Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/02

HUMAN BIOLOGY – HB4

A.M. TUESDAY, 11 June 2013

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**4**	
2	**13**	
3	**8**	
4	**10**	
5	**7**	
6	**18**	
7	**10**	
8	**10**	
Total	**80**	

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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.

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1. Complete the sentences below by giving the correct term in each case. [4]

(a) A clone arising from a single bacterium on an agar plate is called a

..... .

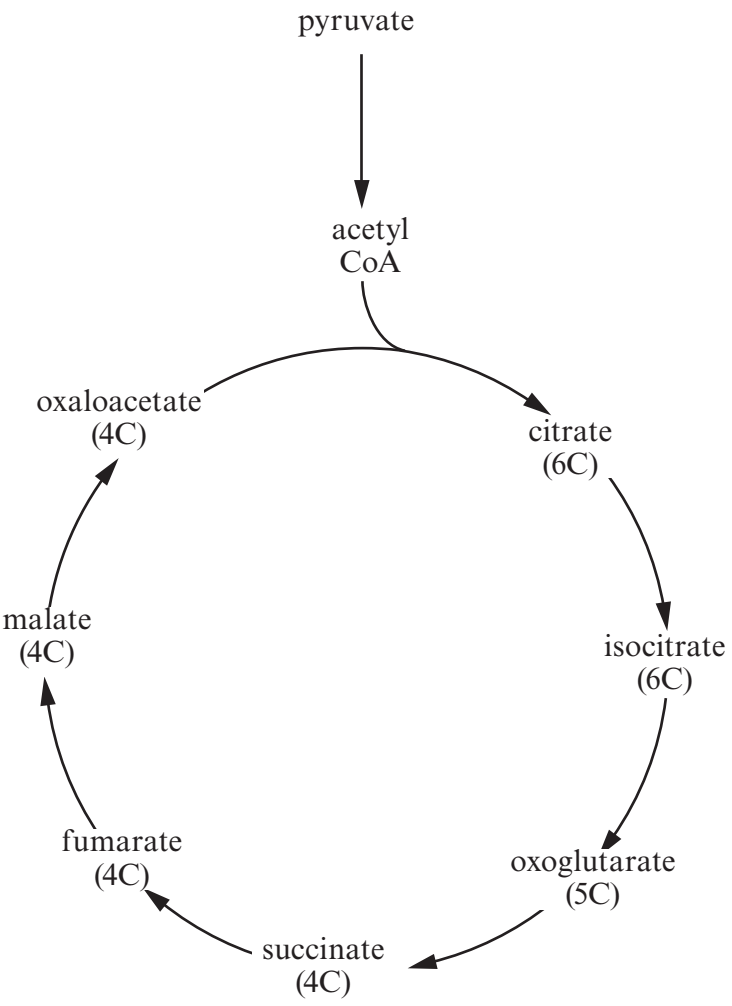
(b) A viable count is a count of ..... bacterial cells.

(c) The type of bacterium that lacks lipopolysaccharides in its cell walls is a

..... bacteria.

(d) A corkscrew or helical shaped bacterium is known as a ..... .

2. The diagram below shows the link reaction and the Krebs Cycle.
The number of carbon atoms present in some of the molecules is shown.



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(a) State **precisely** where in the cell the reactions of the Krebs Cycle take place. [2]

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(b) (i) On the diagram opposite, use **arrows** marked $\mathbf{CO_2}$ to show the points where carbon dioxide is removed. [2]

(ii) Name the process by which the carbon dioxide is removed. [1]

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(iii) Describe briefly what happens to a molecule of carbon dioxide removed in this way in a human. [3]

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(c) The role of the Krebs Cycle and glycolysis is to generate reduced NAD to be used in ATP manufacture.

Describe the way in which reduced NAD is produced in the Krebs Cycle. [3]

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(d) Reduced NAD is also produced during glycolysis.

