Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B400U20-1

O20-B400U20-1

FRIDAY, 16 OCTOBER 2020 – MORNING

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.	**15**	
2.	**16**	
3.	**15**	
4.	**20**	
5.	**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.

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 continuation 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 **5**.

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

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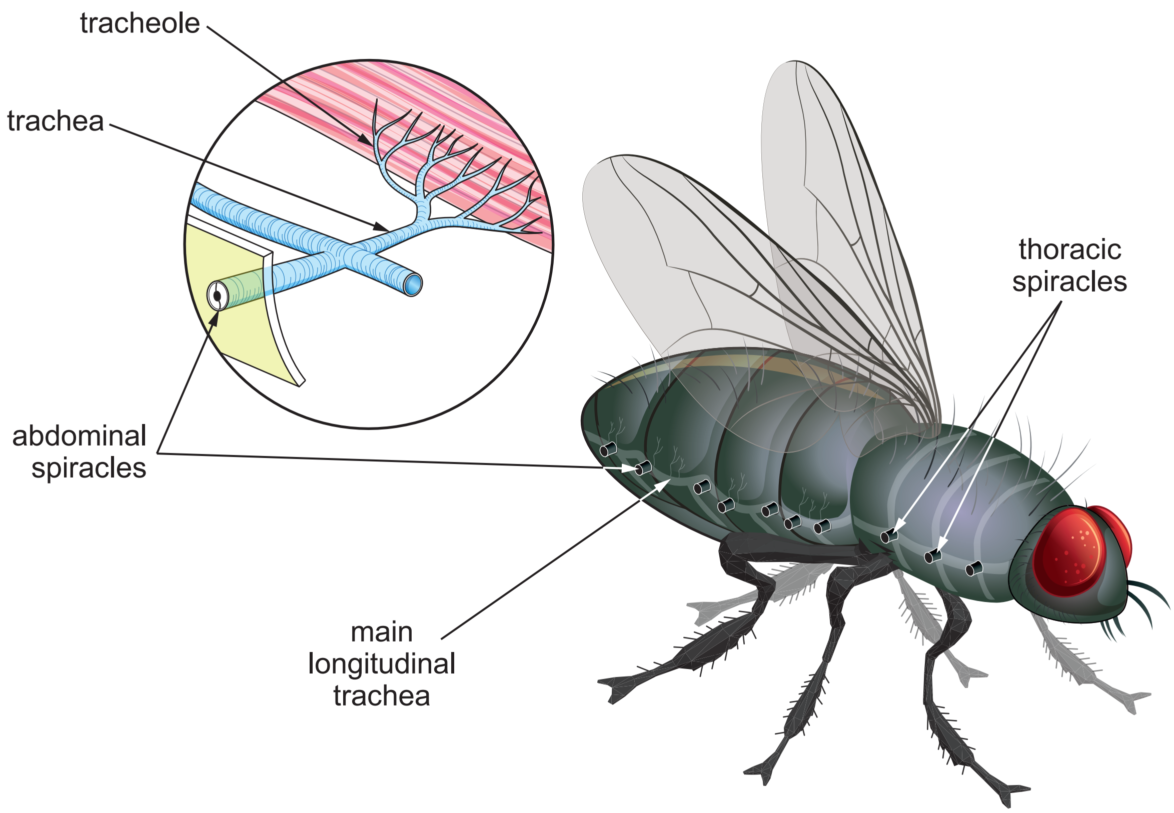
Answer **all** *questions.*

1. The tracheal system, as shown in **image 1.1**, is the site of gas exchange in insects.

Image 1.1



(a) (i) State precisely where gas exchange takes place in the tracheal system. [1]

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(ii) One problem facing terrestrial animals like insects is water loss.
State **two** adaptations of the insect tracheal system to reduce water loss. [2]

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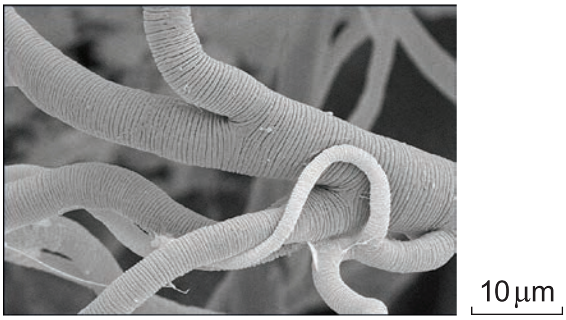
(iii) **Image 1.2** is an electron photomicrograph which shows the detail of the insect tracheae.

