OCR
Oxford Cambridge and RSA

Monday 13 May 2024 – Morning

AS Level Biology A

H020/01 Breadth in biology

Time allowed: 1 hour 30 minutes

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

H020/01

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 **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **28** pages.

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

Section A

You should spend a **maximum** of **25 minutes** on this section.

Write your answer for each question in the box provided.

1 Which process occurs during ventilation in bony fish?

A During expiration, the operculum opens

B During expiration, the volume in the buccal cavity increases and the pressure decreases

C During inspiration, the mouth opens causing the operculum to open

D During inspiration, the volume in the buccal cavity decreases and the pressure decreases

Your answer ☐ **[1]**

2 Which change in the mammalian gas exchange system takes place only during forced expiration?

A Abdominal muscles relax

B Diaphragm contracts to become dome-shaped

C External intercostal muscles contract

D Internal intercostal muscles contract

Your answer ☐ **[1]**

3 The blue whale can grow up to 30 m long and can weigh up to 200 000 kg.

Whales have specialised surfaces for gas exchange.

Which option is **not** a reason why blue whales need a specialised surface for gas exchange?

A Transport of gases by diffusion is too slow

B Whales are multicellular organisms

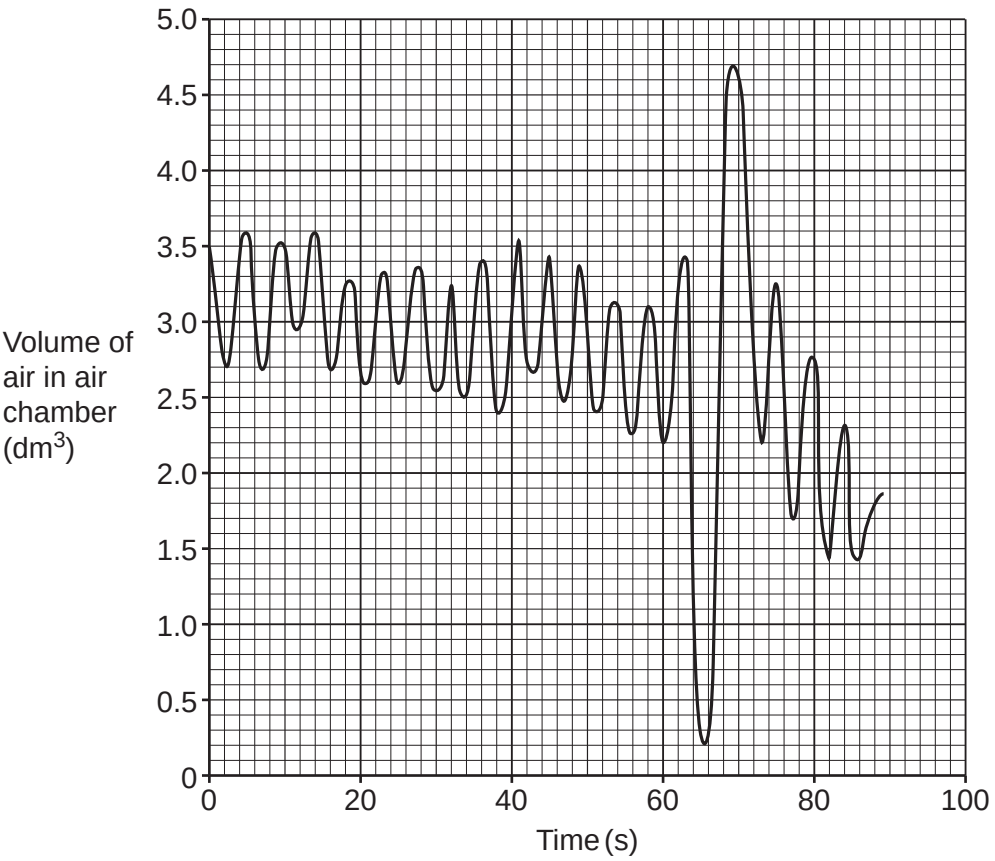
C Whales have a high metabolic demand

D Whales have a large surface area to volume ratio

Your answer ☐ **[1]**

4 The graph shows a trace recorded by a spirometer.

The trace shows a period of normal breathing whilst at rest, followed by a maximum inhalation and maximum exhalation.



