Model Answer

AU-7005

B.Sc I Semester (Rural Technology) - 2014.

Cell Biology : RTB-106

Section - A.

Multiple choice question

(i) (a) Robert Hook

(ii) (c) Bacteria

(iii) (a) Cristae

(iv) (d) Mitochondria

(v) (d) All of them

(vi) (c) Pachytene

(vii) (b) Balbiani (1881)

(viii) (c) Kornberg and Thomas

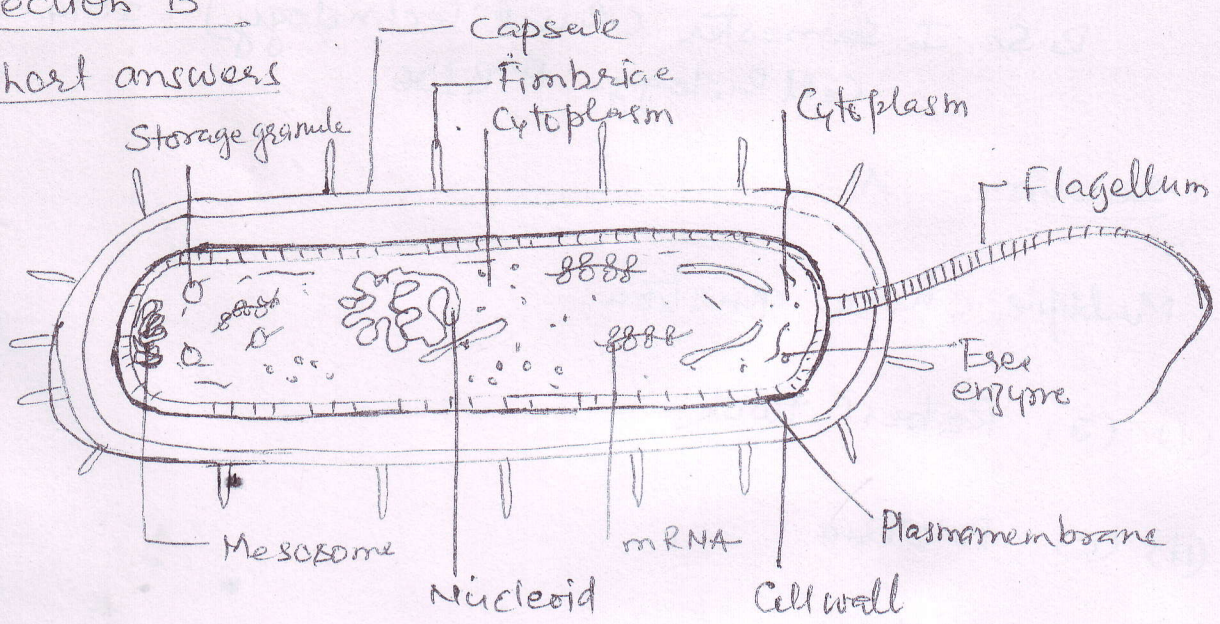
(ix) (d) Guanine

(x) (d) Retroviruses

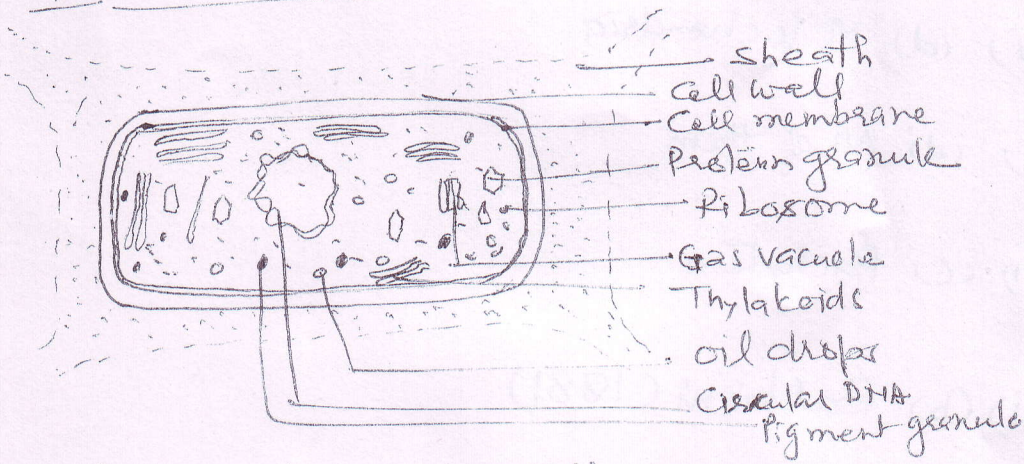
Section B

Short answers

2.



