Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B400U20-1

Z22-B400U20-1

THURSDAY, 9JUNE 2022 – AFTERNOON

BIOLOGY – AS component 2
Biodiversity and Physiology of Body Systems

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**13**	
2.	**9**	
3.	**12**	
4.	**14**	
5.	**18**	
6.	**9**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of quality of extended response (QER) will take place in question **6**.

The quality of written communication will affect the awarding of marks.

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Answer **all** questions.

1. (a) All organisms need to obtain nutrients from their environment to survive. Define the following terms: [3]

(i) Holozoic;

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(ii) Saprotrophic;

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(iii) Photoautotrophic.

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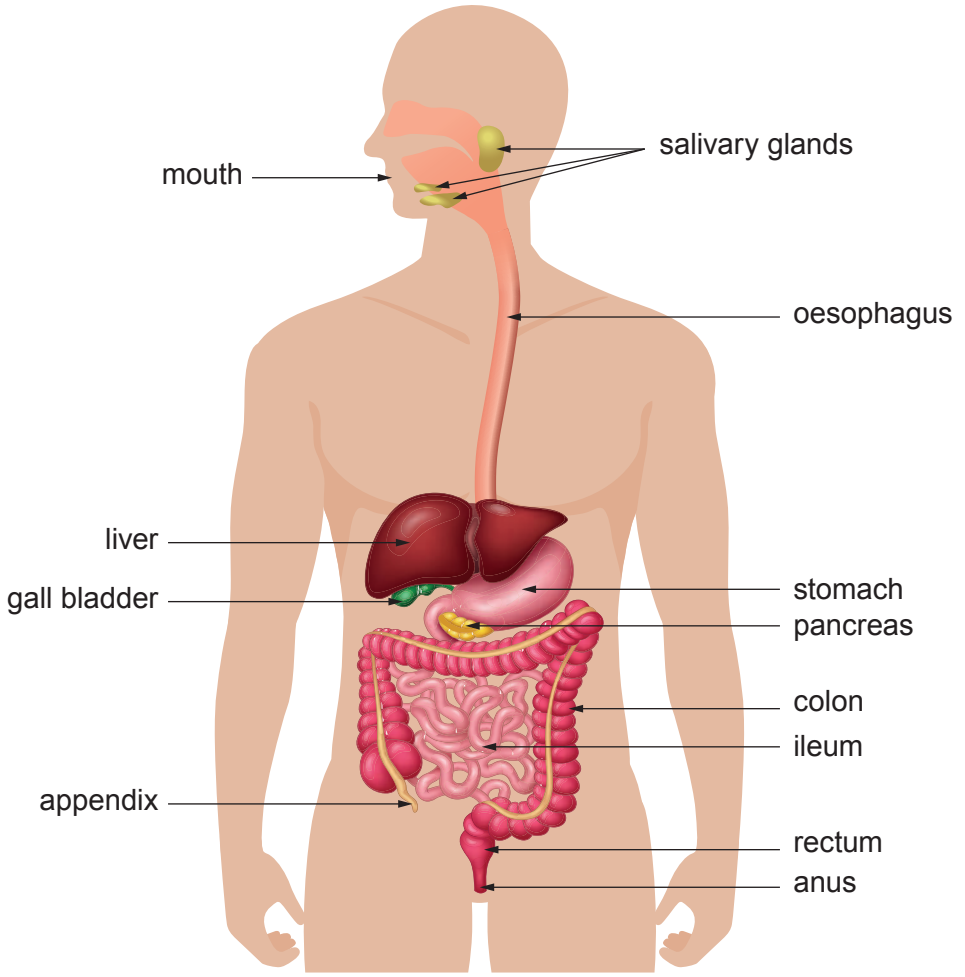
(b) **Image 1.1** shows the human digestive system.

