Oxford Cambridge and RSA

Thursday 23 May 2024 – Morning

AS Level Biology B (Advancing Biology)

H022/02 Biology in depth

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 answer should be supported with working. Marks might be given for 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 **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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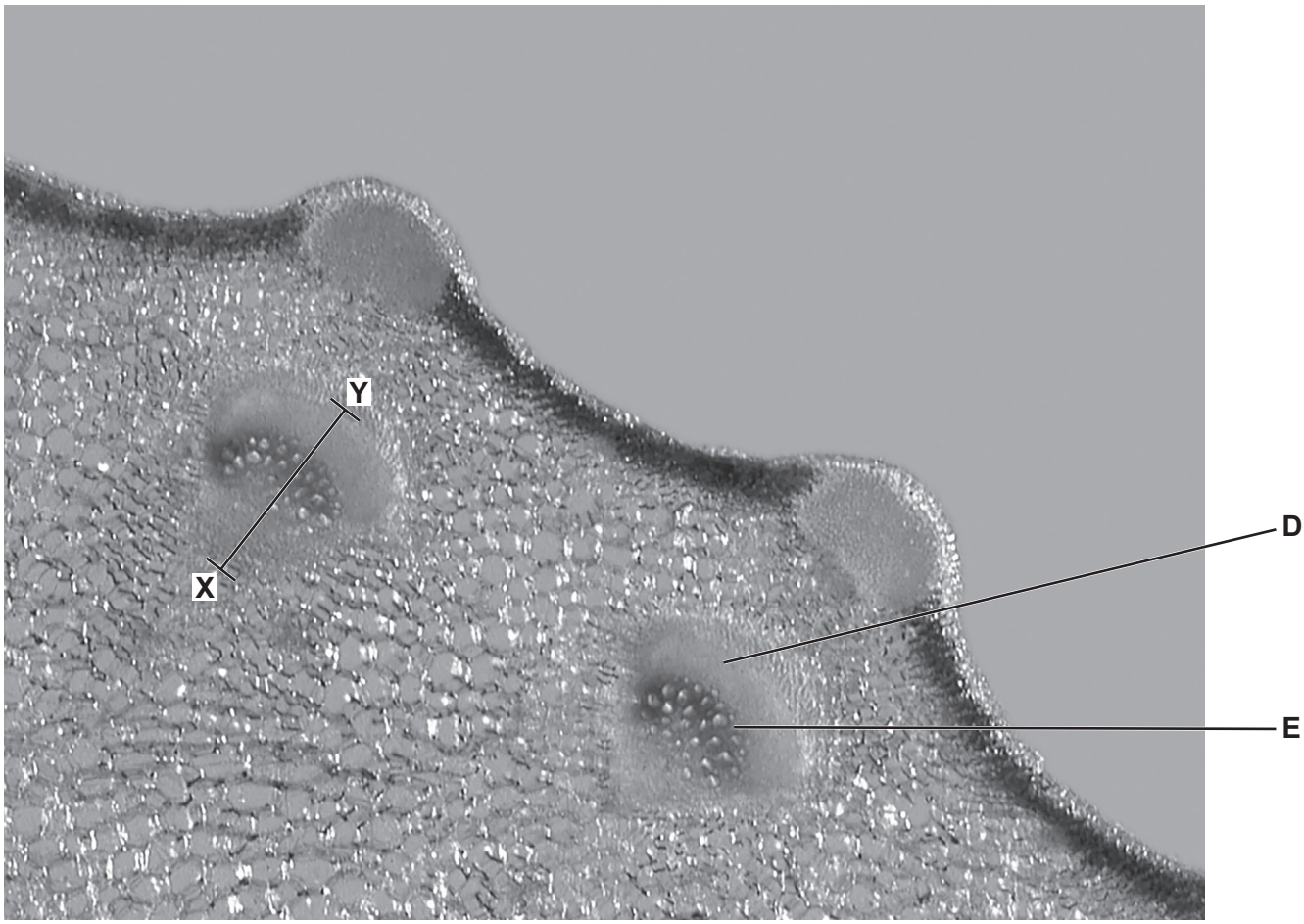
1 The image below shows a transverse section of stem from a celery plant seen through a light microscope.



