



## **GCE AS Level Biology**

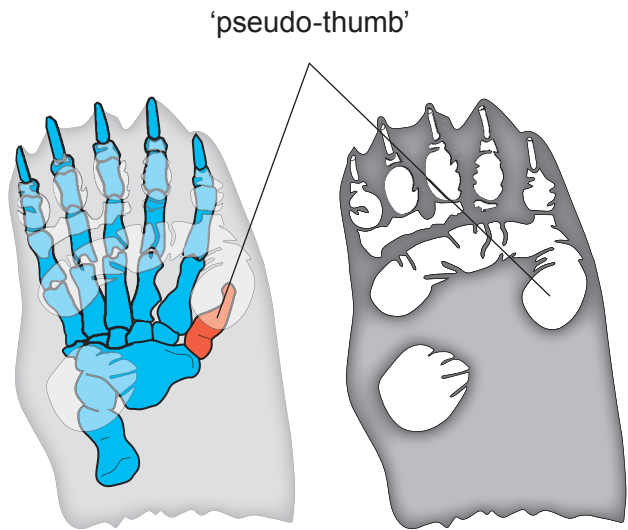
S21-B400U20-1

### **Assessment Resource 8**

Biodiversity and Physiology of Body Systems Resource B

1. Giant pandas, *Ailuropoda melanoleuca* and red pandas, *Ailurus fulgens* are both mammals which are native to China. It was long believed that giant pandas and red pandas were close evolutionary relatives and there is much evidence to support this hypothesis:

- both animals live in similar habitats,
- both have digestive systems similarly adapted to their bamboo diet,
- both have a sixth digit, known as a pseudo-thumb, which they use to grip and shred bamboo shoots.



With the advent of DNA sequencing techniques, it has been possible to compare the DNA of different species to confirm how closely related they are to each other. The table below shows mitochondrial DNA sequences from four species of mammal including giant panda and red panda.

Species	Mitochondrial DNA (mtDNA) codes
Black bear	.....ATTGGAGCAGACTTA.....
Giant panda	.....ATTGGCACTAATCTA.....
Red panda	.....ATTGGAACTAATCTT.....
Raccoon	.....ATCGGAACTAATCTT.....

(a) Use the table to identify which of the species is most closely related to the red panda. Explain your answer. [2]

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- (b) In the study, mitochondrial DNA base pairs were analysed. The following number of differences were found between giant panda DNA and that of the other species analysed:

Red panda	17
Black bear	12
Raccoon	21

One estimate of the mutation rate for the mitochondrial DNA sequence analysed is  $3.95 \times 10^{-7}$  mutations  $\text{yr}^{-1}$ .

Estimate how many years ago the giant panda and the red panda last shared a common ancestor. **Give your answer in standard form to two significant figures.** [3]

Answer: .....

- (c) There has been some debate as to whether the pseudo-thumb in red pandas and giant pandas are examples of analogous or homologous structures. Distinguish between analogous and homologous structures. Explain why analogous features are not considered evidence of common ancestry. [3]

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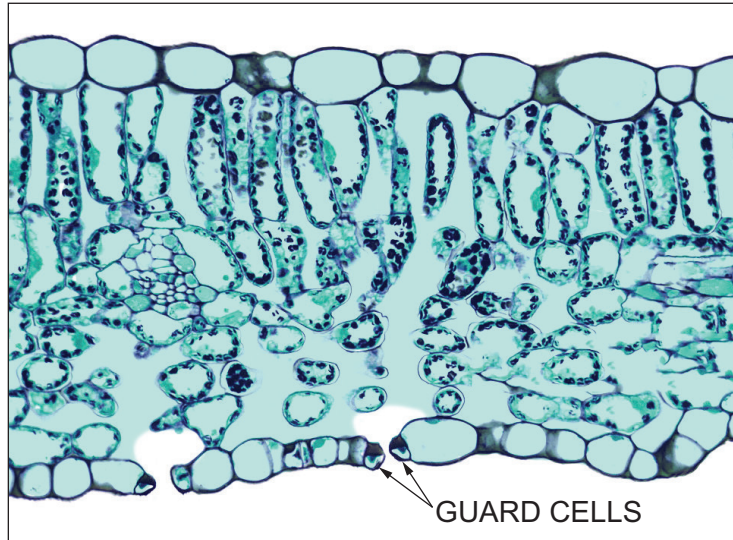
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- (d) In 1977, Carl Woese proposed the three domain system based on analysis of differences in the nucleotide sequences of 16S rRNA genes. Identify the domain to which the giant panda would belong. Give a reason for your answer. [2]

