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

J257/02 Depth in Biology (Foundation Tier)

Monday 11 June 2018 – Morning

Time allowed: 1 hour 45 minutes

7028535768

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

You may use:
- a scientific or graphical calculator
- an HB pencil

J257702

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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Answer **all** the questions.

1 Diabetes and cardiovascular disease are common diseases in the UK.

(a) There are two different types of diabetes.

Put **one** tick (✓) in each row of the table to show whether the statement applies to **both types of diabetes**, **only type 1 diabetes**, or **only type 2 diabetes**.

Statement	Both types of diabetes	Only type 1 diabetes	Only type 2 diabetes
The person cannot control their blood sugar level.			
The body stops responding to the insulin it makes.			
The disease can be treated using injections of insulin.			
In the future, the disease could be treated using stem cells to replace insulin-secreting cells in the pancreas.			

[4]

(b) Ben is a middle-aged man with type 2 diabetes.

He is worried because he has heard that having type 2 diabetes will mean he also gets cardiovascular disease.

What advice would you give to Ben?

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

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(c) A class of students is learning about cardiovascular disease.

They do a practical activity to investigate the levels of fitness of people in the class.

The students work in pairs to measure each other's resting pulse rate.

(i) They start by sitting quietly for five minutes.

Explain why they do this.

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

(ii) Describe how a student could measure the resting pulse rate of their partner.

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

(iii) The method that the students are working from says they should repeat the resting pulse rate measurement until they have enough data to calculate an average.

There are three types of average: **mean**, **median** or **mode**.

Suggest which type of average the students should calculate.

Put a (ring) around the correct answer.

Mean **Median** **Mode** **[1]**

(iv) Suggest why it is a good idea to calculate the average selected in **(c)(iii)**.

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

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Each student then exercises for 3 minutes by stepping up and down on a bench.

After 3 minutes, the student sits down and their partner immediately measures their pulse rate.

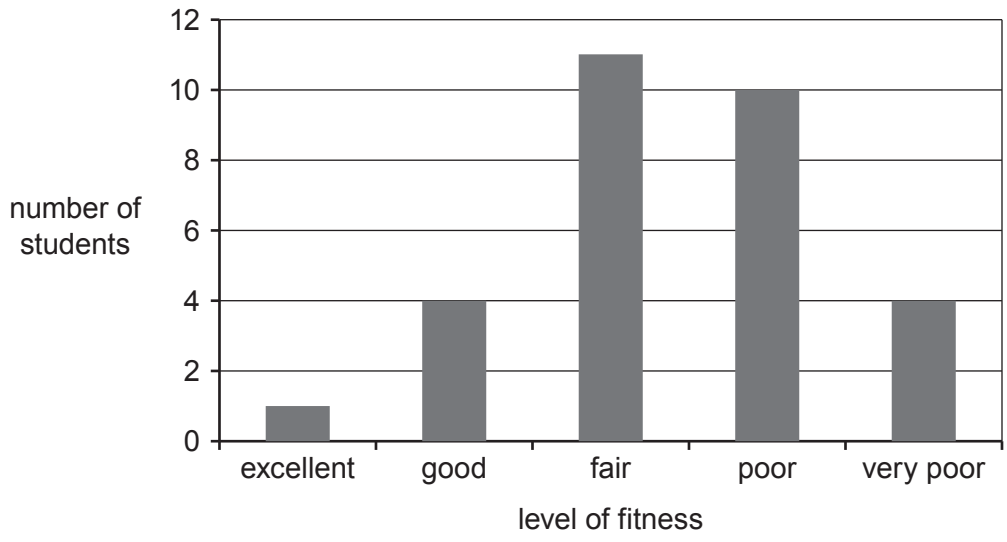
Their partner measures the student's pulse again 1 minute and 2 minutes after exercise.

The resting and other pulse rates are used to calculate a 'fitness index score'.

A person's fitness index score gives an estimate of their level of fitness.

'Unit 4 - Resting pulse and recovery rate, Iechyd, Gofal Cymdeithasol a Gwasanaethau Plant', www.resources.hwb.wales.gov.uk, Hwb - Digital learning for Wales. Item removed due to third party copyright restrictions. Link to material: http://resources.hwb.wales.gov.uk/VTC/2012-13/22032013/hsc/cym/unit-4/u5-ioph/unit-4-resting-pulse-and-recovery-rate.htm

The class data is pooled and used to draw a bar chart.



