



**Chapter 10 Human Nervous System**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **107 minutes**

Marks: **107 marks**

Comments:

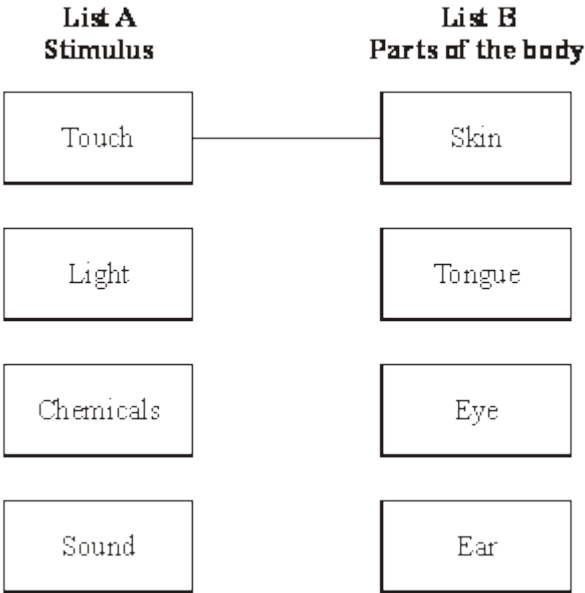
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1

(a) List **A** gives the names of four stimuli. List **B** gives four parts of the human body.

Draw a straight line from each stimulus in List **A** to the part of the body in List **B** which has receptors for that stimulus.

(One has been done for you.)



(3)

(b) Complete the following sentence by choosing the correct words from the box.

brain glands motor sensory

To make us aware of a stimulus, impulses are sent along a ..... n  
to the .....

(2)

(Total 5 marks)

2

The photograph shows a new-born baby.



By SCA Svenska Cellulosa Aktiebolaget [CC-BY-2.0], via Wikimedia Commons

(a) New-born babies have reflex actions. The reflex actions help new-born babies to survive.

Draw a line from each reflex action to the way in which it helps the baby to survive.

**Reflex action**

**How the reflex action helps the baby**

If milk goes down the baby's windpipe the baby coughs

If the mother touches the palm of the baby's hand, the baby clenches its fist.

If the mother strokes the baby's mouth, the baby begins to suck.

If a bright light shines on the baby, the baby's eyes shut.

Helps the baby to hold on to the mother

Prevents the baby from choking

Helps to protect some of the baby's receptors

Helps the baby to crawl

Helps the baby to feed

(4)

(b) Which **two** of the following may be effectors in reflex actions?

Tick (✓) **two** boxes.

Brain

Glands

Motor neurones

Muscles

Sensory neurones

(2)

(Total 6 marks)

3

Humans use the nervous system to react to changes in the environment.

(a) (i) Which word means a change in the environment?

Draw a ring around the correct answer.

**neurone**

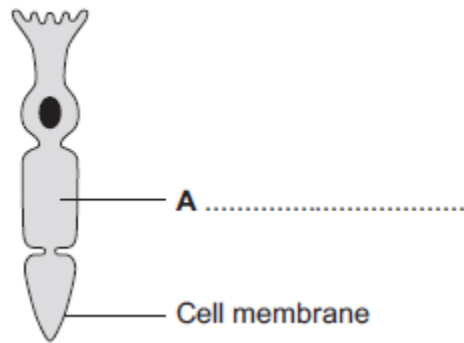
**reflex**

**stimulus**

(1)

(ii) **Figure 1** shows a light receptor cell.

**Figure 1**



Use the correct answer from the box to label part **A** on **Figure 1**.

<b>chloroplast</b>	<b>cytoplasm</b>	<b>vacuole</b>
--------------------	------------------	----------------

(1)

(b) **Figure 2** shows a boy riding a bicycle on a sunny day.

**Figure 2**



© Stockbyte/Thinkstock

(i) Receptors in the boy's body detect changes in the environment.

Complete the table to show which organ of the body contains the receptors for each change in the environment.

<b>Change in the environment</b>	<b>Organ that contains the receptors</b>
Sound of traffic from behind him	
Flashing blue lights of a police car	
Cooler air temperature in the shadows	

(3)

(ii) The boy's response to danger is to pull on the bicycle brakes.

Which type of effector causes this response?

Tick (✓) **one** box.

A gland

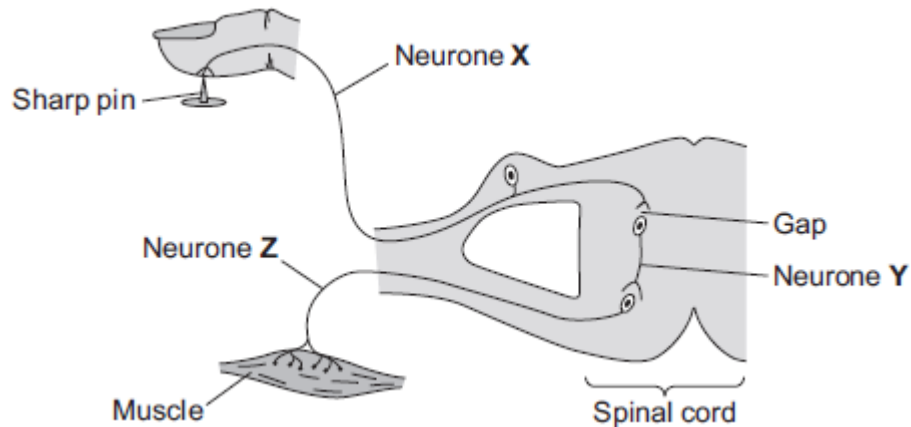
A muscle

A synapse

(1)  
(Total 6 marks)

4

The diagram below shows the pathway for a simple reflex action.



