beings into various groups and sub groups on the basis of similar and dissimilar characteristics.

The two importance of classification are:

1. It makes the study of plants and animals easier and systematic.
2. It gives us the idea about the evolution of plants and animals.

A **genus** is the group of closely related species.

A **species** is the group of closely related organisms having almost all similar characteristics which can interbreed freely and produce fertile offspring.

Nomenclature is the system of naming living organisms. The scientific way of assigning two names to an organism is called Binomial System of Nomenclature.

Taxonomy is defined as the branch of biological science that deals with the identification, nomenclature and classification of living organisms.

Living things are classified into two kingdoms:

1. Plant Kingdom
2. Animal Kingdom

Plant Kingdom

On the basis of the flowering and no- flowering, the plants kingdom are divided into two **sub - kingdom.**

1. **Cryptograms:** They are non-flowering plants. On the basis of their appearance they are divided into three division thallophyta, bryophyte, and pteridophyta.
2. **Phanerogams:** Phanerogams are the developed seed bearing and flowering plants

It is further divided into two sub divisions:

Sub division Gymnosperms:

1. They are cone bearing plants.
2. They grow in dry places.
3. They bear naked seeds.
4. Pollination takes place through wind.

Sub division Angiosperms:

1. They grow both in land and water.
2. They bear developed flowers.
3. Their seed are enclosed in true fruits.
4. They may be herbs, shrubs and trees.

Class monocotyledons:

1. A seed bears only one cotyledon.
2. Fibrous root is present.
3. Distinct nodes and inter nodes are present.
4. Leaves are elongated having parallel venation.

Class dicotyledons

1. A seed bears two cotyledons
2. Tap root is present
3. Distinct nodes and internodes are absent
4. Leaves are broad having reticulate venation.

Animal kingdom

All the animals different in size from unicellular to multicellular belongs to this group. Animal kingdom is divided into two sub-kingdom i.e.protozoa (unicellular) and metazoan(multicellular).

Metazoa: Metozoa is divided into different phyla

Phylum chordata:

The characteristics of phylum Chorodata are as follows:

1. Closed type of circulatory system is developed.
2. Heart is well developed and is ventrally placed.
3. These animals are unisexual.
4. Skull is developed and internal skeleton is covered with muscles.

Phylum chordata is further divided into four subphylum .they are:

1. Sub phylum: Hemichordata
2. Sub phylum: Urochordata
3. Sub phylum: Cephalochordata
4. Sub phylum: Vertebrata

On the basis of adaptioncharacteristics, habitats vertebrates are categorized into two groups:

Poikilothermic (cold-blooded): Includes Pisces, amphibia and reptilia. These animals change their body temperature according to the environment.

Homoeothermic (warm-blooded):

It includes aves and mammalia. These animals have constant body temperature.

Pieces

Characteristics:

1. They lay eggs and have external fertilization.
2. They have long and streamlined body to reduce water resistance.
3. Respiration takes place through gills.

Aves

Characteristics

1. Their fore limbs are modified into wings.
2. Body is divided into head neck trunk and tail.

3. They have four chambered heart two auricles and two ventricles.
4. They have air sacs for easy flight.

Amphibia

Characteristics

1. They have smooth and moist skin.
2. They are first land vertebrates.
3. They have 3 chamberedheart, two auricles and one ventricle.

Mammalia

Characteristics

1. They give birth to their babies directly and contain mammary glands.
2. Their sense organ is well developed and heart is four-chambered
3. They have external ears and pinnae.

Reptilia

Characteristics

1. Their outer surface is covered with dry, hard and horny scales.
2. Fertilization is internal
3. They have three-chambered heart.
4. They have pair of pentadactyle limbs with claws.

VIRUS

Virus

Viruses are microscopic organisms. Viruses can exist outside the living cell for a long period of time but they cannot reproduce outside the living cell. Since the viruses can reproduce only inside the specific cell of the living host, they are called obligatory parasites.

Characteristics of virus

1. Virus is composed of RNA or DNA and protein.
2. It can reproduce inside the cell.
3. It contains genetic characteristics which are transmitted to offspring.
4. It does not have cellular structure.
5. It does not perform metabolic activities
6. They show the response to the light, chemical and heat.

The **importance of Virus** is:

- It consists of genetic materials which are transmitted to their offspring's.
- Some viruses contain enzymes or vitamins e .g. Small pox virus contains enzymes like riboflavin and biotin.

Diseases caused by viruses and their preventive measures are as follows:

Common Cold:

Common cold is disease caused by **Rhino** virus.
Preventive Measures

a. Use of handkerchief while sneezing, coughing and yawning.
b. Sanitary disposal of nose and mouth discharge.

Measles:

It is caused by the **RNA-paramyxo** virus
Preventive Measures

a. Anti-Measles vaccines should be given to the children at the age of nine month.
b. Use of handkerchief while sneezing and coughing.

Rabies:

It is caused by RNA virus
Preventive Measures

a. Anti rabies vaccines should be taken to prevent the disease.
b. Registration of all domestic dogs.

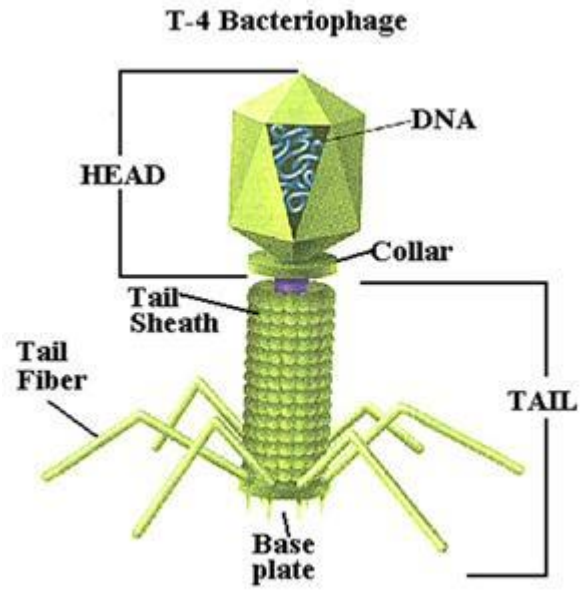
AIDS:

The full form of AIDS is 'Acquired Immuno Deficiency Syndrome'. It is a sexually transmitted disease which attacks the WBC of human blood and weakens the immune system. It is caused by Retro virus.
Preventive measures

a. Avoid unsafe sexual intercourse.

b. Avoid the use of intravenous drugs.