Explain what happens to the reduced NAD under anaerobic conditions and why this is essential for glycolysis to continue. [2]

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3. *(a)* Explain what is meant by the term *homeostasis*. [2]

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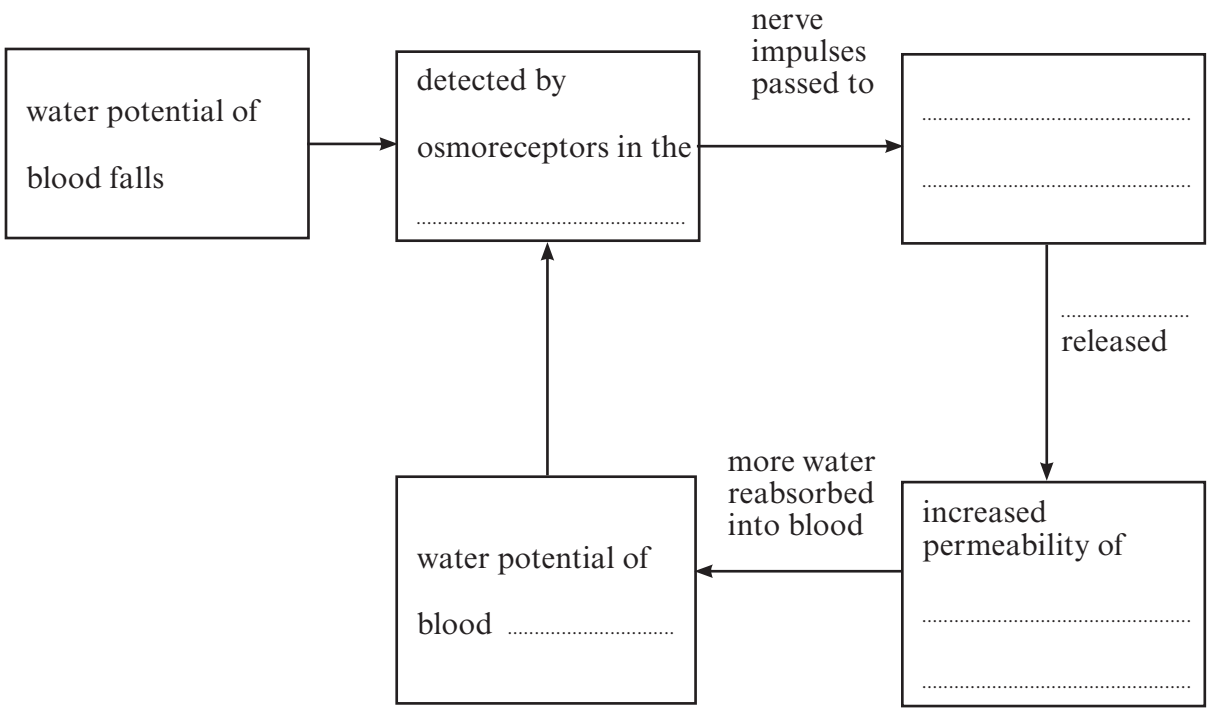
(b) Complete the diagram below showing the process of osmoregulation in the human body. [6]



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4. Vigorous exercise can result in muscle fatigue, which means muscles can no longer contract. This state is reached very quickly in people who show poor aerobic fitness.

(a) Explain why muscle becomes fatigued after vigorous exercise. [3]

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Skeletal muscle consists of two types of muscle fibre: fast twitch and slow twitch. The table below shows characteristics of these two types of muscle fibre.

features	**muscle fibre**	
	fast twitch	**slow twitch**
time taken to reach maximum contraction	fast	slow
force of contraction	high	low
time taken to become fatigued	fast	slow
aerobic capacity	low	high
anaerobic capacity	high	low
number of mitochondria	few	many
blood supply	poor	good

(b) The leg muscles of long distance athletes, such as marathon runners, contain a high proportion of slow twitch fibres.

Use the information in the table and your own knowledge to explain the advantage of this high proportion to the marathon runner. [3]

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(c) Aerobic training improves the respiratory efficiency of slow twitch fibres.

(i) Suggest **two** advantages of having a large number of capillaries around the slow twitch fibres. [2]

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(ii) Suggest **two** *other* changes that may occur in slow twitch fibres during aerobic training. [2]

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Turn over.

