

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1074/01

BIOLOGY – BY4

P.M. FRIDAY, 11 January 2013

1¾ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	6	
2	14	
3	10	
4	13	
5	17	
6	10	
7	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.

1. (a) Flowering in some plants is affected by the relative periods of dark and light that they are exposed to.

Identify the following:

(i) the name given to this process; [1]

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(ii) the chemical that acts as a photoreceptor in plants; [1]

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(iii) the part of a plant that detects changes in day length. [1]

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(b) Nitrogen is required for healthy plant growth.

Identify the following:

(i) **two** forms in which nitrogen can be absorbed by plant roots; [1]

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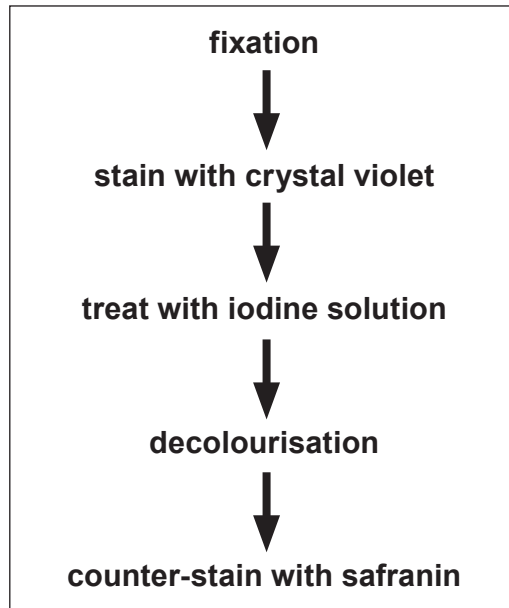
(ii) the stage in the nitrogen cycle that would be slowed down by ploughing and drainage of soils; [1]

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(iii) free-living bacteria involved in the fixation of atmospheric nitrogen. [1]

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- 2. The diagram below shows the process of Gram staining to identify Gram positive (+) and Gram negative (-) bacteria.



- (a) State the colour of the bacteria following the application of the counter stain: [1]

Gram positive;

Gram negative.

- (b) Use your knowledge of the structure of the bacterial cell wall to explain the differences in the appearance of the two types of bacteria when stained with the Gram staining technique. [3]

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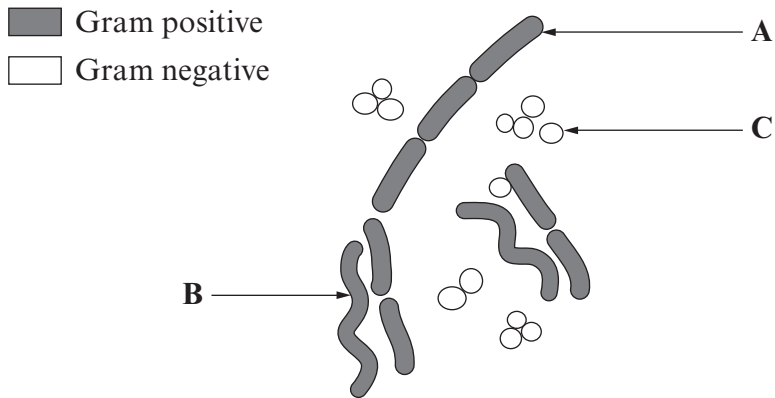
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(c) Following an outbreak of food poisoning in a school, samples were taken from infected patients. The Gram staining technique was used, in conjunction with the shape of bacterial cells, to identify potentially pathogenic bacteria in the samples.

The diagram below shows part of a bacterial smear stained using the Gram staining technique.



