The treatment consists of a series of injections given daily for 14 days. The injection is prepared from "fixed virus" which induces the formation of antibody.

Important diseases caused by Protozoans

1. Malaria—It is caused by a protozoan plasmodium.

The infective stage of the parasite is transmitted through the bite of the females anopheles mosquito along with its saliva.

The parasites destroy the R. B. C. chill and high fever are repeated. Preventive measures include drugs like chloroquine and primaquine, use of mosquito net during sleeping etc.

2. Amoebic dysentery or Amoebiasis—Caused by a kind of amoeba **entamoeba histolytica**. It causes destruction of one living of the intestine and diarrhoea with acute pain and discharge of mucus and sometimes blood in the stoool.

Infection is by contaminated food and drinks. Incubation period is about one week.

Prevention—Proper sanitation and protecting food from dust and flies prevents the spreading of disease.

Disease like Kalazar, sleeping sickness etc are also caused by protozoans

3. Diseases caused by Moulds and Fungi—Moulds are usually transmitted in the form of spores. They attack the skin or enter through mouth or nose.

1. Ringworm is a highly contagious disease of the skin, hair or nails. it also affects domestic animals like the dog. The disease is marked by ring-shaped discoloured patches on the skin which are covered by vesicles and scales. The person suffering from ringworm must keep his personal clothes and articles separate from others.

2. Athelete's foot is similar to ringworm which attacks skin of the foot, particalarly between the toes. Spores of the mould are picked up by walking barefoot in moist places, like the swimming pool.

◆

Lesson—2

Lipids, Proteins and Carbohydrates

Fats and their derivatives are called lipids. The term lipid was suggested by Bloor to include compounds related to fatty acids characterised by their being insoluble in water but soluble in organic solvents such as ether, benzine and chloroform, etc. Lipids are also

composed of atom C, H and O but oxygen present in less proportion than is found in carbohydrates. Lipids are important dietry constituent having high energy values. Fats are found in biological membranes.

Classification :

Lipid can be classified in the following manner:—

(i) **Simple lipids**—These are esters of fatty acids with alcohols.
(ii) **Compounds lipids**—These are also esters of fatty acids.
(iii) **Derived lipids**—These are substances derived from the hydrolysis of simple compound lipids. These hydrolysed products may be fatty acids, lycerol steroids, alcohol etc.

Simple lipids include fats and waxes. Compound lipids phosplipids oh, glycolipids, lipoprotiens, sulpholipids etc.

Derived units—Includes compounds derived from the hydrolysis of simple and compound lipids.

Fatty acids—One of the important constituents of lipid is fatty acid. It is represented by a general formula.

$CH_3(CH_3)_n$ COOH.

Saturated fatty acid :

Acetic Acid—	CH_3 COOH
Propionic Acid—	$C_2 H_5$ COOH
Butyric Acid—	$C_3 H_7$ COOH
Caproic Acid—	$C_3 H_{11}$ COOH
Lauric Acid—	$C_{11} H_{23}$ COOH

Chemical and Physical Properties

Hydrolysis—Lipid may be hydrolysed by lipase to yield fatty Acid and glycerol.

Saponification—Lipid may be hydrolysed by alkali. This process is called Saponification. The final products of alkaline hydrolysis are glyceral and alkali salts of the fatty acids, called soaps.

Hydrogenation—Hydrogenation of unsaturated fat can be done in the presence of a catylyst. This is called hardening of fat. By this process, lipids of plant origin are congealed. For example, margines of corn.

The melting point of fat depends upon the length of the fatty acid chain and the double bonds there of.

Physical properties :

(i) **Colour, odour and taste**—Pure fats are colourless and odourless and have a bland taste.

(ii) **Solublity**—Fats and oils are completely insoluble in water, but these are soluble or nearly soluble in organic solvents ether, hot alcohal benzene, chloroform and carbon disulphide etc.

(iii) **Specific gravity**—The specific gravity of fat is about 0.86 i. e. these are lighter than water.

(iv) **Melting Point**—It varies according to the nature of constituent fatty acids. Glycerides of lower fatty acids meet at lower temperature than the glycorides of higher fatty acids.

(v) **Crystallization**—Fats can crystallize very easily. When fats are dissolved in ether, then alcohol is added to the solution in equal volumes the ether evaporates leaving fats in crystalline form.

(vi) **Conductivity**—Fats are bad conductor of heat and, therefore, act as heat insulators. A layer of fats below skin provides an insulating blanket in all the warm blooded animal.

Bilogical Significance of Lipids

(i) **Rich source of energy**—Lipids provide food of high calorific value.

(ii) **As food reserve**—Lipids are stored in the body as reserve food material.

(iii) **As heat insulators**—Fats are deposited in the sub-cotinuous tissue. These act as insulators, conserving body heat.

(iv) **Solvents**—Lipids act as solvent for fat soluble vitamins like vitamin A D and E.

(v) **Structural unit**—Phospholipids are structural components of all the membrane system of the cell.

(vi) **Fat transport**—Phospholipids play an important role in the absorption and transportation of fatty acid.

(vii) **Harmones synthesis**—Adrenocorticoids, sex harmones, vit D and cholic Acids are synthesized form cholesterol.

Protein

Protiens are linear polymers of amino acids. Proteins are the most complex chemical compounds of high molecular weight. These are compounds of carbon, hydrogen, oxygen, nitrogon, sulphur and phosphorous. The characterstic element is nitrogen. These are most important and most abundant constituent in the body of all living organism.

Protiens are stored as a reserve of amino acids in the seeds of many plants.

Composition :

Proteins are most complex chemical compounds known in the world. Their chemical composition and structure are quite complicated.

Carbon	50% ot 55%
Oxygen	21% to 24%

Nitrogen	13% to 17%
Hydrogen	about 7%
Sulphur	0.2% to 7%

Structure—Proteins are polymers made up of chains of amino acids. Thus amino acids are the building blocks of protien.

Peptide bond—The amino acids of a protien are united to one another by their respective amino and carboxyle group i. e. the carbonyle group of one amino acid. This bonding is known as peptide bond or peptide linkage.

Biological significance of protiens :

Protiens are the most significant compounds in living beings, because of the following physiological role performed by them.

(i) **Protein as enzymes**—Protiens act as enzymes or biocatalyst and regulate almost all the life processes.

(ii) **Proteins as harmones**—A few protien function as harmones. eg somatotrophic or growth harmone of anterior pituitary, and insulin.

(iii) **Proteins and protection**—Protective proteins are antibodies or immuno-globulins.

(iv) **The blood proteins**—Thrombin and fibrinogen are reponsible for blood clotting.

(v) **Transport**—Some protiens bind and transport specific types of molecules via blood.

(vi) **Toxin**—Some proteins are highly poisonous to higher animals, such as snake venom.

(vii) **Contraction**—The contractibility of all living tissues and the contractile system of skeletal muscles is due to the proteins—actin and myosin.

(viii) **Structual Proteins**—Proteins form an important part of all membrane.

(ix) **Cell secretion**—Cell secretion like mucous are glycoprotien. These provide slippery texture and help in protection.

(x) **Secretion of cell**—Cell secretions like mucous are glycoprotien.

(xi) **Special Secretion**—Spiders and silkworms secrete a thick solution of protien fibrin.

(xii) **Storage Proteins**—Protiens are stored as reserve food.

Classification of protien

Proteins have been variously classified on the basis of structure, solubility and coagulability.

Types of proteins are following—

(i) Simple Protein.

(ii) Conjugated Protein.

(iii) Derived protein.

Simple Proteins

Simple proteins on hydrolysis yield only amino acid.

(A) Simple globular proteins—

These protiens are soluble in one or more solvents.

1. Soluble in distilled water—

(i) **Albumins**—These are precipitated from water by dilute acids and alkalies, e.g.—egg's white or ova albumen. Blood serum albumen.

(ii) **Pseudoglobulins**—These can be precipitated from water solution with an acid salt ($NHCl_4$) SO_2

(iii) **Protamines**—These are basic protiens, highly soluble in water and in dilute acids and dilute amonium hpdroxide solution.

(iv) **Histones**—These are basic proteins of high molecular weight. These are soluble in water and dilute mineral acids but not in Amonium hydroxide.

2. Insoluble in distilled water—

(i) **Gluteline**—These are insoluble in diluted water and neutral salt solution but are soluble in dilute alkalies and acids.

(ii) **Prolaminds**—These are soluble in water but are soluble in dilute alkalies and 60-80% alcohol.

Ex-plant

(iii) **Globulins**—These protiens are insoluble in water readily soluble in dilute neutral acid solution such as NaCl.

Ex–Legumins, tuberin, edesin.

B Simple Eibrous Protein

(i) **Keratins**—These are found in the outer layer of skin and in hair, feathers, horuns hoof and nails. keratin is indigestible.

(ii) **Collagen**—Collagen proteins are found in white fibrous connective tissue which constitute tendous, aponeuroses durametes and fascia.

(iii) **Biastin**—It is found in yellew clastic tissue like ligaments and blood vessels.

(iv) **Fibrin**—This protein is present in silk.

II. Conjugated Proteins

These proteins are composed of a simple protein united with some non-protein substance. This non-protein group is known as prosthetic group. Depending upon the nature of prosthetic group, the conjugated proteins have been divided into several classes—

1. **Chromoprotiens**—The Simple protein in combination with a pigment, for example, haemoglobin, cytochromes and flore protein.
2. **Glycoprotiens**—In glycoproteins the simple proteins are combined with carbohydrates.
   Ex—Mucin of saliva, heparin of bile juice.
3. **Nucleo proteins**—Protein molecules are combined with nucleic acids.
4. Lipoprotiens combined with lipid.
5. **Phospho Protein**—Proteins combines with phosphoric acid or with pyro or orthophosphoric acid.
6. **Mucoproteins**—These are similar to glycoprotien.
7. **Flavoprotiens**—These are enzyme.
8. **Metalloprotein**—These are proteins bound to some metaliciron like iron, coper or zinc.

III Derived Proteins

1. **Metaproteins**—These are derived by the hydrolysts of complex protiens.
2. **Conjugated Protein**—The coagulated or denatured proteins are fromed when ordinary proteins are heated.

Properties of Proteins :

The Proteins exihibit following general properties—

(A) Physical Properties—

(i) **Colloid**—Proteins exist in colloidal state.

(ii) **Solubility**—Proteins are colloids of large sized molecules, these form turbid solution in water.

(B) Chemical Properties—

(iii) **Amphoteric character**—Protein are amphoteric.

(iv) **Coagulation**—On heating proteins are coagulated

(v) **Optical property**—Amino Acids are optical

(vi) **Hydrolysis**—When proteins are boiled with dilute mineral acids in a reflux condenser.

Colour Reaction—

(vii) **(a) Biuret reactions**—All proteins give Piuret test with caustic soda and a drop of dilute copper sulphate giving pinksh violet colour

(b) **Millon's Reagent**—It shows the Millon's test.

(c) **Rosenheim's reaction**—A drop of formal dehyde solution to one rol of protein and shake throughly and add sulphuric Acid slowly, a purple colour appears at the junction.

(d) Xanthproteic reaction

(e) Diazo reaction.

(f) Glyoxolic and reaction.

Carbohydrates

Carbohydrates are compound of carbon hydrogen and oxyen generally occuring in the ratio of 2:1, hence named carbohydrates (hydrates of carbons.)

Chemically these are aldenyde and ketone derivaties of polyhydric alcohol.

It is widely distributed among plants animal and micro-organism the emprical formula of carbohydrate in (CHO) in which n is 3 or greater.

Classification

Carbohydrates are classified into 4 major categories—

(i) Monosaccharides,

(ii) Disaccharides.

(iii) Oligosaccharides, and

(iv) Polysaccharides.

Monosaccharides and disaccharides are commonly known as sugars and readily soluble in water while polysaccharrides are known as starch.

Monosaccharides

The monosaccharides have 3 to 9 carbon atoms and contain one aldehyde or ketone group.

Monosaccharides can not be hydrolysed into more simple molecules.

These are represented by general formula Cn H_2 On. These are colourless, crystalline, sweet tasting substances, insoluble in water sparingly soluble in alcohol and insoluble in ether.

Monosacharides may be classified in two ways—

1. On the basis of number of carbon atoms these possess, and

2. On the presence of aldehyde or ketone group.

(A) Classification of Monosaccharides—

On the basis of number of carbon atoms.

(i) Trioses—With three carbon atoms($C_3 H_6 O_3$)

(ii) Tetoroses—With four carbon atoms ($C_4 H_8 O_4$)

(iii) Pentoses—With five carbon atoms($C_5 H_{10} O_6$)

(iv) Hexoses—With six carbon atmos ($C_5 H_{12} O_6$)

(v) Heptoses—With seven carbon atoms ($C_7 H_{14} O_7$)

(B) Classification of Monsaccharides—

On the basis of aldehydic or ketonic group—

1. Trioses—$C_3 H_5 O_2$—Glyceraldelyde or glycerose	Dihydroxy acetone.
2. Tetroses—$C_3 H_6 O_3$—Erythose and Threose	Erythrulose
3. Pentoses—$C_5 H_{10} O_5$—Ribose Xylose Lyxose	Ribulose Xylulose and Arabinose
4. Hexoses—$C_4 H_{12} O_6$—Glucose, Galactose	Fructose
Mannose, allose	Sorbose
Altrose and talose	Psicoses
etc.	Tagatose
5. Heptoses—$C_7 H_{14} O_7$—	Sedohetulose

Monosaccharides of physiological importance—

1. Trioses—These are formed during metabolic break down of hexoses and are not found in nature.

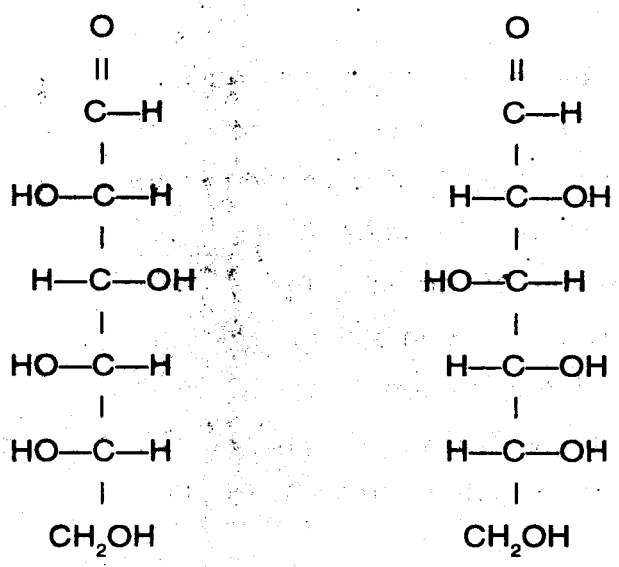
2. Pentoses—These are the main constituents of uncleic Acids (DNA and RNA) and many co-enzymes (NAD, NADP, Flavoprotiens).

These occurs in the forms of Ribose, deoxyribose, ribulose xylose and arabinose etc.

3. Hexoses—These are compounds of carbon atoms and are found as Glucose (rape sugar), fructose (fruit sugar) and galactose.