A. Bacterial Cell



B. Cyanobacterial Cell

Diagram of Prokaryotic Cells

Ans. 3. Functions and Biological significance of Plasmamembrane.

1. Transport of water across membrane.
2. Transport of molecules and ions.
3. It forms a protective layer around protoplasm of the cell.
4. It maintains the ionic equilibrium between a cell and its external environment.

5. It also help in the excretion of waste products.
6. Many phenomena like pinocytosis, phagocytosis and movement in protozoans take place with the help of plasma membrane.
7. The infolding in the plasma membrane help in cellular respiration in prokaryotes.
8. Due to presence of many enzymes on its surface it helps in cellular metabolism.
9. Due to presence of membranes, cell organelles are able to remain apart from each other.
10. It functions as a selective barrier and check the inflow of undesired substances inside the cell.

Ans 4. Structure and functions of nucleolus:

Nucleolus: It is discovered by Fontana (1781) and the term nucleolus was coined by Bowman (1840). The size of nucleolus is comparatively larger in those cells which have rapid rate of protein synthesis. It is granular, naked and large organelle without limiting membrane.
On the basis of electron microscopic studies, it contain four parts.

(i) Fibrillar regions (ii) Granular regions
(iii) Protein region (iv) Chromatid part

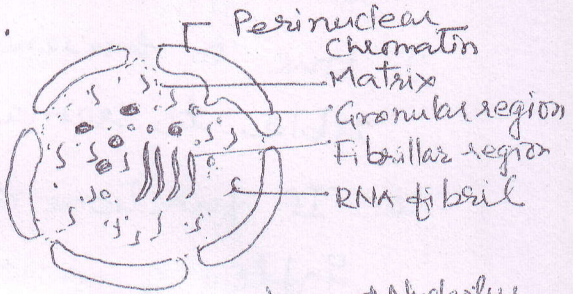
(i) Fibrillar regions: It is made up of ribonucleo-protein fibres. Each fibre has a length of around

50-80 Å. It is also called nucleolemma.

(ii) Granular region: This part is made up of granule, each having the diameter of 150-200 Å. These granules are also ribonucleoproteins.

(iii) Protein region: This is the fluidy part of nucleolus. It is also called parsamorpha.

(iv) Chromatin part: It is made up of chromatin fibres containing DNA. These DNA molecules function as template for RNA synthesis.



Ultrastructure of Nucleolus

Functions of Nucleolus

(i) They site of RNA synthesis
(ii) It store rRNA
(iii) It helps in biogenesis of ribosome
(iv) It helps in the formation of spindle fibre.

Ans 5. Importance of Mitosis:

1. It is a means of ~~mul~~ multiplying the number of somatic cells which is essential for organisation and multiplication of unicellular and multicellular organisms.
2. It keeps the chromosome number constant in all the cell of individuals of a species. It also provide genetic stability to them.
3. It provides new cells for repair and regeneration of lost or damaged parts or organs and healing of wounds.
4. It helps in asexual reproduction by fragmentation, budding ~~ex~~ etc.
5. Somatic variations produced during mitosis when maintained by vegetative propagation can play important role in speciation.
6. It ascertains the equal distribution of chromosomes and genes on them into all the daughter cells.

Ans 6.

Salivary gland chromosome

Polytene chromosomes were first discovered by Balbiani.

