GCE A Level – **LEGACY**

1074/02

**HUMAN BIOLOGY – HB4**

THURSDAY, 7 JUNE 2018 – MORNING

1 hour 45 minutes

### ADDITIONAL MATERIALS

In addition to this examination paper, you will 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. The following terms refer to the nitrogen cycle.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>primary consumer</td>
</tr>
<tr>
<td>B</td>
<td>secondary consumer</td>
</tr>
<tr>
<td>C</td>
<td>saprotroph</td>
</tr>
<tr>
<td>D</td>
<td>legume</td>
</tr>
<tr>
<td>E</td>
<td>nitrogen fixing bacteria</td>
</tr>
<tr>
<td>F</td>
<td>nitrification</td>
</tr>
<tr>
<td>G</td>
<td>excretion</td>
</tr>
<tr>
<td>H</td>
<td>egestion</td>
</tr>
<tr>
<td>I</td>
<td>denitrification</td>
</tr>
</tbody>
</table>

Select from the list above, the letter of the most appropriate term that matches each statement below. [5]

(i) a plant in which atmospheric nitrogen is converted into nitrogen containing compounds.

(ii) a type of organism that breaks down the bodies of dead plants and animals

(iii) the release of undigested food from an animal

(iv) the process of removing nitrogenous waste from an organism

(v) the conversion of ammonium ions to nitrate ions
2. Septicaemia is a condition in which bacteria move into the bloodstream and multiply rapidly. Toxins are secreted and can cause severe damage to vital organs. It is important to identify the bacteria causing the condition correctly so that the best treatment can be given.

*Listeria monocytogenes* is one of a large number of bacteria that are known to cause septicaemia. It is a Gram positive bacillus.

Bacteria can be cultured in the laboratory and can be identified in several ways. One of these involves staining and examining the bacteria under a microscope.

(a) (i) Describe the shape of *Listeria monocytogenes*. [1]

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(ii) State the result of staining these bacteria with Gram stain and explain what this would tell you about the structure of its cell wall. [3]

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(iii) Could septicaemia caused by *Listeria monocytogenes* be treated with penicillin? Explain your answer. [2]

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Growing the bacteria under different levels of oxygen in a liquid culture medium can also be used to identify bacteria. *Listeria monocytogenes* is described as being a facultative anaerobe.

The drawing shows the appearance of three cultures of bacteria in liquid culture medium.

![Diagram of three cultures of bacteria](image)

**(b)**

(i) **Explain why the bacteria growing in tube 1 are described as being obligate anaerobes.**

(ii) **Describe the distribution of the bacteria in tube 2 and explain why this tube could show the expected growth pattern for *Listeria monocytogenes*.**
3. There are three main stages in aerobic respiration, glycolysis, Kreb’s cycle and the electron transport chain.

(a) (i) State precisely where each of these stages occur. [2]

glycolysis ................................................................................
Kreb’s Cycle ............................................................................
electron transport chain ..........................................................

(ii) Describe the reactions that link glycolysis to Kreb’s cycle. [3]

The diagram below shows an outline of Kreb’s cycle.
(b) (i) Name the type of enzyme involved at P and Q in this sequence of reactions. [1]
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(ii) Name the waste product produced at P and Q. [1]
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(c) ATP can be produced directly from Kreb’s cycle or indirectly by the electron transport chain using reduced NAD and FAD produced in Kreb’s cycle.

(i) Name the type of reaction in which ATP is produced directly from Kreb’s cycle. [1]
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(ii) State how many ATP molecules are produced by this type of reaction in Kreb’s cycle from the oxidation of one molecule of glucose. [1]
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(iii) Complete the table below to show how many ATP molecules could be produced indirectly through the electron transport chain for one molecule of glucose. [2]

<table>
<thead>
<tr>
<th></th>
<th>using reduced NAD from Kreb’s cycle</th>
<th>using reduced FAD from Kreb’s cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of ATP molecules produced</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(iv) Explain why reduced NAD and reduced FAD lead to the production of different numbers of ATP molecules. [1]
4. Humans have many protective responses called reflexes.

(a) Explain why reflex actions are protective. [2]

(b) Simple reflexes involve the neurones shown in the diagram below.

(i) Name the types of neurone labelled A, B and C. [1]

A ........................................................................................................................................................................................

B ........................................................................................................................................................................................

C ........................................................................................................................................................................................

(ii) Draw an arrow on each of these three neurones to show the direction of the passage of an action potential. [1]
(c) The diagram below shows the structure of the neurone labelled A opposite.

Name the structures labelled X and Y. [2]

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

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

(d) One symptom of Alzheimer’s disease is a reduction in the levels of acetylcholine in the brain. Describe the sequence of events by which acetylcholine in synaptic vesicles causes an action potential to be generated in a postsynaptic neurone. [4]
(e) The diagrams below show neurones from the brains of a healthy 70 year old, A, and a 70 year old with Alzheimer's disease, B.

(i) Describe **two** differences between the neurones shown in the diagram. [2]

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

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

(ii) Suggest how these changes could lead to a reduction in acetylcholine levels. [1]

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5. The electron micrograph below shows part of a nephron.

(a) (i) Name structures J and L. [2]

J...................................................................................................................................................
L...................................................................................................................................................

(ii) Name the region of the kidney where these structures would be found. [1]

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(iii) In a live nephron, structure J would contain a solution of substances that would be passed into structure K. Describe briefly how this solution would be formed. [3]

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(iv) The inner wall of structure J contains specialised cells called podocytes. Explain how they are adapted to their role in the formation of this solution. [2]
(b) The solution found at J and K would contain both waste and useful substances. Useful substances would be reabsorbed into the blood in structure K.

(i) Explain why the process that would have taken place in K is known as selective reabsorption. [1]

(ii) Tick (√) the correct boxes in the table below to show how some useful substances are reabsorbed. [3]

<table>
<thead>
<tr>
<th>molecule</th>
<th>facilitated diffusion</th>
<th>active transport</th>
<th>osmosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>amino acids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glucose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium ions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(c) The permeability of the walls of the collecting duct and distal convoluted tubule are controlled by a hormone. Name this hormone and explain how a high blood level of this hormone would affect the volume and concentration of urine produced. [3]
6. (a) Skeletal muscle is made of fibres called slow twitch and fast twitch fibres. The type of training used by marathon runners has been shown to increase the relative proportions of slow twitch fibres.

(i) Describe **two** differences between slow twitch and fast twitch muscle fibres. [2]

(ii) Describe **one other** change that takes place in muscles during endurance training and explain the benefit of this change to a marathon runner. [2]

(b) The diagram below shows a section through part of one muscle fibre taken from skeletal muscle.

![Diagram of muscle fibre]

**Label the diagram** to show the positions of the following: [3]

(i) M line
(ii) Z line
(iii) I band
(iv) **one** sarcomere
(c) In the space below draw the muscle section shown opposite as it would appear following contraction. Label the actin and myosin filaments clearly. [3]
7. The diagram below summarises the light dependent stage of photosynthesis.

(a) State precisely where the light dependent stage takes place. [1]

(b) Name the process by which ADP is converted into ATP as shown in the diagram. [1]

(c) Name the group of biological molecules to which ATP belongs. [1]

(d) Explain the role of water in the light dependent stage. [3]
8. Answer one of the following questions.

Any diagrams included must be fully annotated.

Either; (a) Give an account of anaerobic respiration in humans and describe how the end product is removed after exercise. [10]

Or. (b) (i) Describe and explain the shape of a bacterial population growth curve. [4]

(ii) Describe how and explain why the shape of a human population growth curve differs from that of a bacterial growth curve. [6]