

THE HUMAN NERVOUS SYSTEM

Q1.

Two students investigated reflex action times.

This is the method used.

1. Student **A** sits with his elbow resting on the edge of a table.
2. Student **B** holds a ruler with the bottom of the ruler level with the thumb of Student **A**.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler and records the distance.
5. Steps **1** to **4** are then repeated.

The same method was also used with Student **A** dropping the ruler and Student **B** catching the ruler.

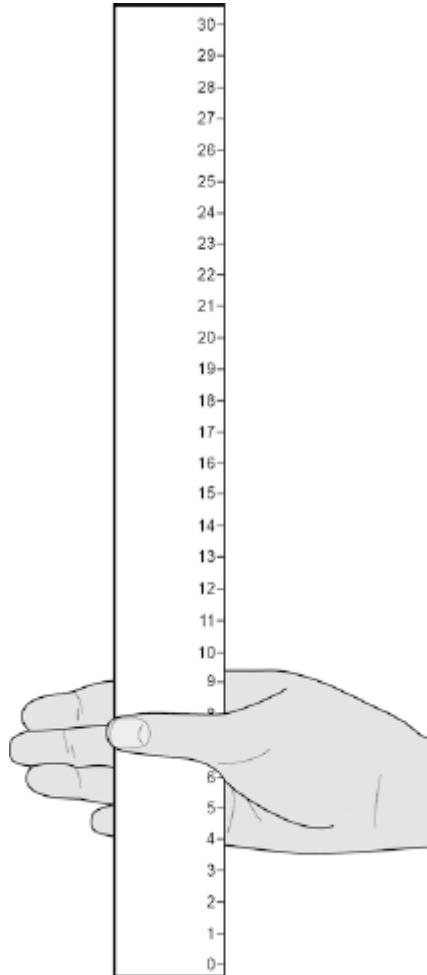
- (a) Give **two** variables the students controlled in their investigation.

1. _____
2. _____

(2)

- (b) **Figure 1** shows one of the results for the Student **A**.

Figure 1



What is the reading shown in **Figure 1**?

Reading on ruler = _____ cm

(1)

(c) **Table 1** shows the students' results.

Table 1

Test number	Distance ruler dropped in cm	
	Student A	Student B
1	9	12
2	2	13
3	6	13
4	7	9
5	7	8
Mean	7	X

Circle the anomalous result in **Table 1** for Student A.

(1)

(d) What is the **median** result for Student **B**?

Tick **one** box.

8

11

12

13

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(1)

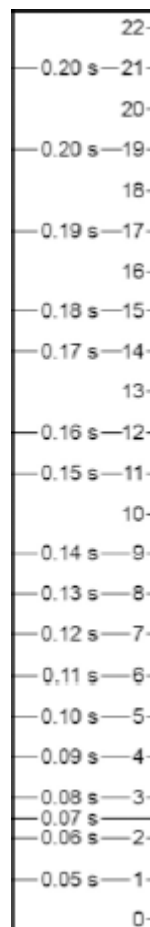
(e) Calculate the value of **X** in **Table 1**.

Mean distance ruler dropped = _____ cm

(1)

(f) **Figure 2** shows the scale used to convert distance of the ruler drop to reaction time.

Figure 2



Calculate how much faster the reaction time of Student **A** was compared to Student **B**.

Use **Figure 2** and **Table 1**.

Answer = _____ s

(2)

- (g) What improvement could the students make to the method so the results are more valid?

Tick **one** box.

Use alternate hands when catching the ruler

Carry out more repeats

Use a longer ruler for catching

Use more than two students to collect results

(1)

- (h) Student **A** carried out a second investigation to see the effect of caffeine on the reflex action.

Table 2 shows his results.

Table 2

Test number	Distance ruler dropped in cm	
	Without caffeine	With caffeine
1	9	5
2	6	5
3	9	4
4	6	7
5	10	4
Mean	8	5

Give **one** conclusion about the effect of caffeine on reflex actions.

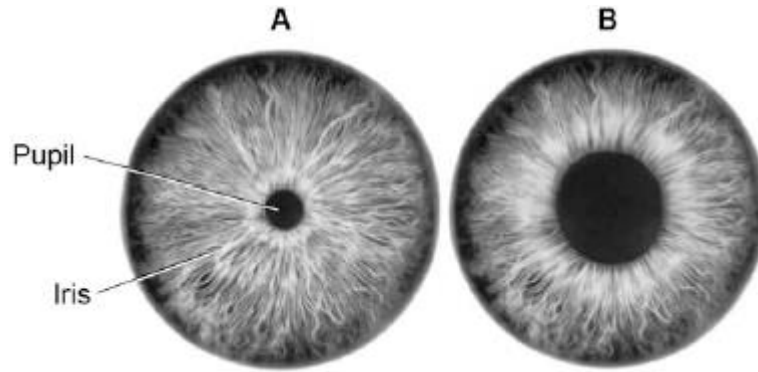
(1)

(Total 10 marks)

Q2.

Figure 1 shows a reflex in the iris of the human eye in response to changes in light levels.

