

1. Excretion and secretion are two processes that take place in the body of a mammal.

Complete the table below to compare the processes of excretion and secretion.

	excretion	secretion
one difference		
one example of a product		
one similarity		

[Total 3 marks]

2. Over 2.3 million people in the UK are known to have diabetes. It is also estimated that a further 0.5 million people have the condition but are unaware of it.

- (i) Explain how **Type 1** diabetes is caused.

.....

.....

.....

.....

[2]

(ii) Describe **three** factors that increase a person's risk of developing **Type 2** diabetes.

.....

.....

.....

.....

.....

.....

.....

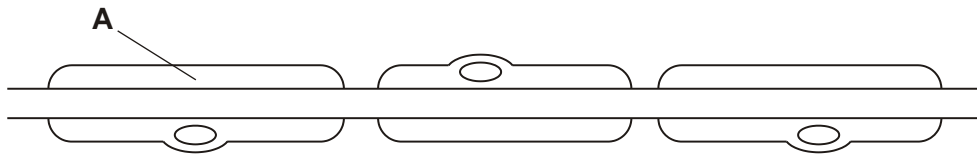
.....

.....

[3]

[Total 5 marks]

3. (a) The figure below represents part of the axon of a neurone.



Describe the **structure** of the feature labelled **A**.

.....

.....

.....

.....

[2]

The table below shows details of the diameter and speed of conduction of impulse along the neurones of different animal taxa.

type of neurone	axon diameter (µm)	speed of conduction (m s ⁻¹)	animal taxon
myelinated	4	25	mammal
myelinated	10	30	amphibian
myelinated	14	35	amphibian
unmyelinated	15	3	mammal
unmyelinated	1000	30	mollusc

(b) Using **only the data in the table above**, describe the effect of each of the following on the speed of conduction:

(i) myelination,

.....

.....

.....

.....

.....

[2]

(ii) axon diameter.

.....

.....

.....

.....

.....

[2]

(c) The speed of conduction of a nerve impulse is also affected by temperature.

(i) Suggest why an increase in temperature results in an increase in the speed of conduction.

.....
.....
.....

[1]

(ii) As the temperature continues to increase, it reaches a point at which the conduction of the impulse ceases. Suggest why.

.....
.....
.....

[1]

[Total 8 marks]

4. Outline the events following the arrival of an action potential at the synaptic knob until the acetylcholine has been released into the synapse.

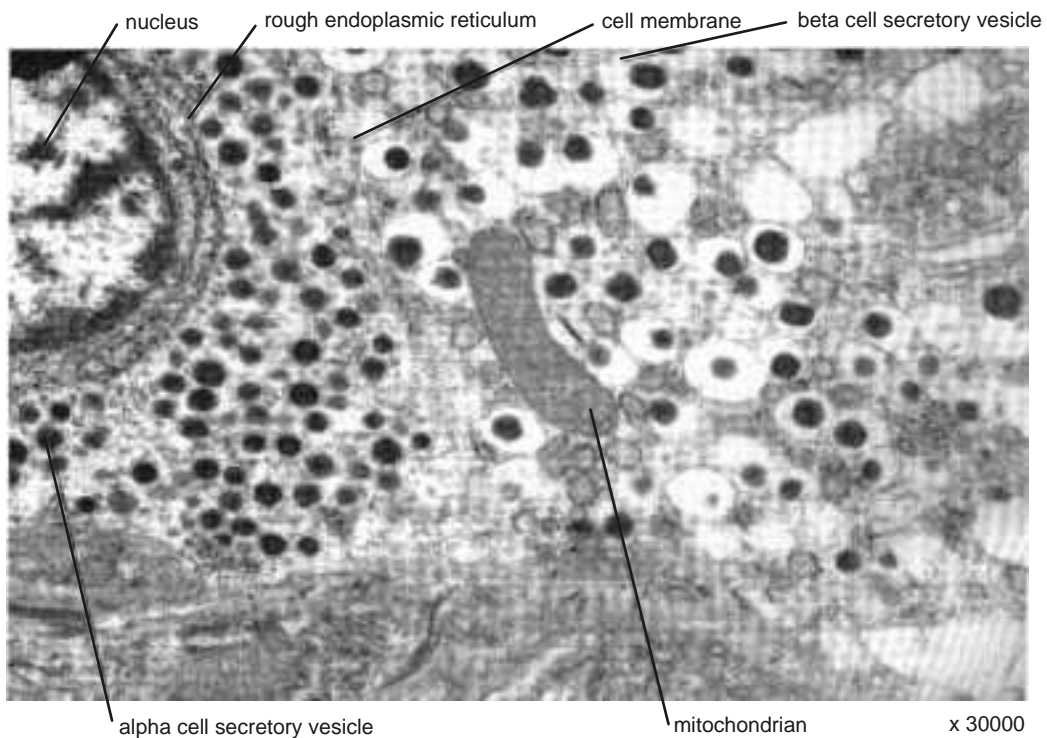


In your answer, you should use appropriate technical terms, spelt correctly.

.....
.....
.....
.....
.....
.....
.....
.....
.....

[Total 4 marks]

5. The pancreas contains endocrine tissue. The figure below shows an electronmicrograph of a section of pancreatic endocrine tissue.



- (a) Name the endocrine tissue shown in the figure.

.....

[1]

- (b) Name the hormone present in the secretory vesicles of alpha cells.

.....

[1]

(c) During vigorous exercise, the blood glucose concentration falls.