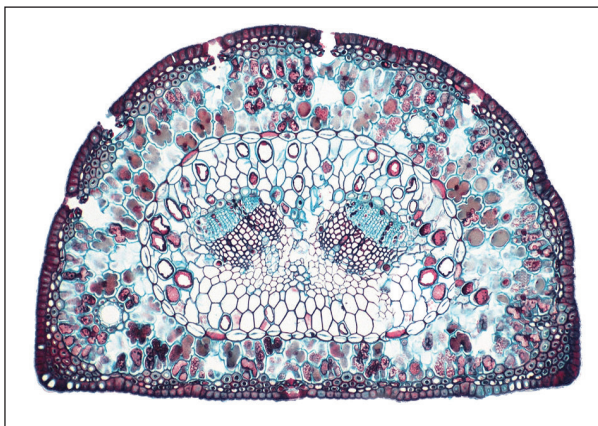
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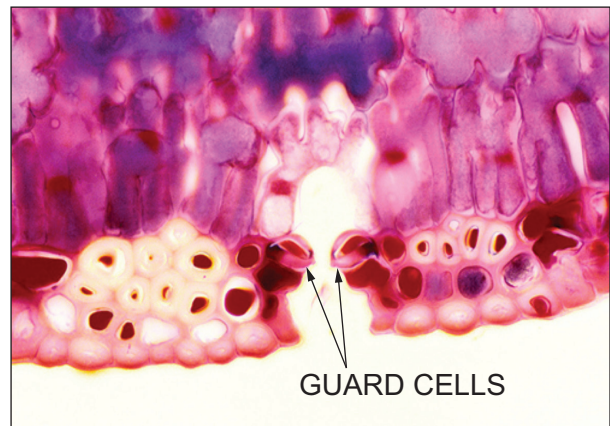
2. There is a wide variation in the rate of water loss from different plant species. Such variation is often due to structural features of the leaf. The photomicrographs below show transverse sections of a leaf of privet (*Ligustrum sp.*) and a leaf of pine (*Pinus sp.*).



*Ligustrum sp.* T.S. leaf



*Pinus sp.* T.S. leaf



detail of stoma of *Pinus sp.*

- (a) Use the photomicrographs to explain why less water vapour is lost through the stomata of *Pinus sp.* than through the stomata of *Ligustrum sp.* . [3]

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- (b) An investigation was carried out into the distribution of stomata on the lower surface of leaves of *Ligustrum*. The image below shows the view through a microscope showing an impression of the lower epidermis of a *Ligustrum* leaf.



- (i) Describe how the investigation would have been carried out. [4]

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- (ii) Calculate the stomatal density of this part of the leaf. The diameter of the field of view of the microscope is 1mm. **Give the answer to two decimal places.** [3]

Use the formula  $\pi r^2$  where  $\pi = 3.142$

Stomatal density = .....  $\text{mm}^{-2}$

- (iii) Suggest why the method used would not be suitable for calculating the stomatal density of *Pinus* leaves. [1]

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- (c) The table below shows the mean number of stomata on the upper and lower surface of leaves from two species of plant.

Species	Mean number of stomata / cm <sup>2</sup>	
	Upper surface	Lower surface
A	850	2651
B	5800	6100

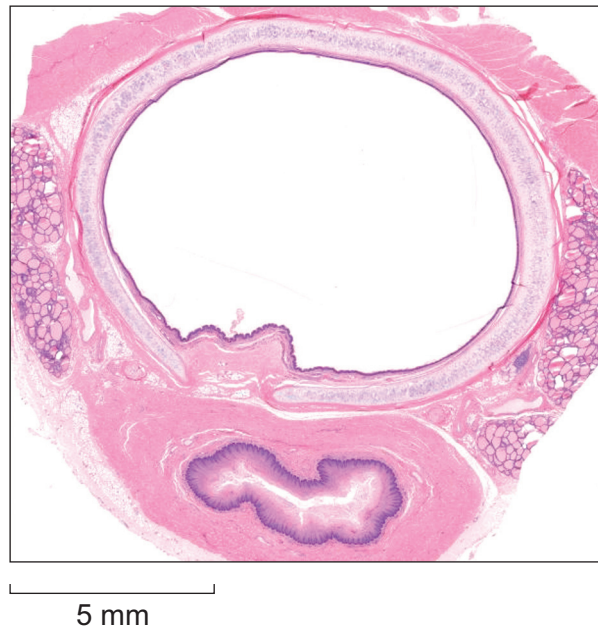
Which of the two species in the table is likely to live in the driest environment? Explain your answer. [2]

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3. The photomicrograph below shows a transverse section (T.S.) of the trachea and oesophagus of a mammal.



