

Student Name: _____



BIOLOGY 2017

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

Materials supplied

- Question book of 12 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

Answer **all** questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

In 1869 Friedrich Miescher, a German doctor, extracted a white substance from the nuclei of white blood cells that he collected from pus on soiled surgical bandages. He called the substance 'nuclein'. Today this molecule is called nucleic acid. Nucleic acids contain the instructions to produce

- A. carbohydrates.
- B. lipids.
- C. DNA.
- D. proteins.

Question 2

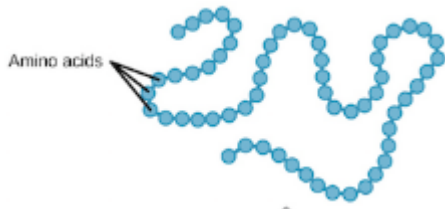
The whole set of proteins produced by a cell is called its

- A. proteome.
- B. protease.
- C. proteomic.
- D. protein library.

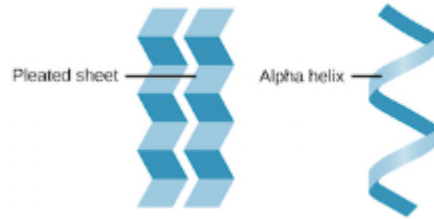
Question 3

Which of the following shows a secondary level of structure?

A.



B.



C.

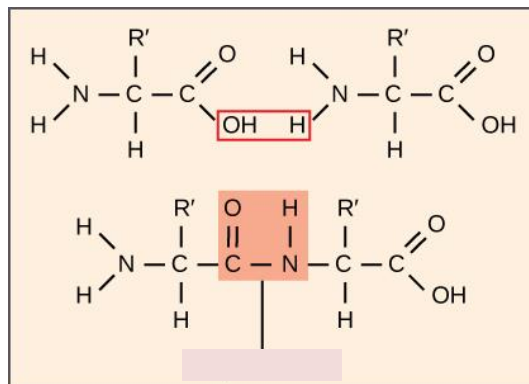


D.



Question 4

The following diagram shows the process two amino acids joining to form a dipeptide.

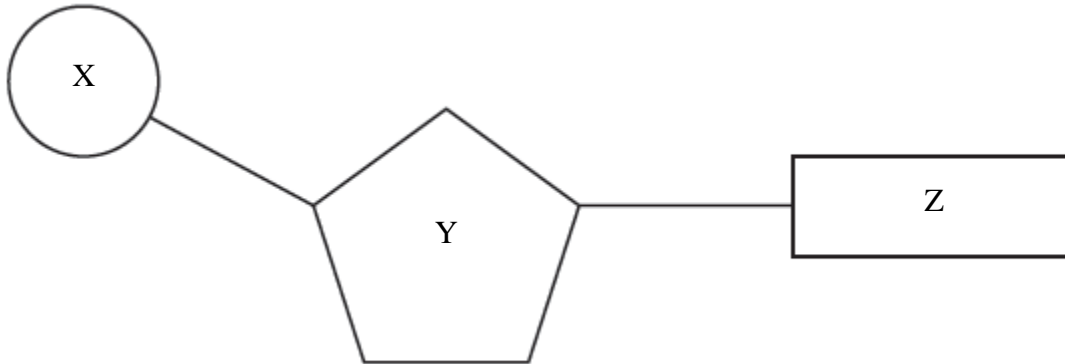


Which of the following correctly describes the type of bond present and the chemical reaction that took place?

- A.** Peptide bond, hydrolysis reaction.
- B.** Acid bond, condensation polymerisation reaction.
- C.** Peptide bond, condensation polymerisation reaction.
- D.** Acid bond, hydrolysis reaction.

Question 5

The following diagram shows a nucleotide which is the building block of nucleic acids.



Which of the following correctly labels X, Y and Z?

- A. X = base, Y = sugar, Z = phosphate group.
- B. X = phosphate, Y = base, Z = sugar.
- C. X = sugar, Y = phosphate, Z = base.
- D. X = phosphate, Y = sugar, Z = base.

Question 6

DNA and RNA are both nucleic acids that contain genetic information. Which of the following is not correct about the two molecules?

- A. DNA is double-stranded whereas RNA is single-stranded.
- B. DNA contains the sugar deoxyribose whereas RNA contains a ribose sugar.
- C. DNA contains a negatively charged phosphate group whereas RNA contains a positively charged phosphate group.
- D. DNA contains the nitrogenous base thymine whereas RNA contains the base uracil.

