Instrument	Use
Tacheometer	A theodolite adapted to measure distances, elevations and bearings during survey
Tangent Galvanometer	Measures the strength of direct current
Telemeter	Records physical happenings at a distant place.
Teleprinter	Receives and sends typed messages from one place to another
Telescope	To view distant objects in space
Thermometer	Measures Temperature
Thermostat	Regulates temperature at a particular point
Tonometer	To measure the pitch of a sound
Transponder	To receive a signal and transmit a reply immediately
Udometer	Rain gauge
Ultrasonoscope	To measure and use ultrasonic sound (beyond hearing); use to make a Ecogram to detect brain tumours, heart defects and abnormal growth
Venturimeter	To measure the rate of flow of liquids
Vernier	Measures small sub-division of scale
Viscometer	Measures the viscosity of liquid
Voltmeter	To measure electric potential difference between two points
Wattmeter	To measure the power of an electric circuit
Wavemeter	To measure the wavelength of a radiowave

21. Inventions

Invention	Inventor	Country	Year
Adding machine	Pascal	France	1642
Aeroplane	Wright brothers	USA	1903
Balloon	Jacques and Joseph Montgolfier	France	1783
Ball-point pen	C. Biro	Hungary	1938
Barometer	E. Torricelli	Italy	1644
Bicycle	K. Macmillan	Scotland	1839
Bicycle Tyre	J.B. Dunlop	Scotland	1888
Calculating machine	Pascal	France	1642
Centrigrade scale	A. Celsius	France	1742
Cinematograph	Thomas Alva Edison	USA	1891
Computer	Charles Babbage	Britain	1834
Cine camera	Friese-Greene	Britain	1889
Cinema	A.L. and J.L. Lumiere	France	1895
Clock (machanical)	Hsing and Ling-Tsan	China	1725
Clock (pendulum)	C. Hugyens	Netherlands	1657
Diesel engine	Rudolf Diesel	Germany	1892
Dynamite	Alfred Nobel	Sweden	1867

Invention	Inventor	Country	Year
Dynamo	Michael Faraday	England	1831
Electric iron	H.W. Seeley	USA	1882
Electric lamp	Thomas Alva Edison	USA	1879
Electromagnet	W. Sturgeon	England	1824
Evolution (theory)	Charles Darwin	England	1858
Film (with sound)	Dr Lee de Forest	USA	1923
Fountain Pen	I.E. Waterman	USA	1884
Gas lighting	William Murdoch	Scotland	1794
Gramophone	T.A. Edison	USA	1878
Jet Engine	Sir Frank Whittle	England	1937
Lift	E.G. Otis	USA	1852
Locomotive	Richard Trevithick	England	1804
Machine gun	Richard Gatling	USA	1861
Match (safety)	J.E. Lurdstrom	Sweden	1855
Microphone	David Hughes	USA	1878
Microscope	Z. Jansen	Netherlands	1590
Motor car (petrol)	Karl Benz	Germany	1885
Motorcycle	Edward Butler	England	1884
Neon-lamp	G. Claude	France	1915
Nylon	Dr W.H. Carothers	USA	1937
Photography (paper)	W.H. Fox Tablot	England	1835
Printing press	J. Gutenberg	Germany	1455
Radar	Dr A.H. Taylor and L.C. Young	USA	1922
Radium	Marie and Pierre Curie	France	1898
Radio	G. Marconi	England	1901
Rayon	American Viscose Co.	USA	1910
Razor (safety)	K.G. Gillette	USA	1895
Razor (electric)	Col. J. Schick	USA	1931
Refrigerator	J. Harrison and A. Catlin	Britain	1834
Revolver	Samuel Colt	USA	1835
Rubber (vulcanized)	Charles Goodyear	USA	1841
Rubber (waterproof)	Charles Macintosh	Scotland	1819
Safety lamp	Sir Humphrey Davy	England	1816
Safety pin	William Hurst	USA	1849
Sewing machine	B. Thimmonnier	France	1830
Scooter	G. Bradshaw	England	1919
Ship (steam)	J.C. Perier	France	1775
Ship (turbine)	Sir Charles Parsons	Britain	1894
Shorthand (modern)	Sir Issac Pitman	Britain	1837
Spinning frame	Sir Richard Arkwright	England	1769

Invention	Inventor	Country	Year
Spinning jenny	James Hargreaves	England	1764
Steam engine (piston)	Thomas Newcome	Britain	1712
Steam engine (condenser)	James Watt	Scotland	1765
Steel production	Henry Bessemer	England	1855
Stainless Steel	Harry Brearley	England	1913
Tank	Sir Ernest Swington	England	1914
Telegraph code	Samuel F.B. Morse	USA	1837
Telephone	Alexander Graham Bell	USA	1876
Telescope	Hans Lippershey	Netherlands	1608
Television	John Logie Bared	Scotland	1926
Terylene	J. Whinfield and H. Dickson	England	1941
Thermometer	Daniel Gabriel Fahrenheit	Germany	1714
Tractor	J. Froelich	USA	1892
Transistor	Bardeen, Shockley	USA & UK	1949
Typewriter	C. Sholes	USA	1868
Valve of radio	Sir J.A. Fleming	Britain	1904
Watch	A.L. Breguet	France	1791
X-ray	Wilhelm Roentgen	Germany	1895
Zip fastener	W.L. Judson	USA	1891

22. Important Discoveries in Physics

Discovery	Scientist	Year
Laws of motion	Newton	1687
Law of electrostatic attraction	Coulomb	1779
Atom	John Dalton	1808
Photography (On metal)	J. Neepse	1826
Law of Electric resistance	G.S. Ohm	1827
Law of floatation	Archemedes	1827
Electromagnetic Induction	Michael Faraday	1831
Photography (On paper)	W.Fox Talbot	1835
Dynamite	Alfred Nobel	1867
Periodic table	Mandeleev	1888
X-Rays	Roentgen	1895
Radioactivity	Henry Becquerel	1896
Electron	J.J. Thomson	1897
Radium	Madam Curie	1898
Quantum theory	Max Plank	1900
Wireless Telegram	Marconi	1901
Diode Bulb	Sir J. S. Fleming	1904
Photo electric effect	Albert Einstein	1905
Principle of Relativity	Albert Einstein	1905
Triode Bulb	Lee de Forest	1906
Atomic Structure	Neil Bohr & Rutherford	1913

Discovery	Scientist	Year
Proton	Rutherford	1919
Raman Effect	C.V. Raman	1928
Neutron	James Chadwick	1932
Nuclear Reactor	Anrico Fermi	1942
Law of electrolytic dissociation	Faraday	—
Thermionic emission	Edison	—

23. S.I. Units of Physical Quantity

Quantity	SI	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Work and Energy	joule	J
Electric current	ampere	A
Temperature	kelvin	K
Intensity of flame	candela	cd
Angle	radian	rad
Solid angle	steredian	sr
Force	newton	N
Area	square meter	m^2
Volume	Cubic meter	m^3
Speed	meter per second	ms^{-1}
Angle Velocity	radian per second	$rad\ s^{-1}$
Frequency	Hertz	Hz
Moment of inertia	kilogram Square meter	kgm^2
Momentum	kilogram meter per second	$Kg\ ms^{-1}$
impulse	newton second	Ns
Angular Momentum	kilogram square meter per second	Kgm^2s^{-1}
Pressure	pascal	Pa
Power	watt	W
Surface tension	newton per meter	Nm^{-1}
Viscosity	newton second per square m.	$N.s.m^{-2}$
Thermal Conductivity	watt per meter per degree celcius	$Wm^{-1}C^{-1}$
Specific Heat capacity	joule per kilogram per Kelvin	$Jkg^{-1}K^{-1}$
Electric charge	coulomb	C
Potential Difference	volt	V
Electric Resistance	ohm	Ω
Electrical Capacity	farad	F
Magnetic Induction	henry	H
Magnetic Flux	weber	Wb

Quantity	SI	Symbol
Luminous Flux or photometric power	lumen	lm
Intensity of illumination	lux	lx
Wave length	Angstrom	A°
Astronomical distance	light year	ly

24. Conversion of Units from One System to Another System

1 Inch	2.54 centimeter	1 grain	64.8 miligram
1 Feet	0.3 meter	1 dram	1.77 gm
1 Yard	0.91 meter	1 ounce	28.35 gm
1 Mile	1.60 kilometer	1 pound	0.4537 kilogram
1 Fathom	1.8 meter	1 dyne	10^{-5} Newton
1 Chain	20.11 meter	1 poundal	0.1383 Newton
1 Nautical mile	1.85 kilometer	1 erg	10^{-7} Joule
1 Angstrom	10^{-10} meter	1 horse power	747 Watt
1 Square inch	6.45 sq. centimeter	1 fathom	6 feet
1 Square feet	0.09 square meter	1 mile	8 furlong
1 Square yard	0.83 square meter	1 mile	5280 feet
1 Acre	10^4 sq. meter	1 nautical mile	6080 feet
1 Square mile	2.58 sq. kilometer	1 feet	12 inch
1 Cubic inch	16.38 cubic centimeter	1 yard	3 feet
1 Cubic feet	0.028 cubic meter	37^0 centigrade	98.6^0 Fahrenheit
1 Cubic yard	0.7 quebec meter	50^0 centigrade	122 Fahrenheit
1 Litre	1000 cubic centimeter	-40^0 Fahrenheit	-40^0 Centigrade
1 Pint	0.56 litre	32^0 Fahrenheit	0^0 Centigrade

★★★

7 CHEMISTRY

1. Introduction

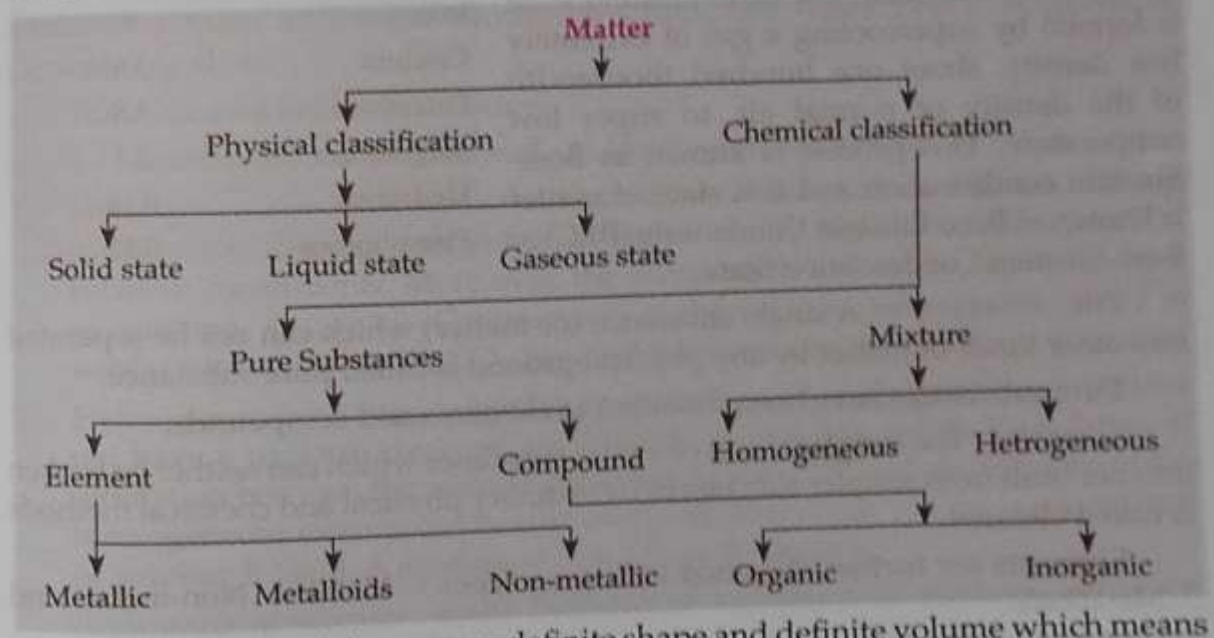
Chemistry is the branch of science which deals with the composition of matter and also the Physical and Chemical characteristics associated with the different material objects.

A French chemist, *Lavoisier (1743–1793)* is regarded as *father of modern chemistry*.

1. Substance and its nature : Anything that occupies space, possesses mass and can be felt by any one or more of our senses is called matter.

Early Indian Philosophers classified matter in the form of five basic elements the "Panch Tatava"—air, earth, fire, sky and water. According to them everything, living or non-living was made up of these five basic elements. Ancient Greek Philosophers had arrived at a similar classification of matter.

Indian sage Maharishi Kanada was perhaps the first to suggest that all forms of matter are composed of very small i.e., tiny particles known as anu and each anu may be made up of still smaller particles called parmanu Greek thinker Domocritus named these tiny particles parmanu as atoms (from the Greek word atomos meaning uncut) Thus matter is composed of tiny particles known as atoms.



Solid State : A solid possesses definite shape and definite volume which means that it can not be compressed on applying pressure. Solids are generally hard and rigid. *Example*—metals, wood, bricks, copper etc.

Liquid State : A liquid possesses definite volume but no definite shape. This means that the liquid can take up the shape of container in which it is placed. *Example*—water, milk, oil, alcohol etc.

Gaseous State : A gas does not have either a definite volume or definite shape. It can be compressed to large extent on applying pressure and also takes the shape of the container where it is enclosed. *Examples*—Air, Oxygen, Nitrogen, Ammonia, Carbondioxide etc.

Solid State $\underset{\text{Cool}}{\overset{\text{Heat}}{\rightleftharpoons}}$ Liquid State $\underset{\text{Cool}}{\overset{\text{Heat}}{\rightleftharpoons}}$ Vapour state

Water exists in three different states.

Ice (Solid) $\rightleftharpoons$ Water (Liquid) $\rightleftharpoons$ Vapour (Gas)

The three states of matter are Solid, liquid and Gaseous state. The fourth state of matter is plasma state and fifth state of matter Bose-Einstein Condensation state.

Plasma state : Plasma state consists of super energetic and super excited particles. These particles are in the form of ionised gases. Plasma can occur when matter is heated to a very high temperature. The matter in plasma state is a collection of free highly energetic and highly excited electrically charged particles.

The fluorescent tubes and neon sign bulbs contain inert gases, when electric current is passed through them, they produce glowing plasma, having a characteristic colour depending upon the nature of the gas. It is the presence of plasma that makes CFL tube glow.

Bose-Einstein Condensation State : In 1920, on the basis of statistical calculation, Satyendra Nath Bose gave the concept of fifth state of matter. Latter American Scientists succeeded in obtaining this state. The Bose-Einstein state is formed by supercooling a gas of extremely low density, about one hundred thousandth of the density of normal air, to super low temperature. This process is known as Bose-Einstein condensation and this state of matter is known as Bose-Einstein Condensate (BEC) or Bose-Einstein Condensation State.

Approximate relative abundance of some elements in the earth crust

Elements	% in Earth Crust
Oxygen	46.6
Silicon	27.7
Aluminium	8
Iron	5
Calcium	3.6
Potassium	2.8
Magnesium	2.1
Hydrogen	0.14
Phosphorous	0.12

Pure substances : A single substance (or matter) which can not be separated into other kinds of matter by any physical process is called pure substance.

Pure substances have been classified as elements and compounds.

Elements : The simplest form of a pure substance which can neither be broken into nor built from simpler substances by ordinary physical and chemical methods is called element.

Elements are further classified into three types 1. Metals 2. Non-metals and 3. Metalloids.

Metals : Metals are solids (exception mercury which is liquid at room temperature) are normally hard. They have lustre, high melting point *(mp)* and boiling point *(bp)* and also good conductor of electricity and heat. The conductivity of metal decreases with increase in temperature due to vibration of positive ions at their Lattice points. *Examples*—Iron, Copper, Silver, Gold, Aluminium, Zinc etc.

Non-metals : Non-metals are the elements with properties opposite to those of the metals. They are found in all states of matter. They do not possess lustre (exception–iodine). They are poor conductors of electricity (exception-graphite) and they are not malleable and ductile. *Examples*—Hydrogen, Carbon, Oxygen, Nitrogen, Sulphur, Phosphorous etc.

Metalloids : Metalloids are the elements which have common properties of both metals and non-metals. *Examples*—Arsenic, Antimony, Bismuth etc.

Compounds : Compounds are pure substances that are composed of two or more different elements in fixed proportion by mass. The properties of a compound are entirely different from those of the elements from which it is made. *Example*—Water, Sugar, Salt, chloroform, Alcohol, Ether etc.

Compounds are classified into two types—

1. Organic Compounds : The Compounds obtained from living sources are called organic compounds. The term organic is now applied to hydrocarbons and their derivatives. *Examples*—Carbohydrates, Proteins, Oils, Fats etc.

Approximate percentage of elements in human body

Elements	Percentage
Oxygen	65
Carbon	18
Hydrogen	10
Nitrogen	3
Calcium	2
Phosphorous	1
Potassium	0.35
Sodium	0.15
Chlorine	0.15
Magnesium	0.05
Iron	0.0004

2. Inorganic Compounds : The Compounds obtained from non-living sources such as rocks and minerals are called inorganic compounds. *Examples*—Common Salt, Marble, Washing Soda etc.

Mixtures : A material obtained by mixing two or more substances in any indefinite proportion is called a mixture. The properties of the components in a mixture remain unchanged. *Example*— Milk, Sea water, Petrol, Paint, Glass, Cement, Wood etc.

There are two types of mixture—

1. Homogeneous mixture and 2. Heterogeneous mixture.

1. Homogeneous mixture : A mixture is said to be homogeneous if it has a uniform composition through out and there are no visible boundaries of separation between constituents. More over, the constituents can not be seen even by a microscope. *Examples*—Common salt dissolved in water, sugar dissolved in water, iodine dissolved in CCl_4, benzene in toluene and methyl alcohol in water.
2. Heterogeneous mixture : A mixture is said to be heterogeneous if it does not have a uniform composition throughout and has visible boundaries of separation between the various constituents. The different constituents of the heterogeneous mixture can be seen even with naked eye. *Example*—A mixture of Sulphur & Sand, A mixture of Iron filings & Sand etc.

Separation of mixture : Some methods of separation of mixtures are given below—

1. Sublimation : Sublimation is a process of conversion of a solid into vapour without passing through the liquid state and This method can be used for the substances which are sublime in their separation from non-sublimate materials. *Examples* of sublimes are Naphthalene, Iodine, Ammonium Chloride, Camphor etc.

2. Filtration : This is a process for quick and complete removal of suspended solid particles from a liquid, by passing the suspension through a filter paper. *Examples*—1. removed of solid particles from the engine oil in car engine. 2. filtration of tea from tea leaves in the preparation of tea etc.

3. Evaporation : The process of conversion of a liquid into its vapours at room temperature is called evaporation. Evaporation causes cooling. *Example*–1. Evaporation of water in summer from Ponds, wells & lakes. 2. Preparation of common salt from sea water by evaporation of water.

4. Crystallization : This method is mostly used for separation and purification of solid substances. In this process, the impure solid or mixture is heated with suitable solvent (e.g. alcohol, water, acetone, chloroform) to its boiling point and the hot solution is filtered. The clear filtrate is cooled slowly to room temperature, when pure solid crystallizes out. This is separated by filtration and dried.

For the separation of more complex mixtures, fractional crystallization is used, in which the components of the mixtures crystallize out at different interval of time.

5. Distillation : It is a process of converting a liquid into its vapour by heating and then condensing the vapour again into the same liquid by cooling. Thus, distillation involves vaporisation and condensation both

Distillation = Vaporisation + Condensation

This method is employed to separate the liquids which have different boiling points or a liquid from non-volatile solid or solids either in solution or suspension. *Example*—A mixture of copper sulphate and water or a mixture of water (B.P 100°C) and methyl alcohol (B.P 45°C) can be separated by this method.

6. Fractional distillation : This process is similar to the distillation process except that a fractionating column is used to separate two or more volatile liquid which have different boiling points. *Example*–1. Methyl alcohol (bp = 338 K) and acetone (bp = 329 K) can be separated by fractional distillation process. 2. Separation of petrol, diesel oil, kerosene oil, heavy oil etc from crude petroleum. 3. Separation of oxygen, nitrogen inert gasses and carbon dioxide from liquid air etc.

7. Chromatography : The name chromatography is derived from Latin word 'Chroma' meaning colour. The technique of chromatography is based on the difference in the rates at which the components of a mixture are absorbed in the suitable absorbent.

There are many types of chromatography.

(a) Column (absorption) Chromatography
(b) Thin layer chromatography
(c) Paper - chromatography
(d) High pressure liquid chromatography
(e) Ion-exchange chromatography
(f) Gas chromatography

8. Sedimentation and Decantation : This method is used when one component is a liquid and other is an insoluble. Insoluble solid, heavier than liquid. i.e, mud and water.

If muddy water is allowed to stand undisturbed for sometime in a beaker, the particles of earth (clay and sand) settle at the bottom. This process is called sedimentation. The clear liquid at the top can be gently transferred into another beaker. This process is known as decantation.

Concept of change in state : (a) Melting Point : The constant temperature at which a solid becomes liquid upon absorbing heat under normal pressure is called melting point of that solid m.p. of ice is 0°C and m.p. of Sodium Chloride (NaCl) is 800°C.

The melting point of a substance is a fixed temperature. But if there are impurities in a substance, the melting point of that substance can change considerably. for example the m.p of mixture of ice and salt i.e. freezing mixture is –15°C.

(b) Boiling point : The constant temperature at which a liquid changes to vapour state under normal atmospheric pressure is called boiling point.

Liquid	Water	Ethanol	Chloroform	Acetone
B.P.	100°C	78.3°C	62°C	46°C

The boiling point decreases with decrease in atmospheric pressure. Soluble impurities increases the boiling point of liquid.

(c) Freezing Point : The constant temperature at which a liquid changes into a solid by giving out heat energy is called freezing point of that liquid. F.P of water = 0°C.

(d) Evaporation : The process of conversion of a liquid into its vapours at room temperature is called evaporation. Evaporation causes cooling. Actually, during evaporation, the molecules having higher kinetic energy escape from the surface of the liquid. Therefore, average kinetic energy of the rest of the molecules decreases. Therefore cooling takes place during evaporation because of temperature of liquid is directly proportional to average kinetic Energy. Evaporation is affected by following factors,

1. Nature of liquid 2. Temperature 3. Surface area.

(e) Vapour pressure : The pressure exerted by the vapours of liquid in equilibrium with liquid at a given temperature is called vapour pressure. Vapour pressure depends upon—1. its nature and 2. temperature.

Higher the vapour pressure of a particular liquid lesser will be the magnitude of intermolecular forces present in molecules. Vapour pressure of a liquid increases with increase in temperature.

2. Atomic Structure

Atom : The smallest particle of an element is called an atom. An atom can take part in chemical combination and does not occur free in nature. The atom of the hydrogen is the smallest and lightest. *Example*—Na, K, Ca, H etc.

Molecule : A molecule is the smallest particle of an element or compound that can have a stable and independent existence. *Example*—O_2, N_2, Cl_2, P_4, S_8 etc.

Mole : A mole is a collection of 6.023×10^{23} particles. It means that

1 mole = 6.023×10^{23} (just like 1 pair = 2)

1 mole atom = 6.023×10^{23} atoms

1 mole molecule = 6.023×10^{23} molecules

Avogadro's Number : The number 6.023×10^{23} is called Avogadro's Number.

Atomic Mass : The atomic mass of an element is a number which states that how many times the mass of one atom of an element is heavier than $\frac{1}{12}$th mass of one atom of carbon–12.

$$\text{Atomic mass of an element} = \frac{\text{Mass of one atom of the element}}{\frac{1}{12} \times \text{mass of one atom of carbon-12}}$$

Actual mass of 1 atom of an element = atomic mass in amu $\times 1.66 \times 10^{-24}$ g

Molecular mass : The molecular mass of a substance is a number which states that how many times mass one molecule of a substance is heavier in comparison to $\frac{1}{12}$th mass of one atom of Carbon–12.

Constituents of an atom : Fundamental particles of an atom are Electron, Proton & Neutron.

Electron :

1. Electron had been discovered by J.J. Thomson.
2. The name of electron was given by Stoney.
3. The relative charge on electron is –1 unit and its absolute charge is -1.6×10^{-19} coulomb or -4.8×10^{-10} e.s.u. (electrostatic unit)
4. The relative mass of an electron is 0.000543 amu and its absolute mass is 9.1×10^{-28} g or 9.1×10^{-31} kg.
5. The charge/mass (e/m) ratio of an electron is -1.76×10^{8} $\frac{\text{Coulomb}}{\text{gram}}$
6. An electron was obtained from Cathode rays experiments.

Proton :

1. A proton had been discovered by Goldstein
2. A proton was named by Rutherford.
3. The relative charge on proton is +1 unit and its absolute charge is $+1.6 \times 10^{-19}$ Coulomb or $+4.8 \times 10^{-10}$ e.s.u.
4. The relative mass of proton is 1.00763 amu and its absolute mass is 1.673×10^{-24} gram or 1.673×10^{-27} kg.
5. The charge/mass (e/m) ratio for a proton is $= 9.58 \times 10^{4}$ $\frac{\text{Coulomb}}{\text{gram}}$
6. An proton was obtained from anode rays experiment.

Neutron :

1. A neutron had been discovered by James Chadwick.
2. Charge on neutron is zero
3. The relative mass of neutron is 1.00863 amu and its absolute mass is 1.675×10^{-24} gram or 1.675×10^{-27} kg.
4. The charge/mass for a neutron is zero.
5. A neutron was obtained from radioactivity phenomenon.

$$^{9}_{4}Be + ^{4}_{2}He \xrightarrow{\alpha\text{–particle}} ^{12}_{6}C + ^{1}_{0}n$$

Atomic number (Z) : The number of proton or electron in an atom of the element is called atomic number. It is denoted by Z.

$Z = e = p$ where, e = no. of electrons and p = no. of protons.

Mass number (A) : The sum of number or protons and neutrons in an atom of the element is called mass number. It is denoted by A.

$A = p + n$ where, p = no. of protons and n = no. of neutrons

Let, $^{23}_{11}Na$,

In Na, $Z = 11$, $A = 23$ and,

$e = 11$, $p = 11$

$\therefore \quad n = A - p = 23 - 11 = 12$

Isotopes : These are atoms of the elements having the same atomic number but different mass number.

Isotopes of Carbon— $^{12}_{6}C$, $^{13}_{6}C$, $^{14}_{6}C$

Isobars : These are atoms of the elements having the same mass number but different atomic numbers. e.g.

$^{40}_{18}Ar$, $^{40}_{19}K$, $^{40}_{20}Ca$

Isotones : These are atoms of different elements having the same number of neutrons.

$^{14}_{6}C$, $^{15}_{7}N$, $^{16}_{8}O$

Isoelectronic : These are atoms/molecules/ions containing the same number of electrons.

1. O^{2-}, F^{-}, Ne, Na^{+}, Mg^{2+} 2. CN^{-}, N_2, O_2^{2+} etc.

Thomson's model of an atom : According to Thomson, an atom is treated as sphere of radius 10^{-8} cm in which positively charged particles are uninformally distributed and negatively charged electrons are embedded through them. This is also called Plum-Pudding model of an atom or water-melon model of an atom.

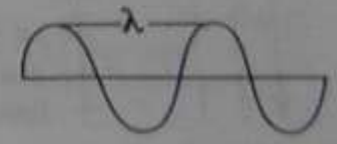
Rutherford's model of an atom : On the basis of scattering experiment, Rutherford proposed a model of the atom which is known as nuclear atomic model.

According to this model,

1. An atom consists of a heavy positively charged nucleus where all protons and neutrons are present. Protons & neutrons are collectively called nucleons. Almost whole mass of the atom is contributed by these nucleons.
2. Radius of a nucleus = 10^{-13} cm
   Radius of an atom = 10^{-8} cm
   Radius of an atom = 10^{5} times of the radius of the nucleons.
3. Volume of an atom is 10^{15} times heavier than volume of a nucleus.
4. Electrons revolve around the nucleus in closed orbits with high speed. This model is similar to the solar system, the nucleus representing the sun and revolving electrons as planets. The electrons are therefore, generally referred as planetary electrons.

Nature of light & Electromagnetic Spectrum : In 1856 James Clark Maxwell stated that light, x–ray, γ–rays and heat etc emit energy continuously in the form of radiations or waves and the energy is called radiant energy. These waves are associated with electric as well as magnetic fields and are therefore known as electromegnetic waves (or radiations).

1. **Wave length (λ)** : The distance between two consecutive crests or troughs is called wavelength. It is denoted by λ (Lamda).



SI unit of λ is metre (m) and CGS unit is centimetre (cm).

$1\ \text{Å} = 10^{-10}$ m, 1 μ (micron) = 10^{-6} m,

1 nm = 10^{-9} m, 1 pm = 10^{-12} m,

2. Frequency (ν) : The number of waves passing through a point in one second is called frequency. It is denoted by ν (nu). The unit of frequency is cycle/second or sec^{-1} or Hertz (Hz)

1Hz = 1 cycle per second

3. Wave number ($\bar{\nu}$) : The number of wavelengths which can be accomodated in one centimetre length along the direction of propagation is called wave number. It is denoted by $\bar{\nu}$. The SI unit of $\bar{\nu}$ is m^{-1} are CGS unit is cm^{-1}.

$$\text{Wave number } (\bar{\nu}) = \frac{1}{\text{wave lenght } (\lambda)}$$

4. The relation between velocity of light (C), frequency (ν) and wavelength (λ) is.

$$\boxed{C = \nu\lambda.}$$

Where $C = 3 \times 10^8 \frac{m}{sec}$

or, $3 \times 10^{10} \frac{cm}{sec}$

Different types of electromatic waves (or radiation) differ with respect to wavelength or frequency. The wavelength of electromagnetic spectrum increase in the following order.

Cosmic rays < Y–rays < X-rays < Ultraviolet rays < Visible < Infrared < Microwaves < Radiowaves.

Planck's quantum theory of Radiations : In 1990 Max Planck put forward a theory which is known as planck's quantum theory According to this theory radiant energy is emitted or absorbed in the form of small energy packets called quanta. In case of light these energy packets are known as photons. The energy of each quantum is directly proportional to the frequency of radiation.

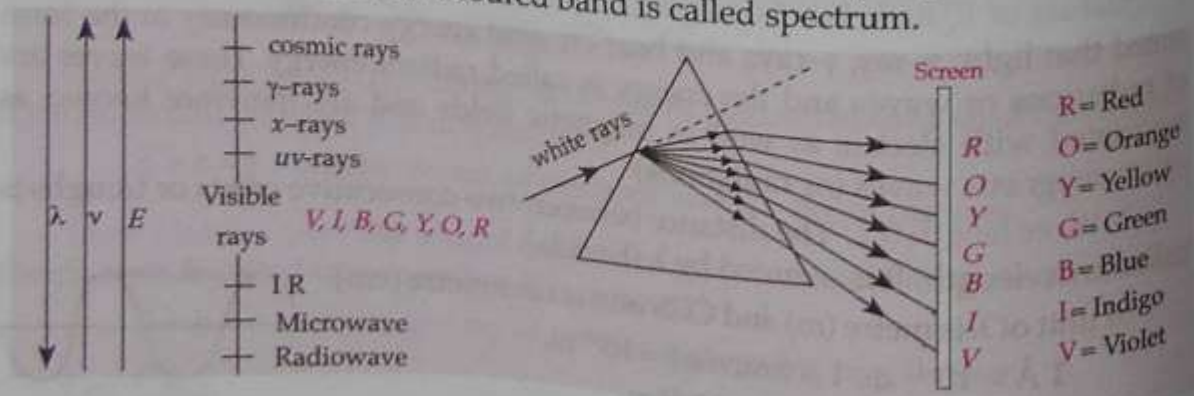
i.e., $E \propto \nu$

or, $E = h\nu = \frac{hC}{\lambda}$

Where h is called Planck's constants. Its value is 6.626×10^{-34} Js and C is the velocity of light and $C = 3 \times 10^{-8}$ m/s

These electromagnetic radiations are expressed in terms of certain characteristics which are given below—

Spectrum : When white light is allowed to pass through a prism, it splits into several colours. These seven coloured band is called spectrum.



Zeeman's effect : When spectral lines obtained from atomic spectra is placed in a magnetic field, they are splitted into number of fine lines, this is called Zeeman's effect.

Stark's effect : When spectral lines obtained from atomic spectra is placed in electric field, they are splitted into number of fine lines this is called Stark's effect.

Thomson's model	Plum pudding model (watermelon model)
Rutherford's model	Nuclear theory
Bohr's model	Concept of Quantization of energy.
Planck's Quantum theory	Photon & quanta.
Sommerfeld's model	Orbital : elliptical & spherical
de-Broglie's equation	Dual nature of electron
Heisenberg's Uncertainty principle	Exact position & momentum can not be determined simultaneously
Schrodinger's wave equation	wave nature of electron.

Quantum Number

The set of four integers requires to define an electron completely in an atom are called quantum number.

1. Principal quantum number (n) : It describes the name, size and energy of the shell to which electron belong. It is denoted by n, where,

$n = 1, 2, 3, 4 \ldots\ldots \infty$.

Value of n	1	2	3	4	5	6	7
Designation of Shell	K	L	M	N	O	P	Q

2. Azimuthal quantum number (l) : It determines the shape of electron cloud and number of sub shells in a shell. The value of l lies between 0 to $n-1$ i.e., $l = 0$ to $n-1$

Value of l	0	1	2	3
Sub Shell	s	p	d	f

3. Magnetic quantum number (m) : It determines the orientation of sub shells. The value of m can have from $-l$ to $+l$ including zero. i.e., $m = 2l + 1$

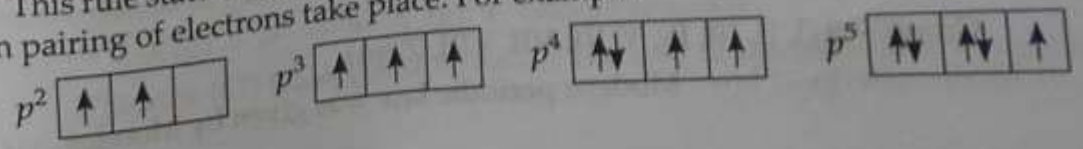
4. Spin quantum number (s) : It represents the direction of electron spin around its own axis. It has $S = +\frac{1}{2}$ for clockwise direction and $S = -\frac{1}{2}$ for anticlockwise direction.

Pauli's Exclusion Principle

According to this principle, all the four quantum numbers for any two electrons in an atom can not be identical.

Hund's Rule

This rule state that the filling of electrons in orbitals first take place singly after than pairing of electrons take place. For example



Aufbau Principle

Aufbau is a German word meaning 'building up'. This principle state that electrons are filled in various orbitals in order of their increasing energies. An orbital of lowest energy is filled first. The sequence of orbitals in order of their increasing energy is.

$1s < 2s < 2p < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s$ ...

3. Periodic classification of Elements

Father of periodic table—Mendeleev.

The arrangement of the known elements in certain groups in such a way so that the elements with similar properties are grouped together is known as classification of elements.

Genesis of periodic classification :

1. Lavoisier classified the elements into metals and non-metals.

2. Dobereinier's Triads : In 1829, Dobereiner, a German chemist arranged certain elements with similar properties in groups of three in such a way that the atomic mass of the middle element was nearly the same as the average atomic masses of the first and third elements.

Triad	Lithium	Sodium	Potassium
Atomic mass	7	23	39

$$\text{atomic mass of sodium} = \frac{39+7}{2} = \frac{46}{2} = 23$$

But only few elements could be covered under triads.

3. Newland's law of octaves : In 1866, John Newlands, An English Chemist proposed the law of octaves by stating that, *When elements are arranged in order to increasing atomic masses, every eighth element has properties similar to the first, just like musical notes.*

But this generalization was also rejected because it could not be extended to the elements with atomic mass more than 40.

4. Lother's–Mayer's atomic volume curve : In 1869 Lother mayer plotted a graph betweeen atomic volume of the elements and their atomic mass and he pointed that the elements with similar properties occupy similar position in the curve.

5. Mendeleev's periodic law : The physical and chemical properties of the elements are the periodic function of their atomic masses.

Mendeleev's arranged all the elements known at that time in increasing order of atomic mass and this arrangement become periodic table.

In a periodic table :

Horizontal line is called periods and Vertical line is called group.

In Mendeleev's periodic table : Total number of periods are seven and total number of groups are nine i.e.,

Period—7

Group—9 (I, II, III, IV, V, VI, VII, VIII, Zero)

6. Modern Periodic law : Modern periodic law was given by Moseley.

According to Moseley : "The physical and chemical properties of the elements are periodic function of their atomic numbers."

In modern periodic table : There are seven and eighteen groups i.e.,

Period—7 Group—18

Period	1	2	3	4	5	6	7
No. of Elements	2	8	8	18	18	32	Incomplete

Modern periodic table are classified as :

1. *s*–block 2. *p*–block 3. *d*–block 4. *f*–block

s–block elements are knowns as Alkali & Alkaline earth metals.

p–block elements are knowns as Chalcogen, Picogens, Halogens and inert gases.

d–block elements are knowns as Transition elements.

f–block elements are knowns as Inner transition elements.

The periodic table shows two horizontal rows each containing 14 elements at the bottom. The first row contains 14 elements from atomic number 58 to 71 and is called Lanthanides series. The second row also contains 14 elements from atomic number 90 to 103 and is called Actinide series.

Periodic properties :

1. Atomic radii : The distance from the centre of the nucleus to the outermost shell containing electrons called atomic radius.

It is not possible to measure the absolute value of atomic radius of an element. However, it may be expressed in three different forms covalent radii, metallic radii, Van der wall radii. The size of these atomic radii are as

Van der wall radii > metallic radii > covalent radii.

Atomic radii decreases from left to right in a period and increases in a group from top to bottom.

2. Ionic radii : The effective distance from the centre of nucleus of the ion upto which it exerts its influence on the electron cloud is called ionic radii. The size of ionic radii and atomic radius are as

Anionic radii > atomic radii > cationic radii

Ionic radii decreases from left to right in a period and increases in a group from top to bottom.

3. Ionization Potential (I.P.) : The amount of energy required to remove an electron from isolated gaseous atom is called Ionization Potential (I.P.) or Ionization Energy (I.E.)

$$A\,(g) - e + \text{Energy required (I.P.)} \longrightarrow A^{+}\,(g)$$

Ionisation potential increases from left to right in a period and decreases fro to top to bottom in a group. The unit of ionisation potential is kJ/mol or eV/atom.

4. Electron affinity (E_a) : The energy released during addition of an extra electron in isolated gaseous atom is called electron Affinity.

$$A\,(g) + e \longrightarrow A^{-}\,(g) + \text{Energy released}$$

Chlorine (Cl) has highest E_a value. The unit of electron affinity is kJ/mol or eV/atom.

Electron affinity increases fro left to right in a period and decrease, from top to bottom in a group.

5. Electronegativity (E_n): The relative electron attracting tendency of an atom for a shared pair of electrons in a chemical bond is called electronegativity. It has no unit.

Fluorine *(F)* is the most electronegative atom

$$E_n = \frac{IP + E_a}{5.6}$$

Where, E_n = Electronegativity, I.P. = Ionisation Potential E_a = Electron Affinity

- For ionic compound E_n value is greater than 1.7
- For polar co-valent compound E_n value is less than 1.7
- For non polar co-valent compound E_n value is 0

Electronegativity increases from left to right in a period and decreases from top to bottom in a group.

6. Lattice Energy : The amount of energy released during formation of one mole of ionic compound from its constituent ions is called Lattice energy.

7. Hydration Energy : The amount of energy released during dissolution of one mole of compound into water, is called hydration energy.

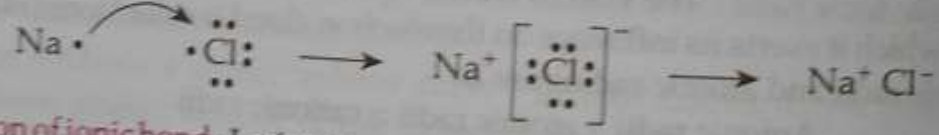
If hydration energy is greater than Lattice energy, then compound is soluble in water and if hydration energy is less than Lattice energy, then compound is insoluble in water.

4. Chemical Bonding

The force that holds together the different atoms in a molecule is called chemical bond. There are many types of chemical bond.

1. Ionic bond or (Electrovalent bond) : A bond formed by the complete transfer of one or more electrons from one atom to other atom is called ionic bond. *Example*—

(a) Formation of NaCl :



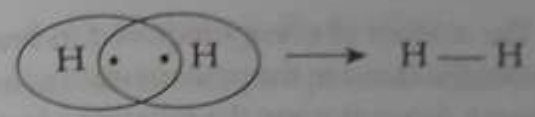
Condition of ionic bond : Ionization energy of metal should be low and Electron affinity of non-metal should be high.

Properties of ionic compounds :

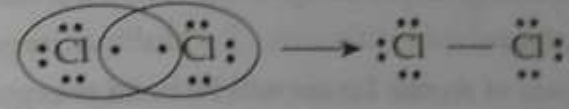
(a) Ionic compounds have high melting point & boiling point.
(b) Ionic compounds are good conductor of electricity in molten state or in water.
(c) Ionic compounds are bad conductor of electricity in solid state.
(d) Ionic compounds are soluble in water.
(e) Ionic compounds are insoluble in non-polar covalent like Benzene, Carbon tetrachloride etc.

Covalent bond : A bond formed between two same or different atoms by mutual contribution and sharing of electrons is called covalent bond. Example—

(a) H_2 molecule :

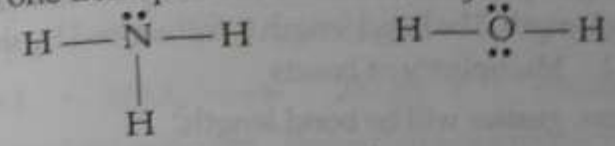


(b) Cl_2 molecule :



Lone pair of electrons : The pair of electrons which do not take part in covalent bond formation are called Lone pair of electrons For example

There is one Lone pair in ammonia (NH_3) and two Lone pair in water (H_2O)

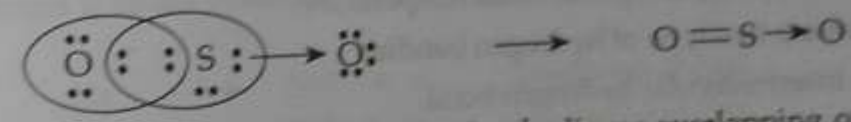


Properties of covalent compounds :

(a) Covalent compounds have high m.p. & b.p.
(b) They are generally bad conductor of electricity (exception graphite)
(c) They are generally insoluble in water.
(d) They are generally soluble in organic solvent like benzene, acetone, chloroform etc.
(e) Covalent bonds are directional.

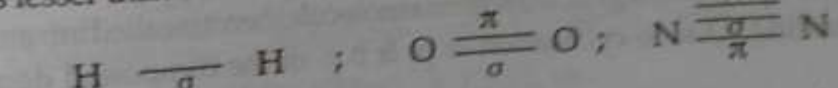
Co-ordinate bond (or Dative bond) : Co-ordinate bond is a special type of covalent bond in which one atom donates electrons to other atom. The bonding between donor to acceptor atom is called co-ordinate bond. It is denoted by →.

Example—



Sigma bond (σ–bond) : A bond formed by the linear overlapping of atomic orbitals is called sigma bond. Since, the extent of overlapping of atomic orbitals in σ-bond in large. Hence σ-bond is a strong bond.

Pi-bond (π-bond) : A bond formed by the sidewise (or lateral overlapping of atomic orbitals is called pi-bond. since, in this case, extent of overlapping of atomic orbitals is lesser than σ-bond. So, π-bond is a weak bond.



Hybridisation : The phenomenon of mixing of two or more atomic orbitals of equivalent energies to form new type of identical number of orbitals is called hybridisation and new type of orbitals obtained are called hybrid orbitals.

Hybrisation	Geometry (Structure/Bond Angle)
sp	Linear / 180°
sp^2	Trigonal / 120°
sp^3	Tetrahedral / 109°28'
sp^3d	Trigonal bipyramidal / 120°, 90°
sp^3d^2	Octahedral / 90°
sp^3d^3	Pentagonal bipyramidal / 72°, 90°

Bond energy : The amount of energy required to break one mole bonds of a particular type between the atoms in the gaseous state of a substance is called bond energy. The bond energy depends upon the following factors.

1. Size of atom
2. Multiplicity of bonds.

Greater the size of atoms, Lesser will be bond energy.

Greater the bond multiplicity more will be bond energy.

Bond energy : Single bond < double bond < triple bond

Bond length : The average equilibrium distance between the centres of the two bonded atoms is called bond length. The bond length is influenced by the following factors—1. Size of atoms 2. Multiplicity of bonds

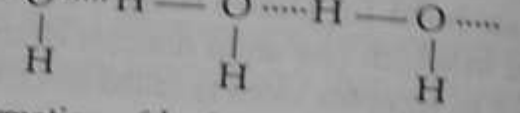
Greater the size of atoms, greater will be bond length.

Greater the multiplicity of bonds, lesser will be bond length.

Hydrogen bond : When hydrogen atom is present between two most electronegative atoms (N, O, F) then it is bonded to one by a covalent bond and to other by a weak force of attraction which is called hydrogen bond. etc. It is denoted by ..... *Example*—

1. $(HF)_n$ $\cdots\cdots H-F\cdots\cdots H-F\cdots\cdots H-F\cdots\cdots H-F\cdots\cdots$

2. $(H_2O)_n$



3. H_2O is liquid due to formation of hydrogen bond. H_2S does not form hydrogen bond. So, it is gas at room temperature.

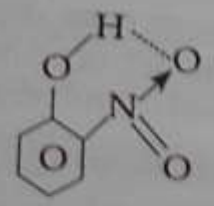
There are two type of hydrogen bonding

1. Intermolecular hydrogen bond.
2. Intramolecular hydrogen bond.

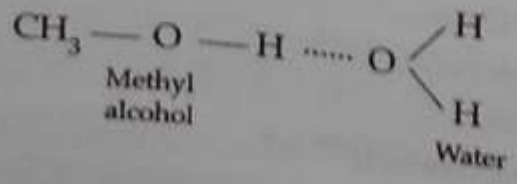
Intermolecular hydrogen bond arises when hydrogen bonding occurs between two or more molecules. In this case m.p. & b.p. of compound increases due to molecular association.

$\cdots\cdots H-F\cdots\cdots H-F\cdots\cdots H-F\cdots\cdots$

When hydrogen bonding occurs within a molecule then it is called intramolecular hydrogen bonding. Due to cyclisation m.p. & b.p. of the compound decreases in this case.



Due to intermolecular hydrogen bonding between alcohol and water, alcohol is soluble in water.



5. Oxidation & Reduction

Oxidation (old concept) : Oxidation is a process which involves either of the following—

1. addition of oxygen
2. removal of hydrogen
3. addition of electro negative element or group
4. removal of electro positive element or group.

$2Mg + O_2 \longrightarrow 2MgO$ (oxidation of Mg)

$H_2S + Cl_2 \longrightarrow 2HCl + S$ (oxidation of H_2S)

$Fe + S \longrightarrow FeS$ (oxidation of Fe)

$2KI + H_2O_2 \longrightarrow 2KOH + I_2$ (oxidation of KI)

Reduction (old concept) : Reduction is a process which involves either of the following—

1. addition of hydrogen
2. removal of oxygen
3. addition of electro positive element or group.
4. removal of electronegative element or group.

$H_2 + Cl_2 \longrightarrow 2HCl$ (reduction of Cl_2)

$CuO + C \longrightarrow Cu + CO$ (reduction of CuO)

$HgCl_2 + Hg \longrightarrow Hg_2Cl_2$ (reduction of $HgCl_2$)

$2FeCl_3 + H_2 \longrightarrow 2FeCl_2 + 2HCl$ (reduction of $FeCl_3$)

Modern concept of oxidation and Reduction : According to modern concept, loss of electrons is called oxidation whereas gain of electrons is called reduction.

Example :

$Na \longrightarrow Na^+ + e$ (oxidation of Na)

$Zn \longrightarrow Zn^{2+} + 2e$ (oxidation of Zn)

$Cl_2 + 2e \longrightarrow 2Cl^-$ (reduction of Cl_2)

$S + 2e \longrightarrow S^{2-}$ (reduction of S)

Oxidising agent (O.A.) : A substance which undergoes reduction is called oxidising agent

$CuO + C \longrightarrow Cu + CO$

Oxidation – C, Reduction– CuO, Oxidising agent – CuO

Examples—O_2, O_3, H_2O_2, $KMnO_4$, $K_2Cr_2O_7$ etc.

Reducing agent (R.A.) : A substance which undergoes oxidation is called reducing agent.

$H_2O + C \longrightarrow CO + H_2$

Oxidation—C, Reduction—H_2O, Reducing agent—C

Examples—H_2, CO, H_2S, SO_2, C, $SnCl_2$ etc.

Redox Reaction : A reaction in which both oxidation and reduction takes place simaltaneously is called redox reaction.

Example—

$CuO + C \longrightarrow Cu + CO$

Oxidation – C, Reduction – CuO

Oxidation number (O.N.) : The charge present on atom in a molecule or ion is called oxidation number. It may be zero, positive or negative.

Rules for determination of oxidation number :

1. Oxidation number of an atom in free state is zero.
2. Oxidation number of alkali metals (Li, Na, K, Rb, Cs) in molecule is always +1.
3. Oxidation number of alkaline earth metals (Be, Mg, Ca, Sr, Ba) in a molecule is always + 2
4. Oxidation number of hydrogen — (+ 1) hydrogen ion; (– 1) hydride ion
5. Oxidation number of Oxygen — (– 2) oxide; (– 1) peroxide; $-\frac{1}{2}$ superoxide
6. Sum of Oxidation number of atoms in a molecule is equal to zero.
7. Sum of oxidation number of atoms in a ion is equal to magnitude of charge with sign.

Oxidation Number of Mn in $KMnO_4$:

Let O.N. of Mn = x

$1 + x + (-2) \times 4 = 0$

$1 + x - 8 = 0$

$x = +7$

Oxidation Number of Cr in $K_2Cr_2O_7$:

Let O.N. of Cr = x

$1 \times 2 + x \times 2 + (-2) \times 7 = 0$

$2 + 2x - 14 = 0$

$x = +6$

Oxidation Number of C in $C_{12}H_{22}O_{11}$:

Let O.N. of C = x

$x \times 12 + 1 \times 22 + (-2) \times 11 = 0$

$12x + 22 - 22 = 0$

$x = 0$

Types of Reactions :

1. **Decomposition reactions :** In these reactions, compound either of its own or upon heating decomposes to give two or more components out of which at least one is in the elemental state.

$$2NaH\,(s) \xrightarrow{\Delta} Na\,(s) + H_2\,(g)$$

$$2H_2O\,(l) \xrightarrow{\Delta} 2H_2\,(g) + O_2\,(g)$$

2. **Combination reactions :** In combination reactions, compounds are formed as a result of the chemical combination of two or more elements.

$$H_2\,(g) + \frac{1}{2}O_2\,(g) \longrightarrow H_2O\,(l)$$

$$C\,(s) + O_2\,(g) \longrightarrow CO_2\,(g)$$

$$3Mg\,(s) + N_2\,(g) \longrightarrow Mg_3N_2\,(s)$$

3. **Displacement reactions :** In these reactions, an atom / ion present in a compound gets replaced by an atom / ion of another element.

$$FeSO_4\,(aq) + Zn\,(s) \longrightarrow ZnSO_4\,(aq) + Fe\,(s)$$

$$MgO\,(aq) + 2\,Na\,(s) \longrightarrow Na_2O\,(aq) + Mg\,(s)$$

4. **Disproportionation reactions:** The chemical reaction in which only one substance is oxidised as well as reduced simultaneously is called disproportionation reaction.

$$Cl_2 + 2NaOH \longrightarrow NaCl + NaOCl + H_2O$$

$$P_4 + NaOH + 2H_2O \longrightarrow 2NaH_2PO_2 + 2PH_3$$

5. **Substitution reaction :** In these reactions, one or more atoms or groups present in organic molecule get substituted or replaced by suitable atoms or groups.

$$C_2H_5Cl + KOH\,(aq) \longrightarrow C_2H_5OH + KCl$$

Ethyl chloride — Ethyl alcohol

6. **Neutralisation reaction :** When an acid reacts with a base, salt and water is formed. This reaction is called neutralisation reaction.

$$\text{acid} + \text{base} \longrightarrow \text{salt} + \text{water}$$

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

7. **Reversible reaction :** A reaction in which reactants combine to form products and again products recombine to reactants is called reversible reaction.

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

8. **Irreversible reaction :** A reaction which proceeds in only one direction is called irreversible reaction.

$$CaCO_3\,(s) \xrightarrow{\Delta} CaO\,(s) + CO_2\,(g)$$

6. Solution

A homogeneous mixture of two or more pure non-reacting substances whose composition can be varied within certain limits is called solution. When solution is composed of only two components, it is called binary solution. For example solution of NaCl in water. Similarly solution containing three components is called ternary solution For example a solution of NaCl and KCl in water.

In binary solution, there are two components—

1. Solute and 2. Solvent

The component which is in smaller proportion or amount in solution is called solute while one present in excess is called solvent.

For example— In a binary solution of sugar in water, sugar acts as solute while water is the solvents.

The better solvent is one which has high dielectric constant. Water is universal solvent because it has high dielectric constant.

On the basis of States of matter binary solution is classified as :

Nature	Solute	Solvent	Examples
Solid Solution	Gas	Solid	Hydrogen in palladium
	Liquid	Solid	Mercury in Zinc amalgem
	Solid	Solid	Various alloys
Liquid Solution	Gas	Liquid	Aerated water ($CO_2 + H_2O$)
	Liquid	Liquid	Alcohol in water
	Solid	Liquid	Sugar in water
Gaseous Solution	Gas	Gas	Air (mixture of many gases)
	Liquid	Gas	Humidity in air
	Solid	Gas	Iodine vapours in air

Saturated Solution : A solution that can not dissolve any more of the solute at a given temperature is called saturated solution.

Unsaturated Solution : A solution in which more of the solute can be dissolved at a given temperature is known as unsaturated solution.

Supersaturated Solution : A super saturated solution at a particular temperature is one that is more concentrated (contains more solute) than its saturated solution at that temperature.

Dilute Solution : It is the solution in which the amount of solute present is rather small compared to the mass of solvent.

Concentrated Solution : It is the solution in which the amount of solute present is relativity large for a given mass of solvent.

Solubility : The maximum amount of solute in gram which can dissolved in 100 g of solvent to form saturated solution at particular temperature is called solubility of that solute.

$$\text{Solubility} = \frac{\text{mass of solute in gram}}{\text{mass of solvent}} \times 100$$

The solubility of the substance depends upon the nature of solute and solvent, temperature and pressure.

The solubility of the substance increase continuously with increase in temperature, if the process of dissolution is endothermic.

For example—

The dissolution of $NaNO_3$, KNO_3, NaCl, KCl in water is endothermic process. So, their solubility increase with increase in temperature.

➢ If the process of dissolution is exothermic in nature, the solubility of a substance decrease with increase in nature.

For example—

The solubility of cerium sulphate, lithium carbonate, sodium carbonate monohydrate ($Na_2CO_3 \cdot H_2O$) etc. decreases with increase in temperature.

➢ The solubility of $Na_2SO_4 \cdot 10H_2O$ first increases up to 32.4°C and then begins to decreases. So, 32.4°C is the transition temperature.

$$Na_2SO_4 \cdot 10H_2O \underset{\text{below } 32.4^\circ C}{\overset{\text{above } 32.4^\circ C}{\rightleftharpoons}} Na_2SO_4$$

➢ The solubility of a gas decreases with increase in temperature because the dissolution of a gas in a liquid is exothermic in nature.

➢ Pressure has very little effect on the solubility of a solid in a liquid because solids and liquids are highly incompressible.

➢ The solubility of a gas in a liquid increases with increases in pressure.

➢ The effect of pressure on the solubility of a gas in liquid was studied by Henry in 1803 and is called Henry's law. It states that the mass of a gas dissolved in a given volume of the liquid at constant temperature is directly proportional to the pressure of the gas present in equilibrium with liquid.

True Solution : True solution is a homogeneous solution in which size of solute particles is less than 10^{-9} m. In true solution, the solute particles and solvent molecules can not be distinguished even under a microscope.

For example—Sodium Chloride in water.

Suspensions : A suspension is a heterogeneous solution in which the size of solute particles is more than 10^{-6} m. The particles of suspensions are visible to naked eye or under microscope.

Colloidal Solution : Colloidal solution is a heterogeneous solution in which size of particles of dispersed phase lies between 10^{-9} m to 10^{-6} m. The colloidal particles can pass through ordinary filter paper but can not pass through animal membrane. The Colloidal particles can not be seen by naked eye but they can be seen by ultramicroscope. Example— Milk, gum, blood, ink etc.

Dispersion System : A system consisting of a substance distributes as very small particles of a solid, droplets of a liquid or tiny bubbles of a gas in a suitable medium is called dispersion system. The distributed substance is called dispersed phase where as the medium in which it is dispersed in known as dispersion medium.

Sols : The colloidal systems with solid as dispersed phase and liquid as dispersion medium are known as sols. Rubbers gloves are manufactures from rubber sols by the process of electroplating.

Aerosols : The colloidal systems with solid or liquid as dispersed phase and gas as dispersion medium are known as aerosols. In smoke, the dispersed phase is solid and dispersion medium is gas. In fog, dispersed phase is liquid and dispersion medium is gas.

Note : When dispersion medium is water, alcohol or benzene, then aquasol (or hydrosol), alcosol or benzosol respectively.

Foam : Foam is a colloidal solution in which dispersed phase is gas and dispersion medium is liquid.

Brownian Movement : The continuous zig-zag movement of colloidal particles in the dispersion medium in a colloidal solution is called Brownian movement. It is due to unequal bombardments of the moving particles of dispersion medium on colloidal particles.

Tyndall Effect : When a beam of light is allowed to pass through a colloidal solution, the colloidal particles can be seen. This effect is called Tyndall effect. The Tyndall effect arises due to scattering of light by colloidal particles present in a colloidal solution.

Dialysis : The process of separating the particles of colloids from those crystalloids by diffusion of mixture through animal membrane (or parchment membrane) is known as dialysis. It is the process of purification of colloidal solution.

Coagulation (Flocculation) : The colloidal particles are either positively or negatively charged particles. When an electrolyte is added to colloidal solution, the particles of the colloidal solution take up the oppositively charged ion of the added electrolyte and get neutralised. The ion responsible for the neutralisation of charge on colloidal particles is called the coagulating ion or flocculating ion and the process is called coagulation.

Electrophoresis : The movement of colloidal particles towards a particles electrodes under the influence of an electric field is called electrophoresis. The positively charged colloidal particles move towards cathode and negatively charged colloidal particles move towards anode.

7. Acids, Bases & Salts

Acid

An acid is a substance which

1. is sour in taste
2. turns blue litmus paper into red
3. contains replaceable hydrogen
4. gives hydrogen ion (H^+) in aqueous solution (Arrhenius theory)
5. can donate a proton (Bronsted & Lowry concept)
6. can accept electron (Lewis theory)

Uses of acid :

1. As food :
   - (a) Citric acid — Lemons or oranges (Citrus fruits)
   - (b) Lactic acid — Sour milk
   - (c) Butyric acid — Rancid butter
   - (d) Tarteric acid — Grapes
   - (e) Acetic acid — Vinegar
   - (f) Maleic acid — Apples
   - (g) Stearic acid — Fats
   - (h) Oxalic and — Tomato, wood sorrel.
   - (i) Carbonic acid— Soda water aerated drinks
2. Hydrochloric acid (HCl) is used in digestion
3. Nitric acid (HNO_3) is used in the purification of gold & silver.
4. Conc. H_2SO_4 and HNO_3 is used to wash iron for its galvanization.
5. Oxalic acid is used to remove rust spot.
6. Boric acid is a constituent of eye wash.
7. Formic acid is present in red ants.
8. Uric acid is present in urine of mammals

Indicator properties of an acid

Indicator	Colour changes
Blue litmus paper	turns red
Methyl orange	From orange to pink
Phenolphthalein	remains colourless

Strength of acids

- Strong acid (completely ionised in water) — HCl, HNO_3, H_2SO_4
- Weak acid (partially ionised in water) — CH_3COOH, H_2CO_3, $HCOOH$

Classification of acids

- Hydra acids — NH_3, H_2S, HCl, HBr, HF
- Oxy acids — HNO_3, H_2SO_4, $HClO_4$, HIO_4

Basicity of an acid : The number of removable hydrogen ions from an acid is called basicity of that acid.