Image 1.1



Using **Image 1.1**, complete the table below to identify **one** structure where each process shown takes place. [2]

Structure	Process
.....	secretes lipase
.....	secretes bile
.....	site of mechanical digestion
.....	absorption of water

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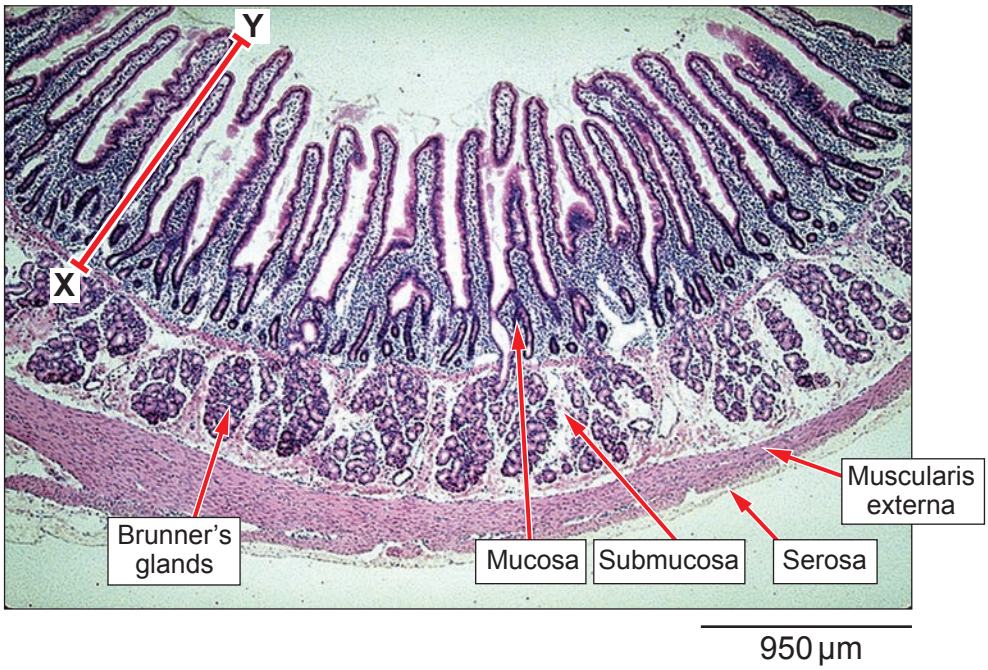
(c) **Image 1.2** shows a photomicrograph of the wall of the duodenum. The duodenum tissue has been stained.

Image 1.2



(i) Explain why it was necessary to stain the tissue before it was viewed under the microscope. [1]

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(ii) Calculate the actual size of the villus along the line **X – Y**. [2]

Actual size = ... µm

(iii) State the function of the villi and how villi are adapted for their function. [1]

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(iv) Ions such as calcium and phosphate are absorbed into the blood in the ileum. State their roles as components of structures or biological molecules in the body. [2]

Calcium ions

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Phosphate ions

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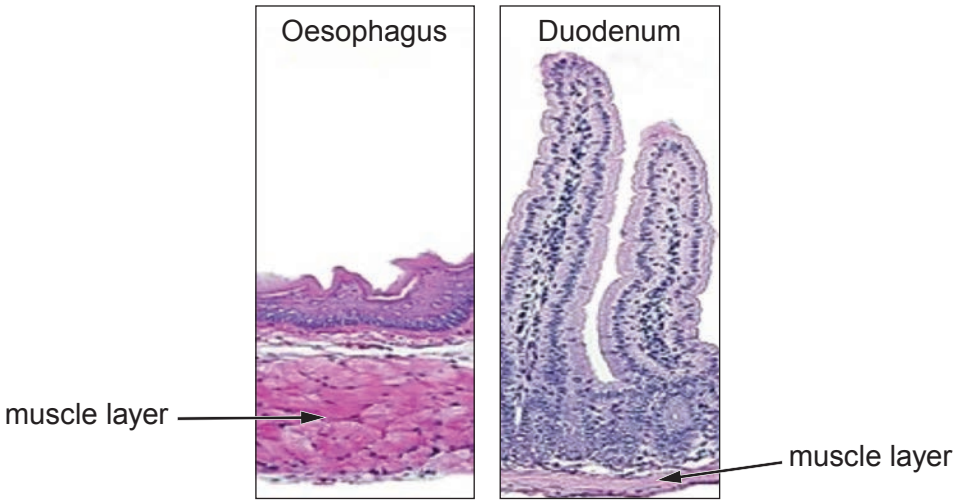
Image 1.3



