Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

A.M. TUESDAY, 11 June 2013

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**3**	
2	**7**	
3	**10**	
4	**9**	
5	**15**	
6	**12**	
7	**14**	
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. *(a)* State the general role of muscles and glands in simple reflexes. [1]

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(b) The phylum Cnidaria includes animals with a relatively simple body plan such as sea anemones, jellyfish and hydra. They respond to stimuli but these responses are slower than in humans. Suggest a reason for the slower speed of response. [1]

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(c) Name the substance that plants use to detect day and night length. [1]

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2. The red kite *(Milvus milvus)* was at one time a common bird of prey in Britain, but by the end of the 19th century it had been driven almost to extinction and just three pairs survived in mid-Wales. As a result of conservation efforts, numbers rose during the 20th century. The table below shows numbers of breeding pairs for years when accurate counts or estimates are available.

Year	Number of breeding pairs
1933	4
1962	15
1976	34
1986	48
1995	100
2009	1000

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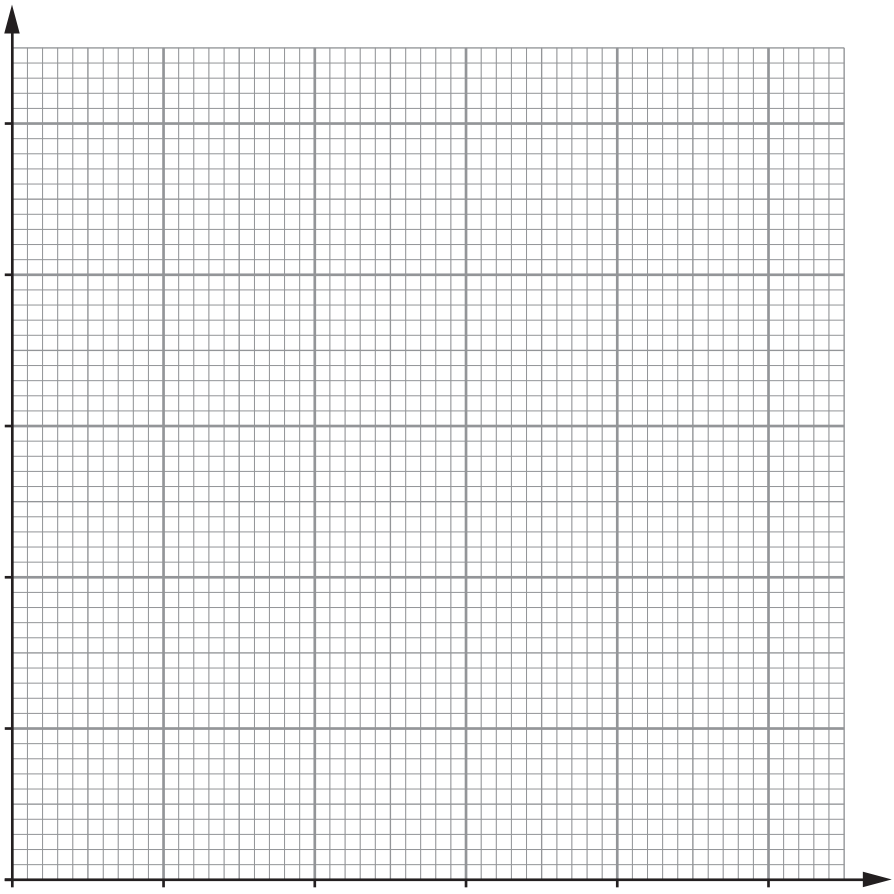
(a) Use the data opposite to draw a graph to show the increase in the number of breeding pairs of red kites in Wales between 1933 and 2009. [3]



(b) Assuming no net migration, state with a reason whether it was the **birth rate** or the **death rate** which was greater between 1976 and 1986. [1]

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(c) (i) Suggest **two** density dependent factors, which might prevent numbers of red kite continuing to rise. [2]

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(ii) Suggest **one** density independent factor that might cause the population of red kite in Wales to crash in the future. [1]