What is the value for vital capacity?

A 0.70 dm^3

B 0.90 dm^3

C 3.15 dm^3

D 4.50 dm^3

Your answer ☐ **[1]**

5 During exercise the cardiac output of an athlete is 28 $dm^3 min^{-1}$ and their stroke volume is 160 cm^3.

How many heart beats occur when the athlete exercises for five minutes? Assume the cardiac output and stroke volume stay constant during the exercise time.

A 22

B 175

C 875

D 4480

Your answer ☐ **[1]**

6 Which option is a feature of tissue fluid?

A Tissue fluid carries oxygen away from muscle cells

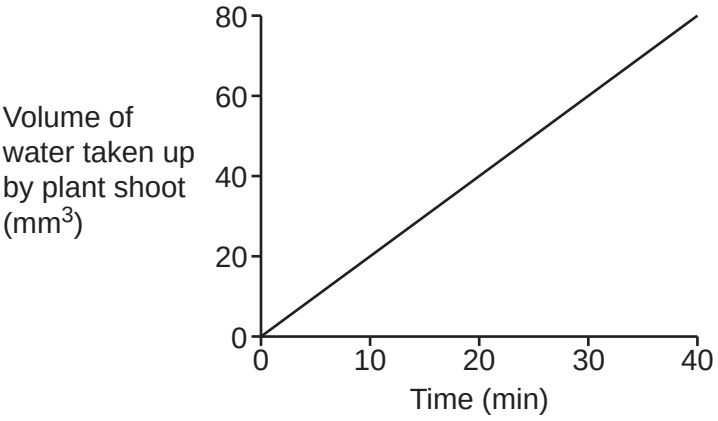
B Tissue fluid does not contain erythrocytes

C Tissue fluid forms when net hydrostatic pressure < net oncotic pressure

D Tissue fluid forms when net hydrostatic pressure = oncotic pressure

Your answer ☐ **[1]**

7 A potometer was used to estimate the rate of transpiration. The graph below shows the results from the experiment.



What is the estimated rate of transpiration?

A $0.5\,mm^3\,min^{-1}$

B $1.0\,mm^3\,min^{-1}$

C $2.0\,mm^3\,min^{-1}$

D $4.0\,mm^3\,min^{-1}$

Your answer ☐ **[1]**

8 *Bacillus thuringiensis* (Bt) is a species of bacterium that lives in soil. Bt makes proteins that are toxic to some insects when eaten.

Which process does **not** occur in Bt?

A Bt modifies and packages toxic proteins in the Golgi apparatus

B Bt reproduces by asexual reproduction to pass on the gene for the toxic protein

C Bt transcribes the gene for the toxic protein using RNA polymerase

D mRNA is translated to make the toxic protein

Your answer ☐ **[1]**

9 Lactose is a carbohydrate.

Which feature describes the structure of lactose?

A Lactose contains glycosidic bonds that are broken by a condensation reaction

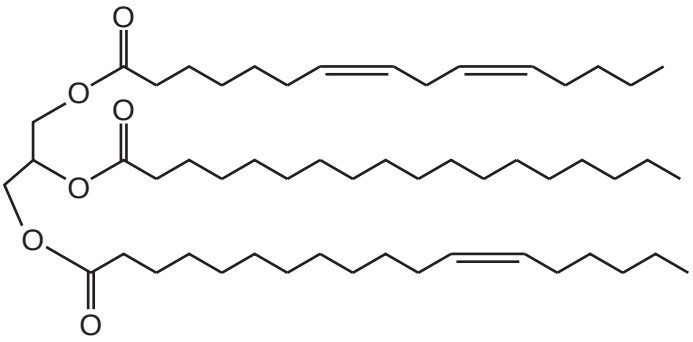
B Lactose is made up of fructose and glucose

C The molecular formula of lactose is $C_{12}H_{22}O_{11}$

D The molecular formula of lactose is $C_{12}H_{24}O_{12}$

Your answer ☐ **[1]**

10 The diagram shows a triglyceride molecule found in sunflower oil.



Which option describes the structure of this triglyceride molecule?

