BIOPHYSICS

ASSIGNMENT - I

$8\frac{1}{2} / 10$

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Q1 Biophysics applies the principle physics, chemistry, maths and biology, to study livings cells and organisms, including structures and fine structures, bioelectric phenomenon, radiation effect, molecular behaviour, photosynthesis, membranes and many more. It is a field that applies theories and methods of physics to understand how biological systems work.

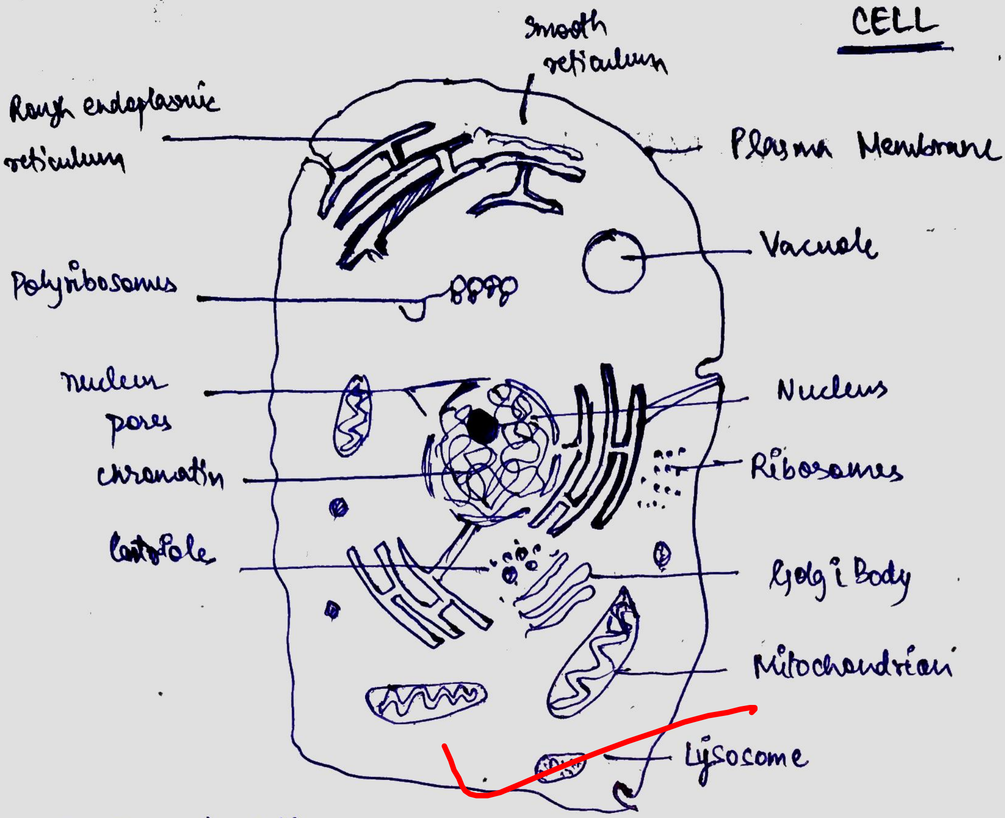
$\frac{1}{2}$

Various opportunities available to Biophysicists are generally teachers and researchers in biology, physics, engineering and many other fields. They work in universities, hospitals, tech startups and companies developing new diagnostic tests, drug delivery systems, or potential biofuels, making 3D models and imaging.

Q2 A cell is the structural and functional fundamental unit of all living beings. A cell can replicate itself independently. Hence, called the building blocks of life.

Each cell contains a fluid called cytoplasm, which enclosed by a membrane. Also present in the cytoplasm are several biomolecules like proteins, nucleic acids and lipids. Cellular structures called cell organelles are suspended in the cytoplasm.

CELL



Functions of cell :

i) provides support and structure - cell membrane and cell wall provides support, and xylem in vascular plants.

ii) facilitate growth mitosis - the parent cell divides into daughter cells, multiplying the growth.

iii) energy production - through respiratn and photosynthesis.

iv) allows transport of substances - eliminated by cells by active and passive transport.

v) aids in reproduction - through mitosis & meiosis.

93 i) Prokaryotic cell is a type of cell that does not have a true nucleus or membrane-bound organelles. ex: Bacteria.

Eukaryotic cells contains membrane-bound organelles. ex: fungi, plants, animals.

Eukaryotic Cell	Prokaryotic Cell
double-membraned cell organelles (chloroplasts, nucleus) and single membraned (golgi, lysosomes).	single membraned cell bodies like mesosomes present. Endoplasmic reticulum, plastids, golgi body absent.
Ribosomes - 80 S	Ribosomes - 70 S
distinct compartments for cell.	no compartments.
number of chromosomes vary from two to many.	one chromosome per cell.
Each chromosome is linear with its two ends free.	chromosome is circular and remains attached to membrane.
has linear double stranded DNA complexed with histones	has single double-stranded circular DNA not associated with histones.

ii)

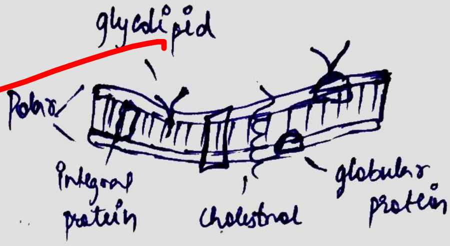
Animal Cells	Plant Cells
flexible layer that surrounds the cell & controls the substances that enter and exit.	hard layer outside cell membrane containing cellulose to provide strength to the plant.
plastids are absent and vacuoles are few.	plastids are present and are few large.
heterotrophic mode of nutrition	autotrophic mode of nutrition.
single high complex and prominent golgi apparatus is present.	Many simpler units of golgi apparatus called dictyosomes are present.