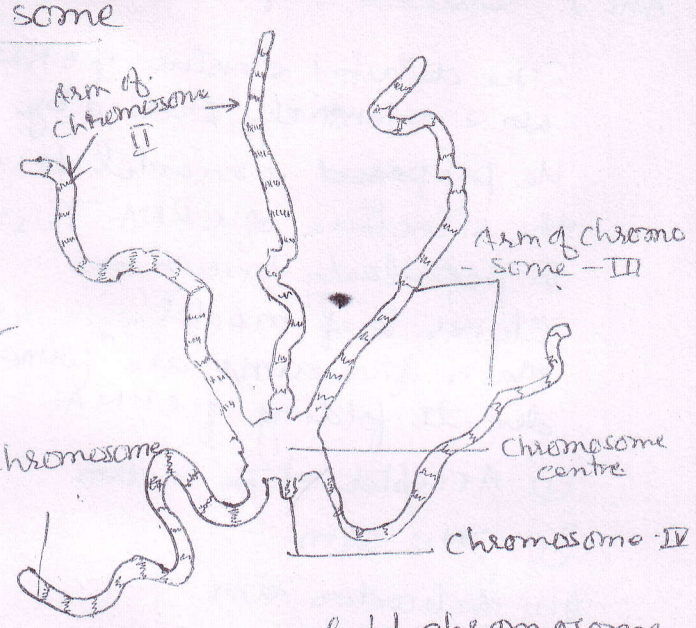
These chromosomes are commonly found in salivary glands cells of insects of the Class Diptera.

Ex. Drosophila, Chironomus

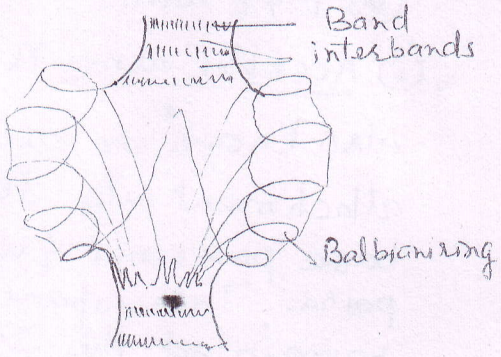
Size ranges from 50 to 200 times larger than the normal Chromosome and may have the length of 2000 μ.

This chromosome appear in the form of five long and one short arm from a deeply staining and more or less amorphous structure called chromocentre.

The chromocentre is formed by fusion of centromeric regions of all the chromosomes and in male entire 'Y' chromosome.



Salivary gland chromosome



Puff

The short arm represents the IV pair of chromosome.

One long arm is XX pair (in female) or X chromosome (in male). Four other long arms are two arms of each II and III chromosomal pair.

Salivary gland chromosomes contain several dark staining regions called bands, which are separated by relatively light staining interband regions.

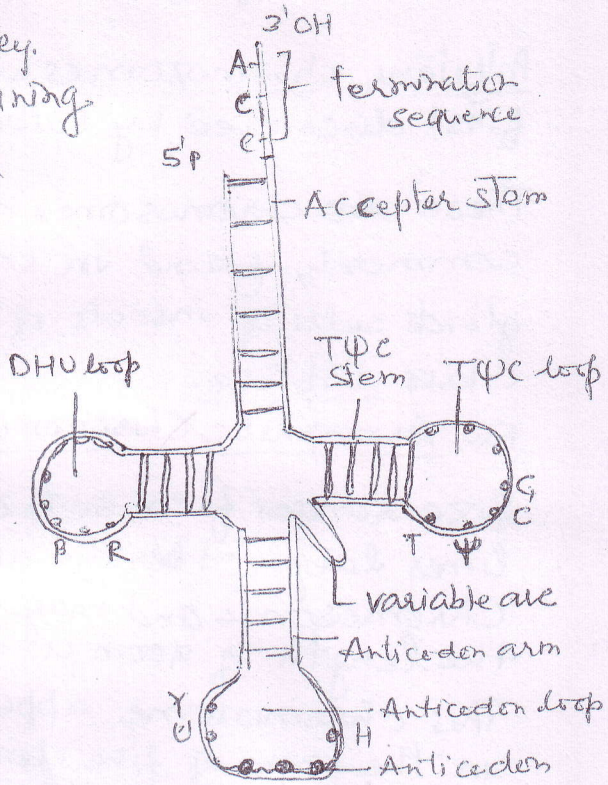
The each polytene chromosome is composed of numerous strands, each strand represenring one chromatid. All the chromatids of a chromosome are produced due to the process of endo-reduplication.

Bands occasionally greatly increase in size and form puff or ring-like structure called Balbiani ring.

Ans. 7. Clover leaf model of tRNA:

The detailed structure of tRNA was extensively studied by R. Holley. He proposed a model for explaining the structure of tRNA. This model is popularly known as 'clover leaf model'. Main five arms are formed due to folding of tRNA.

