Oxford Cambridge and RSA

Friday 24 June 2022 – Morning

A Level Biology B (Advancing Biology)

H422/03 Practical skills in biology

Time allowed: 1 hour 30 minutes

You must have:
- a ruler (cm/mm)

You can use:
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

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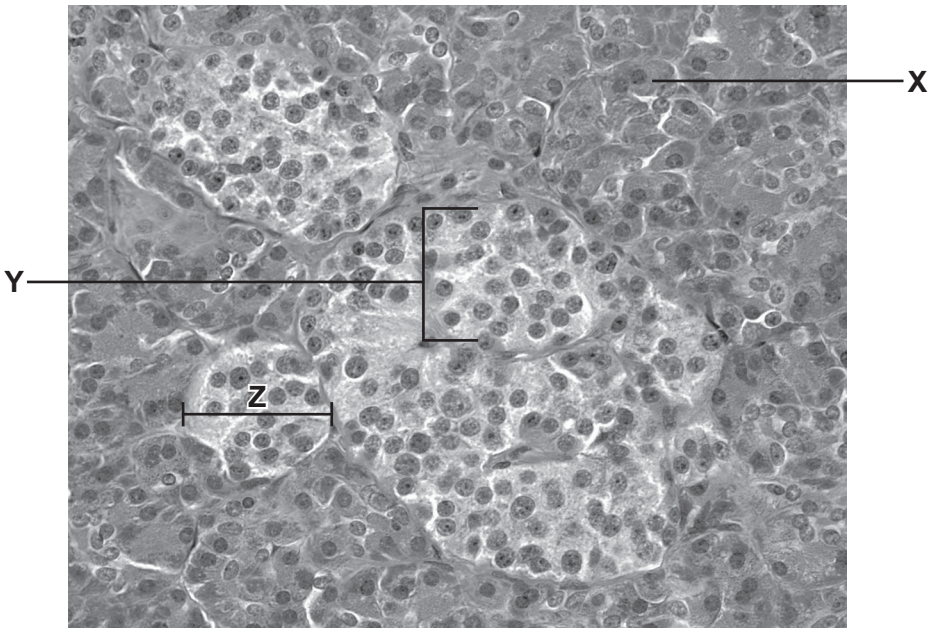
Answer **all** the questions.

1 **(a)** **Fig. 1.1** shows a light micrograph of pancreatic tissue.



×360

Fig. 1.1

(i) State **one** function of the cell labelled **X**.

..... **[1]**

(ii) Name the **two** different types of cell in the region labelled **Y**.

..... **[1]**

(iii) The diameter of one region of pancreatic tissue is represented by the line **Z**.

Calculate the actual diameter of the region labelled **Z**.

Give your answer in μm and to **3** significant figures.

Actual diameter = ... μm **[2]**

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(iv) A stage micrometer can be used when measuring the linear dimensions of cells, such as those of the pancreatic tissue, viewed under a light microscope.

Outline how a stage micrometer is used to measure the linear dimensions of cells.

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..... **[2]**

(b) The pancreas has an essential role in controlling blood glucose concentration.

A person was given a glucose tolerance test. Two months later, the same person was given a fasting blood glucose test. The table shows the results of the two tests.

	Glucose tolerance test	**Fasting blood glucose test**
Blood glucose concentration 2 hours after the beginning of the test (mmol dm^{-3})	10.7	7.0

Suggest what conclusions can be made from the results of the two tests.

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(c) An incomplete structure of **α-glucose** is shown in **Fig. 1.2**.

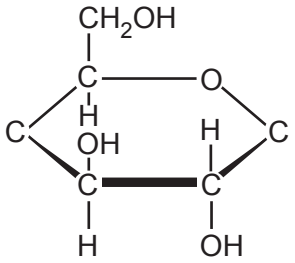

Fig. 1.2

Complete the structure of α-glucose **in Fig. 1.2** to show all of the atoms in the structure. **[1]**

(d) The table lists glucose and two other carbohydrate molecules: lactose and amylose.

Fill in the table to show, for each carbohydrate, a reagent that would give a positive result when used in a test to help identify the carbohydrate **and** the number of glycosidic bonds in each molecule.

Carbohydrate molecule	**Reagent used in test for identification**	**Number of glycosidic bonds per molecule**
Glucose		
Lactose		
Amylose		many

[2]

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2 Drugs such as alcohol, heroin and caffeine produce psychological and physical effects in people.