×120 magnification

(a)
(i) State the functions of tissues **D** and **E**.

D .....

E .....

[2]

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(ii) Using this image, produce a low power plan drawing of the stem tissues.

[3]

(iii) Calculate the actual length of the structure between **X–Y**.

Actual length = ... μm **[2]**

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(b)* A teacher wanted their students to investigate how the presence of leaves changes the rate of transpiration in celery plants.

The teacher supplied the students with the following equipment and materials to choose from.

Balance	Beaker	Celery plant
Food colouring	Ruler	Scalpel
Stop clock	Vegetable oil	Water

Using only the equipment and materials supplied, plan a method to investigate how the presence of leaves changes the rate of transpiration in celery stems.

Include details of the variables involved.

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

Extra answer space if required.

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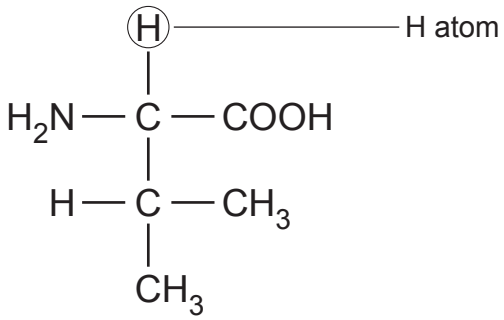
2 Amino acids have the same general structure with four different chemical groups attached to a central carbon atom.

The structure of the amino acid valine is shown in the diagram.



(a) One of the chemical groups in valine has been labelled on the diagram.

Circle and label **two** other chemical groups in valine **on the diagram**. **[2]**

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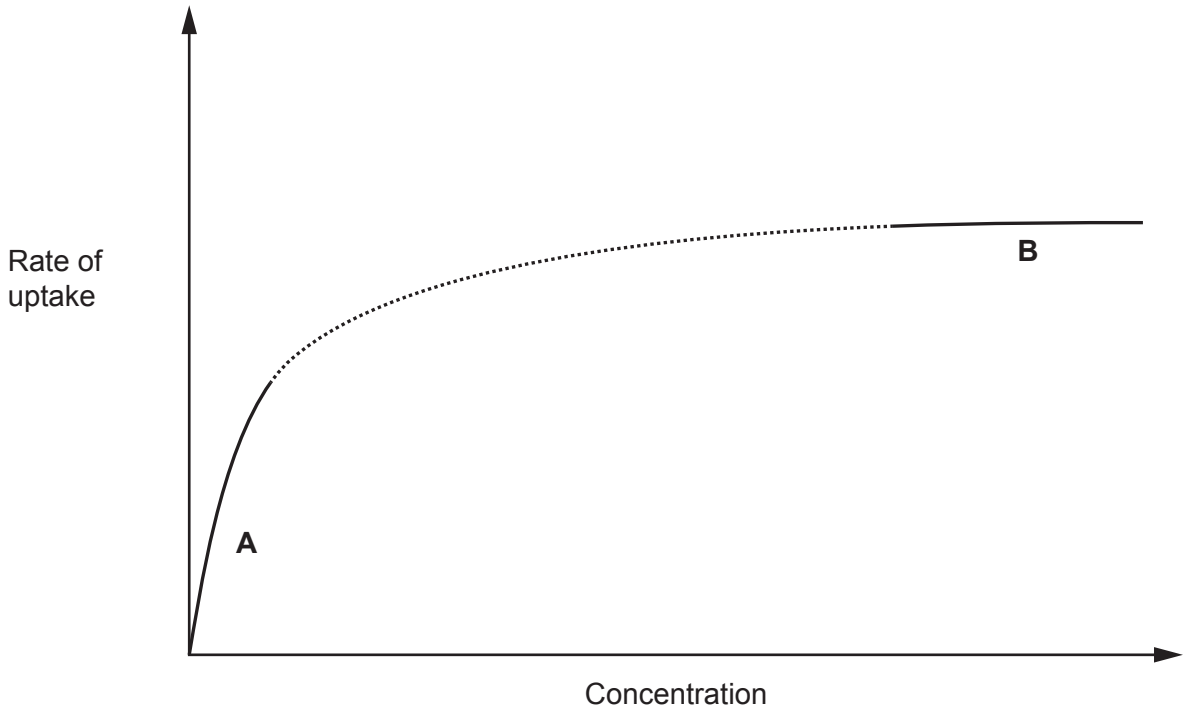
(b) Amino acids are taken up by some cells to produce enzymes.