Stucture of Glucose—The most important Hexose present in the living organism is called Glucose—

(A)



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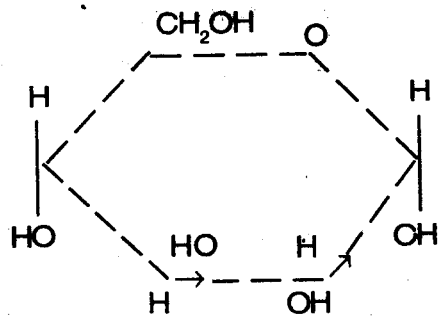

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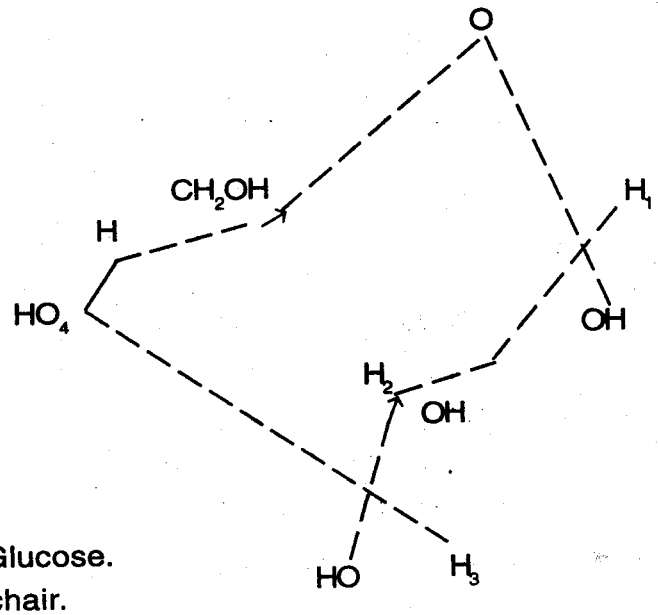


Fig L—D Glucose.
A—Open chair.
B—Ring form
C—Chair-Configuration.

Reaction of Monsaccharides—

(i) **Ioco Compounds**—When aldose in heated with concentrated hydroiodic acid Hi. it loses all of its oxygen and is converted into zodohexane.

$(C_6 H_{13} I)$

(ii) **Accetylation**—Glucose can be acetylated with accetyle chloride (CH_3 COC). In this case OH groups of Glucose participate in acetylation.

(iii) **Reaction involving aldehyde or ketone group**—Metallic hydroxides can be reduced and sugar can be oxidised.

(iv) **Osazone formation**—When glucose is heated with phenyle hydrozine hydrochloride and sodium accetate in a boiling water both osazone is formed.

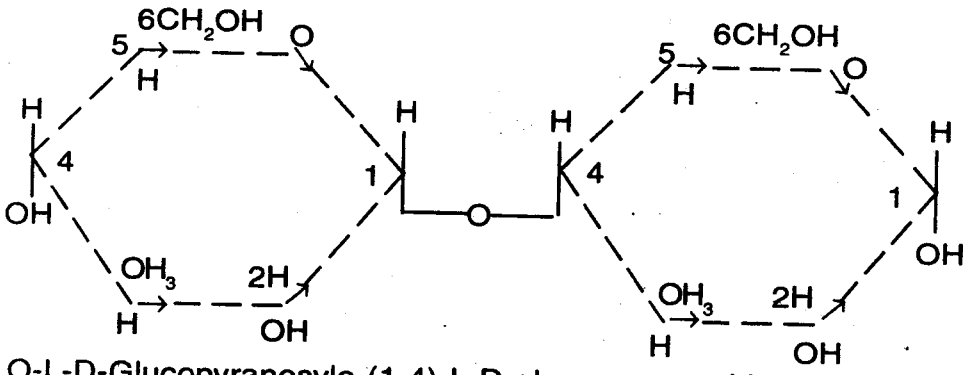
(v) **Inter conversion**—Glucose, fructose and mannose are interconvertible if treated with Ba $(OH)_2$ or Ca COH_{12}.

(vi) **Oxidation**—Alcohal and aldelyde group of sugar can be Oxidised to form Acids.

(vii) **Reduction**—Sugar can be reduced to corresponding alcohol.

Disaccharides

Two monosaccharides linked by Glycosidic linkage forms a disacharides.
Maltose present in cereals
Lactose present in milk.
Sucrose present in cane Sugar.
And treholose present in insect haemolymph are the eamples of disaccharides.



O-L-D-Glucopyranosyle-(1-4)-L-D-glucopyransoside.

Disaciharides are fomed by the condensation of two molecules of same or different monosaccharides with the loss of one molecule of with the imprical formula C_{12} H_{22} O_{11}. Sucrose and maltose in plants and laetose in animals are main diassaccharides,

These are derived from condensation of hexoses.

$$C_7H_{12}O_6 + C_6H_{12}O_6 \longrightarrow C_{13}H_{12}0_{12} + H_2O$$

Glucose Fructose or Glucose

Disaccharides.

Example of Diasaccharides—

(a) Sucrose.
(b) Lactose.
(c) Maltose.
(d) Cellobiose.

(a) Sucrose—Sucrose or cane sugar occurs in abundance in plants, such as sugar cane, beets, carrots and fruits.

(b) Lactose—Lactose of milk sugar occurs on milk and is the only carbohydrate for sucking. It forms white gritty crystals at the milk.

(c) Maltose—(Malt sugar). It does not occur in nature. It is a product of hydrolysis of starch and Glycogen by amylase and ptylin enzymes.

(d) Cellobiose—It is obtained from celulose and hydrolyses into two molecules of Glucose.

2. Trisaccharides—

This type of oligosaccharies produce 3 molecules monosachharides.
These include—

(a) **Mannotriose**—These are formed of two molecules of galactose and one molecule of glucose.

(b) **Rabinose**—These are formed by condensation of one molecule of galactose and two molecules of shamnose.

(c) **Reffinose**—These are formed of molecule of fructose, one molecule of glucose and one molecule of galactose.

(d) **Gentianose**—It is obtained from one molecule of fructose and two molecules of Glucose.

(e) **Melibiose**—It gives rise to one molecule of fructiose and two molecules of glucose.

3. Tetrasacchardies—

These are formed of four molecules of monosaccharides only two tetrasaccharides are known—

(a) Stachyose.

(b) Scorodose.

Polysaccharides

The bulk of carbohydrates in nature are in the form of polysaccharides.

Some of the important polysaccharides are—

(i) **Cellulose**—It is found almost exclusively in plants.

(ii) **Chitin**—It is the second most abundant organic molecules found on earth, it is found in flower plants, invertebrates particularly the arthropod.

(iii) **Insulin**—It is a starch found in roots of deahelias. It is soluble in water

(iv) **Dextrin**—Partial hydrolysis of starch produces dextrins which give red colour in iodine solution.

(v) **Starch**—It is found in cereals potatoes and legumes. It yields only glucose upon hydrolysis.

(vi) **Glycogen**—It is a polyglucose being branched and highly elaborated polysacharides. It is found in animal tissues.

(vii) **Hyaluronic acid**—It is a hetero-polysaccharides composed of equimolary quantities of D-glucornic acid and N-acetyle D-glucosamine. It is found in the connnective tissues of animal.

(viii) **Chondroitin Sulphates**—These are composed of equimolar quantities of D-glucuronic acid and N-acetyle galactosanine and sulphate.

(ix) Keto Sulphate—It is composed of D-galactose and aceto amino-2-deoxy. D-6 glucose sulphate connected by alternating—

C_1—C_4 and C_1—C_3 linkages

(x) Heparin—It is found in the mammalian circulating system.

(ix) Glycoprotein—When Proteins are coralently found to the carbohydrates, they constitute glycoprotien.

Classification of poly saccharides—Polysaccharides can be classified in four different ways—

(A) Based on the nature of constituents—

(i) Pentosans—Formed of pentose units.

(ii) Hexosans—Formed of hexose units.

(B) Based on the Name of constituents—

(i) Glucosans—Formed of glucose units

(ii) Fructosans—Formed of fructose units.

(iii) Galactans—Formed of galactose units.

(C) Based on the chemical nature of polysaccharides—

Homopolysaccharides—Polymers of glucose.

(ii) Heteropolysaccharides—Formed of two or more types of monosaccharides.

(D) Based on Function—

(i) Structural Polysaccharides—

Ex—Cellulose forms cell wall in plant cell.

(ii) Storage polysaccharides—

Ex—Starch and glycogen.

Complex poly saccharides—

These fall into two categories—

(a) Mucopolysaccharides.

(b) Glycoprotein.

Biological significance of carbohydrates

(i) Major source of energy.

(ii) Structural component of cell.

(iii) Storage.

(iv) Role in metabolism.

(v) Special function.

Chemical Properties of Mono saccharides

Chemically, monosaccharides are derivates of polyhydric alcohols.

Therefore, these exhibit properties of both hydroxyle and carbonyle groups

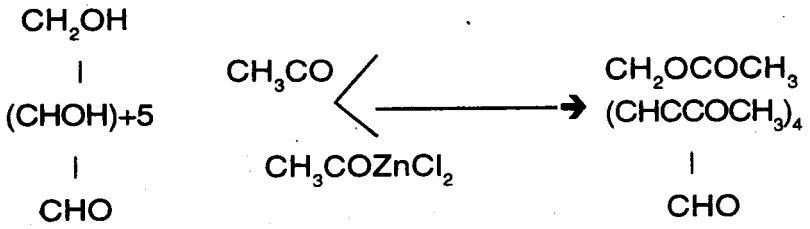
(A) Properties of Hydroxyle groups.

(i) Esterification—Formotion of Ester—

Due to presence of hydroxyle group (-OH) monosaccharides form esters with organic and inorganic acid.

2. Acetylation—

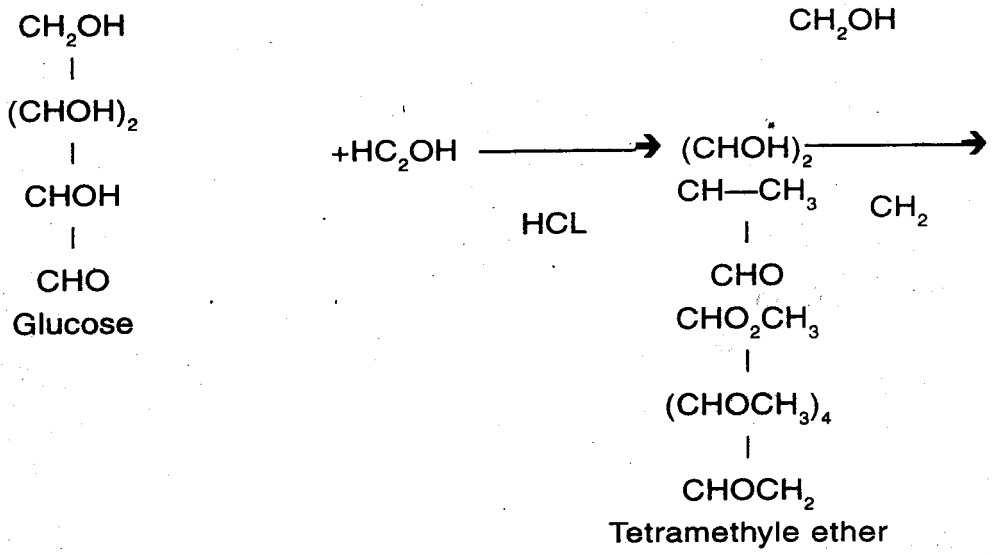
When monosaccharides are heated with acetic anhydrate or Accetyle chloride in presence of zink chloride, their off group are acetylated.



Glucose—Acceticanhydrate—glucose—penta accetate.

Formation of methyle ether (glycoside)—

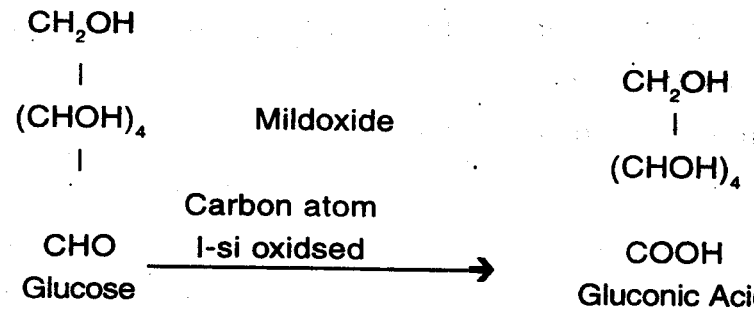
With methyle alcohol and dry HCl gas or methyle chloride or methyle iodide monosaccharides formed from glucose in glucoside.



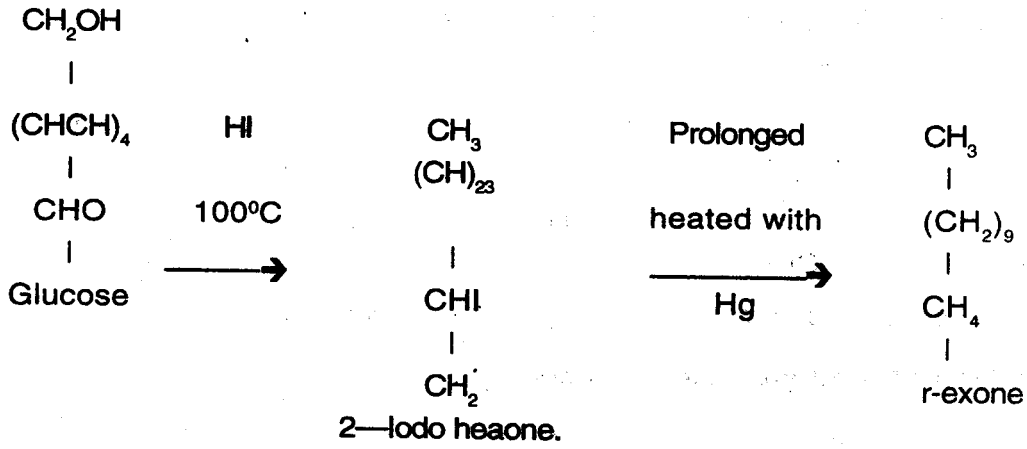
4. Formation of Glucosates or Fructosates Hexoses forms hexosates with certain metallic hydroxide.

(B) Reaction of carbonyl group.

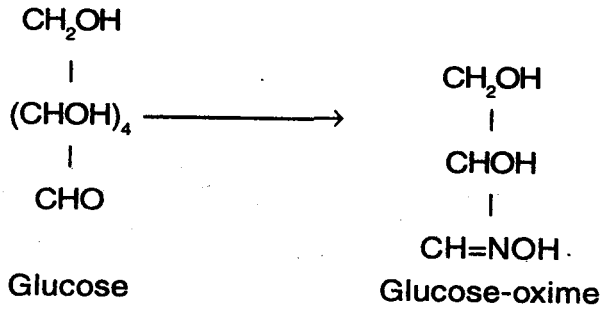
(i) Oxidation—Aldoses can be oxidised with milk exidising agents.



(ii) Reduction—After reduction it gives—Sorbitol, galactose yields dulcitol.



(iii) Reaction with hydroxylanding saccharides condense to form oximes.



(iv) Fermentation

Monosaccharides are realily fermented by yeast to alchol.

$$C_6H_{12}O_6—2C_3HOH_5+2CO_2$$

Glucose
or
Fructose

Uses of monosaccharides—

(i) Glucose is the easily accessible food for children and invalids.

(ii) Glucose is the source of energy and is the major product of photosgatuges.