Mono basic acid (one removable H^+ ion) — HCl, HNO_3

Dibasic acid (two removable H^+ ion) — H_2SO_4, H_2CO_3, H_3PO_3

Tribasic acid (three removable H^+ ion) — H_3PO_4

Acidic strength 1. $HF < HCl < HBr < HI$

2. $CH_3COOH < H_2SO_4 < HNO_3 < HCl$

Uses of HCl

1. HCl present in gastric juices are responsible for the digestion.
2. Used as bathroom cleaner.
3. As a pickling agent before galvanization.
4. In the tanning of leather.
5. In the dying and textile industry.
6. In the manufacture of gelatine from bones.

Uses of HNO_3

1. In the manufacture of fertilizers like ammonium nitrate.
2. In the manufacture of explosives like TNT (Trinitro toluene), TNB (Trinitro benzene), Picric acid (Trinitro phenol) etc.
3. Nitro Glycerine (Dynamite)
4. Found in rain water (first shower)
5. It forms nitrates in the soil.
6. In the manufacture of rayon.
7. In the manufacture of dyes & drugs.

Uses of Sulphuric acid (H_2SO_4)

1. In lead storage battery.
2. In the manufacture of HCl.
3. In the manufacture of Alum.
4. In the manufacture of fertilizers, drugs, detergents & explosives.

Use of Boric acids : As an antiseptic.

Uses of Phosphoric acid

1. Its calcium salt makes our bones.
2. It forms phosphatic fertilizers.
3. PO_4^{-3} is involved in providing energy for chemical reactions in our body.

Uses of Ascorbic acid : Source of Vitamin C

Uses of Citric acid : Flavouring agent & food preservative.

Uses of Acetic acid : Flavouring agent & food preservative.

Uses of Tartaric acid : 1. Souring agent for pickles 2. A component of baking powder (sodium bicarbonate + tartaric acid)

Bases :

A. Base is a substance which

1. bitter in taste
2. turns red litmus paper into blue
3. gives hydroxyl ions (OH^-) in aqueous solution.
4. can accept proton (Bronsted & lowry concept)
5. can donate electrons (Lewis theory)

- Oxides & hydroxides of metals are bases
- Water soluble bases are called alkali e.g. NaOH, KOH, etc.
- All alkalies are bases but all bases are not alkalies because all bases are not soluble in water.

Indicator properties of bases

Indicator	Change of colour
Red litmus paper	turns blue
Methyl orange	from orange to yellow
Phenolphthalein	from colourless to pink

Strength of bases

Strong bases: NaOH, KOH

Weak bases: NH_4OH, $Fe(OH)_3$

Acidity of a base : The number of removable hydroxyl (OH^-) ions from a base is called acidity of a base.

Acidity of NaOH = 1 Acidity of KOH = 1

Acidity of $Ca(OH)_2$ = 2

The pH scale : pH of a solution is the negative logarithm of the concentration of hydrogen ions in mole per litre.

$$pH = -\log[H^+]$$

If pH < 7 then solution is acidic

If pH > 7 then solution is basic

If pH = 7 then solution is neutral

The pH value of some common liquids

Liquid	pH
Lemon Juice	2.5
Wine	2.8
Apple Juice	3.0
Vinegar	3.0
Urine	4.8
Coffee	5.0
Saliva	6.5
Milk	6.5
Blood	7.4
Pure water	7.0
Sea water	8.5
Toothpaste	9.0
Milk of magnesia	10.5

Importance of pH in everyday life :

1. Our body works within a narrow pH range of 7.0 to 7.8. Plants and animals also survive in a narrow range.
2. **In digestive system :** Hydrochloric acid is produced in the stomach which helps in the digestion of food but if it becomes excess, the pH falls, and pain and irritation occurs. To get rid of this ANTACIDS like milk of magnesia ($Mg(OH)_2$) is generally used to adjust the pH.
3. **In saving tooth decay :** Substances like chocolates and sweets are degraded by bacteria present in our mouth. When the pH falls to 5.5 tooth decay starts. Tooth enamel (calcium phosphate) is the hardest substance in our body and it gets corroded. The saliva produced by salivary glands is slightly alkaline, it helps to increase the pH, to some extent, but tooth paste is used to neutralise excess acid in the mouth.

Buffer Solution

1. A solution whose pH is not altered to great extent by the addition of small quantities of either an acid (H^+ ions) or a base (OH^- ions) is called buffer solution. A buffer solution can be obtained by (a) Mixing of weak acid and its salt with a strong base ($CH_3COOH + CH_3COONa$), (b) Mixing of weak base and in salt with strong acid $NH_4OH + NH_4Cl$

The buffer action of blood is due to the presence of H_2CO_3 and HCO_3^-

Salt : When an acid reacts with a base, salt and water are formed.

Acid + Base ⟶ Salt + Water

$HCl + NaOH \longrightarrow NaCl + H_2O$

Uses of some important salts :

1. **Sodium Chloride :** As a flavouring agent in food. In saline water for a patient of dehydration (0.9% NaCl), In the manufacture of HCl etc.
2. **Sodium iodate :** Iodised salt to prevent Goitre disease.
3. **Sodium Carbonate :** As washing soda, manufacturing of glass etc.
4. **Sodium Benzoate :** As a food preservative for pickles.
5. **Potassium nitrate :** As a fertilizer giving both K & N to the solid, In gun powder ($C + S + KNO_3$), In match sticks etc.
6. **Calcium Chloride :** Dehydrating agent used for removing moisture from gases.
7. **Calcium carbonate (lime stone) :** In the construction of building, In the cement industry., In the extraction of metals etc.
8. **Calcium sulphate :** Plaster of Paris ($2\,CaSO_4 \cdot H_2O$) – For moulds & statues, in the cement industry in the form of Gypsum ($CaSO_4 \cdot 2H_2O$).
9. **Calcium Phosphate :** As a fertilizer (Superphosphate of lime)
10. **Bleaching powder :** (a) As a disinfectant (b) As a bleaching agent (removing colours)
11. **Alum (Potassium aluminium sulphate) :** (a) In the purification of water. (b) In the dyeing industry (c) As antiseptic after shave.

The acidic and basic nature of some household substances

Acidic	Basic (Alkaline)
1. Bathroom acid	1. Milk of magnesia (Anta acids)
2. Vitamin C tablets (Ascorbic acid)	2. Toothpaste
3. Lemon juice	3. Soap solution or detergent soln.
4. Orange juice	4. Solution of washing soda.
5. Tomato juice	5. Slaked lime & white wash
6. Vinegar	
7. Fizzy drinks (Colas & Sodawater)	

8. Behaviour of Gases

1. **Boyle's law :** At constant temperature, the volume of a definite mass of a gas is inversely proportional to pressure.

$$V \propto \frac{1}{p} \quad \text{(at constant } T\text{)}$$

2. **Charle's law** : At constant pressure, the volume of a definite mass of a gas is directly proportional to absolute temperature.

   i.e. $V \propto T$ (at constant p)

3. **Gay-Lussac's law** : At constant volume, the pressure of given mass of a gas is directly proportional to the temperature in Kelvin.

   $p \propto T$ (at constant V)

4. **Avogardo's gas law** : At constant temperature and pressure the volume of a gas is directly proportional to the number of molecules.

   $V \propto n$ (at constant T & p)

5. **Ideal gas equation** : $pV = nRT$ is called ideal gas equation. Where

   p = Pressure, V = volume

   n = number of mole T = temperature in Kelvin.

   R = gas constant

   $= 0.0821$ lit atm K^{-1} mol^{-1}

   $= 8.314$ J K^{-1} mol^{-1}

   $= 1.987$ cal K^{-1} mol^{-1}

6. **S.T.P. & N.T.P.** :

   S.T.P. — Standard temperature and pressure.

   N.T.P. — Normal temperature and pressure.

   At S.T.P., for 1 mole gas

   $V = 22.4$ litre $= 22400$ ml

   $p = 1$ atm $= 76$ cm of Hg $= 760$ mm of Hg

   $T = 273$ K

Diffusion of gases : The process of intermixing of gases irrespective of the density relationship and without the effect of external agency is called diffusion of gases.

In a gas, the molecules are far separated and the empty space among the molecules are very large. Therefore the molecules of one gas can move into the empty spaces or voids of the other gas and vice-versa. This leads to diffusion.

Graham's law of diffusion : Under the similar conditions of temperature and pressure, the rates of diffusion of gases are inversely proportional to the square roots of their densities.

Let r_1 and r_2 be the rates of diffusion of two gases A and B, d_1 and d_2 be their respective densities, then according to Graham's law of diffusion.

$$\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{M_2}{M_1}}$$

Since molecular mass $= 2 \times$ vapour density.

$$M = 2 \times d$$

Dalton's law of partial pressure : It states that– If two or more gases which do not react chemically are enclosed in a vessel, the total pressure of the gaseous mixture is equal to the sum of the partial pressure that each gases which exert pressure when enclosed separately in the same vessel at constant temperature.

Let P_1, P_2 and P_3 be the pressure of three non-reactive gases when enclosed separately. Let total pressure be P

then $P = P_1 + P_2 + P_3$

9. Electrolysis

1. **Electrolytes** : These are the substances which allow the electricity to pass through them in their molten states or in the form of their aqueous solution and undergo chemical decomposition. *Examples*—acids, bases & salts.

2. **Strong electrolytes**: The electrolytes which are almost completely dissociated into ions in solution are called strong electrolytes. *Examples*—NaCl, KCl, HCl, NaOH etc.

3. **Weak electrolytes**: The electrolytes which do not ionise completely in solution are called weak electrolytes. *Examples*—CH_3COOH, H_2CO_3, HCN, $ZnCl_2$, NH_4OH etc.

4. **Electrolysis** : The process of chemical decomposition of an electrolyte by passage of electric current through its molten state or its solution is called electrolysis.

5. **Electrodes**: In order to pass the current through an electrolytes in molten state or in aqueous solution, two rods or plates are needed to connect with the terminal of a battery. These rods or plates are called electrodes.

Anode : The electrode which is attached to positive terminal of battery is called anode. Oxidation occurs at anode.

Cathode : The electrode which is attached to negative terminal of batteries is called Cathode. Reduction occurs at cathode.

Examples— Electrolysis of molten NaCl

At anode : $Cl^- - e \longrightarrow Cl$

$Cl + Cl \longrightarrow Cl_2$

At cathode : $Na^+ + e \longrightarrow Na$

So, Cl_2 gas occurs at anode while Na at cathode.

10. Carbon and its Compounds

Carbon is non-metal having atomic number 6 and mass number 12. It is placed in group (IV) A or group 14 in periodic table

Allotropy.

The substances which have same chemical properties, but different physical properties are called allotropes and this property is called allotropy. *Example*—Allotropies of Carbon—Diamond, graphite, charcoal.

Diamond.

1. It is the purest form of carbon.
2. It is the hardest natural known substance.
3. It is transparent, and specific gravity 3.52.
4. It is bad conductor of electricity and heat.
5. It has very high refractive index 2.415.
6. It is chemically inert and on heating above 1500° c, transferred into graphic.
7. It form tetrahedral crystals and hybridisation of Carbon-atom is sp^3.
8. It has high mp & density.
9. Black diamonds called carbonado contains traces of graphite.

Graphite (Plumbago or black lead)

1. It is soft, greasy, dark greyish colored crystalline solid.
2. It is good conductor of heat and electricity.
3. Its specific gravity is 2.3
4. The hybridization of carbon in graphite is sp^2 and it has hexagonal layer structure
5. It is chemically more reactive than diamond
6. Its layer structure is held by weak van der waal's force.
7. Graphite is used in making for lining and making electrodes of electric furnances, in making refractory crucibles, in making lead pencils, as a moderator in nuclear reactor as lubricant in machinery, as a reducing agent in steel manufacturing.

Forms of Amorphous carbon obtained by destructive distillation.

1.	Wood charcoal	Obtained from wood
2.	Sugar charcoal	Obtained from cane sugar
3.	Bone or animal charcoal	Obtained from animal bones
4.	Coke charcoal	Obtained from coal

Hydrocarbons

Compounds made of carbon and hydrogen atoms only are celled hydrocarbons. The natural source of hydrocarbons is petroleum.

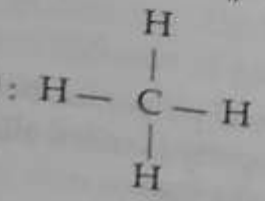
Hydrocarbons are classified as :

1. saturated hydrocarbons
2. unsaturated hydrocarbon
3. aromatic hydrocarbons.

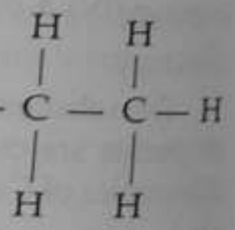
1. Saturated hydrocarbons : The hydrocarbons in which carbon atoms are singly bonded are called saturated hydrocarbons. Saturated hydrocarbons are also called alkanes or paraffins. Alkanes are relatively unreactive under ordinary laboratory conditions. So, alkanes are also called paraffins because paraffins means little reactive.

general formula of alkane—C_nH_{2n+2}

Methane (CH_4) :

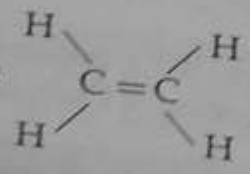


Ethane (C_2H_6) :

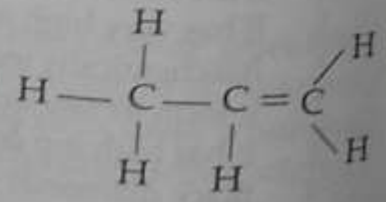


2. Unsaturated hydrocarbons : The hydrocarbons in which carbon atoms are either doubly or triply bonded are called unsaturated hydrocarbons. Doubly bonded carbon atoms ($C=C$) hydrocarbons are called alkenes. The general formula of alkene is C_nH_{2n}.

Ethane (C_2H_4) :



Propane (C_3H_6) :

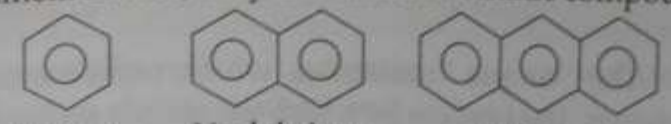


Triply bonded carbon atoms ($C\equiv C$) containing hydrocarbons are called alkynes. The general formula of alkynes are C_nH_{2n-2}

3. Aromatic hydrocarbons : These are homocyclic compounds which contain atleast one benzene ring in which carbon atoms are linked to one another by alternate single and double bonds.

In Greek, aroma stands for sweet smell. Compounds in these classification have pleasant smell. Hence, they are called aromatic compounds.

Example :



Benzene Naphthalene Anthracene

Isomerism : Two or more compounds having same molecular formula but different physical and chemical properties are called isomers and this phenomenon is called isomerism

Petroleum : The term petroleum (Latin petra = rock, oleum = oil) is applied to the dark-coloured oily liquid with offensive odour found at various depths in many regions below the surface of the earth. It is also called rock oil, mineral oil or crude oil.

A complete list of petroleum products, approximate composition, boiling range and their uses is given ahead.

S.	Fraction	Boiling range (°C)	Approximate Composition	Uses
1.	Uncondensed gas	Up to room temperature	C_1–C_4	Fuel gases
2.	Crude naphtha on refraction	30–150°	C_5–C_{10}	—
(a)	Petroleum ether	30 – 70°	C_5–C_6	Solvent
(b)	Petrol or gasoline	70–120°		Motor fuel, dry cleaning, petrol gas
(c)	Benzene derivatives	120–150°	C_8–C_{10}	Solvent, dry cleaning
3.	Kerosene	150–250°	C_{11}–C_{16}	Fuel, illuminant, oil gas
4.	Heavy oil	250–400°	C_{15}–C_{18}	As a fuel for diesel engines, converted to gasoline by cracking
(a)	Gas oil	—	—	—
(b)	Fuel oil	—	—	—
(c)	Diesel oil	—	—	—
5.	Residual oil on fraction by vacuum distillation gives	Above 400°C	C_{17}–C_{40}	—
(a)	Lubricating oil	—	C_{17}–C_{20}	Lubrication
(b)	Paraffin wax	—	C_{20}–C_{30}	Candles, boot polish, wax paper etc

S.	Fraction	Boiling range (°C)	Approximate Composition	Uses
(c)	Vaseline	—	C_{20}–C_{30}	Toilets, ointments lubrication
(d)	Pitch	—	C_{30}–C_{40}	Paints, road surfacing
6.	Petroleum coke (redistilling tar)	—	—	As fuel

Polymerisation : The simple molecules which combine to form a macro molecule is called polymer. The process by which the simple molecules (monomers) are converted polymer is called polymerisation.

$$\underset{\text{ethene}}{n\,CH_2=CH_2} \xrightarrow{\text{polymerisation}} \underset{\text{Polyethene}}{(-CH_2-CH_2-)_n}$$

Natural occurring polymers are protein, nucleic acid, cellulose, starch etc.

Plastics : Plastics are cross linked polymers and are very tough. Lac is a natural plastic chemically plastic can be of two types.

1. Thermoplastic 2. Thermosetting plastics.

1. Thermoplastic : These are the polymers which can be easily softened repeatedly when heated and hardened when cooled with little change in their properties.

Examples : Polyethylene, polystyrene, polyvinyl chloride, teflon. etc.

2. Thermosetting plastics : These are the polymers which undergo permanent change on heating. On heating they undergo extensive cross linking in moulds and become hard and infusible therefore, they can not be reused.

Examples : Bakelite, glyptal, terrylene etc.

Bakelite (Phenol-formaldehyde resins) : It is a condensation polymer and is obtained from phenol and formaldehyde in presence of either an acid or a base catalyst. It is used for making combs, fountain pens, photographs records, electrical goods etc.

Rubber : It is a polymer which is capable of returning to its original length, shape or size after being stretched or deformed. The rubber obtained from natural sources are called natural rubber and polymer prepared in laboratory which are similar to natural rubber are known as synthesize rubber.

Natural rubber

$$\underset{\text{Isoprene}}{n\,CH_2=C(CH_3)-CH=CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Natural rubber}}{-\left[CH_2-C(CH_3)=CH-CH_2\right]_n-}$$

Synthetic rubber

1. Neoprene

$$\underset{\text{Chloroprene}}{n\,CH_2=CH-C(Cl)=CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Neoprene}}{-\left[CH_2-CH=C(Cl)-CH_2\right]_n-}$$

2. Thiokol : Thiokol is made by polymerisation of ethylene chloride and sodium polysulphide

$$Cl\,CH_2-CH_2\,Cl + Na-S-S-Na + Cl\,CH_2-CH_2\,Cl$$

$$\downarrow \text{Polymerisation}$$

$$\underset{\text{Thiokol rubber}}{-CH_2-CH_2-S-S-CH_2-CH_2-}$$

repeating unit is $-CH_2-S-S-CH_2-$

Thiokol is chemically resistant polymer. It is used in the manufacture of hoses and tank linings, engine gaskets and rocket fuel.

Vulcanization of rubber : Natural rubber is soft and sticky and therefore, in order to give strength and elasticity Natural rubber is vulcanized. Vulcanization is a process of treating the natural rubber with sulphur or some compound of sulphur (SF_6) under heat. Vulcanized rubber is used for manufacturing rubber bands, gloves, car, tyres etc.

Fibres : Fibres are the polymers which have quite strong intermolecular forces such as hydrogen bonding. Nylon–6,6, dacron, orlon etc are the examples of this type.

Rayon : Synthetic fibre obtained from cellulose is known as Rayon.

11. Fuels

A substance that can supply energy either alone or by reacting with another substance is known as fuel. Heat produced by fuel is measured in Calories. An ideal fuel should

1. have high calorific value
2. be cheap and easily available
3. be easily stored & transport
4. be regulated and controlled
5. have low ignition temperature

The quantity of fuel is expressed in the form of calorific value.

Calorific value is the total quantity of heat liberated by complete combustion of a unit mass of fuel in air or oxygen.

Calorific value of fuels are expressed in kcal/m^3 or British Thermal unit (B.T.U) per cubic foot.

$$1\ kcal/m^3 = 0.107\ B.T.U/ft^3$$

Fuel may be solid (e.g wood, coal etc.)

Liquid (e.g kerosene oil, petroleum, alcohol etc.) or gas (e.g water gas, producer gas, coal gas, oil gas, natural gas, gobar gas, LPG etc.) However, gaseous fuel are considered to be the best fuels.

1. Water gas (syn gas) : It is a mixture of carbon monoxide and hydrogen. It is obtained by the action of steam on a red hot coke at 1000° C.

$$C + H_2O \longrightarrow \underset{\text{Water gas}}{CO + H_2} - 28\ kcal$$

Producer gas : It is a mixture of CO and N_2. It is prepared by burning coke in limited supply of air. It is the cheapest gaseous fuel, however its calorific value is not very high because it has a large proportion of nitrogen.

Coal gas : It is a mixture of H_2, CH_4, CO and other gases like N_2, C_2H_4, O_2 etc. It is obtained by destructive distillation of coal at about 1000°C

Oil gas : It is a mixture of H_2, CH_4, C_2H_4, CO and other gases like CO_2. It is obtaineal by thermal cracking of kerosene oil. It is used in laboratories.

Gobar gas : It contains CH_4, CO and H_2. It is produced by fermentation of gobar in absence of air. It is used as a domestic fuel in villages.

Natural gas : It is a mixture of gaseous hydrocarbons viz methane 85%, ethane, propane butane etc. Liquefied petroleum mainly butane and isobutane.

LPG and CNG (Petroleum Gases)

Liquified Petroleum Gas (LPG) : The petroleum gas liquified under pressure is called liquified petroleum gas. It is a mixture of butane and isobutane with small amount of propane and is easily compressed under pressure as liquid and stored in iron cylinders. It is used as domestic fuel.

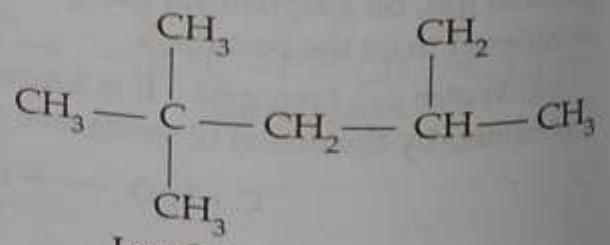
$$2C_4H_{10} + 13O_2 \xrightarrow{\text{burning}} 8CO_2 + 10H_2O + \text{Heat}$$

Compressed Natural Gas (CNG) : The natural gas compressed at very high pressure is called compressed natural gas (CNG). It consists mainly of methane (95%) which is a relatively unreactive hydrocarbons and make it nearly complete combustion possible. The other 5% is made of various gases such that ethane, propane and butane including small amount of other gases N_2, CO_2, H_2S, water vapour etc. The CNG is now being used as a better fuel than gasoline for running buses, cars and three-wheelers in metropolitan cities like Delhi, Mumbai etc, because of its complete combustion and no unburnt carbon is being released in the atmosphere to cause air pollution.

Knocking and Octane Number : The metallic sound produced due to irregular burning of the fuel is known as knocking. The knocking lowers the efficiency of the engine and results the loss of energy. A fuel which has minimum knocking property is always preferred. It has been observed that the straight chain aliphatic hydrocarbons have a higher tendency to knock while branched or unsaturated hydrocarbons have less tendency to knock.

To indicate the quality of gasoline (petrol), a method of gradation has been introduced which is termed octane rating or octane number. Two compounds heptane and iso-octane have been taken as standard. Heptane which causes maximum knocking is assigned to octane number zero which iso-octane which causes minimum knocking is assigned the octane number 100.

$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
Heptane
Octane number = 0



Iso–Octane
(2, 2, 4–Trimethyl pentane)
Octane number = 100

Antiknock Compounds : To reduce the knocking property or to improve the octane number of a fuel certain chemicals are added it. These are called antiknock compounds. TEL (Tetra Ethyl Lead) is the best antiknock compound.

Cetane Number : Cetane number of a diesel oil is the percentage of cetane (hexadecane) by volume in a mixture of cetane and α–methyl naphthalene. Hexa decane has been assigned cetane number 100 while α–methyl nephthalene is assigned zero cetane number.

The diesel oil having cetane number 75 would have same ignition property as a mixture of 75% cetane and 25% α–methyl naphthalene.

Flash Point : The lowest temperature at which an oil gives sufficient vapours to form an explosive mixture with air is known as flash point of the oil. The flash point in India is fixed at 44°C.

Coal : On the basis of carbon % and calorific value there are four types of coal.

S.N.	Nature	% of carbon	Calorific value
1.	**Peat** : Low grade coal produces less heat & more smoke & ash.	50 – 60%	2500 – 3500
2.	**Lignite** : High moisture content burns easily, low calorific value.	60 – 70%	3500 – 4500
3.	**Bituminous** : Black, hard, smoky, flame, domestic fuel.	75 – 80%	7500 – 8000
4.	**Anthracite** : Superior quality, hardest form, high calorific value.	90 – 95%	6700 – 7500

12. Metallurgy

The process of extracting metal in pure form from its ore is known as metallurgy.

Minerals : The compound of a metal found in nature is called a mineral. A mineral may be a single compound or a complex mixture.

Ores : Those minerals from which metal can be economically and easily extracted are called ores.

All ores are mineral but all minerals are not ores.

Gangue (or matrix) : The ore is generally associated with earthy impurities like sand, rocks and limestone known as gangue or matrix.

Flux : A substance added to ore to remove impurities is called flux. There are two types of flux— 1. acidic flux. 2. basic flux.

Acidic flux is added to remove basic impurity

$$\underset{\text{acidic flux}}{SiO_2} + \underset{\text{basic impurity}}{FeO} \longrightarrow \underset{\text{Ferrous silicate}}{FeSiO_3}$$

Basic flux is added to remove acidic impurity.

$$\underset{\text{basic flux}}{CaCO_3} + \underset{\text{acidic impurity}}{SiO_2} \longrightarrow \underset{\text{Calcium silicate}}{CaSiO_3} + CO_2$$

Slag : Combination of gangue with flux in ores forms a fusible material which is called slag.

$$\text{Gangue} + \text{flux} \longrightarrow \text{slag}$$
$$SiO_2 + CaO \longrightarrow CaSiO_3$$

Concentration : The process of removal of gangue from the ore is known as concentration of ore. Concentration of ore can be carried out in the following ways depending upon the nature of the ore.

1. Gravity separation
2. Magnetic concentration
3. Froth flotation process
4. Chemical methods

Calcination : Calcination is a process in which ore is heated, generally in the absence of air, to expel water from hydrated oxide or carbon dioxide from a carbonate at temperature below their melting point example :

$$Al_2O_3 \cdot 2H_2O \xrightarrow{\Delta} Al_2O_3 + 2H_2O$$
$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

Roasting : Roasting is a process in which ore is heated usually in the presence of air, at temperatures below its melting points.

$$ZnS + 2O_2 \longrightarrow ZnSO_4;$$
$$CuS + 2O_2 \longrightarrow CuSO_4$$

Smelting : The reduction of oxide ore with carbon at high temperature is known as smelting.

$$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO; \quad PbO + C \longrightarrow Pb + CO$$

A series is obtained by arranging the metals in decreasing order of reactivity which is known as Activity series.

Corrosion : The process of slow conversion of metals into their undesirable compounds (usually oxides) by reaction with moisture and other gases present in the atmosphere is called corrosion.

Examples Rusting of Iron, Green coating on the surface of copper, tarnishing of silver etc are examples of corrosion.

The formula of rust is $Fe_2O_3 \cdot xH_2O$:

Reactivity of the metal, Presence of impurities, Air and moisture, Strains in metal, Presence of electrolytes etc are factor which affect the corrosion.

Relative reactivity of metals

Metal	
K (Potassium)	Decreasing reactivity — Most Reactive Metal
Na (Sodium)	
Ca (Calcium)	
Mg (Magnesium)	
Al (Aluminium)	Decreasing order of reactivity
Zn (Zinc)	
Fe (Iron)	
H (Hydogen)	
Cu (Copper)	
Ag (Silver)	
Au (Gold)	Least Reactive Metal

Important metals and their ores

Metal	Ores	Chemical Formula
Sodium (Na)	Chile saltpeter	$NaNO_3$
	Trona	$Na_2CO_3, 2NaHCO_3 \cdot 3H_2O$
	Borax	$Na_2B_4O_7 \cdot 10H_2O$
	Common salt	NaCl
Calcium (Ca)	Dolomite	$CaCO_3 \cdot MgCO_3$
	Calcite	$CaCO_3$
	Gypsum	$CaSO_4 \cdot 2H_2O$
	Fluorspar	CaF_2
	Asbestus	$CaSiO_3 \cdot MgSiO_3$

Metal	Ores	Chemical Formula
Aluminium (Al)	Bauxite	$Al_2O_3 \cdot 2H_2O$
	Corundum	Al_2O_3
	Felspar	$K Al Si_3 O_8$
	Cryolite	$Na_3Al F_6$
	Alunite	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 4 Al(OH)_3$
	Kaolin	$3 Al_2O_3 \cdot 6 SiO_2 \cdot 2H_2O$
Potassium (K)	Nitre (salt peter)	KNO_3
	Carnalite	$KCl \cdot MgCl_2 \cdot 6 H_2O$
Magnesium (Mg)	Magnesite	$MgCO_3$
	Dolomite	$MgCO_3 \cdot CaCO_3$
	Epsom salt	$MgSO_4 \cdot 7 H_2O$
	Kieserite	$MgSO_4 \cdot H_2O$
	Carnalite	$KCl \cdot MgCl_2 \cdot 6 H_2O$
Strontium (Sr)	Strontianite	$SrCO_3$
	Silestine	$SrSO_4$
Copper (Cu)	Cuprite	Cu_2O
	Copper glance	Cu_2S
	Copper pyrites	$CuFeS_2$
Silver (Ag)	Ruby Silver	$3 Ag_2 S \cdot Sb_2S_3$
	Horn Silver	AgCl
Gold (Au)	Calaverite	$AuTe_2$
	Silvenites	$[(Ag, Au) Te_2]$
Barium (Ba)	Barytes	$BaSO_4$
Zinc (Zn)	Zinc blende	ZnS
	Zincite	ZnO
	Calamine	$ZnCO_3$
Mercury (Hg)	Cinnabar	HgS
Tin (Sn)	Casseterite	SnO_2
Lead (Pb)	Galena	PbS
Antimony (Sb)	Stibenite	Sb_2S_3
Cadmium (Cd)	Greenocite	CdS
Bismuth (Bi)	Bismuthite	Bi_2S_3
Iron (Fe)	Haemetite	Fe_2O_3
	Lemonite	$2Fe_2O_3 \cdot 3H_2O$
	Magnetite	Fe_3O_4
	Siderite	$FeCO_3$
	Iron Pyrite	FeS_2
	Copper Pyrites	$CuFeS_2$
Cobalt (Co)	Smelite	$CoAsS_2$
Nickel (Ni)	Milarite	NiS

Metal	Ores	Chemical Formula
Magnese (Mn)	Pyrolusite	MnO_2
	Magnite	$Mn_2O_3 \cdot 2H_2O$
Uranium (U)	Carnetite	$K(UO)_2 \cdot VO_4 \cdot 3H_2O$
	Pitch blende	U_3O_8

Alloys : An alloy is a metallic intimately mixed solid mixture of two or more different elements, at least one of which is metal.

Alloys are homogeneous in molten state but they may be homogeneous or heterogeneous in solid state.

Important alloys & their uses

Alloys	Compositions	Uses
Brass	Cu (70%) + Zn (30%)	In making utensils
Bronze	Cu (90%) + Sn (10%)	In making coins, bell and utensils
German Silver	Cu + Zn + Ni (60% + 20% + 20%)	In making utensils
Rolled gold	Cu (90%) + Al (10%)	In making cheap ornaments
Gun metal	Cu + Sn + Zn + Pb (88% 10% 1% 1%)	In making gun, barrels, gears & bearings
Delta metal	Cu + Zn + Fe (60% 38% 2%)	In making blades of aeroplane
Munz metal	Cu (60%) + Zn (40%)	In making coins
Dutch metal	Cu (80%) + Zn (20%)	In making Artificial ornaments
Monel metal	Cu (70%) + Ni (30%)	For base containing container
Rose metal	Bi + Pb + Sn (50% 28% 22%)	For making automatic fuse
Solder	Pb (50%) + Sn (50%)	For soldering
Magnalium	Al (95%) + Mg (5%)	For frame of Aeroplane
Duralumin	Al + Cu + Mg+ Mn (94% 3% 2% 1%)	For making utensils
Type metal	Sn + Pb + Sb (5% 80% 15%)	In printing industry
Bell metal	Cu (80%) + Sn (20%)	For casting bells, statues
Stainless steel	Fe + Cr + Ni + C (75%,15%,10%,.05%)	For making utensils and surgical cutlery
Nickel steel	Fe (95%) + Ni (5%)	For making electrical wire, automobile parts

Amalgum : An alloy in which one of the component metals is mercury, is called amalgam.

In alloys, the chemical properties of the component elements are retained but certain physical properties are improved.

Compounds of metal and non-metal and their uses :

1. Ferrous oxide (FeO) : In green glass, Ferrous salt.
2. Ferric oxide (Fe_3O_4) : In electroplating of ornaments and formation of ferric slat
3. Ferrous sulphate ($FeSO_4 \cdot 7H_2O$) : In dye industry, and Mohr's salt

4. Ferric hydroxide [$(Fe(OH)_3)$] : In laboratory reagent and in making medicines.
5. Iodine (I_2) : (a) As antiseptic, (b) In making tincture of iodine.
6. Bromine (Br_2) : (a) In dye industry (b) As laboratory reagent
7. Chlorine (Cl_2) : In the formation of (a) Mustard gas (b) Bleaching powder
8. Hydrochloric acid (HCl) : In the formation of aquaregia (3 HCl : 1 HNO_3) and dyes
9. Sulphuric acid (H_2SO_4) : (a) As a reagent (b) In purification of petroleum (c) In lead storage battery.
10. Sulphur dioxide (SO_2) : (a) As oxidants & reductants (b) As bleaching agent
11. Hydrogen Sulphides (H_2S) : In qualitative analysis of basic radical (group separation)
12. Sulphur (S) : Antiseptics, vulcanization of rubber, gun powder, medicine.
13. Ammonia (NH_3) : As reagent in ice factory.
14. Phosphorous : (a) Red (P_4) refrigerent, in match industry etc. (b) White (P_4) – Rat killing Medicine.
15. Producer gas ($CO + N_2$) : (a) In heating furnace (b) Cheap fuel (c) In Extraction of metal
16. Water gas ($CO + H_2$) : (a) As fuel (b) Welding work
17. Coal gas : (a) As fuel (b) Inert atmosphere
18. Nitrous oxide (N_2O) : Laughing gas, Surgery.
19. Carbondioxide (CO_2) : Sodawater, Fire extinguisher.
20. Carbon monoxide (CO) : In phosgene gas ($COCl_2$).
21. Graphite : As electrodes.
22. Diamond : Ornaments, Glass cutting, Rock drilling.
23. Alum [$K_2SO_4 Al_2(SO_4)_3 \cdot 24H_2O$] : (a) Purification of water (b) Leather industry.
24. Aluminium sulphate [$Al_2(SO_4)_3 \cdot 18H_2O$] : In paper industry / fire extinguisher.
25. Anhydrous aluminium chloride ($AlCl_3$) : Cracking of petroleum.
26. Mercuric Chloride ($HgCl_2$) : Calomel, Insecticides (Corrosive sublimate)
27. Mercuric oxide (HgO) : Oientment, poison.
28. Mercury (Hg) : Thermometer vermillion, amalgum.
29. Zinc Sulphide (ZnS) : White pigment.
30. Zinc Sulphate (White vitriol) ($ZnSO_4 \cdot 7H_2O$) : Lithopone, Eye ointment.
31. Zinc Chloride ($ZnCl_2$) : Textile industry.
32. Zinc oxide (ZnO) : Ointment.
33. Zinc (Zn) : In battery.
34. Calcium carbide (CaC_2) : Calcium cyanide & acetylene gas.
35. Bleaching powder [Ca(OCl) Cl] : Insecticides, Bleaching actions.
36. Common salt : The chemical name of common salt is sodium chloride.
37. Calcium sulphate ($CaSO_4 \cdot 2H_2O$) : Cement industry.
38. Calcium carbonate ($CaCO_3$) : Lime & toothpaste.

39. Copper sulphate ($CuSO_4 \cdot 5H_2O$) : Insecticides, Electric cells.
40. Cupric oxide (CuO) : Blue & green glass, purification of petroleum
41. Cuprous Oxide (Cu_2O) : Red glass, pesticides.
42. Copper (Cu) : Electrical wire.
43. Sodium nitrate ($NaNO_3$) : Fertilizer.
44. Sodium Sulphate (Glauber salt) ($Na_2SO_4 \cdot 10H_2O$) : Medicine, cheap glass
45. Sodium bicarbonate (Baking soda) ($NaHCO_3$) : Fire extinguisher, bakery, reagent.
46. Sodium Carbonate (Washing soda) : (a) Glass industry (b) Paper industry (c) Removal of permanent hardness of water (d) washing (e) The chemical formula of is $Na_2CO_3 \cdot 10H_2O$
47. Hydrogen peroxide (H_2O_2) : Oxidants & reductants, Insecticides.
48. Heavy water (D_2O) : Nuclear reactor.
49. Liquid hydrogen : Rocket fuel.
50. Plaster of paris [$(CaSO_4)_2 \cdot 2H_2O / CaSO_4 \frac{1}{2} H_2O$)] : Statue, Surgery.
Plaster of paris is obtained by heating gypsum at 120°C.

$$2[CaSO_4 \cdot 2H_2O] \xrightarrow{\Delta} 2CaSO_4 \cdot H_2O + 3H_2O$$

Gypsum → Plaster of Paris

13. Important Facts About Some Metals

- Zinc phosphide is used for killing rats.
- Wood furnitures are coated with zinc chloride to prevent termites.
- Excess of copper in human beings causes disease called Wilson.
- Galvanised iron is coated with zinc.
- Rusting of iron is a chemical change which increases the weight of iron.
- Calcium hydride is called hydrolith.
- Calcium hydride is used to prepare fire proof and waterproof clothes.
- In flash-bulb, magnesium wire is kept in atmosphere of nitrogen gas.
- Titanium is called strategic metal because it is lighter than iron.
- Group 1st element are called alkali metals because its hydroxides are alkaline whereas group 2nd elements are called alkaline earth metals.
- Babbitt metal contains 89% Sn (Tin), 9% Sb (Antimony) and 2% Cu (Copper).
- Gun powder contains 75% Potassium nitrate, 10% sulphur and 15% charcoal.
- Chromium trioxide is known as chromic acid.
- Nichrome wire is used in electrical heater [(Ni, Cr, Fe)]
- Potassium carbonate (K_2CO_3) is known as pearl ash.
- Generally transition metals and their compounds are coloured.
- Zeolite is used to remove hardness of water.
- In cytochrome iron (Fe) is present.
- Selenium metal is used in photo electric cell.
- Galium metal is liquid at room temperature.
- Palladium metal is used in aeroplane.

- Radium is extracted from pitchblende.
- World famous Eiffel Tower has steel and cement base.
- Actinides are radio-active elements.
- Cadmium rod is used in nuclear reactor to slow down the speed of neutron.
- Sodium peroxide is used in submarine and also to purify closed air in hospital.
- Co (60) is used in cancer treatment.
- Onion and garlic have odour due to potassium.
- Oxides of metals are alkaline.
- Silver and copper are the best conductor of electricity.
- Gold and Silver are the most malleable metal.
- Mercury and iron produces more resistance in comparison to the other during the flow of electricity.
- Lithium is the lightest and the most reductant element.
- In fireworks, crimson red colour is due to presence of strontium (Sr).
- Green colour is due to the presence of Barium in fireworks.
- Barium sulphate is used in X-ray of abdomen as barium meal.
- Barium hydroxide is known as Baryta water.
- Osmium is the heaviest metal and the Platinum is the hardest.
- Zinc oxide is known as flower of zinc. It is also known as chinese white and used as white paint.
- Silver chloride is used in photochromatic glass.
- Silver iodide is used in artificial rain.
- Silver nitrate is used as marker during election. It is kept in coloured bottle to avoid decomposition.
- Silver spoon is not used in egg food because it forms black silver sulphide.
- To harden the gold, copper is mixed. Pure gold is 24 carrat.
- Iron Pyrites (FeS_2) is known as fool's gold.
- Mercury is kept in iron pot because it doesn't form amalgum with iron.
- In tubelight there is the vapour of mercury and argon.
- Tetra-Ethyl lead is used as anti knocking compound.
- Lead-pipe is not used for drinking water because it forms poisonous lead hydroxide.
- Fuse wire is made up of lead and tin.
- Wrought iron is the purest from of Iron.
- Percentage of carbon in cast iron = 2.5 – 5%, wrought iron = 0.1 – 0.2%
- The melting point of Tungsten (W) is 3500°C. In India, Tungsten is produced in Degana mine situated in Rajasthan.
- To prevent oxidation of tungsten, air is removed from the electric bulb.
- Zirconium (Zr) metal burns in oxygen as wall as in nitrogen.
- Baddeleyite or Zircona (ZrO_2) is an ore of Zirconium.
- Zirconium (Zr), Cadmium (Cd) and Boron (B) have the capability to absorb neutrons. So, they are used in nuclear reactor.
- Beryl ($3BeO \cdot Al_2O_3 \cdot 6SiO_2$) is an ore of Beryllium.

- Stannous Sulphide (SnS_2) is also called Mosaic gold. It is used as paint. Tin shows the allotropy.
- Barium Sulphate ($BaSO_4$) is used as barium meal in X-ray of Stomach.
- The green light produced while burning crackers is due to presence of Barium.
- The Crimson red light produced while burning crackers is due to Strontium (Sr).
- Silver (Ag), Gold (Au), Copper (Cu), Platinum (Pt) and Bismuth (Bi) are found in independent state because they are very less reactive.
- Gold, platinum, silver and mercury are noble metals.
- Gold and silver are the most malleable among metals.
- Mercury and Iron provide much resistance in the flow of electric current.
- Aluminium was first extracted in 1827 A.D. is potassium urangly ortho vanedate.
- Greenocite (CdS) is the ore of Cadmium.
- Britannia metal is an alloy of Antimony (Sb), Copper (Cu) and Tin (Sn).
- Thulium has symbol Tm.
- Group I elements are called alkali metals and its hydroxides are alkaline while group II elements are called Alkaline earth metal.
- Flash bulb contain magnesium wire in medium of nitrogen.
- Aluminium hydroxide is used to make water proof and Stainless Clothes.
- Calcium Carbide (CaS_2) reacts with water to produce acetylene gas.
- The reaction of Ferric Oxide (Fe_2O_3) with aluminium is used to fill up the cracks of railway tracks and machine parts. This reaction is called Thermite reaction.
- Anaemia is caused due to deficiency of Iron in the body while excess of Iron in the body may cause siderosis. Bantu tribes of Africa suffer from siderosis because they drink beer in iron utensils.
- Auric Chloride ($AuCl_3$) is used to make antivenom needles.
- Mercury is also known as quick silver. Mercury is kept in iron vessels because it does not make amalgams with Iron.
- Lead is a stable element. So, it is used to write on paper.
- Lead arsenic is an alloy used to make bullets. Carbon lead is used to make artificial parts of body.
- Lead Oxide is also called Litharge. It is an amphoteric oxide. It is used in rubber industries in manufacturing of storage batteries and flint glass.
- Uranium is a heavy radioactive metal. It belongs to actinide group. It is used in manufacture atom bomb. The bombs dropped on Hiroshima and Nagasaki were made of Uranium.

14. Non metal

In modern periodic table there are 24 non metals, 11 are gases, 1 is liquid (Br_2) and 12 are solid.

Electronegative elements are non metals.

Non metals are bad conductor of heat and electricity except graphite, Si & Ge are semi conductor.

Hydrogen (H_2)

The lightest gas having three isotopes

$_1H^1$, $_1H^2$, $_1H^3$.

Protium Deuterium Tritium (Radioactive)

Protium is only one isotope in Periodic Table having zero neutron.

Deuterium oxide is known as heavy water and used in nuclear reactor as moderator.

Liquid hydrogen is used as rocket fuel.

Hydrogen is known as range element because it may kept in group I & group VII A.

Water (H_2O)

Hard water – Less froth with soap

Soft water – more froth with soap.

Hard water – Due to the presence of soluble impurities of bicarbonates, chlorides & sulphates of Ca & Mg.

Temporary hardness – Due to the presence of bicarbonate of calcium and magnesium.

Permanent hardness – Due to the presence of chlorides and sulphates of calcium and magnesium.

Temporary hardness is removed by boiling and by Clark's method while permanent hardness is removed by Soda ash (Na_2CO_3) process.

Permanent hardness is also removed by permutit process.

In ice every molecule of H_2O is associated with four other H_2O molecules by hydrogen bonding in a tetrahedral fashion. Thus, ice has an open structure with large empty space due to existence of hydrogen bonding. Thus ice has less density than water.

As ice melts at 0°C, a number of hydrogen bonds are broken down and space between water molecules decreases so that water molecules move closer together. Therefore, the density of water increases and maximum at 0° to 4°C. Above 4°C the increase in Kinetic Energy of the molecules is sufficient to cause the molecule to disperse and the result is that the density steadily decreases with increases in temperature.

Oxygen

Important constituent of air, exists in three different isotopes.

$_8O^{16}$, $_8O^{17}$, $_8O^{18}$

Ozone (O_3) is the allotrope of Oxygen .

Ozone reduces the effect of ultraviolet rays in the atmosphere.

Nitrogen

78% by volume in atmosphere, liquid nitrogen is used for refrigeration. Nitrogen gas is essential for protein synthesis.

Ammonia is an important compound of N_2 which is prepared by Haber's process.

Ammonia

As refrigerent, In the manufacture of HNO_3.
In fertilizer like urea, ammonium sulphate etc.
In the manufacture of Na_2CO_3 & $NaHCO_3$.
In preparation of ammonium salt.
In preparation of explosive.
In preparation of Artificial silk.
Nitrogen fixation in leguminous plants

Phosphorous

An important constituent of animals and plants. It is present in bones & DNA. Phosphorous is an essential constituent of nucleic acid.

Phosphorous shows allotropy – White or yellow phosphorous, Red phosphorous, Black phosphorous etc.

White phosphorous is more reactive than red phosphorous.

Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) acts as bleaching agent due to its reducing nature and bleaches in presence of moisture.

$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2(H)$$

Coloured matter + H ⟶ Colourless matter
(Bleached)

The bleaching by SO_2 is temporary. When the bleached article is exposed to air, it regains its original colour.

Halogens

17th group elements

Uses of fluorine : In the preparation of UF_6 and SF_6 for energy production and as dielectric constant respectively.

By using HF, chloro fluoro carbon compound and polytetra fluoro ethylene can be synthesised.

Chlorofluoro carbon is known as Freon used as refrigerent and aerosol.

Non-stick utensil is made up of teflon.

Chlorine is used to prepare PVC, insecticides herbicides etc.

Chlorine also acts as a bleaching agent and its bleaching action is due to oxidation

$$Cl_2 + H_2O \longrightarrow 2HCl + (O)$$

Coloured substance + (O) ⟶ Colourless product
(Bleached)

The bleaching action of chlorine is permanent. The colour of bleached articles can not be a restored. It acts as bleaching agent for vegetable and organic matter.

Bromine is used in ethylene bromide synthesis which is mixed with leaded pertrol. In the preparation of AgBr which is used in photography.

Inert gases

It belongs to 18th group of P.T.

He, Ne, Ar, Kr, Xe, Rn

Except Rn, all inert gases are present in atmosphere.
Argon is used in Arc. welding & electric bulb.
Helium is light & non-inflammable so, used in balloon, weather indicator etc.
Neon is used in discharge tube glow light.

15. Common Facts

	Catalyst	Process
1.	Fe + Mo	Synthesis of NH_3 by Haber's process.
2.	Ni	Synthesis of vanaspati Ghee (hydrogenation)
3.	Pt	Synthesis of H_2SO_4 by Contact process.
4.	NO	In the manufacture of H_2SO_4 by the Lead chamber process.
5.	Hot Al_2O_3	In the preparation of Ether from Alcohol.
6.	$CuCl_2$	Preparation of chlorine gas by Deacon process.

Some Important Explosive

- Dynamite : It was discovered Alfred Nobel in 1863. It is prepared by absorption of raw dust with Nitro-glycerine. In modern dynamite Sodium Nitrate is used in place of Nitro-glycerine.
- Tri Nitro Toluene (TNT)
- Tri Nitro Benzene (TNB)
- Tri Nitro Phenol (TNP) : It is also known as picric acid.
- R.D.X is highly explosive known as plastisizer in which Aluminium powder is mixed to increase the temperature and the speed of fire.

Some Important Facts

- Age of fossils and archeological excavation is determined by radioactive carbon (C^{14}).
- Diamond has maximum refractive index and due to total internal reflection. It has lustre.
- Chloroform in sunlight forms poisonous gas 'Phosgene' ($COCl_2$).
- To decrease the basicity of soil gypsum is used.
- In the preparation of Talcom powder theophestal mineral is used.
- Potassium chloride is most suitable for the removal of permanent hardness of water.
- To avoid melting of ice gelatine is used.
- When dry ice is heated it is directly converted into gas.
- Saccharine is prepared from toluene.
- Cream is a type of milk in which amount of fat is increased while amount of water decrease.
- From one kilogram of honeybee 3500 calorie energy is produced.
- N_2O is known as laughing gas.
- Bones contain about 58% calcium phosphate.
- Phosphine gas is used in voyage as Holmes signal.

- Chlorine gas bleaches the colour of flower due to oxidation.
- Red phosphorus is used in match industry.
- Urea contains 46% nitrogen.
- In the electroplating of vessel NH_4Cl is used.
- Power alcohol is prepared from mixing pure alcohol in benzene which is used as rocket fuel.
- Artificial perfumes are prepared from Ethyl acetate.
- Urea was the first organic compound synthesised in Laboratory.
- Vinegar contains 10% acetic acid.
- Acetylene is used for light production.
- Ferric chloride is used to stop bleeding.
- Barium is responsible for green colour in fireworks.
- Cesium is used in solar cells.
- Yellow phosphorus is kept in water.
- Sea weeds contains iodine.
- During cooking maximum vitamin is lost.
- For the preparation of silver mirror, glucose is used.
- When cream is separated from milk, it's density increases.
- For artificial respiration mixture of oxygen and helium gas cylinder is used.
- In cold places, to decrease the freezing point ethylene glycol is used.
- Hydrogen peroxide is used for oil paintings.
- Sodium is kept in kerosene oil.
- The heaviest element is Osmium (Os).
- The lightest element, least dense and most reductant is lithium (Li).
- Flourine is the most oxidising agent.
- Silver is the best conductor of electricity.
- Radon is the heaviest gas.
- Polonium has the maximum number of isotopes.
- Sulphuric acid is known as oil of vitriol.
- Noble metals — Ag, Au, Pt, Ir, Hg, Pd, Rh, Ru, and Os.
- When methyl alcohol (methanol) is taken even in minute quantities, it acts as poison and serves as a cause for blindness.
- Glass makes a soluble silicate in hydrofloric acid (HF). This is the reason why hydrofluoric acid is not stored in glass containers.
- The density of gold is higher than the density of mercury. So, gold drowns in mercury.
- Bisphenol A is a chemical used for progress in food packaging matenal.
- Xenon is also called stranger gas.
- If soluble substance is added to a liquid, the surface tension of that liquid is increased.
- Conversion of force nitrogen in atmosphere into nitrates is known as Nitrogen fixation.

- Picric acid is an organic compound which is used as a reagent in Laboratory.
- Bones are composed of 8% phosphorous.
- Safety matches are made by using red phosphorous.
- Ammonium chloride is used to electroplate utensils.
- Benzene or Ether is dissolved in pure alcohol to form power alcohol, which is used as a fuel for aeroplanes.
- Milk is an emulsion.
- Platinum is also called 'White Gold'.

16. Man made substances

1. Fertilizers : The substances added to the soil to make up the deficiency of essential elements are known as fertilizers, these are either natural or synthetic (chemical). For a chemical fertilizer, the following requirements should be met :

(a) It must be sufficiently soluble in water

(b) It should be stable so that the element in it may be available for a longer time.

(c) It should contain nothing injurious to plants.

Phosphatic Fertilizers : The minerals of phosphorous such as phosphorite $[Ca_3(PO_4)_2]$ and apatite $[3Ca_3(PO_4)_2 \cdot CaF_2]$ are sparingly soluble in water and thus do not serve as source of phosphosrous for plants. Therefore, these are converted into soluble materials which can act as good fertilizers. Important phosphatic fertilizers are—

1. Calcium superphosphate
2. Nitrophosphate
3. Triple phosphate
4. Phosphatic slag

Nitrogenous Fertilizers : Plants need nitrogen for rapid growth and increase in their protein content. For this reason, nitrogenous fertilizers become more important. The chief nitrogeneous fertilizers are ammonium sulphate, calcium cyanamide, ammonium nitrate, urea, calcium ammonium nitrate. Urea contains 46.6% nitrogen.

Potash Fertilizers : Potassium gives the structural length to plants. Potassium nitrate, potassium choride and potassium sulphates etc are important potash fertilizers.

NPK Fertilizers: Fertilizers containing N, P are K in suitable adjusted proportions are known as NPK fertilizers. These are obtained by mixing nitrogeneous, phosphatic and potash fertilizers in suitable proportions. Expression like 4–8–2 used for a mixed fertilizer indicates that it contains 4% N_2, 8% P_2O_5 and 2% K_2O

2. Dyes : Coloured substances used for colouring textiles, foodstuffs, silk, wool, etc. are called dyes.

Different classes of dyes are given below.

(a) Nitro dyes : These are polynitro derivatives of phenol where nitro group acts as a chromophore and hydroxyl group as auxochrome.

(b) Azo dyes : These are an important class of dyes and are characterised by the presence of azo group (—N=N—) as the chromophore. The groups like NH_2, NR_2 or —OH, etc., present in the molecule containing one or more azo gruops act as the auxochromes.

(c) Triphenylmethane dyes : These dyes contain the paraquinoid moiety as a chromophore and —OH, $—NH_2$ or $—NR_2$ as auxochrome. These dyes are not fast to light and washing and hence are mainly used for colouring paper or typewriter ribbons, e.g. malachite green which is used for dyeing wool and silk directly and cotton after mordanting with tannin.

(d) Mordant dyes : Those dyes which are fixed on the fibre with the help of a mordant are known as mordant dyes. For acidic dyes, basic mordants (such as hydroxides of iron, aluminium and chromium) are used, while for basic dyes, acidic mordants (like tannic acid) are used. Here the fabric is first dipped into a solution of mordant and then into the dye solution. The colour produced depends on the nature of the mordant used.

(e) Vat dyes : These are water insoluble dyes and are introduced into the fibre in its (soluble) reduced form, also known as *leuco*form (colourless). These are called vat dyes because reducing operation (using sodium hydrosulphite) was formerly carried out in wooden vats. Indigo is a vat dye and is used for dyeing cotton.

Composition of Cement

Compound	Percentage
CaO	60-70%
SiO_2	20-25%
Al_2O_3	5-10%
Fe_2O_3	2-3%
MgO	2%
Na_2O	1.5%
K_2O	1.5%
SO_2	1%

Cement : It is a complex material containing the silicates of calcium and aluminium. A paste of it in water sets into a hard rocky mass-called the setting of cement. A paste of sand, cement and water called mortar, is very conveniently used for joining bricks and plastering walls.

A mixture of stone chips (gravel) sand cement and water known as concrete, sets harder than ordinary mortar. It is used for flooring and making roads. Concrete with steel bars and wires called reinforced concrete (RC) forms a very strong material. It is used for constructing roofs, bridges and pillars.

In 1824, by an English Mason, Joseph Aspdin who observed that when strongly heated mixture of limestone and clay was mixed with water and allow to stand, it hardened to a stone-like mass which resembled portland rock—a famous building stone of England. Since then the name portland cement has been given to a mixture containing high percentage of lime with silica, iron oxide, alumina etc.

Glass : Supercooled liquid is called glass. SiO_2 is its common constituent.

(a) Soda glass or soda lime glass : It is Sodium calcium silicate ($Na_2O\,CaO\,5\,SiO_2$). It is the cheapest of all glasses and used for making window panes and bottles and easily attacked by chemicals.

(b) Potash glass : It contains potassium in place of sodium. it has higher softening temperature as also a greater resistance to chemicals. So it is used for chemical apparatus; beakers, flasks, funnels etc.

(c) Optical glass: It is used for making lenses, prisms and optical instruments like telescopes and microscopes. It contains boric oxide (B_2O_3) and silica (SiO_2)

Types : 1. Crown glass : Contains K_2O & BaO as the basic oxide
2. Flint glass : Contains PbO as the basic oxide.

(d) Crooks glass : for spectacles : Absorbs ultraviolet rays which are harmful for the eyes.

(e) Lead crystal and crystal glass : Lead glass sparkles used for making decorative

items. It contains 24% or more of PbO called lead crystal. If it contains term than 24% lead oxide called crystal glass.

(f) Borosilicate glass : It contains less alkali (K_2O or CaO) and more SiO_2 than potash glass and some B_2O_3

(g) Coloured glass :

Colour	Substance added to the glass melt
Red	Selenium (Se) or copper (I) oxide (Cu_2O)
Green	Chromium III oxide (Cr_2O_3)
Violed	Maganese IV oxide (MnO_2)
Blue	Copper II oxide (CuO) or cobalt II oxide (CoO)
Brown	Iron on III oxide (Fe_2O_3)

It is used for making artificial jewellery, crockery and stained glass windows.

(h) Milky glass : Milky glass is prepared by adding tin oxide (SnO_2). Calcium phosphate ($Ca_3(PO_4)_2$) or cryolite ($AlF_3 3NaF$) to the melt glass. All these substances are white so look milky.

(i) Glass laminates : It is made by fixing polymer sheets between layers of glass. It is used to make windows & Screens of cars, trains and aircraft specially manufactured glass laminates are used bulletproof material.

Polymerisation : The simple molecules which combine to form a macro molecule is called polymer. The process by which the simple molecules (monomers) are converted polymer is called polymerisation.

$$\underset{\text{ethene}}{n\,CH_2=CH_2} \xrightarrow{\text{polymerisation}} \underset{\text{Polyethene}}{(-CH_2-CH_2-)_n}$$

Some common man-made polymers and their uses.

Polymer	Use
Polythene	Packaging material, carry bags, bottles.
Polypropene	Bottles, Crates.
Polyvinyl chloride (PVC)	Pipes insulation
Nylon (Polyester)	Fibres, ropes
Teflon	Nonstick kitchen ware
Vinyl rubber	Rubber erasers
Polystyrene	Foam Thermocole
Poly (Styrene butadiene)	Rubber bubble gum
Bakelite	Electrical insulation buttons
Lexan	Bullet proof glass
Melamine	Crockery

Paints : Paints can be applied on a surface to protect it from corrosion and weathering or to give it an attractive look.

A paint contains a pigment, a vehicle and a thinner. Zinc oxide, white lead and titanium oxide are the commonly used white pigments. The pigments is mixed with

oil like linseed or soya bean oil or a polymer. A thinner is a solvent such as *turpentine oil* or *kerosene*. It makes the paint more fluid so that it may be applied easily.

Luminous paints : Glow when exposed to light, paints are applied on a surface to protect it from corrosion and weathering or to give it an attractive look.

Soaps and Detergents : Soaps are the sodium or Potassium salts of fatty acids. They are made by the saponification of fats. Detergents are made from some petroleum products.

Antibiotic : Medicinal compounds produced by moulds and bacteria, capable of destroying or preventing the growth of bacteria in animal systems.

