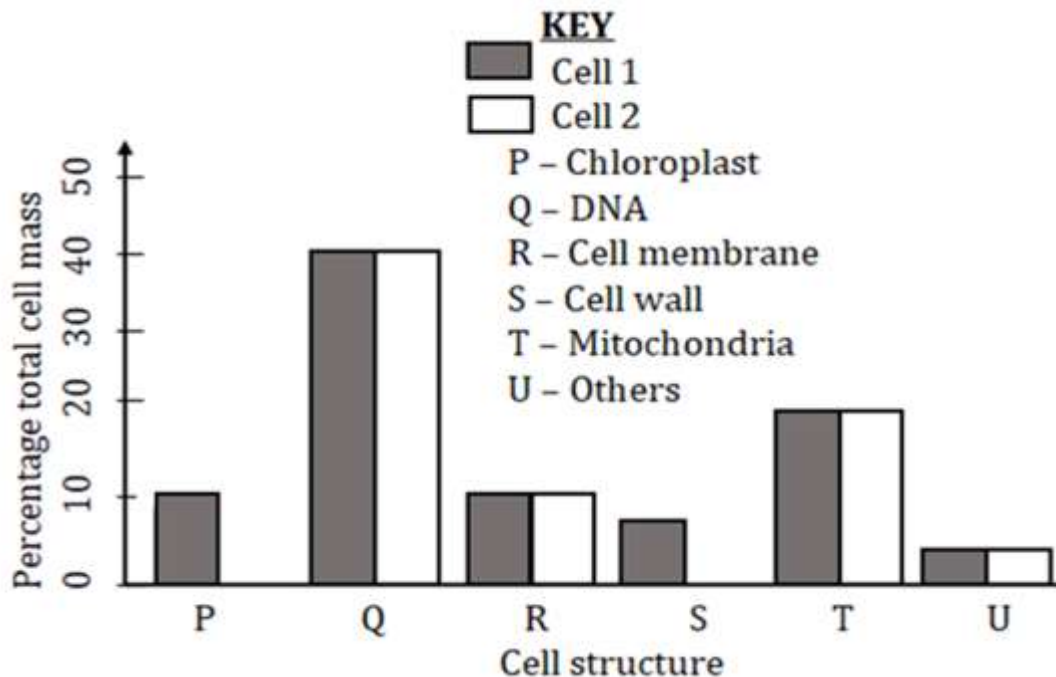


MARKING GUIDE SET III.

1. a) The data below was obtained from two different **eukaryotic cells, 1 and 2** as shown in the graph below. Study the graph carefully and answer the questions that follow.



(i) With reasons, identify which cell is **most likely** to be from Plants. (03 marks)

Cell 1; Contains both structure-P (chloroplast); and Structure-S (Cell wall); (03)

(ii) Account for the percentage total cell mass of **structure Q** and **T**. Basing on the percentage total cell **mass of structure T**, with reasons state which **cell(s)** could be studied in this experiment.

(07marks)

Structure Q- (Very) High DNA Content in both Cell 1 and 2; Cells are Diploid/two complete sets of chromosomes; Increasing genetic variations; AVP- IF one gene faulty, second one provides normal back up; Structure T- High Mitochondrial concentration/density; both cells have high metabolic rate/Highly active/require much energy; (05)

Cells studied.

Any 02 cells explained max=02 marks.

Accept any cell with High mitochondrial concentrations.

One plant cell and one animal cell.

Liver cell/hepatocyte; energy to drive various biochemical reactions;

01

Sperm cell/Spermatozoon; provide energy to propel sperm;

01

Striated/stripped/voluntary/skeletal muscle cell; energy needed for muscle contraction;

01

Nerve cell/neurone; energy for production and release neurotransmitter substances;

01

Intestinal Epithelial cell/enterocyte; energy needed in absorption of food by active transport;

01

Transfer cell; provide energy for guttation and active loading of sieve tubes with sucrose;

01

Meristematic cell; provide energy for extensive cell division;

01

Endodermal cell; provide energy for active secretion of NO_3^- Ions into the xylem sap;

01

(iii) State the structural differences in the chemical Compositions of cell structure R and S.