(iii) Glucose is used, for making sweets candies, jellies, syrup etc.

(iv) Glucose is used for the manufacture of wines and glyccrol.

(v) It forms the raw material in the synthesis of vitamic C.
(vi) Glucose is used as a cheap reducing agent in the industry in sivering mirrors and in that dyeing with indigo.
(vii) Ribose is constituent of several co-enzymes.
(viii) d—glucose in solution form is given intravenously

□

Lesson—4

Environment and its Conservation

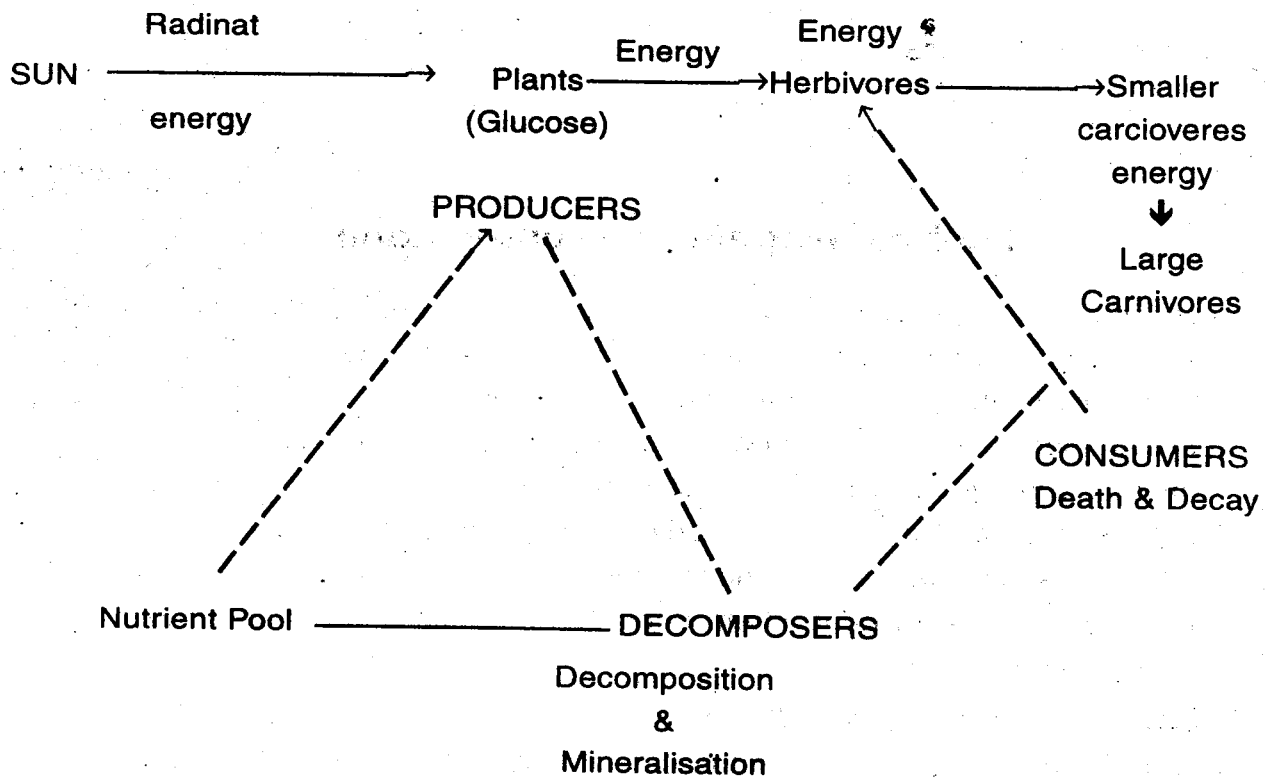
Anything surrounding us which affects our behaviour, reproduction and community is called our environment. In other words, environment may be the synonym of surroundings. Broadly the environment includes all the living and non living components of the world. An individual is also surrounded by its society thus the latter also becomes part of former's environment. But for all practical purposes the livings and non-livings are the compoments of the environment. The study of environment and its relationship with the living organisms is known as Ecology and the interrelationship between living (biotic) and non-livings (abiotic) is called Ecosystem. Ecosystem is also defined as structural and functional unit of nature.

The livings are further subdivided into—

1. Producers (all chlorophyll bearning plants and chromosynthetic bacteria),
2. Consumers (all the animals), and
3. Decomposers (Bacteria and fungi). The non livings include all the physicochemical components, like, light, temperature, height death, all the gases, chemicals, soil, water etc.

The producers trap radiant energy from the sun and converts this energy into chemical form i. e. glucose by the process of photosynthesis. This is the main energy upon which the whole living world depends. From the plants the energy flows to herbivores and from herbivores to carnivores and so on. At every step i. e. plants herbivores, carnivores etc. The amount of energy gets recycled which limits the sustaining capacity of the food chain i.e. unlimited number of herbivores and carnivores can not get food from limited number of plants or herbivores. This means that at least a minimum number of plants must be available to feed the herbivores and similarly the number of herbivores should be such that they can provide food to all the carnivores.

Similarly, these organisms, producers or plants, and animals including herbivores and carnivores undergo decomposition after their death and decay. The process of decomposition is carried out by the decomposers which includes bacteria and fungi. The fungi acts first on the dead organisms and it is followed by bactiria. The decomposition leads to breakage of large mocromolecules into smaller ones and ultimately undergo mineralisation which converts the decaying plants and animals into minerals and elemental forms. These chemicals finally go to the nutrient pool. From the pool nutrients got plants and plants to arimals and so on Thus the cycling of nutrients take place.



Simplified diagram of energy flow and nutrient cycling in Environment.

Thus we see that every components of the environment is dependent on the other. If the number or population of any of the components decreasae or indiscriminately exploited, it will affect adversely the subsequent component of the environment. Meaning thereby we must maintain the minimum number of plants, animals and even microrganisms to keep our ecosystem balanced so that the functions of the ecosystem can be carried out smoothly.

The human beings are continuosly exploiting the natural resources, both livings and non livings for its own purposes since time immemorial. And with the advancement of technical know-how the standard of living is also increasing day by day. The temptation of man to exploit and consume the natural resources indiscriminately has resulted into extinction of several species of animals and plant and many more have been pushed on the brink of extinction and have become endangered and threatened. The unfortunate part

is that the animals and plants cannot be brought back on this earth once they become extinct; and the whole 'gene pool' associated with that particular species are lost for ever. Thus the need of the hour is to have these natural resources for the survival of the human beings itself.

The basic principle and philosophy of conservation is to have the natural resources for the maximum number of people for maximum period of time. The simple definition of the conservation may be given as follows :

The most judicious and efficient exploitation of natural resources for the maximum people for maximum period of time.

Thus conservation never means that the natural resources should not be used or exploited, rather it allows the judicious and efficient exploitation. If we donot exploit the natural resources, the process of our development will come to halt.

The conservation of environment means the conservation of its components or natural resources which include livings and non-livings. The livings are renewable natural resource because they can reproduce and regenerate with short span of time. The non-livings can not repreduce, thus they are non-renewable resources.

If we intend to conserve the living beings, their minimum number must be maintained so that they can reproduce and are available for us for a long period. We can cut the trees for our developmental purpose on one hand and can plant them on the other. Depending upon their rate of growth, we can calculate how many trees can be cut and how many needs plantation. Similarly, the number of animals can also be conserved.

Regarding the conservation of non-renewable resources we will have to be more conscious and should exploit them in such a way that they can be available for a longer period. They should be used most efficienty on one hand and their alternatives should be searched on the other. At any cost they should not be misused.

Due to indiscriminate exploitation of our environment we are facing a lot of natural calamities in the from of flood and drought. The vast stretches of land is becoming unproductive and barren & waste. Greenhouse effect has resulted into global warming and ozone layer, our umbrella against the ultra-violet radiation, is being destroyed and the whole world of humanity is under threat and leading to its own destruction. The global warming has revolted in the melting of snow from the Arctic and Antractic which are resulting in rise in the level of ocean and seas which are ultimately causing submergence of the low lying areas of the world and inundating them. The typhoon in Bangladesh and Philippines are also the result of global warming.

On the smaller scale also we are loosing, millions and millions of tone of precious soil during flood and also life and properties of crores and crores of rupees. Every now and then one species of animals and plants are becoming extinct leaving us to depend upon the limited number of species and space to live in.

The practice of environmental conservation in India is a very old. The concept of conservation among Indians date back to Vedic period when the people in other developed

countries of today were leading a tribal life. The leader of the society, the 'Hermits' 'Rishis' and 'Gurus' of that period were having a good scientific temperament and the common mass was having a deep affiliation with the religion. Those leaders simply correlated the conservation of each and every animals, plants, water body. soil and other natural resources with some God and Goddsses. Thus they prevented the people from polluting the water bodies like rivers etc., they encouraged the people to plant the trees and not kill the animals. Even the animals like snake is worshipped in our country during 'Nag Panchami'. Today we know that every animal including the snake has certain role to play in biological control and maintaining our environment clean and balanced. Even the relict of such practices can even today be seen in our villages where several types of plants are worshipped even today.

Under the influence of modern civilization, our age old culture and practice of environment conservation has gone to the back benches, but fortunately we are now very much conscious and worried about conservation of our environment. There is a global consciousness for conservation and our country is not lagging behind. At all the level, right from national to international, the fight is going on to conserve the environment. Several steps have been taken for this mass awareness among the people through mass media of communication through non-governmental organisations, inclusion of science of conservation in our curriculum, framing legislation and establishment of implementing agencies are some of the important steps towards conservation of environment. The biggest gathering of people of the whole world during 'Earth Summit-1992 in Brazil in June 1992 for conservation of environment will be the most important events in the world history towards the conservation of environment.

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Lesson—5

Pollutants (Air, Water & Soil)

The agents which causes pollution are called pollutants. Pollution is the undesirable change in the environment which adversely affects the health of enviornment, biota and man. This undesirable change may be in air, water or soil, Most of the pollutants are chemicals and are bye-products of human activities. The problem of pollution and pollutants started since the time immemorial but the natural systems, atmosphere, water bodies and land, each of them has got power of self purification and can sustain the load of pollutants to a certain degree. But the load of these agents increases beyond the limit of sustaining capacity, they start posing threat to the system and then such agents are called pollutants and this phenomenon is called pollution.

Pollutants of air

The main pollutants of air are :

1. Aerosols
2. Corbon-dioxide
3. Chloroffluoro-carbons
4. Heavy metals
5. Acid rain
6. Insecticides, pesticides etc. and
7. Radioactive substances.

Aerosols :

They are the particulate matter in the air and are the result of both natural and human processes. The particulates must be solid particles or liquide droplets as small as cluster of molecules or as large as a visible dust particles. They are directly injected into the atmoshpere from industrial sources, like gravel crushers, blast furnaces smoke stacks etc. and form natural source as forest fires and ocean spray. Some of the smaller particles result from the chemical reactions in the atmosphere. They include sulphates, nitrates and hydro-carbons.

Aerosole affects health, environment and climate, Human health is adversely affected by many particulates, e.g. common ailments as high fever. allergic reactions etc. Heavy concentrations of particulates can result in a rapid build up of pollutants. A tragic episode ocurred in London from December 5 to 9, 1952, resulting in 3500 to 4000 deaths. The mentality was due to bronchites, coronary diseases, pneumonia, lung cancer, respirator tuberculosis etc.

Besides the unaesthetic quality of sedimenting soot and dirt the particulates have corrotive effects. They adversely affects the metals, paints.

Carbon di-oxide :

Carbon di-oxide and carbonmono-oxide are the main pollutants of air and they have a impact on world climate. The main sources of Cabon di-oxide and carbon-mono-oxide are burning of fossil fuel, industries, vehicles on one hand and indiscriminate deforestation on the other. According to one estimate the total release of carbon di-oxide to the atmosphere between 1850 and 1950 as $12X10^9$ tons/year. This resulted increase of carbon di-oxide from 268 parts per million (ppm) to 316 ppm in 1950. During 1979 it rose to the level of 334 ppm. According to another estimate before 900 A. D. forests covered 90% of Europe but by 1900 forests covered only 20%. India should hvae at least 33% of total area under forests whereas it is only about 21% area of our country under thick forest. It has recently been estimated that the total reduction of forests worldwide is on the order of 0.5 to 1.5% annually. Decay of soil of humous and biota are also one of the major sources of carbon di-oxide,

Carbon monoxide is very-very dangerous for human health as it reduces the oxygen carrying capacity of the blood. It is because of the fact that CO is indigenously produced within the human body, so even the slight increase in the atmospheric concentration of CO

will cause a great harm to human life and may cause instantaneous death. The carbon di-oxide and carbon monoxide are the major gasses of Green-house effect which is resulting in global warming and changing the earth climate. The national Academy of Sciences of United States of America has projected that a doubling of atmospheric carbon di-oxide will result in a global warming of 1.5 to 4.5^0 C i. e. about 4% per year. At the present rate of increase the level of carbon di-oxide will be double by year 2030. The global warming will lead to erosion of ice-sheet of Antacrtica with a consequent rise in sea level and high waves and tides, typhoon and inundation of low-lying areas of the world like Bangladesh etc. It will also result in drought-prone areas in North America and Central Europe.

Chlorofluorocarbons :

The most common chlorofluorocarbons are $CFCl_3$ which is used primarily as a propellent in aerosol spray cans and CF_2Cl_2 which is used as a refrigerant (commercially known as Freon). Other chlorofluorocarbons are used as the blowing agent for soft polycrethane foams and as the agent of metal cleaning and drying/industrial sterilization of medical equipment and fast freezing of foods.

The main concern about the chlorofluorocarbon is that they are destroying large quantities of ozone by a photolytic process. Ozone screens out most of the damaging portions of ultra-violet radiation emitted by the sun. According one estimate a 16% radiation in atmospheric ozone will produce a 44% increase in damaging ultra-violet radiation reaching the earth's surface.

The increased ultra-violet radiation would increase causes of skin cancer, reduce the productivities of agricultural crops and produce a slight warming of the earth's atmospere. The ultra-violet radiation affects the immune system by decreasing the viability of circulating lymphocyte. One percent decrease in Ozone concertration will lead to 2-5% increase in incidence of skin cancer.

The main danger with clorfluorocarbons is that they have major long atmospheric lifetime; $CFCl_3$ has 55 years and CF_2Cl_2 has more than 100 years. This means that even if the use of this pollutant is banned now, its effects can be felt for another decades to come.

Heavy Metals—

Heavy metals are those that exisit as cations under biologically significant conditions. They occur as salts and other combined forms rather than as elements except mercury. The most biologicallly significant and the most studical of these metals include cadmium, mercury, lead, zinc, chromium and copper.

Heavy metals affect the ecosystem in most directive way and are very-very detrimental for diversity and stability. It adversely affects the plant productivity, the most general symptoms being structing growth and chlorosis. Through foodchain it also enters into the human body which causes several types of fatal diseases including renal failure and cancer. Thus the heavy metals cause food contamination and food poisoning. One of the most disastrous example is the Minamate disese of Japan due to mercury pollution.

