Exam: F.Y.BSc Semester – I
Subject: Life Science Paper – I
Date of Exam: 30th November 2018
Question Paper code: 55226

Q. 1

A. Fill in the blanks **07mks**

1.Prokaryotic
2.Lyophilization
3.Prokaryotes
4. E. coli, Salmonella, Shigella
5.Pour plate/Spread plate/ Streak plate
6. Differential media
7.Plant virus

B Match the column:

	Column A	Column B
a)	Microtubules	vi)Spindle fibres
b)	Nucleosome	v) Histone octomer
c)	Neurofilaments	i)Axons of nerve fibres
d)	Pectin	vii) Middle lamella
e)	Teichoic acid	ii)Bacterial cell wall
f)	Nucleolus	iii)Ribosoma RNA
g)	Sarcomere	iv) Straited muscle fibre

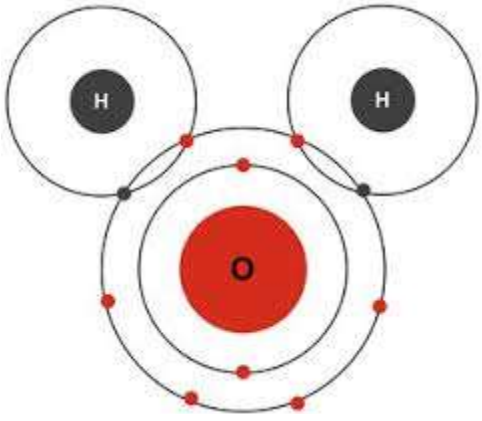
C) Define / Explain the following terms: **(06)**

1. Surface tension

Surface tension is the elastic tendency of a fluid **surface** which makes it acquire the least **surface** area possible. **Surface tension** allows insects (e.g. water striders), usually denser than water, to float and slide on a water **surface**.

2. Structure of water molecule.

The water molecule is comprised of two hydrogen (H) **atom s**and one **oxygen atom**. The **oxygen atom** has 8 electrons, and each H has 1 electron. The H **atoms** bond to the oxygen by sharing a pair of electrons in what is called a covalent bond.



3. Zwitterions

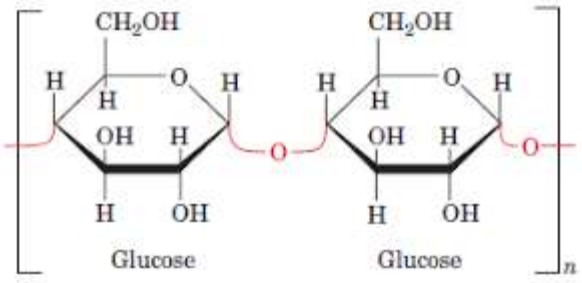
A **zwitterion** is a compound with no overall electrical charge, but which contains separate parts which are positively and negatively charged.

4. Phosphate buffers

Phosphate-buffered saline (abbreviated **PBS**) is a buffer solution commonly used in biological research. It is a water-based salt solution containing disodium hydrogen phosphate, sodium chloride and, in some formulations, potassium chloride and potassium dihydrogen phosphate. The buffer helps to maintain a constant pH. The osmolarity and ion concentrations of the solutions match those of the human body (isotonic).

5. Glycosidic bonds

A glycosidic bond is a covalent bond that joins a carbohydrate to another functional group or molecule. A substance containing a glycosidic bond is termed a **glycoside**



6. Epimers

Monosaccharides are generally represented in open chain form. Sometimes their chemical and physical properties cannot be explained by using open chain form and for that purpose they can represent in cyclic forms called as **Haworth projections.**

Monosaccharide like glucose, fructose, mannose and galactose can show different isomerism. For example, glucose and fructose are functional isomer of each other as glucose contains aldehyde group and fructose contains ketonic group in molecule. They can also show **stereoisomerism** due to the presence of chiral carbon atoms. Those stereoisomers which are differing in its configuration at only one chiral carbon atom are called as **Epimers**.

Q.2. A) Describe <u>any one</u> of the following: (10)

1. The ionic product of water. Explain the concept of pH and buffers.

[H+][OH-] = Kw The constant, Kw, is termed as **ionic product of water**. The **product** of concentrations of H1 and OH **ions** in **water** at a particular temperature is known as **ionic product of water**.

The pH of a solution is a **measure** of the molar concentration of hydrogen ions in the solution and as such is a **measure** of the acidity or basicity of the solution.

A **buffer** is a solution that can maintain a nearly constant pH if it is diluted, or if relatively small amounts of strong acids or bases are added. A **buffer** solution can be made by mixing a weak acid with one of its salts OR mixing a weak base with one of its salts.
The characteristics associated with a Good′s buffer include the following: pKa value between 6.0 and 8.0, high solubility, **non** toxic, limited effect on biochemical reactions, very **low** absorbence between 240 nm and 700 nm, enzymatic and hydrolytic **stability**, minimal changes due to **temperature** and concentration

2. Quaternary structure of protein with Hemoglobin as example. Explain the forces contributing to the structure.

Proteins have four levels of structure: primary, secondary, tertiary, and quaternary. The first three involve only one molecule. However, quaternary structure describes how proteins interact to form complex molecular structures.
By definition, **quaternary structure** is the arrangement of more than one protein molecule in a multi-subunit complex. The nomenclature here can get a bit confusing because we call a single polypeptide chain a protein if it can function on its own. However, many proteins are actually comprised of several polypeptide chains. In this case, the individual peptide chains are called **protein subunits**, and they cannot function on their own.

Atomic structure of the 50S Subunit from Haloarcula marismortui. Proteins are shown in blue and the two RNA strands in orange and yellow.[11] This is an example of the tertiary structure of the large unit of a ribosome

A quaternary structure refers to two or more polypeptide chains held together by intermolecular interactions to form a multi-subunit complex. The interactions that hold together these folded protein molecules include disulfide bridges, hydrogen bonding, hydrogen bonding interactions, hydrophobic interactions interactions and London forces. These forces are usually conveyed by the side chains of the peptides.

These polypeptide chains are the subunits of a protein, capable of taking part in a variety of functions such as serving as **enzymatic catalysts**, providing structural support in the **cytoskeletons** of cells, and even composing the hair on our heads.

The peptides of the protein can be identical or different. **Insulin** is a dimer consisting of two identical peptides, while **Hemoglobin** is a tetramer consisting of two identical alpha subunits and two identical beta subunits.

The quaternary structure are held together to form the larger protein by **bonds** that exist between the side groups of different chains. As with tertiary structure, the **bonds** involved in holding these separate chains together can be **van der Waals bonds**, **hydrogen bonds**, **ionic bonds**, or at times **covalent bonds**.

Quaternary structure is the three-dimensional **structure** consisting of the aggregation of two or more individual polypeptide chains (subunits) that operate as a single functional unit

(multimer). The resulting multimer is **stabilized** by the same non-covalent interactions and disulfide bonds as in tertiary **structure**.

Q. 2. B) Explain <u>any two</u> of the following: (10)

1. Physical properties of water and its biological significance.

Water is highly cohesive and adhesive:

Because of hydrogen bonds, water molecules develop strong intermolecular attraction between them. This is called cohesion.

When water form hydrogen bonds with other substance, the attraction is called adhesion. Due to cohesion and adhesion, seeds swell and germinate; ascent of sap and capillary movement of water takes place.

2. Water has high tension:

This is due to cohesion of water molecules. Due to this property, small organism float or walk on water surface.

3. Water has high specific heat and high heat of Vaporization:

Both of these properties are due to requirement of more energy to break hydrogen bonds. Specific heat means the amount of heat absorbed or lost by 1 gm. of substance to change its temperature by 1°C. The specific heat of water is high (1 calorie/gm/°C). This property ensures slow heating of water; maintain constant temperature of living organisms and environment.

Water has high heat of vaporization (540 cal gm. -1) i.e. about 540 cal heat required to change 1 gm of liquid water into gas. Thus, evaporation of water from a surface removes excess heat energy. This causes cooling effect of leaves, remove body heat through sweating and protect organism from thermal shock.

4. Water has high boiling point and high thermal conductivity:

Because of these properties water store and spreads heat and prevent from overheating

5. Water has high heat of fusion:

Water requires a loss of lot of heat to freeze. This prevents freezing and ice formation in the protoplasm even when exposed to very low temperature.

6. Water has lower density on freezing:

Water has maximum density at 4°C. But below 4°C water become less dense because they placed apart because of it so ice is less dense than liquid water and floats on surface water surface ice insulated the underwater film freezing and protect the aquatic life.

7. Water is transparent:

This allows light to penetrate 200mt depth in sea and lakes. So plants carry on photosynthesis under submerged conditions.

8. Water has high dielectric constant:

This opposes the attraction of opposite charges of ions. Because of this water acts as powerful solvent for salts and many non-ionizable organic molecules.

