

Student Name: _____



BIOLOGY 2020

Unit 3

Key Topic Test 2 – Nucleic acids and proteins

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this test

Materials supplied

- Question and answer book of 10 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is **correct** for the question. A correct answer scores 1; an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than 1 answer is completed for any question, no mark will be given.

Question 1

The monomers of proteins are

- A. amino acids
- B. ribose sugars
- C. nucleotides
- D. nitrogenous bases

Question 2

DNA is known as a universal degenerate code. This means that

- A. DNA is found in all living organisms
- B. DNA is found across the universe and breaks down over time
- C. DNA is a coding molecule that only has one codon per amino acid
- D. DNA always codes for RNA (universal) and RNA codes for amino acids (degenerate)

Question 3

DNA, mRNA and tRNA are all involved in protein production. The equivalent set of nucleotides are called

- A. DNA codon, RNA codon, anticodon
- B. template strand, coding strand, pre mRNA
- C. codon, anticodon, amino acid
- D. triplet, codon, anticodon

Question 4

The proteome is

- A. the entire set of amino acids found in a species
- B. the entire set of proteins that is expressed by an organism
- C. the entire set of genes that is expressed by an organism
- D. the study of proteins and their functions

Question 5

A secondary structure differs from a tertiary structure because

- A. only secondary structures have beta pleated sheets
- B. a tertiary structure is a functional 2D shape
- C. tertiary structures have hydrogen bonds while secondary structures have disulphide bonds
- D. tertiary structures can act as functional components of a cell

Question 6

Protein functional diversity refers to the

- A. many similar functions that proteins perform in different organisms
- B. range of genes that code for the proteins that are made by a cell
- C. range of roles that proteins undertake based on the order of amino acid monomers
- D. diverse range of amino acids that are used to build proteins.

Question 7

Condensation reactions occur in a variety of biological situations to produce more complex polymers from monomers. An examples of a condensation reaction includes

- A. a water being released through evaporation when sweating
- B. an R group on an amino acid joining another R group on another amino acid
- C. an amino acid being added to the end of a polypeptide chain in a ribosome
- D. a protein being digested by the enzyme trypsin in the small intestine

Question 8

DNA polymerase is a quaternary structure because the molecule(s)

- A. has four peptide subunits
- B. are composed of more than two polypeptide chains
- C. forms a three-dimensional structure
- D. is used to join nucleotides onto DNA molecules

Question 9

DNA and RNA are both essential nucleic acids that are used to code for proteins. DNA and RNA are similar in that

- A. DNA and RNA molecules have amino acids as monomers
- B. DNA and RNA molecules are found in the cytosol of prokaryotes
- C. DNA and RNA molecules contain exons and introns
- D. DNA and RNA molecules are single stranded during translation

Question 10

Gene expression involves the building of a protein based on the instructions in DNA. A process in gene expression involves

- A. splicing of RNA in prokaryotes to remove introns
- B. the removal of exons from mRNA
- C. adding a poly A cap and methyl tail to mRNA
- D. processing of pre-mRNA to prepare for translation

Question 11

Translation refers to the building of the polypeptide chain based on the coding found in mRNA. To transcribe this code into an amino acid chain

- A. tRNA would undergo a condensation reaction when it drops off an amino acid
- B. tRNA codons join mRNA anticodons when adding an amino acid to the chain
- C. amino acid monomers must be present in the cytosol for mRNA to pick up
- D. mRNA links with tRNA that is carrying complementary amino acids

Question 12

mRNA, tRNA and rRNA are all subunits of RNA. A similarity between each of the subunits is that

- A. all are found in the nucleus and cytosol
- B. all are single stranded
- C. all have exons which are expressed and introns which are removed during RNA processing
- D. all are found in eukaryotes but not prokaryotes

Question 13

The advantage of the degenerate triplet code is that it

- A. allows for more than one protein to be made by the same DNA
- B. can be found in all organisms allowing for transgenic organisms to be made
- C. reduces the effect of point mutations on the amino acid sequences
- D. ensures that the thymine base is correctly transcribed to the uracil base in RNA

Question 14

RNA processing is an important step in Eukaryotic protein production. RNA processing allows organisms to produce over 90000 proteins from just 26000 genes. This is because

- A. exons are removed allowing introns to be expressed
- B. a Poly A tail and methyl cap are added
- C. alternative RNA splicing removes all introns and some exons depending on the protein being made
- D. the spliceosome removes only the introns that are not needed, adding extra exons from other genes where required

Question 15

Translation is the name of the process where mRNA and tRNA moves to the ribosome and a polypeptide is formed. Upon entry to the ribosome

