

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1074/02

HUMAN BIOLOGY – HB4

A.M. WEDNESDAY, 25 January 2012

1³/₄ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	4	
2	14	
3	12	
4	15	
5	14	
6	11	
7	10	
Total	80	

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. Describe the role in the nitrogen cycle of each of the bacteria named below.

(a) *Azotobacter* [1]

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(b) *Nitrobacter* [1]

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(c) *Nitrosomonas* [1]

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(d) *Rhizobium* [1]

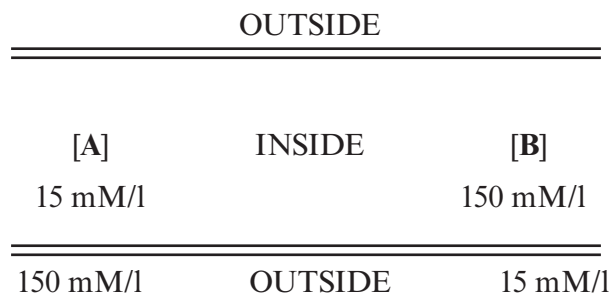
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(Total 4 marks)

2. The diagram below represents part of the axon of a nerve cell.

In the resting cell, the ions **A** and **B** diffuse across the membrane.



(a) (i) I Draw arrows on the diagram to indicate the direction of diffusion in each case. [1]

II Name **A** and **B**. [1]

A **B**

(ii) The membrane is more permeable to one of these ions. Which one? [1]

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(b) (i) What is the resting potential across the membrane? [1]

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(ii) Give a full explanation of the way in which this potential is maintained. [3]

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(c) The function of most motor nerve cells is the activation of muscle cells. Muscle cells are classified as either slow twitch or fast twitch cells.

(i) Apart from the length of time of each individual contraction, give **two** differences between slow and fast twitch muscle. [2]

1.

2.

(ii) What is the importance of each of these two types of muscle cell for athletic performance? [2]

Fast:

Slow:

(d) (i) Name the disease that causes degeneration in the nerves supplying muscles. [1]

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(ii) Give **two** symptoms of this disease. [2]

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(Total 14 marks)

3. The electron transport chain provides the energy for ATP synthesis in both animals and plants. Fill in the boxes in the table below to show the differences between the electron transport chain in respiration and photosynthesis.

		<i>Respiration</i>	<i>Photosynthesis</i>	
(a)	Name the organelle in which ATP is produced.	.....	.....	[2]
(b)	Name the source of high energy electrons for the electron transport chain.	.....	.....	[2]
(c)	Name the final electron acceptor.	.....	.....	[2]
(d)	The synthesis of ATP results from a flow of protons (H^+) across a membrane. Name the membrane.	.....	.....	[2]
(e)	The direction of proton flow across the membrane is - from to	..... .....	..... .....	[2]

- (f) Give **two** similarities between respiration and photosynthesis in their production of ATP. [2]

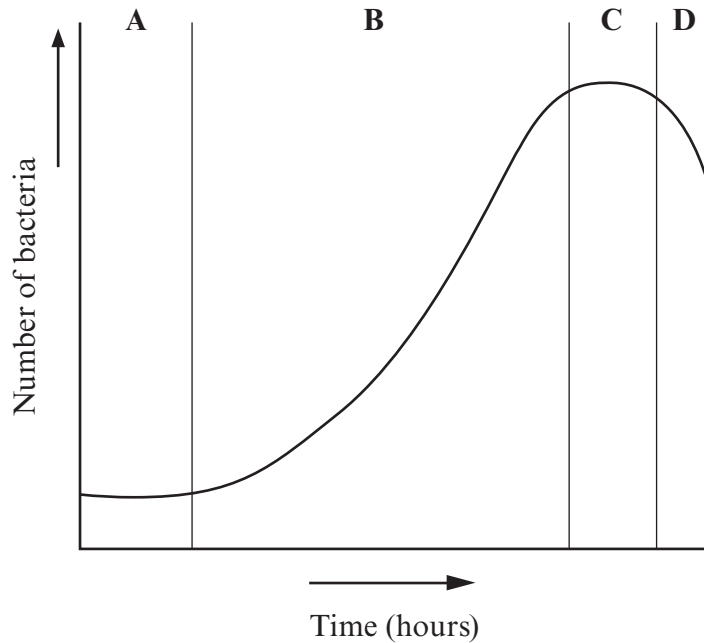
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(Total 12 marks)

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4. The graph shows the growth of a colony of bacteria in the laboratory.



At each time interval a sample was taken from the culture and serially diluted before counting the bacteria under a microscope.

(a) (i) Describe how a serial dilution is carried out. [3]

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(ii) Explain why it is necessary. [1]

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(iii) The concentration of bacteria counted in a sample after four tenfold dilutions was 85/ml. Calculate the total number of bacteria in the original culture if its volume was 20ml. Show your working. [3]

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(iv) What is the advantage of viable counts over total counts? [1]

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(b) (i) Name the four phases labelled **A**, **B**, **C** and **D** on the graph. [1]

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.....

