

Solution of Biophysics QP

May 2018 - Sem-V - Biotechnology

[Soln] (a) Passive transport :-

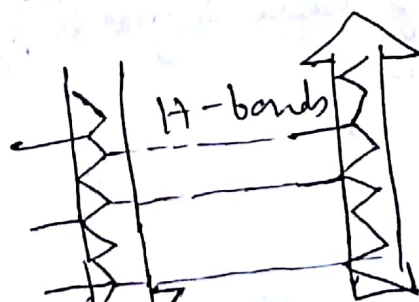
- along the concn gradient
- Energy is not required
- From Higher to lower concn
- Eg → osmosis, Diffusion

(b) Reducing Sugar :-

- Capable of acting as a reducing agent
- Free aldehyde or ketone group is present.
- Eg all monosaccharides, maltose & lactose.
- Several qualitative tests are used to detect reducing sugars.
- Fehling's solution, Tollen's reagent etc.

(c) Antiparallel Beta-Sheet :-

- polypeptide strands run in opposite directions
- The N-terminus of one ~~β -strand~~ ^{strand} will be opposite the C-terminus of the other β -strand.
- In antiparallel β -pleated sheet arrangement the H-bonds are aligned opposite to each other, making more stable and stronger bonds.



Antiparallel β -sheets.

(d) Lipoprotein:-

A lipoprotein is a biochemical assembly that contains both proteins & lipids, bound to the proteins, which allow fats to move through the water inside & outside cell. The proteins serve to emulsify the lipid molecules, many enzymes, transporters, antigens etc. are lipoproteins.

(e) Van der Waals Forces:-

→ weak ~~are~~ forces that attract neutral molecules to one another in gases.

→ Types;

> London Dispersion forces

> Dipole-dipole forces.

[Sol 2.] (a) Biophysical tech used for struc. determination of Biomolecules:-

- X-ray crystallography
- Nuclear Magnetic Resonance
- Spectroscopy -

(b) Secondary structures of protein

- 3-D form of local segments of proteins
- Most common:
 - > alpha helices
 - > β -sheets



α -helix



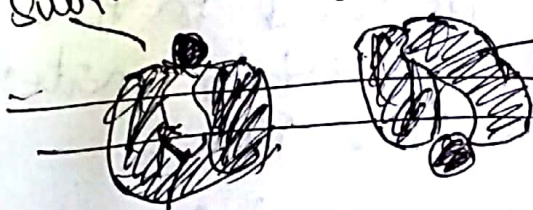
β -pleated sheet

(Soln 3.) (a)

Active transport:-

- type of transport against concⁿ gradient
- i.e. from low concⁿ to higher concⁿ
- Require energy in the form of ATP.
- Membrane proteins act as carrier proteins or pumps.

Substrate → Eg:- Na^+/K^+ pump.



Carrier protein changes conformation on binding substrate.

