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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

Bachelor of Science in Applied Sciences
Third Year – Semester I Examination – July/August 2023

BIO 3201 – MOLECULAR BIOLOGY

Time: Two (02) hours

Answer ALL questions in Section 1 (Multiple Choice and Structured Essay) and TWO (02) questions only in Section 2.

Section 1: [Approximate time allocation is **ONE (01)** hour]

1. **Answer ALL parts of the question. Underline** the **most suitable answer** using a **pen**. **No marks will be given for multiple responses**. **(100 marks)**

a) Which of the following is **not** a property that a genetic material must have?
   i. It must be in a stable form.
   ii. It must be double stranded.
   iii. It must replicate accurately.
   iv. It must be capable of small changes.

b) The main enzyme that adds nucleotides to the growing chain in eukaryotic DNA replication is
   i. DNA Polymerase δ
   ii. DNA Polymerase β
   iii. DNA Polymerase II
   iv. DNA Polymerase III

c) The correct statement regarding ribosomes is,
   i. The smaller subunit binds to mRNA molecule before larger subunit.
   ii. Its larger subunit is made of protein and smaller subunit is made of ribosomal RNA (rRNA).
   iii. Prokaryotes have 70S ribosome, with a 60S larger subunit and 30S smaller subunit.
   iv. It dissociates into a larger and a smaller subunit at the initiation step of translation.

d) Nucleosome is a segment of DNA
   i. wound around four histone protein cores.
   ii. surrounded by four histone protein cores.
   iii. wound around eight histone protein cores.
   iv. surrounded by eight histone protein cores.

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e) Which of the following is **not** a type of posttranslational modification?
i. Polyadenylation ii. Methylation iii. Phosphorylation iv. Ubiquitination

f) Two types of dyes which are usually used during practical application of Agarose Gel Electrophoresis to separate DNA molecules are
i. basic dye and loading dye.
ii. DNA binding dye and UV dye
iii. nucleic acid binding dye and loading dye.
iv. nucleic acid binding dye and UV dye

g) The starting amino acid of a prokaryotic peptide sequence is
i. Methionine. ii. Serine. iii. Formyl methionine. iv. Arginine.

h) The enzyme which protects the end of the chromosome from deterioration during eukaryotic DNA replication is
i. Telomerase. ii. Topoisomerase. iii. Primase. iv. Gyrase.

i) The **incorrect** statement regarding DNA molecule is,
i. Basic unit of DNA consists of a pentose sugar, phosphate group and nitrogenous base.
ii. DNA can be subjected to repair within a cell.
iii. DNA is a molecule where the genetic information is stored.
iv. DNA is present in a double helix configuration in all organisms.

j) Sequence of a transcription unit where RNA polymerase binds and initiates transcription is known as
i. promoter. ii. enhancer. iii. mediator. iv. regulator.

k) Which of the following **is not** a constituent of the prokaryotic promoter?
i. Pribnow box ii. -35 sequence
iii. CAAT box iv. Distance between -10 and -35

l) The translation initiation factor which make sure the first incoming tRNA with fMet amino acid only binds to P site by blocking A site is,
i. IF-1 ii. IF-2 iii. IF-3 iv. IF-4

m) Which of the following statement is true about both RNA polymerase and DNA polymerase enzymes?
i. Both require a primer to initiate their actions.
ii. Both can only add nucleotides in the 5' to 3' direction of the growing nucleotide chain.
iii. While RNA polymerase may use an RNA template, DNA polymerase uses a DNA template.
iv. DNA polymerase rarely makes mistakes in its action while RNA polymerase is very accurate.

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n) Which of the following is not usually included in commercially available PCR Master Mix?
   i. Taq DNA polymerase
   ii. dNTPs
   iii. $MgCl_2$
   iv. Forward and reverse primers

o) The **incorrect** statement regarding an enhancer is,
   i. It helps in activating transcription process.
   ii. It has an ability to function from a long distance away from start site.
   iii. It is an activator protein.
   iv. It can either be upstream or downstream from start site.

2. Answer <u>ALL parts</u> of the question in the space provided.

a) i. Define a codon? **(05 marks)**

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ii. "More than one codon can specify the same amino acid". Name and explain the hypothesis which explains how the above statement is possible. **(20 marks)**

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iii. Out of the 64 codons, only 61 codons code for amino acids. Write the name given to the remaining three codons and list those three codons. **(15 marks)**

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iv. What is Shine-Dalgarno Sequence and state its function? **(15 marks)**

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v. Shine-Dalgarno Sequence is not found in Eukaryotes. How does the Eukaryotes complete the above said function? **(05 marks)**

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b) i. Write **FOUR (04)** differences between the end products of DNA replication and transcription **(16 marks)**

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ii. Given below is a DNA sequence of a prokaryotic organism. Write the sequence of **mRNA transcript,** in correct orientation, that is formed at the end of the transcription of this. **(04 marks)**

3' TACGGTCTGTCA 5'

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iii. Using the mRNA transcript obtained, deduce the **amino acid sequence** of the protein (with correct orientation) that will be produced after the translation process with the help of the genetic code table given below. **(20 marks)**

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Genetic Code Table					
First Position	Second position				Third position
	U	C	A	G	
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Section 2[Approximate time allocation is **ONE (01)** hour]

Answer any TWO (02) questions only.

3. Describe briefly, how the enzymes/proteins involved in prokaryotic DNA replication mechanism functions to ensure production of DNA molecules which are identical to the parental DNA molecules. **(100 marks)**

4. a) "Bacterial RNA polymerase is a malfunctional enzyme". Do you agree? Justify your answer. **(40 marks)**

   b) Describe briefly the post-transcriptional modifications that occur in a eukaryotic cell. **(60 marks)**

5. "End replication problem occurs in eukaryotic DNA replication". Explain what the end replication problem is and how the replication machinery resolves it. In your answer include why this problem has to be resolved (use diagrams if needed). **(100 marks)**

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