A Contains phosphodiester bonds

B Monounsaturated

C Polyunsaturated

D Saturated

Your answer ☐ **[1]**

11 Chloramphenicol is an antibiotic that works by binding to bacterial ribosomes.

What process stops when chloramphenicol is present?

A Cytokinesis

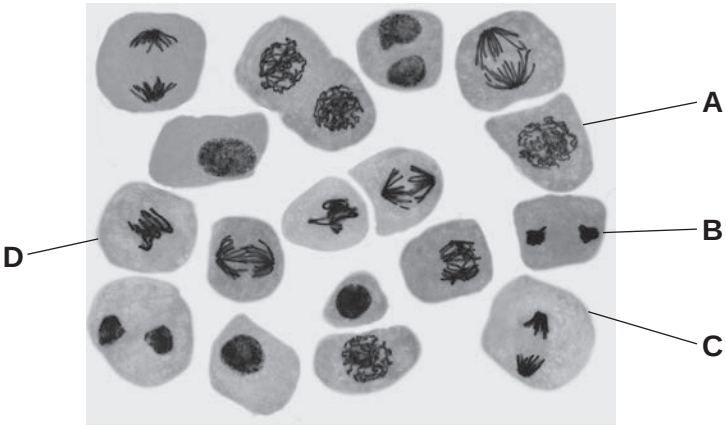
B Endocytosis

C Transcription

D Translation

Your answer ☐ **[1]**

12 The photomicrograph shows a group of cells prepared from an onion root tip squash.



Which of the label lines shows a cell that is in metaphase?

Your answer ☐ **[1]**

13 Ring rot is an infection that can kill potato plants.

Which kingdom does the organism that causes ring rot belong to?

A Fungi

B Prokaryotae

C Protoctista

D Viruses

Your answer ☐ **[1]**

14 What is an example of a disease transmitted by a vector?

A Hepatitis C from sharing needles

B Herpes simplex virus from sharing lipstick

C HIV from unprotected sex

D Malaria from mosquitoes

Your answer ☐ **[1]**

15 Plant defences can be described as chemical or physical.

Which of the following results in a **physical** defence against a pathogen?

A Plants produce hormones, which alert nearby plants of their own infection

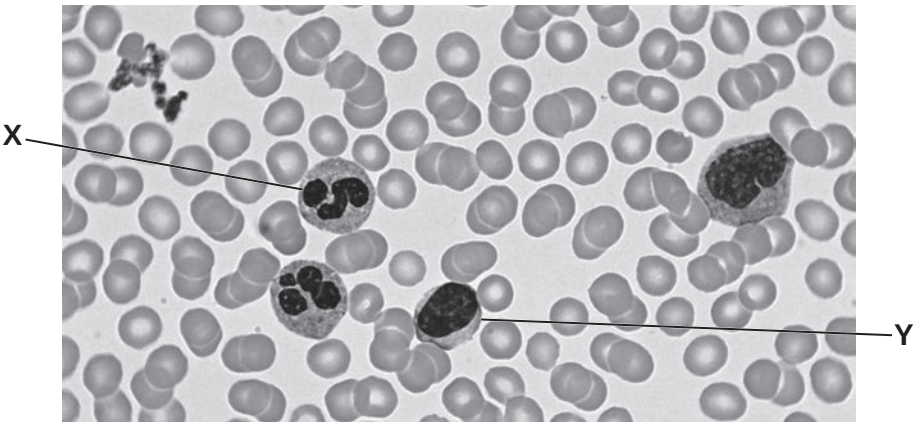
B Plants synthesise callose, which they use to block plasmodesmata

C Plants synthesise enzymes called chitinases to break down fungal cell walls

D Plants synthesise proteins called defensins, which disrupt metabolism to cause cell death of the pathogen

Your answer ☐ **[1]**

16 The image shows a photomicrograph of a blood smear.



Which row in the table below correctly identifies cell **X** and cell **Y**?