Structure of virus



The body of bacteriophage virus can be divided into two parts that is head and tail. The head is hexagonal in shape which consists of a protein called capsid. The capsid surrounds the genetic material that is DNA. The cylindrical tail consists of end plate and tail fibers. The tail fibers are adapted to stick it the surface of host body.

STIMULATION AND REACTION

The environmental change that brings about a response in the organism is called **stimulus.** For e.g.: Removal of hand from a hot thing.

The response of the organism to the stimulus is called **reaction**. For E.g. closing the leaflets to touch me not plant.

Taxis: The movement of the organism in the response of the stimulus by changing the location is called taxis.

Photo taxis: It is the movement of the organism under the influence of the light. E.g. earthworm

Chemo taxis: It is the movement of the organism under the influence of the chemicals.eg antheroziods of ferns moves towards the malic acid

Tropism: The movement of **parts of plants** (roots, steam or leaves) in response to an external stimulus is called tropism. It is a directional movement of the plant caused by their growth.

Phototropism: The movement of the parts of the plants in response to the stimulus of the light is known as phototropism. Example: movement of the shoot towards the light and roots away from the light.

Geotropism: The movement of the parts of plants in response to the stimulus of gravity is known as geotropism. Example: The stem grows upward i.e. Negative geotropism.

Hydrotropism: The movement of the parts of the plants in response to the stimulus of water is known as hydrotropism. Example: Roots of the plants grow in the direction of water.

Chemotropism: The movement of the parts of the plants in response to the stimulus of chemical is known as chemotropism. Example: Pollen tubes moves towards style because of positive chemotropism.

Thermotropism: Movement of the parts of the plants in the response to the heat.

Nervous system

The system of the body that receives the information from the surroundings and transmits to the other parts of the body to show the corresponding effects is called nervous system.

Neurons: Neurons or nerves cell are the cells that transmits the message from one parts of the body to another.

The structures of neuron are:

Afferent or sensory nerves: They carry impulses from various parts of the body to the brain or to the spinal cord.

Efferent or motor nerves: They carry impulses from the brain or the spinal cord to various parts of the body.

Mixed nerves: Sometimes axons of both motor and sensor neurons from a nerve which is called mixed nerves. All the spinal nerves are of mixed type.

Parts of nervous system

Central nervous system

It is the controlling centre of the body which consists of brain and spinal cord

It is composed of three membranes together called meninges. The brain is located in sub arachnid cavity. This cavity is filled with the spinal fluid that protects the brain from shocks.

The three parts of brain are:

Cerebrum

It is the centre of intelligence, memory, imagination and emotions.

It controls the functions of other part of the brain.

Cerebellum

It maintains the equilibrium and controls the posture of the body.

It makes body movement smooth, steady and coordinate.

Brain stem

Brain stem connects the cerebrum and spinal cord. The bottom of the brain stem is medulla oblongata.

The functions of Medulla Oblongata are:

It receives and integrates signal from the spinal cord and sends resulting impulses to the cerebrum and cerebellum.

It contains different centers that regulate heart beat rate, blood pressure, breathing, vomiting and some involuntary action.

Spinal cord

Spinal cord is protected cylindrical structure that arises from the medulla oblongata and passes through the neural canal of the vertebral column. Spinal cords act as link between spinal nerves and brain. It is the main centre of the reflex action.

The involuntary action performed by the muscles under the control of spinal cord without the involvement of brain is called reflex action.

Peripheral nervous system

The peripheral nervous system consists of spinal and cranial nerves.

The spinal nerves arise from the spinal cord and spread to different parts of the body. There are thirty-one pairs of spinal nerves in the human beings. Out of them 8 pairs are cervical, 12 pairs are thoracic, 5 pairs are lumbar, 5 pairs are sacral and one pair is coccygeal. They are mainly responsible for reflex actions of the body.

The cranial nerves arise from the brain and terminate inside I, except the vagus. The vagus is connected to the alimentary canal. There are 12 pairs of cranial nerves in human being. They control the activities of eyes, ears, tongue etc. Three pairs are cranial nerves are sensory, 5 pairs are motor and four pairs are of mixed types.

Autonomous nervous system

This nervous system maintains and regulates the internal environment by controlling the involuntary actions of the internal organs. It is divided in to sympathetic and parasympathetic.

Exocrine glands are ducted glands. The secret juices like mucus, saliva, tear etc. Their secretions are related life processes like respiration, digestion etc.

Endocrine are ductless glands. The secret juices like mucus, saliva, and tear etc. They secrete hormones. Their secretions are responsible for control and coordination of growth.

Hormones

Hormones are the chemical substance secreted by endocrine and heterocrine glands. They are chemical messenger of the body because it carries chemicals to all parts of the body through blood circulation to bring about the harmonious working of the body.

The functions of hormones are as follows:

They stimulate and control various physiological and metabolic activities of the body.

They regulate growth and reproduction.

Some of the major glands and their functions:

Thyroid gland: It is situated in the neck. Its function is to secrete thyroxin which contains iodine which controls general metabolism.

Pancreas: It is found in alimentary canal. It secretes insulin and glucagon. Insulin maintains sugar level in the blood and glucagon supplies sugar in the blood.

Pituitary gland: It is found in the skull. It secretes growth hormone and stimulating hormone. Growth hormone controls the growth of the body and stimulating hormone controls and stimulates in the secretion of the other glands.

Gonads: Male gonads are found in the scrotum. It secretes testosterone, which develops and maintains male secondary characters. It is also responsible for production of sperms.

Female gonads are found in the female reproductive system. It secretes Oestrogen and Progesterone. Oestrogen controls the growth of mammary gland as well as development of female secondary characters. Progesterone prepares uterus suitable for the development of embryo.

Adrenal gland: Adrenal gland is situated on the top of each kidney. Adrenalin hormone secreted by the adrenal gland at the time of emergency prepares the body face and emergency situation for flight, fright or fight. So adrenalin is called an emergency hormone.

Parathyroid gland: They are located on the thyroid gland. They secrete parathormone, which controls the calcium metabolism of the body and helps in normal growth of bones and tissues.