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Use the table and the graph to help you answer these questions.

(v) How many of the students in the class have a fitness index score of 79 or lower?

Number of students = ... **[1]**

(vi) One of the students in the class has a fitness index score of 80.

How does their level of fitness compare to that of their classmates?

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

(vii) Some of the students in the class have suggested that the school should organise regular lunchtime exercise sessions.

Do you agree with their suggestion?

Explain your answer and include supporting evidence from the class data.

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

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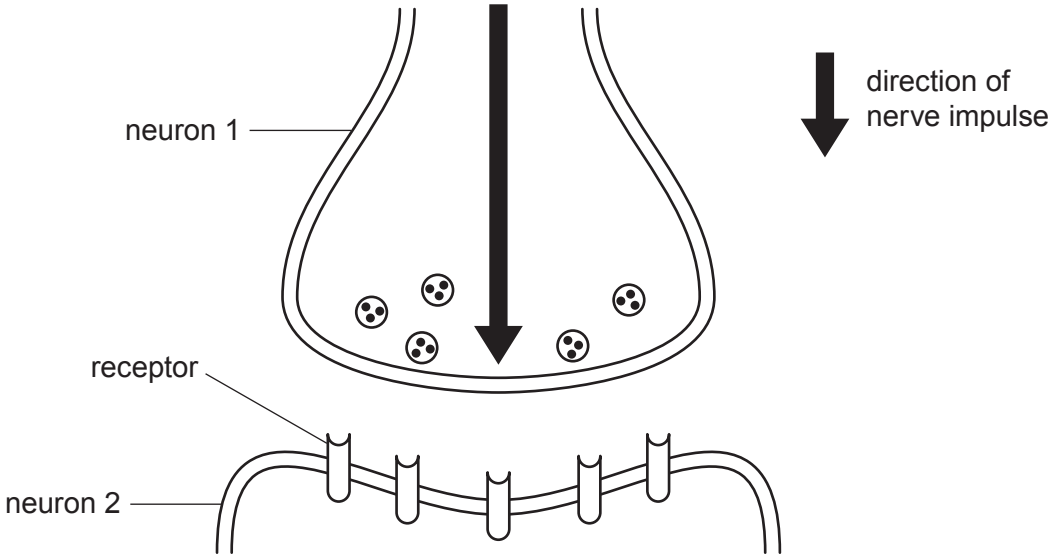
2 Insecticides called neonics are widely used by farmers.

Neonics kill insect pests that live on crop plants.

(a) Neonics block receptors in synapses in the nervous system of an insect.

This stops the transmission of a nerve impulse across the synapse.

The diagram shows these receptors in a synapse.



Explain how neonics blocking receptors in a synapse stops the transmission of a nerve impulse across the synapse.

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

(b) Explain why a farmer would want to use neonics to kill insects that live on their crops.

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

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(c) One farmer grows a crop called oilseed rape.

Honey bees feed on the oilseed rape, as shown in the food chain in **Fig. 2.1**.

The measurements below the food chain show the amount of biomass in each trophic level.

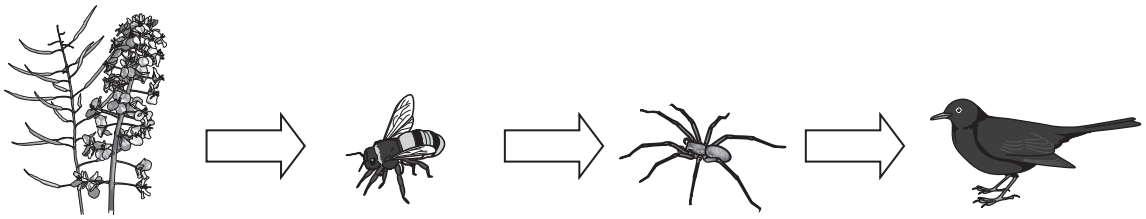

Fig. 2.1

(i) A food chain is one way of showing the feeding relationships in this ecosystem. A pyramid of biomass is another way.

Complete the pyramid of biomass for this ecosystem.

