CAMBRIDGE
OCR

Cambridge OCR Level 3 Advanced Subsidiary GCE in Biology A

H020/01 Breadth in Biology
Sample Question Paper

Date – Morning/Afternoon

Version 3.0

Time allowed: 1 hour 30 minutes

You can use:

- a scientific or graphical calculator
- a ruler (cm/mm)

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 answers 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 **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE

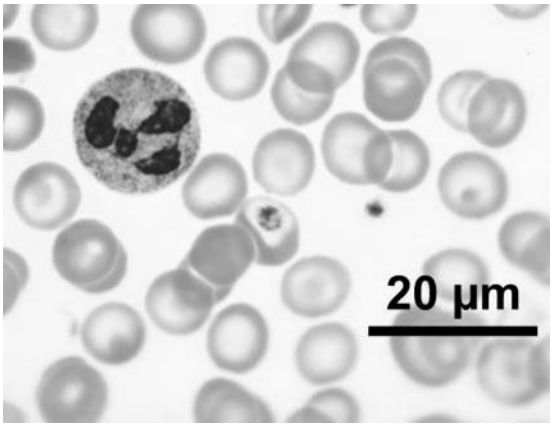
- Read each question carefully before your start your answer.

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Section A

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

1 This is a light micrograph of blood.



What is the approximate volume of the neutrophil?

Use the formula: volume of sphere = $\frac{4}{3}\pi r^3$

A 2 µm^3

B 20 µm^3

C 200 µm^3

D 2000 µm^3

Your answer ☐ **[1]**

2 The table lists three types of microscopes.

Which row shows the type of structures that are best viewed using each microscope?

	Light microscope	**Transmission electron microscope**	**Scanning electron microscope**
A	a section of a tissue	cell surfaces	cell surfaces
B	organelles	cell surfaces	a detailed section of cells and organelles
C	cell surfaces	organelles	a detailed section of cells and organelles
D	a section of a tissue	a detailed section of cells and organelles	cell surfaces

Your answer ☐ **[1]**

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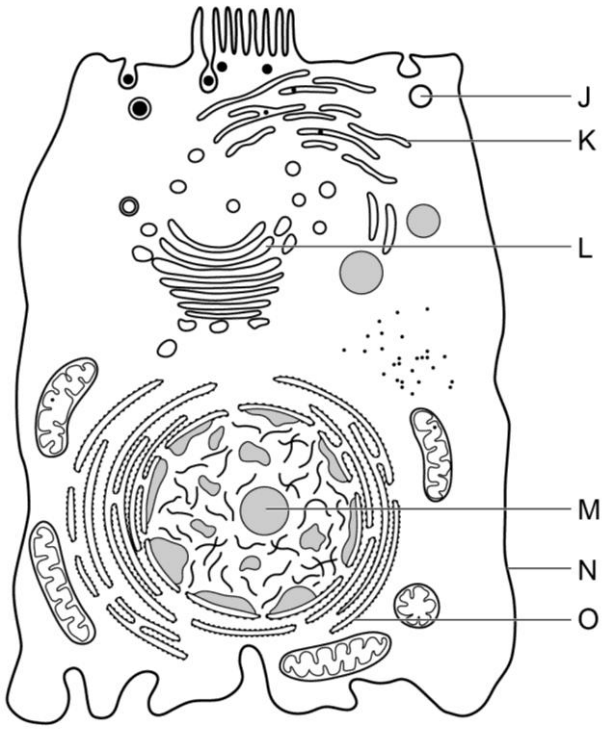
3 Cyanobacteria are organisms that use light to make their own food.

Which row describes the structure of cyanobacteria?

	Nucleus	Circular DNA	Mitochondria	Ribosomes	Chloroplast	Cell wall
A	✓		✓		✓	
B			✓		✓	✓
C	✓	✓		✓		
D		✓		✓		✓

Your answer ☐ **[1]**

4 This is a diagram of an animal cell.



Which order of letters indicates the correct sequence of organelles involved during the production and secretion of a protein from this cell?

A M, L, J, N

B M, O, L, J

C O, K, J, N

D O, L, J, N

Your answer ☐ **[1]**

5 Which option is a saturated fatty acid?

A Erucic acid, $C_{22}H_{42}O_2$

B Linoleic acid, $C_{18}H_{32}O_2$

C Oleic acid, $C_{17}H_{33}COOH$

D Palmitic acid, $C_{15}H_{31}COOH$

Your answer ☐ **[1]**

6 This is a DNA sequence:

AATCGCGGTCGCTCA.

Which row shows the complementary DNA sequence and the mRNA sequence?