(a) A group of scientists assessed the harm caused by various drugs, including alcohol and heroin.

The scientists produced weighted 'harm scores' for the drugs in several categories.

Some of the scientists' harm scores for alcohol and heroin are shown in **Fig. 2.1**.

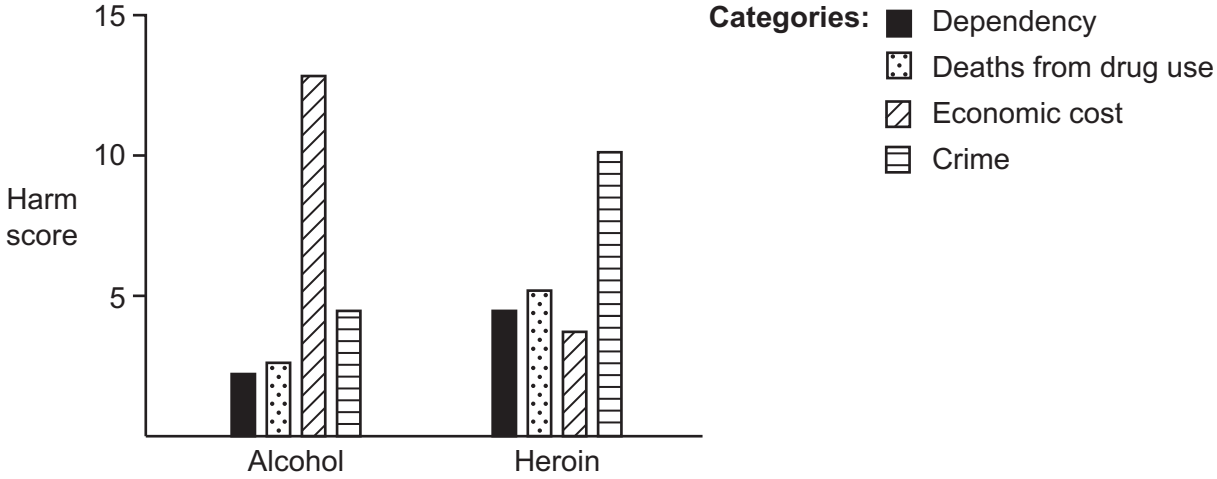

Fig. 2.1

A student looked at **Fig. 2.1** and concluded that 'heroin is more harmful than alcohol'.

Evaluate the student's conclusion.

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..... **[4]**

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(b) Alcohol and heroin both affect the activity of neurones.

Fig. 2.2 shows the binding sites of alcohol and heroin at a synapse that uses the neurotransmitter GABA.

