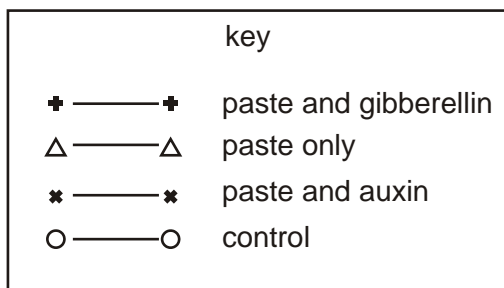
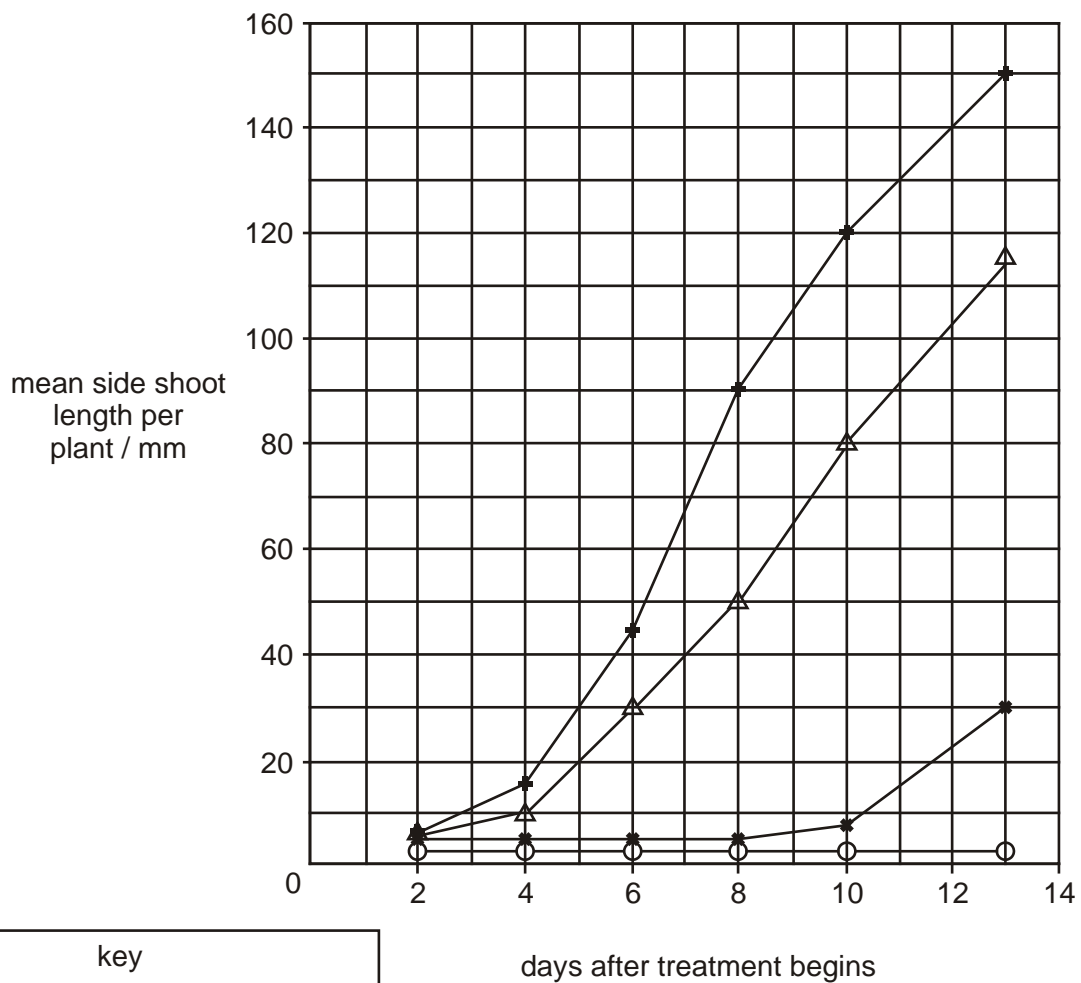


1. An investigation was carried out into the effects of two plant growth substances, gibberellins and auxins, on apical dominance. The terminal (apical) buds of a number of pea plants were removed and discarded. The tops of each of the remaining shoots were given one of the following treatments:
 - Coated with a paste containing gibberellin.
 - Coated with a paste containing auxin (IAA).
 - Coated with a paste without any plant growth substance.

In addition, a control group of plants did not have their terminal buds removed and were not coated with paste.

The growth of the side shoots was measured at regular time intervals and a mean value calculated. The results are shown in the figure below.



(a) Explain why the side shoots grow when the terminal buds are removed.

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

[3]

(b) Side shoots show greater growth when paste containing gibberellin is applied than when paste without any plant growth substance is applied.

Calculate the percentage increase in growth due to gibberellin in 8 day old seedlings compared to seedlings with paste only. Show your working.

Answer =%

[2]

(c) Using data from the figure above describe **and** explain the effect of auxin (IAA) on the growth of side shoots.

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

[3]

[Total 8 marks]

2. An experiment was carried out to investigate the effect of gibberellins on stem elongation in both wild type and dwarf varieties of *Brassica campestris*. Plants from both varieties were germinated and grown under controlled laboratory conditions. Stem measurements were taken on day 12 after planting, and then on five more occasions, as indicated in the table below. Stems were measured from the point at which they join the seed to the apical meristem. The plants were divided into four groups as follows:

- wild type variety treated with a gibberellin solution
- dwarf variety treated with gibberellin solution
- wild type variety treated with water (control)
- dwarf variety treated with water (control).

The stem lengths were measured and the mean values are shown in the table.

age of plants / days	mean length of stem / mm			
	plants treated with gibberellin		plants treated with water	
	wild type	dwarf	wild type	dwarf
12	25.58	1.27	30.04	0.78
13	52.19	2.50	53.42	1.21
15	65.33	4.46	72.49	2.69
18	96.87	10.63	93.97	4.15
20	97.19	21.55	100.81	6.79
23	104.71	35.44	108.78	8.48

From Russell and Sunday <http://www.sfu.ca/~msr/Papers/BISC/brassica.html>

(a) (i) Suggest how the dwarf variety may have arisen.

.....

.....

.....

[2]

(ii) State **two** environmental factors that would need to be controlled during this experiment.

1

2

[2]

- (b) With reference to the table, describe the effect of the gibberellin solution on stem elongation in both the wild type and dwarf varieties.

wild type

.....

.....

.....

.....

.....

dwarf

.....

.....