Figure 1



@ Gandee Vasan/Stone/Getty Images

(a) Describe the changes in the pupil and iris going from **A** to **B** in **Figure 1**.

Explain how these changes occur.

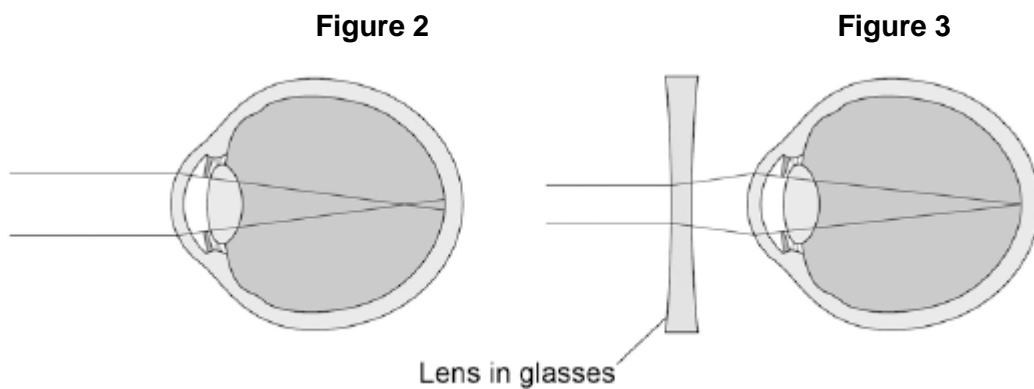
Refer to the changes in light level in your answer.

(4)

(b) Some people wear glasses to improve their vision.

Figure 2 shows light entering the eye in a person with blurred vision.

Figure 3 shows how this condition is corrected with glasses.



Compare **Figure 2** and **Figure 3**.

Explain how the blurred vision is corrected.

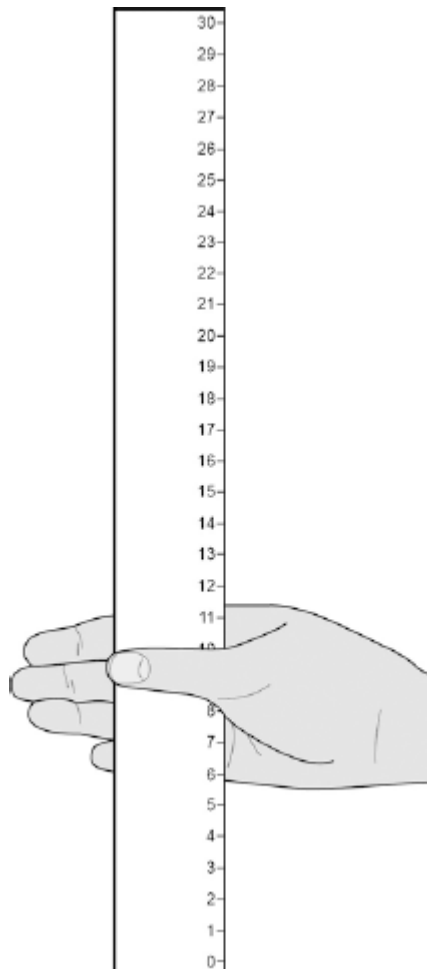
(2)
(Total 6 marks)

Q3.

Two students investigated reflex action times.

This is the method used.

1. Student **A** sits with her elbow resting on the edge of a table.
2. Student **B** holds a ruler with the bottom of the ruler level with the thumb of Student **A**.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler and records the distance, as shown in the diagram below.
5. Steps **1** to **4** were then repeated.



- (a) Suggest **two** ways the students could improve the method to make sure the test would give valid results.

1. _____

2. _____

(2)

- (b) The table below shows Student **A**'s results.

Test Number	Distance ruler dropped in mm
1	117
2	120
3	115
4	106
5	123
6	125
7	106

What is the **median** result?

Tick **one** box.

106

115

116

117

123

(1)

- (c) The mean distance the ruler was dropped is 116 mm.

Calculate the mean reaction time.

Use the equation:

$$\text{reaction time in s} = \sqrt{\frac{\text{mean drop distance in cm}}{490}}$$

Give your answer to 3 significant figures

Mean reaction time = _____ s

(3)

(d) The students then measured Student **A**'s reaction time using a computer program.

This is the method used.

1. The computer shows a red box at the start.
2. As soon as the box turns green the student has to press a key on the keyboard as fast as possible.
3. The test is repeated five times and a mean reaction time is displayed.

Student **A**'s mean reaction time was 110 ms.

Using a computer program to measure reaction times is likely to be more valid than the method using a dropped ruler.

Give **two** reasons why.

1. _____

2. _____

(2)

(e) A woman has a head injury.

Her symptoms include:

- finding it difficult to name familiar objects
- not being able to remember recent events.

Suggest which part of her brain has been damaged.

(1)

(f) A man has a head injury.

He staggers and sways as he walks.

Suggest which part of his brain has been damaged.