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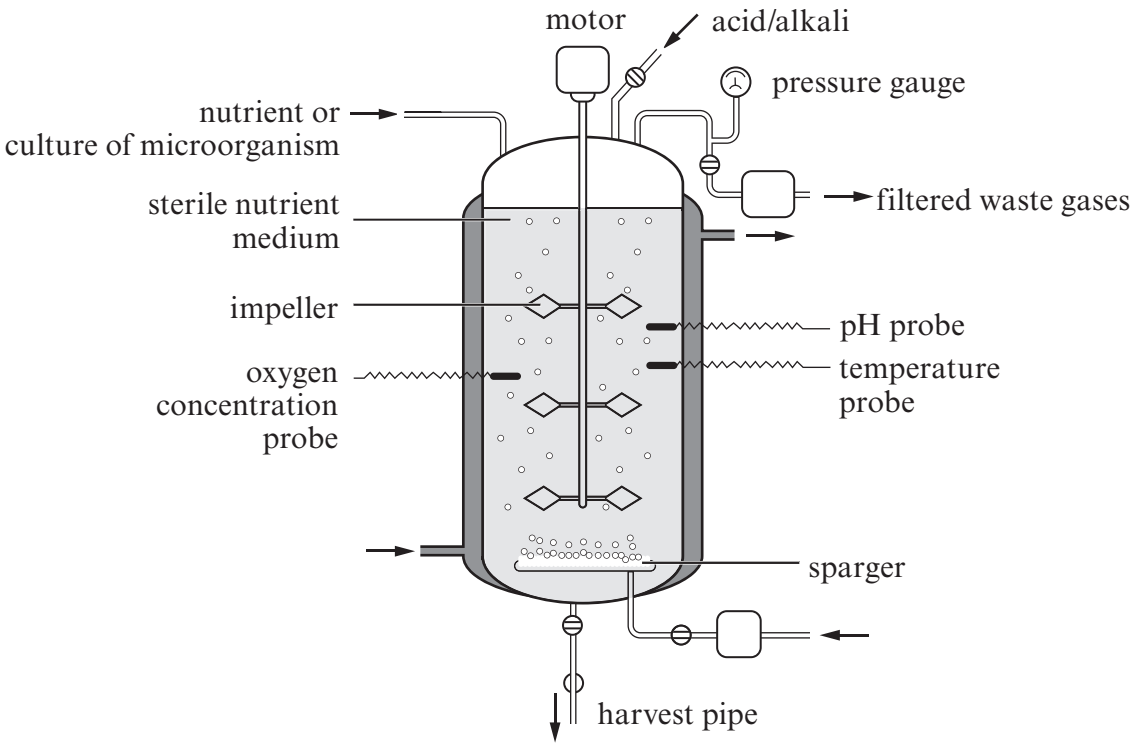
5. The diagram below shows a fermenter that has been set up to culture a microorganism and harvest a product from it.



(a) Suggest **two** reasons for the use of a sparger in fermenters. [2]

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(b) (i) Using information in the diagram opposite, suggest why the pH probe is needed. [2]

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(ii) If the microorganism in the fermenter is an obligate aerobe, state one waste gas that will need to be removed. [1]

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(iii) In the early stages of fermentation by batch culture, it may be necessary to warm the contents of the fermenter but cooling is often needed towards the end. Suggest reasons for this difference. [2]

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Turn over.