	Complementary DNA sequence	**mRNA sequence from original DNA sequence**
A	AATCGCGGTCGCTCA	UUAGCGCCAGCGAGU
B	TTAGCGCCAGCGAGT	UUAGCGCCAGCGAGU
C	TTAGCGCCAGCGAGT	TTAGCGCCAGCGAGT
D	TTAGCGCCAGCGAGT	AAUCGCGGUCGCUCA

Your answer ☐ **[1]**

7 Zinc ions are necessary for the enzyme carbonic anhydrase to work.

Which option describes the nature and function of a zinc ion in its interaction with carbonic anhydrase?

A Inorganic ion and coenzyme

B Inorganic ion and prosthetic group

C Vitamin and coenzyme

D Vitamin and prosthetic group

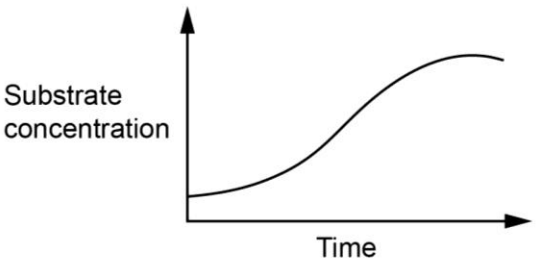
Your answer ☐ **[1]**

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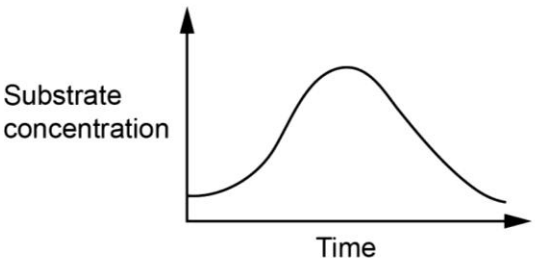
8 A group of students recorded the substrate concentration during an enzyme-controlled reaction.

Which graph shows how the substrate concentration changes during the reaction?

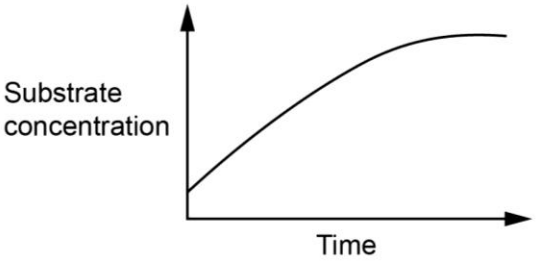
A



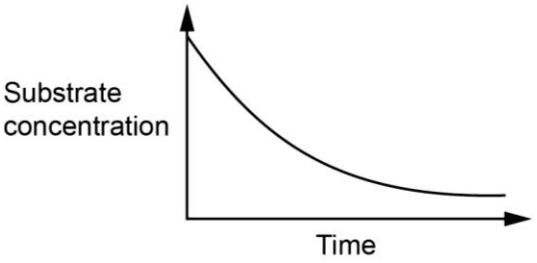
B



C



D



Your answer ☐ **[1]**

9 A chemical produced by a metabolic pathway binds to the initial enzyme in the pathway. The chemical binds to the enzyme at a site away from the active site and inhibits the enzyme action.

What is the mode of action of the chemical?

A It competes with the substrate by blocking the active site.

B It is a competitive inhibitor and an end product inhibitor.

C It is an end product inhibitor and can lead to non-reversible inhibition.

D It is an end product inhibitor and it binds to the allosteric site of the enzyme.

Your answer ☐ **[1]**

10 Nuclear division results in genetic variation and reduction division. There are two types of nuclear division, mitosis and meiosis. In meiosis, there are two divisions of the nucleus.

Which table shows the results of nuclear division?

A

	Genetic variation	Reduction division
Mitosis	×	×
Meiosis 1	✓	✓
Meiosis 2	×	×

B

	Genetic variation	Reduction division
Mitosis	×	×
Meiosis 1	✓	✓
Meiosis 2	✓	×

C

	Genetic variation	Reduction division
Mitosis	×	✓
Meiosis 1	✓	×
Meiosis 2	✓	✓

D

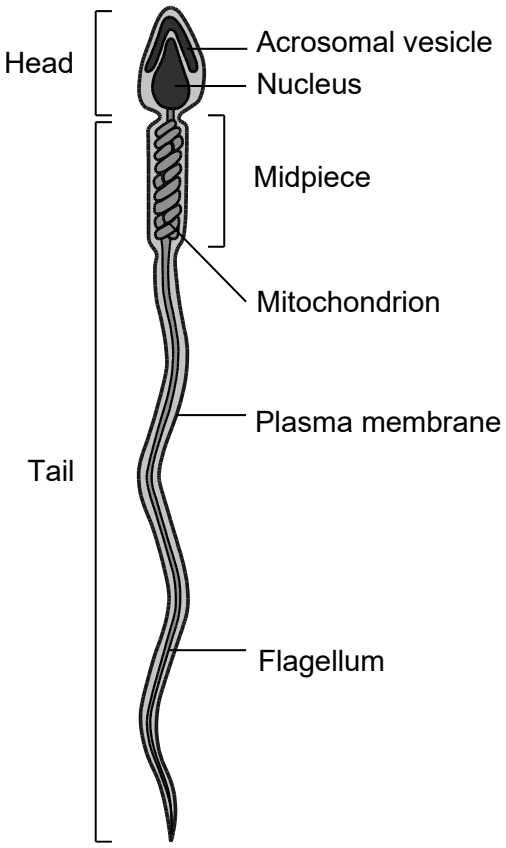
	Genetic variation	Reduction division
Mitosis	×	×
Meiosis 1	✓	✓
Meiosis 2	×	✓