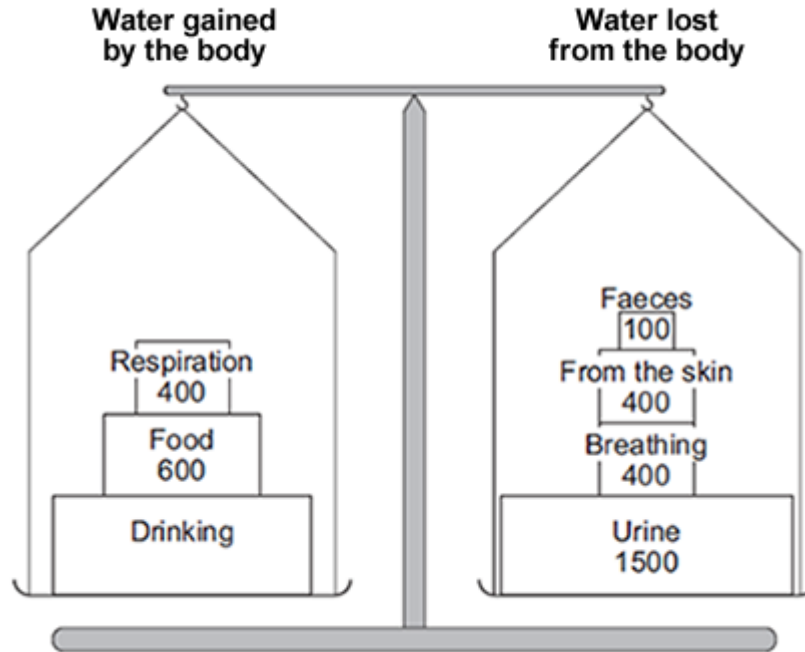
(1)

(Total 10 marks)

Q4.

The diagram below shows the water balance for a person on a cold day.

The numbers show the volume of water, in cm^3 , the person's body gained and lost.



- (a) (i) How much water was lost from the body on the cold day?

Draw a ring around the correct answer.

1800 cm^3

2400 cm^3

3300 cm^3

(1)

- (ii) The volume of water gained by the body should balance the volume of water lost from the body.

How much water should the person have drunk to keep the balance?

Volume of water = _____ cm^3

(2)

- (b) (i) Name the process by which water is lost from the skin.

(1)

- (ii) Why does the body need to lose water from the skin?

(1)

(c) The next day was a hot day. The person gained the same volume of water and did the same activities.

(i) What effect did the increase in temperature have on the volume of water the person lost?

Tick (✓) **one** box.

Less water was lost through the skin.

More water was lost through the skin.

More water was lost in faeces.

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

(1)

(ii) What effect would the increase in temperature have on the volume of urine the person lost?

Draw a ring around the correct answer.

decrease

increase

no change

(1)

(Total 7 marks)

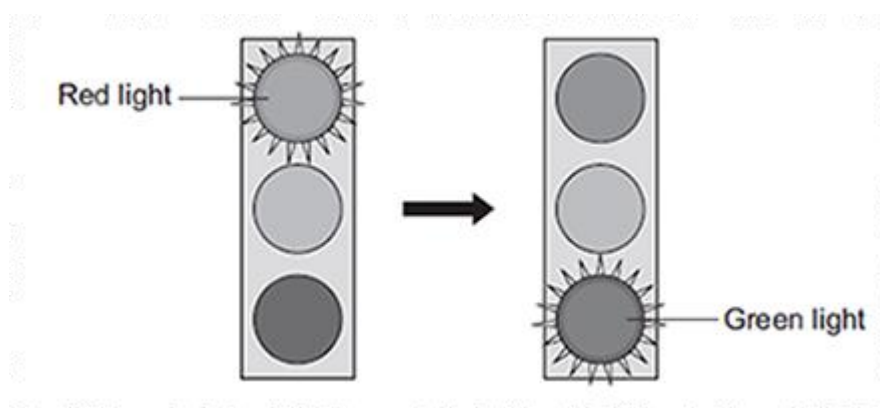
Q5.

Car drivers need quick reactions to avoid accidents.

A student uses a computer program to measure reaction time.

The computer screen shows a traffic light on red. The traffic light then changes to green.

The diagram below shows the change the person sees on the computer screen.



When the traffic light changes to green the person has to click the computer mouse as quickly as possible.

The computer program works out the time taken to react to the light changing colour.

(a) Special cells detect the change in colour.

(i) What word is used to describe special cells that detect a change in the environment?

Draw a ring around the correct answer.

receptor cells

reflex cells

stimulus cells

(1)

- (ii) Where in the body are the special cells that detect the change in colour of the traffic lights?

(1)

- (b) The student used the computer program on one computer to measure the reaction times of people of different ages.

- (i) Give **one** variable the student should control so that a fair comparison can be made between the people of different ages.

(1)

- (ii) The student did each measurement three times to calculate a mean value.

The table shows the results.

Age in years	Mean reaction time in milliseconds
15	242
30	
45	221
60	258
75	364
90	526

The reaction times for the 30-year-old person were **192, 174** and **180** milliseconds.