Acid Rain :

When the rain drops, snow, sleet, fog etc; becomes acidic i.e, contain high level of acid precisely it is called acid rain, Normally the rain water is slightly acidic with a pH value of 5.6. But due to havy industrialization, the oxides of sulphur and nitrogen are emitted into the atmosphere; the rain drops when combines with such gases form, acid and precipitates on the earth in the form of acid rain. In February 1979 the average pH of rainfall in Toronto was 3.5. In the fall of 1981 for in Los Angeles had a PH as low as 2.2. The most acidic rainfall in the United State was 1.4 in Wheeling, West Virginia. Both sulphur and nitrogen emissions are attributed largely to the burning of fossil fuels. In Sweden 16,000 freshwater lakes have become acidic from decades of air pollution, the bulk of which originate in continental Europe and England. Most of these acidic lakes have become fishless. Acid rain also destorys masonry building like Taj Mahal etc. besides agricultural crop and forest damages.

Insecticides and Pesticides :

The insecticides and pesticides are used indiscriminately for agricultural as well as domestic purposes. Some pesticides are subject to normal biological degradation by soil and water bacteria. The commonly used weed killer 2,4—D is one of them. It is quite quickly destroyed in the soil. On the other hand some of the widely used pesticides like deeblirin and DDT are non-biodegradable compounds and are 'fixed' in the soil. They collect on plant surfaces and can thus be passed directly along a food-chain; residue levels tend to increase with higher trophic levels, popularly known as biomagnification. There is some evidence to suggest that DDT interferes with the calcium metabolism, resulting in symptoms of calcium deficiency and creating hormonal disturbance that results in delayed ovulation and inhibition of general developmet.

Radioactive Substances :

Humans are exposed to low-level ionizing radiation from cosmic rays, radioactive elements in the earth crust (e.g. radium, uranium) and emissions from certain radio isotopes occurring naturally in the body. This natural exposure is almost doubled by radiation from man made sources mostly medical and dental in the form of X–rays, but also from radio active substances incorporated in building materials television sets and smoke detectors, fallout from atomic weapons and leakage from nuclear reactors. Such radiation causes a variety of cancers, chromosomal aberrations and hence genetic defects, and produce infertility and deficiencies in growth among other health effects,. It causes mutapenic consequences. Radioactive wastes if accessible to natural ecosystems, enter them through biogeochemical pathways and thus can affect the human health also.

Pollutants of water :

Water is the most essential after air for our life. We use water for various purposes and discharge the waste products into the water bodies making them pollutant. The main pollutants of water can be categorised under following heads—

1. Domestic wastes
2. Industrial wastes
3. Agricultural run offs
4. Bathing and wasting
5. Cattle wallowing
6. Burining ghats, dead bodies and corpses
7. Defication along the bank of water bodies and
8. Mineral oils.

Domestic wates :

It mainly incudes kitchen wastes and sewages including fecal matter, urine etc. They are mainly organic in nature and most of them are bio-degradable substances. The bacterial load is very high in such wastes whenever these wastes are discharged into the water bodies. They deplete the dissolved oxygen level in the water body resulting in dwindling in the population of aquatic biota. Only enaerobes and tolerant organisms survive and the sensitive one are destroyed. This results in lowering down of bio-diversity and make the ecosysten unbalanced.

Some of the contents of the domestic wastes are soaps and detergents plastic etc. which are non-degradable substances. They undergo bio-accumulation and bio-magnification through their trophic levels in food chain and ultimately make their way to human beings where they cause several fatal diseases and some of them are carcinogenic.

The urban domestic affluents contain small amount of oil and greases also, especially when it contains storm water passing through the garbages and road side. These oil and greases reaches the water bodies and make them polluted.

Industrial wastes :

It contains both organic and inorganic compounds including heavy metals. The industrial affluents are more dangerous than those of domestic wastes. The quantum of industrial wastes are also very high. The nature of pollutants from the industries depend on the nature of industries. Sometimes the affiluents from industries like fertilizer etc. becomes disastrous for the aquatic fauna especially fishes which a large number of fishes die out due to affiuent discharge from the fertilizer factory. Mercury pollution, and pollution due to other heavy metals like calcium, lead etc. take place due to industrial affluents.

Industries and factories also cause thermal pollution as they pour hot water after cooling into water bodies. Mines, especially open-cast mines, also play havoc to the water bodies when run off during rainy season from such open mines flow to the rivers or streams making the water acidic.

Agriculture run off :

The residues of chemical fertilizers and insecticides and pesticides which are used indiscriminately flows to the water bodies through non-point sources especially during rainy season. Most of the residues are non dependable and dangerous for the organisms and human health. Besides this the leaf, liffers, twigs, etc. also flowing in the water body.

Bathing and washing :

Due to bathing and washing in the water bodies the soap, detergents and other impurities flow-down to the water which lead to increase in bacterial load and load of non dependable substances.

Cattle-wallowing :

Washing of cattle especially buffaloes in the water body is a common practice in our country. Such practices are the great source of bacterial pollution of water sources.

Burning ghats, dead bodies & caracasses :

In India the last rites are performed mainly on the banks of rivers especially among Hindu communities. Unburnt, half-burnt or ashes of burnt dead bodies are thrown direclly into the river water. The caracasses of cattles are also dumped into the river water. All these are great source of bacterial pollution.

Defecation along water bodies :

It is a common practice to use the banks of water bodies especially river banks as open lavatory by the flowing population in the big cities. The fecal matters ultimately flows into the river water where they increase bacterial load especially califorms.

Mineral oils :

Due to leakage and sometimes due to accidents the petroleum products are discharged into the marine water as the tankers from oil producing countries transport oil through marine routes. In 1991 due to gulf war a huge quantities of oil was discharged into the Arabian Sea causing a great damage to the marine ecosystem.

Pollutants of soil :

Due to urbanisation and industrialization, the soil is also being polluted to large extent. Waste materials as well as bye products of the industrial products are dumped cutside the premises on so called waste land. Such wastes contain heavy metals, oil & greases, acidic substances which make the soil acidic and unproductive. All the flora are destroyed. Due to indiscriminate use of inorganic fertilizers and pesticides in agriculture the soil is also getting polluted

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Lesson—6

Energy : Source And Importance

Introduction :

Energy is required for all motion and growth in the physical world. Since the earliest days of civilization, human beings have used their own musle power, animal power and fire for meeting the essential energy needs. It is said that even in 400 B. C. oil was used as lamp fuel in Greenland. The Burmese are credited with having drilled oil as early as 100 A.D. Their use of wind energy for navigation and in the form of wind mills is pretty old and was prevalent in different parts of the world. With the invention of steam engine in the 18th century energy acquired a special significance ushering in the industrial revolution.

Source of Energy :

The important physical forms of energy are mechanical (Potential & Kinetic), heat radiant (Light, radio etc.) electro/magnetic, chemical and nuclear. Some of the energy conversions are reversible but some others are irreversible. "However, the ultimate source of all energy in the solar system is the sun. "The energy that emitted from the sun in the form of radiation and is incident of the earth, is ultimately responsible for all different forms. The solar radiation takes three different forms of the elector-magnetic spectrum ultra-violet, light and infra-red. The light from the sun is essential for the existence of all plant and animal life on earth. "All chemical fuels like wood, cow dung and whole range of fossil fuels (coal, oil and natural gas) are ultimately derived from plants and animal life that have grown because of the action of the sun. The human and animal energy also can be ultimately traced to the solar energy.

Different Sources of energy :

The primitive sources of fuel energy include wood, cow dung etc. The conventional sources of energy are coal, oil natural gas etc. Those conventional sources are also described as non-renewable or exhaustible, since all of them are likely to be depleted in the long run. Nuclear energy is also some time considered a conventional source of energy; but it may as well be included in the list of "non-conventional and renewable sources of energy, which includes solar energy. bio-energy wind energy, tidal energy, ocean energy, geothermal energy, etc. The term alternate source of energy used to cover to renewable sources of energy listed above.

Solar energy :

Since the world started looking round for new and renewable sources in addition to the convential sources, naturally, the first such renewable source to attract the attention

of the scientist was the solar energy. It is estimated that nearly 35% of the energy from the sun incident on the atmosphere is reflected back into open space; about 18% is absorbed by the atmosphere and is used to derive the wind systems. Nearly 47% of solar radiation thus reaches the earth, "This quantum energy incident on India is equivalent to 120 trillion tones of coal. i. e. more than 20 times the cole reserves of the world."

The use of solar energy for drying the crops, clothes and other products has been known since the ancient times. Even efforts have been made in the remote past to concentrate solar energy through reflectors. However, the modern uses of solar energy are contemplated in the form of

(i) Conversion of solar energy into high heat
(ii) Conversion of solar energy directly into electricity,
(iii) Bio-energy, conversion of solar energy into other forms by making use of winds, waves, temperature gradient in the ocean etc.

Solar energy in the form of Heat :

By using a blackened sheet for collecting the radiant energy of the sun, and preventing loss of heat from the sheet due to conduction, convection and radiation, the temperature of the sheet can be raised to a miximum of 140° C. Solar collector is a device to insulate the blackened sheet. "A solar collector forms part of the various solar energy appliances used as cookers. heaters, driers, air heaters, steam generators and as a desalination device. In fact India became the first country to start commercial manufacture of solar cookers on large scale in 1982.

Photo-voltaic technology :

The conversion of solar radiant energy directly into electricity is done using photo-voltaic technology. The first practical solar cell was produced in the USA in 1954. using a single crystal silicon. Since then the solar cells have been used mainly in the outer space to provide power for various requirements in satellites. A solar cell is essentially a semi-conductor device which permits generation of voltage when light falls on it. In commercial production its efficiency is around 41% A photo-voltaic panel produces electricity in the D. C. form. The photo voltaic system have been demonstrated for use in water pumping, lighting, communication, radio and T. V. receivers, power for light houses, offshore oil platforms, etc. The department of Science and Technology in India has developed photo-voltic technology in 1980.

Wind Energy :

Wind energy has been used for thousands of years for propelling ships. pumping water and grinding grain. The wind energy conversion takes place through the wind turbine. The shaft power from the wind turbine can be utilised for a variety of purposes including electricity (A. C & D.C.) generation, direct pumping direct mechanical work etc. Small wind mills for water pumping are operating in several countries including India. Wind energy is a high quality form of mechanical energy can be converted into electrical energy with minimal energy loss.

Ocean Energy :

Energy from the ocean is available in several form such as ocean thermal energy, wave energy, tidal energy, salinity gradients, ocean currents, ocean winds and bio-mass of the ocean. Attempts at setting up ocean thermal energy conversion plants are on throughout the world. In India a plant has been set up in Lakshadweep. Apart from electricity it produces by-products like food, fertilisers, methane, aluminium, ammonia, liquid hydrogen and fresh water. Tidal energy has been in use for nearly 15 years and the potential of tidal energy favourable compares with the hydro-electric resources in certain locations. France has a large tidal plant of 240 M. W. In India three potential sites have been identified so far. A tidal plant of 600 M. W. capacity is proposed in the Gulf of Cutch.

Bio-energy :

This term includes all those processes where biological forms of matter such as plants, vegetable, bacteria, enzymes etc. Provide the basis for energy. The widest use of bio-energy is in the buring of wood, plants and agricultural matter to produce heat, Vegetable bio-mass is a new name for plant organic material wherein solar energy is trapped and stored through the process of photo synthesis. Bio-mass includes terrestrial and aquatic matters which are grouped into three categories—new plant growth, plant residues and wastes. About 40% of the total energy consumed in India today comes from wood, wood wastes and animal wastes. Most dried forms of bio-mass can be burnt directly to produce heat, stem or electricity but biological conversion technologies utilising natural anacrotose decay process produce high quality fuels directly from bio-mass of methane from bacterial fermentation or ethanal from yeast fermentation. Thermochemical conversion technologies utilise high temperatures and pressures in the absence of oxygen.

Non-Conventional Energy Sources :

The Government have given high priority to the promotion and utilisation of new and renewable source of energy (NRSE) as supplement to the fast depletion conventional sources of energy and also to meet the energy need of the rural areas. Energy planners and scientists of the world are now thinking in terms of decentralised energy systems. The CASE formulate the policies and programmes, the Department of Non-Conventional Energy sources is responsible for their implementation.

Micro-Hydel System :

Power from micro-hydel projects which can provide renewable energy for rural needs in a decentralised manner remains largely untapped in the country so far, especially from small streams and canal dropping During the Sixth Plan, efforts to set up the necessary R & D were intitiated by establishing the Alternate Hydro Energy Centre at Roorkee with central Government funding, for developing techologies for tapping low head and low-capacity micro-hydel potential.

Improved Chullahs :

The thermal efficiency of traditional chullahs ranges from 2 to 10 precent (average 6.1 percent) whereas the thermal efficiency of improved chullahs ranges from 14 to 25 percent considering that about 120 million tonnes of fuel wood are consumed for cooking annually, the saving of fuel wood from intorduction of improved chullahs would he enormous. Besides energy conservation and presevation of forest cover, the programme also provides many tangible environmental benefits like pollution control, relief from health hazards and improvement in the quality of life, especially in the rural areas. 8.12 lakhs improved chullahs were installed in the Sixth Plan against the target of 5 lakhs.

Draught Animal Power (DAP) :

DAP in India is derived from a livestok population of about 80 million, of which 10 million are bullocks and 8 million, are buffaloes, Improvements in various implements and technologies utilised in animal driven system would clearly yield significant benefits. The ground work has been laid for a centre of Animal Energy for organising and co-ordinating such programmes.

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Lesson—7

Fermentation and Preservation

The Fermentation of ethanol from sugar by yeast is called fermentation. This process is completed under anaerobic condition with the help of enzymes. First of all this process was discovered by Louis Pasteur in 1857. Yeast secretes invertose and zymase enzymes which act on sugar to convert to into alcohol and corbon di-oxide.

Fermentation is the basis of brewing and wine making. To make wine yeast is added to malt(crushed germinating barley in water) and the ethanol is formed from the sugar in the malt; hope (a type of climber plant) are added to give it a bitter taste. A wine is formed when sweet juices usually from fruits are allowed to ferment. Natural yeasts occur on the sweets of fruit, e.g. the bloom on grapes, so when grapes are crushed the sweet juice become mixed with the yeast and fermentation takes place.

Yeast is also used in bread making to make the dough rise. When yeast with a little sugar solution is mixed with the dough (flour, water and a little salt) it respires anaerobically and the carbon di-oxide given out being a gas, blows up the bread. That is why holes are formed inside the loaf.

The other processes of fermentation in or day-to-day life are formation of vinegar, conversion of milk into curd etc. Fermentation is very-very useful for certain industries like, jute industry for softening of fibre; leather industry for tanning i.e. conversion of hide into leather use.

Beside these useful uses of fermentation, it destroys our food and food products. Butter and cheese, fruits fishes etc. are destroyed due to fermentation.

Presereation—We know that air contains bacteria so if food is left exposed to the air bacteria will settle on it to cause its decay. If the food is damp and the temperature warm it will decay all the more quickly. This is great problem in the tropics and probably explains why traditionally so many curry powder herbs and spices were used in preparing food which was going bad. In our country there aere severl traditional practices for food preservation. Today we have many scientific ways for preservation of food from decaying and we can allow the food to be stored for almost indefinite periods and transported all over the two world. The importanct methods of preservation are as follow—

Refrigeration :

By this method the temperature is kept lower which prevents the bacteria form multiplying and slow their decaying action.