The graph shows the rate of uptake of amino acids by cells in the salivary glands.



(i) Using your knowledge of transport of molecules across membranes, explain the shape of the curve at region **A** and at region **B**.

Region **A** .....

.....

.....

Region **B** .....

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.....

[2]

(ii) Cells in the salivary glands require oxygen for aerobic respiration.

Draw a line **on the graph** to show the rate of uptake of oxygen by the cells of the salivary glands as the concentration of oxygen increases. **[1]**

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(c)* Amylase is an enzyme produced by cells in the salivary glands.

Amylase is secreted from the cells to break down starch in the mouth.

Explain how the organelles in salivary cells work together to secrete amylase with the specific shape needed to break down starch.

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Extra answer space if required.

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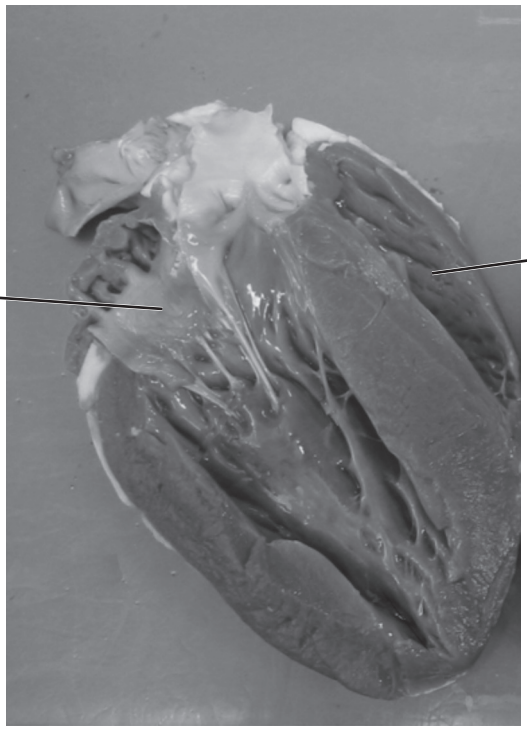
3

(a) The image shows a dissected mammalian heart.



(i) Name the structures labelled **G** and **H**.

G .....

H .....

[2]

(ii) State **two** safety precautions that should be taken during a heart dissection **and** explain why each is important.

Precaution 1 .....

Explanation .....

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Precaution 2 .....

Explanation .....

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[2]