(i) State the name given to the shapes of the bacteria labelled **A**, **B** and **C**. [3]

A

B

C

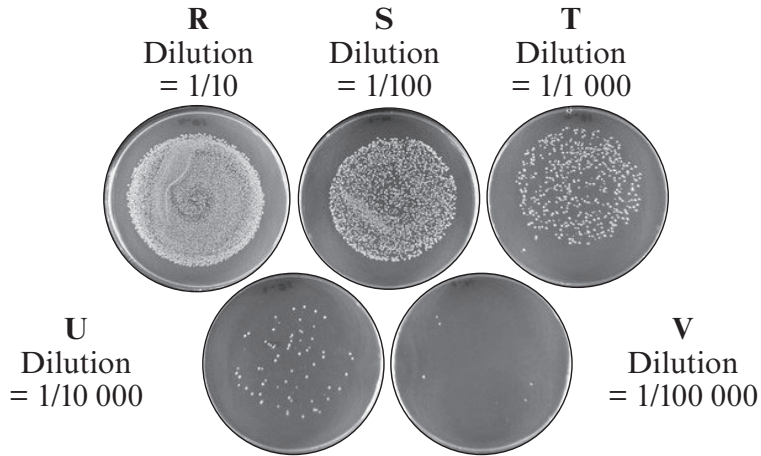
(ii) Suggest why the bacteria labelled **C** in the diagram might be the possible cause of the food poisoning. [1]

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(d) Using the viable count method Environmental Health Officers made an estimate of the number of bacteria in various foods in the school canteen. Dilutions of 1/10, 1/100, 1/1 000, 1/10 000 and 1/100 000 were prepared and 0.5 cm³ of each dilution were spread evenly over the surface of agar plates. The plates were incubated at 35°C for 24 hours. A photograph of the results for one of the samples is shown below.



They decided to use Plate U to estimate the number of bacteria in the food sample.

(i) With reference to the plates shown above explain why they decided to use Plate U and **not** any of the other plates. [2]

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(ii) On plate U 69 bacterial colonies were counted. Estimate the number of bacteria present in 1 cm³ of the original food sample. Show your working. [2]

Estimated number of bacteria = per cm³

(iii) Suggest why this number is likely to be an underestimate of the actual number of bacteria present. [1]

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(iv) Suggest why the bacteria were cultured at 35°C and not at 25°C. [1]

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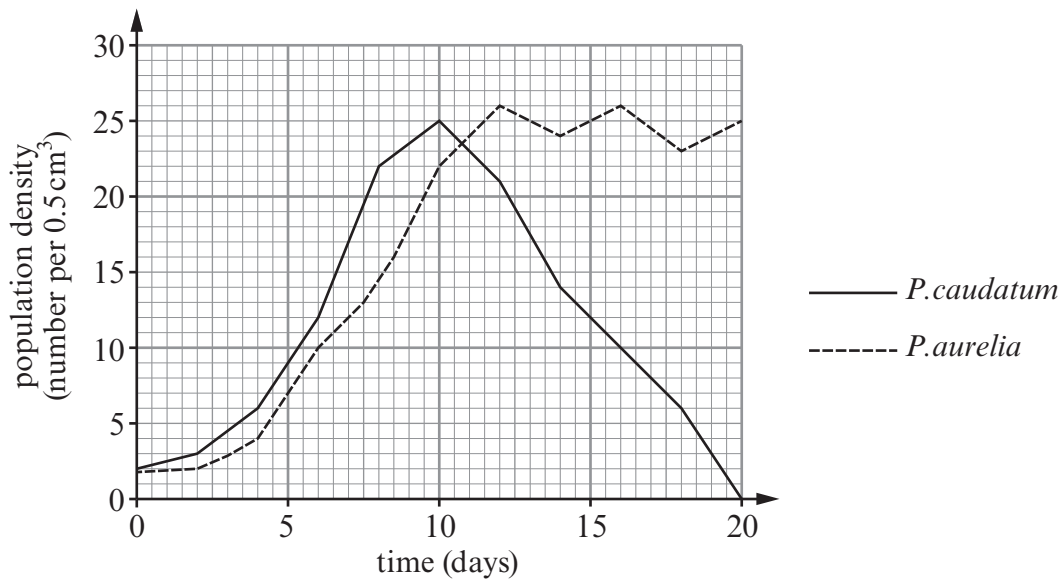
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3. In the 1930s G.F.Gause investigated the population dynamics of different species of a protocystan of the genus *Paramecium*. These single-celled organisms live in ponds and feed mainly on yeast. Two species, *P.aurelia* and *P.caudatum* swim freely and feed in all parts of a pond while another species, *P.bursaria* feeds mostly at the bottom of the habitat.

