# SBI4U Unit 3 Test: Molecular Genetics (50 Marks Total)

Name:\_\_\_\_\_

Signature:\_\_\_\_\_

### Marks obtained:

Category	Total Marks	Possible Marks
Knowledge/Understanding (K/U)		10
Thinking/Investigation (T/I)		15
Communication (C)		5
Application (A)		20
Total		50
Percentage		

# SECTION 1: Knowledge/Understanding - Multiple Choice (Questions 1-10) [K/U, 10: 1 each]

### Write your section 1 answers here:

Question	1	2	3	4	5	6	7	8	9	10
Answer										

SBI4U Unit 3 Test: Molecular Genetics					
K/U T/I A C					
/10					

#### \*\*NOTE: FOR SECTIONS 1 WRITE YOUR ANSWERS IN THE TABLES ON THE FIRST PAGE OF THIS TEST\*\*

#### **SECTION 1: Knowledge/Understanding - Multiple Choice (Questions 1-10)**

[K/U, 10: 1 each]

- 1. The X and Y chromosomes are called
  - a) extra chromosomes.
  - b) sex chromosomes.
  - c) homologous chromosomes.
  - d) autosomes.
- 2. The amount of guanine in an organism always equals the amount of
  - a) protein.
  - b) adenine.
  - c) thymine.
  - d) cytosine.
- 3. The attachment of nucleotides to form a complementary strand of DNA during replication
  - a) is accomplished by DNA polymerase.
  - b) is accomplished only in the presence of tRNA.
  - c) prevents separation of complementary strands of RNA.
  - d) is the responsibility of the proofreading enzymes.
- 4. DNA strands run \_\_\_\_\_ in relation to each other.
  - a) antiparallel
  - b) parallel
  - c) perpendicular
  - d) both a and b
- 5. Between the two strands of a DNA segment the nitrogen bases are held together by \_\_\_\_\_.
  - a) covalent bonds

- c) ionic bonds
- b) hydrogen bonds
- d) metallic bonds

- 6. Okazaki fragments are used to elongate
  - a) the leading strand toward the replication fork
  - b) the lagging strand toward the replication fork
  - c) the leading strand away from the replication fork
  - d) the lagging strand away from the replication fork
- 7. Each of the following is a type of RNA except
  - a) carrier RNA.
  - b) ribosomal RNA.
  - c) messenger RNA.
  - d) transfer RNA.
- 8. During transcription,
  - a) proteins are synthesized.
  - b) RNA is produced.
  - c) DNA is replicated.
  - d) translation occurs.
- 9. Each nucleotide triplet in mRNA that specifies a particular amino acid is called a(n)
  - a) peptide bond.
  - b) anticodon.

- c) codon.
- d) helicase.
- 10. Transcription begins when RNA polymerase
  - a) attaches to a ribosome.
  - b) unwinds a strand of DNA.
  - c) binds to a strand of RNA.
  - d) attaches to the promoter sequence of a gene.

#### ROSEDALE A C A D E M Y

# SECTION 2: Application - Labeling (Questions 11-12)

# [A, 13: 1 each]

11. Write the corresponding letter to each term in the table below to label the following replication fork. [A, 6]



12. Write the term for each corresponding label, in the table below, to label the following DNA translation process. [A, 7]

Label (letter)	Term	
(a)		(a) <sup>°</sup> (b)
(b)		
(c)		
(d)		
(e)		
(f)		(g)
(g)		

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K/U T/I A C						
		/13				

## SECTION 3: Thinking/Inquiry & Application – Short Answer (Questions 13-18) [T/I, 15; A, 5]

- 13. Linus Pauling proposed a DNA structure in which the phosphate groups were tightly packed on the inside of the molecule, thus leaving the nitrogenous bases sticking outward.
  - a. Which scientist's findings did Linus Pauling needed to propose the correct 3D structure of DNA? [T/I, 1]

b. If DNA replication occurred in this structure, how do you think it would differ from what you know is the actual process? Explain your reasoning. [T/I, 3]

14. While working with a particular strain of E. coli, you discover that it transcribes the lac genes at a high level when no lactose is present in the cell's medium.

a. Explain how the lac operon normally functions.

[T/I, 2]

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K/U	T/I	А	С			

/6

b. List the possible causes of this abnormal activity.

c. Then design an experiment to determine which of these possible causes is the case with your bacterial colony. [T/I, 3]

15. This illustration shows the electrophoretic gel pattern that resulted from a chain termination sequencing process. What is the nucleotide sequence of the original DNA sample? [A, 3]

	A	C	T	G
-				
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+				

SBI4U Unit 3 Test: Molecular Genetics			
K/U	Т/І	Α	С
	/6	/3	

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16. Researchers have the ability to add a number of adenine nucleotides to the end of a strand of mRNA. What could be a practical application of this procedure? [A, 2]

- 17. You are given three different substances that are known mutagens. Using a variety of techniques, you analyze the results of exposure to these substances. Your findings are shown in the table at right. Using this information, link each of the three substances with one of the following molecular properties and explain your choices:
  - i. a molecule that can insert itself between a purine and a pyrimidine in an intact DNA strand
  - ii. a molecule similar in structure to thymine but capable of forming a hydrogen bond with guanine
  - iii. a molecule that converts cytosine to a form that can base-pair with adenine. [T/I, 3]

Substance in medium	Result of exposure			
A	increase in the number of mutant colonies that synthesize mRNA in which the codon AAA is replaced by AGA			
В	significantly fewer viable colonies			
С	increase in the number of mutant colonies that produce modified proteins in which arginine is replaced by a "stop" codon			

L	

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K/U	т/і	А	С				
	/3	/2					

18. A researcher develops a new form of polymerase chain reaction that can amplify long sequences of DNA. Is this technique likely to replace entirely the use of bacteria as cloning vectors? Why or why not?

## SECTION 4: Communication – Short Answer (Question 19)

[C, 5]

19. You are studying DNA replication in bacterial cells. In one culture, you note that replication is not producing viable daughter cells. Your analysis shows that about 50 percent of the daughter DNA appears normal, while about 50 percent is very unstable and does not form a double helix.
a. Draw and label a diagram that could account for your observations. [C, 3]

#### b. If you centrifuged the DNA from this culture, what would you expect to see? [C, 2]

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K/U	Т/І	Α	С							
		/2	/5							

# ROSEDALE A C A D E M Y

## **REFERENCE:**

# Second letter

		U	С	А	G	
First letter	υ	$\left. \begin{array}{c} UUU\\ UUC \end{array} \right\}$ Phe $\left. \begin{array}{c} UUA\\ UUA\\ UUG \end{array} \right\}$ Leu	UCU UCC UCA UCG	UAU UAC UAA Stop UAG Stop	UGU UGC <b>UGA Stop</b> UGG Trp	UCAG
	с	CUU CUC CUA CUG	CCU CCC CCA CCG	CAU CAC CAA CAG GIn	CGU CGC CGA CGG	UCAG
	A	AUU AUC AUA AUG Met	ACU ACC ACA ACG	AAU AAC AAA AAG } Lys	AGU }Ser AGC }AGA AGA }Arg AGG }	UCAG
	G	GUU GUC GUA GUG	GCU GCC GCA GCG	GAU GAC GAA GAG GIu	GGU GGC GGA GGG	UCAG

Third letter