GCE Biology

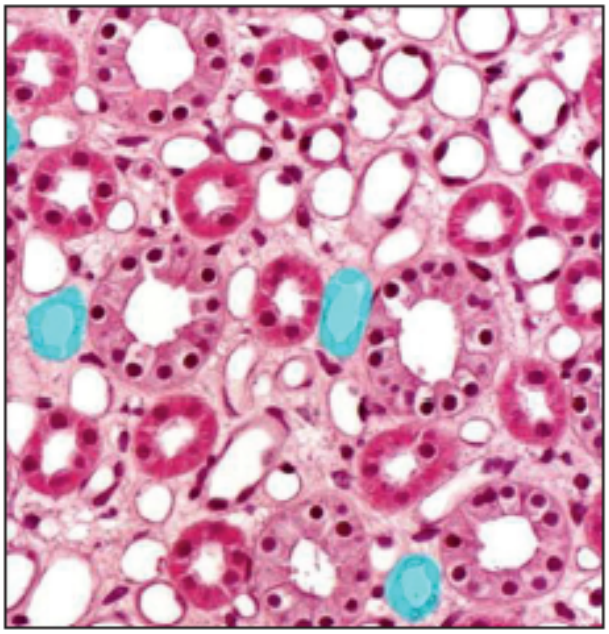
S21-A400U30-1

Assessment Resource 26

Requirements for Life Resource H

1. **Image 1.1** shows a cross section through the medulla of the kidney.

Image 1.1



(a) (i) State the evidence shown in **image 1.1** that this is a section through the medulla and not through the cortex. [1]

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Patients with the condition Bartter syndrome have sodium ion and chloride ion channels in the ascending limb of the loop of Henle that are less effective than in people who do not have the condition.

(ii) Explain the effects of Bartter syndrome on the function of the nephron and suggest **one** symptom of this condition. [3]

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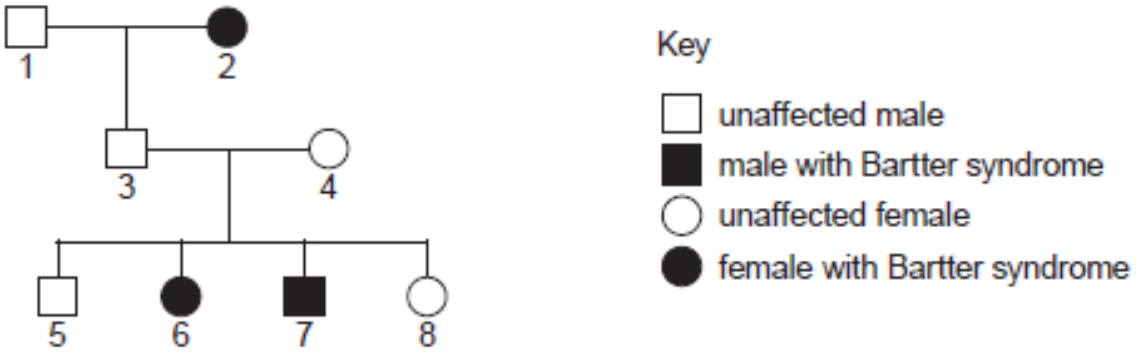
(b) One type of Bartter syndrome is caused by a recessive allele found on chromosome number 1. The allele for functioning ion channels, **N**, is dominant to that for Bartter syndrome, **n**. **Image 1.2** shows the inheritance of Bartter syndrome in one family.

Image 1.2



Identify **one** piece of evidence from the diagram that shows the allele for Bartter syndrome is recessive. Explain your answer. [2]