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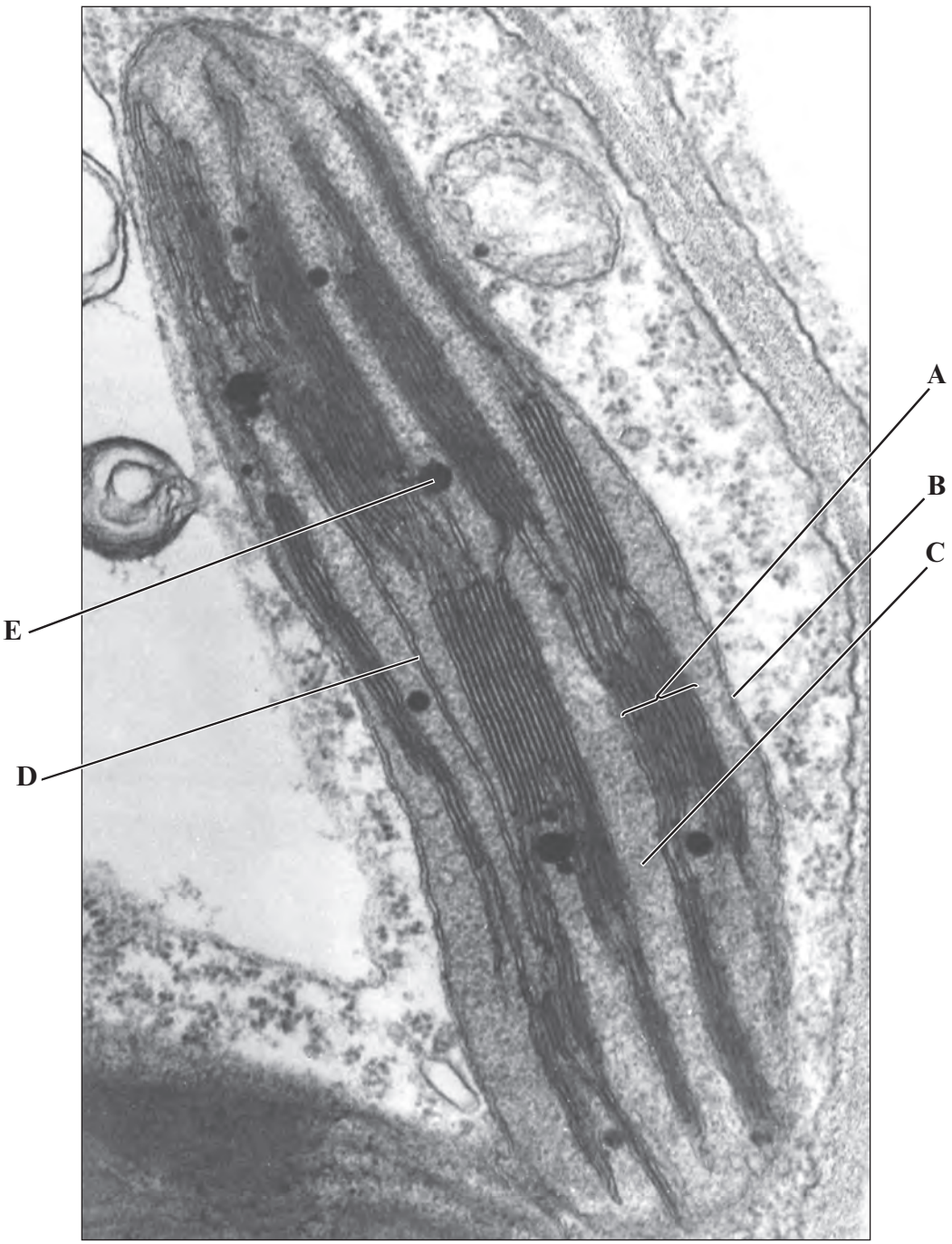
3. The electron micrograph below shows part of a palisade cell, including one chloroplast.



(a) Choose a letter or letters from the electron micrograph above that indicate [3]

(i) one granum, ...

(ii) parts of the chloroplast where photosynthetic pigments are located, ...

(iii) where reactions of the Calvin cycle occur. .....

