BIOLOGY MIND

Edexcel

A-Level

BIOLOGY

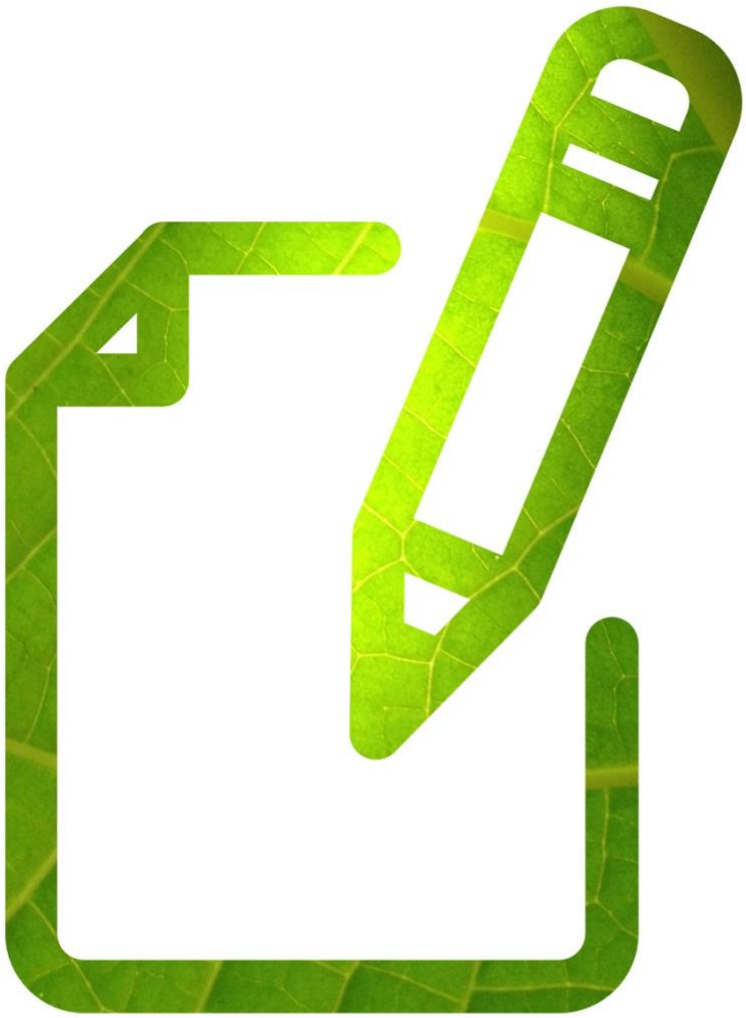
Biological Molecules

DNA & Protein Synthesis 1

Time allowed

56 minutes

QUESTION PAPER

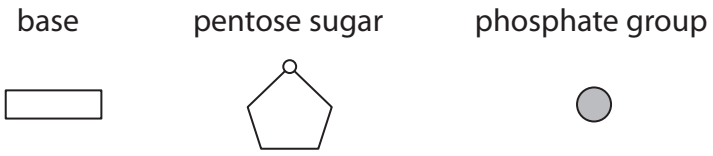


Score	Percentage
/47	%

1 The polynucleotides, DNA and RNA, are involved in the process of protein synthesis.

(a) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

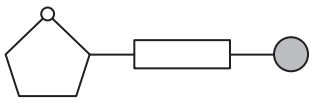
(i) A mononucleotide consists of three components represented by the diagrams below.



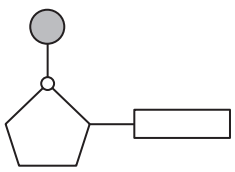
The diagram that shows the correct arrangement of these components in a mononucleotide is

(1)

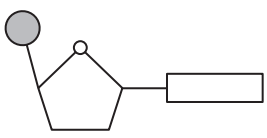
☐ **A**



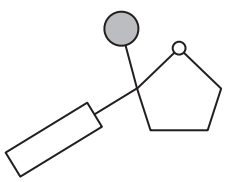
☐ **B**



☐ **C**



☐ **D**



(ii) During transcription of the section of DNA shown below, **a single base** is paired **incorrectly**.

C - T - A - A - C - T - G - C - A

This transcription error results in an mRNA molecule with the following sequence.