Domestic refrigeration are usually kept temperatures just above 0°C. This is low enough to reduce bacterial activity to an extremely low state and at the same-time to reduce the metabolic and respiration rates of living food such as fruit and green vegetable so that they keep fresh for longer periods. Food does not remain fresh indefinitely at these temperatures and when it is taken out of the refrigerator bacterial activity will be resumed

Thus use of deep freeze is more efficient as the temperature is much lower and all metabolic activity is stopped, so food keeps indefinitely. By this method fresh meat, fish, fruit and vegetables can be stored when supplies are plenty & cheap and used when needed. The best examples of presservation at low temperature are food left by Captain Scott in 1912 at Antarctica was discovered in perfect condition after many years and another one is preserved unammoth about 3900 years ago is Siberia which was discovered in this century only and even its stomach contents could be identified.

2. Sterilization by heat treatment—

(a) Canning—The food is subjected to high-temperature cooking, placed in sterilized tins, reheated under pressure and sealed when still hot. In this way bacteria in food are killed and no other can enter. These methods are very useful for meat, fish, fruit and vegetables.

(b) Pasturisation of milk—By this method majority of the bacteria of the milk are killed without spoiling the flavour of the milk by boiling it. The usual method is to heat the milk to 72° C for 15 seconds quikly cool it to 12° C and put it into sterilized bottles which are capped at once. Some decay bacteria may survive in this treatment, so it will go sour, but not so quickly as unpreached milk Another method is to heat the milk to a very high temperature (135° C.) for one second and immediately put it into containers and seal. The milk keeps fresh for much longer.

3. Osmotic Methods—

The principle is that bacteria cannot survive in an active state in a solution of high osmotic strength as water is drawn out of them. Sugar and salt in high concentration have this effect so that honey, jam and salted meat, fish or vegetable donot go bad. The sun-drying of various kinds of grapes to produce reisins has the same effect as the drying concentration the sugar solutions in their cells. The salting and sun-drying of fish on a large scale especially tropical countries works on the same principle.

4. Dehydration—

The method is to remove so much water from the food that bacterial action become negligible. The thchnique is suitable for milk, eggs, vegetables such as potatoes and many cereal products. After drying, it is necessary to keep in foods in water proof containers. A great advantage of this method is that it reduces the weight and bulk of the product making transport cheaper and easier.

5. Chemical methods—

Some foods are preserved by adding chemicals which kill bacteria but considered to be harmless to man in the quantities used. The common preservations are benzoic acid and sulphur dioxide. This is the least satifactory method as certain preservatives used in the past have been found later to be harmful.

The smoking of fish is basically a chemical process as the smoke contains substances which are poisonous to bacteria and these become impregnated in the outer layers which are also dried and hardened in the process.

Pickling food in vinegar (which contains acetic acid) is another chemical method; it is sucecssful because the acid kills the bacteria.

6. Irradiation—

This mordern and effective method is to package and seal the food first and then irradiate it using radio-active cobolt which is powerful enough to kill all organisms which are present.

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Lesson—8

Fertilizers—Organic and Inorganic

Living organisms, both plants and animals, need nutrients for their development and they are inter-dependent. Nutrients are absorbed by roots, leaves and stems, but the major portions by roots. Carbon, Hydrogen and Oxygen are made available from air and water

where soil and water also play an important role. The other essential nutrients are Nitrogen, Phoshphorus, Potassium, Calcium, Magnesium, Sulphur, Iron, Manganese, Zinc, Copper, Molybdenum, Boron and Chlorine and the source of availability is soil. To this list is added sodium, cobalt, vanadium, silicon, selenium, gallium, aluminium and iodine but their essentialities depend on the crop types. The cycle goes on and maintains the soil-plant-animal ecosystem.

Nutrients are continuously removed from the soil by crops in addition to losses by leaching and erosion. It is estimated that different agricultural crops in India remove annually about 4.27 million tonnes of nitrogen, 2.13 million tonnes of phosphorus, 7.42 million tonnes of potassium and 4.88 million tonnes of calcium. It is, therefore, imperative that sound soil's and crop management practices are adopted to improve and maintain soil fertility and soil, physical condition for the purpose of sustained crop production. The management practices are proper crop-rotation and use of manures and fertilizers which are also termed as organic and inorganic manures.

Orgainc manures :

Manures are the organic materials derived from animal, human and plant residues which contain nutrients in complex organic form. The importance of manures was known to India, Chinese ard Japanese farmers from very ancient time. Scientific interest in the subject started since early twentieth century when complex matter was converted into "artificial or synthetic humus" before application in the soil. The main technique was the microbial decomposition to narrow down the C/N ratio to the level of 10:2 to 12:1 since it was the optimum limit of absorption of nutrients by plants.

The major sources of organic matters are as follows—

(i) Cattleshed wastes, viz. dung, wine and slurry of biogas plant.
(ii) Human habitation wastes, viz. night soil, human urine, town refuse, sewage, sludge and sullage.
(iii) Poultry litter, droppings of sheep and goat.
(iv) Slaughter house wastes, viz. bone meal from animal carcasses, meat meal, blood meal, horn and hoof meal.
(v) Fisheries wastes.
(vi) By products of agro industries. viz oil cakes, bagasse pressmud from sugar industries etc.
(vii) Crop wastes, like sugarcane trash, stubbles of different crops etc.
(viii) Water hyacinth and tank silk.
(ix) Green manuring crops.

Looking at the ecosystem, the left over of the living organisms after utilising the organic matter are the major source of organic manure. Excreta from animals and men are the components of manures. The average composition of original matter of cattle and human excreta and urine are as follows—

	Animal		Human	
Elements	**Dung**	**Urine**	**Faecee**	**Urine**
Water	82.4	92.6	75.0	97.0
Organic matter	15.2	4.8	22.1	2.0
nineral matter	3.6	2.1	2.9	1.0
Nitrogen	0.3	1.2	1.5	0.6
Phosphorus	0.18	0.01	1.1	0.1
Potash	0.1	1.35	0.5	0.2
Calcium	0.36	0.01	1.0	0.3

In addition, both the human and animal excreta contain the essential micronutrient elements. Microbiological transformations convert them into simpler inorganic compounds which are absorbed by plants. Organic matters are essential for the population build up of microbes vis-a-vis converting them into organic manures.

Manures are mainly evaluated on the basis of their nitrogen content and the amount of organic matter present in them. On the basis of nitrogen content, therefore, manures may be arbitrarily grouped into bulky organic manures and concentrated organic manures. Green manure, although a bulky manure, is ploughed under in the field and hence has to be considered differently. They also contain microorganisms which decompose carbonaceous and nitrogenous materials.

Farm yard manure is prepared from a combination of cattle dung and swine, wastes, feeds and fodder, materials used as litter etc. The percentage of nutrients content depends upon feed, litters material, variety, age and the way of preparation of manures. The upland is selected and decomposition is carried out in pits/trenches whose size depends upon the quantity of raw materials to be decomposed. On being allowed to decompose under favourbale conditions with the help of microbes already present in the excreta, both acrobic and anaecrobic reactions take place simultaneously. The cattle shed wastes are dumped directly into the trench/pit till the level of heaped material 30 to 40 cm above the ground level. The top is plastered with a slurry of cattle dung and soil. To check the loss of nutrients content it is advised to add recommended dosage of single super phosphate in the litter itself. After about two months or so, the materials are ready for use as manures,. Composting, as in the case of farmyard manure, is essentially a microbial decomposition of organic residues, collected either from the rural area or the urban area, and they are called as rural compost and urban compost. The process followed is same as farmyard manure but in this case nitrogenous fertilizer is recommended dosage is added to facilitate fast decomposition of the more complex organic matter. On an average percentage of nutrient content of FYM is 0.5 : 0.3 : 0.5 (N : P : K); in rural compost it is 1.0 : 0.5 : 1.5.

A slurry of biogas plant has got great importance since it produces energy and the leftover acts as very good manure having N, P and K contents respectively, 1.6-1.8, 1-2.0 and 0.8—1.2 percent on an over dry basis.

Other animal excreta are also good sources of nitrogen and the content in percentage greatly varries—

Pig— 3.0 : 2.5 : 2.0
Sheep and goat— 1.5 : 1.0 : 2.0
Horse—2.5 : 1.5 : 1.5
Poultry—3.0 : 2.5 : 1.5 etc.

Night soil, sewage and sludge are also good source of nitrogen but its handling and preparation needs precaution. In these cases, it is to be practiced not to take uncooked products.

Green manuring is the another good source of nitrogen. The principal green manure crops are sunhemp (crotalnia jndcea) and dhaincha (sesbania spp) but all leguminous crops are also used as green manure crop since they have got nodules in their root having bacteria (Rhizobium spp) to fix atmospheric nitrogen symbiotically. On an average nitrogen content varry from 7.0 : 0.2 : 0.6 where as water hyacinth it is 2.0 : 1.0 : 2.0.

The use of bulky manures improve the soil condition. The slow release of ammonical nitrogen, slow the conversion to nitrates and the leaching loss of nitrogen is low, have got advantages in using manures and fertilizers in combination. Its requirement is huge having low nutrient content causing thereby difficulty in transportation of the site of application.

The concentrated organic manures like oil cakes, bone meal, blood meal, meat meal and fish meal are also very useful having more nitrogen content along with insecticideal value especially in case of Neem cake etc. The contents of N : P : K are as follows—

Groundnut cake— 7.0 : 1.5 : 1.5
Mustard cake—4.5 : 1.5 : 1.0
Linseed cake—5.0 : 1.5 : 1.0
Castor cake—5.5 : 2.0 : 1.5
Neem cake—5.0 : 1.5 : 1.5
Karanj cake—4.0 : 1.0 : 1.0
Bone meal—3.0 : 20.0 : 0.0
Fish meal—7.0 : 6.0 : 1.0
Blood meal—10.0 : 1.5 : 1.0
Meat meal— :10.0 : 2.5 : 0.5 etc.

Inroganic manures—

Inorganic manures (fertilizers) are classified on the basis of the nutrients present—

1. Nitrogenous— nitrogen source for plants

2. Phosphatic—phosphorus source for plants
3. Potassic—Potassium source for plants
4. Mixed—tow or more nutrients source for plants

Futher, they are also grouped on their chemical actions—

1. Acidic — Fertilizers having acidic nature eg. Ammonium sulphate, Ammonium chloride etc.
2. Alkaline — Fertilizers having alkaline nature eg. Potassium nitrate, bone meal etc.
3. Natural — Fertilizers are neither acidic nor alkaline, eg. Calcium ammonium nitrate, Single Super Phosphate etc.

Plants requirements for nitrogen, phosphorus and potash can only be fulfilled by the application of fertilizers though their requirements are lesser as against carbon, hydrogen and oxygen. These three are abundant in air and water and as such further additon is required.

Nitrogen is an essensial constituent of metabolically active compunds such as amino acids, proteins, enzymes and some non-proteinous compounds. When nitrogen is a limiting factor, the rate and extent of protein synthesis are depressed and as a result plant growth is affected. The plant gets sunted and develps chlorosis.

To supplement the requirment, commercial nitrogenous fertilizers are used and grouped on the basis of the chemical form in which nitrogen is combind with other elements within a fertilizer—

Form	Name of the Fertilizer	Nitrogen (%)	Equivalant Acidity (Parts by wt)	Alkalinity (Parts by wt)
Nitrate	Sodium nitrate	16.0	—	29
	Potassioum Nitrate	13.0	—	23
	Calcium nitrate	15.5	—	21
Ammonical—	Amonium sulphate	20.5	110	—
	Anhydrous ammonia	82.2	148	—
	Ammonium chloride	26.0	128	—
	Ammonia solution	20.0-25.0	—	—
Nitrate & Ammonical :	Ammonium sulphate nitrate	26.0	99	—
	Ammonium nitrate	33.5	60	—
	Calcium ammonium nitrate	25.0	—	—
Amide :	Calcium cyanamide	21.0	—	63
	Urea	46.0	80	—

In nitrate form, nitrogen is fast water soluble and easily available to crops. On the other hand, there is increased danger of leaching loss and as such not advisable to use in monsoon. They are basic in their residual effects.

Ammonium fertilizers are readily soluble in water and as such readily available. However, they are less rapidly utilized by the growing plants than nitrate nitrogen, as ammonium has to be nitrified to nitrate form before it can be absorbed by the plants. Paddy crop is an exception and prefers the ammonium form or nitrogen in the early stage. They are resistant to leaching loss and are acidic in their residual effect.

Nitrate and ammonium fertilizers contain nitrogen in both the ammonical and nitrate forms. They are readily soluble in water and suitable to use under a wide variety of soils and cropping conditions. They are acidic in their residual effect except calcium ammonium nitrate.

Amide forms are carbon compounds and so are technically classified as organic compounds. Urea is of the form, hygroscopic and freely soluble in water. Amide forms are easily decomposed by micro-organism in the soil there after the nitrate form nitrogen is utilised by plant. They are acidic in their residual effect.

Phosphorus is a structural component of all membranes, chloroplasts and mitochondria and a constituent of sugar phosphate, viz. ADP, ATP, nucleic acid, etc., phospholipids and phosphatides. Phosphorus plays an important role in energy transformations and metabolic processer in plants. It stimulates root growth. Phosphorus deficient crops show the following symptoms :

(a) Leaves developing red and purple colours.
(b) Slow growth and late maturity
(c) Lower leaves becoming dry, developing purple colour between veins.
(d) Leaf petiols developing purple colur. Commorcial phosphatic fertilizers use are phosphate compounds to calcium mono calcium phosphate [$Ca(H_2 Po_4)_2$] dicalcium phosphate [$Ca_2(HPO_4)_2$] and tricaleium phosphate [$Ca_3(PO_4)_2$] Mono calcium phosphate is soluble in water, dicalcium phosphate in weak acids, where as taicalcium phosphate is almost insoluble.

Monocalcium phosphate fertilizers contains phosporic acidic in an available forms. Such fertilizers are;

1. Single super phosphate	—	26 to 18% P_2O_5
2. Double super phosphate	—	32% P_2O_5
3. Triple super phosphate	—	46 to 48% P_2O_5
4. Ammonium phosphate	—	10% N and 20% P_2O_5
	Or	16% N and 20% P_2O_5

The main characteristics of these fertilizers are water soluble and can be absorbed quickly, as plants utilizes phosphrus as H_2PO_4 and available to plant in the young stage;

rapidly transformed in the soil into a water insoluble form causing thereby less of nutrient by leaching and should be based on neutral to alkaline soils but not on acidic soils. Under acidic conditions, water-soluble phosphoric acid gets converted into unavailable iron and aluminium phosphates.

Di-calcium phosphates are :

1. Basic slag — 14 to 18% P_2O_5
2. Dicalcium phosphate — 34.0% P_2O_5

They are suitable for the acidic soil, because citrate soluble phosphoric acid gets converted into monocalcium phosphate in low pH and there are less chances of phosphate getting fixed as iron and aluminium phosphates.

Tricalcium phosphates are :

1. Rock Phosphate — 20 to 30% P_2O_5
2. Raw bone meal — 20 to 25% P_2O_5 & 3 to 4% N
3. Steamed bone meal — 22% P_2O_5

These fertilizers are well suited for strongly acidic soils or organic soils which require larger quantities and availability increases when applied along with green manuring crops or other organic materials.