9. Water is incompressible:

It helps organisms to tolerate pressure and compression. Because of this in earthworm water acts as hydro skeleton. Loss or gain of water causes various plant movements like stomatal movement, seismonasty of Mimosa leaves etc.

10. Water can ionize:

A small amount of water spontaneously dissociated into hydrogen ion (H^+) and hydroxyl ion (OH^-) which depends on temperature. This is called ionization.

$H_2O \leftrightharpoons H^+ OH^-$

At 25°C, out of 550 million water molecules, only one undergoes ionization. In water, H^+ has no stable existence and occurs in association with another water molecule to form of hydronium ion (H_3O^+).

$H^+H_2O \leftrightharpoons H_3O^+$

In aqueous solutions, the concentration of H^+ and OH- becomes the basis for the pH scale. At standard condition of temperature and pressure only 10^{-7} moles. It. of water molecules are dissociated. It means in pure water, the $[H^+]$ is 10^{-7} moles/liter.

Thus the pH of pure water is:

$pH = - \log [H^+] = - \log 10^{-7} = 7.0$

11. Water is a reagent:

In many biochemical reactions water is a source of H^+ and OH". During photolysis, water donates electron (e-) to chlorophyll and itself oxidized to molecular oxygen.

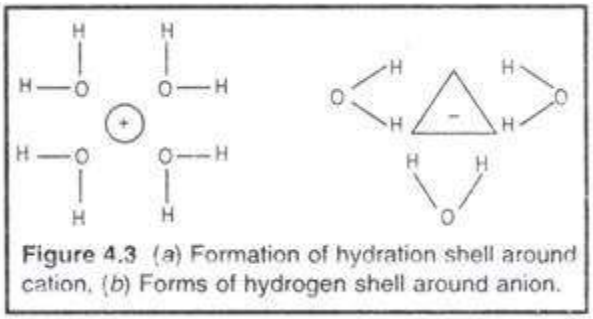


Figure 4.3 (*a*) Formation of hydration shell around cation, (*b*) Forms of hydrogen shell around anion.

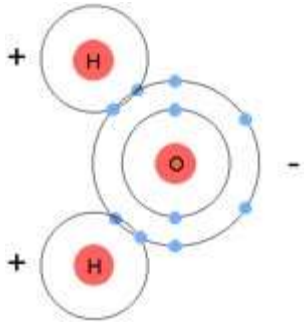
The Biological Importance of Water

- Water is the basis of life on our planet. It exists in different physical states – solid, liquid and gas – and makes up 70% of the surface of Earth, plus 65 – 90% of the weight of all

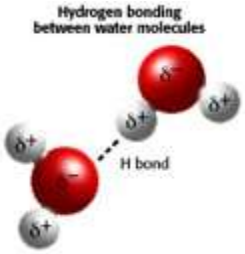
living organisms. Water also plays an important role in all vital processes of living organisms.

- The water molecule, H_2O, is composed of one oxygen atom and two hydrogen atoms. These atoms are bound covalently (by a covalent bond). In a water molecule, hydrogen carries a positive molecular charge, while oxygen carries a negative molecular charge

  . Thus, a water molecule is a 'polar' molecule, because it has both positive and negative poles.



- Close water molecules are attracted to each other by a relatively low electrical attraction, (negative hydrogen atoms attract positive oxygen atoms in other molecules). This bond is called a 'hydrogen bond'. Water has unique properties because of its polarity and the hydrogen bonds between its molecules.



***1*- Water is a polar solvent.**

- Water is regarded as the 'general solvent' or 'universal solvent' due to the polarity of its molecules.
  For example, when sodium chloride (NaCl) dissolves in water, it produces positive sodium ions and negative chlorine ions. The positive oxygen atoms in water attract the negative chlorine ions, and the negative hydrogen atoms attract the positive sodium ions. All polar substances (substances containing ions) can dissolve in polar solvents, such as water.
- All the essential substances for living organisms (vitamins, salts, amino acids, gases, and glucose) transport inside their bodies in the form of solutes dissolved in water. These substances take part in metabolic reactions inside the cells.

2- Water has the ability to ionize molecules, which are necessary for life.

- This means that water has the ability to disassociate the molecules necessary for life into positive and negative ions (water can do so due to the polarity of its molecules). **For example**, the pancreas secretes sodium bicarbonate ($NaHCO_{3)}$. This compound ionizes in water into positive hydrogen ions and negative bicarbonate ions, which makes the medium alkaline and thus suitable for the enzymes' work.

3- Water has high specific heat.

- Specific heat is the amount of heat required to increase the temperature of one gram of matter by 1 degree Celsius.
- Water has the highest specific heat on Earth due to the hydrogen bonds between its molecules.
- As a result of having high specific heat, water needs a great amount of energy to increase its temperature and loses a great amount of energy when its temperature decreases. This helps living organisms to have a constant temperature which is essential for the vital processes occurring within their bodies. Cells contain lots of water to keep their temperature constant.
- Animals and plants lose water by sweating and transpiration processes to decrease their temperature.
- The high specific heat of water provides living organisms with temperatures suitable for life on Earth.
- Water forms almost 70% of the surface area of Earth. If water didn't exist in such a great amount, the temperature of the Earth would decrease dramatically because the substances forming the Earth's crust have low specific heat.
- The water that makes up oceans absorb a great number of sun rays in the morning and spread them into the atmosphere at night in order to keep the temperature of the Earth suitable for living organisms.

4- Water has low viscosity and high surface tension.

- Surface tension is the cohesion of the molecules on the surface of a fluid to occupy the least possible volume. Viscosity is the resistance of a fluid to flowing.
- Water has low viscosity and high surface tension due to the hydrogen bonds between its molecules; these conditions are suitable for life.

These properties are important because:

1- They work on the cohesion of cell substances.

2- It slows down water loss in plants' leaves through pores.

3- Some insects can walk on water due to the cohesion of the molecules on its surface.

5- Water density decreases under 4°C.

- Water expands when its temperature becomes less than 4°C (instead of shrinking). THis decreases its density and makes it float. In frozen lakes, we find ice on the surface, while we find liquid water underneath.
- This property is because of the hydrogen bonds between water molecules.
- This property is important because it enables living organisms to live in oceans and seas. Without this property, all oceans and seas will turn into ice, rather than just the surface. Surface freezing works as an insulator to prevent the rest of water from freezing.

6- The freezing point of water decreases if it has substances dissol*ved* in it.

- This property is very important for living organisms, as it prevents the water in the cells of from freezing when exposed to temperatures less than 0◦C.

7- Water can turn into vapour in temperatures lower than boiling point (100◦C).

- Water vapour formed on the surfaces of oceans is carried by convection currents to cold layers in the atmosphere. This changes into clouds which provide living organisms with rain and water.

8- Water rise in capillary tubes.

- Water has the ability to rise in capillary tubes without being pumped and in opposition to external forces such as gravity. This property helps water transport from trees' roots to all of its parts.

Q.2.B. 2. Chemical reaction of a polymer from a monomer with respect to Carbohydrates.
Carbohydrate monomers, short chains, and polymers perform important cellular functions to maintain life. The number and type of monosaccharides used, as well as the position of the bond

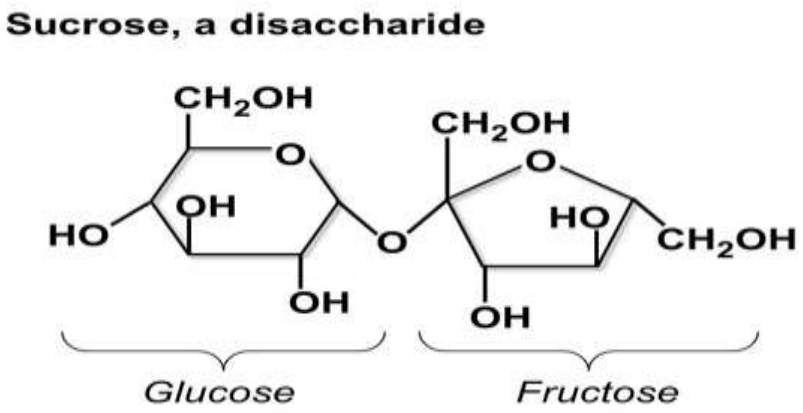
between them, determines the three-dimensional structure of each carbohydrate. By recognizing the structural and functional differences between common carbohydrate monomers and polymers, we can better understand the roles carbohydrates play inside cells and in the human diet.

Cells build carbohydrate polymers by using energy to form glycosidic linkages, the bonds between monosaccharides. A dehydration synthesis reaction forms a bond between carbon atoms in two monosaccharides, sandwiching an oxygen atom between them and releasing a water molecule. A disaccharide forms when two monomers are joined. Sucrose (table sugar) is made by joining two specific monomers, glucose and fructose. Different monosaccharide pairs produce many of the common disaccharide sugars we associate with food, including sucrose, maltose (malt sugar, two glucose monomers) and lactose (milk sugar, glucose and galactose monomers).

