نموذج اجابة لمادة فيزياء حيوية ف٣٢٣

كلية العلوم
قسم :الفيزياء

المادة :فيزياء حيوية phys٣٢٣ تاريخ
الامتحان: ٢٠١٧/١/٢١

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1. A) What are alpha, beta and gamma dispersions. (10 Marks)

The measurement of ε' and ε"as a function of frequency and temperature from, which the dispersion parameters may be deduced. These, in turn, are interpreted in terms of structure. For a biological material this may be quite a complicated procedure due to the possible presence of several dispersion regions which, in some cases, may overlap. There are at least three dispersions (α,β and γ) which occur at Hz , KHz - MHz , and GHz frequency respectively
And the student has to provide figures and illustrating plots

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B) What is the cell membrane function? (6 Marks)

Membrane function's

In animal cells the cell membrane alone establishes a separation between interior and environment, whereas in fungi, bacteria, and plants an additional cell wall forms the outermost boundary. However, the cell wall plays mostly a mechanical support role rather than a role as a selective boundary. One of the key roles of the membrane is to maintain the cell potential. The functions of the cell membrane include, but are not limited to:

- Controlling what goes in and out of the cell.
- Anchoring of the cytoskeleton to provide shape to the cell
- Attaching to the extracellular matrix to help group cells together in the formation of tissues
- Transportation of particles by way of ion pumps, ion channels, and carrier proteins
- Containing receptors that allow chemical messages to pass between cells and systems
- Participation in enzyme activity important in such things as metabolism and immunity

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2. A) Properties of electrodes. (8 Marks)

Properties of electrodes:

An electrode is a conductor through which electric current is passed. Found in variable forms, electrodes may be wires, plates, or rods. An electrode may be constructed of metal, such as copper, silver, lead, or zinc. However, an electrode may also be made of a non-metal substance, such as carbon or glass. The electrode must be a good conductor and when it is used for intracellular recording must be very small in diameter with respect to the cell. There are some problems of electrodes as:

1. They may have a toxic effect (ions from electrodes pass into tissue under the action of current).
2. It is difficult to make them fine in diameter to suit the diameter of the cell, even if it becomes fine it becomes flexible.
3. Polarization effect, as the tow electrodes one of them is connected to the outside of the cell

(+ve) and the other to the inside of the cell (-ve), causing polarization of the

4. 4. Electrolyte, change in chemical equilibrium and a potential is formed over the electrodes,
5. We can avoid the polarization effect of the metal electrode by coating it by a layer of salt of anion which is found in the cell [e.g. Ag with a layer of Agcl] by that method we can convert polarizable electrodes into non polarizable,

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B) Electrode used to measure the action potential. (8 Marks)

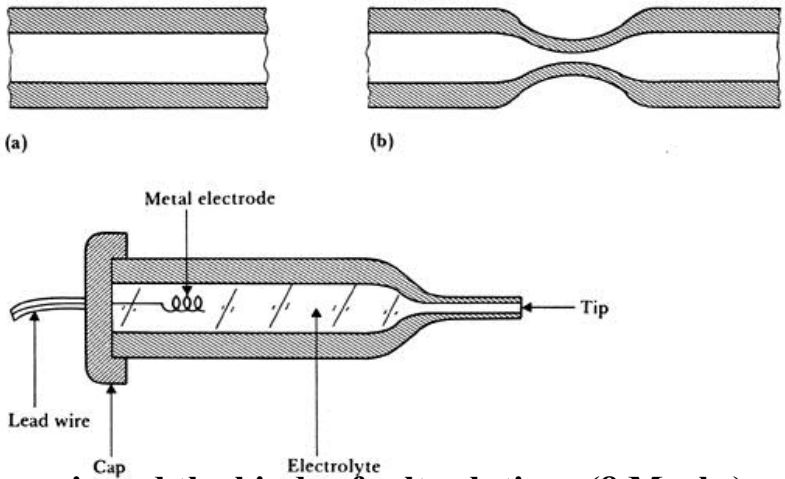
Glass microelectrodes:

Due to the above disadvantages of the metal microelectrodes, glass microelectrodes are now most commonly used for the intracellular stimulation and recording from the living cells and tissues. they are prepared with tip diameter greatly less than 0.1 micron and electric resistance more than 100MΩ.