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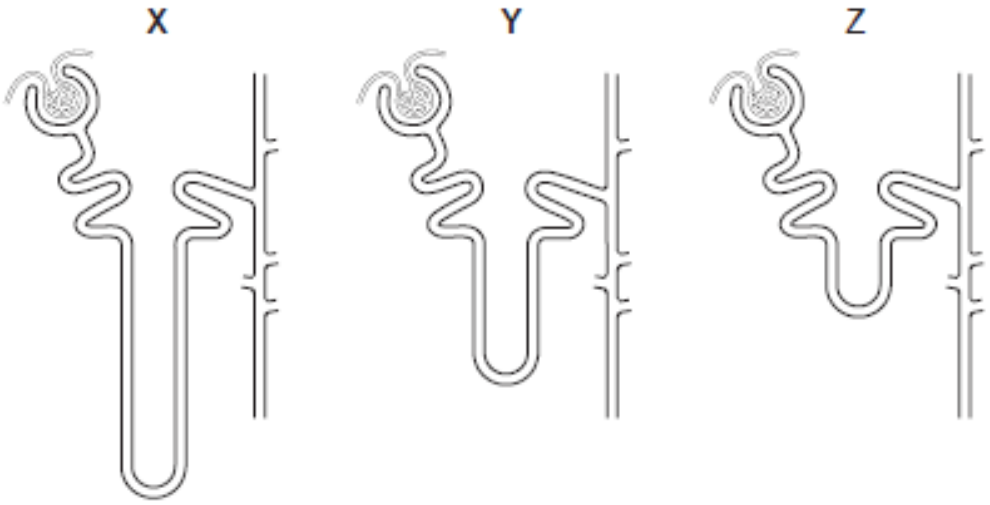
(c) **Image 1.3** shows the nephrons of three different mammals **X**, **Y** and Z.

Image 1.3



Identify which nephron is most likely to belong to a mammal adapted to living in desert conditions. Explain your answer. [3]

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2. Aphids can be used to investigate translocation in plants. When an aphid inserts its stylet (mouthparts) into a plant, it pierces the phloem. The body of the aphid can be cut off leaving the stylet in place. The fluid moving through the phloem can be collected as it drips from the stylet.

(a) (i) Removing the body of the aphid results in the death of the aphid.

Describe what could be done to ensure that the removal of the body of the aphid does not result in the suffering of the insect. [1]

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(ii) The fluid collected contains sucrose. Describe a chemical test that the scientist could use to confirm that it was **sucrose** present in the fluid collected from the phloem and **not glucose**. [3]

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(b) The rate of movement of solutes through the phloem can be measured using radioactive carbon dioxide ($^{14}CO_2$) and aphids. Scientists set up the equipment as shown in **image 2.1**. The fluid from the stylets was tested every minute for the presence of radioactive sucrose.

Image 2.1

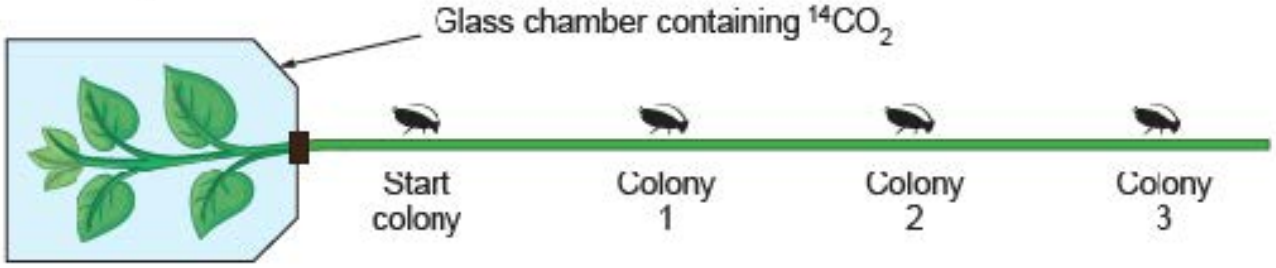

Table 2.2 shows the results of one experiment using a tomato plant.

Table 2.2

	Colony 1	Colony 2	Colony 3
Distance from start colony/mm	200	400	600
Time for radiation to be detected at colony/minutes	52	108	164

(i) Calculate the rate of movement of radioactive sucrose from the start colony to colony 2 in $\mathbf{mm\,s^{-1}}$. [2]

Rate = ... $mm\,s^{-1}$

The scientist who carried out this experiment used a ruler to measure the distances. The ruler was accurate to ± 1 mm.

(ii) Calculate the percentage error of the equipment over the distance from the start colony to colony 2. [2]

Percentage error = ...