(04marks)

Structure R (Cell membrane)	Structure S (Cell wall)
Phospholipids present	Cellulose present; 01
Cholesterol present	Cholesterol absent; 01
Lignin absent	Lignin present; 01
Pectin absent	Pectin present; 01
Hemicellulose absent	Hemicellulose present; 01
Glycoproteins and Glycolipids present	Glycoprotein and Glycolipids absent; 01
Any Four structural differences well stated.	

b) Explain the **adaptations** of the following cell structures to their functions. **(05 marks)**

(i) S

Cell wall adaptations.

Cellulose's Hydrogen bonds or cross-linkages binds microfibrils into fibres with great tensile strength and rigidity; 01

Thick layers giving cell wall support and strength; 01

Proteins eg Pectinase and cellulase play role in fruit ripening process; 01

Cell wall has spaces making it fully permeable to water and solutes; 01

Lignin and xylan deposited giving it more tensile strength; 01

Large prevents being lost in solution; 01

Suberin or cutin coated to prevent dessication, stretchability and invasion by pathogens; 01

Flexible cell wall due to alternate arrangements of microfibrils to prevent bursting following turgidity; 01

Plasmodesmata run through pits allows communication between cells; 01

Middle lamellae has magnesium and calcium pectates holding adjacent walls firmly together for strength and support; 01

Hemicellulose and pectates in the matrix hold together cellulose microfibrils firmly for maximum rigidity; 01

(ii) P

Adaptations of the chloroplasts.

Numerous granal membranes; provide a large surface area for the attachment of photosynthetic pigments; (chlorophyll and carotenoids) electron carriers and enzymes that carry out dark reaction; 01

A network of many proteins in the grana; hold the photosynthetic pigments in a precise manner forming photosystems for maximum absorption of light; 01

Granal membranes with ATP synthase enzyme; manufacture ATP by chemiosmosis; 01

Dense fluid of stroma; houses enzymes needed for Calvin cycle/dark stage; 01

Stroma fluid surrounds the grana; products of light-dependent reactions can easily pass into the stroma; 01

DNA and ribosomes; quickly manufacture some proteins needed for photosynthesis; 01

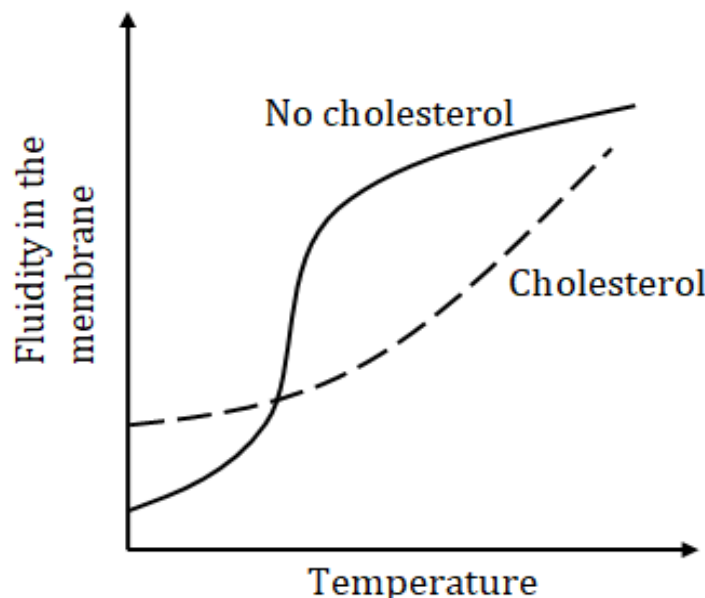
Thylakoid lumen; photolysis/photo-oxidation/photo-decomposition of water molecules occurs; 01

Double chloroplast envelope; isolates opposing reactions; 01

Numerous starch grains; to store large quantities of starch formed; 01

Thylakoids are stacked on top of each; to provide large surface area in little space; 01

c) In the study of the **ultra-structure** of the **plasma membrane**. An investigation was made by scientists concerning fluidity in two different **Phospholipid bilayers** at varying **temperatures**. **One bilayer had cholesterol** while the **other lacked cholesterol**. The results of the investigation were plotted on the graph below. Study the graph carefully and provide suitable answers.



- (i) Describe the **effect of temperature** on the fluidity of the Phospholipid bilayer in the **presence** and **absence** of Cholesterol. (05marks)

Cholesterol rich membrane.

