



# **MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2018/2019 ACADEMIC YEAR**

**FOURTH YEAR FIRST SEMESTER  
EXAMINATIONS  
FOR  
THE DEGREE OF BACHELOR OF SCIENCE AND  
BACHELOR OF EDUCATION (SCIENCE)**

**COURSE CODE: BOT 416  
COURSE TITLE: PLANT CELL BIOLOGY**

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**DATE: 10<sup>TH</sup> DECEMBER 2018**

**TIME: 1430 - 1630 HRS**

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## **INSTRUCTIONS**

Answer **ALL** questions in section **A** and any other **TWO** questions in section **B**. Illustrate your answers with diagrams and give examples where appropriate.

## **SECTION A: ANSWER ALL QUESTIONS (30 MARKS)**

1. State the tenets of the modern cell theory. **(3 marks)**
2. Explain the role of plasmodesmata in water absorption. **(3 marks)**
3. Describe the role of ribosomes in a plant cell. **(3 marks)**
4. Explain how the endoplasmic reticulum can also be isolated mechanically with the help of a centrifuge. **(3 marks)**
5. Using a clearly labeled diagram, describe the “Fluid Mosaic Model” of a plasma membrane. **(3 marks)**
6. Describe the role of peroxisomes in photorespiration. **(3 marks)**
7. Explain how the Golgi apparatus structure reflect its function. **(3 marks)**
8. Describe any three basic mechanisms that cells use to communicate. **(3 marks)**
9. Explain why mitochondria are the “power plants” of the cell. **(3 marks)**
10. Comment on the significance of discovery of the nucleus. **(3 marks)**

## **SECTION B: ANSWER ANY OTHER TWO QUESTIONS (40 MARKS)**

11. Describe in details the techniques used in studying plant cells. **(20 marks)**
12. Write an essay on what plant cell biology is and its objectives. **(20 marks)**
13. Write an essay on “chloroplast and photosynthesis.” **(20marks)**
14. Discuss the mechanisms of cell membrane transport. **(20 marks)**

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## MARKING SCHEME (30 MARKS)

**1. State the tenets of the modern cell theory. (1x3 marks; well explained)**

- all living organisms are composed of one or more cells.
- The cell is the basic unit of structure and organization in organisms.
- Cells arise from pre-existing cells

**2. Explain the role of plasmodesmata in water absorption. (1x3 marks)**

- Soil water enters the root through its epidermis. It appears that water then travels in both the cytoplasm of root cells — called the symplast — that is, it crosses the plasma membrane and then passes from cell to cell through plasmodesmata.
- in the nonliving parts of the root — called the apoplast — that is, in the spaces between the cells and in the cells walls themselves. This water has not crossed a plasma membrane.
- However, the inner boundary of the cortex, the endodermis, is impervious to water because of a band of lignified matrix called the casparian strip. Therefore, to enter the stele, apoplastic water must enter the symplast of the endodermal cells. From here it can pass by plasmodesmata into the cells of the stele.

**3. Describe the role of ribosomes in a plant cell. (1x3 marks)**

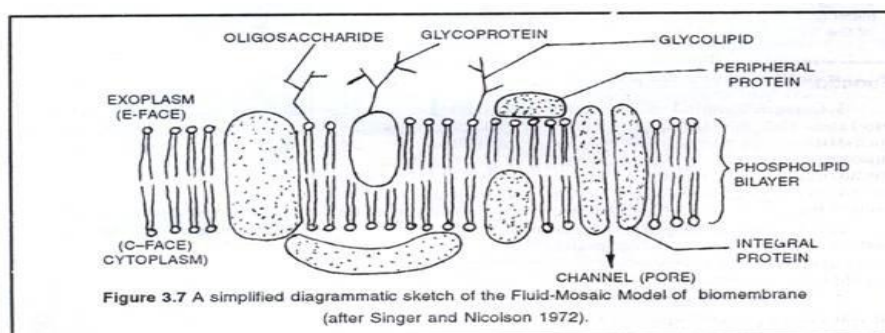
- The act of protein synthesis, initiated and completed by ribosomes, requires several key catalysts and actors, including the fundamental agent called mRNA.
- Ribosomes launch the protein synthesis process by translating mRNA into specific amino acid chains.
- Ribosomes direct the proteins to their new cell locations and encode them to perform specific functions. In addition to sending out proteins, ribosomes dictate cell size and shape.

**4. (1x3 marks)**

- to isolate ER membranes, aleurone layers are homogenized, filtered through cheesecloth to remove the extracellular matrix, and then centrifuged to remove the large organelles. The supernatant is then centrifuged on a discontinuous sucrose density gradient consisting

**5. Using a clearly labeled diagram, describe the “Fluid Mosaic Model” of a plasma membrane. (1 mark explanation; 2 marks diagram)**

- The fluid mosaic model of the plasma membrane describes the plasma membrane as a fluid combination of phospholipids, cholesterol, and proteins.
- Carbohydrates attached to lipids (glycolipids) and to proteins (glycoproteins) extend from the outward-facing surface of the membrane.



**6. Describe the role of peroxisomes in photorespiration. (1x3 marks)**

- Glycolate is transported out of the chloroplast and into nearby peroxisomes.
- Peroxisomal oxidase converts glycolate to glyoxylate, and hydrogen peroxide is produced as a by-product.
- Because hydrogen peroxide is toxic, it is quickly converted by a catalase to water and oxygen.