Carbohydrate chains are extended by additional dehydration synthesis reactions, adding one monomer at a time to a growing chain. Short chains called oligosaccharides are frequently attached to lipids and proteins. These carbohydrate "tags" support immune system functions, participate in cell communication, and help attach cells to extracellular surfaces and other cells.

Carbohydrate chains with hundreds or more monosaccharide units are polysaccharides. Unlike shorter chains, carbohydrate polymers are frequently composed of a single type of monosaccharide unit. Differences in the structure and function of these polymers arise mainly from differences in the glycosidic linkage, rather than the presence of different monosaccharides. Glycosidic linkages involve covalent bonds from one carbon atom in each monosaccharide to a single oxygen atom between them. However, which carbon atoms participate in this covalent bond may be different in each carbohydrate molecule.

The most common polysaccharides are built solely with glucose monomers, while significant structural differences between these polysaccharides arise mainly from the position and number of the glycosidic linkages in each glucose unit. Although these bond differences appear insignificant at first glance, the functional effect of minor structural differences in each glycosidic linkage is enormous.



Q.2.B.3. Biological role of Proteins

Proteins may be defined as the high molecular weight mixed polymers of α-amino acids joined together with peptide linkage (-CO-N H-). Proteins are the chief constituents of all living matter. They contain carbon, hydrogen, nitrogen and sulphur and some contain phosphorus also.

2. Biological Importance of Proteins:

i. Proteins are the essence of life processes.

ii. They are the fundamental constituents of all protoplasm and are involved in the structure of the living cell and in its function.

iii. Enzymes are made up of proteins.

iv. Many of the hormones are proteins.

v. The cement substances and the reticulum which bind or hold the cells as tissues or organs are made up partly of proteins.

vi. They execute their activities in the transport of oxygen and carbon dioxide by hemoglobin and special enzymes in the red cells.

vii. They function in the homostatic control of the volume of the circulating blood and that of the interstitial fluids through the plasma proteins.

viii. They are involved in blood clotting through thrombin, fibrinogen and other protein factors.

ix. They act as the defence against infections by means of protein antibodies.

x. They perform hereditary transmission by nucleoproteins of the cell nucleus.

3. Classification of Proteins:

I. Simple proteins

(i) Albumins:

Soluble in water, coagulable by heat and 1 precipitated at high salt concentrations.

ADVERTISEMENTS:

Examples – Serum albumin, egg albumin, lactalbumin (Milk), leucosin (wheat), legumelin (soyabeans).

(ii) Globulins:

Insoluble in water, soluble in dilute salt 1 solutions and precipitated by half 1 saturated salt solutions.

Examples – Serum globulin, vitellin (egg yolk), tuberin (potato), myosinogen (muscle), legumin (peas).

(iii) Glutelins:

Insoluble in water but soluble in dilute 1 acids and alkalis. Mostly found in plants.

Examples – Glutenin (wheat), oryzenin (rice).

(iv) Prolamines: Insoluble in water and absolute alcohol 1 but soluble in 70 to 80 per cent alcohol.

Examples – Gliadin (wheat), zein (maize).

(v) Protamines:

Basic proteins of low molecular weight. 1 Soluble in water, dilute acids and alkalis, j Not coagulable by heat.

Examples – Salmine (salmon sperm).

(vi) Histones:

Soluble in water and insoluble in very I dilute ammonium hydroxide.

Examples – Globin of hemoglobin and thymus histones.

(vii) Scleroproteins:

Insoluble in water, dilute acids and alkalis.

Examples – Keratin (hair, horn, nail, hoof and feathers), collagen (bone, skin), elastin (ligament).

II. Conjugated Proteins

(i) Nucleoproteins:

Composed of simple basic proteins (protamines or histones) with nucleic acids, I found in nuclei. Soluble in water.

Examples – Nucleoprotamines and nucleohistones.

(ii) Lipoproteins:

Combination of proteins with lipids, such ‘ as fatty acids, cholesterol and 1 phospholipids etc.

Examples – Lipoproteins of egg-yolk, milk and cell membranes, lipoproteins of blood.

(iii) Glycoproteins:

Combination of proteins with carbohydrate (mucopolysaccharides).

Examples – Mucin (saliva), ovomucoid (egg white), osseomucoid (bone), tendomucoid (tendon).

(iv) Phosphoproteins:

Contain phosphorus radical as a | prosthetic group.

Examples – Caseinogen (milk), ovovitellin (egg yolk).

(v) Metalloproteins:

Contain metal ions as their prosthetic | groups. The metal ions generally are Fe, I Co. Mg, Mn, Zn, Cu etc.

Examples – Siderophilin (Fe), ceruloplasmin (Cu).

(vi) Chromoproteins:

Contain porphyrin (with a metal ion) as | their prosthetic groups.

Examples – Haemoglobin , myoglobin, catalase, peroxidase, cytochromes.

(vii) Flavoproteins:

Contain riboflavin as their prosthetic 1 groups.

Examples – Flavoproteins of liver and kidney.

III. Derived Protein

A. Primary derivatives

(i) Proteans:

Derived in the early stage of protein hydrolysis by dilute acids, enzymes or alkalis.

Examples – Fibrin from fibrinogen.

(ii) Metaproteins:
Derived in the later stage of protein hydrolysis by slightly stronger acids and alkalis.

Examples – Acid and alkali metaproteins.

(iii) Coagulated:
They are denatured proteins formed by the action of heat. X-rays, ultraviolet rays etc.

Cooked proteins, coagulated albumins.

B. Secondary derivatives
(i) Proteoses:
Formed by the action of pepsin or trypsin. Precipitated by saturated solution of ammonium sulphate, incoagulable by heat.

Examples – Albumose from albumin, globulose from globulin.

(ii) Peptones: .
Further stage of cleavage than the proteoses. Soluble in water, incoagulable by heat and not precipitated by saturated ammonium sulphate solutions.

(iii) Peptides:
Compounds containing two or more amino acids. They may be di-, tri-, and porypeptides.

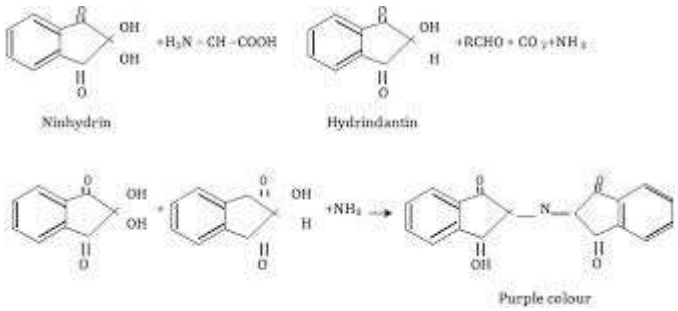
Examples – Glycyl-alanine, leucyl-glutamic acid.

4. Protein Hydrolyzing Enzymes:
i. Pepsin:
In Gastric Juice.

ii. Trypsin, Chymotrypsin and Carboxypeptidases:
In Pancreatic Juice.

iii. Amino-peptidases, Dipeptidases and Poly-peptidases:
In intestinal juice.

Q.2.B.4. Reaction of amino acids with ninhydrin



Ninhydrin (2,2-dihydroxyindane-1,3-dione) is a chemical used to detect ammonia or primary and secondary amines. When reacting with these free amines, a deep blue or purple color known as Ruhemann's purple is produced. Ninhydrin is most commonly used to detect fingerprints, as the terminal amines of lysine residues in peptides and proteins sloughed off in fingerprints react with ninhydrin. It is a white solid which is soluble in ethanol and acetone at room temperature. Ninhydrin can be considered as the hydrate of indane-1,2,3-trione.