Antibody : Kinds of substances formed in the blood, tending to inhibit or destroy harmful bacteria, etc.

Antidote : Medicine used against a poison, or to prevent a disease from having effect.

Antigen : Substance capable of stimulating formation of antibodies.

Antimony : A brittle, crystalline, silvery white metal.

Antipyretie : A substance used to lower body temperature.

Pesticides : Many living organisms destroy crops or eat away grains. They are collectively known as pests. To kill them chemicals used are called pesticides.

Insecticides : D.D.T. aluminium phosphate, gammexine.

Fungicide : Thiram, Bordeanx mixture $CaSO_4 \cdot 5H_2O + Ca(OH)_2$

Rodenticides : Aluminium phosphide.

Herbicides : Benzipram, benzadox.

Medicines : To cure diseases by biological changes in the body.

Analgesics : Painkillers are called analgesics eg, Aspirin, Paracetamol and morphine.

Antimalarial drugs : Used to treat malaria quinine derivatives eg, chlovoquine.

Destroy microorganism : Penicillin, Aminogly considers, oftoxaim, Homophonic.

Sulphadrugs : Alternatives of antibiotics, sulphanilamide, sulphadiazine, Sulpha gunamidine.

Antaoxide : Substances which remove the excess acid and raise the pH to appropriate level in stomach are called antacids. It is caused by excess of HCl in the gastric juice magnesium hydrate, magazines carbonate, magnesium truistical, aluminium phosphene are common antacids.

Epsom salt : Hydrated magnesium sulphate ($MgSO_4 \cdot 7H_2O$), used in medicines to empty bowels.

Chloroform : A sweetish, colourless liquid. It is used as a solvent and anaesthetic.

Saccharin : A white crystalline solid which is 550 times sweeter than sugar, but does not have any food value. It is used by diabetic patients.

DDT : Dichloro diphenyl tricholoro ethane, a white powder used as an insecticide.

★★★

BIOLOGY 8

1. Introduction

Biology – Branch of science in which living beings are studied.

Bios = Life & *Logos* = Study. Therefore study of life is called *Biology*. The term *biology* was first coined by *Lamarck* and *Treviranus* in the year 1801. Biology has two main branch—

1. **Botany** : Study of different aspects of plants. *Theophrastus* is known as father of Botany.
2. **Zoology** : Study of various aspects of animals. *Aristotle* is called father of Zoology as well as Biology.

Important Terms of Biology :

- **Anatomy** : Study of internal structure of organism.
- **Agrology** : Soil science dealing specially with production of crop.
- **Agronomy** : Science of soil management and production of crop.
- **Agrostology** : Study of grass.
- **Arthrology** : Study of joints.
- **Apiculture** : Rearing of honey bee for honey.
- **Anthropology** : Study of origin, development and relationship between the culture of past and present human.
- **Anthology** : Study of flower and flowering plant.
- **Angiology** : Study of blood vascular system including arteries and veins.
- **Andrology** : Study of male reproductive organ.
- **Bryology** : Study of Bryophytes.
- **Biometrics** : Statical study of Biological problem.
- **Biomedical engineering** : Production and designing of spare part for overcoming various defects in man. e.g. Artificial limbs, Iron lung, Pacemaker etc.
- **Biotechnology** : Technology concerned with living beings for wilful manipulation on molecular level.
- **Bacteriology** : Study of bacteria.
- **Cytology** : Study of cell.
- **Cryobiology** : It is the study of effect of low temperature on organisms and their preservation.
- **Clone** : Clones are genetically identical individual in a population.
- **Cardiology** : Study of heart.
- **Demography** : Study of population.
- **Diffusion** : Random movement of molecule/ ion or gases from a region of higher concentration to lower concentration.
- **Dermatology** : Study of skin.
- **Dendrochronology** : Counting and analysing annual growth rings of tree to know its age.

- **Ecology** : Study of inter-relationship between living and their environment.
- **Evolution** : Study of origin of life, variation and formation of new species.
- **Embryology** : Study of fertilization of egg, formation of zygote and development of embryo.
- **Eugenics** : Study of factors connected with the improvement of human race.
- **Euthenics** : Study of environmental condition that contribute to the improvement of human beings.
- **Euphenics** : Treatment of defective in heredity through genetics engineering.
- **Ethnology** : Study of science dealing with different races of human.
- **Ethology** : Study of animal behaviour in their natured habitats.
- **Etiology** : Study of causative agent of disease.
- **Entomology** : Study of insects.
- **Exobiology** : Study of possibility of life in space.
- **Floriculture** : Cultivation of plant for flower.
- **Food technology** : Scientific processing, preservation, storage and transportation of food.
- **Forensic science** : Application of science for analysis of various fact and evidence to identify the cause or the person involve in criminal act.
- **Fishery** : Catching, breeding, rearing and marketing of fishes.
- **Forestry** : Development and management of forest.
- **Fermentation**: Process of incomplete oxidation that occur in microbes and other cells in absence of oxygen, leading to the formation of ethyl alcohol.
- **Genetics** : Study of variation and transmission of heredity character from parents to their young ones.
- **Growth** : Permanent increase in weight, volume and size of an organism.
- **Genetic Engineering** : Manipulation of gene in order to improve the organism.
- **Gynecology** : Study of female reproductive organ.
- **Gerontology** : Study of ageing.
- **Gastroenterology** : Study of alimentary canal or stomach and intestine related disorders.
- **Hypertonic** : When two solution have different solute concentration. The solution which have higher concentration is called hypertonic.
- **Hypotonic** : In two solutions which have lower solute concentration is called hypotonic
- **Homeothermic** : Animals who have constant body temperature are called homeothermic or warmblooded animal.
- **Histology** : Study of tissue organisation and their internal structure with the help of microscope.
- **Hygiene** : Science taking care of health.
- **Hydroponics** : Study of growing plant without soil in water which contain nutrient.
- **Haematology** : Study of blood.
- **Hepatology** : Study of liver.

- **Ichthyology** : Study of fishes.
- **Immunology** : Study of immune system or resistance of body to disease.
- **Kalology** : Study of human beauty.
- **Metazoans** : All multicellular animals are called metazoans.
- **Monoecious** : Plants which have both male and female flower
- **Morphology** : Study of external structure.
- **Microbiology** : Study of micro-organism like virus, bacteria, algae, fungi and protozoa.
- **Molecular biology** : Study of molecule found in the body of living organism.
- **Medicine** : Study of treating disease by drug.
- **Mammography** : Branch of science which deal test for breast cancer.
- **Mycology** : Study of fungi.
- **Myrmecology** : Study of ant is called myrmecology.
- **Mixed farming** : Farming along with animal husbandry.
- **Nutrients** : Chemical substances taken as food which are necessary for various function, growth and health of living.
- **Nanotechnology** : The study 'Science of small' is known as nanotechnology.
- **Neurology** : Study of nervous system.
- **Neonatology** : Study of new born.
- **Nephrology** : Study of kidneys.
- **Osmosis** : Movement of water molecule across semipermeable membrane from the region of its higher concentration to the region of lower concentration.
- **Odontology** : Study of teeth and gum.
- **Osteology** : Study of bones.
- **Oncology** : Study of cancer and tumours.
- **Obstetrics** : Science related with care of pregnant women before, during and after child birth.
- **Ornithology** : Study of birds.
- **Ophthalmology** : Study of eyes.
- **Orthopaedics** : Diagnosis and repair of disorder of locomotery system.
- **Phytoplankton** : Microscopic organism which passively float on the surface of water.
- **Parasite** : Organism which depend on other living organism for their food and shelter.
- **Poikilothermic** : Organism which change their body temperature according to surrounding. These are also called cold blooded animal.
- **Pigment** : A substance which absorb light of certain wavelength like chlorophyll found in green leaves.
- **Paleontology** : Study of fossils.
- **Physiology** : Study of function of various system of organism.
- **Pathology** : Study of diseases, effects, causable agents and transmission of pathogens.

- **Pomology** : Study of fruit and fruit yielding plant.
- **Psychiatry** : Treatment of mental disorders.
- **Psychology** : Study of human mind and behaviour.
- **Pisciculture** : Rearing of fishes.
- **Phycology** : Study of algae.
- **Paediatrics** : Branch of medicine dealing with children.
- **Parasitology** : Study of parasites.
- **Pharmacology** : The science which deal with drugs.
- **Photobiology** : Effect of light on various biological processes.
- **Phylogeny** : Evolutionary history of organism.
- **Physiotherapy** : Treatment of body defects through massage and exercise.
- **Radiology** : Science dealing with the effect of radiation on living beings.
- **Rhinology** : Study of nose and olfactory organs.
- **Sonography** : Study of ultrasound imaging.
- **Saurology** : Study of lizards.
- **Serology** : Study of serum, interaction of antigen and antibodies in the blood.
- **Sphygmology** : Study of pulse and arterial pressure.
- **Taxonomy** : Study of classification, nomenclature and identification of organism.
- **Telepathy** : Communication of thoughts or ideas from one mind to another without normal use of senses. In other word this is the process of mental contact.
- **Veterinary Science** : Science of health care and treatment of domestic animals.

2. What is living ?

- The word living cannot be defined.
- Living organism mostly uses of solar energy.
- There are certain characters by which living can be distinguished from non living.
  1. **Growth** : Increase in the number of cell or mass is called growth
  2. **Reproduction** : Living organism produce young ones of their same kind.
  3. **Metabolism** : Chemical reaction occurring inside a living cell.
  4. **Response of stimuli** : Living have the ability to sense the condition of their surrounding and respond to these stimuli
- When we touch leaves of "Touch me not" plant they close, these movement are called sesmonastic movement.

3. Classification of Organism

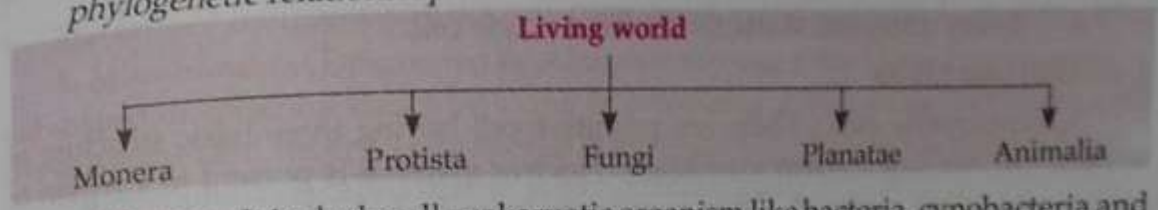
- There are millions of organisms. It is impossible to study each individual separately. Classification means to categories organism into different groups. Study of an individual of a group gives us the idea of rest of the member of that group.
- *Linnaeus* divide all organism into two kingdoms— *Planate* and *Animalia* in his book *"Systema Nature"*. The foundation of modern classification system was laid in the line of classification system started by *Linnaeus*. Therefore

Linnaeus is called *'Father of Taxonomy'*. Due to disputed position of organism like bacteria, virus, fungi and euglena, there is a need of reconsideration of system of classification.

- The book 'Genera plantarium' was written by **Benthem** and **Hooker**.

Five Kingdom Classification

- Five Kingdom Classification was proposed in 1969 by *R.H. Whittaker*. The criteria of classifying organism into five kingdoms are *complexity of cell structure, complexity of body of organism, mode of nutrition, life style and phylogenetic relationship.*



1. Monera : It includes all prokaryotic organism like bacteria, cynobacteria and archiobacteria. Filamentous bacteria also come under this kingdom. All organism of this kingdom are microscopic.

2. Protista : This kingdom includes unicellular form usually found in aquatic habitats. On the basis of mode of nutrition they are autotrophic, parasitic, and saprophytic. Diatoms flagellates and protozoa come under this kingdom. *Euglena* have both heterotrophic and autotrophic mode of nutrition. So, it is placed between plant and animal.

3. Fungi : This kingdom includes nongreen plants. It has saprophytic nutrition and growing on dead and decaying organic matter. The cell wall is composed of chitin. Example : *Mushroom, Mucor, Albugo* etc.

4. Planatae : This kingdom includes all plants except algae, diatoms, fungi and member of monera and protista.

5. Animalia : Almost all animal comes under this kingdom except protozoan.

- **Binomial nomenclature :** There was the need of uniform international naming of organism. In biology every organism is given two proper names. The first name is *genus* name always started with capital letter and the second name is *species* started with small letter. For example scientific name of human is *Homo sapiens*. Homo is the name of genus, whose one species is sapiens.
- Basic unit of classification is species.
- Carlos Linnus is the father of taxonomy.

Scientific Names of Some Organisms

Man	*Homo sapiens*	Frog	*Rana tigrina*	Mustard	*Brassica campestris*
Cat	*Felis domestica*	Dog	*Canis familaris*	Housefly	*Musca domestica*
Mango	*Mangifera indica*	Rice	*Oryza sativa*	Wheat	*Triticum aestivum*
Gram	*Cicer arietinum*	Cow	*Bos indicus*	Pea	*Pisum sativum*

4. Study of Cell

- Study of cell is called cytology.
- **Cell** : Cell is the basic structural and functional unit of life.
- The word *'cell'* was first coined by British scientist *Robert Hook* in the year 1665.

- The smallest cell is *Mycoplasma gallisepticum.*
- The longest cell in human body is *Neuron.*
- The biggest cell is *egg of Ostrich.*
- Schilden and Schwan established cell theory in the year 1838-39.

Main features of the cell theory :

1. All organism are composed of cell.
2. Body of every organism is made of cell.
3. Each cell arises from pre-existing cell.
4. Every organism starts its life from single cell.

Cell is of two kinds

1. Prokaryotic cell : These are primitive cell having three basic structure of typical cell but lack nuclear membrane. Nuclear material is present in a region of cytoplasm called nucleoid. Other membrane bound organelles are absent such as mitochondria, lysosome, golgi bodies etc. Ex.-Virus, bacteria and cynobacteria are Prokaryotes.

- Number of Mitochondria in bacterial cell is zero.
- The smallest known prokaryotic organism is Mycoplasma.

2. Eukaryotic cell : These are complete cell which contain membrane bound organelles and nucleus. Unicellular and multicellular plant and animal have Eukaryotic cell.

- The biggest single called organism is Acetabularia.
- Nucleus contain chromatin made up of DNA and histone protein.
- Nucleolus is present inside nucleus.

Difference between Prokaryotes and Eukaryotes

Prokaryotes	Eukaryotes
1. Size of cell is generally small.	1. Size of cell is generally large.
2. Nucleus absent.	2. Nucleus present.
3. It contain single chromosome which is circular in shape.	3. It contains more than one chromosome
4. Membrane bound cell organelles are absent.	4. Cell organelles present.
5. Cell division takes place by fission or budding.	5. Cell division takes place by mitosis and meiosis.

- **Structure of typical cell :** A cell have following structure.

1. Cell wall : In plant cell there is a rigid cell wall which is non living and freely permeable. It is made up of cellulose or chitin. It provide shape and rigidity to the cell.

- Cell wall of bacteria is made up of peptidoglycan.

2. Cell membrane : It is also known as *plasma membrane* which form the outer covering of animal cell. In plant cell it is found within cell wall. It is thin, elastic, living, double layer, permeable membrane. It is made up of phospholipid molecules.

Function : It regulates movement of molecules inside and outside of the cell.

3. Protoplasm : The whole fluid present inside plasma membrane is protoplasm. The name protoplasm is given by *Purkenje* in 1839. Protoplasm is made up of

various chemical substances like water, ions, salt and organic molecule. It is the living part of cell.

Protoplasm is divided into two parts.

A. Cytoplasm : The fluid found outside the nuclear membrane.

B. Nucleoplasm : The fluid found inside the nuclear membrane.

- 99% of protoplasm is made up of oxygen (76%), carbon (10.5%) hydrogen (10%) and nitrogen (2.5%).
- 80% of protoplasm is water.
- The ratio of inorganic and organic compound found in protoplasm is 81 : 19.

4. Mitochondria : Discovered by *Altman* in the year 1886. These are cylindrical, rod shaped or spherical structure found in cytoplasm. It is surrounded by double layered membrane. Inner membrane has many fold called *cristae*. The fluid presents inside mitochondria is called *matrix*, which contains many enzyme and co-enzyme.

- Mitochondria is considered as prokaryotic cell inside eukaryotic.

Function : Mitochondria is the respiratory site of cellular respiration. Mitochondria synthesize energy rich compound ATP. It is also known as 'Power House' of the cell.

5. Golgi bodies : Discovered by scientist *Camilo Golgi*. Golgi bodies are made up of group of tubes, vesicles and vacuoles. In plant it is more in number and here it is known as dictyosomes.

Function : It work as storage, processing and packaging of material. It also involved in the synthesis of cell wall, plasma membrane and lysosomes.

- It help in the synthesis of carbohydrate from simple sugar which combine with protein made by ribosome forming glycoprotein.

6. Endoplasmic reticulum : Membranous network of tubules like structure found in cytoplasm is called *endoplasmic reticulum*. It is attached with the nucleus on one side and on other side it is joined with plasma membrane.

Function : Endoplasmic reticulum helps in the distribution of material. It forms supporting framework of cell.

7. Ribosome : Discovered by *Palade*. Small granules like structure found attached to the endoplasmic reticulum or in free state. It is made up of ribonucleic acid (RNA).

Function : Take part in protein synthesis.

8. Lysosome : Discovered by *De Duve*. These are sac like structure bounded by single membrane and contain hydrolytic enzyme.

Function : It helps in intracellular digestion. The enzyme found in lysosome may digest the entire cell. So it is also known as suicidal bag.

- Lysosome is not found in Red blood corpuscles of mammal.

9. Centrosome : Discovered by *Boveri*. It is only found in animal cell taking part in cell division. It is not bounded by membrane consist of two centriole.

Function : Help in the formation of spindle fibre between pole during cell division.

10. Plastid : Only found in plant cell. It is of three type : (a) Chloroplast (b) Chromoplast (c) Leucoplast.

(a) **Chloroplasts** : These are green pigment found in green plant involve in photosynthesis. So, it is known as *'Kitchen of the cell'*. Chloroplast is bounded by two unit membrane having grana and stroma. Grana are membrane bounded sac like structure found in stacks containing chlorophyll molecule. Stroma is the matrix present inside the chloroplast which contain photosynthetic enzymes and starch grain. Granum is the site of light reaction during photosynthesis while stroma is the site of dark reaction.

Function : Chloroplast provides green colour to plant & take part in photosynthesis.

(b) **Chromoplast** provides various colours to the plant like flower, fruit etc.

➢ Chromoplasts are of different kind.

Lycopene : In tomato it provide red colour.

Carotine : Provide yellow or orange colour in plant. Example—Carrot.

Betanin : Found in sugar beet.

(c) **Leucoplast** is colourless. It stores the food in the form of starch, fat & protein.

➢ Leucoplast is found in root and underground stem.

11. Vacuole : It is fluid filled single membrane bounded, dead organelles of cell. In plant cell it is larger in size but in animal it is smaller in size.

Function : It helps in osmoregulation. It stores toxic metabolic waste.

12. Nucleus : The nucleus is a spherical, centrally located is a major structure found in the cell. In plant cell it is shifted towards periphery. It is bounded by double layered nuclear membrane having pore. Within nucleoplasm nucleolus and chromatin material is present. Nucleolus is rich in protein and RNA. Chromatin material is thin thread like structure forming network. This is made up of genetic substance DNA (deoxyribo nucleic acid) and histone protein. During cell division chromatin breaks into pieces and form chromosome.

Function : It controls all the activity of cells. So it is also known as 'control room' of cell. Chromatin transmits hereditary characters from parents to their offspring.

➢ Other than nucleus DNA is also found in mitochondria and chloroplast.

Difference between Plant and Animal cells

Plant cell	Animal Cell
1. Plant cells are larger in size.	1. Animal cells are generally smaller in size.
2. Cell wall present, made up of cellulose and chitin.	2. Cell wall absent.
3. Plastid present.	3. Plastid absent.
4. Centrosome absent.	4. Centrosome present.
5. Vacuoles are larger in size	5. Vacuoles are smaller in size.

➢ Cell becomes turgid because of endosmosis

➢ The process of imbibition involves both diffusion and capillary action.

➢ A cell increases in volume when it is placed in hypotonic solution.

Chromosome

➢ Chromosome is thread like structure found in the nucleus. It becomes visible during cell division. Each chromosome is made up of two chromatids joined together at a point centromere. Bead like structure found on chromosome is called *gene*. Genes are made up of DNA (deoxyribo nucleic acid) which is the carrier of genetic information from generation to generation. In some viruses RNA is the genetic material called *retrovirus*. In prokaryotes there is only one chromosome, like bacteria and virus.

➢ Chromosome was named by Waldeyer in 1888 capable of self replication, which transmit coded information from one generation to other.

➢ Eukaryotic cell possess many chromosome. A particular kind of species have definite number of chromosome in their cell, which are in pair known as *diploid*. The set of unpaired chromosome is called *haploid*. Gametes have haploid set of chromosome.

Number of chromosome in different organism

Pegion	40 pairs	Dog	39 pairs	Horse	32 pairs
Chimpanzee	24 pairs	Human	23 pairs	Wheat	21 pairs
Cat	19 pairs	Frog	13 pairs	Tomato	12 pairs
Onion	8 pairs	Pea	7 pairs	Ascaris	1 pairs

➢ **Nucleic Acid :** Nucleic acid is complex organic compound found in cell. It contains special genetic instruction in coded form. Nucleic acids are of two kinds—

A. Deoxyribo Nucleic Acid (DNA) : *Frederic Meischer* was the first who isolated DNA from the nucleus of pus cells. DNA is a macro molecule in which large number of nucleotides are present. Chemically a nucleotide has three components. 1. Nitrogen base 2. Sugar 3. Phosphate group.

➢ Nitrogen base are of two types—*Purines & Pyrimidines*. Purines contain two types of nitrogen base—*Adinine* and *Guanine*. Pyrimidine nitrogen base are *Thymine* and *Cytosine*.

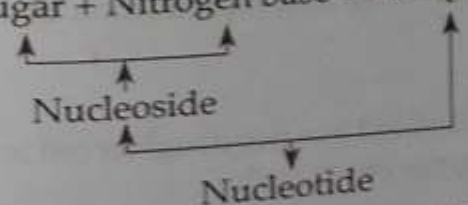
Thus there are four kinds of nucleotides present in DNA.

Watson and *Crick* give the structural model of DNA —

1. DNA molecule is consist of two polynucleotide strand, forming a *double helix*. Each strand has a backbone of sugar and phosphate. Nitrogen base is attached to the sugar.

➢ Sugar + Nitrogen base = Neucleoside.

➢ Sugar + Nitrogen base + Phosphate = Nucleotide



2. Nitrogenous base of the two strands of a double helix form a pair with the help of hydrogen bonds. Adenine pairs with thymine where as guanine pairs with cytosine. Adenine and thymine are complementary to each other and cytosine is

complementary to guanine. Hydrogen bonding between nitrogenous base holds the two strands together. This structure can be compared with the steps of spiral staircase.

Function : 1. It contain genetic information in coded form.
2. DNA synthesise RNA.

Note : *DNA is mainly found in nucleus. In small amount it is also found in mitochondria and chloroplast.*

➢ Phosphorous is an essential constituent of nucleic acid.

Gene : Gene is hereditary unit which is made by a segment of DNA found on the chromosome.

B. Ribonucleic Acid (RNA) : RNA is single stranded nucleic acid made up of phosphate, ribose sugar and nitrogen base uracil, adenine, guanine and cytosine. It is found in nucleus as well as cytoplasm.

RNA is of three kind—

1. Messenger RNA (*m*RNA) : It brings the message from DNA found in the nucleus to cytoplasm in the coded form.

2. Ribosomal RNA (*r*RNA) : Present in ribosome which is the site of protein synthesis.

3. Transfer RNA (*t* RNA) : It is the carrier of amino acid and transfer it to the ribosome.

Function : Synthesis of protein.

Difference between RNA and DNA

DNA	RNA
1. Sugar is deoxyribose type.	1. Sugar is ribose type.
2. It contains the base adenine, thymine and cytosine and guanine.	2. It contains uracil at the place of thymine.
3. It is double stranded structure.	3. It is single stranded structure.
4. It is mainly found in nucleus.	4. It is found in both nucleus and cytoplasm.

➢ **Cell cycle :** It is the sequence of events in which cell duplicates its genetic material, synthesise the other constituents of cell and ultimately divide into two daughter cell.

➢ **Cell Division :** The process in which cell increase in their number is called cell division. It is needed for growth, development and repair of body. There are mainly two kind of cell division—

A. Mitosis : Mitosis cell division occur in somatic cell which take part in growth, repair and development. In unicellular organism asexual reproduction takes place by this type of cell division.

➢ **Significance of Mitosis :**

1. After Mitosis cell division one cell divided into two daughter cell in which number of chromosome is equal to the parent cell.
2. Uncontrolled Mitosis may cause tumor or cancerous growth.

B. Meiosis : 1. Meiosis cell division occur in reproductive cell. This type of division takes place during the formation of haploid gamete. i.e. ova & sperm.

2. It is also known as *reduction division* during which each daughter cell have haploid number of chromosome.
3. Four daughter cells are produced from one meiotic cell division.

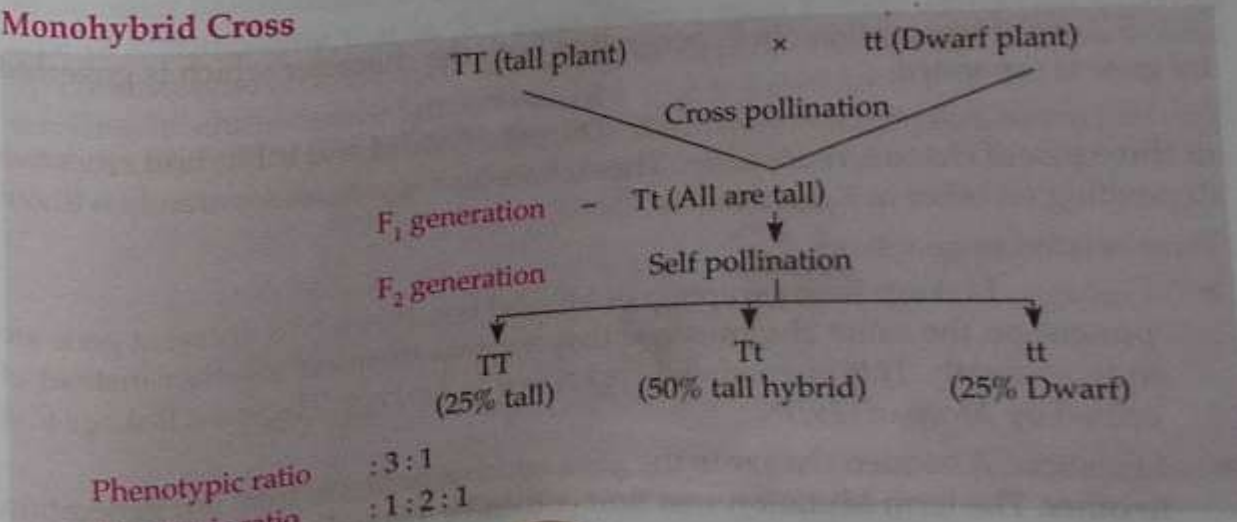
Terms related to cytology :

➢ Karyokinesis : Division of nucleus during cell division is called *Karyokinesis.*
➢ Cytokinesis : Division of cytoplasm is called *cytokinesis.*
➢ Diploid : Two complete set of chromosome is called *diploid,* found in somatic cell.
➢ Haploid : Single set of chromosome in cell is called *haploid,* found in gametes.
➢ Crossing over : Exchange of genetic material between two non sister chromatids takes place during meiosis cell division is called *crossing over.*
➢ Homologous chromosome : A pair of chromosome having same size and shape bearing corresponding gene.
➢ Allele : Alternative form of characters governed by gene.
➢ Phenotype : The character of organism which can be seen directly.
➢ Genotype : Genetic constitution of organism is called genotype.
➢ Tonoplast : The membrane surrounding the vacuole.
➢ Unit membrane : The basic trilamilar structure of cell membrane.

5. Genetics

➢ Transmission of character from one generation to next generation is called heredity.
➢ The process of transfer of hereditary character from generation to generation is called genetics.
➢ The name genetics was first coined by W. Wattson in 1905.
➢ Johannes was first used the name gene in 1909.
➢ Gregar Johan Mendal was the first who gave the idea of heredity based on his experiment in 1822-1884. He is also known as father of genetics.
➢ Mendal chosen pea plant for his experiment.
➢ Mendal made a cross between two pure plant having contrasting character for single trait called monohybrid cross i.e. tall and dwarf plant for height.

Monohybrid Cross



Phenotypic ratio : 3 : 1
Genotypic ratio : 1 : 2 : 1

Dihybrid cross : Mendal made a cross between two pure plant having in two pair of contransting character i.e. colour and shape of seed called dihybrid cross. He made a cross between plant having round seed with yellow colour and wrinkled seed with green colour.

RRYY (Round & yellow seed) — rryy (Wrinkled & green)

Gametes — RY × ry

Cross Pollination

F_1 generation : Rr Yy (All are round and yellow seed)

F_2 generation : Self pollination

♀ \ ♂	RY	Ry	rY	ry
RY	RRYY round yellow	RRYy round yellow	RrYY round yellow	RrYy round yellow
Ry	RRYy round yellow	RRyy round green	RrYy round yellow	Rryy round green
rY	RrYY round yellow	RrYy round yellow	rrYY wrinkled yellow	rrYy wrinkled yellow
ry	RrYy round yellow	Rryy round green	rrYy wrinkled yellow	rryy wrinkled green

Phenotypic ratio of F_2 generation— 9 : 3 : 3 : 1

Genotypic ratio : 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1

On the basis of mono and dihybrid cross Mendal proposed law of heredity

1. Law of paired unit : Mendal proposed that when two dissimilar unit factors are present in an individual only one is able to express. One that expresses itself is *dominant unit factor* while other which fail to express is *recessive unit factor*. For example tallness is dominant over dwarfness.

2. Law of dominance : Offspring of cross breed parent only show dominant characters in F_1 generation.

3. Law of segregation : In F_2 generation both the character which is governed by gene is separated.

4. Law of independent assortment : During dihybrid and tribhybrid cross two or three pair of characters are taken. These characters segregate separately without depending on other in F_2 generation.

Term related to genetics :

- Linkage : Linkage is an exception of Mendel law. When two different gene are present on the same chromosome they express themself together instead of independently. This phenomenon is known as *Linkage*. The word linkage first coined by *Morgan (1910)*.
- Mutation : A sudden change in the gene which is heritable from one generation to other. The term Mutation was first coined by *Hugo De Vries*.

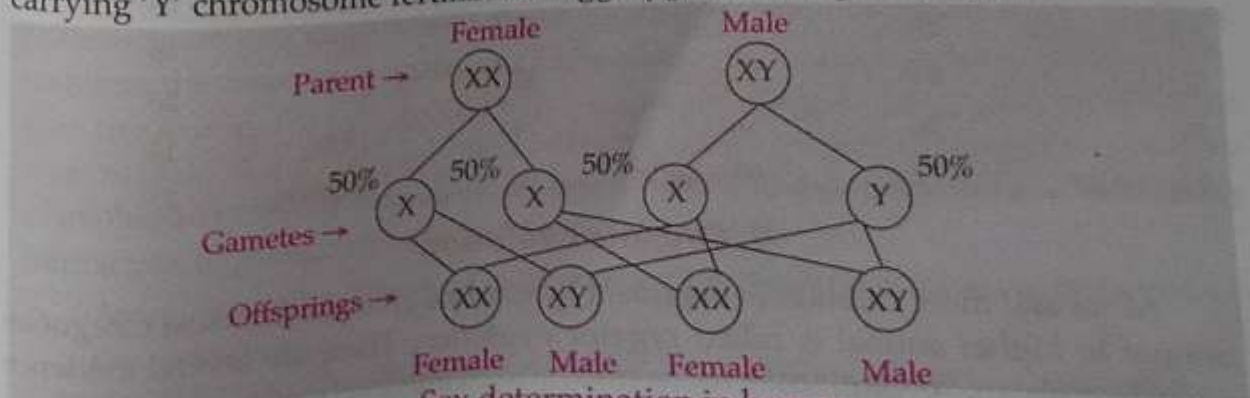
- Variation : When characters are transmitted from one generation to next generation there is some change. Change in characters by recombination of gene in offspring takes place they looks different from their parents. This phenomenon is known as *Variation*.
- Chromosomal aberrations : Any change in chromosomal structure is known as *Chromosomal aberrations*.
- Cloning : It is a process of producing many identical organism from a single cell having same genetic character as his mother. Ex : *Sheep Dolly* was produced from single cell.
- Totipotency : It is the potential ability of a plant cell to grow in a complete plant.
- Pluriopotency : It is the potential ability of a cell to develop into any kinds of the cell of animal body.
- Genetically modified organism (GMO) : Manipulation of gene by cutting or joining the segment of DNA to get desired varieties of organism is called *genetically modified organism*. This is also known as *genetic engineering*.
- Autosomes : Chromosomes found in cell which are responsible for characters other than sex are called *autosomes*.
- Sex chromosome : The pair of chromosome which determine the sex of organism is called *sex chromosome*.

Human have 23 pair of chromosomes in which 22 pair are autosomes and one pair is sex chromosome.

- Genome : All gene present in a haploid cell is called *genome*.
- Plasmagen : Gene are found in organelles found in cytoplasm called plasmagen.
- Cistron : Functional unit of gene is called cistron.
- Muton : Unit of gene responsible for mutation.
- Recon : Unit of gene take part in recombination.
- S.Benzer (1962) had given the modern definition of gene.

6. Sex Determination in Human

In human male sex chromosome is 'XY', where as in female sex chromosome is XX. During gamete formation in male half of the sperm contain 'X' chromosome while other half contain 'Y' Chromosome. In female all gametes contain only one type of chromosome that is 'X'. Thus when a male gamete i.e. sperm carrying 'X' chromosome fertilize an ova, the zygote develop into female. When a sperm carrying 'Y' chromosome fertilizes an egg, zygote develops into male.



Sex determination in human

- Barr body is found in female somatic cells.
- Fertilization is done in test tube but further development takes place inside mother womb in test tube baby.
- Sometime sex determination is regulated by environmental factor. In some reptiles temperature determine the sex at which the fertilized egg is incubated.
- In human each cell contains 46 chromosomes. Any addition or removal in the number of sex chromosome or autosome cause genetic disorder.

1. Klinefelter Syndrome : When a male have an extra X or Y chromosome in sex chromosome then the condition will be XXY or XYY instead of XY. The male individual with this syndrome have masculine development but feminine development is not completely suppressed and the individual became sterile.

In female when extra X chromosome is present instead of XX they show normal development but limited fertility. Mental retardness is also seen in this type of syndrome. Number of chromosome became 47 instead of 46.

2. Turner's Syndrome : When female has single sex chromosome (XO) their ovaries are rudimentary, lack of secondary sexual character.

3. Down's Syndrome : When an extra chromosome is added to 21st autosomal chromosomes this lead to develop Down's syndrome. In this syndrome person became Mangolism. The person is mentally retarded, eyes protruded an irregular physical structure is present.

4. Patau's Syndrome : This type of syndrome is develop by an addition of autosomal chromosome in 13th chromosome. There is a cut mark in the lip and person is mentally retarded.

5. Sickle Cell Anaemia : In this disorder erythrocytes destroyed more rapidly than normal leading to anaemia. These occur due to change in 11th autosomal chromosome.

6. Phenylketonuria : It is an in born error of metabolism which result in mental retardation cause due to change in 12th autosomal chromosomes.

7. Haemophilia : Gene responsible for this disorder is linked with sex chromosomes. This disease lead to failure of blood clotting.

8. Colour blindness : This disorder lead to failure to distinguished red & green colour. The gene responsible for this disease is situated on sex chromosomes.

Number of Chromosomes in Different Organisms :

Pigeon	80	Dog	78	Horse	64
Chimpanzee	48	Potato	48	Human	46
Rabbit	44	Wheat	42	Cat	38
Frog	26	Tomato	24	Pea	14
House fly	12	Mosquito	6	Ascaris	2

7. Organic Evolution

More and more creation of organism by gradual changes from low categories animal to higher animal is called *organic evolution*. There are several evidence regarding organic evolution.

- Homologous organ : Organ which are seen different due to use in its function but internal structure and embryonic development are similar. Ex – *Flipper of whale, feather of bat, forelimb of horse, Paw of cat,* and *hands of human.*
- Analogous organ : Organ which looks similar due to be used in similar function but their internal structure and embryonic development are different. Ex – *Feather of butterfly, bats* and *birds* all looks similar but their internal structure and origin are different.
- Vestigial organ : These are organs which appear functionless in an organism but functional in their ancestor. For example *vermiform appendix of large intestine* and *nictitating membrane of human.* Vermiform appendix is functional in herbivorous mammal even now.
- Fossils – Fossils are the remains of ancient plant or animal which provide evidences for evolution. Example–Archaeopteryx.
- Archaeopteryx : It is a fossils look like bird but bear a number of features found in reptiles. So, it is a connecting link between aves and reptile.

Theories of evolution

1. **Carolus Linnaeus** (1707–1778) contribution to classification provide an evolutionary relationship among the organism. He was also supported an idea that no species is new. Each and every species originates from some pre-existing species.

He wrote 'species plantarum' and proposed binomial system of nomenclature.

2. **Jean Baptist Lamarck** (1744–1829) tried to explain the evolutionary process in his book *Philosophic zoologique.* The theory proposed by Lamark is known as *theory of inheritance of acquired characters.* According to this theory use and disuse of an organ lead to acquiring change in the features of that organ. These changes are also inherited to offspring. The favourable changes after long period of time result in evolution of new species. But Lamarckism was very strongly criticised by *August Weismann.*

3. **Charles Robert Darwin** (1809–1882) explain the evolutionary principle in his book *'The origin of species'*. The theory proposed by him is popularly known as *'Theory of natural selection'* or *Darwinism.* Darwin explained that despite having the enormous potential of fertility, the population of organism remains within a limit. It is due to struggle between members of same species and different species for food, space and mate. Struggle eliminates the unfit individual. The fit organism possess some variations which are favourable and they can leave the progeny to continue the favourable variation. The variation when accumulated for long time give rise to origin of new species with progress in genetics, the sources of variation were explained and Darwin's theory was modified. Now the most excepted theory of evolution is *Modern synthetic theory,* in which origin of species is based on the interaction of genetic variation and natural selection.

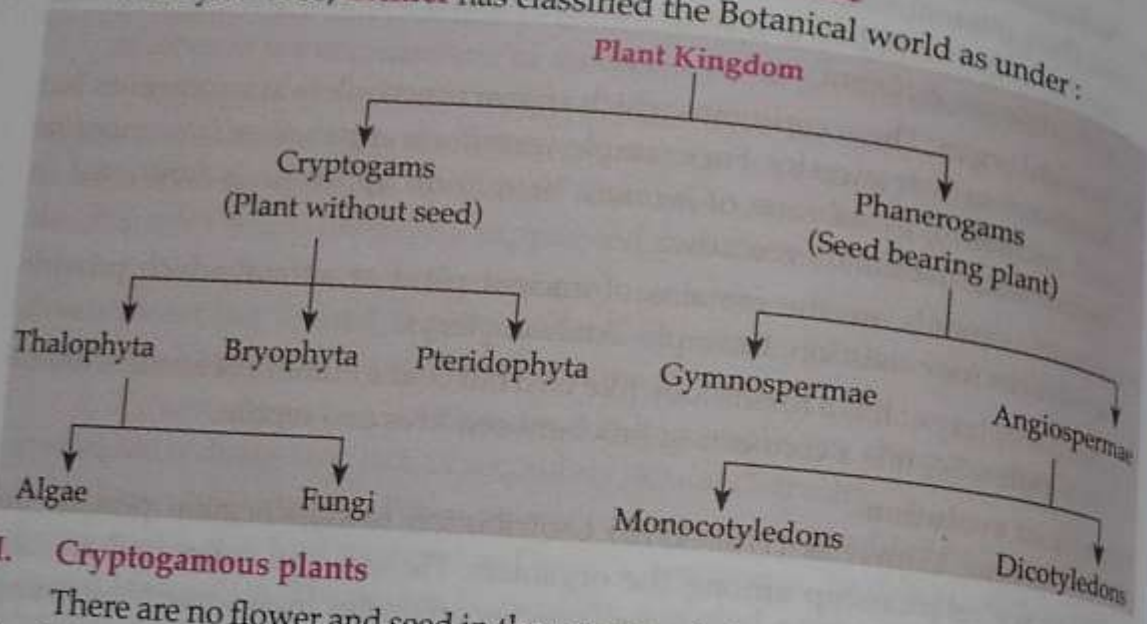
- Among permian, Triassic, Cretaceous and Jurassic geological era cretaceous is the newest one.
- The book which contains information about plant is called red data book.

BOTANY

The study of different types of Trees, plants is called *Botany*.
Theophrastus is called the *father of Botany*.

1. Classification of Plantae

In the year 1883, **Eichler** has classified the Botanical world as under :



I. Cryptogamous plants

There are no flower and seed in these types of plants. These are classified into the following groups :

Thalophyta :

1. This is the largest group of the plant kingdom.
2. The body of the plants in this group is thalus like i.e., plant are not differentiated into root, stem and leaves.
3. There is no conducting tissue. It is divided into two groups.
   (a) Algae and (b) Fungi

(a) Algae

1. The study of algae is called *Phycology*.
2. The algae normally have *chlorophyll* and *autotrophic* mode of nutrition.
3. Its body is thalus like. It may be *unicellular, colonial* or *filamentous*.

Useful Algae :

1. As a food : *Porphyra, Ulva, Surgassum, Laeminaria, Nostoc* etc.
2. In making Iodine : *Laeminaria, Fucus, Echlonia* etc.
3. As a manure : *Nostoc, Anabana, kelp* etc.
4. In making medicines : *Chloreloline* from *Chlorella* and *Tincher iodine* is made from *Laminaria*.
5. In research works : *Chlorella Acetabularia, Belonia* etc.

Note : *An astronaut can get protein food, water and oxygen by sowing the chlorella algae in the tank of the aircraft so chlorella is known as space algae.*

➢ Agar-agar is prepared from algae.

(b) Fungi

1. Study of fungi is called *Mycology*.

2. Fungi is chlorophyll less, central carrier tissue less, Thalophyta.
3. Accumulated food in fungi remains as *Glycogen*.
4. Its cell wall is made up of *chitin*. Ex. Albugo, Phytophthora Mucor etc.

Fungi may creates serious diseases in plants. Most damage is caused by rust and smut. Main Fungal diseases in plants are as :

White rust of crucifer, Loose smut of wheat, Rust of wheat, early Blight of potato, Red rot of sugarcane, Tikka diseases of groundnut, Wart disease of potato, Brown leaf spot of rice, Late blight of potato, Damping off of seedlings etc.

➢ Rhizopus is a fungi commonly known as 'bread mould'

Bryophyta

This is the first group of land plants. In this division approximately 25000 species are included.

1. In bryophyta there is lack of Xylem and phloem tissue.
2. Plant body may be of thallus like and leafy erect structure as in moss.
3. They lack true roots, Stem and leaves.
4. This community is also called *Amphibian category of the plant kingdom*.

➢ Water conduction takes place in mosses through parenchyma.

The moss namely Sphagnum is capable of soaking water 18 times of its own weight. Therefore, gardeners use it to protect from drying while taking the plants from one place to another.

➢ The Sphagnum moss is used as fuel.

➢ The Sphagnum moss is also used as antiseptic.

Pteridophyta

The plants of this group is mostly found in wet shady places, forests and mountains.

1. The body of plants is differentiated into root, stem, and leaves. Stem remains as normal rhizome.
2. Reproduction occurs by spores produced inside the sporangia.

➢ Sporangia bearing leaf of a fern is called 'Sorus'.

3. Gametophytic phase is short lived. The diploid zygote develops into an embryo.

➢ Gametophyte is called prothallus in pteridophytes.

4. Plants of this community have conducting tissues. But Xylem does not contain Vessels and Phloem does not contain companion cells.
   Examples : *Ferns, Azolla, Pteridium, Lycopodium* etc.

➢ In the neack cell of archegonium of fern one binucleated cell is present.

II. Phanerogamous or Floral plant

Plants of this group is well developed. All the plants in this group bears flowers, fruits and seeds. Plants in this group can be classified into two sub-groups – *Gymnosperm* and *Angiosperm*.

(A) Gymnosperm

1. These plants are in the forms of trees and bushes. Plant body are differentiated into root, stem & leaves.

2. Plants are woody, perennial and tall. Plant bear naked seed.
3. Its tap roots are well developed.
4. Pollination takes place through air.

The longest plant of the Plant kingdom, *Sequoia gigentia* comes under it. Its height is 120 meters. This is also called *Red Wood of California.*

- The smallest plant is *Zaimia Pygmia.*
- Living fossils are *Cycas, Ginkgo biloba* and *Metasequoia.*
- *Ginkgo biloba* is also called *Maiden hair tree.*
- Ovule and Antherozoids of *Cycas* is the largest in Plant kingdom.
- Corolloid roof of cycas help in absorption of water and fixation of nitrogen.
- The pollen grains of Pinus are so much in number that later it turns into Sulphur showers.

Importance of Gymnosperm

1. *As a food* – Sago is made by extracting the juice from the stems of Cycas. Therefore, Cycas is called *Sago-palm.*
2. *Wood* – The wood of Pine, Sequoia, Deodar, Spruce etc is used for making furniture.
3. *Vapour oil* – We get Tarpin oil from the trees of Pine, Cedrus oil from Deodar tree and Cedcast oil from Juniperous wood.
4. *Tannin* - It is useful in tanning and making ink.
5. *Resin* – Resin is extracted from some conical plants which are used in making varnish, polish, paint etc.

- Resin is the product of coniferous tree.
- Best example of polyembryony is citrus.

(B) Angiosperm

1. In the plants of this sub-group seeds are found inside the fruits.
2. In these plants root leaves, flowers, fruits and seeds are fully developed.

In the plants of this sub-group there is seed-coat in seeds. On the basis of number of cotyledons plants are divided into two categories –

1. *Monocotyledon* and 2. *Dicotyledon*

Monocotyledon plants : Those plants which have only one cotyledon in seed. *Example :*

	Name of category	Name of main plants
1.	*Liliaceae*	Garlic, Onion etc.
2.	*Palmae*	Nut, Palm, Coconut, Date etc.
3.	*Graminaeceae*	Wheat, Maize, Bamboo, Sugarcane, Rice, Bajra Oat etc.

Dicotyledon plants : Those plants which have two cotyledon in its seed are called dicotyledons. Example :

	Name of category	Name of main plants
1.	*Cruciferae*	Radish, Turnip, Mustard etc.
2.	*Malvaceae*	Jute, Lady's finger

	Name of category	Name of main plants
3.	*Leguminaceae*	Babool, Lajwanti, Ashok, Tamarind and all Pulse crops.
4.	*Composite*	Sunflower, Marigold, Lily etc.
5.	*Rutaceae*	Lemon, Orange etc.
6.	*Cucurbitaceae*	Melon, Water melon, Guard bitter etc.
7.	*Solanaceae*	Potato, Chilly, Brinjal, Belladonna, Tomato etc.
8.	*Rosaceae*	Strawberry, Apple, Almond etc.

- Leaves are the lung of plant.
- Plant from which coca and chocolate are obtained is a shurb.
- Banana is a shurb.
- Trochodendron is a vesselless angiosperm.

Virus

- Study of virus is called virology.
- Virus was discovered by Russian scientist *Ivanovsky* in the year 1892. (During the tests of Mosaic disease in tobacco).
- In nature, there are ultra microscopic particle known as viruses.
- It has both the characters of living and non living, so it is a connecting link between living & non living.
- Dr. Stanley first isolated the virus causing mosaic disease in tobacco in the form of crystals.

Characters of virus

1. They became active inside a living cells.
2. Nucleic acids replicate themselves and they reproduce rapidly.
3. They cause disease like bacteria & fungi.

According to parasitic nature, virus is of three types –

1. *Plant virus* – RNA is present as its nucleic acid.
2. *Animal virus* – DNA or sometimes RNA is found in it.
3. *Bacteriophage* – They depend only on bacteria. They kill the bacteria. DNA is found in them. *Example* – T-2 phage.

- In man virus cause disease like mumps, chicken pox, hepatitis, polio, AIDs and Herpes.
- HIV often change its shape due to the presence of an enzyme reverse transcriptase.
- **Bacteriophages :** Bacteriophages are those virus which infect the bacteria. Example —Tobacco mosaic virus.

Note : *Those viruses in which RNA is found as genetic material are called Retrovirus.*

Bacteria

It was discovered by Antony Von Leeuwenhook of Holland in the year 1683.

- *Leeuwenhook* is called the *father of Bacteriology.*

In the year 1829 *Ehrenberg* called it bacteria.

- The year 1843-1892 – Robert Koch discovered the bacteria of Tuberculosis diseases.

➢ The year 1812-1892 – *Louis Pasteur* discovered the vaccine of Rabies and pasteurization of milk.

On the basis of shape, bacteria is of different types :

1. Bacillus : This is rod-like or cylindrical.
2. Round or Cocus : These are round and the smallest bacteria.
3. Comma shaped or Vibrio : Like the English sign (,) example – *Vibrio cholerae* etc.
4. Spirillum : Spring or screw shaped.

➢ Some species of *Azotobacter, Azospirillum* and *Clostridium* bacteria live freely in the soil and fix atmospheric nitrogen into the nitrogenous compound.

➢ The Bacteria capable of converting nitrite to nitrate is nitrosomonas.

Anabaena and *Nostoc cynobacteria* fix atmospheric nitrogen into soil.

➢ The species of *Rhizobium* and *Bradyrhizobium* etc. bacteria live in the roots of the Leguminous plants capable of converting atmospheric nitrogen into its compound.

➢ Rhizobium are called symbiotic bacteria.

➢ The harmful substances produced by the microbes are known as Toxins.

Note : *To preserve the milk for many days pasteurization is done. There are two methods of pasteurization –*

(a) Low temperature holding method (LTH) : Milk is boiled at 62.8 degree celsius for 30 minutes.

(b) High temperature short time method (HTST) : Milk is boiled at 71.7 degree Celsius for 15 seconds.

➢ In leather industry separation of hair and fat from leather is done by bacteria. This is called *tanning of leather.*

➢ Pickles, syrup is kept in salt or in dense liquid of sugar so that in case of bacterial attack bacteria are plasmolysed and destroyed. Therefore, pickles etc do not get spoiled soon and can be preserved for long time.

➢ The citrus fruit and pickels are not stored in iron container because it contain organic acid.

➢ In the cold storage objects are kept at low temperature (-10 degree celsius to -18 degree celsius).

➢ **Mycoplasma :** Smallest known prokaryotic cell causing pleuropneumonia. It is also known as PPLO

2. Plant Morphology

➢ **Morphology :** The study of forms and features of different parts of plants like roots, stems, leaves, flowers, fruits etc is called *Morphology.*

Root

Root is the descending part of the plant which develops from *radicle.*

Root generally grows in the soil away from light.

Roots are of two types—

➢ Root hairs arises from epidermis.

1. *Tap root* and 2. *Adventitious root.*

Modification of Tap roots are :

1. *Conical* – like Carrot 2. *Napiform* – like Turnip, beet etc.
3. *Fusiform* – like Radish.

➢ Rootless plant is lemna.

Stem

This is the part of a plant which grows towards light.

➢ So, they are usually positively phototrophic.

It develops from *plumule.*

The modification of stems are as under –

Underground stem

1. *Tuber* – like Potato.
2. *Corm* – like Colocasia, Saffron etc.
3. *Bulb* – like Onion, Garlic etc.
4. *Rhizome* – like Turmeric, Ginger etc.

Leaf

➢ It is green. Its main function is synthesis of food through photosynthesis.

➢ In cactus leaves are modified into spines.

➢ Cactus is referred as xerophyte.

Flower

This is the reproductive part of the plant.

In the flower *Calyx, Corolla, Androecium* and *Gynoecium* are found. Out of these androecium is male sex organ and the Gynoecium is female sex organ.

➢ Androecium : Unit of androecium is stamen there is one or more stamens in the androecium. Pollen grains are found in anther.

➢ Gynoecium : Unit of gynoecium is *carpel.* There are three parts of carpel – 1. *Ovary,* 2. *Style* and 3. *Stigma.*

➢ Pollination : After maturation of Anther, the process of transfer of pollen grains to stigma is called *pollination.* Pollination is of two types – 1. *Self-pollination* 2. *Cross-pollination*

➢ Fertilization : Pollen tube reaches the egg cell after entering into the ovule through a pore called *micropyle.* After that a male nucleus fuse with egg-cell. This is called *fertilization.* Fertilized egg is called *zygote.*

In angiosperm, the fertilization is triple fusion where as in other category of plants it is double fusion.

➢ Parthenocarpy : In some plants fruits are developed from ovary without fertilization. This type of fruit is called *parthenocarpy.* Normally these types of fruits are seedless. Example – Banana, Papaya, Orange, Grapes, Pine-apple etc.

➢ Bulbil take part in vegetative reproduction.

➢ The inflorescence of wheat is spike.

Formation of fruits

➢ Fruit is a matured or ripened ovary developed after fertilization.

➢ Formation of fruit takes place from ovary.

Fruits are divided into three types –

1. *Simple fruits* – like Banana, Guava etc.
2. *Aggregate fruit* – Strawberry, Custard apple etc.
3. *Composite fruit* – Jackfruit, Mulbery etc.

In the development of some fruits, Calyx, Corolla and thalmus takes part. These types of fruits are called *False fruits.* Example – Apple, Jackfruit, pear etc.

Some fruits and their edible parts

Fruit	Edible part	Fruit	Edible part
Apple	Fleshy thalamus	Wheat	starchy endosperm
Pear	Fleshy thalamus	Cashew nut	Peduncle & cotyledons
Mango	Mesocarp	Lichi	Aril
Guava	Entire fruit	Gram	cotyledons & embryo
Grapes	Pericarp and Placenta	Groundnut	Cotyledons
Papaya	Mesocarp	Mulberry	entire fruit
Coconut	Endosperm	Jackfruit	Bract, Perianth and seed
Tomato	Pericarp and Placenta	Pine apple	Bract and Perianth
Banana	Mesocarp & Endocarp	Orange	Juicy hair.

➢ Water of coconut is liquid nucellus.

➢ The medicinal plant used in the preparation of skin care is aloevera.

➢ In the seed of neem major pesticidal properties are present.

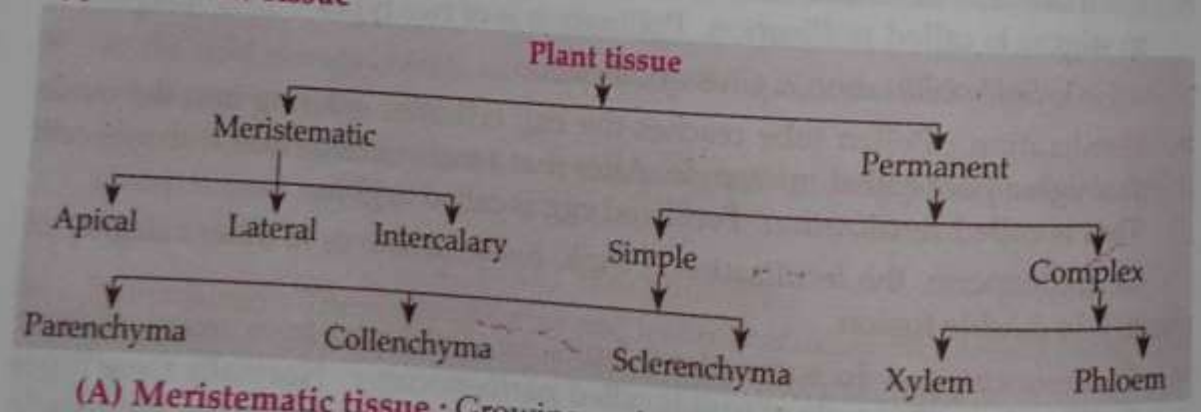
➢ The alkaloid naturally found in Coffee, Cocoa, and Cola nut is Caffeine.

➢ Hot peppers are hot due to presence of capsaicin.

3. Plant Tissue

Tissue : The group of cells of similar origin, structure and functions is called tissue.

Types of Plant Tissue



(A) Meristematic tissue : Growing regions of the plants are called *Meristem.* Meristematic tissue have capability of cell division. Daughter cells formed out. It grow and constitute the different parts of the plant. This process continues till the life-span of the plant.

Specific features of the Meristematic tissues are as follows –

1. It is round, oval or multisided.
2. Its wall is thin and cytoplasm is homogeneous.

3. Cell contains dense cytoplasm and a single large nucleus.
4. There is lack of inter-cellular spaces between the cells.

➢ **Apical Meristems :** These tissues are found in the root and stem apex and the initial growth (specially length) of the plants take place due to these tissue.

➢ **Lateral Meristems :** Due to the division in these tissue growth in the girth of roots and stems takes place. Hence, it increases the width of the root and stem.

➢ **Intercalary Meristems:** They are located at the base of internode. In fact, this is the remains of the Apical Meristems, which is divided by the incoming of permanent tissues in the centre. Plants increase its length by the activity of this. Its importance is for those plants whose apical parts are eaten by vegetarian animals. After being eaten the apex part the plants grow with the help of intercalary meristems only. Like – grass.

(B) Permanent tissue : Permanent tissues are made of those mature tissues that have lost their capacity of division and attain a definite forms for various works. These cells can be alive or dead.

➢ **Simple tissue :** If permanent tissue is made up of similar types of cells, it is called *simple tissue.*

➢ **Complex tissue :** If permanent tissue is made up of one or more types of cells, it is called *Complex tissue.*

➢ **Xylem :** This is usually called *wood.* This is conducting tissue. Its two main functions are –

1. Conduction of water and minerals and
2. To provide mechanical consistency.

The determination of age of the plant is done by counting annual rings of the xylem tissue. The method of determining the age of plant is called *Dendrochronology.*

➢ **Phloem :** This is a conducting tissue. Its main function is to conduct foods prepared by the leaves to different parts of the plant.

➢ Companion cells of phloem are found in angiosperm.

➢ Transpiration in plant is a process of water loss from its aerial part

➢ The cells which are closely associated and interacting with guard cells are subsidiary cells.

4. Photosynthesis

In the presence of water, light, chlorophyll and carbon dioxide, the formation of carbohydrates in plant is called *photosynthesis.*

$$\underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Water}}{6H_2O} + \underset{\text{Oxygen}}{6O_2} \xleftarrow[\text{Chlorophyll}]{\text{Light}} 6CO_2 + 12H_2O$$

Carbon dioxide, water, chlorophyll and sunlight are necessary for photosynthesis

➢ Terrestrial plants takes CO_2 from atmosphere whereas aquatic plants use carbon dioxide disolve in water.

➢ Water enters into the cells of the leaves through osmosis and CO_2 through diffusion from atmosphere or release during respiration.

➢ Water necessary for photosynthesis is absorbed by the roots. Oxygen produced during photosynthesis is due to photolysis of water.

➢ The green colour of the plants is due to the presence of chlorophyll. Chlorophyll are photoreceptor molecule, which trap the solar energy. There are different type of chlorophyll molecule like 'a', 'b', 'c', 'd' & 'e'. Chlorophyll 'a' & 'b' are most common and are found in plant.

➢ There is an atom of magnesium in the centre of chlorophyll.

➢ Chlorophyll absorbs the violet, blue and red colours of light.

The rate of photosynthesis is maximum in red light and is minimum in violet light.

➢ The process of photosynthesis is a reaction of oxidation and reduction. Oxidation of water takes place forming oxygen and reduction of carbon dioxide takes place forming glucose.

The stages of process of photosynthesis

1. Photochemical reaction or light reaction and
2. Dark chemical reaction

1. Photochemical reaction : This reaction is completed in the grana of the chlorophyll. This is also called *Hill reaction*. In this process breaking down of water takes place releasing hydrogen ion and electron. For photolysis of water, energy is received from the light. At the end of this process, ATP is formed from ADP & P.