.....

.....

.....

[5]

- (c) Explain the different effects of the gibberellin solution on stem elongation in these two varieties.

.....

.....

.....

.....

[2]

[Total: 11 marks]

3. Plants must respond to changes in both their external and internal environments. Communication in plants is achieved by using a number of plant growth regulators.

List **three** stimuli that plants respond to.

- 1
- 2
- 3

[Total 3 marks]

4. 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]

5. Flowering plants have chemical communication systems.

(i) Outline the nature of chemical communication within flowering plants.

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

[2]

(ii) Explain why plants need such a communication system.

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

[2]

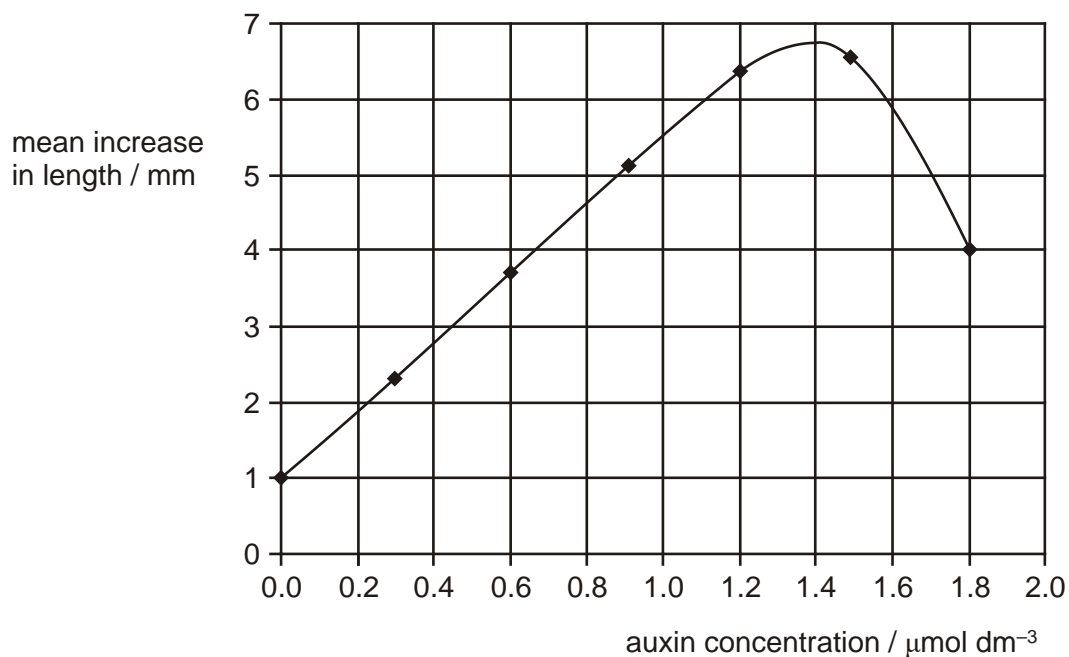
[Total 4 marks]

6. Sections of young, growing stems were cut from just below the terminal buds of several similar plants of the same species. Each section was 5 mm long.

The stem sections were placed in Petri dishes containing different solutions of auxin, with ten sections in each dish.

After 12 hours, the sections were removed from the Petri dishes and measured.

The figure below shows the mean **increase** in length of the sections in each dish, plotted against the concentration of auxin in the solution in the dish.



- (a) (i) Using the figure above, describe the relationship between the concentration of auxin in the solutions in the Petri dishes and the mean increase in length of the stem sections.

.....

.....

.....

.....

.....

.....

(ii) List **three** variables which should have been controlled in the investigation.

1

2

3

[3]

(b) Suggest **two** ways in which auxin might have caused the change in growth of the stems as shown in the figure above.

1

.....

2

.....

[2]

(c) State **two** ways in which the control of plant growth by growth substances differs from the control of blood sugar concentration by mammalian hormones.

1

.....

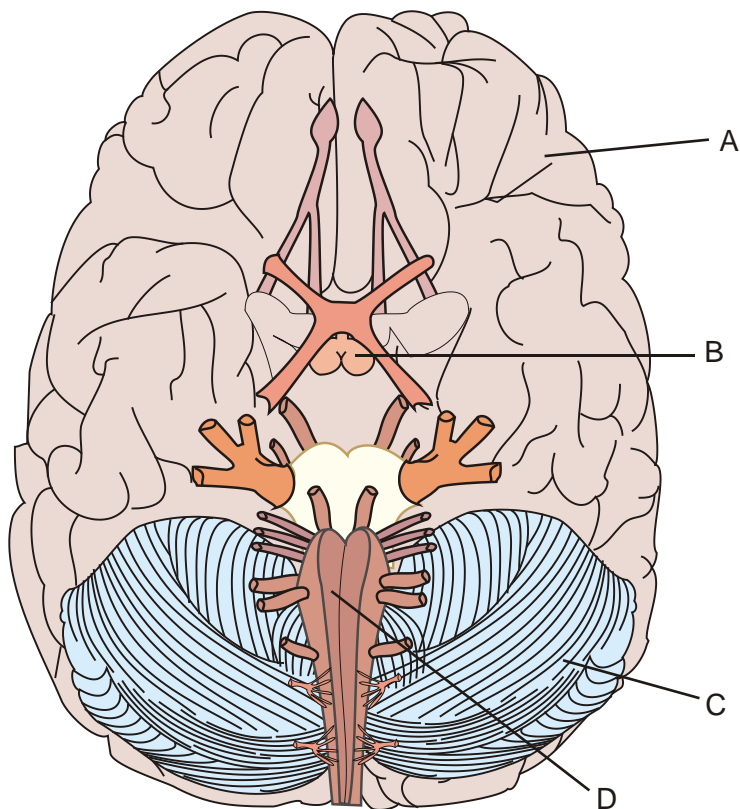
2

.....

[2]

[Total 10 marks]

7. Below is a drawing of the brain that shows the origin of the cranial nerves.



(a) State the direction from which the brain has been drawn.

.....

[1]

(b) (i) Name the structures **A**, **B**, **C** and **D** shown on the diagram.

A

B

C

D

[4]

(ii) State **two** roles of structure **D**.

1

2

[2]

(c) The hypothalamus constantly monitors and regulates the concentration of hormones in the blood. Outline how the hypothalamus regulates the concentration of hormones in the blood.

