1 A student who was interested in animal behaviour did a day's work experience at a zoo. He made these notes about some examples of animal behaviour that he observed.

A When I approached the otter enclosure tapping a bucket of food, the otters made rapid squeaking noises and ran to the door to meet me!

B A mother duck escaped from her enclosure and all her baby ducklings followed her through a hole in the wire.

C I moved a log in one enclosure and noticed that the woodlice, which had been resting underneath the log, began to move around quickly once the log was lifted.

D A banana had fallen a short distance away from the chimpanzee pen. A chimpanzee used a stick to reach out and drag the banana towards her.

E The ring-tailed lemurs showed mutual grooming behaviour, taking it in turns to search through another lemur's fur for parasites.

F Cockroaches living in the dark in the house for nocturnal animals ran away from the light of my torch.

G Zoo deer are free to roam amongst the visitors. Although deer usually run away from humans, the zoo deer do not.

H When a chimpanzee threw an apple at the keeper, the keeper ducked his head very fast.

Match the examples **A**–**H** to the names of different **types of behaviour** by writing the correct letter beside the name. One has been done for you.

1 social behaviour .....

2 kinesis .....

3 imprinting .....

4 escape reflex **H**

5 taxis .....

6 operant conditioning .....

7 habituation .....

8 insight learning .....

[7]

[Total: 7]

2 Fig. 2.1 is an electron micrograph showing a longitudinal section of contracted striated muscle.

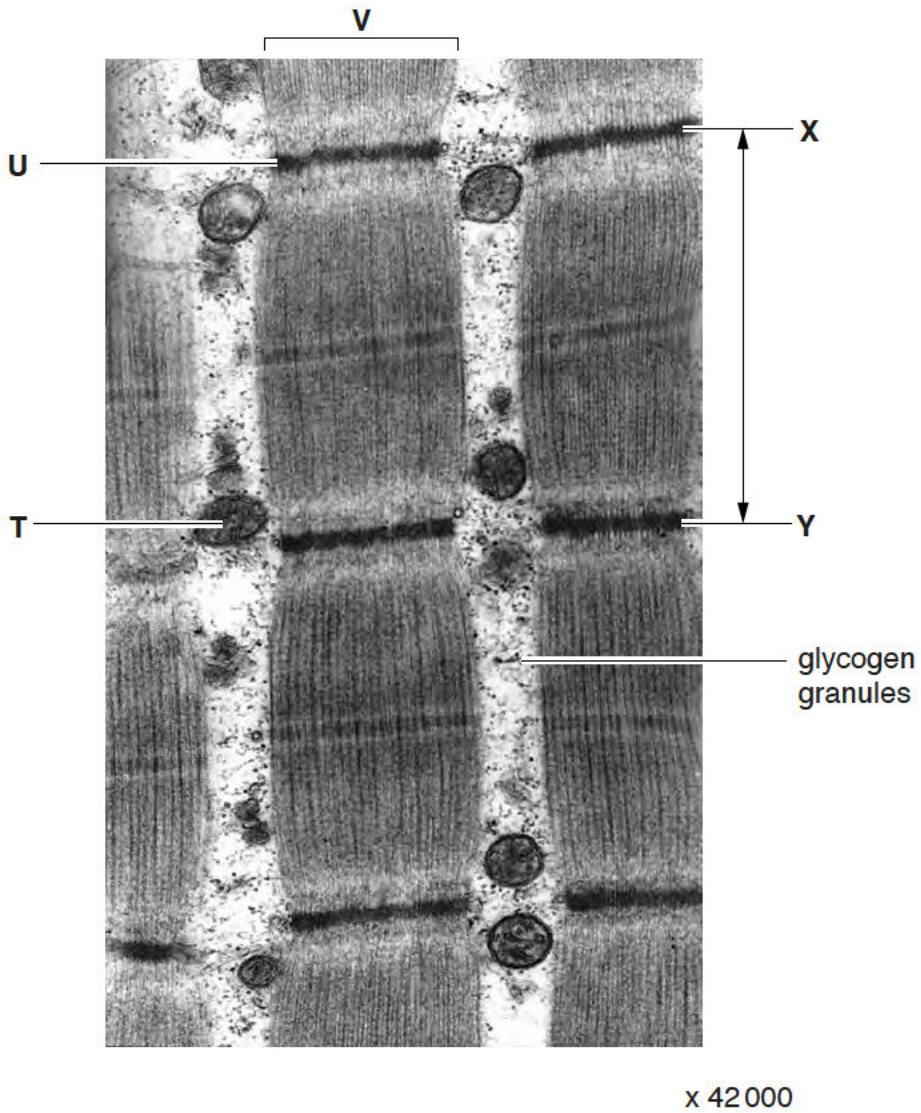


Fig. 2.1

(a) (i) Using Fig. 2.1, identify **T**, **U** and **V**.

T .....

U .....

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

(ii) Using Fig. 2.1, name the structure between positions **X** and **Y**.

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

(iii) Explain why glycogen granules are present in striated muscle.

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

(iv) Calculate the actual distance between positions **X** and **Y** on Fig. 2.1.