2. Dark chemical reaction : This reaction takes place in the stroma of chlorophyll. In this reaction reduction of carbon dioxide takes place and sugar or starch are formed. It is also known as *Calvin Benson cycle*.

➢ Root pressure is measured by auxanometer.

➢ The cell which are closely associated and interacting with guard cells are subsidiary cells.

➢ Conversion of starch to sugar is essential for stomatal opening.

5. Plant Hormones

Following five hormones are found in plants –

1. **Auxins :** Auxins was discovered by Darwin in the year 1880.
This is the hormone which controls the growth of plants.
Its formation takes place in the apical parts of the plants.
Its main functions are –
   1. It prevents the separation of the leaves.
   2. It destroys the straws.
   3. It saves the crops from falling.
2. **Gibberellins :** It was discovered by a Japanese scientist *Kurosava* in the year 1926.

➢ The growth harmone gibberellins was first extracted from fungus in 1938 by Yabuta and Sumiki.

Functions :

1. It turns the dwarf plants into long plants. It helps in creating flowering.
2. It help in breaking the dormancy of plant.
3. It motivates the seeds to be sprout.
4. It increases the activity of cambium in the wooden plants.
5. Large sized fruits and flowers can be produced by its scattering.

3. **Cytokinins :** It was discovered by Miller in the year 1955 but it was named by Lethem.

Functions :

1. It naturally works in coordination with auxins.
2. It help in cell division and development in the presence of auxins.
3. It help in breaking the dormancy of seed.
3. It is helpful in making RNA and protein.

4. **Abscisic Acid or ABA :** This hormone was initially discovered by Carnes and Adicote and later on by *Waring*.

Functions :

1. This hormone is against to the growth.
2. It keeps the seeds & bud in dormant condition.
3. It plays main role in separation of leaves.
4. It delays in flowering of long day plant.

5. **Ethylene :** This is the only hormone found in gaseous form. In 1962 Burg proven it as harmone.

Functions :

1. It helps in the ripening the fruits.
2. It increases the number of female flowers.
3. It motivates the separation of leaves, flowers and fruits.

➢ Gas used for artificial ripening of fruit is ethane or ethylene.

6. **Florigens :** It is formed in leaves but helps in blooming of the flowers. Therefore, it is also called *flowering hormones*.

7. **Traumatin :** This is a type of dicarboxylic acid. It is formed in injured cells by which the injury of plants is healed.

➢ The concept of tissue culture was introduced by Haberlandt.

6. Plant Diseases

1. Viral Diseases : (a) *Mosaic disease of tobacco* : In this disease leaves get shrinked and become small. The chlorophyll of leaves get destroyed. The factor of this disease is *Tobacco Mosaic Virus* (TMV).

Control – Affected plants should be burnt.

(b) *Bunchy top of banana* – This diseases is caused by *banana virus*. In this disease plants become dwarf and all the leaves get accumulated like a rose on the branch.

2. Bacterial Disease : (a) *Wilt of Potato* : It is also known as *ring disease* because brown ring is formed on the xylem. The factor of this disease is *Pseudomonas solonacearum* bacteria. In this disease the conduction system of the plant is affected.

(b) *Black Arm of cotton* : The factor of this disease is *Xanthomonas Bacteria*. In this disease a water body (brown) is formed on the leaves.

(c) *Bacterial blight of Rice* : This disease is caused by *Xanthomonas oryzae bacteria*. Yellow-greenish spot is seen on both side of leaves. Vascular bundles get blocked due to bacterial growth.

(d) *Citrus Canker* : The factor of this disease is *Xanthomonas citri* bacteria. It has originated in China. Leaves, branches, fruits all are affected by this disease.

(e) *Tundu disease of wheat* : The factors of this disease are *Corinobacterium tritrici* bacteria and Enzuina Titriki Nematode. In this disease lower parts of the leaves are faded and turned.

3. Fungal Diseases : The diseases included in this group are caused by fungi.

➢ Rust of wheat is a disease caused by fungi Puccinia.

Disease caused due to deficiency of element

Disease	Deficiency of Element
Little leaf of mango and brinjal	Zinc (Zn)
Dieback of lemon	Copper
Little leaf of lemon	Copper (Cu)
Marsh disease of pea	Manganese (Mn)
Black hut disease of potato	O_2
Microsis of amla	Boron
Burning of leaf of litchi	Potassium (K)
White bud in maize	Zinc (Zn)
Koter spot of Turnip	Calcium (Ca)

Some Important Facts Regarding Botany

Facts	Example and details
Largest angiosperm tree	*Eucalyptus.*
Longest tree in the world	*Sequoia* giganteum. This is a gymnosperm. Its height is 120 meter. This is also called *Coast Red Wood of California.*
Smallest (in shape) angiosperm plant	Lemna. This is aquatic angiosperm which is found in India too.
Plant with largest leaf	Victoria Regia. This is an aquatic plant which is found in West Bengal in India.
Largest seed	*Lodoicea.* This is also called double coconut. This is found in Kerala in India.
Smallest Pteridophyta	*Azolla.* This is an aquatic plant.
Smallest seed	*Orchid.*
Smallest flower	*Wolfia.* Its diameter is 0.1 millimeter.
Largest flower	*Reflesia arnoldii.* Its diameter is 1 meter and its weight can be 8 kilograms.
Smallest angiosperm parasite	*Arceuthobium* is a parasite on the stems of gymnosperms.
Largest male couplet	*Cycas.* This is a gymnosperm plant.
Largest seed-egg	*Cycas.*
Alive fossil	*Cycas.*
Smallest chromosomes	*In algae.*
Longest chromosomes	In *Trillium.*
The plant with the largest	Ophioglossum (*Fern*). There are 1266

Facts	Example and details
Number of Chromosomes	Chromosomes in its Diploid cell.
The plant with the least number of chromosomes	Heplapapopus *gracilis.*
The smallest gymnosperm plant	*Zamia pygmea.*
The heaviest wooden plant	*Hardwichia binata.*
The lightest wooden plant	*Ochroma lagopus-balsa.*
The smallest cell	*Mycoplasma gallisepticum.*
Fruit like a tennis ball	*Kenth*
Fire of the forest	*Dhak*
Coffee giving plant	*Coffea arabica.* Caffin contains in it.
Coco giving plant	*Theobroma cococa.* Theobromin and caffeine contain in it.
Morphine	*Pepaver somniferum (opium plant)* morphine is obtain from fruit coat (pod).
Green manure	Decomposing green legume.
Clove	Bud of flower
Saffron	Stigma of flower

7. Ecology

➢ Study of inter relationship between living organisms and their environment.

➢ Environment include both biotic and abiotic factors.

➢ Various population of living in a definite geographical region is called *Biotic Community.*

➢ Ecosystem or Ecological system word was first coined by the scientist namely *Tansley.*

Every ecosystem is made up of two components –

(a) Biotic component – Living part

(b) Abiotic component – Non living part

(a) Biotic components : It is divided into three parts –

1. Producer 2. Consumer 3. Decomposers

(1) Producer : Those components that make their own food. Like – green plants.

(2) Consumer : Those components that consumes the food made by plant. Consumers are of three types –

(a) *Primary consumers :* In this category those organisms are included that lives on green plants or some parts of them.

(b) *Secondary consumers :* In this category those organisms are included that depends on the primary consumers as their food. Like – fox, wolf, peacock etc.

(c) *Tertiary consumers :* In this category those organisms are included that depends on the secondary consumers. Like – Tiger, lion, cheetah etc.

(3) Decomposers : Mainly fungi and bacteria are included in this category. These decomposes dead producers and consumers and changes them into physical elements.

(b) Abiotic components : Abiotic components are as follows –

1. Carbonic substance, 2. Non-carbonic substance, 3. Climatic factor

Example : Water, light, temperature, air, humidity, minerals etc.

- **Food Chain :** Transfer of energy from the producer through a series of organisms.
- The term steppe is associated with bio-region grass-lands.
- About 2% of the world's land area is tropical rainforest.
- Beef is the world growing appetite for food product which is the leading cause of tropical deforestation.

8. Nitrogen cycle

- Nitrogen fixation is a process in which free atmospheric nitrogen is converted by living organism into nitrogenous compound that can be used by plant
- **Ammonification :** Formation of ammonia from organic compound like proteins and nucleic acid by micro organism.
- **Nitrification :** A process in which ammonia is converted into nitrates and nitrates by Nitrobacteria.
- **Denitrification :** It is the process of converting fix nitrogen like nitrates, nitrites and ammonia into free nitrogen by denitrifying bacteria eg Pseudomonas.

9. Pollution

Unwanted changes in the chemical and physical features of air, water and land (environment) that are dangerous to human and other organisms, their life conditions, industrial process and cultural achievements are called *pollution.*

The types of pollution are mainly –1. Air pollution, 2. Water pollution, 3. Sound pollution, 4. Soil pollution, 5. Nuclear pollution.

1. Air pollution : When the pollution is in the atmosphere and the sufficient quantity of atmosphere reduces then it is called *Air pollution.*

Main air pollutants – *Carbon monoxide* (CO), Sulphur dioxide (SO_2), Hydrogen sulphide (H_2S), Hydrogen fluoride (HF), Nitrogen oxide (NO and NO_2), Hydrocarbon, Ammonia (NH_3), Smoke of tobacco, Fluorides smoke and particles of smoke, Aerosols etc.

Sulphur dioxide (SO_2), Sulphur trioxide (SO_3), Nitrogen oxide (NO) react with environmental water and form Sulphuric acid and Nitric acid. These acids reach to the earth with rain water called *acid rain.*

- On 3rd December, 1984 an incidence of leakage of Methyl Isocyanide gas took place in the fertilizer making Union Carbide Factory (Bhopal).

2. Water pollution : Mixing of unwanted substances with water is called *water pollution.*

- Only 2.5 to 3% water present on the earth is usable.

Sources of water pollution : The water pollution takes place mainly due to mixing up of Carbonate, sulphates of Magnesium and Potassium, Ammonia, Carbon monoxide, Carbon dioxide and Industrial remains in water. Sea-water pollution is due to mixing up of heavy metals, hydro carbon, petroleum etc in water.

- Oil spill from the tanker spread soon on the surface of sea water.

- Contaminated water in which mercury is present cause Minimata disease.
- Pollution of river water is measured by oxygen dissolve in it.

3. Sound pollution : The unwanted and undesirable sounds scattered in atmosphere are called *sound pollution.*

Sources of sound pollution : The source of sound pollution is loud sound or noise, in whatever ways it has produced.

4. Soil pollution : Distorted form of soil which change its chemical nature is called *Soil pollution.*

Sources of Soil pollution : acid rain, water from mines, excessive use of fertilizers and germicide chemicals, garbage, industrial remaining, excretion in open field etc are the main sources of soil pollution.

5. Nuclear pollution : This pollution is created by radioactive rays.

Following can be the sources of radioactive pollution –

(a) Pollution from the rays which are used in treatment.
(b) Pollution created from fuels used in Atomic reactors.
(c) Pollution created from the use of nuclear weapons.
(d) Pollution created remaining substances coming out of Atomic power-houses.

- Pollutant responsible for ozone hole is CFC.
- One of the best solutions to get rid of non-biodegradable wastes is recycling.
- Vermi composting is done by worms.
- Soil erosion can be prevented by afforestation.
- Natural sources of air pollution are volcanic eruptions.

Population, Biotic Community

- Population : Population is a group of individuals of same species occupying the same area at a given time.
- Population density : Total number of individual present in per unit area.
- Natality : Increase in the number of individuals in a given population by birth is called natality.
- Mortality : Number of individuals removed from a population due to death under given environmental condition at a given time is called mortality
- Biotic potential : It refers the maximum capacity of inherent of an organism to reproduce.
- Environmental resistance : Environmental factors, which put a check on the growth of population.
- Mutalism : It is a functional association between two different species in which both the species are benefited.
- Commensalism : It is an association between individuals of two different species in which one species is benefited and other one is neither benefited nor affected.
- Population Explosion : The dramatic increase in population size over a relatively short period is called population explosion.
- Demographic transition : If the birth rate is equal to the death rate, it results in zero population growth, which is called demographic transition.

➢ **Psychosis :** It is a mild form of mental illness where the patient show prolonged emotional reaction.

➢ **Drug abuse :** When drugs are taken for a purpose other than their normal clinical use in an amount that impairs ones physical, physiological and psychological function of body is called drug abuse.

➢ **Biosphere :** The space retaining life in any form is called biosphere.

ZOOLOGY

Zoology : Scientific study of the structure, form and distribution of animals.

1. Classification of Animal Kingdom

Animals kingdom of the world is divided into two sub-kingdoms :

1. Unicellular animal 2. Multi-cellular animal or Metazoans.

Unicellular animals are kept in a single phylum Protozoa whereas multi-cellular animals are divided into 9 phylums.

Classification of animals according to *Storer* and *Usinger* –

A. Phylum Protozoa : Main features – Unicellular

1. It's body is made of only one cell.
2. There is one or more nuclei in its cytoplasm.
3. It is parasitic and free living.
4. All the metabolic activity (eating, digestion, respiration, excretion, reproduction) takes place in unicellular body.
5. Respiration and excretion take place by diffusion.

Example–*Amoeba, Euglena, Trypanosoma* etc.

B. Phylum Porifera : All animal of this group are found in marine water & bear pores in body.

1. These are multicellular animals but cells do not make regular tissues.
2. Numerous pores known as *ostia* found on body wall.
3. Skeleton is made up of minute calcareous or silicon spicules.

Example–*Sycon, Sponge* etc.

➢ Sponges are also used as sound absorber.

C. Phylum Coelenterate : Main features – Coelenteron is present inside body.

1. Animals are aquatic and diploblastic.
2. Around the mouth some thread-like structure are found known as tentacles, which help in holding the food.
3. Body radial symmetry.
4. Specialized cnidoblast cell are found help in catching the food.

Example–*Hydra, Jelly fish, Sea Anemone* etc.

D. Phylum Platyhelminthes : Main features – Flat worm

1. Triploblastic and nobody cavity.
2. Dorso-ventraly flattened animal.
3. Alimentary canal with single opening, anus absent.

4. Excretion takes place by flame cells.
5. There is no skeleton, respiratory organ, circulatory system etc.
6. These are hermaphrodite animal.

Example–*Planaria, Liver fluke, Tape worm* etc.

E. Phylum Aschelminthes : Main features – Round worm

1. Long, cylindrical, unsegmented worm.
2. Bilaterally symmetrical and triploblastic.
3. Alimentary canal is complete in which mouth and anus both are present.
4. There is no circulatory and respiratory systems but nervous system is developed.
5. Excretion takes place through *Protonephridia.*
6. They are unisexual.
7. Most form are parasitic but some are free living in soil and water.

Example–Round worm, like – *Ascaris, Thread worm, Wuchereia* etc.

Note : *1. Enterobius (pin worm/thread worm) – It is found mainly in the anus of child. Children feel itching and often vomits. Some children urinate on the bed at night.*

2. Filarial disease is caused by Wuchereia bancrofti.

F. Phylum Annelida : Main features – Annulus body Bearing ring

1. Body is long, thin, soft and metamerically segmented.
2. Locomotion takes place through *Setae* made up of Chitin.
3. Alimentary canal is well developed.
4. Normally respiration through skin, in some animals it takes place through *gills.*
5. Nervous system is normal and blood is red.
6. Excretion by *nephridia.*
7. True coelom is present.
8. Both unisexual and bisexual.

Example–*Earthworm, Nereis, Leech* etc.

Note : *There are four pairs of heart in earthworm.*

G. Phylum Arthropoda : Main features – Jointed leg

1. Body is divided into three parts – Head, Thorax and Abdomen.
2. Body is covered with a thick chitinous exoskeleton.
3. Jointed leg.
4. Circulatory system is open type.
5. Its body cavities are called *haemocoel.*
6. *Trachea, book lungs, body surface* are respiratory organ.
7. These are mainly unisexual and fertilization takes place inside the body.

Example–*Cockroach, prawn, crab, bug, fly, mosquito, bees* etc.

Note : *1. There are six feet and four wings in insects. 2. There are 13 chamber in the Cockroach's heart. 3. Ant is a social animal which reflects labour division. 4. Termite is also a social animal which lives in colony.*

➢ The main excretory organ of insects are malpighian tubules.

H. Phylum Mollusca : Main features – Soft bodies animal

1. Body is soft divided into head and muscular foot.
2. Mantle is always present in it, which secretes a hard calcareous shell.
3. Alimentary canal is well developed.
4. Respiration takes place through *gills* or *ctenidia*.
5. Blood is colourless.
6. Excretion takes place through kidneys.

Example–*Pila, Octopus, Loligo, Squid* etc.

Note : Mollusca Other name in vogue

Aplysia	Sea rabbit
Doris	Sea lemon
Octopus	Devil-fish
Sepia	Cuttle-fish

I. Phylum Echinodermata : Main features – Spiny skin

1. All the animals in this group are marine.
2. Water vascular system is present.
3. There is Tube feet for locomotion, taking food which works as sensation organ.
4. Brain is not developed in nervous system.
5. There is a special capacity of regeneration.

Example–*Star fish, Sea urchin, Sea cucumber, Brittle stars* etc.

Note : *The function of the Aristotle lantern is to chew the food. It is found in sea urchin.*

J. Phylum Chordata : Main features

1. Notochord is present in it.
2. All the chordates are triploblastic, coelomate and bilaterally symmetrical.
3. A dorsal hollow tubular nerve cord and paired pharyngeal gill slits are other features of chordates.

According to classification there are two subphyla in Chordata.

(a) Protochordates and (b) Vertebrata

Some main groups of phylum Chordata :

1. Pisces : Main features – Aquatic life

(a) All these are cold blooded animals.
(b) Its heart pumps only impure blood and have two chamber.
(c) Respiration takes place through *gills*.

Example–*Hippopotamus, Scoliodon, Torpedo* etc.

2. Amphibia : Main features – Found both on land & water

(a) All these creatures are amphibian.
(b) All these are cold-blooded.
(c) Respiration takes place through gill, skin and lungs. Heart have three chamber two auricles and one ventricle.

Example–Frog, Necturus, Toad etc. *Icthyophis, Salamander.*

Note : *In fact the croaking of frogs is the call for sex.*

3. Reptilia : Main features – Crawlling animal

(a) Land vertebrate, cold-booded, terrestrial or aquatic vertebrates.
(b) It contains two pair of limbs.
(c) The skeleton is completely flexible.
(d) Respiration takes place through lungs.
(e) Its eggs are covered with shell made up of Calcium carbonate.

Example–*Lizard, snake, tortoise, crocodile, turtle, sphenodon* etc.

Note : *Mesozoic era is called the era of reptiles.*

➢ *Cobra is the only snake which makes nests.*
➢ Cobra emits their venom through fangs.
➢ *Heloderma is the only poisonous lizard.*
➢ *Sea snake which is called Hydrophis is the world's most poisonous snake.*

4. Aves : Main features – Warm blooded tetrapod vertebrates with flight adaptation.

(a) Its fore-feet modified into wings to fly.
(b) Boat shaped body is divisible into head , neck, trunk and tail.
(c) Its respiratory organ is lungs.
(d) Birds have no teeth. Beak help in feeding.

➢ Beak is formed by jaw.

Example–*crow, peacock, parrot* etc.

Note : *1. Flightless Birds – Kiwi and Emus. 2. Largest alive bird is Ostrich. 3. Smallest bird is Humming-bird. 4. Largest zoo in India is Alipur (Kolkata) and the largest zoo of the world is Cruiser National Park in South Africa.*

5. Mammalia : Main features

(a) Sweat glands and oil glands are found on skin.
(b) All these animals are warm blooded.
(c) Its hearts are divided into four chamber.
(d) Tooth comes twice in these animals. (Diphyodont)
(e) There is no nucleus in its red blood cells (except in camel and lama).
(f) Skin of mammal have hair.
(g) External ear (Pinna) is present in mammal.

➢ Pinna is present in mammal.

Mammals are divided into three sub-classes :

1. *Prototheria* – It lays eggs. Example – *Echidna*
2. *Metatheria* – It bears the immature child. Example – *Kangaroo*
3. *Eutheria* – It bears the well developed child. Example – *Human*

Note : *1. In mammal the highest body temperature is of goat. (Average 39 degree Celsius).*
2. Echidna and Duck billed Platypus are the egg laying mammal.

2. Animal Tissue

The animal tissues can be divided into following categories–1. Epithelial Tissue, 2. Connective Tissue, 3. Muscular Tissue, 4. Nervous Tissue.

1. Epithelial Tissue : Epithelial tissue cover the external surface of the body and internal free surface of many organs. Epithelial cell arranged very close to each other. There is no blood vessels supplying nourishment to epithelial cells. They receive nourishment from underlaying connective tissue. The principle functions of epithelial tissues are covering and lining of free surface.

Example : skin, intestine, gland, hollow organ like fallopian tube, nasal passage bronchioles, trachea etc.

2. Connective Tissue : These tissue connect and bind different tissues or organs. It provides the structural frame work and mechanical support to body. It play role in body as defense tissue, repair fat storage etc.

Example : Adipose tissue found beneath the skin. Ligament made up of fibrous connective tissue. Cartilage, bone and blood.

Note : *Blood is only tissue which is found in the form of fluid.*

3. Muscular Tissue : This is also known as contractile tissue. All the muscles of the body are made up of this tissue. Muscle tissue is of three types – (a) Unstriped, (b) Striped and (c) Cardiac.

(a) Unstriped : This muscle tissue is found on the walls of those parts which do not controlled by will. These are called involuntary muscle, like – Alimentary canal, Rectum, Ureter, Blood vessels. Unstriped muscles control the motions of all those organs that move on their own.

(b) Striped : These muscles are found in the parts of the body that move voluntary. Normally one or both the end of these muscles turn and connect with bones as tendon.

(c) Cardiac : These muscles are found only on the walls of the heart. The contraction and expansion of the heart is due to these muscles that move throughout the life without fail.

- There are 639 muscles in the human body.
- The largest muscle of the human body is *Gluteus Maximus* (muscle of the hip).
- The smallest muscle of the human body is *Stapedius*.

4. Nervous Tissue : This tissue is also called sensitive tissue. The nervous systems of the organisms is made up of these tissues. This is made up of two specific cells – (a) Nerve cell or Neurons and (b) Neuroglia.

Nervous tissue controls all the voluntary and involuntary activities of the body.

3. Human Blood

- Blood is a fluid connective tissue.
- The quantity of blood in the human's body is 7% of the total weight.
- This is a dissolution of base whose pH value is 7.4.
- There is an average of 5-6 litres of blood in human body.
- Female contains half litre of blood less in comparison to male.

Blood is consist of two part :

(A) Plasma and (B) Blood corpuscles.

(A) Plasma : This is the liquid part of blood. 60% of the blood is plasma. Its 90% parts is water, 7% protein, 0.9% salt and 0.1% is glucose. Remaining substances are in a very low quantity.

Function of plasma : Transportation of digested food, hormones, exeretory product etc from one part of the body to another part.

- **Serum :** When Fibrinogen and protein is extracted out of plasma, the remaining plasma is called *serum*.

(B) Blood corpuscles : This is the remaining 40% part of the blood. This is divided into three parts —

1. *Red Blood Corpuscles* (RBCs)
2. *White Blood Corpuscles* (WBCs) and 3. *Blood Platelets*.

1. Red Blood Corpuscles (RBC) : Red Blood Corpuscles (RBC) of a mammal is biconcave.

- There is no nucleus in it. Exception – Camel and Lama
- RBC is formed in Bone marrow.
- (At the embroynic stage its formation takes place in liver).
- Its life span is from 20 days to 120 days.
- Its destruction takes place in liver and spleen. Therefore, liver is called grave of RBC.
- It contains haemoglobin, in which *haeme is* iron containing compound and due to this the colour of blood is red.
- *Globin* is a proteinous compound. With haeme it is extremely capable of combining with oxygen and carbon dioxide.
- The iron compound found in haemoglobin, as *haematin*.
- The main function of RBC is to carry oxygen from the lung to all cells of the body and bring back the carbon dioxide.
- *Anaemia* disease is caused due the deficiency of haemoglobin.
- At the time of sleeping RBC reduced by 5% and people who are at the height of 4200 meters RBC increases by 30% in them.
- Number of RBC is measured by an instrument called hemocytometer.

2. White Blood Corpuscles (WBC) or Leucocytes : In shape is similar to Amoeba.

- Its formation takes place in Bone marrow, lymph node and sometimes in liver and spleen.
- Its life span is from 2 to 4 days.
- Nucleus is present in the White Blood Corpuscles.
- Its main function is to protect the body from the disease.
- The ratio of RBC and WBC is 600 : 1.
- About 60 to 70% part of WBC is made up of neutrophile corpuscles which help in engulfing disease causing microorganism and bacteria.

3. Blood Platelets or Thrombocytes : It is found only in the blood of human and other mammals.

- There is no nucleus in it.
- Its formation takes place in Bone marrow.
- Its life span is from 3 to 5 days.
- It dies in the spleen.
- Its main function is to help in clotting of blood.
- In dengue fever number of platelets reduced.

Functions of blood :

1. To control the temperature of the body and to protect the body from diseases.
2. Clotting of blood.
3. Transportation of O_2, CO_2, digested food, conduction of hormones etc.
4. To help in establishing coordination among different parts.

Clotting of Blood : Three important reactions during clotting of blood.

1. Thromboplastin + Prothrombin + Calcium = Thrombin.
2. Thrombin + Fibrinogen = Fibrin.
3. Fibrin + Blood Corpuscles = Clot.

The formation of Prothrombin and Fibrinogen of the blood plasma takes place with the help of Vitamin K. Vitamin K is helpful in making clots of blood. Normally clotting takes the time from 2 to 5 minutes.

The compulsory protein in making clots of blood is *Fibrinogen.*

Blood Group of human : Blood Group was discovered by Landsteiner in 1900. For this, he was awarded with Nobel Prize in the year 1930.

➢ The main reason behind the difference in blood of human is the glyco protein which is found in Red Blood Corpuscles called *antigen.*

Antigen are of two types – Antigen A and Antigen B.

➢ On the basis of presence of Antigen or Glyco Protein, there are four group of blood in human :

(a) That contains Antigen A – Blood Group A.
(b) That contains Antigen B – Blood Group B.
(c) That contains both the Antigens A and B - Blood Group AB.
(d) That contains neither of the Antigens - Blood Group O.

An opposite type of protein, is found in blood plasma. This is called *antibody.* This is also of two types – Antibody 'a' and Antibody 'b'.

Therefore, with the four groups of blood division of antibody is as under–

	Blood Group	Antigen (In Red Blood Corpuscles)	Antibody (In plasma)
1.	A	Only 'A'	Only 'b'
2.	B	Only 'B'	Only 'a'
3.	AB	Both 'A' and 'B'	Absent
4.	O	Absent	Both 'a' and 'b'

Blood Transfusion : Antigen 'A' and antibody 'a', Antigen 'B' and antibody 'b' cannot live together. In case of so happened these get most sticky, which spoils the blood. This is called *agglutination of blood.* Therefore, in blood transfusion adjustment of Antigen and Antibody should be done carefully so that agglutination of blood do not takes place.

Blood Group O is called Universal Donor because it does not contain any antigen.

Blood Group AB is called Universal Receptor because it does not contain any antibody.

Rh factor : In the year 1940, Landsteiner and Wiener discovered a different type of antigen in the blood. They discovered it in the *Rhesus monkey;* therefore, it is called *Rh-factor.* In the blood of that person it is found, their blood is called Rh-positive and in the blood of that person it is not found, is called *Rh-negative.*

At the time of blood transfusion Rh-factor is also tested. Rh+ is given to Rh^+ and Rh^- is given Rh-blood only.

If the blood of Rh+ blood group is transferred to a person with Rh-blood group, then due to the less quantity for the first time there does not seem any bad effect but if this process is repeated then due to agglutination the person with Rh-blood group dies.

Erythroblastosis Foetalis : If the father's blood is Rh+ and the mother's blood is Rh- then the child to be born dies at the pregnancy or short span of time after the birth. (This happens in the case of second issue).

The possible blood group of the child on the basis of blood group of mother and father.

Blood group of Mother and father	Expected blood group of the child	Unexpected blood of the child
O × O	O	A, B, AB
O × A	O, A	B, AB
O × B	O, B	A, AB
O × AB	A, B	O, AB
A × A	A, O	B, AB
A × B	O, A, B, AB	None
A × AB	A, B, AB	O
B × B	B, O	A, AB
B × AB	A, B, AB	O
AB × AB	A, B, AB	O

Haemolymph : Body fluid of arthropoda is colourless made of plasma and haemocytes. It donot contain any respiratory pigment Ex–Cockroach.

4. System of the Human Body

(a) Digestive System

The complete process of nutritioin is divided into five stages :

1. Ingestion 2. Digestion 3. Absorption
4. Assimilation 5. Defecation

1. Ingestion : Taking the food into the mouth is called *Ingestion.*

2. Digestion : Conversion of nonabsorbable food into absorbable form. The digestion of the food is started from the mouth.

➢ Saliva is secreted by salivary gland in mouth in which enzyme amylase is present. They convert starch into simple sugar and make it digestible.
➢ In human secretion of saliva is approximately 1.5 litre per day.
➢ The nature of saliva is acidic (pH 6.8).
➢ From the mouth food reach into stomach through food pipe.
➢ No digestion takes place in food pipe.
➢ The teeth used for grinding of food is molar.

Digestion in Stomach

- The foods lies approximately for four hours in stomach.
- After reaching the food in stomach gastric glands secretes the gastric juice. This is a light yellow acidic liquid.
- Hydrochloric acid secreted from the Oxyntic cells of the stomach kills all the bacteria coming with food and accelerates the reaction of enzymes. Hydrochloric acid makes the food acidic by which amylase reaction of the saliva end.
- The enzymes in the gastric juice of stomach are – Pepsin and Renin.
- Pepsin breaks down the protein into peptones.
- Renin breaks down the Caseinogen into Casein found in milk.

Digestion in Duodenum

- As soon as the food reaches the duodenum bile juice from liver combines with it. Bile juice is an alkaline and it turns the acidic medium of food into alkaline.
- Here, pancreatic juice from pancreas combines with food. It contains three types of enzymes :

(a) Trypsin : It converts the protein and peptone into polypeptides and amino acid.

(b) Amylase : It converts the starch into soluble sugar.

(c) Lipase : It converts the emulsified fats into glycerol and fatty acids.

Small Intestine

- Here, the process of digestion completed and absorption of digested foods start.
- From the wall of small intestine, intestinal juices secretes. The following enzymes contain :

(a) *Erepsin* : It converts the remaining protein and peptone into amino acids.

(b) *Maltase* : It converts the maltose into glucose.

(c) *Sucrase* : It converts the sucrose into glucose and fructose.

(d) *Lactase* : It converts the lactose into glucose and galactose.

(e) *Lipase* : It converts the emulsified fats into glycerol and fatty acids.

Intestinal juice is alkaline in nature.

In a healthy people approximately 2 litres of intestinal juice secretes every day.

3. Absorption : Digested food get mixed into blood is called absorption.

- The absorption of digested foods takes place through villi found in the wall of small intestinal.

4. Assimilation : Use of absorbed food in the body is called assimilation.

5. Defecation : Undigested food reaches into large intestine where bacteria turns it into *faeces*, which is excreted through anus.

Summary of Digestion

	Gland juice		Enzyme	Edible substance	After reaction
1.	Saliva	(i)	Amylase	Starch	Maltose
2.	Gastric Juice	(i)	Pepsin	Protein	Peptones
		(ii)	Rennin	Casein	Calcium paracasein

	Gland juice		Enzyme	Edible substance	After reaction
3.	Pancreatic Juice	(i)	Trypsin	Protein	Polypeptides
		(ii)	Amylase	Starch	Sugar
		(iii)	Lipase	Fat	Fatty acid and glycerol
4.	Intestinal Juice	(i)	Erepsin	Protein	Amino acid
		(ii)	Maltase	Maltose	Glucose
		(iii)	Lactase	Lactose	Glucose and fructose
		(iv)	Sucrase	Sucrose	Glucose and glactose
		(v)	Lipase	Fat	Fatty acid and glycerol

The main organs participating in digestion :

Liver : This is the largest gland of the human body. Its weight is approximately 1.5–2 kilogram.

- Bile is secreted through liver only. This bile accelerate the reaction of enzymes present in the intestine.
- Liver convert excess of amino acid into ammonia by deamination. These ammonia are further converted into urea by ornithine cycle. Urea comes out from body through kidney.
- Liver converts some quantity of protein into glucose during deficiency of carbohydrate.
- In carbohydrates metabolism liver converts the excess of glucose found in blood into glycogen and stores it into hepatic Cell as reserve nutrients. If the necessity of glucose arises the liver convert reserve glycogen into glucose. Thus, it regulates the quantity of glucose in the blood.
- In case of decrease of fat in food liver converts some of the parts of the carbohydrates into fat.
- The production of fibrinogen protein takes place by liver which helps in clotting of blood.
- The production of Heparin protein takes place in liver which prohibit the clotting of blood inside the body.
- The dead RBC is destroyed by the liver only.
- The liver reserve some quantity of iron, copper and vitamin.
- It helps in regulating the body temperature.
- Liver is an important clue in investigating a person's death that has been due to poison in food.

Gall Bladder : Gall bladder is a pear shaped sac, in which the bile coming out of liver is stored.

- Bile comes into the duodenum from gall bladder through the bile duct.
- Secretion of bile into the duodenum takes place by reflex action.
- Bile is a yellowish-green coloured alkaline liquid. Its pH value is 7.7.
- The quantity of water is 85% and the quantity of bile pigment is 12%.
- The quantity of bile are as under :

The Main functions of bile are as under :

1. It makes the medium of food alkaline so that pancreatic juice can worked.

2. It kills the harmful bacteria coming with food.
3. It emulsifies the fats.
4. It accelerates the bowel movement of intestine by which digestive juices in the food mix well.
5. It is helpful in the absorption of vitamin K and other vitamins mixed in fats.

In case of obstruction in bile duct, liver cells stop taking bilirubin from blood. As a result, bilirubin spreads throughout the body. This is called *jaundice.*

Pancreas : This is the second largest gland of the human body. It acts as simultaneously endocrine and exocrine type of gland.

- Pancreatic juice secretes out of it in which 9.8% water and the remaining parts contain salt and enzymes. It is alkaline liquid, whose pH value is 7.5 – 8.3. It contains the enzymes which can digest all the three types of food materials (like carbohydrates, fat and protein), therefore it is called complete digestive juice.

Islets of Langerhans : This is a part of the Pancreas.

- It was discovered by the medical scientist Langerhans.
- From its β cell- insulin, from α cell-glucagons and from δ cell- somatostaintin hormones are secreted :

Insulin : It is secreted by β-cell of islets of Langerhans.

- Glucagon is secreted by α-cell and somatostatin harmone is secreted by γ-cell of islets of langerhans.
- It was discovered by Banting and Best in the year 1921.
- It controls the process of making glycogen from glucose.
- Diabetes is caused due to the deficiency of insulin.
- Excessive flow of insulin causes Hypoglycemia in which one loses the reproducing capacity and vision deterioration.

Glucagon : It re-converts the glycogen into glucose.

Somatostatin : This is a polypeptide hormone which increases the duration of assimilation of food.

(b) Circulatory System

The discovery of blood circulation was done by *William Harvey* in the year 1628.

There are four parts under it –

(a) Heart (b) Arteries (c) Veins (d) Blood.

Heart : It remains safe in the *pericardial membrane.* Its weight is approximately 300 grams.

Heart of the human is made up of four chambers. In the anterior side there is a *right auricle* and a *left auricle.* In the posterior side of the heart there is a *right ventricle* and a *left ventricle* persist.

- Between the right auricle and the right ventricle there is a *tricuspid valve.*
- Between the left auricle and left ventricle there is a *bicuspid valve.*

- The blood vessels carrying the blood from the body towards the heart is called *vein.*
- In the vein there is impure blood i.e. carbon dioxide mixed blood. Its exception is pulmonary vein, which always carry pure blood.
- Pulmonary vein carries the blood from lungs to left auricle. It has pure blood.
- The blood vessels carrying the blood from the heart towards the body is called *artery.*
- In artery there is pure blood i.e. oxygen mixed blood. Its exception is pulmonary artery.
- Pulmonary artery carries the blood from right ventricle to lungs. It contains impure blood.
- In the right part of the heart, there remains impure blood i.e. carbon dioxide mixed blood and in the left part of the heart there remains pure blood i.e. oxygen mixed blood.
- The artery carrying blood to the muscles of the heart are called *coronary arteries.* Any type of hindrance in it causes heart attack.

Course of circulation : Mammals have double circulation. It mean blood have to cross two times from heart before circulating throughout the body.

- Right auricle receive impure blood from the body which goes into right ventricle. From here the blood went into pulmonary artery which send it to the lung for purification. After purification it is collected by pulmonary vein which bring it back to heart in left auricle. From auricle it went into left ventricle. Now this purified blood is went into aorta for different organ of body.

This circulation is done is a cardiac cycle.

- **Cardiac cycle :** Rhythmic systole (Contraction) and diastole (relaxation) of auricle and ventricle constitutes a cardiac cycle.
- **Heart beat :** Heart keeps beating rhythmically throughout the life. There is a node from which originate contraction of heart.

1. Sino auricular node (SA node) : It is a specialised area of cardiac muscle fibre in right auricle. SA node is also known as *pacemaker* as it generates each wave of cardiac impulse.

2. Auriculo Ventricular node (AV node) : AV node is present close to the interatrial septum near the right AV aperture. Wave of contraction is picked up by AV node which spread through.

- Wave of excitation is picked up by AV node which spread through AV bundle of muscles fibres present on inter artrial septum as well as inter-ventricular septum.
- **Artificial pacemaker :** When SA node becomes defective or damaged, the cardiac impulses do not generate. This can be cured by surgical grafting of an artificial pacemaker an electric device in the chest of the patient. It stimulate the heart electrically at regular intervals.
- Systole and diastole of the heart are collectively called *heart beat.* In the normal condition the heart of the human beats 72 times and in a single beat it pumps approximately 70 ml blood.

- The blood pressure of a normal human is 120/80. (Systolic – 120 and Diastolic – 80).
- Blood pressure is measured by *sphygmomanometer.*
- *Thyroxin* and *adrenaline* are the hormones which independently controls the heart beat.
- The CO_2 present in the blood accelerates the heart beat by reducing the pH.

(c) Lymph Circulatory System

- The light yellow fluid found in the inter-cellular intervals between different tissues and cells is called *lymph.*
- Lymph is a fluid whose composition is like blood plasma, in which nutrient, oxygen and various other substances are present.
- The corpuscles found in lymph are called *lymphocytes.* In fact, these are White Blood Corpuscles (WBC).
- Lymph flows only in one direction from tissue towards heart.

Functions of lymph :

1. The lymphocytes present in lymph helps to prevents the body from diseases by killing the harmful bacteria or other substances.
2. Lymph form the lymphocytes.
3. The node found in lymph vessels are called *lymph node* works as a filter in the human body.
4. Lymph helps in healing the wounds.
5. Lymph circulates different material from tissues to veins.

(d) Excretory System

Excretion : Removal of nitrogenous substances formed during metabolism from the body of human is called *excretion.* Normally excretion means the release of nitrogenous excretory substances like urea, ammonia, uric acid etc.

The main excretory organs of human are as follows—

1. Kidneys, 2. Skin, 3. Liver and 4. Lungs.

1. Kidneys : The main excretory organ in human and other mammals is a pair of kidneys. Its weight is 140 grams. There are two parts of it. Outer part is called *cortex* and the inner part is called *medulla.* Each kidney is made up of approximately 1,30,00000 kidney ducts which are called *nephrons.* Nephron is the structural and functional unit of the kidney. There is a cup like structure in the every nephron called *Bowman's capsule.* Glomerulus is made up of thin blood vessels found in the Bowman's capsule which is made up of two types of arterioles.

(a) Afferent arteriole : Which carries the blood to the glomerulus.

(b) Efferent arteriole : By which the blood is taken out of the glomerulus.

- The process of filtration of liquids into the cavity of Bowman's capsule, is called *ultra filtration.*
- The main function of the kidneys is purification of blood plasma i.e. to excrete the unwanted nitrogenous waste substances through urination.
- The supply of blood to kidneys takes place in large quantity in comparison to other organs.

- In the kidneys average 125 ml per minute blood is filtrated i.e. 180 litres per day. Out of it 1.45 litres urine is formed daily and the remaining is absorbed back by the cells of nephron and mix into the blood.
- In the normal urine there is 95% water, 2% salt, 2.7% urea and 0.3% uric acid.
- The colour of the urine is light yellow due to the presence of *urochromes* in it. Urochrome is formed by the dissociation of haemoglobin.
- Urine is acidic. Its pH value is 6.
- The stone formed in the kidneys is made up of calcium oxalate.

2. Skin : Oil gland and sweat glands found in the skin respectively secretes *sebum* and *sweat.*

3. Liver : Liver cells play the main role in excretion by converting more and more amino acids and ammonia of blood into urea.

4. Lungs : The lungs excretes two types of gaseous substances carbon dioxide and water vapour. The excretion of some substances like garlic, onion and some spices in which vapour component is present excreted by the lungs.

Different Animals and Excretory parts

	Animal	Excretory parts
1.	Unicellular animal	By diffusion through general body surface and contractile vacoule
2.	Animals of Porifera Phylum	By general body surface
3.	Coelenterates	Directly by cells
4.	Flat worm	By flame cells
5.	Animals of Annelida Phylum	By nephridia
6.	Arthropods	By Malpighian tubules
7.	Curstaceans	Antennal gland
8.	Mollusca	By urinary organ
9.	Vertebrate	Mainly by kidneys

Hemodialysis : Process of removal of excess urea from the blood of patient using artificial kidney.

(e) Nervous System

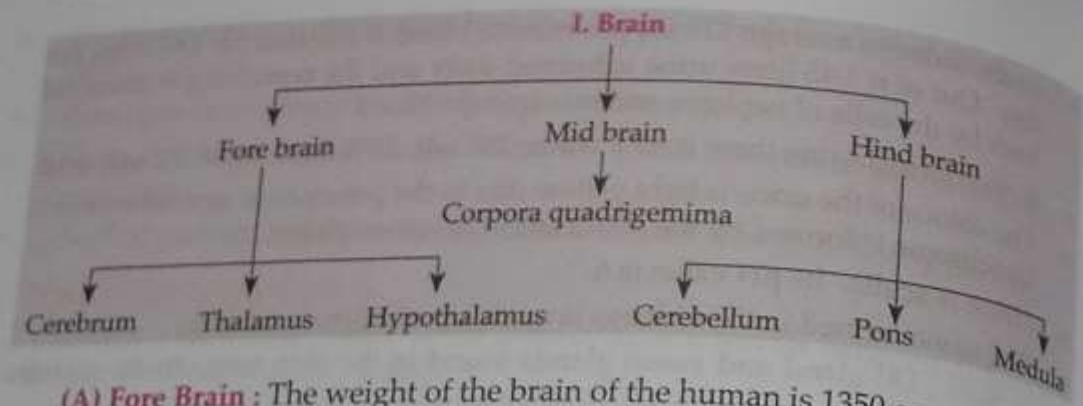
Under this system thin thread like nerves are spread throughout the body. After receiving the information of environmental changes from the sensitive organs, it spreads them speedly like electrical impulses and establishes working and coordination among different organs.

Nervous System of human is divided into three parts :

1. Central Nervous System
2. Peripheral Nervous System
3. Autonomic Nervous System

1. Central Nervous System–Part of the nervous system which keeps control on the whole body and on nervous system itself is called *Central Nervous System.* The Central Nervous System of human is made up of two parts - *Brain* and *Spinal Cord.*

Brain is covered by membrane called *meninges.* It is situated in a bony box called *craninum* which protect it from external injury.



(A) Fore Brain : The weight of the brain of the human is 1350 grams.

(i) The function of the Cerebrum : This is the most developed part of the brain. This is the centre of wisdom, memory, will power, movements, knowledge and thinking. The analysis and coordination of muscular movement received from sense organs.

(ii) The function of thalamus : It is the centre of the pain, cold and heat.

(iii) The function of hypothalamus : It controls the hormonal secretion of endocrine glands. Hormones secreted from posterior pituitary gland secrete through it. This is the centre of hunger, thirst, temperature control, love, hate etc. Blood pressure, metabolism of water, sweat, anger, joy etc are controlled by it.

(B) Mid brain

The function of Corpora quadrigemina : This is the centre of control on vision and hearing power.

(C) Hind Brain

(i) Function of cerebellum : It is some what at the back of head and consist of two cerebellar hemisphere like cerebrum. It is large reflex centre for coordination of muscular body movements and maintenance of posture.

(ii) Pons : It act as bridge carrying ascending and descending tracts between brain and spinal cord.

(iii) Medulla : It is posterior most part of brain and continuous into the spinal cord. It connect and communicate the brain with spinal cord. It contains the cardiac respiratory and vasomotor centres that control complex activity like heart action, respiration, coughing, sneezing etc.

➢ The brain of the human is covered in the cranium which protects it from external injury. Brain is covered by membrane called *meanings.*

Note : *EEG (Electro encephlo graph) is done to known the function of brain.*

➢ **Spinal cord :** The posterior region of the medulla oblongata forms the spinal cord. Its main functions are :

(a) Coordination and control of reflex actions i.e. it works as the centre of the reflex actions.

(b) It carries the impulses coming out of brain.

Note : *Reflex action was first discovered by the scientist, Marshall Hall.*

2. Peripheral Nervous System : Peripheral Nervous System is made up of the nerves arising from brain and spinal cord. These are called cranial and spinal nerves respectively. There are sensory, motor and mixed nerve.

➢ There are 12 pairs of cranial nerves and 31 pairs of spinal nerve found in a human.

➢ The unit of nervous tissues is called *Neuron* or *nerve cell.*

3. Autonomic Nervous System : Autonomic Nervous System is made up of some brain nerves and some spinal cord nerves. It supplies nerves to all the internal organs and blood vessel of the body. *Langley,* first presented the concept of Autonomic Nervous System in the year 1921. There are two parts of Autonomic Nervous System :

(a) Sympathetic Nervous System

(b) Parasympathetic Nervous System.

Functions of Sympathetic Nervous System

1. It narrows the blood vessels in the skin.
2. By its action hair gets erected.
3. It reduces the secretion of salivary glands.
4. It increases the heart beat.
5. It increase the secretion of sweat glands.
6. It stretches the pupil of eye ball.
7. It relax the muscles of urinary bladder.
8. It reduces the speed of contraction & relaxation of intestine.
9. The rate of respiration increase.
10. It increases the blood pressure.
11. It increases the sugar level in the blood.
12. It increases the number of Red Blood Corpuscles in the blood.
13. It helps in clotting of blood.
14. Collective impact of this affects fear, pain and anger.

Functions of Parasympathetic Nervous System :

The functions of this system is normally the opposite of Sympathetic Nervous System. For example :

1. It widens the lumen of blood vessels except the coronary blood vessels.
2. It increases the secretion of saliva and other digestive juices.
3. The contraction of pupil is caused by this.
4. It creates contraction in the other muscles of the urinary bladder.
5. It creates contraction and motion in intestinal walls.
6. The effect of this nervous system collectively creates the occasion of rest and joy.

(f) Skeletal System

The skeletal system of human is made up of two parts :

(a) Axial skeleton

(b) Appendicular skeleton.

(a) Axial skeleton : The skeleton, which makes the main axis of the body is called *axial skeleton.* Skull, vertebral column and bones of chest comes under it. There are 80 bones in axial skeleton.

(i) Skull : There are 29 bones in it. Out of these, 8 bones jointly protect the brain of the human. The structure made up of these bones is called *forehead*. All the bones of the forehead remain joined strongly by the sutures. There are 14 bones in addition to this which form the face. Six ear ossicles and one hyoid bone.

(ii) Vertebral Column : The vertebral column of the human is made up of 33 vertebra. All the vertebra are joined by intervertebral disc. Vertebra is made flexible by these intervertebral disc. We divide the whole vertebral column into the following parts –

1.	Cervical region	7 vertebras
2.	Thoracic region	12 vertebras
3.	Lumber region	5 vertebras
4.	Sacral region	(1) 5 vertebras
5.	Caudal region	(1) 4 vertebras
		Total – 33

➢ Its first vertebra which is called *atlas* holds the skull.

Functions of vertebral column :

1. Holds the head.
2. It provides the base to the neck and body.
3. It helps the human in standing, walking etc.
4. It provides flexibility to the neck and body by which a human can move its neck and body in any direction.
5. It provides protection to spinal cord.

(b) Appendicular skeleton : The following are the parts of it –

(i) Foot bones— Both hands and feet have 118 bones.

(ii) To hold the forelimb and hind limb on the axial skeleton in human there are two girdles.

➢ The girdle of forelimb is called *pectoral girdle* and girdle of hindlimb is called *pelvic girdle*.

➢ Pectoral girdle joined with forelimb is called *humerus* and the bone from pelvic girdle join to hindlimb is called *femur*.

Functions of the skeletal system :

1. To provide a definite shape to the body.
2. To provide protection to soft parts of the body.
3. To provide a base to the muscles for joining.
4. To help in respiration and nutrition.
5. To form Red Blood Corpuscles.

➢ The total number of bones in a human's body — 206

➢ The total number of bones during childhood — 300

➢ The total number of bones of head — 29
(forehead-8, facial-14, ear-6 ,hyoid -1)

➢ The total number of bones in vertebral column, initially-33
After development – 26 (5 sacral fuse into 1 and 4 caudal fuse into 1)

➢ The total number of bones of ribs 24

➢ The largest bone of the body *Femur* (bone of thigh)

➢ The smallest bone of the body *Stapes* (bone of ear)

➢ Foramen Magnum is an aperture found in the skull.

The name and number of bones of some specific regions –

Ear bones	*Maleus*	(2)	Upper arm	*Humerus*	(2)
	Incus	(2)	Fore arm	*Radio ulna*	(2)
	Stapes	(2)	Wrist	*Carpals*	(16)
Palm	*Meta carpals*	(10)	Fingers	*Phalanges*	(28)
Thigh	*Femur*	(2)	Hindlimb	*Tibia fibula*	(4)
Knee	*Patella*	(2)	Ankle	*Tarsal*	(14)
Sole	*Meta tarsal*	(10)			

➢ External ear of man is mainly made up of Cartilage.

Note : 1. *The muscles and bones are join together by tendon.*

2. *The muscle which join bone to bone is called ligaments.*

➢ Ligaments of human body are made up of yellow fibre.

(g) Endocrine System

(a) Exocrine glands : Gland which have duct are called *exocrine gland*. Secretion of enzymes pass through it. Example – *Digestive gland, Sweat gland, Mucous gland, Salivary gland* etc.

(b) Endocrine gland : These are *ductless gland*. Hormones are secreted by these gland. Hormones are sent to the different parts of the body through blood plasma. Example – *Pituitary gland, Thyroid gland, Parathyroid gland* etc.

Functions and effect of the main endocrine system of the human body and hormone secreted by them –

1. Pituitary gland : It is situated in a depression of the sphenoid bone of the fore head. This is called *sella – tunica*.

➢ Its weight is approximately 0.6 grams.

➢ This is also known as *master gland*. Pitutary gland is controlled by hypothalmus.

The functions of the hormones secreted by Pituitary gland :

1. STH Hormone (Somatotropic hormone) : It controls the growth of the body especially the growth of bones. By the excessiveness of STH *gigantism* and *acromegaly* are caused, in which height of the human grows abnormally. Lack of STH causes *dwarfism* in human.

2. TSH Hormone (Thyroid Stimulating Hormone) : It stimulates the thyroid gland to secrete hormone.

3. ACTH Hormone (Adrenocorticotropic Hormone) : It controls the secretion of adrenal cortex.

4. GTH Hormone (Growth Hormone) : It controls the functions of gonads. This is of two types :

(a) FSH Hormone (Follicle - Stimulating Hormone) : In male it stimulates spermatogenesis in the seminiferous tubules of the testis. In female, it stimulates the Graffian follicles of the ovary to secret the hormone *Oestrogen*.

(b) LH Hormone (Luteiniging Hormone) : Interstitial cell stimulating hormone –, secretion of *testosterone* hormone takes place in male and in case of female *estrogen* hormone secreted.

5. LTH Hormone (Lactogenic Hormone) : Its main function is to stimulate secretion of milk in breasts for infants.

6. ADH Hormone (Antidiuretic Hormone) : It causes increase in blood pressure. It is helpful in maintaining the water balance in the body and reduce the volume of urine.

2. Thyroid gland : This is situated below the larynx on both side of respiratory trachea in throat of human.

➢ The hormones secreted by it are Thyroxine and Triiodothyronine.

Functions of Thyroxin :

1. It increases the speed of cellular respiration.
2. It is necessary for the normal growth of the body particularly for the development of bones, hair etc.
3. The normal functions of reproductive organs depend on the activeness of thyroid gland.
4. It controls the water balance of the body in coordination with the hormones of pituitary gland.

Diseases Caused by the Deficiency of Thyroxin :

1. Cretinism : This disease affects the children. The mental and physical retardness of the child.

2. Myxedema : In this disease which normally attack during youth the metabolism does not take place properly which causes reduction in heart beat and blood pressure.

3. Hypothyroidism : This disease is caused due to a chronic deficiency of thyroxin hormone. Due to this diseases the normal reproduction is not possible. Sometimes due to its deficiency, human becomes dumb and deaf.

4. Goitre : This disease is caused by the deficiency of iodine in food. In this disease the shape of the thyroid gland enlarges abnormally.

Diseases caused by the Excessiveness of Thyroxin :

Exothalmic Goitre : In this disease eyes get bulging out of the eye socket with increased metabolic rate.

3. Parathyroid gland : This is situated in the right back of the thyroid gland of the throat. Two hormones are secreted by it :

(a) Parathyroid hormone : This hormone is secreted when there is a deficiency of calcium in the blood.

(b) Calcitonin : This hormone is released when there is excess of calcium in the blood is present.

Hence, hormone secreted by parathyroid gland controls the quantity of calcium in blood.

4. Adrenal gland : There are two parts of this gland – (a) outer part is cortex and (b) inner part is medulla.

Hormones secreted by cortex and their function :

(i) Glucocorticoids : This controls the metabolism of carbohydrate, protein and fat.

(ii) Mineralocorticoids : Its main function is reabsorption of ion by kidney ducts and to control the quantity of other on in the body.

(iii) Sex hormone : It controls the sexual behaviour and secondary sexual characters.

Note : 1. Cortex is essential for life. If this is extracted completely from the body, human will remain alive only for a week or two.

2. In case of deformation of cortex, the process of metabolism gets disturbed; this disease is called Addison's disease.

Hormones secreted by Medulla and their function :

(a) *Epinephrine* – This is an amino acid.

(b) *Nor epinephrine* – This is also an amino acid.

➢ The work of both the hormones is similar. These equally increase the relaxation and contraction of heart muscles. As a result, blood pressure increases and decreases.

➢ In case of sudden stop of heart beat, epinephrine is helpful in re-starting the heart beat.

➢ The hormone secreted by Adrenal gland is called fight flight, fright fight hormone.

5. Gonads :

(1) Ovary : The following hormones are secreted by this :

(a) Estrogen : It completes the development of reproductive organs.

(b) Progesterone : It stimulates the thickening of uterus lining during ovarien cycle.

(c) Relaxin : During pregnancy it is found in uterus and placenta. This hormone smoothens the pubic symphysis and it widens the uterine cervix so that a child is delivered easily.

(2) Testes : The hormone secreted by it is called *testosterone*. It motivates the sexual behaviour and growth of secondary sexual characters.

(h) Respiratory System

➢ The most important organ of the respiratory system of human is lungs where the exchange of gases takes place.

➢ All those organs comes under respiratory system which help in exchange of gases are – Nasal passage, Pharynx, Larynx or Voice box, Trachea, Bronchi, Bronchioles, Lungs etc.

➢ **Nasal passage :** Its main function is related to sniffing. Its inner cavity is lined with mucous membrane. This secretes approximately ½ litre of mucous everyday. This prevents the particles of dust, bacteria or other small organisms from entering into the body. It makes the air wet entering into the body and equalises it with the temperature of the body.

➢ **Pharynx :** It is situated behind the nasal cavity a common passage for both respiratory and digestive system.

➢ **Larynx :** Pharynx open into anterior wider part of trachea called larynx. The opening is called glottis. A cartilaginous flop like structure cover the glottis called epiglottis which prevent the entry of food during swallowing. A pair of vocal cord is present inside the larynx help in producing sound.

➢ **Trachea** : From the base of larynx a tube is arises, passes through the neck and reaches upto middle of thorax is called trachea. It is supported by 'C' shaped cartilaginous ring. Internally trachea is lined by ciliated and mucus secreting epithelium.

➢ **Bronchi** : In the thorocic region trachea divides into two branches called bronchi. Each bronchus enters into the lung of its own side. After entering into the lung bronchous of each side divide and redevide into very fine tube called bronchioles. Finally bronchioles give rise alveoli or alveolar sac. Alveoli are the site of gaseous exchange.

➢ **Lungs** : There is a pair of lungs in the thoracic cavity. Its colour is pink, red and looks like sponge. Right lung is larger in comparison to left lung. Each lung is surrounded by a membrane which is called *pleural membrane*. There is a network of blood capillaries. Here Oxygen enters into the blood and CO_2 release out from blood.

The process of respiration can be divided into four parts :

1. External respiration.
2. Transportation of gases.
3. Internal respiration.
4. Cellular respiration.

1. External respiration : This is divided into two parts –

(a) Breathing (b) Exchange of gases.

(a) Breathing : In lungs air is taken and given out at a certain rate which is called *breathing*.

Mechanism of Breathing :

(i) Inspiration : At this stage, air from the environment enters into the lungs through the nasal passage, due to increases in the dimension of thoracic cavity a low pressure is formed in the lungs and air enters into the lungs from environment. This air continues to enter until the pressure of air inside and outside the body became equal.

(ii) Expiration : In this process air comes out of the lungs.

Constitution of air in Breathing

	Nitrogen	Oxygen	Carbon dioxide
The air inhaled	79%	21%	0.03%
The air exhaled	79%	17%	4%

Everyday approximately 400 ml water is excreted out through breathing.

(b) Exchange of gases : The exchange of gases takes place inside the lungs. This gaseous exchange takes place on the basis of concentration gradient through normal diffusion.

The exchange of oxygen and carbon dioxide gases takes place due to their difference in partial pressures. The direction of diffusion is both side.

2. Transportation of gases : The process of reaching of gases (oxygen and carbon dioxide) from lungs to the cells of body and coming back again to the lungs is called the *transportation of gases*.

➢ Transportation of oxygen takes place by haemoglobin present in blood.

➢ Transportation of carbon dioxide from cells to lung takes place by haemoglobin only to the extent of 10 to 20%.

➢ Transportation of carbon dioxide takes place through circulation of blood :

(a) By mixing with plasma : Carbon dioxide forms carbonic acid after mixing in plasma. Transportation of 7% carbon dioxide takes place in this form.

(b) In the form of bicarbonates : 70% part of carbon dioxide in the form of bicarbonates is transported. It mixes with potassium and sodium of blood and forms potassium bicarbonate and sodium bicarbonate.

3. Internal respiration : Inside the body, gaseous exchange takes place between blood and tissue fluid which is called *internal respiration*.

Note : *The gaseous exchange in lungs is called external respiration.*

4. Cellular respiration : Glucose is oxidised by oxygen reached into the cell. This process is called *cellular respiration*.

Types of cellular respiration :

There are two types of Respiration

(a) Anaerobic respiration : If the oxidation of food takes place in absence of oxygen. During this only 2 ATP molecules are produced from one molecule of glucose. Final product of anaerobic respiration in animal tissue like skeletal muscle cell is lactic acid.