Image 1.2



Use the scale bar in **image 1.2** to calculate the magnification of the photomicrograph. [2]

Magnification = × ....

(b) In the experiment shown in **image 1.3**, a grasshopper was placed in a gas syringe. Its abdomen was observed and the number of abdominal movements per minute was counted for three consecutive minutes. The student then exhaled one breath gently into the syringe through the plastic tubing and the number of abdominal movements was counted again in the same way. The experiment was repeated using two, three and four exhalations. The results are shown in **table 1.4**.

Image 1.3

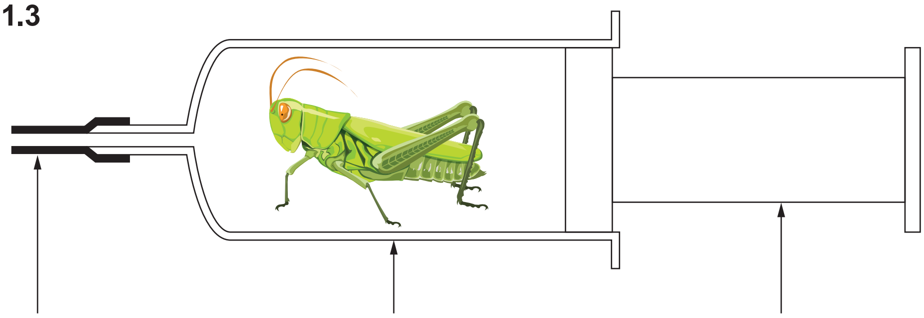


Table 1.4

Number of exhalations	Number of abdomen movements per min			
	Minute 1	Minute 2	Minute 3	Mean
0	47	43	50	47
1	64	66	62	64
2	89	89	91	90
3	103	99	106	103
4	104	106	105	105

(i) State **two** factors that would need to be controlled during the experiment. [2]

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(ii) Explain how abdominal movements are linked to ventilation in the insect. [2]

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(iii) Plot the mean data from the experiment as a **bar graph** on the graph paper below [2]

(iv) Describe and explain the trend shown by the data. [4]

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2. Transpiration is the loss of water vapour from the leaves of a plant. This allows water to move through the xylem of the plant.

(a) (i) Explain how the cohesion-tension theory accounts for most of the water movement through the xylem of the plant. [4]

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(ii) Explain how water moves by osmosis into the xylem of the root. [2]