(a) What type of neurone is neurone **X**?

Draw a ring around the correct answer.

**motor neurone**

**relay neurone**

**sensory neurone**

(1)

(b) There is a gap between neurone **X** and neurone **Y**.

(i) What word is used to describe a gap between two neurones?

Draw a ring around the correct answer.

**effector**

**receptor**

**synapse**

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Information passes across the gap as

- a chemical.
- an electrical impulse.
- pressure.

(1)

(c) Describe what happens to the muscle when it receives an impulse from neurone Z. How does this reflex action help the body?

What happens to the muscle .....

.....

How this helps the body .....

.....

(2)

(Total 5 marks)

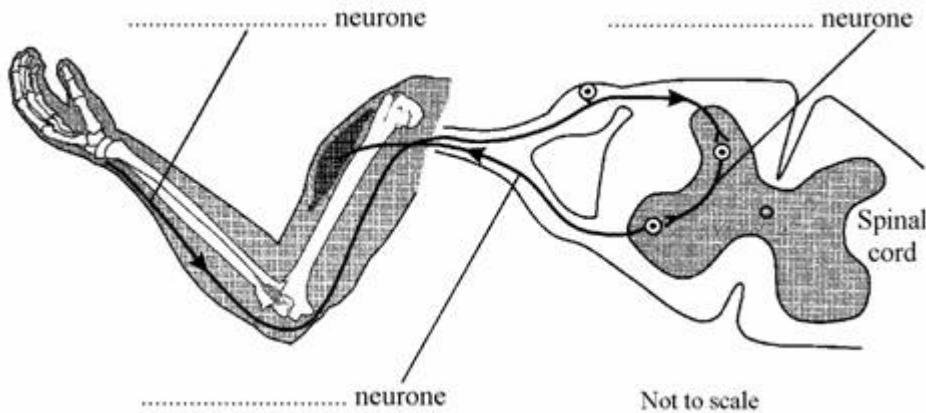
5

(a) What is the name of the organ which controls the nervous system?

.....

(1)

(b) The diagram shows a reflex arc. Label the **three** neurones.



(3)

(c) Snatching your hand from a hot object is an example of a reflex action. Give **one** other example of a reflex action.

.....

(1)



(d) Describe the stages that happen in a reflex action.

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

**(3)**

**(Total 8 marks)**

**6**

Reflex actions are rapid and automatic.

(a) Name the following structures in a reflex action.

(i) The structure that detects the stimulus.

.....

**(1)**

(ii) The neurone that carries impulses to the central nervous system.

.....

**(1)**

(iii) The neurone that carries impulses away from the central nervous system.

.....

**(1)**

(iv) The structure that brings about the response.

.....

**(1)**

(b) Describe what happens at a synapse when an impulse arrives.

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

**(2)**

(c) Some people have a condition in which information from the skin does not reach the brain.

Explain why this is dangerous for the person.

.....

.....

.....

.....

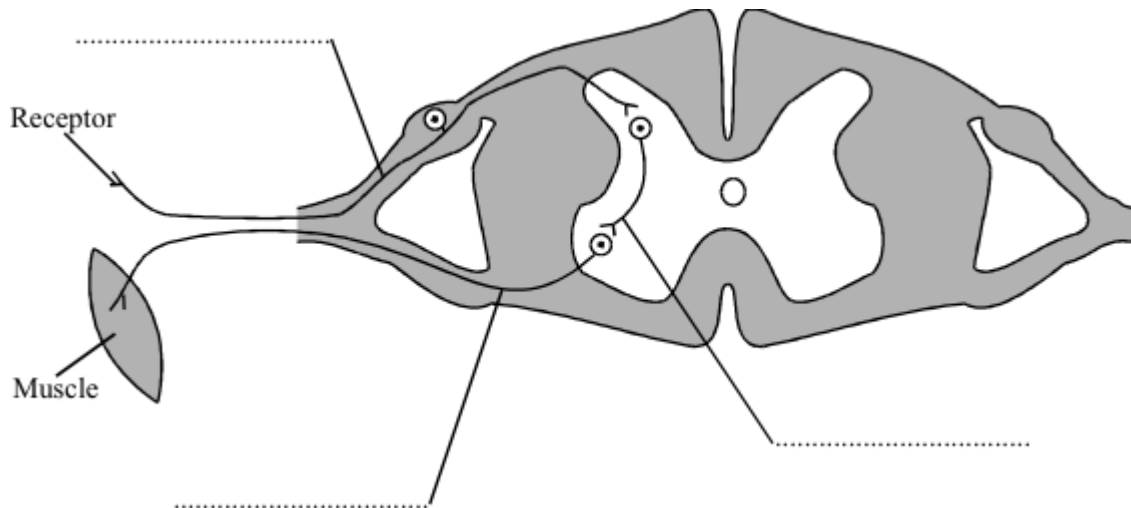
.....

(2)  
(Total 8 marks)

7

Information is also passed by impulses in the nervous system. Neurones carry impulses very rapidly. The diagram shows a reflex arc.