Describe the changes that take place to make sure that the blood glucose concentration does not fall to a dangerous level.



In your answer, you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]
[Total 8 marks]

6. (a) Fig. 1 is a diagram of a neurone.

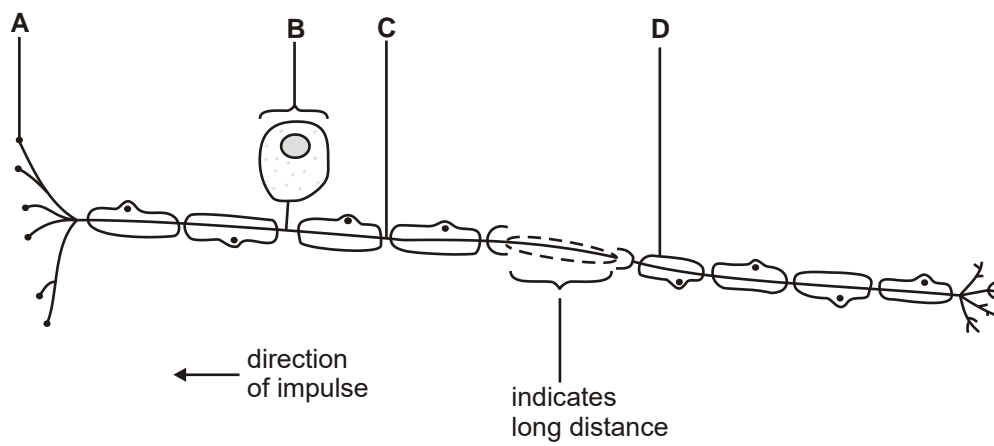


Fig. 1

Name the structures **A** and **B**.

A

B

Fig. 2 shows a recording of the potential difference across the membrane of an axon as an action potential is transmitted.

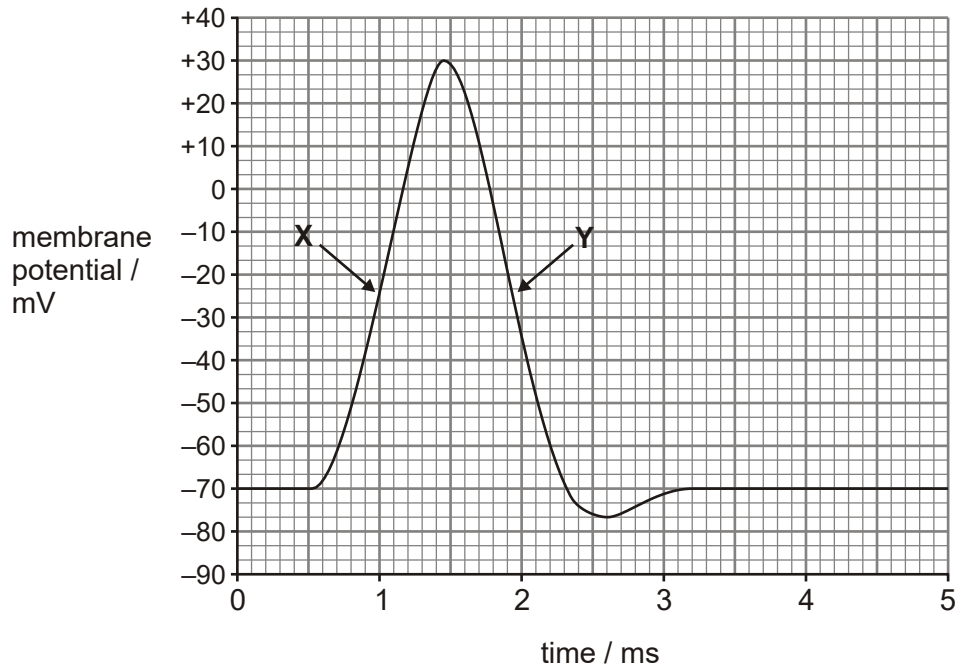


Fig. 2

(b) Describe the events taking place in the neurone during stages X and Y.

.....

.....

.....

.....

.....

.....

.....

.....

The table below shows how the speed of conduction of an action potential varies with the diameter of myelinated and non-myelinated axons in different organisms.

organism	type of axon	axon diameter / μm	speed of conduction / ms^{-1}
crab	non-myelinated	30	5
squid	non-myelinated	500	25
cat	myelinated	20	100
frog	myelinated	16	32

- (c) Describe the effect of myelination on the **rate** of conduction of an action potential **and** explain how this effect is achieved.



In your answer, you should use appropriate technical terms, spelled correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[Total 11 marks]

7. Fig.1 represents **some** of the changes that occur across the membrane of the axon. Three protein complexes are shown to be present in the membrane:

- sodium channels
- potassium channels
- sodium-potassium pumps.