Low temperature and Moderate (Further increase in temperature) caused/led/resulted into gradual increase in membrane fluidity; 01
High temperature caused rapid increase in the membrane Fluidity; 01

Cholesterol Free membrane.

Low temperature caused gradual increase in membrane fluidity; 01
Moderate temperature (Further increase in temperature) caused rapid increase in membrane Fluidity; 01
High temperature caused gradual increase in membrane fluidity; 01

- (ii) Account for the **differences** in fluidity of the two plasma Membranes with varying temperatures. (07marks)

At low temperature, Fluidity was higher in the Cholesterol rich membrane and Lower in the cholesterol Free membrane; because Cholesterol in the cholesterol rich membrane disturbs/prevents/hinders close packing of phospholipids which occurs in the cholesterol free membrane; cholesterol lowers temperature required for Phospholipids to solidify; 02

At moderate temperatures, Cholesterol rich membrane fluidity increased gradually while in Cholesterol free membrane fluidity increased rapidly; because cholesterol free bilayer attained the Critical/transitional temperature with all Van derwaals and Hydrophobic interaction forces broken, phospholipids move faster due to higher kinetic energy; Phospholipids in cholesterol rich membrane have fewer intermolecular attractions broken hence few phospholipids are free to move; Cholesterol increases the critical temperature;

03

At high temperature, fluidity increased gradually in cholesterol free membrane and rapidly in cholesterol rich bilayer; because of melting of phospholipids in cholesterol free membrane; and forces holding phospholipids in cholesterol rich membrane were all broken so move faster due to high kinetic energy;

