



# KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF  
SCIENCE IN BIOCHEMISTRY AND BIOTECHNOLOGY

**SBC 203: BIOMEMBRANES AND SUBCELLULAR ORGANELLES**

DATE: MONDAY, 26<sup>TH</sup> MARCH 2012

TIME: 11.00 A.M. – 1.00 P.M.

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**SECTION A: Answer all 20 questions (each question is 1 mark)**

1. The component of the cell membrane primarily responsible for its functionality is the:
  - A. Phospholipid
  - B. Cholesterol
  - C. Fatty acid
  - D. Protein
2. Based on your knowledge of the cell membrane's chemistry, where would steroid hormones most likely interact with their target cell?
  - A. Through interaction with an integral membrane protein
  - B. Inside the target cell's cytoplasm or nucleus
  - C. Steroid hormones don't interact with target cells
  - D. On the exterior surface of the cell
3. Peripheral membrane proteins:
  - A. Are generally noncovalently bound to membrane lipids.
  - B. Are usually denatured when released from membranes.
  - C. Can be released from membranes only by treatment with detergent(s).
  - D. May have functional units on both sides of the membrane.
  - E. Penetrate deeply into the lipid bilayer.

4. Which of these statements about the composition of biological membranes is false?
- A. In a given eukaryotic cell type (e.g., a hepatocyte), all intracellular membranes have essentially the same complement of lipids and proteins.
  - B. The carbohydrate found in membranes is virtually all part of either glycolipids or glycoproteins.
  - C. The plasma membranes of the cells of vertebrate animals contain more cholesterol than the mitochondrial membranes.
  - D. The ratio of lipid to protein varies widely among cell types in a single organism.
  - E. Triacylglycerols are not commonly found in membranes
5. The fluidity of the lipid side chains in the interior of a bilayer is generally increased by:
- A. Decrease in temperature.
  - B. Increase in fatty acyl chain length.
  - C. Increase in the number of double bonds in fatty acids.
  - D. Increase in the percentage of phosphatidyl ethanolamine
  - E. Binding of water to the fatty acyl side chains.
6. Water soluble molecular aggregates of lipids are known as
- A. Lipid bilayer
  - B. Micelle
  - C. Colloids
  - D. Liposome
7. Glucose transport into erythrocytes is an example of:
- A. Active transport.
  - B. Antiport.
  - C. Electrogenicuniport
  - D. Facilitated diffusion.
  - Symport.
8. The type of membrane transport that uses ion gradients as the energy source is:
- A. Facilitated diffusion
  - B. Passive transport.
  - C. Primary active transport.
  - D. Secondary active transport.
  - E. Simple diffusion.

9. A glycoprotein destined for secretion from the cell would move through the Golgi complex in this sequence:
- A. Cis face to medial region to trans face
  - B. Trans face to cis face to medial region
  - C. Trans face to medial region to cis face
  - D. Cis face to trans face to medial region
  - E. Medial face to trans face to cis face
10. Alcohol consumption adversely affects the digestion of proteins within liver cells, which can eventually lead to liver damage. Given this information, which organelle in liver cells is most directly affected?
- A. Nucleus
  - B. Golgi apparatus
  - C. Rough endoplasmic reticulum
  - D. Lysosome
11. Organized clathrin structures are typically associated with
- A. Nuclear envelope and endoplasmic reticulum
  - B. Trans-Golgi network and plasma membrane
  - C. Lysosome
  - D. Inner membrane complexes of mitochondria and chloroplasts
  - E. Extracellular matrix
12. Which of the following best supports the endosymbiotic theory of the evolutionary origin of mitochondria?
- A. Mitochondria, chloroplasts, and prokaryotes contain electron carriers.
  - B. Genes for mitochondrial pyruvate dehydrogenase subunits are found in the nuclear DNA.
  - C. Mitochondrial and bacterial ribosomal functions are inhibited by the same antibiotics.
  - D. The outer mitochondrial membrane contains the protein porin.
  - E. Many mitochondrial proteins are imported across both inner and outer membranes after translation on cytoplasmic ribosomes is completed.