(c) (i) It was observed that the rate of movement varied throughout the day. The rate was greatest at midday. Explain this observation. [3]

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The destination of translocated sucrose was calculated for a mature tomato plant. The results are shown in **table** 2.3

Table 2.3

Destination	% of total translocated sucrose
Leaves	8
Stem	22
Roots	28
Fruit	42

(ii) Using your knowledge of plant reproduction, suggest **two** reasons why more sucrose is transported to the fruit rather than other parts of the plant. [2]

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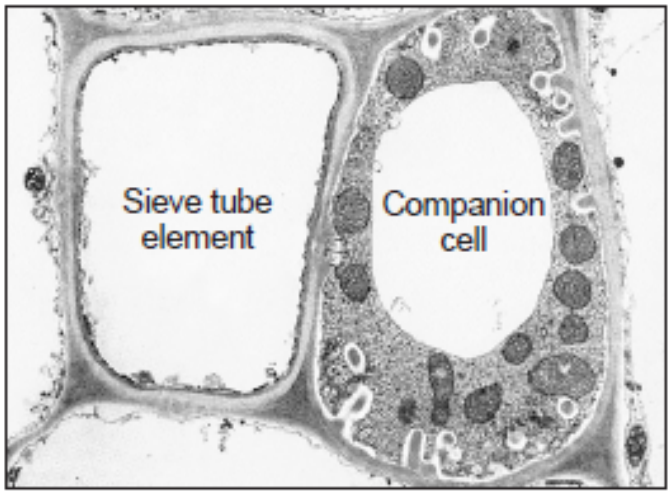
(d) **Image 2.4** shows part of the phloem from a tomato plant.

Image 2.4



Explain how **one** feature of each cell shown in **image 2.4** enables the translocation of sucrose through the plant. [4]

Companion cell

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Sieve tube element

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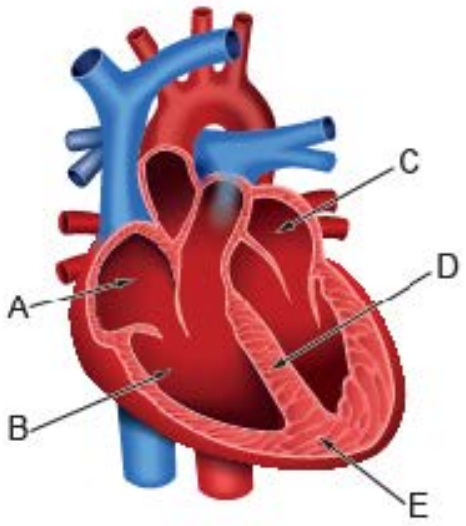
3. **Image 3.1** shows a vertical section through the heart.

Image 3.1



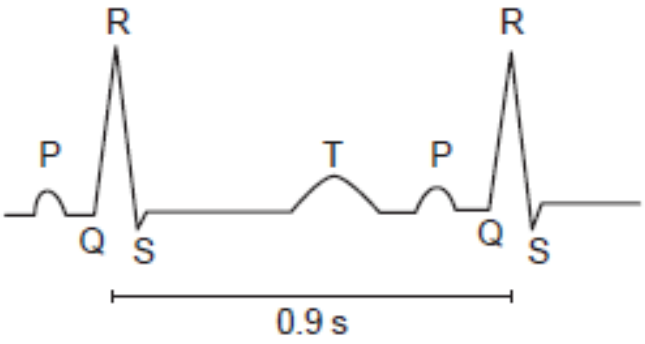
(a) Give the **letter** which indicates the position of the structure that initiates the electrical impulse through the heart. Name this structure. [1]

Letter .....

Name of structure .....

Sotalol is a drug used to slow heart rate down. **Image 3.2** shows an electrical impulse moving across the heart of a patient who is receiving sotalol.

Image 3.2



The normal heart rate for this patient when not receiving sotalol is 75 beats per minute.

(b) (i) Calculate the difference between the normal heart rate of this patient and the heart rate when he is taking sotalol. [2]

Difference = ... beats per minute.

T orsades de Pointes (TdP) is a condition where there is a prolonged QT interval. It can degenerate into a sustained ventricular fibrillation (uncontrolled contractions) and can be fatal.

TdP can be caused by lifestyle choices or it can be caused by taking certain medications.