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(b) The Calvin cycle involves the conversion of inorganic carbon dioxide into useful organic compounds.

(i) Explain how carbon dioxide is used in the production of glycerate-3-phosphate. [2]

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(ii) Describe how glycerate-3-phosphate is converted to triose phosphate. [3]

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(c) (i) State why only some of the triose phosphate produced by the Calvin cycle can be used to produce hexose phosphate. [1]

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(ii) Suggest how many times the Calvin cycle must occur to produce one molecule of glucose. [1]

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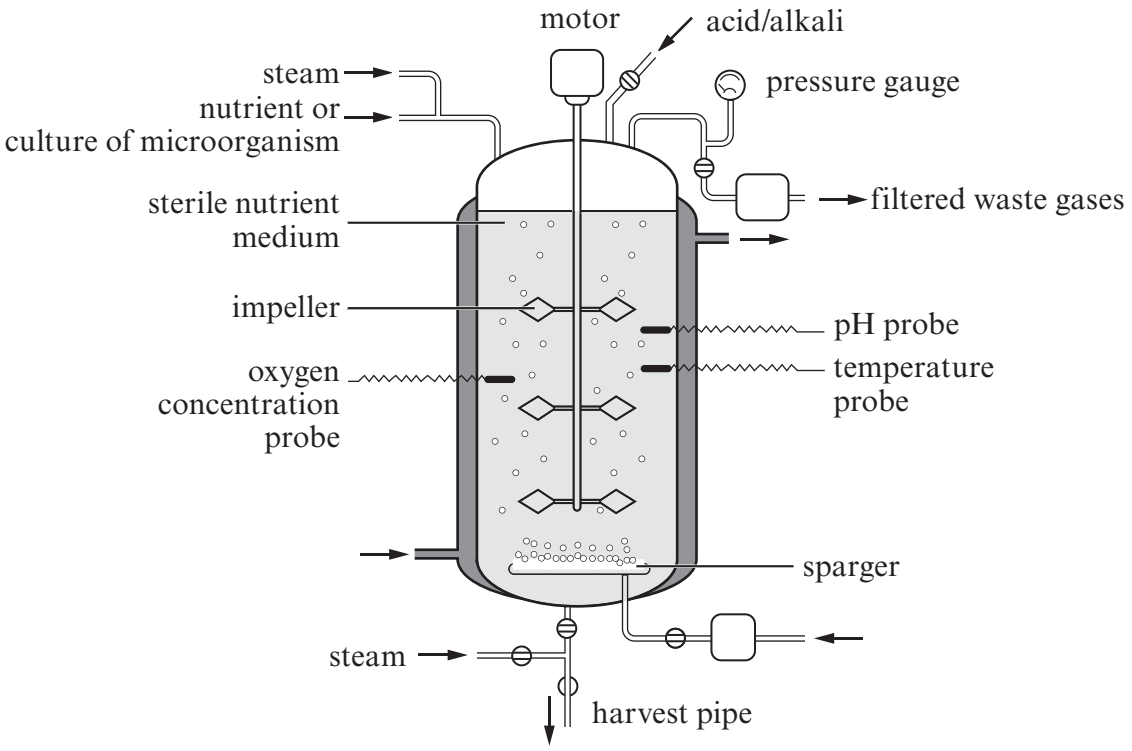
4. The diagram below shows a fermenter that has been set up to culture a microorganism and harvest a product from it.



(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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(c) Suggest reasons for preventing the fermenter becoming contaminated with other microorganisms. [2]