Your answer ☐ **[1]**

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11 Sperm cells are an example of a specialised cell.

This is a diagram of a sperm cell.



Which option describes one specialisation of a sperm cell?

A The acrosome contains enzymes to digest the outer portion of the egg cell.

B The head contains chromosomes in homologous pairs.

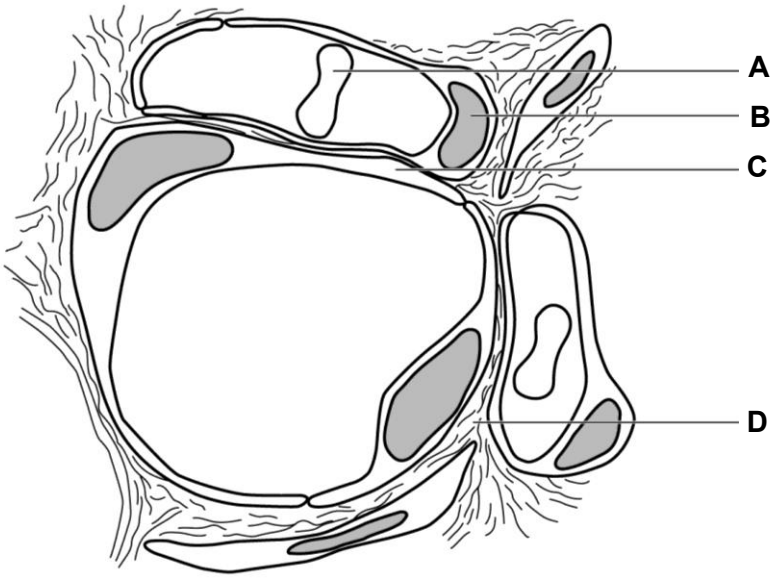
C The midpiece contains mitochondria which enter the egg cell.

D The tail contains flagellum which generates ATP.

Your answer ☐ **[1]**

12 Emphysema is a chronic respiratory disease. A person with emphysema cannot fully exhale because the lung tissue is broken down by the enzyme elastase.

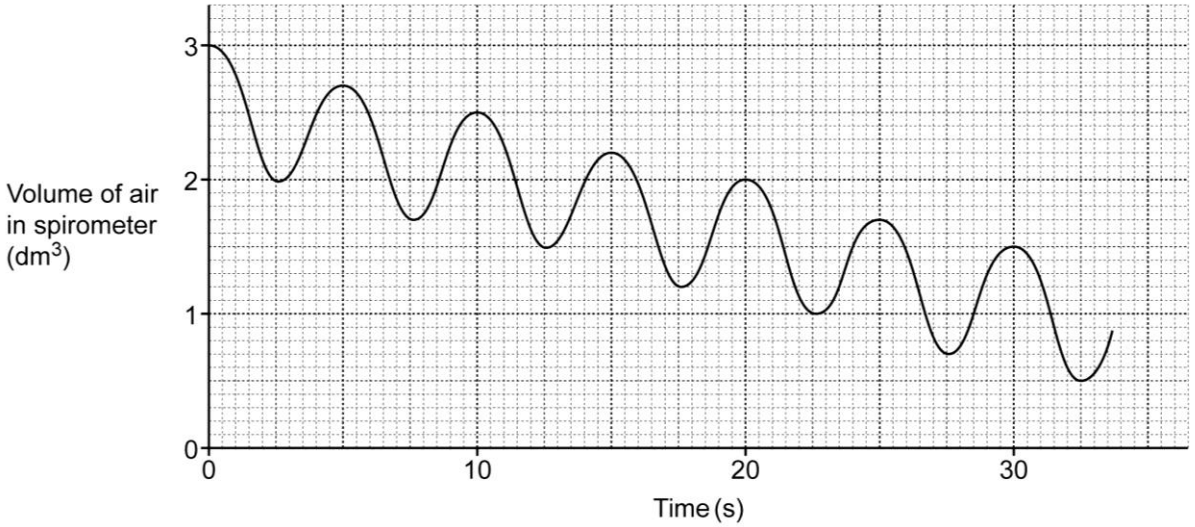
This is a diagram of a small section of a healthy lung.



