

1 Transcription and translation are processes involved in the synthesis of proteins.

(a) Put a cross ☒ in the box to complete each of the following statements.

(i) Individual mononucleotides in a molecule of mRNA are joined together by (1)

- A glycosidic bonds
- B hydrogen bonds
- C peptide bonds
- D phosphodiester bonds

(ii) The maximum number of amino acids coded for by a molecule of mRNA that is 600 mononucleotides long is (1)

- A 100
- B 200
- C 300
- D 600

(iii) When a gene that contains 22% adenine is transcribed, the mRNA produced will have (1)

- A 22% adenine
- B 0% cytosine
- C 0% thymine
- D 28% uracil

(b) Describe the structure of a mononucleotide found in RNA.

(2)

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*(c) Describe the process of protein synthesis that occurs in the cytoplasm.

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(Total for Question 1 = 10 marks)

2 The diagram below shows the sequence of bases in a short length of mRNA.



(a) (i) Place a cross ☒ in the box next to the letter that shows the DNA sequence which is complementary to the **first four** of these bases.

(1)

A

T	A	C	C
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B

T	U	C	C
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C

U	A	C	C
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D

U	T	C	C
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(ii) State the maximum number of amino acids coded for by this length of mRNA.

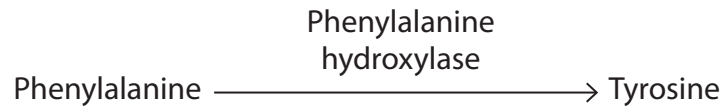
(1)

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(b) Name the process by which mRNA is formed in the nucleus.

(1)

(c) Phenylalanine is an amino acid found in many proteins in the human diet.

In most people it is converted to the amino acid tyrosine by an enzyme, as shown in the diagram below.



Phenylketonuria is the result of a gene mutation.

People with phenylketonuria cannot convert phenylalanine to tyrosine.

Explain why people with this gene mutation cannot convert phenylalanine to tyrosine.

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(d) Explain why a gene mutation involving the replacement of one base with another has less effect than the loss of a base.

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(Total for Question 2 = 9 marks)

3 *(a) Explain how the expression of a gene mutation in a person with cystic fibrosis causes a build-up of mucus in their respiratory system.

(5)

A series of horizontal dotted lines for writing the answer.

(b) Describe **one** way in which gene therapy could be used to treat cystic fibrosis.

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(Total for Question 3 = 8 marks)

- 4 The Atlantic tomcod is a fish found in the rivers of North America.
The photograph below shows an Atlantic tomcod.



Magnification $\times 1$

Atlantic tomcod in the Hudson River are able to survive high levels of polychlorinated biphenyls (PCBs). PCBs enter the water from industrial processes.

One group of scientists identified a mutation in the DNA of these fish. They found that the AHR2 gene had six bases missing. This mutation was rarely found in Atlantic tomcod in the unpolluted St. Lawrence River.

- (a) Suggest how scientists in other countries learnt of these findings.

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* (b) (i) Describe how the DNA and protein of Atlantic tomcod from the Hudson River could be compared with the DNA and protein of Atlantic tomcod from the St. Lawrence River.

(6)

(ii) Suggest **one** similarity in the DNA of the Atlantic tomcod from these two rivers.

Give an explanation for your answer.

(2)

(iii) Suggest **one** difference in the protein of the Atlantic tomcod from these two rivers.

Give an explanation for your answer.

(2)

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(Total for Question 4 = 12 marks)

5 DNA is a very important molecule in living organisms as it carries the genetic code. Before a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

(a) Explain the nature of the genetic code.

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*(b) Describe the process of DNA replication.

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(Total for Question 5 = 7 marks)