



Oxford Cambridge and RSA

Monday 9 June 2025 – Morning

GCSE (9–1) Biology B (Twenty First Century Science)

J257/02 Depth in Biology (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:

- a ruler (cm/mm)

You can use:

- a scientific or graphical calculator
- an HB pencil



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

Centre number

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Candidate number

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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 page 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 **90**.
- 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 **24** pages.

ADVICE

- Read each question carefully before you start your answer.

2

1

- (a) Which system transports oxygen and dissolved food molecules around the human body in the blood?

Tick (✓) **one** box.

Circulatory system

☐

Digestive system

☐

Excretory system

☐

Gaseous exchange system

☐

[1]

- (b) Which organ pumps blood around the human body?

Tick (✓) **one** box.

Brain

☐

Eye

☐

Heart

☐

Kidney

☐

[1]

- (c) Which type of blood vessel has valves to stop blood flowing backwards?

Tick (✓) **one** box.

Artery

☐

Capillary

☐

Neuron

☐

Vein

☐

[1]

3

(d) Draw lines to connect each **part** of the blood with its correct **function**.

Part	Function
Plasma	Destroy pathogens
Platelets	Help seal wounds
Red blood cells	Transport dissolved food molecules
White blood cells	Transport oxygen

[3]

4

2

- (a) Put these three structures in order of size, from the **largest** to the **smallest**.

Chromosome**Gene****Nucleotide**

Largest

.....

Smallest

[2]

- (b) Which statement describes the genome?

Tick (✓) **one** box.

A section of DNA that stores the instructions to make a protein.

☐

All the physical features of an organism.

☐

The combination of alleles that an organism has.

☐

The entire genetic material of an organism.

☐

[1]

- (c) Draw lines to connect each **description** with the correct **number**.

Description**Number**

The number of bases in each nucleotide.

1

The number of different nucleotides found in DNA.

2

The number of nucleotide strands in a DNA molecule.

3

4

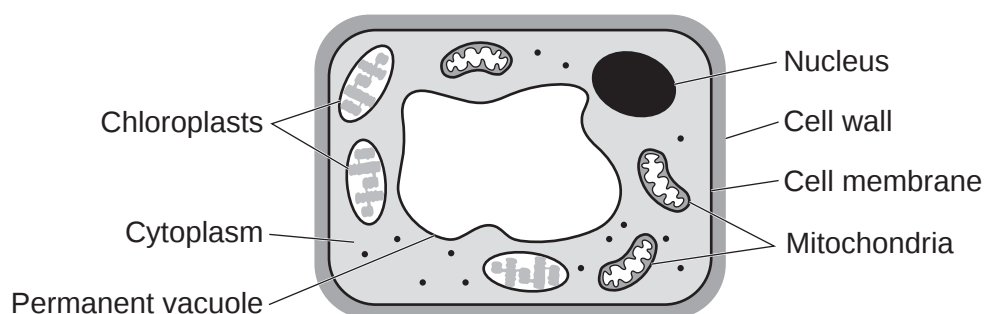
5

[3]

3 Organisms can be classified based on their sub-cellular structures.

(a) Fig. 3.1 is a diagram of a cell showing its sub-cellular structures.

Fig. 3.1



(i) Classify the organism that the cell in Fig. 3.1 has come from.

Tick (✓) **one** box.

Animal	☐
Bacterium	☐
Plant	☐

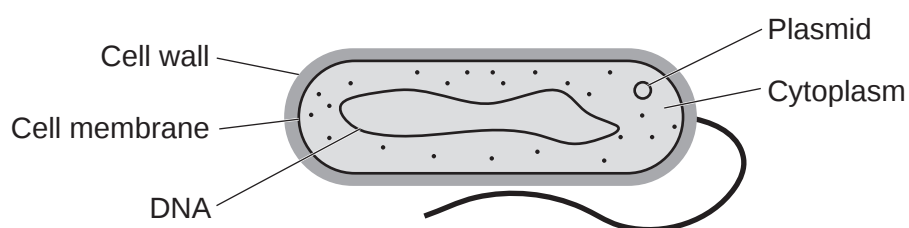
[1]

(ii) State **one** piece of evidence present in the **nucleus** of the cell in Fig. 3.1 that scientists could use to help classify the organism.