ASEXUAL AND SEXUAL REPRODUCTION

A biological process in which living organisms produce their own kind by asexual and sexual method is called **reproduction**. Living organism produces their own kind to maintain the life of their species on the earth.

The **types of reproduction** are:

1. **Asexual reproduction**
2. **Sexual reproduction**

Asexual Reproduction

- Only one organism is involved.
- Mitosis cell division occurs.
- The reproduction takes place in short period.
- The offspring is genetically similar with parents.

The types of asexual reproduction are:

Fission: The process of asexual reproduction in which a parent organism divides into two or more daughter organisms in called fission. For e.g.: amoeba and paramecium

Budding: The method of asexual reproduction which takes place by the formation of a bud is called budding. For e.g.: Hydra and yeast.

Fragmentation: Fragmentation is the process in which the elongated body of an organism breaks into two or more fragments due to various agencies like heat, wind etc. For e.g.: Tapeworm and starfish.

Sporulation: The method of asexual reproduction which takes place by the formation of spores is called sporulation. For e.g.: Mucor and Moss.

Vegetative propagation: Vegetative propagation is the method of asexual reproduction in which new plants are produces by cutting, sowing or grafting of the vegetative parts of plant like root, stem or leaves.

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The **threes methods** of artificial vegetative propagation are:

1. **By cutting**: In this method plants are propagated by cutting small pieces of the steam. When the pieces are placed in soil, roots emerge from the nodes.

2. Layering: In this method one of the lower branches of the plant is bent and covered partially with soil. The part inside the soil develops roots after three to four months.
3. Tissue Culture: It is a modern technique of vegetative propagation. A small piece of tissue from a plant is kept in a container with essential nutrients under proper conditions.

Sexual Reproduction

Both male and female individuals are involved.

Here, meiosis division occurs first then mitosis cell division occurs.

The offspring are not genetically same with their parents as they show characters of both parents.

In the plants, sexual reproduction takes place in two ways:

Pollination: It is the transfer of pollen grains from anther to the stigma of the flower. It can be sub divided into self-pollination and cross-pollination. In self-pollination, the transfer of pollen grains takes place from anther to the stigma of the same flower plant. In cross pollination, the transfer of pollen grains takes place from anther of one plant flower to the stigma of another flower of the same or other plant.

Fertilization: The fusion of male and female gametes is known as fertilization. In the plants, the stigma produces sticky substance so pollen grains get stuck in it. The pollen grain is covered by two layers. In the internal layer, pollen tube is formed. The pollen tube reaches to the ovary through style. The pollen tubes divide and form male gametes which emerge towards the ovule. Then fertilization takes place and zygote is formed.

REPRODUCTION IN PLANTS THROUGH SPORES

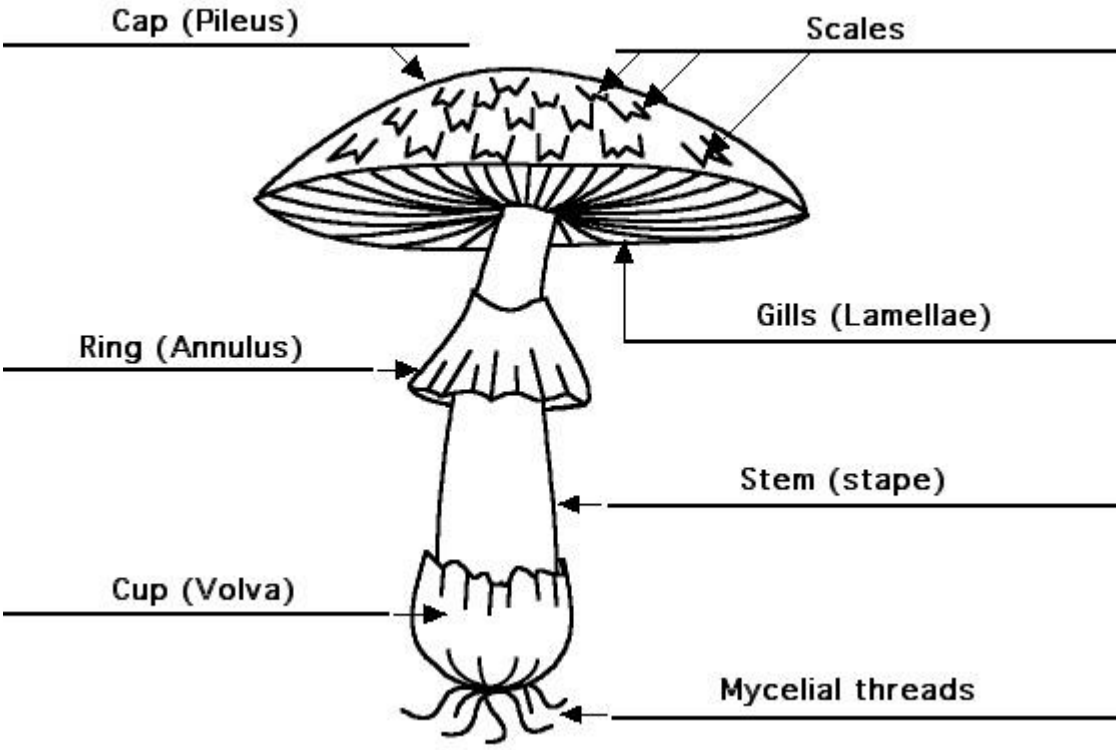
Mushroom

Kingdom: Plant

Sub kingdom: cryptogams

Division: Thallophyta

Type: mushroom



Mushroom is a non-vascular, multi cellular, saprophytic fungus. Generally, it grows in dark, moist and shady places on rotten logs of woods, tree trunks, decaying organic matter and in rich soil. It gets food from decomposing dead and decaying organic matters. So it is called saprophytic fungus.

The plant body of mushroom consists of two parts. They are mycelium and fruiting body. The vegetative body of mushroom which is thin thread like structure is called mycelium. The mycelium absorbs soluble food materials from the substratum.

Mushroom grows during the rainy season on the soil rich in dead and decaying organic matter, damp places and truck of trees.

The advantages of mushroom are:

- Mushroom is taken as a nutritious food because it contains proteins, vitamins and minerals in a remarkable amount.
- Mushroom helps to prevent high blood pressure, blood cholesterol, heart disease etc.
- Mushrooms are cultivated from business point of view.

The disadvantages of mushroom are:

- Some mushroom is poisonous, may cause the death of person if mistakenly taken.
- Some mushroom paralyses the central nervous system.