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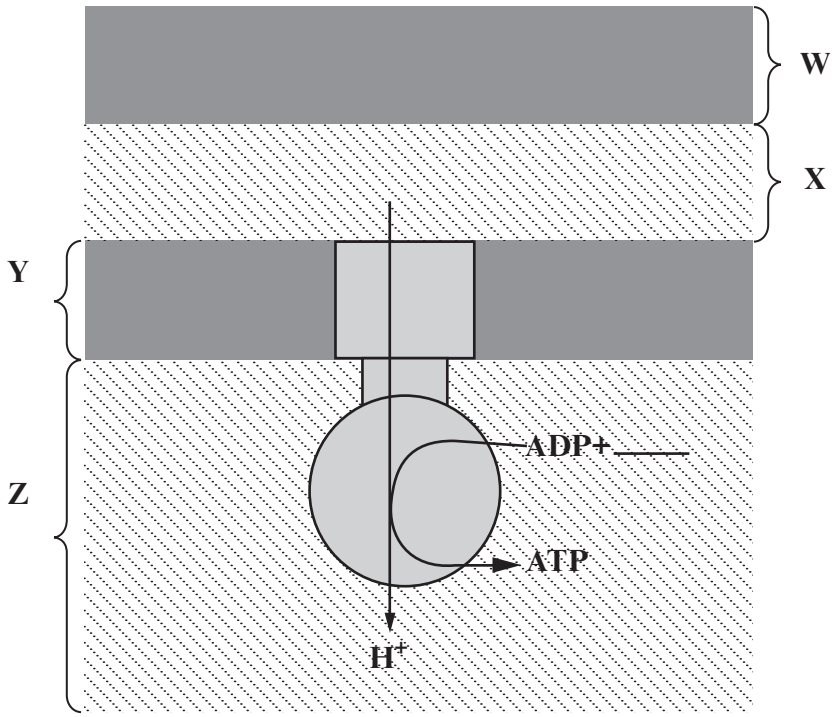
5. Respiration results in the production of ATP in cells. Production of ATP in the mitochondrion is catalysed by an enzyme and requires energy supplied by a proton gradient. The diagram below represents a model of the ATP synthetase complex.



(a) (i) On the diagram above, complete the equation for the production of ATP. [1]

(ii) Name parts **W** and **Z** shown on the diagram above. [2]

W ..... **Z** .....

(iii) State whether the H^+ concentration is highest in part **W**, **X**, **Y** or **Z**. [1]

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(b) The proton gradient can be maintained as long as reduced NAD is available in the mitochondrion. Explain the reasons for reduced NAD being required to maintain a proton gradient. [2]

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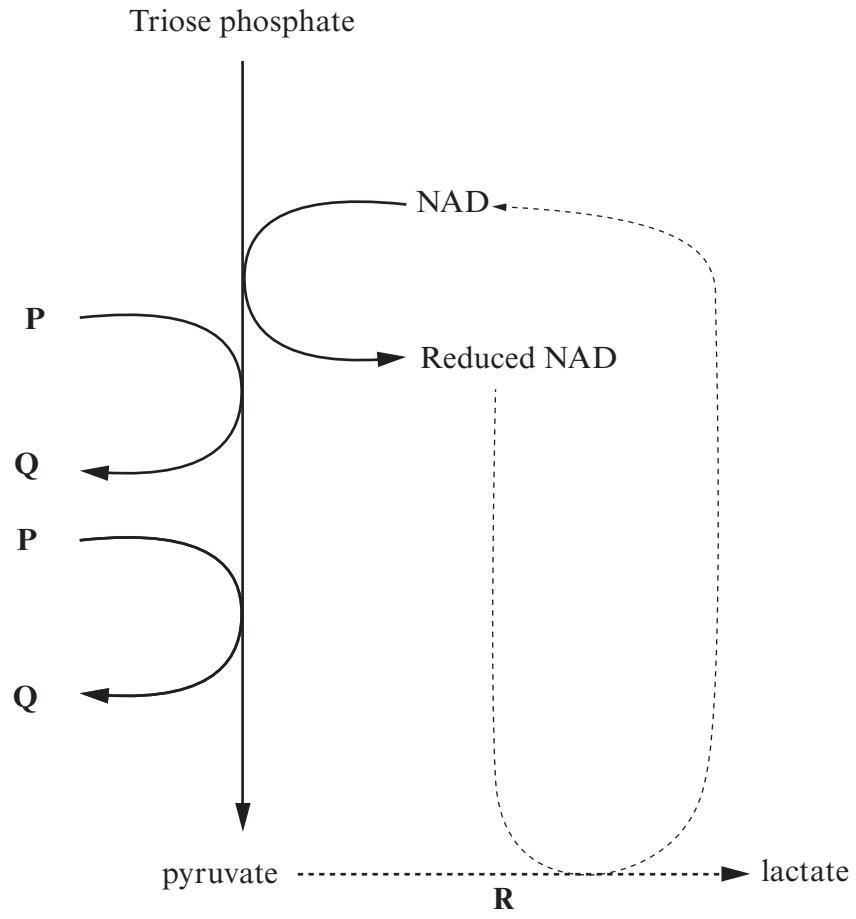
(c) The diagram below shows one stage of respiration in which reduced NAD is produced.