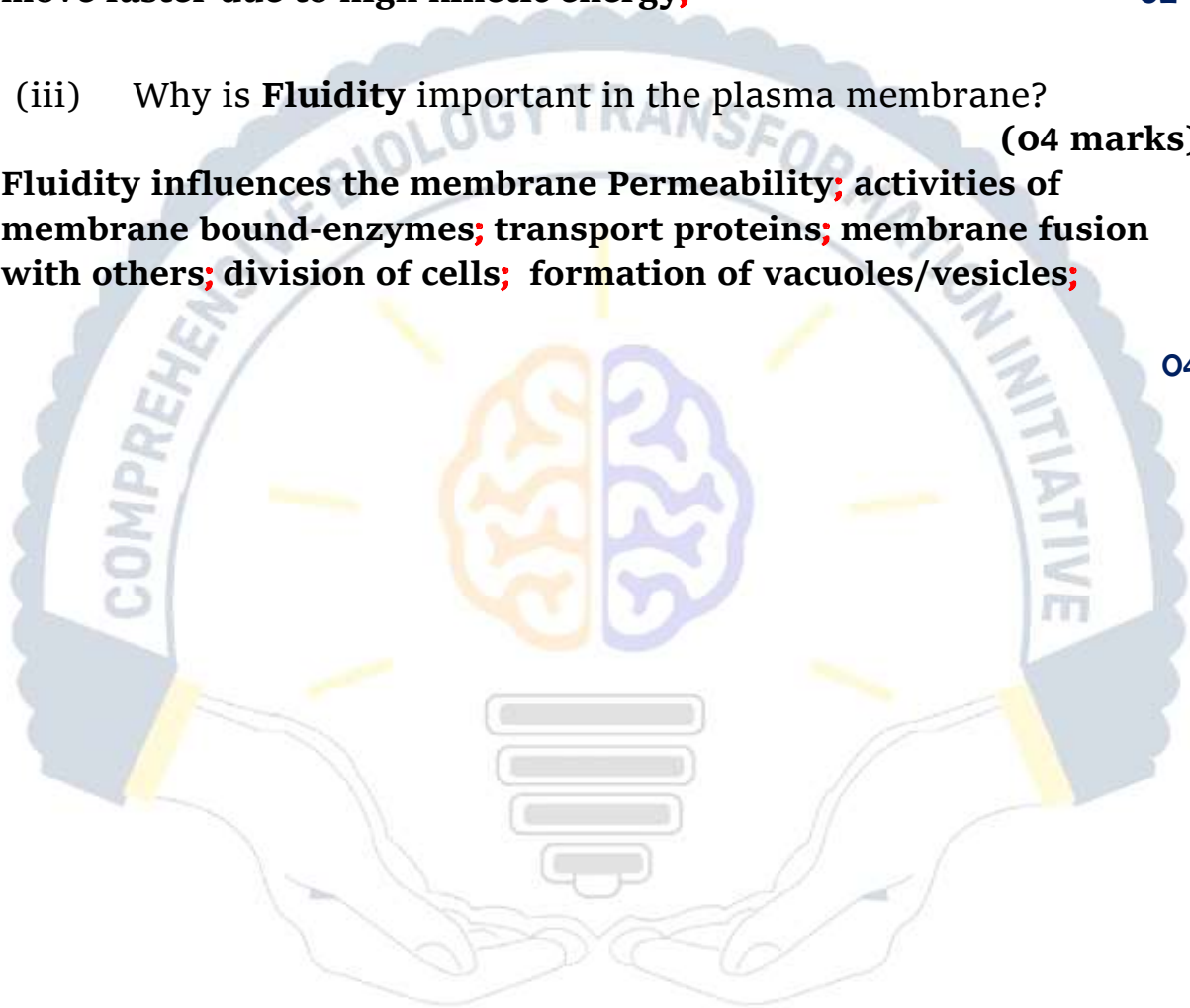
02

(iii) Why is **Fluidity** important in the plasma membrane?

(04 marks)

Fluidity influences the membrane Permeability; activities of membrane bound-enzymes; transport proteins; membrane fusion with others; division of cells; formation of vacuoles/vesicles;

04



SECTION B (60 MARKS)

Attempt any three questions from this section.

2. a) With examples, describe how the **properties** of **globular** proteins suit to their functions in organisms. (07 marks)
- Compact or Spherical with polar-R groups outside and non-polar R groups in wards; soluble to function in aqueous environment; eg enzymes, haemoglobin; 1 1/2**
- Conjugated with prosthetic groups; increases their working efficiency; eg haem and copper; 1 1/2**
- Carrier proteins; with binding /receptor sites where molecules bind for transport; 01**
- Channel proteins; water filled hydrophilic pores/lined with polar R-groups for transport of large, polar and charged particles; 01**
- Gated channel proteins to regulate flow of substances/Particles into Cells; 01**
- Biological (Metabolic) pumps; with ATPase enzyme for energy release during active transport; 01**
- Active sites of enzymes; catalysis specific biochemical reactions; 01**
- Allosteric; change shape; eg haemoglobin; 1 1/2**
- Amphoteric; work as PH buffers; eg albumin and globulin; 1 1/2**
- Linkages of several sorts; eg Ionic and Hydrogen stabilizing the structure; 01**
- Large sized/macro-molecules; prevent being lost in solution; 01**
- Form Colloidal solutions; increasing reaction surfaces; 01**
- b) (i) Describe the **chemical bonds** that **maintain** the **three dimensional** structure of globular proteins. (07 marks)
- Hydrogen bond; between hydrogen atoms, oxygen or nitrogen atoms in the polypeptides; 02**
- Ionic bond; between carboxyl and amino groups not joined to peptide bond; 02**
- Disulphide bridges; between two sulphur atoms; of cysteine amino acids which are close; 03**

(c) Explain the effect of the following factors on the chemical compositions of enzymes. (06marks)

(i) Acid and bases.

Hydrogen ions/protons combine with COO^- groups forming COOH ; breaking the ionic bond; 02