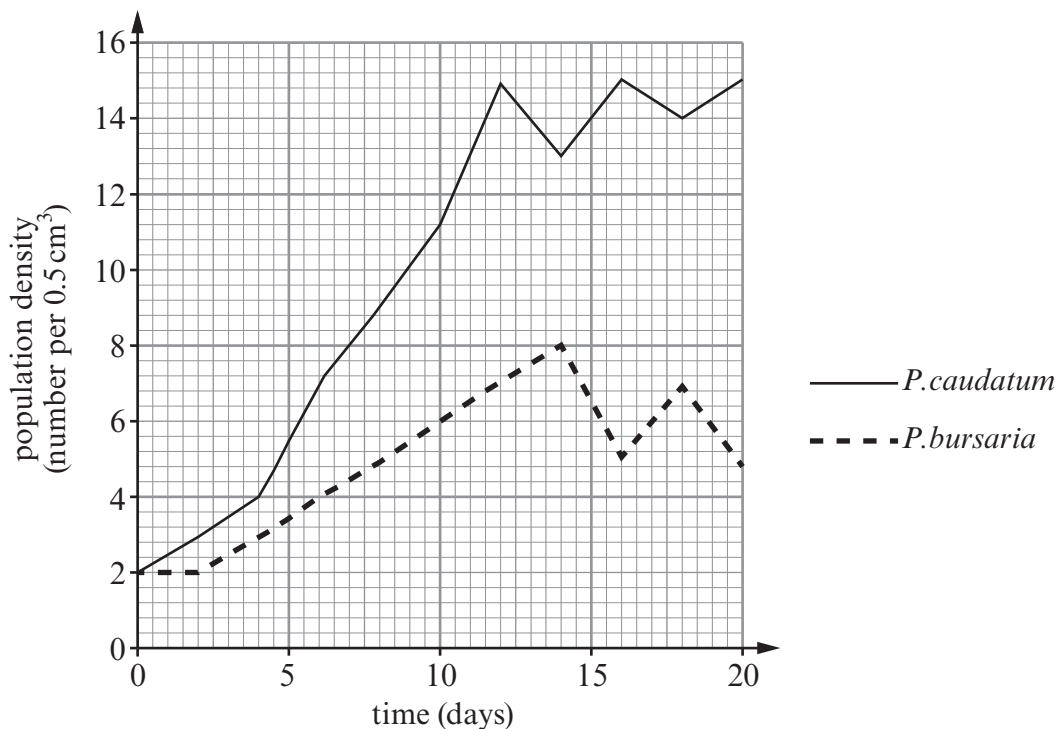
In a series of experiments Gause grew different species of *Paramecium* together in the same container, under the same conditions, to investigate interspecific competition.

The graphs below show results from two of his experiments.

Graph 1 shows the change in population densities of *P.caudatum* and *P.aurelia* when grown together.



Graph 2 shows the change in population densities of *P.caudatum* and *P.bursaria* when grown together.



(a) (i) Explain what is meant by the term **carrying capacity**. [2]

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(ii) From **Graph 1** opposite estimate the carrying capacity for *P.aurelia* in this experiment. [1]

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(iii) Describe **TWO** density dependent factors and **ONE** density independent factor that could have prevented the population of *P.aurelia* from exceeding its carrying capacity.

