Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

DC (LK/SW) 127829/3

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[Turn over

Answer **all** questions.

1 The root apical meristem is a region of undifferentiated cells in the root tips of plants. Mitosis occurs in this region.

(a) Fig. 1.1 is an image of the root tip of *Allium* as observed using a microscope with a low-power objective lens.

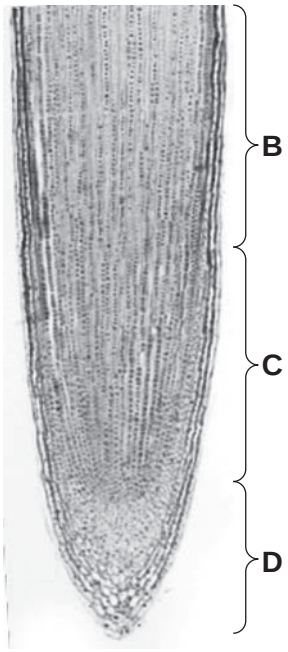

Fig. 1.1

State which region, **B**, **C**, or **D**, should be chosen in order to observe the highest proportion of cells in stages of mitosis.

.....[1]

(b) (i) Draw a labelled diagram to show the structure of a chromosome at late prophase of mitosis.

[3]

(ii) Describe the behaviour of the nuclear envelope during mitosis.

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[Total: 6]

2 Triglycerides and phospholipids are types of lipid.

Fig. 2.1 shows the structure of one type of phospholipid known as phosphatidylcholine.
F1 and F2 are fatty acid residues.

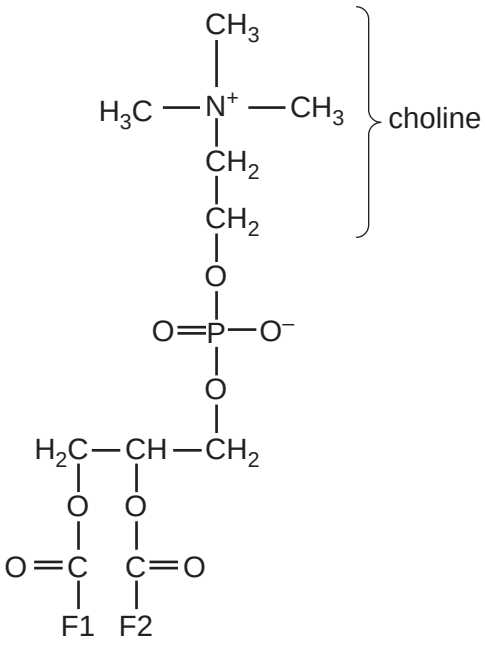

Fig. 2.1

(a) Phospholipase is an enzyme that can break down phospholipids. This enzyme is found in the venom of some insects, such as bees.

Bee venom can destroy red blood cells, a condition known as haemolysis.

Suggest how bee venom destroys red blood cells.

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(b) Compare, stating similarities and differences, the structure of the phosphatidylcholine shown in Fig. 2.1 with the structure of a triglyceride molecule.

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differences .....

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(c) Name **and** describe the cell structure in which the synthesis of triglycerides and other lipids takes place.

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[Total: 9]

3 Hydrolytic enzymes can function within the cell or can be secreted by the cell, where they are able to catalyse reactions.

(a) State the term used to describe an enzyme that functions within the cell.

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(b) The rates of reaction of two different hydrolytic enzymes, enzyme **G** and enzyme **H**, were measured at different substrate concentrations. The results are shown in Fig. 3.1.

The two enzymes have different values of the Michaelis–Menten constant (K_m).