Bases causes NH_3^+ to lose proton forming NH_2 ; breaking the ionic bond; 02

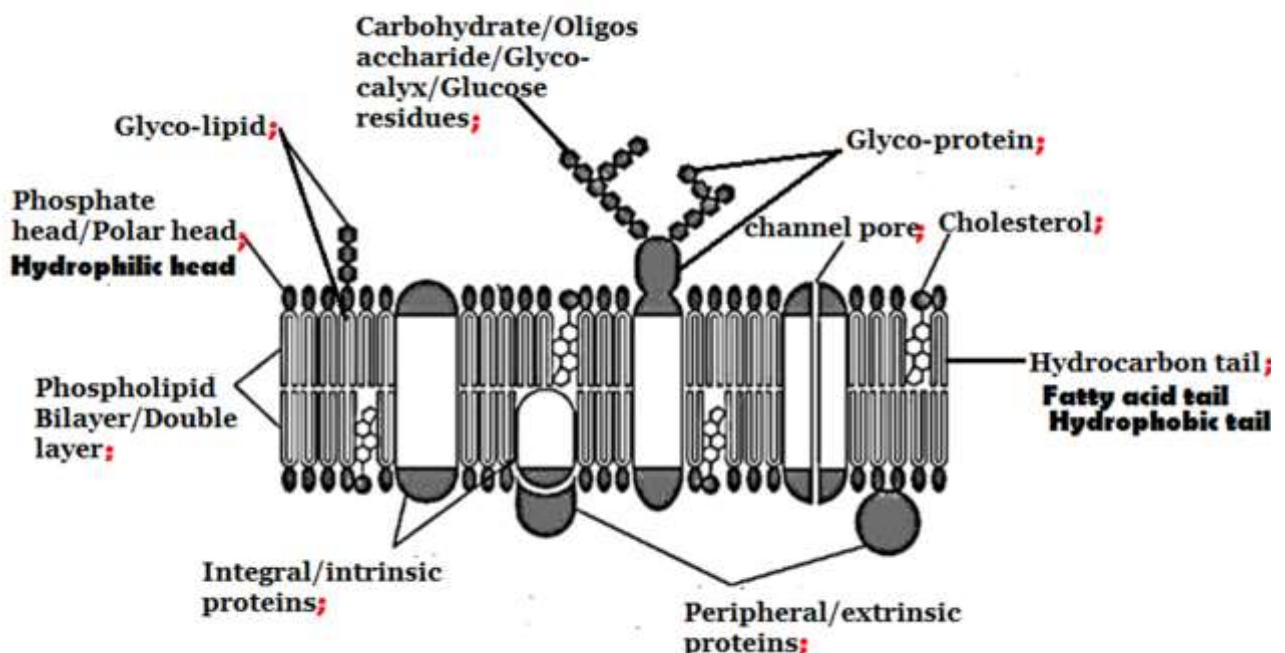
(ii) Heat

Causes atoms to vibrate; breaking the ionic and hydrogen bonds; 02

3. a) Describe the structure of the plasma membrane according to the fluid mosaic model. (10marks)

Bimolecular layer of phospholipids; with inwardly directed hydrophobic tails; and outwardly directed hydrophilic heads; protein molecules with irregular/scattered arrangement; some proteins occur on the surface of the phospholipid layer/peripheral/extrinsic; while some extend partly into it; some extend completely across/trans-membrane proteins; present between phospholipids is cholesterol; glycoproteins and glycolipids; which are antennae like structures at the surface;

Accept drawing with (10) parts labelled. (10)



b) Explain the role of the **chemical** components of the plasma membrane. (10marks)

chemical	roles
Proteins; (01)	Structural support; carriers by transporting water soluble substances; ion channels transport dissolved ions; enzymes for energy transducers; adhesion of cells; receptors for hormones and neurotransmitter substances; cell to cell recognition; Any 02
Phospholipids; and Cholesterol; (Lipids) (02)	Phospholipids--Passage of lipid soluble substances; insulators for transmission of impulses; prevent leakage of water soluble substances; membrane fluidity; Cholesterol--Reduce lateral diffusion of phospholipids; regulate fluidity; prevent leakage of water and dissolved ions; Any 02
Carbohydrates; (01)	Receptors for signaling molecules ie hormones; Adhesion between similar cells forming tissues; Surface antigens recognized by lymphocytes; Any 02

4. Outline the process of **transcription** in the nucleus (10 marks)

RNA polymerase; binds to promoter/initiation region; and breaks hydrogen bonds holding the double helix hence unwinds/unzips the cistron/segment of DNA/gene; 03

RNA polymerase moves along the **template strand;** ribonucleotides are taken from nucleoplasm; and matched up in precise way/adding complementary nucleotides forming mRNA; 03

RNA polymerase moves on to another region of the template strand or transcribing DNA strand, double helix of the DNA reforms behind; 02

RNA polymerase reaches end of the gene/termination sequence/Stop code; enzyme RNA polymerase detaches; mRNA peels away from DNA; 02