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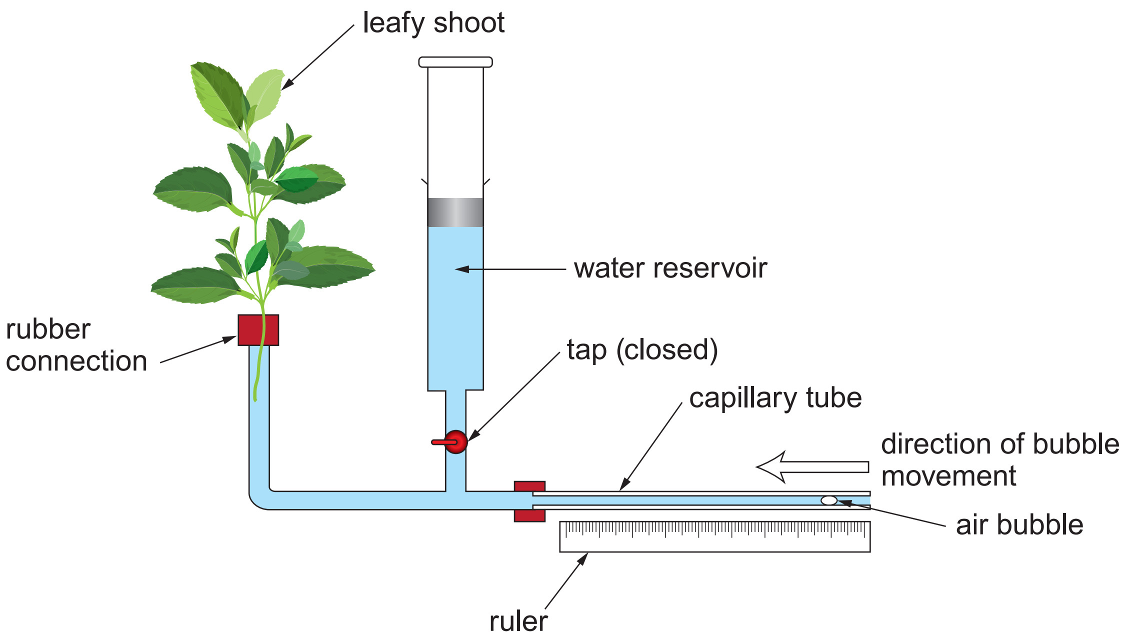
(b) A potometer was set up, as shown in **image 2.1**, to investigate transpiration in plants. The shoot was exposed to a range of different air speeds using a hairdryer.

Image 2.1



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(i) Using the fast air speed, the air bubble in the capillary tubing moved 47 mm in 12 minutes. The capillary tubing diameter was 1 mm. Calculate the volume of water lost through transpiration from the shoot **per hour** using the formula $\pi r^2 h$. [3]

π = 3.14
h = distance moved

Volume of water lost = ... $mm^3\ hr^{-1}$

(ii) Explain why it would be incorrect to conclude that all the water taken up was lost in transpiration from the shoot. [1]

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(iii) Explain how and why the results obtained would differ if a **xerophytic** plant was used in the same experiment. [3]

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(c) **Table 2.2** shows the results of the experiment for three air speeds generated by the hairdryer.

Table 2.2

Air speed setting	Distance moved by the bubble in 12 minutes / mm
slow	28
medium	35
fast	47

A student made the following conclusion from these results: '*Increasing the air speed caused an increase in the distance the bubble moved.*'
Suggest **three** reasons why it would not be possible to be confident in this conclusion. [3]