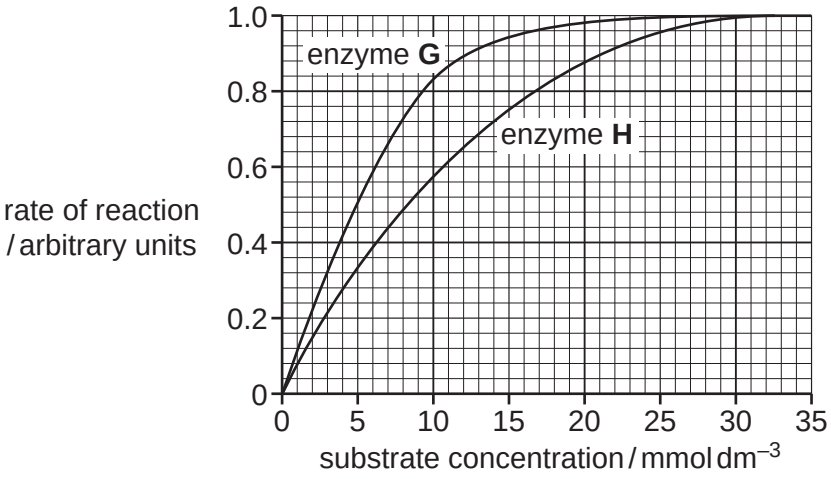

Fig. 3.1

(i) The K_m value of enzyme **G** is 5 mmol dm^{-3}.

Use Fig. 3.1 to derive the K_m value for enzyme **H**.

Show your working.

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(ii) With reference to Fig. 3.1, explain how the values of K_m for these enzymes provide information about the relationship between the enzyme and their substrates.

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Cells can break down an old or damaged organelle, such as a mitochondrion, by enclosing the organelle in a membrane formed from the endoplasmic reticulum. This forms a vacuole. Vesicles containing hydrolytic enzymes fuse with the vacuole and the organelle is then digested.

(c) Name the vesicles in the cell that contain hydrolytic enzymes.

.....[1]

(d) The cell has internal chemical messengers that signal when an old or damaged mitochondrion should be broken down.

Suggest **one** feature involving mitochondrial structure or function that could lead to the release of these internal signals.

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Question 3 continues on page 8

(e) Glucocerebrosidase is an enzyme synthesised by macrophages to hydrolyse glucocerebroside, a glycolipid found in cell membranes.

The *GBA* gene codes for glucocerebrosidase. There are a number of different mutations of the *GBA* gene. Some mutations result in a single amino acid change in the enzyme molecule produced, and this causes a disorder known as Gaucher's disease. Two of these mutations, at different positions in the *GBA* gene, are shown in Table 3.1.

Table 3.1

amino acid change caused by mutation			**severity of Gaucher's disease**
	from	**to**	
mutation 1	asparagine (Asn)	serine (Ser)	mild
mutation 2	leucine (Leu)	proline (Pro)	severe

With reference to Table 3.1,

- outline how a mutation leads to a single amino acid change in the enzyme glucocerebrosidase **and**
- suggest why the two different amino acid changes, Asn to Ser and Leu to Pro, will result in differences in the tertiary structure of the enzyme.

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[Total: 12]

4 Fig. 4.1 is a transmission electron micrograph of the bacterium that causes cholera, *Vibrio cholerae*.

The flagellum shown in Fig. 4.1 allows movement of the bacterium within the gut and may also function to help it to bind to an intestinal epithelial cell. The organism does not enter the cell but the toxin it releases can enter and cause damage. Large quantities of water, chloride ions and sodium ions are lost from the cell.

Fig. 4.1

People with symptoms of cholera have severe watery diarrhoea and as a result can become very dehydrated.

(a) Explain how a loss of chloride ions and sodium ions from the intestinal epithelial cell will cause a loss of water from the cell.

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(b) The main treatment for cholera is oral rehydration therapy (ORT) using oral rehydration salts (ORS). This involves drinking a solution of electrolytes (mineral ions) and glucose.

Fig. 4.2 summarises the movement of glucose and sodium ions across an intestinal epithelial cell.

Fig. 4.2 includes three different types of cell surface membrane proteins:

- SGLT1 is a cotransporter protein
- GLUT2 and Na^+/K^+ pump are two types of carrier protein.