..... [1]

(b) Fig. 3.2 is a diagram of a different cell.

Fig. 3.2



State **two** reasons why the cell in Fig. 3.2 would be classified as prokaryotic and **not** as eukaryotic.

1

2

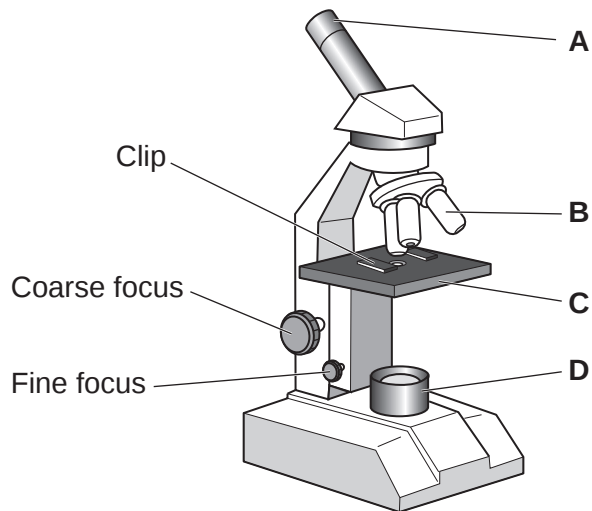
[2]

4 Plant leaves have tiny holes called stomata on their surfaces.

A student uses a light microscope to observe stomata on the underside of a small rectangular piece of a leaf.

(a) Fig. 4.1 shows a light microscope.

Fig. 4.1



Write the correct letter, **A**, **B**, **C** or **D**, next to each part.

Eyepiece lens

Light

Objective lens

Stage

[2]

(b) Complete the method to describe how to set up the light microscope to observe stomata on a slide.

Use words from the list.

eyepiece	light	objective	slide	stage
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1. Place the under the clips.
2. Looking from the side, turn the coarse focus to move the stage towards the lens.
3. Looking into the lens, use the coarse and fine focus to adjust the image until it is clear.

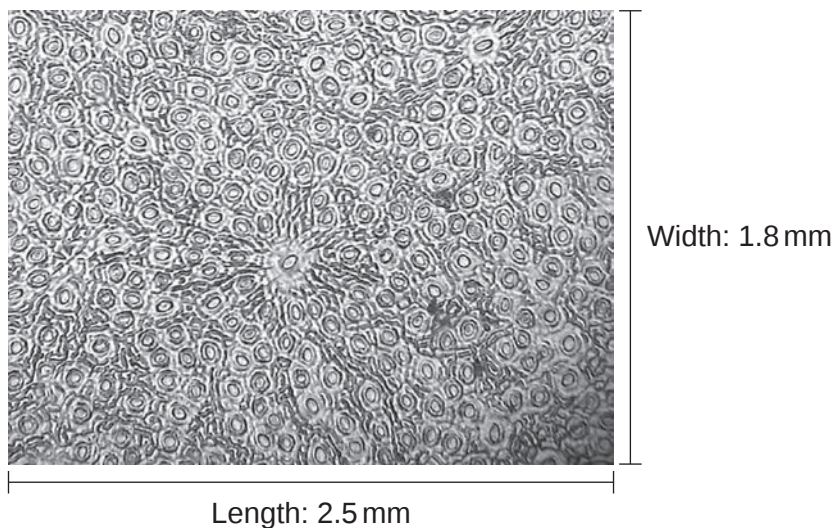
[3]

- (c) Why is it important to look from the side in step 2 of the method?

.....
 [1]

- (d) Fig. 4.2 shows what the student observes.