Which label shows the area of lung tissue that is broken down by the enzyme elastase?

Your answer ☐ **[1]**

13 The spirometer trace shows the results of an experiment. Soda lime was used to extract carbon dioxide from exhaled air.



What is the rate of oxygen consumption in the experiment?

A 1.0 dm^3

B 3.0 $dm^3\,min^{-1}$

C 5.0 $dm^3\,min^{-1}$

D 12 breaths min^{-1}

Your answer ☐ **[1]**

14 When carbon dioxide enters an erythrocyte in a capillary a series of events take place.

The events that take place are:

1. Hydrogencarbonate ions diffuse into the plasma from the erythrocyte
2. Dissociation of carbonic acid
3. Carbon dioxide reacts with water forming carbonic acid
4. Chloride ions diffuse into the erythrocyte from plasma.

Which row shows the events in the correct order?

	First event →			**Final event**
A	2	3	4	1
B	2	4	1	3
C	3	1	4	2
D	3	2	1	4

Your answer ☐ **[1]**

15 Which option describes how water moves between plasma and tissue fluid at the venule end of a capillary?

A The hydrostatic pressure is greater than the oncotic pressure so water moves into the capillary.

B The hydrostatic pressure is greater than the oncotic pressure so water moves out of the capillary.

C The oncotic pressure is greater than the hydrostatic pressure so water moves into the capillary.

D The oncotic pressure is greater than the hydrostatic pressure so water moves out of the capillary.

Your answer ☐ **[1]**

16 When you listen to a human heartbeat through a stethoscope you can hear a two stage 'lub–dub' sound.

What causes the first 'lub' part of the sound?

A Closing of the atrioventricular valves

B Closing of semilunar valves

C Sound of blood rushing into the atria

D Sound of blood rushing into the ventricles

Your answer ☐ **[1]**

17 Which type of immunity is gained by young mammals when they receive antibodies in their mother's milk?

A Artificial active immunity

B Artificial passive immunity

C Natural active immunity

D Natural passive immunity

Your answer ☐ **[1]**

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18 How does vaccination work?

A All vaccinations provide short-term protection and need to be repeated frequently.

B Vaccination introduces antibodies into the body to stimulate the immune response and develop immunity.

C Vaccination introduces antigens into the body to stimulate the immune response and develop immunity.

D Vaccination provides long-term protection by injecting antibodies into the body.

Your answer ☐ **[1]**

19 Which option describes the movement of water from the cortex of the root into the xylem.

A At the endodermis, water has to enter the apoplast pathway.

B At the Casparian strip, water movement is blocked because of the chemical callose.

C At the Casparian strip, water movement via the symplast pathway is blocked.

D Most of the water moves across the root cortex by the apoplast pathway.

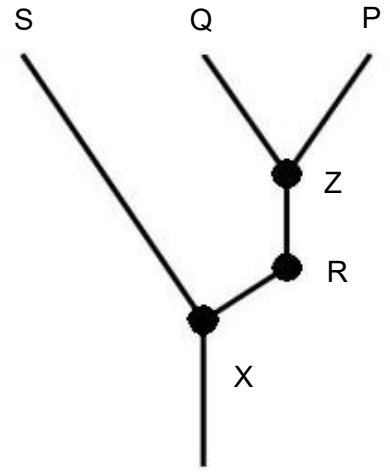
Your answer ☐ **[1]**

20 Q, P, R and S are related species of organisms.

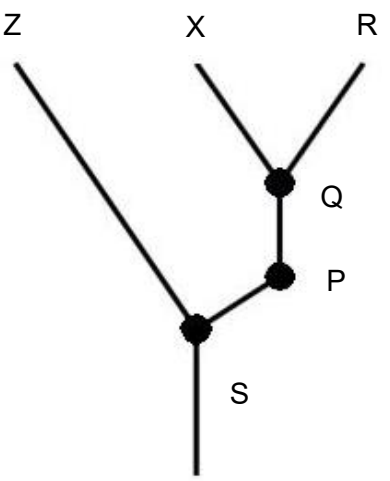
Species X is an extinct recent common ancestor of species Q and R.
X, Q and R all evolved from species P.
Species S is the least related to the others, with extinct species Z being its most recent phylogenetic link to the other species.

Which phylogenetic tree represents the relationships described above?