Calculate the mean reaction time of the 30-year-old person.

Mean reaction time = _____ milliseconds

(1)

- (iii) Which **one** of the following is an advantage of repeating each test three times and **not** doing the test just once?

Tick (✓) **one** box.

Any anomalies can be identified.

The results will be more precise.

There will be no errors.

(1)

(iv) Some people think that old people should **not** be allowed to drive a car.

Why is it more dangerous for old people to drive cars?

Use information from the table above to support your answer.

(2)

(Total 7 marks)

Q6.

This question is about the nervous system.

(a) Describe the difference between the function of a receptor and the function of an effector.

In your answer you should give **one** example of a receptor and **one** example of an effector.

(4)

(b) Synapses are important in the nervous system.

(i) What is a synapse?

(2)

(ii) Describe how information passes across a synapse.

(2)

(c) Reflexes may be co-ordinated by the brain or by the spinal cord.

(i) The reflexes from sense organs in the head are co-ordinated by the brain.

Name a sense organ involved in a reflex co-ordinated by the spinal cord.

(1)

(ii) The table shows information about reflexes co-ordinated by the brain and reflexes co-ordinated by the spinal cord.

Organ co-ordinating the reflex	Mean length of neurones involved in cm	Mean time taken for reflex in milliseconds	Mean speed of impulse in cm per millisecond
Brain	12	4	3
Spinal cord	80	50	

Calculate the mean speed of the impulse for the reflex co-ordinated by the spinal cord.

Mean speed = _____ cm per millisecond

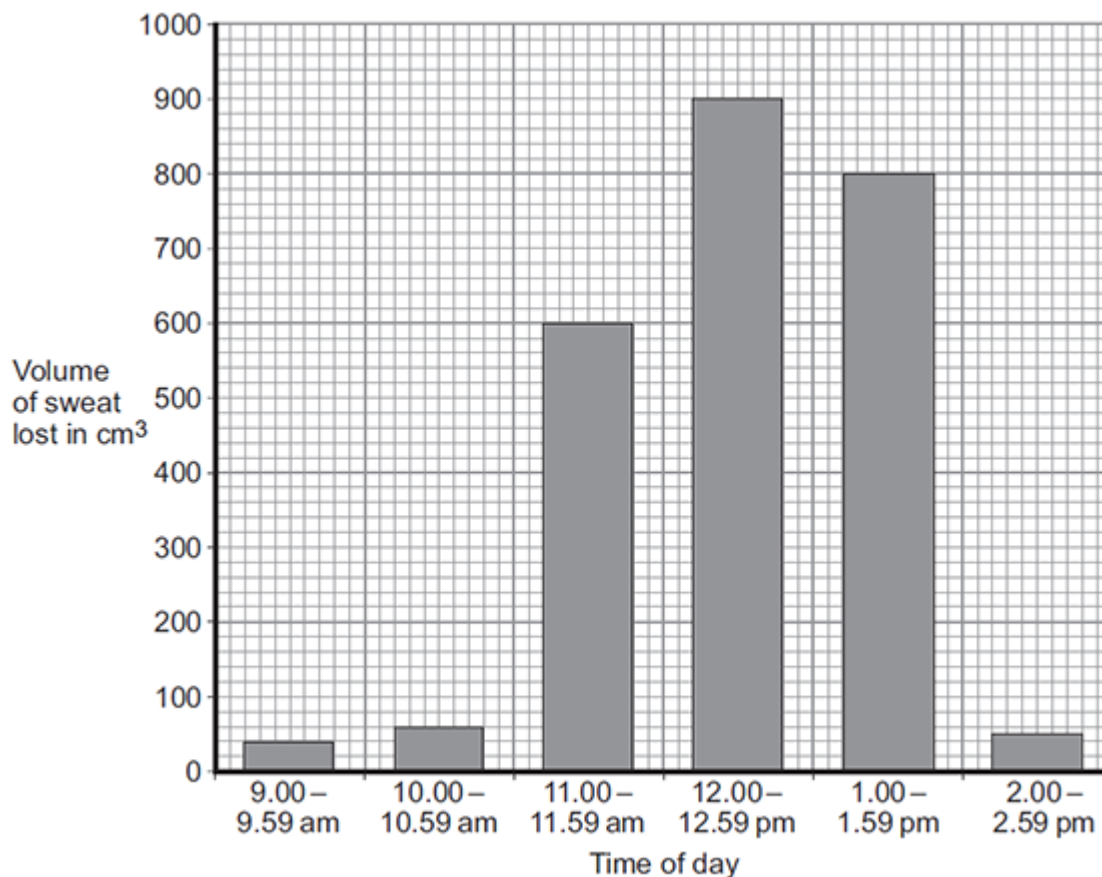
(1)

(iii) In reflexes co-ordinated by the brain there are **no** relay neurones.

Suggest why there is a difference in the mean speed of the impulse for the two reflexes.

Q7.

A scientist measured the volume of sweat lost between 9.00 am and 2.59 pm in one day by one person. The graph below shows the results.



(a) (i) Suggest what happened at 11.00 am.

