Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

S15-1074-01

BIOLOGY – BY4

P.M. MONDAY, 8 June 2015

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**8**	
3.	**11**	
4.	**12**	
5.	**12**	
6.	**14**	
7.	**9**	
8.	**10**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

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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Answer **all** *questions.*

1. Complete the following table indicating whether the statement is true or false by placing a tick (✓) in the correct box. [4]

Statement	True	False
Motor neurones have only a single dendrite.		
Motor neurones have many axons.		
Dendrites receive and integrate impulses.		
Dendrites of motor neurones are rarely myelinated.		

4

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2. A denitrifying bioreactor is a trench in the ground packed with wood chips. It becomes colonised by soil bacteria that convert nitrate in drainage water to nitrogen gas. Woodchip bioreactors may be a cost-effective, farm-scale practice for nitrate removal from agricultural drainage. When placed strategically, these bioreactors can reduce nitrate levels flowing into streams and help meet environmental demands for the reduction of total nitrogen content in streams and rivers.

Read the passage above and answer the following questions.

(a) (i) What is the correct term for the process where nitrate is washed from the land in the drainage water? [1]

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(ii) Name **one** source of the nitrate on the farmland. [1]

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(b) Various soil bacteria can change ammonia or ammonium into nitrite, or nitrite into nitrate as part of the nitrogen cycle. Bacteria of the genus **X** are the primary converters of ammonium into nitrite and bacteria of the genus **Y** oxidise the nitrite to form nitrate.

Name the **two** genera **X** and **Y** in the paragraph above and explain why it is important for plants that ammonia is converted to nitrate. [4]

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

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(c) The drainage of land is important for improving crop growth. Explain why farmers want to drain their land. [2]

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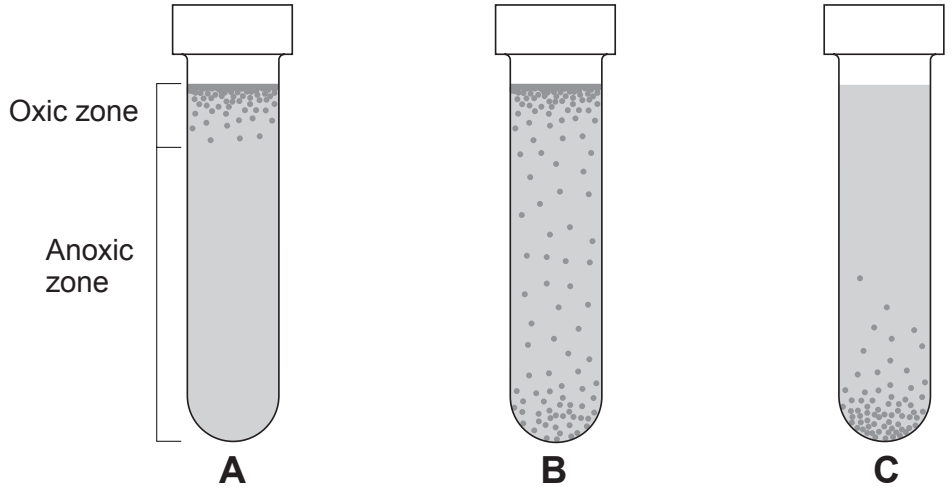
3. The diagrams below show the results of a number of experiments investigating bacterial growth with different levels of oxygen.
Bacteria were mixed with agar in bacteriology tubes and the agar was allowed to set. The tubes were incubated for 24 hours at 37°C.



Each dot represents an individual bacterial colony within the agar or on its surface. The surface which is directly exposed to atmospheric oxygen contains oxygen (oxic zone). The oxygen content of the agar decreases with depth until it does not contain oxygen (anoxic zone) towards the bottom of the tube.

(a) Using the results above, what terms are given to the types of bacteria which grow in tubes **A**, **B** and **C**? [2]

A .....

B .....

C .....