(v) **Image 1.3** shows that the muscle layer of the wall of the oesophagus is thicker than that of the duodenum. Suggest an explanation for this. [2]

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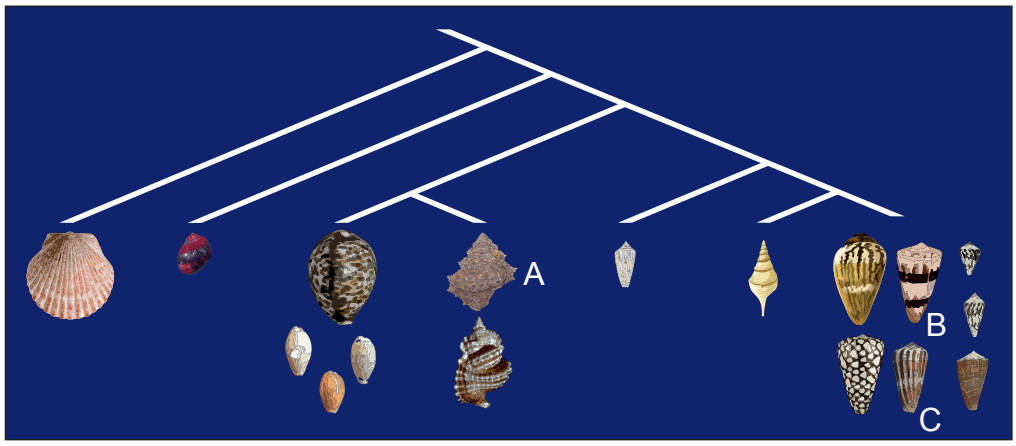
2. Cone snails are venomous, predatory marine snails. There are approximately 10 000 species of cone snails identified mainly by the shape, colour and banding patterns of the shell. **Image 2.1** shows some of these organisms.

Image 2.1



Organism	Binomial name	Common name
A	*Bursa nobilis*	The Noble Frog Shell
B	*Conus capitaneus*	The Captain's Cone
C	*Conus omaria*	Omaria Cone

(a) State the name given to the type of diagram shown in **Image 2.1** and explain how the diagram shows the relatedness of the cone snails. [2]

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(b) **Image 2.1** also shows the binomial names and common names of some of the snails. With reference to organism **A**, explain what is meant by the binomial system and the reasons for scientists using this rather than the common names. [3]

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(c) Classification of the cone snails is based upon the shell morphology. Explain how DNA analysis could be used to determine the position of organisms in **Image 2.1**. [2]

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(d) There are over 10 000 different species of cone snails which indicates there is a high level of biodiversity. State how the genetic diversity within **one species** of cone snail could be assessed. [1]

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(e) Cone snails **B** and **C** from **Image 2.1** were kept together in a tank. They interbred and produced offspring which were infertile. Explain why the offspring were infertile. [1]

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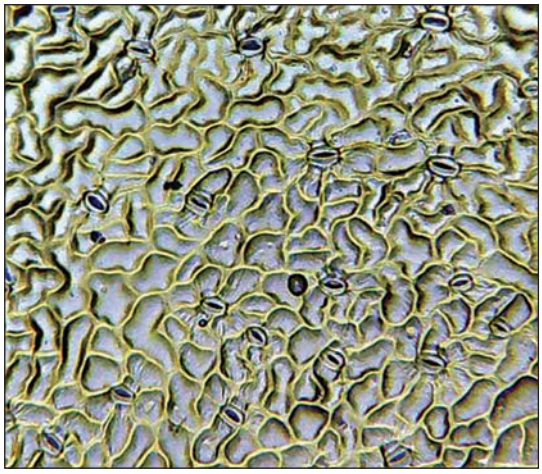
3. (a) Stomata on the surface of leaves are the main site of gas exchange in plants.

Stomatal density can be measured by applying nail varnish to the under-surface of the leaf to create an impression of the leaf surface. **Image 3.1** shows an impression of part of the leaf surface of a mesophyte leaf measuring 0.2 mm × 0.2 mm.