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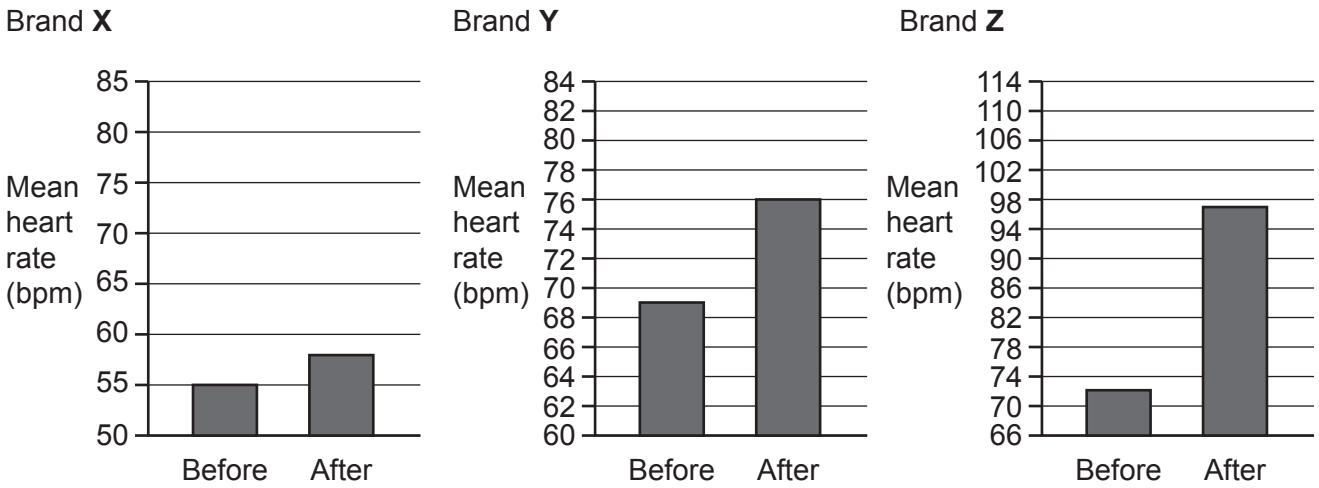
(b) High energy caffeine drinks are becoming more popular with young adults.

A scientist investigated the effect of different brands of high energy caffeine drinks on the heart rate of 60 volunteers.

The resting heart rate of each volunteer was taken before drinking each brand of energy drink and again two hours later.

The results of the investigation are shown below.



(i) All the volunteers were aged between 20–24 years of age.

State **one** other factor that should be controlled to make the results valid.

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

(ii) The mean cardiac output of the group given brand **Y** was 4900 $cm^3 min^{-1}$ before taking the drink and 5800 $cm^3 min^{-1}$ two hours after taking the drink.

Calculate the increase in stroke volume two hours after taking the high energy caffeine drink.

Increase in stroke volume = ... cm^3 **[2]**

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(iii) The difference in mean heart rate between the three groups could be due to the different glucose content of each drink.

Suggest how the scientist could improve the method to show that caffeine is responsible for increasing heart rate.

Give a reason for your answer.

Improvement .....

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Reason .....

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[2]

(iv) The cardiac output of all the volunteers increased after taking the high energy caffeine drink.

Caffeine can affect the activity of the sino-atrial node (SAN) of the heart.

Explain how caffeine could affect the coordination of heart activity leading to an increase in cardiac output.

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..... **[4]**

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4

(a) Species can be classified based on a taxonomic hierarchy.

(i) What is meant by the term **hierarchy** in this context?

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

(ii) Two concepts used in classifying organisms are the biological species concept and the phylogenetic species concept.

Describe the difference between these two concepts.

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

(b) Cytochrome c is a protein found in mitochondria.

Scientists can sequence the order of amino acids in cytochrome c and use the results to show similarities between different species.

(i) State **one** other type of molecule, apart from proteins, that can be sequenced in order to classify organisms.

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

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(ii) The table shows the number of differences in the amino acid sequence of cytochrome c of some animal species compared to humans.

Species	**Number of differences in the amino acid sequence of cytochrome c compared to humans**
Chimpanzee	1
Rabbit	4
Horse	5
Chicken	6
Frog	8
Shark	13

A scientist concluded that the chimpanzee is the most closely related species to humans.

Describe **one** reason why the information in the table supports the scientist's conclusion and **one** reason why it does **not** support the conclusion.

Conclusion **is** supported because .....

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Conclusion **is not** supported because .....