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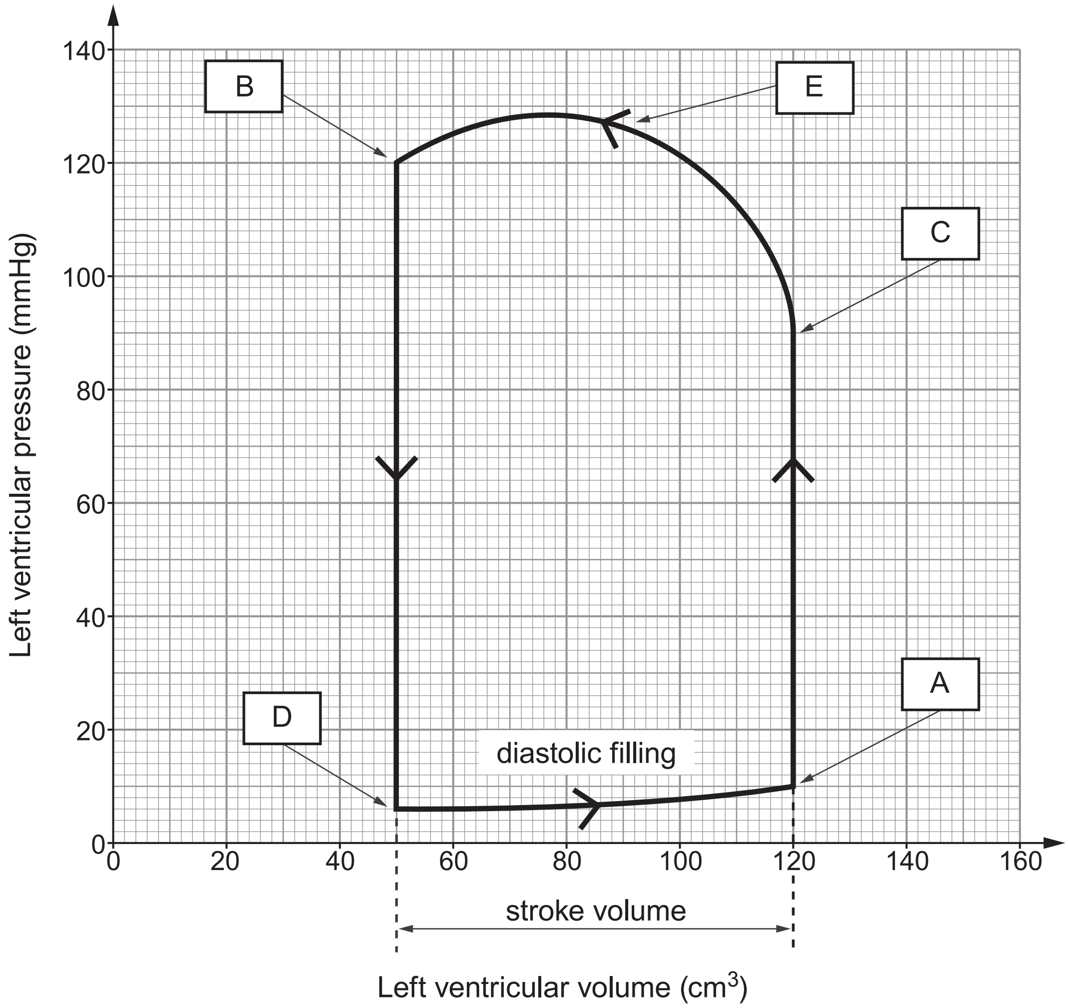
3. **Graph 3.1** shows how pressure and volume change in the left ventricle during the cardiac cycle in mammals. This is known as a pressure-volume loop. The arrows represent the sequence of these changes during one cardiac cycle. The diagram also shows the stroke volume (SV), which is the volume of blood pumped from the left ventricle during each contraction.

Graph 3.1



(a) (i) Using **graph 3.1**, determine which letter(s) fits the statements in **table 3.2**. The letters can be used, once, more than once or not at all. [4]

Table 3.2

Statement	Letter(s)
Atrio-ventricular valve closes	
Left ventricle is relaxed	
Left ventricle pressure is greater than in the aorta	
Semi-lunar valves close	

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(ii) A patient has a heart rate (HR) of 80 beats per minute. Using the information from **graph 3.1** and the following formula, **calculate their cardiac output in cm^3 min^{-1}**.

Cardiac output (CO) = HR × SV [2]

Cardiac output = ... cm^3 min^{-1}

(b) (i) Name the structures which ensure that the atrio-ventricular valves only open in one direction. [1]

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(ii) Explain why blood only flows into the aorta and nowhere else when the left ventricle contracts. [3]

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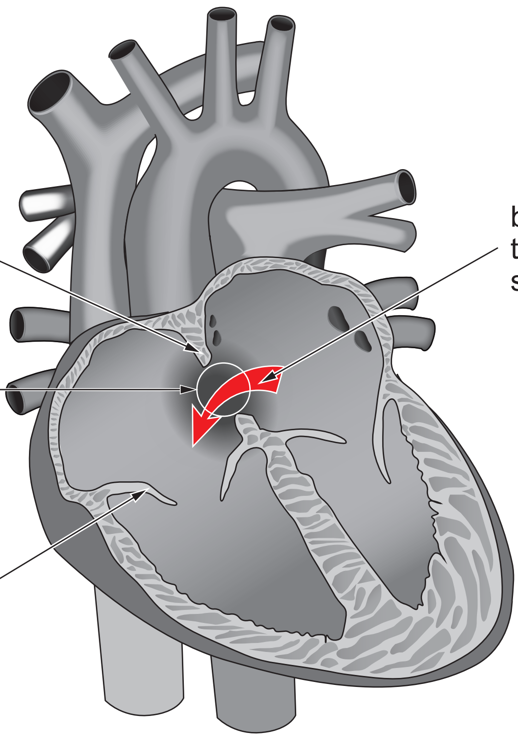
(c) **Image 3.3** shows a condition called atrial septal defect in the heart of a child. The septum of the atria has a hole which allows blood to flow from the left atrium to the right atrium.