- (a) (i) Calculate the magnification of the photograph. [2]

Magnification = .....

- (ii) Explain how a feature visible in the photograph ensures that the trachea can function effectively during inspiration. [2]

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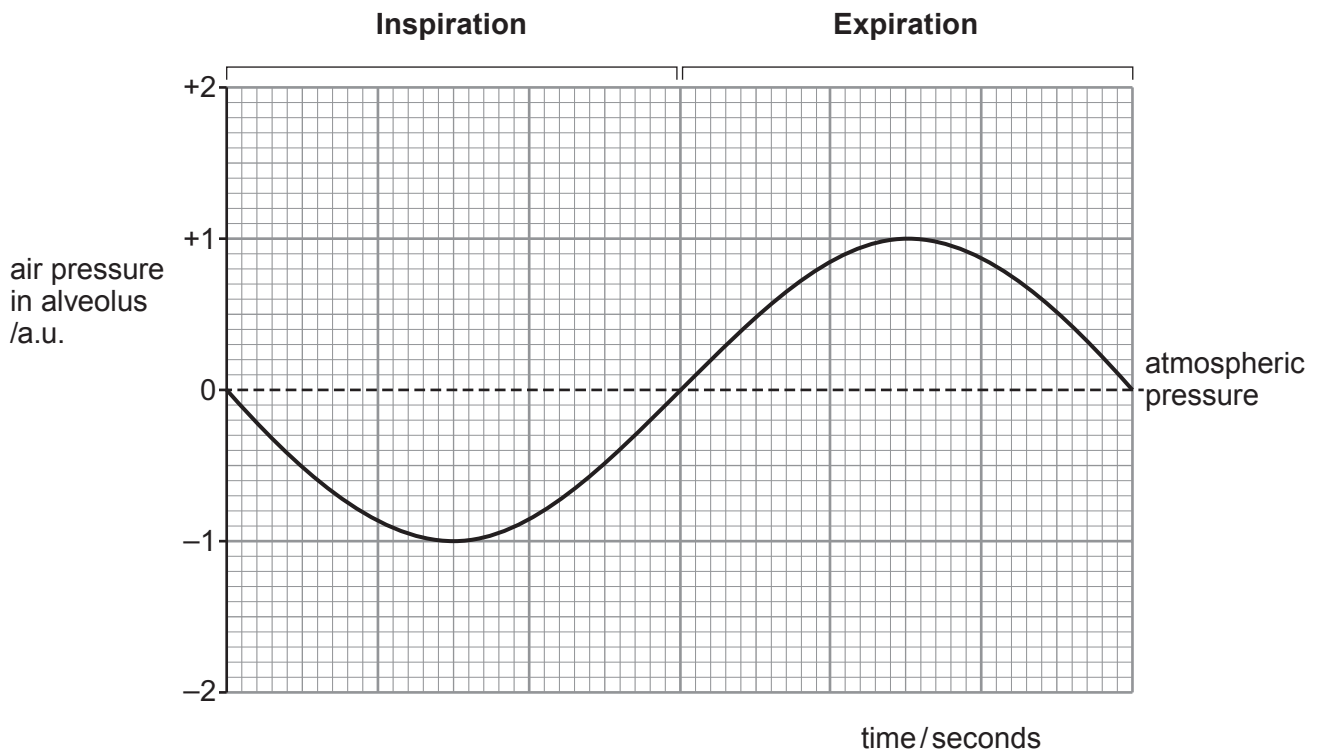
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(b) The graph below shows how the air pressure changes in the alveoli during ventilation of the lungs.