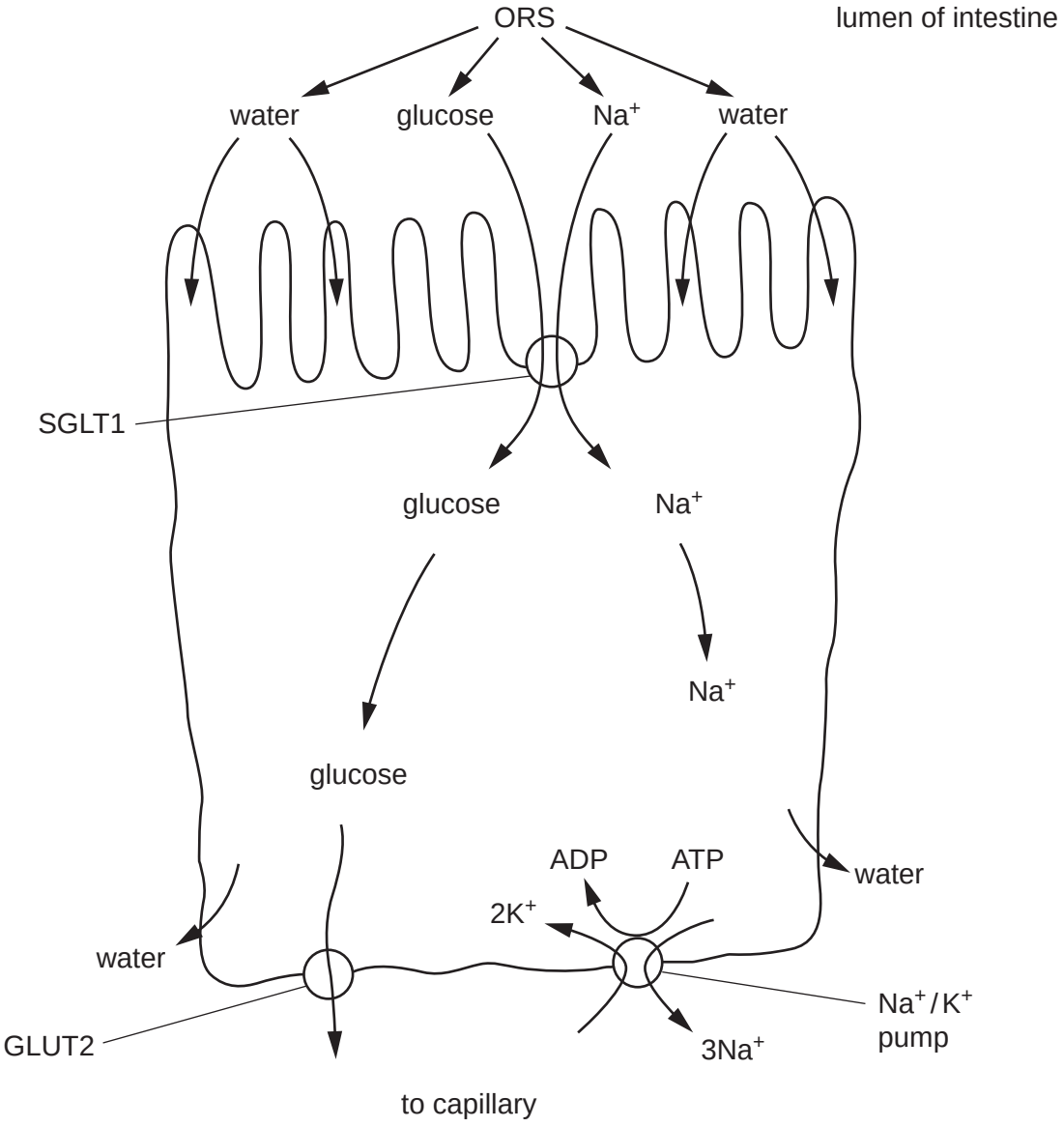

Fig. 4.2

The first rehydrating solution developed for the treatment of cholera did not contain glucose. Using ORS, patients absorb a higher concentration of sodium ions and there is an increase in water uptake.

With reference to Fig. 4.2:

- outline the transport mechanisms that result in the movement of glucose and sodium ions across the intestinal epithelial cell
- suggest how the movement of glucose and sodium ions increases water uptake by the cell.