(i) Accepter stem or arm
(ii) DHU arm
(iii) Anticodon arm
(iv) Variable arm
(v) TψC arm.



Diagrammatic representation of tRNA (Clover leaf model)

(i) Accepter arm: This arm is also known as amino acid attachment site. It has 7 paired base pairs and 4 unpaired base pairs. The unpaired base pairs remain at the 3'end. CCA sequence is essentially found at 3'end. The 5'end has either terminal G or C.

(ii) DHU arm: It is made up of 15-18 nucleotide and consists of two parts. One part is stem which have 3-4 paired base. Another part is loop. It consist 7-11 unpaired nucleotide. It has modified nucleotide, dihydroxy uridine (DHU) in high proportion. A part of DHU loop function is recognition amino acid activating enzyme.

(iii) Anticodon arm: It faces opposite to the accepter arm. It has an anticodon stem and an anticodon loop. The anticodon stem has 5 base pairs while the anticodon loop has 7 unpaired nucleotide. The three nucleotide in the middle of loop constitute the anticodon. These anticodon identifies the codon on mRNA chains.

(iv) Variable arm: This arm lacks stem. It may contain small loop having 4-5 nucleotides or larger loop with 13-21 nucleotides. Larger loop may have stem.

(v) TψC arm: This arm has a stem having 5 base pairs and a loop of 7 nucleotide. In the outer region of stem there is G≡C base pair. The loop has a TψC sequence. This further has G-T-ψ-R-A sequence. This loop binds with the ribosome during translation hencefarth known as ribosome binding loop.

Function of tRNA:

Transfer RNA are specific to amino acids and mainly function in the transfer of activated amino acid molecules to the protein synthesizing site, the mRNA - ribosome complex.

Section - C

Long Answers

Ans. 8. The nucleic acid was discovered by Friedrich Miescher (1869) from pus cells. This was isolated from nuclei of pus cells hencefarth, named by him as 'nuclein'. Later on, he also isolated the compound from sperms.

Zacharias (1881) proved that nuclein is associated with chromatin which is found in all eukaryotic nuclei. Due to its acidic nature Altman (1899) named the chemical compound nuclein as nucleic acid. This can be defined in the light of modern researches as:

"The chemical compound present in all the living organisms which is made up of C, H, O, N and P and is the polymer of nucleotides, carry out heredity characters from generation to generation and also perform some other functions in cellular metabolism is known as the nucleic acid."

Chemical composition of Nucleic acid:

Chemically, nucleic acid is the polymer of nucleotide. In a nucleic acid molecule, all the nucleotide units (monomers) are in the form of a long chain.

Nucleotide: Each nucleotide is made up of a nucleosides and a phosphate group. Each nucleoside is in turn consists of a pentose sugar and a nitrogenous base. The pentose sugar is the ribose sugar in case of RNA (ribose nucleic acid) and deoxyribose sugar in case of DNA (deoxyribose nucleic acid).

Nucleoside: It is made up of nitrogenous bases and pentose sugar.

Nitrogenous bases: Generally, two types of nitrogenous bases are found in nucleic acids.

(i) Purines (ii) Pyrimidines.

(i) Purines: These are two ring nitrogenous bases which are again of two types (i) Adenine (ii) Guanine

One ring of the two purines (A and G) is the six membered while another ring is five membered.

(ii) Pyrimidines: These nitrogenous bases consisting of single ring of carbon atoms. Pyrimidines may be of following three types:

(i) Cytosine (ii) Thymine and (iii) Uracil.

Out of three pyrimidines cytosine and thymine are found in DNA while cytosine and uracil are found in RNA.

Functions of Nucleic acid.

(i) DNA is the universal genetic material in all organism except some viruses where RNA is the genetic material

(ii) Nucleic acid controls and regulates all the biochemical mechanisms taking place within a cell as proteins and enzymes are synthesized through DNA.

(iii) Different RNAs (mRNA, tRNA, rRNA) function as structural component of a cells.

(iv) Nucleic acid (Rasmi) hereditary characters from generation to generation of a species.