(b) Some bacteria will not grow at all in the presence of oxygen. These bacteria cannot generate ATP through aerobic respiration. Using your knowledge of respiratory pathways describe how they are able to produce ATP in the absence of oxygen. [4]

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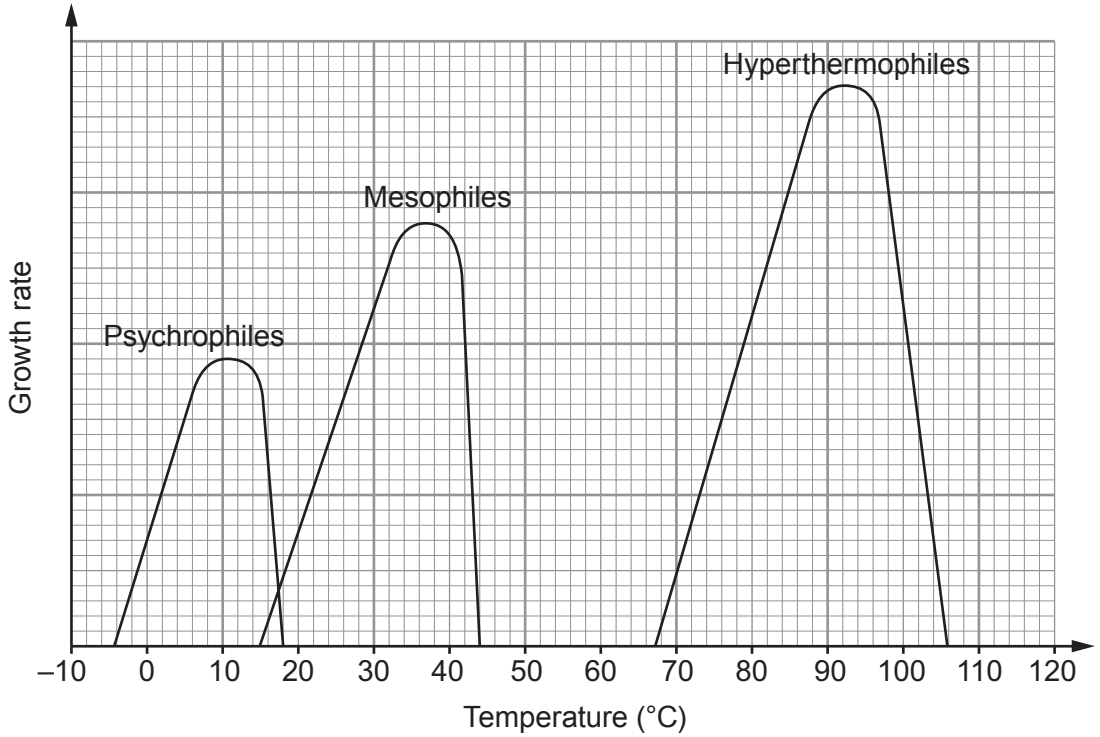
(c) Microorganisms can be grouped based on the temperatures in which they actively grow, as shown below.



(i) Using the graphs, state the optimum temperature for each group and suggest an environment where they can actively grow. [3]

	Optimum temperature (°C)	Environment
psychrophiles		
mesophiles		
hyperthermophiles		

(ii) Using your knowledge of cell biology, suggest **two** biological problems which psychrophiles must overcome in order to carry out cellular processes. [2]

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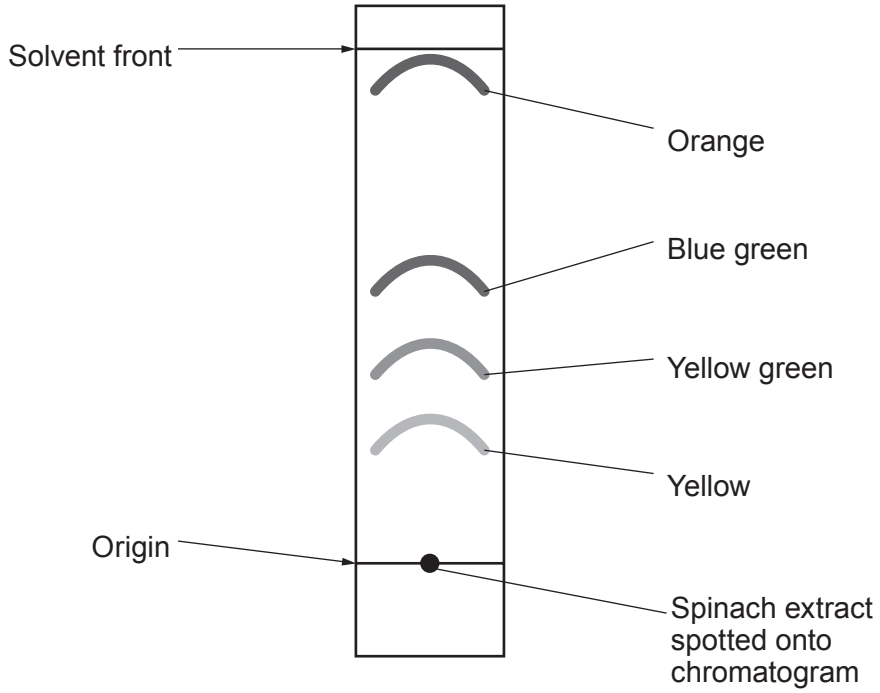
4. A student carried out a practical to separate the pigments in spinach leaves and the results are shown in the diagram below.