(ii) Explain the shape of the graph in each of the four phases **A**, **B**, **C** and **D**. [4]

A

.....

B

.....

C

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D

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(c) If a continuous culture of these bacteria was to be maintained in the laboratory, a sample would be transferred to a fresh culture medium.

(i) Suggest which of the labelled phases would be the best source of this sample. [1]

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(ii) Give a reason for your choice. [1]

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(Total 15 marks)

5. Aerobic cell respiration initially releases chemical energy from glucose by a series of reactions which break glucose down to pyruvic acid.

(a) (i) What is the name given to this series of reactions which break down glucose to pyruvic acid? [1]

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(ii) Where in the cell does it take place? [1]

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(b) At the beginning of this series of reactions, glucose reacts with ATP and the phosphorylated 6-carbon sugar that is formed splits into 2 molecules of 3-carbon sugars (triose phosphates). Each triose phosphate is then oxidised to pyruvic acid. The oxidising agent is NAD which is reduced to NADH.

(i) Fill in the table, which summarises this process, for one molecule of glucose. [3]

	<i>Number of molecules</i>		
	<i>ATP used</i>	<i>ATP produced</i>	<i>NADH produced</i>
Glucose to triose phosphate			
Triose phosphate to pyruvate			

(ii) The NADH is used to produce ATP in the electron transport chain.

How many molecules of ATP are formed from each NADH molecule? [1]

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(c) The reaction $\text{ADP} + \text{P}_i + \text{H}^+ = \text{ATP} + \text{H}_2\text{O}$ required an input of 30kJ/mol to take place.

Use all of the information in (b) to calculate, in kJ/mol, the total energy stored in ATP after the conversion of 1 molecule of glucose into pyruvic acid. (Show your working).

[3]

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(d) In the next stage of respiration the pyruvic acid enters the link reaction.

(i) Describe this reaction.

[3]

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(ii) Where in the cell does this reaction take place?

[1]

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(e) Name the main source of the glucose used during exercise.

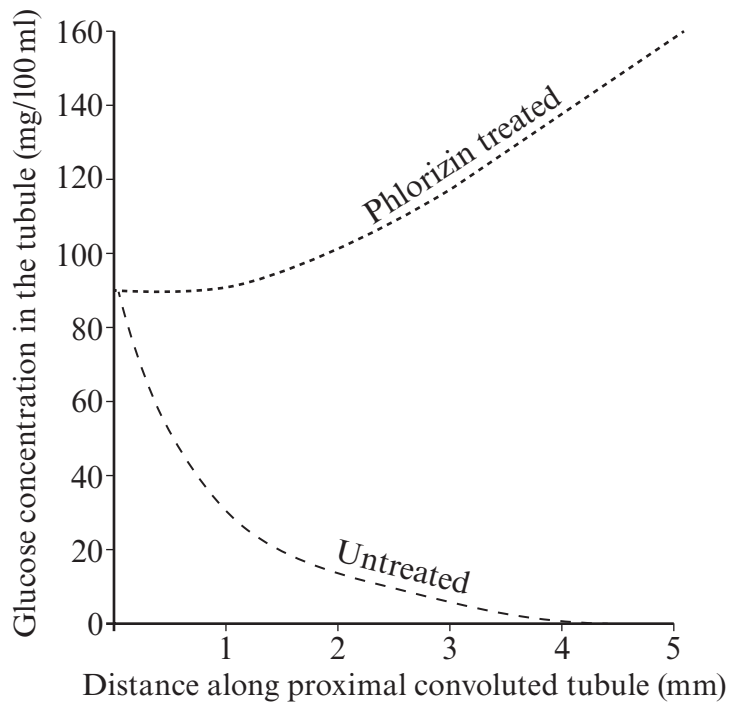
[1]

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(Total 14 marks)

6. (a) Name the part of the kidney in which the proximal and distal convoluted tubules of the nephron are found. [1]

The proximal convoluted tubule of the kidney nephron selectively reabsorbs glucose and sodium ions into the surrounding blood capillaries. The graph below shows the concentration change of glucose as the filtrate passes along the tubule. The uptake of glucose from the lumen of the tubule can be prevented completely by introducing a chemical called phlorizin, but the uptake of sodium ions is unaffected by this chemical.



- (b) (i) Suggest a reason for this change in glucose concentration in the phlorizin treated tubule. [1]

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- (ii) Explain how the sodium ions are involved in the change in glucose concentration. [3]

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- (c) State the blood glucose concentration at the start of the experiment. [1]

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- (d) (i) The blood glucose concentration is normally controlled between narrow limits by negative feedback.

State the general term for this type of control. [1]

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- (ii) If the hormone preventing a rise in blood glucose levels fails (Diabetes mellitus), glucose appears in the urine.
What does this suggest about the active transport system in the proximal convoluted tubule? [2]

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- (e) Name the other parts of the kidney where active transport of sodium ions takes place. [2]

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(Total 11 marks)