Fig. 4.2



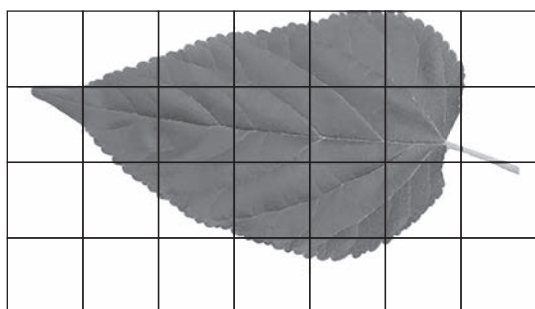
- (i) Calculate the area of the piece of leaf shown in **Fig. 4.2**.

Area = mm^2 [2]

- (ii) **Fig. 4.3** shows the underside of the leaf on a grid.

Each square of the grid measures $1\text{ cm} \times 1\text{ cm}$.

Fig. 4.3



Estimate the surface area of the underside of the leaf.

Use **Fig. 4.3**.

Include every square that is half-filled or more than half-filled with leaf.

Estimated area = cm^2 [1]
Turn over

8

- (iii) Describe how the student can produce an **estimate** of the total number of stomata on the underside of the leaf without counting all of them.

.....

.....

.....

..... [2]

- (iv) Explain **one** benefit of producing an estimate of the total number of stomata on a leaf rather than counting all of them.

.....

..... [1]

- (e) The student produces estimates of the total number of stomata present on the top side and underside of five leaves from the same plant.

The table shows their results.

Leaf	Number of stomata on top side	Number of stomata on underside
1	150 000	750 000
2	125 000	625 000
3	170 000	850 000
4	160 000	800 000
5	142 000	710 000

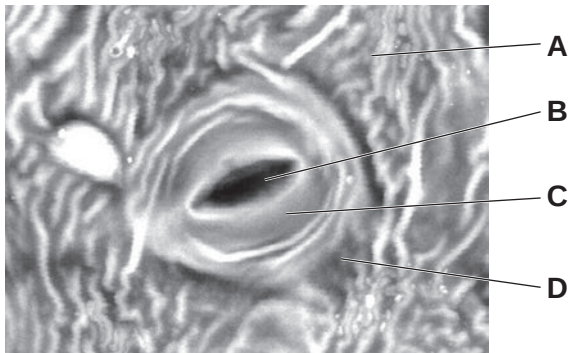
Write **one** conclusion about the distribution of stomata on leaves shown by the data in the table.

.....

..... [1]

(f) Fig. 4.4 shows one of the stomata observed with a more powerful microscope.

Fig. 4.4



Which part is a guard cell?

Tick (✓) **one** box.

- A ☐
- B ☐
- C ☐
- D ☐

[1]