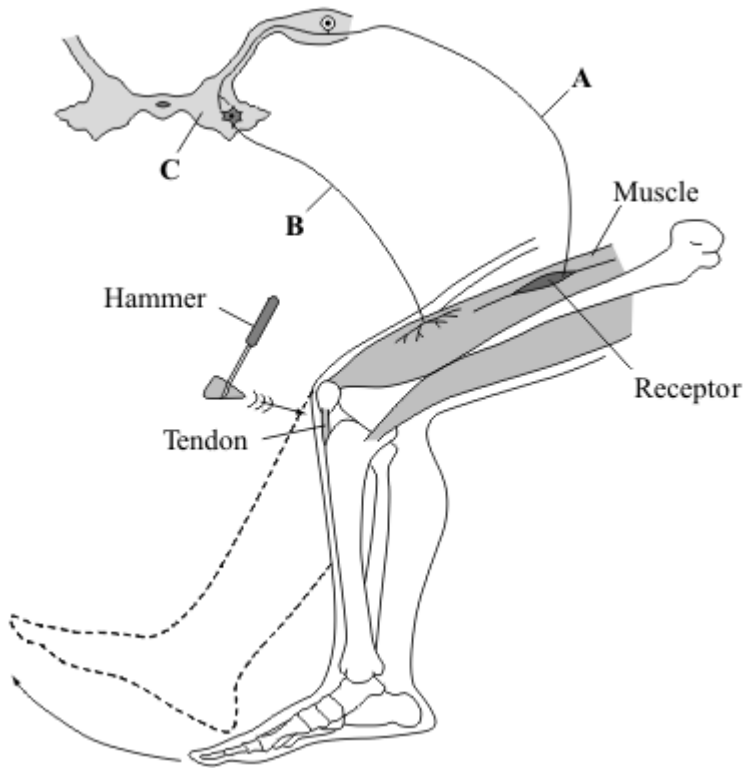
Label the diagram by adding the names of the neurones.



(Total 3 marks)

8

The diagram shows the structures involved in the knee-jerk reflex. When the tendon is struck with the hammer, the receptor is stimulated and the lower leg moves forward.



(a) Name the structures labelled **A**, **B** and **C**.

**A** .....

**B** .....

**C** .....

(3)

(b) How is information passed from structure **A** to structure **B**?

.....

.....

(1)

(c) What is the effector in this response?

.....

(1)

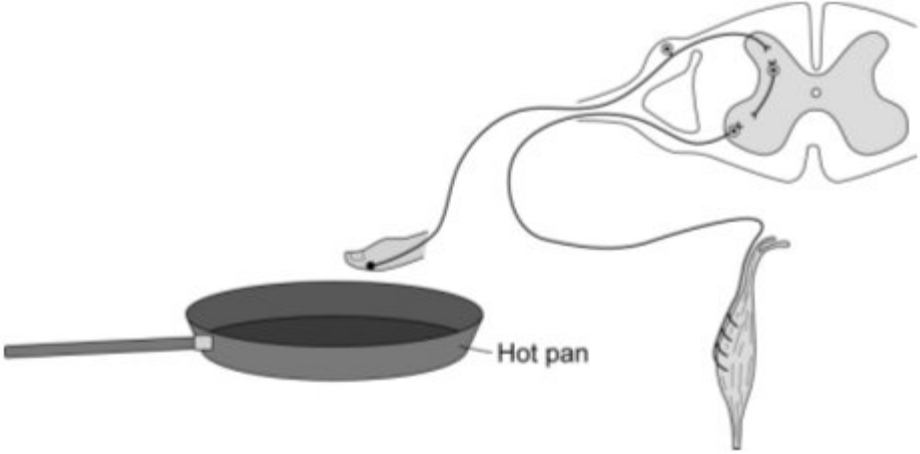
(Total 5 marks)

9

A person accidentally touches a hot pan.

Her hand automatically moves away from the pan.

The diagram shows the structures involved in this action.



(a) Describe fully how the structures shown in the diagram bring about this reflex action.

.....

.....

.....

.....

.....

.....

.....

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.....

.....

.....

.....

(6)

- (b) (i) The nerve pathway in this reflex action is about 1.5 metres in length. A nerve impulse travels at  $75 \text{ m s}^{-1}$ .

Use this information to calculate the time taken for this reflex action to occur.

Show clearly how you work out your answer.

.....  
 .....

Time intervals ..... s

(2)

- (ii) The actual time interval is longer than the interval you have calculated in part (i).

Suggest an explanation for the difference.

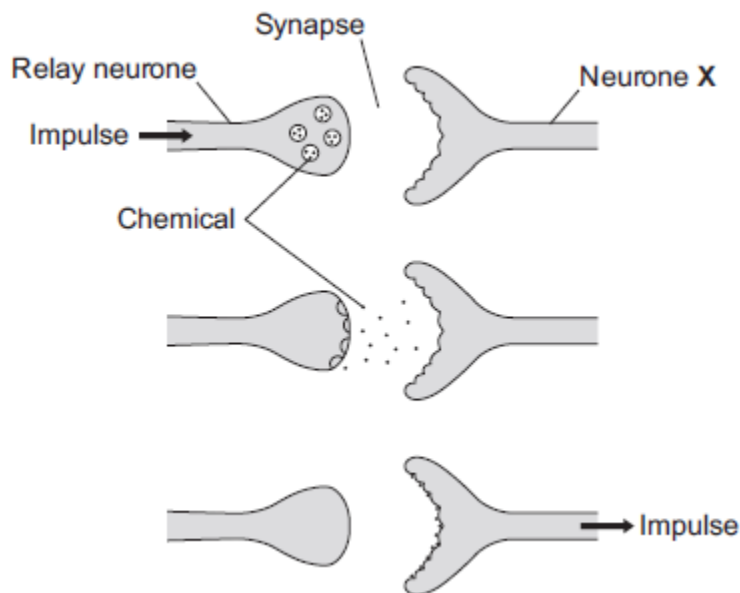
.....  
 .....