	X	Y
A	neutrophil	erythrocyte
B	neutrophil	lymphocyte
C	lymphocyte	neutrophil
D	platelet	neutrophil

Your answer ☐ **[1]**

17 Which statement describes species evenness?

A The number of different species

B The number of organisms in a community

C The number of organisms of a particular species

D The relative number of individuals of each species in an ecosystem

Your answer ☐ **[1]**

18 Students carried out fieldwork in two different woodlands. They marked out an area measuring 10 m by 10 m in each woodland. For each plant species present they recorded the number of individuals of each species.

The table shows their results.

Species	Number of Individuals	
	Area 1	Area 2
Greater celandine	5	25
Lesser celandine	7	10
Herb robert	2	5
Wild strawberry	8	0
Dog's mercury	4	0
Violet	4	0
Snowdrop	0	2

The students made some conclusions about their data.

Which of these conclusions is supported by their data?

A Area 1 has a lower value of Simpson's index of diversity

B Area 1 is a more stable habitat

C Area 2 has a greater species evenness

D Both area 1 and area 2 have the same species richness

Your answer ☐ **[1]**

19 *In situ* and *ex situ* conservation methods maintain biodiversity.

Which example describes an *ex situ* conservation method?

A Collecting and storing seeds of clover glycine after an Australian forest fire

B Estimating the number of mountain hares in the Peak District National Park

C Protecting ancient oak trees by restricting access to their location

D Protecting the nesting grounds of leatherback sea turtles in the Great Barrier Reef

Your answer ☐ **[1]**

20 Bats are mammals that hunt insects while flying. Dolphins are mammals that hunt fish while swimming. Some bats and all dolphins use a technique known as echolocation to hunt their prey. They emit sound waves which reflect back to them to show the location of prey.

What explains why bats and dolphins show the same adaptation of having echolocation?

A Bats and dolphins are in the same family

B Both had different environmental conditions

C Both had the same selection pressure

D The environment caused both to have the same mutation

Your answer ☐ **[1]**

Section B

21 A group of students are investigating osmosis in plant cells.

This is the method they use:

- Use a cork borer to cut cylinders of sweet potato to 30 mm in length.
- Dry each cylinder using a paper towel and record its mass.
- Prepare 5 cm^3 of sucrose concentrations of 0.0, 0.1, 0.2, 0.4 and 0.8 mol dm^{-3} in test tubes.
- Place one cylinder into each test tube.
- Leave test tubes at room temperature for 48 hours.
- Remove each cylinder, dry using a paper towel and record its mass.
- Repeat the experiment three times at each sucrose concentration.
- Calculate the percentage change in mass for each cylinder.

The table shows the processed results obtained by the students.

Sucrose concentration / (mol dm^{-3})	Percentage change in mass				Mean percentage change in mass
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	
0.0	+30.3	+25.5	+28.8	+29.2	+28.5
0.1	+23.3	+25.5	+10.3	+22.2	+20.3
0.2	+12.7	+14.4	+14.8	+12.3	+13.6
0.4	+2.7	+4.3	+4.4	+2.9	+3.6
0.8	–13.9	–10.9	–12.5	–12.8	–12.5

(a) Explain the difference between the mean results obtained at the 0.0 mol dm^{-3} and 0.8 mol dm^{-3} sucrose concentrations.

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(b) The students suggested that there was an anomaly in their results.

Identify the anomalous result **and** explain how the anomalous result affects the **precision** of the data obtained.

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(c) The students prepared the sucrose concentrations using a serial dilution technique. The students were provided with 10 cm^3 of a 0.8 mol dm^{-3} sucrose concentration.

Describe how the students produced 0.4, 0.2 and 0.1 mol dm^{-3} sucrose concentrations each with a volume of 10 cm^3.

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(d) The students carried out a similar experiment with carrot tissue.

Explain how the students could use their data to estimate whether sweet potato tissue or carrot tissue had a higher sucrose concentration in its cells.

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22 Living organisms are organised into tissues, organs, and organ systems.

(a) State the difference between a tissue and an organ.