The glass microelectrodes are in the first stage prepared from Pyrex glass capillary tubes of diameter 1-2mm. this tube is then horded between the two microelectrode puller machine clamps, which was first constructed by Alexander and Nastuk, 1953. This machine is consisted of two clamps one is fixed and the other moves freely by the action of an electromagnet coil. Fig.(3) shows a simple schematic diagram for such machine.

The technique of this machine could be as the follows. At the beginning, a Pyrex glass capillary tube of diameter 1-2mm is holded between the two machine clamps, as shown in Fig.(3). When the machine is started on, the heater begins to heat up the capillary tube. When it gets red, the machine relay system starts to control the current passing in the electromagnet coil in a manner that first to produce a gentle pull proceeded by a strong one. The result is the production of two identical microelectrodes.

The tip diameter of the produced electrodes depends on both the heater temperature and the pulling forces in addition to the initial diameter of the capillary tube.



3. A). The Osmosis and the kinds of salt solutions (8 Marks)

Osmosis and kinds of solutions

Osmosis is a special term used for the diffusion of water through cell membranes. Although water is a polar molecule, it is able to pass through the lipid bilayer of the plasma membrane. Transmembrane proteins that form hydrophilic channels accelerate the process, but even without these, water is still able to get through

Water passes by diffusion from a region of higher to a region of lower concentration. Note that this refers to the concentration of water, NOT the concentration of any solutes present in the water.

Water is never transported actively; that is, it never moves against its concentration gradient. However, the concentration of water can be altered by the active transport of solutes and in this way the movement of water in and out of the cell can be controlled.

Example: the reabsorption of water from the kidney tubules back into the blood depends on the water following behind the active transport of Na^+.

Hypotonic solutions

If the concentration of water in the medium surrounding a cell is greater than that of the cytosol, the medium is said to be **hypotonic**. Water enters the cell by osmosis, as in fig.(8-a) a red blood cell placed in a hypotonic solution (e.g., pure water) bursts immediately ("hemolysis") from the influx of water.

Plant cells and bacterial cells avoid bursting in hypotonic surroundings by their strong cell walls. These allow the buildup of **turgor** within the cell. When the turgor pressure equals the osmotic pressure, osmosis ceases.

Hypertonic solutions

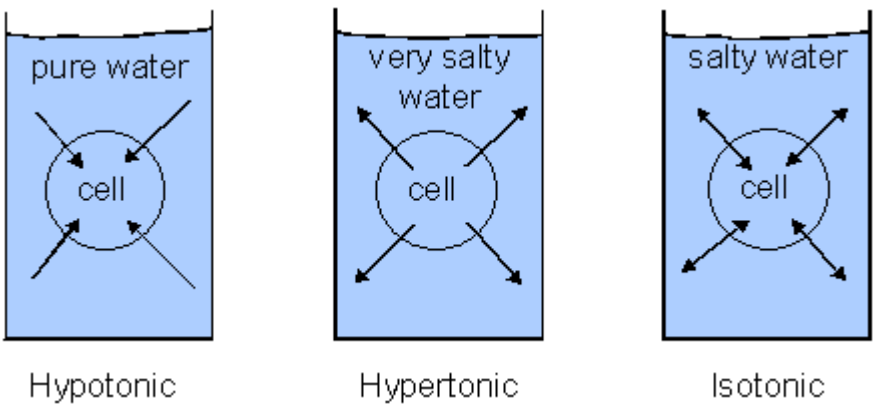
If red cells are placed in sea water (about 3% salt), they lose water by osmosis and the cells shrivel up. Sea water is **hypertonic** to their cytosol

Similarly, if a plant tissue is placed in sea water, the cell contents shrink away from the rigid cell wall. This is called **plasmolysis**.

Sea water is also hypertonic to the ECF of most marine vertebrates. To avoid fatal dehydration, these animals (e.g., bony fishes like the cod) must continuously drink sea water and then desalt it by pumping ions out of their gills by active transport. (Marine reptiles — turtles and snakes — use special salt glands for the same purpose.)

Isotonic solutions

When red blood cells are placed in a 0.9% salt solution, they neither gain nor lose water by osmosis as in Such a solution is said to be **isotonic**.



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B) The genetic effects of radiation. (8 Marks)

Genetic Effects of Radiation:

We saw earlier that if the chromosome of a cell gets permanently damaged, it can lead to genetic changes. If the exposed cell is related to reproduction, the damage to its DNA can lead to developmental problems in the offspring of the person. Such cell changes are generally termed as germline mutations and do not affect the exposed person. The hazards associated with germline mutations range from premature death and miscarriage to cancer in later life.