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[2]

(iii) The scientist also concluded that rabbits and horses are as closely related to each other as humans are to chimpanzees.

Explain why this might **not** be true.

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

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5

(a) Snake venom is a type of poison injected into the body during a bite from a venomous snake.

Some snake bites can be treated using antivenom.

Antivenom contains antibodies that have been produced by a horse.

To make antivenom, horses are given a small dose of snake venom.

(i) Explain how a horse produces antibodies when it is given snake venom.

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

(ii) The horses produce a small quantity of antibody the first time they are used to produce antivenom.

When they are given doses of venom on future occasions they produce larger quantities of antibody.

Explain why the horses produce larger quantities of antibody after the first dose of antivenom.

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

(iii) The dose of venom given to different horses is calculated in $\mu g\,kg^{-1}$ of body mass.

Suggest why the dose is calculated based on the horse's body mass.

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

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(b) *Daboia siamensis* is a species of snake native to Southeast Asia.

To produce antivenom for *Daboia siamensis*, a 600 kg horse is given a dose of 3.5 $\mu g\,kg^{-1}$ of body mass.

The venom yield of one snake is 78 mg.

Calculate the maximum number of antivenom doses that can be produced from one snake.

Maximum number of antivenom doses = ... **[2]**

(c) There is a small risk that patients might have an allergic reaction to antivenom if they are given a particular antivenom more than once.

Explain what causes an allergic reaction.

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

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(d) Some snake venoms contain a toxin made of protein, called cytotoxin.

Cytotoxin can bind to the membrane of blood cells causing damage to the cell.

(i) Suggest how antivenom acts on cytotoxin to prevent damage to the cell.

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

(ii) Cytotoxin has both polar and non-polar regions.

Suggest how cytotoxin binds to the membrane and causes damage to the blood cells.

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

(iii) Cytotoxin can cause the death of T lymphocytes.

Explain why even if a patient receives the correct antivenom immediately after a snake bite, they can be more vulnerable to other infections for months afterwards.

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

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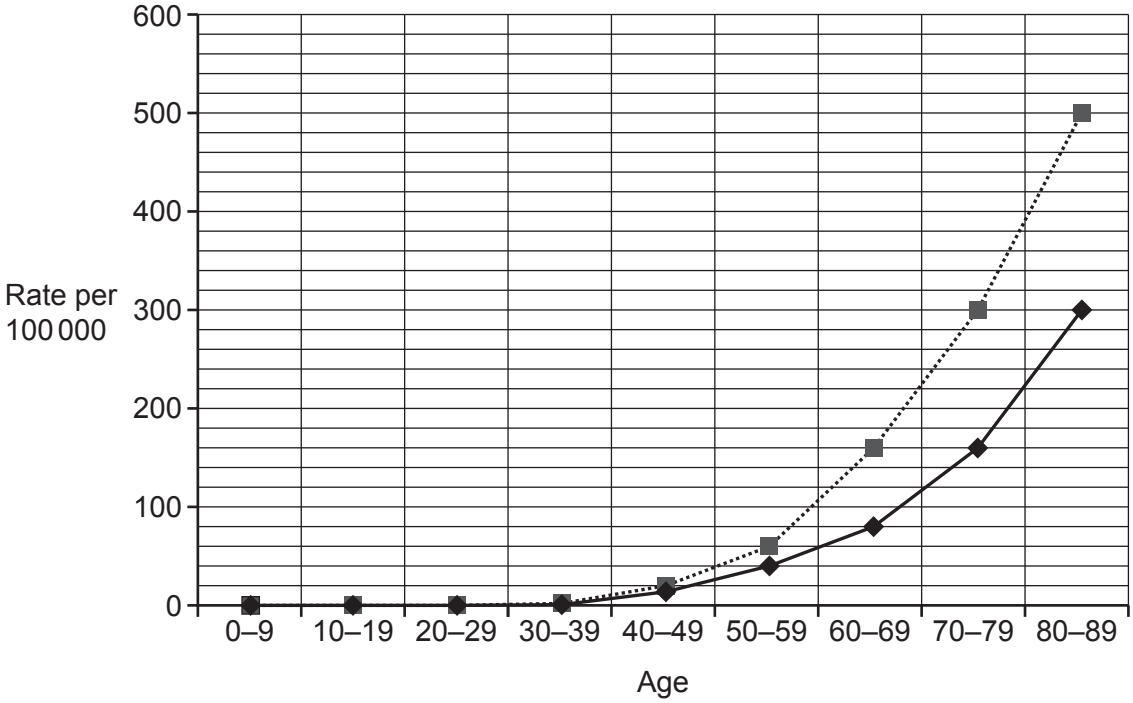
6