Species		**Biomass (g/m^2)**
birds		40
spiders		550
.....		.....
oilseed rape		8000

[2]

(ii) Calculate the efficiency of biomass transfer from the **oilseed rape** to the **honey bees**.

Give your answer as a percentage.

Efficiency = ... % **[2]**

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(d) Research studies have suggested that use of neonics on crops can cause honey bee populations to decrease.

Other studies have linked neonics to decreases in bird populations.

(i) To try to protect honey bees, the European Union banned the use of neonics on flowering crops.

Suggest why the ban applied to **flowering** crops.

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

(ii) Write down **two** ways in which use of neonics could have caused a decrease in the numbers of birds.

1 .....

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2 .....

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

(iii) Do you support the continued use of neonics on flowering crops?

Justify your answer.

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

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3 Amir works in a laboratory. His job is to identify the pathogens that cause plant diseases.

(a) Different types of pathogens cause different diseases in plants.

Draw lines to join each **type of pathogen** with the correct **disease** it causes.

Type of pathogen	Disease
Bacterium	Ash dieback
Fungus	Tobacco mosaic
Virus	Crown gall

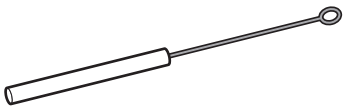
[2]

(b) Amir has a sample of bacteria from an infected plant.

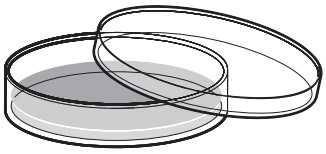
He wants to test the effectiveness of different antibiotics against the bacteria.

Amir writes a method for transferring bacteria from the sample onto a Petri dish.

glass bottle containing the sample of bacteria



wire loop



Petri dish containing agar jelly

Method:

1. Pick up the wire loop from the bench.
2. Open the glass bottle containing the sample of bacteria.
3. Dip the loop in the sample of bacteria
4. Take the lid off the Petri dish.
5. Wipe the loop over the agar jelly in the Petri dish to spread bacteria.
6. Put the lid back on the Petri dish.

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(i) Suggest **three** improvements Amir could make to his method to reduce the risk of contaminating the Petri dish with unwanted bacteria.

1 .....

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2 .....

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3 .....

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

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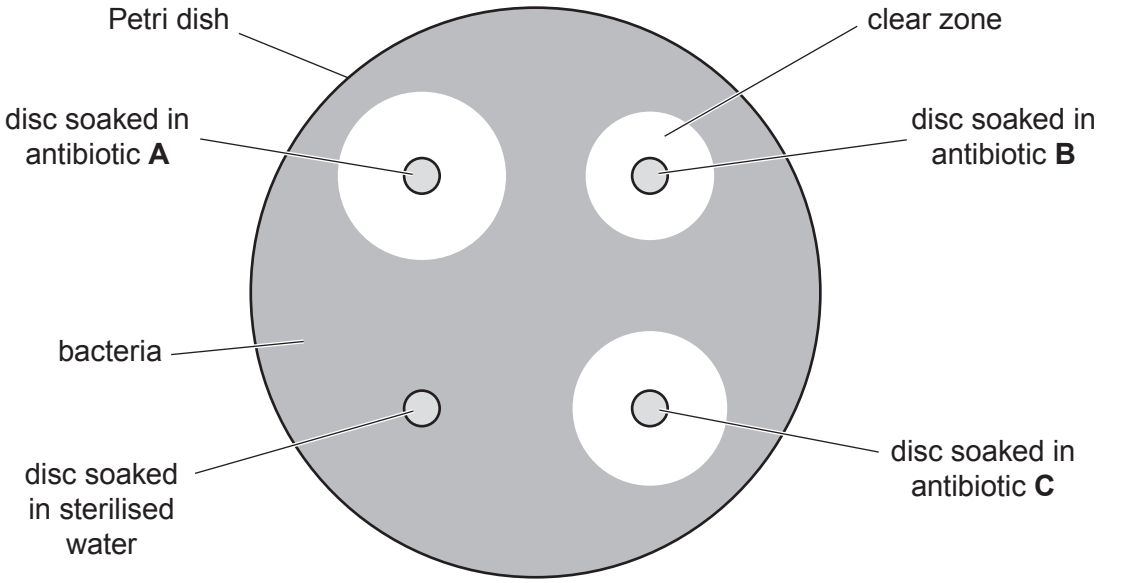
After transferring bacteria from the sample onto a Petri dish, Amir adds four different paper discs to the agar.