A number of studies have been performed to determine the probability of damage due to germline mutations. Since it is difficult to determine whether a germline mutation in an individual has occurred or not, these studies have largely been based on finding the correlation of dose received by radiation workers and the genetic disorders in their children. Fortunately up until now, no conclusive evidence of strong correlation between the exposure and childbirth defects has been found. However a few studies have indicated that the occurrence of leukemia on the children whose fathers received occupational exposures was about 2 to 2.5 times higher than in general population. Unfortunately these studies have suffered from low statistics, that is, the number of individuals available for analysis was fairly small. Because of this, many researchers do not regard this inference as conclusive evidence of leukemia occurrence in children. It should, however, be mentioned that the type of exposure to father has also been found to be important in this regard. The internal exposure to radionuclides is considered as a high risk cause of childhood cancer as opposed to whole body exposure.

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4. A) Facilitated diffusion methods (8 Marks)

Facilitated Diffusion:

Unlike simple diffusion, facilitated diffusion involves a limited number of carrier proteins. At low concentrations, molecules pass through the carrier proteins in a way similar to that of simple diffusion. At high solute concentrations, however, all the proteins are occupied with the diffusing molecules. Increasing the solute concentration further will not change the rate of diffusion. There are three gated channels:

1-Ligand-gated channels:

Ligand-gated channels also referred to as ion tropic receptors or channel-linked receptors, are a group of trans-membrane ion channels that are opened or closed in response to the binding of a chemical messenger (i.e., a ligand), such as a neurotransmitter. The binding site of endogenous ligands on LGICs protein complexes are normally located on a different portion of the protein (an allosteric binding site) compared to where the ion conduction pore is located. The direct link between ligand binding and opening or closing of the ion channel, which is characteristic of ligand-gated ion channels, is contrasted with the indirect function of metabotropic receptors as in fig.(4), which use second messengers. Ligand-gated ion channels are also different from voltage-gated ion channels (which open and close depending on membrane potential), and stretch-activated ion channels (which open and close depending on mechanical deformation of the cell membrane).

2-The mechanically –gated ion channels:

The Mechanically –gated ion channels apply sound waves for bending the cilia –like projections on the hair cells of the inner ear to open up ion channels leading to the creation of nerve impulses that the brain interprets as sound. Mechanical deformation of the cells of stretch receptors opens ions channels leading to the creation of nerve impulses is also an example of the mechanically –gated ion channels.

3-The Voltage –gated ion channels:

The voltage –gated ion channels open or close in response to the charges that is the difference in potential across the plasma membrane. Thus, an impulse passes down a neuron cases the reduction in the voltage opens sodium channels in the adjacent portion of the membrane. this allows the influx of Na^+ into the neuron and thus the continuation of nerve impulse. The increase of Na^+ inside the neuron depolarizes it and consequently opens the K^+ channels to repolarize the neuron again.

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B) Ionizing radiation. (8 Marks)

ionizing radiation?

The special bulbs called ``black lights" produce a lot of UV and were used by hospitals to kill bacteria, amoebas, and other micro-organisms. X-rays are produced by very hot things in space. X-rays have more energy than UV, so they can pass through skin, muscles, and organs. They are blocked by bones, so when the doctor takes your X-ray, the picture that results is the shadow image of the X-rays that passed through your body. Because X-rays have such high energy, they can damage or kill cells. A few brief exposures to low-intensity X-rays are okay. The X-ray technician would be exposed to thousands of X-ray exposures if s/he did not use some sort of shielding. Gamma rays are the most energetic form of electromagnetic radiation and are produced in nuclear reactions. For example:

X-ray:

X-radiation (composed of X-rays) is a form of electromagnetic radiation. X-rays have a wavelength in the range of 10 to 0.01 nanometers, corresponding to frequencies in the range 30 peta hertz to 30 exa hertz (3 × 1016 Hz to 3 × 1019 Hz) and energies in the range 120 eV to 120 keV. They are shorter in wavelength than UV rays. In many languages, X-radiation is called Röntgen radiation after Wilhelm Conrad Röntgen, who is generally credited as their discoverer, and who had called them X-rays to signify an unknown type of radiation.

X-rays can penetrate solid objects, and their largest use is to take images of the inside of objects in diagnostic radiography and crystallography. As a result, the term X-ray is metonymically used to refer to a radiographic image produced using this method, in addition to the method itself. X-rays are a form of ionizing radiation, and exposure to them can be a health hazard