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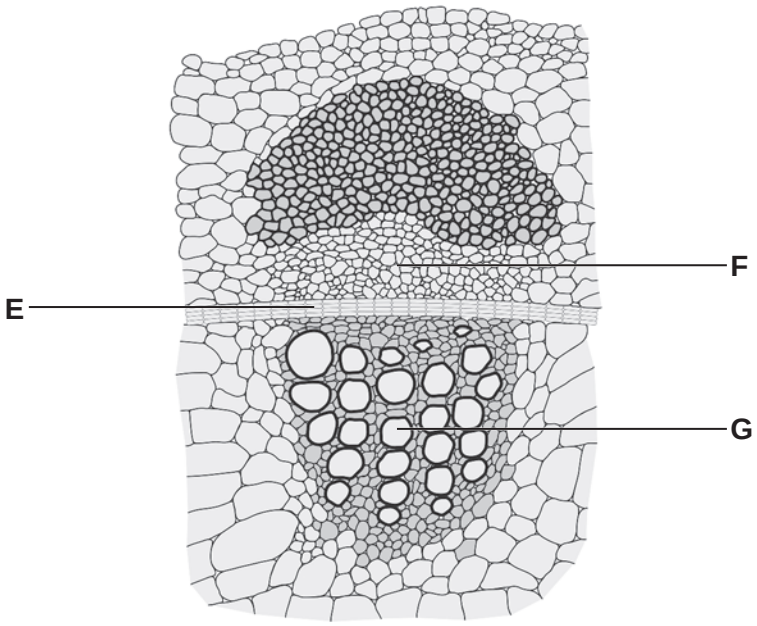
(b) A light microscope image from a transverse-section through the stem of a plant was used to produce the drawing shown below.



(i) Identify tissues **E** and **F**.

Tissue **E** .....

Tissue **F** .....

[2]

(ii) Explain **two** ways tissue **G** is adapted for its function.

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

(c) The sentences are about the transport of water through a plant.

Complete the sentences using the most appropriate terms.

In the apoplast pathway, water moves through the ..... of plant cells. When water reaches the endodermis, its movement is blocked by an impermeable barrier called the ..... .

Water is then forced into the symplast pathway. It moves between cells through channels called ..... .

[3]

(d) Xerophytes are plants that are adapted to living in dry environments.

Explain **two** ways that xerophytes are adapted to prevent water loss in dry environments.

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2 .....

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[2]

23 DNA has a double helix structure made from polynucleotides.

(a) Describe how a polynucleotide is formed from its monomers.

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

(b) DNA is replicated during interphase of the eukaryotic cell cycle.

(i) The enzyme helicase is active during DNA replication.

Describe the action of helicase.

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(ii) DNA replication conserves genetic information with accuracy.

Explain how errors may occur during DNA replication.

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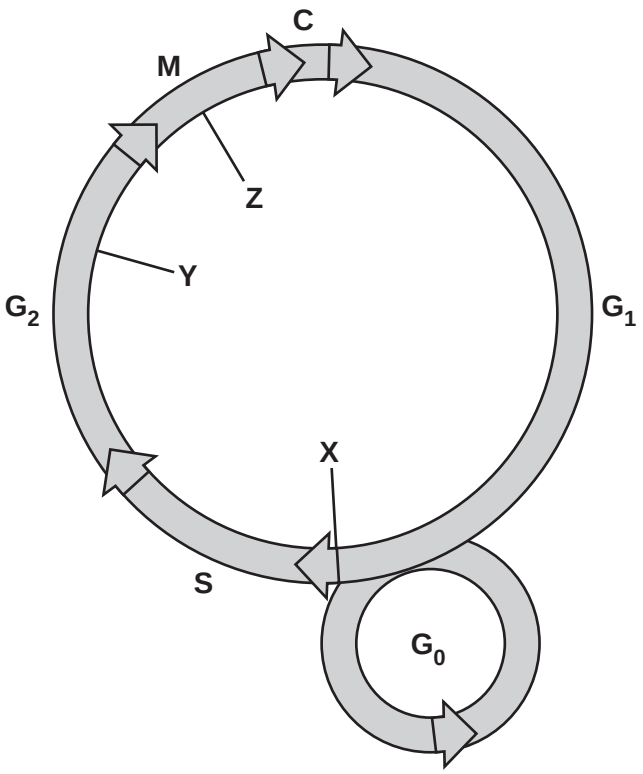
(c) An outline of the eukaryotic cell cycle is shown below.