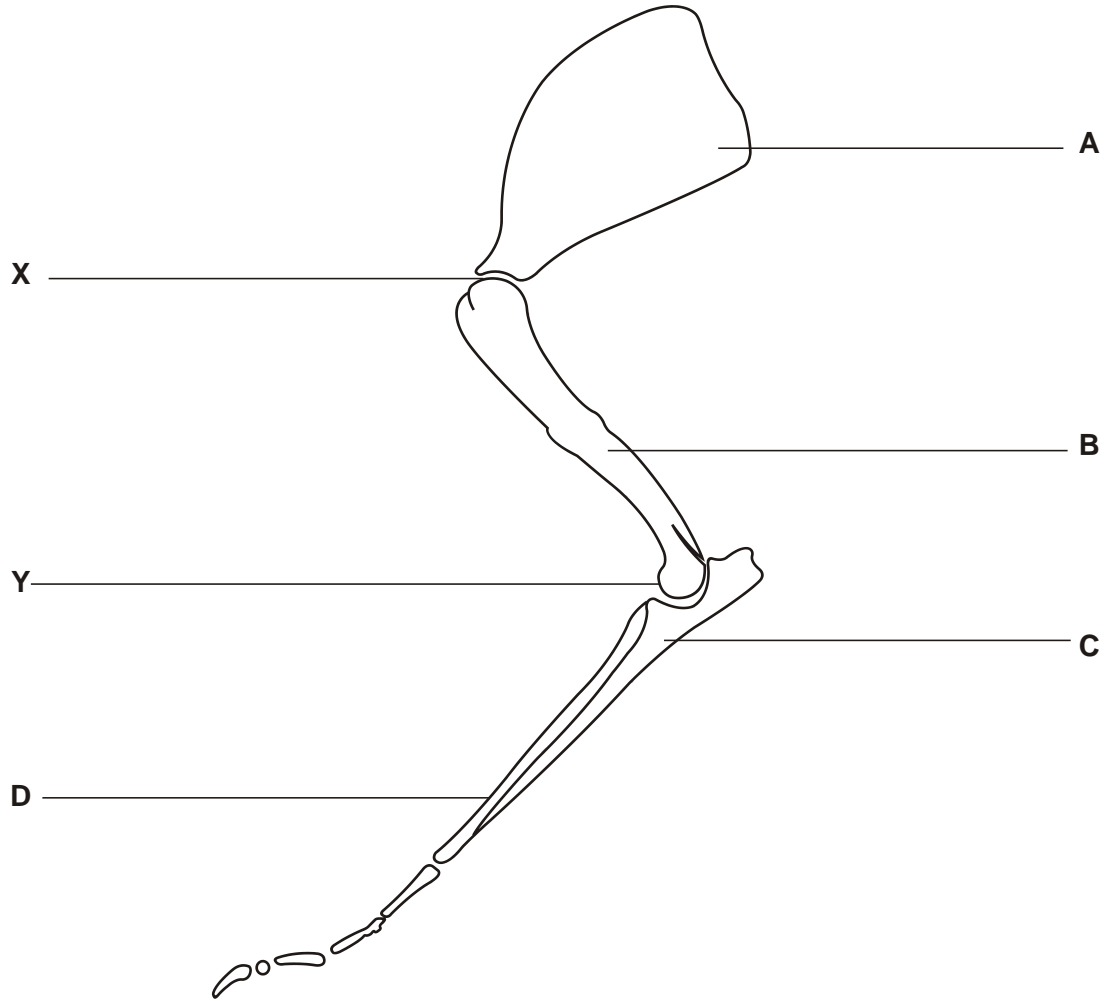
.....

.....

[2]

[Total 9 marks]

8. The figure below shows the major bones of the front leg of a cheetah.



- (i) Name bones **A** to **D**.
 - A**
 - B**
 - C**
 - D**

(ii) Joints **X** and **Y** are synovial joints. Describe the roles played by ligaments and cartilage in this type of joint.

ligaments

.....

.....

.....

cartilage

.....

.....

.....

[4]

(iii) The muscles that move the lower part of the front leg at joint **Y** are antagonistic. Describe how antagonistic muscles are used to move the lower arm of a human.

.....

.....

.....

.....

.....

.....

[3]

[Total 9 marks]

9. Calcium ions are necessary for the contraction of rabbit's striated muscle.

Describe the role played by calcium ions in the contraction of striated muscle.

.....

.....

.....

.....

.....

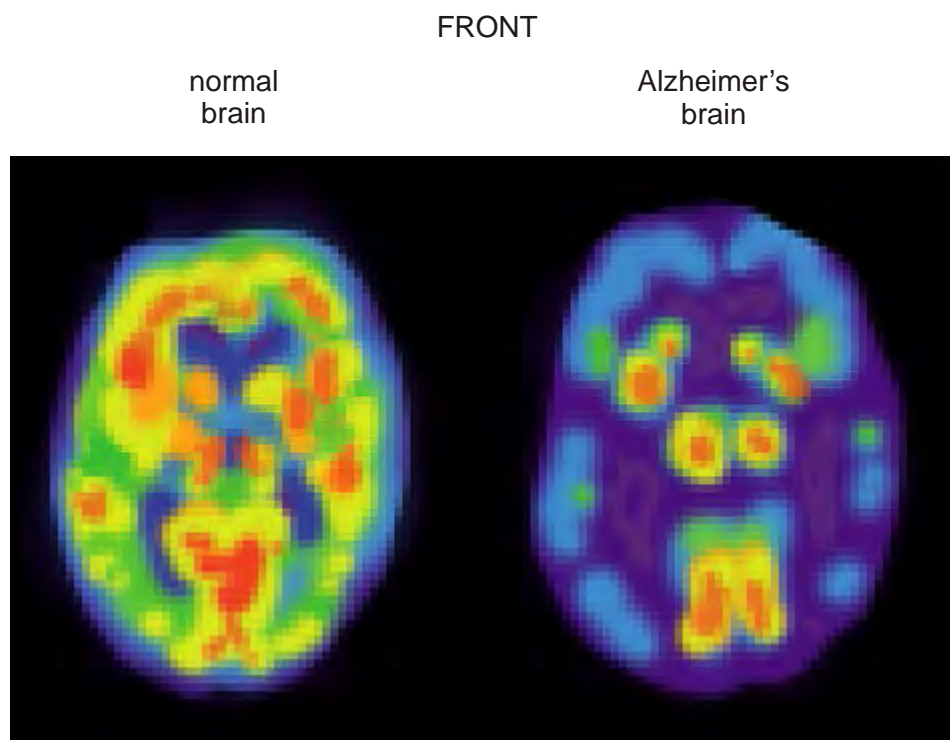
.....