13. The synthesis of mRNA's that encode the proteins of eukaryotic ribosomes occurs in the
- A. Cytoplasm
  - B. Nuclear envelope
  - C. Nucleolus
  - D. Euchromatin
  - E. Heterochromatin
14. The rate of O<sub>2</sub> consumption increased upon addition of NADH because
- A. NADH is an allosteric activator of NADH ubiquinone oxidoreductase
  - B. NADH uncouples oxidation from phosphorylation
  - C. NADH displaces O<sub>2</sub> from the reaction mixture
  - D. Cytochrome oxidase binds NADH and transfers electrons from NADH to O<sub>2</sub>
  - E. Electrons from the oxidation of NADH are transferred through the electron transport chain to O<sub>2</sub>
15. Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large and complex lipids. Which cellular organelle must be involved in this condition?
- A. Endoplasmic reticulum
  - B. Golgi apparatus
  - C. Lysosome
  - D. Mitochondria
  - E. Membrane-bound ribosomes
16. One function of peroxisomes involves the process of:
- A. Cell death.
  - B. Water storage.
  - C. Protein synthesis.
  - D. DNA replication.
  - E. Detoxification.
17. One of the relationships that exists between ribosomes and lysosomes is that
- A. Ribosomes produce enzymes that could be stored in lysosomes.
  - B. Ribosomes produce lipids that could be stored in lysosomes.
  - C. Lysosomes are located near ribosomes on the surface of the endoplasmic reticulum.

D. Lysosomes are produced by ribosomes and therefore contain proteins that were synthesized at the ribosomes.

18. The ability of the cell membrane to act as a selective barrier depends upon
- A. The lipid composition of the membrane
  - B. The pores which allows small molecules
  - C. The special mediated transport systems
  - D. All of these
19. Sphingomyelins are composed of fatty acids, phosphoric acid and
- A. Sphingosine and choline
  - B. Glycerol and sphingosine
  - C. Glycerol and Serine
  - D. Glycerol and Choline
20. Depot fats of mammalian cells comprise mostly of
- A. Cholesterol
  - B. Cholesterol esters
  - C. Triacyl glycerol
  - D. Phospholipids

**SECTION B: Answer ALL questions (5 MARKS EACH)**

1.

- a) Draw the structure of a biological membrane as proposed by the fluid mosaic model (2 marks).
- b) When a preparation of mitochondrial membranes was treated with high salt (0.5 M NaCl), it was observed that 40% of the total protein in this preparation was solubilized. (i) What kind of membrane proteins are in this soluble extract, and what forces normally hold them to the membrane? (ii) What kind of proteins constitutes the insoluble 60%, and what forces hold these proteins in the membrane? (3 marks)

2.

- a) A plant breeder has developed a new frost-resistant variety of tomato that contains higher levels of unsaturated fatty acids in membrane lipids than those found in standard tomato varieties. However, when temperatures climb above 95 °F, this frost-resistant variety dies, whereas the standard variety continues to grow. Provide a likely explanation of the biochemical basis of increased tolerance to cold and increased susceptibility to heat of this new tomato variety (2 marks).
- b) What is meant by the transition temperature of a membrane? List the two characteristics of the fatty acids in a biological membrane that affect the transition temperature. Using ↑ or ↓, show in which direction an increase in these characteristics would change the transition temperature (3 marks).

3. Compare and contrast:

- a) Symport and antiport transport (2 marks).
- b) Ligand-gated channels and voltage-gated ion channels (2 marks)

4.

- a) Outline the biogenesis of mitochondria and chloroplasts, their proteins and lipids (5 marks).
- b) State the evidence which supports this biogenesis

5. Explain the formation of different amphipathic aggregates when lipids are mixed with water (5 marks)

6. Outline the functions of plasma membrane (5 marks)

**SECTION C: Answer ANY TWO questions (10 marks each)**

1. Describe the role of endoplasmic reticulum and Golgi apparatus in biosynthesis proteins, glycoproteins and membrane lipids, cellular secretions and intracellular targeting of proteins (10 marks).
2. Describe energy transaction by mitochondrial membrane via membrane-embedded supramolecular complexes which catalyzes a flow of electrons from NADH to O<sub>2</sub> (10 marks)
3. Describe

- a) Synthesis of RNA (5 marks)
- b) Lysosome mechanism of action (5 marks)