(a) Bowel cancer is the term used to describe the development of a tumour in the large intestine.

The graph shows the rate of bowel cancer in different age groups.



Key: —◆— Female ·····■····· Male

(i) Calculate the percentage increase in the rate of bowel cancer in females from age 50–59 to age 80–89.

Percentage increase = ... % **[2]**

(ii) 53% of patients survive for ten years after diagnosis.

A student stated that, 'Almost half of all patients die from bowel cancer within ten years'.

Give **one** reason why the student's claim is unlikely to be true.

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

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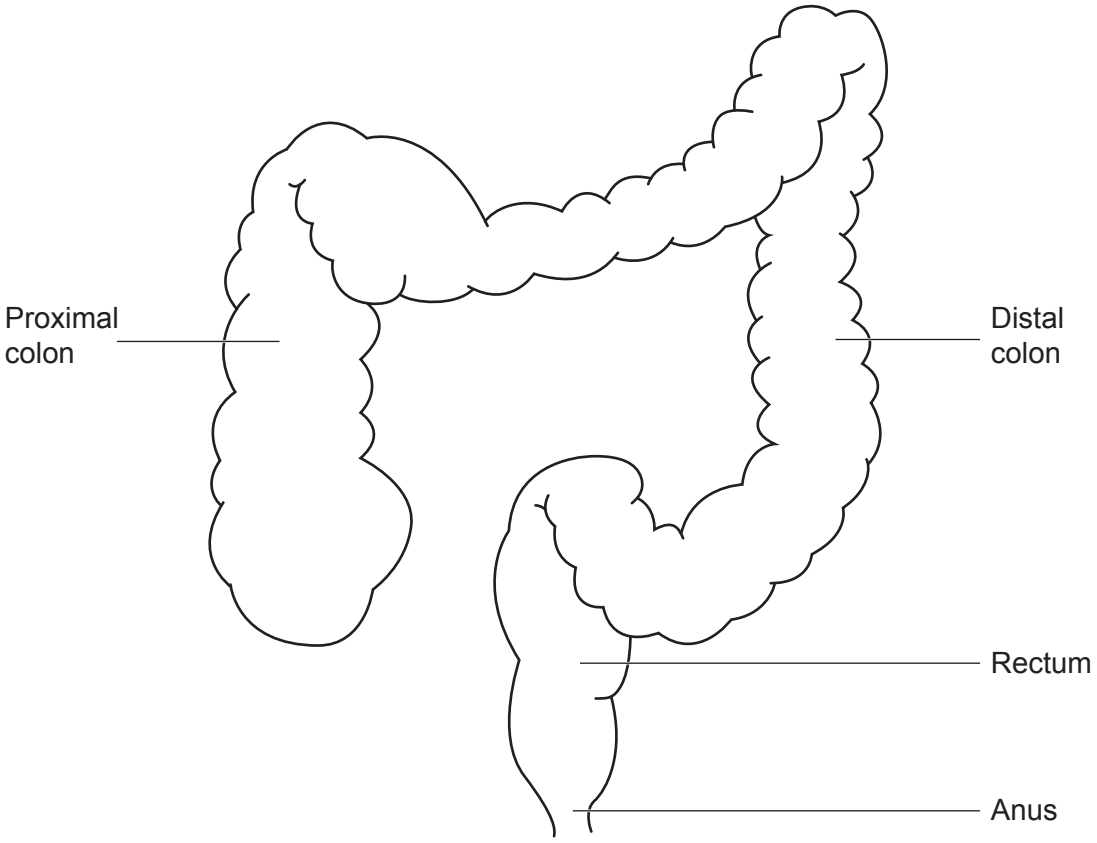
(b) The diagram shows the different regions that make up the large intestine.