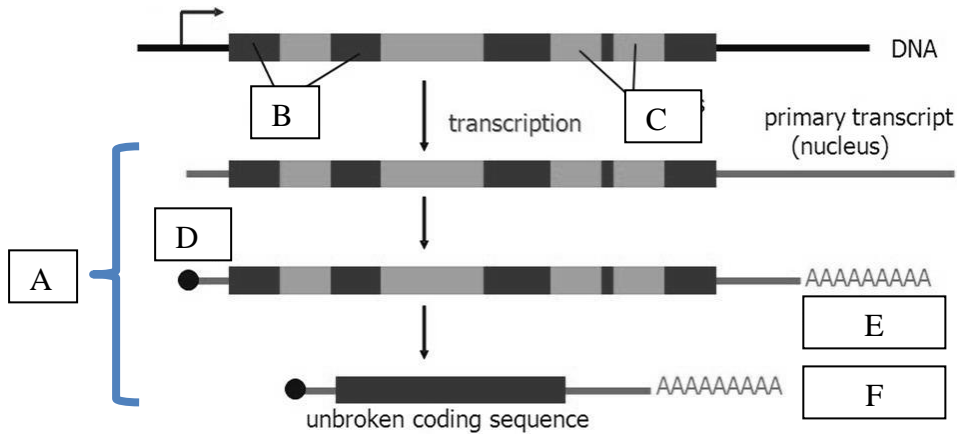
- A. the methyl cap is removed, and a Met amino acid is put into its place as a start codon
- B. tRNA anticodons check the mRNA codon before leaving to pick up the corresponding amino acid
- C. the mRNA introns are ignored, and the exons are expressed and matched with amino acids
- D. amino acids attached to specific tRNA molecules are dropped off at the ribosome and joined via condensation reactions

SECTION B - Short-answer questions

Instructions for Section B
 Answer **all** questions in the space provided. Write using a blue or black pen.

Question 1

DNA and RNA molecules encode for protein synthesis through a series of related processes. Each of these processes has key steps that must be completed before a protein is formed. Below is one of these steps.



Modified from: <https://slideplayer.com/slide/7719572/>

a. Name process A illustrated in the diagram above

_____ 1 mark

b. Complete the table below with the corresponding structure

Label	Structure
B	
C	
D	
E	

4 marks

c. Why are structures C removed?

2 marks

d. Why are structures D and E added?

1 mark

e. Name the final product labelled F.

1 mark

f. Where does this process take place in the cell?

1 mark

g. What happens to F next?

1 mark

A genome has approximately 26000 genes which produce over 90000 proteins as part of the proteome. This is possible through a process known as alternate splicing.

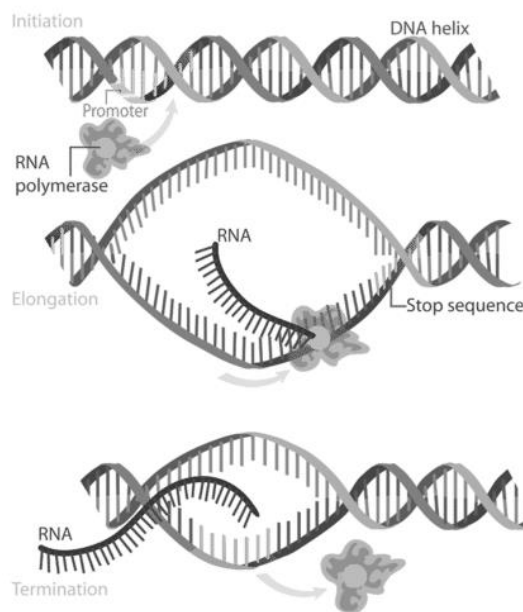
h. Explain what the term alternate splicing means and how this may lead to different proteins

3 marks

Total 14 marks

Question 2

The diagram below shows another process in protein production



Modified from: <https://courses.lumenlearning.com/wm-biology1/chapter/reading-steps-of-genetic-transcription>

a. Name the process and where it occurs?

_____ 2 marks

b. What is the name of the reaction that joins the RNA nucleotides together?

_____ 1 mark

c. Name 3 differences between RNA and DNA?

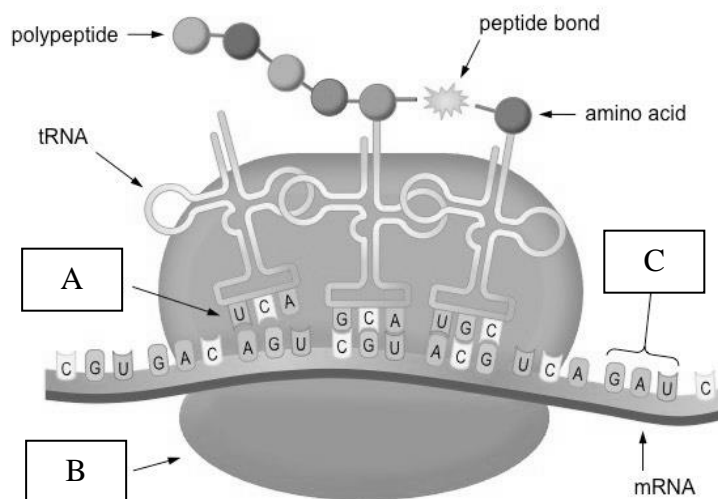
_____ 3 marks

d. The RNA that is produced is not ready to enter a ribosome and code for a protein. Explain why?

_____ 2 marks
Total 8 marks

Question 3

The diagram below shows the final process associated with coding for a protein



Source modified from <https://ib.bioninja.com.au/standard-level/topic-2-molecular-biology/27-dna-replication-transcri/translation.html>

- a. What is the name of the reaction that occurs to produce a peptide bond?

1 mark

- b. Name the structures from the diagram

Structure	
A	
B	
C	

3 marks

- c. Referring to the table below and the diagram above name the next two amino acids to be added to the polypeptide

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

2 marks

- d. Using an example from the above table explain what is meant by the term ‘degenerate code.’

2 marks

Total 8 marks

END OF KEY TOPIC TEST