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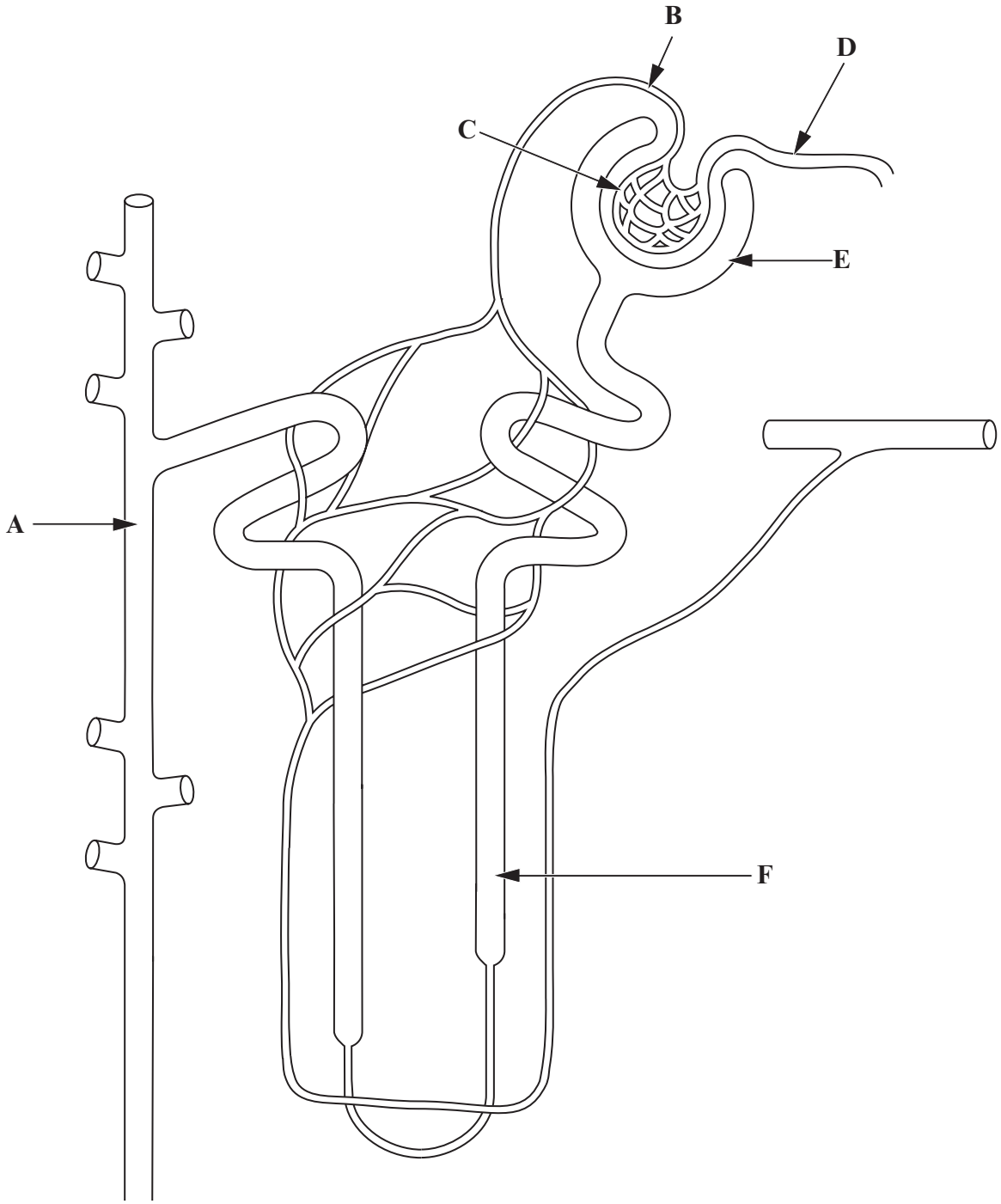
6. The diagram below shows a kidney nephron and part of its blood supply.



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(a) (i) Name the structures labelled **A-F** in the diagram opposite. [3]

A = ...

B = ...

C = ...

D = ...

E = ...

F = ...

(ii) Draw a line labelled **X** on the diagram opposite, to show the part of the nephron where most of the water is reabsorbed. [1]

(iii) Draw a line labelled **Y** on the diagram opposite, to show the part of the nephron where glucose is reabsorbed. [1]

(iv) Explain the significance of the differences in diameter between structure **B** and structure **D**. [2]

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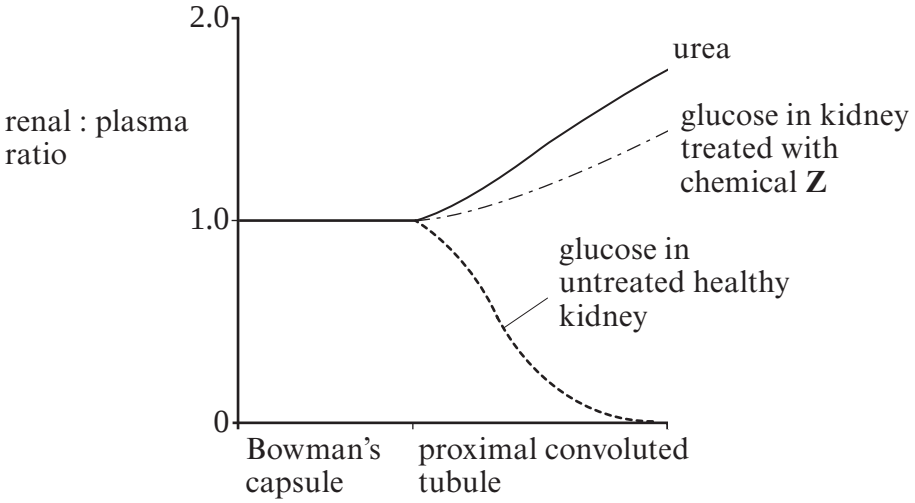
(b) The composition of filtrate for a particular substance in a nephron can be expressed as its renal : plasma ratio. This compares the concentration of a substance in the filtrate with that in the blood plasma.