(1)

(Total 9 marks)

10

The diagram below shows how a nerve impulse passing along a relay neurone causes an impulse to be sent along another type of neurone, neurone X.



- (a) What type of neurone is neurone X?

.....

(1)

- (b) Describe how information passes from the relay neurone to neurone **X**.  
Use the diagram to help you.

.....

.....

.....

.....

.....

.....

**(3)**

- (c) Scientists investigated the effect of two toxins on the way in which information passes across synapses. The table below shows the results.

Toxin	Effect at the synapse
Curare	Decreases the effect of the chemical on neurone <b>X</b>
Strychnine	Increases the amount of the chemical made in the relay neurone

Describe the effect of each of the toxins on the response by muscles.

Curare .....

.....

.....

Strychnine .....

.....

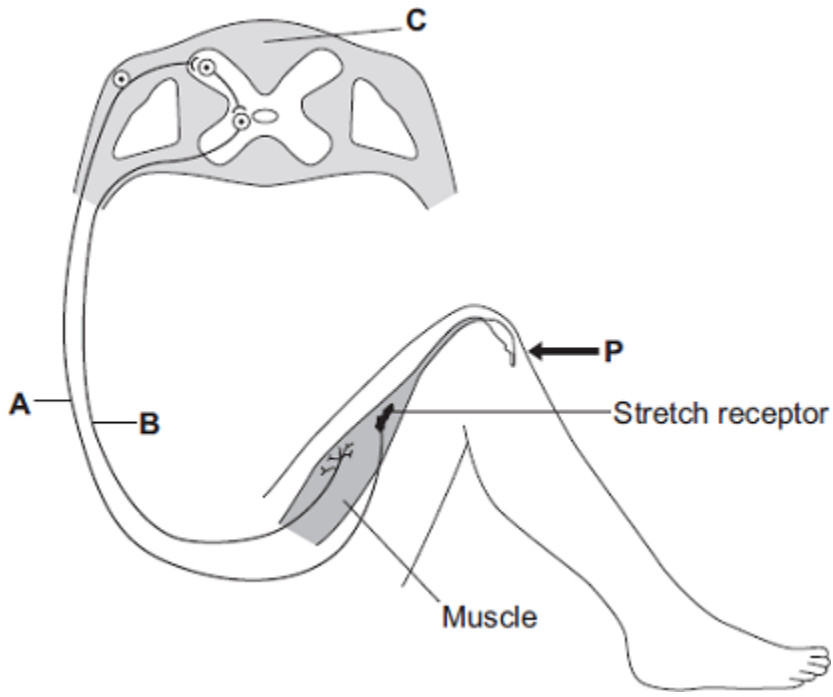
.....

**(2)**

**(Total 6 marks)**

11

The diagram shows the structures involved in the knee-jerk reflex. When the person is hit at point P, the lower leg is suddenly raised.



(a) Name the structures labelled A, B and C.

A .....

B .....

C .....

(3)

(b) How is information passed across a synapse?

.....

.....

(1)

(c) What is the effector in this response?

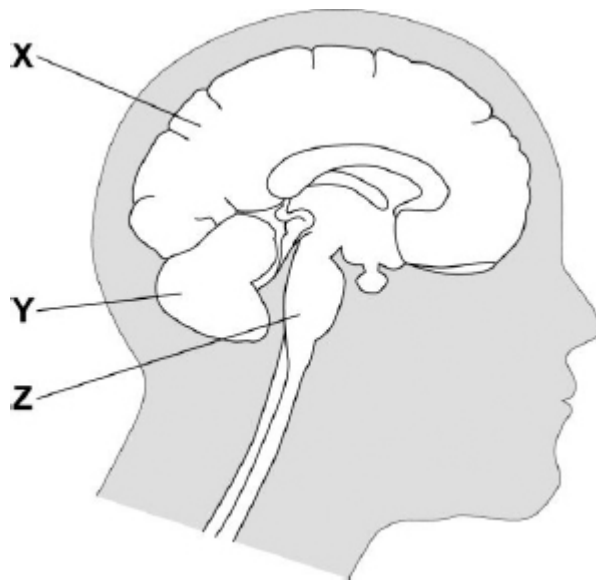
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(1)

(Total 5 marks)

12

The diagram shows a vertical section through the head, showing the brain.



(a) Use words from the box to name the structures labelled X, Y and Z on the diagram.

cerebral cortex	cerebellum	medulla	spinal cord	synapse
-----------------	------------	---------	-------------	---------

X .....

Y .....

Z .....

(3)

(b) One method of mapping brain function is to observe changes in body functions following a stroke.

(i) Give **two** other methods of mapping brain function.

1. ....
2. ....

(2)

(ii) Give **one** way in which disruption of the blood supply to part Y might affect the functioning of the body.

.....

.....