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(c) In severe cases of cholera, the rehydrating solution is given intravenously, as a drip directly into a vein.

Suggest **one** reason why the rehydrating solution is given as a drip directly into a vein rather than into an artery.

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In very severe cases of cholera, antibiotics are also prescribed. The preferred antibiotic for treatment of cholera is a single dose of doxycycline, a form of tetracycline antibiotic.

(d) Tetracycline binds to a ribosomal subunit.

Suggest what effect this will have on the metabolism of *V. cholerae*.

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.....[1]

[Turn over

(e) A study was carried out to compare the effectiveness of the antibiotic tetracycline in the treatment of 118 patients with cholera. The patients were divided into four different treatment groups:

- Group **A**, given one dose of 1 g tetracycline
- Group **B**, given one dose of 2 g tetracycline
- Group **C**, given a multiple dose (one dose of 500 mg tetracycline every 6 hours for 24 hours)
- Group **D**, no antibiotic given.

Following treatment, the volume of diarrhoea collected from each patient was measured every 16 hours for 128 hours. Fig. 4.3 shows the mean volume collected for each group.

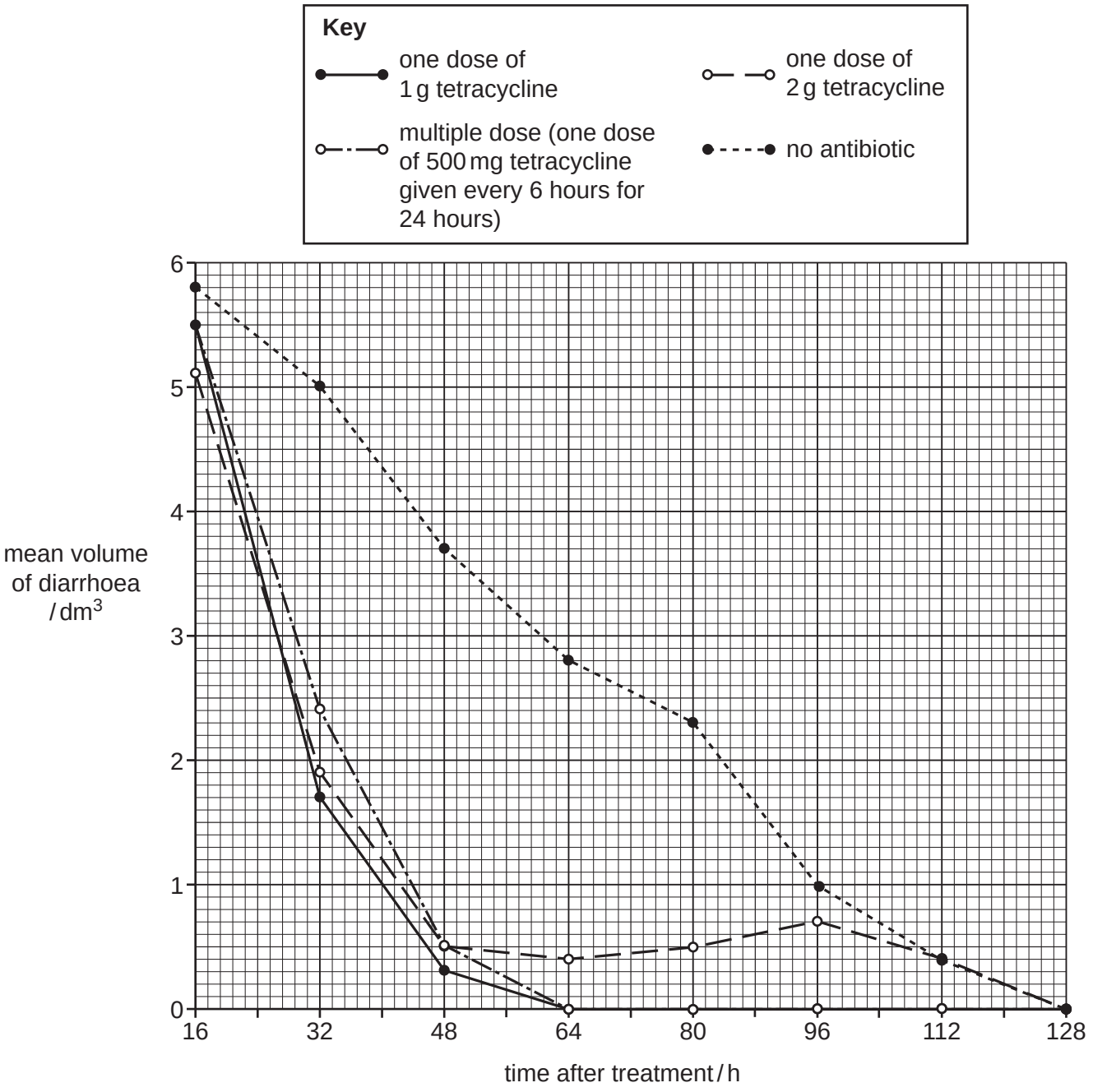

Fig. 4.3

(i) Describe the trends shown in Fig. 4.3.

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(ii) Explain whether the results support, or do not support, treating very severe cases of cholera with tetracycline.

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(f) Some strains of *V. cholerae* are antibiotic resistant.

Explain why this means that medical practitioners prefer to treat cholera with a single dose of antibiotic, rather than a multiple dose of the same antibiotic.

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(g) Most people who have recovered from cholera rarely become ill again from the disease. In these people, antibodies have been identified that will bind either to the cholera toxin, or to the bacterial flagellum, or to the main bacterial cell.

