

UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER: MAY 2018

- TITLE OF PAPER:** INTRODUCTORY MOLECULAR BIOLOGY
- COURSE CODE:** BIO 202
- TIME ALLOWED:** THREE HOURS
- INSTRUCTIONS:**
1. ANSWER SECTION A (COMPULSORY) AND ANY TWO QUESTIONS IN SECTION B.
 2. ANSWER A TOTAL OF 3 (THREE) QUESTIONS USE THE PROVIDED GRID FOR ANSWERS TO QUESTION 1A.
 3. EACH QUESTION IN SECTION B CARRIES TWENTY FIVE (25) MARKS
 4. ILLUSTRATE YOUR ANSWERS WITH LARGE AND CLEARLY LABELLED DIAGRAMS WHERE APPROPRIATE
- SPECIAL REQUIREMENTS:** NONE

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INTRODUCTORY MOLECULAR BIOLOGY BIO 202 (M) 2017/2018

STUDENT ID NUMBER _____

Place an 'X' against the most appropriate answer. For instance if the answer for Question 99 is D, the answer appear as shown below.

Question	A	B	C	D	E
99				X	

Question	A	B	C	D	E
1					
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SECTION A: COMPULSORY (ANSWER ALL QUESTIONS IN THIS SECTION)

Question 1 A. (MULTIPLE CHOICE, 20 MARKS)

1. A component of DNA but not of RNA is:
 - A) Adenine.
 - B) Guanine.
 - C) Uracil.
 - D) Cytosine
 - E) Thymine

2. The difference between a ribonucleotide and a deoxyribonucleotide is:
 - A) A deoxyribonucleotide has an —H instead of an —OH at C-3 of the pentose sugar.
 - B) A deoxyribonucleotide has an —H instead of an —OH at C-2 of the pentose sugar.
 - C) A ribonucleotide has an extra —OH at C-4.
 - D) A ribonucleotide has more structural flexibility than deoxyribonucleotide.

3. The phosphodiester bonds that link adjacent nucleotides in both RNA and DNA:
 - A) Always link A with T and G with C.
 - B) Join the 3' hydroxyl of one nucleotide to the 5' hydroxyl of the next.
 - C) Are susceptible to alkaline hydrolysis.
 - D) Are uncharged at neutral pH.

4. The mRNA codon 5'-CAU-3' will form temporary bonds with the
 - A) mRNA anticodon CAU.
 - B) mRNA codon GUA.
 - C) tRNA anticodon AUG.
 - D) tRNA codon CAU.

5. Which statement is true?
 - A) Coiled eukaryotic DNA strands with attached proteins are called HU proteins.
 - B) Histone clusters are called nucleosomes.
 - C) The prokaryotic DNA strands should be referred to as chromatin fibers.
 - D) All of the above.

6. DNA polymerase is the enzyme that
 - A) Unzips the DNA strands.
 - B) Adds new nucleotides to the growing DNA strand.
 - C) Edits the new DNA molecule.
 - D) Ties together new pieces of DNA.

7. The fundamental repeating unit of organization in a eukaryotic chromosome is the:
- centrosome.
 - lysosome.
 - microsome.
 - nucleosome.
 - polysome.
8. Aminoacyl-tRNA synthetases (amino acid activating enzymes):
- "Recognize" specific tRNA molecules and specific amino acids.
 - In conjunction with another enzyme attach the amino acid to the tRNA.
 - Interact directly with free ribosomes.
 - Occur in multiple forms for each amino acid.
9. Which one of the following is *true* about the genetic code?
- All codons recognized by a given tRNA encode different amino acids.
 - It is absolutely identical in all living things.
 - Several different codons may encode the same amino acid.
 - The base in the middle position of the tRNA anticodon sometimes permits "wobble" base pairing with two or three different codons.
 - The first position of the tRNA anticodon is always adenosine.
10. Which of the following is *not* true of tRNA molecules?
- With the right enzyme, any given tRNA molecule will accept any of the 20 amino acids.
 - Their anticodons are complementary to the triplet codon in the mRNA.
 - They contain more than four different bases.
 - They contain several short regions of double helix.
11. Which of the following is a mechanism that controls the rate of transcriptional control?
- Organization of chromatin
 - DNA polymerase
 - The presence or absence of an inducer
 - None of the above
12. A (n) _____ is a piece of DNA with a group of genes that are transcribed together as a unit.
- Promoter
 - Repressor
 - Operator
 - Operon
13. DNA methylation of genes
- Inhibits transcription by blocking the base-pairing between methylated cytosine and guanine.
 - Inhibits transcription by blocking the base-pairing between uracil and

adenine.