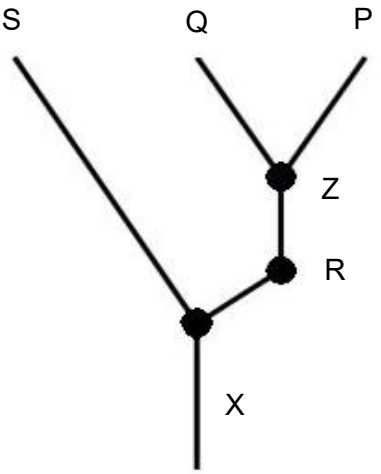
A



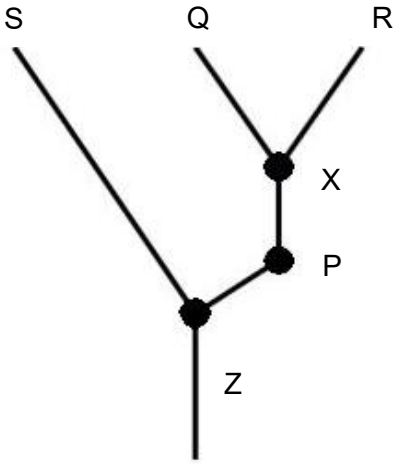
B



C



D



Your answer ☐ **[1]**

Section B

21 Transmembrane proteins are involved in the transport of sugars across the plasma membrane.

(a) Glucose can be moved into cells by facilitated diffusion using proteins called GLUT proteins. These proteins expose a single binding site on one side of the membrane. Glucose binds to this site and causes a change in the shape of the protein. This change moves the glucose across the membrane and releases it on the other side.

(i) Explain why facilitated diffusion via GLUT proteins does **not** require an input of energy.

……

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……

……

…… **[2]**

(ii) Glucose can also be absorbed by an active process which requires energy.

State the immediate source of energy used in cells.

……

…… **[1]**

(iii) Explain why glucose cannot pass through a cell membrane by simple diffusion.

……

……

……

……

…… **[2]**

(b) A student investigates the effect of ethanol on the permeability of membranes in plant cells.

The student wants to find the minimum concentration of ethanol at which all the cells became permeable to the stain methylene blue. Methylene blue stains the nucleus of the cell.

This is the method they use:

- Place samples of onion epidermis into different concentrations of ethanol.
- After five minutes add a few drops of methylene blue stain to each sample.
- After a further five minutes, view the samples using a light microscope.
- Observe 20 cells and record how many contain a blue nucleus.

The table shows the student's results.

Concentration of ethanol (%)	Number of cells with a blue nucleus	Percentage of cells with blue nucleus
0	1	5
10	4	20
20	16	80
30	20	100
40	20	100

(i) Identify **one** limitation of the student's method.

……

…… **[1]**

(ii) The student decides to use a narrower range of ethanol concentrations.

Suggest what range of ethanol concentrations the student should use **and** give a reason for your choice.

……

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……

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…… **[2]**

(iii) Explain why using a narrower range of ethanol concentrations would improve the investigation.

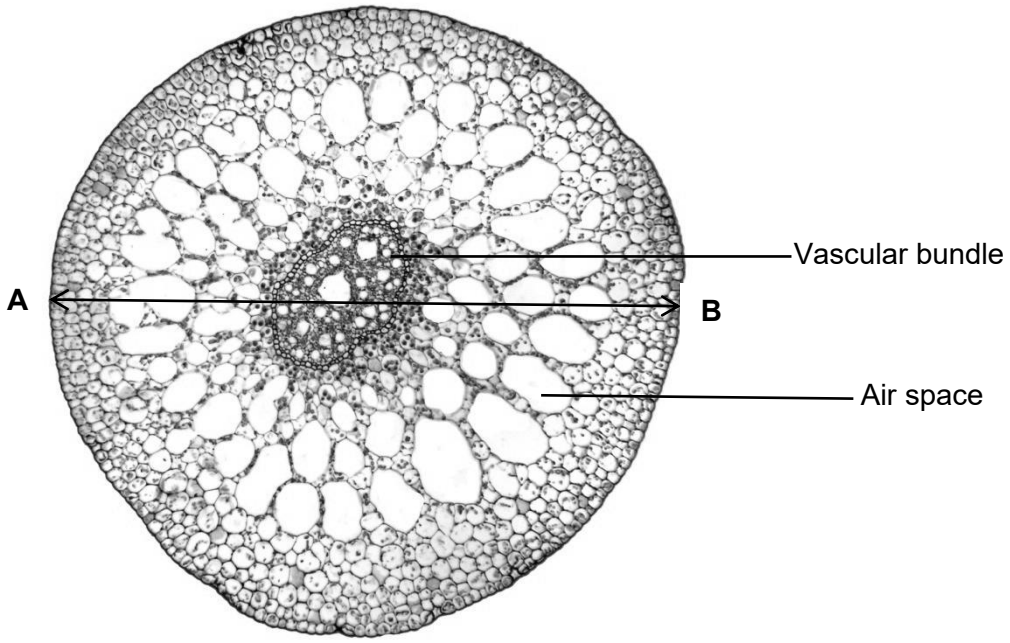
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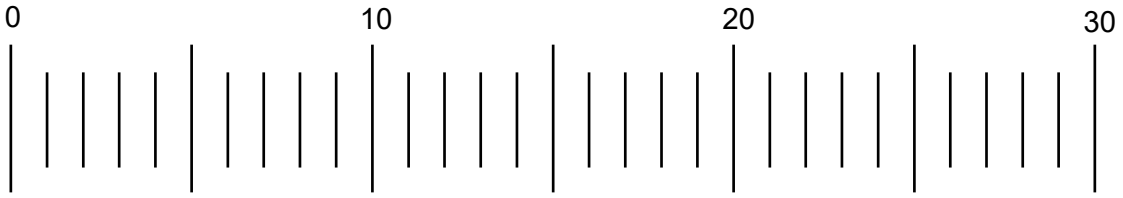
…… **[1]**

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22 The image shows a transverse section of the stem of a typical pondweed viewed using a ×10 objective lens.