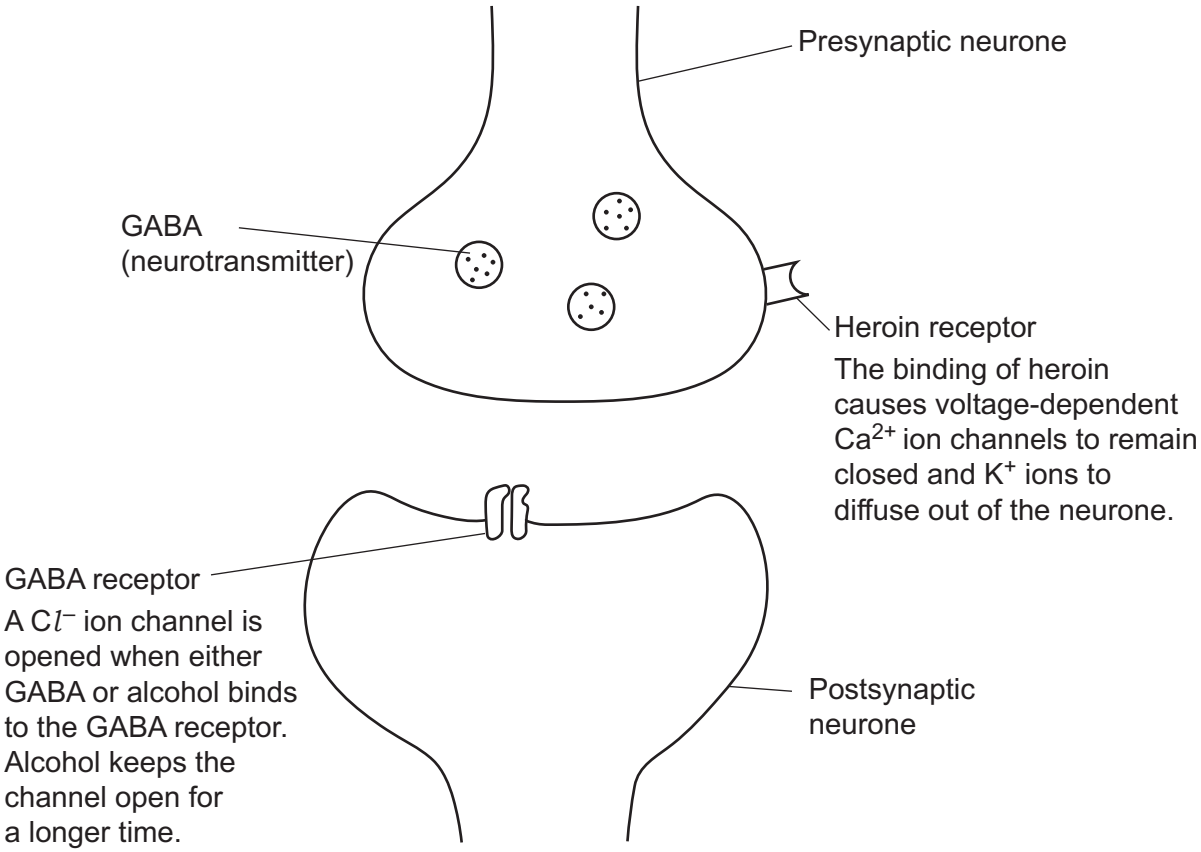

Fig. 2.2

(i) State the type of membrane protein represented by the GABA receptor.

..... **[1]**

(ii) Compare **and** explain the effects of alcohol and heroin on the postsynaptic neurone in **Fig. 2.2**.

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..... **[3]**

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(c)* A student planned to test the effect of caffeine on reaction time.

The student decided to assess reaction time using a 'ruler drop' test. They planned to record the time taken for each participant to catch a ruler after it was dropped.

The student had access to standard laboratory equipment, including rulers, and a caffeinated drink of known concentration.

Outline an experimental plan that the student could use to investigate **and** statistically test the effect of caffeine on reaction time.

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..... **[6]**

Additional answer space if required.

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3 Photosynthetic pigments absorb light energy, which is used during the production of ATP and NADPH in the light-dependent reactions of photosynthesis.

(a) **Fig. 3.1** shows a paper chromatogram produced with four photosynthetic pigments.

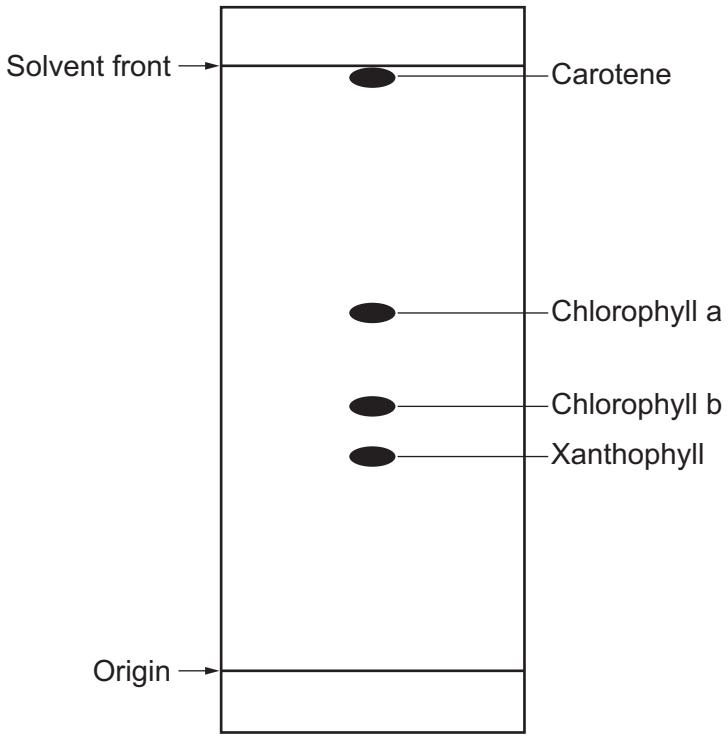

Fig. 3.1

(i) Use **Fig. 3.1** to calculate the Rf value of chlorophyll a.

Give your answer to **2** significant figures.