X, **Y** and **Z** represent checkpoints in the regulation of the cell cycle.



A cell that had completed the cell cycle had more chromosomes than its normal diploid number.

Identify which cell cycle checkpoint, **X**, **Y** or **Z**, had failed to work in this cell. Give a reason for your choice.

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(d) Students use this method to extract DNA from the fruit of a strawberry plant:

- Take a fruit from a strawberry plant and crush it using a mortar and pestle.
- Add salt to the crushed strawberry fruit mixture.
- Add an enzyme to the mixture.
- Add ethanol to the mixture.

Evaluate whether the method used by the students would successfully extract DNA.

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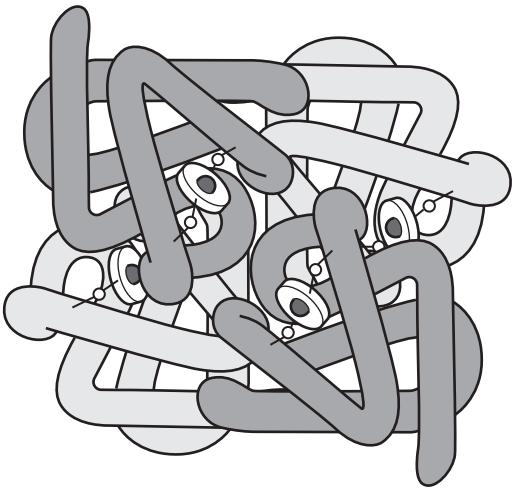
24 Haemoglobin is a conjugated protein with quaternary structure.

(a) The image shows the quaternary structure of a haemoglobin molecule.



(i) In addition to having a quaternary structure, haemoglobin also has primary, secondary and tertiary structures.

The table below contains statements about the structure of haemoglobin.

Complete the table to show the level of protein structure described in each statement.

You can choose each level of protein structure **once**, **more than once** or **not at all**.

Statement	Level of Protein Structure
Disulfide bonds are formed when two cysteine amino acids in an α-globin chain come together after the alpha helix folds	
Haemoglobin is made up of two α-globin chains and two β-globin chains	
Each α-globin and β-globin chain is folded into a spherical shape	
The β-globin chain has 147 amino acids in a specific sequence	

[3]

(ii) Name the enzyme in an erythrocyte that allows haemoglobinic acid to be formed.

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

(b) The bacterium, *Pseudomonas aeruginosa*, does not have haemoglobin.

P. aeruginosa is found in natural water sources.

Infection by *P. aeruginosa* can cause the disease, hospital-acquired pneumonia (HAP).

One hospital assessed the frequency of people admitted to the intensive care unit (ICU) with HAP in 2013.

The results were:

- 346 people were admitted to the ICU and HAP was diagnosed in 25.4% of these people.
- 14.6% of people diagnosed with HAP died due to infection by *P. aeruginosa*.
- This number was 35% higher than in 2012.

Calculate the **number** of people who died due to infection by *P. aeruginosa* in **2012**.

Give your answer to the **nearest whole number**.

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

(c) The treatment for people in hospitals that have HAP due to *P. aeruginosa* is to give antibiotics. Some populations of *P. aeruginosa* have become resistant to specific antibiotics.

Suggest **and** explain the potential implications of antibiotic resistance for hospitals.

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(d) Scientists have suggested that personalised medicine may be used to help with the problem of antibiotic resistance.

State what is meant by personalised medicine.