Image 3.3



(i) Using **image 3.3** and your own knowledge of the cardiac cycle, explain how the defect shown could result in tiredness and a lack of energy. [4]

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(ii) Suggest why the atrial septal defect could reduce the stroke volume of the child. [1]

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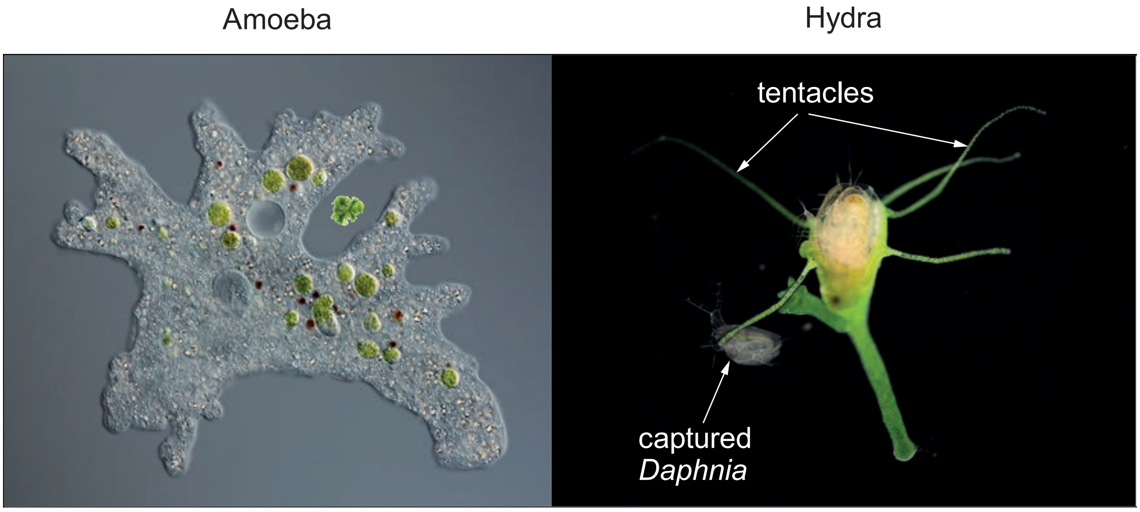
4. **Image 4.1** shows an amoeba and a hydra feeding. Both organisms are holozoic and heterotrophic.

Image 4.1



(a) Define the following terms: [2]

holozoic; ....

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heterotrophic. ....

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(b) The giant panda, *Ailuropoda melanoleuca*, is a bear which eats bamboo. It is also holozoic and heterotrophic. The giant panda is classified as a carnivore but eats mainly plants. The ancestors of giant pandas were originally carnivores and began consuming bamboo in their diet around 7 million years ago. It is thought that they then switched to eating mainly bamboo about 2 million years ago.

(i) The binomial naming system uses the genus and species name for the giant panda. State the main reason for using this system of naming organisms. [1]

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(ii) **Image 4.2** shows the skull of a giant panda.