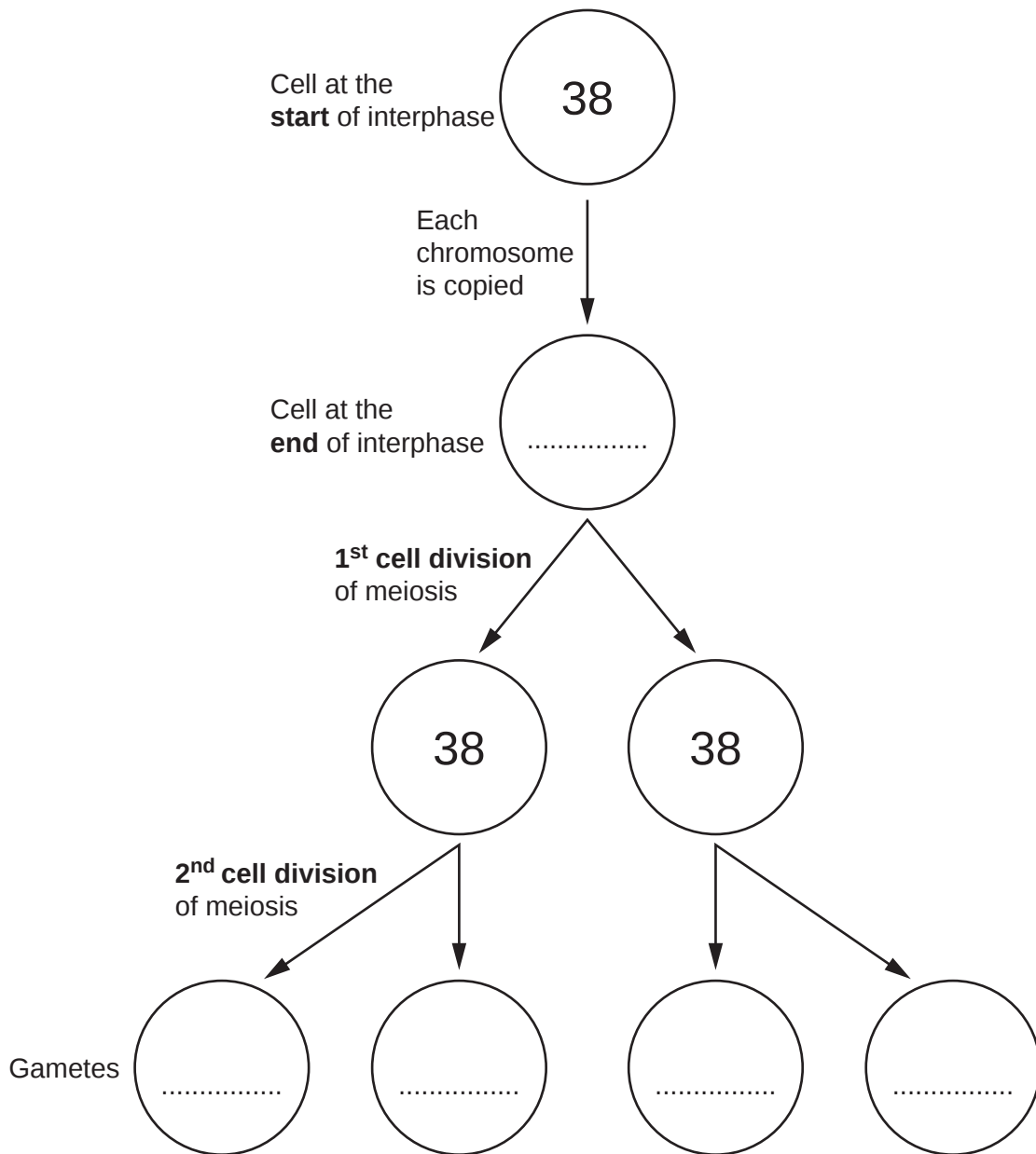
10

5 Each body cell in a cat has 38 chromosomes.

(a) Cats reproduce sexually.

The gametes are made by meiosis, starting with one of the cat's cells.

Complete the diagram to show the number of chromosomes found in each cell during the stages of meiosis.



[2]

(b) How many chromosomes will be present in a cat's zygote after fertilisation?

Number of chromosomes in cat's zygote = chromosomes [1]

11

- (c) Adult body cells divide to make more body cells as part of the cell cycle.

Statements **A** to **E** are steps in this process. The statements are **not** in the correct order.

- A** The cell divides.
- B** The cell grows larger.
- C** The chromosomes are copied.
- D** The chromosome copies separate.
- E** The nucleus divides.

- (i) Write **one** letter in each box to show the correct order of the steps.

One of the steps has been done for you.

	C			
--	----------	--	--	--

[3]

- (ii) The cell cycle is divided into two parts called interphase and mitosis.

Tick (✓) **two** boxes to show the steps that take place during **interphase**.

	Interphase
The cell divides.	
The cell grows larger.	
The chromosomes are copied.	
The chromosome copies separate.	
The nucleus divides.	

[1]

- (d) Complete the sentence about **mitosis**.