[Total: 3 marks]

10. A positron emission tomography (PET) scan can be used to investigate the activity of the brain. PET scans can help to diagnose conditions such as Alzheimer's disease. A radioactive isotope is attached to molecules similar to glucose and injected into the blood supplying the brain. The molecules with the radioactive isotope are taken up by healthy cells, but are not metabolised. Instead they emit positrons, which can be detected by the PET scanner.

The figure below shows PET scans of a normal brain and the brain of a person with Alzheimer's disease.

- Red and yellow indicate high emissions of positrons.
- Blue and black indicate low emissions of positrons.



With reference to the figure and the information above, explain the differences between the two PET scans.

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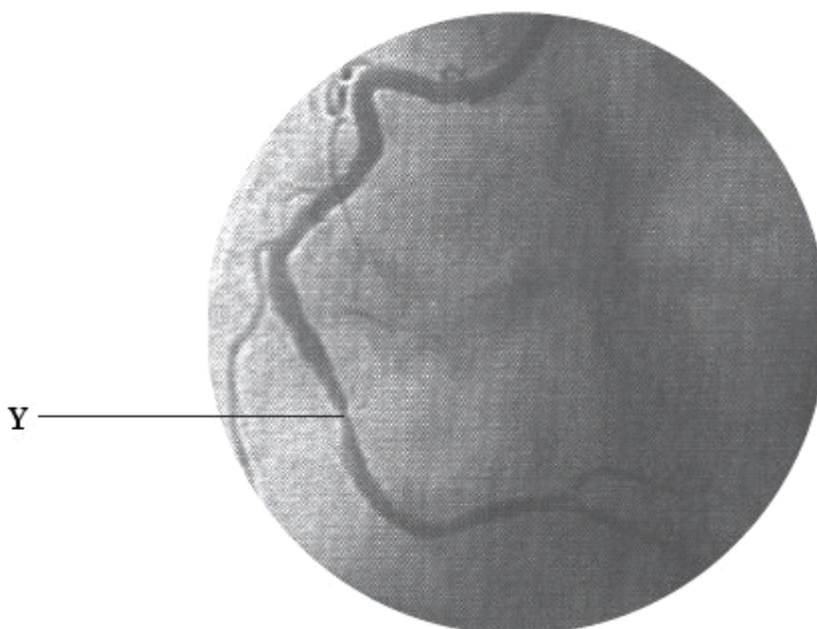
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.....

[Total: 3 marks]

- 11. The diagram below shows an artery lying on the surface of living heart muscle as seen by an instrument called an endoscope. The lumen of the artery has become narrowed at the point labelled Y.



The Forum on Ischaemic Heart Disease.
Reproduced by kind permission of Dr Graham Jackson,
Cardiology Unit, Guy's and St Thomas' Hospital.

(i) Describe the effects that this narrowing of the artery is likely to have on the **heart muscle**.

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

[3]

(ii) State **two** symptoms that might be shown by a person whose artery has been narrowed in this way.

1

.....

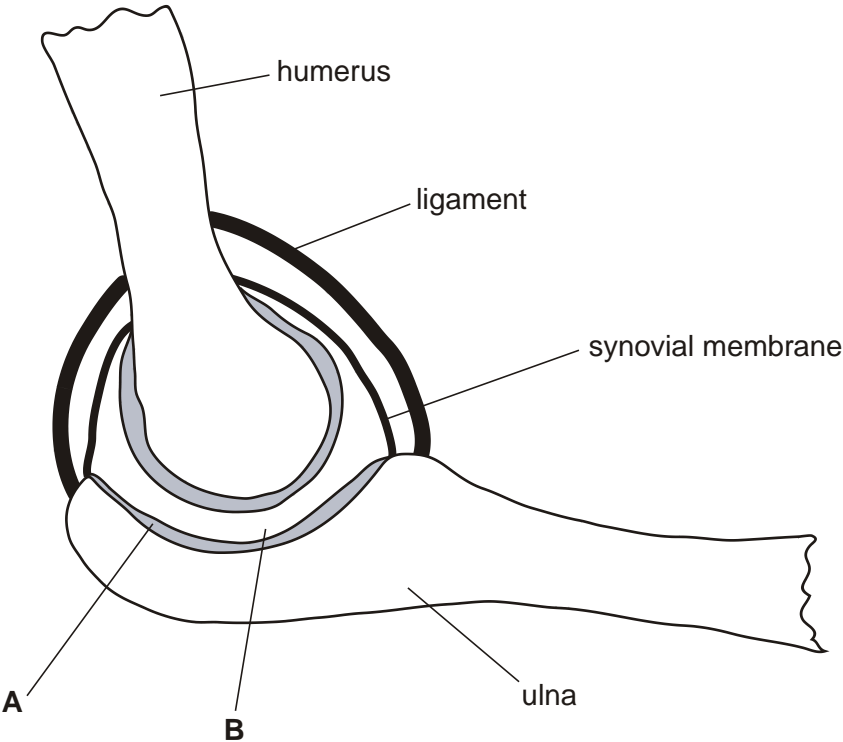
2

.....

[2]

[Total 5 marks]

12. The figure below shows a section through a human elbow joint.



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

A

B

[2]

(ii) Describe the roles of **A** and **B** in the movement of the elbow joint.

.....

.....

.....

.....

.....

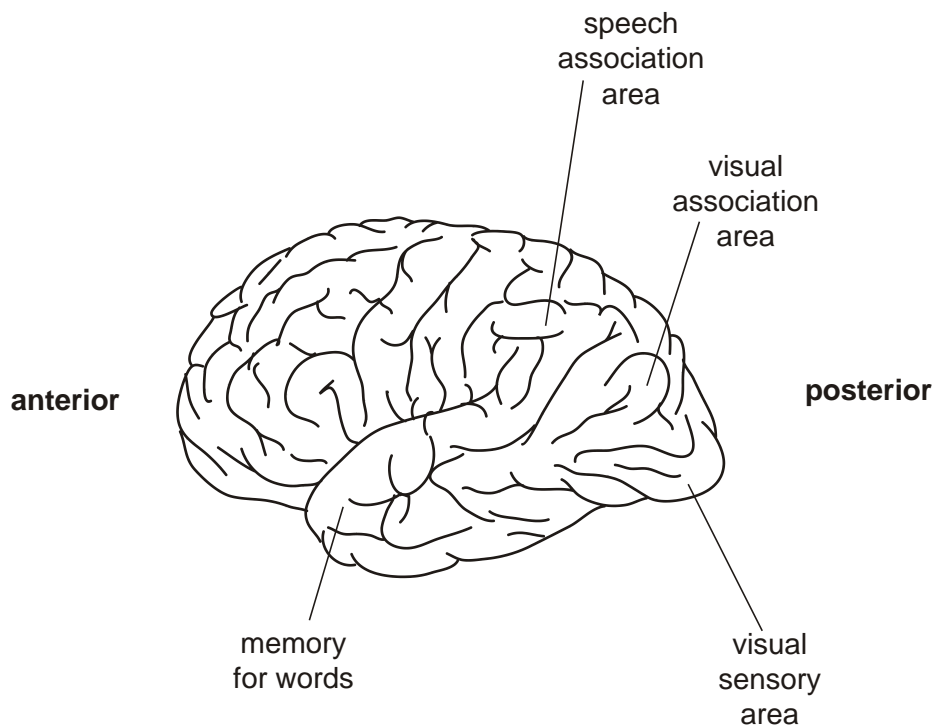
.....