(i) Name chemicals **P** and **Q**. [1]

P ..... **Q** .....

(ii) Where in the cell do the reactions shown in the diagram above occur? [1]

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(iii) Outline the pathway for the production of triose phosphate in glycolysis. [3]

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(d) (i) The reaction labelled **R** on the diagram on the previous page occurs in humans when there are **anaerobic** conditions in a tissue.
Explain the **biochemical** reasons for carrying out the reaction, despite the fact that lactate is toxic in high concentrations. [3]

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(ii) Reaction **R** sometimes occurs in muscle fibres when a short burst of very rapid ATP production is needed. Suggest a reason for this. [1]

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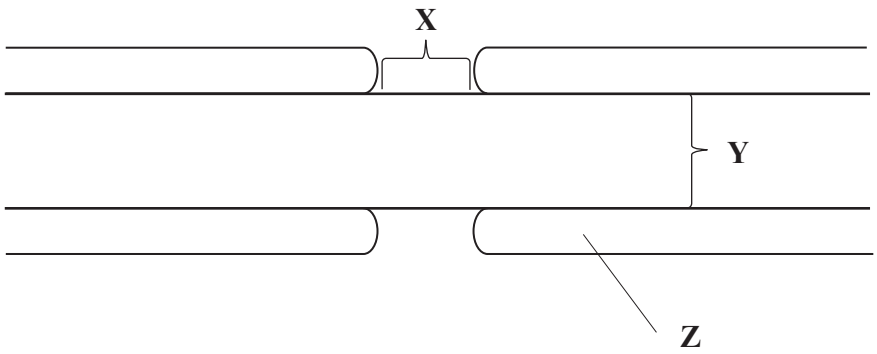
6. The diagram below represents part of a myelinated neurone.



(a) Name **X** and **Y** shown on the diagram above. [2]

X ..... **Y** .....

(b) Name the cell type that forms layer **Z**. [1]

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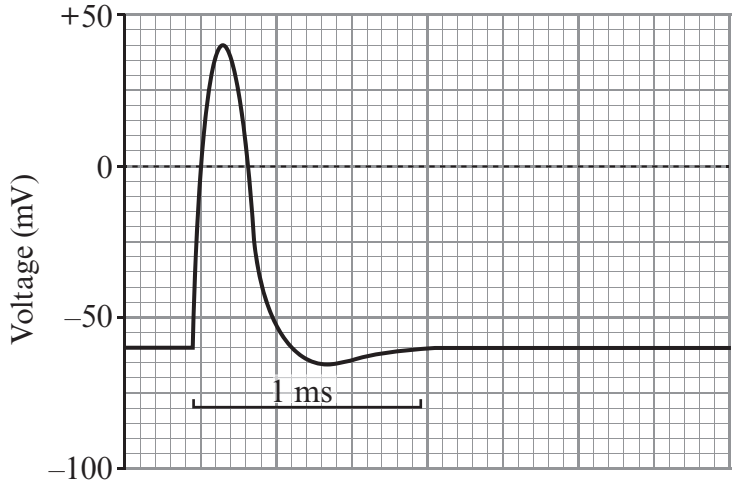
Trace **A** below is an oscilloscope recording of changes in voltage across the membrane of a myelinated neurone during an action potential.