Image 3.1



(i) Using a light microscope, **21** stomata were counted in the area. Use this number to calculate the number of stomata per mm^2. [2]

Number of stomata = ... per mm^2

(ii) Some of the stomata shown in **Image 3.1** are open. Explain the mechanism of stomatal opening which allows gas exchange to take place. [4]

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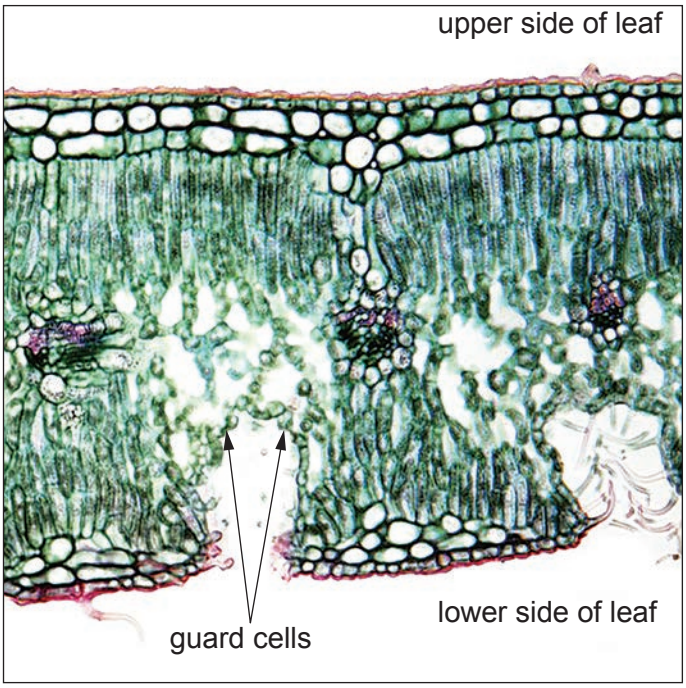
(b) When the stomata are open, loss of water vapour also occurs. **Image 3.2** shows a section of a leaf from a plant which has adaptations to reduce this loss of water vapour from its leaves.

Image 3.2



(i) Identify the **type** of plant which has the type of adaptations shown in **Image 3.2**. Describe **and** explain **three** adaptations shown in **Image 3.2** which reduce the loss of water vapour. [4]

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(ii) Suggest why the method used to obtain the impression in **Image 3.1** would not be a suitable technique to measure stomatal density in the leaf shown in **Image 3.2**. [1]

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(iii) Suggest how the method used to obtain the impression of the stomata in **Image 3.1** may need to be modified if using a **hydrophyte** leaf. [1]

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4. (a) The head of a bony fish was dissected to remove its gills as shown in **Image 4.1**.

Image 4.1

(i) Complete the risk assessment below for the **main** hazard in the fish head dissection. [2]

Hazard	Risk	Control measure
.....	.....	.....
.....	.....	.....
.....	.....	.....

(ii) Explain **four** ways in which the gills are adapted for gas exchange. [4]