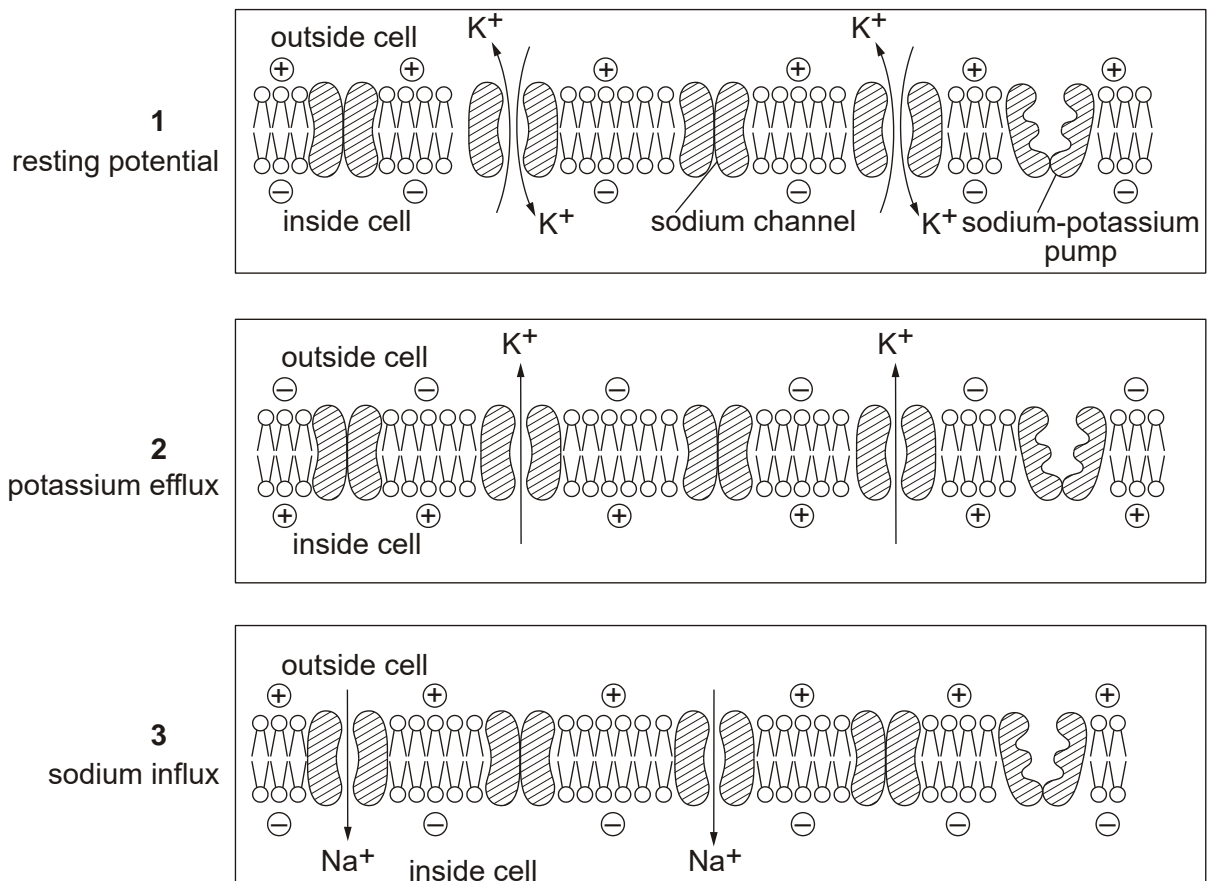


Fig. 1

Fig. 2 shows the change of membrane potential associated with an action potential.

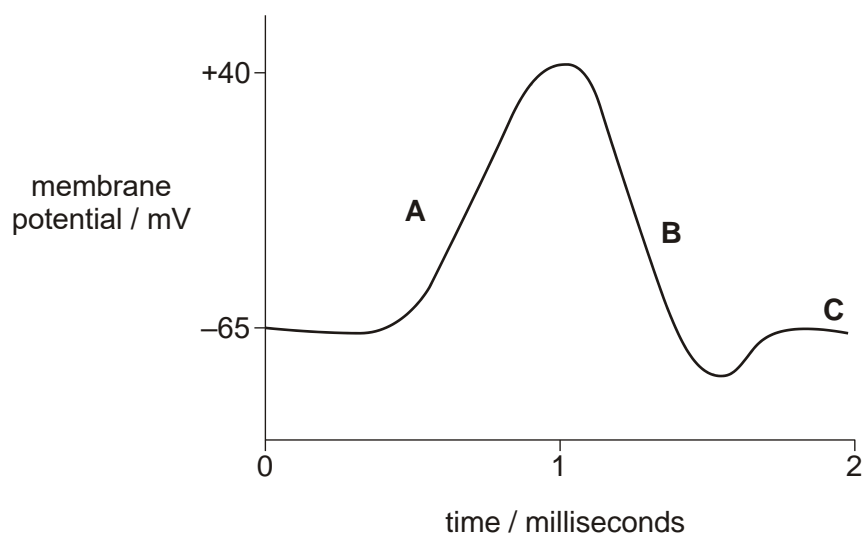


Fig. 2

- (i) State which of the three diagrams of the axon membrane in Fig. 1 match up to the phases labelled in Fig. 2. Write your answers in the table below.

phase	number
A	
B	
C	

[1]

(ii) With reference to Fig. 1, explain the changes in membrane potential in Fig. 2.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[Total 6 marks]

8. In this question, one mark is available for the quality of spelling, punctuation and grammar.

In order to transfer information from one point to another in the nervous system, it is necessary that action potentials be transmitted along axons. In humans, the rate of transmission is 0.5 m s^{-1} in a nonmyelinated neurone, increasing to 100 m s^{-1} in a myelinated neurone.

Explain how action potentials are transmitted along a nonmyelinated neurone **and** describe which parts of this process are different in myelinated neurones.