In yeast and certain bacteria ethyl alcohol or ethanol is produced.

$$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + \text{Energy (in animal)}$$
(Lactic acid)

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + \text{Energy (in plant)}$$
(Ethyl alcohol)

(b) Aerobic respiration : It takes place in the presence of oxygen. The complete oxidation of glucose takes place. As a result CO_2 and H_2O is formed and energy is released in huge amount.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 2870 \text{ KJ energy. (38 ATP)}$$

The complex process in cellular respiration is divided into two parts–

1. Glycolysis (cytoplasm) 2. Kreb's cycle (Mitochondria)

1. Glycolysis : Its study was first done by *Embden Meyorh pathway*. Therefore, it is also called *EMP path*

➢ Glycolysis is present in both types of respiration, Aerobic and Anaerobic. This process takes place in cytoplasm.

➢ As a result of decomposition of one glucose atom in glycolysis two atoms of pyruvic acid is formed.

➢ To start this process 2 atoms of ATP (Adenosine Triphosphate) takes part but at the end of the process 4 atoms ATP are obtained. Therefore, as a result of glycolysis 2 atom ATP are obtained i.e. 16000 calorie (2 × 8000) energy is obtained.

➢ There is no need of oxygen in glycolysis. Hence, this process is similar in both anaerobic and aerobic respiration.

➢ In this, four molecules of hydrogen formed which is used in converting NAD to $2NADH_2$.

➢ The enzyme which take part in glycolysis during respiration are found in cell cytoplasm.

2. Kreb's Cycle : It was described by *Hens Krebs* in 1937.

- This is also called *Citric Acid Cycle* or *Tricarboxylic Cycle.*
- This process is completed inside the Mitochondria in the presence of specific enzymes.
- Two atoms of each ADP and ATP are formed.
- In this cycle 4 pair of hydrogen atom are released.
- In complete cycle two molecule of pyruvic acid produce 12 molecule of carbondioxide.
- In our system maximum number of ATP molecule are formed during Kreb's Cycle.

Production of energy : By the oxidation of pyruvic acid one atom of ATP, five atoms of NADH and one atom of $NADH_2$ are formed. From one atom of NADH three atoms of ATP and from one atom of $NADH_2$ two atoms of ATP are obtained. Hence, from one atom of pyruvic acid $1 + (3 \times 5) + (2 \times 1) = 18$ atoms of ATP are formed. From one atom of glucose two atoms of pyruvic acid are formed, by which 36 atoms of ATP are released. During the glycolysis, two atoms of ATP are obtained. Hence, during oxidation of one atom of glucose total $2 + 36 = 38$ ATP atoms are obtained.

Respiratory substances : Carbohydrate, fat and protein are the main respiratory substances. At first, oxidation of glucose takes place, then fat. After the consumption of carbohydrate and fat oxidation of protein start.

Note : *Respiration is a Catabolic Process. It also reduces the weight of the body.*

5. Nutrients

To maintain life organisms performs some basic function is called *nutrition.* Nutrition is one of the basic function of life in which intake of food, digestion, absorption, assimilation and egestion of undigested foods are included.

Nutrient : Nutrient are the substance by which an organism get energy or it is used for biosynthesis of its body.

For example carbohydrate and fat are the source of energy. Whereas proteins and minerals are the nutrient used for biosynthesis.

1. Carbohydrate : Carbohydrates are organic compounds in which the ratio of Carbon, Hydrogen and Oxygen is 1 : 2 : 1. Carbohydrate in the form of sugar and starch are major intake in animals and human. 50 to 75% energy is obtained by oxidation of carbohydrate. Carbohydrate containing aldehyde group is called *aldose* and with ketone group is called *ketose.* Carbohydrates are derivatives of polyhydroxy alcohols.

Classification of carbohydrate : Carbohydrates are classified into three major group.

(a) Monosaccharides : These are the simple sugar made up of single polyhydroxy or ketone unit. Most abundant monosaccharides found in nature is glucose containing six carbon atom. *Triose, tetrose, pentoses, heptoses* are the type of monosaccharides.

- Glucose is a type of hexose sugar.

(b Oligosaccharides : When 2 to 10 monosaccharides join together they form oligosaccharides. They are usually crystalline in nature and sweet in test. *Maltose, sucrose, lactose* are disaccharides made up of two monosaccharides.

(c) Polysaccharides : These are the compound of sugar which are formed due to joining large number of monosaccharide. There are insoluble and tasteless. Some example of polysaccharides are *starch, glycogen, cellulose, chitin* etc.

Function of Carbohydrate

1. Carbohydrate works as fuel. During the process of respiration, glucose break into CO_2 and H_2O with the release of energy. One gram of glucose gives 4.2 kilo calories energy.
2. Glucose is the source of immediate energy production in the cell.
3. Nucleic acids are polymers of nucleosides and nucleotides and contain pentose sugar.
4. Lactose of milk is formed from glucose and glactose.
5. Glucose is used for the formation of fat and amino acid.
6. Carbon skeleton of monosaccharides is used in the formation of fatty acid, chitin, cellulose etc.

Source of Carbohydrate : Wheat, rice, maize, sweet potato, potato and other plant and animals are the sources of carbohydrate.

2. Protein : Protein word was first used by *J. Berzelius.* This is a complex organic compound made up of 20 type of amino acids. Approximately 15% of the human body is made up of protein. Nitrogen is present in protein in addition to C, H & O.

- N_2 gas is essential for protein synthesis.

Twenty types of amino acid are necessary for human body, out of which 12 are synthesized by body itself and remaining 8 are obtained by food are called essential amino acid.

Types of proteins :

On the basis of chemical composition

It is divided into three types.

(1) Simple Protein : It consists of only amino acid.

Example–*Albumins, Globulins, Histones* etc.

(2) Conjugated Protein : Having some another chemical compounds in addition to amino acid.

Example–*Chromo protein, Glyco protein* etc.

(3) Derived Protein : It is derived from the partial digestion of natural proteins or its hydrolysis.

Example–*Peptone, Peptide, Proteinase* etc.

Function of Protein :

1. It takes part in the formation of cells, protoplasm and tissues.
2. These are important for physical growth. Physical growth hampers by its deficiency. Lack of proteins causes *Kwashiorkor* and *Marasmus* diseases in children.
3. In case of necessity these provide energy to the body.
4. Control the development of genetic characters.
5. Helpful in conduction also.

Kwashiorkor : In this disease hands and legs of children get slimmed and the stomach comes out.

Marasmus : In this disease muscles of children are loosened.

3. Fats : Fat is an ester of glycerol and fatty acid.

In these carbon, hydrogen and oxygen are present in different quantities, but proportionally less oxygen than carbohydrate.

Normally *fat* remains as solid at 20°C temperature, but if it is in liquid form at this temperature, this is called *oil.*

Fatty acids are of two types – Saturated and unsaturated. Unsaturated fatty acids are found in fish oil and vegetable oil. Only coconut oil and palm oil are the examples of saturated oil.

9.3 kilo calorie energy is liberated from 1 gram fat.

Normally an adult person should get 20-30% of energy from fat.

Main functions of fat :

1. It provides energy to the body.
2. It remains under the skin and prevents the loss of heat from the body.
3. It make the food material testy.
4. It protects different parts of the body from Injury.

Due to the lack of fat skin gets dried, weight of the body decreases and the development of the body checked.

Due to the excessiveness of fat the body gets fatty, heart disease takes place and blood pressure increases.

4. Vitamins : Vitamin was invented by Sir F. G. Hopkins. The term vitamin was coined by Funk.

Vitamins are organic compound required in minute quantities. No calorie is obtained from it, but it is very important in regulating chemical reactions in the metabolism of the body.

On the basis of solubility, vitamins are of two types :

(a) Vitamin soluble in water : Vitamin-B and Vitamin-C.

(b) Vitamin soluble in fat : Vitamin-A, Vitamin-D, Vitamin-E and Vitamin-K.

The diseases caused by the deficiency of vitamins and their sources

Vitamin	Chemical name	Deficiency diseases	Sources
Vitamin-A	Retinol	Colour blindness, Xerophthalmia	Milk, Egg, Cheese, Green vegetable fish liver oil
Vitamin-B_1	Thymine	Beriberi	Groundnut, Rapseed, Dried Chilli, Pulses, Liver, Egg, Vegetables etc.
Vitamin-B_2	Riboflavin	Cracking of skin, red-dish eye, cracking of tongue	Meat, Green vegetables, Milk etc.
Vitamin-B_3	Nicotinamide or Niacin	Whitening of hair, mentally retardness	Meat, Milk, Nut, Tomato, Sugarcane etc.
Vitamin-B_5	Pantothenic acid	Pellagra or 4-D Syndrome	Meat, Ground Potato, Tomato, nut, Leafy vegetables etc.
Vitamin-B_6	Pyridoxine	Anaemia, skin disease	Liver, Meat, Grains etc.

Vitamin	Chemical name	Deficiency diseases	Sources
Vitamin-B_7	Biotin	Paralysis, body pain, hair falling	Meat, Egg, Liver, Milk etc.
Vitamin-B_{11}	Folic acid	Anaemia, dysentry	Pulse, Liver, Egg
Vitamin-B_{12}	Cynocobalamin	Anaemia, jaundice Teroile Glutemic	Meat, Milk etc.
Folic acid	–	Anaemia, diarrhoea	Pulses, Liver, Vegetables, Eggs etc.
Vitamin-C	Ascorbic acid	Scurvy, Swelling of gums	Lemon, Orange, Tomato, Sour substances, Chilly, Sprouted grain
Vitamin-D	Calciferol	Rickets (in children), Osteomalasia (in adults)	Fish liver oil, Milk, Eggs etc.
Vitamin-E	Tocopherol	Less fertility	Leafy vegetables, Milk, Butter, Sprouted wheat, Vegetable oil etc.
Vitamin-K	Phylloquinone	Non-clotting of blood	Tomato, Soybean oil Green vegetables etc.

- Cobalt is found in Vitamin-B_{12}.
- Synthesis of vitamins cannot be done by the cells and it is fulfilled by the vitamin containing foods.
- However, synthesis of Vitamin-D and K takes place in our body.
- Synthesis of Vitamin-D takes place by the ultra violet rays present in the sunlight through cholesterol (Irgesterol) of skin.
- Vitamin-K is synthesized in our colon by the bacteria and from there it is absorbed.

6. Minerals : Mineral is a homogenous inorganic material needed for body. These control the metabolism of body.

Important Minerals and their functions

Minerals	Daily quantity	Main sources	Functions
Sodium (as sodium chloride)	2 – 5 gram	Normal salt, fish, meat, eggs, milk etc.	It normally found in external fluid of cell and is related to following functions Contractions of muscles, In the transmission of nerve impulses in nerve fiber. Control of positive electrolyte balance in body etc.
Potassium	1 gram	Approximately all edibles	It is normally found in protoplasm. It is important for following different chemical reactions in cells : Muscular contraction, nerve conduction, maintenance of positive electrolyte in body etc.
Calcium	Approx 1.2 gram	Milk, cheese, eggs, grains, gram, fish etc.	This provides strength to bones and teeth with vitamin, Important role in blood formation, Related with muscular contraction. Help in clotting the blood etc.

Minerals	Daily quantity	Main sources	Functions
Phosphorus	1.2 gram	Milk, cheese, Bajra, green leaf vegetables etc.	This provides strength to bones and teeth, in coordination with calcium.
Iron	25 mg (boy) 35 mg (girl)	Albumen of egg, bread, Bajra, Banana, Spinach apple	Iron is important in formation of Red Blood Corpuscles and haemoglobin.
Iodine	20 mg	Sea fish, sea food, green leaf vegetables, Iodized salt	This is important for synthesis of thyroxin hormone secreted by Thyroid gland.
Magnesium	Very small quantity	Vegetables	For functioning of muscular system and nervous system.
Zinc	Very small quantity	Liver and fishes	For insulin functioning.
Copper	Very small quantity	Meat, fish, liver and grains	Formation of haemoglobin and bones and as a conductor of electron.
Cobalt	Very small quantity	Meat, fish and water	For synthesis of RBC and Vitamin B_{12}

➢ Deficiency of calcium and iron is generally found in pregnant women.

7. Water : Human gets it by drinking. Water is the important component of our body. 65-75% weight of the body is water.

Main functions of water :

1. Water controls the temperature of our body by sweating and vaporizing.
2. It is the important way of excretion of the excretory substances from the body.
3. Maximum chemical reactions in the body perform through hydrolysis.

Balance Diet : That nutrition, in which all the important nutrients for organism are available in sufficient quantity, is called *Balance Diet.*

Balance nutrition is obtained from Balance Diet, which is given in the chart below :

Edibles	Adult male			Adult female			Children		Boy	Girl
	N	M	Hard	N	M	Hard	1-3 yrs.	4-6 yrs.	10-18 yrs.	10-16 yrs.
Grain (wheat, rice)	400 g	520 g	670 g	410 g	440 g	575 g	175 g	270 g	420 g	380 g
Pulses	40 g	50 g	60 g	40 g	45 g	50 g	35 g	35 g	45 g	45 g
Leafy vegetables	40 g	40 g	40 g	100 g	100 g	50 g	40 g	50 g	50 g	50 g
Vegetables (other)	60 g	70 g	80 g	40 g	40 g	100 g	20 g	30 g	50 g	50 g
Milk	150 g	200 g	250 g	100 g	150 g	200 g	300 g	250 g	250 g	250 g
Tuber root	50 g	60 g	80 g	50 g	50 g	60 g	10 g	20 g	30 g	30 g
Sugar	30 g	35 g	55	20 g	20 g	40 g	30 g	40 g	45 g	45 g
Fat and oil	40 g	45 g	65 g	20 g	25 g	40 g	15 g	25 g	40 g	35 g

➢ Brinjal is a genetically modified vegetable recently being made available in Indian market.

Necessary calorie for a human being :

	Nature of work	Male	Female
1.	Light worker	2000 calorie	2100 calorie
2.	Eight hours worker	3000 calorie	2500 calorie
3.	Hard worker	3600 calorie	3000 calorie

➢ Sodium Benzoate is used as preservative to preserve food item.

➢ Milk is not considered as complete food due to lack of vitamin C and iron.

6. Human Diseases

Diseases caused by Protozoa :

	Disease	Affected organ	Parasites	Carrier	Symptoms Mosquito
1.	Malaria	RBC & Liver	*Plasmodium*	Female Anopheles	Fever with shivering
2.	Pyorrhoea	Gums	*Entamoeba gingivelis*	—	Bleeding from gums.
3.	Sleeping sickness	Brain	*Trypanosoma*	Tse-Tse flies	Fever with severe sleep.
4.	Diarrhoea	Intestine	*Entamoeba histolytica*	—	Mucous & Diarrohea with blood.
5.	Kala-ajar	Bone marrow	*Leismania donovani*	Sand flies	High fever.

➢ Malignant malaria is pernicious malaria.

Charles Leveran discovered the Malaria Parasite, *plasmodium* in the blood of the affected person in the year 1880.

Ronald Ross (1897) confirmed the Malaria is caused by malaria parasite and told that mosquito is the carrier of it.

Diseases caused by Bacteria :

Disease	Affected organ	Name of Bacteria	Symptoms
Tetanus	Nervous system	*Clostridium Tetani*	High fever, spasm in body, Closing of jaws etc
Cholera	Intestine	*Vibrio cholerae*	Continuous stool and vomiting
Typhoid	Intestine	*Salmonella typhia*	High fever, headache
Tuberculosis	Lungs	*Mycobacterium tuberculosis*	Repeated coughing
Diphtheria	Respiratory tube	*Corynebacterium diphtheriae*	Difficulty in respiration and suffocation
Plague	Lungs, area between the two legs	*Pasteurella pestis*	Very high fever, muscular eruptions on the body
Whooping cough	Respiratory system	*Hemophilis pertusis*	Continuous coughing
Pneumonia	Lungs	*Diplococcus pneumoniae*	High fever, swelling in lungs
Leprosy	Nervous System Skin	*Mycobacterium leprae*	Spots on body, nerves affected

Disease	Affected organ	Name of Bacteria	Symptoms
Gonorrhea	Urinary Path	*Neisseria Gonorrhoeae*	Swelling in urinary path
Syphilis	Urinary path	*Treponema pallidum*	Wounds in urinogenial tract

Note : *In the year 1882, German scientist Robert Koch discovered the bacteria of Cholera and T.B.*

- Birds flu is a disease that affects human beings and spread through poultry.
- If waste material contaminate the source of drinking water, the most probability to spread the disease is Typhoid.
- Vaccine : It is a biological preparation of a weakened or killed pathogen which provides active acquired immunity to the body for a particular disease.
- Vaccination : Administration of vaccine to stimulate an individual's immune system to develop immunity to a pathogen.

Vaccine	Name of disease
DTP	Diptheria, Pertussis, Tetanus given to child up to one year.
BCG	Bacillus, Calmette-Guerin. It provide immunization against tuberculosis given to the child up to one to four month
OPV (Polio)	Oral polio vaccine is given to the child from 2 month to 6 year.

Louis Pasteur discovered the vaccine of Rabies and pasteurization of milk.

Diseases caused by Viruses

	Disease	Affected organ	Name of virus	Symptoms
1.	AIDS	Defensive system (WBC)	HIV	Immune system of body became weak
2.	Dengue fever	Whole body particularly head, eyes and joints	Billions of virus	Pain in eyes, muscles, head and joints
3.	Polio	Throat, backbone Nerve	Pilio virus	Fever, body pain, backbone and intestine cells are destroyed
4.	Influenza (flu)	Whole body	Mixo virus	Suffocation, sneezing, restlessness
5.	Chicken pox	Whole body	Variola virus	High fever, radish eruption on body
6.	Small pox	Whole body	Varicella virus	Light fever, eruption of bile on body
7.	Goitre	Parathyroid gland	—	Difficulty in opening the mouth with fever
8.	Measles	Whole body	Morbeli virus	Reddish eruptions on body
9.	Trachoma	Eyes	—	Reddish eyes, pain in eyes
10.	Hepatitis or Jaundice	Liver	—	Yellow urine, Eyes and skin become yellow.
11.	Rabies	Nervous system	Rabies virus	The patient becomes mad with sever headache and high fever
12.	Meningitis	Brain	—	High fever
13.	Herpes	Skin	Herpes	Swelling in skin

Note : *AIDS – Acquired Immuno Deficiency Syndrome.*

Elisa Test : *Test of HIV Virus (AIDS)*

Medical Instrument

- Pacemaker : It is a small device that is placed in the chest to control abnormal heart beat.
- Computed Tomography Scan (CT Scan) : Used to investigate abnormal functioning of the body.
- Electro cardiograph (ECG) : To find out the abnormality of heart.
- Electroencephalogram (EEG) : Use to detect malfunctioning of brain.
- Magnetic resonance imaging (MRI) : Use to find out any abnormality in the whole body.
- Auto analyser : Use to examine glucose, area and cholestrole.

Diseases caused by Protozoa :

1. Diarrhoea : The reason of this disease is the presence of internal protozoa namely *Entamoeba histolytica* which is spread through house flies. It causes wounds in the intestine. Protein digesting enzyme, trypsin is destroyed in this. This disease is mostly found in children. Disease caused by helminthes.

2. Filaria : This disease is caused by *Wuchereia baoncrofti*. This worm is transmitted by the stings of culex mosquitoes. This disease causes swelling in legs, testes and other parts of the body. This disease is also known as *Elephantiasis*.

Diseases caused by Fungus :

1. Asthma : The spores of the fungi, namely *Aspergillus fumigatus* reaches the lungs of the human and constitutes a net like formation, thus, obstructs the function of lungs. This is a infectious disease.

2. Athlete's foot : This disease is caused by the fungi namely *Tenia Pedes*. This is a infectious disease of skin which spreads mainly due to the cracking of feet.

3. Scabies : This disease is caused by the fungi namely *Acarus scabies*. In this disease the skin itches and white spots found on the skin.

4. Baldness : This is caused by the fungi namely *Taenia capitis*. Due to this hair of the head falls.

5. Ringworm : This disease spreads through the fungi namely *Trycophyton Lerucosum*. This is a infectious disease. Round red spot found on the skin.

Some Other Diseases :

1. Paralysis or Hemiplegia : In this disease within a few minutes half of the body is paralyzed. The nerves of the paralyzed part become inactive. The reason of this disease is due to high blood pressure bursting of any blood vessels of brain or insufficient supply of blood to brain.

2. Allergy : Some substance like dust, smoke, chemical, clothes, cold are dangerous to some persons and there are reactions in their body, which causes various diseases. Itching, pimples, swelling in body, black spot, eczema etc. are the examples of allergy.

3. Schizophrenia : This is a mental disease which usually found in youth. The patient considers the imagination as a truth, not to the facts. These patients are lazy, emotionless etc. Electropathy is helpful in this disease.

4. Epilepsy : This disease is caused by the internal disturbance of brain. In this disease, foam coming out of the mouth and the patient falls down unconscious.

5. Diplopia : This disease is caused by the paralysis of muscles of the eyes, in which double image is formed.

6. Bronchitis : It is caused by the inflammation of tubes leading from the wind pipe to lungs.

7. Colds : This is highly infections disease and is caused by a virus which result in bad throat, headache and watery nose.

8. Colic : Severe pain in the abdomen caused by spasm of the internal organs usually the intestines.

9. Delirium : It is a serious mental disturbance occurring under the influence of poisonous drugs.

10. Hydrophobia : A disease cause by bite of a mad dog.

11. Hyper metropia (long sightedness) : One can see the object of longer distance but not the object of nearer one. It can be corrected by convex lens.

12. Myopia (short sightedness) : In this disease person can see the object of nearer distance but can not see the object of longer distance. It is corrected by using concave lens.

13. Leukaemia : There is a great increase in the number of white blood corpuscles in system. Swelling of spleen takes place. Death occur within few days.

14. Migrain : An allergic disease in which there is a periodic attack of headache takes place. It is an incurable disease.

15. Obesity : Excessive fatness is called *obesity*.

16. Piles : There are a various vein in the rectum. Due to extra pressure on vein it prevent the free flow of blood creating problem. It is caused due to constipation.

17. Rheumatism : The symptom of this disease is fever with joints pain.

Other Disease

Atherosclerosis : Deposition of cholesterol particles in the lumen of arteries which prevent the flow of blood is called atherosclerosis.

Arteriosclerosis : Due to deposition of cholesterol and calcium salt arteries became stiff and rigid. It loses the property of elasticity due to which wall of arteries may rapture.

Uremia : Presence of excess of urea in blood is called uremia. This is caused by malfunctioning of kidney.

Glycosuria : Presence of excess of glucose in urine is known as glycosuria.

Arthritis : It is disease in which inflammation of joints takes place.

Osteoporosis : It is a age dependent disorder of bone in which low bone mass and increased fragility takes place.

Hyperglycemia : It is disorder in which the concentration of glucose in the blood is high.

Hypoglycemia : It is a condition in which the concentration of glucose in the blood is very low.

Pneumonia : Acute inflamation of alveoli of lung.

Emphysema : It is the abnormal distension of alveoli which result in the loss of elasticity. Cigarette smoke and chronic bronchitis are two main causes.

Cancer : The uncontrolled growth of cell by its multiplication.
Their are four type of cancer.

Carcinoma : It is also known as skin cancer occur in epithelial tissue.

Sarconoma : Cancerous growth in connective tissue, bones, cartilage and muscles is called sarconoma.

Leukamia : Abnormal growth in the number of leucocytes.

Lymphonoma : Cancerous growth occur in lymph node or spleen.

7. Miscellaneous

Medicinal Discoveries

Inventions/Discoveries	Inventor/Discoverer
Vitamin*	F. G. Hopkins, Cosimir Funk
Vitamin-A	Mc. Collum
Vitamin-B	Mc. Collum
Vitamin-C	Holst
Vitamin-D	Mc. Collum
Sulpha drugs	Dagmanck (Dogmanck)
Streptomycin	Selman Waksmann
Heart Transplantation	Christian Bernard
Homoeopathy	Hahnemann
Malaria parasite and treatment	Ronald Ross
Diarrhoea and treatment of plague	Kitajato
Sex hormone	Stenach
Open heart surgery	Waltallilehak
Contraceptive pills	Pincus
First test tube baby	Edwards and Stepto
Electrocardiograph	Iwanyaan
Antigen	Karl Landsteiner
RNA	James Watson and Arther Arg
DNA	James Watson and Crick
Insulin	Banting

** Funk named it 'Vitamine' (in 1912)*

Chloroform	Harrison and Sympson
Vaccine of chicken pox	Edward Jenner
T.B. bacteria	Robert Koch
Diabetes	Banting
Penicillin	Alexander Flemming
Polio vaccine	Johan E. Salk
BCG	Guerin Calmatte
Bacteria	Luwenhook – Leeuwenhock
Blood transfer	Karl Landsteiner

Important Informations :

Largest and heaviest mammal	Blue whale
Largest land mammal	African elephant
Largest living reptile	Sea turtle (Tortoise)
Largest living bird	Ostrich
Largest snake	Python
Largest monkey	Gorilla
Smallest bird	Humming-bird
Smallest mammal	Shrew
Largest egg	Ostrich's egg
Fastest running animal	Cheetah (Panther)
Fastest flying bird	Spine tailed Swift

Inventions/Discoveries	Inventor/Discoverer
Egg lying mammal	Echidna and Duckbiled Platypus
Tallest mammal	Giraffe (Africa)
Busiest human organ	Heart

Some Important facts

1. The study of dreams is called Oneirology.
2. The study of the beauty of human is called Kalology.
3. At the time of creation of life there was no oxygen.
4. The strongest part in the body is the enamel of teeth.
5. The sex determination of human depends on male sex chromosomes.
6. The fastest nervous speed is 532 kmph.
7. The internal area of the lungs of human is 93 sq. m. which is forty times of the external area of the body.
8. The bones are as strong as concrete and as hard as granite.
9. Inside the body approximately 150 lakh cells are destroyed every second.
10. The weight of the uterus of the woman which has not given birth to a child is 50 grams and after giving birth to a child the weight becomes 100 grams.
11. The weight of the kidney is approximately 150 grams.
12. In a single inhaling, a normal adult takes 500 ml air inside the body.
13. The capacity of heart to pump the blood is 4.5 liters per minute.
14. The length of the small intestine is approximately 7 meter and its diameter is 2.5 centimeter.
15. The blood circulation inside the body takes approximately 23 seconds.
16. The antibiotic namely, penicillin is obtained from penicillium fungus.
17. Human is the most intelligent hominid of the universe.
18. Albatross is the largest sea bird, whose spread of feather is 10-12 ft.
19. There are approximately 50 lakhs hair in the body of human.
20. In the initial stage of formation of placenta, H.C.G. hormones flow at a large quantity and excreted through urine. At this time, in the testing of urine due to presence of this hormone pregnancy test is carried out.
21. The heart beat of a child is more than that of an adult.
22. A single respiration completes in 5 seconds i.e. 2 seconds of inspiration and 3 seconds of expiration.
23. Everyday blood in the body of the human carries approximately 350 liters of oxygen to the cells of the body. Out of this 97% oxygen is carried by haemoglobin and remaining 3% is circulated by blood plasma.
24. Zinc sulphide is used as rodenticide.
25. First child born after operative procedure was caesar.
26. The largest living ape is Gorilla
27. Fish is first class protein as it contain essential amino acid.
28. The soil which are rich in calcium are known as pedocals.
29. Contour farming is a biological method of soil conservation.
30. Vermi composting is done by worm.
31. ASHA : Accredited social health activist. It is a national rural health mission which provide community health care by trained female in every village.

★★★

MISCELLANY 9

1. Firsts in India (Male)

First Governor of Bengal	Lord Clive (1757 - 60)
Last Governor of Bengal	Warren Hastings (1772 - 74)
First Governor General of Bengal	Warren Hastings (1774 - 85)
First Governor General of India	Lord William Bentic (1833 - 35)
Last Governor General and First Viceroy of India	Lord Canning (1856-62)
First President of Indian National Congress	W.C. Banerjee
First Indian Governor General of Independent India	C. Rajgopalachari (21.06.1948 - 25.01.1950)
First Indian to pass ICS	Surendra Nath Banerjee
First Indian I.C.S. Officer	Satyendra Nath Tagore
First Governor General of India (after independence)	Lord Louis Mountbatten (15 Aug. 1947 - 20 June, 1948)
First Indian Cosmonaut (to go into space)	Sqn. Ldr. Rakesh Sharma
First temporary President of the Constitutent Assembly	Dr. Sachchida Nand Sinha
First Commander-in-Chief of Free India	General K.M. Cariappa
First Indian Nobel Laureate	Rabindra Nath Tagore
First Indian Judge of the International Court of Justice	Dr. Nagendra Singh
First Indian to get Bharat Ratna Award	Dr. S. Radhakrishnan
First Field Marshal	General S.F.J. Manekshaw
The President of Constituent Assembly	Dr. Rajendra Prasad
First Indian to swim across the English Channel	Mihir Sen
First Indian to get Jnanpeeth Award	G. Shankar Kurup
First Muslim President of Indian Republic	Dr. Zakir Hussain
First Indian to win Palk-Strait Ocean Swimming Contest	Baidyanath Nath
First Speaker of Lok Sabha	G.V. Mavlankar (1952-57)
First person to make Printing Press popular in India	James Hicky
First Education Minister of Independent India	Maulana Abul Kalam Azad
First President of Indian Republic	Dr. Rajendra Prasad
First Prime Minister of Independent India	Pt. Jawahar Lal Nehru
First Home Minister of Independent India	Sardar Vallabh Bhai Patel
First Vice- President of Independent India	Dr. S. Radhakrishnan
First Chief of Air Staff	Air Marshal Sir Thomas Elmhirst
First Indian Air Chief of India	Air Marshal S. Mukherjee
First Chief of Army Staff	General M. Rajendra Singh
First Chief of Naval Staff of India	Vice-Admiral R.D. Katari
First large-scale Atomic Reactor of India	Apsara (1956)

First Person to get Paramvir Chakra	Major Somnath Sharma
First Atomic Submarine of India	I.N.S. Chakra
First Indian Scientist to get Nobel Prize	C.V. Raman (Physics)
First Indian Submarine	I.N.S. Cauvert
First Scientist of Indian origin, to get Nobel Prize in the field of Medical Science	Dr. Hargovind Khurana
First Aircraft Carrier Indian Ship	I.N.S. Vikrant
First Chinese pilgrim to visit India	Fa - hien
First Medium Range Missile	Agni
First e-business News Paper of India	Financial Express
First Scientist of Indian origin to win Nobel Prize in Physics	Subrahmanium Chandrashekhar
First Indian Missile	Prithvi
First Indian to win Stalin Award	Saiffudin Kichlu
India's first Nuclear Centre	Tarapur
First Indian to win Magsaysay Award	Acharya Vinoba Bhave (1958)
India's first Open University	Andhra Pradesh Open University
India's first Lok Sabha Member to be elected with a record maximum number of votes	P.V. Narasimha Rao
India's first minister to resign from Union Cabinet	Shyama Prasad Mukherjee (1950)
First British to visit India	Hawkins
First Asian Games organised	Delhi (in 1951)
India's first Election Commissioner	Sukumar Sen
First Muslim President of Indian National Congress	Badruddin Tayab Ji
First Chief Justice of India	Justice Hiralal J. Kania
First Person to submit the proposal of Indian Independence in a Congress Session	Hasrat Mohani
India's first University	Nalanda University
First Indian to climb Mt. Everest without Oxygen cylinder	Sherpa Phu Dorji
First foreign recipient of Bharat Ratna	Khan Abdul Gaffar Khan
First Indian recipient of Nobel Prize in Economics	Dr. Amartya Sen
First Army Institute of Information Technology founded	Hyderabad
First Test Tube Baby of India	Indira (Baby Harsha)
First Indian Pilot	J.R.D. Tata (1929)
First Indian to reach Antarctica	Lt. Ram Charan (1960)
First Post- Office opened in India	Kolkata (1727)
First Deputy Prime Minister of India	Sardar Vallabh Bhai Patel
First Indian Prime Minister to resign from office	Morarji Desai
First Indian Prime Minister to loose an Election	Indira Gandhi
First President of India to die in office	Dr. Zakir Hussain
First Man to climb Mt. Everest twice	Nawang Gombu

First Indian to reach the South Pole	Col. I.K. Bajaj
First Indian recipient of 'Oscar Award'	Bhanu Athaiya
First American President to visit India	Dwight David Eisenhower
First British Prime Minister to visit India	Harold Mc Millon
First Indian author to get Anderson Award	Ruskin Bond
First Indian to win World Billiards Trophy	Wilson Jones
First Indian Space Tourist	Santosh George

2. Firsts in India (Female)

Indis's first Woman President	Smt. Pratibha Patil
India's first Woman Prime Minister	Smt. Indira Gandhi
India's first Woman Governor	Sarojini Naidu
India's first Woman ruler (on Delhi's throne)	Razia Sultan
India's first Woman I.P.S. officer	Kiran Bedi
First Woman Chief Minister of a state	Sucheta Kripalani (U.P.)
First Woman Union Minister	Rajkumari Amrita Kaur
First Woman President of INC	Annie Besant
First Woman Judge of the Suprime Court	Meera Sahib Fatima Bibi
First Woman to get Ashok Chakra	Nirja Bhanot
First Indian Woman Ambassador at United Nations	Vijayalakshmi Pandit
First Indian Woman to swim across English Channel	Arati Saha (Gupta)
First Indian Woman to get the Noble Prize	Mother Teresa (1979)
First Indian Woman to climb the Mt. Everest	Bachendri Pal
First Indian Woman to become 'Miss World'	Miss Reita Faria
First Indian Woman to climb the 'Mt. Everest' twice	Santosh Yadav
First Indian Woman to become 'Miss Universe'	Sushmita Sen
First Indian Woman to get Bharat Ratna	Smt. Indira Gandhi
First Woman to get Jnanpith Award	Ashapurna Devi
First Indian Woman to win WTA Title	Sania Mirza
First Indian Woman Airline Pilot	Durga Banerjee
First Indian Woman to win a Gold in Asian Games	Kamaljeet Sandhu
First Indian Woman President of I. N. Congress	Sarojini Naidu (1925)
First Indian Woman to win the Booker Prize	Arundhati Roy
First Woman Musician to get 'Bharat Ratna'	M.S. Subbulakshmi
First Indian Woman to go into space	Kalpana Chawla

3. Firsts in the World (Male & Female)

First men to climb Mt. Everest	Sherpa Tenzing Norgay & Sir Edmund Hillary (29th May, 1953)
First man to reach North Pole	Robert Peary
First man to reach South Pole	Ronald Amundsen
First religion of the world	Sanatan Dharma
First country to print books	China

First country to issue paper currency	China
First country to start Civil Services Competetion	China
First President of United States of America	George Washington
First Prime Minister of Great Britain	Robert Walpole
First Secretary General of United Nations	Trigve Li
First country to make education compulsory	Prussia
First country to win the World Cup Football	Uruguay (1930)
First country to make a constitution	United States of America
Pakistan's first Governor General	Mohammed Ali Jinnah
First summit of NAM was organised in	Belgrade (former Yugoslavia)
First European to visit China	Marco Polo
First men to fly an aeroplane	Wright Brothers
First person to sail around the world	Ferdinand Magellan
First country to send human to Moon	United States of America
First country to launch satellite into space	Russia (former USSR)
First country to host the modern Olympic games	Greece
First President of the Republic of China	Dr. Sun Yat-sen
First city to be attacked with Atom bomb	Heroshima (Japan)
First Radio Telescope Satellite was launched into space	Japan
First Russian (Soviet) Prime Minister to visit India	V.I. Bulganin
First University of the world	Taxila University
First man to set foot on the Moon	Neil Armstrong (U.S.A.)
First man to go into space	Major Yuri Gagarin (USSR)
First Space Shuttle launched	Columbia
First Space Ship landed on Mars	Viking-I (July, 1976)
First Woman Prime Minister of England	Margaret Thacher
First Woman Prime Minister of any muslim country	Benazir Bhutto (Pakistan)
First Woman Prime Minister of a country	S. Bhandarnayake (Sri Lanka)
First Woman cosmonaut in space	Valentina Tereshkova (USSR)
First Woman to climb Mt. Everest	Junko Tabei (Japan)
First deaf and dumb to cross the Srait of Gibralter	Taranath Shenoy (India)
First Woman President of UN General Assembly	Smt. Vijayalakshmi Pandit (1953)
First European Invader of Indian soil	Alexander, The Great
First Woman to reach the North Pole	Ann Bancroft
First Woman to reach Antartica	Jackie Ronne
First man to draw the map of earth	Anaxiemander (610-542 BC)
First man to compile Encyclopaedia	Aspheosis (Athens)
The oldest man to climb Mt. Everest	Yuichiro Miura (Japan)
First Asian to win Wimbledon Trophy	Arthur Ashe (U.S.A.)
First man to win Nobel Prize for Literature	Rene F.A. & Sulli Pradhom (France)
First man to win Nobel Prize for Peace	Jin F. Dunant (Switzerland) & Frederic Peiry (France)
First man to win Nobel Prize for Physics	W.K. Roentgen (Germany)

First man to win Nobel Prize for Chemistry	J.H. Wenthoff (Howlland)
First man to win Nobel Prize for Medicine	A.F. Wonn Behrig (Germany)
First man to win Nobel Prize for Economics	Rangar Fish (Norway) & John Tinbergen (Howlland)
First Woman President of a country	Maria Estela Peron (Argentina)
First Space Tourist (Male)	Dennis Tito (U.S.A.)
First Space Tourist (Female)	Mrs. Anousheh Ansari (Irani American)

Space Tourists : 1st : Dennis Tito (2001); 2nd : Mark Shuttleworth (2002); 3rd : Gregory Olsen (2003); 4th : Mrs. Anousheh Ansari (2004); 5th : Charles Simonyi (2006); 6th : Richards Gariatte (2008); 7th : Guy Laliberte (2009)

4. Superlatives : India

(Biggest, Highest, Largest, Longest, , Smallest etc.)

The longest river Bridge	Mahatma Gandhi Setu Patna (5.575 km.)
The largest animal Fair	Sonepur (Bihar)
The largest Auditorium	Sri Shanmukhanand Hall (Mumbai)
The largest Lake	Wular Lake (J & K)
The highest Dam	Tehri Dam, on Bhagirathi river (Uttarakhand)
The largest Desert	Thar (Rajasthan)
The largest cave Temple	Kailash Temple (Ellora, Maharashtra)
The largest Zoo	Zoological Garden (Kolkata)
The largest Mosque	Jama Masjid (Delhi)
The highest Peak	Godwin Austen/K-2 (8611m)
The longest Tunnel	Jawahar Tunnel, Banihal Pass (J & K)
The largest Delta	Sunderbans (W. Bengal)
The state with maximum forest area	Madhya Pradesh
The longest Corridor	Corridor of Ramnathswami Temple at Rameswaram (Tamil Nadu)
The highest Waterfall	Jog or Garsoppa (Karnataka)
The longest Road	Grand Trunk Road (Kolkata to Delhi)
The highest Gate way	Buland Darwaza, Fatehpur Sikri (UP)
The longest River	The Ganga
The largest Museum	Indian Museum, Kolkata
The largest Dome	Gol Gumbuz, Bijapur (in Karnataka)
The tallest Statue	Gomateswara (Karnataka)
The largest Public Sector Bank	State Bank of India
The biggest canti lever Bridge	Rabindra Setu or Howrah Bridge (Kolkata)
The longest Canal	Indira Gandhi Canal or Rajasthan Canal (Rajasthan)
The longest Railway platform	Gorakhpur (U.P.) 1355.4 m
The longest Railway tunnel	Pir Panjal Rly. Tunnel (J & K) 11.215 km
The bigest Stadium	Yuva Bharti (Salt Lake) Stadium Kolkata
The most populous City	Mumbai (Maharashtra)
The largest Sea Bridge	Anna Indira Gandhi Bridge/Pamban Bridge (Tamil Nadu)
The longest Passenger Train Route	Dibrugarh to Kanyakumari

The oldest Church	St. Thomas Church at Palayar, Trichur (Kerala)
The longest National Highway	NH—7 (Varanasi to Kanyakumari)
The state with longest Coast line	Gujarat
The highest Lake	Devtal Lake, Gadhwal (Uttarakhand)
The largest saline water Lake	Chilka Lake (Odisha)
The largest fresh water Lake	Kolleru Lake (Andhra Pradesh)
Largest Cave	Amarnath (J&K)
The longest river of southern India	Godawari
The longest Dam	Hirakud Dam (Odisha)
The highest Gallantry Award	Param Vir Chakra
The highest Award	Bharat Ratna
The largest Gurudwara	Golden Temple, Amritsar
The biggest Church	Saint Cathedral at old Goa (Goa)
The tallest TV Tower	Fazilka (Punjab)
The southern Indian state with Longest Coast line	Andhra Pradesh
The longest Sea Beach	Marina Beach (Chennai)
The Highest Road	Road at Khardungla, (in Leh-Manali Sector)
The largest Artificial Lake	Govind Sagar (Bhakhra Nangal)
The deepest River Valley	Bhagirathi and Alaknanda
The largest River without delta	Narmada and Tapti
The highest battle field and the longest Glacier	Siachen Glacier
The biggest river Island	Majuli Bramhaputra river, (Assam)
The largest Planetarium	Birla Planetorium (Kolkata)
The Highest Airport	Leh Airport (Ladakh)

5. Superlatives : World

(The Largest, Biggest, Smallest, Longest, Highest etc.)

Tallest Animal (on land)	Giraffe
Biggest Bell	Great Bell at Moscow
Fastest Bird	Peregrine Falcon (322 km/hr)
Largest Bird	Ostrich
Smallest Bird	Humming Bird
Longest Bridge (Railway)	Lower Zambeji (Africa)
Tallest Building	Burj Khalifa, Dubai (U.A.E.)
Tallest Office Building	Petronas Twin Towers Kuala Lumpur (Malaysia)
Longest Big-ship Canal	Suez canal (linking Red Sea and Mediterranean)
Busiest Canal (Ship)	Baltic White Sea Canal (152 miles)
Biggest Cinema House	Roxy (New York)
Highest City	Wen Chuan (Tibet, China) 16,732 ft.
Largest City (in population)	Tokyo [(3,43,00,000), Est. population in 2011]
Biggest City (in area)	Mount Isa, Queensland, Australia (41,225 sq. km.)

Largest Continent	Asia
Smallest Continent	Australia
Largest Country (in population)	China
Largest Country (in area)	Russia
Largest Coral Formation	The Great Barrier Reef (Australia)
Largest Dam	Grand Coulee – Concrete Dam (U.S.A.)
Longest Day	June 21 (in Northern Hemisphere)
Shortest Day	Dec. 22 (in Northern Hemisphere)
Largest Delta	Sundarbans, India (8000 sq. miles)
Largest Desert (world)	Sahara, Africa (84,00,000 sq. km)
Largest Diamond	The Cullinan (over 1 ½ lb.)
Longest Epic	The Mahabharata
Largest Island	Greenland (renamed Kalaatdlit Nunaat)
Largest Lake (Artificial)	Lake Volta (Ghana)
Deepest Lake	Baikal (Siberia, Russia); depth 5314 feet (1,637 m)
Highest Lake	Titicaca (Bolivia) 12,645 ft. above sea level
Largest Lake (Fresh water)	Lake Superior, U.S.A.
Largest Lake (Salt water)	Caspian Sea (3,71,000 sq. km.)
Largest Mosque	Masjid al-Haram, Mecca, Saudi Arabia (3,56,800 sq.m)
Biggest Library	National Kiev Library, Moscow and Library of the Congress, Washington
Highest Mountain Peak (world)	Everest (Nepal) 29,035 ft. (8,850 m)
Highest Mountain Range	Himalayas
Longest Mountain Range	Andes (S. America) about 7,000 km in length
Biggest Museum	British Museum (London)
Tallest Minaret (Free standing)	Qutub Minar, Delhi 238 ft.
Tallest minaret	Great Hassan Mosque, Casablanca, Morocco
Deepest And Biggest Ocean	The Pacific
Largest Palace	Imperial Palace (Gugong), Beijing (China)
Largest Park	National Park, Greenland
Largest Peninsula	Arabia (32,50,000 sq. km.)
Coldest Place or Region	Vostok (Antarctica), Temperature –89.2°C
Driest Place	Atacama Desert (South America)
Largest Planet	Jupiter
Brightest and Hottest Planet (also nearest to Earth)	Venus
Farthest Planet (from the sun)	Neptune
Nearest Planet (to the sun)	Mercury
Smallest Planet	Mercury
Highest Plateau	Pamir (Tibet)

Longest Platform (Railway)	*Gorakhpur (U.P.) India (1355.4 m)*
Largest Platform (Railway)	*Grand Central Terminal, New York (U.S.A.)*
Largest Port	*Europoort Port and Port of Rotterdam (together), Netherlands*
Busiest Port	*Rotterdam (the Netherlands)*
Longest Railway	*Trans-Siberian Railway (5,772 miles long)*
Longest River	*Nile (6690 km), Amazon (6570 km)*
Longest River Dam	*Hirakud Dam (Odisha), India 15.8 miles*
Largest Sea-bird	*Albatross*
Largest Sea (inland)	*Caspian Sea (1,43,200 sq. miles)*
Brightest Star	*Sirius (also called Dog Star)*
Tallest Statue	*Statue of Liberty, New York (USA), 150 feet high*
Tallest Statue (bronze)	*Bronze Statue of Lrod Buddha, Tokyo (Japan)*
Tallest Tower	*Tokyo Sky Tree (Japan) 2,080 ft*
Longest Train nonstop	*Flying Scoutsman*
Longest and Deepest Rail Tunnel	*Seikan Tunnel (Japan), (53.85 km.)*
Longest and Largest Canal Tunnel	*Le Rove Tunnel (South of France)*
Longest Tunnel (Road)	*Laerdal, Norway*
Highest Volcano	*Ojos del Salado, Andes, Argentine-Chile (6,885 m.)*
Largest Volcano	*Mauna Loa (Hawaii)*
Longest Wall	*Great Wall of China (1500 miles)*
Highest Waterfall	*Salto Angel Falls (Venezuela)*
Longest Strait	*Tartar Straits (Sakhalin Island and the Russian mainland)*
Broadest Strait	*Davis Straits (Greenland and Baffin Island, Canada)*
Narrowest Strait	*Chaliks – 45 yards (Between the Greek mainland the island of Euboea in the Aegean Sea)*
Largest Bay	*Hudson Bay, Canada (shore line 7623 miles)*
Largest Gulf	*Gulf of Mexico, Shoreline 2100 miles*
Largest Archipelago	*Indonesia (over 3000 islands)*
Tallest Active Geyser	*Giant (geyser) Yelowstone Park U.S.A. 200 feet high*
Largest River Basin	*Amazon basin-27,20,000 sq. miles*
World's Rainiest spot	*Cherrapunji (Mawsynram), India*
Largest Gorge	*Grand Canyon, on the Colorado river, U.S.A.*
Lightest Gas	*Hydrogen*
Lightest Metal	*Lithium*
Highest Melting Point	*Tungsten, 3410°C*
Hardest Substance	*Diamond*
Longest Animal	*Blue whale, (recorded length 106 feet, weight – 195 tons)*
Longest Life-span of an Animal	*190 to 200 years, (Giant tortoise)*

Largest Land Animal	*African Bush Elephant*
Fastest Animal	*Cheetah (Leopard) 70 m.p.h.*
Longest jump Animal	*Kangaroo*
Longest wing spread bird	*Albatross*
Slowest Animal	*Snail*
Fastest Dog	*Persian Grey Hound (speed 43 m.p.h.)*
Longest Poisonous Snake	*King Cobra*
Biggest Flower	*Rafflesia (Java)*
Largest Stadium	*Strahov Stadium in Prague, (the Czech Republic)*
Largest Church	*Basilica of St. Peter, Vatican City, Rome (Italy)*
Largest Temple	*Angkor Vat (Combodia)*
Largest Diamond Mine	*Kimbarley (S.Africa)*
Largest River in Volume	*Amazon, Brazil*
Longest Corridor	*Rameshwaram Temple's Corridor (5000 feet)*
Highest Straight Dam	*Bhakhra Dam (India)*
Highest Capital City	*La Paz (Bolivia)*
Largest Asian desert	*Gobi, Mongolia*
Largest Democracy	*India*
Longest Thoroughfare	*Verazano-Narrows, New York City Harbour*
Largest Neck Animal	*Giraffe*
Largest Animal of the Cat Family	*Lion*
Most Intelligent Animal	*Chimpanzee*
Bird, that never makes its nest	*Cuckoo*
Wingless Bird	*Kiwi*
Reptile which changes its colours	*Chameleon*
Largest Mammal	*Whale*

6. Some Important Monuments / Structures of the World

Monuments / Structure	Country	Monuments / Structure	Country
The Leaning Tower of Pisa	Italy	Kremlin (Moscow)	Russia
Imperial Palace (Tokyo)	Japan	Parthanon (Athens)	Greece
Statue of Liberty (New York)	U.S.A.	Pyramid (Giza)	Egypt
Opera House (Sydney)	Australia	Wailing Wall	Jerusalem
Eiffel Tower (Paris)	France	Taj Mahal (Agra)	India
Great Wall (North China)	China		

7. International Boundaries

Maginot Line	Germany & France	*Mannerhiem Line*	Russia & Finland
Mc Mahon Line	India & China	*Durand Line*	Pakistan & Afghanistan
Radcliffe Line	India & Pakistan	*38th Parallel*	North & South Korea
49th Parallel	U.S.A. & Canada	*Hindenburg Line*	Germany & Poland

8. National Emblems of some important Countries

Country	Emblem	Country	Emblem
India	Lioned Capitol	New Zealand	Kiwi
Pakistan*	Crescent & Star	Germany	Corn Flower
Bangladesh	Water Lily	Norway	Lion
Netherlands	Lion	France	Lily
U.K.	Rose	Iran	Rose
U.S.A.	Golden Rod	Spain	Eagle
Italy	White Lily	Japan	Chrysanthemum
Australia	Kangaroo	Canada	Maple Leaf, Lily

* *Jasmin and four main crops of Pakistan*

9. National Animals of some Countries

	Country	Animal		Country	Animal
1.	Australia	Kangaroo	2.	New Zealand	Kiwi
3.	Canada	Eagle	4.	United Kingdom	Robin redbreast
5.	Japan	Ibis	6.	India	Tiger

10. News Agencies of some Countries

Country	Agencies
U.S.A.	Associated Press (AP), United Press International (UP)
U.K.	Reuters
Russia	Telegraph Agency of the Sovereign States (TASS)
Malaysia	Malaysian National News Agency (MNNA)
Italy	Agenzia Nazionale Stampa Associate (ANSA)
Israel	Associated Israel Press (AIP)
France	Agence France Presse (A.F.P.)
India	Press Trust of India (PTI), United News of India (UNI), Samachar Bharti, Univarta
China	Xin Hua
Japan	Kyodo
Indonesia	Antara
Iran	Islamic Republic News Agency (IRNA)
Germany	Deutsche Presse Agentur (D.P.A.)
Palestine	WAFA
Australia	Australian Associated Press(A.A.P.)
Russia	Novosti
Pakistan	Pakistan Press International (PPI), Associated Press of Pakistan (APP)
Egypt	Middle East News Agency (MENA)

11. Map Lines

1. **Isohaline** : An imaginary line drawn on the map to join places of the ocean having equal salinity.

2. **Isobar**: An imaginary line drawn on the map to join places of equal atmospheric pressure.
3. **Isobaths** : An imaginary line drawn on the map to join places of equal depth in the ocean.
4. **Isohypers or Contour lines**: An imaginary line drawn on the map to join places of equal height.
5. **Isohyetes** : An imaginary line drawn on the map to join places having same amount of rainfall.
6. **Isopleth** : An imaginary line drawn on the map to join places of equal value of certain factors viz. isohyete, isotherm etc.
7. **Isohel** : An imaginary line drawn on the map to join places having recieved equal amount of sunlight.
8. **Isotherm** : An imaginary line drawn on the map to join equal temperature zones.

12. Some Important Political Parties of different Countries

Country	Political Parties
U.S.A.	Republican Party, Democratic Party
Iraq	Bath Party
Israel	Labour Party, Likud Party, Hamas Party, Shas Party
France	Socialist Party, National Front, Union for French Democracy
Australia	Liberal Party, Labour Party
Bangladesh	Bangladesh Nationalist Party, Awami League, Jatiya Party
Nepal	Nepali Communist Party, Nepali Congress Party
China	Communist Party of China
Sri Lanka	United National Party, Freedom Party
South Africa	African National Congress, National Party, Inkatha Freedom Party
U.K.	Conservative Party, Labour Party, Liberal Democratic Party,
Russia	Communist Party, Liberal Democratic Party, Russias' Choice
India	Indian National Congress, Bharatiya Janata Party, RJD, CPI, CPM, SP, BSP, LJP, TDP, AAP
Pakistan	Muslim League, Pakistan Peoples Party, Tahriq-e-Insaf Party

13. Intelligence / Detective Agencies of the World

Detective Agencies	Country
Central External Liaison Department	China
Australian Security & Intelligence Organisation	Australia
K.G.B./G.R.U.	Russia
Bureau of State Security (B.O.S.S.)	South Africa
M.I. (Military Intelligence)-5 & 6, Special Branch, Joint Intelligence Organisation	U. K.
Inter Services Intelligence (I.S.I.)	Pakistan
Research & Analysis Wing (RAW), Intelligence Bureau (IB)	India

Detective Agencies	Country
Central Intelligence Agencies (CIA), Federal Bureau of Investigation (FBI)	U.S.A.
MOSSAD	Israel
Mukhbarat	Egypt
Naicho	Japan
SAVAK (Sazamane Etelaat va Amniate Kechvar)	Iran
Al Mukhbarat	Iraq
D.G.S.E. (Direction General de Securite Exterieur)	France

14. Parliaments of different Countries

Country	Parliament	Country	Parliament
India	Sansad (Lok Sabha and Rajya Sabha)	Nepal	Rashtriya Panchayat
Pakistan	National Assembly	Denmark	Folketing
Britain	Parliament (House of Commons and House of Lords)	Russia	Duma and Federal Council
Germany	Bundstag (Lower House) and Bundesrat (Upper House)	China	National People's Congress
Switzerland	Federal Assembly	France	National Assembly
U.S.A.	Congress (House of Representatives and Senate)	Turkey	Grand National Assembly
Bhutan	Tshogdu	Iran	Majlis
Bangladesh	Jatiya Sansad	Afghanistan	Shora
Norway	Storting	Israel	Knesset
Spain	Cortes Generales	Maldives	Mazlis
Australia	Federal Parliament	Japan	Diet
Myanmar	Pyithu Hluttaw (People's Assembly)	Canada	Parliament

15. Some Important Signs or Symbols

Pen	Symbol of Culture & Civilization
Lotus	Culture and Civilization
Red Cross	Medical Aid & Hospital
Red Flag	Revolution; also sign of danger
Black Flag	Symbol of protest
Yellow Flag	Flown on ships or vehicles carrying patients suffering from infectious diseases
Flag flown upside down	Symbol of Distress
Flag flown at half mast	Symbol of National mourning
White Flag	Symbol of Truce
Red Tringle	Sign of Family Planning
Pegion or Dove	Symbol of Peace
Red Light	Traffic sign of 'Stop', also sign of 'Danger' or 'Emergency'
Green Light	Line clear signal or traffic sign of 'Go'
A blindfolded woman holding a balanced scale	Symbol of Justice
Black strip on fore arm	Sign of mourning or protest
One skull on two bones crossing each other diagonally	Sign of 'Danger'
Wheel (Chakra)	Symbol of progress
Olive Branch	Symbol of peace
Tricolour	National Flag of India
Union Jack	National Flag of the U.K.
Stars and Stripes	National Flag of the U.S.A.

16. Some important Official Books

Green Book	Official reports or publications of Italy & Iran
White Book	The official publications of Portugal, China & Germany
Blue Book	Any official report of the British government
Yellow Book	The report or publication of the French government
Orange Book	Official report of the government of Netherlands
White Paper	The authoritative recital of facts issued by the government stating its views on a particular matter
Grey Book	Report of the government of Belgium and Japan
Joint Paper	The joint report of two or more than two governments

17. Newspapers & their place of publication (World)

Newspaper	Place	Newspaper	Place
The Times	London	The Gardian	London
Daily Mirror	London	Daily Mail	London
La Figaro	Paris	Le Mand	Paris
Ezbestia	Moscow	Pravda	Moscow
The Island	Colombo	Khalij Times	Dubai
Eastern Sun	Singapore	Mainichi Shimbun	Tokyo
Al Ahram	Cairo	People's Daily	Beijing
Mardeka	Jakarta	La Republica	Rome
Washington Post	Washington	Daily News	New York
New York Times	New York	Financial Times	London
Star	Johanesberg	Independent	London
The Times of India	India	The Hindu	Chennei
The Sun	U.K.	Daily Telegraph	U.K.
New Statesman	U.K.	China Times	Taiwan
Red Flag	China	Toronto Star	Canada
Bangladesh Observer	Dhaka	Dawn	Karachi

18. United Nations

- The name 'United Nations' was adopted of the suggestion of the then US President F.D. Rooswelt.
- To prepare the format of the UN, a meeting of representatives of prominent countries held from 21st August to 7th October, 1944 at Dumbarton Ox building in Washington.
- The UNO was formed on the 24th October 1945.
- The *character* of the UN was signed on the 26th June, 1945 by representatives of 50 nations, though the number of founder member countries was 51 who attended the San Fransisco Conference. Later on Poland signed the Charter and become the 51st founder member.
- At present 193 countries are members of the UN. South Sudan is the latest (193rd) member.
- The UN Charter came into force on October 24, 1945, when the Governments of China, France, the U.K., the Soviet Union and the U.S.A. and a majority of other counties had ratified it.
- The *Preamble* to the *Charter* was the work of Field Marshal Smuts.
- The Head Quarter of the UN is situated in New York (USA).
- John D Rockfeller had donated 17 acres of land in Manhutton island, on which a 39 storeyed secretariate building of the UN has been constructed.
- The main office of the UN was built in 1952, where the first meeting of the General Assembly was held in 1952.
- The UN Charter is the *Constitution* of the UN. It contains the aim and objectives of the UN and the rules and regulations for achieving these aims and purposes.
- Flag of the UN : White UN emblem (two bent olive branches open at the top, and in between them is world map) on a light blue background.
- Languages of the UN : The official languages of the UN are : (a) English (b) French (c) Chinese (d) Russian (e) Arabic and (f) Spanish. But the working Languages are English and French only.
- Major Organs of the UN : (1) General Assembly (GA) 2. Security Council (SC) (3) Economic and Social Council (ECOSOC) (4) Trusteeship Council (TC) (5) International Court of Justice (6) The Secretariat.
- International Court of Justice sits at The Hague (Netherlands), while all other organs of the UN are situated in New York (USA).
- The Security Council consists of 15 members, each of which has one representative and one vote.
- There are 5 permanent and 10 non-permanent members of the SC. The non-permanent members are elected for a 2 year term by two thirds majority of the GA.
- The five permanent members are—USA, Russia, UK, France and China.
- The proverb 'Policeman of the world' is used for the Security Council.
- Only the permanent members have the right to 'veto'.