Q. 3 A. Describe any one of the following: 10mks

1. Similarity and differences between a Prokaryote and Eukaryote

Prokaryotic versus Eukaryotic Chromosomes

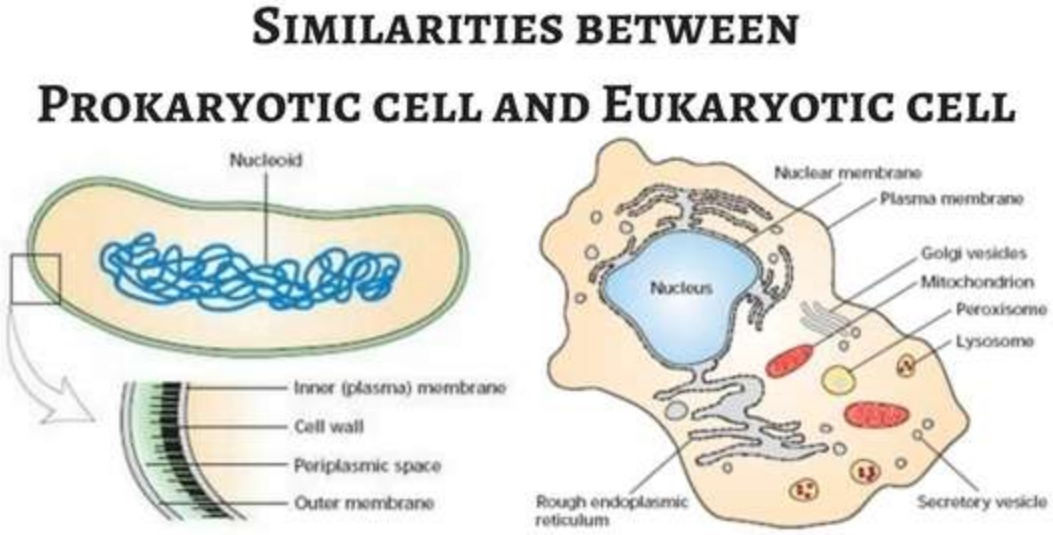
Prokaryotic Chromosomes	Eukaryotic Chromosomes
• Many prokaryotes contain a single circular chromosome. • Prokaryotic chromosomes are condensed in the nucleoid via DNA supercoiling and the binding of various architectural proteins. • Because prokaryotic DNA can interact with the cytoplasm, transcription and translation occur simultaneously. • Most prokaryotes contain only one copy of each gene (i.e., they are haploid). • Nonessential prokaryotic genes are commonly encoded on extrachromosomal plasmids. • Prokaryotic genomes are efficient and compact, containing little repetitive DNA.	• Eukaryotes contain multiple linear chromosomes. • Eukaryotic chromosomes are condensed in a membrane-bound nucleus via histones. • In eukaryotes, transcription occurs in the nucleus, and translation occurs in the cytoplasm. • Most eukaryotes contain two copies of each gene (i.e., they are diploid). • Some eukaryotic genomes are organized into operons, but most are not. • Extrachromosomal plasmids are not commonly present in eukaryotes. • Eukaryotes contain large amounts of noncoding and repetitive DNA.

	Eukaryotic Cell	**Prokaryotic Cell**
Nucleus	Present	Absent

Number of chromosomes	More than one	One--but not true chromosome: Plasmids
Cell Type	Usually multicellular	Usually unicellular (some cyanobacteria may be multicellular)
True Membrane bound Nucleus	Present	Absent
Example	Animals and Plants	Bacteria and Archaea
Genetic Recombination	Meiosis and fusion of gametes	Partial, undirectional transfers DNA
Lysosomes and peroxisomes	Present	Absent
Microtubules	Present	Absent or rare
Endoplasmic reticulum	Present	Absent
Mitochondria	Present	Absent
Cytoskeleton	Present	May be absent
DNA wrapping on proteins.	Eukaryotes wrap their DNA around proteins called histones.	Multiple proteins act together to fold and condense prokaryotic DNA. Folded DNA is then organized into a variety of conformations that are supercoiled and wound around tetramers of the HU protein.
Ribosomes	Larger	Smaller
Vesicles	Present	Present
Golgi apparatus	Present	Absent
Chloroplasts	Present (in plants)	Absent; chlorophyll scattered in the cytoplasm
Flagella	Microscopic in size; membrane bound; usually arranged as nine	Submicroscopic in size, composed of only one fiber

	doublets surrounding two singlets	
Permeability of Nuclear Membrane	Selective	not present
Plasma membrane with steroid	Yes	Usually no
Cell wall	Only in plant cells and fungi (chemically simpler)	Usually chemically complexed
Vacuoles	Present	Present
Cell size	10-100um	1-10um

Diagram of pro and eukaryotic cell:



2. Parts and Working of Compound Microscope:

A compound microscope is an indispensable instrument in any biological laboratory. It is used for passive observation of structural details of a cell, tissue or organ in sections.

A modern compound microscope has following structural components.

Non-Optical Components:

1. Base (foot):

It is U or horseshoe-shaped metallic structure that supports the whole microscope.

2. Pillar:
It is a short upright part that connects to base as well as arm.

3. Arm (Limb):
It is a curved metallic handle that connects with the arm by inclination joint. It supports stage and body tube.

4. Inclination Joint:
It is used for tilting the microscope if required for observation in sitting position.

5. Stage:
It is a metallic platform with a central hole fitted to the lower part of the arm. Microscopic slides held on the stage by either simple side clips or by a mechanical stage clip.

6. Body tube:
It is meant for holding ocular and objective lenses at its two ends. The end holding ocular lens is called head while the end containing 3-4 objective lens is called nose piece. The body tube has an internal pathway for the passage of light rays which form the enlarged image or microscopic objects.

7. Draw tube:
It is a small tube that remains fixed at the upper end of the body tube. It holds eyepiece or ocular lens.

8. Rack and pinion:
The microscope has a rack and pinion attached either to body tube or the stage for bringing the object under focus.

9. Adjustment screws:
There are two pairs of screws for moving the body tube in relation to stage, larger for coarse adjustment and smaller for fine adjustment. In fine adjustment the body tube or stages moves for extremely short distances. In coarse adjustment the body tube or stage can move up and distance. In coarse adjustment is meant for briefly objective lens at a proper distance from the object so as to form image of the same at the ocular end. Fine adjustment is required to obtain sharp image.

10. Automatic Stop:

It is a small screw fitted at lower end or rack and pinion. It is meant for stopping the downward sliding of the body tube so as to prevent the damage of objective lens and the slide.

Optical Components:

11. Diaphragm:

It is flitted just below the stage for regulating the amount of light failing on the object. Diaphragm is of two types, disc and iris.

12. Condenser:

It is attached below the diaphragm. Condenser can be moved up and down to focus light on the object.

13. Reflector (Mirror):

It is attached just above the base. Both its surface bear mirrors, plane on one side and concave on other side. Plane side is used in strong light and concave side in weak light. Reflector directs the light on the object through the condenser and diaphragm system.

14. Objective Lenses:

They are fitted over the nose piece. Objective lenses are of two 10 three types – low power (commonly 10X or 5X), high power (commonly 45X) and oil immersion (commonly 100X, can be more). An objective lens is not a simple lens but compound lens. It forms real inverted image of the object inside the body tube.

15. Ocular Lens or Eyepiece:

It is lens through which image of the microscopic object is observed. It also takes part in magnification. Depending upon magnification, the eye piece is of four types-5X, 10X, 15X, and 20 X. Advanced microscope has two eye pieces so that both the eyes can be used (Fig. 1.4). Microscope head having device for using two eye pieces is called binocular head. It contains a number of internal mirrors and prisms for the passage of light.