Use a word from the list.

different	fertilised	gametes	identical
------------------	-------------------	----------------	------------------

The cells produced by mitosis are genetically

[1]

- (e) Describe how cancer can sometimes result from mitosis.

.....

.....

.....

..... [2]

12

6 Ash trees are common in the UK.

(a) What is the role of an ash tree in a food chain?

Tick (✓) **one** box.

Herbivore

☐

Primary consumer

☐

Predator

☐

Producer

☐

[1]

(b) Describe **two** ways animals can be affected if an ash tree is removed from the ecosystem it was growing in.

1

.....

2

.....

[2]

13

- (c) Many of the UK's ash trees are being killed by a disease called ash dieback. Ash dieback is caused by a pathogen that can spread from tree to tree.

- (i) Tick (✓) **one** box in each table to identify the pathogen that causes ash dieback and how it spreads between plants.

	Bacterium	Fungus	Protist	Virus
Pathogen that causes ash dieback				

	By insects	Contaminated soil	During pollination	Spores carried by the wind
How it spreads between plants				

[2]

- (ii) Which **two** of these are used by plants as a defence against pathogens?

Tick (✓) **two** boxes.

Antibodies

☐

Antimicrobial substances

☐

Phloem

☐

Waxy leaf cuticle

☐

Xylem

☐

[2]

- (iii) A few ash trees are resistant and do **not** die when infected with ash dieback.

Complete the sentences to explain why resistant trees will gradually become more common.

Use words from the list.

adaptation	competition	mutation
natural selection	reproduction	variation

Resistant trees have a genetic variant created by

These trees are more likely to make offspring by

The offspring could inherit the genetic variant for resistance.

This is the process of

[3]

15
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DO NOT WRITE ON THIS PAGE
Turn over for the next question

7

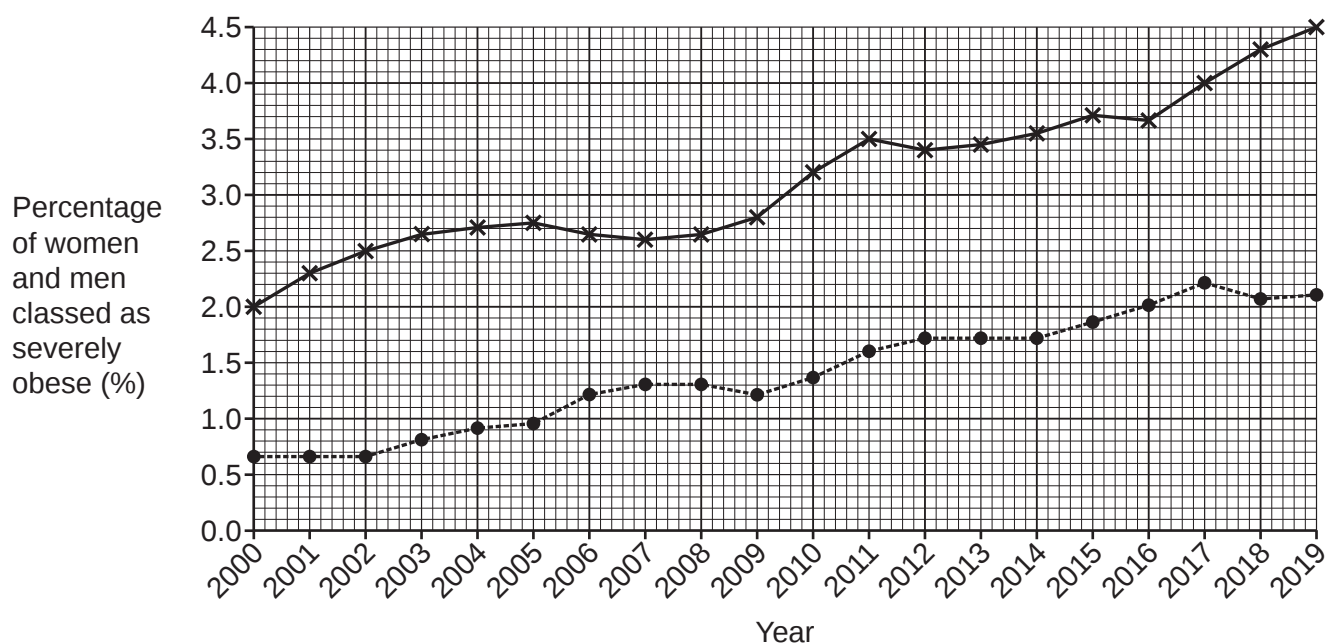
- (a) Fig. 7.1 shows the percentage of women and men in the UK who were classed as severely obese each year from 2000 to 2019.