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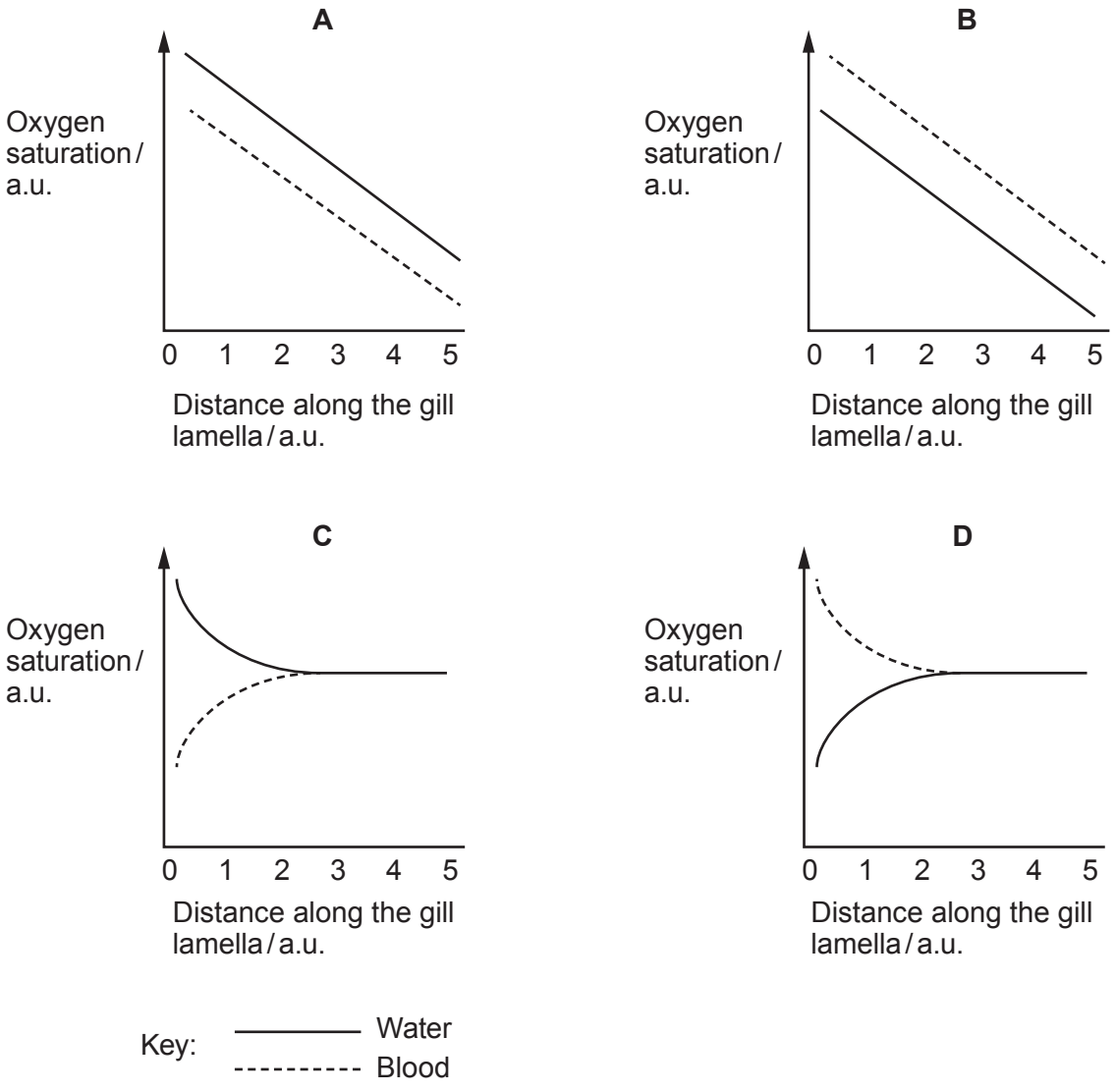
(b) **Table 4.2** shows the effect of the different anatomical arrangement of blood vessels in a bony fish (salmon) and a cartilaginous fish (shark).

Table 4.2

Distance along the gill lamella / mm	Oxygen concentration / a.u.			
	Salmon		Shark	
	Water	Blood	Water	Blood
1	5.00	4.43	5.00	1.82
2	4.23	3.97	4.42	3.45
3	3.57	3.42	3.58	3.58
4	2.98	2.54	3.58	3.58
5	2.01	1.97	3.58	3.58

Graph 4.3



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(i) Using evidence from **Table 4.2**, identify which graph **(A – D)** shows blood and water flow in the: [1]

Salmon .....

Shark .....

(ii) **Add arrows to the two graphs chosen** in (b)(i) to identify the direction of blood and water flow. [1]

(iii) Explain why the salmon is more efficient than the shark in absorbing oxygen from the water passing over the gills. [3]

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(c) The ventilation rate in salmon can be determined by counting the number of times the operculum opens and closes per minute. In one experiment, the ventilation rate in polluted water (low oxygen concentration) was compared to the ventilation rate in unpolluted water (higher oxygen concentration). The mean ventilation rate of salmon in polluted water was found to be 15 per minute, whereas in salmon from unpolluted water, the mean ventilation rate was 6 per minute.