(b) Plasma Membrane:-

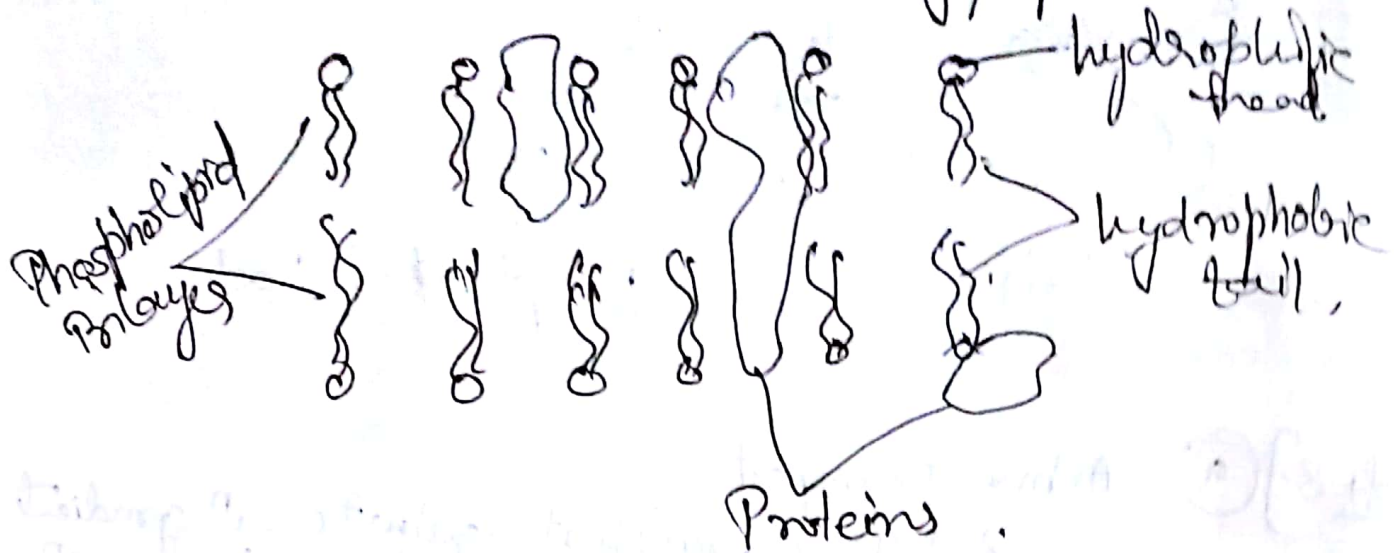
- It is the outer covering of a cell. also known as Phospholipid bilayer.

Chemical Composition:-

(1) Lipids:- phospholipids, galactolipids, cholesterol
Major lipid is phospholipid.

(2) Proteins:- Integral proteins (TM)
Peripheral "

(5) Carbohydrates:- in the form of glycolipids and glycoproteins.



Properties:-

- It is selectively permeable memb.
- Regulate the flow of materials in and out of the cell.
- Carrier proteins in the memb are involved in the transport of certain materials across the PM.
- Fluid Mosaic Model → Phospholipids are amphipathic molecules i.e. have both hydrophilic & hydrophobic ends.
- Cholesterol provide rigidity.
- PM behaves as 3-D fluid.

(Soln 4)

(a) Henderson-Hasselbalch Equation:-



for this, $K_a = \frac{[H^+][A^-]}{[HA]}$

or $[H^+] = K_a \frac{[HA]}{[A^-]}$

or $pH = pK_a + \log \frac{[A^-]}{[HA]}$

→ Human Blood is normally slightly basic or alkaline with a pH range 7.35 to 7.45.

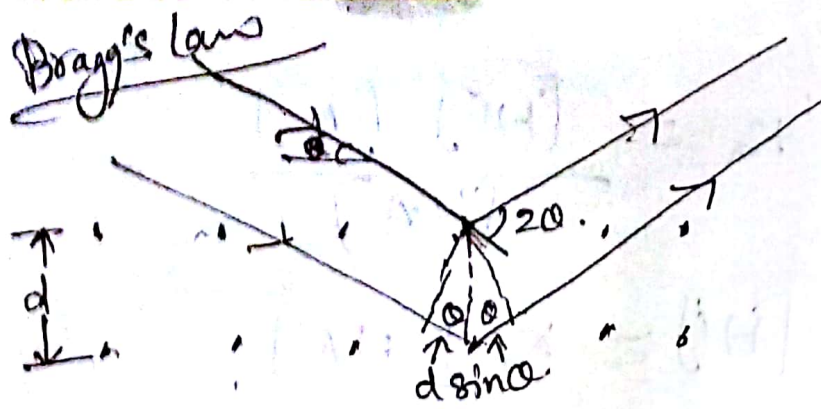
(b) X-ray Crystallography:-

→ technique used for determining atomic and molecular structure of a crystal.

→ Crystalline atoms cause a beam of incident X-rays to diffract into many specific directions.

→ By measuring the angles and intensities of these diffracted beams a crystallographer can produce a 3-D picture of e⁻ density within the crystal.