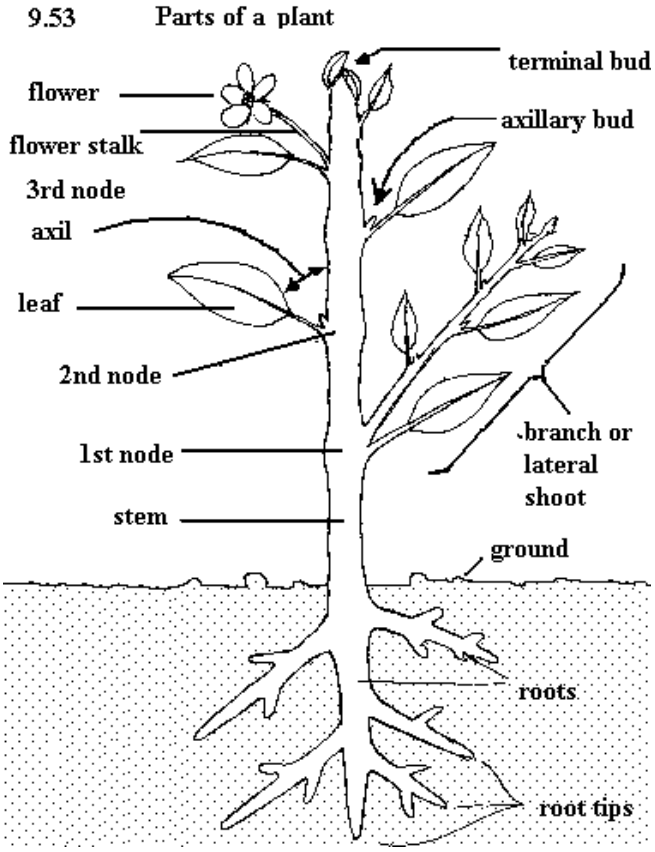
Ferns:

Kingdom: plant

Sub kingdom: cryptogams

Division: pteridophyta

Type: fern



Ferns are terrestrial plants. Fern plants are kept under tracheophyta because it is differentiated into roots, steam and leaves. These plants show the alternation of generations with the sporophyte which is more prominent.

The systemic position of fern plant are : Adult sporophyte, Fertile pinna, V.S. of fertile pinnule, Young sporangium, Spore germination, Prothallus, Aechegonium, Fertilization, Young Embryo, Young Sporophyte.

The life cycle of fern plant is completed by the alternation of two distinct generations which are as follows:

Sporophytic generation: The fern plant is called sporophyte because it bears spores and reproduces asexually by means of spores. Under the favorable condition the spores in the soil undergo germination.

Gametophytic generation: In the early stage of germination the spores grow in the form of elongated tube like structure which continues to grow and finally forms a heart shaped structure called prothallus. The prothallus decays and the young sporophyte grow into a fern plant.

The phenomenon in which gametophytic and sporophytic generations come one after another and depend upon each other in a life cycle of fern plant is known as alternation of generation.

BLOOD CIRCULATION SYSTEM IN HUMAN BODY

Blood is a red colored fluid connective tissue that circulates in the arteries and veins of humans and other vertebrate animals, carrying oxygen to and carbon dioxide from the tissues of the body.

The main functions of blood are as follows:

1. It carries oxygen and provides it to all the parts of the body.
2. It contains WBC which protects our body from bacteria, viruses etc.
3. It transports digested food to various parts of the body.
4. It transports harmful substances like carbon dioxide, urea, uric acid etc. to the excretory organs.

The components of blood are as follows:

1. Plasma
2. Red Blood Cells (RBC)
3. White Blood Cells (WBC)
4. Platelets

Plasma is important because plasma contains carries harmful substances from the body. It also helps in transportation of nutrition. It also controls the flow and composition of water in the blood.

The functions of plasma are as follows:

It helps in blood clotting at the wounds.

It helps in transporting hormones secreted from endocrine glands.

It transports digested food to different parts of the body.

It balances the water content of the blood.

Red Blood Cells (RBC)

RBCs are circular, biconcave fluid which is formed in bone marrow. They are red in color due to presence of hemoglobin, scarcity of which leads to anemia. They are small in size and helps in respiration

White Blood Cells (WBC)

They are colorless and irregular in shape which plays an important role to fight against the disease. They are formed in bone marrow and lymph glands. The excess in the number of WBC leads to the leukemia.

Platelets

Platelets are colorless oval cells produce in bone marrow and dies in spleen. They have very short life span. They help in healing the wounds.

Heart

Heart is a strong hollow muscular organ made up of cardiac muscle. It is enclosed in a thin membrane called pericardium and the fluid present in between them is called pericardial fluid. It allows free movement of heart and protects it from external shock and mechanical injuries.

The human heart consists of four chambers; two on each side. Two upper and smaller chambers are called right auricles and left auricles. The two lower and larger chambers are called right ventricles and left ventricles. The two auricles are separated by inter-auricular septum and likewise the ventricles are separated by interventricular septum. The left auricle and left ventricle are separated by bicuspid valve and the right auricle and right ventricle are separated by tricuspid valve. The right auricle has venacava; the right ventricle has pulmonary artery. The left auricle has pulmonary veins and the left ventricle has aorta.

The blood vessels that take part in blood circulation are arteries, veins and, capillaries.

The functions of arteries are:

- To carry oxygenated blood from right ventricles to the lung for purification.
- The pulmonary artery carries deoxygenated blood from the heart to the lungs.

The functions of veins are:

- To carry deoxygenated blood from lungs to the left auricle of the heart.
- The pulmonary veins carry oxygenated blood from lungs to the heart.

The functions of capillaries are:

- To provide definite path for the flow of blood
- To transfer the molecules of glucose, water, oxygen, hormones to the cells and tissues

Blood pressure:

It is the pressure exerted by the flow of blood on the walls of the arteries. The pressure exerted when the ventricle is contracted is called systolic pressure. The pressure exerted when the ventricle is relaxed is diastolic pressure.

HEREDITY

Genetics is the branch of biological science, which deals with the nature, and behavior of genes. Genetics is also defined as the biological science of heredity and variation.

Heredity is the phenomenon by which living organisms transmit parental characteristics to their offspring.