The third primary important nutrient is potassium. It plays an inportant role in the maintenance of cellular organisation by regulating permeability of all membranes and keeping the protoplasm in a proper degree of hydration. It activates the enzymes in protein and carbohydrate metabolism and translocation of carbohydrates and imparts resistante to plants against fungal and bacterial diseases.

The deficiency symptoms show, bottom leaves scorched or burned on margins and tips; leaves thicken and curl and first appears in the portion of the field.

Potassium on exposure to air rapidly oxidises to K_2O and with water form highly potassium hydroxide. That is why it must be combined with one or more to the other elements to form soluble compounds and available to crop plants. The most common compounds of potassium in use as fertilizers are potassium chloride (sold as muriate of potash), potassium sulphate (sold as sulphate of potash) and potassium nitrate.

Potassium chloride is muriate of potash is universly used as fertilizer being cheaper and highly soluble in water. Potassium is directly utilized by plants in ionic form and may be absorbed on the exchange complex of soil. It is applied before or at the time of sowing and is suitable for all crops except for tobacco and potato because of chloride.

Potassium fertilizers of this group are sulphate of potassium, sulphate of potash, magnesium and potassium nitrate. Potassium content is 40.0%. It is a costlier on per unit of potassium (K^+) and special crops itke potato, tobacco and tomato, in which the quality of the produce is as inportant as the total yield per acre.

Schoenite contains both magnesium and potassium. The salt contains 22 to 24 percent K_2O and 9 to 11 percent Mgo. It is a good potassic fertilizer and more beneficial for magnessium deficient soil.

Mixed fertilizers :

A mixture of two or more straight fertilizer materials is referred to as fertilizer mixture (mixed fertilizer). The term has been referred to those fertilizers that contain three major plant nutrients namely, nitrogen, phosphorus and potassum. The advantage of mixed fertilizers is that all the three nutrients can be had in one packet, thus facilitating purchases, transport, storage and application. Moreover, balance application of major nutrients is assured. The use of complex and mixed fertilizers has the limitation that initial fertility status. as by soil testing, is not taken into consideration. The need of a particulars soil for a particular nutrient is ignored. The following fertilizers are marketed :

Hara Banaar	18 : 18 : 6
Sufla	20 : 20 : 0
Sufla	15 : 15 : 15
Shyamla	15 : 15 : 15
Growmore	28 : 28 : 0
Laxmi	12 : 12 : 12
Ifco–I	10 : 26 : 26
Ifco–II	12 : 32 : 16
Ifco–III	14 : 36 : 12

The following way the organic and inorganic (fertilizer) differ in their effect and use)

Organic manures	Fertilizer (Inorganic) manures
1. Physical effect on soil	
(i) Addition imporoves soil aggregation and soil becomes granular under the condition proper soil aeration and water movement takes place.	(i) Addition does not improve soil aggregation.
(ii) Checks soil erosion due to rain	(ii) No capacity to check soil erosion
(iii) Improves water holding capacity of soil.	(iii) No effect on water holding capacity
(iv) By additon of organic manures, heavy soil becomes friable and sandy soil becomes granular and as such it can be added in any soil.	(iv) All fertilizers or inorganic manures can not be use in each and every type of soil. If sodium contanis fertilizer is used excessively, the soil texture is spoiled.
(v) Its use reduces soil-water evaporation.	(v) There is no such quality.

(II) Chemical effect on soil

(i) Stored nutrients released slowly. By decomposition it produces harmones and antibiotics whch have got beneficial effect on plants.	(i) Fertilizers especially nitrogenous fertilizer can not be retained for ling and plant takes up immediately. More quantity of phosphoric and less nitrogenous and potassic fertilizers fix up in the soil.
(ii) By addition it produces Co_2 and H_2CO_3 which solublizes mineral Matter in available form to the crop plants.	(ii) No such quality prevails.
(iii) It increases the buffering capacity of the soil.	(iii) No such quality prevails.
(iv) It never cause acidity and alkalinity in the soil rather by decomposition of organic matter $H_2 CO_3$ is produced and have got beneficial effect on crop plants.	(iv) By the use of one type of fertilizer continuously reduces or increased the soil pH causing thereby acidity and alkalinity, viz, Ammonium splphate and Ammonium nitrate, respectively.
(v) Reduces leaching loss of nutrients.	(v) No such quality prevails.
(vi) It adds micro-nutrients also in addition to primay nutrients.	(vi) Generally, micro-nutrients are absent.

(III) Biological effect on soil

(i) By addition increases the beneficial soil microorganisms since it is essential for food and energy.	(i) N. P. K. is made available to soil microbes but for energy carbon is only available from organic manure.
(ii) By decomposition of organic matter, nitrification and nitrogen fixation depends upon soil microbes. Nitrogen in the from of ammonia from organic matter is converted to nitrate form by soil microbes.	(ii) Addition increases the function of soil microbes but the population build up depends upon organic matter.
(iii) Organic manure is the main food for soil-organims especially for earthworm which maintains soil fertility.	(iii) No such quality prevails.

(IV) Use differences

(i) It requires in huge quantity since the nutrient contents less	(i) It is required in less quantity having more nutrient content.
(ii) It is added in the soil a month or two early than cropping so that it can decompose further and nutrients become available to crop plants.	(ii) It is added just before sowing and transplanting, if not, its appli- cation will be useless.
(iii) It should be thoroughly mixed in the soil.	(iii) Its application varies like band placement, broadcasting etc.
(iv) It is usually not applied in standing crop	(iv) Except phosphatic fertilizer, top dressing is common with nitrogen.
(v) Its solution is not prepared nor sprayed on the crop.	(v) Spraying is done on standing crop especially with urea.

□

Lesson—9

Preliminary Ideas about Fundamental Particles

An atom is the smallest particle of an element, It is made up of different types of fundamental particles. The three most important particles are the protone, the neutron and the electron.

The following are the important characters of these fundamental particles.

Fundamental Particles	Absolut Charge	Relative Charge	Absolute mass	Relative mass
Proton	$+4.8 \times 10^{-10}$ e.s.u. $+1.6 \times 10^{19}$ Columb	+1	1.674×10^{-24} gram	1
Neutron	O	O	1.665×10^{-24} gram	
Electron	-4.8×10^{-10} e.s.u. -16×10^{-16} Columb	−1	$9.1=10^{-23}$ gram	1 1840

Discovery of these fundamental particles—

Discovering of electron—

Sir J. J. Thomson showed in 1817 that when an electric discharge is passed through a gas at a very low pressure and a high voltage, Cathode rays stream from the Cathode.

Characters of Cathode rays—

(a) They travel in straight line from the Cathode to the anode.

(b) They produce fluorescence in the glass walls.

(c) They can produce mechanical motion.

(d) They possess heating effect and heat their metal films.

(e) They cause ionisation in gases.

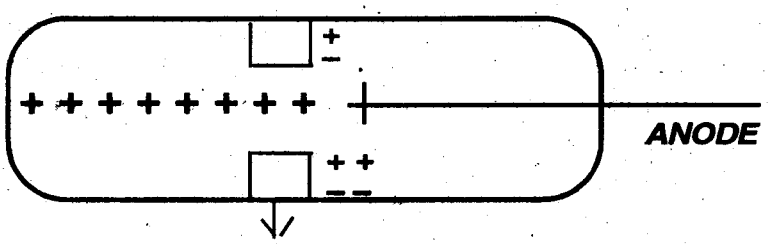
(f) They have effect on photographic plate and,

(g) They are deflected by the magnetic and the electric field and the deflections of a charged partical in a magnetic field or electric field is directly proportional to its charge (c) and inversely proportional to its mass.

These properties indicate that the Cathode rays are made up of very small particles carrying a negative charge. These particles are now called electrons.

Discovery of Proton :

In 1886 E Gold Stein used a discharge tube with perforated Cathode and found a another type of radiation that passed through the perforation in the Cathode.



PERFORATED CATHODE

The rays are made up of positively-charged prticles which are shown by various experiments and they are called positive rays or canal rays.

Character of Positive Rays :

(a) They show deflection in electric field as well as magnetic field. But the direction of deflection is opposite to that the cathode rays.

(b) The ratio of the charge and mass of these particles are found to vary in magnitude with, the nature of the gas in discharge tube.

(c) They travel in straight-line.

(d) They have effect on the photgraphic plate.

(e) These paticles contain unit positive charges and known as proton

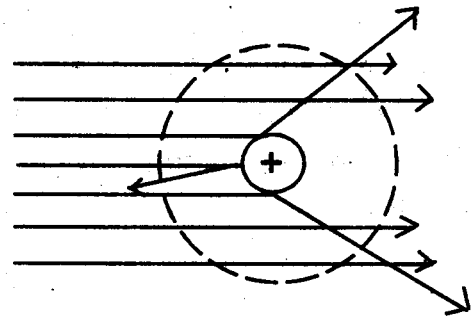
Discovery of the Neutron :

In 193-J. Chadwick found new chargeless particles by the bombardment of α-particles of Berium atom and these are called neutron.

$$^{9}Be_{2} + {}^{4}H_{2}O = {}^{1}On + {}^{12}C_{6}$$

Character of Neutrons :

1. They do not show deflection in electric field and magnetic field. This indicates that they are electrically neutral or charge-lines.
2. They posess a penetrating power



Discovery of nucleus :

Or (Rutherfored atomic model or α-rays scattering experiment.)

IN 1911 Lord Rutherford preformed an experiment. He bombared a thin sheet of α-particles. He observed most of the α-particles passed through the foil without deflection, a few of them were found to be deflected from their original path.

On the basis of the above experiment Rutherford gave a model of a atom known as-Ruthcrford model of atom. The following are the important facts of his model.

(a) The major part inisde an atom is empty space.
(b) The central part of the atom is positively charged and called nucleus.
(c) The mass of an atom is entirely in the nucleus.
(d) The electrons are moving around the nucleus in circular paths, so that the centrifugal force arising from the motions of electrons balance the electrostatic force of attraction. Thus the Rutherford model of an atom is just like a solar system.

Defect of Rutherford model of atom :

According to the electro-dynamics theory—When a charged particle (electrons) moves around the nucleus; it will lose energy by emitting radiation. As a consequence of this, the orbits become smaller due to the spiral path of moving electrons will fall into the nucleus.

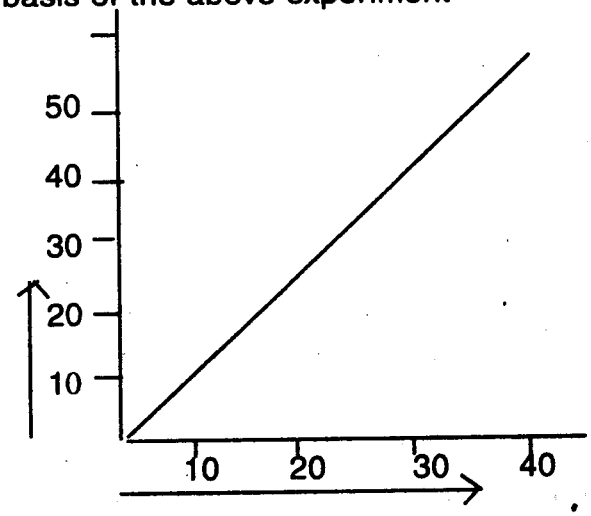
Secondly, the Rutherford model has no explantion about the discontinuous time spectra. Therefore, the Rutherford atomic model is unstable.

Fundamental property of an element :

In 1913 Mosley showed that the frequency of x-rays developed by the bombardment of cathode ray on different element depending upon the Atomic number of the element not on the atomic weight of the element. He plotted a graph of square root of the greatest frequencies of the x-rays of elements and their atomic number and obtained a straight line i.e.

Atomic number α $\sqrt{\text{frequencies of x-rays.}}$

On the basis of the above experiment



Atomic Number

It is found, that the atomic number is the fundamental property of an element.

Atomtc number :

The total number of protons present in an atom is called atomic number. Atomic number=No. of protons (p) present in an atom

(Z) = No. of electrons(p) present in an atom

Z = p=e .....(i)

Atomic mass (Mass number)

Mass number is the sum of the total number of protons and neutrons present in the nucleus of an atom.

I.e.,

Mass number=No. of proton+No. of neutron

(A) (p) (n)

A=p+n .....(ii)

Above relation in terms of atomic number—

form (i) $Z = P$

form (ii) $A = Y+n$

$A—Z = n.$

Thus the differences of the mass number and the atomic number gives the number of neutrons—Present in a nucleus of an atom.

Planck's Quanum Theory :

In 8,900 Max Plancks put forward a theory known as Planck's Quantum theory of Radition according to which "a black body emits or absorbs the energy such as light and heat not continuously but in the whole number of a small product of energy called quantum.

The energy of one quantum is—

E = hd

h = Planck contant.

d = frequency of radiation.

e = Eneergy of Quantum

Bohr's Atomic Model—

In 1913 Neils Bohr presented a Model of atom on the basis of Max-Planck's quantum theory.

The following are the main features of his theory—

(a) The electrons revolve around the nucleus in certain fixed or stationary orbits. The electrons while revolving in these orbits neither absorb nor emit energy.

(b) These fixed orbits are named as K, L, M, N,.....or integers 1, 2, 3,.....

(c) These stationary orbits are also known as Energy levels.

(d) Only those orbits are permissible to which the angular momentum of electron is—

integral multiple of $h/2\pi$

$mvr=nh/2\pi$, mvr=angular momentum of electron

m = mass of electron.

v = velocity of electron.

r = radius of orbit

n = not of orbit,

h = Planck's constant.

(e) Energy change i.e., emmission of energy a absorption of energy is only possible when an electron jumps from one orbit to another.

$\Delta E=E_2—E_1=hv$

E_2=Energy of orbit (where the electron jumps)

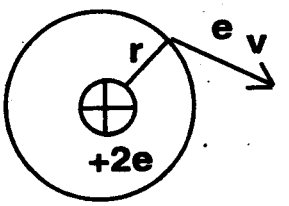
E_1=Energy orbit (From where the electron jumps)

Defects of Bohr Model of atom—

(a) Bohr Model can only explain spectrum obtained by atoms ions having one electron.

(b) Bohr Model have no explanation for Zeemean effect 2—stark effect.

Energy of electron revolving around the nucleus—



Electron in an orbit of radius 'r'

If the mass of electron=m and is revolving around the nucleus of charge + Ze in a circular obit wilts velocity 'V' the radius of the circular orbit is 'r' the Force of attraction towards the nuleus of electron is $=\frac{ZeXe}{r^2}=\frac{Ze^2}{r^2}$ ...(1)

This attractive force is balanced by the centrifugal force.

Centrifugal force$=\frac{mv^2}{r}$ ...(2)

For the stability of Atom, there must be centrifugal force

Or $\frac{mv^2}{r}=\frac{Ze^2}{r^2}$

Or $Mv^2=\frac{Ze^2r}{r^2}=\frac{Ze^2}{r}$ ...(3)

Or $MV \times V=\frac{Ze^2}{r}$

Or $Mvr \times V = Ze^2$

$mvr=\frac{Ze^2}{r}$ ...(4)

We know from the Bohr's theory

$mvr=\frac{nh}{2\pi}$

$v=\frac{nh}{2\pi mr}$ ...(5)

Putting the value of v eg, (4) we get.

$$mvr=\frac{Ze^2}{nh}\frac{Ze^2}{nh}=\frac{Ze^2}{nh}\times 2\pi mr$$

$2\pi mr$

Or $\frac{nh}{2\pi}Ze^2\times 4\pi mr$ $\left[mvr=\frac{nh}{2\pi}\right.$

Or $n^2h^2=Ze^2 \times 4\ \pi^2 mr$

$$r=\frac{nh}{4\pi^2 mZe^2}$$

Or $r=\frac{nh}{4\pi^2 nZe^2}$ ...(6)

$$r=\frac{n^2}{Z}\left(\frac{h^2}{4\pi^2 me^2}\right)$$

[n=orbit no.
[Z=Atomic no.