Three of the discs have been soaked in solutions of different antibiotics, **A**, **B** and **C**. One disc has been soaked in sterilised water.

Amir places the dish in an incubator overnight. The bacteria grow to cover the surface of the agar jelly.

The diagram shows what he sees after the dish has been incubated.



not to scale

(ii) The radius (r) of the clear zone around the disc soaked in antibiotic **A** is 11 mm.

Calculate the area of this clear zone.

Use the equation: area of clear zone = $3.14 \times r^2$

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

Area of clear zone = ... mm^2 **[3]**

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(iii) Amir sets up three more Petri dishes in the same way as the first.

The table shows his results for all four dishes.

Disc	Soaked in	Area of clear zone (mm^2)			
		Petri dish 1	**Petri dish 2**	**Petri dish 3**	**Petri dish 4**
1	Antibiotic **A**		363	346	346
2	Antibiotic **B**	227	363	227	214
3	Antibiotic **C**	314	283	298	314
4	Sterilised water	0	0	0	0

Amir thinks one of the discs was soaked in the wrong solution.

Suggest which disc may have been soaked in the wrong solution.

Give a reason for your answer.

Disc ..... in Petri dish .....

Reason .....

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

(c) Plant cells make their own antimicrobial substances.

Explain how antimicrobial substances help plants to survive and why this is essential for **human** survival.

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

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(d) Amir plans to look at a sample of infected plant tissue using a light microscope.

The table shows some information about the cells in the sample.

Cell type	Diameter (μm)	Diameter (m)
Plant cell		8×10^{-5}
Bacterium	2	

(i) What is the diameter of the bacterium, in m, in standard form?

Put a (ring) around the correct answer.

2×10^{6} m **20^{6} m** **2×10^{-6} m** **20^{-6} m** **[1]**

(ii) What is the diameter of the plant cell, in μm?

Put a (ring) around the correct answer.

80^{-6} μm **80 μm** **75 μm** **40 μm** **0.00008 μm** **[1]**

(iii) Amir knows that:

- most viruses measure less than 250 nm in diameter
- his light microscope will not allow him to see objects smaller than 1 μm in diameter.

Can Amir use his light microscope to see viruses in the sample of infected plant cells?

Explain your answer.

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

(iv) Suggest a piece of apparatus that Amir could use to see viruses in the infected plant cells.

Explain your answer.

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

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(e) Humans can be vaccinated to protect them from pathogens. However, plants cannot be protected in the same way.

Explain why vaccination cannot work in plants in the same way as it works in humans.

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

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4 Warfarin is a medicine that helps to prevent the formation of blood clots.

It is given to people who are at risk from a blood clot blocking one of their veins.

(a) Warfarin interferes with an enzyme involved in the blood clotting process.

(i) Which statement about enzymes is true?

Tick (✓) **one** box.

An enzyme blocks a chemical reaction. ☐

An enzyme recognizes many different substrates. ☐

An enzyme speeds up a chemical reaction. ☐

An enzyme is used up during a chemical reaction. ☐

[1]

(ii) Warfarin blocks the active site of the blood clotting enzyme.

The diagram represents a molecule of warfarin.

Which **one** of the following diagrams, **A**, **B**, **C** or **D**, could represent the enzyme's normal substrate?

A **B** **C** **D**

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

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(b) Warfarin helps to prevent the formation of blood clots when it is given to a patient in the correct amount.

The amount of medicine given to a patient is called the dose.

However, there is not one correct dose of warfarin that works for everybody. Different patients need a different dose.

(i) Doctors usually start by giving a low dose of warfarin to a patient. They then increase the dose if necessary.

Explain why it is better to start with a low dose of warfarin **and** suggest what could happen if the dose is too high.

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

(ii) Doctors think that different people need a different dose of warfarin because of differences in their genomes.

Explain how differences in the genome could cause a person to need a different dose of warfarin.

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

(iii) Explain how gene technology could be used to help a doctor to give the correct dose of warfarin to a patient.

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

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(c)* Warfarin has also been used as rat poison since 1948.