Image 4.2

Using **image 4.2** and your own knowledge of dentition, state the evidence which supports the classification of giant pandas as carnivores. [3]

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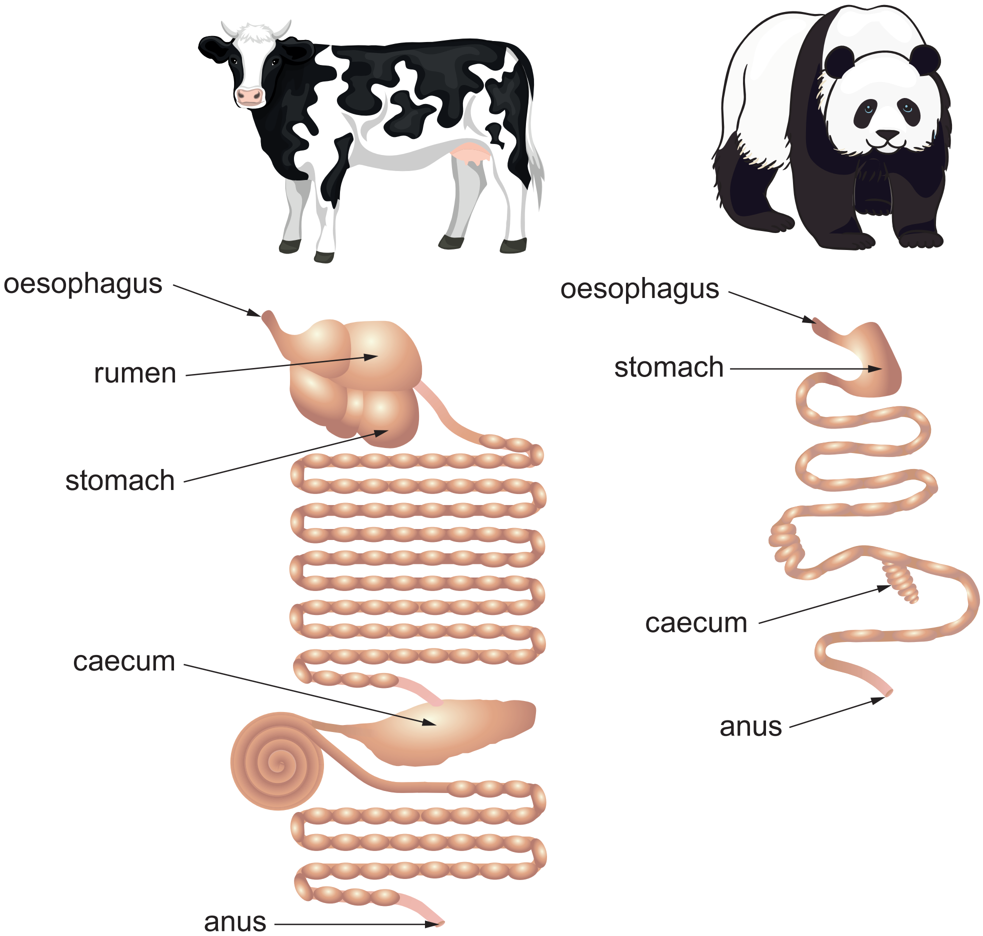
Image 4.3 shows the digestive tract of a cow and a giant panda.

Image 4.3



(iii) Describe how **and** explain why the gut of the panda differs from the gut of a cow. [4]

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(c) Cellulase producing bacteria have been found in the faeces of some giant pandas. Using your knowledge of digestion, suggest where in the gut the bacteria would need to be located to provide the greatest benefit to the panda. Explain your answer. [3]