(a) The blue-green pigment is chlorophyll *a*.
State precisely where chlorophyll *a* is found in a photosynthetic cell. [2]

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(b) The Rf value of the pigments can be calculated using the following formula.

$$\textbf{Rf} = \frac{\text{distance moved by pigment from origin}}{\text{distance moved by solvent front from origin}}$$

Calculate the Rf value of the yellow band and use the following table of Rf values to identify it. Show your working. [3]

Rf value = ...

Pigment	Rf value
xanthophyll	0.28
chlorophyll *b*	0.42
chlorophyll *a*	0.59
carotene	0.98

Identity of yellow band .....

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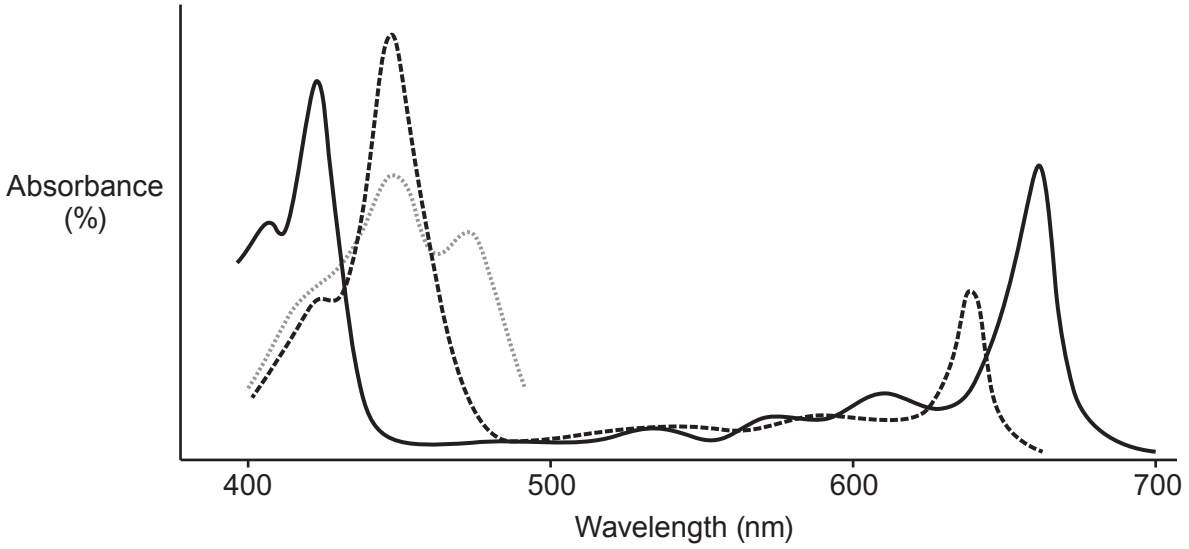
(c) Some of the pigments were extracted from the chromatogram separately. The percentage of light absorbed at wavelengths from 400 to 700 nm by each of them was measured and a chart produced.