Tick (✓) **one** box.

The person moved into a cold room.

The person removed their coat.

The person started running a race.

(1)

(ii) Calculate the total volume of sweat lost between 11.00 am and 1.59 pm.

Total volume of sweat lost = _____ cm³

(1)

(iii) Suggest **one** way the person could replace the water that was lost as sweat.

(1)

(b) (i) Sweating helps keep our internal body temperature within a narrow range.

Which organ monitors body temperature?

Tick (✓) **one** box.

brain

kidney

pancreas

(1)

(ii) The organ that monitors internal body temperature receives information about temperature from the skin.

Which structures in the skin send impulses with this information?

Tick (✓) **one** box.

capillaries

glands

receptors

(1)

(c) How does sweating help to control body temperature?

(1)

(Total 6 marks)

Q8.

Humans keep their internal conditions almost constant.

Body temperature is kept within a narrow range.

When the core body temperature is too low, this is detected by the thermoregulatory centre in the brain.

Describe how the body responds when a decrease in core body temperature is detected.

(Total 6 marks)

Q9.

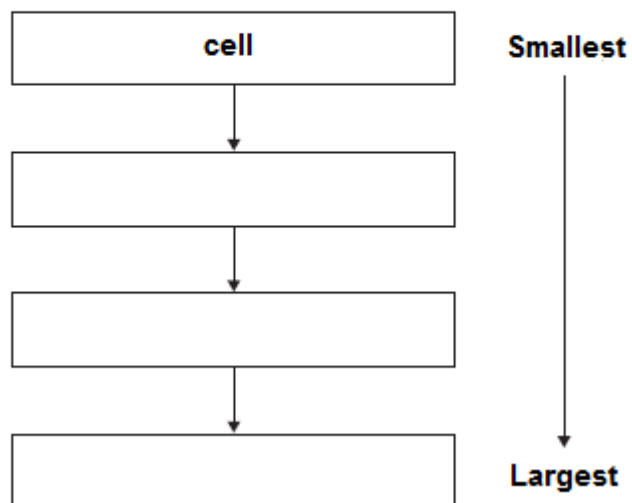
The human body is organised to carry out many different functions.

- (a) Use words from the box to complete **Figure 1** by putting the parts of the body in order of size from smallest to largest.

The smallest one has been done for you.

cell	organ system	organ	tissue
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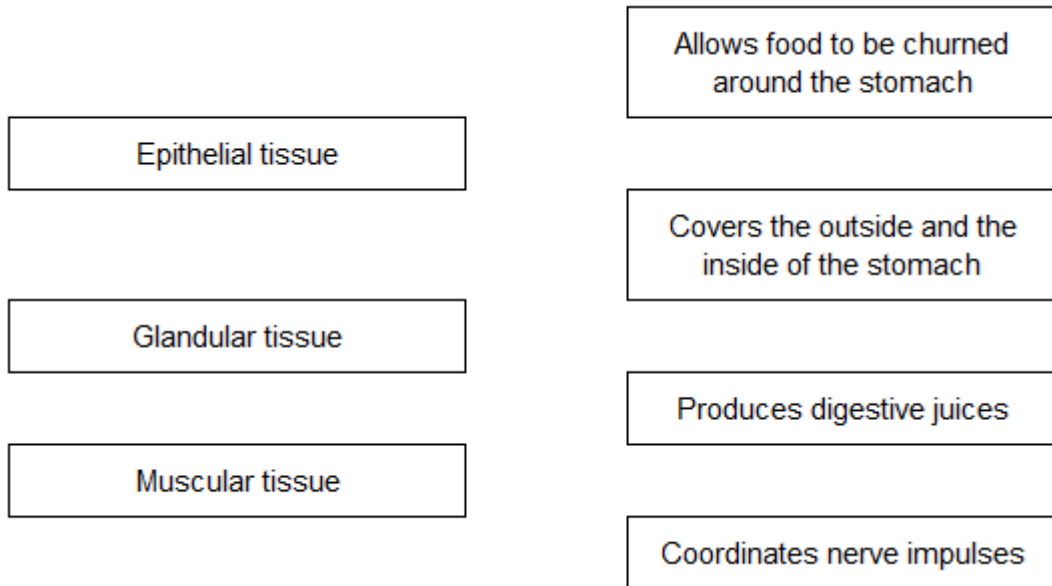
Figure 1



(2)

- (b) The stomach is made of different types of tissue.

Draw **one** line from each type of stomach tissue to the correct description.



