

Name: _____

Molecular Genetics Quiz #1
SBI4U

K	T/I	A	C	TOTAL

Part A: Multiple Choice (15 marks)

Circle the letter of choice that best completes the statement or answers the question. One mark for each correct answer.

- The percentage composition of a nucleic acid molecule found in bacterial cells is as followed: adenine- 32.3%, thymine- 30.7%, cytosine- 19.1%, guanine- 17.9%. The molecule is most likely to be
 - Double- stranded DNA
 - Mitochondrial DNA
 - Double- stranded RNA
 - Single- stranded DNA
- Complementary base pairing is the result of
 - hydrogen bonding
 - the fact that complementary bases fit together physically
 - covalent bonding
 - ionic bonding
- The parts of the gene that are transcribed into mRNA but later removed are called:
 - Exons
 - Spliceosomes
 - Introns
 - Peptides
 - Mutations
- The codons that code for phenylalanine are UUU and UUC. What characteristic of the genetic code explains this fact?
 - the genetic code is universal
 - the genetic code is continuous
 - the genetic code is redundant
 - the genetic code has 64 different codons
 - the genetic code has 20 different amino acid
- When DNA helicase is active, the result is
 - Annealing of RNA primers to the DNA
 - Formation of phosphodiester bonds
 - Formation of hydrogen bonds
 - Separation of the two strands of the double helix
 - Swiveling of the single separated strands of DNA

6. Compare the two mRNA sequences below:

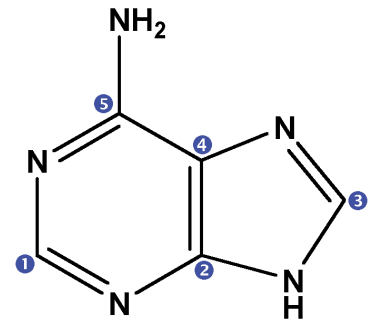
AUAUUCGGCAAUCCG

AUAUCCGCAAUCCG

This could be a result of a

- a. nonsense mutation
 - b. addition mutation
 - c. deletion mutation
 - d. translocation
 - e. point mutation
7. Which of the following best describes southern blotting?
- a. The detection of RNA fragments on membranes by specific radioactive antibodies
 - b. The detection of DNA fragments on membranes by a radioactive DNA probe
 - c. The detection of proteins on membranes using a radioactive DNA probe
 - d. The detection of DNA fragments on membranes by specific radioactive antibodies
 - e. All of the above
8. The Hershey and Chase experiment proved that DNA is the genetic material. This:
- a. was intended to demonstrate that the protein case of a bacteriophage remained outside a bacterial cell after infection
 - b. involved finding radioactivity inside bacteria infected with bacteriophage having DNA labeled with ^{32}P
 - c. involved finding radioactivity inside bacteria infected with bacteriophage having DNA labeled with ^{35}S
 - d. involved finding radioactivity inside bacteria infected with bacteriophage having protein labeled with ^{32}P
 - e. involved finding radioactivity inside bacteria infected with bacteriophage having protein labeled with ^{35}S
9. What is the advantage, for a cell, of using a two-stage process (DNA \rightarrow RNA, followed by RNA \rightarrow cytoplasm) to transfer genetic information from the nucleus to the cytoplasm?
- a. The cell saves the energy that would be required to transport an entire chromosome to the cytoplasm
 - b. The cell protects its hereditary material copies of a DNA molecule to speed up protein production
 - c. The cell can produce multiple copies of a DNA molecule to speed up protein production
 - d. There are several opportunities to regulate gene expression
 - e. All of the above
10. Which statement about RNA polymerase is **true**?
- a. RNA polymerase has a proofreading function
 - b. RNA polymerase works in a 3' to 5' direction
 - c. During initiation of transcription, RNA polymerase binds to the promoter region
 - d. RNA polymerase transcribes both strands of DNA at the same time
 - e. RNA polymerase uses the anti-sense strand of DNA as a template