Rf = ... **[2]**

(ii) Another student carried out paper chromatography on the four photosynthetic pigments but they used a different solvent.

Suggest why the Rf values obtained by the student would have been different to those obtained from the chromatogram shown in **Fig. 3.1**.

.....

..... **[1]**

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(iii) Photosynthetic pigments have colours that make them visible on a chromatogram.

Amino acids that are separated on a chromatogram are not visible.

State the name of the chemical that is used to make amino acids visible on a chromatogram.

..... **[1]**

(b) The student used DCPIP solution to test the activity of photosynthetic pigments in the light-dependent stage of photosynthesis.

The student used a pestle and mortar to grind spinach plant leaves. The student then obtained extracts from the spinach in two forms:

- leaf extract pellets (solid green pellets)
- supernatant (containing liquid and a low concentration of organelles from the spinach cells).

The student stored the leaf extracts in an ice-cold water bath before adding DCPIP solution to four test tubes:

- Tube 1: sucrose solution + DCPIP (in light)
- Tube 2: resuspended leaf extract pellet + DCPIP (in light)
- Tube 3: resuspended leaf extract pellet + DCPIP (in dark)
- Tube 4: supernatant + DCPIP (in light).

(i) Describe **and** explain how the student obtained the leaf extract pellets and supernatant.

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..... **[2]**

(ii) Explain why the student stored the leaf extracts in an ice-cold water bath before they added the DCPIP solution.

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..... **[1]**

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(iii) The student monitored the colour change in the four tubes using colorimetry.

State **and** explain the colour of filter that the student should have placed in the colorimeter during this experiment.

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..... **[2]**

(iv) The sentences below describe some of the details of the colorimetry procedure used by the student.

Complete the sentences using the most appropriate words or phrases.

Every minute, the student transferred a sample of the solution from each tube into a small container called a ..... , which they placed in the colorimeter.

The DCPIP changed colour in two tubes because it was ..... by electrons from the light-dependent reactions of photosynthesis. The student did not observe a colour change in the tubes numbered ..... and ..... .

[3]

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(v) **Fig. 3.2** shows the results from two of the student's tubes.