A study was carried out into the effects of sotalol on 34 patients who had suffered from TdP previously.

The group was divided into 17 patients who had a history of lifestyle choice induced TdP and 17 patients who had medication induced TdP.

All the patients gave informed consent for the test. They were given sotalol intravenously at a constant rate over a 20 minute period and their ECGs were recorded during this time. The patients were closely monitored in the intensive care unit of a hospital. Their ECGs were studied to show signs of a prolonged QT interval.

Some information regarding the patients is shown in **table 3.3**

Table 3.3

Medication-induced TdP	
Age	Gender
39	f
47	f
58	m
72	f
54	f
55	m
77	f
61	f
64	f
70	m
64	m
63	m
39	m
72	f
52	m
75	f
40	m

Lifestyle-induced TdP	
Age	Gender
47	f
60	f
67	f
70	f
61	f
65	f
70	f
64	f
62	f
82	f
63	m
56	m
36	m
70	f
54	m
73	f
37	m

(ii) Comment on the validity of this study. [4]

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4. **Table 4.1** shows information for several species of fish found in the Amazon River in Brazil.

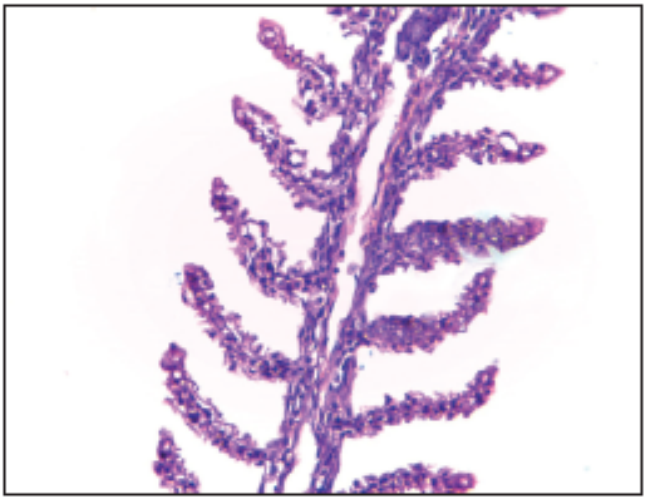
Table 4.1

Genus	Mean Mass / kg	Mean surface area of gills / mm^2kg^{-1}	Behaviour	Habitat
Colossoma	48	1000	fast swimmer	fast moving water
Hydrolycus	30	950	fast swimmer	fast moving water
Electrophorus	20	143	hides on river bed ambushes prey	often buried in mud
Cichla	12	350	swims slowly but will make sudden movements to catch prey	slow moving water

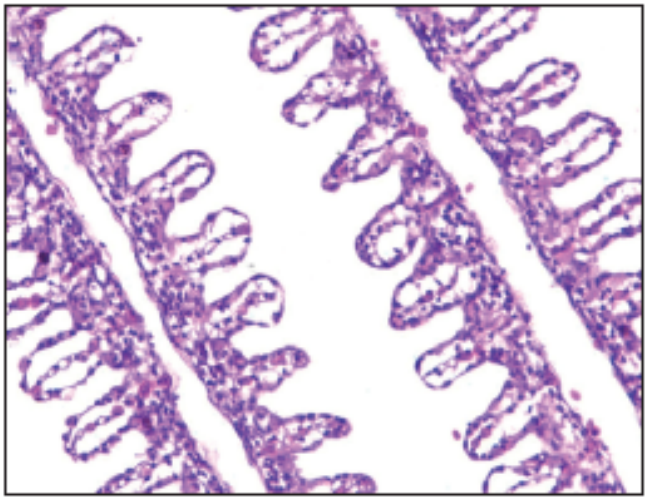
Image 4.2 shows the lamellae from the gills of the *Cichla* from a non-polluted and a polluted area of the Amazon river drawn to the same scale.

Image 4.2

Healthy gill lamellae



Lamellae from fish in a polluted area



With reference to **table 4.1** and **image 4.2** and your own knowledge, describe and explain the general relationship between mass of fish and the surface area of their gills. Describe and explain the relationship between the surface area of gills and their behaviour and habitat. Describe and explain the effect of pollution on the fish gills and how this would affect the fish. [9 QER]