(i) Name this type of chart. [1]

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(ii) Explain the results in the 500 to 600 nm range. [1]

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(iii) Explain the advantage to plants of having more than one pigment in their leaves. [2]

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(d) Use your knowledge of photosynthesis to explain the role of these pigments in the production of ATP. [3]

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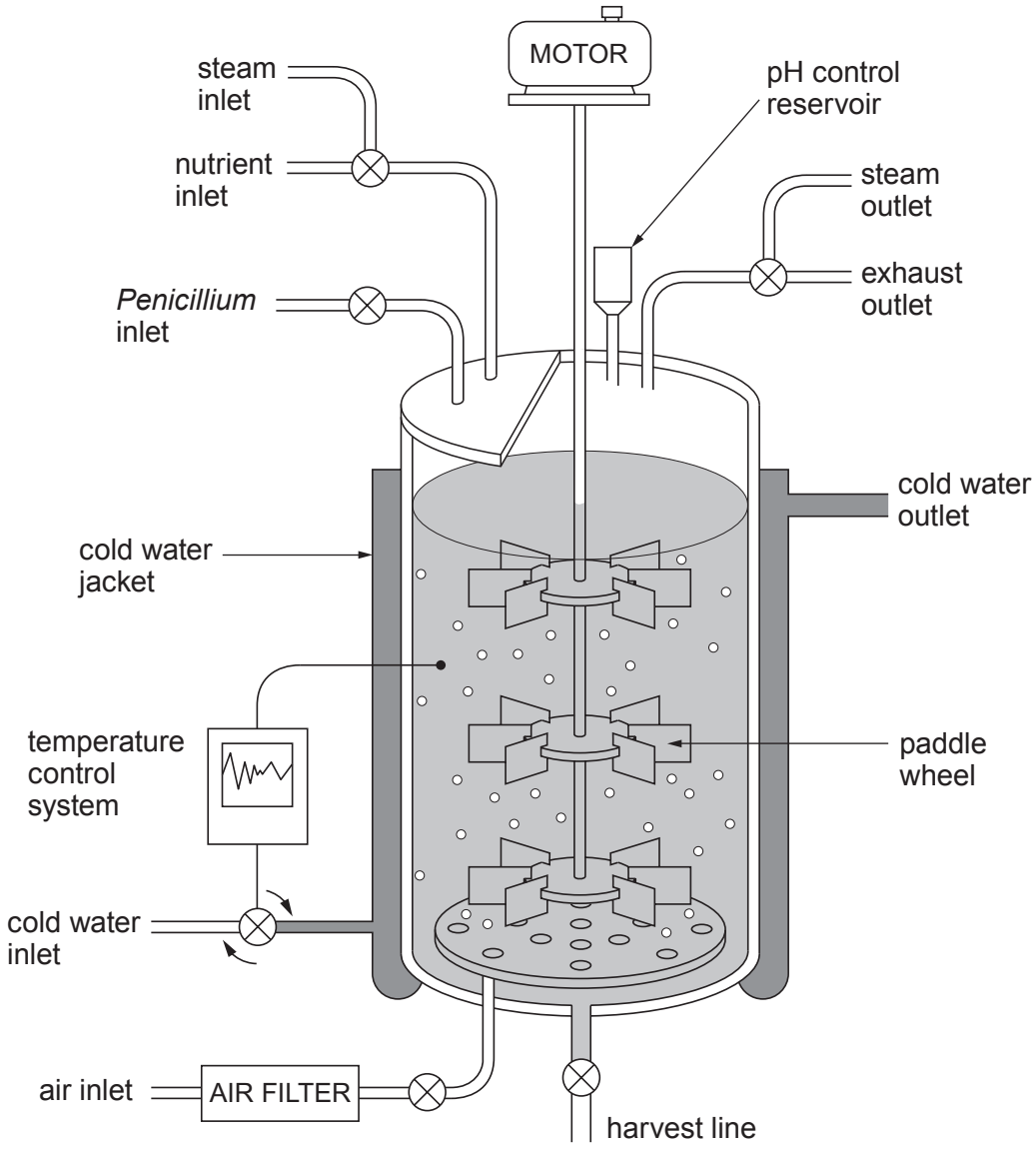
5. The diagram below shows a type of batch fermenter used to produce penicillin.



(a) (i) Apart from helping with the mixing, explain why sterile air is pumped into the fermenter. [2]

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(ii) The fungus that produces penicillin requires a supply of carbon and nitrogen. In what form might these elements be supplied to the fungus? [2]

Carbon source .....

Nitrogen source .....