Part of a graticule is shown below the stem. The markings on the graticule are 0.1 mm apart.





(a)

(i) Calculate the actual width of the stem between points **A** and **B**.

Give your answer to the nearest 0.1 mm.

Width = ... mm **[1]**

(ii) Calculate the magnification of the image.

Magnification = ... **[2]**

(iii) The thin stem and thin cell walls do not provide much support for the leaf.

Suggest how the leaf is supported.

……

……

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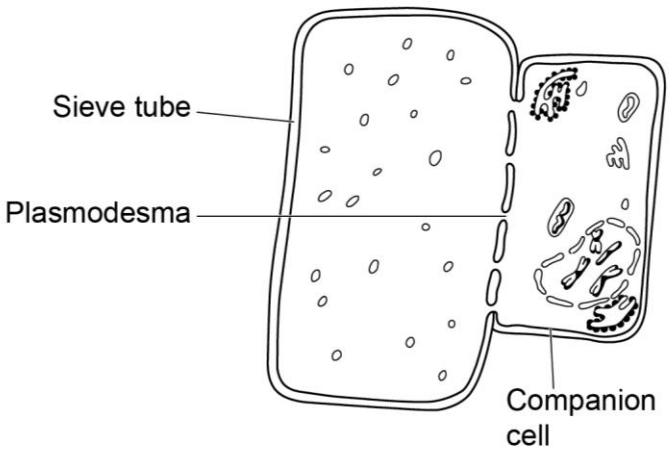
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…… **[2]**

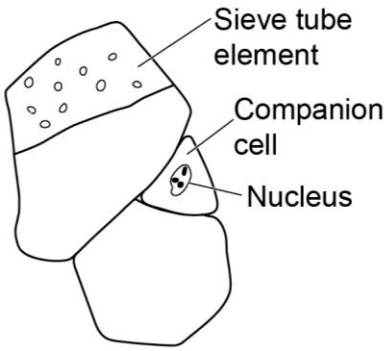
(b) A student is asked to view cells from the phloem in transverse section using a light microscope.

The two diagrams, **C** and **D**, show phloem tissue.

C



D



(i) Suggest which diagram is the more accurate representation of what the student could see when using a light microscope.

Justify your decision using **two** separate features of the diagrams.

……

……

……

……

…… **[2]**

(ii) State what is meant by the **resolution** of a microscope.

……

…… **[1]**

(iii) The cells viewed to draw diagrams **C** and **D** were stained.

The table shows a list of stains and the cell feature that can be stained.

Stain	Cell feature stained
Methylene blue	Nuclei
Eosin	Cytoplasm
Sudan red	Cell membrane
Iodine	Starch

State which stain the student used on the microscope slide **and** explain why the student used this stain.

Stain……

Explanation……

……

…… **[2]**

23 Molecules with complementary shapes can be used to explain many processes in living things.

(a) Complete the sentences about the mechanism of enzyme action.

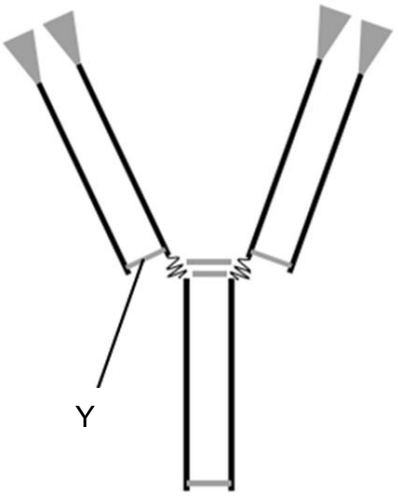
Enzymes are proteins which speed up the rate of biological reactions. They form ..... by binding to their substrate at a site known as the ..... . This site has a specific shape created by the ..... structure of the protein molecule. This means that each enzyme can bind to only one type of substrate molecule.

This is explained by the lock and key hypothesis. In an alternative hypothesis, the binding site changes shape to fit more closely around the substrate molecule. This is called the ..... hypothesis. This hypothesis can help to explain how enzymes enable reactions to occur at lower temperatures by reducing the ..... required for the reaction to occur.