Show your working. **Give your answer to the nearest 0.1 of a micrometre (μm).**

Answer = ... μm **[2]**

(b) Fig. 2.2 below shows the arrangement of thick and thin filaments in striated muscle.

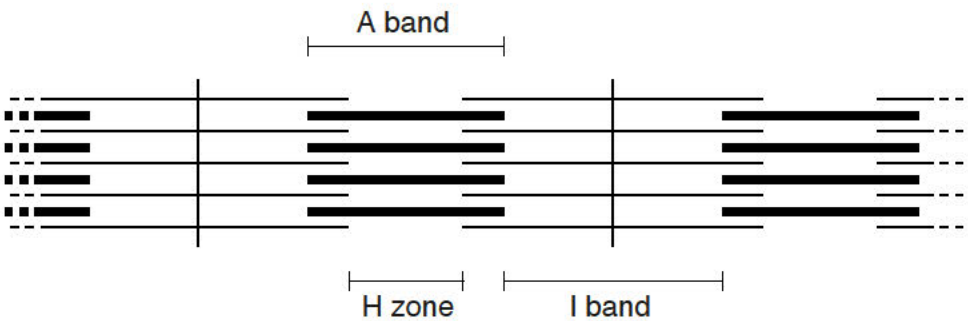


Fig. 2.2

State what happens to the lengths of the following when muscle contracts:

A band .....

H zone .....

I band ..... **[3]**

(c) During strenuous exercise, the concentration of hydrogen ions in muscle tissue increases. A high concentration of hydrogen ions reduces the ability of calcium ions to bind to proteins in the myofibrils. This reduces the force with which a muscle can contract.

Use this information and your own knowledge of the proteins in muscle cells to explain how an increased concentration of hydrogen ions leads to a reduction in the force of contraction of a muscle.

In your answer you should make clear the link between the increased concentration of hydrogen ions and the reduction in the force of contraction of a muscle.

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.... **[6]**

[Total: 17]

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3 In order to survive, animals need to be able to respond to changes in the internal and external environment.

(a) Complete the following passage by using the most appropriate word(s) or term(s).

Specialised cells that are able to detect stimuli can be found both within and at the surface of an animal's body. These specialised cells can be found singly or in groups and are known as sensory ..... .

Each cell is specialised to respond to a particular type of stimulus. Some specialised cells in the retina of the eye respond to the ..... and wavelength of light. Groups of specialised cells in the nose and on the tongue detect ..... stimuli and this results in the ability to smell and taste.

When specialised cells receive an appropriate stimulus which is above the threshold ..... , the cells are able to convert this energy into a nerve ..... . **[5]**

(b) Following the detection of a stimulus, sensory and motor neurones co-ordinate the body's response to this stimulus.

State **one** way in which:

(i) the **structure** of a motor neurone differs from that of a sensory neurone

.....

.....

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

(ii) the **function** of a motor neurone differs from that of a sensory neurone.

.....

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

[Total: 7]

4 Animals respond to frightening or stressful stimuli in their environment.

This question is about the 'fight or flight' response in mammals.

Fig. 2.1 (**on the insert**) shows a husky dog in a calm state.

Fig. 2.2 (**on the insert**) shows a different husky displaying external signs of the 'fight or flight' response.

(a) Describe **three** features in the external appearance of the husky in Fig. 2.2 that are due to the 'fight or flight' response.

1 .....

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2 .....

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3 .....

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

(b) The 'fight or flight' response is brought about by the hormone adrenaline and the autonomic nervous system working together. As well as causing external differences in appearance, the 'fight or flight' response causes numerous changes in the functioning of the internal organs.

Complete Table 2.1 to describe how **two** internal organs would function differently in a calm mammal compared to a frightened mammal.

Table 2.1

internal organ	calm mammal	frightened mammal

[6]

(c) The differences you described in part **(b)** are coordinated by the **autonomic** nervous system. The autonomic nervous system has two divisions, each of which uses a different neurotransmitter to bring about effects in the internal organs.

In the table below, state which division of the autonomic nervous system will be active in each case, and name the **neurotransmitter** that will be secreted by neurones into the organs.

	calm mammal	frightened mammal
division of the autonomic nervous system activated		
name of neurotransmitter secreted by neurones		

[4]

(d) State precisely where in the body adrenaline is produced.

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

(e) The adrenaline molecule is not lipid-soluble, therefore it cannot pass directly through the cell surface membrane. In order to bring about changes inside the cell, adrenaline relies on a second messenger system.

(i) Describe the events that occur after adrenaline reaches the cell surface membrane that then result in changes in metabolism inside the cell cytoplasm.

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

(ii) The second messenger system is a multi-step mechanism. It enables large changes in cell metabolism to occur rapidly, although only relatively small numbers of adrenaline molecules are involved.

Suggest how having a number of steps in the signalling pathway enables a small number of adrenaline molecules to rapidly cause large effects.

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

[Total: 21]

5 Describe the differences between:

(a) somatic cell gene therapy and germ line cell gene therapy

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

(b) the central nervous system and the peripheral nervous system

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

(c) prophase 1 of meiosis and prophase 2 of meiosis.

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

[Total: 8]