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(iii) How would the pH be controlled? [1]

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(iv) What is the purpose of the *temperature control system*? [2]

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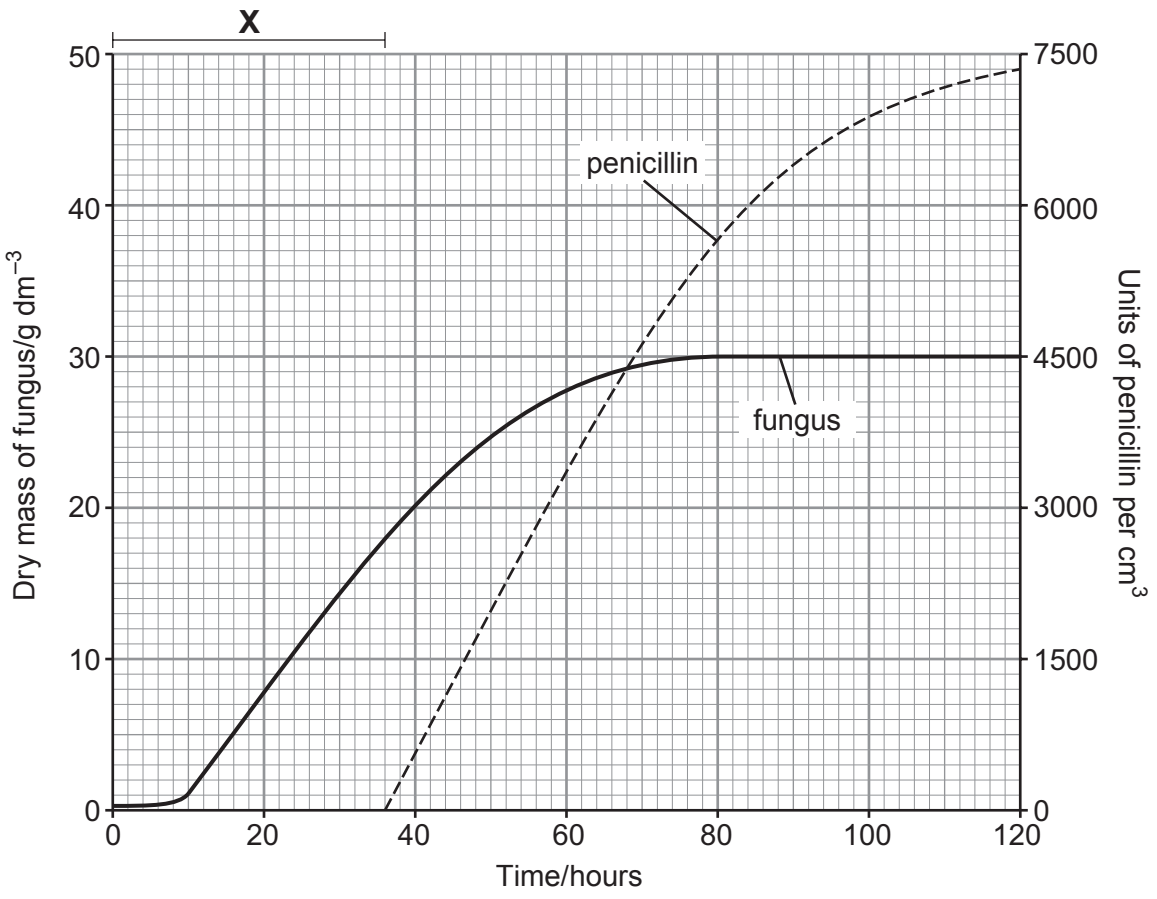
(b) Below is a graph showing the production of penicillin and the growth of the fungus, *Penicillium*, in the fermenter shown on page 10.