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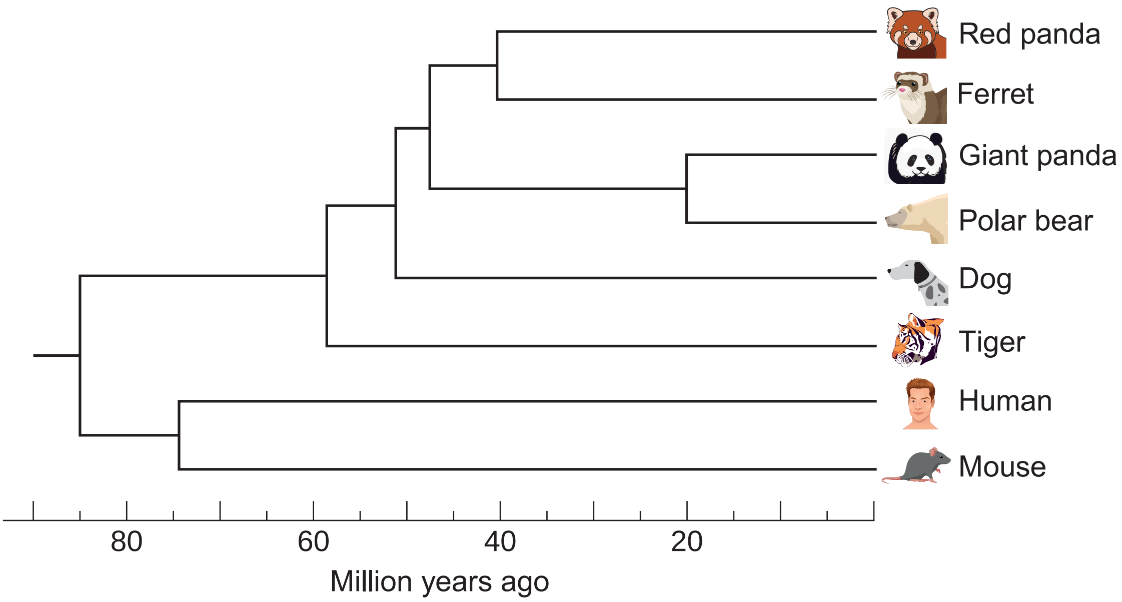
Image 4.4 shows a phylogenetic tree. The tree was constructed using information gathered after analysis of haemoglobin from a number of species.

Image 4.4



(d) (i) Using **image 4.4**, state how many million years ago the last common ancestor existed between the giant panda and a human. [1]

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(ii) State the information that the analysis of the haemoglobin would provide, and how this could have been used to construct the phylogenetic tree shown in **image 4.4**. [4]

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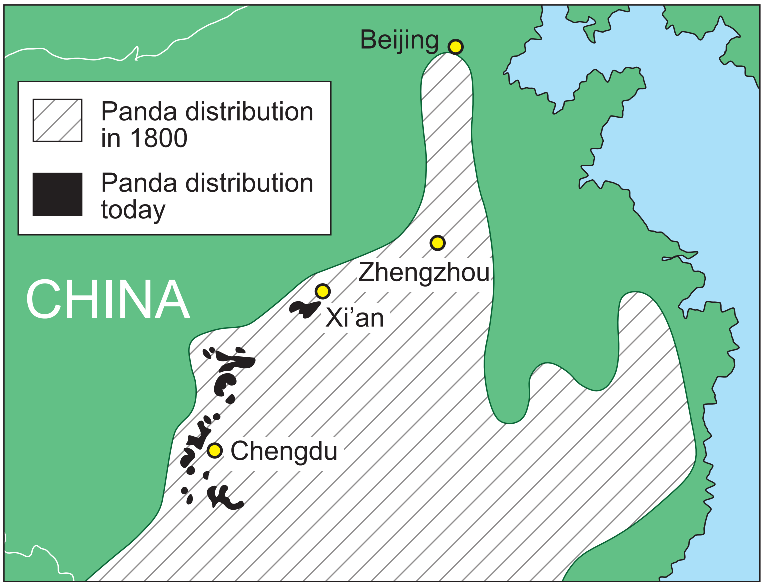
There are only around 1 000 giant pandas living in the wild. These are split between three areas in China as shown in **image 4.5**.

Image 4.5.



The separation of the populations of giant pandas was thought to have caused a reduction in the biodiversity of the species. Further studies have revealed that the biodiversity is high even though the number of individuals is low. The high biodiversity is caused by a high level of genetic polymorphism.