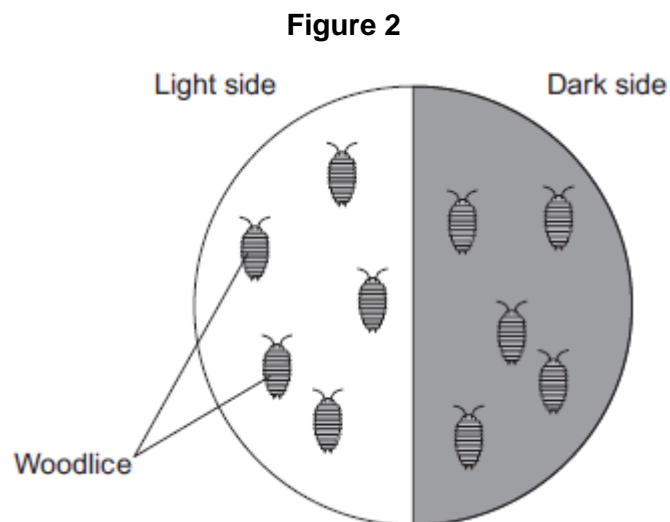
(3)

(c) Animals can react to their surroundings because they have nervous systems.

A student investigated the behaviour of small animals called woodlice.

The student set up the investigation as shown in **Figure 2**.

- The student covered one half of a Petri dish with black paper to make that side of the Petri dish dark.
- The other side had no cover.
- The student put five woodlice into each side of the dish and then put the clear Petri dish lid back on the dish.



After 30 minutes, all the woodlice had moved to the dark side of the Petri dish.

- (i) In this investigation, what is the **stimulus** that the woodlice responded to?

(1)

- (ii) In this investigation, what is the **response** that the woodlice made?

_____ (1)

(iii) The student concluded that woodlice prefer dark conditions.

Give **two** ways in which the student could improve the investigation to be sure that his conclusion was correct.

1. _____

2. _____

(2)
(Total 9 marks)

Q10.

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

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

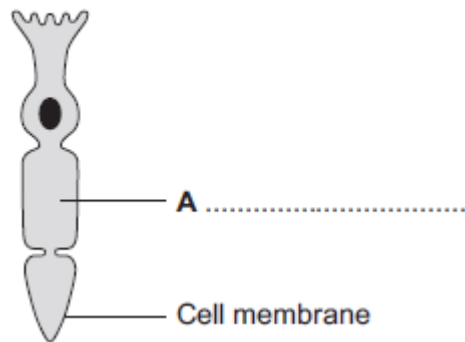
Draw a ring around the correct answer.

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**.

chloroplast	cytoplasm	vacuole
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(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.

Change in the environment	Organ that contains the receptors
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)

Q11.

This question is about the nervous system.

- (a) Describe the function of receptors in the skin.

(2)

- (b) A response is caused when information in the nervous system reaches an effector.

- (i) There are two different types of effector.

Complete the table to show:

- the two different types of effector
- the response each type of effector makes.

Type of effector	Response the effector makes
1
2

(4)

- (ii) Some effectors help to control body temperature.

Give **one** reason why it is important to control body temperature.

(1)

(Total 7 marks)

Q12.

Many runners drink sports drinks to improve their performance in races.

A group of students investigated the effects of three brands of sports drink, **A**, **B** and **C**, on the performance of three runners on a running machine. One of the runners is shown in

the image below.



© Keith Brofsky/Photodisc/Thinkstock

Table 1 gives information for each drink.

Table 1

	Brand of sports drink		
Nutrient per dm^3	A	B	C
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

- (a) (i) In the investigation, performance was measured as the time taken to reach the point of exhaustion.

Exhaustion is when the runners could not run anymore.

All three runners:

- ran on a running machine until the point of exhaustion
- each drank 500 cm^3 of a different brand of sports drink
- rested for 4 hours to recover
- ran on the running machine again and recorded how much time they ran until the point of exhaustion.

The speed at which the runners ran was the same and all other variables were controlled.

The students predicted that the runner drinking brand **B** would run for the shortest time on the second run before reaching the point of exhaustion.

Use information from **Table 1** to suggest an explanation for the students' prediction.

(2)

- (ii) If the balance between ions and water in a runner's body is not correct, the runner's body cells will be affected.

Describe **one** possible effect on the cells if the balance between ions and water is **not** correct.

(1)

- (b) When running, a runner's body temperature increases.

Describe how the brain monitors body temperature.

(3)

- (c) (i) **Table 2** is repeated here to help you answer this question.

Table 2

Nutrient per dm ³	Brand of sports drink		
	A	B	C
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

People with diabetes need to be careful about drinking too much sports drink.

Use information from **Table 2** to explain why drinking too much sports drink could make people with diabetes ill.

(3)

- (ii) Other than paying attention to diet, how do people with diabetes control their diabetes?

