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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. in Health Promotion
First Year – Semester I Examination – May 2022

BIO 1201 – CELL BIOLOGY AND BIOCHEMISTRY

Time: Two (02) hours

This question paper consists of sections A, B and C. Answer ALL questions in section A and B and TWO (02) questions from section C.

Section A: Multiple choice questions (20 minutes)
Underline the **most suitable option** using a **pen**.

1.

a) Which of the following is **true** about a protein motif?
   i. A unit that is responsible for a particular function or interaction
   ii. A unit that is about 50 to 250 amino acids in length
   iii. Secondary structures that form specific geometric arrangements
   iv. Distinct functional or structural unit of a protein

b) In substrate level phosphorylation, ATP is formed by
   i. transferring electrons to ADP and a phosphate group.
   ii. the ATP synthase enzyme using the proton gradient.
   iii. transferring a Phosphate group to ADP.
   iv. transferring energy directly to ADP from a substrate.

c) All monosaccharides are reducing sugars because,
   i. they can be reduced by reducing agents.
   i. they can be reduced by oxidising agents.
   ii. they can be oxidized by oxidising agents.
   iii. they can be oxidized by reducing agents.

d) The following are K_M values of an enzyme inhibitor. If someone were trying to develop a drug to inhibit this specific enzyme, which one of the following would be best?
   i. $K_M = 4.7 \times 10^{5}$ M
   ii. $K_M = 1.5 \times 10^{8}$ M
   iii. $K_M = 1.5 \times 10^{-8}$ M
   iv. $K_M = 4.7 \times 10^{-5}$ M

e) Which of the following statements is **not true** about endocytosis?
   i. It is the importation of large materials in to cells by engulfing them with their plasma membranes.
   ii. Pinocytosis is a form of endocytosis in which the engulfed material is solid.
   iii. Phagocytosis is a form of endocytosis in which the engulfed material is organic matter.
   iv. It is a form of active transport.

f) Meiosis generates genetic diversity through
   i. the exchange of genetic material between homologous chromosomes.
   ii. the random alignment of maternal and paternal chromosomes.
   iii. the random alignment of the sister chromatids.
   iv. all of the above.

g) Which of the following correctly describes chromatin?
   i. Complex of DNA and protein from which chromosomes are composed of.
   ii. Total genetic content of a cell.
   iii. Proteins that give structural support to a chromosome.
   iv. Unpacked DNA in the form in which DNA exists when it is not tightly packed into chromosomes.

h) Which of the following statements are correct?
   A. Frederick Sanger received the Nobel Prize in Chemistry for developing DNA sequencing technology.

   B. Maurice Wilkins, Francis Crick and James Watson received the Nobel Prize in Physiology or Medicine for deciphering the structure of DNA.

   C. Rosalind Franklin did not receive the Nobel Prize since her contribution for deciphering the structure of DNA was not significant.

   i. A, B & C
   ii. A & B
   iii. A & C
   iv. B & C

j) The role of second messengers like cAMP in cellular communication is to
   i. relay the signal molecule's message within the cytoplasm.
   ii. serve as cell surface receptors.
   iii. amplify the external signal within the cell.
   iv. serve as a intra-cellular receptors.

k) In plant cell walls,
   i. the primary cell wall is the outermost layer, which is laid first.
   ii. the secondary cell wall is a thin flexible and an extensible layer.
   iii. the primary cell wall is a thin flexible and an extensible layer.
   iv. the middle lamella is a layer in between primary and secondary cell walls.