[5]

(b) An antibody is a molecule that relies on a specific shape to bind to a specific compound.

The diagram shows the generalised structure of an antibody.



(i) Draw a circle **on the diagram** to show a part of the molecule that has a shape complementary to the shape of an antigen.

[1]

(ii) The component labelled **Y** on the antibody is a bond.

State the type of bond shown at **Y and** give its function.

Type …….....

Function …….

[2]

(c) Lupus is an autoimmune disease. Lupus occurs when nuclear proteins are exposed and the immune system makes antibodies against these proteins. As a result the proteins stick together. They stick to surfaces such as the blood vessel walls and cause fatigue, joint pain and skin rashes.

(i) State what is meant by **autoimmune disease**.

…….....

…….....

…….....

…….....

…….. **[2]**

(ii) Suggest why antibodies specific to nuclear proteins are **not** normally made.

…….....

……..... **[1]**

(d) Scientists often use natural substances to help develop new medicines.

State **two** possible sources of such natural substances.

1 …….....

2 ……

[2]

24

(a) The cassowary is a large, flightless bird found in the rainforest in parts of Australia. It feeds mainly on fruit. As the cassowary eat the fruit, the seeds are dropped onto the rainforest floor.

(i) The cassowary is known as a keystone species. This means it is important for the survival of other species.

Suggest what role the cassowary plays in the survival of other species.

……

…… **[1]**

(ii) The cassowary needs to be conserved for ecological reasons.

State **two other** reasons for maintaining biodiversity.

1 ……..

2 ……..

[2]

(b) The mountain gorilla is an endangered species with as few as 880 individuals surviving in the wild.

The gorilla population in the Virunga area has been regularly monitored using indirect methods, such as collecting faeces samples from nest sites.

The data from Virunga is shown in the table. DNA analysis of another gorilla population suggests that these indirect methods may have an inaccuracy of up to 6%.

Year	Population in Virunga
1981	254
1989	320
2003	380
2010	480

(i) Calculate the annual average percentage increase in the gorilla population in Virunga between 1981 and 2010, assuming a linear increase.

Average percentage increase = ……**%** **[2]**

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(ii) In 1993, the Rio Convention on Biodiversity was established.

In 2010, one conservationist commented that the Rio Convention had affected the gorilla population.

Evaluate the effect that the Rio Convention on Biodiversity has had on the gorillas in Virunga, using the data in the table.

……

……

……

……

……

……

……

…… **[3]**

(iii) Some of the gorillas in Virunga are used to humans. The health of these gorillas is monitored and medical assistance is given when necessary. Other gorillas that are not used to humans are rarely visited.

Suggest **one** advantage **and one** disadvantage of ensuring that some of the gorilla families are not used to humans.

Advantage ……

……

……

Disadvantage ……

……

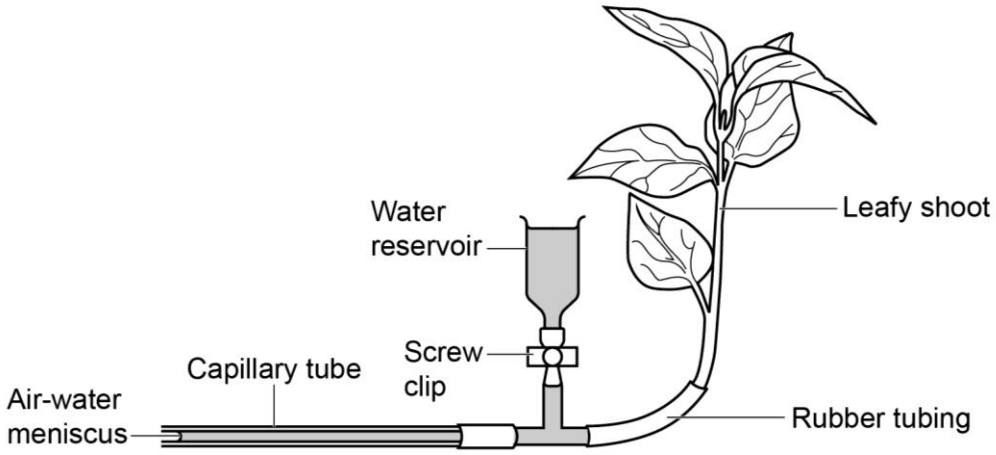
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[2]

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Turn over for the next question

25 This is a diagram of a potometer.



(a) A student uses a potometer to investigate the role of stomata in transpiration. The student notes the position of the air–water meniscus each minute for five minutes.

The student then covers the underside of one of the leaves in petroleum jelly and repeats the measurements. This process continues until the undersides of all the leaves are covered.

The table shows the results.