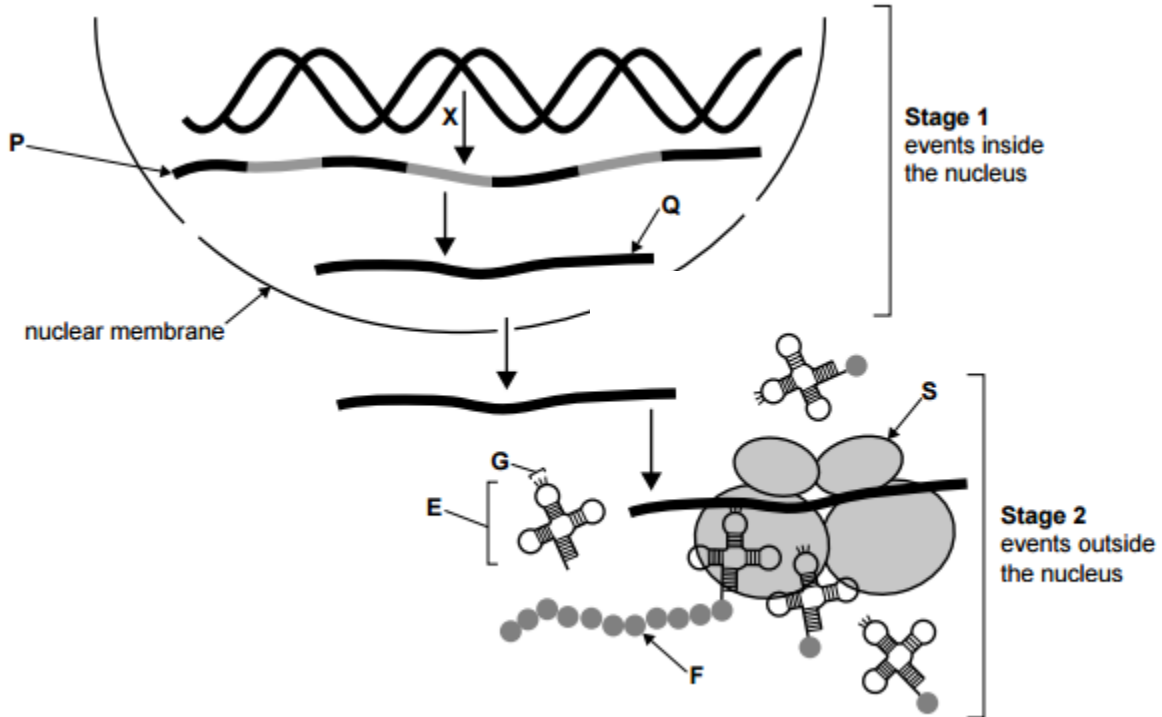
Question 7

Which of the following correctly identifies the function of tRNA?

- A. makes up the ribosome.
- B. takes the DNA code out of the nucleus.
- C. transfers proteins out of the cell.
- D. brings the correct amino acid to the ribosome.

Use the following diagram to answer Questions 8 – 10

The diagram below shows the two stages of protein production. Stage 1 occurs inside the nucleus and stage 2 occurs outside the nucleus.



Question 8

What name is given to Stage 1?

- A. Translation.
- B. Transcription.
- C. Exportation.
- D. Conversion.

Question 9

F is

- A. a carbohydrate chain.
- B. a growing polypeptide chain.
- C. a lipid tail.
- D. DNA.

Question 10

Identify **Q**.

- A. messenger RNA.
- B. messenger DNA.
- C. transfer RNA.
- D. ribosomal RNA.

SECTION B - Short-answer questions

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

Question 1

Virtually everything a cell does depends on the proteins it contains. Proteins have diverse range of functions in living things.

a. Fill in the table below identifying some of the functional diversity of proteins.

Types of protein	Function	Example
Structural		
Enzymes		
Transport		
Hormones		

8 marks

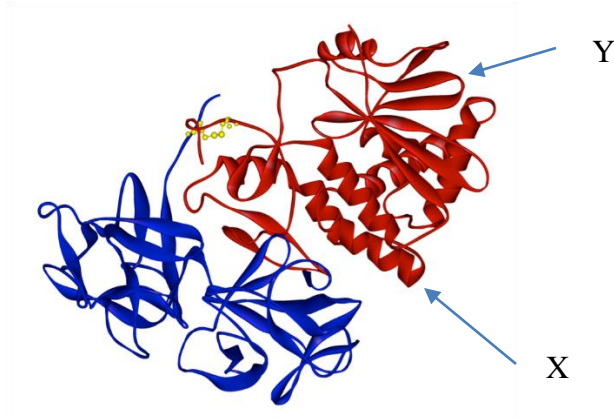
b. What is the proteome? Explain why scientists might be interested in studying the proteome.