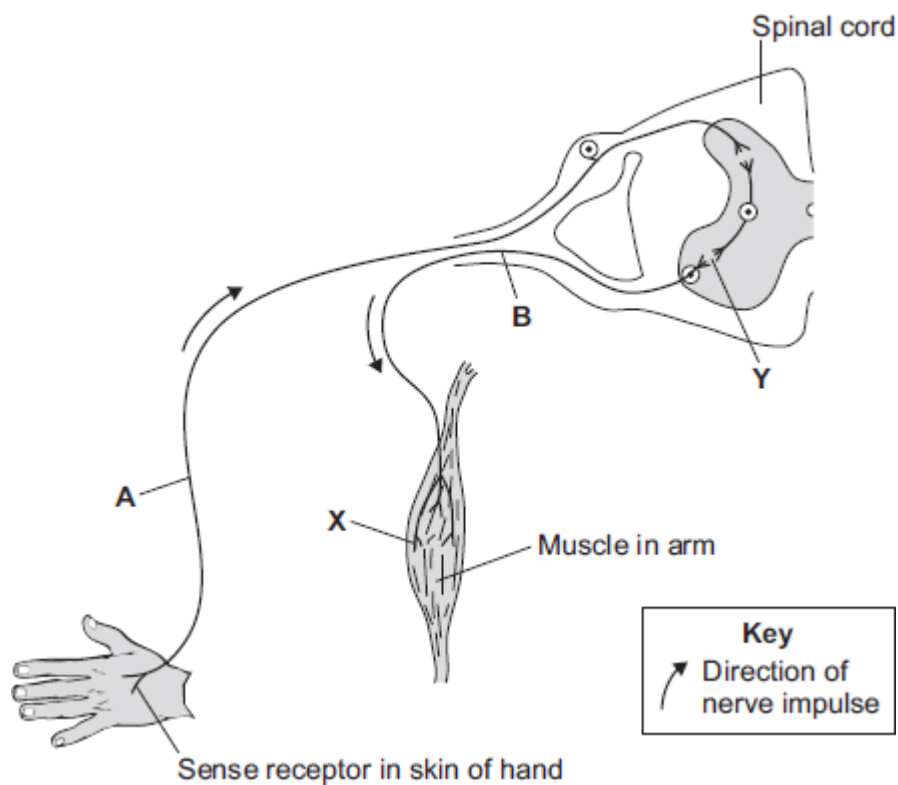
(1)

(Total 10 marks)

Q13.

- (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.

an effector.
a receptor.
a synapse.

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

(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)

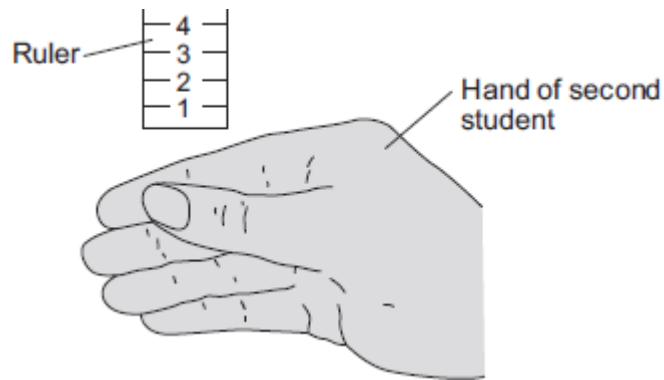
- (b) Some students investigated the effect of caffeine on a person's reaction time.

The students used the following steps.

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

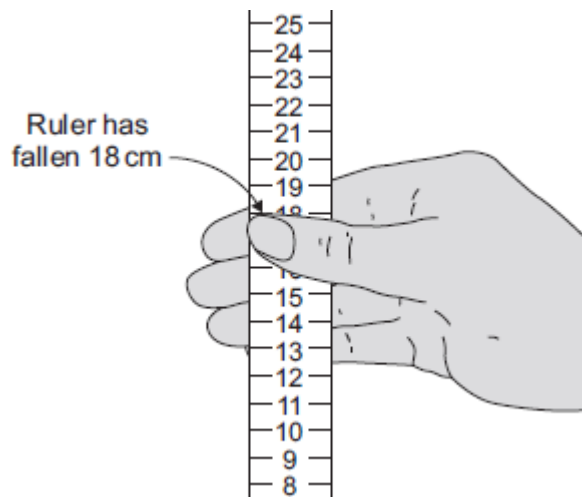
Diagram 2.

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
Before drinking coffee
18
21

Table 2

Distance ruler fell before it was caught in cm
After drinking coffee
8
13

25
15
19
16
12
21
Mean = 18.4

11
17
10
14
13
13
Mean = 12.4

- (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)

Q14.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The human body is kept at a constant internal temperature of about 37 °C.

Body temperature is monitored and controlled by the thermoregulatory centre in the brain.

Describe what happens in the body to keep the body temperature constant.

		Faeces	100
Total	2600	Total	2600

- (i) Calculate the volume of water lost from the body through breathing.

Use information from the table above.

Volume of water lost through breathing = _____ cm³

(2)

- (ii) Metabolic water is water produced by aerobic respiration.

Complete the equation for aerobic respiration.

_____ + oxygen \longrightarrow _____ + water (+ energy)

(2)

- (iii) If the water intake stays the same, what will happen to the volumes of sweat and urine lost from the body on a much hotter day?

Draw a ring around the correct answer to complete each sentence.

The volume of sweat will

decrease.

increase.

stay the same.

The volume of urine will

decrease.

increase.

stay the same.

(2)

- (b) The kidneys help to control the water content of the body and the concentrations of substances dissolved in the body fluids. The kidneys do this by filtering the blood and then reabsorbing back into the blood the substances needed by the body.

The table above shows typical concentrations of some of the substances dissolved in a person's blood plasma, in the kidney filtrate, and in the urine.