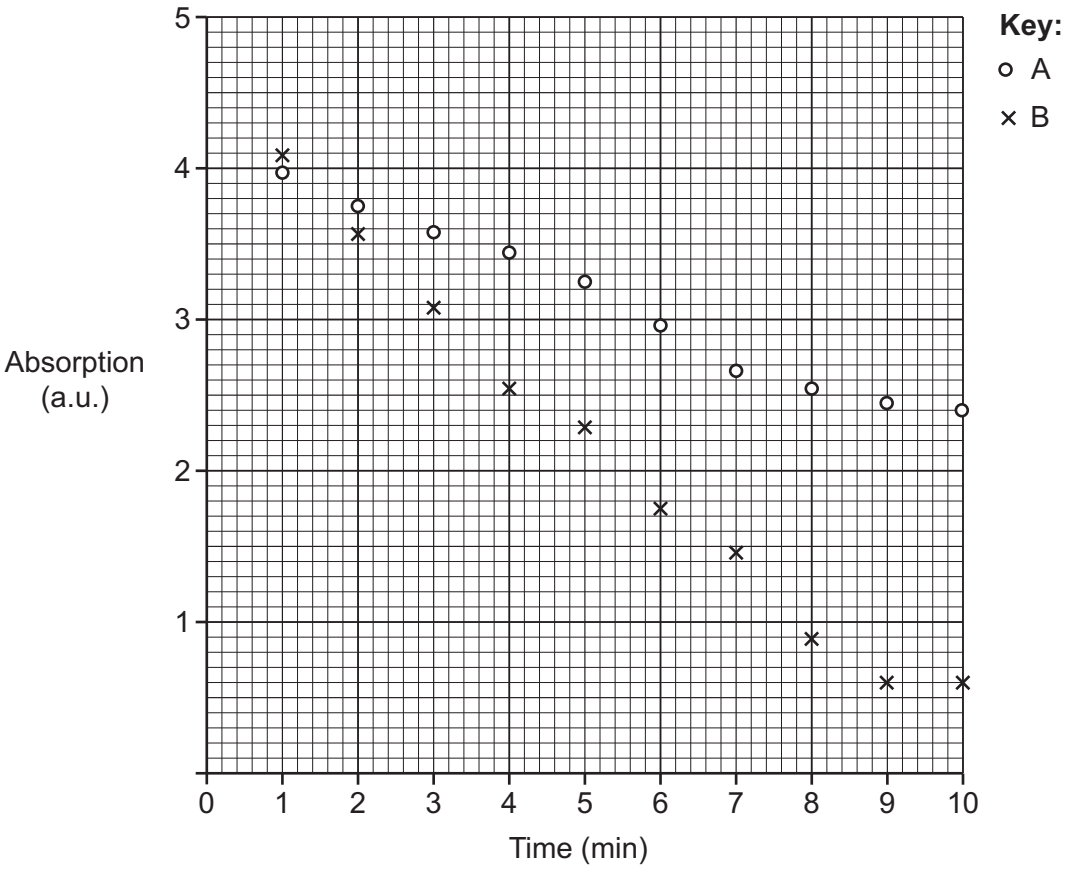

Fig. 3.2

The student forgot to label the two tubes for which the results are shown in **Fig. 3.2**.

Identify the two tubes and explain your conclusion.

A ..... B .....

Explanation .....

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..... **[3]**

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4 The structure of bacterial cells determines how they are identified and the type of antibiotics that are used against them.

(a) The table shows some of the features of Gram-positive and Gram-negative bacteria.

Use ticks (✓) to indicate in the table whether each feature is observed in Gram-positive bacteria, Gram-negative bacteria, or both. The first row has been filled in for you.

Feature	**Gram-positive bacteria**	**Gram-negative bacteria**
Peptidoglycan cell wall	✓	✓
Lipopolysaccharide outer envelope		
Plasma membrane		
Stained with crystal violet during the Gram staining procedure		
Final colour of pink after Gram staining		

[3]

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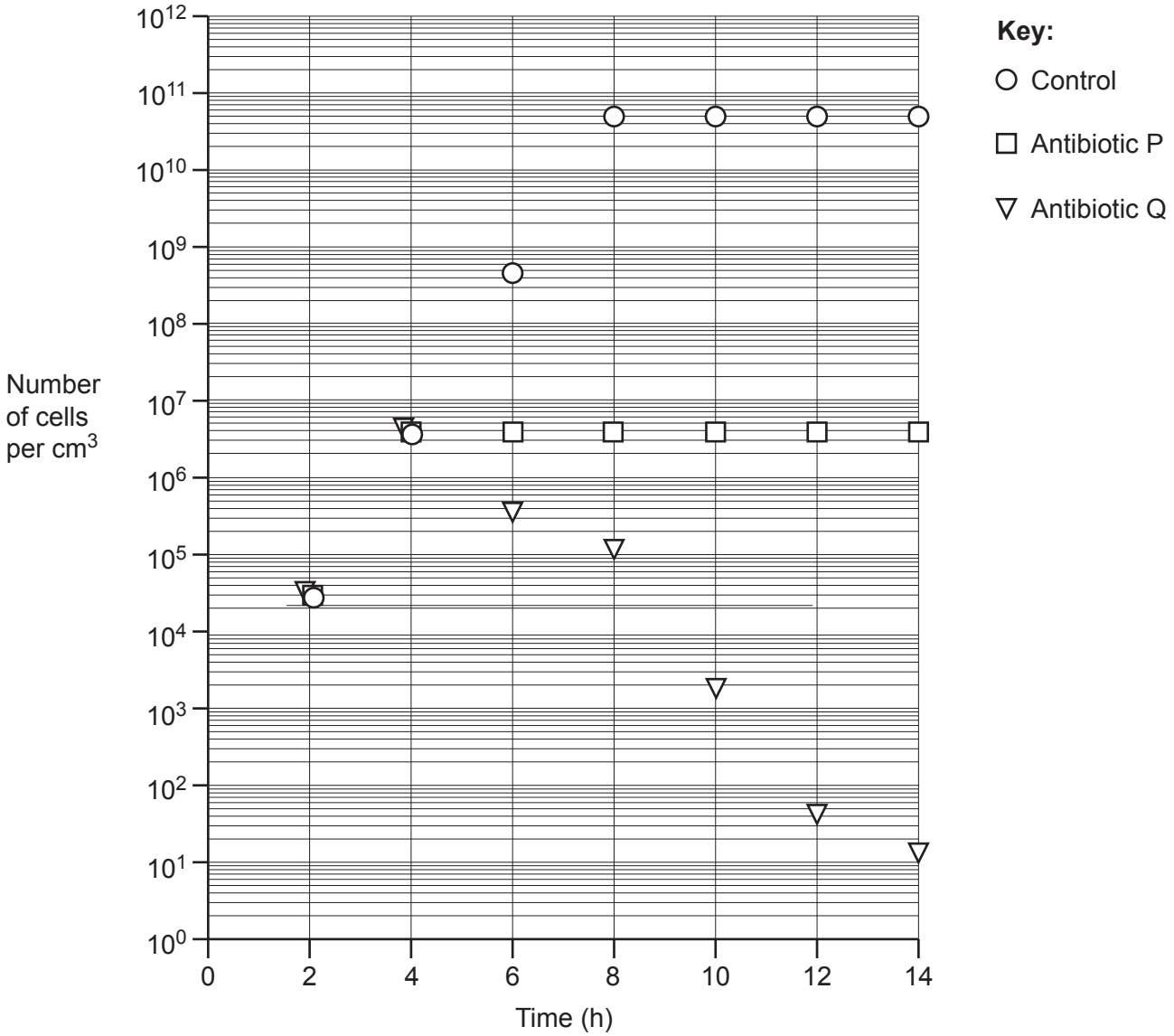
(b) A scientist analysed the effect of two different antibiotics, P and Q, on a particular bacterium. The scientist set up three separate populations of the bacterium, one to test antibiotic P, one to test antibiotic Q, and one as a control which was not exposed to an antibiotic.