[3]

[Total 5 marks]

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

The figure below shows the left side of the cerebrum of a human.



A person is reading a book. Outline the events that take place in the nervous system from the time an image of a word is formed on the retina to the time that word is recognised by the brain.

You may refer to the figure in your answer.

[6]

Quality of Written Communication [1]

[Total 7 marks]

14. The cerebellum and medulla oblongata are regions of the brain. The cerebellum is concerned with the control and coordination of movement and posture.

Suggest why the cerebellum of a chimpanzee is **relatively** larger than the cerebellum of a cow.

.....

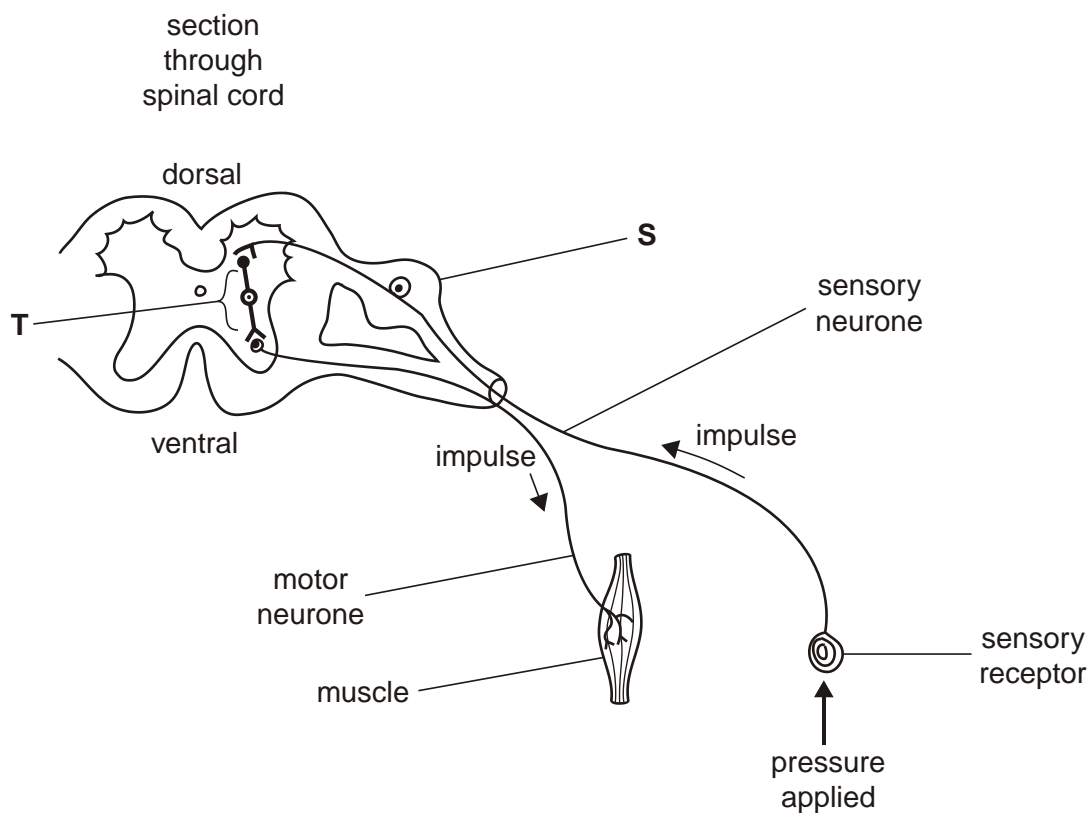
.....

.....

.....

[Total: 2 marks]

15. 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]

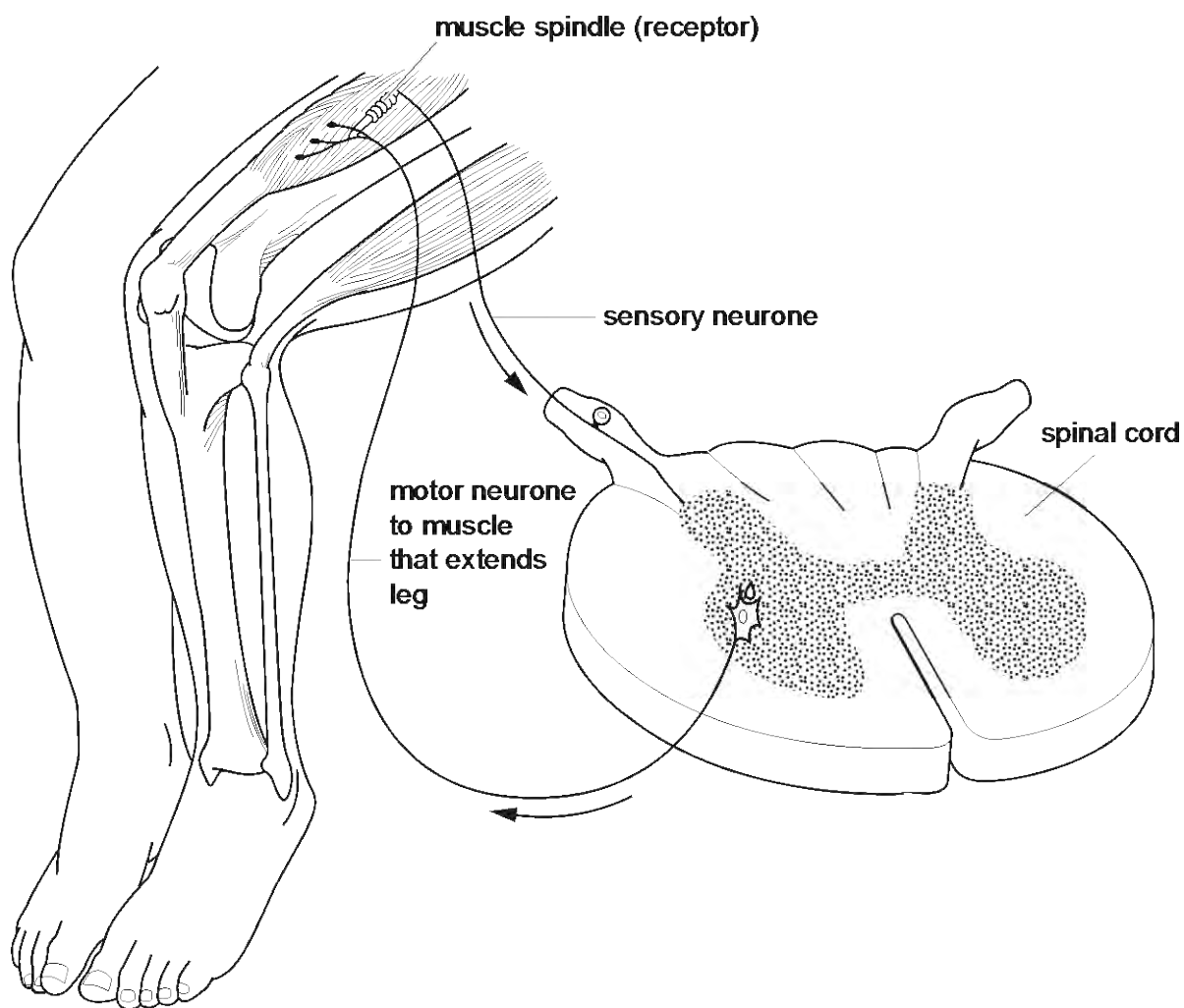
[Total: 10 marks]