Accept-Helicase Breaking Hydrogen Bonds.

b (i) Compare the structure of **Deoxyribonucleic acid (DNA)** and **Ribonucleic acid(RNA)**. (05marks)

Similarities

- (Both) Contain nucleotides;
- (Both) Play role in protein synthesis;
- (Both) have High molecular mass or macromolecules or polymers;
- (Both) are found in the nucleus;
- (Both) are elongated/long chain of nucleotides; 02
- (Both) store genetic information;
- (Both) Carry out base pairing;
- (Both) sugar phosphate backbone held by Phosphodiester bonds;
- (Both) Pentose sugar bonded to nitrogenous bases;

Differences.

DNA	RNA
Contains thymine	Contains uracil;
Double polynucleotide chain	Single polynucleotide chain;
Higher molecular mass	lower molecular mass;
Found exclusively in the nucleus	Found in the nucleus and cytoplasm;
One type.	Three types i.e. mRNA, rRNA and tRNA.
Ratio of adenine and thymine to cytosine and guanine is one	Ratio of adenine and uracil to cytosine and guanine varies;
Chemically stable	Chemically less stable;
Can make precise copies of its self	Cannot make precise copies of its self;
Permanent	Temporary existing;
Pentose sugar is deoxyribose	pentose sugar is ribose;
Amount constant for all cells of a species except gametes and spores	Amount varies from cell to cell;
Any 03	

(ii) Suggest reasons that make **DNA** a suitable genetic material.

(05 marks)

- Self-replication;** make exact copies for transmission to off springs; 01
- Chemical stability;** to prevent change during transmission; 01
- Mutation;** to create new alleles increasing genetic variations; 01

Stores genetic information correctly; so that it can be read and interpreted easily; 01

Strategically located in the nucleus; for easy protection from damage and transmission of genetic materials; 01

Half DNA quantity in the gametic cells; allows restoration of diploid number on fertilization without errors/accurately; 01

5a) With examples, explain the meaning of the following concepts in biology.

(i) Cell specialization. (06marks)
Cells modified to perform specific task/function; cell changes shape and physiology; allows division of Labour; with increased levels of efficiency/perform task more effectively; cells are entirely dependent on the activities of other cells; eg Nerve cell, chondroblasts and mesophyll cells; 06

(ii) Levels of cellular organizations. (05 marks)
Multicellular organisms contain variety of cells; cells differentiate to form tissues; different tissues combine to form organs; organs work together to form systems; all systems make up organism; 05

b) Explain the adaptations of **epithelial tissues** to their roles. (09marks)

Pavement (squamous) epithelia are thin to reduce diffusion distance of materials; flattened to increase surface area for exchange of materials; smooth to provide friction free surface; 02

Glandular epithelia, serous cells secrete secretion containing enzymes catalyzing chemical reactions; mucocytes secrete mucus which prevents autolysis; 02

Microvilli increase surface area for absorption; 01

Ciliated to move materials in one direction eg cilia in oviduct moves ovum; 01

Thickened/stratified protects against abrasions; 01

Keratinized protects against abrasions; 01

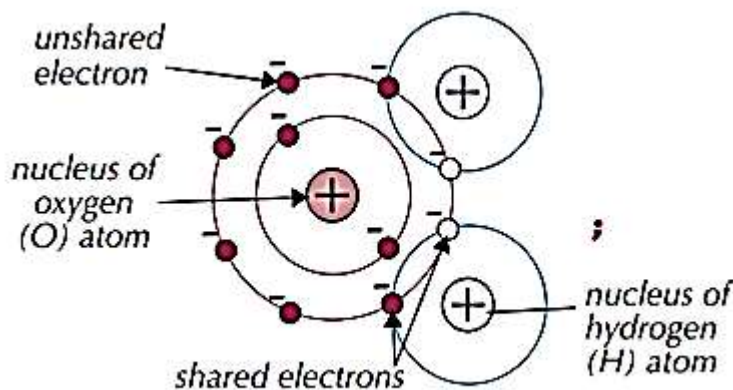
Innervated to detect mechanical forces; 01