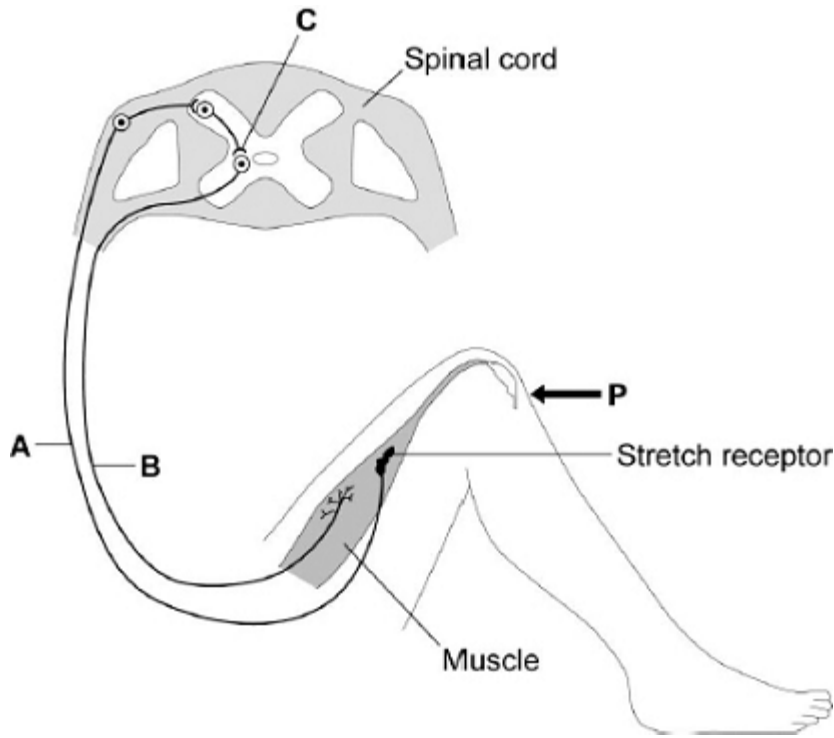
(1)

(Total 6 marks)



13

The diagram shows the nervous pathway that is used to coordinate the knee-jerk reflex. When the tendon below the knee is tapped with a hammer, the lower leg jerks upwards in a reflex action.



(a) On the diagram, draw arrows next to the neurones labelled **A** and **B** to show the direction in which an impulse moves in each neurone.

(1)

(b) How is information passed across the synapse at **C**?

.....

(1)

(c) On the diagram, label the effector with the letter **X**.

(1)

(d) (i) The nerve pathway linking the stretch receptor with the muscle is about 1.5 metres in length.

A nerve impulse travels at  $75 \text{ ms}^{-1}$ .

Use this information to calculate the time interval between the stimulus and the response.

.....  
.....

Time interval ..... s

(2)

(ii) The actual time interval is longer than the interval you have calculated in part (d)(i).

Suggest an explanation for the difference.

.....

.....

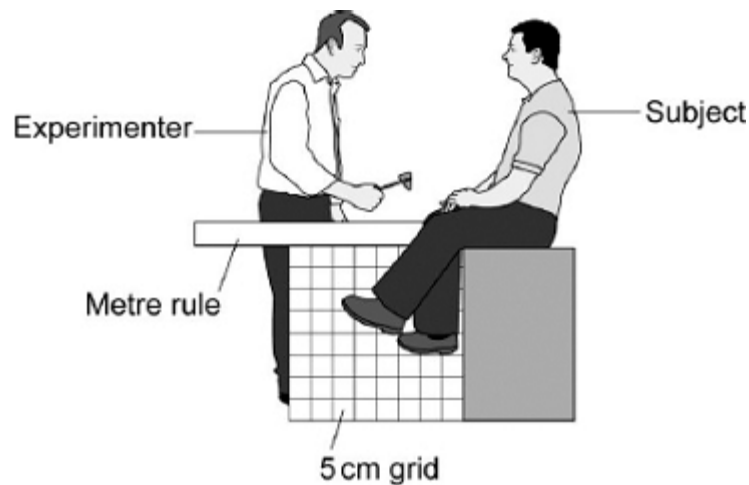
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(2)

(e) A group of students wanted to find out how the speed of the hammer affected the distance the lower leg moved.

The diagram shows how the experiment was set up.



Each trial was recorded on a video. A frame was taken every 33 milliseconds. The video was then played using single-frame advance. The number of frames for the hammer to move to the knee was found. The faster the speed, the smaller was the number of frames. The video was also used to find the distance moved by the toe.

In each trial, the experimenter held the hammer 20 cm from the subject's knee and then hit the subject's tendon. For each trial the experimenter used the hammer at a different speed.

The table shows some of the results.

Trial number	1	2	3	4	5	6	7	8	9	10
Distance hammer moved to knee in cm	20	20	20	20	20	20	20	20	20	20
Number of frames it took the hammer to move to the knee	15	14	12	10	9	8	7	6	2	2
Distance moved by toe in cm	0	0	5	5	4	10	10	10	10	10

(i) What variable did the experimenter control in this experiment?

.....

(1)

(ii) Give **two** advantages of using a video to measure the time it took for the hammer to move to hit the tendon.

1 .....

.....

2 .....

.....

(2)

(iii) One of the results seems to be anomalous.

Draw a ring around the anomalous result in the table.

Suggest **one** reason why the anomalous result may have happened.

.....

(2)

(iv) Draw a conclusion from the results of the experiment.

.....

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.....

.....

(2)

- (v) Suggest **one** way in which the precision of the experiment could have been improved.

.....

.....