(i) Using the graph, state the time that *Penicillium* enters the stationary phase. [1]

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(ii) Why is there a high level of protein synthesis in the first ten hours of the *Penicillium* culture? [1]

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Examiner only

(iii) Explain why no penicillin is produced during time period **X**. [3]

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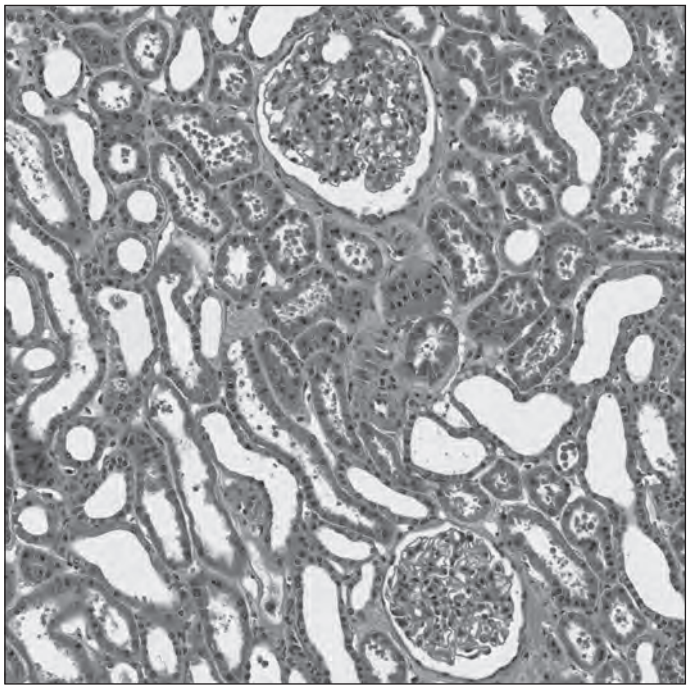
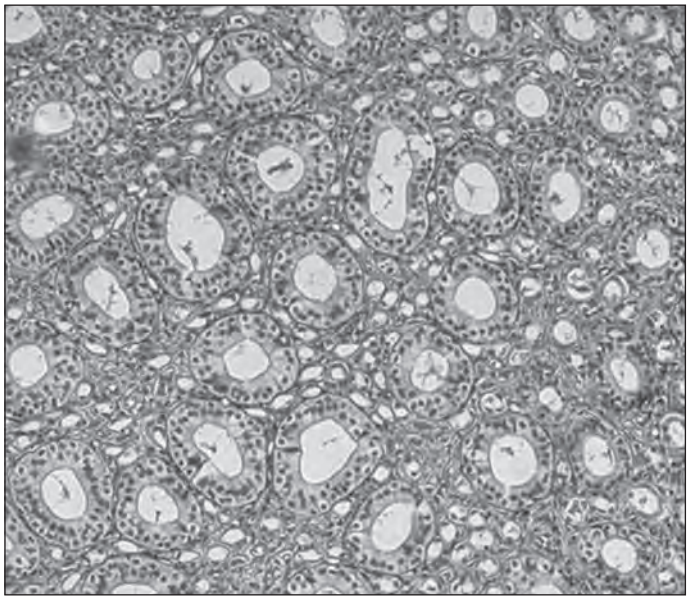
6. The two sections below were taken from different regions of a kidney.

A



B



(a) Identify the regions from which these two sections were taken, giving a reason for each answer. [2]

	Region of kidney	Reason
A		
B		

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(b) Explain how the nephron and its blood supply is adapted for **ultrafiltration**. [5]

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(c) Patients with severe kidney disease may be told to follow a protein controlled diet with low sodium chloride (salt) intake. Using your knowledge of the role of the kidney, suggest why this diet is recommended. [3]

Protein controlled diet

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Low sodium chloride (salt) intake