No credit will be given for reference to events at the synapse.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[7]

Quality of Written Communication [1]

[Total 8 marks]

9. Hummingbirds are very small. Typically their mass is between 3 and 5 g. They are able to hover at a fixed point in the air by beating their wings very rapidly. The rufous hummingbird, *Selasphorus rufus*, is a migratory species. It breeds in Canada and Alaska in the summer, migrates south to Mexico in the autumn and returns to high latitudes in spring after completing its annual moult (loss of feathers, which are then re-grown).

- (a) Suggest why the rufous hummingbird has a very high requirement for energy.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

In order to save energy, rufous hummingbirds can enter a state called torpor during the night. This is when their metabolic rate and body temperature both drop to a very low level. An investigation into how rufous hummingbirds use, save and store energy at different times of year was carried out. Key findings of the study are given in Figs. 1, 2 and 3 below.

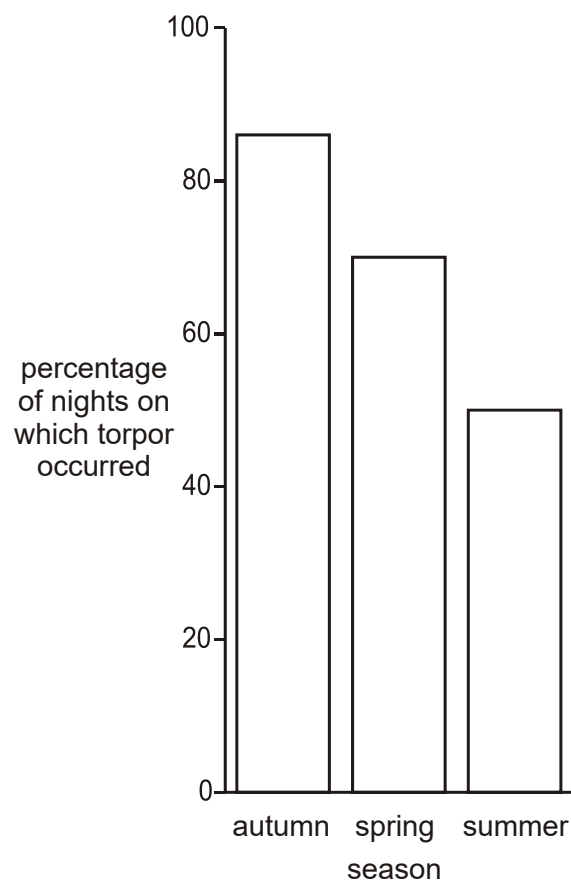


Fig. 1

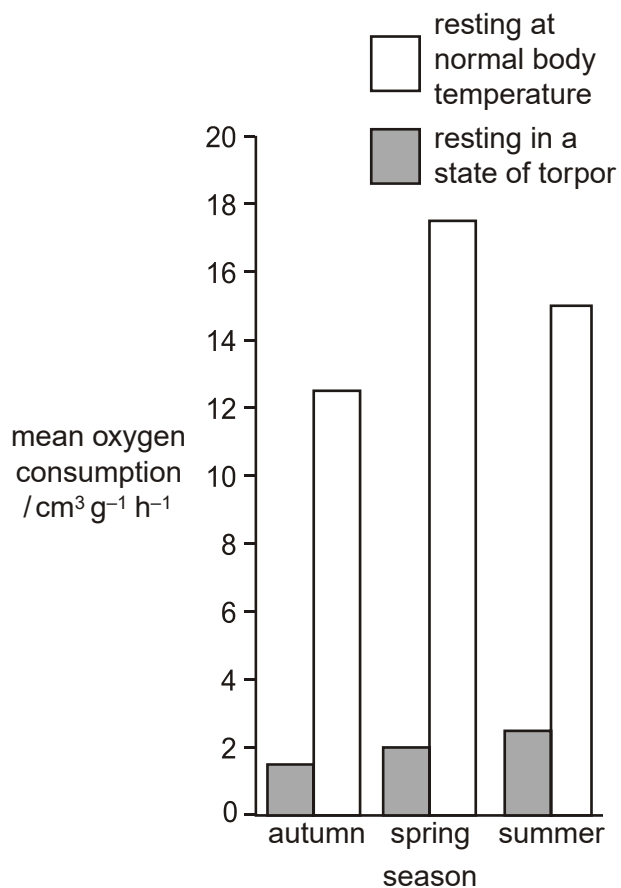


Fig. 2

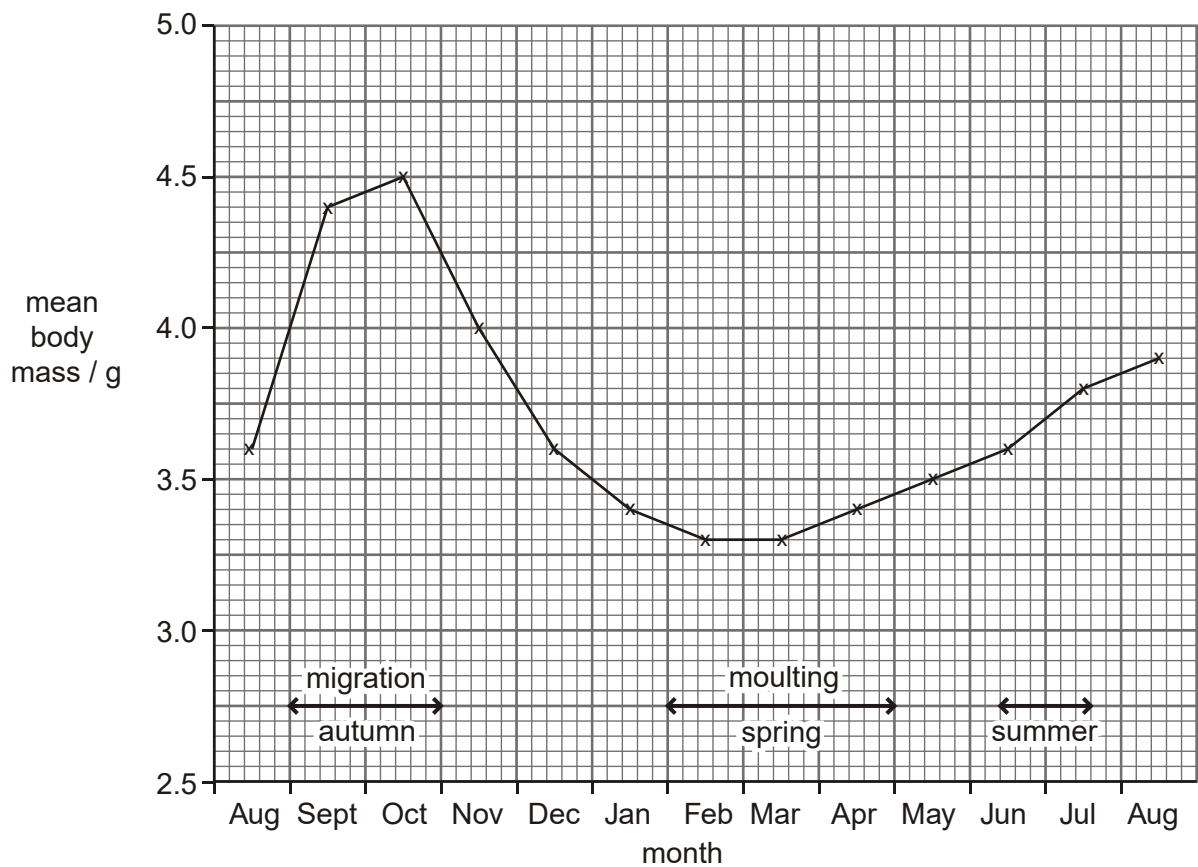