With reference to the graph explain how the muscles involved in the process of inspiration bring about the changes in pressure shown. [3]

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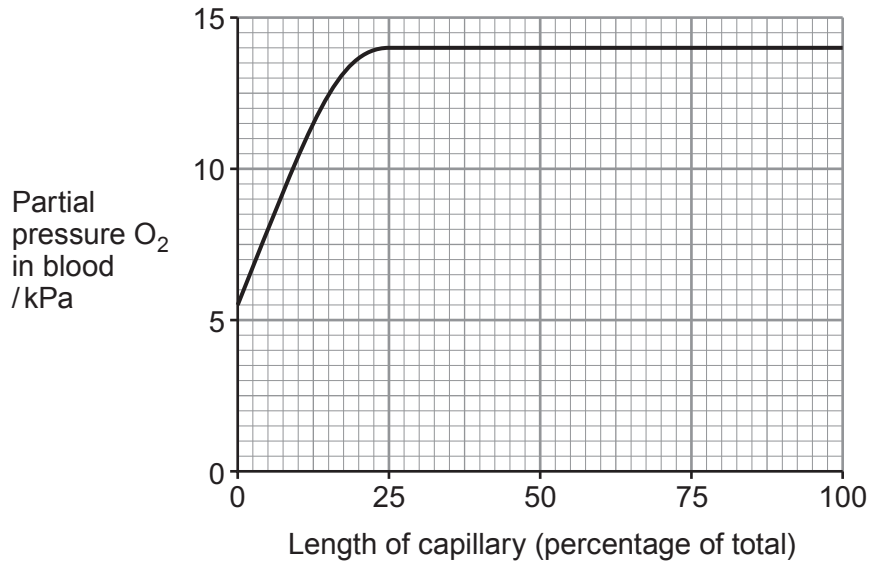
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- (c) The graph below shows how the partial pressure of oxygen in blood changes as blood flows through the pulmonary capillaries.



- (i) I. Describe and explain the change in the partial pressure of oxygen in the blood as it passes along the pulmonary capillaries. [2]

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- II. What conclusion could be reached about the minimum partial pressure of oxygen in the air in the alveoli? Explain your answer. [1]

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- (ii) Describe the features of the capillaries that allow this change to take place. [2]

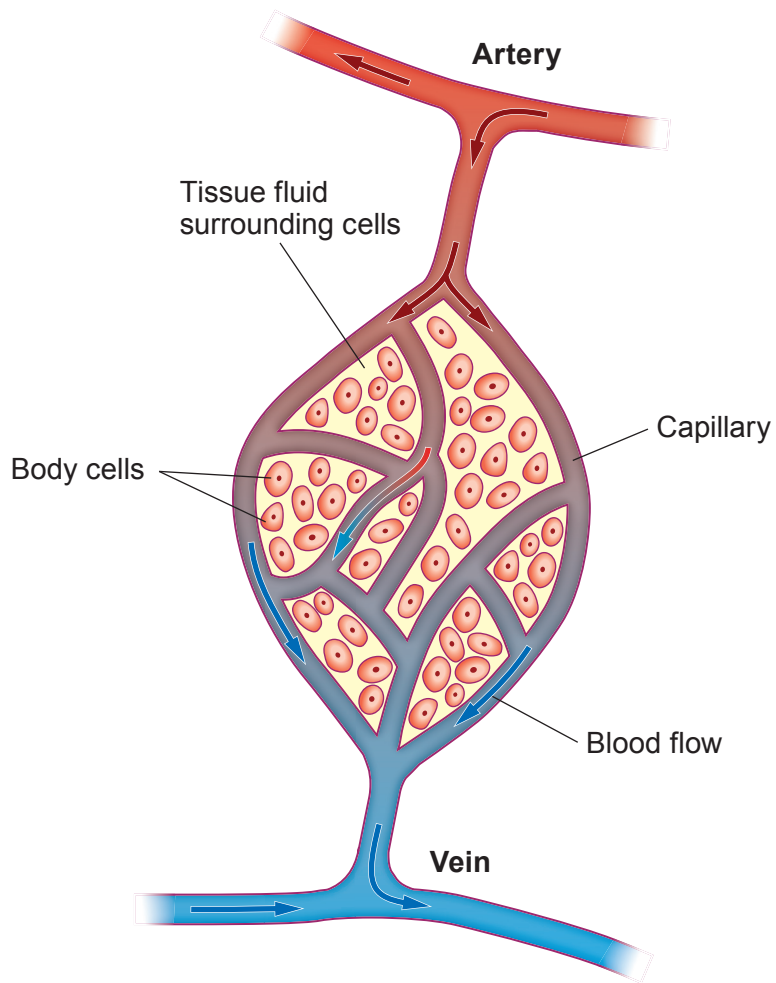
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The diagram below shows the arrangement of blood vessels in a capillary bed.



(d) With reference to the diagram, describe how tissue fluid is formed.

[3]

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