However, many populations of rats are now resistant to warfarin.

Explain how a population of rats could have become resistant to warfarin.

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

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5 Nina is learning about substances absorbed by plants. She finds out that plants absorb nitrate ions from the soil.

(a) Explain why nitrate ions are essential for plant growth and survival.

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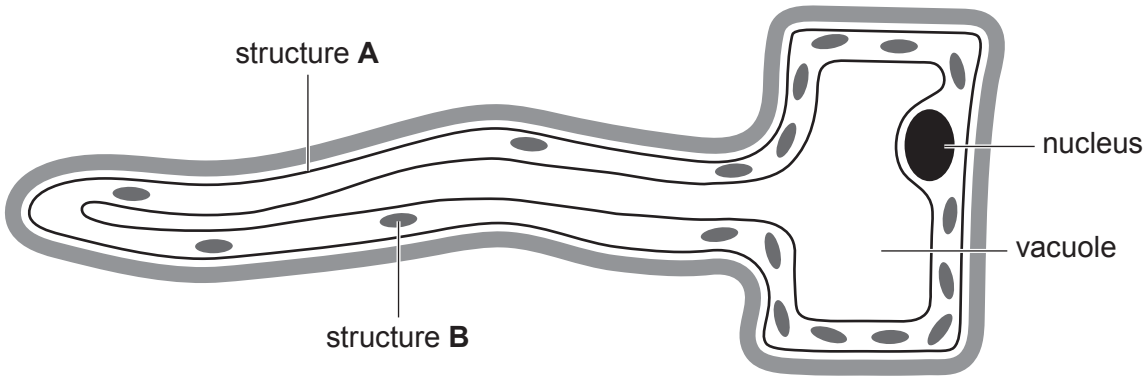
..... **[2]**

(b) Nitrate ions are absorbed into a plant root through root hair cells.

Nina finds this diagram of a root hair cell.



(i) State the names of structures **A** and **B**.

A .....

B .....

[2]

(ii) Explain the roles of **A** and **B** in transporting nitrate ions into the root hair cell.

A .....

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B .....

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[2]

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(iii) The shape of the root hair cell is an adaptation.

Explain how this adaptation helps the root hair cell to absorb nitrate ions more effectively.

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

(c) The root hair cells also absorb water from the soil.

Complete the sentences below to describe how water is transported through a plant.

Choose the correct words from the list.

Each word may be used once, more than once or not at all.

diffusion **flowers** **meristem** **osmosis**

phloem **stomata** **xylem**

Water is transported from the soil into the root cells by .....

Water is pulled from roots to leaves through the ..... tissue

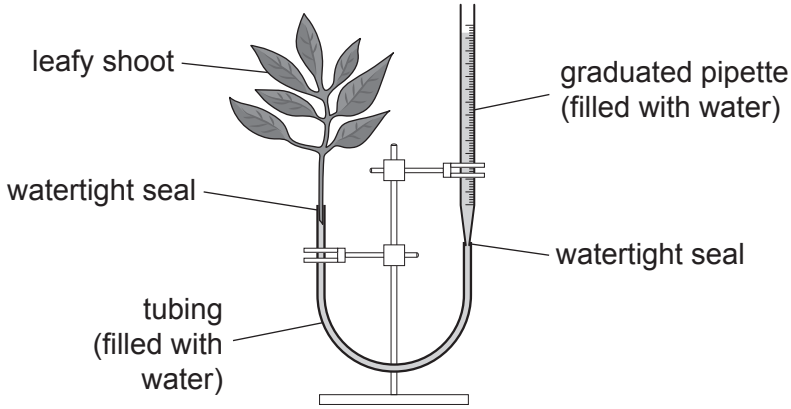
in the plant stem.

Water molecules are lost from the leaves into the atmosphere because of

..... through open ..... . **[4]**

(d)* Nina wants to investigate how changing the light intensity affects the rate of water uptake by a leafy shoot.

She sets up a leafy shoot in a simple potometer as shown in the diagram.



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Nina has access to other apparatus including:

fan **glass tank filled with water** **lamp** **metre ruler**

small heater **stopwatch** **thermometer**

She does **not** have to use all the apparatus.

Describe the experimental procedure Nina should follow and how she should process her results.

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

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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