Genes are tiny units of heredity located in chromosomes. They are arranged chromosomes in a linear fashion. Each gene occupies a fixed position in fixed chromosomes. Genes determine the physical, anatomical and physiological characters of organisms. These characters are transmitted from generation to generation.

Definite external character of an individual of a cross is called its **unit character.** Each organism consists of its own type of characters. For e.g. a rose plant has its own type of leaf, flower, stem etc. which act as unit character for it.

Alleles are one form of a gene. There may be two or more alleles of a gene. In genetics different alleles are donated by letters e.g. TT, Tt etc.

Hybrids are the organisms produced after cross fertilization between two genetically different organisms. Hybrids are of various types for e.g. Mono hybrids, dihybrids etc.

- The cross involving only one pair of contrasting characteristics is called **monohybrid cross**
- The cross involving two pairs of contrasting characteristics is called **di-hybrid cross.**
- The cross involving more than two pairs of contrasting characteristics is called **poly-hybrid cross.**

The characteristics which are prominent and appear in successive generations are called **dominant characteristics**. For e.g.: In the cross pollination between tall tree plant and dwarf pea plant tall is dominant characteristics.

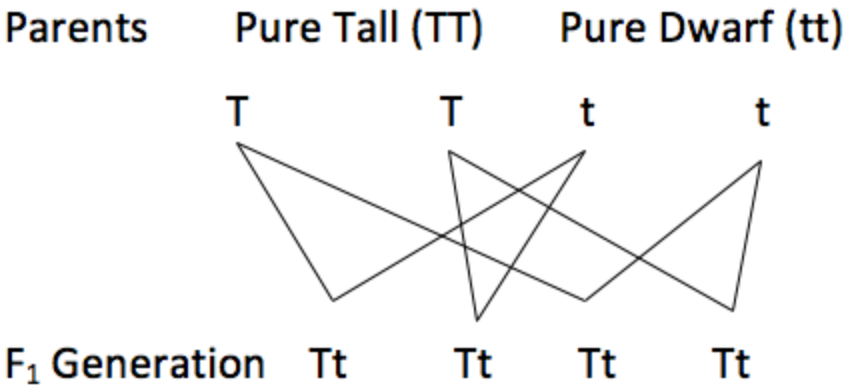
The suppressed characteristics which remain unexpressed in successive generation are called **recessive characteristics**. For e.g.: In the cross pollination between tall pea plant and dwarf pea plant dwarf is recessive characteristics.

The external appearance of an organism for a contrasting character is called **phenotype**. It is expressed in words for e.g.: Tall, dwarf etc.

The genetic makeup or genetic constitution of an organism is called **genotype.** It is expressed in letters e.g.: TT, Tt etc.

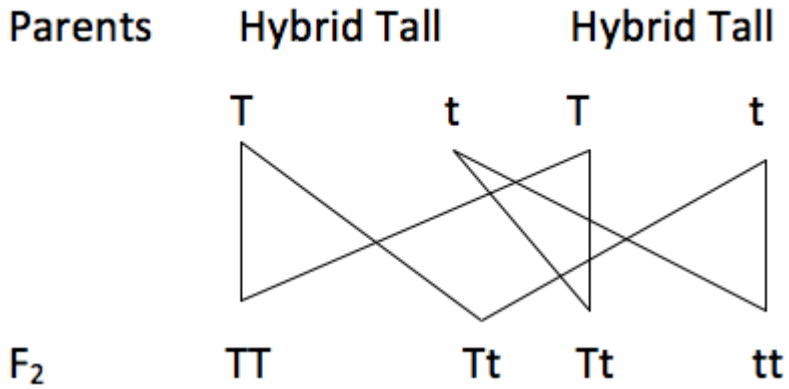
Mendel's law of Mendelism

According to Mendel's experiments, '**Law of dominance'** states that in crossing between pure organisms for contrasting characteristics of a pair, only one characteristics of the pair appears in the first filial generation.



When pure tall (TT) and pure short (t t) cross is made only tall can express itself as a dominant character in F_1 generation.

According to Mendel's **law of purity of gametes,** the two members of a pair of factors separate during the formation of gametes. They do not blend with each other but segregate out into different gametes. Thus, any gamete is not impure.

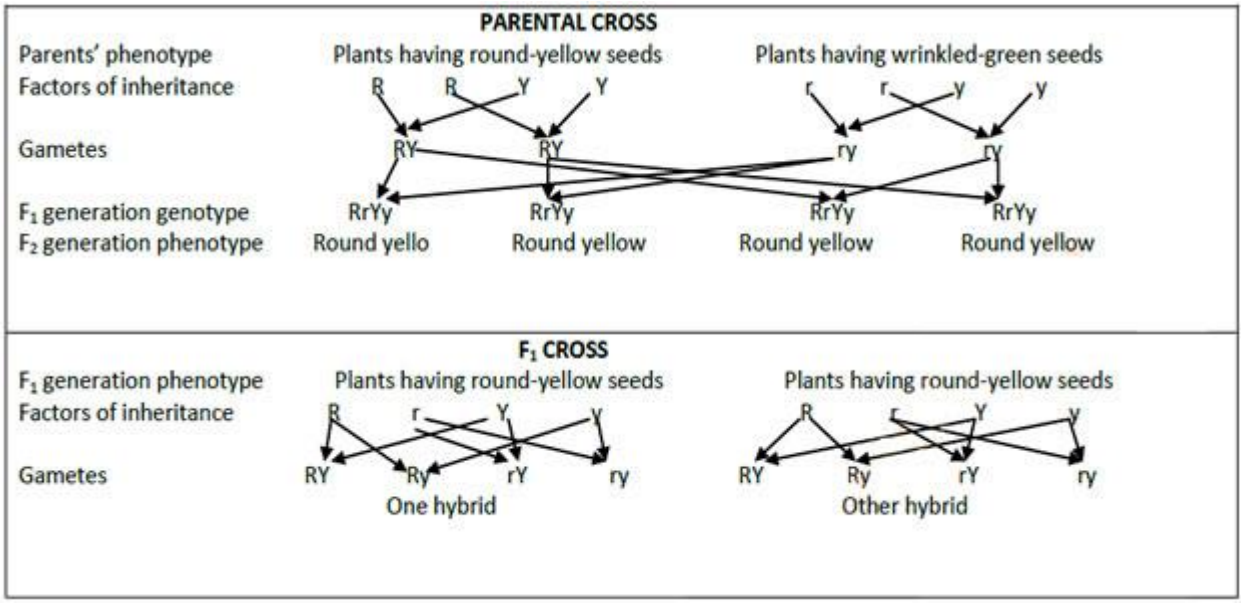


Phenotype ratio = 3:1 (75% tall and 25% dwarf)

Genotype ratio = 1:2:1 (25% pure tall, 50% hybrid tall, 25% pure dwarf)

Law of independent assortment: It states that when two independent alleles are brought together at a time of gamete formation, they assort at random and freely.