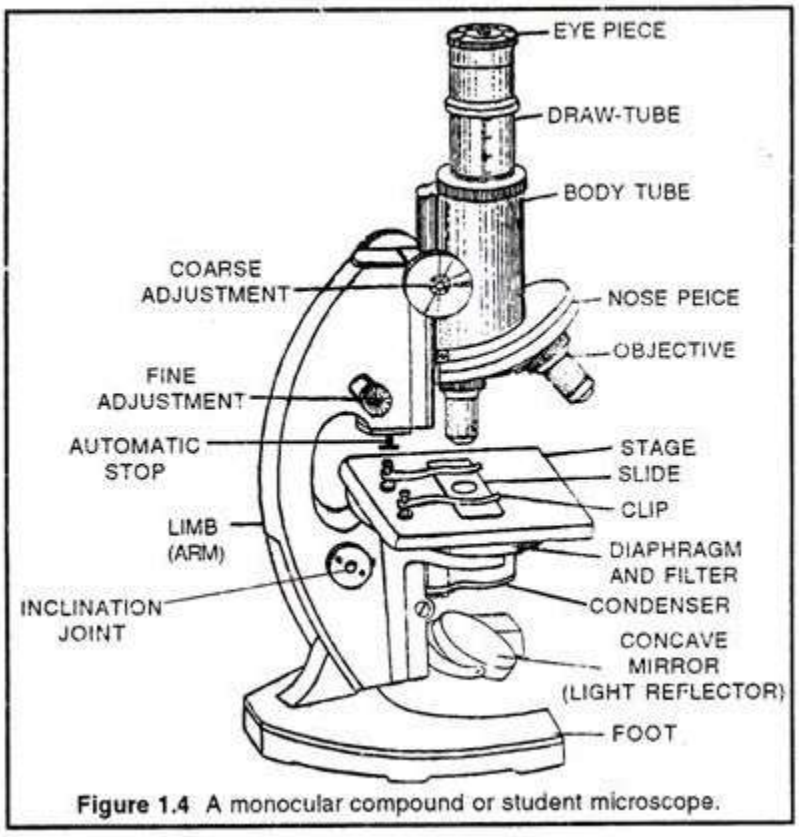


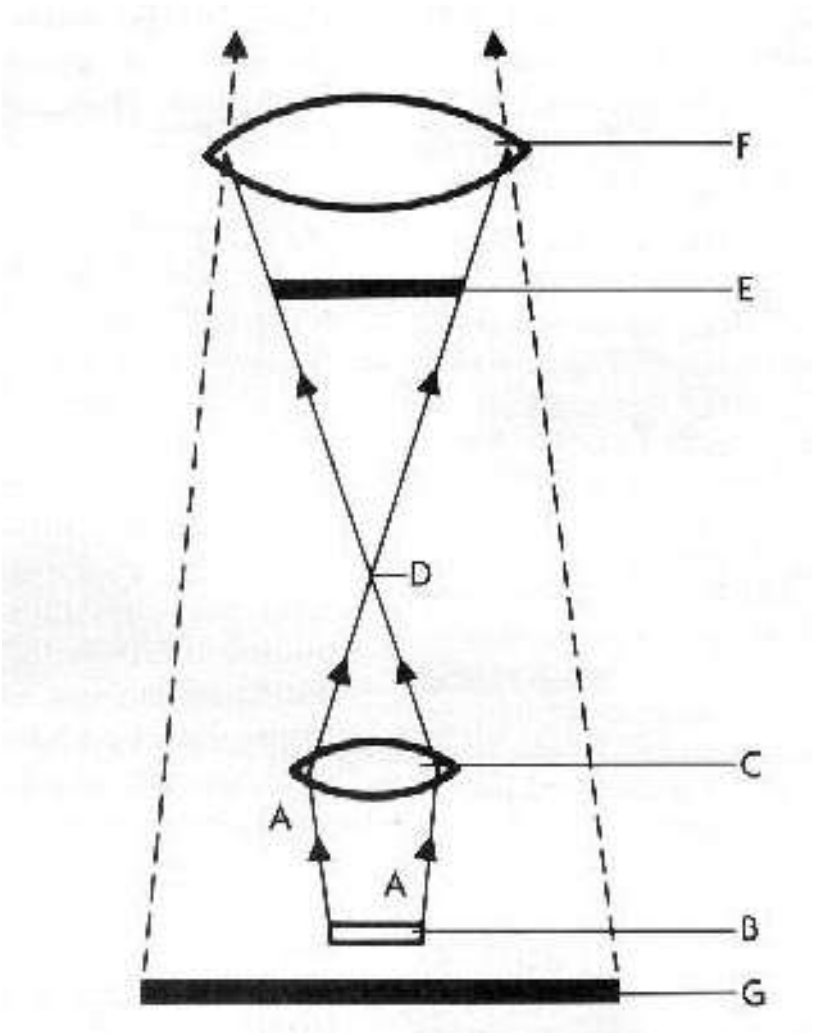
Figure 1.4 A monocular compound or student microscope.

Working Principle of Compound Microscope:

The compound microscope is most commonly used in clinical and educational laboratories. It has a combination of lenses that enhances both magnifying power as well as the resolving power. The specimen or object, to be examined is usually mounted on a transparent glass slide and positioned on the specimen stage between the condenser lens and objective lens.A beam of visible light from the base is focused by a condenser lens onto the specimen. The objective lens picks up the light transmitted by the specimen and create a magnified image of the specimen called primary image inside the body tube. This image is again magnified by the ocular lens or eye piece.When higher magnification is required, the nose piece is rotated after low power focusing to bring the objective of higher power (generally 45X) in line with the illuminated part of the slide. The objective lens comes very near the cover slip but it does not touch the same. Only fine adjustment it moved for proper focusing. More light may be required. After observation under high power, the nose piece is rotated to bring back the slide under low power.

Occasionally very high magnification it required (e.g. for observing bacterial cell). In that case, oil immersion objective lens (usually 100X) is employed. After focusing under low power a drop of immersion oil (e.g. cedar oil, olive oil) placed over the illuminated part of the cover-slip.

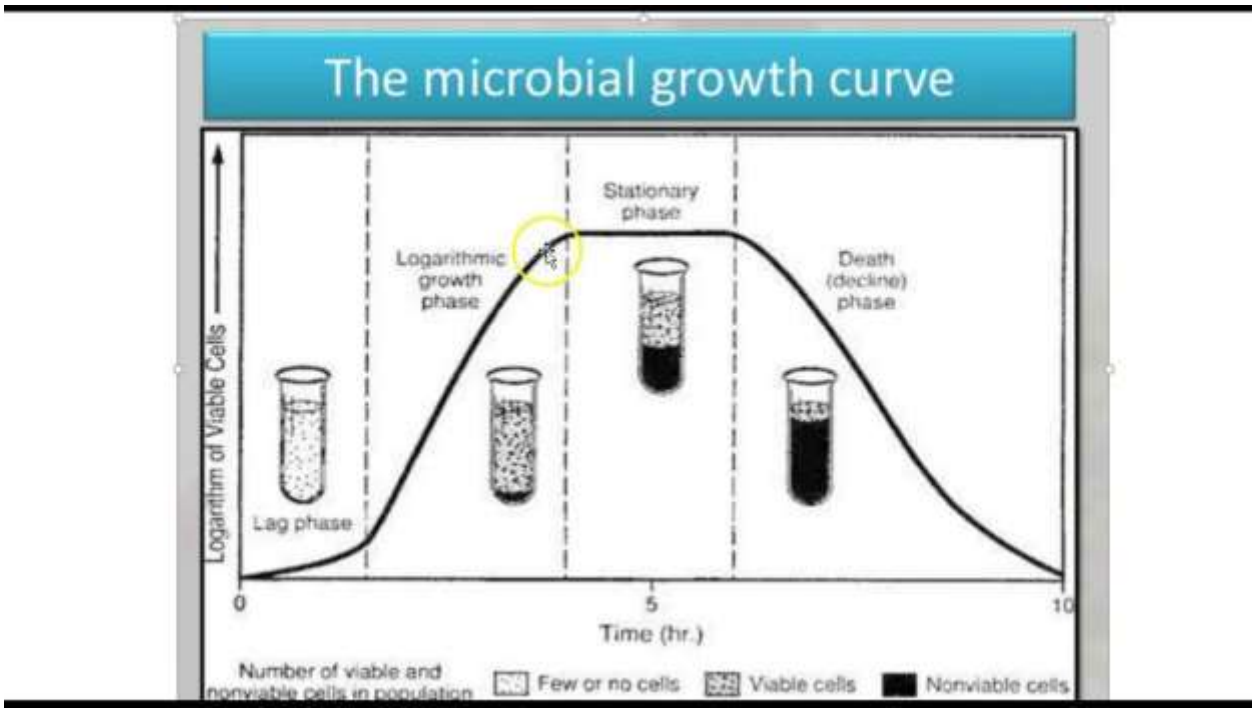
The nose piece is rotated to bring the oil immersion lens in line with die specimen. It comes in contact with the oil. By using fine adjustment only, the specimen is brought under focus. Immersion oil increases the sharpness of the image. Soon after observation, both the lens and the slide are cleared of the oil by fine cotton cloth or lens paper.The common light microscope is also called bright field microscope because the image is produced amidst a brightly illuminated field. The image appears darker because the specimen or object is denser and somewhat opaque than the surroundings. Part of the light passing through or object is absorbed. Bright field microscope is used [or study or preserved and stained material as well as live and unstained object or material. However, differentiation is poor in case of live unstained specimen. Special microscopes for their study are dark field, phase contrast and differential interference contract microscopes.



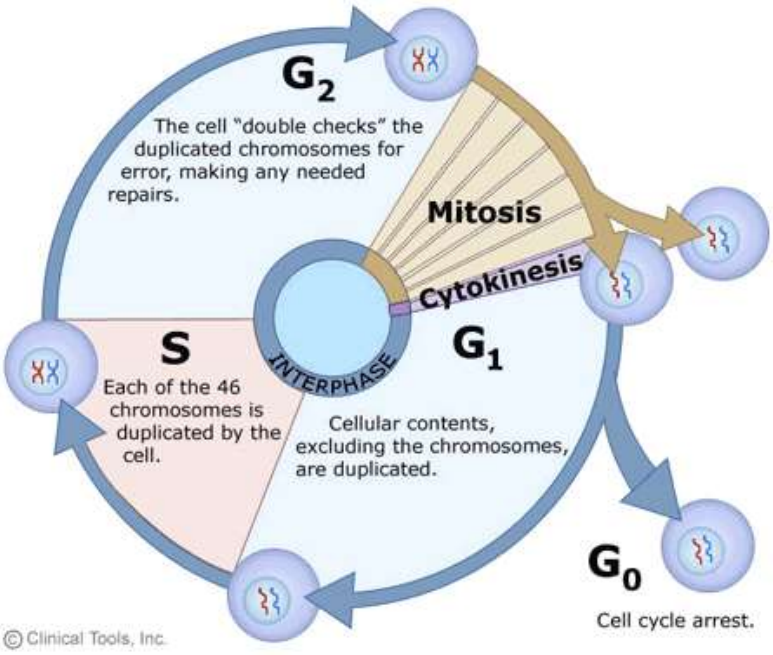
Students should Label the parts.