Ans. 9. Structure and function of Lisosome

Lysosomes were discovered by Christian de Duve (1955).

occurrence: Absent in prokaryotes and present in all eukaryotes except mature RBCs, some fungi like yeasts, Neurospora.

Shape: These are spherical in shape but sometimes irregularly shaped.

Size: 0.2 to .8 μ

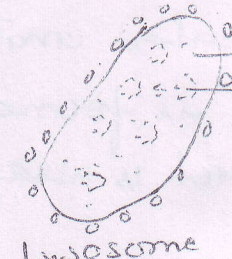
Structure: Lysosomes consists of following two parts:

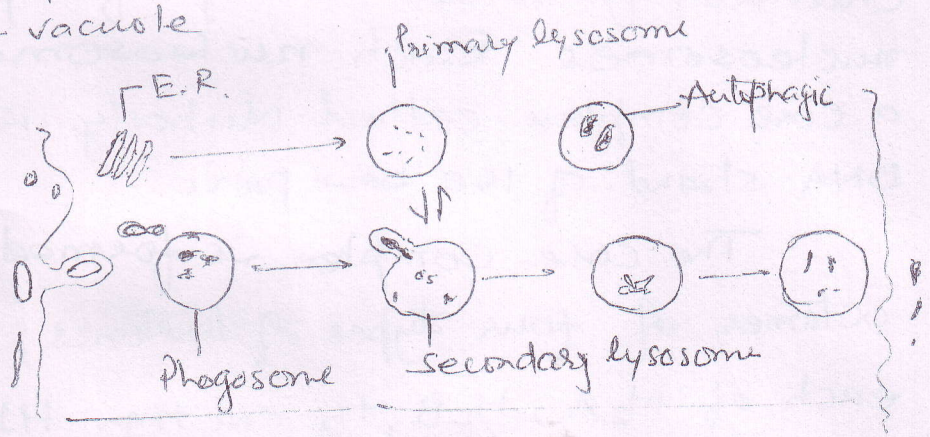
(i) Limiting membrane (ii) Matrix

(i) Limiting membrane: It is outer single layered lipoproteinous and trilaminar unit membrane which encircles the enzymes present inside.

(ii) Matrix: It is inner, finely granular and highly heterogenous ground substance inside the membrane. In each lysosome the matrix contains almost 24 types of digestive enzymes like proteases, glucocidase, ribonuclease, phosphatase etc.

Whenever the lysosomal membrane bursts and the matrix come out, the intracellular substances like proteins, carbohydrates, nucleic acid etc. get digested by enzymes. All theses results into death of lysosome, therefore Lysosomes are called "suicidal bags of the cell."





Origin of different types of lysosomes.

Types of lysosome: On the basis of the nature of matrix and functions, lysosomes may of following four types.

(i) Primary lysosome
(ii) Secondary lysosome
(iii) Residual body of lysosome
(iv) Autophagic (lysosomes) vacuoles.

Functions: It perform following functions.

(i) Heterophagy :- Digestion of exogenous materials which are engulfed by cells by phagocytosis.

(ii) Autophagy: Digestion of feed material stored inside the cell.

(iii) Dead cells inside the body are removed by lysosome

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10. Nucleosome:

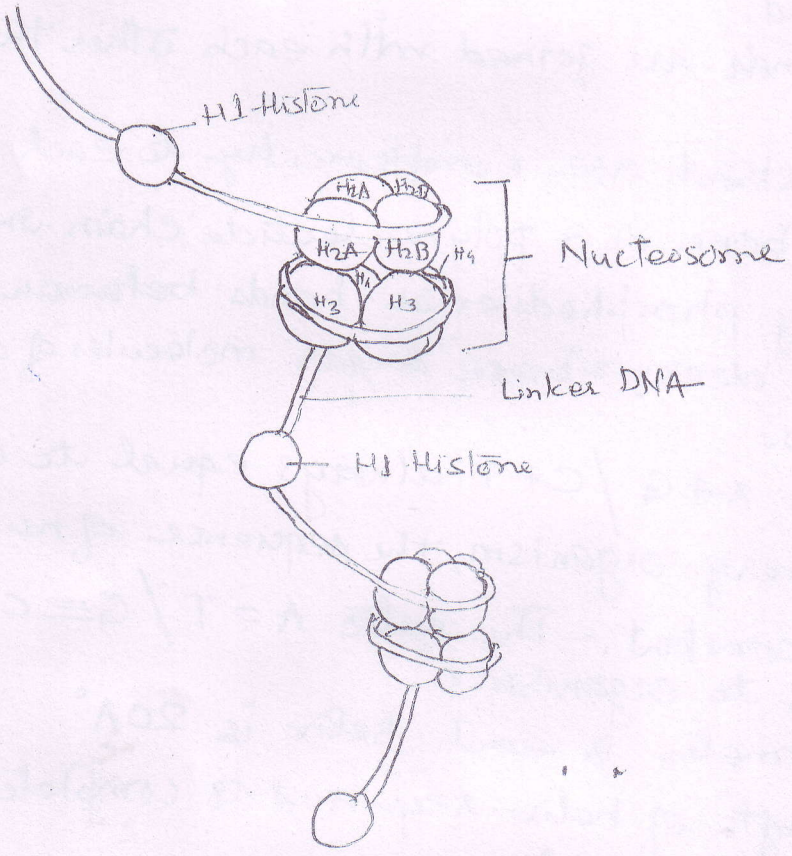
For explaining the ultrastructure of chromatin under electron microscope, a nucleosome model has been proposed by Kornberg and Thomas (1974). Chromatin fibre is made up of repeated units called nucleosomes. Each nucleosome is formed of a core complex called Nubody which is wrapped by DNA strand of 166 base pairs.

The core complex is formed of a histone octamer of four types of histones; two molecules each of H_2A, H_2B, H_3 and H_4. H1 molecules do not form part of the octamer. It helps in grouping of nucleosome and is not passed from generation to generation.

Nucleosome is a disc like structure: 11 nm in diameter and 6 nm in height.

A DNA segment of 200 base pairs is wrap around the octamer, making 1 3/4 turn. This segment of DNA in chromatin fiber is nuclease resistant.

Two nucleosome units are joined with a segment of DNA which is called linker DNA. It consist of 50-70 base pairs. H1 histone is associated with this linker DNA which makes a connection between two adjacent nucleosomes.

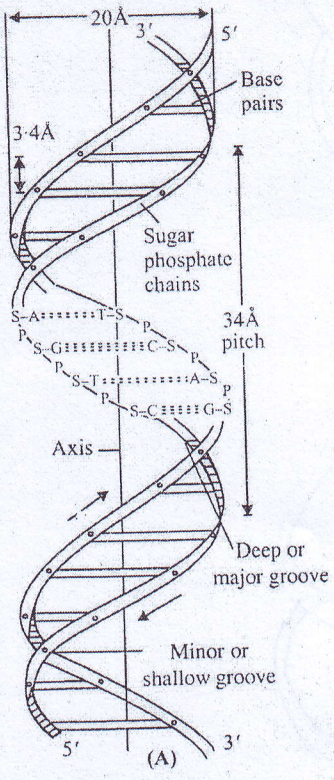


Nucleosome and linker DNA

Ans 11 Watson and Crick Model of DNA

On the basis of their studies related to x-ray crystallography of DNA, Watson and Crick (1953) gave a model of DNA explaining its secondary structure.
Main features of DNA model is given below.

1. DNA is made up of two strands of polynucleotides which coil around each other forming a helical structure.
2. The two chains of polynucleotides are completely unbranched
3. The two chains of polynucleotides are antiparallel to each other. i.e. 3' end of one strand remains with 5' end of the other at one end of the DNA and vice-versa at the other end.
4. Both strands are joined with each other through Hydrogen bonds.
5. The both strands are complementary to each other.
6. The back bone of a polynucleatide chain in DNA is formed by phosphodiester bonds between phosphoric acid and deoxyribose sugar molecules of adjacent nucleotides.
7. The ratio A+G / C+T always equal to one.
8. In every organism, the sequence of nucleotides in DNA is constant. The ratio A=T / G≡C is also specific to organisms.
9. The diameter is each helix is 20A°
10. The length of helix required to complete turn (a pitch) is 34°A.
11. In each helix 10 base pairs are present i.e. each pitch contains 10 base paires. It means the distance between two base pairs in a pitch is equal to 34/10 = 3.4 A°.
12. Each pitch of DNA has two major and two minor groove.



Watson and Crick Model of DNA