GCE AS/A Level – LEGACY

1071/01

HUMAN BIOLOGY – BY1

THURSDAY, 24 MAY 2018 – AFTERNOON

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you may need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
The quality of written communication will affect the awarding of marks.
1. (a) Complete the table below to compare the structures of plant cells, bacteria and viruses by placing a tick (✓) in the appropriate boxes. Each row may have one or more than one tick.

<table>
<thead>
<tr>
<th>structural feature</th>
<th>plant cell</th>
<th>bacteria</th>
<th>virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>may contain mitochondria</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>have cell walls</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>may contain DNA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>may contain chloroplasts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>do not have a membrane-bound nucleus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>may have plasmids</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) The diagram below shows a generalised animal cell.
With reference to the structures labelled A to F in the diagram opposite, answer the following questions.

(i) Which structure, or structures, would be found in a bacterial cell? [1]

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(ii) Describe one difference in the function of the structures labelled E and F. [2]

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(iii) What is the relationship between structures A and B? [1]

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2. The diagram below shows two amino acids.

\[
\begin{align*}
\text{CH}_2\text{OH} & \quad \text{CH}_3 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\text{C} & \quad \text{C} \\
\text{COOH} & \quad \text{COOH} \\
\text{H} & \quad \text{H}
\end{align*}
\]

(a) (i) Identify the \textbf{R} group of one of the amino acids \textbf{by drawing a ring around it}. [1]

(ii) Using suitable molecular diagrams, show how the two amino acids shown above would be joined together to form a dipeptide. [2]

(b) Explain what is meant by the \textbf{tertiary structure} of a protein molecule. [2]

(c) A protein in solution can be detected in the laboratory.

(i) Name the reagent that you would use. [1]

(ii) What would be the colour of a positive reaction? [1]
(d) Why is collagen referred to as a **fibrous protein**?
3. (a) The diagram shows the structure of a DNA nucleotide.

Identify the parts of the nucleotide labelled X and Y. [2]

X ....................................................................................................................

Y .....................................................................................................................

(b) The table below shows the percentage composition of bases in the DNA of cattle and octopus.

<table>
<thead>
<tr>
<th>organism</th>
<th>percentage composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adenine</td>
</tr>
<tr>
<td>cattle</td>
<td>29</td>
</tr>
<tr>
<td>octopus</td>
<td>33</td>
</tr>
</tbody>
</table>

(i) Complete the table by calculating and inserting the missing values. [2]

(ii) Explain how you used your knowledge of the structure of DNA to calculate the missing values. [2]

(c) Describe two differences between the structure of DNA and RNA. [2]
4. Fructose can be made from glucose using the enzyme isomerase. This enzyme can be immobilised and glucose is allowed to flow over the immobilised enzyme. A high proportion of the glucose is converted to fructose.

(a) (i) What is meant by the term **immobilised enzyme**. [1]

(ii) Suggest **two** advantages of using immobilised enzymes in this industrial process. [2]

I. ............................................................................................................................................................................................

II. ...........................................................................................................................................................................................

(b) The graph shows the effect of changing the flow rate of the glucose solution on the rate of fructose production.
(i) The rate of flow was increased from 2.5 to 4.5 dm$^3$ min$^{-1}$.
Calculate the increase in fructose production per hour. Show your working. [3]

Answer: ..........................................................

(ii) Explain what is happening at flow rates above 6 dm$^3$ min$^{-1}$. [2]

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5. All cells are surrounded by a membrane.

(a) Describe **three** functions of the cell membrane. [3]

The currently accepted model of the structure of biological membranes is known as the fluid-mosaic model.

(b) (i) Name the **class** of biologically important chemicals which form the main components of the parts labelled X, Y and Z. [3]

X .....................................................................................

Y .....................................................................................

Z .....................................................................................

(ii) **Draw a labelled diagram** to show the arrangement of molecules in part Y. [3]
(c) The model is described as fluid because the component molecules are free to move about. Evidence for this includes experiments like the one shown below, in which component molecules X are labelled with a dye.

Using the information above, suggest how the colour was restored to the bleached area. [2]
6. An enzyme extract was added to a known concentration of substrate and the rate of reaction monitored every two minutes over a twenty minute period. The results are plotted on the graph below.

(a) State two factors that should have been controlled in this experiment in order to obtain valid results. [2]

I. ...............................................................................................................................................................................................

II. ...............................................................................................................................................................................................

(b) (i) Explain why the region labelled A on the graph is horizontal. [1]

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(ii) Explain the shape of the region labelled B on the graph. [1]

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(c) The experiment was repeated using an enzyme extract at half the original concentration. Draw accurately on the graph the expected results at this enzyme concentration. [3]
7. (a) State the water potential of pure water. ........................................ kPa

(b) The diagrams below show the water potential in three plant cells which are in contact with each other.

Using the equation

\[ \Psi_{\text{cell}} = \Psi_p + \Psi_s \]

answer the following questions. [2]

(i) Calculate the solute potential of cell F. ........................................ kPa

(ii) Calculate the pressure potential of cell G. ........................................ kPa

(c) (i) Which cell would gain the most water from the other cells? ........................................ [1]

(ii) Which cell would lose most water? ........................................ [1]

(d) What term is used to describe the process by which a plant cell loses water until its plasma membrane draws away from its cell wall? ........................................ [1]

(e) What would happen to an animal cell placed in a hypotonic solution? ........................................ [1]
8. **Answer one** of the following questions.

   Any diagrams included must be fully annotated.

   **Either; (a)** Describe the stages of mitosis. [10]

   **Or. (b)** Describe the structure and functions of lipids in plants and animals. [10]