When the cross is made between round yellow seeds and wrinkled green seeds, in F_1 generation round is dominant over wrinkled and yellow is dominant over green. In F_2 generation, they were round yellow, round green ,wrinkled yellow and wrinkled green in the ratio 9:3:3:1.



Variation

The structural difference that provides individuality to each member of a species is called variation.

We know, a human gives birth to a human, a chick hatches from hen's egg. These variations depend upon the genes present in the organism. These genes transfer various characters from parents to offspring. Variation is the result determined by the factors like environment and heredity. Though similarity can be found in the members of the family, they are not exactly alike i.e. there are some dissimilarities in them. This results in the change in the new generation.

Mutation is defined as sudden chromosomal change by very new and different characters from parents is seen in offspring's. For e.g. six fingered limbs, cut at lip by birth etc.

ECOSYSTEM

Ecosystem is defined as the structural, functional and self-sustaining unit of biosphere, which consists of biotic and abiotic components.

Biotic components of ecosystem

Producers are the green plants which can prepare food themselves. Green plants can prepare their own food due to the presence of chlorophyll. For e.g.: Sunflower, mango plant.

Consumers are the heterotrophs that depend on green plants directly or indirectly for their food. For e.g.: Dog, Lion etc.

Decomposers are the saprophytic organisms that feed on dead and decaying organic matters and decompose them into simpler forms. For e.g.: Bacteria, Fungi etc.

Types of ecosystem

There are two types of ecosystem

1. Aquatic ecosystem (pond ecosystem)
2. Terrestrial ecosystem (grassland ecosystem)

Pond ecosystem: Pond is a typical stagnant fresh water body. It represents a self-regularity fresh water ecosystem. There are biotic and abiotic components of pond ecosystem. They are as follows:

Abiotic component: In the pond ecosystem, abiotic substances contain inorganic substances like nitrogen, calcium, water etc. It also includes air, light, heat, soil etc.

Biotic components: Biotic component of the pond ecosystem includes producers, consumers and decomposers. Aquatic plants like algae, volvox, hydrilla etc. are the producers of the pond ecosystem. Small fish, earthworms, tadpole larva etc. depends on the plants for the foods are primary consumers. Frogs, water insects etc. are the secondary consumers. Big fishes and snakes that feed on secondary consumers are the tertiary consumers. After the death of the consumers, decomposer like bacteria, fungi and other micro-organisms decompose the dead bodies and mix them into the soil. These decomposed materials again become the source of the nutrients of the producers. In this way, this process goes on and the ecosystem is maintained.

Grassland ecosystem: The grassland is an open land with grasses. The biotic and abiotic components of grassland ecosystem are as follows:

Abiotic components: Stones, soil, climate factors like heat, light, air etc are the abiotic components of the grassland ecosystem.

Biotic components: The biotic component of the grassland ecosystem consists of producers, consumers and the decomposers. The grasses, shrubs, trees are the producers which uses the inorganic materials to prepare their own food in the presence of sunlight. The primary consumers like insects, herbivores etc. feed on the producers. The primary producers are the food source for the secondary consumer. The secondary consumers such as wolf, jackal, fox, snakes etc. feed on the primary consumers. The animals like tiger, eagle etc. feed on the secondary consumers and are known as tertiary consumers. These consumers after the death are decomposed by the decomposers like bacteria and fungi. The decomposer decomposes the consumers into simpler compounds which are utilized by the producers for the synthesis of the food. In these ways, animals and plants are controlled in the grassland ecosystem.

Ecological pyramid

It is the graphical representation of a food cycle that demonstrates energy, number and biomass at different topic level.

Pyramid of number

It is the graphical representation that shows the relationship between producers and consumers at different level in terms of their number. Pyramid of number for the grassland is upright whereas pyramid of number for parasitic is inverted.

Pyramid of energy

It is the graphical representation that shows the relationship between producers and consumers at different level in terms of their energy. There is a decrease of energy at different levels.

Pyramid of biomass is the graphic representation of biomass of organism present in unit area of various tropic levels of a food chain. In this pyramid, the biomass of producers is placed at the base and that of producers is kept at the apex. The pyramid of biomass of an aquatic ecosystem is inverted because of the progressive increase in the biomass of organisms from the second tropic level to the final tropic level.

The exchange of biogeochemical between living and non-living components of the biosphere is called biogeochemical cycle. The four important biogeochemical cycles in the biosphere are:

1. Water Cycle
2. Oxygen Cycle
3. Carbon Cycle
4. Nitrogen Cycle

Nitrogen cycle is defined as the cyclic process in which nitrogen is circulated continuously through the living and non-living components of a biosphere. The nitrogen present in the atmosphere is turned nitrates with the help of leguminous plant so it is helpful in nitrogen cycle.

The bacteria which convert atmospheric nitrogen into nitrates in soil are nitrogen fixing bacteria. The bacteria which converts ammonia into nitrites and nitrites into nitrates are called nitrifying bacteria. For e.g.: Nitrosomonas, Nitrobacteria etc.

Ammonification is the conversion of complex organic compounds into ammonia gas. Various bacteria and fungi are involved in this process.

Carbon cycle

In the nature, carbon dioxide is consumed by the plants from the atmosphere. They use carbon dioxide for the process of photosynthesis to prepare the food in the body. Herbivores eat green plants and carnivores eat herbivores. In this way, carbon dioxide enters in the plants and animals. Animals and plants return the carbon dioxide in the different ways. When plants are burnt in the atmosphere, carbon dioxide is given out. Also, during the respiration of the living beings, carbon dioxide is given out in the surroundings. It is also returned in the atmosphere after the death of the living beings. The dead bodies decay or are preserved in the sedimentary rocks. During the decay, they give carbon dioxide. The preserved dead bodies forms coal, petroleum etc. They get burned during volcanic eruption and act as fuel source which again emits carbon dioxide. Ocean water also balances the amount in carbon dioxide by absorbing the excess CO_2 and when it is reduced in the atmosphere, the ocean water releases CO_2. In this way, CO_2 is balanced in the atmosphere.