16. 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.



[8]

Quality of Written Communication [1]

[Total 9 marks]

17. Reflex actions are unlearned responses to a stimulus.

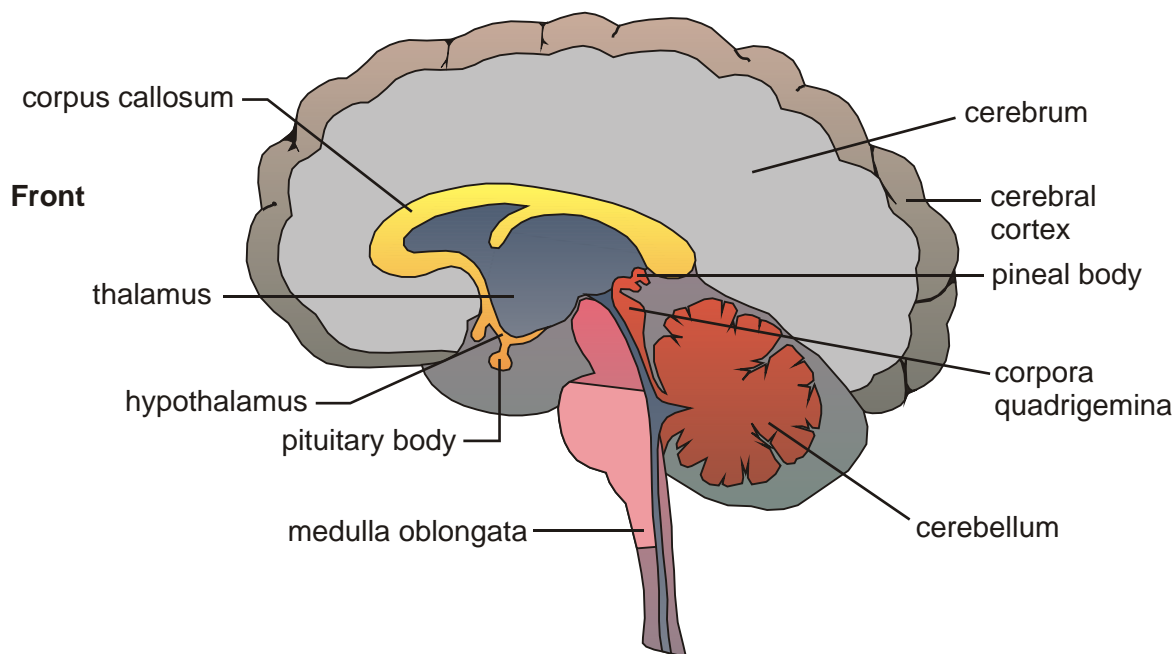
Describe **one** advantage of reflex actions compared to learned responses in a mammal.

.....

.....

[Total 1 mark]

18. The figure below shows a vertical section through the human brain.



(i) Name the structure shown above that links the two cerebral hemispheres.

.....

[1]

(ii) The table below shows the functions of some areas of the brain.

Complete the table using the labels in the figure above.

area of brain	example of function
.....	co-ordination of posture
.....	control of heart rate
.....	control of temperature regulation
.....	control of speech

[4]

[Total 5 marks]

19. Alzheimer’s disease is a complex, degenerative disease that affects the brain. The risk of developing this disease increases with age, particularly over the age of 65. Symptoms include a gradual loss of memory, disorientation, difficulty with learning, loss of language skills and a decline in the ability to perform routine tasks. The areas of the brain that control memory and thinking skills are affected first.

State the functions of acetylcholine and acetylcholinesterase in synapses in the brain.