I. Density Dependent [2]

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II. Density Independent [1]

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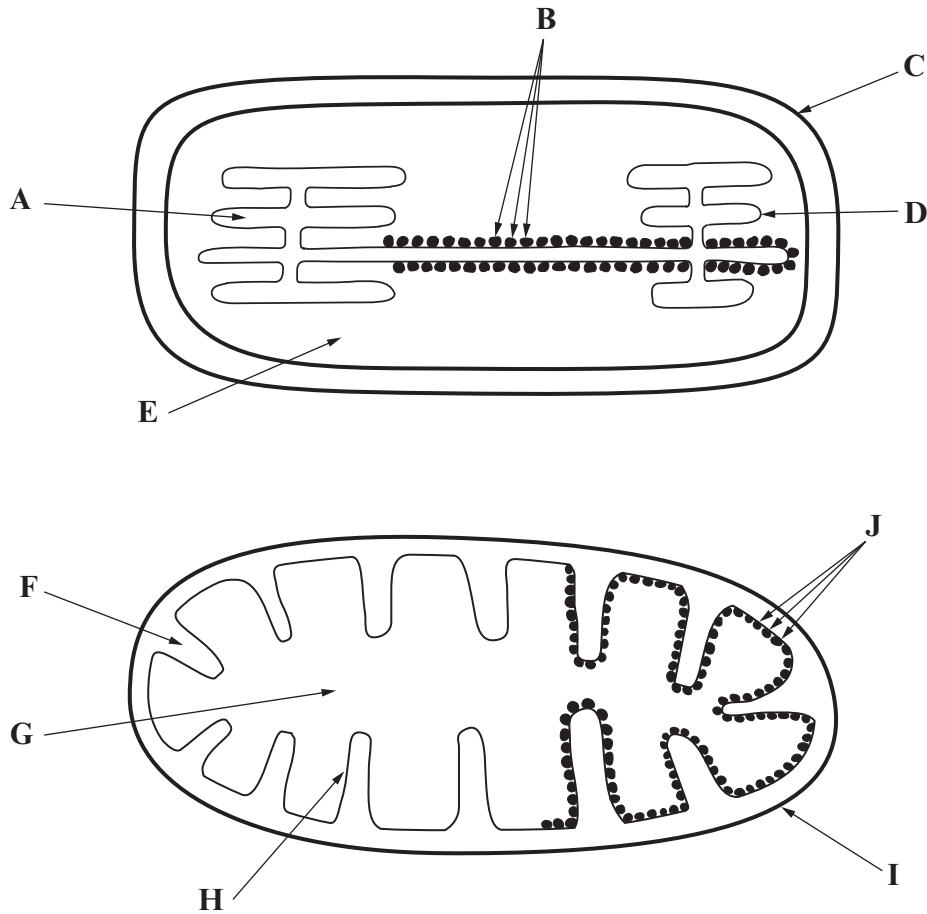
(b) (i) Explain how interspecific competition caused the decrease in the population of *P.caudatum* shown in **Graph 1**. [2]

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(ii) Suggest why *P.caudatum* and *P.bursaria* could co-exist when grown in the same container but *P.caudatum* became extinct when grown with *P.aurelia*. [2]

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4. The diagrams below show the main structures in mitochondria and chloroplasts that are involved in the production of ATP.



- (a) Use a letter from **each** diagram to identify where the following stages of ATP production take place in chloroplasts and mitochondria. [8]

Stage in ATP Production	Chloroplasts	Mitochondria
Protons are pumped across a membrane by proton pumps fuelled by electron energy		
A high concentration of hydrogen ions builds up		
Protons flow down a concentration gradient and provide the energy for ATP synthesis		
Free electrons are taken up by a final electron acceptor		

(b) (i) Explain the importance of ATP in cells.

[3]

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(ii) Explain why ATP is sometimes called the *universal energy currency*.