Fig. 3

© Sara Hiebert, Hummingbird Torpor and Body Mass, from *The Auk*, vol. 110, October 1993.
Reproduced by kind permission of Sara Hiebert

- Fig. 1 shows how use of torpor by the birds varies according to season.
- Fig. 2 compares the oxygen consumption of birds resting at normal body temperature with that of birds resting in a state of torpor.
- Fig. 3 shows how body mass of the birds changes over the course of a year.

(b) Use Figs. 1, 2 and 3 to describe and explain the results for the birds in the September-October (autumn) period.

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(c) Suggest how the low body mass of the birds in spring may be related to enhancing the birds' survival during the moulting period, when the feathers are lost and regrown.

.....

.....

.....

.....

[2]

- (d) It is suggested that **smaller** birds, which have a larger surface area to volume ratio when compared to larger birds, require **more** oxygen per gram of their body mass.

Discuss whether the data given in Figs. 3.1, 3.2 and 3.3 support this hypothesis.

.....

.....

.....

.....

.....

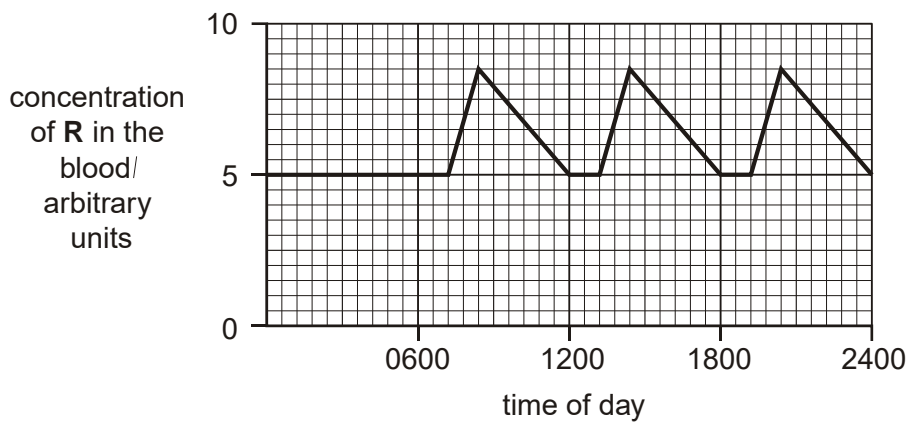
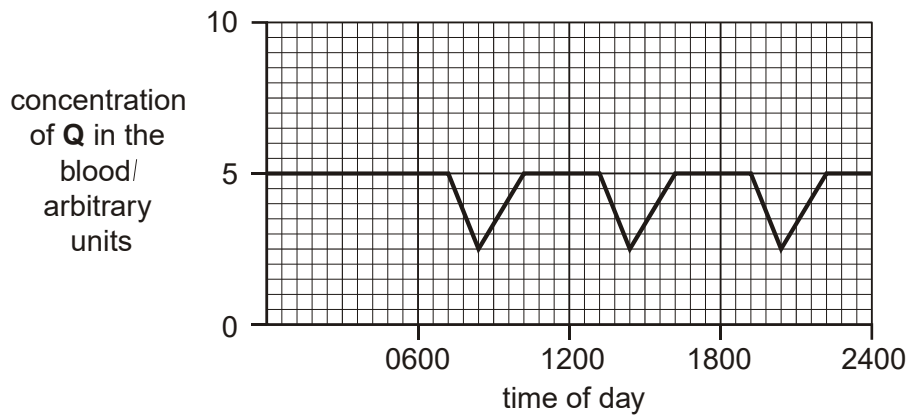
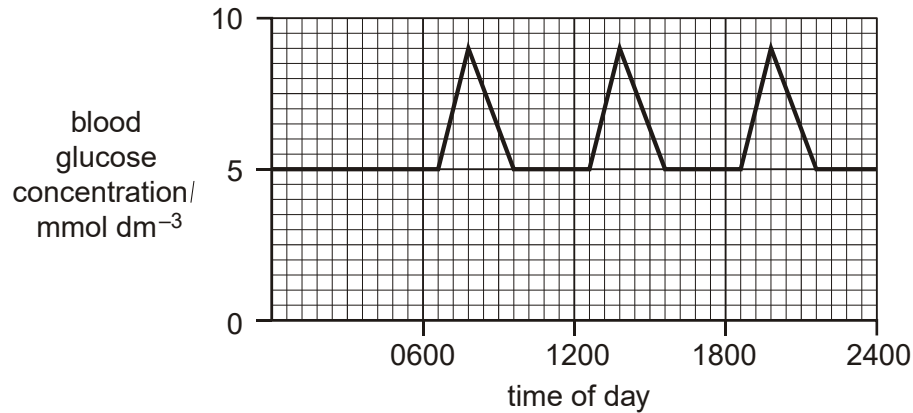
.....