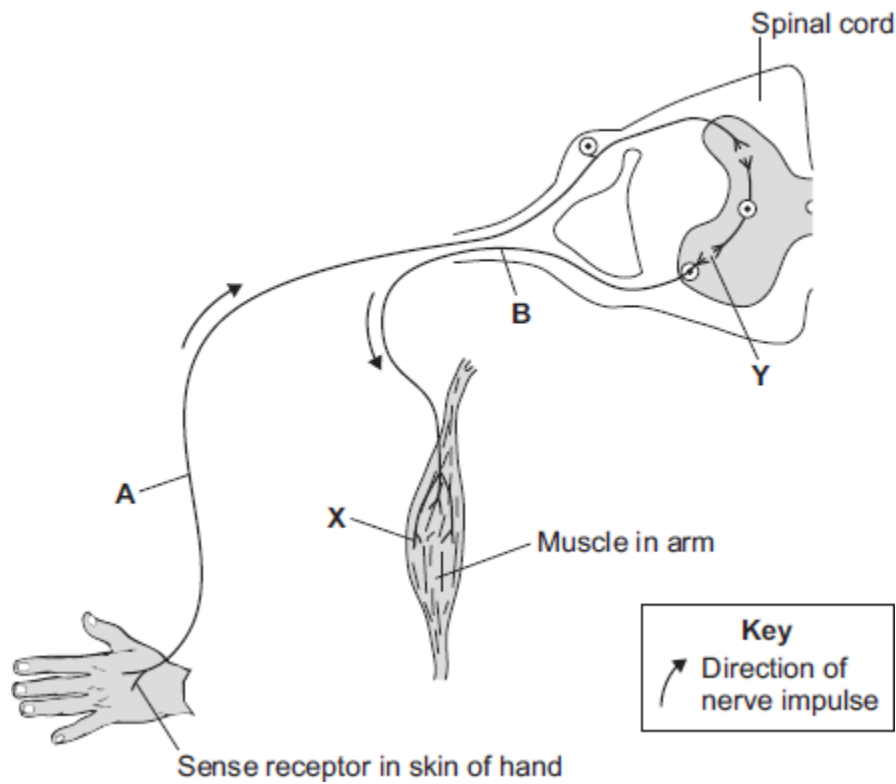
(1)

(Total 15 marks)

14

- (a) **Diagram 1** shows the neurones and parts of the body involved in a response to touching a hot object.

**Diagram 1**



A neurone is a nerve cell. Neurones carry impulses around the body.

- (i) Draw a ring around the correct answer to complete each sentence.

Neurone **A** is a

- motor neurone.  
 relay neurone.  
 sensory neurone.

At point **Y** there is a tiny gap between two neurones called

- an effector.  
 a receptor.  
 a synapse.

(2)

- (ii) The hand touches a hot object. An impulse travels through the nervous system to the muscle (point **X**). The muscle moves the hand away from the hot object.

What does the muscle do to move the hand away from the hot object?

Tick (✓) **one** box.

contract

relax

stretch

(1)

- (iii) The action described in part (a) (ii) is a reflex action.

How can you tell that this action is **not** a conscious action?

Use information from the diagram.

.....  
.....

(1)

- (iv) Reflex actions like this are useful.

Explain why.

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

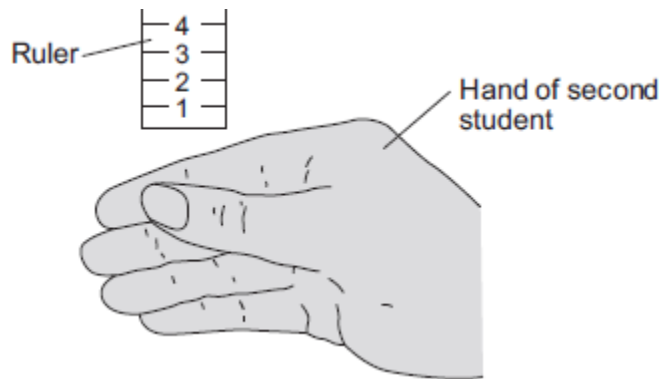
(2)

- (b) Some students investigated the effect of caffeine on a person's reaction time.

The students used the following steps.

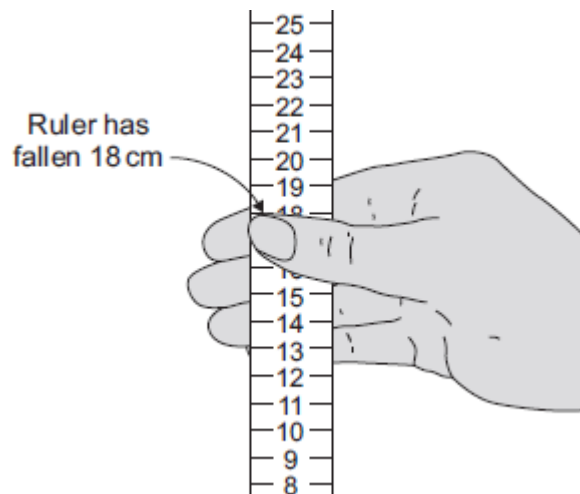
1. One student held a ruler just above a second student's hand, as shown in **Diagram 2**.

**Diagram 2**



2. The student let go of the ruler. The second student caught it as soon as possible, as shown in **Diagram 3**.

**Diagram 3**



3. The students repeated this experiment seven more times.

4. The student catching the ruler then drank a cup of strong coffee.

Coffee contains caffeine.

5. Fifteen minutes after drinking the coffee the students repeated steps 1 to 3.

**Table 1** and **Table 2** show the students' results.

**Table 1**

Distance ruler fell before it was caught in cm
<b>Before drinking coffee</b>
18
21
25
15
19
16
12
21
<b>Mean = 18.4</b>

**Table 2**

Distance ruler fell before it was caught in cm
<b>After drinking coffee</b>
8
13
11
17
10
14
13
13
<b>Mean = 12.4</b>

(i) The students used the reading on the ruler as a measure of the reaction time.

What do the results show about the effect of caffeine on reaction time?

.....  
.....

(1)

(ii) Look carefully at **all** the data in **Table 1** and **Table 2**.

Using the data in **Table 1** and **Table 2**, give **one** reason why a scientist may **not** accept your conclusion in part (b) (i).

.....  
.....

(1)

(iii) How could the students improve their investigation?

Suggest **two** ways.

1 .....

.....

2 .....