[2]

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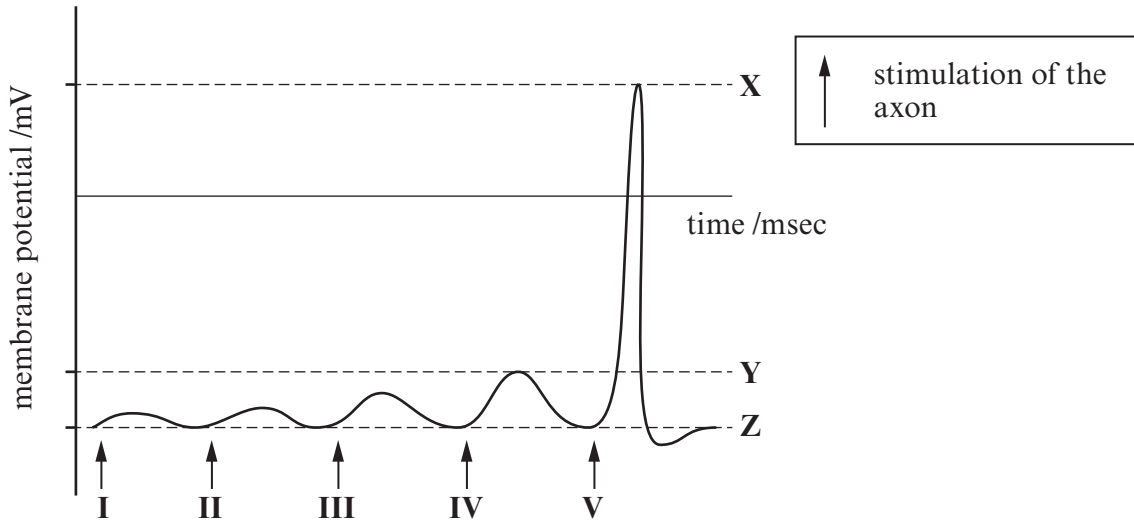
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5. (a) The axon of a motor neurone was stimulated using an intracellular electrode. The strength of each stimulus was increased by the same amount each time and the potential difference across the cell membrane was monitored using an oscilloscope.

The results of the experiment are shown in the graph below.



- (i) Suggest values for the membrane potential at: [1]
 X mV and Z mV
- (ii) Generation of an action potential involves ion-channels.

Explain how opening and closing of ion channels results in the depolarisation and repolarisation of the axon membrane shown at point V on the graph.

I. Depolarisation; [2]

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II. Repolarisation. [2]

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(iii) Explain why an action potential was not generated by stimuli **I** to **IV**. [2]

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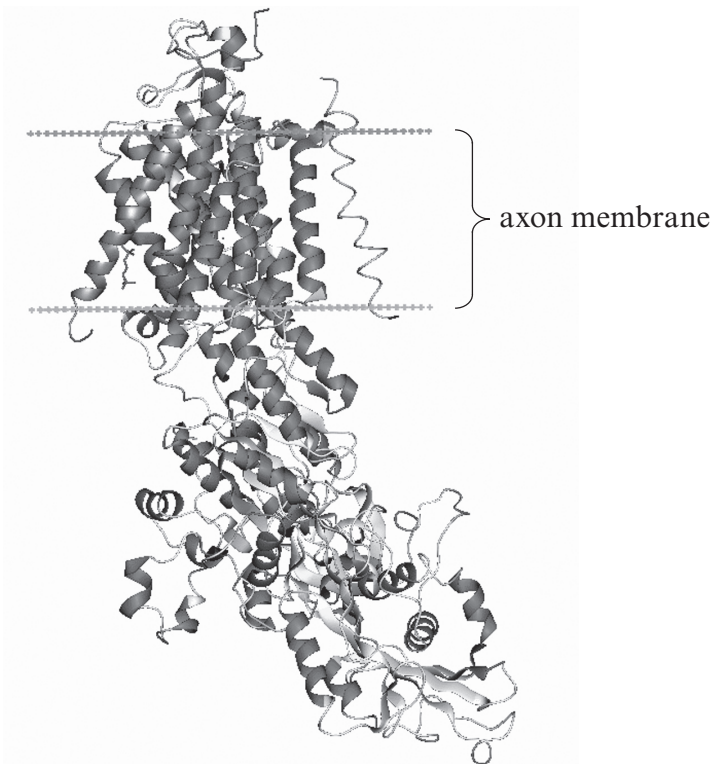
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(b) At rest the sodium-potassium pump helps to maintain a constant membrane potential. A model of this protein is shown in the diagram below.