acetylcholine

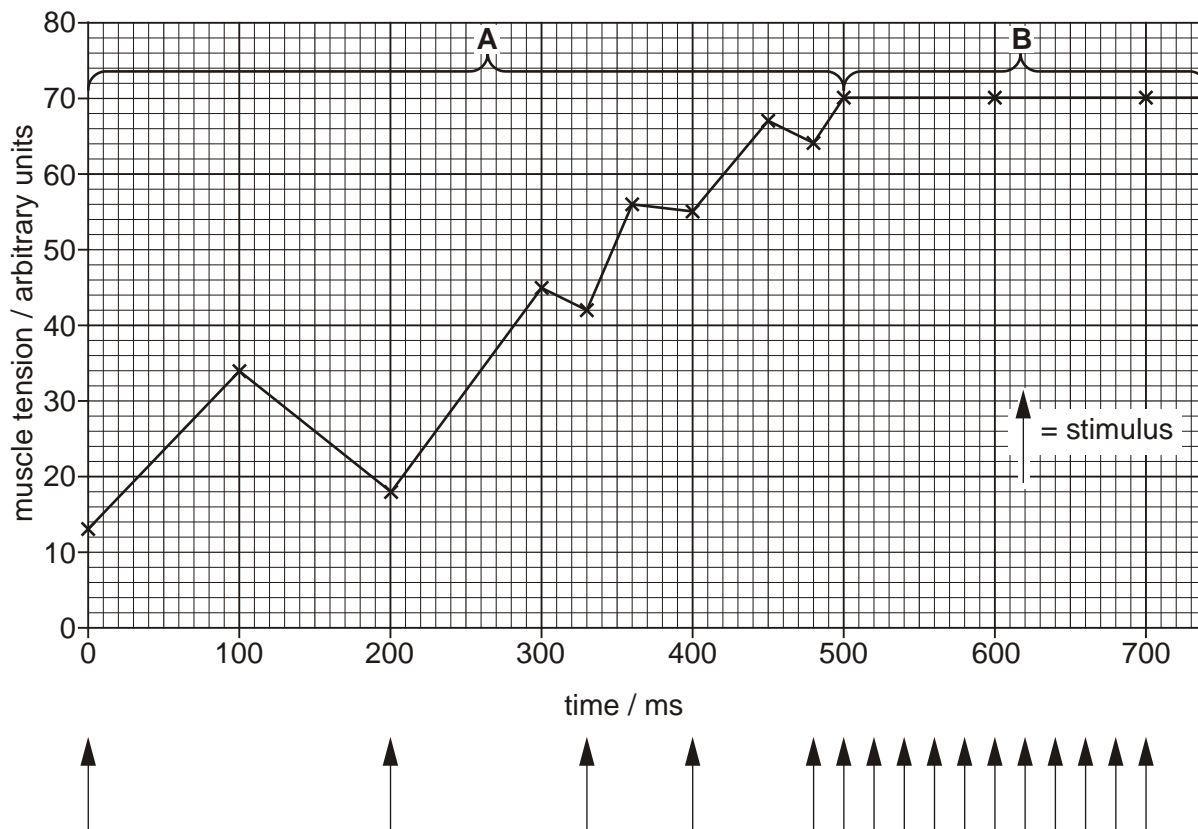
.....

acetylcholinesterase

.....

[Total 2 marks]

20. In an investigation, striated muscle tissue from a mammal was electrically stimulated over a period of 700 milliseconds (ms). The tension generated by the muscle was measured during the investigation and the results are shown in the figure below.



From *Nuffield Advanced Science Biology*. Study Guide 1, adapted from graph p. 349, published by Longman, 1985 (ISBN 0-582-35431-5)

(i) Describe the relationship between muscle stimulation and muscle tension in region **A** on the figure.

.....

.....

.....

.....

- (ii) Region **B** on the figure above shows the tension of the muscle with repeated stimulation. Some toxins, such as those released by the tetanus bacterium, also cause the effect shown in region **B**.

Suggest why these toxins may be fatal.

.....

.....

.....

.....

.....

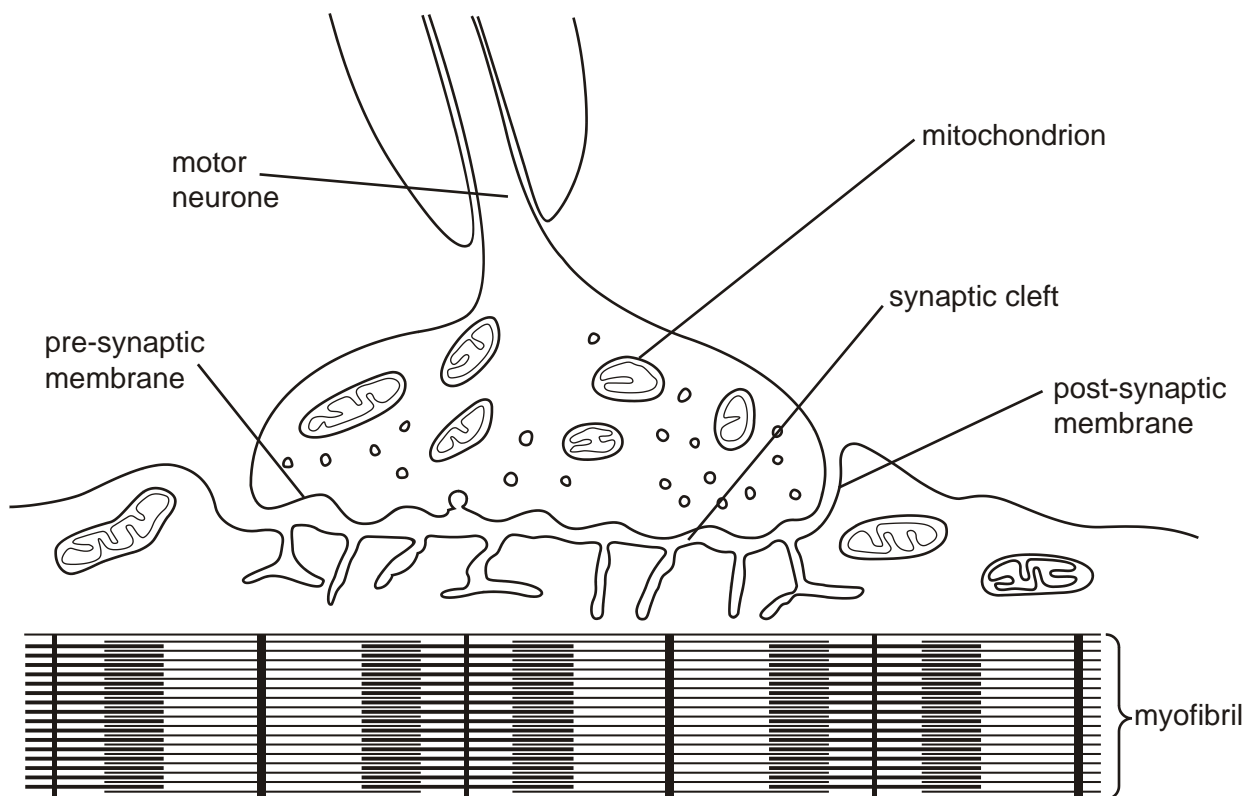
.....

[3]

[Total 5 marks]

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

The following figure shows a neuromuscular junction.



The figure above shows that mitochondria are present on **both** sides of the synaptic cleft. Explain why mitochondria are essential for the transmission of impulses across the cleft and for muscular contraction.

transmission of impulses across the cleft

.....