- C) Prevents transcription by blocking the TATA sequence.
- D) Makes sure that genes that are turned off remain turned off.

14. Which of the following is *not* true?
- A) RNA splicing occurs in the nucleus
 - B) snRNP splices out exons from the transcript
 - C) poly-A tail increases transcript stability
 - D) None of the above.
15. Which of the following is *not* a method of posttranscriptional control in eukaryotic cells?
- A) processing the transcript
 - B) selecting the mRNA molecules that are translated
 - C) digesting the DNA immediately after translation
 - D) selectively degrading the mRNA transcripts
16. A type of DNA sequence that is located far from a gene but can promote its expression is a (n)
- A) Promoter.
 - B) Activator.
 - C) Enhancer.
 - D) TATA box.
17. The site of protein synthesis is:
- A) At the nuclear membrane.
 - B) At ribosomes.
 - C) Near microfilaments.
 - D) Always at a Golgi body.
18. While one strand of duplex DNA is being transcribed to mRNA:
- A) The complementary strand makes tRNA.
 - B) The complementary strand is inactive.
 - C) The complementary strand at this point is replicating.
 - D) Mutations are impossible during this short period.
19. A DNA gene strand with the base sequence 3'-CCA - TAT - TCG-5' codes for the amino acid sequence: (consult the genetic code)
- A) N-Proline - tyrosine - serine-C.
 - B) N-Glycine - isoleucine - threonine-C.
 - C) N-Proline- tyrosine - threonine-C.
 - D) N-Glycine - isoleucine - serine-C.
20. In eukaryotic cells, mature RNA is formed by the
- A) Removal of introns.
 - B) Removal of exons.
 - C) Addition of introns.
 - D) Addition of exons.

Question 1 B. (Short Answer Questions, 25 marks)

21. Explain the difference between mitosis and meiosis (2 marks)

22. State differences between DNA and RNA (6 marks)

23. Write down the missing terms/phrases in the following paragraph (8 marks)
 When both strands of DNA serve as templates, the mechanism of DNA replication is said to be (i) _____. DNA replication in *E. coli* begins at a site in the DNA called the (ii) _____. At the replication fork the (iii) _____ strand is synthesized continuously while the other strand is synthesized discontinuously. On the strand synthesized discontinuously, the short pieces are called (iv) _____. An RNA primer for synthesis of (iv) is synthesized by an enzyme called (v) _____, and this RNA primer is later removed after the fragment is synthesized by the enzyme (vi) _____, using its (vii) _____. The nicks left behind in this process are sealed by the enzyme (viii) _____.

24. Consider the following hypothetical mRNA; what would be the sequence of the peptide produced if this were translated in an *E. coli* cell?

5' -AUAGGAGGUUUGACCUAUGCCUCGUUUUAUAGCC-3'

(2 marks)

25. The template strand of a segment of double-stranded DNA contains the sequence:

(5')-TCA CTT TGA TAA GGA TAG CCC TTC CAT-(3')

- i. Write down the base sequence of the mRNA that can be transcribed from this strand. (2 marks)
- ii. Write down the amino acid sequence that could be coded by the mRNA base sequence in (i) above. (2 marks)
- iii. Suppose the other (complementary) strand is used as a template for transcription. Give the amino acid sequence of the resulting peptide. (3 marks)

		Second Letter					
		U	C	A	G		
1st letter	U	UUU Phe UUC UUA Leu UUG	UCU Ser UCC UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G	
	C	CUU Leu CUC CUA CUG	CCU Pro CCC CCA CCG	CAU His CAC CAA Gln CAG	CGU Arg CGC CGA CGG	U C A G	
	A	AUU Ile AUC AUA AUG Met	ACU Thr ACC ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G	
	G	GUU Val GUC GUA GUG	GCU Ala GCC GCA GCG	GAU Asp GAC GAA Glu GAG	GGU Gly GGC GGA GGG	U C A G	

SECTION B : (ANSWER ANY TWO QUESTIONS)

Question 2

Describe the process of DNA replication in prokaryotes, highlighting roles of the different enzymes (proteins) at the replication fork. (25 marks)

Question 3

- (a) Briefly describe the relationship between chromatin structure and transcription in eukaryotes. (3 marks)
- (b) Using annotated diagrams, discuss ways in which an RNA transcript is processed to get a mature mRNA. (10 marks)
- (c) Discuss the characteristics of the Genetic code. (12 marks)

Question 4

Discuss eukaryotic and prokaryotic gene expression, highlighting their similarities and differences. (25 marks)

END OF QUESTION PAPER