Q. 3 B. Explain any two of the following: **(10 mks)**

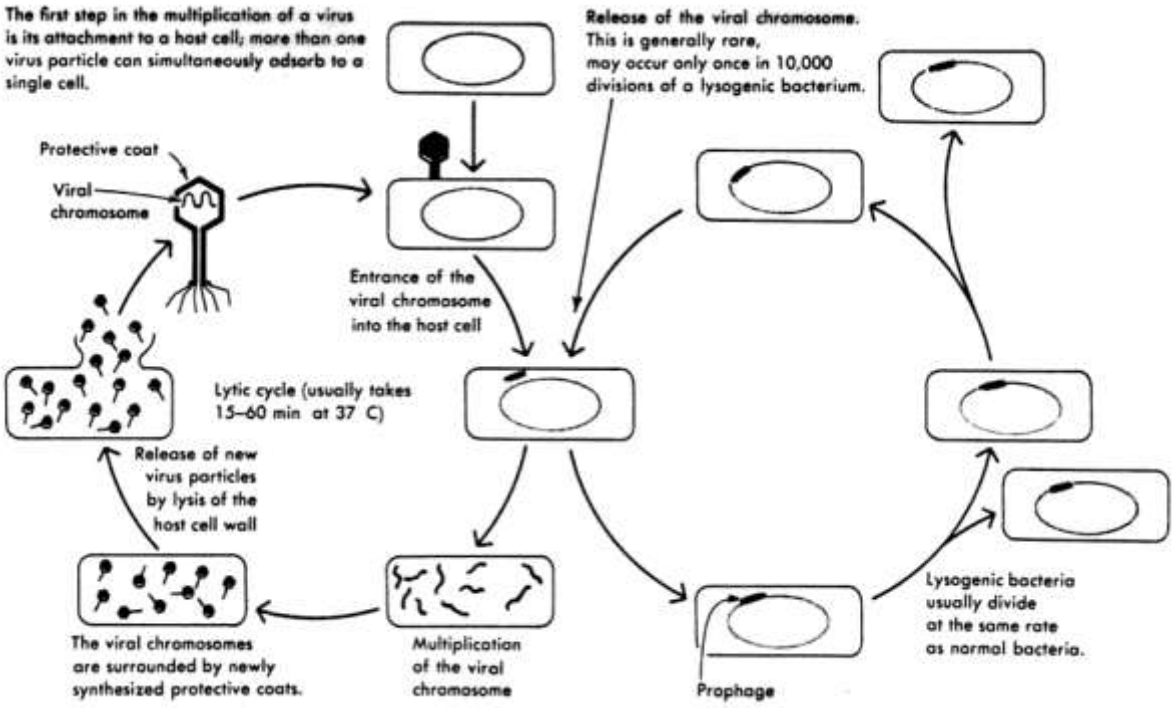
1. Stages in Bacterial growth curve:



2. Diagrammatic representation of Cell Cycle:



3. Life Cycle of Bacteriophage:



4. Preservation Technique of Microbial Culture:

Once a pure culture of a microorganism is obtained, it has maintained and preserved for futher use.

(1) Periodic transfer to fresh media:Bacteria can be maintained by periodically preparing a fresh stock culture from the previous culture. The culture medium, the storage temperature, and the time interval at which the transfers are made vary from one bacteria to another. The temperature and the typr of media chosen should support a slow rather than a rapid growth rate so that the time interval between transfers can be as long as possible.

(2) Preservation by overlaying cultures with Mineral Oil: Many bacteria are successfully preserved by covering the growth on an agar slant with sterile mineral oil. The oil should cover the slant completely. To ensure this, the oil should be about half an inch above the tip of the slant.

(3) Preservation by Lyophilization: Most bacteria die if cultures are allowed to become dry. However, freeze-drying can preserve many kinds of bacteria that would be killed by ordinary preservation techniques.

(i) Equipment used for Lyophilization: A lyophilizer consists of:

- A vacuum chamber that contains shelves.
- A vacuum pump.
- A refrigeration unit.

(ii) Procedure:

- The first step in the lyophilization process is to freeze a product to solidify all of its water molecules.
- Once frozen, the product is placed in a vacuum and gradually heated without melting the product.
- This process, called sublimation, transforms the ice directly into water vapor, without first passing through the liquid state.
- The water vapor given off by the product in the sublimation phase condenses as ice in a condenser, within the lyophilizer's vacuum chamber.
- The vials are now sealed off under vacuum and stored in a refrigerator.

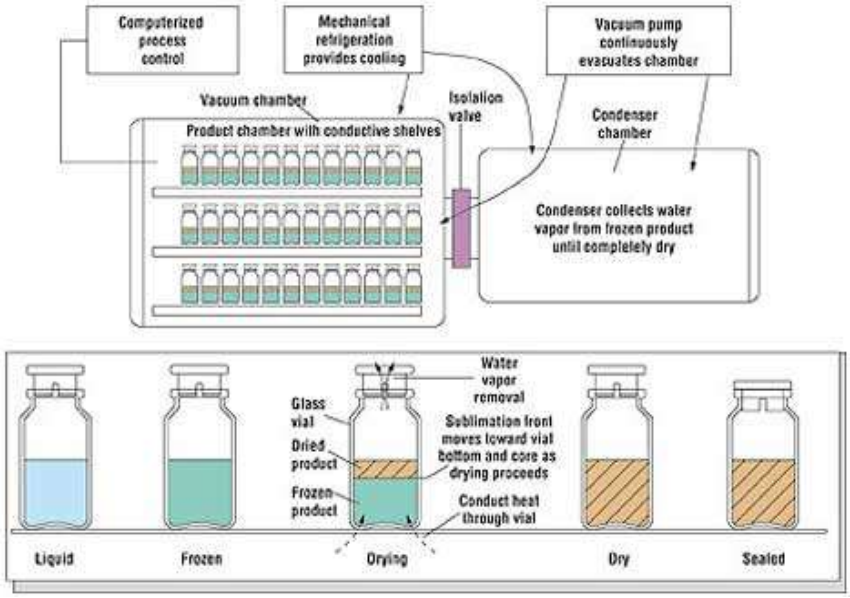


Figure above: The key components of a lyophilizer and each component's function, along with the five significant stages of processing that a standard serum vial goes through.

(4) Storage at Low Temperatures: The ready availability of liquid nitrogen has provided us with another very useful means for long-term preservation of bacterial cultures. In this procedure a dense suspension of bacteria is made in a medium containing a cryoprotective agent such as glycerol or dimethyl sulfoxide (DMSO), which prevents cellular damage due to ice crystal formation. The cell suspension is sealed into small vials and then frozen to -150°C. The vials are then stored in a liquid nitrogen refrigerator.

Q. 4. A) Describe any one of the following: (10)

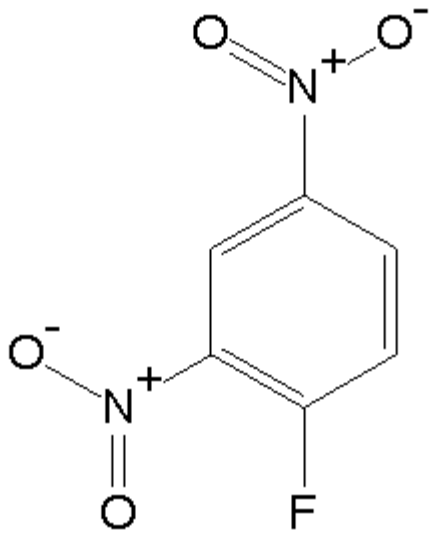
1. Structure of primary and secondary cell wall.
Description of primary cell wall composed of cellulose.
Description of secondary cell wall which lies inner to primary cell wall.
List of chemical compounds of primary and secondary cell wall.
Diagram expected.
2. Lampbrush chromosome
Which cell was it first observed. Structure. Function.
Diagram in details is expected.

Q. 4. B) Explain **any two** of the following:
1. Euchrmatin and heteromatin.
Their location, characteristic features.. Diagram can be considered.
2. Structure of nuclear membrane
Outer and inner membrane, nuclear pores. Intra-membrane space. Attachments to both outer and inner membrane.
Diagram with nuclear membrane pore is expected.
3. Mechanism of movement of flagella
Basic internal structure of flagella with axoneme. The theories of sliding movement and stretching movement.
Diagram is expected.
4. Structure of cell wall of Gram positive bacteria.
Peptidoglycan structure. Chemical nature of cell wall components.. Thickens layers of cell wall.
Diagram is expected.