Trace **A**



(c) Use Trace **A** to estimate the resting potential of **this neurone**. [1]

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(d) (i) Explain, in terms of movement of ions, what causes the rise in membrane potential seen in Trace **A** opposite. [2]

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(ii) State the name given to the rapid fall in membrane potential seen in Trace **A**. [1]

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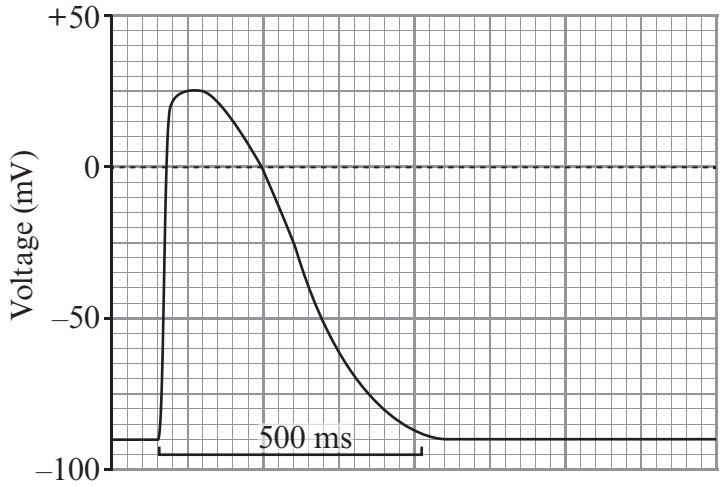
Trace **B** is another oscilloscope recording, showing changes in voltage across the membrane of a cardiac muscle fibre.

Trace **B**



(e) Compare Trace **A** and Trace **B** by giving two differences between them. [2]

1. .....

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2. .....

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(f) Suggest how cardiac muscle fibres would respond when the voltage across the membrane rises. [1]

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(g) The cardiac muscle fibres used to obtain the oscilloscope trace were obtained from a frog's heart. Consider the ethics of killing a frog to obtain cardiac muscle fibres by giving **one** argument in favour and **one** against. [2]

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7. *(a)* Name the vessel that brings blood to the kidney. [1]

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(b) Describe **two structural** features of glomeruli that allow ultrafiltration to occur. [2]

1. .....

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2. .....

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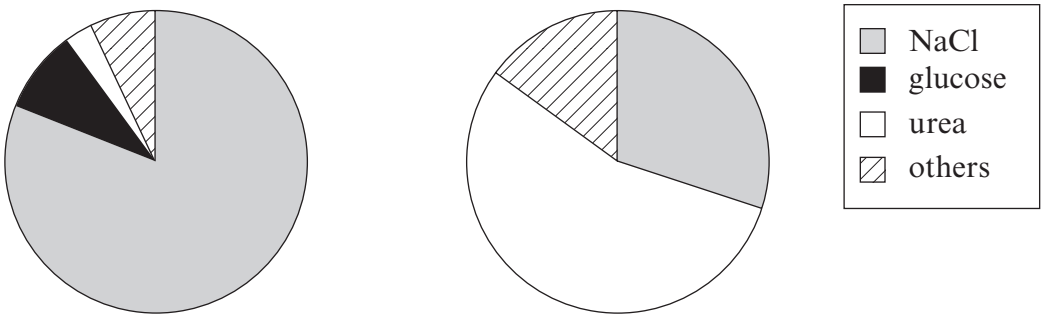
Ultrafiltration in the glomerulus results in the production of glomerular filtrate. The pie charts below show the percentage composition of solutes in human glomerular filtrate and in urine.

Glomerular filtrate **Urine**



(c) Using your knowledge of processes occurring in the nephron, explain the difference in glucose concentration between glomerular filtrate and urine shown in the pie charts. [2]

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(d) (i) The urea concentration of urine is much higher than that of glomerular filtrate. Describe the role of the nephron and collecting duct in achieving this increase in concentration. [5]

(ii) Suggest an advantage to mammals of excreting urine with a high concentration of urea. [2]

(e) The concentration of sodium ions in the urine of a person varies. The concentration is affected by the level of a hormone. Name this hormone and explain how it affects the concentration of ions in urine. [2]

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

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Describe the light dependent reactions of photosynthesis. [10]

Or *(b)* Describe how the nitrogen cycle allows nitrogen in one plant to become available to another plant and the various roles of nitrogen in plant metabolism. [10]

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END OF PAPER