Suggest and explain the reason for this difference in ventilation rate. [3]

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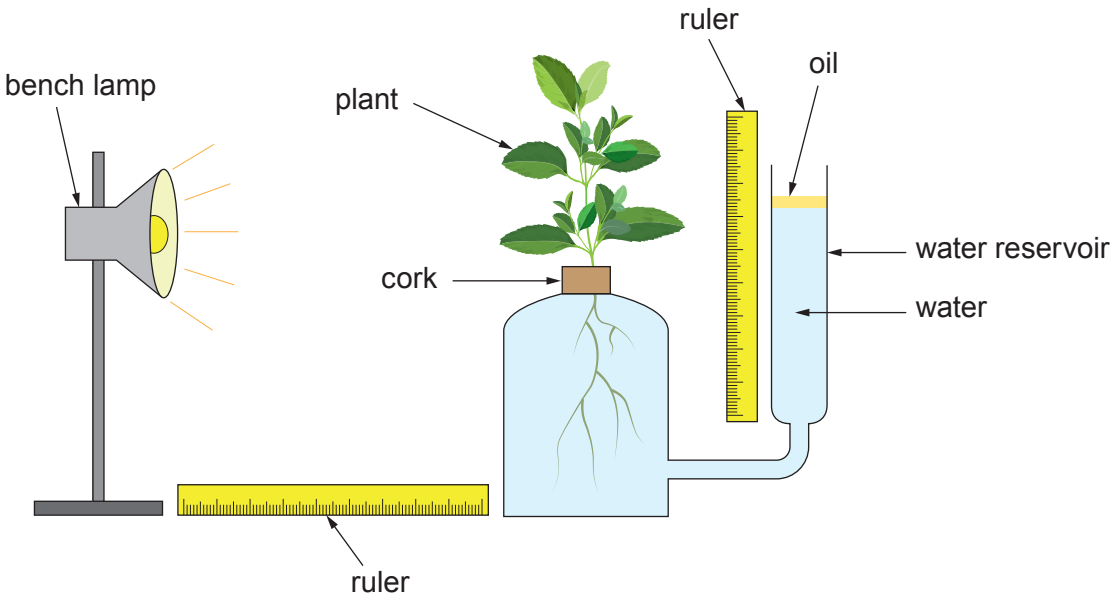
5. (a) A potometer can be used to measure the uptake of water by a plant. **Image 5.1** shows one type of potometer.

Image 5.1



(i) The potometer was used to investigate the effect of changing light intensity on the uptake of water by the roots.

State the following for this investigation: [2]

I. the independent variable;

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II. the dependent variable.

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(ii) Suggest and explain why oil was added to the surface of the water in the reservoir before the investigation started. [2]

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(iii) Other factors apart from light intensity can also affect the uptake of water by a plant. Complete the table below to identify **two** other factors which could affect the water loss from the plant used in this experiment. Justify why each of these factors needs to be controlled. [3]

Factor	Justification
.....	....
.....	....

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(b) **Table 5.2** shows the results from the experiment shown in **Image 5.1**.

Table 5.2

	Distance the water had moved in one hour / mm			
Distance of lamp from plant / cm	Trial 1	Trial 2	Trial 3	Mean
10	6	5	8	6.33
20	4	4	6	.....
30	3	3	3	3.00
40	2	2	2	2.00
50	1	0	0	0.33

(i) Calculate the mean distance the water had moved for a distance of 20 cm. **Express your answer to 3 significant figures. Write your answer in Table 5.2.** [2]

(ii) Calculate the volume of water taken up by the roots per minute when the lamp was 30 cm from the plant, using the formula $\pi r^2 h$. [3]

The diameter of the water reservoir was 8 mm.