$\frac{h^2}{4\pi^2 mc^2}$ a^0 = 052.9A^0

$$r=\frac{n^2}{Z^{a_0}}$$

$$r=\frac{n^2}{Z}=0.529\ A^0$$

For Hydrogen atom=Z=1, 2n=1

$$r=\frac{(1)^2}{1}\times 0.529A^0=0.529A^0$$

Thus the radius for the smallest orbit is 0.529 A^0 and this is known as Bohr radius.

Total energy of electorn=K.E. + P.E.

=½mv^2+P.E.

(From eq. (3) $mv^2=\frac{Ze^2}{r}$)

Therefore,

$$=\frac{1}{2}\times\frac{Ze^2}{r}+P.E$$

$$=\frac{Ze^2}{r}+P.E$$

(From eq. (3) $Mv^2=\frac{Ze^2}{r}$)

Therefore,

$$=\frac{1}{2r}\times\frac{Ze^2}{r}+P.E.$$

P. E. (Potential energy) of electron $=\frac{-ze^2}{r}$

Therefore Total enegry of electron $=\frac{Ze^2}{2}+(\frac{-Ze^2}{r})$

$$=\frac{Ze^2}{2r}=\frac{Ze^2}{r}$$

$$=\frac{-Ze^2}{2r} \qquad .....(7)$$

$$=\frac{-Ze^2}{2}+\frac{1}{r}$$

$$=\frac{-Ze^2}{2}+\frac{4\pi^2mZe^2}{n^2h^2}$$

$$=\frac{-2\pi mZ^2e^4}{n^2h^2} \qquad .....(8)$$

Equation (8) gives the value of total energy of electron in the nith orbit of an atom having atomic number Z.

Bohr-Bury Scheme—

In 1921 Bohr-Bury put forward a scheme to show the distribution of electrons in different orbit of an atom and this scheme is known as Bohr-Bury scheme.

The main points of the scheme is as follow—

(i) The maximum number of electrons present in any orbit is given by $2n^2$, where is the orbit number. For example.

Orbit No.	maximum No. of electrons.
1 (K)	$2 \times 1^2=2$
2 (L)	$2 \times 2^2=8$
3 (M)	$2 \times 3^2=18$
4 (N)	$2 \times 4^2=32$

(ii) The maximum number of electrons in the outer most orbit of an atom will not be more than 8 and the penultimate (orbit just before the outer most orbit) will not have more than 18 electrons.

(iii) It is not essential for an orbit to be completed before a new orbit is formed. In fact a new orbit is formed. In fact a new orbit beigns after attaining the 8 electron in the outer most orbit.

Distribution of electrons in different' orbit 'according' to the Bohr-Bury scheme—

Element	At. No.	No. of elements	Electrons Present in different orbits				
			K 1	L 2	M 3	N 4	O 5
H	1	1	1				
C	6	6	2	4			
Na	10	10	2	8			
P	15	15	2	8	5		
Ar	18	18	2	8	8		
Ca	20	20	2	8	8	2	
Xe	54	54	2	8	18	18	8

Quantnm Numbers :

"Quantum numbers are the numbers which give the idea about the energy an spend of an electron in an abound".

Putting the value of refrom e. q. (6)

There are four Quantum No.

1. Principal Q. No.
2. Ajimuthal Q. No.
3. Magnetic Q. No.
4. Spin Q. No.

1 Principal Q. No :

Principal Q. No. (n) denotes the energy of the electron, distance of the electron from the nucleus and orbit of the electron.

n can have only integral value $1+\alpha$ Thus N=1,2,3,4.....the letter used are K, L, M, N.....respectively.

n gives an idea of the size of the orbit.

2. Azmuthal Q. No.—It is denoted by letter 'l'. It is also called angular momentum quantum number, orbital quantum number and some times subsidiary quantum number. It gives an idea of the shape of the orbital.

Permitted value of 1 for a given value of n. 1 can have any value from O to (n—1) for a given of n i.e.

1—0, 1, 2.....(n—2), (n—1)

The total number of different value of 1 is equal to n. Thus if

if n = 1 1 = 0

if n = 2 1 = 0, 1

if n = 3 1 = 0, 1, 2

if n = 4 1 = 0, 1, 2, 3

The azmuthal quantum number 1=o, 1, 2, 3.....denotes the sub-orbit or orbitals s, p, d, f.....respectively.

3. Magnetic Q. No—This Q. No. is represented by 'm'. This is also known as orientation Q. No. It indicates the orientation of orbitals in space. The value of dependent upon the value of l. m can have the following value for given value of 1.

1	orbital	Total Value of m=(2l+1)	Value of me +2 to—1)	No of orientations,
O	s	1	0	1
1	p	3	1, 0,—1	1
2	d	5	2, 1, 0, –1,–2	5
3	f	7	3, 2, 1,—1,—2,—3	7

Thus the total value of m for a given value of l gives the total number of space oriental of s, p, d, f orbitals.

Spin Quantum Number (S) :

It is denoted by S and defines the angular momentum of the electron. The electron can spin clockwise or anti-clockwise. Therefore, two values of S are possible, +½ & ½ depending upon whether the electron spin in the other.

Hund's Rule :

According to Hund's Rule the electrons enter the rule orbital (e.g. s, px, py, pz.....) in such a way as to give the maximum number of unpaired electrons and these unparied electrons have the same directions of spins".

Thus,

(a) The electrons tend to avoid being the same orbital as far as possible and

(b) Electrons tend to have the same spin if they are equivalent orbitals.

Pauli's Exclusion Principle :

The principle states that "no to electrons in an atom can have the same set of four quantum numbers."

For Example :

He contains two electrons

The value of for Quantum Number of both electrons are as follows—

	e_1	e_2
n	1	1
l	0	0
m	3	0
z	+½	–½

Thus the value of the fourth quantum number is different.

Aufdan Principle—"The process of filling up of electrons in orbitals on the basis of increasing order of energy of orbitals is called Anfdan principle."

According to this rule :

(i) The electron enters to that orbital first for which the value of (n+1) is minium.

(ii) It the (n+1) value is the same for two orbitals, the electron enters to that orbital for which the value of 'n' is minimum.

The above rule can be shown as such.

n	1	n+1	Orbitals
1	0	1	1s
2	0	2	2s
	1	3	2p
3	0	3	3s
	1	4	3p
	2	5	3d
4	0	4	4s
	1	5	4p
	2	6	4d
	3	7	4f

So the energy of various orbitals increases in order given below.

$1s \leq 2s \leq 2p \leq 3s \leq 3p \leq 3d \leq 4p \leq 5s \leq 4d \leq 5 \leq 5s \leq 4o \leq 5p \leq 6s.....$

$\xrightarrow{\text{Energy increases}}$

This is also known as energy level diagram,

Atomic Energy—

Atomic energy of an element is mainly associated with its properties of nucleus so it is known as nuclear energy.

Nuclear Energy—The energy released when neutrons protons combine to form the neutrons is called the Nuclear binding energy.

It is also stated "The energy required to separate the neutrons and protons from the nucleus is also the nuclear binding energy".

For Example—

$_1H^1 + On^1 \longrightarrow {}_1H^2$

Reactant Product

Here, Nucleus (with proton & neutron (is formed by protons & neutrons

Mass of proton=1.000783 Mass of $_1H^2$=2.01410

Mass of neutron =1.00866.

$\therefore$ Mass of Reactants = 2.01749

The difference in mass between reactants and products and is known as 'Mass defect".

So here mass defect is= Δ m=2.01649—2.01410

=0.00239 gm.

According to the Einstein equation Energy related to the mass as such

$E = MC^2$

Energy=(Change in mass) X (velocity of light)^2

$\therefore$ $E=o.00239 \times (3X10^{10})^2 \frac{gram}{mole} \times \frac{(cm)^2}{sec^2}$

$E=5.15+10^7$ K. Cal/mole.

Nuclear Fission—

The process in which a heavy nucleides or uncleus is broken into lighter nucleides by the bombardment with a particle with a tremendous release of energy is called Nuclear fission.

Example—

$_{92}U^{235} + O^{u1} \rightarrow (_{92}U^{236}) \rightarrow_{56} Ba^{141} +_{39} Kr^{92} + 30^{n1} + 200Mev.$

Since, in fission more neturons are produced than are needed to initiate the fission,

the process become a chain reaction. This Nuclear chain reaction produces an—enormous amount of energy.

Nuclear Fission—The process in which higher nucleides are converted into larger ones with a release of tremendous amount of energy is called Nuclear fussion.

For Example—

$_1H^2 +_1 O^3 \rightarrow 2He^4 + O^{n1} + 17.6Mev.$

Here, fission reaction takes place between Deutrium (isotope of hydrogen) in which Hellium Nucleus is the product.

❐

General Studies (Geography)

Lesson—1

Physical Geography of India—Location Physical Division and Rivers

Facts about India

Name	—	Indian Union
Capital	—	New Delhi
Nationality	—	Indian
Geographical Area	—	32,87,263 Km^2
Population (1991)	—	846,302,688
Independence Day	—	15th August
Republic Day	—	26th January
Location	—	Souta Asia

Location of India—India is the seventh largest country of the world and ranks second only after China in Asia. The whole country is located in the Northern Hemisphere. It extends between 8° 4' N to 37° 6' N latitudes and 68° 7' E to 97° 25' E longitudes. Himalyan mountain is located on its northern border. In the south, it extends upto Kaniya Kumari, India is the largest country of South Asia.

India is a peninsula. Bay of Bengal lies in its east, Arabian sea in its west and Indian ocean in the south. The country consists of two groups of islands—Andaman-Nicobar island group in the Bay of Bengal and Lakshadweep group in Arabian sea. The former has a total of 223 islands and the latter has 27 islands. Seven islands of the former and

seventeen islands of latter are uninhabited. The N-S length of the country is 3214 km. and the maximum width from west to east is 2933 km. The total area of the country is 32,87,263 Km^2. The land boundary of the country is 15200 km. and the water frontier is 7516.6 km. It also includes the coast length of the islands.

India has a number of neighbouring states. Pakistan and Afghanistan lies in its north-west, Tibet and China in its north, Bhutan in its north-east, Bangladesh and Myanmar (Burma) in the east. Sri Lanka is also a neighbouring country separated from mainland of India by Palk strait. All other mentioned above have land boundary with India Thar or Rajasthan desert lies between India and Pakistan and Himalyas between India and China. Patkoi, Naga and Lusai hills separates India from Myanmar (Burma).

The tropic of Cancer (23½° N Lat) almost passes through the middle of the country through Gujarat, Rajasthan, Madhya Pradesh, Bihar, West Bengal, Tripura and Mizorm. The 82½° E Longitude is the Standard Meridian and determines Indian Standard Time(IST). This passes through Eastern U. P., Eastern M. P., S. W. Orissa and N. E. Andhra Pradesh.

There are 26 states including Delhi National Capital Region and 6 Union Territories in India. Andaman-Nicobar, Chandigarh, Dadra-Nagar Haveli, Daman and Diu, Lakshadweep and Pondicherry are Union Territories and are centrally administered. Others are all states of India.

Physical Division—India has four distinct physical units—

(i) Himalyan Mountain Chain,'
(ii) The Great Plains of India,
(iii) The Plateau of the South, and
(iv) The Coastal Plain.

(i) Himalyan Mountain Chain—This mountain is situated on the northern border of the country. It is 2500 Km. long and 160-500 km. broad. The average height of the mountain is 5,000 mts. It has three ranges—

(a) Greater Himalyas—This is the highest range of the Himalayas Its peaks are snow capped hence called 'Himadri'. Everest is the highest peak, 8848 meters high. In Nepal it is popularly known as 'Sagar Matha'. Within the Indian territory Kanchenjunga (8598m.) is the highest peak on the border of Nepal and Sikkim. Other peaks are Makalu (8481 mts.), Nanga Parbat (8126 mts.) and Nandadevi (7816 mts).

(b) Middle Himalyas—This is also known as Lesser Himalyas or 'Himanchal". Its average elevation is 1800 metrs. All the hill stations and health resorts centres are located on this range. The two important peaks of Middle Himalyas are Trishul and Badrinath.

(c) Outer Himalyas—This is also known as Siwalik Himalyas. It height varies between 900-1200 meters. The Sumeshwar hill in Bihar belongs to Siwalik. Between Middle and the Outer Himalyas there is a broad valley 25km. wide. it is called 'Dun' valley. Kangra valey, and Butwal valley are other examples.

Himalyas in defferent parts are known by defferent names. In Jammu-Kasmir it is known as Kashmir Himalya; between Indus are Satluj rivers it is Punjab Himalya; between Satluj and Kali river it is known as Kumaon Himalya; between Kali and Teesta rivers it is known as Napal Himalya and between Teesta and Brahmputra it is known as Assam Himalya.

Along Myanmar border there are several hills which jointly known as Purbanchal hills. The prominent ranges are Patkoi, Mizo, Naga and Lusai. There are also some hill extending east & west in Assam and Meghalay. They are Garo, Khasi, Jayantia and Mikir hills.

Himalyas stand like a wall and it is difficult to cross it. But there are several passes through which it can be crossed over to Tibet and China. Most important passes are Khaiber, Bolan, Gomal, Khurram, Shipki, Nathula, Bomdila etc.

(ii) The Great Plains of India—Between Himalyas and the plateau of the south the Great Plains of India is situated. The plain has been built by the deposition of sediments brought by tributaries of Indus (mainly Satluj) in the west, Ganga and its tributaries in the middle and Brahmputra and its tributaries in the east. This is an alluvial plain as it has been built by river borne sediments The flood plain of the rivers are lower and the water spills over the bank to flood a lange tract. The flood plains have younger alluvium called 'Khadar' Between the flood plains older alluvium is found known as 'Bhangar'. At the foot-hills of the Himalyas there is a narrow belt of coarser sediments which present swampy condition. The belt is known as Bhabhar. It is covered under thick sal forest. The plain is higher in the west and slopes in south-east direction. The river Ganga has meandering course and occupies low level. From the bank the land rises both towards the north and south.

(iii) The Plateau of the South—The entire country south of the Great Plain comes under this unit except the coastal plain. This is ancient plateau and a part of the Gondwana land. The land consists of mostly metamorphic rocks because of its long age. The plateau rises to an average height of about 600 metres.