11. To facilitate movement of mRNA from the nucleus into the cytoplasm, what is added to the 3' end of mRNA?
- a cap of modified nucleotides
 - modified tRNA molecules
 - ribosomes
 - a poly A- tail
 - transcription factors
12. Which statement about regulation of gene expression in prokaryotes is true?
- The most common form of regulation of gene expression is at the level of translation
 - The most common form of regulation of gene expression is at the post-transcriptional level
 - Regulation of gene expression occurs through operons
 - Regulation of gene expression occurs through alternative splicing
 - Regulation of gene expression occurs through the removal of introns
13. The molecule depicted to the right is which one of the following?
- Sugar
 - Nucleotide
 - Amino acid
 - Purine
 - Pyrimidine
14. Transcription is similar to what other process:
- Translation
 - Protein Synthesis
 - Gene regulation
 - DNA replication
 - All of the above
15. In DNA sequencing, dideoxy analogues terminate replication because:
- They are missing an OH group on the 3' carbon
 - They are radioactive, making them unstable
 - Like DNA, they are negatively charged, causing repulsion
 - They lack a phosphate group
 - They reach a stop codon



Part B: True/ False

Indicate whether the answer is true or false. Place your response "T" for true and "F" for false beside the number.

- A missense mutation has no harmful effect on a cell.
- The polymerase chain reaction makes a large number of copies of a desired DNA sequence.
- Okazaki fragments are short segments of DNA that are produced during the synthesis of the leading strand.
- During translation, RNA polymerase uses the template strand of DNA as a template to synthesize the complementary mRNA.
- Translation is the process in which a polypeptide strand is produced from mRNA.

Part C: Short Answer (23 marks)

Answer the questions below in the space provided.

21. Using the chart below, answer the following questions. **(6 marks)**

	Level of protein	Transcription of gene in Operon
Molecule A	High	High
	low	low
Molecule B	High	low
	Low	high

a) Determine which molecule is a corepressor and which is an inducer. Circle the correct response. **(2 marks)**

Molecule A: inducer corepressor

Molecule B: inducer corepressor

b) Identify which system resembles the lac operon and which one resembles the trp operon. Circle the correct response. **(2 marks)**

Molecule A system: lac trp

Molecule B system: lac trp

c) For each system state what happens when the substrate is present. **(2 marks)**

22. Why is it advantageous for some genes to be inactive? (2 marks)

23. Draw and label a tRNA molecule carry an amino acid. *Be sure to specify which amino acid (abbreviation is fine).* **(2 marks)**

24. Use the DNA sequence below to answer the following questions. **(5 marks)**

3'- TACTTACTCGTCAACCTT-5'

- a) Write the corresponding mRNA coding sequence **(1 mark)**
- b) Use the genetic code (provided below) to determine the amino acid sequence **(1 mark)**
- c) A nucleotide substitution occurs in the DNA template at position 14, where adenine becomes thymine. Write the new mRNA coding sequence and amino acid sequence that would result from this substitution. **(2 mark)**
- d) What type of mutation would this yield? **(1 mark)**

	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	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

25. Ten years from now, you are a crime scene investigator, and you have just been called to a murder scene. You arrive at the scene of the crime, blood everywhere, and realize the person who was murdered was Ms. Williams, your student teacher in grade 12 biology. ☹ Talking to your partner who was first to arrive at the scene, he tells you that the blood is not Ms. Williams (she died a natural death). Assuming this blood sample provides enough DNA, use an appropriate biotechnology tool or technique and explain how you could help find out who killed Ms. Williams. **(6 marks)** *In your answer be sure to include what the method is called, how it works, and how it will help you determine who the murderer is.*

26. How is it possible for information on DNA that is confined to the nucleus of a eukaryotic cell to be expressed as a protein outside the nucleus? **(4 marks)**

Part D: Choice (9 marks)

Please circle which question you will be answering and provide the answer below.

27. Many enzymes are used in DNA replication. Identify three other than helicase that are needed and explain the critical role that each one plays during this process. **(4 marks)**

OR

27. Identify 3 of the 4 types of RNA and explain their role in protein synthesis. **(4 marks)**

28. Identify the steps in transcription and describe the process at each step. **(5 marks)**

OR

28. Identify the steps in translation and describe the process at each step. **(5 mark)**