.....

(2)

(Total 10 marks)

15

A man hurt his head in an accident.

Doctors found that he could not remember anything that had happened on the day of the accident.

(a) (i) Name the part of the brain concerned with memory.

.....

(1)

(ii) Name **one** method the doctors could use to find out how much the brain was damaged.

.....

(1)

(b) The doctors were worried that the man might also have injured his spine.  
They touched different areas of his skin with a sharp point.  
They asked him to tell them each time if he could feel the sharp point.



- (i) Explain how the information about the sharp point touching the skin reaches the man's brain.

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**(6)**

- (ii) The doctors found that the man could feel the sharp point when the point touched his arms but not when the point touched his legs.

Suggest what this information could tell the doctors about the damage to the man's spinal cord. Explain your answer.

.....

.....

.....

.....

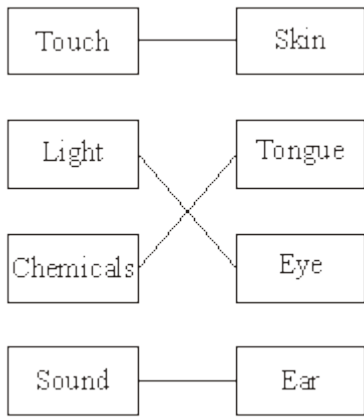
**(2)**

**(Total 10 marks)**

# Mark schemes

1

(a) **Stimulus**                      **Part of the body**



*1 mark for each correct line  
if 2 lines to **one** box, CANCEL mark*

**max 3**

(b) in correct sequence:

sensory

1

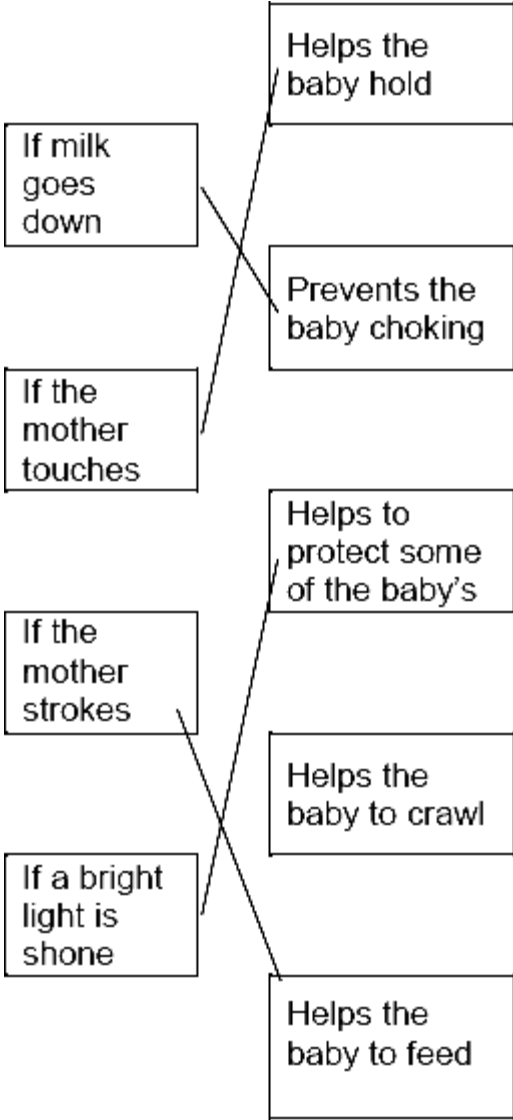
brain

1

**[5]**

**2**

(a)



*all four correct = 4 marks*  
*three correct = 3 marks*  
*two correct = 2 marks*  
*one correct = 1 mark*  
*extra line from a statement cancels the mark*

4

(b) glands

1

muscles

*1 mark for each correct tick*  
*each extra box ticked cancels 1 mark*

1

**[6]**

**3**

(a) (i) stimulus

1

(ii) cytoplasm

1

- (b) (i) ear(s)  
*in this order only* 1
- eye(s)  
*accept retina* 1
- skin  
*ignore extra detail* 1
- (ii) A muscle 1

[6]

- 4** (a) sensory neurone 1
- (b) (i) synapse 1
- (ii) a chemical 1
- (c) (What happens to the muscle)  
*mark both parts of the question together*
- any **one** from:
- contraction / contracts  
*ignore relaxation / relaxes / tenses* 1
  - gets shorter
- (How this helps the body)
- idea of protection for body (from damage / pain)  
*eg moves finger / arm away (from pin / stimulus / source of pain)* 1

[5]

- 5** (a) brain 1
- (b) receptor **or** sensory **or** afferent  
*connector or relay* 3
- effector **or** motor **or** efferent

- (c) any **one** from  
blink (of eye)  
*accept a violent movement of a limb from pain or sharp object*
- knee jerk  
*do not credit snatch from cold object or any temperature reference  
e.g. boiling water  
accept sneezing, coughing, choking, vomitting, pupil closing or  
reflex*
- (d) danger **or** a signal detected (by nerve)  
**or** impulse sent
- goes to **or** through spine  
*accept impulse by-passes the brain  
do not award mark if brain mentioned  
do not credit message to spine*
- a very rapid response occurs **or** then to  
effector **or** muscle **or** motor  
*accept no thinking time is needed*

1

1

1

1

[8]

6

- (a) (i) receptor  
*allow named receptor eg light receptor  
ignore sensory neurone  
allow sense organ / named sensory organ eg skin / eye*
- (ii) sensory (neurone)  
*allow afferent*
- (iii) motor (neurone)  
*allow efferent*
- (iv) effector / muscle / gland / named