Q. 5. Write short notes on

1. Sanger's reaction

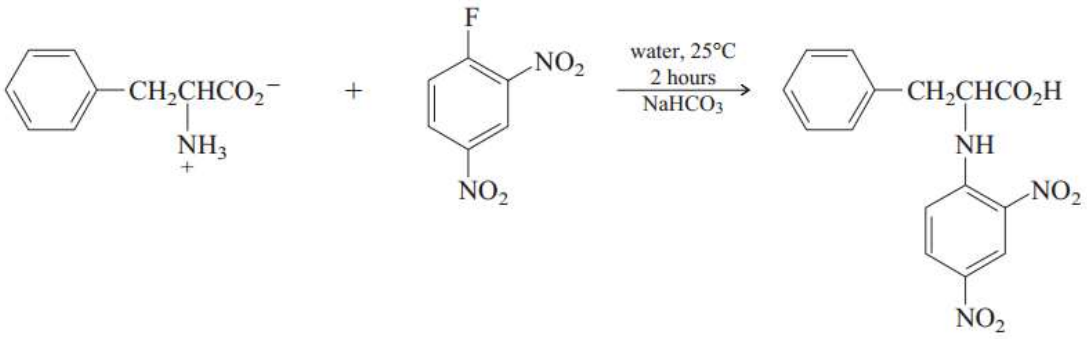
Sanger's reagent is 1-fluoro-2,4-dinitrobenzene, a trisubstituted, highly activated benzene ring towards nucleophilic aromatic substitution, because all three groups are electron-withdrawing (fluoride is a mildly activating group and an ortho/para- director, and the nitro groups in the ortho- and para- positions to the fluoride are very strongly activating).



All of the above means that the most reactive site on Sanger's reagent is the carbon bonded to the fluorine atom, and that carbon is strongly electropositive.

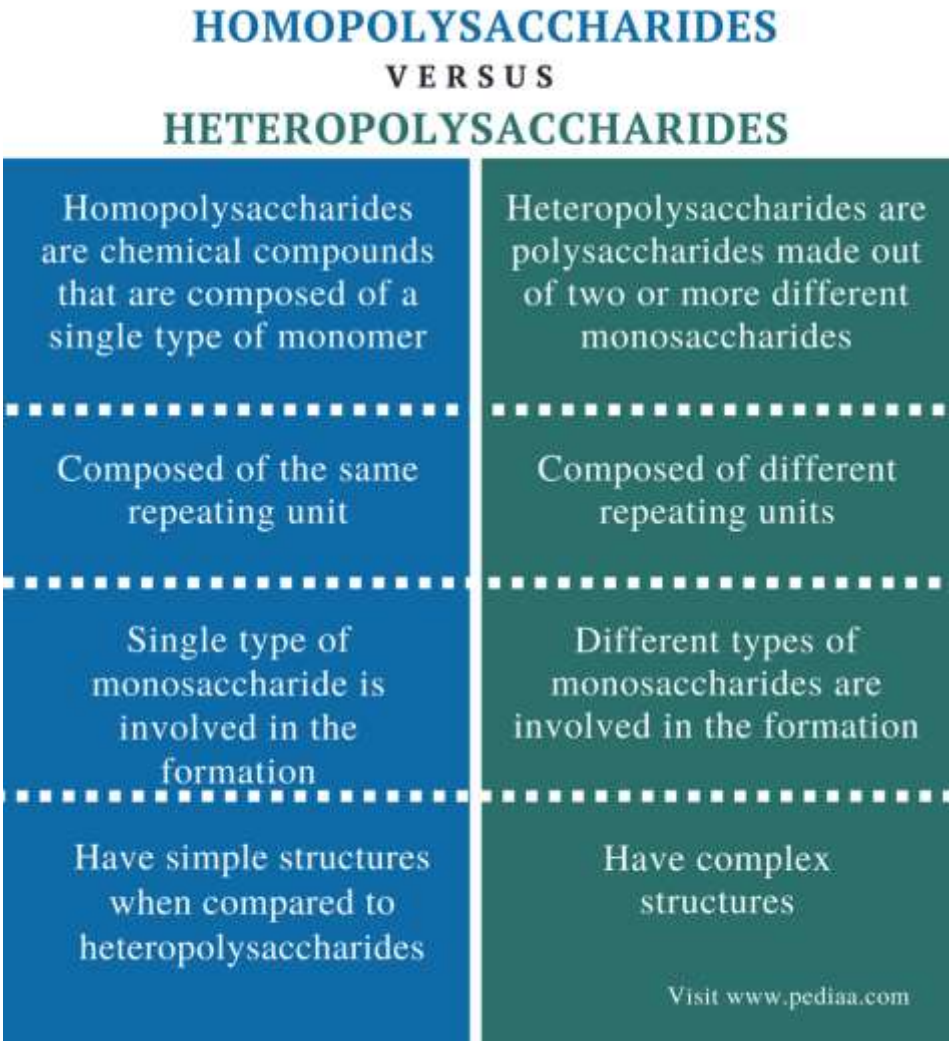
Now here's (below is) a sample reaction with phenylalanine (zwitterionic form) in water and a weak base at room temperature with Sanger's reagent to yield a 2,4-DNP derivative of phenylalanine.

Aryl fluorides with two nitro groups are very reactive toward **nucleophilic aromatic substitution.** The reaction of 1-fluoro-2,4-dinitrobenzene, known as Sanger's reagent, with the amino acid phenylalanine occurs at room temperature. This reaction forms the basis of a method used in the analysis of proteins that is described in Section 25.11.

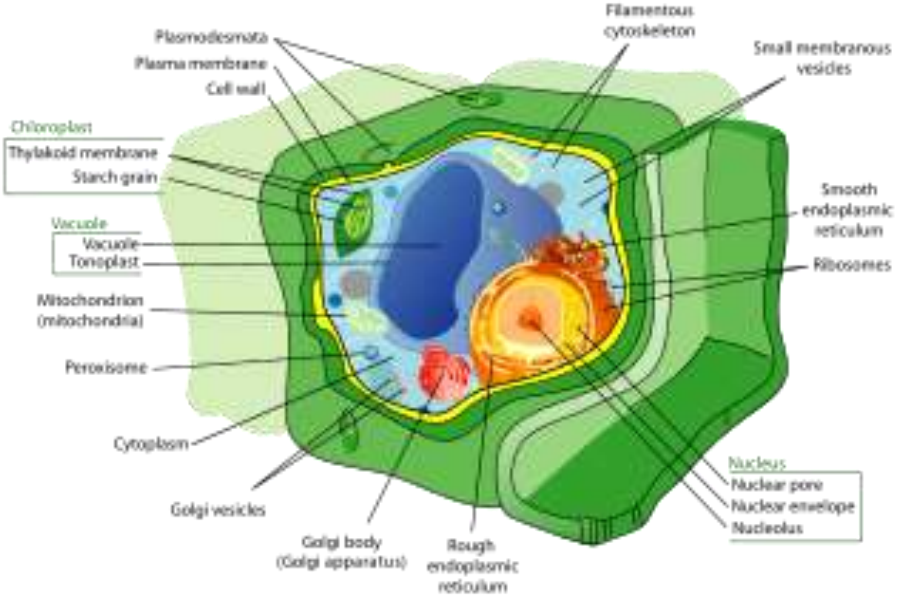


Phenylalanine | 1-Fluoro-2,4-dinitrobenzene | *N*-(2,4-Dinitrophenyl)-phenylalanine (67%)

2. Difference between homo and hetero polysaccharides



3. Typical Plant Cell



Plant cells are eukaryotic cells of the types present in green plants, photosynthetic eukaryotes of the kingdom Plantae. Their distinctive features include primary cell walls containing cellulose, hemicelluloses and pectin, the presence of plastids with the capability to perform photosynthesis and store starch, a large vacuole that regulates turgor pressure, the absence of flagellae or centrioles, except in the gametes, and a unique method of cell division involving the formation of a cell plate or phragmoplast that separates the new daughter cells.

- Plant primary cell walls are constructed on the outside of the cell membrane and are composed of cellulose and hemicelluloses and pectin. In many cases lignin, suberin or cutinare secreted by the protoplast as secondary wall layers inside the primary cell wall. This contrasts with the cell walls of fungi, which are made of chitin, of bacteria, which are made of peptidoglycan and of archaea, which are made of pseudopeptidoglycan. Cell walls perform many essential functions. They provide shape to form the tissue and organs of the plant, and play an important role in intercellular communication and plant-microbe interactions.

- Many types of plant cells contain a large central vacuole, a water-filled volume enclosed by a membrane known as the tonoplast that maintains the cell's turgor, controls movement of molecules between the cytosol and sap, stores useful material and digests waste proteins and organelles.