. The plateau is bounded on three sides by mountains. On the north lies the Vindhyan mountain, on the west and the east are the Western Ghats and the Eastern Ghats mountain Besides, in the north west from Gujarat to Delhi lies the famous Aravalli mountain. There are also saveral plateanus within the frame-work of these mountains. South of the Vindhyans are Bundelkhand and Baghelkhand. In the east of it lies the Chotangpur plateau. Between Aravlli and Vindhyan lies the Malwa Plateau. The group of plateaus south of Vindhyans are called Deccan Plateau. The Western Ghat mountains consists of Sahyadri in the north and Nilgiri, Anamalai and Cardamom hills in the south. The highest peak of western ghats is Anamudi (peak of Anamalai). It is 2695 metress high. The second highest peak is Dodabeta (2637 metres). The famous hill station of the south-Otacamund (Octy) is situated on Nilgiri hills. On the estern part there are dissected hills of Eastern Ghats. In Orissa it is known as Mahendragiri. In Andhra Pradesh the hills are

Nalamai Palkonda and Velikonda. Near Madras in Tamil Nadu Pachamaliai and Shevroy are important hills. On the east of the Western Ghats is an extensive plateau of Lava known as Deccan Lave Plateau. It extends over Gujarat, Madhya Pradesh, Maharastra, Karnataka and Tamilnadu.

In the north west of Malwa Plateau is the famous. Thar Desert covering the western part of Rajasthan. It is covered under sand. Its major part has gone to Pakistan. The climate is hot and dry and not suitable for human habitation.

(iv) Coastal Region—The plains on the west and east of the Deccan Plateau is called coastal plains. The coastal plains along the Bay of Bengal is the Eastern Coastal Plain, over 100 km. wide and flat. The rivers which join this bay makes Detlas. Ganga Delta or Sunderban Delta is the most extensive and largest Delta in the world. The southern part of the coastal plain from Kanniya Kumari to Visakhapatnam is called Coromandel coast, in Andhra Pradesh it is called southern Circars and in Orissa northern Circars. These two—Northern and southern Circars combined together is known as Golkunda coast.

The coast adjoining Arabian sea is called Western Coastal Plain. It is narrow and highly dissected. It is about 50 km. broad. Along the coast there are several logoons. The coast upto the river Tapi is called Southern Gujarat coast. Between Tapti and upto Karnataka it is called Konkan coast and beyond that upto Kanniya Kumari it is known as Malabar coast.

Islands of India—Beyond the mainland of India there are two groups of islands also. In the Bay of Bengal lies the Andman and Nicobar group having 204 islands in Andman and 19 islands in Nicobar. Portblair is its capital.

In Arabian sea lies Lakshadweep group of islands. There are 27 islands in this group. There is no habitation over 17 islands. These islands are coral islands, Kawasti is its capital. The islands are 300 km. away from Kerala.

Rivers of India—India is a country of innumerable rivers. The rivers are grouped under two types—Himalyan rivers and Peninsular rivers. Himalyan rivers are perennial as they are fed by melting of the glacial ice. During monsoon when there is heavy rainfall, they are full and cause flood. Ganga is the longest among the Himalyan rivers.

Ganga originaties from Gangotri Glacier at Gomukh. In the begining it is known as Bhagirathi. After its confluence with Alakhnanda at Dev Prayag, it is known as Ganga. It descends from Himalyas near Haridwar and turn sotheastward. After flowing up to Bihar it suddenly turns southward, splits into several distributaries and meet the Bay of Bengal. One of its distributaries is Hooghly on the bank of which the city of Calcutta is located. Before being divided into distributaries Ganga again takes its original name—Bhagirathi for some distance. Ganga makes largest delta in the world.

Ganga has a large number of tributaries. Yamuna is its largest tributary. It is right bank tributary and meets Ganga at Allahabad. The rivers which join its left bank are Gomti (Lucknow), Saryu (Ayodhya), Ghaghra (Chhapra), Gandak (Patna), Kosi (Saharsa) and

Mahananda (Katihar) etc. Technically Brahmputra is also a tributary to the river Ganga which meets the latter within the territory of Bangladesh. The rivers joining Ganga from the south are ephemeral. Important among them are Chambal, Betwa and Ken which discharge their waters in Yamuna and through it goes to the river Ganga. Other rivers directly flowing to Ganga are son, Punpun, Harohar, Mayurakshi etc. The river Damodar also joins Hooghly in west Bengal by the name Rupnarain.

Brahmputra originates in the Himalyas but descends following over northern slopes in Tibet. It flows eastward along the Himalyas in the name of Tsang-Po. In the north east of India it takes a sudden sharp 'U' turn and enters India through Arunachal Pradesh. Flowing through Assam the river enters into Bangladesh and assumes the name Jammuna. The tributares of Brahmputra from Himalyas are Subansree, Kameng. Dhanshree, Manas and Teesta. The rivers joining from south are Burhi Dihang, Disang, Kapoli and Lohit.

There are five main rivers which go to Bay of Bengal.

(i) **Subarnarekha**—It originates near Ranchi and flowing over Chotanagpur plateau enters into Orissa where it meets with the Bay of Bengal. Its important tributaries are Raru, Kharkai, Vaitarni and Brahmani Near Ranchi. Swarnarekha makes a magestic waterfall called Hundru falls.

(ii) **Mahanadi**—It rises near Raipur. Flowing eastward through Madhya Pradesh and Orissa meets the sea. Its main tributaries are Sheonath, Mand, Jonk, Tel etc.

(iii) **Godavari**—It rises near Nasik in Western Ghats. It passes through Maharastra, Madhya Pradesh, Andhra Pradesh before meeting the Bay of Bengal. This is the largest river system of South India. Penganga, Wardha. Pranhita, Indravati and Savari are its main tributaries.

(iv) **Krishna**—It rises near Mahabaleshwar in Western Ghats and flows through the states of Maharastra, Madhya Pradesh and Andhra Pradesh. Its main tributaries are Koyna, Dudh Ganga, Bhima and Tungbhadra.

Kaveri (Cauveri)—This is the holiest river of South India. After rising in Kurg (Coorg) it flows through Karnatak and Tamilnadu. its main tributaries are Hemvati, Lokpawni, Akravali, Laxman Tirtha, Bhawani etc.

There are two rivers which go to Arabian sea. They are—

(i) **Narmada**—It originates in Madhya Pradesh from Amarkantak hills and discharges its water in gulf of Cambay. It flows between Vindhyan mountains in the north and Satpura in the south. It does not have any significant tributary.

(ii) **Tapti(Tapi)**—It flows south of Narmada between Satpura mountains in the north and Ajanta ranges in the south. Purna is the only important tributary to this river.

There are also a number of small streams that originate in the Western Ghats and

go to the Arabian sea. They are the following—

Goa—Mandovi and Zuari.

Karnataka—Kalindi, Sharvati, Netravati. The famous Jog fall is located on River Sharvati.

Kerala—Ponnar, Periyar and Pamba.

In the north-west Sabarmati rises in Mewar hills and flows to the Gulf of Cambay. The only river which crosses the desert is Luni. It rises brom near Ajmer and goes to Arabian sea near Runn of Kutch.

Some important Statistics

Hamalyan Peaks

K_2 mountain is located Trans-Himalyas	8611 mts.
Kanchenjunga	8598 mts
Nanga Parwat	8126 mts.
Nandadevi	7817 mts.
Trishul	7138 mts.

Length of Important rivers

Brhmputra	2900 kms.
Ganga	2510 Kms.
Godavari	1450 Kms.
Narmada	1290 Kms.
Krishna	1290 Kms.
Mahanadi	810 Kms.
Kaveri	760 Kms.

□

Lesson—2

Climate, Natural Vegetation and Soils of India

India has monsoon climate. The term monsoon has been probably coined from the word 'Mausim' in Arab languge. The term was used by Arab navigators for the wind which changed the direction with the change in season. In India monsoon is synonimous with rainfall. Good monsoon always means good rainfall. Over the mainland of India the general direction of monsoon is from south-west for six months and then for another six months it is from north-east. Hence the winds are known as south-west and North-east monsoon winds.

Season—In India, there are commonly three seasons—
Winter season–From November to February. It is a period of scanty rainfall,
Summer season–From March to early June. It is a period of hot and dry climate.
Rainy Season–From June to October. It is a period of heavy rainfall.

Winter Season—It begins in November. The sun by this time has moved deep into southern hemisphere. Therefore, the entire country experiences low temperature but it is higher in Southern India and sharply decreases in Northern India. The average temperature in South India is over 20°C where as it is around 10°C in northern India. During this time the plain of northern India expriences cold wave. Most of the country is dry except two regions–

(i) N.W. India where cyclonic rain occurs from the wind coming from Mediterranean through Iraq, Iran and Pakistan. There is altogether 5-10 cm. of rainfall which is useful for rabi crops.

(ii) S.E. India where rainfall occurs from North-east Monsoon. This monsoon picks up moisture from Bay of Bengal and gives rainfall in Tamil Nadu, Karnataka and Kerala. The rainfall ranges between 40-50 cm.

Summer Season–When the sun on the northerly march crosses the equator and moves towards tropic of Cancer, the summer season begins in India. It begins in March and remains up to mid-June in large part of the country. In the south, due to altitude of the plateau and nearness to the sea the temperature is lower in the northern plain. The average temperature in plain is around 30°C but the day temperature remains at 40°-45°C. During this period hot dry, and dusty wind blows which is called 'Loo'. Due to 'loo' the trees and plants start drying-up. Tanks and wells also dry-up. But the cyclonic storm formed in the Bay of Bengal brings rainfall in Andhra Pradesh, Orissa, Bihar and West Bengal and gives respite from unbearable heat. Such cyclones are called 'Norwesters'. In West Bengal it is called 'Kal-Baisakhi'. It is also famous as Mango-Showers.

Rainy Season—This season begins in the month of June and continues upto October. Right from the end of May S.W. Monsoon starts advancing in Andman-Nicobar, Islands and Kerala Coast. But most part of the country ramains hot and dry till mid-June. When the S. W. Monsoon advances, the sky is over-cast with thick clouds and rainfall associated with lightening and thunder occurs. This is called 'burst of monsoon'. The monsoon reaches NE Indian and Goa by Ist of June. West Bengal and Bombay coast by 10th of June, Bihar and Madhya Pradesh by 15th of June and Delhi by 1st of July. By July the whole of the country is under the influence of the SW monsoon and there is wide spread rainfall. The rainfall varies from over 200 cm. in the North-east and Western slope of the Western Ghats to less than 10 cm. in Rajasthan. During this period the following rainfall regime emerges–

(i) **Over 200 cm. rainfall**—Western Ghats and Western Coast, Assam, Southern slopes of the Himalyas, North-Eastern part of the West-Bengal and Andaman and Nicobar islands.

(ii) **100-200 cm. rainfall**—Eastern Slopes of the Western Ghats, Eastern coast of Tamilnadu, West Bengal, Bihar, Orissa, Eastern part of Madhya Pradesh, foot-hills of the Himalyas.

(iii) **50-100 cm. rainfall**—Most part of the South India Upper Ganga plain.

(iv) **Less than 50 cm. rainfall**—Punjab, Haryana, Rajasthan, Northern Gujarat and rain-shadow area of the Western Ghats.

The above rainfall regimes have great significance. They not only determine the natural vegetation but also the agriculture of the country. Almost 80 percent of the rainfall occurs from S.W. monsoon wind in a period of about four months.

Characteristics of Rainfall :

(i) The seasonal rainfall distribution is not uniform.

(ii) There are regional variations in rainfall. In some parts the rainfall is heavy while in other parts it is very meagre.

(iii) The rainfall occurs for 2-5 months. The rest of the months are dry.

(iv) The rainfall mainly occurs from S.W. Monsoon,

(v) The rainfall is highly erratic. In some year the rainfall is heavy while in other year there is little rainfall and drought like condition develops.

(vi) A long spell of drought during monsoon also results into drought.

Rainfall and Agriculture :

There is close relationship between rainfall and agriculture. Therefore, the agriculture has the following characteristics—

(I) As the rainfall in the country takes place between June and October, therefore, five months period is the main agricultural season.

(ii) The agriculture beyond the monsoon period mainly depends upon irrigation.

(iii) Where rainfall is heavy crops like Paddy, Jute, Sugarcane, Maize etc. are chiefly grown. But where the rainfall is low, wheat, Jowar, Bajra, Millets and Cotton are grown.

(iv) In winter rabi crops, viz, wheat, pulses and oilseeds are the main cultivation.

(v) When rainfall is inadequate, the grasses dry and there is shortage of fodder.

Natural Vegetation and Forest

The natural vegetation has close relationship with the amount of rainfall. Hence, most of the forests are controlled by amount of rainfall. Some forests are controlled also by the altitude. In India Six vegetation regime, four of them are controlled by rainfall and two by other factors.

(i) Evergreen forest or Rainforest—The region having more than 200 cm. rainfall has this type of vegatation. They are similar to selvas forest of the equatorial region.

The forest occurs on the western slope of the Western Ghats, North-Eastern part of India and Andaman and Nicobar islands up the 1000 metres. The trees are tall, 30-60 metres and has dense canopy. The trees are mainly Sal, Rose-wood, Ebony, Iron-wood, Bamboos etc. The wood is hard and therfore, economically they are not important.

(ii) Wet Deciduous forest—Wet deciduous is the characteristic of the region having 100-200 cm. rainfall. This vegetation province lies along the eastern slope of the Western Ghats, Chotanagpur, Eastern M.P, Orissa and in the foot-hill Zones of the Himalyas. The trees shed their leaves before the advent of the rain to conserve moisture for ensuing summer season. The wood of the forest are valuable. They include teak, Sal, Sissam, Mahua, Sandal etc. This forest is economically most important. The trees are generally 25-30 metres in height.

(iii) Dry Deciduous Forest—This type of forest is the main forest of the monsoon climate. The forest occurs mainly in the Penisular India–(Madhya Pradesh, Maharastra, Andhra Pradesh, Tamil Nadu, Karnataka). Uttar Pradesh and Eastern Rajasthan where rainfall occurs between 50-100 cm. the forest is dominated by thorny bushes and shrubs, cactus and resin plants are dominant. Other trees are Neem. Sissam, Pipal, Palm etc. Along the river stall grasses grow, main being Sabai, kans, elephant grass and munj.

(iv) Semi-desert vegetation—In those region where rainfall is below 50 cm. no vegetation of significance is found. Only thorny bushes grow. Among trees date is important. This vegetation is the characteristics of Punjab, Rajasthan and the rainshadow zone of the Western Ghats.

(v) Tidal forest—In the coastal areas where tides come this type of forest is found. It is called mangrove forest. The most extensive forest is found in the delta region of Ganga. Here the most dominant tree is Sundari, hence the forest is known as Sunderbans. Similar vegetation is found over Mahandi, Godavari, Krishna and kaveri deltas also.

(vi) Mountain vegetation—Mountain vegetation is the characteristics of the Himalyas. Here the nature of vegetation changes with the change in altitude. Upto an altitude of 900 metres normal forest depending upon rainfall is found but above that altitude the nature of the forests varies.

(a) Between 900-1800 metres broad leaved forests dominate. They consist of Oak and Chestnut in Eastern Himalyas and Chestnut, Poplar, Chir etc, in western Himalyas.

(b) Between 1800-2700 metres temperate forest is found. They are dominated by the coniferous trees. The main varieties are Pine, Spruce, Silver fir, Birch, Larch Juniper etc. The wood are light and soft and are of great economic importance.

(c) Over 2700 metres no tree grows due to extreme cold. However, some coniferous trees only gorw. The soft grasses are common over rolling plain, called meadows (Marg in Kashmir). For instance Gulmarg, Sonmarg, Khilanmarg and meadows. The vegetation is popularly known as 'Alpine' vegetaion.