[3]

[Total: 13 marks]

10. An investigation was carried out into the effect of consuming meals rich in carbohydrate on two hormones in the blood.

The figure below shows the relationship between glucose concentration in the blood and the concentrations in the blood of the two hormones, **Q** and **R**.



key:



= carbohydrate meal

Name hormones **Q** and **R**.

Q

R

[Total 2 marks]

11. In this question, one mark is available for the quality of the use and organisation of scientific terms.

The medulla oblongata controls breathing, heart rate and blood pressure.

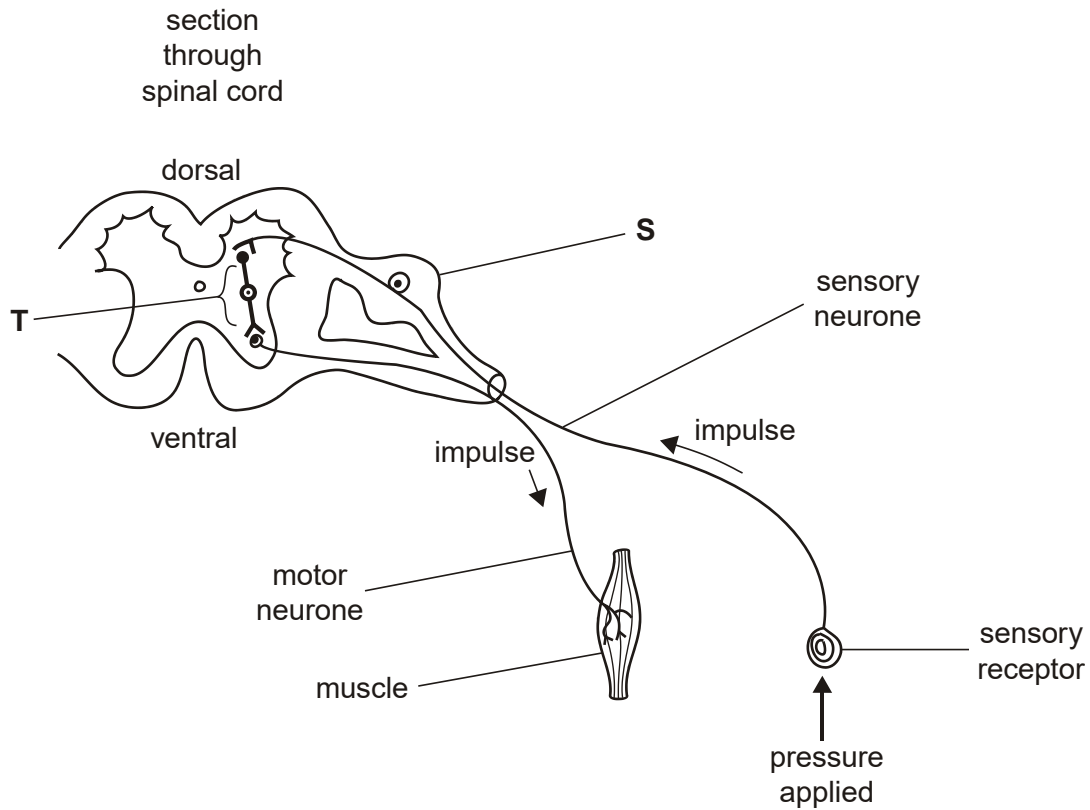
Describe how the medulla oblongata responds to an increase in carbon dioxide concentration in the blood during exercise. Explain how this response leads to a decrease in the concentration of carbon dioxide in the blood.

[7]

Quality of Written Communication [1]

[Total 8 marks]

12. The figure below shows a simplified diagram of a mammalian reflex arc.



(i) Name **S** and **T**.

S

T

[2]

(ii) Explain why the withdrawal of a hand, which has been subjected to pressure, is an example of a reflex action.