Fig. 7.1

Key:

—×— Women

---●--- Men



- (i) What percentage of **women** were classed as severely obese in 2002?

Percentage = % [1]

- (ii) Which **three** statements about the data in Fig. 7.1 are **true**?

Tick (✓) **three** boxes.

2000 to 2002 was the only time period where the percentage of men classed as severely obese stayed the same.

☐

2019 was the year with the highest percentage of severely obese men.

☐

Every year, a higher percentage of women than men were severely obese.

☐

The overall change in percentage of people classed as severely obese between 2000 and 2019 was bigger for women than men.

☐

The percentage of women classed as severely obese increased every year.

☐

The overall trend is an increase in severe obesity levels for both women and men.

☐

[3]

- (iii) The percentages of women and men with **cardiovascular disease** also increased from 2000 to 2019.

Suggest how the data in **Fig. 7.1** could be linked to the increase in cardiovascular disease.

.....

.....

.....

..... [2]

- (b) Measurements of a person's body can be used to draw conclusions about their health.

- (i) An adult has a mass of 81 kg and a height of 1.80 m

Calculate the body mass index (BMI) of the adult.

Use the equation: $\text{BMI} = \frac{\text{body mass}}{\text{height}^2}$, where body mass is in kg and height is in m.

BMI = kg/m² [2]

(ii) Table 7.2 shows how BMI values can be categorised.

Table 7.2

BMI (kg/m ²)	< 18.5	18.5 – 24.9	25.0 – 29.9	30.0 – 34.9	> 34.9
Category	Underweight	Ideal	Overweight	Obese	Severely obese

Which category is an adult with a BMI of 23.0 kg/m² in?

..... [1]

(iii) Some doctors think that a person's BMI alone can be misleading. They recommend that a person's waist-to-height ratio should also be considered.

Zayn has a waist circumference of 81 cm and a height of 179 cm.

Calculate the waist-to-height ratio for Zayn.

Use the equation: waist-to-height ratio = $\frac{\text{waist circumference (cm)}}{\text{height (cm)}}$

Give your answer to 2 decimal places.

Waist-to-height ratio = [2]

(iv) **Table 7.3** shows how waist-to-height ratios can be categorised.

Table 7.3

Waist-to-height ratio	< 0.40	0.40 – 0.49	0.50 – 0.53	> 0.53
Category	Underweight	Ideal	Overweight	Obese

Amaya does very little exercise.

She has a BMI of 31.6 kg/m^2 and her waist-to-height ratio is 0.56.

Explain:

- why Amaya is at high risk of developing type 2 diabetes
- how she can reduce her risk.

Use **Table 7.2** and **Table 7.3** to help you.

.....

.....

.....

.....

.....

..... [3]

(v) Alex is thinking about his health. Here are some notes about Alex.

Waist-to-height ratio: 0.43

Body type: Very muscular.
Low levels of body fat.

Exercise: Running daily.
Regular muscle-building at the gym.

Alex finds out that his BMI is classed as obese.

He thinks he should lose weight to lower his risk of disease.

Explain why Alex is **not** correct.

Use **Table 7.3** and the notes on Alex to help you.