19. World Organisations and their Headquarters

GATT (General Agreement on Tariffs & Trade)	Geneva
Amnesty International	London (England)
Asian Development Bank (ADB)	Manila (Philippines)
ASEAN (Assosiation of South- East Asian Nations)	Jakarta (Indonesia)
NATO (North Atlantic Treaty Organisation)	Brussels (Belgium)
African Union (AU)	Addis-Ababa (Ethopia)
International Committee of the Red Cross (ICRC)	Geneva (Switzerland)
SAARC (South Asian Association for Regional Corporation)	Kathmandu (Nepal)
United Nations Environment Programme (UNEP)	Nairobi (Kenya)
INTERPOLE (International Police)	Lyons (France)
World Trade Organisation (WTO)(w.e.f. Jan 1, 1995)	Geneva
League of Arab States	Cario (Egypt)
COMECON	Minsk (Belarus)
World Council of Churches (WCC)	Geneva
European Energy Commission (EEC)	Geneva
Economic Commission of Africa (ECA)	Addis-Ababa
Economic Commission of West Asia (ECWA)	Baghdad
United Nations High Commission for Refugees (UNHCR)	Geneva
International Atomic Energy Agency (IAEA)	Vienna (Austria)
United Nations Industrial Development Organisation (UNIDO)	Vienna (Austria)
UNCTAD (United Nations Conference on Trade and Development)	Geneva
WWF (World Wildlife Fund)	Gland (Switzerland)
International Olympic Committee (IOC)	Lusane
European Common Market (ECM)	Geneva
CHOGM (Common wealth Heads of Governments Meet)	London
OPEC (Organisation of Petroleum Exporting Countries)	Vienna
OECD (Organisation for Economic Co-operation and Development)	Paris
CENTO (Central Treaty Organisation)	Ankara (Turkey)
Comonwealth	London
European Economy Community (EEC)	Brussels
Council of European	Strasbourg
European Space Research Organization (ESRO)	Paris
BENELUX Economic Union	Brussels
Economic and Social Commission for Asia and the Pacific (ESCAP)	Bangkok (Thiland)
Economic Commission for Europe (ECE)	Geneva
Economic Commission for Latin America and the Carribbean (ECLAC)	Santiago (Chile)
Economic and Social Commission for Western Asia (ESCWA)	Jordan (Amman)
ANZUS Council	Canberra (Australia)
United Nations Centre for Human Settlements (UNCHS)	New York

United Nations International Children's Emergency Fund (UNICEF)	New York
United Nations Fund for Population Activities (UNFPA)	New York
United Nations Development Programme (UNDP)	New York
United Nations Institute for Training and Research (UNITAR)	New York
United Nations Population Fund (UNFPA)	New York
United Natons Research Institute for Social Development (UNRISD)	Geneva
World Food Programme (WFP)	Rome (Italy)
Food and Agriculture Organisation (FAO)	Rome (Italy)
International Civil Aviation Organisation (ICAO)	Montreal (Canada)
International Fund for Agricultural Development (IFAD)	Rome
International Labour Organisation (ILO)	Geneva
International Monetary Fund (IMF)	Washington
International Telecommunication Union (ITU)	Geneva
United Nations Educational, Scientific and Cultural Organisation (UNESCO)	Paris
Universal Postal Union (UPU)	Berne (Switzerland)
World Health Organisation (WHO)	Geneva
World Intellectual Property Organisation (WIPO)	Geneva
World Meteorological Organisation (WMO)	Geneva
Voluntary Service Overseas (VSO)	London
Woman Aid International	London
European Free Trade Association (EFTA)	Geneva
Organisation of Arab Petroleum Exporting Countries	Kuwait
International Bank for Reconstruction and Development (IBRD) (World Bank)	Washington
Organisation of Economic Cooperation and Development (OECD)	Paris
Organisation of Islamic Conference (OIC)	Mecca

20. Secretary Generals of UNO and their Tenure

Name	Country	Tenure
1. Trygve Lie (1st UN Secy. Gen.)	Norway	1946 - 1952
2. Dag Hammarskjold	Sweden	1953 - 1961
3. U - Thant	Myanmar (Burma)	1961 - 1971
4. Kurt - Waldheim	Austria	1972 - 1982
5. Javier Perez de Cuellar	Peru	1982 - 1991
6. Boutros Boutros-Ghali (1st African UN Secy. Gen.)	Egypt	1992 - 1996
7. Kofi Annan	Ghana	1997 - 2006
8. Ban Ki -moon	S. Korea	2007 - —

21. UN International Decades

2015-2024	International Decade for People of African Descent
2014-2024	United Nations Decade of Sustainable Energy for All
2013-2022	International Decade for the Rapprochement of Cultures (UNESCO)
2011-2020	Third International Decade for the Eradication of Colonialism, UN Decade on Biodiversity*, Decade of Action for Road Safety
2010-2020	UN Decade for Deserts and the Fight against Desertification*

2008-2017	Second United Nations Decade for the Eradication of Poverty*
2006-2016	Decade of Recovery and Sustainable Development of the Affected Regions (third decade after the Chernobyl disaster)
2005-2015	International Decade for Action, "Water for Life"*
2005-2014	UN Nations Decade of Education for Sustainable Development*, Second International Decade of the World's Indigenous People*
2003-2012	United Nations Literacy Decade : Education For All*
2001-2010	Second UN Decade for the Eradication of Colonialism*, International Decade for Peace and Non Violence for the Children of the World*

UNESCO participates in the celebration of the following International Decades proclaimed by the General Assembly of the United Nations.

22. International Years

2001	International Year of Woman Empowerment
2001	International Year for Eradication of Mental Diseases (WHO)
2001	United Nation's Year for Interaction among Civilizations
2002	International Mountain Year
2002	International Year of Eco-tourism
2003	International Fresh Water Year
2004	International Rice Year
2005	International Year of Microcredit and International Year of Physics
2006	International Year of Desert and Desertification
2008	Year of Good Governance (for SAARC countries)
2010	International Year of Biodiversity
2012	International Year of Cooperatives
2012	International Year of Sustainable Energy for All
2013	International Year of Quinoa
2013	International Year of Water Cooperation
2014	International Year of Crystallography, International Year of Family Farming, International Year of Small Island Developing States, International Year of Solidarity with the Palestinian People
2015	International Year of Light and Light-based Technologies, International Year of Soils
2016	International Year of Pulses, International Year of Camelids

23. Designated SAARC Years

1989	Year of Combating Drug Abuse and Drug Trafficking	1996	Year of Literacy
1990	Year of Girl Child	1997	Year of Participatory Governance
1991	Year of Shelter	1999	Year of Biodiversity
1992	Year of Environment	2002-03	Year of Contribution of Youth to Environment
1993	Year of Disabled Persons	2004	Year of TB and HIV/AIDS
1994	Year of the Youth	2005	Year of South Asian Tourism
1995	Year of Poverty Eradication	2007	Year of Green South Asia

24. International U.N. Weeks

February 1st Week	World Interfaith Harmony Week
March 21 to 28	International Week of Solidarity with the people struggling against Racism and Racial Discrimination
October 4 to 10	World Space Week
October 24 to 30	International Disarmament Week

25. Important (India and World) Days

January	
Louis Braille Day	4th January
National Youth Day (Birthday of Swami Vivekanand)	12th January
Army Day (India)	15th January
Tourism Day (India)	25th January
Republic Day (India)	26th January
International Day of Commemoration in Memory of the Victims of the Holocaust	27th January
Martyrs' Day (India)	30th January
Leprosy Prevention Day	30th January
Sarvodaya Day (India)	30th January
February	
World Radio Day	13th February
Valentine Day	14th February
World Day of Social Justice	20th February
International Mother Language Day	21st February
Central Excise Tax Day	24th February
National Science Day	28th February
March	
National Safety Day (Security of Industrial Institutions)	4th March
International Women's Day, UN Day for Women's Rights & International Peace	8th March
World Kidney Day	9th March
Central Industrial Security Force (CISF) Foundation day	12th March
World Consumer Rights Day	15th March
Ordnance Manufacturing Day	18th March
World Disabled Day, International day of Happiness	20th March
World Forestry Day, International Day for the Elimination of Racial Discrimination	21st March
World Water Day	22nd March
World Meteorological Day	23rd March
Ram Manohar Lohia's Birth Day (Anniversary)	23rd March
Bhagat Singh, Sukhdev and Rajguru's Martyrdam Day	23rd March
World TB (Tuberculosis) Day	24th March
Rural Postal Life Insurance Day	24th March
Sacrifice Day of Ganesh Shankar Vidyarthi	25th March
National Day of Bangladesh	26th March
World Theatre Day	27th March
April	
World Autism Awareness Day	2nd April
International Day for Mine Awareness and Assistance in Mine Action	4th April
National Maritime Day	5th April
Special Protection Group (SPG) Foundation Day	7th April
World Health Day	7th April
World Homeopathy Day (Birth day of Samuel Hanimen)	10th April
World Aeronautics and Cosmology Day	14th April
Ambedkar's Birth Anniversary	14th April
World Haemophilia Day	17th April
World Heritage Day	18th April
Indian Civil Service Day	21st April
International Mother Earth Day	22nd April
World Books and Copyright Day	23rd April
Panchayat Divas	24th April
May	
International Labour Day (Worker's Day or May Day)	1st May
World Asthma Day	1st Tuesday of May
World Press Freedom Day	3rd May
World Red Cross Day	4th May
World Laughter Day	1st Sunday of May
Mother's Day	2nd Sunday of May
World Migratory Birds Day	8th May
International Pthyliesemia Day	8th May
National Technological Day	11th May
International Nurse Day	13th May
International Family Day	15th May
World Telecommunication/Information Society Day	17th May
Anti-Terrorism Day, World Day for Cultural Diversity for Dialogue & Development	21st May
International Day for Biological Diversity	22r d May
Commonwealth Day	24th May
Death Anniversary of Jawahar Lal Nehru	27th May
International Day of UN Peacekeepers	29th May
World No-Tobacco/No-smoking Day	31st May
June	
International Day of Innocent Children Victims of Agression	4th June
World Environment Day	5th June
World Oceans Day	8th June
Father's Day (in many countries)	3rd Sunday of June
World Elder Abuse Awareness Day	15th June
World Day to Combat Desertification & Drought	17th June

World Refugee Day	20th June
International Day of Yoga	21st June (w.e.f. 2015
UN Public Service Day	23rd June
International Day (UN) against Drug Abuse and Illicit Trafficking, Int. Day in Support of Victims of Torture	26th June
July	
Doctor's Day (Birthday of Dr. Bidhan Chandra Roy)	1st July
State Bank of India Foundation Day	1st July
International Day of Cooperatives	1st Saturday of July
World Population Day	11th July
International Nelson Mandela Day	18th July
Kargil Memorial Day (India)	26th July
International Day of Friendship	30th July
August	
World Breast Feeding Day	1st August
World Peace Day, Hiroshima Day	6th August
Quit India Day (India), Nagasaki Day, International Day of the World's Indigenous People	9th August
International Youth Day	12th August
Independence Day (India)	15th August
World Humanitarian Day	19th August
National Sports Day (Birth Day of Dhyanchand)	29th August
International Day against Nuclear Tests	29th August
September	
Teacher's Day (Birth Day of S. Radhakrishnan)	5th September
International Literacy Day	8th September
World Fraternity and Apology Day	14th September
Hindi Divas (Day)	14th September
International Day of Democracy	15th September
Engineer's Day (Birth Day of M. Vishweshwaraiya)	15th September
World Ozone Day	16th September
Railway Police Force (RPF) Foundation Day	20th September
International Day of Peace, Alzheimer's Day	21st September
World Deaf Day and World Heart Day	24th September
World Tourism Day	27th September
October	
International Day for Older Persons	1st October
Mahatma Gandhi's Birth Day *(International Day of Non-Violence)*	2nd October
Birth Day of Lal Bahadur Shastri	2nd October
World Habitat Day	1st Monday of October

World Animal Welfare Day	4th October
World Teacher's Day	5th October
World Wild Animal Day	6th October
Indian Air Force Day	8th October
World Post Day	9th october
International Day of the Girl Child	11th October
Birthday of Loknayak Jay Prakash Narayan	11th October
UN International Day for Natural Disaster Reduction	2nd Wednesday of October
World Standards Day	14th October
World Food Day	16th October
World Allergy Awareness Day	16th October
International Day for the Eradication of Poverty	17th October
World Iodine Shortage Day	21st October
U N Day, World Development Information Day	24th October
World Thrift Day	30th October
Death Anniversary of Indira Gandhi	31st October
November	
International Day for Preventing the Exploitation of the Environment in War & Armed Conflict	6th November
World Service Day	9th November
National Education Day (Birth Day of Maulana Azad)	11th November
Children's Day (Birth anniversary of Jawaharlal Nehru)	14th November
World Diabetes Day	14th November
International Day for Tolerance	16th November
National Press Day	16th November
World Students Day, World Epilepsy Day	17th November
World Day of Rememberance for Road Traffic Victims	3rd Sunday of November
National Journalism Day	17th November
World Adult Day	18th November
World Citizen Day	19th November
Universal Children's Day, Africa Industrialization Day	20th November
World Television Day	21st November
International Day for the Elimination of Violence Against Women,	25th November
World Non-veg Prevention Day	26th November
World Environment Protection Day	26th November
National Law Day	29th November
International Day of Solidarity with the Palestinian People	1st December
December	
World AIDS Day	

International Day for the Abolition of Slavery	2nd December
World Disabled Day/International Day of Persons with Disabilities	3rd December
Chemical Accidents Prevention Day	4th December
Navy Day	4th December
International Volunteers Day	5th December
International Civil Aviation Day	7th December
Armed Forces Flag Day	7th December
International Anti-Corruption Day	9th December
Girl Child Day (Balika Divas, India)	9th December
International Human Rights Day	10th December
World Children's Fund Day	11th December
International Mountain Day	11th December
National Energy Conservation Day	14th December
International Migrants Day	18th December
Liberation Day of Goa	19th December
UN Day for South-South Cooperation	19th December
International Human Solidarity Day	20th December
Kisan Divas (Birthday of Chaudhary Charan Singh)	23rd December
X-mas Day	25th December
Central Reserve Police Force (CRPF) Foundation Day	26th December

26. India's World Heritage Sites (included in UNESCO's list)

Sl.	Site	Year of inclusion
1.	Ajanta Caves (Maharashtra)	1983
2.	Ellora Caves (Maharashtra)	1983
3.	Agra Fort (U.P.)	1983
4.	Taj Mahal (U.P.)	1983
5.	Sun Temple, Konark (Odisha)	1984
6.	Mahabalipuram Temples (TN)	1984
7.	Kaziranga National Park (Assam)	1985
8.	Manas Wildlife Sanctuary (Assam)	1985
9.	Keoladeo National Park (Rajasthan)	1985
10.	Churches and Convents of Goa	1986
11.	Khajuraho Temples (M.P)	1986
12.	Monuments at Hampi (Karnataka)	1986
13.	Fatehpur Sikri (UP)	1986
14.	Pattadakal Temples (Karnataka)	1987
15.	Elephanta Caves	1987
16.	Sundarbans National Park (W.B)	1987
17.	Chola Temples, Brihadishwara Temple, Thanjavur (1987), Brihadishwara Temple, Gangaikonda Cholapuram, Airavateshwara Temple (2004)	1987–2004

18.	Nanda Devi and Valley of Flowers National Parks	1988-2005
19.	Sanchi Stupa (MP)	1989
20.	Humayun's Tomb (Delhi)	1993
21.	Qutub Minar and its Momuments (Delhi)	1993
22.	Mountain Railways *(Darjeeling Himalayan Rly.-1999, Neelgiri Mountain Rly.-2005, Kalka-Shimla Rly.-2008)*	1999–2008
23.	Mahabodhi Temple, Bodh Gaya (Bihar)	2002
24.	Rock Shelters of Bhimbetka (MP)	2003
25.	Champaner - Pavagadh Park (Gujarat)	2004
26.	Chhatrapati Shivaji Terminus (CST), Mumbai	2004
27.	Red Fort (Lal Quila) Complex, Delhi	2007
28.	Jantar Mantar of Jaipur (Rajsthan)	2010
29.	Western Ghats	2012
30.	Hill Forts of Rajasthan (6 majestic forts) *(Chittorgarh, Kumbhalgarh, Sawai Madhopur, Jhalawar, Jaipur and Jaisalmer Fort[1])*	2013
31.	*Rani-ki-Vav (the Queen's Stepwell) at Patan, Gujarat*	2014
32.	*Great Himalayan National Park Conservation Area*	2014

[1] *First inhabited World Heritage Monument (constructed in 1156).*

27. Famous Tourist Spots of India

Site	Location	Founder
Kanheri Caves	Mumbai	Buddhists
Elephanta Caves	Mumbai	Rashtrakutas
Ajanta Caves	Aurangabad	Gupta Rulers
Ellora Caves	Aurangabad	Buddhists
Kandaria Mahadev	Khajurao(M.P)	Chandela Kings
Madan Palace	Jabalpur (M.P.)	Raja Madan Shah
Mrignayani Palace	Gwalior(M.P.)	Raja Man Singh Tomar
Dhar Fort	Dhar (M.P.)	Mohammad Bin Tughlaq
Golconda Fort	Hyderabad	Qutubshahi
Cochin Fort	Kerala	Portuguese
Vijay Stambh	Chittorgarh (Raj.)	Rana Kumbha
Qutub Minar	Delhi	Qutub-ud-din Aibak
Adhai Din Ka Jhopda	Ajmer (Raj.)	Qutub-ud-din Aibak
Hauz Khas	Delhi	Alauddin Khilji
Tughlakabad	Delhi	Ghiyasuddin Tughlaq
Firoz shah Kotla	Delhi	Firoz Shah Tughlaq
Bundi Fort	Bundi (Raj.)	Raja Nagar Singh
Pichhola Lake	Udaipur	—
Kakaria Lake	Ahmedabad	Sultan Qutub ud din
Jodhpur Fort	Jodhpur (Raj.)	Rao Jodha Ji
Fateh Sagar	Udaipur (Raj.)	Maharana Fateh Singh
Deeg Palace	Deeg (Raj.)	Raja Badan Singh
Rani Ki Badi	Bundi (Raj.)	Rani Nathvati

Site	Location	Founder
Chhatra Mahal	Bundi Fort	Rani Chhatrasal
Junagarh	Bikaner (Raj.)	Raja Jay Singh
Jantar-Mantar	Delhi and Jaipur	Sawai Jay Singh
Nahargarh Fort	Jaipur (Raj.)	Sawai Jay Singh
Bharatpur Fort	Bharatpur (Raj.)	Raja Surajmal Singh
Moti Masjid	Delhi Fort	Aurangzeb
Ummed Palace	Jodhpur (Raj.)	Maharaja Ummed Singh
Aram Bagh	Agra (U.P.)	Babur
Red Fort	Delhi	Shahjehan
Humayun's Tomb	Delhi	Hameeda Bano Beghum (wife of Humayun)
Shalimar Bagh (Garden)	Sri Nagar	Jehangir
St. George Fort	Chennei (T.N.)	East India Company
Sher Shah's Tomb	Sasaram (Bihar)	Son of Sher Shah
Fatehpur Sikri	Agra (U.P.)	Akbar
Old Fort (Purana Quila)	Delhi	Sher Shah Suri
Akbar's Tomb	Sikandera(U.P.)	Jehangir
Chashma - Shahi	Jammu-Kashmir	Ali Mardan Khan
Etamad-ud-daulah's Tomb	Agra (U.P.)	Noorjehan
Taj Mahal	Agra (U.P)	Shahjehan
Nishaat Bagh	Jammu - Kashmir	Asaf Ali
Sheesh Mahal	Agra (U.P.)	Shahjehan
Khas Mahal	Agra (U.P.)	Shahjehan
Dewan-e-Khas	Agra Fort (U.P.)	Shahjehan
Bada Imambada	Lucknow (U.P.)	Nawab Asaf-Ud-daulah
Chhota Imambada	Lucknow (U.P.)	Mohammad Ali Shah
Gol Ghar	Patna (Bihar)	British Government
Padari Ki Haveli	Patna (Bihar)	Father Capuchin
Fort William	Kolkata (W.B.)	Lord Clive
Bibi Ka Maqbara	Aurangabad (Maharashtra)	Aurangzeb
Safderjung ka Maqbara	Delhi	Shuja-ud-daulah
Belur Math	Kolkata (W.B.)	Swami Vivekanand
Anand Bhawan	Allahabad (U.P.)	Moti Lal Nehru
Laxman Jhula	Rishikesh (Uttarakhand)	—
Shanti Niketan	W. Bengal	Rabindranath Tagore
Sabarmati Ashram	Ahmedabad	Mahatma Gandhi
Prince of Wales Museum	Mumbai	George V
Gateway of India	Mumbai	British Government
President House	Delhi	British Government
Victoria Memorial	Kolkata (W.B)	—
Botanical Garden	Shivpur (W.B)	—
Sunset Point	Mount Abu (Raj.)	—

Site	Location	Founder
Char Minar	Hyderabad	Kuli Qutub Shah
Sun Temple	Konark (Orissa)	Narasingh Dev I
Jagannath Temple	Puri (Orissa)	Chola Gang Dev
Chenna KeshabTemple	Belur	Vishnu Vardhan
Laxman Temple	Chhatarpur (M.P.)	Chandela Rulers
Dilwada Jain Temple	Mount Abu (Raj.)	Vimal Shah
Vishnupad Temple	Gaya (Bihar)	Rani Ahilya Bai
Harmandir Sahib	Patna (Bihar)	Maharaja Ranjit Singh
Kali Temple	Kolkata (W.B.)	Rani Ras Moni
Laxmi Narayan Temple	Delhi	Birla Family
Khirki Masjid	Delhi	Ghiyasuddin Tughlaq
Shershahi Masjid	Patna (Bihar)	Parvez Shah
Mecca Masjid	Hyderabad	Kuli Kutub Shah
Patthar Ki Masjid	Patna (Bihar)	Parvez Shah
Patthar Ki Masjid	Jammu-Kashmir	Noorjehan
Jama Masjid	Agra (U.P.)	Shahjehan
Moti Masjid	Agra Fort (U.P.)	Shahjehan
Jama Masjid	Delhi	Shahjehan
Charar-e-Sarif	Sri Nagar(Kashmir)	Jainul Abedin
Hajratbal Masjid	Sri Nagar(Kashmir)	—
Nakhuda Masjid	Kolkata (W. B.)	—

28. Defence of India

- The defence policy of India aims at promoting and sustaining durable peace in the subcontinent and equipping the defence forces adequately.
- The supreme commander of the Indian Armed Forces is the President of India. The responsibility for national defence, however, rests with the union cabinet. The Defence Minister is responsible to the Parliament for all matters concerning the defence of the country. Administrative and operational control of the armed force is exercised by the Ministry of Defence and the three Service Headquarters.
- The Defence Ministry consists of 4 departments : (i) Department of Defence (ii) Department of Defence Production (iii) Department of Defence Research and Development (iv) Department of Ex-Serviceman Welfare.
- In 2002, the Defence Ministry given a new name—'Integrated Headquarters of Ministry of Defence'. Indian Armed Forces are divided into three Services Army, Navy and Air Force. The three services function under their respective Chiefs of Staff. These three chiefs of staff constitute the Chief of staff Committee, the chairmanship of which rotates among the service chiefs according to seniority.
- In the contemporary world India has the fourth largest army in the world, the fifth largest air force and the seventh largest navy.

Indian Armed Forces are divided into three services :

1. **Army :** The Chief is 'Chief of the Army Staff'. Its headquarters is in New Delhi. The army is organised into the following seven commands :

Command	Headquarters	Command	Headquarters
Western Command	Chandigarh	Eastern Comm.	Kolkata
Northern Command	Udhampur	Southern Comm.	Pune
Army Training Comm.	Shimla	Central Comm.	Lucknow
South Western Comm.	Jaipur		

Note : *Each Command of Indian Army is commanded by a General Officer Commanding in Chief of the rank of Lieutenant General.*

2. **Navy :** The Chief is an Admiral ranked " Chief of the Naval Staff". The headquarters is in New Delhi. The Navy has three Naval Commands, commanded by Flag Officers Commanding-in-Chief of the rank of Vice-Admiral. They are :

Command	Headquarters	Command	Headquarters
Eastern Command	Visakhapatnam	Southern Command	Kochi
Western Command	Mumbai		

3. **Air Force :** The Chief is an Air Chief Marshal ranked 'Chief of the Air Staff'. Its headquarters is in New Delhi. The Air force is organized into seven commands (five Operational and two Functional Commands) :

Command	Headquarter	Command	Headquarter
Operational Commands			
Eastern Air Comd.	Shillong	Western Air Comd.	New Delhi
South-Western Air Comd.	Gandhinagar	Central Air Comd.	Allahabad
Southern Air Comd.	Tiruvananthpuram		
Functional Commands			
Maintenance Comd.	Nagpur	Training Comd.	Bangalore

4. **Commissioned Ranks**

Army	Air Force	Navy
General	Air Chief Marshal	Admiral
Lieutenant General	Air Marshal	Vice-Admiral
Major General	Air Vice-Marshal	Rear Admiral
Brigadier	Air Commodor	Commodor
Colonel	Group Captain	Captain
Lieutenant Colonel	Wing Commander	Commander
Major	Squadron Leader	Lieutenant Commander
Captain	Flight Lieutenant	Lieutenant
Lieutenant	Flying Officer	Sub Lieutenant

29. Internal Security of India

Organization	Year	Headquater
Assam Rifles (AR)(former Catchar Levy)	1835	Shillong
Central Reserve Police Force (CRPF)	1939	New Delhi
National Cadet Corps (NCC)	1948	New Delhi
Territorial Army (TA)	1949	In different states
Indo-Tibetan Border Police (ITBP)	1962	New Delhi

Home Guards (HG)	1962	In different states
Border Security Force (BSF)	1965	New Delhi
Central Industrial Security Force (CISF)	1969	New Delhi
Coast Guards (CG)	1977	New Delhi
National Security Guards (NSG)	1984	New Delhi

30. Defence Training Institutions of India

Army

- National Defence Academy (NDA), Khadakwasla (near Pune)
- National Defence College (NDC), New Delhi
- College of Defence Management (CDM), Secunderabad (A.P.)
- College of Military Engineering (CME), Pune (Maharashtra)
- Rashtriya Indian Military College (RIMC), Dehradun
- Armed Forces Medical College (AFMC), Pune
- Officer's Training School (OTS), Chennai
- High Altitude Warfare School Gulmarg (J&K)
- Counter Insurgency and Jungle Warfare School, Vairengte
- Infantry Schools, Mhow and Belgaum
- Armoured Corps Centre and School, Ahmednagar (Maharashtra)
- School of Artilary, Deolali

Air Force

- Air Force School, Sambra (Belgaum)
- Flying Instructors' School, Tambaram,
- Helicopter Training School, Avadi
- College of Air Warfare, Secunderabad
- Air Force Administrative College, Coimbatore
- Air Force Academy, Hyderabad
- Air Force Technical College, Jalahalli (Bangalore)
- Elementary Flying School, Bidar
- Paratroopers Training School, Agra (UP)
- Institute of Aviation Medicine, Banglore

Navy

- I.S.S. Chilka, Bhubaneswar (Orissa)
- I.N.S. Hansa, Goa
- Navy Shipwright School, Vishakhapatnam
- I.N.S. Satavahana, Visakhapatnam (AP)
- I.N.S. , Garuda, Kochi (Cochin)
- I.N.S. Shivaji, Lonavala
- I.N.S. Valsura, Jamnagar (Gujarat)
- I.N.S. Hamla, Mumbai
- I.N.S. kunjai, Mumbai
- I.N.S. Ashwini (INM), Mumbai
- I.N.S. Agrani, Coimbator
- Naval Academy, Goa

31. Foundation Day of Some States

Jan. 1	Nagaland Day
Jan. 21	Manipur, Meghalaya and Tripura Day
Feb. 6	Jammu-Kashmir Day
Feb. 20	Mizoram and Arunachal Pradesh Day
Mar. 11	Andaman & Nicobar Islands Day
Mar. 22	Bihar Day (Bihar Diwas)
Mar. 30	Rajasthan Day
Apr. 1	Utkal (Orissa), Day
Apr. 14	Tamil Nadu Day
Apr. 15	Himachal Pradesh Day
May 1	Gujarat and Maharashtra Day
May 16	Sikkim Day
Nov. 1	Chhattisgarh, Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Karnataka, Kerala & Andhra Pradesh Day
Nov. 9	Uttaranchal (Now Uttarakhand) Day
Nov. 15	Jharkhand Day (Jharkhand Diwas)
Dec. 19	Goa Day

32. Research Centres of India

1.	Indian Agricultural Research Institute	New Delhi
2.	Central Rice Research Institute	Cuttack
3.	Central Sugarcane Research Institute	Coimbatore
4.	Central Potato Research Institute	Shimla
5.	Central Tobacco Research Institute	Rajamundry
6.	Central Forest Research Institute	Dehradun
7.	National Sugar Research Institute	Kanpur
8.	Indian Lac Research Institute	Ranchi
9.	National Dairy Research Institute	Karnal
10.	Central Fuel Research Institute	Dhanbad
11.	Central Leather Research Institute	Chennai
12.	Central Mining Research Institute	Dhanbad
13.	Central Drug Research Institute	Lucknow
14.	Indian Meteorological Observatory	Pune and Delhi
15.	Raman Research Centre	Bangalore
16.	Central Scientific Instruments Organisation	Chandigarh
17.	National Metallurgical Laboratory	Jamshedpur
18.	Central Salt & Marine Chemical Research institute	Bhavnagar
19.	Archaeological Survey of India, India Museum	Kolkata
20.	Central Jute Technological Research Institute	Kolkata
21.	Central Coconut Research Institute	Kasergod, Kerala
22.	Textile Research Institute	Ahmedabad
23.	All India Institute of Medical Sciences (AIIMS)	New Delhi

24.	National Aeronautical Laboratory	Bangalore
25.	National Institute of Oceanography	Panaji
26.	National Geophysics Research Institute	Hyderabad
27.	Indian Institute of Petroleum	Dehradun
28.	Central Building Research Institute	Roorkee
29.	Central Road Research Institute	New Delhi
30.	Tata Institute of Fundamental Research	Mumbai
31.	High Altitude Research Laboratory	Gulmarg
32.	National Botanical Research Institute	Lucknow
33.	Central Food Technological Research Institute	Mysore
34.	Central Glass and Ceramic Research Institute	Kolkata
35.	National Enviornmental Engineering Research Institute	Nagpur
36.	Central Electro - Chemical Research Institute	Karaikudi
37.	Indian Institute of Chemical Biology	Kolkata
38.	Industrial Toxicology Research Centre	Lucknow
39.	Central Mechanical Engineering Research Institute	Durgapur
40.	Centre for Cellular and Molecular Biology	Hyderabad

33. Nuclear And Space Research Centres in India

1.	India Rare Earths Limited	Alwaye (Kerela)
2.	Uranium Corporation of India	Jadugoda
3.	Atomic Energy Commission (AEC)	Mumbai
4.	Electronics Corporation of India	Hyderabad
5.	Bhabha Atomic Research Centre (BARC)	Trombay (Mumbai)
6.	Radio Astronomy Centre	Ootacamund
7.	Tata Institute of Fundamental Research	Mumbai
8.	Saha Institute of Nuclear Physics	Kolkata
9.	Nuclear Fuel Complex	Hyderabad
10.	Nuclear Power Complex	Mumbai
11.	Centre of Earth Science's studies	Trivendrum (Kerala)
12.	Physical Research Laboratory	Ahmedabad
13.	Space Commission	Bangalore
14.	Vikram Sarabhai Space Centre	Thiruvananthpuram
15.	Indian Space Research Organisation (ISRO)	Bangalore
16.	Space Application Centre	Ahmedabad
17.	Thumba Equatorial Rocket Launching Station	Thumba (Kerala)
18.	Indian Scientific Satellite Project	Bangalore
19.	College of Satellite Communication Technology	Ahmedabad
20.	Saha Institute of Nuclear Physics	Kolkata

34. Health and Medicinal Research Centres in India

All India Malaria Research Institute	New Delhi
National Tuberculosis Institute	Bangalore

Indian Cancer Research Centre	Mumbai
Indian Veterinary Research Institute	Mukteshwar (H.P.), Izzatnagar (U.P.)
Institute of Ayurvedic Studies and Research	Jamnagar (Gujarat)
Vallabh Bhai Patel Chest Institute	Delhi
Haffkine Institute	Mumbai
National Institute of Communicable Diseases	Delhi
School of Tropical Medicine	Kolkata
Central Leprosy Training and Research Institute	Chingelpet
P.G.I. Medical Education and Research	Chandigarh
National Institute of Nutrition	Hyderabad
National Institute of Occupational Health	Ahmedabad
King Institute of Preventive Medicine	Guindy (Chennai)
All India Institute of Hygiene & Public Health	Kolkata

35. Defence Institutes in India

Air Defence Guided Missiles School	Gopalpur (Odisha)
Aircraft And System Training Establishment	Bangalore (Karnataka)
Airforce Academy	Dundigal, Hyderabad (Telangana)
Airforce Technical College	Jalahali (Bengaluru)
Armed Forces Medical College (AFMC)	Pune (Maharashtra)
Defence Services Staff College (DSSC)	Wellington (Tamil Nadu)
Indian Millitary Academy (IMA)	Dehradun (Uttarakhand)
Defence Science Laboratory	Dehradun (Uttarakhand)
College of Millitary Engineering (CME)	Kirki (Pune)

36. Government Industrial Undertakings

Bharat Electronics Limited	Jalahalli (Bengaluru)
Heavy Engineering Corporation Ltd.	Ranchi (Jharkhand)
Heavy Machine Building Plant	Ranchi (Jharkhand)
Heavy Vehicles Factory	Avadi (Chennai), TN
Hindustan Aeronautics Ltd.	Bengaluru (Karnataka)
Hindustan Aircraft Factory	Bengaluru (Karnataka)
Hindustan Cables Ltd.	Rupnarayanpur (W.B.)
Hindustan Housing Factory Ltd.	New Delhi
Hindustan Latex Ltd.	Peroorkada (Kerala)
Hindustan Organic Chemicals Ltd.	Kolaba (Maharashtra)
Hindustan Photo Films Manufacturing Company Ltd.	Ooti (Tamil Nadu/TN)
Hindustan Zinc Ltd.	Udaipur (Rajasthan)
Hindustan Teleprinters Ltd.	Chennai (Tamil Nadu)
Integral Coach Factory	Perambadur (T.N.)
Security Paper Mill	Hoshangabad (M.P.)
Neyveli Lignite Corporation Ltd.	Neyveli (Tamil Nadu)

37. Famous Musical Instruments and their Exponents

Sitar	Pt. Ravi Shankar, Nikhil Banerjee, Ustad Vilayat Khan, Shujaat Khan, Jaya Biswas, Debu Choudhary, Nishaat Khan, Bande Hasan, Shahid Parvez, Uma Shankar Mishra, Buddhaditya Mukherjee, Anushka Shankar etc.
Tabla	Ustad Shafat Ahmed Khan, Sapan Choudhary, Zakir Hussain, Latif Khan, Allah Rakha Khan, Gudai Maharaj, Kishan Maharaj, Fayaz Khan, Sukhbinder Singh etc.
Flute	Pannalal Ghosh, Hari Prasad Chaurasia, Raghunath Seth, B.Kunjamani, N. Neela, Rajendra Prasanna, Rajendra Kulkarni, Prakash Saxena etc.
Sarod	Ustad Amjad Ali Khan, Ustad Ali Akbar Khan, Ustad Alauddin Khan, Hafiz Khan, Zarin Daruwala, Mukesh Sharma, Chandan Rai, Biswajit Roy Chaudhury, Sharan Rani etc.
Shehnai	Ustad Bishmillah Khan, Daya Shankar, Jagannath, Hari Singh, Shailesh Bhagwat, Ali Ahmad, Hussain Khan etc.
Violin	Dr. Smt. N. Rajan, Vishnu Gobind (VG) Jog, L. Subramaniam, Sangitha Rajan, Kunakkadi Baidyanathan, Shishir Choudhary, Lalgudi Jayaraman, R.P. Shastri, Suryadev Pawar, Govind Swami Pillai, T.N. Krishnan etc.
Veena	S. Balachandran, Badruddin Dagar, Kalyan Krishna Bhagavatar, B. Doraiswami Iyengar Gopal Krishna, Asad Ali etc.
Santoor	Pt. Shiv Kumar Sharma, Tarun Bhattacharya, Bhajan Sopori, etc.
Pakhawaj	Ustad Rehman Khan, Gopal Das, Chhatrapati Singh, Ramakant Pathak, Arun Saiwal etc.
Rudra Veena	Ushtad Sadiq Ali Khan, Zia Moinuddin Dagar Asad Ali Khan, etc.
Mridang	Thakur Bhikam Singh, Palghat Raju, Dr. Jagdish Singh, T.K. Moorthy, U.K. Sivaram, K.R. Mani etc.
Sarangi	Ustad Bendu Khan, Pt.Ramnarayanji, Aruna Kale, Santosh Mishra, Indralal, Ashiq Ali Khan etc.
Nadaswaram	Sheikh Chinna Maulana, Rajaratna Pillai, Niru Swami Pillai, N. Krishna etc.
Simphoni	Zubin Mehta.
Guitar	Vishwa Mohan Bhatt, Jatin Mazumdar, Brij Bhushan Kabra, Sri Krishna Nalin, Keshav Jalegaonkar etc.
Mandolin	U. Srinivas, Khagen Dey, Nagen Dey, etc.
Vichitra Veena	Ahmed Raza Khan, Abdul Aziz Khan etc.
Piano	V. Balsara
Ghatam	T.H. Vinayakaram
Harmonium	Jnan Prakash Ghosh, Shri Purushottam Walawalkar, Appa Jalgaonkar etc.
Jal Tarang	Himanshu Biswas, Jagdish Mohan, Ghasiram Nirmal, Ram Swaroop Prabhakar etc.
Surbahar	Imrat Khan, Anapurna Devi etc.
Israj	Alauddin Khan.
Mohan Veena	Pt. Vishwa Mohan Bhatt

38. States and their Folk Dances

Jharkhand	Chhau, Sarahul, Jat-Jatin, Karma, Danga, Bidesia, Sohrai.
Uttarakhand	Gadhwali, Kumayuni, Kajari, Jhora, Raslila, Chappeli.
Chhattisgarh	Goudi, Karma, Jhumar, Dagla, Pali, Tapali, Navrani, Diwari, Mundari.

Andhra Pradesh	Kuchipudi (Classical), Ghantamardala, Ottam Thedal, Mohiniattam, Kummi, Siddhi Madhuri, Chhadi.
Arunachal Pradesh	Mask dance (Mukhauta Nritya), War dance.
Himachal Pradesh	Jhora, Jhali, Chharhi, Dhaman, Chhapeli, Mahasu, Nati, Dangi, Chamba, Thali, Jhainta, Daf, Stick dance etc.
Goa	Mandi, Jhagor, Khol , Dakni etc.
Assam	Bihu, Bichhua, Natpuja, Maharas, Kaligopal, Bagurumba, Naga dance, Khel Gopal,Tabal Chongli, Canoe, Jhumura Hobjanai etc.
West Bengal	Kathi, Gambhira, Dhali, Jatra, Baul, Marasia, Mahal, Keertan etc.
Kerala	Kathakali (Classical), Ottam Thulal , Mohini-attam, Kaikottikali, Tappatikali, Kali Auttam.
Meghalaya	Laho, Baagla etc.
Manipur	Manipuri (Classical), Rakhal, Nat Rash, Maha Rash, Raukhat etc.
Nagaland	Chong, Khaiva, Lim, Nuralim etc.
Orissa	Odissi (Classical), Savari, Ghumara, Painka, Munari, Chhau, Chadya Dandanata etc.
Maharashtra	Lavani, Nakata, Koli, Lezim, Gafa, Dahikala Dasavtar or Bohada, Tamasha, Mauni, Powara, Gouricha etc.
Karnataka	Yakshagan, Huttari, Suggi, Kunitha, Karga, Lambi
Gujarat	Garba, Dandiya Ras,Tippani Juriun, Bhavai.
Punjab	Bhangra, Giddha, Daff, Dhaman etc.
Rajasthan	Ghumar, Chakri, Ganagor, Jhulan Leela, Jhuma, Suisini, Ghapal, Panihari, Ginad etc.
Mizoram	Khanatm, Pakhupila, Cherokan etc.
Jammu & Kashmir	Rauf, Hikat, Mandjas, Kud Dandi nach, Damali.
Tamil Nadu	Bharatnatyam, Kumi, Kolattam, Kavadi,
Uttar Pradesh	Nautanki, Raslila, Kajri, Jhora, Chappeli, Jaita.
Bihar	Jata-Jatin, Bakho-Bakhain, Panwariya, Sama-Chakwa, Bidesia, Jatra etc.
Haryana	Jhumar, Phag Dance, Daph, Dhamal, Loor, Gugga, Khor, Gagor etc.

39. Famous Places associated with eminent Persons

Place	Person	Place	Person
Corsica	Nepoleon Bonaparte	Jerusalem	Jesus Christ
Kapilvastu	Gautam Buddha	Lumbini	Gautam Buddha
Macedonia	Alexander, the Great	Mecca	Prophet Mohammed
Jeeradei	Dr. Rajendra Prasad	Waterloo	Nepoleon Bonaparte
Jalianwala Bagh	General Dyer	Porbundar	Mahatma Gandhi
Anand Bhawan	Jawaharlal Nehru	Bardoli	Sardar Patel
Chittore	Maharana Pratap	Fatehpur Sikri	Akbar, the Great
Haldi Ghati	Maharana Pratap	Puducherry	Aurobindo Ghosh
Sabarmati	Mahatma Gandhi	Talwandi	Guru Nanak
Sitab Diyara	Jai Prakash Narayan	Pawanar	Vinoba Bhave

Place	Person	Place	Person
Shantiniketan	Rabindra Nath Tagore	Seringapatnam	Tipu Sultan
Belur Math	Rama Kris. Paramhans	Kundgram	Mahavir
Sevagram	Mahatma Gandhi	Trafalgar	Nelson
Cuttack	Subhash Chandra Bose	Pawapuri	Mahavir
Kushi Nagar	Gautam Buddha	Trimurti Bhawan	Jawaharlal Nehru

40. Crematorium of Famous Persons

Raj Ghat	Mahatma Gandhi	Shanti Van	Jawahar Lal Nehru
Vijay Ghat	Lal Bahadur Shastri	Shakti Sthal	Indira Gandhi
Kishan Ghat	Ch. Charan Singh	Abhay Ghat	Morarji Desai
Veer Bhumi	Rajiv Gandhi	Samata Asthal	Jagjeevan Ram
Ekta Asthal	Giani Zail Singh, Chandra Shekhar	Karma Bhumi	Dr. Shankar Dayal Sharma
Uday Bhoomi	K.R. Narayanan	Mahaprayan Ghat	Dr. Rajendra Prasad

41. Famous Nicknames of Eminent Persons

Nickname	Person	Nickname	Person
Father of the Nation; Bapu	Mahatma Gandhi	*Grandfather of Indian Films*	Dhundiraj Govind Phalke
Frontier Gandhi; Badshah Khan	Khan Abdul Ghaffar Khan	*Grand Old Man of India*	Dadabhai Naoroji
Strong (Iron) Man	Sardar Vallabhbhai Patel	*Mahamana*	Pt. Madan Mohan Malaviya
Sher-e-Kashmir	Sheikh Abdullah	*Andhra Kesari*	T. Prakasam
Napoleon of India	Samudra Gupta	*Sahid-e-Azam*	Bhagat Singh
Shakespeare of India	Mahakavi Kalidas	*Deshbandhu*	Chitta Ranjan Das
Machiavelli of India	Chanakya	*Deenbandhu*	C.F. Andrews
Akbar of Kashmir	Jainul Abdin	*Lokmanya*	Bal Gangadhar Tilak
Vishwa Kavi; Kaviguru; Gurudev	Rabindranath Tagore	*Loknayak*	Jayaprakash Narayan
Rajaji / C.R.	Chakravarti Rajagopalachari	*Bangabandhu*	Sheikh Mujibur Rahman
Bihar Kesari	Dr. Srikrishna Singh	*Chacha*	Jawaharlal Nehru
Bengal Kesari	Ashutosh Mukherji	*Man of Peace*	Lal Bahadur Shastri
Punjab Kesari	Lala Lajpat Rai	*Guruji*	M.S. Golvalkar
Desh Ratna; Ajatshatru	Dr. Rajendra Prasad	*Sparrow*	Major General Rajinder Singh
Father of Gujarat	Ravi Sankar Maharaj	*Swar Kokila*	Lata Mangeshkar
Tau	Chaudhury Devi Lal	*Udanpari*	P.T. Usha
King Maker	Earl of Warwick	*Mother*	Mother Teresa
Nightingale of India	Sarojini Naidu	*Sardar*	Vallabhbhai Patel
Lady with the lamp	Florence Nightingale	*Young Turk*	Chandra Shekhar
Lal, Bal, Pal	Lala Lajpat Rai, Bal Gangadhar Tilak and Bipin Chandra Pal	*G.B.S.*	George Bernard Shaw

Nickname	Person	Nickname	Person
Bihar Vibhuti	Dr. Anugrah Narayan Singh	Deshpriya	Yatindra Mohan Sengupta
Babuji	Jagjeevan Ram	Kuvempu	K.V. Puttappa
Morning Star of India Renaissance	Raja Ram Mohan Roy	Little Corporal; Man of Destiny	Napoleon Bonaparte
King maker of Indian History	Sayyed Bandhu	Father of English Poetry	Geoffery Chaucer
Rajarshee	Purushottam Das Tandon	Netaji	Subhash Chandra Bose
Haryana Hurricane	Kapil Dev	Uncle Ho	Ho Chi Minh
Magician of Hockey	Dhyanchand	Li- Kwan	Pearl Buck
Jana Nayak	Karpuri Thakur	Grand Old Man of Britain	Willium E. Gladstone
Il Duce	Benito Mussolini	Desert Fox	Gen. Ervin Rommel
Tota-e-Hind	Amir Khushro	Quaid-i-Azam	Md. Ali Jinnah
Maiden Queen	Queen Elizabeth I	Little Master	Sunil Gavaskar
Maid of Orleans	Joan of Arc	Anna	C.N. Annadurai
Man of Blood and Iron	Otto Van Bismark	Bard of Avon	William Shakespeare
Fuehrer	Adolf Hitler		

42. Some Great Works associated with Famous Persons

1.	Foundation of Red Cross	Henery Dunant
2.	Foundation of Scout	Baden Powell
3.	Foundation of Red Gaurds	Garrywaldy
4.	Founder of Socialism	Acharya Narendra Dev
5.	Father of Sanskrit Grammar	Panini
6.	Founder of Anand Van	Baba Amte
7.	Founder of 'Auroville Ashram' (Puducherry)	Aurobindo Ghosh
8.	Founder of Shantiniketan	Rabindra Nath Tagore
9.	Founder of Vishwabharati	Rabindra Nath Tagore
10.	Founder of Pawnar Ashram	Vinoba Bhave
11.	Founder of Bhudan Movement	Vinoba Bhave
12.	Founder of League of Nations	Woodrow Willson
13.	Founder of Golden Temple	Guru Arjun Dev
14.	Founder of Khalsa Panth	Guru Gobind Singh

43. Awards and Honours

Prize	Field
Nobel Prize	Peace, Literature, Medicine, Physics, Chemistry, (From 1901) and Economics (From 1969)
Pulitzer Prize	Journalism (From 1917)
Academy (Oscar) Awards	Film (From 1929)

Prize	Field
Kalinga Award	Science (From 1952)
Booker Prize	Literature (From 1929)
Grammy Award	Music (From 1958)
Ramon Magasaysay Award	Government (Public) Service, Social Service, Journalism, Literature, Communication and International Understanding (From 1957)
Bharat Ratna	For outstanding contributions in the field of Art/Literature/ Science and Public Service
Dada Saheb Phalke Award	Film (From 1969)
Jnanpith Award	Literature (From 1965)
Saraswati Samman	Literature (From 1991)
Vachaspati Samman	Sanskrit Literature (From 1992)
Shankar Award	Indian Philosophy , Culture and Art
Vyasa Samman	Literature
Kabir Samman	Socio - communal Harmony
Dronacharya Award	Sports Coaching / Training (From 1985)
Arjuna Award	Sports (From 1961)
Bhatnagar Award	Science (From 1957)
Dhanwantari Award	Medical Science (From 1971)
Bourlog Award	Agriculture (From 1992)

44. National and Padma Awards

Republic Day Awards : Bharat Ratna, Padma Vibhushan and Padma Shree are given for exceptional service towards the advancement of Art, Literature and Science and in recognition of public service of a high (or the highest) order.

Param Vir Chakra : It is the highest Gallantry Award. It is given for extraordinary act of bravery in the field of Naval, Air and Army.

Mahavir Chakra : It is the second highest Gallantry Award.

Vir Chakra : It is the third highest Gallantry Award.

Bharat Ratna

Bharat Ratna : The highest-civilian award is given for exceptional service the advancement of art, literature and science, and in recognition of public service of the highest order.

- The decoration is in the form of a *peepal leaf*, about 5.8 cm long, 4.7 cm wide and 3.1 mm thick. It is of toned bronze. On its obverse is embossed a replica of the sun, 1.6 cm in diameter, below which the words "Bharat Ratna" are embossed in Hindi. On the reverse are State emblem and the motto, also in Hindi. The emblem, the sun and the rim are of platinum. The inscriptions are in burnished bronze.
- The first three recipients of Bharat Ratna were C. Rajagopalchari, Dr. S. Radhakrishnan and Dr. C.V. Raman in 1954 while Khan Abdul Ghaffar Khan was the *first foreigner* to be honoured with this award in 1987.

1954	Chakravarti Rajagopalachari Dr. Sarvepalli Radhakrishnan, Dr. Chandrasekhar Venkat Raman
1955	Dr. Bhagwan Das, Dr. Mokshagundam Visvesvaraiya, Pt. Jawaharlal Nehru.
1957	Pt. Govind Ballabh Pant
1958	Dr. Dhondo Keshave Karve
1961	Rajarshi Purushottam Das Tandon, Dr. Bidhan Chandra (B.C.) Roy
1962	Dr. Rajendra Prasad
1963	Dr. Zakir Hussain, Dr. Pandurang Vaman (P. V.) Kane
1966	Lal Bahadur Shastri (Posthumous)
1972	Mrs. Indira Gandhi
1975	Varahagiri Venkat (V.V.) Giri
1976	Kumaraswami (K.) Kamraj (Posthumous)
1980	Mary Teresa Bojaxhiu (Mother Teresa)
1983	Acharya Vinoba Bhave (Posthumous)
1987	Khan Abdul Ghaffar Khan
1988	Marudur Gopalan (MG) Ramachandran (Posthumous)
1990	Dr. Bhim Rao Ramji Ambedkar (Posthumous), Dr. Nelson Rolihlahla Mandela
1991	Rajiv Gandhi (Posthumous), Sardar Vallabh Bhai Patel (Posthumous), Morarji Ranchhodji Desai
1992	Jehangir Ratanji Dadabhai (J.R.D.) Tata, Maulana Abul Kalam Azad (Posthumous), Satyajit Ray (Posthumous)
1997	Aruna Asaf Ali (Posthumous), Guljarilal Nanda (Posthumous), Dr. Avul Pakir Jainulabdeen (A.P.J.) Abdul Kalam
1998	Madurai Sanmukhavadivu (M. S.) Subbulakshmi, Chidambaram (C.) Subramaniam
1999	Prof. Amartya Sen, Pt. Ravi Shankar, Loknayak Jay Prakash Narayan (Posthumous) and Gopinath Bordoloi (Posthumous)
2001	Lata Dinanath Mangeshkar, Ustad Bismillah Khan
2009	Pt. Bhimsen Gururaj Joshi
2014	Prof. C.N.R. Rao, Sachin Ramesh Tendulkar* (*1st player and the youngest one to get 'Bhart Ratna')
2015	Atal Bihari Bajpai, Pandit Madan Mohan Malviya (Posthumous)

Note : *Lal Bahadur Shastri was the first person to be honoured with Bharat Ratna posthumously and Indira Gandhi was the first woman recipient of Bharat Ratna.*

Padma Vibhushan : The award is given for exceptional and distinguished services in any field including service rendered by government servants.

- The decoration is circular in design, with a geometrical pattern superimposed on the circle. The diameter of the circular portion is 4.4 cm and the thickness about 0.6 mm. On the obverse, there is a lotus flower embossed on the circular space. The word "Padma" is embossed in Hindi above the word "Vibhushan" below the lotus flower. On the reverse are the State emblem and the motto in Hindi. It is of *toned bronze*. The inscription "Padma Vibhushan" on the obverse, the geometrical pattern on either side and the border around periphery are in *burnished bronze*. All embossing on either side of decoration is in *white gold*.

Padma Bhushan : The award is given for distinguished service of a high order in any field, including service rendered by government servants.

- It has the same design as the "Padma Vibhushan". On its obverse the word "Padma" appears above and the word "Bhushan" below the lotus flower. The inscription "Padma Bhushan" on the obverse, the geometrical pattern on either side and the border around periphery are in *burnished bronze*. All embossing either side of the decoration is in *standard gold*.

Padma Shri : The award is given for distinguished service in any field including service rendered by government servants.

- The name of the decoration is embossed in Hindi with the word "Padma" above and the word "Shri" below the lotus flower on the obverse. The inscription "Padam Shri" on the obverse, the geometrical pattern on either side and the border around the periphery are in *burnished bronze*. All embossing on either side of the decoration is in *stainless steel*.

Other National Awards

Appan Menon Memorial Award : The award which carries a cash prize of Rs. 1 lakh aims at providing financial assistance to journalists interested in undertaking projects related to international affairs and developmental issues relevant to India and South Asia.

Aditya Vikram Birla Kalashikhar Puraskar : The award is conferred on an artiste in the field of visual and performing arts for lifetime achievement carries Rs. 1.5 lakh in cash, a momento and scroll of honour. Previous recipients of the award include Lata Mangeshkar, M. F. Hussain, Guru Kelucharan Mohapatra, Pandit Ram Narayan, Pandit Bhimsen Joshi.

45. Gallantry Awards

Param Vir Chakra : The highest decoration for valour is the Param Vir Chakra which is awarded for the most conspicuous bravery or some daring or pre-eminent act of valour or self-sacrifice in the presence of the enemy, whether on land, at sea or in the air.

- The decoration is made of bronze and is circular in shape. It has, on the obverse, four replicas of "Indra's Vajra" embossed round the State emblem in the centre. On the reverse the words "Param Vir Chakra" are embossed both in Hindi and English with two lotus flowers in the middle.
- the decoration is worn on the left breast with a plain purple coloured riband about 3.2 cm in width.

Mahavir Chakra : Mahavir Chakra is the second highest decoration and is awarded for acts of conspicuous gallantry in the presence of enemy, whether on land, at sea or in the air.

- It is made of standard silver and is circular in shape. Embossed on the obverse is a five pointed heraldic star with domed centre-piece bearing the gilded State emblem in the centre. The words "Mahavir Chakra" are embossed both in Hindi and English on the reverse with two lotus flowers in the middle. The decoration is worn on the left breast with a half-white and half-orange riband about 3.2 cm in width, the orange being near the left shoulder.

Vir Chakra : Vir Chakra is third in the order of awards given for act of gallantry in the presence of the enemy, whether on land, at sea or in the air.

- The decoration is made of standard silver and is circular in shape. Embossed

on the obverse is a five pointed heraldic star which has an Ashoka Chakra in the centre. Within this chakra is a domed centre-piece bearing gilded State emblem. On the reverse, words "Vir Chakra" are embossed, both in Hindi and English, with two lotus flowers in the middle. The Chakra is worn on the left breast with a half-blue and half-orange riband, about 3.2 cm in width, the orange being nearer the left shoulder.

Ashok Chakra : Ashok Chakra is the country's highest peacetime gallantry award equivalent to Param Vir Chakra.

- The Chakra is made of *gilt gold* and is circular in shape. Embossed on the obsverse is a replica of Ashok Chakra surrounded by a lotus wreath. Along the edge is pattern of lotus leaves, flowers and buds. On the reverse, the words "Ashok Chakra" are embossed both in Hindi and English, with lotus flowers in the intervening space.
- The Chakra is worn on the left breast with a green silk riband, about 3.2 cm in width and divided into two equal segments by an orange vertical line.

Kirti Chakra : The decoration is awarded for conspicuous gallantry. It is made of *standard silver* and is circular in shape. The obverse and the reverse are exactly the same as in Ashok Chakra.

- The Chakra is worn on the left breast with a green silk riband, about 3.2 cm in width and divided equally into two by orange vertical lines.

Shaurya Chakra : The decoration is awarded for an act of gallantry. It is exactly like Ashok Chakra, except that it is made of *bronze*.

- The Chakra is worn on the left breast with a green silk riband, about 3.2 cm in width and divided into four equal segments by three orange vertical lines.

Param Vishisht Seva Medal (PVSM), Ati Vishisht Seva Medal (AVSM), Vishisht Seva Medal (VSM) : The Vishist Seva Medals are awarded to personnel of all the three services in recognition of distinguished service of the "most exceptional", "exceptional" and "high" order respectively. Param Vishisht Seva Medal is made of *gold*, Ati Vishisht Seva Medal of *standard silver* and Vishisht Seva Medal of *bronze*, all circular in shape and 3.5 cm in diameter. Each medal has on its obverse five pointed stars and on its reverse the Lion Capitol. Its ribbon is golden with *one dark-blue stripe* down the centre for Param Vishisht Seva Medal, *two dark-blue stripes* dividing it into three equal parts for Ati Vishisht Seva Medal and *three dark-blue stripes* dividing it into four equal parts for Vishisht Seva Medal.

46. Recipients of the Bharatiya Jnanpith Award

- The first Jnanpith Award was given in 1965.
- The Jnanpith Award carries a citation, shawl, srifal, a bronze idol of Vagdevi Saraswati and a cash prize of ₹ 11,00,000

Sl.	Year	Recipient	Work
1st	1965	G. Shankar Kurup	Auda Kujai (Malayalam)
2nd	1966	Tara Shankar Bandyopadhyay	Ganadevata (Bengali)
3rd	1967	K.V. Putappa, Uma Shankar Joshi	Ramayan Darshanam (Kannada), Nisheeth (Gujarati)
4th	1968	Sumitra Nandan Pant	Chidambara (Hindi)

Sl.	Year	Recipient	Work
5th	1969	Prof. Raghupati Sahay 'Firaq Gorakhpuri'	Gul-e-Naghma (Urdu)
6th	1970	Vishwanath Satyanarayana	Shreemad Ramayan Kalpavriksham (Telugu)
7th	1971	Vishnu Dey	Smriti Satta Bhavishya (Bengali)
8th	1972	Ramdhari Singh 'Dinkar'	Urvashi (Hindi)
9th	1973	Gopinath Mohanty, D.R Bendre	Mati Matal (Oriya) Naku Thanthi (Kannada)
10th	1974	Vishnu Sakharam Khandekar	Yayati (Marathi)
11th	1975	P.V. Akilandam	Chittirappavai (Tamil)
12th	1976	Smt. Ashapurna Devi	Pratham Pratishruti (Bengali)
13th	1977	Dr.K. Shivram Karanth	Mukajjiya Kanasugalu (Kannada)
14th	1978	Dr Sachidananda Hiranand Vatsyayana 'Agyeya'	Kitni Nawon Mein Kitni Bar (Hindi)
15th	1979	Dr. Virendra Kumar Bhattacharya	Mrityunjay (Assamia)
16th	1980	S.K Pottekat	Oru Dishatinte Katha (Malayalam)
17th	1981	Amrita Pritam	Kagaz te Canvas (Punjabi)
18th	1982	Mahadevi Verma	Yama (Hindi)
19th	1983	Masti Venkatesh Iyengar	Chikaveer Rajendra (Kannada)
20th	1984	T. Shiv Shankar Pillai	Kayar (Malayalam)
21st	1985	Pannalal Patel	Manvini Bhavai (Gujarati)
22nd	1986	Sachida Nanda Routroy	Oriya Literature
23rd	1987	Vishnu Vaman Shirwadkar	Marathi Literature
24th	1988	Dr. C. Narayana Reddy	Telugu Literature
25th	1989	Qurrtul - ain - Hyder	Urdu Literature
26th	1990	Prof. Vinayak Krishna Gokak	Kannada Literature
27th	1991	Subhash Mukhopadhyay	Bengali Literature
28th	1992	Naresh Mehta	Hindi Literature
29th	1993	Dr. Sitakant Mahapatra	Oriya Literature
30th	1994	Prof. U. R. Ananthamurthy	Kannada Literature
31st	1995	M.T. Vasudevan Nair	Malayalam Literature
32nd	1996	Mrs. Mahashweta Devi	Bengali Literature
33rd	1997	Ali Sardar Jafri	Urdu Literature
34th	1998	Girish Karnad	Kannada Literature
35th	1999	Nirmal Verma, Gurdayal Singh	Hindi Literature, Punjabi Literature
36th	2000	Dr. Indira Goswami	Assamese Literature
37th	2001	Rajendra Keshavlal Shah	Gujarati Literature
38th	2002	D. Jayakanthan	Tamil Literature
39th	2003	Vinda Karandikar	Marathi Literature
40th	2004	Rehman Rahi	Kashmiri
41th	2005	Kunwar Narayan	Hindi Literature
42nd	2006	Satyavrat Shastri, Ravindra Kelekar	Sanskrit Literature, Konkani Literature
43rd	2007	O.N.V. Kurup	Malayalam Literature

Sl.	Year	Recipient	Work
44th	2008	Akhlaq Mohammad Khan 'Shaharyar'	Urdu Literature
45th	2009	Amarkant and Shrilal Shukla (jointly)	Hindi Literature
46th	2010	Chandrashekhar Kambar	Kannada Literature
47th	2011	Pratibha Ray	Odiya Literature
48th	2012	Ravuri Bharadhwaja	Telugu Literature
49th	2013	Kedar Nath Singh	Hindi Literature
50th	2014	Bhal Chandra Nemade	Marathi Literature

47. Recipients of Dada Saheb Falke Award

- Phalke award carries a 'Swarna Kamal', a shawl and a cash prize of Rs. 2 lakh.
- Introduced in 1969, the Dada Saheb Phalke award was first given to actress Devika Rani.