(1)

☒ **A** C - A - T - T - G - A - C - G - T

☒ **B** G - A - U - U - C - A - C - G - U

☒ **C** G - A - U - U - G - A - C - G - U

☒ **D** G - T - U - U - G - U - C - G - U

(iii) The following stages occur in the production of a protein from a section of DNA:

1. the mRNA molecule leaves the nucleus
2. peptide bonds form between adjacent amino acids
3. the base sequence is transcribed
4. the tRNA anticodons pair with the mRNA codons.

The sequence of events occurs in the following order.

(1)

☒ **A** 1 3 4 2

☒ **B** 2 4 1 3

☒ **C** 3 1 4 2

☒ **D** 3 4 1 2

(b) The diagram below shows the sequence of bases in part of a messenger RNA molecule that codes for the amino acids in a polypeptide chain.

A - U - G - G - C - C - U - C - G - A - U - A - A - C - G - G - C - C - A - C - C - A - C - C

(i) State the maximum number of amino acids in the polypeptide chain produced from this part of the messenger RNA molecule.

(1)

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(ii) State the number of different tRNA molecules that would be used to produce the polypeptide chain from this part of the messenger RNA molecule.

(1)

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(c) State **three** differences between the structure of DNA and the structure of RNA.

(3)

1 .....

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2 .....

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3 .....

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(Total for Question 1 = 8 marks)

2 The scientific article you have studied is from *Science News*.

Use the information from the article and your own knowledge to answer the following questions.

(a) Ginkgo BioWorks could engineer a bacterium to 'suck carbon dioxide out of the atmosphere' (paragraph 5).

(i) Suggest why there may be a need to 'suck carbon dioxide out of the atmosphere'.

(2)

*(ii) Suggest how Ginkgo BioWorks could engineer such a bacterium.

(6)

(b) The bacterium *Mycoplasma* has the 'shortest known genome' (paragraph 13). This bacterium contains only 525 genes.

Calculate the mean number of bases per *Mycoplasma* gene.

Show your working.

(2)

Answer = ... bases

(c) (i) Describe how 'building a stretch of DNA' would differ from 'building a stretch of RNA' (paragraph 21).

(3)

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(ii) Suggest why the scientists would 'insert the whole thing into a circular strand of DNA until they need it' (paragraph 21).

(1)

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(d) Suggest how 'three genes inhibited one another in sequence, their activity cycling regularly' (paragraph 26).

(3)

(e) A metabolic pathway is a many-stepped process.

Suggest the features of a metabolic pathway 'through which bacteria convert atmospheric nitrogen to ammonia' (paragraph 32).

(4)

(f) Weiss and his team are 'working to harness a virus that could be used to test the idea in mice' (paragraph 40).

Suggest **two** features of the virus selected for this role.

(2)

(g) After 'testing the idea in mice', phase 1 testing must be carried out (paragraph 40).

Explain why phase 1 testing must be carried out before using this treatment on a patient with cancer.

(3)

(h) 'Synthetic gene circuits could steer stem cells to develop into insulin-producing cells' (paragraph 41).

Describe **three** differences between a stem cell and an insulin-producing cell.

(3)

1. .....

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2. .....

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3. .....

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(i) Suggest why it is necessary to 'keep track of exposure to things like radiation within a cell' (paragraph 45).

(1)

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(Total for Question 2 = 30 marks)

3 One function of DNA is to act as a template for the synthesis of messenger RNA.

(a) State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

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

(i) DNA and mRNA both

(1)

☒ **A** contain ribose

☒ **B** contain thymine

☒ **C** have a double helix structure

☒ **D** have a sugar-phosphate chain

(ii) One advantage of DNA having two complementary strands is that

(1)

☒ **A** diploid cells can inherit DNA from both parents

☒ **B** hydrolysis of DNA is faster

☒ **C** semi-conservative replication is possible

☒ **D** transcription and replication can occur at the same time

(iii) Analysis of a sample of DNA found that 40% of the nucleotides contained cytosine. In the same sample of DNA the percentage of nucleotides containing adenine would be

(1)

☒ **A** 10%

☒ **B** 20%

☒ **C** 40%

☒ **D** 60%

(c) The DNA base sequence for part of a gene is shown below.

A	C	T	T		C	G	C	C	C	G	A

Write the mRNA base sequence produced from this sequence of bases.

(2)

(d) Describe **three** differences between the processes of replication and transcription of DNA.

(3)

1 .....

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2 .....

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3 .....

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(Total for Question 3 = 9 marks)