The results are shown in the graph.



(i) The bacteria in the control group were suspended in 10 cm^3 of a nutrient solution at the beginning of the experiment.

Estimate the number of bacterial cells in the control group population at the beginning of the experiment.

Give your answer to **3** significant figures.

Number of cells = ... **[2]**

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(ii)* Describe **and** explain the results for the three bacterial populations shown in the graph.

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..... **[6]**

Additional answer space if required.

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(c) **(i)** Many bacterial species can produce ATP only through anaerobic respiration.

Explain why the rate of ATP production in these bacterial species is relatively low.

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..... **[1]**

(ii) Some bacterial species can produce ATP through aerobic respiration, using electron transport chains and ATP synthase.

Suggest the location of electron transport chains and ATP synthase in bacterial cells.

..... **[1]**

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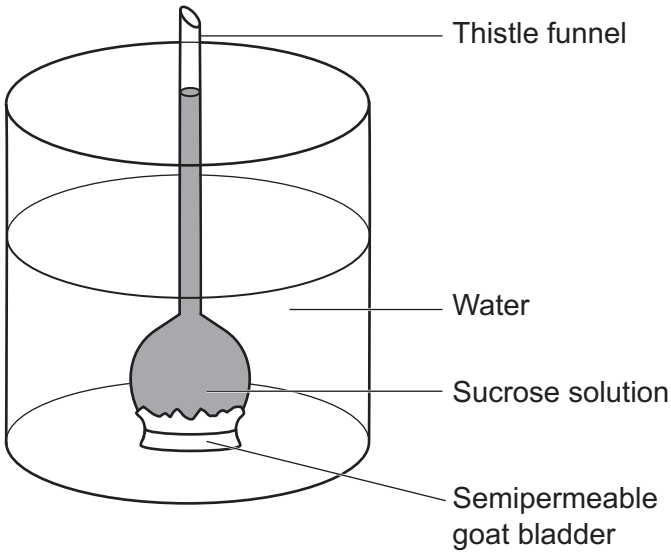
5 The factors affecting osmosis can be investigated using a thistle funnel, which is shown in the diagram.



(a) A student wanted to investigate the factors affecting osmosis and used the experimental set-up shown.

(i) Suggest **and** explain **three** changes that the student could make to the experimental set-up that would **increase** the rate of osmosis.

Change .....

Explanation .....

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Change .....

Explanation .....

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Change .....

Explanation .....

.....

[3]

(ii) The student decided to measure the rate of osmosis by measuring how the height of the solution changed over time in the thistle funnel.

Suggest appropriate units for the student's dependent variable in the investigation.

..... **[1]**

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(iii) Suggest a semipermeable material that the student could use instead of the goat bladder.

..... **[1]**

(b) Osmosis occurs in several parts of a kidney nephron.

(i) State the part of a kidney nephron in which most of the water is reabsorbed.

..... **[1]**

(ii) State a part of a kidney nephron in which ADH can change the permeability to water.

..... **[1]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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