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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. in Applied Sciences
First Year – Semester I Examination – March 2021

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 **not true** about a protein domain?
   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. They are secondary structures that form specific geometric arrangements.
   iv. It is a distinct functional or structural unit of a protein.

b) All monosaccharide ketose sugars are reducing sugars because,
   i. they also have a hidden aldehyde group.
   i. they are in equilibrium with their aldose isomer.
   ii. their carbonyl carbon can be oxidised.
   iii. they are strong reducers.

c) Which one of the following is a common component of both plant and animal cells?
   i. endosomes
   ii. glyoxisomes
   iii. centrosomes
   iv. peroxisomes

d) The nucleosome consists of
   i. DNA, RNA and chromatin.
   ii. DNA, central histone, and chromatin.
   iii. DNA, spacer histone, and chromatin.
   iv. DNA, spacer histone, and central histone.

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e) Post-translational modification of proteins takes place in the
   i. rough endoplasmic reticulum.
   ii. smooth endoplasmic reticulum.
   iii. Golgi apparatus.
   iv. lysosome.

f) Chitin is a polysaccharide that consists of
   i. β glucose subunits that have been modified with a nitrogen group.
   ii. α glucose subunits that have been modified with a nitrogen group.
   iii. β glucose subunits that have been modified with protein.
   iv. α glucose subunits that have been modified with protein.

h) Which of the following statements are correct?
   A. Hooke was the first to observe living cells and introduce the word cell.
   B. Schwann was the first to state that all animals consist of cells.
   C. Leeuwenhoek was the first to observe live cells in pond water.

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

j) Though hydrolysis of pyrophosphate and anhydride bonds in ATP yields same amount of energy, ATP is considered to be better suited as the energy carrier molecule in the cell. This is because,
   i. ATP strongly binds to substrate molecules in biological reactions.
   ii. pyrophosphate does not bind to substrate molecules in biological reactions.
   iii. pyrophosphate cannot be hydrolysed easily in biological reactions.
   iv. pyrophosphate binds irreversibly to substrate molecules in biological reactions.

k) DNA replication always proceeds in the 5' to 3' direction because
   i. DNA polymerase can add nucleotides only to the 3' prime end of the strand.
   ii. DNA polymerase can add nucleotides only to the 5' prime end of the strand.
   iii. it requires less energy to add nucleotides to the 3' prime end of the strand.
   iv. it requires less energy to add nucleotides to the 5' prime end of the strand.

l) The reason why the peptide bond is **not** freely rotatable around the N-C linkage in polypeptide is because
   i. it has a partial double bond character.
   ii. it has hydrophobic and hydrophilic interactions with other amino acids.
   iii. they can be ionized to have positive and negative charges at the two ends.
   iv. it has a partial triple bond character.

m) Which of the following biomolecules are not formed by condensation reactions?
   i. Polypeptides
   ii. Polysaccharides
   iii. Steroids
   iv. Nucleic acids

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) How does a somatic cell that has just completed the S phase of its cell cycle compared in respect to its number of chromosomes and amount of DNA with a gamete of the same species?
   i. It has twice the number of chromosomes and twice the amount of DNA.
   ii. It has the same number of chromosomes but twice the amount of DNA
   iii. It has twice the number of chromosomes and four times the amount of DNA.
   iv. It has four times the number of chromosomes and twice the amount of DNA

p) The pair of chemical functional groups involved in a condensation reaction between two monosaccharides is
   i. hydroxyl (-OH) and hydroxyl groups
   ii. carboxylic acid and carboxylic acid
   iii. aldehyde and carboxylic acid groups
   iv. aldehyde and hydroxyl groups

q) Which of the following groups of proteins associated with kinases and are synthesized and degraded at specific points during the cell cycle?
   i. Growth factors
   ii. Cyclins
   iii. p53 proteins
   iv. Cyclin dependent kinases

(15 x 4 = 60 Marks)

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Section B: Structured Essay Questions (40 minutes)
Answer all sections only in the space provided.

2.

a) Provide **four (04)** different types of molecules that multi-cellular organisms use for inter cellular communication.

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(08 marks)

b) State the **two (02)** ways that the above-mentioned molecules are used in inter-cellular communication.

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(08 marks)

c) Explain briefly how cells maintain the specificity for each signaling molecule.

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(06 marks)

d) Name the **three (03)** main modes of inter-cellular communication.

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(09 marks)

e) Describe how G-protein linked receptors convert extracellular signals into intra-cellular signals.

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(9 marks)

f) Ca^{+2} is a second messenger molecule that initiates the intracellular signal. Explain the role of Ca^{+2} in initiation the intracellular signals using a suitable illustration.

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(30 marks)

(Total: 70 marks)

3.

a) Give **two (02)** main ways the eukaryotic cells produce ATP.

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(06 marks)

b) Describe the difference between these two methods.

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(10 marks)

c) What is the method of ATP production utilised in glycolysis?

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(02 marks)

d) Describe the **three (03)** basic steps of the process that converts glucose to its end product in glycolysis.

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(09 marks)

e) Describe the role of Acetyl Coenzyme A in the Krebs cycle.

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(04 marks)

f) What is the total yield of ATP, $FADH_2$, and NADH generated per single glucose molecule in the Krebs cycle?

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(06 marks)

g) Describe how energy captured by the electrons in glycolysis and Krebs cycle is used to harvest energy in the electron transport chain.

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(20 marks)

h) What is the maximum theoretical yield of ATP in aerobic respiration per single glucose molecule?

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(03 marks)

i) Explain briefly why the actual ATP yield is lower than the maximum theoretical ATP yield in aerobic respiration per single glucose molecule.

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(10 marks)

(Total: 70 marks)

Section C: Essay questions (1 hour)

4.

a) Describe the different forms of enzymes seen in nature. **(50 marks)**

b) Explain how enzymes are involved in catalysis of biological reactions. **(50 marks)**

(100 marks)

5. Compare processes of DNA replication and transcription.

(100 marks)

6.

a) Explain the benefit of having organelles in cells. **(20 marks)**

b) Lysosomes are cellular organelles that are called the cells recycling centre. Justify this statement. **(70 marks)**

c) The 'Lysosome storage disease' is a genetic disorder that leads to the build-up of toxic material in cells. Using your knowledge on the functions of lysosomes, state the possible reason for this disease. **(10 marks)**

(100 marks)

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