.....

[3]

- (iii) In this reflex, when pressure is applied to the receptor, impulses are generated in the sensory neurone.

Outline what happens in the membrane of the sensory receptor in response to pressure.

.....

.....

.....

.....

.....

.....

[3]

- (iv) Explain why, in the reflex arc shown in the figure above, impulses can only travel in the direction shown.

.....

.....

.....

.....

[2]

[Total: 10 marks]

13. In both plants and animals, chemical messengers help to transfer information from one part of the organism to another to achieve coordination.

The table below lists some of these chemicals together with their functions.

Complete the table.

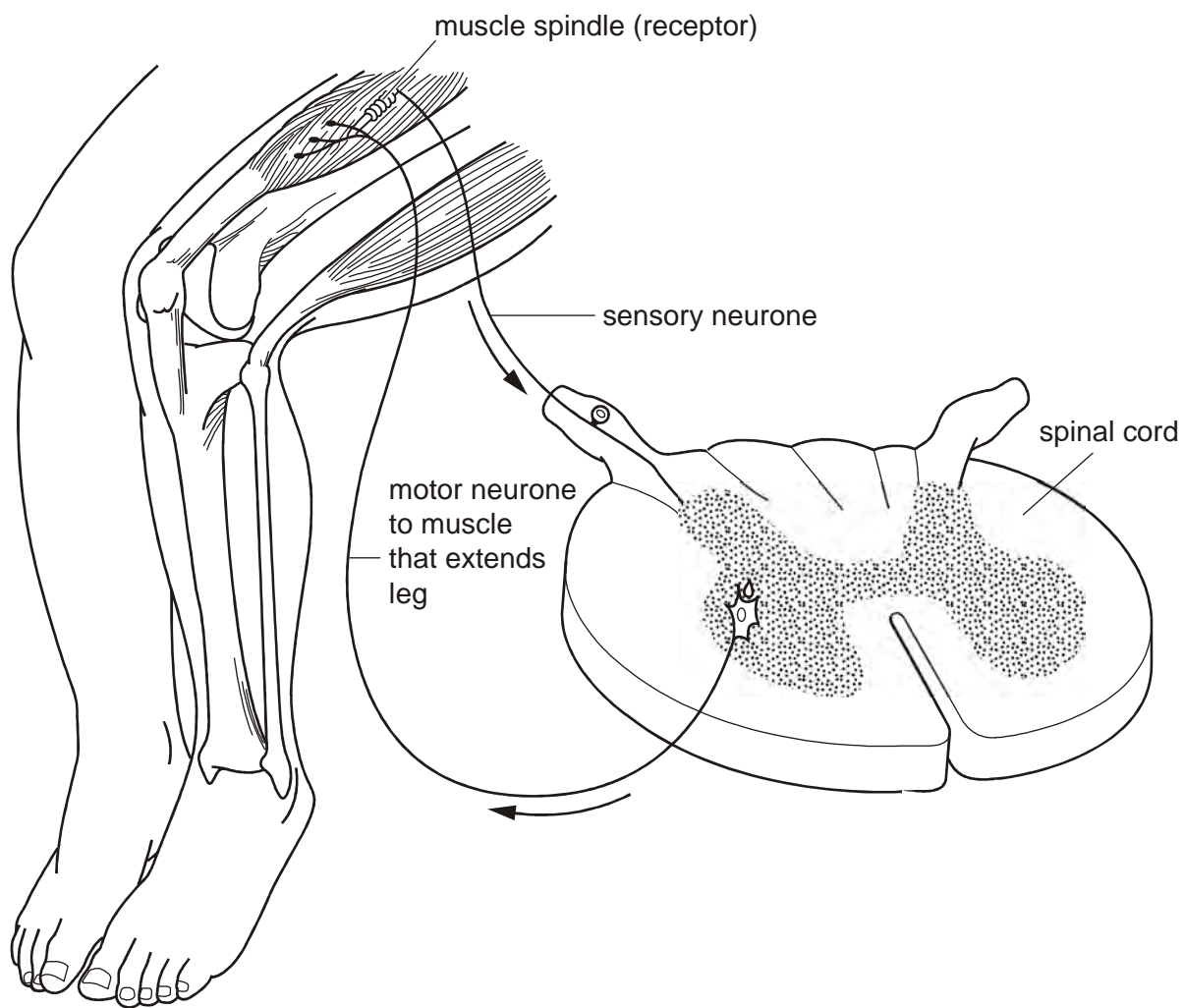
name of chemical messenger	function
.....	controls water permeability of collecting ducts in kidney
insulin
glucagon
.....	stimulates stomatal closure during water stress
.....	controls apical dominance

[Total 5 marks]

14. In this question, one mark is available for the quality of spelling, punctuation and grammar.

Mammals also rely on nerves to transfer information in the form of electrical impulses.

Using the information shown in the figure below, outline how impulses are transmitted from receptor to effector.