Year	Recipient	Year	Recipient
1969	Devika Rani Roerich	1970	Birendra Nath Sircar
1971	Prithvi Raj Kapoor (Posthumously)	1972	Pankaj Mallick
1973	Sulochana (Rubi Myers)	1974	B.N. Reddi
1975	Dhiren Ganguli	1976	Kanan Devi
1977	Nitin Bose	1978	Ray Chandra (R.C.) Boral
1979	Sohrab Modi	1980	P. Jairaj
1981	Naushad Ali	1982	L.V. Prasad
1983	Durga Khote	1984	Satyajit Ray
1985	V. Shantaram	1986	B. Nagi Reddi
1987	Raj Kapoor	1988	Ashok Kumar
1989	Lata Mangeshkar	1990	Akkineni Nageshwar Rao
1991	Bhalji (Bhalchandra Govind) Pendharkar	1992	Dr. Bhupen Hazarika
1993	Majrooh Sultanpuri	1994	Dilip Kumar
1995	Dr. Rajkumar	1996	Sivaji Ganesan
1997	Kavi Pradeep	1998	B.R. Chopra
1999	Hrishikesh Mukherjee	2000	Asha Bhonsle
2001	Yash Chopra	2002	Dev Anand
2003	Mrinal Sen	2004	Adoor Gopalkrishnan
2005	Braj Bhushan Chaturvedi	2006	Shyam Benegal
2007	Manna Dey	2008	V.K.Moorthy
2009	D. Rama Naidu	2010	K. Balachander
2011	Soumitra Chatterjee	2012	Praan Krishan Sikand
2013	Gulzar (Sampooran Singh Kalra)	2014	Shashi Kapoor

48. Important Books and Authors

[A] Indian writers and their books :

Writer	Books
Pt. Vishnu Sharma	Panchatantra
Vishakhadatta	Mudra Rakshas
Raskhan	Prem Vatika

Writer	Books
Panini	Ashtadhyayi
Shudrak	Mrichhakatikam
Kalidasa	Raghuvansham, Kumarsambhavam, Meghdootam, Abhigyanshakuntalam
Vatsyayana	Kama Sutra
Vigyaneshwar	Mitakshara
Jeemootwahan	Daybhag
Kalhana	Rajtarangini
Plini	Natural History
Kautilya	Arthashastra
Dandi	Avanti Sundari, Dashkumaracharitam
Ved Vyas	Bhagwat Gita, Mahabharata
Ashwaghosh	Buddha Charitam
Jayadev	Geet Govind
Bana Bhatt	Kadambari
Bhavabhuti	Malti Madhav
Amar Singh	Amar Kosh
Bhartrihari	Niti-Shatak, Shringar Shatak, Vairagya Shatak
Firdausi	Shahnama
Abul Fazal	Ain-i- Akbari, Akabarnama
Surdas	Sahityalahari, Sursagar
Kabirdas	Bijak, Ramayani, Sabar
Gulbadan Beghum	Humanyunama
Al-Beruni	Kitab-ul-Hind
Malik Mohammed Jayasi	Padmavat
Mulk Raj Anand	Coolie, Confession of a Lover, Two leaves and a bud
Nirad C. Chaudhury	Hinduism, Autobiography of an Unknown Indian, A Passage to England, Culture in the Vanity Bag, Continent of Crime
Rabindra Nath Tagore	Chitrangada, Gitanjali, Gora, Chandalika, Visarjana, Hungry Stones
Sumitranandan Pant	Jyotsana, Yugwani, Chidambara
Kuldip Nayyar	The Judgment, Distant Neighbours; India, The Critical Years; In Jail, India after Nehru, Between the Lines
Sri Aurobindo Ghosh	Life Divine, Essays on Gita
Swami Shivanand	Divine Life
Amrita Pritam	Death of a City, Kagaz te Canvas, Forty nine Days
Munsi Premchand	Godan, Gaban, Karmabhumi, Rangbhumi
Khushwant Singh	Indira Gandhi Returns, Indira Gandhi : Badhate Kadam, The Company of Women
B. M. Kaul	Untold Story, Confrontation with Pakistan

Writer	Books
M. K. Gandhi	Gokhale, My Political Guru ; My Experiments with Truth
Vijay Tendulkar	Sakharam Binder
R. K. Narayanan	The Dark Room, Malgudi Days, Guide, My Days, Swami and Friends
Dr. S. Radhakrishnan	Indian Philosophy
Sarojini Naidu	Golden Threshold, Broken Wings
Suryakant Tripathi Nirala	Anamika, Parimal, Gunjan, Juhi Ki Kali
Yashpal	Jhootha Sach
Jai Shankar Prasad	Kamayani, Aansoo, Skandagupta, Ajatshatru
Kazi Nazrul Islam	Agni Veena
Maithilisharan Gupt	Bharat Bharati
Ramdhari Singh Dinkar	Kurukshetra, Urvashi
Mrs. Indira Gandhi	Eternal India
S.H.Vatsyayan 'Agyeya'	Kitni Nawon Mein Kitnee Bar, Aangan Ke Paar, Dwar, Shekhar: Ek Jivani, Nadi Ke Dweep
Mahadevi Verma	Yama, Niharika, Neeraja
Amrit Lal Nagar	Amrit Aur Vish
Nayantara Sehgal	A Voice of Freedom
V. S. Naipal	Area of Darkness, A House for Mr. Biswas, A Million Mutinies Now, A Bend in the River
Devkinandan Khatri	Chandrakanta Santati
Sharat Chandra Chattopadhyay	Devdas, Charitraheen, Shrikant, Parineeta
Vrindavanlal Verma	Jhansi Ki Rani
Jainendra Kumar	Sunita, Tyagpatra
Bhagwati Charan Verma	Chitralekha
Phanishwar Nath 'Renu'	Maila Aanchal, Mare Gaye Gulfam
GajananMadhav'Muktibodh'	Chand Ka Munh Tedha Hai
Bhartendu Harischandra	Bharat Durdasha, Satya Harischandra

[B] Some Important Foreign Writers and their Books

Writer	Book
Adam Smith	Wealth of Nations
Adolf Hitler	Mein Kamph
Albert Einstein	The World as I See it
Alexander Solzhenitsyn	August 1914
A. L. Basham	The Wonder that was India
Anton Chekhov	Cherry Orchard
Arther Hele	Airport
Aristotle	Politics
Boris Pasternak	Dr. Zhivago
David Baldacci	Absolute Power

Writer	Book
Dante	Divine Comedy
E. M. Forster	A Passage to India, Maurice
Homer	Odyssey, Illiad
H. G. Wells	Shape of Things to Come
Harold Evans	Good Times, Bad Times
Henry Miller	Tropic of Cancer
Issac Newton	Principia
Katherine Mayo	Mother India
Machiavelli	The Prince
Maxim Gorky	Mother
Plato	Republic
Jean J. Rousseau	The Social Contract
John Milton	Paradise Lost, Lycidas
Winston Churchill	Gathering Storm
George Orwell	Farm House, Animal Farm
Charles Darwin	Descent of Man, Origin of Species
William Shakespeare	Commedy of Errors, As You Like It, A Mid Summer Night's Dream, Merchant of Venice, Hamlet, King Lear, Othello
George Bernard Shaw	Major Barbara, Man and Superman, Apple Carte, Arms and the Man, Pygmalion, Caesar and Cleopatra, Candida
Charles Dickens	A Tale of Two Cities, Oliver Twist, David Copperfield
J. K. Galbraith	Affluent Society, Ambassador's Journal, The Triumph
Herold Joseph Laski	Grammar of Politics, Dilema of Our Time
J. M. Barrie	Hindu Civilization, Peter Pan
Gunnar Myrdal	Against the Stream, Asian Drama
Leo Tolstoy	War and Peace
Z. A. Bhutto	Great Tragedy
Vladimir Nabakov	Lolita
Mao-tse Tung	On Contradiction

[C] Some Latest Books and Authors

Book	Writer
Playing It My Way	Sachin Tendulkar
My Journey : Trasnforming Dreams into Actions	A. P. J. Abdul Kalam
Fractured Times	Eric Hobsbawm
Neither a Hawk nor a Dove	Khurshid Mahmood Kasuri
The Sergeant's Son	Ashim Choudhury
The Cuckoo's Calling	Robert Galbraith
And then one day	Nasiruddin Shah
Gone Girl	Gilian Flynn
And The Mountains Echoed	Khaled Hosseini
The Red Sari (Biography of Sonia Gandhi)	Javier Moro
This Town	Mark Leibovish
Happy, Happy, Happy	Phil Robertson, Mark Schlabach

Book	Writer
The Dramatic Decade : The Indira Gandhi Years	Pranab Mukharjee
Shiva Triology 1. The Immortals of Meluha, 2. The Secrets of Nagas and 3. The Oath of Vayuputras)	Amish Tripathi
Romancing with Life	Dev Anand
Saurabh Ganguli : The Maharaja of Cricket	Debasheesh Dutta
Born Again on the Mountain : A Story of Losing Everything and Finding I	Arunima Sinha
Lets Kill Gandhi	Tushar Gandhi
When God is a Traveller	Arundhati Subramaniam
Manzilon se Jyada Safar	V.P. Singh
A Call To Honour : In Service of Emergent India	Jaswant Singh
Guiding Souls	Dr. A.P.J. Abdul Kalam
Half Girlfriend	Chetan Bhagat
All My Sisters	Zudith Lenox
The Longest Race	Tom Alter
Gulab Bai : The Queen of Nautanki Theatre	Deepti Priya Mehrotra
Touch Play (Biography of Prakash Padukone)	Dev Sukumar
Out of My Comfort Zone : The Autobiography	Steev Waugh
Honeymoon	James Petterson
Da Vinci Code	Don Brown
The Gods of Antarctica	Yashwardhan Shukla
God of Small Things	Arundhati Rai
Speed Post	Shobha De
The Better Man	Anita Nayyar
Bookless in Baghdad	Shashi Thiroor
The Argumentative Indians	Dr. Amartya Sen
The Algebra of Infinite Justice	Arundhati Rai
Fire fly : A Fairy Tale	Ritu Beri
Two Lives	Vikram Seth
Glass Palace	Amitav Ghosh
The Brief History of Time	Stephen Hawking
Freedom from Fear	Aung San Suu Kyi
Fasting, Feasting	Anita Desai
The Lord of the Flies	William Goldings
Struggle for Change	K.B. Lal
Nehru Gazing at Tomorrow	H.R. Bharadwaj
Life of Pi	Yann Martel
Not Just an Accountant	Vinod Rai
Ignited Minds, Wings of Fire	Dr. A.P.J. Abdul Kalam
Envisioning an Empowered Nation	Dr. A.P.J. Abdul Kalam
The Lowland, Interpreter of Maladies	Jhumpa Lahiri
One Day Cricket, The Indian Challenge	Ashish Roy

Book	Writer
A View from Outside	P. Chidambaram
Harry Potter and the Deathly Hallows	J.K. Rawlling
The Year of the Roester	Guy Sorman
Above Average	Amitabh Bagchi
Dalits in India : A Profile	Sukhdeo Thorat
The Top of the Raintree	Kamalini Sengapta
Terrifying Visions : Golwalkar,the RSS and India	Jyotirmay Sharma
Frontline Pakistan : The Struggle with Militant Islam	Zahid Hussain
The Lowland	Jhumpa Lahiri
The Splender of Silence	Indu Sundaresan
The Leopard and the Fox : A Pakistani Tragedy	Tariq Ali
A Time of Transition : Rajiv Gandhi To The 21st Century	Mani Shankar Aiyer

49. Games and Sports

Olympic Games

The origin of the ancient Olympic Games is lost in the midst of pre-history, but for many centuries they were only a festival of the Greek people. The Games were first held in honour of the Greek god, Zeus in 776 BC in the plain of the kingdom of Elis, nestled in a lush valley between the Alpheus River and Mount Kronion, 15 km from the Ionian Sea. The Olympiad celebrated that year was considered as the first and was used to date subsequent historic events. But religious ceremonies and games were held in Olympia before that time. The oldest sanctuary of Greece was there, the altar of the Great Mother of Gods, Rhea (Earth). On the day of the feast, the priest stood in front of the altar, ready to perform a sacrifice. Women were forbidden to be present and the male contestants were naked. Young men waited at a distance on one stadium (about 200 yds). As soon as a signal was given they ran and the first to arrive at the altar received the torch from the priest's hand and lit the sacrificial fire.

The old Olympiads were held after every four years and the Greeks measured time in terms of Games started on the first new moon after the summer solstice, around mid-July. The ancient Olympic Games lasted for five days and the events took place in a precise order. On the first day, there were sacrifices and opening ceremonies. On the second day there were special competitions for the "ephebians". The third day was devoted to events for adult competitors : dromos, diaulos, dolichos, pugilism, wrestling, pancratium. On the fourth day, there were equestrian events, pentathlon, race with arms. On the fifth and the final day, there were closing ceremonies and proclamation of the heroes.

During the first six Olympic Games, however, the prize had been a portion of meat or 'meria' taken from an animal sacrificed to the gods. It was only after the VII Games that the olive crown was given to the winners and the moral significance of this prize was considerable. Once the prize were awarded, a flock of pigeons was released to carry the names of the champions to all the corners of Greece.

The Games came to a sudden end when the Roman Emperor Theodosius banned the competitions and their attendant sacrificial offerings as pagan manifestations.

From 395 AD onwards the fall of Olympia was very rapid. In that year the first damage was caused by the invasion of Alaric's barbarians. A year earlier the famous crysele-phantide statue of Zeus had been taken to Constantinople. It was destroyed in 475 AD during the great fire. Following the attacks of the Goths, a fire destroyed the temple of Zeus; earthquakes from 522 to 551 and the most severe of all in 580 brought down whatever had remained standing. Glory had vanished and of the vast riches there were now left but a few ruins and the name of Olympia. Something immortal remained, however, and that was the Olympic spirit.

Modern Olympic Games

The revival work of the Games was undertaken by Baron Pierre de Coubertin nearly 1,500 years after the last of the ancient Games. He was born into a family of Italian origin which had settled in France. It was on November 25, 1892, during a conference at Sorbonne about the history of physical exercises, that he first pronounced those famous six words in public "The Restoration of the Olympic Games!" He said that the Games would ennoble and strengthen amateur sports to give them strength and lasting quality for an essential role in the world of modern education.

It was at the International Congress for the Study of the Propagation of the Principles of Amateurism held in Paris in June 1894 that the delegates led by Baron Pierre de Coubertin and associates unanimously voted to restore the Olympic Games and to create an International Olympic Committee to oversee them. De Coubertin had planned to propose Paris for the site of the first modern Olympics in 1900 but the enthusiasm and zeal of the delegates was so great that they insisted the first Games to be held in 1896. Athens was, therefore, the venue for the 1896 Games. Since then these Games are held every four years.

Olympic Symbol : It comprises five rings or circles, linked together to represent the sporting friendship of all people. The rings also symbolise the continents—Europe, Asia, Africa, Australia and America. Each ring is of a different colour, i.e., blue, yellow, black, green and red. The rings are meant to represent five continents viz., Africa (black), America (red), Asia (yellow), Australia (green) and Europe (Blue).

Olympic Flag : The Olympic flag, created in 1913 at the suggestion of Baron Pierre de Coubertin, was solemnly inaugurated in Paris in June 1914 but it was riased over an Olympic stadium for the first time at the Antwerp Games (Belgium) in 1920. There is also a second Olympic flag, which is used for the Winter Games. These flags are made of white silk and contain above mentioned five interwined rings. From left to right the rings are blue, yellow, black, green and red.

Olympic Flame : It was at the Amsterdam Games in 1928 that for the first time an Olympic flame was ceremonially lighted and burned in a giant torch at the entrance of the stadium. The modern version of the flame was adopted in 1936 at the Berlin Games. The Olympic flame symbolises the continuity between the ancient and modern Games. The torch, used to kindle the flame, is first lit by the sun's rays at Olympia, Greece, and then carried to the site of the Games by relay of runners. Ships and planes are used when necessary. On July 15, 1976, space age technology was used to transport the flame from one continent to another.

Olympic Motto : The Olympic motto is *"Citius-Altius-Fortius"* (faster, higher, stronger). Rev. Father Didon (1840-1900), headmaster of a school near Paris and a

great promoter of sports in the French Catholic colleges first used the *motto* and had it embroidered on the pennants of his school clubs. This succinct definition of the philosophy of sport appealed to father Didon's friend, Baron Pierre de Coubertin who was responsible for the revival of the Olympic Games nearly 1,500 years after the last of the ancient Games. It was adopted at his suggestion at the International congress for the "Study and Propagation of the Principles of Amateurism" on June 23, 1894, the same day on which the restoration of the Olympic Games and the creation of the International Olympic Committee were also decided.

Olympic Prizes, Medals and Certificates : While in ancient times the Olympic heroes received a crown of olive branches for their exploits, modern Olympic champions are rewarded with medals and certificates. The winning athlete now receives a Gold medal, the athlete in the second place is awarded a Silver medal and the third placed athlete wins a Bronze medal. In addition, all athletes ranking from first to sixth receive a certificate. Each medal is 60 mm in diameter and 3 mm thick. The first and second place medals are made of 92.5 per cent silver and the medals for the first winner is then plated with 6 gram of fine gold. Thus this medal is not of full gold. The third place medal is of bronze.

- Olympic games were started in 776 B.C. on Mount Olympus in the honour of Greek God 'Zeus'.
- The modern Olympic games started in Athens, the capital of Greece on 6th April, 1896 with great efforts made by Pierre de Coubertin of France.
- The Olympic games are organised after every four years.
- In the flag of Olympics, there is a symbol of five coloured circles joining each other.
- The flag of Olympic Games was recognised in the year 1913 and was hoisted first time in the Antwerp Olympic Games in 1920.
- The tradition to lit the Olympic flame was started in Amsterdom Olympic Games in 1928.
- The Head Office of International Olympic Committee is in Lusane (Switzerland).
- Participation of women in the Olympic games started in the Second Olympic Games in 1900.
- First Indian player who participated in the Olympic games was an Anglo Indian 'Norman Prichard', who took part in the Second Olympic Games in 1900 and won two Silver medals in Athletics.
- Marrie Lila Ro is 1st Indian woman participant in the Olympic games.
- International Olympic Committee was founded in 1894 at "Chakhon".
- Generally, in the inaugural ceremony of Olympic games the team of Greece got first place and host team is placed in the last in March Past parade. The teams of other places are placed in the alphabetical order of English alphabets.
- The first woman referee in the football was a Canadian lady Sonia Denancord in (Atlanta Olympics).
- The maximum no. of gold medal winner sports woman is Larina Lavyanina. She won 18 medals including 9 gold medals.
- The maximum gold medal winner sports woman is Christina Otty. She got 6 gold medals in swimming in Seoul Olympic of 1986.

- The maximum gold medal winner male player in an Olympic is Michael Phelps of USA. He won 8 gold medals in swimming in the Beijing Olympics 2008.

London Olympics 2012

Mascot : Wenlock and Mandeville

- India ranked 55th in the medals tally with a total of 6 medals (2 Silver and 4 Bronze).
- The London Olympic Games were inaugurated by Queen Elizabeth II on July 27, 2012 in the Olympic Stadium, London.
- London is the first city in the world to stage Olympic Games thrice, after the 1908 and 1948 Summer Olympics. Entitled *Isles of Wonder*, the opening ceremony was devised by Oscar Award – winning director Daniel Boyle of *Slumdog Millionaire* fame with music directors Rick Smith and Karl Hyde of the electronic music duo *Underworld*.
- The inaugural ceremony of the London Olympic 2012 also had an Indian flavour in the form of music composers Ilayaraja and A. R. Rahman.
- The theme for the night, *Isles of Wonder* was inspired by William Shakespeare's play *'The Tempest'*.
- The 2012 Olympic programme featured 26 sports disciplines. For the first time, women's boxing is included in the programme. In tennis, mixed doubles event returns to the Olympic programme for the first time since 1924.
- Under the slogan "Inspire a Generation", the 30th edition of the Olympic Games will also be recorded as the first in which all participating delegations have female athletes. Brunei, Qatar and Saudi Arabia have included women for the first time, and Qatar named the female shooter, Bahiya–al–Hamad, as its flag-bearer.
- Yi Siling of China took the honour of claiming the first Gold Medal of the London Olympics when she won the women's 10 metre Air Rifle event on July 28, 2012.
- Wrestler Sushil Kumar led the Indian contingent holding the Indian tricolour in the opening ceremony, while female boxer M. C. Mary Kom was the flag bearer in the closing ceremony.
- The Indian Olympic Association (IOA) had sent a total of 83 athletes to compete in 13 sports, making it the largest contingent India has ever sent to the Olympic Games.
- In London Olympics India bagged a total of 6 medals with 1 Silver of Vijay Kumar in Shooting (Men's 25m Rapid Fire Pistol) and the second Silver medal of Sushil Kumar in Wrestling (Men's 66kg Freestyle), alongwith one Bronze each of Gagan Narang in Shooting (Men's 10m Air Rifle), Yogeshwar Dutt in Wrestling (Men's 60kg Freestyle), Saina Nehwal in Badminton (Women's Singles) and M. C. Mary Kom in Boxing (Women's Fly, 51 kg).
- Sushil Kumar's historic feat of winning back-to-back Olympic medals on the very last day of London Olympics 2012 turned out to be the high point of country's compaign. His Silver was India's fourth Wrestling medal in the Olympics and second in London after Yogeshwar Dutt, who won a Bronze in the 60 kg Freestyle event.

- KD (Khashaba Dadasaheb) Jadhav had won the country's first medal in Wrestling in 1952 Olympics at Helsinki.
- American swimmer Michael Phelps, the greatest Olympian of all time with his record 22 Olympic Medals, out of which 6 are from London Olympics, retired from the game after winning his fourth consecutive Gold on August 4, 2012. He also holds the all time records for Gold Medals (18, double that of the next highest record holders), Gold Medals in individual events (11), and Olympic medals in individual events for a male (13).
- Jamaica was dominant on the track again in London; highlighted by the men's 4 × 100m relay record. This record-breaking race marked the third time since 2008 that the Jamiacan team had broken the record. Bolt also became an Olympic legend by repeating as champion in both the 100 metre and 200-metre sprints.

Medals Tally (Top Ten Nations and India) of London Olympics, 2012

S.No.	Country	Gold	Silver	Bronze	Total
1	USA	46	29	29	104
2	China	38	27	23	88
3	Britain	29	17	19	65
4	Russia	24	26	32	82
5	S. Korea	13	08	07	28
6	Germany	11	19	14	44
7	France	11	11	12	34
8	Italy	08	09	11	28
9	Hungary	08	04	05	17
10	Australia	07	16	12	35
55	India	00	02	04	06

Some important results of Team events in London Olympics

Sport	Male		Female	
	Winner	Runner	Winner	Runner
Hockey	Germany	Netherlands	Netherlands	Argentina
Football	Mexico	Brazil	U.S.A.	Japan
Volleyball	Russia	Brazil	Brazil	U.S.A.
Basketball	U.S.A.	Spain	U.S.A.	France
Water Polo	Croatia	Italy	U.S.A.	Spain

Journey of Olympics (Since 1896)

First Olympics

- Year – 1896
- Date – April 4 to 15
- Place – Athens (Greece)
- Participating Countries – 13
- Players – 311 (all males)
- Game Competitions – 42
- India's position – *Not participated*

Second Olympics

- Year – 1900
- Date – May 20 to October 28
- Place – Paris (France)
- Participating Countries – 22
- Players – 1330 (11 females)
- Competitions – 60
- India's position – 2 Silver medals (Wonby Norman Prichard–Athletics)

Third Olympics
- Year – 1904
- Date – July 1 to November 23
- Place – St. Louis (America)
- Participating Countries – 12
- Players – 625 (8 females)
- Competitions – 67
- India's position –

Not participated

Fourth Olympics
- Year – 1908
- Date – April 27 to October 31
- Place – London (Britain)
- Participating Countries – 22
- Players – 2035 (36 females)
- Competitions – 104
- India's position –

Not participated

Fifth Olympics
- Year – 1912
- Date – May 5 to July 22
- Place – Stockholm (Sweden)
- Participating Countries – 28
- Players – 2547 (57 females)
- Competitions – 106
- India's position –

Not participated

Sixth Olympics
- Year – 1916
- Date – Cancelled due to World War I
- Place – Berlin (Germany)

Seventh Olympics
- Year – 1920
- Date – April 20 to Sept. 12
- Place – Antwerp (Belgium)
- Participating Countries – 29
- Players – 2607 (64 females)
- Competitions – 104
- India's position – Did not win any medal

Eighth Olympics
- Year – 1924
- Date – May 4 to July 27
- Place – Paris (France)
- Participating Countries – 44
- Players – 3092 (136 females)
- Competitions - 126
- India's position – Did not win any medal

Ninth Olympics
- Year – 1928
- Date – May 17 to August 12
- Place – Amsterdam (Holland)
- Participating Countries – 46
- Players – 3014 (290 females)
- Competitions – 109
- India's position – 1 Gold medal (in hockey)

Tenth Olympics
- Year – 1932
- Date – July 30 to August 14
- Place – Los Angels (USA)
- Participating Countries – 37
- Players – 1408 (127 females)
- Competitions – 117
- India's position – 1 Gold medal (in hockey)

Eleventh Olympics
- Year – 1936
- Date – August 1 to 16
- Place – Berlin (Germany)
- Participating Countries – 49
- Players – 4066 (328 females)
- Competitions – 129
- India's position – 1 Gold medal (in hockey)

Twelfth Olympics
- Year – 1940
- Cancelled due to World War II
- Place – Tokyo, later on Helsinki

Thirteenth Olympics
- Year – 1944
- Cancelled due to World War II
- Place – London (Britain)

Fourteenth Olympics
- Year – 1948
- Date – July 29 to August 14
- Place – London (Britain)
- Participating Countries – 59
- Players – 4099 (385 females)
- Competitions – 136
- India's position – 1 Gold medal (in hockey)

Fifteenth Olympics
- Year – 1952
- Date – July 19 to August 3
- Place – Helsinki (Finland)
- Participating Countries – 69
- Players – 4925 (518 females)
- Competitions – 149
- India's position – 1 Gold medal (in hockey) and 1 Bronze medal (in wrestling)

Sixteenth Olympics
- Year – 1956
- Date – Nov. 22 to Dec. 8
- Place – Melbourne (Australia)
- Participating Countries – 71
- Players – 3342 (384 females)
- Competitions – 145
- India's position – 1 Gold medal (in hockey)

Seventeenth Olympics
- Year – 1960
- Date–August 25 to September 11
- Place – Rome (Italy)
- Participating Countries – 83
- Players – 5348 (61 females)
- Competitions – 150
- India's position - 1 Silver medal (in hockey)

Eighteenth Olympics
- Year – 1964
- Date – October 10 to 24
- Place – Tokyo (Japan)
- Participating Countries – 93
- Players – 5140 (683 females)
- Competitions – 163
- India's position – 1 Gold medal (hockey)

Nineteenth Olympics
- Year – 1968
- Date – October 12 to 27
- Place – Mexico City (Mexico)
- Participating Countries – 112
- Players – 5531 (781 females)
- Competitions – 182
- India's position – 1 Bronze medal (in hockey)

Twentieth Olympics
- Year – 1972
- Date – August 26 to Sept. 10
- Place – Munich (W. Germany)
- Participating Countries – 122
- Players – 7147 (1070 females)
- Competitions – 195
- India's position –1 Bronze medal (in hockey)

Twenty First Olympics
- Year – 1976
- Date – July 17 to August 1
- Place – Montreal (Canada)
- Participating Countries – 92
- Players – 6152 (1261 females)
- Competitions – 198
- India's position - Did not win any medal, were at position 7th in hockey

Twenty Second Olympics
- Year – 1980
- Date – July 19 to August 3
- Place – Moscow (Soviet Union)
- Participating Countries – 81
- Players – 5326 (1088 females)
- Competitions – 203
- India's position – 1 Gold medal (in hockey)

Twenty Third Olympics
- Year – 1984
- Date – July 28 to August 12
- Place – Los Angeles (U.S.A.)
- Participating Countries – 140
- Players – 7078 (1620 females)
- Competitions – 221
- India's position – Did not win any medal, 5th position in hockey

Twenty Fourth Olympics
- Year – 1988
- Date – September 17 to October 2
- Place – Seoul (S. Korea)
- Participating Countries – 159
- Players – 8,465
- Competitions - 237
- India's position – Did not win any medal, ranked sixth in hockey

Twenty Fifth Olympics
- Year – 1992
- Date – July 25 to August 9
- Place – Barcelona (Spain)
- Participating Countries – 169
- Players – 9,367
- Competitions - 257
- India's position – Did not win any medal

Twenty Sixth Olympics
- Year – 1996
- Date – July 19 to August 4
- Place – Atlanta (U.S.A.)
- Participating Countries – 197
- Players – 10,310
- Competitions – 271
- India's position – Leander Paes won a Bronze medal (in Lawn Tennis).

Twenty Seventh Olympics
- Year – 2000
- Date – Sept. 15 to Oct. 1
- Place – Sydney (Australia)
- Participating Countries – 200
- Number of players – 10,321
- Competitions – 300
- India's position – Karnam Malleshwari won a Bronze medal in the Weight lifting (in the 69 kg category).

Twenty Eighth Olympics
- Year – 2004
- Date – August 13 to August 29
- Place – Athens (Egypt)
- Participating Countries – 201
- Number of players – 10,500
- Competitions – 301
- India's position – Major Rajyavardhan Singh Rathore won a Silver medal (Shooting).

Twenty Ninth Olympics
- Year – 2008
- Place – Beijing (China)
- Participating Countries – 204
- Players – 10,708
- Competitions – 302
- India's position - 50th (with 1 Gold and 2 Bronze medals)

Thirtyth Olympics
- Year – 2012 (July. 27 – Aug. 12)
- Place – London
- Participating Countries – 204
- Players – 10,500
- Competitions (events) – 302
- India's position - 55th (with 2 Silver and 4 Bronze medals)

Thirty-first Olympics
- Year – 2016 (Aug. 05 – Sep. 21)
- Place (Proposed)- Rio de Janerio (Brazil)

Thirty-second Olympics
- Year—2020
- Place (Proposed)—Tokyo (Japan)

Paralympics and Winter Olympics

- London Paralympics 2012 (Aug. 29-Sept. 09, 2012) : London, the host city welcomed the 14th Paralympic Games with a spectacular Opening Ceremony, held in the Olympic Stadium. A total of 4294 athletes from 164 countries participated in the Games. China won the most medals – 231 (95 Gold, 71 Silver, 65 Bronze) followed by Russian Federation - 102 (36 G, 38S, 28 B) and Great Britain- 120 (34 G, 43 S, 43 B).

- In London Paralympics 2012 :Girisha H. Nagarajegowda (Karnataka) clinched the only medal after bagging the Silver in the Men's High Jump F42 event. Girisha is the third Indian after Javelin thrower Bhimrao Kesarkar and Shot put thrower Joginder Singh Bedi to claim Silver at the Paralympic Games. Kesarkar and Bedi won Silver at the 1984 Paralympics.
- First Ever Gold for India : India's Devendra created history by winning the first ever gold for the country in Athens Paralympics 2004. He claimed gold in Javelin throw.
- The first Games for disabled athletes were held in 1948 in Stoke Mandeville, England. On the day of the Opening Ceremony of the 1948 Olympic Games in London, the Stoke Mandeville Games were also launched and the first competition for wheelchair-bound athletes was organized.
- Olympic style Games for athletes with disability were organized for the first time in Rome in 1960, immediately after the Olympic Games. They are considered the first Paralympic Games.
- Since then, Paralympic Games have been organized after every four years. The Paralympic Games have always been held in the same year as the Olympic Games.
- Other disability groups were added in Toronto (Canada) in 1976 and the idea of merging together different disability groups for international sports competitions, was conceived. In the same year, the first Paralympic Winter Games took place in Sweden.

The next Paralympic Games will be held in 2016 in Rio de Janerio.

Winter Olympic Games :The Winter Olympic Games started in 1924 AD when the first Games were held at Chamonix, France followed by St. Moritz, Switzerland (1928 & 1948); Lake Placid, New York (1932 & 1980); Garmisch-Parthenkirchen, Germany (1936); Oslo, Norway (1952); Cortina d'Ampezzo, Italy (1956); Squaw Valley, California (1960); Innsbruck, Austria (1964 & 1976); Grenoble, France (1968); Sapporo, Japan (1972); Sarajevo, Yugoslavia (1984); Calgary, Canada (1988) and Albertville, France (1992). The XVII Winter Olympic Games were held in Lilleharnmer (Norway) in February 1994. Incidentally, the 1994 Games were the first in accordance with the International Olympic Committee's new cycle of having Winter Games and Summer Games two years apart, instead of in the same year, as had been the tradition since the commencement of these Games in 1924.

The XIX Winter Games were held in Salt Lake City (USA) from February 9 to 24, 2002. Germany topped in the Medals Tally winning 35 medals (including 12 Golds) while Norway finished as runner-up bagging 24 medals (11 Golds).

The XX Winter Olympics 2006 were held in Turin (Italy) from February 10-26, 2006. Germany once again topped the medals tally, after the 2002 Salt Lake Winter Olympics. The four-member Indian team was led by luge athlete Shiva Keshavan.

XXI Winter Olympics 2010 (February 12-28, 2010) :The 21st Winter Olympic was held in Vancouver, Canada from February 12 to 28, 2010. Total 2700 players of 82 countries participated in this 17 days sports festival.

XXII Winter Olympics 2014 (February 7-23, 2014) :22nd Winter Olympic Games at Sochi (Russia), the 17 day costlisest Olympics ever ($51 billion) of sport-driven global unity concluded on February 23, 2014.

Sochi Winter Olympics 2014 saw three athletes from India, luger Shiva Keshawan (fifth consecutive participation in the Winter Olympics), Alpine skier Himanshu Thakur and cross-country skier Nadeem Iqbal represent the country, but their performance was dismal.

Medals Tally of Top Five Countries in the 22nd Winter Olympics 2014

Country	Gold	Silver	Bronze	Total
Russia	13	11	9	33
Norway	11	5	10	26
Canada	10	10	5	25
USA	9	7	12	28
Netherlands	06	06	02	14

Sites of Winter Olympic Games

Year	Place	Year	Place
1924	Chamonix, France	1928	St. Moritz, Switzerland
1932	Lake Placid, New York	1936	Garmisch-Partenkirchen, Germany
1948	St. Moritz, Switzerland	1952	Oslo, Norway
1956	Cortina d'Ampezzo, Italy	1960	Squaw Valley, California
1964	Innsbruck, Austria	1968	Grenoble, France
1972	Sapporo, Japan	1976	Innsbruck, Austria
1980	Lake Placid, New York	1984	Sarajevo, Yugoslavia
1988	Calgary, Alberta	1992	Albertville, France
1994	Lillehammer, Norway	1998	Nagano, Japan
2002	Salt Lake City, USA	2006	Turin, Italy
2010	Vancouver, Canada	2014	Sochi, Russia
2018	Pyeong Chang, S. Korea (Scheduled)		

Commonwealth Games

After Olympics, Commonwealth Games is the second largest sports festival in the world. The Games are held once in four years but only in between the Olympic years. The Games were originally known as the British Empire Games.

- The 1st Commonwealth Games were held in 1930 at Hamilton, Canada.
- The 10th Commonwealth Games were held at Christchurch, New Zealand in 1974 and the 15th in Victoria (Canada) in 1994, where about 3,350 athletes from 64 nations (including South Africa, which joined the family of Commonwealth athletes after 36 years) participated.
- Namibia also, which gained its independence in 1990, made its debut while Hong Kong made its final appearance in the Games before being ceded to China in 1997.
- India, for the first time, participated in the second Commonwealth games held in London in 1934.

Commonwealth Games : At a Glance

Year	Places	Countries	Events	First	India's Medals
1930	Hamilton (Canada)	11	6	England	N. P.
1934	London (England)	16	6	England	B–1
1938	Sydney (Australia)	15	7	Australia	No medal
1950	Auckland (New Zealand)	12	7	Australia	N. P.
1954	Vancouver (Canada)	24	9	England	No medal
1958	Cardiff (Britain)	35	9	England	G–2, S–1
1962	Perth (Australia)	35	9	Australia	N. P.

Year	Places	Countries	Events	First	India's Medals
1966	Kingston (Jamaica)	34	9	England	G–3, S–4, B–5
1970	Edinburgh (U.K.)	42	9	Australia	G–5, S–3
1974	Christchurch (N. Zealand)	38	9	Australia	G–4, S–8, B–3
1978	Edmonton (Canada)	48	10	Canada	G–5, S–4, B–6
1982	Brisbane (Australia)	47	10	Australia	G–5, S–8, B–3
1986	Edinburgh (U.K.)	26	10	England	N. P.
1990	Auckland (New Zealand)	55	10	Australia	G–13, S–8, B–11
1994	Victoria (Canada)	64	—	Australia	G–6, S–11, B–7
1998	Kuala Lumpur (Malaysia)	70	16	Australia	G–7, S–10, B–8
2002	Manchester (England)	72	17	Australia	G–30, S–22, B–17 (3rd)
2006	Melbourne (Australia)	71	—	Australia	G–22, S–17, B–12 (4th)
2010	Delhi (India)	71	—	Australia	G–38, S–27, B–36 (2nd)
2014	Glassgow (Scottland)	71	18	England	G–15, S–30, B–19 (5th)
2018	Gold Coast City (Australia)	Scheduled			

XX Commonwealth Games (July 23 to August 3, 2014)

- The XIX Commonwealth Games were held in Glasgow (Scottland) from July 23 to August 3, 2014. Around 4,950 athletes from 71 nations participated in this 11-day sports extravaganza.
- England topped the medals tally with 174 (58 Gold, 59 Silver and 57 Bronze) medals, while Australia finished second with 137 (49 Gold, 42 Silver and 46 Bronze) medals. Canada was placed third with 82 medals (32 Gold, 16 Silver and 34 Bronze).
- The England's Jodie Stimpson won the first gold medal of the XX Commonwealth Games in Glasgow on July 24.
- The thistle man named 'Clyde' (named after the river w hich flows through the host city, Glasgow), the official mascot of the XX Commonwealth Games, was designed by Beth Gilmour (aged 12 years).

MEDALS TALLY (Top Ten Countries)

Country	Gold	Silver	Bronze	Total
England	58	59	57	174
Australia	49	42	46	137
Canada	32	16	34	82
Scottland	19	15	19	53
India	15	30	19	64
New Zealand	14	14	17	45
South Africa	13	10	17	40
Nigeria	11	11	14	36
Kenya	10	10	05	25
Jamaica	10	4	08	22

Best Athlete : *Canadian gymnast Franki Jones (won 6 medals, including 1 gold in the rhythmic gymnastics events) was honoured with the David Dixon Award after being adjudged the 'Best Athlete of the XX Commonwealth Games'.*

- **'Clyde'** was the **mascot** of the 2014 Commonwealth Games.
- No. of Commonwealth countries : 53
- No. of exhisting teams : 71
- Inauguration : 23rd July, 2014
- Closing : 3rd August, 2014
- Events : 272 events in 21 disciplines
- Officially opened by : Queen Elizabeth II on 23rd July, 2014 at Celtic Park, Glasgow.
- Queen's Baton last runner : Sir Chris Hoy

ASIAN GAMES

- The first Asian Games began on March 4, 1951 in New Delhi.
- The Asian Games Association has chosen shining sun as its symbol.
- The AGF (Asian Games Federation) adopted *'Ever Onward'*, given by Pt. Jawaharlal Nehru, as the *motto* of the Asian Games.
- The emblem of Asian Games is a 'bright full rising sun' with interlocking rings.
- The Maharaja of Patiala presented the Torch and the Flag for the first Asian Games and since then they have been carried from country to country.

ASIAN Games since 1951

Game Serial	Year	Places	Number of countries	Number of sports	Number of players
1st	1951	New Delhi (India)	11	6	491
2nd	1954	Manila (Philippines)	18	8	1021
3rd	1958	Tokyo (Japan)	20	13	1422
4th	1962	Jakarta (Indonesia)	16	13	1545
5th	1966	Bangkok (Thailand)	18	14	1945
6th	1970	Bangkok (Thailand)	18	13	1752
7th	1974	Tehran (Iran)	25	16	2869
8th	1978	Bangkok (Thailand)	25	19	3000
9th	1982	New Delhi (India)	33	21	3447
10th	1986	Seoul (S. Korea)	27	25	3883
11th	1990	Beijing (China)	37	27	4500
12th	1994	Hiroshima (Japan)	42	34	7300
13th	1998	Bangkok (Thailand)	41	38	7000
14th	2002	Busan (S. Korea)	44	38	9919
15th	2006	Doha (Qatar)	45	39	10000+
16th	2010	Guangzou (China)	45	42	9704
17th	2014	Incheon (South Korea)	45	36	9501

- 18th Asian Games will be held in Jakarta, Indonesia in 2018.

Position of India in Asian Games Medal Tally

Sl.	Year	Gold	Silver	Bronze	Total	Position
1.	1951	15	18	21	54	2nd
2.	1954	5	4	9	18	5th
3.	1958	5	4	4	13	7th
4.	1962	10	13	11	34	3rd
5.	1966	7	5	11	23	5th
6.	1970	6	9	10	25	5th
7.	1974	4	12	12	28	7th
8.	1978	11	11	6	28	5th
9.	1982	13	19	25	57	5th
10.	1986	5	9	23	37	5th
11.	1990	1	8	14	23	11th

Sl.	Year	Gold	Silver	Bronze	Total	Position
12.	1994	4	3	15	22	8th
13.	1998	7	11	17	35	9th
14.	2002	11	12	13	36	8th
15.	2006	10	18	26	54	8th
16.	2010	14	17	33	64	6th
17.	2014	11	10	36	57	8th

XVII Asian Games (19 Sept. – 4 Oct. 2014)

- 17th Asian Games (2014), officially known as the XVII Asiad, was opened by S.Korean President Ms. Park Geun-hye on 19 Sept. 2014 at Incheon Asiad Main Stadium.
- India bagged the first gold medal at Incheon, when Jitu Rai won Gold in the men's 50 m pistol.
- China, South Korea and Japan came first, second and third respectively in the 17th Asian Games.
- XVII Asiad came to a close on Oct. 4, 2014 with China (151 Gold, 108 Silver and 83 Bronze) topping the overall medals tally.
- India won 11 gold, 10 silver and 36 bronze medals and managed to occupy the 8th position.

17th ASIAN GAMES
Final Medals Tally of Top 10 Countries

Country	Gold	Silver	Bronze	Total
China	151	108	83	342
S. Korea	79	71	84	234
Japan	47	76	77	200
Kazakhastan	28	23	33	84
Iran	21	18	18	57
Thailand	12	7	28	47
North Korea	11	11	14	36
India	11	10	36	57
Chinese Taipei	10	18	23	51
Qatar	10	0	4	14

XVII ASIAN GAMES : General Information

★ Host city : Incheon, South Korea

- Incheon was awarded the right on April 17, 2007, defeating Delhi, India to host the Games. Incheon is the third city in South Korea after Seoul (1986) and Busan (2002) to host the Asian Games.

★ Motto : *Diversity Shines Here* ★ Participating Nations : 45 ★ Athletes participating : 9,501 (5,823 men, 3,678 women ★ Events : 439 in 36 sports ★ Opening ceremony : September 19 ★ Closing ceremony : October 4 ★ Athlete's Oath : Oh Jin-hyek Nam Hyun-hee ★ Torch Lighter : Lee Young-ae ★ Main venue : Incheon Asiad Main Stadium ★ Total Medals : 1454 [439 (G) + 439 (S) + 576 (B)] ★ Timekeeper : Swiss watchmaker company Tissot was the official timekeeper of the Games.

★ Mascots :

- The Prototypes for Harbour seals from Baengnyeong island off west coast of the Korean Peninsula, named Vichuon, Barame and Chumuro, were the mascots of the Games.
- Three Spotted seal siblings was unveiled on 4 November ,2010 as official mascot of the Games in Songdo Island, Incheon. The three seals, known as "Barame", "Chumuro" and "Vichuon", means

Fig. : (From left to right Chumuro Vichuon and Barame)

wind, dance and light in Korean language, is in accordance with the theme of main venue.

➢ The prototype was taken from Baengnyeong Island. According to the organisers, the mascot was chosen as symbolic to the future peace between South Korea and North Korea.

★ Emblem :

➢ A huge wing consisting of a string of "A", the first letter of "Asia", with a shining sun at its upper left, symbolising the Asian people holding hands in the sky was the official emblem. The official emblem also unveiled on same day (4 Nov., 2010).

Fig. : (Official emblem of the 2014 Asian Games)

➢ China broke the 150-Gold barrier and finished on top with a tally of 342 medals in all. It was followed by South Korea with 79 Gold and Japan with 47 Gold. Kazakhstan, Iran, Thailand and North Korea took 4th, 5th, 6th and 7th spots respectively.

➢ India signed off with 57 medals—11 Gold, 10 Silver and 36 Bronze, taking the 8th position. The tally dipped considerably compared to the 2010 edition in Guangzhou, China. In 2010, the country had ended sixth with 65 medals—14 Gold, 17 Silver and 34 Bronze.

➢ The first Gold at the Incheon Games for India was earned by Jitu Rai in men's 50m pistol.

➢ Legendary boxer M C Mary Kom became the first Indian woman boxer to clinch Asian Games Gold.

➢ Yogeshwar Dutt won Gold in 65 kg freestyle wrestling, ending country's 28-year-old medal drought in that event.

➢ Seema Punia earned country its first athletics Gold medal in the Asian Games by winning the women's discus throw event.

➢ In a nail-biting action, hockey squad led by Sardar Singh defeated Pakistan to win the Asian Games men's hockey Gold after 16 years.

➢ Women's 4 × 400m relay team clinched the record fourth consecutive Gold. Gold medals in other disciplines—fetched by compound men's team archers, men's squash team spearheaded by Saurav Ghosal, tennis mixed doubles pair of Sania Mirza and Saket Myneni, and the kabaddi men's and women's teams. Other notable achievement was the women sailing team winning the first medal at the Asian Games.

★ Records :

➢ The 17th edition of the Asian Games registered 14 new world records and 28 Asian ones. More than half of the new world records were set by weightlifters breaking nine of the preexisting records in the sport of weightlifting.

➢ Japanese swimmer Hagino Kosuke, who won seven medals, including four Golds, won the Samsung Most Valuable Player of the Games award.

★ Other major achievers :

➢ Swimmer Dmitry Igorevich Balandin of Kazakhstan won three Golds in 50, 100 and 200 metre breaststroke competitions.

➢ Korea's Kim Cheong-yong (17) became the youngest shooter in Asian Games to achieve top honour in 10 metre air pistol, winning two Golds.

➢ Sorn Seavmey earned Cambodia its first Gold at Asian Games after a 44 years of wait, by winning the Taekwondo, 73-kg event.

➢ Yao Jinnan, the Chinese Gymnast, won four Golds in Team, Individual all-around, Uneven bars and Floor exercise events.

★ The Host : Incheon was the third city in South Korea, after Seoul and Busan, to host the Asian Games.

★ The Next Host : Indonesia will host the next XVIII edition of the Asian Games in Jakarta, in 2018.

★ Closing Ceremony : The closing ceremony was held on Oct. 4, 2014 with the theme "Our Cherished Memories of Incheon".

➢ The ceremony also included the segment from next Asian Games host city, Jakarta. It started with "The colours of Jakarta", featured a Javanese dance known as Ronggeng. It followed by "The spirit of South Sumatra featured Malay dance.

➢ Participants from 45 countries participated in 439 events in the following 36 sports :

1. Aquatics (Diving, Swimming, Synchronised Swimming, Water Polo), 2. Archery, 3. Athletics, 4. Badminton, 5. Baseball (Baseball, Softball), 6. Basketball, 7. Bowling, 8. Boxing, 9. Canoe (Canoe Sprint, Obstacle, Slalom) 10. Cricket, 11. Cycling (Track, Road, Mountain Bike, BMX), 12. Equestrian, 13. Fencing, 14. Football 15. Golf, 16. Gymnastic (Artistic, Rhythmic, Trampoline), 17. Handball, 18. Hockey, 19. Judo, 20. Kabaddi, 21. Karate, 22. Modern Pantathlon, 23. Rowing, 24. Rugby, 25. Sailing, 26. Sepaktakraw, 27. Shooting, 28. Squash, 29. Table Tennis, 30. Tackwando, 31. Tennis (Tennis, Soft Tennis), 32. Triathlon, 33. Volleyball (Beach Volleyball, Volleyball), 34. Weightlifting 35.Wrestling, 36. Wushu.

SAF Games

The South Asian Federation Games (SAF Games) is a sport festival of South Asian countries. The South Asian Sports Federation comprising India, Pakistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives was formed in New Delhi on November 26, 1982.

➢ The first SAF Games were held in Kathmandu in 1984 followed by Dhaka (1985), Kolkata (1987), Islamabad (1989), Colombo (1991), Dhaka (1993) and Chennai (1995).

➢ The Eighth SAF Games (Septemebr 25-October 4, 1999) were held in Kathmandu.

➢ As hitherto, India notched the top position winning 197 medals including 102 Gold. Nepal with 65 medals including 31 golds and Sri Lanka 119 medals (16 golds) finished on the second and third places, respectively.

➢ The 10th South Asian Federation Games (18-28 August, 2006) were held in Sri Lanka and India retained the crown, with 118 Gold, 69 Silver and 47 Bronze. Pakistan (43 – 44 – 71) and hosts Sri Lanka (37–63–78) came on the second and third positions respectively in the medals tally.

Flag and Motto of the SAF Games : The SAF Games flag includes a dove, suggesting the desire for peace in the area. The motto of the SAF Games is 'Peace, Prosperity and Progress'.

New Name for SAF Games : The SAF Games have been rechristened as South Asian Games, according to a decision taken by the South Asian Sports Federation at its 32nd meeting held in Islamabad (Pakistan) on April 2, 2004.

11th South Asian Games

- India retained the crown at the 11th SA Games (January 29 - February 09, 2010) played in Dhaka, Bangladesh.
- It finished on top of the medals tally with 90 gold, 55 silver and 30 bronze medals.
- Pakistan came second and the hosts Bangladesh third.
- India dominated the events in badminton, swimming, T.T. and shooting.

Medals Tally

S. No.	Country	Gold	Silver	Bronze	Total
1.	India	90	55	30	175
2.	Pakistan	19	25	36	80
3.	Bangladesh	18	23	56	97
4.	Sri Lanka	16	35	54	105
5.	Nepal	08	09	19	36
6.	Afghanistan	07	09	16	32
7.	Bhutan	0	02	03	05
8.	Maldives	0	0	02	02

12th South Asian Games : India will be the host for the 12th South Asian Games, were rescheduled to be held in 2013, but not held till now.

Some Important Sports And Related Information

Cricket

- It is believed that Cricket was started in England in 1300 A.D.
- It started as a game of shepherds and became popular among other classes in 18th century A.D.
- After some time a club known as "Merylebone Cricket Club" (M.C.C.) was formed at Lords in London.
- Cricket became popular in Australia due to British influence there.
- The first official cricket test match was played in the year 1877 between Australia and England in Melbourne.
- When some other countries started playing Cricket Imperical Cricket Conference was formed in 1909 which gave birth to International Cricket Conference in 1956.
- The first One Day International cricket match was played in the year 1971 between England and Australia in Melbourne.

The ICC World Test Championship

The ICC World Test Championship is intended to become the premier championship for Test cricket run by International Cricket Council (ICC).

The first ICC World Test Championship is to be held in 2017 in England.

The original plans to hold the competition in 2013 were abandoned due to financial problems.

It will replace the One-day International competition the ICC Champions Trophy, which was held in 2013 for the last time.

- The first World Cup of one day matches was played in 1975 in London. West Indies won the World Cup beating Australia by 17 runs.
- The apex institution of world cricket is the 'International Cricket Council' (ICC) and its headquarters is now in Dubai from August 1, 2005. Earlier it was in Lords (England).
- Australia has won maximum of five World Cups till 2015.
- In India Cricket was introduced by British royalty. Parsee community of India was the first to take part in Cricket in 1848.
- Later on Parsee team visited England in 1886. Matches between European and Parsee teams, called Presidency matches, were started in Poona (now Pune) and Bombay (now Mumbai).
- Raja Bhupindra Singh of Patiala donated the Ranji Trophy in 1934 for the national championship of Cricket.
- The Board of Control for Cricket in India was formed in 1927.

Measurements in cricket :

Length of the Pitch – 22 yards (20.11metres)
Length of the Crease – 1.22 – 1.83 metres (4 ft.)
Weight of the Ball – 155 to 163 gram
Circumference of the Ball – 22.4 -22.9 cm (9 Inch)
Length of the Bat – 96.5 cm (38 inch)
Width of the Bat – 10.8 cm (4.25 inch)
Length of the Stumps – 71.1 cm (28 inch)
Length of Bells – 11.1cm (each bell)

Winners of World Cup Cricket since 1975

Year	Place	Winner	Runners up
1975	England	West Indies	Australia
1979	England	West Indies	England
1983	England	India	West Indies
1987	India and Pakistan	Australia	England
1991	Australia and New Zealand	Pakistan	England
1996	India, Pakistan and Sri Lanka	Sri Lanka	Australia
1999	England	Australia	Pakistan
2003	South Africa	Australia	India
2007	West Indies	Australia	Sri Lanka
2011	India, Sri Lanka & Bangladesh	India	Sri Lanka
2015	Australia & New Zealand	Australia	New Zealand
2019	England	Scheduled	
2023	India	Scheduled	

Cricket World Cup 2011, 2015 and 2019

- Initially India, Pakistan, Sri Lanka and Bangladesh were to host jointly the 2011 cricket World Cup, which comes to the sub continent after a gap of 15 years, but after the terrorist attack on Sri Lankan cricket team in Pakistan, Pakistan's name has been canceled from the hosts' list by the ICC.
- India was the main host of World Cup 2011.

- Inauguration ceremony was held at Sheikh Muzib Statidum, Dhaka, Bangladesh on 17th Feb., 2011, while the final match was held at Wankhede Stadium, Mumbai on April 2, 2011.
- M.S. Dhoni, the Captain of Indian Team was adjudged the 'Man of the Match', while Yuvraj Singh was declared the 'Man of the Tournament' in ICC Cricket World Cup 2011.
- India, Pakistan and Sri Lanka were the co-hosts for the 1996 world cup.
- Out of total 49 matches in 2011 World Cup India hosted 29 matches (including the final), Sri Lanka 12 and Bangladesh 8 matches respectively.
- The matches of Cricket World Cup 2011 held in 12 cities of three host countries (India, Sri Lanka and Bangladesh and total 14 teams participated in two groups, i.e. Group 'A' and Group 'B'. India was in Group 'B'.
- India beat Australia in Quarter Final (QF), Pakistan in Semi Final (SF) and Sri Lanka in Final match.
- Jumbo (the elephant) : The mascot of 2011 World Cup Cricket was unveiled in Colombo on April 02, 2010.
- The 2015 World Cup has been awarded jointly to Australia and New Zealand, while England will be the host for the 2019 edition of the Cup.
- Some important Terminologies of Cricket : Played on, Appeal, Bye, Leg Bye, Power Play, Follow on, Dusara, Beamer, Hoober Shot, Lost Ball, Duck worthLuis, Retired Hurt, Chinaman, Batsman, Bowler, Wicket Keeper, Fielder, LBW (Leg Before Wicket), Catch, Hit wicket, Throw, Maiden over, Four, Sixer, Wide, Swing, Stroke, Cover, Mid on, Mid Off, Mid wicket, Over the wicket, Round the wicket, Leg spinner, Off spinner, Over throw, Over Slip, Gulley, Cover point, Silly point, Long off, Long on, Third man, Short pitch, Hook, Dead ball, Run out, Popping crease, Pitch, Bouncer (or Bumper), Full Toss, Yorker, Yorked, Googly, Wicket Maiden, Snick, Duck, Hat -Trick, Rubber, The Ashes, Scoring a Ton etc.

ICC Twenty-20 Cricket World Cup

- The first ICC Twenty-20 (T–20) World Cup Cricket held in South Africa in September 11-24, 2007. In the final match played at Wanderers stadium in Johannesburg, India thrashed Pakistan by 5 runs and clinched the first T-20 world cup trophy.
- Pakistan emerged winners of the second (2009) edition of the ICC Twenty-20 World Cup Cricket, beating Sri Lanka by 8 wickets in the final in London, England on June 21, 2009.
- In the third (2010) edition of the ICC T-20 World Cup Cricket England clinched the cup, defeating Australia by 7 wickets in the final in Bridgetown, Barbados (West Indies), on May 16, 2010.
- In the fourth ICC T-20 World Cup (2012) West Indies defeated the host Sri Lanka in the final at Colombo on Oct. 7, 2012.
- The fifth (ICC T-20 World Cup) was hosted by Bangladesh in 2014, from March 16 to April 6. Sri Lanka defeated India in the final by 6 wickets at Sher-e-Bangla Stadium in Dhaka (Bangladesh). Virat Kohli was declared 'Man of the Series'.
- India will host its sixth edition in 2016.

- In all the five ICC T-20 World Cup held till 2014, M.S. Dhoni was the Captain of Indian team.

4th ICC Women's World Twenty-20

- Two time defending champion Australia won ICC Women's World Twenty-20 Championship 2014, defeating England by 6 wickets, in the final at Dhaka (Bangladesh) on April 06, 2014.

Football

- It is believed that Football is also of British origin. However, it is said that a game similar to Football was played in 500 B.C. by the Greeks of Sparta and they called this game 'Harpaston'. The first football club of the world 'Sheffield Football Club' was founded in the year 1857 in England. Football was introduced in India by the Britishers in 1848 and the first football club of India was 'Dalhousie Club'. The Indian Football Association, the oldest football association in the east, was formed in 1878. The apex institution of football is 'Federation of International de Football Association' (FIFA), which was formed by seven countries on May 21, 1904. The headquarters of FIFA is in Paris (France). In order to distinguish this game from the carrying cum kicking game i.e. Rugby, it was given the name of "Soccer". This name was given to this game (Football) by an association named London Football Association which was formed in 1863 in England. The Football World Cup, organized by the FIFA, is the biggest competition.
- Football was included as a competitive game in Olympic Games officially in 1908.
- India took part in the World Olympic Football Competition in 1948 in London.
- Besides Olympic competitions, World Cup Football Championships were planned by two Frenchmen i.e. M Jules Rimet and Henry Delaunay.
- Jules Rimet was president of the French Football Federation and remained president of FIFA from 1924 to 1954.
- The first World Cup was organised at Monte Video (Uruguay) in 1930.
- The Trophy for this championship was named as "Jules Rimet Cup". This trophy became the permanent property of Brazil, as this country had won the world title for the third time (1958, 1962 and 1970).
- From 1974 (Xth championship of Germany) onwards, the trophy was named as "The FIFA World Cup". This was a new trophy cast in 18 ct. gold.
- In India Indian Football Association (IFA) organises National Football Championship.
- The trophy awarded in their competition is called Santosh Trophy, which was donated in the memory of Manmath Nath Roy Chaudhary of Santosh (now a part of Bangladesh).
- Durand Cup tournament, the oldest football tournament of India and the second oldest tournament of the world was started in 1888.
- Durand Cup tournament was first organised at Shimla and is being held in Delhi since 1940.
- A new chapter was added to the annals of the country's (India's) soccer with the launch of the Football Players' Association (FPA) of India in Kolkata on August 13, 2006.