HISTORY OF EARTH

The name of hypothesis given about the origin of Earth is:

Old planetesimal hypothesis: This hypothesis states that earth was formed from the collision of the gases mass and comet. When they collide, a huge amount of matter was thrown which in later cooled to form planets.

New planetesimal hypothesis: This hypothesis states that when the gaseous mass and comet come close to each other, due to their gravity, great tides form on the gaseous mass which remained as large spiral arms. These arms later cooled to form the solid particles called planets.

Dust cloud hypothesis: This hypothesis states that sun and planets were formed from the large amount of cloud and gases. These dust and gaseous combined due to the pull of gravity and form a huge mass of materials. Thus formed mass became sun and solar energy was produced by nuclear fusion. The rotating cloud forms small globes of gases and dust to form planets.

Nebular hypothesis: A German philosopher named Immanuel Kant proposed nebular hypothesis about the origin of the solar system in 1796 AD, and it was improved by a French astronomer named Laplace later in 1796 AD. According to this hypothesis the sun and the planets were formed from a large whirling cloud of gases and dust. When the cloud cooled and grew smaller, it began to spin faster. As the surface of the cloud cooled by radiation, a ring of matter was formed at the equatorial region of it. The ring was escaped out from the surface of the main mass and the first planet was formed. This process was repeated again and again till the entire solar system was formed and the remaining mass was the sun.

Tidal hypothesis: English astronomers Sir James Jeans and Sir Harold Jeffrey proposed the tidal hypothesis in 1917 AD. They also supposed that a passing comet had exerted a tidal pull upon the gaseous mass but the effect was to cause a long filament of gas to be drawn from the mass. The outer part of the filament escaped in to space the inner part came back into the gaseous mass and the middle part formed a series of round structures of different sizes which were the planets and the remaining mass was the sun.

This hypothesis proposed that the sun and the planets were formed from a large cloud of gases and dust. The light of the star pushed the atoms of the gases and dust to form large particles. These large particles were attracted to each other by the pull of gravity and they began to crowd together. Eventually a huge ball of material formed the sun and the solar energy produced in it by the nuclear fusion.

Geological time scale: The time scale that includes the earth origin to present is called geological time scale. This age of the earth is divided into three eons they are as follows:

a. Phanerozoic Eon began about 570 million years ago and it is still continuing a present. In this eon vertebrates and phanerogams are developed. This eon is divided into three eras.

Cenozoic era: Cenozoic Era began about 65 million years ago and is still continuing. It is divided into two periods. Quaternary and tertiary. The wide variety of plants and animals that we know today came into existence during Cenozoic Era.

Mesozoic era: Mesozoic era began from 250 million years ago and ended at 65.5 million years ago. In this era, different types of hills and mountains were formed. It is supposed that the vital conditions for the survival of life on land, water and air were formed. This era is divided into three periods.

Paleozoic era: Paleozoic era began from 540 million years ago and ended at 250 million years ago. In this era, the plants and animals were found to have developed which was found from the studies of the fossils remained in sedimentary rocks. Similarly, it is also believed that there was a change in atmosphere and whether. This era is divided into six periods.

b. Proterozoic Eon was extended from 570 million years ago to about 2500 million years ago. In this eon invertebrates and cryptogams were evolved.

c. Archean Eon extended from 200 to 3800 million years ago. In this eon life was originated on the earth. Proterozoic Eon was extended from 570 million years ago to about 2500 million years ago. In this eon invertebrates and cryptogams were evolved. Phanerozoic Eon began about 570 million years ago and it is still continuing a present. In this eon vertebrates and phanerogams are developed.

Fossils:

A fossil is the mark or hardening remains of a plant or animal that lived thousands or millions of years ago. Some fossils are leaves, shells or skeletons that were preserved after a plant or animal died.

Fossils can be identified by following ways:

a. The impression of a whole or a part of any organ of dead body remains in hard ground or stone.

b. The whole skeleton of animals and plants are pressed into rocks.

c. Fossils are identified by morphology.

Organisms are fossilized in the form of cast in sediments. The water inside the sediment dissolves the hard parts, leaving a hollow space in the sediments. The hollow space is called mold. The space is then filled with minerals which harden to form a cast.

Fossils are mainly formed due to following reasons:

a. If the animal has hard body parts, the chance of fossilization increases.

b. The organism must be covered by the protective materials shortly after the death.

Importance of fossils:

- They are main source of coal and petroleum.
- They help us to know about the animals and plants once existed on the earth

Minerals

Mineral fuel is the mixture of hydrocarbons (about 90% to 95%) and the other substances like Oxygen, Nitrogen, Sulphur, etc.

Some of the importance of mineral fuel is as follows:

- It is used as lubricant.
- It is used as fuel for cooking.
- It is used in vehicle as fuel.
- It is used in construction of road (black tar or bitumen)
- It is used in manufacturing of plastics, chemical fertilizers, pesticides, paints, explosives, medicines, etc.

Coal

Plants and animals, which died millions of years ago, got buried beneath the Earth. They got covered under clay and sands, which prevents oxygen of air from reaching them. Due to high temperature and pressure inside the Earth, those dead bodies got decomposed in the absence of oxygen. This results in the formation of coal.

The **importance of coal** are as follows:

- It is used as fuel in railway transportation, industries, brick factories, iron etc.
- It is used to generate electricity, for manufacturing petrol like natural gas etc.
- It is also used for making various organic compounds like benzene, phenol etc.

ATMOSPHERE

The thick layer of air surrounding the earth is called **atmosphere.** The atmosphere is divided into five layers. They are:

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere
5. Exosphere

Troposphere: It is the lowermost layer of the atmosphere. It lies up to 16 km up from the surface of the earth. This layer lies nearest to the surface of the earth. The topmost layer of troposphere is called the tropopause. It separates the troposphere and stratosphere. Its average temperature is -56◦C.

Stratosphere: The layer of atmosphere between troposphere and mesosphere is known as stratosphere. The layer extends from 16 km to 50 km vertically upward the earth's surface. There is temperature of about -55◦C to -75◦C. It contains ozone layer which protects the earth from harmful rays coming from the sun.