**7. Explain how the Golgi apparatus structure reflect its function. (1x3 marks)**

Although Golgi bodies **differ** somewhat in organization from one type of tissue or cell to another, they characteristically take the form of a stack of flattened, oval *cisternae* surrounded at their circumferential edges and above and below by *vesicles* and *tubular structures*

**8. (1x3 marks)**

- Direct Contact When cells are very close to one another, some of the molecules on the cells' plasma membranes may bind together in specific ways.
- Paracrine Signaling Signal molecules released by cells can diffuse through the extracellular fluid to other cells.
- Endocrine Signaling If a released signal molecule remains in the extracellular fluid, it may enter the organism's circulatory system and travel widely throughout the body.
- Synaptic Signaling the long, fiberlike extensions of nerve cells release neurotransmitters from their tips very close to the target cells

**9. Explain why mitochondria are the "power plants" of the cell.**

**(3 marks)**

- mitochondria are best known as the cell's power plants: they use complex biochemical reactions involving oxygen to extract energy from glucose and fats.
- This energy is then used to fuel the cell's vital activities and meet its various demands.

**10. Comment on the discovery of the nucleus. (1x3 marks)**

- The term cell nucleus was used by Robert Brown for the first time in 1831 in a paper to the Linnean Society and it was published in 1833.
- At the time of publishing he did not realize that cell nucleus was present in cells other than those belonging to plants.
- During his stay in Australia Brown studied nearly 1700 plant species and other notable observations include the identification of naked ovule of the gymnospermae.

**SECTION B: ANSWER ANY OTHER TWO QUESTIONS (40 MARKS)**

**11. Describe in details the techniques used in studying plant cells.**

**(10x2 marks)**

- Cytochemistry
- Cell Fractionation and Centrifugation
- Cytophotometry and Cytofluorometry
- Autoradiography
- Immunofluorescence
- X-ray Diffraction
- Cell Culture
- Microscopy
- Two main types of microscopes: Light and Electron

**12. Write an essay on what plant cell biology is and its objectives. (15X1 marks; Introduction 5mks)**

- It provides an understanding of the unique features of plant cells and of the cellular mechanisms that allow plants to interact with their environment.
- Responses at the cellular level to important environmental problems encountered worldwide are discussed and the mechanisms plants use to adapt and survive are covered.
- The application of modern techniques in cell biology is included and so this module is also of value to those with a broad interest in cell biology.
- Using the information gathered from lectures, discussion sessions and extended reading you should:
- have knowledge of the properties, components and functions of the plasma membrane and endomembrane systems of plant cells
- be familiar with the main techniques used to isolate and purify cell components and to investigate the properties of certain plant cell organelles, plant cell membranes and their components
- be familiar with the properties, functions and location in cells of a range of membrane transport systems including, where appropriate, the mechanisms which generate the driving forces for solute transport
- understand the properties and function of the plant cell vacuole
- be conversant with semi-autonomy of chloroplasts and understand chloroplast assembly, including coordination between chloroplast and cytoplasmic protein synthesis

- understand the mechanisms involved in the targeting and transport of proteins across organelle membranes
- understand the basic principles of signal transduction processes in plants including the nature and roles of signal receptors
- be familiar with the mechanisms involved in signal perception, and in signal generation and transmission
- have a basic knowledge of how plants respond to heavy metal stress, including mechanisms of heavy metal homeostasis
- have a basic knowledge of how plants respond to salt stress
- understand the cellular processes that may be sensitive to changes in the gaseous environment, particularly ozone
- be able to find and critically assess published information on a given topic
- have had practice in verbal and written presentation of scientific information.

**13. Write an essay on “chloroplast and photosynthesis.” (8x2 marks; introduction 4marks)**

- The energy of sunlight striking chlorophyll causes chloroplasts to synthesize sugars, starches and free oxygen.
- Plants and animals take advantage of these sugars for food and energy, while animals use oxygen for survival.
- The stroma of chloroplasts produces carbon fixation reactions known as "dark reactions," while the thylakoids contain chlorophyll in their membranes.
- The stroma contains various enzymes that carry out reactions using ATP, NADPH and carbon dioxide that lead to the formation of sugars, which are stored as starch and used either in respiration or in cellulose production.
- Thylakoids are arranged into a stack called a granum, and several grana are connected by stromal lamellae.
- The lamellae maintain the integrity of the chloroplast by keeping a safe distance between the grana, and they increase the efficiency of the organelle.
- The main pigment that converts light energy into chemical energy is chlorophyll a.
- The other pigments are chlorophyll b, carotene and xanthophyll.

**14. Discuss methods of cell membrane transport. (10x2 marks)**

- There are 3 types of transport in cells:
- Passive Transport: does not use the cell's energy in bringing materials in & out of the cell
- Active Transport: does use the cell's energy in bringing materials in & out of the cell
- Bulk Transport: involves the cell making membrane bound vesicles to bring materials in & out of the cell
- There are 3 types of passive transport:
- Diffusion: involves small or uncharged molecules entering & leaving the cell
- Osmosis: involves water entering & leaving the cell
- Facilitated Diffusion: involves large or charged molecules that need a protein helper to get in & out of the cell
- Bulk Transport The last kind of cell transport is bulk transport. Bulk transport involves the cell membrane making vesicles to bring materials in and out of the cell. There are two kinds of bulk transport:
- Exocytosis: moving materials OUT of the cell.
- Endocytosis: moving materials INTO the cell. There are 2 types of endocytosis:
- Pinocytosis: bringing small molecules or liquids into the cell
- Phagocytosis: bringing large molecules into the cell