- FIFA announced (in April 17, 2007) an assistance of $ 1 million to Indian football by launching 'Win in India with India' project that will initially run for a period of four year.
- FIFA President Joseph S. Blatter (during his visit to India in April, 2007) hinted that India could gain another grant of $ 400,000 for the third 'FIFA Goal Project' it was entitled to.
- The All India Football Federation (AIFF) has started the 'Goal Project' in Manipur and the second was launched in Delhi.
- FIFA and the Asian Football Confederation (AFC) have identified Sikkim as the third site of the project.
- According to Mr. Blatter the new project that the FIFA has specially launched for India will get annual grant of $ 250,000 for four years.
- FIFA World Cup is played after every four years.

Winners of World Cup Football

Year	Place	Mascot	Winner	Runners up
1930	Uruguay	—	Uruguay	Argentina
1934	Italy	—	Italy	Czechoslovakia
1938	France	—	Italy	Hungary
1942	Cancelled	—	—	—
1946	(2nd World War)			
1950	Brazil	—	Uruguay	Brazil
1954	Switzerland	—	West Germany	Hungary
1958	Sweden	—	Brazil	Sweden
1962	Chile	—	Brazil	Czechoslovakia
1966	England	Willie	England	West Germany
1970	Mexico	Juanito	Brazil	Italy
1974	West Germany	Tip and Tap	West Germany	Holland
1978	Argentina	Gauchito	Argentina	Holland
1982	Spain	Naranjito	Italy	West Germany
1986	Mexico	Pique	Argentina	West Germany
1990	Italy	Ciao	West Germany	Argentina
1994	U.S.A.	Striker	Brazil	Italy
1998	France	Footix	France	Brazil
2002	Japan and S. Korea	Ato, Kaz & Nik	Brazil	Germany
2006	Germany	Goleo	Italy	France
2010	South Africa	Zakumi	Spain	Netherlands(Holland)
2014	Brazil	Fuleco	Germany	Argentina
2018	Russia	—	(Scheduled)	—
2022	Qatar	—	(Scheduled)	

- The measurements of the playground :
  Length of the ground (Field)– 91 to 120 metres
  Width of the ground (Field) – 45 to 91 metres
  Weight of the ball – 396 to 453 grams
  Circumference of the ball – 68 to 71 cm

- Some important Terminologies of Football : Abbey, Dribble, Extra time, Full back, Half back, Striker, Centre, Forward, Penalty kick, Free kick, Scissor Kick, Goal Kick, Direct Kick, Corner Kick, Referee, Tie breaker, Hat trick, Hand ball, Sweeper, Back, Throw in, Hand-ball (fault), Touch line, Place Kick or Kick off, Direct Free Kick, Indirect Free Kick, Tackle, Off side, Sliding Tackle, Drop Ball, Sudden death, Penalty shoot out etc.

20th FIFA World Cup Football–2014

Official Logo : Juntos num so ritmo (all in one rhythm)

- Mascot—Fuleco
- Started—June 12, 2014 in Sao Paulo (Brazil)
- Final Match held—July 13, 2014 in Maracana, Rio de Janerio (Brazil)
- Winner—Germany
- Runners up—Argentina
- Third Position—Netherlands
- Total—64 matches
- Golden Ball Award Winner (for best player)—Lionel Messi (Argentina)
- Golden Boot Award Winner (for top scorer)—James Rodriguez (Columbia)
- Golden Glove Award Winner (for best goalkeeper)—Manuel Neuer (Germany)

Hockey

- 'Blackheath Rugby and Hockey Club' is the first hockey club in the world which was set up in the year 1861 in England.
- London was the first city in England to popularize this game in the 1870s.
- In the year 1886, Hockey Association of England was formed in London.
- The apex institution of hockey is *'Federation Internationale de Hockey'*, established on January 7, 1924, with headquarters at Vienna (Austria) and later shifted to Paris (France). The first International Hockey Match was played between Wales and Ireland in Rayle on June 26, 1895.
- Hockey was introduced in the Olympic games for the first time in 1908 in London.
- Indian Hockey Federation (IHF) was formed on the 7th November, 1925 at Gwalior.
- Since 1944, National Hockey Championship is organised by the I.H.F. every year.
- All India Women's Hockey Federation was formed in 1947.
- India took that part in Olympics for the first time in 1928 (in Amsterdam Olympics).
- In Olympics, India has won the hockey title a maximum of 8 times. The first World Cup Hockey was played in Barcelona in 1971.

World Cup Hockey

Year	Place	Winner	Runners up	India's position
1971	Barcelona	Pakistan	Spain	Third
1972	Amsterdam	Holland	India	Second

Year	Place	Winner	Runners up	India's position
1975	Kuala Lumpur	India	Pakistan	First
1978	Buenos Aires	Pakistan	Holland	Sixth
1982	Mumbai	Pakistan	West Germany	Fifth
1986	London	Australia	England	Twelfth
1990	Lahore	Holland	Pakistan	Tenth
1994	Sydney	Pakistan	Holland	Fifth
1998	Utrecht	Holland	Spain	Ninth
2002	Kuala Lumpur	Germany	Australia	Tenth
2006	Monchengladbach (Germany)	Germany	Australia	Eleventh
2010	New Delhi	Australia	Germany	Eighth
2014	The Hegue	Australia	Netherlands	Ninth

- The next World Cup Hockey (Mens) is proposed to be held in 2018 in Bhubneshwar (India).
- Measurements (Hockey) :

  No. of Players – 11 players in each team

  Length of the Playing field – 91.44 metres

  Width of the Playing field – 50 to 55 metres

  Weight of the Ball – 155 to 163 grams

  Circumference of the Ball – 223 - 224 cm.

  Colour of the Ball – White

  Weight of the Hockey (Stick) – 280 grams (max)
- Terminology – Advantage, Back -stick, Bully, Carry, Dribble, Dodge, Goal line, Green Card, Flick, Free hit, Face of stick, Jab Stroke, Lung Stroke, Melee, Off side, Penalty shoot out, Short Corner, Striking circle or Shooting circle, Square pass, Tackling, Through pass, Under cutting, Stick, Penalty stroke, Scoop, Side line, Tie breaker, Penalty, Under cutting, Volley, Centre forward, Roll in, Push in, Shooting, Half volley, Full back etc.

Volleyball

- Volleyball, the game played with an inflated bladder and a high net was invented in 1895 at Holyoke Y.M.C.A. Gymnasium in United States of America by a Physical Director William J. Morgan.
- Its first name was 'MINTONNETTE' which was later named as Volleyball by Dr. A.T. Halsted of Springfield College because the ball had to be volleyed with hands from one side to the other.
- 'International Volleyball Association' was formed in 1947 with its headquarters in Paris (France).
- The first World Volleyball Championship was held in 1949 at Prague.
- The first Asian Volleyball Championship was held at Tokyo (Japan) in 1955 (India beats Japan in the final).
- The Volleyball Federation of India was formed in 1950.
- Measurements (Volleyball) – Length of the court - 18 metre, Width of the court – 9 metre, Weight of the ball – 250 to 260 grams, Circumference of the ball – 65-67 cm, Net – 1m (± 3 cm) wide and 9.5 m long, Net's height – 2.43m (for men) and 2.24 m (for women)

  Ball's internal pressure – 0.40 - 0.45 Kg/cm.

- Terminology (Volleyball) – Antennae, Attack hit, Back zone players, Dribbling, Libero, Front zone players, Blocking, Smash, Rotation, Boosting, Net fault, Volley pass, Forearm pass, Service, Hook serve, Set up, Referee etc.

Table Tennis

- This game was started in England in 1880s. 'International Table Tennis Association' was established in 1926.
- The first match of The Table Tennis World Championship was played in 1927.
- Table Tennis was introduced in the Olympic games much later in 1988 at Seoul (S. Korea).
- Table Tennis Association of India was formed in 1938.
- Measurements (Table Tennis) : Length of the table – 2.74 metre (9 feet), Width of the table – 1.52 metre (5 feet), Height of the table – 76 cm, Weight of the ball – 2.4 to 2.53 gram, Diametre of the ball – 37.2 -38.2 mm, Colour of the ball – white or yellow.
- Terminologies (Table Tennis) : Foil , End line, Late control, Flat hit, Block stroke, Service, Penholder grip, Back spin, Centre line, Half court, Side spin, Swing stroke, Push stroke, Rally, Let, Reverse, Top spin, Drop shot, Lob, Chopped return,Counter hitting etc.

Basketball

- The game Basketball was invented by Dr. James Naismith of U.S.A. in 1891 at Springfield College.
- International Basketball Federation was set up in 1932.
- Basketball Federation of India was formed in 1950. Its first World Championship was played in 1950.
- Measurements (Basketball) : Length of the court – 28 metre, Width of the court – 15 metre, Height of the basket from ground – 3.05 metre, Weight of the ball – 600 to 650 grams.
- Terminology (Basketball)– Dribbling, Front court, Second dribble, Two count stop, Travelling or shifting, Pivoting, Held ball, Jump ball, Violation, Foul, Feinting or Dodging, Shooting, Set shot, Ring, Guard point, Dead ball, Basket Rudnick, Hook pass, Goal, Centre line, Free throw line, Onsted, Fast break, Lay-up shot, Man to man defence, Pack, Three point, Turn over, Assist, Throw, Goal Tending, Steal, Tap etc.

Badminton

- Modern Badminton was probably developed in the 17th century and named from the place 'Badminton' in Gloucestershire (England).
- The International Badminton Federation (IBF) was established in 1934.
- Badminton Association of India was formed in 1934.
- The trophy for the international matches was named Thomas Cup after the name of the first president of the IBF Sir George Thomas. Thomas Cup competition (for men) started in 1948 - 49. Uber Cup Championship (for women) started in 1956.
- World Badminton Championship started in 1977.
- Measurements (Badminton) : Length of the court – 44 feet, Width – 20 feet (for Doubles) and 17 feet (for Singles), Height of the net – 5 feet, Weight of the

Shuttle cock – 4.74 to 5.50 gram, Overall length of the Racket – 680 mm (2.5 ft.) maximum, Overall width of the Racket – 230 mm (9 inches) maximum, Overall length of the racket head – 290 mm (11.5 inches) maximum, Weight of the racket – between 85 to 140 grams.

- Terminology (Badminton) : Badminton Court, End, Trans Lines, Back gallery, Service Court, Let, Forward Stroke, Backward Stroke, Toss or Lob, Clear, Smash, Net strokes, Rally, Setting, First hand or Second hand, Side out, Base of operation, Rotation, Long service, Net fault, Double fault, Foot Fault, Service break, Match point, Set point, High service, Cross shot, Service change, Drive, Drop shot, Duce, Advance etc.

Lawn Tennis

- Tennis was introduced by Major Wingfeild in Wales in 1870.
- All England Championship (popularly known as Wimbledon Championship) started in 1877 for men only. Tennis competitions for women (in Wimbledon Championship) were introduced in 1884.
- Measurements (Tennis) : Length of the court – 78 feet or 23.77 m (singles), Width of the court – 27 feet or 8.23 m (singles), 36 feet or 10.97 m (doubles), Height of the net – 3 feet (0.914 m) , Weight of the ball – 56.0 to 59.4 gram, Maximum length of the frame of the racket – 32 inches (81.28 cm), Colour of the ball – white or yellow
- Terminology (Tennis) : Ace, Advantage, A Let, Back hand drive, Deuce, Chip Shot, Volley, Half volley, Let fault, Foot fault, Double fault, Smash, Service, Grand slam, Singles sticks, Love, Slice.

Polo

- Measurements (Polo) : Length of the field – 300 yards, Width of the field – 150 yards, Distance between the goals – 250 yards, Distance between the goal posts – 8 yards.
- Terminology : Bunker, Chuker, Mallet etc.

Wrestling

- Measurements (Wrestling) : In International Competitions there is a circular area with 9 metre diameter with circle in the centre of 1 metre diameter . Competitions played on a mattress, the mattress is 1:1 metre diameter high.
- Terminology : Heave, Half, Nelson, Rebuts, Hold sager etc.

Chess

- The number of squares on a chessboard : 64, Colour of the squares – White and black, Number of same colour Chess - 16
- Terminology : Bishop, Gambit, Checkmate, Stalemate, Pawn, Grandmaster etc.

Golf

- Diameter of the hole : 4 inches
- Terminology : Bogie, Fore some, Stymie, T, Put hole, Nib lick, Caddy, Limns, Iron, Putting, The green, Bunker etc.

Water Polo

- The length and width of the field : 30 X 20 yards
- Terminology : 2 metre line, 4 metre line, Goal line, Caps, Personal, Fault, Ball under etc.

Baseball

- The distance of each base is 90 feet, The distance of the base along with its hypotenuse – 127 feet
- Terminology : Home, Diamond, Pitcher, Put out, Home run, Strike, Ant rubber etc.

Billiards

- Terminology : Cue, Jigger, Pot, Break Pot, In luck, In off, Cans, Bolting, Hazard, Long etc.

Rifle Shooting

- Terminology : Target, Bulls eye, Muzzle flub etc.

Kho-Kho

- Terminology : Chasers, Active Chaser, Runners, Diving, Taking a direction, To recede, Tapping, Trapping, Dupe turn, Late Kho, Giving Kho, Fake Kho etc.

Swimming

- Terminology : Crawl, Breast Stroke, Spring Board, Twist, Butter fly.

Boxing

- Length and width of the ring : Minimum 4.9X4.9 m^2 and maximum 6.10X6.10 m^2
- Terminology : Punch, Upper cut, Round, Jab, Hook, Knock down, Knock out, Hitting willow, Ring, Break, Bell, Belt, Blow, Bounce, Bout.

Marathon

- The distance of the marathon run : 26 mile 385 yards or 42.195 km.

Cups and Trophies (Associated with Sports /Games)

Sport	Cups and Trophies
Hockey	Aga Khan Cup, Begam Rasul Trophy (women's), Maharaja Ranjit Singh Gold Cup, Lady Ratan Tata Trophy (women's), Gurunanak Championship (women's) Dhyanchand Trophy, Nehru Trophy, Sindhia Gold Cup, Murugappa Gold Cup, Wellington Cup etc.
Football	Beghum Hazarat Mahal Cup, BILT Cup, Bordoloi Trophy, Colombo Cup, Confederation Cup, D C M Trophy, Durand Cup, Rovers Cup, B.C. Rai Trophy (National Championship), FIFA World Cup, Jules Rimet Trophy, Kalinga Cup, Santosh Trophy (National Championship), IFA Shield, Scissor Cup, Subroto Mukherjee Cup, Sir Ashutosh Mukherjee Trophy, Todd Memorial Trophy, Vittal Trophy, etc.
Cricket	Anthony D' Mellow Trophy, Ashes, Asia Cup, Benson and Hedges Cup, Bose Trophy, Champions Trophy, Charminar Challenger Cup, C.K. Naidu Trophy, Cooch - Behar Trophy, Deodhar Trophy, Duleep Trophy, Gavaskar - Border Trophy, G.D. Birla Trophy, Gillette Cup, Ghulam Ahmad Trophy, Hakumat Rai Trophy, ICC World Cup, Irani Trophy, Interface Cup, Jawaharlal Nehru Cup, Lomboard World Challenge Cup, Mc Dowells Challenge Cup, Merchant Cup, Moin - ud - Dowla Cup, Nat West Trophy, Prudential Cup (World Cup), Rani Jhansi Trophy, Ranji Trophy, Rohinton Baria Trophy, Rothmans Cup, Sahara Cup, Sharjah Cup, Sheesh Mahal Trophy, Sheffield Shield, Singer Cup, Sir Frank Worrel Trophy, Texaco Cup, Titan Cup, Vijay Hazare Trophy, Vijay Merchant Trophy, Vizzy Trophy, Wisden Trophy, Wills Trophy, World Series Cup.

Sport	Cups and Trophies
Table Tennis	Berna Bellack cup (men), Corbillion Cup (women), Jai Laxmi cup (women), Rajkumari Challenge Cup (women junior), Ramanuja Trophy (men junior), Travancore Cup (women), Swathling Cup (men)etc.
Badminton	Aggrawal Cup, Amrit Diwan Cup, Asia Cup, Australasia Cup, Chaddha Cup, European Cup, Harilela Cup, Ibrahim Rahimatollah Challenger Cup, Konica Cup, Narang Cup, S.R. Ruia Cup, Sophia Cup, Kitiakara Cup, Thomas Cup, Tunku Abdulrahman Cup, Uber Cup, World Cup, Yonex Cup etc.
Basket ball	Basalat Jha Trophy, B.C. Gupta Trophy, Federation Cup, S.M. Arjuna Raja Trophy, Todd Memorial Trophy, William Jones Cup, Bangalore Blues Challenge Cup, Nehru Cup, Federation Cup
Bridge	Basalat Jha Trophy, Holkar Trophy, Ruia Gold Cup, Singhania Trophy, etc.
Polo	Ezra Cup, Gold Cup, King's Cup, Prithi Pal Singh Cup, Radha Mohan Cup, Winchester Cup etc.
Athletics	Charminar Trophy, Federation Cup etc.
Air Racing	Jawaharlal Challenge Trophy, King's Cup, Schneider Cup
Billiards	Arthur Walker Trophy, Thomas Cup etc.
Boxing	Aspy Adjahia Trophy, Federation Cup , Val Baker Trophy etc.
Golf	Canada Cup, Eisenhower Trophy, Muthiah Gold Cup, Nomura Trophy, President's Trophy, Prince of Wales Cup, Ryder Cup, Solheim Cup, Topolino Trophy, Walker Cup, World Cup etc.
Chess	Naidu Trophy, Khaitan Trophy, Limca Trophy, Lin Arec City Trophy, World Cup etc.
Horse Racing	Beresford Cup, Blue Riband Cup, Derby, Grand National Cup etc.
Netball	Anantrao Pawar Trophy etc.
Rugby Football	Bledisloe Cup, Calcutta Cup, Webb Ellis Trophy, etc.
Shooting	North Wales Cup, Welsh Grand Prix etc.
Volleyball	Centennial Cup, Federation Cup, Indira Pradhan Trophy, Shivanthi Gold Cup, etc.
Yatching	America Cup etc.

Famous Stadia and Sports

➢ Government of India has recently constituted "National Playing Fields Association of India (NPFAI)" under an ambitious scheme of 'Kendriya Yuva Karya Evam Khel Mantralay' to cater to the development of Games & Sports and the players as well.

Stadium	Sports	Place
Indraprastha Stadium	Indoor Games	Delhi
Jawaharlal Nehru Stadium	Athletics	Delhi
Ferozeshah Kotla Ground	Cricket	Delhi
Ambedkar Stadium	Football	Delhi
Shivaji Stadium	Hockey	Delhi
National Stadium	Hockey	Delhi
National Stadium	Hockey & others	Mumbai
Wankhede Stadium	Cricket	Mumbai

Stadium	Sports	Place
Brabourne Stadium	Cricket	Mumbai
Eden Gardens	Cricket	Kolkata
Green Park Stadium	Cricket	Kanpur
Keenan Stadium	Cricket	Jamshedpur
Nehru (Chepak) Stadium	Cricket	Chennai
Varabati Stadium	Cricket	Cuttack
Aintree, Doncaster, Epsom	Horse racing	England (U.K.)
Flemington	Horse racing	Melbourn (Australia)
Headingley Manchester	Cricket	England (U.K.)
Lords, Oval, Leeds	Cricket	England (U.K.)
Black Heath	Rugby Football	London (U.K.)
Wimbledon	Lawn Tennis	London (U.K.)
Wembley Stadium	Football	London (U.K.)
Brookland	Football	England (U.K.)
Twickenham	Rugby Football	England (U.K.)
Putney Mart Lake	Boat race	England (U.K.)
Trent Bridge	Cricket	England (U.K.)
White City	Dog race	England (U.K.)
Hurlington	Polo	England (U.K.)
Henlay	Regata	England
Brisbane, Melbourne, Perth, Sydney	Cricket	Australia
Yankee Stadium	Boxing	New York (USA)
Brooklyn	Baseball	New York (USA)
Forest Hill	Tennis	USA
Sendy Lodge	Golf	Scotland

National Games and Sports of Some Countries

Country	Sports	Country	Sports
United States of America	Baseball	England	Cricket
Spain	Bull -fighting	Japan	Ju-Jitsu
Canada	Ice Hockey	Australia	Cricket
India	Hockey	Pakistan	Hockey
Russia	Chess	China	Table Tennis
Scotland	Rugby Football		

Court, Campus or Field Associated with Sports

Court/Campus/Field	Games / Sports	Court/Campus/Field	Games / Sports
Arena	Horse riding	Diamond	Baseball
Field	Polo, Football, Hockey	Track	Athletics
Ring	Sketing, Boxing	Pitch	Cricket
Course	Golf	Greens	Bowls
Pool	Swimming	Rink	Curling, Ice hockey
Board	Table tennis	Range	Shooting, Archery
Mat	Judo, Karate, Taikwondo	Vellodrome	Cycling
Court	Tennis, Badminton, Net Ball, Handball, Volleyball, Squash, Kho – kho, Kabaddi		

Number of Players in Some Popular Sports/Games

Sports	Number of Players (on each side or in each team)
Baseball	9
Rugby football	15
Polo	4
Water polo	7
Kho Kho	9
Kabaddi	7
Hockey, Football and Cricket	11
Netball	7
Volleyball	6
Badminton, Tennis and Table tennis	1 or 2 (Singles & Doubles respectively)
Basketball	5
Gymnastic	Several individuals compete simultaneously
Billiards / Snooker	1
Boxing / Chess	1
Bridge	2
Croquet	13 or 15
Golf	Several individuals compete simultaneously
Lacrosse	12

50. National Parks (Established after, 1998)

Name	State	Estd. Year	Popular Species
Balphakram National Park	Meghalaya	2013	Wild water buffalo, Red panda, Elephant and eight cat species, Tiger and Marbled cat
Chandoli National Park	Maharashtra	2004	Bengal Tiger, Indian leopard, Indian bison, Sloth bear, Indian giant squirrels, Barking dear
Jaldapara National Park	West Bengal	2012	Indian one horned Rhinoceros, Leopard, Hog deer, Wild pigs, Bison, Sambhar, Barking deer
Kalesar National Park	Haryana	2003	Wildboar, Sambhar, Hare, Red jungle Fowl, Chital, Parcupine
Mathikettan Shola National Park	Kerala	2003	Elephant
Mukurthi National Park	Tamil Nadu	2001	Nilgiri tahr, Indian Elephant, Bengal Tiger, Nilgiri Langur
Orang National Park	Assam	1999	Royal Bengal Tiger, One horned rhinoceros, Asiatic Elephant, Pygmydog, Wild bear, Hog deer
Papikonda National Park	Andhra Pradesh	2008	Tiger, Leopard, Sambhar, Spotted dear, Bison

★★★

10 COMPUTER

Introduction

- The era of 20th and 21st century has witnessed rapid developments in science and technology influencing every aspect of human life. One of the greatest things that man has ever created is, perhaps, 'the Computer'. The computer is truly an amazing machine. Computer is being used in areas of administration, medicine, education, sports, defence, shops, home, markets and many more. Computer and Information Technology (IT), in recent years, has become an integral part of our life. We can see it almost everywhere.
- A computer is an electronic machine that helps to process data. It is used to solve problems relating to almost all fields such as education, home, medicine, science and technology, research, designing, publishing, communication etc.
- A computer is an information-processing and information-accessing tool. This means that a computer accepts some information or data from the outside world. It processes it to produce a new information.
- Information processing is the essence of computing.
- Meaning of Computer : The word computer has derived from an English word 'Compute', which means 'to calculate'.
- Computer is an electronic device which processes the input informations according to the given set of instructions, called program.
- Blaise Pascal had developed the first mechanical calculator in 1642 AD, which is called 'Pascalene'.
- British scientist Charles Babbage was the first person to conceive an automatic calculator or a computer in 1833. He is called the 'Father of modern computer'.
- The credit of developing first computer program goes to Lady Ada Augusta, a student of Babbage.
- Herman Holorith prepared an electronic tabulating machine in 1880, which was automatically functional with the help of Punch Card.
- Howard Ekin developed the first Mechanical Computer 'Mark - I' in 1937.
- J.P. Ekart and John Moschley invented world's first electronic computer 'ENIAC-I' in 1946 and paved the way for first revolution in the field of calculating machine or computer. Electronic Valve or Vacuum Tube was used as a switch in the computer.
- John Van Newman invented EDVAC (Electronic Descrete Variable Computer) in 1951, in which he used Stored Program. The credit of using Binary System in computers also goes to him. Indeed Mr. Newman contributed most in the development of computer and thus gave a right direction to the Computer Revolution (Second Revolution).

Five Generations of Computer

Generation	Period	Main Electronic components	Main Computers
I	1940-52	Electronic Valve Vacuum Tube	EDSAC, EDVAC, UNIVAC
II	1952-64	Transistor	IBM-700, IBM-1401, IBM-1620, CDC-1604, CDC-3600, ATLAS, ICL-1901

Generation	Period	Main Electronic components	Main Computers
III	1964-71	Integrated Circuit	IBM–360, IBM–370, NCR–395, CDC–1700, ICL–2903
IV	1971 -	Largely Integrated Circuit	APPLE, DCM
V	—	Optical Fibre	

Types of Computer : According to size and capacity these are following types of Computer —

1. **Micro Computer :** These computers are used by individual, thus also called PC or Personal Computer. These days P.Cs are largely used for domestic and official purposes etc.
2. **Mini Computer :** This type of computer is comparatively larger than that of micro computer. This is 5 to 50 times more powerful than that of a Micro Computer.
3. **Main Frame Computer :** These are large sized computers. By Time Sharing and Multi Tasking techniques many people rather more than 100 people can work at a time on different terminals of this computer.
4. **Super Computer :** These are very powerful computers and have more storage capacity. These are the most expensive and the fastest computers, able to process most complex jobs with a very high speed.
5. **Quantum Computer :** The development of this type is in final stage. Probably Quantum Computers will be more advanced than that of human brain. In Quantum Computers Q -Bit will be used in lieu of Binary Bits.

Programming Languages of different generations

Generation	Languages
1st Generation (1940-52)	FORTRAN- i
2nd Generation (1952-64)	FORTRAN-ii, ALGOL - 60, COBOL, LISP
3rd Generation (1964-71)	PL / I, ALGOL - W, ALGOL - 68, Pascal, SIMULA - 67, APL, SNOBOL, 4 BASIC, C
4th Generation (1971- —)	CLUE, ALFARD, UCLID, Reformed Pascal, MODULA, EDA, ORACLE
5th Generation (For future)	Artificial Intelligence Languages.

Some Important Facts related to Computers

- December 2 is observed as Computer Literacy Day.
- India has announced New Computer Policy in 1984.
- First computer (made in India) is 'Siddharth', which was manufactured by Electronics Corporation of India.
- First computer in India was installed in the *Main Post Office of Bangalore* on August 16, 1986.
- First Pollution Free Computerized Petrol Pump of India is in Mumbai.
- First Computer University (in Private Sector) in India is Rajeev Gandhi Computer University.
- Bangalore (now Bangaluru) is also known as the Silicon Valley of India.
- First Indian News Paper to be available on Internet is 'The Hindu'.
- First Indian magazine to be available on Internet is 'India Today'.

- First Indian political party which has created its website on internet is 'Bhartiya Janata Party (BJP)'.
- Mainly there are three types of Computer, Digital, Analog and Hybrid.
- First Super Computer of the world is CRAY K-1-S, developed by Cray K Company of U.S.A.
- 'Deep Blue' is a Super Computer which had defeated World Chess Champion Garry Kasparov. This Super Computer is able to do the work equivalent to the work of 32 computers and can think 20 crore steps of chess in 1 second.

Super Computers developed in the World	
Name	Manufacturer
CRAY KIS	CRAY K Research Co., USA
Deep Blue	IBM Co., USA
Blue Gene	IBM Co., USA
COSMOS	Cambridge University, UK.

- First Electronic Digital Computer of the world is 'ENIAC'.
- Most popular Operating System in the world is WINDOWS.
- USENET is a link to connect all the universities.
- First book on Personal Computer was written by Ted Nelson.
- The book of Ted Nelson 'Soul of New Machine', won Pulitzer Prize.
- First magazine on Computer is 'Computer and Automotion'.
- First home Computer is Comodor VIC / 20.
- First Practical Digital computer is UNIVAC.
- FORTRAN is the first Programming Language.
- PROLOG is the language of the fifth generation of computer.
- J.S. Kilbi developed the IC chips.
- A computer error is known as Bug.
- C-DAC (Centre for Development and Advanced Computing) was established in Pune in 1988.

Super Computers developed in India	
Name	Manufacturer
FLO SOLVER	NAL, Bangalore
PACE	DRDO
PARAM-10000	C - DAC, Pune
CHIPP - 16	C-Dot, Bangalore
MULTIMICRO	IIS, Bangalore
MACH	IIT, Bombay

- Super computer PARAM - 10000, having the capacity of 1 billion calculations per second, was made by the scientists of C - DAC of Pune on March 28, 1998. The main credit for the development of the PARAM-10000 goes to Dr. Vijay P. Bhaskar, Executive Director of C-DAC, Pune.
- National Aeronautics Laboratories, Bangalore was the first in India to develop a Super Computer named FLO SOLVER.
- Laser Printers are the fastest printers.
- IBM (International Business Machine) is an American computer company.
- Computer virus is a man made digital parasite, which corrupts (infects) the file and known as 'File corrupter'.
- Modem is a device which connects the computers and works based on telephone lines.
- Y-2 K was a technical problem, associated with the calendar (Date, Month and Year) known as 'Millenium Bug'.
- The development of computer started in India since 1955.
- Indian Institute of Science, Bangalore has developed 'Simputer', which is a small palm sized touch screen computer.

- First computerarium in India is in Bangaluru (Karnataka).
- Vellanad of Thiruvananthpuram district in Kerala has been declared the first fully computerised village of India.
- PC, Home computer, Electronic notebook etc. are the examples of micro computer.
- Some Operating Systems, used in micro computers are — CP / M, Mac OS (Apple), DOS, Pro DOS, MS DOS / PC DOS, XENIX, WINDOWS, LINUX etc.
- *Linus Benedict Torvalds*, creator and coordinator of the Unix like Operating System. Linus was born in Helsinki, Finland on December 28, 1969.
- On Sept. 17, 1991 Linus completed the first version of Linux. He made the wisest decision in Operating System history by releasing Linux under General Public Licence, thereby making it open and free to all.
- He is one of the pioneers who advocated the idea of free software and thereby changed the software market.
- A computer may be used to control purely mechanical action. It has two main parts : (i) Hardware and (ii) Software.

Hardware

Computer performs some operations to solve problems. For this the various units of a computer system must perform and co-ordinate all operations.

- A computer has three main units : 1. Input unit, 2. Processing unit and 3. Output unit. These are the physical units of a computer system. These units constitute the hardware of a computer.
- The computer has its own internal 'language'.
- The computer is essentially made of electronic components. All these components are capable of generating any one of the two states, either a low (or a 0 volt) or a high (say 5 volts).
- It is difficult to talk always in terms of currents and voltages to represent information. Therefore, computer scientists use a special convention. A high is symbolically represented by a '1' and a low is represented by a '0'. The 1s and 0s are known as binary digits, or in short 'bits' (the term 'binary' refers to something that has two parts).
- Computers always work with bits. They do not understand any other form.
- Computer scientists use combination of 8 bits taken together to represent various symbols.
- Because every bit can take one of 2 possible values, the total number of combinations possible, using 8 bits, the computer can represent 256 different symbols.
- This is enough to cover our entire range of alphabets, numbers and other special characters like $, @, +, ₹ etc. Such a combination of 8 bits is called a byte.
- To build complex information like paragraphs and mathematical equations, we would need a larger number of bytes or characters. Thus we have the kilobyte, megabyte and gigabyte.
- In computers information is represented using multiples of 8 (2^3) bits, since 8 bits are the smallest unit of information. Therefore, higher units are expressible in multiples of 2^3.

- The power of two closest to a kilo (1000) is $2^{10} = 1024$.
- Megabytes is used in a more conventional sense and is equal to 1 million bytes or 1000 kilobytes.
- A gigabyte refers to 1000 megabytes approximately or 1 million kilobytes.
- The earliest computers were designed so that there components could work with 8 bits at a time.
- While the earliest machine were 8-bit machines, contemporary computers can work with 16, 32 and even 64 bits. This is called the data width of the computer.

Units of Data Measurement

4 Bit	=	1 Nibble
2 Nibble (8 Bit)	=	1 Byte
1024 Byte	=	1 Kilo byte (KB)
1024 KB	=	1 Mega byte (MB)
1024 MB	=	1 Giga byte (GB)
1024 GB	=	1 Tera byte (TB)
1024 TB	=	1 Peta byte (PB)

- The basic elements of computers that can signal a 1 or a 0 are called flip-flops. It is a simple electrical device and can either be a '0' or a '1', which means that the flow of current is either inward or outward.
- Modern computers use a very tiny set of flip-flops known as a register. The most important characteristic of these registers is that the binary digits can be stored in them using certain voltages.
- The entire independent circuits can be designed on a small piece of a semi conductor material like silicon.
- Silicon is obtained from sand and is a poor conductor of electricity. But, by chemical processes, the surface and the enterior of a silicon 'chip' are modified to give it electronic capabilities. Such miniature circuits are called Integrated Circuits (IC).
- By 1971, engineers were able to put a few component switches — necessary to build a complete computer on a single chip of silicon. This tiny silicon chip was called the microprocessor.
- Because the computer is a binary machine, it performs mathematical operations using the binary number system.
- The binary number system is similar to the decimal system where we use ten digits, 0, 1, 2, 3.... 8, 9 to represent all numerical values. The only difference is in the number of digits used.
- The computer converts all decimal numbers into binary numbers or combinations of bits. Then by acting upon individual bits, it can perform the required mathematical operation addition, subtraction, etc.
- The internal circuits that can perform mathematical operations on bits are usually made of two or more logic gates. Logic gates are components that generate a 1 or a 0 depending on the input.
- The three basic logic gates are AND, OR and NOT.
- A computer is organized into three basic units :
  1. the Central Processing Unit (CPU)
  2. the Memory Unit (MU) and
  3. the Input / Output Unit

1. Central Processing Unit (CPU)

The CPU is the part of a computer that performs the main function of information processing. The memory unit stores data. The computer supplies processed information back to the users using special output devices.

- The Central Processing Unit or CPU, is the most important part of the computer. It is called the brain of the computer. It makes all the required calculations and processes data.
- The CPU can be divided into three main components : (a) ALU (b) CU and (c) Registers.

(a) *The Arithmetic and Logic Unit (ALU)* : ALU performs all the mathematical and logical operations on the information supplied to the CPU.

(b) *Control Unit (CU)* : This unit directs the working of the CPU. It fetches instructions (Programs) from the memory and according to the instructions, controls the flow of data between the ALU and other parts of the computer.

(c) *Registers* : Registers are storage locations that hold instructions or data while the CPU is using them. The registers consist of flip-flops and the registers used by the CPU are the fastest memory elements in the computer. In contrast, the memory unit holds instructions and data before or after the CPU processes these.

Main attributes of CPU

(a) *Data Width* : It refers to the number of bits of data that can be manipulated within the CPU at one given time.

- The data width of a computer is also called its word size.
- Computers have data widths ranging from 8 to 64 bits.
- A higher data width means the CPU is capable of processing data faster. A CPU with a higher data width is more powerful.

(b) *Address Range* : Address range refers to the amount of memory that can be directly read or written by the CPU.

(c) *Clock Speed* : The speed of CPU is known as Clock Speed. The computer is essentially composed of tiny devices that can be put on or off to indicate 1 or 0.

- At any moment several thousand such devices change their state. To synchronize the change of all these components the CPU uses an internal clock.
- With every tick of this clock all switches that need to change their position do so in perfect harmony.
- The larger the number of ticks per second the faster is the speed of the CPU.
- The ticks per second of the internal clock are measured in megahertz and gigahertz.
- Hertz is a unit of frequency .
- 1 MHz = 1million 'ticks' per second, 1 GHz = 1000 MHz
- Higher the clock-speed, faster the computer.

2. Memory Unit (MU)

The memory unit stores all instructions and data for the CPU. Memory Unit is an important part of the computer system. The storage device of a computer system is known as memory. Memory Unit can receive data, hold it and deliver according to the instructions from the control unit.

- Memory is of two kinds : (a) Primary and (b) Secondary.

(a) *Primary Memory* : It is often referred to as the working memory or the main memory of a computer system. It is capable of sending and receiving data at a very high speed. It is temporary in nature i.e. Data stored in primary memory are lost when the computer is switched off. So it is also called volatile memory. Example of primary memory is RAM.

- Primary memory is directly accessible to the CPU. It must be able to provide data very quickly.
- The two basic kinds of primary memory are the Random Access Memory (RAM) and the Read Only Memory (ROM).
- The RAM is a read/write memory.
- The CPU can change the contents of the RAM at any time. In addition, RAM is volatile.
- The RAM capacity greatly influences the computing ability of the computer. Capacity is usually measured in kilobytes and megabytes.
- The ROM can not be altered.
- Informations is stored on the ROM at the time of its manufacture. The information might be in the form of crucial instructions that govern the working of the computer.
- The ROM is non-volatile and retains its information even after the power is turned off.
- The PROM (Programmable Read Only Memory), however, has the option of being programmed, i.e. the manufacturer of the computer may choose to load a program designed by his company into this PROM, and then the computer would use this PROM like any other ROM.

(b) *Secondary Memory* : It is used to store data for a long term. It operates at a much slower rate than primary memory. Secondary memory is permanent in nature, so it is also called non-volatile. It is also cheaper than primary memory. Examples of secondary memory are floppy disks, hard disks, magnetic tapes etc.

- Primary memory is fast but expensive. To reduce storage costs, computers also use secondary memory.
- It is not directly accessible to the CPU. Information is moved from the secondary memory to the primary memory first and then to the CPU.
- Common examples of secondary memory are floppy diskettes, hard (fixed) discs and magnetic tapes.
- A floppy diskette is a plastic disk coated with magnetic material.
- Special devices known as disk drives are capable of reading from and writing to floppies using special magnetic 'head'.
- Any piece of information stored on a floppy diskette can be directly accessed.
- Magnetic tapes are long plastic tapes coated with magnetic material.

- Magnetic tapes can store far larger amounts of data than the floppy diskette. But a problem with magnetic tapes is that information can not be accessed directly as in the case of floppy diskettes.
- The third type of medium, called fixed or hard disks, are more or less similar to the floppy diskette. But one hard disk drive contains several discs of a hard material.
- Another popular storage medium is the compact disk (CD). Unlike the media described above, CDs are an 'optical' medium.
- An optical medium is one where the properties of light is used for the medium to perform its basic functions.
- Conventional CDs are made of a special kind of plastic.
- The CD is read using a laser beam .
- Secondary memory is much slower, but it is non-volatile and can be used to store information for long periods of time.

3. Input/Output

- There has to be a physical channel that permits users to supply informations to the computer.
- Devices that permit users to supply information to the computer are called 'input' devices.
- Input unit enables us to enter (or "Input") data into a computer. The common input devices are keyboard and mouse.
- Similarly, a physical channel that permits a computer to convey the processed information to the outside world. Devices that permit such a function are called 'output' devices.
- Output unit enables the computer to show us the result and the information that we want. The common output devices are monitor, printer and speakers.
- Input and output devices are indispensable, but are not a part of the CPU. They are also called peripheral devices, suggesting that they lie on the periphery of the CPU.
- These devices are also called an interface, because they translate informations for man and machine.
- The most popular input device used in contemporary computers is the keyboard.
- Another way to input information into a computer is to use an Optical Mark Reader (OMR). Optical Mark Readers are capable of reading specially prepared forms. These forms have a provision for black marks to be made using a pen or a pencil in a specific position.
- Most competitive examinations that deal with a large number of students usually use this system.
- Banks use another input device called a Magnetic Ink Character Reader (MICR).
- Special numbers are written on bank cheques using magnetic ink and in a particular style to write different numbers. The MICR passes over the words or characters, examines the shape of the magnetic field created by the character, and is thus able to recognize it.

- Bar codes are often imprinted on products in merchandise stores. A bar code consists of several parallel vertical lines of different thickness that represent the binary digits.
- The bits form a code that can be used to identify the object on which the bar code is imprinted. A bar code reader is used to read the bar codes by detecting the bars by using light.
- The bar code can represent information like the price of the product or its date of expiry etc.
- Menu-driven programs, where the user sees the host of on-screen choices, sometimes use another input devices called the mouse.
- The mouse is a pointing device. It can be gripped in the palm of the hand and moved over a horizontal surface. The motion of the mouse can be monitored by the computer in different ways.
- The movement is measured and transmitted to the computer. This generates a corresponding movement of an on-screen marker called a cursor from one option to another.
- To select an option, the user presses one of the mouse's buttons.
- Another, input device is a digital camera. A digital camera has a circuit that is sensitive to light.
- The two most common devices are the Visual Display Unit (VDU) and the printer.
- A Visual Display Unit (VDU) uses a cathode ray tube to display informations.
- To represent any character, VDU illuminates a particular pattern of these dots. These dots are also known as pixels, a short form for picture - elements.
- Printers print characters on paper or other similar medium.
- Printers come in three popular versions : dot matrix printers, ink-jet printers and laser printers.
- Dot matrix printers print characters in the form of combinations of very tiny dots. The printing head aligns its 'pins' to match a particular pattern of dots.
- Ink-jet printers spray jets of ink on to the paper to print any character. The characters are absolutely smooth as ink is sprayed in a continuous flow.
- Laser printer, uses a laser beam to actually 'burn' the characters on to the paper.
- We need to issue the computer a detailed sequence of instructions that it needs to follow to operate upon any data. Such a sequence is called a program.
- A program may directly be written to the RAM or may be stored in some form of secondary memory.
- It may be transferred from the secondary memory to the RAM as and when required.
- Execution of a program means that data is moved around in the CPU according to a well-detailed sequence by the programme.
- Computer programs are written using special languages called programming languages.
- There are several programming languages. Each language has its own 'grammar' called its syntax.

Types of Programming Languages

- Machine language and the assembly language are examples of low-level languages.
- A special program called Assembler converts all instructions into the binary format.
- Because all such instructions must finally be converted to the binary form, all high - level languages have their own translation programs called compilers or interpreters.
- Examples of popular high - level languages are C, C++, JAVA, Pascal, Fortran etc.

Software

- Software relates to set of programs. The software controls the computer hardware parts and make them operational. In other words, it governs the operations of a computer system.
- Software is a general term used for all computer programs. This distinguishes programs from the physical components of the computer, which are collectively called the hardware.
- Software is generally divided into two kinds of programs : Application programs and System's programs.
- Applications programs are programs that permit the computer to be used as a tool for some specific tasks.
- A common term used for special text editors is word processors.
- Another popular type of application programs is the Data Base Management Systems (DBMS).
- The most important system's program is an operating system.
- Operating systems help users interact with the computer.
- Unix, MS - DOS, Linux, Windows, Mac OS are some of the most popular operating systems used by contemporary computers.

Important Keyboard Shortcuts (Commands)

Short Cut Keys	Description	Short Cut Keys	Description
Ctrl + A	Select All	Ctrl + Y	Redo
Ctrl + B	Bold	Ctrl + Z	Undo
Ctrl + C	Copy	Ctrl + W	Close File
Ctrl + D	Font Dialogue Box	Ctrl + X	Cut
Ctrl + E	Centre Alignment	Ctrl + F2	Print Preview
Ctrl + I	Italics	F1	Help
Ctrl + J	Justified Alignment	F2	Edit/Rename
Ctrl + L	Left Alignment	F4	Properties
Ctrl + N	Opens New blank document	F5	Go to
Ctrl + O	Opens existing document	F7	Spell Check
Ctrl + R	Right Alligrment	F12	Save As
Prtscn	Print screen/Take a screen shot	ESC	Escape
Alt + Tab	Switch to next opened program	Ctrl + S	Save

Short Cut Keys	Description	Short Cut Keys	Description
Ctrl + Home	Go to beginning of a File/Worksheet	Ctrl + U	Underline
Ctrl + End	Go to end of a File/Worksheet	Ctrl + P	Print
Alt + Shift + Tab	Switch to previous opened program	Ctrl + K	Hyperlink
Alt + F4	Close window/Shut down		

Glossary

Active Cell : The cell in MS Excel with dark boundary is called the active cell.

ALU : It stands for Arithmetic Logic Unit. All calculations in computer are done here.

Application Software : It is designed to perform some specific applications such as payroll, word processing, graphics etc.

Batch Processing : Data are processed in a batch.

BIOS : It stands for Basic Input Output System. This program is stored in ROM.

Bit : It is the short form of Binary Digit.

Boot Loader : It reads the main portion of the operating system from secondary memory.

Byte : One byte is a collection of 8 bits.

Cell : Cells are boxes created by the intersection of rows and columns.

Cell Pointer : The boundary of active cell is called cell pointer.

Copyright : It means the material and information are the personal property of the owner or producer.

Counter feiting : It is a process of making and distributing illegal copies of software packages.

Cracker : A cracker is a person who breaks into a computer system to steal the information as programs for unauthorized use.

CU : It stands for Control Unit. It controls the computer system.

Data : Data are raw facts and figures.

Database : It is a collection of files. Data remains in an organized form in a database.

Data Capture : It is a process of collecting or capturing data from a site or a source.

Data Manipulation : Captured data are manipulated to produce information.

Data processing : It is the process to get meaningful information from. data.

DBMS : It stands for Database Management System. It is a software package to manage database.

DHTML : It stands for Dynamic Hyper Text Markup Language. It is used to create dynamic content on web pages.

Dial Up Networking : It is the method by which a computer is connected to the Internet using telephone.

DOS : It stands for Disk Operating System. It is an operating system.

Ethics : Ethics are rules and beliefs.

Fields : A field in database is a collection of bytes that contain data about an item.

File : A file is a collection of related records.

GML : It stands for General Mark-up Language.

Hacker : A hacker is a person who breaks into a computer system to get access the information stored there.

HTML : It stands for Hyper Text Markup Language. It is used to create web-pages.

IAB : It stands for Internet Activities Board which was formed in 1983. It is now called as Internet Architectural Board.

IAS : It stands for Internet Application Software also known as Browsers.

IETF : It stands for Internet Engineer Task Force.

IRTF : It stands for Internet Research Task Force.

ISP : It stands for Internet Service Provider.

Internet Society : It was formed in 1992 to promote the use of Internet.

Input Unit : It is a part of computer system and used to enter data.

Linux : It is a Unix like Operating System with graphical user interface.

MAC OS : It is an Operating System used in Macintosh Computer, developed by Apple.

Modem : It is a device to connect different computer systems to the internet using telephone or cable lines.

MU : It stands for Memory Unit. It is used to store data.

Online Processing : It is used when data are coming continuously without delay.

Operating Unit : It is used to take output from the computer.

Operating System : It is an interface between the human user and the computer hardware.

Piracy : It is the illegal reproduction and distribution of software application.

Primary Key : It is a field with unique value for each record.

Primary Memory : It is the main memory of a computer system.

Query : It is used to extract information from a database.

Range of Cells : It is group of neighbouring cells that touch each other.

RDBMS : It stands for Relational Database Management System.

Record : It is the collection of related fields.

Secondary Memory : It is the permanent memory of the computer.

Software : It relates to sets of programs.

SOLARIS : It is a Unix like Operating System developed by Sun Microsystems.

Sorting : It is arranging of data in order.

System Software : It performs the basic functions that are necessary to operate a computer system.

Tag : It is part of HTML. It determines the way, the browser displays text in a Web Page.

Unix : It is a powerful multiuser operating system. It uses command line user interface.

Virus : It is a harmful computer program.

Some Memorable Facts

- A computer is a data processing machine.
- It has two main parts: hardware and software.
- Hardware comprises of the physical units of a computer system.
- Software is a set of programs.
- Both hardware and software together make a computer system functional.
- Data are raw facts and figures.
- An operating system is an interface between the user and the computer hardware.
- An operating system manages computer resources.
- An operating system performs different functions.
- An operating system is responsible for process management, file management, etc.
- There are many kinds of operating system.
- Some popular operating systems are DOS, UNIX, Windows, LINUX, Mac OS, etc.
- The Windows Explorer program is more efficient for viewing folders in Windows.
- Windows Explorer is divided vertically into two parts or two panes.
- The left side pane displays disk drives and folders in a hierarchical order.
- The right pane displays the contents of the folder / drive that is selected on left side pane.
- The process of linking text values in a series within a formula is called 'concatenation'.
- The computer is a data processing machine.
- Data processing involves some activities like data computing data manipulation and information management.
- A database is a collection of interrelated data.
- Computers are very useful for maintaining databases.
- A relational database is a collection of data items organized as a set of formally described tables from which data can be accessed or reassembled in many different ways without having to reorganize the database tables.
- MS Access is a powerful program to create and manage our databases.
- A table is a collection of data about a specific topic.
- A form is a graphical representation of a table.
- A report is a presentation of data in a printed format.
- We can create mailing labels for your database using MS Access.
- Internet is the network of computer networks with millions of computer attached to it.
- Websites are files in servers, which are powerful computers.
- Websites contain pages called Web Pages.
- The collection of all websites is called World Wide Web or WWW.
- Hyper text was first coined by Ted Nelson in 1960s.

Most popular Social Networking Sites
Facebook, Twitter, Linkedin and Instagram

Most popular online Shopping Websites
Amazon.com, Flipkart.com and ebay.com

- HTML is a markup language. It is used to create Web Pages. It uses commands called Tags.
- Text editors are used to compose HTML documents. HTML documents are viewed in Web browsers.
- In the Photoshop toolbox, the tools are grouped by type.
- Some of the tool icons have a tiny black triangle in the lower - right corner of their icons. This means that there are more tools of the same general kind available on a pop-up menu.
- Most Popular Mobile Operating System is Android, followed by iOS & Windows.
- Versions of Android (old to now) are :

Cupcake → Donut → Eclairs → Froyo → Ginger Bread → Ice Cream Sandwich → Jelly Beam → Kit-kat → Lollipop.

Abbreviations associated with Computer

CDAC	Centre for Development of Advanced Parallel Computing
C-DOT	Centre for Development Of Telematrics
HTTP	Hyper Text Transfer Protocol
ROM	Read Only Memory
RAM	Random Access Memory
BIOS	Basic Input-Output System
MODEM	Modulation-Demodulation
CAD	Computer Aided Design
PSTN	Public Switched Telephone Network
PSPDN	Packet Switched Public Data Network
RABMN	Remote Area Business Message Network
LAN	Local Area Network
WAN	Wide Area Network
MAN	Metropolitan Area Network
CDMA	Code Division Multiple Access
GAIS	Gateway Internet Access Service
E-Mail	Electronic Mail
CD	Compact Disc
LDU	Liquid Display Unit
CPU	Central Processing Unit
CAM	Computer Aided Manufacturing
CATScan	Computerised Axial Tomography Scan
COBOL	Common Business Oriented Language
COMAL	Common Algorithmic Language
DOS	Disc Operating System
DTS	Desk Top System
DTP	Desk Top Publishing

E-Commerce	Electronic Commerce
ENIAC	Electronic Numerical Integrator And Calculator
FAX	Fascimile Automated Xerox
FLOPS	Floating Operations Per Second
FORTRAN	Formula Translation
HLL	High Level Language
HTML	Hyper Text Markup Language
IBM	International Business Machine
IC	Integrated Circuit
ISH	International Super Highway
LISP	List Processing
LLL	Low Level Language
MICR	Magnetic Ink Character Recognition/Reader
MIPS	Million Instructions Per Second
MOPS	Million Operations Per Second
MPU	Micro Processor Unit
NICNET	National Informatics Centre Network
OMR	Optical Mark Reader/Recognition
PC-DOS	Personal Computer Disk Operation System
PROM	Programmable Read Only Memory
SNOBOL	StriNg Oriented symBOlic Language
UPS	Uninterruptable Power Supply
VDU	Visual Display Unit
VLSI	Very Large Scale Integration
WWW	World Wide Web

Abbreviations

AVES	Acute Viral Encephalitic Syndrome
BCTT	Bank Cash Transaction Tax
BCSBI	Banking Codes and Standard Board of India
CIC	Central Information Commission
CSTO	Collective Security Treaty Organization
CNLU	Chanakya National Law University
DII	Domestic Institutional Investor
DTH	Direct to Home
ECGC	Export Credit Guarantee Corporation
FDI	Foreign Direct Investment
FII	Foreign Institutional Investor
GANDHI	Green Action for National Dandi Heritage Initiative
GUAM	Georgia, Ukraine, Azerbaijan and Moldova
GAGAN	GPS Aided Geo-Augmented Navigation

HPAI	Highly Pathogenic Avian Influenza
IAEA	International Atomic Ener gy Agency
IITF	India International Trade Fair
IMO	Instant Money Order
IBSA	India, Brazil, South Africa
IRDA	Insurance Regulatory Authority
KYC	Know Your Customer
MRO	Mars Reconnaissance Orbiter
NADT	National Authority on Drugs and Therapeutics
NCCE	National Council for Clinical Establishments
NCH	National Consumer Helpline
NEIA	National Export Insurance Account
NMDP	National Maritime Development Programme
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NJC	National Judicial Council
NOTE	National Organization for Tobacco Eradication
OCI	Overseas Citizen of India
PETA	Peoples for Ethical Treatment of Animal
PURA	Providing Urban Amenities in Rural Areas
PHFI	Public Health Foundation of India
QIB	Qualified Institutional Buyer
QIP	Qualified Institutional Placement
RLDA	Railway Land Development Authority
RTA	Railway Territorial Army
RTC	Round Table Conference
RTG	Radio-isotope Thermo-electric Generator
SCRAMJET	Supersonic Combustion Ramjet
SIM	Subscriber Identification Module
SWIFT	Society for World-Wide International Financial Transactions
SWOT	Strengths, Weaknesses, Opportunities, Threats
SYL	Sutlej-Yamuna Link (canal)
YWCA	Young Women's Christian Association
UID	Unique Identity Number
UIDAI	Unique Identification Authority of India
VAT	Value Added Tax
ZSI	Zoological Survey of India

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Appendix-1

Census of India 2011 : Figures At A Glance

(Revised as per Final Population Totals)

	2001	2011	Increase
No. of States/UTs	35	35	—
No. of Districts	593	640	47
No. of Sub-Districts	5,463	5,924	461
No. of Towns	5,161	7,933	2,772
No. of Statutory Towns	3,799	4,041	242
No. of Census Towns	1,362	3,892	2,530
No. of Villages	6,38,588	6,40,930	2,342

Total Population	Absolute			Percentage*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	1,21,08,54,977	83,37,48,852	37,71,06,125	100.0	68.8	31.2
Males	62,32,70,258	42,77,81,058	19,54,89,200	100.0	68.6	31.4
Females	58,75,84,719	40,59,67,794	18,16,16,925	100.0	69.1	30.9
Decadal change 2001–2011	Absolute			Percentage*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	18,19,59,458	9,09,73,022	9,09,86,436	17.7	12.3	31.8
Males	9,09,65,182	4,60,30,080	4,49,35,102	17.1	12.1	29.9
Females	9,09,94,276	4,49,42,942	4,60,51,334	18.3	12.5	34.0
Sex Ratio	943	949	929			
Child Population in the Age Group 0-6 years	Absolute			% to Total Population*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	16,45,15,253	12,13,22,865	4,31,92,388	13.6	14.6	11.5
Males	8,57,52,254	6,30,84,449	2,26,67,805	13.8	14.7	11.6
Females	7,87,62,999	5,82,38,416	2,05,24,583	13.4	14.3	11.3
Child Sex Ratio	918	923	905			
Literates Age Group 7 + years	Absolute			Literacy rate		
	Total	Rural	Urban	Total	Rural	Urban
Persons	76,36,38,812	48,27,93,835	28,08,44,977	73.0	67.8	84.1
Males	43,47,63,622	28,13,61,374	15,34,02,248	80.9	77.1	88.8
Females	32,88,75,190	20,14,32,461	12,74,42,729	64.6	57.9	79.1
Scheduled Caste Population	Absolute			% to Total Population*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	20,13,78,086	15,38,50,562	4,75,27,524	16.6	18.5	12.6
Males	10,35,35,165	7,91,18,138	2,44,17,027	16.6	18.5	12.5
Females	9,78,42,921	7,47,32,424	2,31,10,497	16.7	18.4	12.7
Scheduled Tribe Population	Absolute			% to Total Population*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	10,42,81,034	9,38,19,162	1,04,61,872	8.6	11.3	2.8
Males	5,24,09,823	4,71,26,341	52,83,482	8.4	11.0	2.7
Females	5,18,71,211	4,66,92,821	51,78,390	8.8	11.5	2.9

Total Workers*	Absolute			Work Participation Rate		
	Total	Rural	Urban	Total	Rural	Urban
Persons	48,17,43,311	34,85,97,535	13,31,45,776	39.8	41.8	35.3
Males	33,18,65,930	22,67,63,068	10,51,02,862	53.3	53.0	53.8
Females	14,98,77,381	12,18,34,467	2,80,42,914	25.5	30.0	15.4
Main Workers	Absolute			% to Total Workers*		
	Total	Rural	Urban	Total	Rural	Urban
Persons	36,25,65,571	24,58,68,421	11,66,97,150	75.2	70.5	87.6
Males	27,32,09,976	17,80,95,330	9,51,14,646	82.3	78.5	90.5
Females	8,93,55,595	6,77,73,091	2,15,82,504	59.6	55.6	77.0
Marginal Workers*	Absolute			% to Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	11,92,96,891	10,28,48,265	1,64,48,626	24.8	29.5	12.4
Males	5,87,16,571	4,87,28,355	99,88,216	17.7	21.5	9.5
Females	6,05,80,320	5,41,19,910	64,60,410	40.4	44.4	23.0
Marginal Workers* (3–6 months)	Absolute			% to Total Marginal Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	9,70,44,107	8,30,31,670	1,40,12,437	81.3	80.7	85.2
Males	4,85,79,387	4,00,34,385	85,45,002	82.7	82.2	85.6
Females	4,84,64,720	4,29,97,285	54,67,435	80.0	79.4	84.6
Marginal Workers* (Less than 3 months)	Absolute			% to Total Marginal Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	2,22,52,784	1,98,16,595	24,36,189	18.7	19.3	14.8
Males	1,01,37,184	86,93,970	14,43,214	17.3	17.8	14.4
Females	1,21,15,600	1,11,22,625	9,92,975	20.0	20.6	15.4
Total Cultivators*	Absolute			% to Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	11,86,92,640	11,49,68,498	37,24,142	24.6	33.0	2.8
Males	8,27,06,724	7,98,39,098	28,67,626	24.9	35.2	2.7
Females	3,59,85,916	3,51,29,400	8,56,516	24.0	28.8	3.1
Total Agricultural Labourers*	Absolute			% to Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	14,43,29,833	13,69,94,451	73,35,382	30.0	39.3	5.5
Males	8,27,40,351	7,79,30,236	48,10,115	24.9	34.4	4.6
Females	6,15,89,482	5,90,64,215	25,25,267	41.1	48.5	9.0
Total Household Industry Workers*	Absolute			% to Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	1,83,36,307	1,19,47,619	63,88,688	3.8	3.4	4.8
Males	97,75,635	58,63,891	39,11,744	2.9	2.6	3.7
Females	85,60,672	60,83,728	24,76,944	5.7	5.0	8.8
Total Other Workers*	Absolute			% to Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Persons	20,03,84,531	8,46,86,967	11,56,97,564	41.6	24.3	86.9
Males	15,66,43,220	6,31,29,843	9,35,13,377	47.2	27.8	89.0
Females	4,37,41,311	2,15,57,124	2,21,84,187	29.2	17.7	79.1

* subject to revision.