Mesosphere: The layer of atmosphere between stratosphere and thermosphere is known as mesosphere. It lies between 50- 80 km from the surface of the earth.

Thermosphere: The layer of atmosphere which lies between mesosphere and exosphere is called thermosphere. It lies in the altitude of 80 – 720 km from the surface of the earth. Since there is more effect of solar radiation in these regions, the temperature is high. Gas molecules split in ions in this layer. So this layer is known as ion layer.

Exosphere: It is the outermost layer of the atmosphere located above 720 km from the surface of the earth. It is also called fringe region. There is no effect of gravity in this layer.

Ozone layer

Ozone layer is found in stratosphere. It is extended from 16 km to 50 km above the earth surface. Its thickness is 34 Km. This layer is clear and cloudless and jet planes fly in this layer. This thick layer of air absorbs most of the solar radiation. Due to absorption of solar radiations, the temperature of the stratosphere increases as the increase in altitude. Ozone layer protects earth from harmful radiation and if there is ozone layer depletion then rays of sun enter earth without any obstacle which causes the rise in temperature of earth.

Ozone layer depletion

The main cause of ozone layer depletion is the chemical substance produced by the human. Chlorofluorocarbon is the major chemical substance which destroys the ozone layer. Along with this, chlorinated compounds such as methyl chloroform, carbon tetrachloride, methyl bromide etc. also destroys the ozone layer.

The three points to **conserve ozone layer** are:

a. The production and use of CFC should be banned.

b. The alternatives for the CFCs should be developed.

c. Release of oxides of nitrogen should be avoided.

Greenhouse effect:

Greenhouse is made up of glass and plastics which allows the light to pass through it but does not allow the light to escape. Greenhouse effect is the phenomenon of increasing the temperature of the earth's surface as in the artificial greenhouse. It is required to maintain the temperature of the earth's surface. The over greenhouse effect made lead to increase in temperature, global warming, affect in the environment and so on. Green house is the process of tapping the radiation of the sun and making the atmosphere warm. It causes global warming as it increases the temperature of the earth.

The **effects caused by the greenhouse** are as follows:

- It absorbs the solar as well as the earth's existing heat which increases the surface temperature of the earth.
- Increase in the temperature forces the ecosystem to change which affect in the biodiversity.
- As a result of the greenhouse effect, it increases the temperature and affects the water cycle.
- The greenhouse effect increases the temperature which results in the melt down of polar ice caps along with global warming.

The **importance of artificial greenhouse** are as follows:

- Different crop plants can be grown in off seasons.
- Summer plants can grow in winter seasons

Industrial gases: In the process of industrial production, different types of toxic gases, lead, metal, complex organic compounds etc. are released. These gases produced in the industrial production are known as industrial gases. Due to the increase in industrial gases, the air gets

polluted. Along with that, it also affects the weather. When rain falls on the earth' surface, due to the presence of industrial gases, acid rain occurs

UNIVERSE

Universe is a huge space which contains everything that exists. The width or extension of universe is about 100000 light years.

The distance between the earth and sun is measured in **astronomical unit**.

1AU = $1.5*10^{11}$m

The distance travelled by the light in one year is called **light year**.

1 light year = $9.5*10^{15}$m

The distance at which mean radius of the earth subtends an angle of second of arc is called **parsec**.

1parsec = $3.1*10^{16}$m

Constellations are the group of stars having fixed shapes. Examples: Aries, Cancer, Aquarius, Leo, Libra etc.

Galaxy is the system of stars that consists star, star clusters, dust and gases held together by gravity.

Our solar system is in the distance of 30000 light years from the Milky Way galaxy.

Solar system is composed of the sun, eight planets including the earth, satellites, asteroids, comets, meteorites etc. The distance in the space is measured in the term of light year.

Planets

Planets are the heavenly bodies which revolve around the sun in elliptical path without being intersected by path of other planets.

There are major eight planets in the solar system.

1. Mercury
2. Venus
3. Earth
4. Mars
5. Jupiter
6. Saturn

7. Uranus
8. Neptune

The closest planet and the farthest planet from the sun is mercury and Neptune respectively

Mercury is the fast rotating planet.

Venus is the brightest planet.

Mars is red planet.

Jupiter is the largest planet.

Satellites

Natural satellites

Those naturally occurring satellites which revolve around the planet in their fixed orbit are called natural satellites.

Moon is the natural satellite of the earth.

Artificial satellites

Satellites made artificially on earth for the specific purpose are called artificial satellites.

Asteroids

Asteroids are the tiny planets made up of rocks and metallic substance which revolve around the sun between the Mars and Jupiter.

Comets

Comets are the non luminous body made up of chunk of gases, dust and ice . When comets come near to the sun, the ice particles in the comet starts to melt but due to the gravity of the comet it does not let the ice particles melt and the melting ice particles are attracted by the comet and as a result a tail is seen in comet when it approaches the sun.

The orbit of the comet is highly elliptical.

Meteoroids

Meteoroids are the small pieces of stony matter falling from the space to the earth due to the earth gravity. They are also called shooting stars and falling stars.

Stars: stars are the luminous bodies that produce the energy inside the core by nuclear fusion. There are large clouds of hydrogen gas called nebula and other materials. When the clouds and other materials attain a certain size, they start to contract due to effect of gravitation among them. Finally, these clouds are compressed to highly condensed mass. As a result, a protostar is formed. The protostar again condenses due to gravity and the clouds heat up and the pressure and the temperature also increases. At last, the core of protostar gains very high pressure and temperature and this results in the nuclear fusion reaction which provides enormous energy to the new star. This way, stars are formed.After a certain period; the hydrogen gas gets turned into helium gas. When helium gas cannot fuse with each other, there is inward gravitational pull, the star contracts continuously and temperature in the core further increases. This causes the expansion of the outer layer and size of star. The size increases considerably. A stage comes when the star becomes very large in size and red in colour. This red star is called red giant. A star remains red giant for million years. At the end of the stage, there is enormous release of energy which causes violent explosion called supernova. The star gets scattered and after some interval of time, its brightness finishes. This is called the death of star.

Black hole

Black holes are the remnant of stars so condensed that its gravitational force pull can even prevent light from escaping it. If the initial mass of the star is five times the mass of the sun, then the red giant of that star will form a black hole.