Epithelia with chromatophores giving skin colour; 01

Epithelia form in folding resulting into channels or ducts eg gastric pits; 01

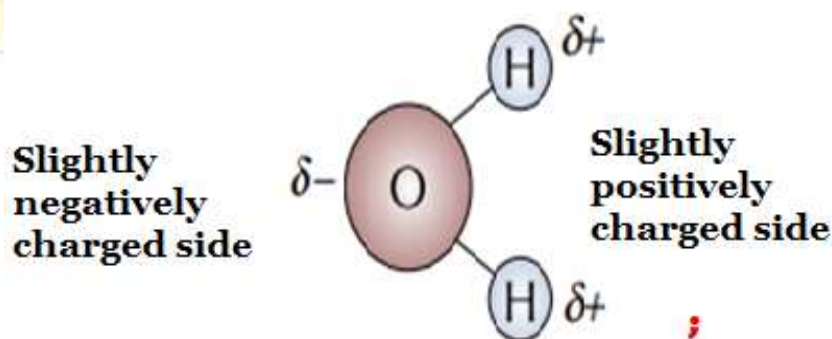
6. a)(i) Using illustrations, explain the cause of the **dipolarity** of a water molecule. (05marks)

A molecule of water (H_2O) is one atom of oxygen (O) joined to two atoms of hydrogen (H) by shared electrons; 01



01

Shared negative hydrogen electrons are pulled towards the oxygen atom hence hydrogen atoms are left with a slight positive charge; (partial positive) unshared negative electrons on the oxygen atom give it a slight negative charge; (partial negative). 02



01

(ii) Explain how the properties of water account for its transport function in organisms? (06marks)

Universal solvent; due to polar nature dissolves most substances; 01

High cohesion; water molecules stick together/form hydrogen bonds which allows continuous column in the xylem; 01

High adhesion; attaches to the walls of the xylem/polar surfaces for upward water movement; 01

High specific heat capacity; prevent change in temperature of materials transported/maintain stable internal body temperature; 01

Liquid at room temperature; allows flow through tubes/vessels easily; 01

High surface tension; form small droplets that easily pass through aquaporins/water channels; 01

Neutral; doesnot react with materials transported; 01

High latent heat of fusion; prevents materials transported freezing due to fall in temperature; **Any Three points.** 01

High tensile strength; water column doesn't break/collapse in the xylem; 01

Low viscosity; allows rapid flow of water through tubes/vessels; 01

b) Explain the significances of acids, salts and bases in our bodies.

Roles of Acids.

•HCl activates (Zymogens) enzymes like pepsinogen and pro-rennin, kills germs in food, provide an optimum acidic pH for enzymes; 01

• Transportation of respiratory gases e.g. carbonic acid is a form in which carbondioxide is transported; 01

• Phosphoric acid forms phospholipids which are chemical components of membranes; 01

• Haemoglobinic acid formed due to buffering role of haemoglobin. 01

• Nucleic acids for protein synthesis process. 01

Fatty acids form phospholipids which are structural components of cell membrane; 01

Any 03 roles of acids.

Importance of bases.

- Provide an optimum alkaline pH for the action of enzymes
- Neutralize acidic chyme; 01
- Constitute the bicarbonate and ammonia buffer systems; 01

Any 01 role of bases.

Roles of salts.

Constituents of various chemicals; eg nitrogen and sulphur are components of proteins; Phosphorous found in ATP and Iodine in thyroxine; Any 01

Constituent of structures; proteins form structural materials such as connective fibres in which nitrogen and sulphur are components; phosphorous in cell membrane; calcium in plant cell wall, calcium and phosphorous in bones; Any 01

Constituent of enzymes; certain enzymes contain metal ion eg copper and iron; Any 01

Metabolic activators; certain ions activate enzymes eg magnesium activates enzymes in phosphate metabolism; 01

Constituents of certain Pigments; eg haemoglobin and Chlorophyll which contain iron and magnesium respectively; 01

Determinants of anion-cation balance; by maintaining concentration of calcium, potassium and chloride which are essential for transmission of nerve impulses; 01

Determinants of osmotic pressure; 01

Organic salts such as sodium glycocholate and taurocholate; emulsify lipids into droplets; 01

Any 05 roles of salts.

CC- Comprehensive Biology Transformation Initiative.

Transforming Biology Pedagogy

Contributions made by MUGWE MARTIN.