→ This e⁻ density map is used to form 3-D model of the crystal.



Constructive interference occurs when

$$n\lambda = 2d \sin \theta$$

When X-rays are scattered from a crystal lattice, peaks of scattered intensity are observed which correspond to ~~the~~ ^{the}:

- (1) The angle of incidence = angle of scattering
- (2) The path length difference is equal to an integer no. of wavelength.

Sol-15) (a) Nucleic-acid binding proteins

DNA binding Proteins
 or RNA " "

→ Specific Interactions eg → ~~Histones~~ ^{TFs}

→ Non-Specific Interactions
 eg → Histones

DNA/NA Binding proteins have domains as:-

- (a) Zinc fingers
- (b) Helix-turn-Helix
- (c) Leucine Zipper

These domains interact with major groove of DNA with different types of interactions such as electrostatic which are of reversible nature.

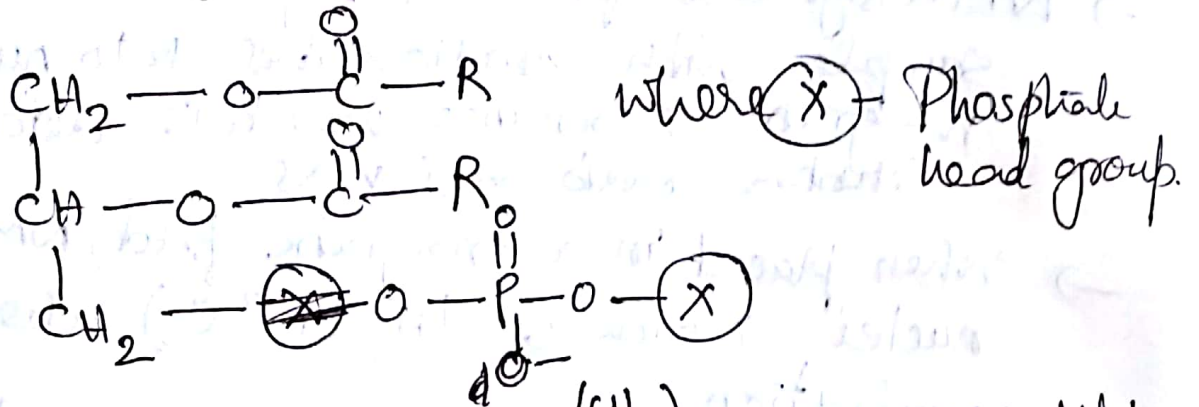
(6) ^1H -NMR:-

- Nuclear Magnetic Resonance spectroscopy is a technique which is used to predict structure of biomolecules based on atomic nuclei magnetic properties.
- NMR signal is produced by excitation of nuclei sample with radio waves into nuclear magnetic resonance which is detected with sensitive radio receivers.
- When placed in a magnetic field, NMR active nuclei (such as ^1H or ^{13}C) absorb EM radiation.
- A spinning charge generates a magnetic field that results in a magnetic moment proportional to the spin. The difference in the energy (ΔE) between the two spin states increases as the strength of field increases.
- Reference signal for NMR is taken for TMS (tetramethylsilane). The chemical shift provides information about the structure of the molecule. The shape & area of peaks indicate the chemical structure of the molecule.

(Soln 6.) (a) Phospholipids :-

- Amphipathic molecule that is, have hydrophobic as well as hydrophilic ends.

- Each Phospholipid is made up of two fatty acids, a phosphate group and a glycerol molecule.
- Phospholipids are amphipathic molecules, arranged themselves into a bilayer to form cell membrane.



if (X) → $\text{CH}_2 - \text{CH}_2 - \text{N}^+(\text{CH}_3)_3$ → Phosphatidylcholine
 → $\text{CH}_2 - \text{CH}_2 - \text{NH}_2$ → Phosphatidylethanolamine etc.

Sol 6 (6) Transmission electron Microscope :-