4 fluid mosaic model was first proposed by S.J. Singer and Garth L. Nicolson in 1972 to explain structure of plasma membrane.

It describes the structure of the plasma membrane as a mosaic of components - that gives membranes a fluid character.

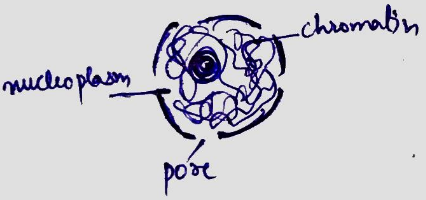
Components of cell are :

① CELL WALLS (MEMBRANE)



① it seperates the interior of all cells from the outside environment.

② CYTOPLASM - a thick solution that fills each cell and is enclosed by the cell membrane.

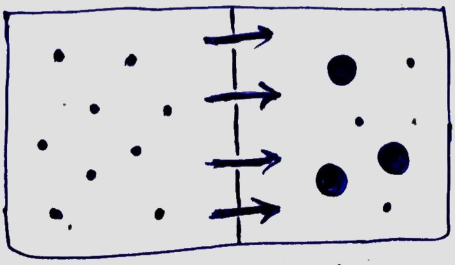


③ Nucleus - a membrane - bound organelle that contains the cells chromosomes.

5 Osmosis is the movement of solvent particles across a semipermeable from a dilute solution into concentrated solution. The solvent moves to dilute and equalize concentn.

Diffusion is the movement of particles from an area of higher concentration to lower concentration.

Dilute solutn containing a high concentration of water molecules.



Contentrated solution containing a low concentration of water molecules.

net movement of water molecules.

Examples of osmosis include red blood cells swelling up when exposed to fresh water and plant root hairs taking up water.

Examples of diffusion include perfume filling a whole room and the movement of small molecules across a cell membrane.

$\boxed{6}$ Donan Equilibrium is name for the behaviour of particles charged near a semi-permeable membrane that sometimes fail to distribute evenly across the two sides of membrane. The usual cause is the presence of different charged substance that is unable to pass through the membrane and thus creates an uneven electrical charge.

$$\frac{[K^+]_{I}}{[K^+]_{II}} = \frac{[Cl^-]_{II}}{[Cl^-]_{I}}$$

number of positive charges must equal the number of negative charges on each side of membrane.

The electric potential arising between two such solution is called Donnan potential.

" Solutions may be gels or colloids as well as solutions of electrolytes.

7 Goldman – Hodgkin – Katz (GHK) voltage equation is used in cell membrane physiology to determine the reversal potential across a cell's membrane.

The equation seeks to determine the voltage E_m across a membrane.

Only two factors, influence the motion of ions across a permeable membrane:

a) average electric field.

b) difference in ionic concentration from one side of the membrane to other.

$$E_m = \frac{RT}{F} \ln \left(\frac{\sum_i^n P_{M_i^+}[M_i^+]_{out} + \sum_j^m P_{A_j^-}[A_j^-]_{in}}{\sum_i^n P_{M_i^+}[M_i^+]_{in} + \sum_j P_{A_j^-}[A_j^-]_{out}} \right)$$

8 A pacemaker is a small device that's placed in the chest or abdomen to help control abnormal heart rythms. It uses electrical pulses to prompt the heart to beat at a normal rate, used to treat arrhythmias.

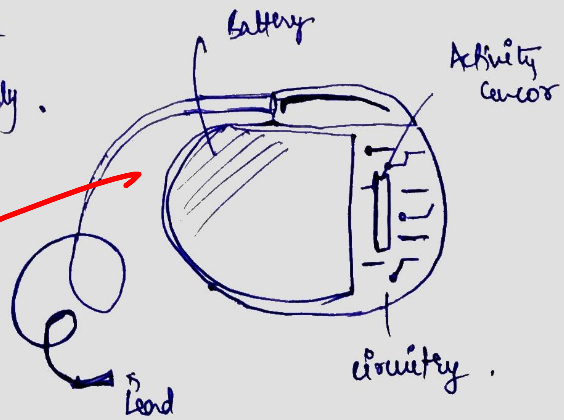
During this, heart may not be able pump enough blood to body.

Housed inside the device:

→ battery, circuitry.

Hermetically sealed:

→ elective replacement.



9 The neuromuscular Junction (NMJ) is a synaptic connection between the terminal end of a ~~terminal~~ motor nerve and a muscle (skeletal/smooth). It is the site for the transmission of action potential from a nerve to the muscle. It is also a site for many diseases and action for pharmacological drugs.

Synaptic transmission at the neuromuscular junction begins when an action potential reaches the presynaptic terminal of neuron, which activates voltage-dependent calcium channels.

10 i) Some international journals publishing papers on Biophysics are:

a) Biophysical Journal, b) Cell, c) International Journal of Biological Sciences, d) PLOS biology
e) Biomedical physics and Engineering Express.

	title	author
ii) a)	Network organisation and dynamics of tubules in endoplasmic reticulum.	Hannah T. perkins, Victoria J. Allan.
b)	Solid-state NMR spectroscopy	Stacey Lium-Paiva
c)	Synthetic tabular molecular transport system.	Pierre Stommer, Henrik Kiefer.
d)	localization atomic force microscopy	George R. Heath, Ekaterina Kots.
e)	Highly accurate Protein structure prediction with AlphaFold.	John Jumper, Richard Evans.