This can be calculated by using the following formula.

$$\text{renal : plasma ratio} = \frac{\text{concentration of substance in filtrate}}{\text{concentration of substance in plasma}}$$

Samples of filtrate were taken from different parts of a nephron and the concentrations of glucose and urea were measured. Their renal : plasma ratios were then calculated. The kidney was treated with a chemical **Z** and the process was repeated.

The results of this investigation are shown in the graph below.



(i) Explain why urea and glucose have a renal : plasma ratio of 1.0 in the Bowman's capsule. [3]

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(ii) Use figures from the graph opposite to explain why the renal : plasma ratio of urea increases in the proximal convoluted tubule. [4]

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(iii) Use figures from the graph opposite to describe and explain the renal : plasma ratio for glucose in both the untreated healthy kidney and the kidney treated with chemical **Z**. [3]

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(iv) Suggest how chemical **Z** could have caused the effect described in part (iii) above. [1]

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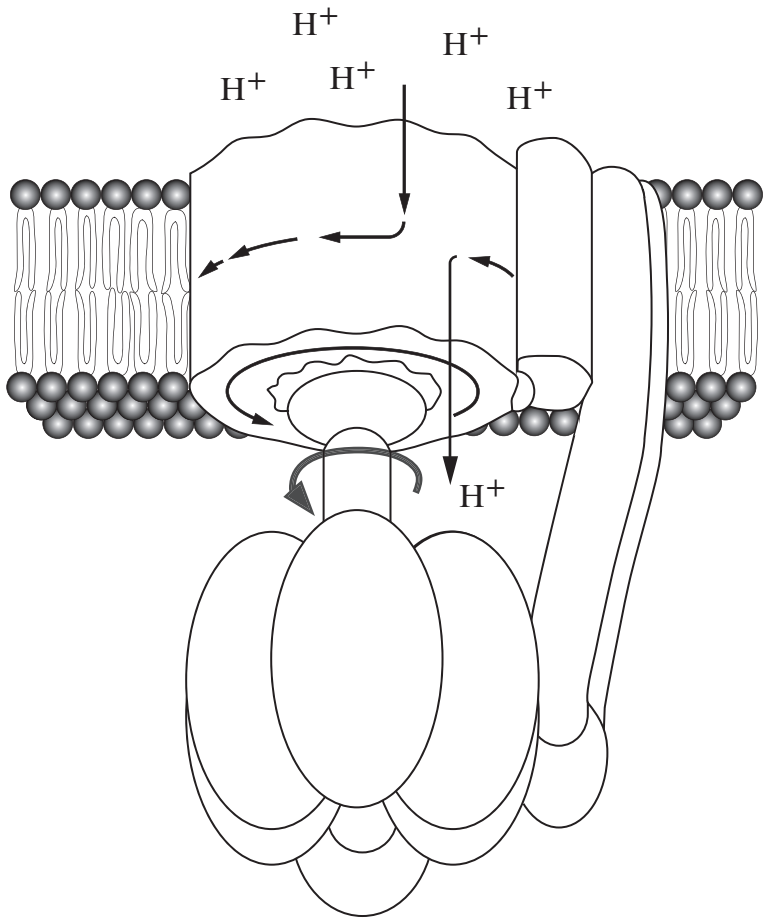
7. The diagram below shows the most recent model of the ATP synthetase complex. This complex results in the synthesis of ATP from ADP and inorganic phosphate.



(a) State the position of this complex within a mitochondrion. [1]

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(b) Describe how the proton gradient that causes ATP synthesis is produced. [3]

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(c) Describe the role of oxygen in the electron transport chain. [2]

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(d) Explain how ATP production continues in humans in **anaerobic** conditions. [4]

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8. Answer **one** of the following.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe how an action potential is transmitted along a myelinated neurone. [10]

Or *(b)* Outline the processes that occur in photosynthesis during

(i) the light dependent reaction, [5]

(ii) the Calvin cycle. [5]

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