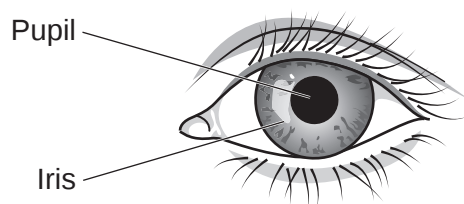
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.....

.....

..... [2]

- 8 The pupil is part of the human eye.



A student investigates the effect of changing the light level on pupil diameter.

The student uses a lamp with adjustable brightness, measured in lumens.
The maximum brightness of the lamp is 1200 lumens (100%).

Table 8.1 shows the data the student records.

Table 8.1

Light level (%)	Light brightness (lumens)	Distance between lamp and eye (m)	Pupil diameter (mm)
80		1.5	4
40	480	1.5	6
20	240	1.5	8

- (a) Complete **Table 8.2** to identify the variables in the investigation.

Put **one** tick (✓) in each row to show whether the variable is the **dependent variable**, the **independent variable** or **neither**.

Table 8.2

	Dependent variable	Independent variable	Neither
Distance between lamp and eye (m)			
Light brightness (lumens)			
Pupil diameter (mm)			

[2]

- (b) Suggest **one** other variable **not** included in **Table 8.2** that should be controlled.

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

- (c) Calculate the number of lumens equivalent to a light level of 80%.

Use the data in **Table 8.1**.

Number of lumens equivalent to a light level of 80% = lumens [2]

- (d) The student measures the pupil diameter by holding a ruler against the person's eye.

Suggest a safer way to measure the pupil diameter.

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

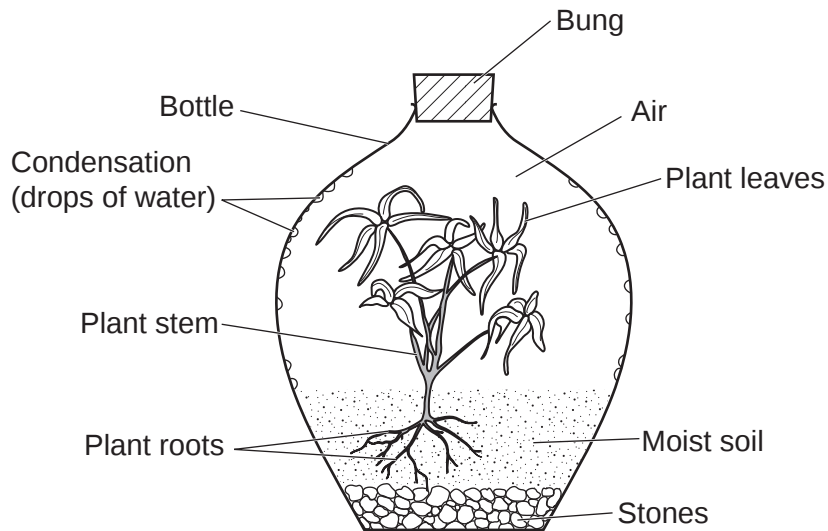
- (e) The student predicts that if a light brightness of 1200 lumens is tested, the pupil diameter will be approximately 2 mm.

Explain why the student is **correct**.

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

- 9 The diagram shows a living plant growing in a bottle garden.

The bottle garden is a small but complete ecosystem.



- (a) Which part of the bottle garden ecosystem is **biotic**?

Tick (✓) **one** box.

Condensation

☐

Plant

☐

Soil water

☐

Stones

☐

[1]

- (b) Explain why the air in the bottle is an **abiotic** part of the ecosystem.

.....
 [1]

- (c) The bottle allows light to pass through it.

Explain why this is essential for the plant to survive.

.....
 [1]

(d)* A bung is used to seal the bottle closed.

The plant stays alive even though the bottle is kept sealed for years and no extra water is added.

Explain:

- why the plant needs water
- how the plant gets enough water even though the bottle is kept sealed.

..... [6]

END OF QUESTION PAPER