1

1

1

1

(b) any **two** from:

- impulse / information passes from one neurone to another  
**or** impulse / information passes across gap
- chemical / transmitter involved
- diffusion (across gap)

2

(c) brain / person not aware of pain / stimulus / can't feel

*allow brain/ person doesn't know / realise / unable to coordinate*  
*ignore reflex*  
*ignore information*

1

possibility of (permanent / serious) damage / eg burning

*ignore danger*

1

[8]

7

top left label sensory

*credit afferent*  
*do not accept receptor*

1

bottom right label connector **or** relay

*credit intermediate*

1

bottom left label motor **or** effector

*credit efferent*

1

[3]

8

(a) **A** sensory (neurone)

*ignore nerve*

1

**B** motor (neurone)

*ignore nerve*

1

**C** spinal cord / central nervous system / grey matter

1

(b) by chemical / substance

*allow transmitter*

1

(c) muscle

*allow extensor*

*ignore muscle names*

1

[5]

9

(a) stimulus / heat detected by temperature receptors in skin

1

impulses travel along sensory neurone to spinal cord / CNS

1

chemical transmission across synapse

1

via relay neurone

1

impulses to muscle / effector via motor neurone

1

muscle / effector contracts, moving the hand away

1

(b) (i) 0.02 s

*correct answer gains 2 marks*

*if answer incorrect, evidence of 1.5 / 75 gains 1 mark*

2

(ii) impulse slowed down because of time taken for diffusion of the chemical across the synapse

1

[9]

10

(a) motor

*allow efferent / postsynaptic*

*allow **another** relay (neurone)*

1

(b) release of chemical (from relay neurone)

*allow ecf for 'motor' neurone from (a)*

*allow release of neurotransmitter / named example*

1

chemical crosses gap / junction / synapse

*allow diffuses across*

*allow chemical moves to X*

1

chemical attaches to X / motor / next neurone (causing impulse)

1

- (c) (curare) decrease / no contraction  
*accept (muscle) relaxes* 1
- (strychnine) increase / more contraction  
*if no other mark awarded allow 1 mark for (curare) decrease / no response **and** (strychnine) increase / more response* 1

[6]

11

- (a) **A** sensory (neurone)  
*ignore nerve* 1
- B** motor (neurone)  
*ignore nerve* 1
- C** spinal cord / central nervous system / white matter  
*accept grey matter* 1
- (b) by chemical / substance  
*allow transmitter* 1
- (c) muscle  
*allow extensor*  
*ignore muscle names* 1

[5]

12

- (a) **X** – cerebral cortex 1
- Y** – cerebellum 1
- Z** – medulla 1
- (b) (i) electrical stimulation 1
- MRI (scanning) 1
- (ii) loss of (some) muscular coordination 1

[6]

13

- (a) towards spinal cord by **A** and away from spinal cord by **B** 1



- (b) by chemicals 1
- (c) muscle labelled X 1
- (d) (i)  $1.5 \div 75$  1  
 $= 0.02 \text{ s}$  1  
*correct answer with or without working gains 2 marks*
- (ii) impulse is slowed down at synapse 1  
because of time taken for diffusion of the chemical (across the synapse) 1  
*award up to 2 marks for any other feasible suggestion*
- (e) (i) distance moved by hammer 1
- (ii) permanent record of results 1  
provides means of measuring the very short time the hammer moved 1
- (iii) circle around distance in trial 5 1  
eg hammer did not hit tendon fully 1
- (iv) increasing the speed of hammer increases the distance the toe moved 1  
up to a maximum of 10 cm 1
- (v) eg reduce grid size to eg 1 cm 1  
*award 1 mark for any feasible suggestion*

[15]

14

- (a) (i) sensory neurone 1  
a synapse 1
- (ii) contract 1
- (iii) not connected to brain / coordinated only by spinal cord 1

(iv) automatic / rapid (response)  
*allow no thinking / faster / less time* 1

protects body from danger / from damage / from burning 1

(b) (i) caffeine decreases reaction time  
*accept caffeine speeds up / quicker reactions* 1

(ii) the two sets of results overlap (considerably)  
*allow use of appropriate numbers – eg 5 of the ‘after’ results overlap with the ‘before’ results*  
*allow ‘wide spread of results’*  
*allow ‘it was just one person’ or ‘it was a small sample’*  
*accept use of one pair of results only – if meaning is clear*  
*accept use of one pair of overlapping results* 1

(iii) any **two** sensible suggestions: eg  

- more repetitions
- perform investigation on several other people
- use other (measured) amounts of coffee
- use different / more time intervals
- other suggested measure of reaction time – eg computer-generated light flash + time measurement
- use pure caffeine or caffeine tablets

 2

[10]

15

(a) (i) cerebral cortex  
*accept cerebrum / cerebral hemisphere* 1

(ii) MRI (scan)  
*allow CAT / CT scan*  
*do **not** accept MIR*

**or**

electrode stimulation  
*allow electrical stimulation* 1

- (b) (i) sharp point stimulates (pain) receptor (in the skin)  
*must be in correct order* 1
- to send (nerve) impulse  
*ignore information and messages* 1
- via sensory neurone 1
- to spinal cord  
*do **not** accept spine, ignore CNS* 1
- crosses synapse  
*allow synapse in any correct context* 1
- to other (relay) neurones / to brain  
*do **not** accept motor neurone*  
*allow explanation in a flow diagram* 1
- (ii) damage must be between arms and legs / below arms  
*accept below the waist* 1
- since information from nerves in arms still reaches the brain / information from  
the legs doesn't reach the brain 1

**[10]**