Explain why the antibodies are different, each one specific to its target.

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(h) Evidence suggests that newborn babies of mothers who have had cholera have immunity to the disease.

State **precisely** the type of immunity these babies are likely to have.

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[Total: 19]

5 **(a)** Descriptions **A**, **B** and **C** relate to the movement of water from the soil to the xylem in roots.

State the correct term to match each of the descriptions **A**, **B** and **C**.

A The specialised root epidermal cell that provides a large surface area for the uptake of water from the soil.

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B The band of suberin in the cell walls of the endodermis that prevents the movement of water by the apoplastic pathway.

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C The cell structures that allow water to pass from one cell to the next as part of the symplastic pathway.

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[3]

(b) Explain, with reference to the structure of xylem vessel elements, why water does **not** take a symplastic pathway in the xylem to the leaves.

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(c) Explain why the rate of movement of water in the xylem may slow down at night.

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[Total: 8]

[Turn over

6 Fig. 6.1 is a diagram of a vertical section through the mammalian heart. The labels **Q** to **X** represent valves and blood vessels of the heart.

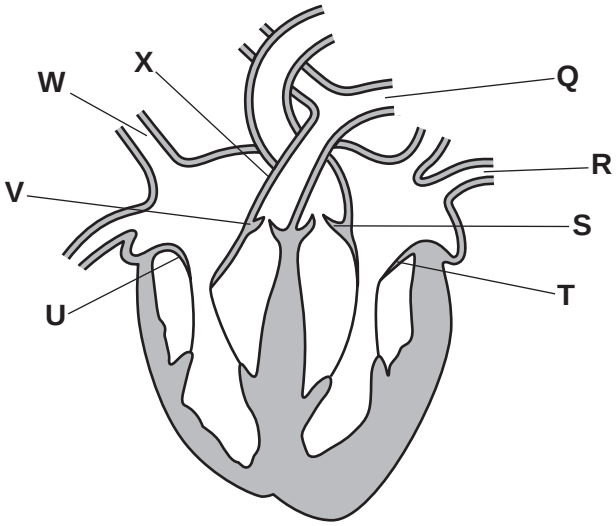

Fig. 6.1

(a) (i) State which label represents the valve that prevents the backflow of blood from the aorta into the ventricle.

.....[1]

(ii) Name the blood vessel that carries oxygenated blood from the lungs to the heart **and** state which label represents this blood vessel.

name .....

label .....[2]

(b) State **precisely** where the sinoatrial node is located.

.....[1]

(c) Explain the role of the atrioventricular node in the coordination of heart action.

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[Total: 6]