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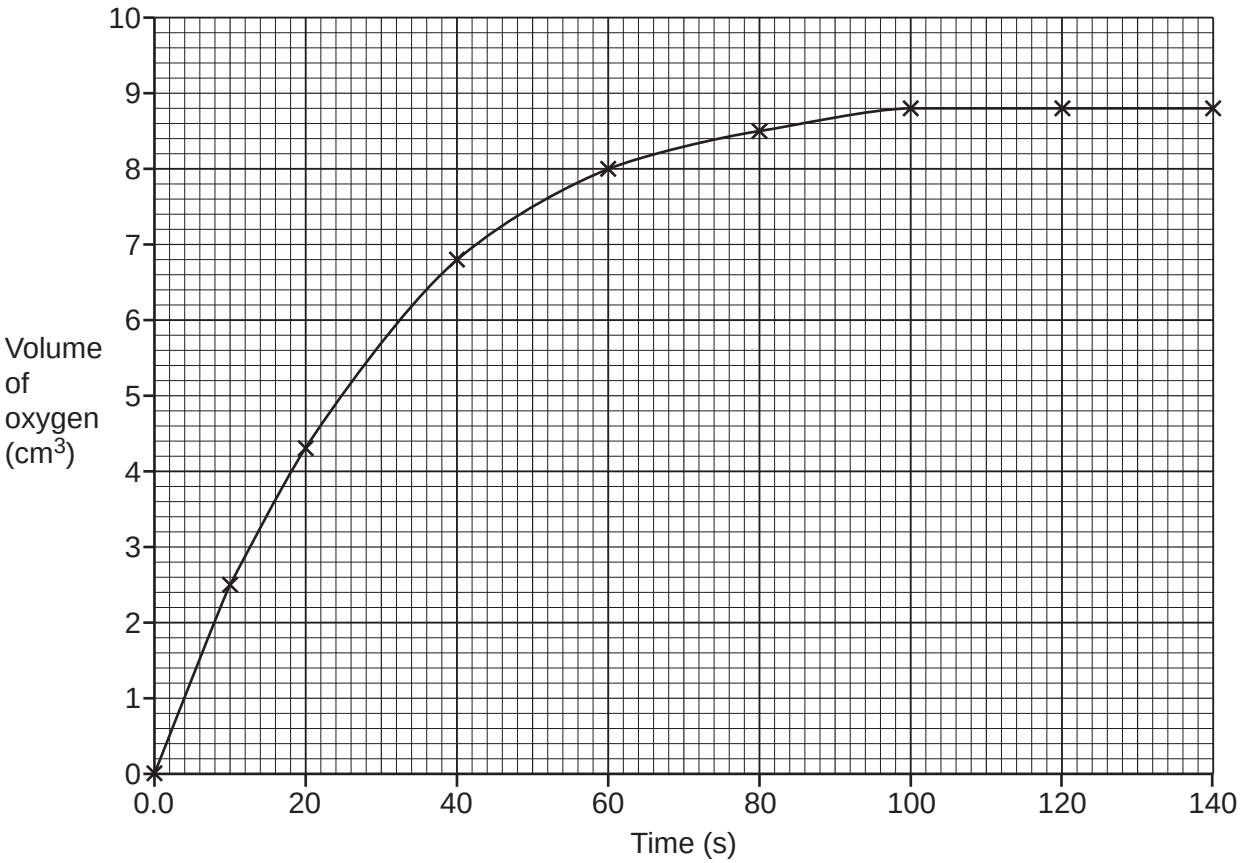
25 A student investigates the rate of catalase activity as it breaks down hydrogen peroxide into oxygen and water.

The volume of oxygen released was recorded over a period of 140 seconds. The results are shown in the graph.



(a) Use the graph to calculate the rate of reaction at **50** seconds.

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

Rate = ... $cm^3 s^{-1}$ **[2]**

(b) Hydroxylamine inhibits catalase.

Describe how the student could show that hydroxylamine is a competitive inhibitor.

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(c) Phagocytes engulf pathogens during phagocytosis and digest them using enzymes.

These enzymes can be found in lysosomes.

Explain how the enzymes inside lysosomes come into contact with pathogens that have been engulfed.

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26 Several factors can have a negative effect on biodiversity.

(a) Explain how agriculture can have a negative effect on biodiversity.

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

(b) State **one** factor other than agriculture that can have a negative effect on biodiversity.

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END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.