2 marks

Total 10 marks

Question 2

Ricin is an enzymatic protein that is highly toxic to animals and insects. Found as a natural toxin in the endosperm cells that line the seed coats of the castor oil plant (*Ricinus communis*), it is one of the most poisonous naturally occurring substances known. Less than 1 mg of ricin can kill an adult human. Ricin is just one of the many cytotoxic proteins produced by plants. The diagram below shows the structure of this protein.



The protein consists of two chains, a Ricin A chain (RTA) which is composed of 267 amino acids and a Ricin B chain (RTB) which is composed of 262 amino acids. Both protein chains must be present in order to produce toxic effects.

a. Ricin is a globular protein with four different levels of structure that give rise to its final structure.

i. What level of structure is indicated in the diagram above by labels X and Y?

ii. Identify the structural name of X and Y.

X: _____ Y: _____

iii. Ricin is made up of two chains, what name is given to its final structure?

- iv. A change in the sequence of the RTA can occur randomly during its synthesis. What level of structure will this change and what effect will it have on the overall function of the protein?

1 + 2 + 1 + 2 = 6 marks

- b. Ricin is classified as a ribosome inactivating protein. Describe how inactivating ribosomes in cells will affect the cell.

2 marks

Total 8 marks

Question 3

In 1966, the complete genetic code (see table below) was determined, a triumph of modern biology. The genetic code shows the relationship between the triplets of bases in mRNA and the amino acids that are translated from the mRNA code. From this is it possible to work out the relationship between the bases in the original DNA and the amino acids that result.

		MIDDLE LETTER					
		U	C	A	G		
FIRST LETTER (5' END)	U	UUU } phenyl - alanine	UCU } Serine	UAU } Tyrosine	UGU } Cysteine	THIRD LETTER (3' END)	U
		UUC } Leucine	UCC } Serine	UAC } Tyrosine	UGC } Cysteine		C
		UUA } Leucine	UCA } Serine	UAA* } Stop	UGA* } Stop		A
		UUG } Leucine	UCG } Serine	UAG* } Stop	UGG } Trypto - phan		G
C	CUU } Leucine	CCU } Proline	CAU } Histidine	CGU } Arginine	U		
	CUC } Leucine	CCC } Proline	CAC } Histidine	CGC } Arginine	C		
	CUA } Leucine	CCA } Proline	CAA } Glutamine	CGA } Arginine	A		
	CUG } Leucine	CCG } Proline	CAG } Glutamine	CGG } Arginine	G		
A	AUU } Isoieu - cine	ACU } Threonine	AAU } Asparagine	AGU } Serine	U		
	AUC } Isoieu - cine	ACC } Threonine	AAC } Asparagine	AGC } Serine	C		
	AUA } Methio - nine	ACA } Threonine	AAA } Lysine	AGA } Arginine	A		
	AUG [†] } Methio - nine	ACG } Threonine	AAG } Lysine	AGG } Arginine	G		
G	GUU } Valine	GCU } Alanine	GAU } Aspartic acid	GGU } Glycine	U		
	GUC } Valine	GCC } Alanine	GAC } Aspartic acid	GGU } Glycine	C		
	GUA } Valine	GCA } Alanine	GAA } Glutamic acid	GGA } Glycine	A		
	GUG [†] } Valine	GCG } Alanine	GAG } Glutamic acid	GGG } Glycine	G		

a. The following is a sequence of codons identified on a section of DNA: - – TTA – CCA – GGG – CCT – TCA –

i. What amino acid sequence would be generated from this DNA sequence?

_____ 1 mark

ii. Before the DNA is converted in an amino acid sequence, it must first be converted into RNA. Both DNA and RNA are nucleic acids but have some key differences. Complete the table below, identifying the differences between DNA and RNA.

	DNA	RNA
No. of strands		
Sugar		
Bases		

iii. Why is the genetic code also known as the ‘universal genetic code’?

_____ 1 + 6 + 1 = 8 marks

b. The process of converting the genetic information stored in DNA to protein occurs in two stages. The first stage occurs in the nucleus and results in the formation of mRNA which is then free to leave the nucleus. Before the mRNA is produced an intermediate product is formed directly from the DNA.

i. What is this intermediate product called?

ii. Describe the changes that occur to this intermediate product to form mRNA.

1 + 2 = 3 marks

Total 11 marks

Question 4

Proteins are polymers made up of monomers that are joined together via a chemical reaction

a. What is the monomer that proteins are made up of?

1 mark

b. Identify the name of the chemical reaction that occurs when the monomers of proteins react. What by-product is formed?

2 marks

c. RNA is critical for the formation of proteins. Complete the following table.

Form of RNA	Function
mRNA	
tRNA	
rRNA	

3 marks

Total 6 marks

END OF KEY TOPIC TEST