(i) The mortality rate is higher in people suffering from cancer in the proximal colon than in the other regions.

Suggest why a patient is at greater risk of death if they have a tumour in the proximal colon.

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

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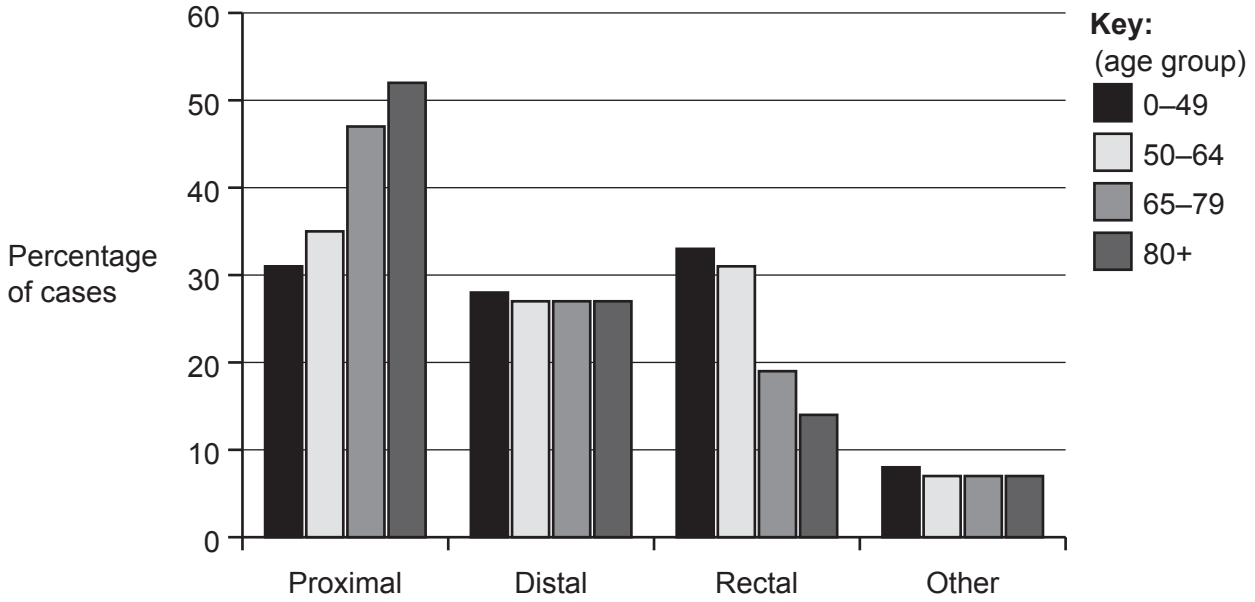
(ii) The graph shows the percentage of bowel cancer cases in different regions of the large intestine.

The bars show the percentages in different age groups.



Until 2021 only people over the age of 60 were eligible for routine bowel cancer screening.

In 2021 the eligibility age was reduced to 56 years old.

Using the information in the graph, evaluate the decision to change the eligibility age.

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

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(iii) Bowel cancer can be diagnosed using a number of diagnostic techniques.

A biopsy or a PET scan are two common techniques.

Give **two** reasons why a doctor may choose to use a PET scan instead of a biopsy.

1 .....

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2 .....

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[2]

END OF QUESTION PAPER

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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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