(Allow one lined page)

[8]

Quality of Written Communication [1]

[Total 9 marks]

15. Following a meal rich in carbohydrates, the plasma glucose concentration rises.

Describe the homeostatic mechanisms that would normally prevent glucose appearing in the urine.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

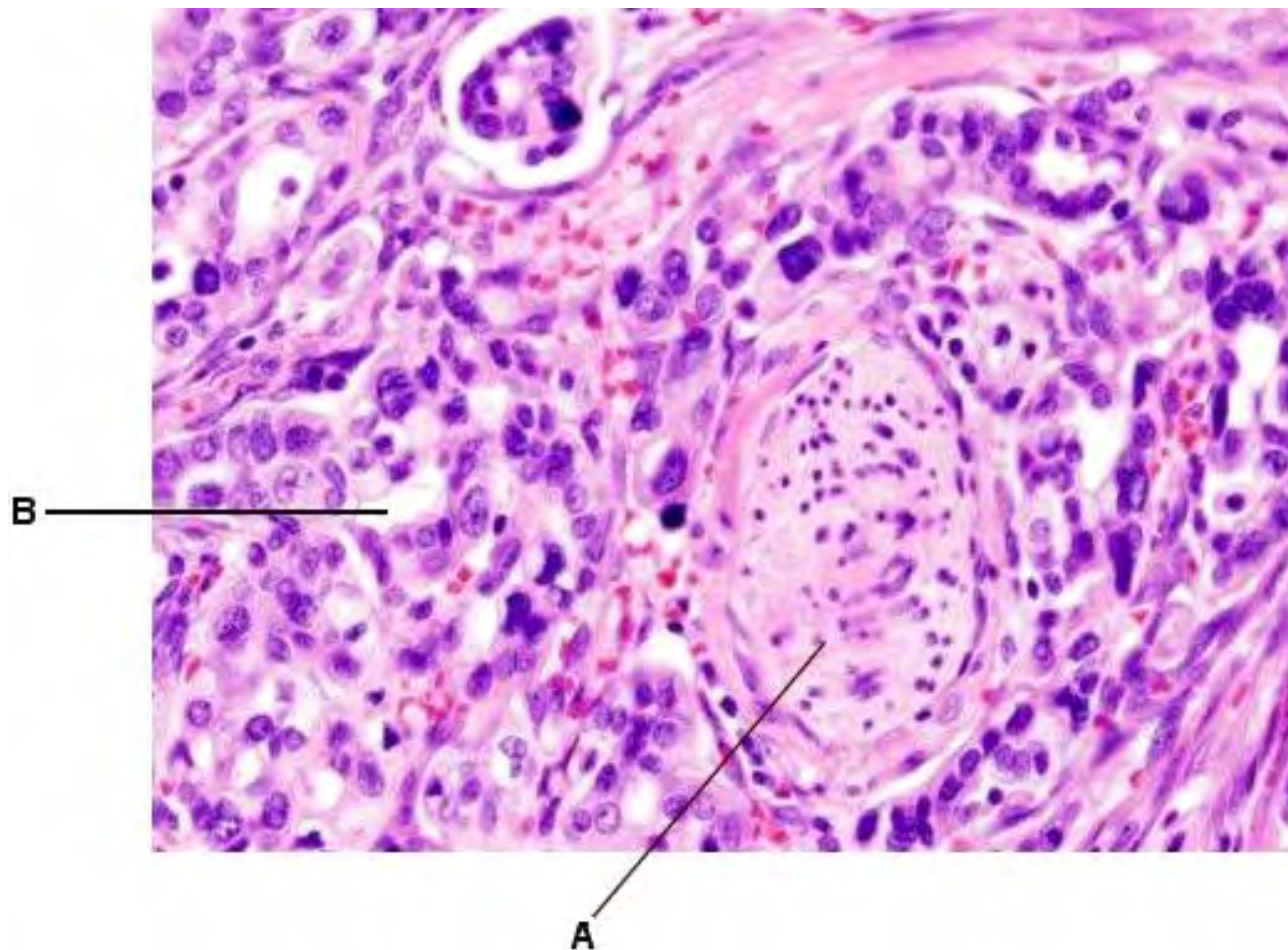
.....

.....

[Total 5 marks]

16. The pancreas is a gland that has both endocrine and exocrine functions.

The figure below shows a section through part of the pancreas.



magnification $\times 400$

(i) Name **A** and **B**.

A

B

[2]

- (ii) Explain the difference between the terms *endocrine* and *exocrine* with regard to the pancreas.

.....

.....

.....

.....

.....

.....

.....

[4]
[Total 6 marks]

- 17. In this question, one mark is available for the quality of spelling, punctuation and grammar.

The autonomic nervous system contains neurones that carry impulses to the internal organs.

Describe the role of the autonomic nervous system in the control of the heart beat.

[7]
Quality of Written Communication [1]
[Total 8 marks]

- 18. Explain the term *endocrine gland*.

.....

.....

.....

[Total 2 marks]

19. Untreated diabetes is a condition that can lead to blood glucose concentrations often rising above $120 \text{ mg } 100 \text{ cm}^{-3}$ of blood. Genetic engineering has been used to improve the treatment of diabetes.

Explain the advantages of using genetic engineering in the treatment of diabetics.

.....

.....

.....

.....

.....

.....

.....

[Total 3 marks]

20. The table below shows how the speed of nerve impulse conduction varies with the diameter of myelinated and non-myelinated axons in different organisms.

organism	type of axon	axon diameter / μm	speed of impulse / m s^{-1}
crab	non-myelinated	30	5
squid	non-myelinated	500	25
cat	myelinated	20	100
frog	myelinated	16	32

Describe the trends shown in the table above.

.....

.....

.....

.....

[Total 2 marks]

21. Explain the term *refractory period* **and** outline its importance in nerve impulse conduction.

.....

.....

.....

.....

.....

.....

.....

[Total 4 marks]