(i) The sodium-potassium pump has a quaternary structure.

Explain what is meant by the term **quaternary structure**. [2]

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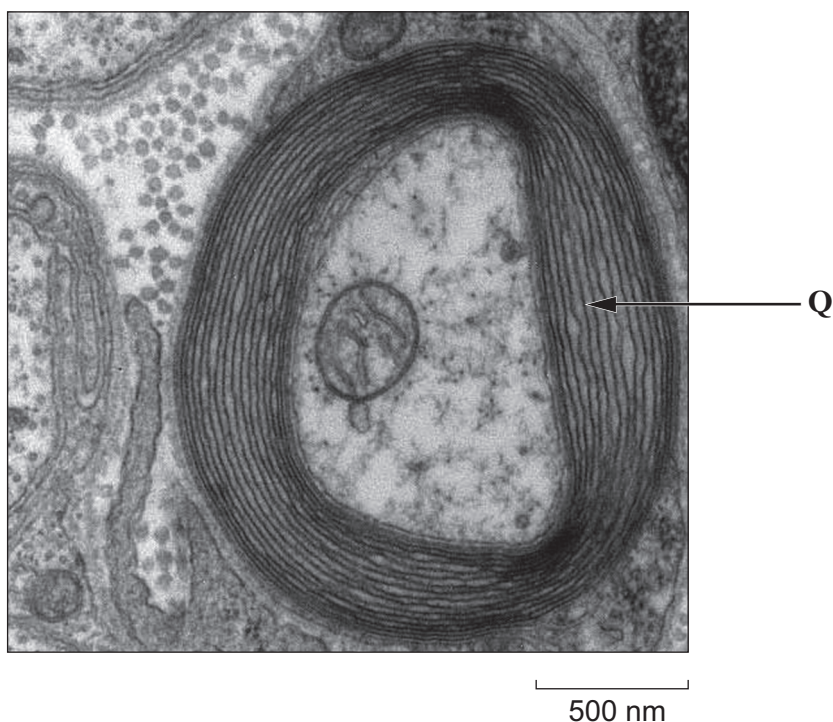
(ii) On the diagram above use a letter **H** to label a region of the sodium-potassium pump that would have hydrophobic properties. [1]

(iii) Explain why this region would be hydrophobic. [1]

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(c) The transmission electron micrograph below shows a cross section of the axon of a motor neurone.



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(i) Name the substance you would expect to find at **Q** shown on the diagram above. [1]

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(ii) Name the cell that produces this substance. [1]