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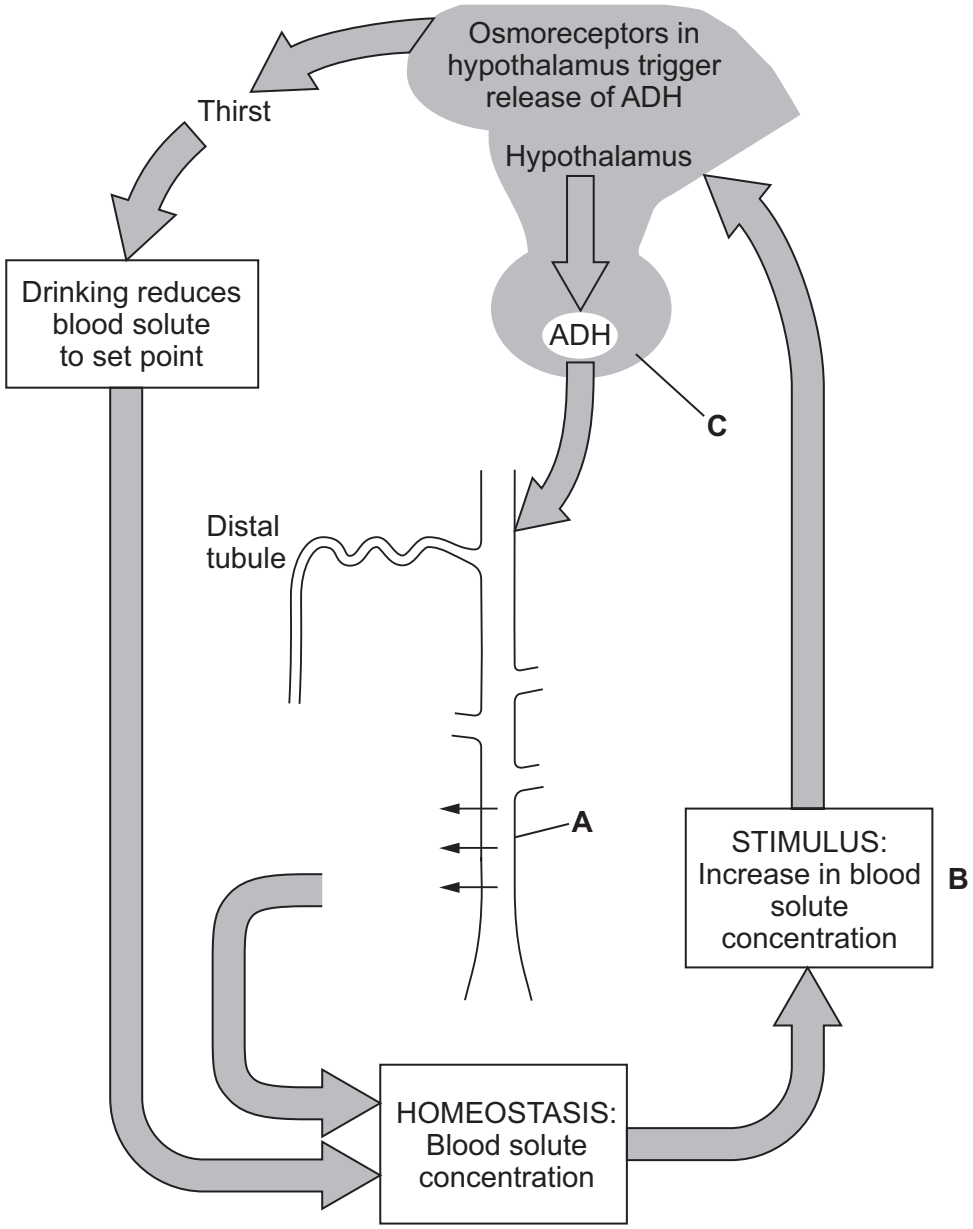
Examiner only

(d) The following diagram shows the feedback mechanisms involved in controlling blood solute concentration.



(i) Name structures **A** and **C** on the diagram above. [2]

A .....

C .....

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(ii) Give **two** examples of what might cause a rise in blood solute concentration as shown in box **B**. [1]

I .....

II .....

(iii) From your knowledge of the kidney, what would be the result of higher levels of ADH at **A**? [1]

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14

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7. Acetyl cholinesterase is one of many enzymes needed for the functioning of the nervous systems of vertebrates and insects. Certain chemical classes of pesticides, such as organophosphates, work against pests by inhibiting cholinesterase. While the effects of cholinesterase-inhibiting products are intended for insect pests, these chemicals can also be toxic to humans.
In severe cases of exposure to organophosphates, symptoms include uncontrollable muscular tremors, breathing difficulty and possible death.

(a) Explain the toxic effects of the organophosphates. [5]

(b) Psychoactive drugs can affect synaptic transmission in a number of different ways. Suggest some different mechanisms by which psychoactive drugs could decrease the rate of synaptic transmission. [4]

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

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the role of the electron transport chain in the synthesis of ATP. (Details of glycolysis, link reaction and Krebs cycle are not required.)
Explain the importance of ATP in living organisms. [10]

Or, *(b)* Describe the processes of glycolysis and the link reaction. [10]

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END OF PAPER

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