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l) DNA strand is directly involved in the formation of **all except**
   i. protein.
   ii. mRNA strand.
   iii. tRNA molecule.
   iv. another DNA strand.

m) Secretory cells that release relatively large quantities of glycoproteins contain relatively large amounts of
   i. rough endoplasmic reticulum.
   ii. smooth endoplasmic reticulum.
   iii. Golgi apparatus.
   iv. mitochondria.

n) Cytochalasin D is an organic compound that inhibits the formation of Actin filaments in cells. Which of the following biological activities Cytochalasin D will inhibit in the cell?
   i. Cytosolic transport of vesicles.
   ii. Movement of substances within the cell.
   iii. Formation of the cleavage furrow following telophase of mitosis.
   iv. Holding of organelles in the cell.

o) The cell surface proteins responsible for self recognition are,
   i. β-adrenergic receptor proteins.
   ii. GTP-binding proteins.
   iii. G-protein-linked receptor proteins.
   iv. MHC proteins.

p) Which of the following pairs of chemical functional groups are involved in a condensation reaction between a glycerol molecule and a fatty acid molecule?
   i. Hydroxyl (-OH) and aldehyde groups (-CHO)
   ii. Carboxylic (-COOH) acid and carboxylic acid (-COOH)
   iii. Aldehyde (-CHO) and carboxylic acid (-COOH) groups
   iv. Hydroxyl (-OH) and carboxylic groups (-COOH)

q) Which of the following is **not a reason** why the theoretical ATP yield in eukaryotic cells is not 38,
   i. Some protons diffuse out of the mitochondrial matrix.
   ii. Some protons re-enter the matrix without passing through ATP-generating channels.
   iii. Mitochondria use the proton gradient for purposes other than ATP generation.
   iv. Two ATP molecules are used for transporting 2 pyruvate molecules.

(16 x 5 = 80 Marks)

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Section B: Structured Essay Questions (40 minutes)

Answer all sections only in the space provided.

2.

a) Define what a protein is.

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(04 marks)

b) Draw the basic structure of chemical subunits that makes proteins.

(06 marks)

c) What are the **five (05) chemical classes** the above-mentioned chemical subunits belong to?

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(10 marks)

d) Chemical subunits that make proteins are bound together by peptide bonds. Peptide bonds have a partial double bond nature. Explain how this is possible.

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(16 marks)

e) Describe how polypeptide chains fold into their natural three-dimensional shapes.

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(9 marks)

f) Sometimes, newly synthesized polypeptide chains do not fold to their natural shape. Explain how cells overcome the issue of incorrectly folded proteins.

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(15 marks)

(Total: 60 marks)

3.

a) Define what the cell cycle is.

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(04 marks)

b) Briefly describe the key events taking place in the five phases of the cell cycle.

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(15 marks)

c) Name the three checkpoints that regulate the cell cycle and the enzyme involved in the process.

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(09 marks)

d) Explain how the above-mentioned enzyme is involved in the regulation of the cell cycle.

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(09 marks)

e) Describe the steps the cellular mechanism will take, if the presence of damaged DNA was detected in the first checkpoint.

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(09 marks)

f) During a routine examination of human somatic cells, a scientist found a cell with 45 chromosomes. Giving reasons, state in which checkpoint could have the error occurred.

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(05 marks)

g) In the three checkpoints you mentioned in '3c', which checkpoint is most important to ensure a healthy life? Give reasons for your selection.

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(09 marks)

(Total: 60 marks)

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Section C: Essay questions (1 hour)

4.

a) Endosymbiotic theory suggests that mitochondria and chloroplasts were prokaryotes that were engulfed by eukaryotic cells, which later developed a symbiotic relationship. Provide **five (5)** structural features of mitochondria and chloroplasts that support this hypothesis. **(50 marks)**

b) Majority of proteins required for metabolism in mitochondria and chloroplasts are coded in the nucleus and are synthesized in the cytoplasm. Describe the form they enter these organelles through the two membranes and explain why this is so. **(25 marks)**

c) Proteins needed for mitochondrial division are coded in the nucleus. Explain the advantage of this. **(25 marks)**

5. Describe the structure and function of membrane proteins present in biological membranes. **(100 marks)**

6. Write short notes on the following.
   a) Ribosomes
   b) Cytoskeleton
   c) Storage lipids
   d) Binary fission

(100 marks)

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