- Specialized cell-to-cell communication pathways known as plasmodesmata, occur in the form of pores in the primary cell wall through which the plasmalemma and endoplasmic reticulum[4] of adjacent cells are continuous.

- Plant cells contain Plastids, the most notable being chloroplasts, which contain the green-colored pigment chlorophyll that absorbs sunlight, and allows the plant to make its own food in the process known as photosynthesis. Other types of plastids are the amyloplasts, specializedfor starch storage, elaioplasts specializedfor fat storage, and chromoplasts specialized for synthesis and storage of pigments. As in mitochondria, which have a genome encoding 37 genes, plastids have their own genomes of about 100–120 unique genes[7] and, it is presumed, arose as prokaryotic endosymbionts living in the cells of an early eukaryotic ancestor of the land plants and algae.

- Plant cell division takes place by construction of a phragmoplast as a template for building a cell plate late in cytokinesis. This process ischaracteristic of land plants and a few groups of algae, notably the Charophytes and the Chlorophyte Order Trentepohliales.

- The motile, free-swimming sperm of bryophytes and pteridophytes, cycads and *Ginkgo* are the only cells of land plants to have flagella[11] similar to those in animal cells, but the conifers and flowering plants do not have motile sperm and lack both flagella and centrioles.

4. Any one technique of Isolation of Microorganism:

Isolation of Microorganisms:

Microorganisms occur in natural environment like soil. They are mixed with several other forms of life. Many microbes are pathogenic. They cause a number of diseases with a variety of symptoms, depending on how they interact with the patient. The isolation and growth of suspected microbe in pure culture is essential for the identification and control the infectious agent.

The primary culture from natural source will normally be a mixed culture containing microbes of different kinds. But in laboratory, the various species may be isolated from one another. A culture which contains just one species of microorganism is called a pure culture. The process of obtaining a pure culture by separating one species of microbe from a mixture of other species, is known as isolation of the organisms.

Methods of Isolation:

There are special techniques employed to obtain pure cultures of microorganisms. In few cases it is possible to secure pure culture by direct isolation or direct transfer. This can be done only in those situations in which pure culture occurs naturally. Kinds of specimens taken for culturing will depend on the nature and habitat of microbes.

Different pathogens can be isolated from body tissues and fluids such as blood, urine, sputum, pus, faces, spinal fluid, bile, pleural fluids, stomach fluids etc. In the blood stream of a patient suffering with typhoid fever, the bacteria Salmonella typhosa may be present.

A pure culture of this bacterium may be obtained by drawing blood sample using a sterilized hypodermic syringe and treating the blood with anticoagulant such as heparin and potassium oxalate. The presence of the anticoagulant prevents the pathogenic microbe from entrapping in fibrin clot. The sample of the blood may be inoculated into a suitable medium.

Following isolation methods are employed to isolate microbes from mixed cultures:

Streaking

2. Plating

3. Dilution

4. Enriched procedure, and

5. Single cell technique.

Streaking:

This is most widely used method of isolation. The technique consists of pouring a suitable sterile medium into sterile petriplate and allowing the medium to solidify. By means of a sterile loope or straight needle or a sterile bent glass-rod a small amount of growth preferably from a broth culture or bacterial suspension is streaked back and forth across the surface of agar until about one third of the diameter of the plate has been covered.

The needle is then flamed and streaking in done at right angles to and across the first streak. This serves to drag bacteria out in a long line from the initial streak. When this streaking is completed the needle is again flamed and streaking is done at right angles to the second streak and parallel to the first.

It includes diluting of a mixture of microorganisms until only a few hundred bacteria are left in each millilitre of the suspension. A very small amount of the dilution is then placed in a sterile petriplateby means of a sterile loop or pipette. The melted agar medium is cooled to about 45°C and is poured into plate. The microorganism and agar are well mixed. When the agar is solidified the individual bacterium will be held in place and will grow to a visible colony.

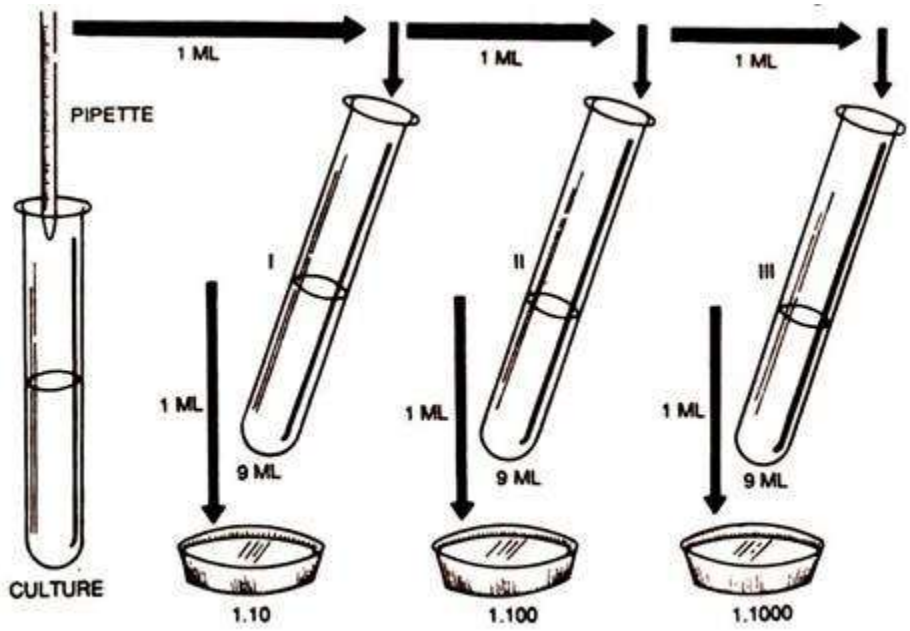


Fig. 2.2 Dilution method of isolation.

3. Dilution:

This method is used for the microorganisms which cannot be easily isolated by streaking or plating method. Sometimes when several organisms are present in a mixture, with one organism predominating, the predominating form may be isolated by this method. For example, when raw milk is allowed to sour at room temperature it will, at the time of curding, have a mixture of microorganisms with high percentage of Streptococcus lactis.

If 1 ml of the sour milk is taken into a tube containing 9 ml. of sterile milk (in which no organisms are present) then 1 ml. of this mixture is transferred with a sterile pipette into a second tube of sterile milk and the procedure is repeated i.e. from second to third tube, third to fourth tube until a series of about 10 tubes are inoculated. By this serial dilution, the chances are that a pure culture of S. lactis will be obtained.

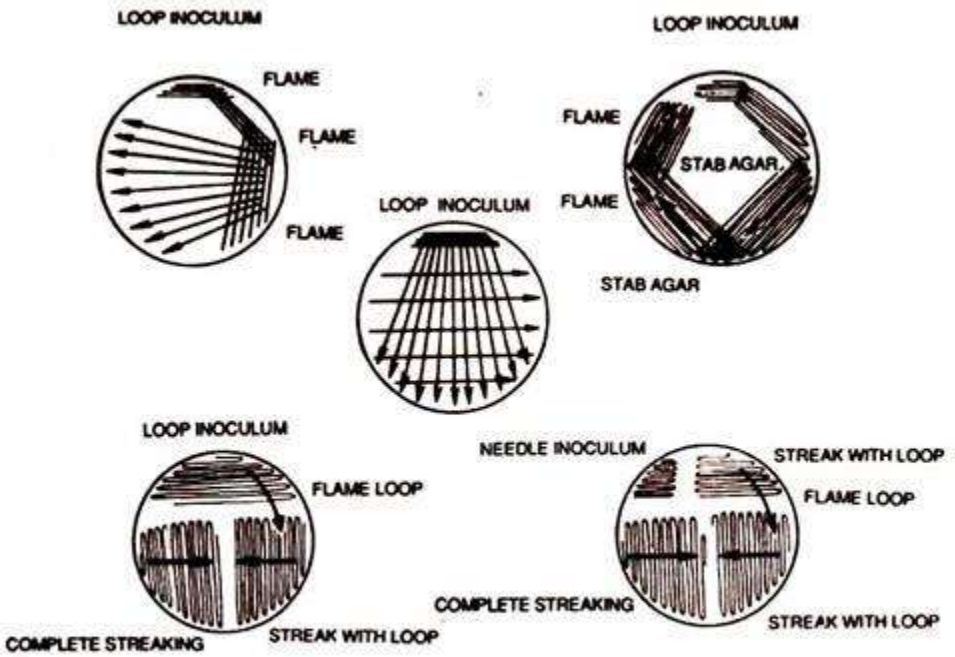


Fig. 2.1 Different patterns used for obtaining pure culture by streaking.

5. Microfilaments.

Structure, diameter, position in cell, functions in cell. Any other relevant point.

6. Polytene chromosome

Structure, cells in which it is observed, functions, Balbiani rings.

Diagram is expected.