(e) State what is meant by a '*high level of genetic polymorphism*'. [2]

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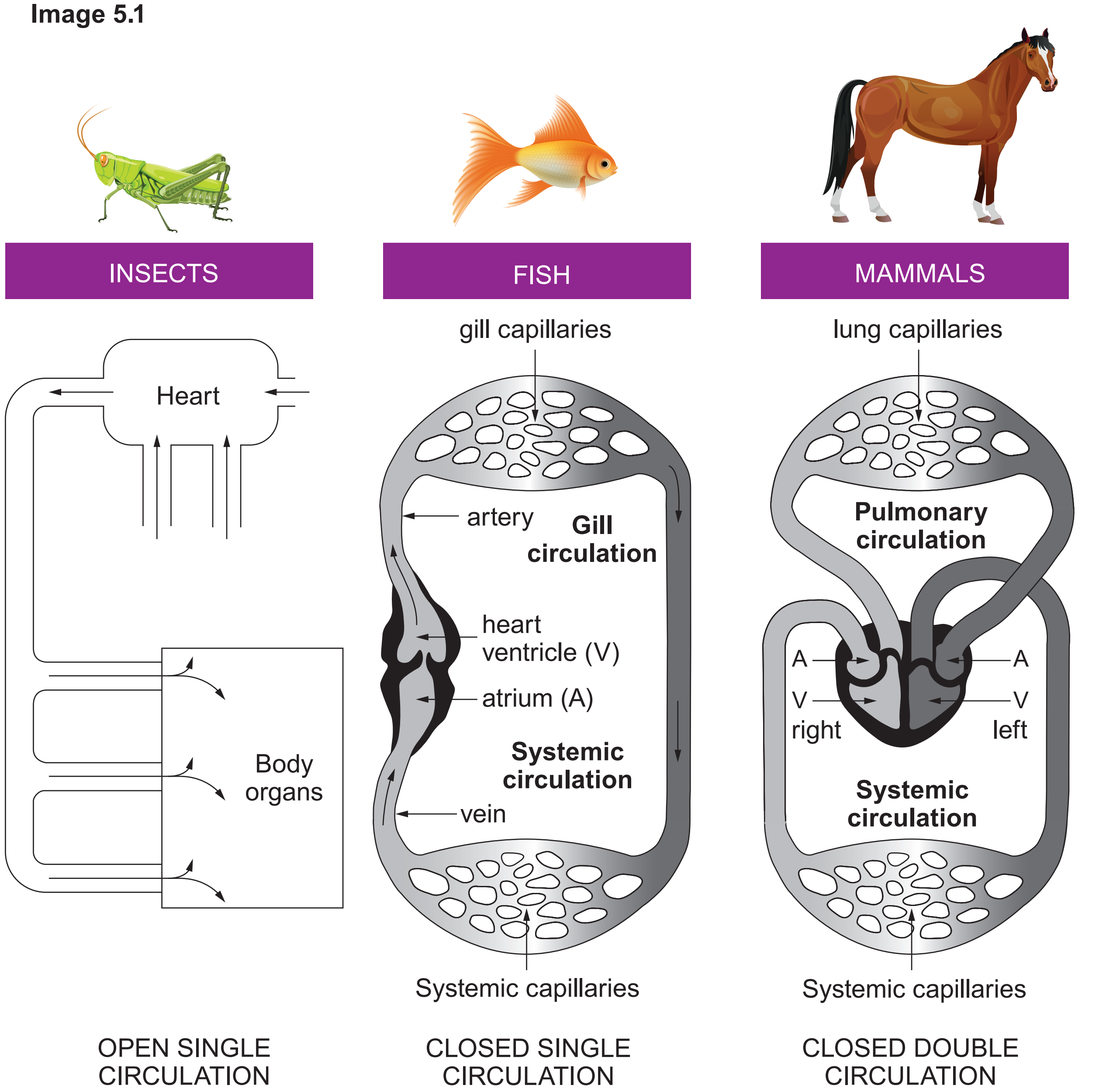
5. Circulatory systems in animals have evolved in different ways.

Image 5.1 shows organisms which have different arrangements of their circulatory systems.

Image 5.1



Explain the similarities and differences between the circulatory systems shown in the diagrams.

Outline the advantages and disadvantages of the single and double circulatory systems.

[9 QER]

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