.....

.....

.....

.....

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.....

.....

.....

.....

.....

.....

.....

.....

.....

muscular contraction

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.....

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.....

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.....

.....

[8]
Quality of Written Communication [1]
[Total 9 marks]

22. The mammalian nervous system consists of the central and peripheral nervous

systems.

Describe how the central nervous system is protected from **mechanical** damage.

.....

.....

.....

.....

.....

[Total 3 marks]

23. (a) The cerebellum and medulla oblongata are both parts of the hindbrain. Outline the functions of these two parts of the brain.

cerebellum

.....

.....

.....

.....

[2]

medulla oblongata

.....

.....

.....

.....

[2]

- (b) Alzheimer's disease is characterised by several changes in the cerebrum, including 'tangles' inside neurones and 'plaques' between neurones.

State what causes

- (i) tangles;

.....

.....

- (ii) plaques.

.....

.....

[2]

Another change in the cerebrum of a person with Alzheimer's disease is a decrease in acetylcholine released by neurones that form memory circuits.

During a clinical trial, people with Alzheimer's disease were treated with a drug that inhibited the enzyme acetylcholinesterase. This improved their short-term memory.

- (c) Suggest how the drug may inhibit acetylcholinesterase.

.....

.....

.....

.....

.....

.....

[3]

- (d) Suggest how the drug improves short-term memory.

.....

[2]

- (e) State **three** precautions that should be taken when designing such clinical trials, to ensure that any effects are due to the drugs being tested.

1

.....

2

.....

3

.....

[3]

[Total 14 marks]

24. Read the passage below and answer the questions that follow.

Snake Venoms

Some types of snake kill their prey and defend themselves by means of a poisonous bite.

Fangs (hollow teeth) inject venom from specialised glands into the victim. The venom contains a protein, which is a toxin.

Different species of snake have toxins that act in different ways. Haemolytic toxins are enzymes that hydrolyse phospholipids. They damage tissues, including heart muscle.

Neurotoxins, such as the one produced by green mamba snakes, bind to acetylcholine receptors on the surface membranes of nerve cells or muscle fibres. This leads to muscle paralysis and heart failure.

Some antibodies bind to toxins and inactivate them. These antibodies are known as antitoxins.

The human immune response is far too slow to be effective in making antitoxins against snake venom.

Injecting a very small, non-lethal quantity of venom into a horse produces antitoxin. The horse produces antitoxins that can be extracted from horse blood and used as an emergency treatment for those bitten by the same species of snake.

Each time the horse is injected with venom, it is able to tolerate larger doses and the concentration of the specific antitoxin in its blood is greater.

(a) State how enzymes which hydrolyse phospholipids damage tissues.

.....
.....

[1]

(b) Suggest how a neurotoxin which binds to acetylcholine receptors on muscle fibres would produce paralysis.

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

[2]

(c) Explain why the **human** immune response is too slow to protect a person from a snake bite.

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

[2]

(d) Explain why a horse is injected more than once with a small amount of venom when it is being prepared for use as a source of antitoxin.

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

[3]

(e) Why would treatment with horse antitoxin produce no long-term protection against snake bites?

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

[2]

[Total 10 marks]

- 25.** The human brain is an organ, protected by the skull. The largest part of the human brain is the cerebrum. The surface of the cerebrum is covered by a highly folded region of tissue, called the cerebral cortex. The cerebrum contains regions of mostly myelinated axons, called white matter, and regions of mostly cell bodies and dendrites, called grey matter.

Explain why the cerebral cortex is a tissue, whereas the brain is an organ.

.....

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.....

.....

[Total 3 marks]

- 26.** The following is a list of the functions of the brain. Put a tick (✓) in the box next to the function performed by the cerebrum.

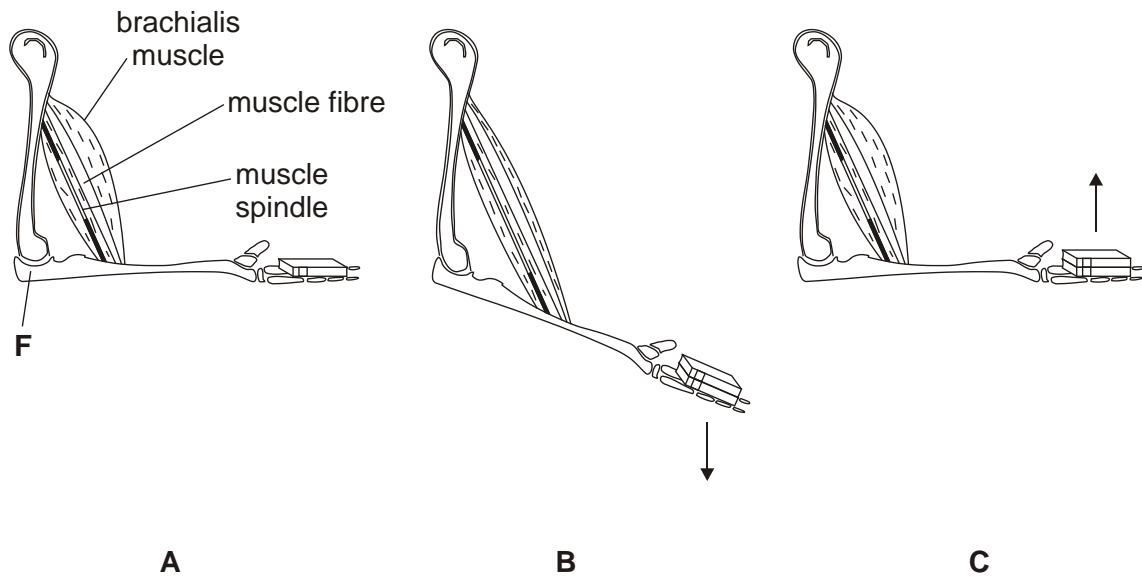
- control of the autonomic nervous system
- coordination of posture
- planning a task
- control of heart rate

[Total 1 mark]

27. When a book is held in the hand, as shown in Fig.1 **A**, there is a constant load. The muscles of the upper arm contract to produce a force that opposes the load, so maintaining the position of the hand.

Muscle spindles are a type of stretch receptor, which detect changes in the length of muscles.

When a second book is placed in the hand, as shown in Fig.1 **B**, the load increases. This stretches the muscle spindle resulting in an almost immediate increase in the contraction of the muscles of the upper arm, to maintain the position of the hand, as shown in the figure Fig.1 **C**.



Name bone F.

.....

[Total 1 mark]