π = 3.14

h = distance moved by water in the reservoir

Volume = ... $mm^3\ min^{-1}$

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(iii) Suggest how the method could be modified to investigate the effect of wind speed on water uptake by the roots. [2]

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(iv) A potometer is normally used to give an indication of transpiration rate. However, the rate of water uptake by the roots is not equal to the rate of water vapour loss from the leaves. Suggest why. [1]

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(v) Most potometers are used with a cut shoot rather than a whole plant. Describe **one** precaution that should be taken when preparing the cut shoot, in order to not affect the movement of water in the xylem. Explain why this is necessary. [3]

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6. The electrical activity of the heart can be measured and analysed using an electrocardiogram (ECG). **Image 6.1** shows an ECG trace from a healthy individual. **Image 6.2** shows an ECG trace from a patient with a heart defect.

Image 6.1 An ECG trace from a healthy individual

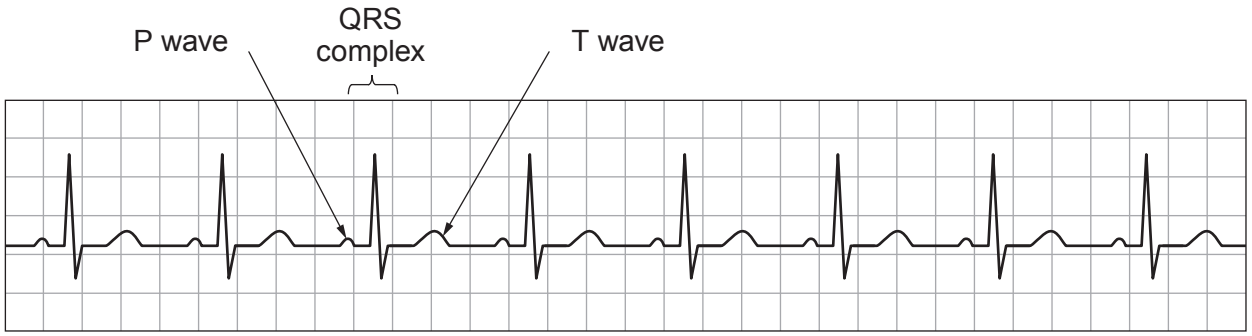
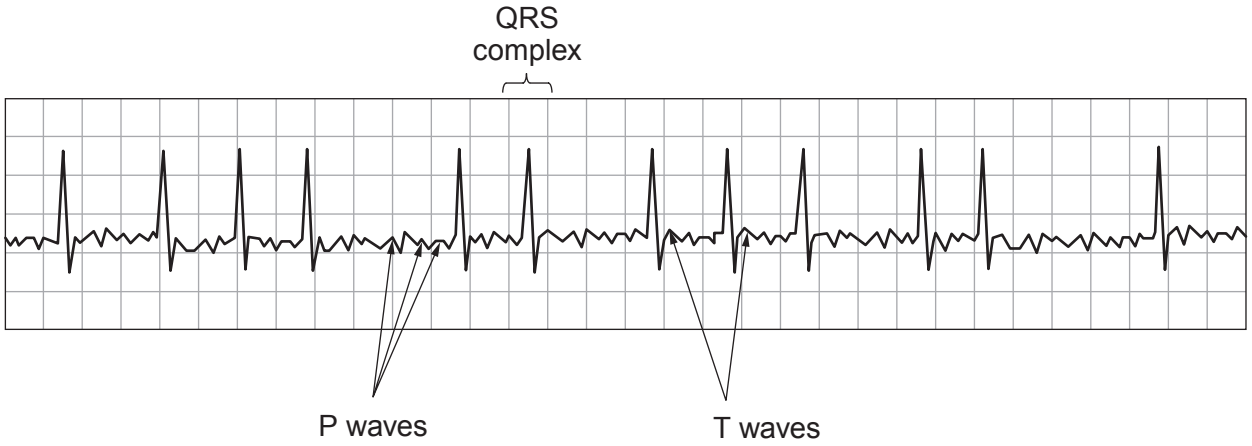


Image 6.2 ECG trace from a patient with a heart defect



Explain how the normal ECG relates to the electrical control of the cardiac cycle. Compare the ECG traces shown in **Images 6.1** and **6.2**. Using **Image 6.2**, suggest how the cardiac cycle would be affected in a patient with this heart defect. [9 QER]

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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