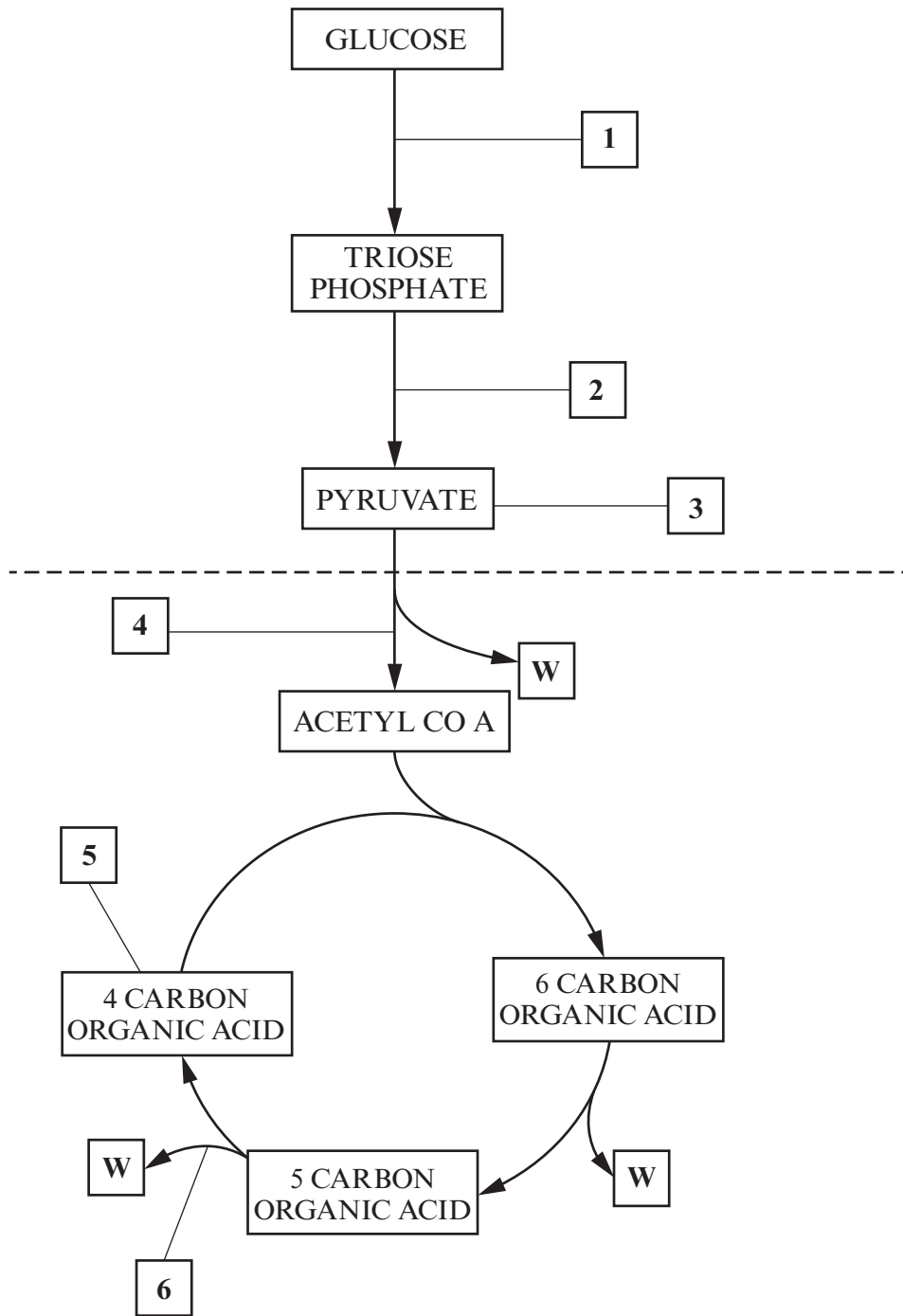
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(iii) Explain how the substance secreted by these cells and their arrangement along the neurone affect the speed of transmission of a nerve impulse. [4]

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6. The diagram shows an outline of three stages of aerobic respiration.



- (a) (i) Name the three stages of respiration shown in the diagram opposite and state where in the cell they occur. [3]

<i>Name of stage of respiration</i>	<i>Where it occurs in the cell</i>

- (ii) Which of these stages will operate in the absence of oxygen? [1]

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- (b) (i) Identify substance **W** shown on the diagram opposite. [1]

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- (ii) Name the enzyme responsible for its production. [1]

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- (c) Use the numbers **1** to **6** from the diagram opposite to identify where the following events take place during respiration. The numbers can be used once, more than once, or not at all. [4]

Event	Point(s) on Diagram
Substrate-level phosphorylation occurs	
Glycerol can be converted to a 3C sugar which enters respiration at this point	
ATP is used in phosphorylation	

7. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, (a) Explain how **the light-independent** stage of photosynthesis (Calvin cycle) leads to the production of triose phosphate. [7]

Indicate the origin of the raw materials required for this stage of photosynthesis and the possible uses of the triose phosphate produced. [3]

Or (b) Explain how the kidney is involved in osmoregulation in mammals. [10]

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END OF PAPER

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