Number of leaves with undersides covered in petroleum jelly	**Position of meniscus (mm) at:**					
	0 min	**1 min**	**2 min**	**3 min**	**4 min**	**5 min**
0	0	23	44	65	84	102
1	0	20	40	58	77	95
2	0	16	31	47	61	76
3	0	11	23	37	50	62
4	0	9	17	24	32	40
5	0	6	11	16	22	28

The student produced this graph of their results.

Key:

------- 0 leaves covered

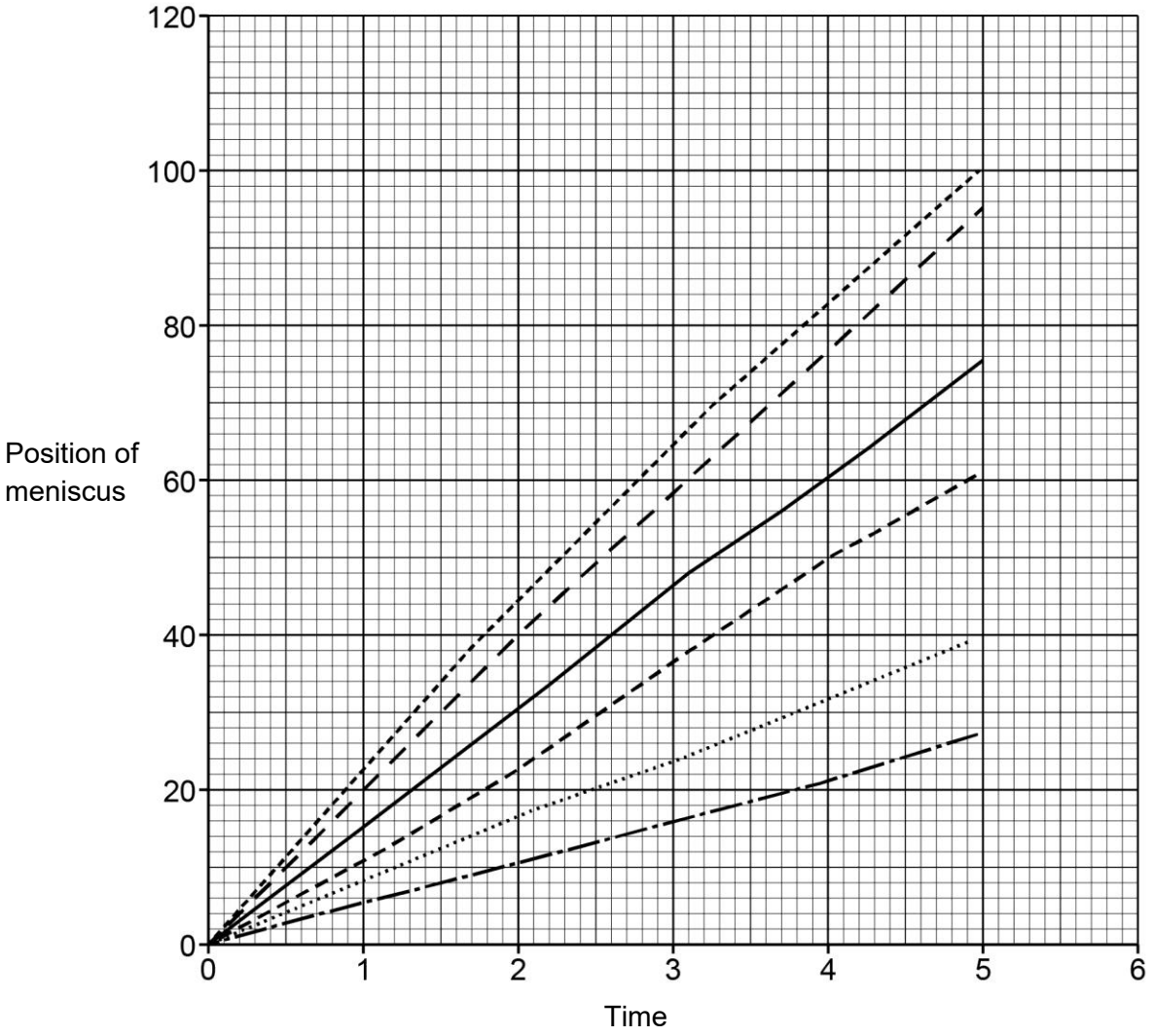
- — - 1 leaves covered

——— 2 leaves covered

– – – – 3 leaves covered

····· 4 leaves covered

–·—·– 5 leaves covered



(i) State **two** different types of information the student has missed from the graph.

1 ……

2 ……

[2]

(ii) Calculate the minimum rate of transpiration, using the data in the graph.

Minimum rate of transpiration = …… $mm\,min^{-1}$ **[2]**

(b) Suggest how water is being lost from the cut stem when all the leaves have been treated with petroleum jelly.

……

……

……

……

…… **[2]**

(c) Suggest **two** possible sources of error in this investigation.

……

……

……

……

…… **[2]**

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.

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