Substance	Blood plasma in g per dm ³	Kidney filtrate in g per dm ³	Urine in g per dm ³
Protein	70	0	0
Glucose	1	1	0
Urea	0.3	0.3	20

Sodium ions	3	3	6
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- (i) The table below shows that sodium ions are twice as concentrated in the urine as in the blood plasma.

Calculate how many times more concentrated **urea** is in the urine compared to the blood plasma.

Use information from the table.

Answer = _____ times more concentrated

(2)

- (ii) What is the main cause of this increase in concentration of urea between the blood plasma and the urine?

Tick (✓) **one** box.

Increased urea production by the kidney

Reabsorption of water by the kidney

Increased deamination of amino acids by the liver

(1)

- (iii) The table shows that both protein and glucose are found in the blood plasma but **not** in the urine.

Use your knowledge of kidney functioning to explain why.

Protein _____

Glucose _____

(4)

- (c) Some people have kidney failure.

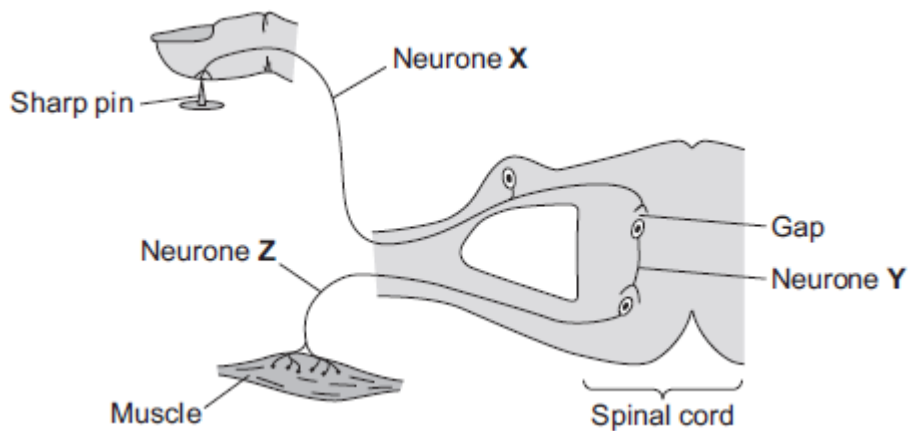
The two main types of treatment for kidney failure are dialysis and a kidney transplant operation.

Suggest reasons why most doctors think that a kidney transplant is better than dialysis treatment.

(4)
(Total 17 marks)

Q16.

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 _____

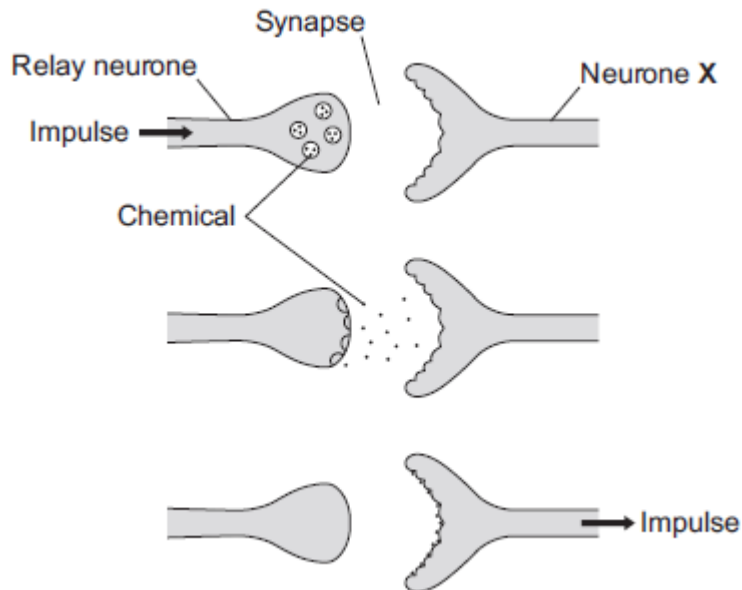
How this helps the body _____

(2)

(Total 5 marks)

Q17.

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 X
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)

Q18.

Human body temperature must be kept within narrow limits.

The image shows a cyclist in a race.



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- (a) Use the correct answer from the box to complete each sentence.

blood	brain	kidney	sweat	urine
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The cyclist's body temperature is monitored by a centre in the _____ .

This centre is sensitive to the temperature of the cyclist's _____ .

If the cyclist's body temperature increases, his body increases

the production of _____ .

(3)

- (b) (i) Cyclists drink sports drinks after a race.

The table below shows the ratio of glucose to ions in three sports drinks, **A**, **B** and **C**.

	Sports drink		
	A	B	C
Ratio of glucose (g per dm³) to ions (mg per dm³)	15:14	12:1	2:7

The closer this ratio of glucose to ions is to 1:1 in a sports drink, the faster the body replaces water.

Which sports drink, **A**, **B** or **C**, would replace water fastest in an

athlete?

(1)

- (ii) Why should sports drinks contain ions?

(1)

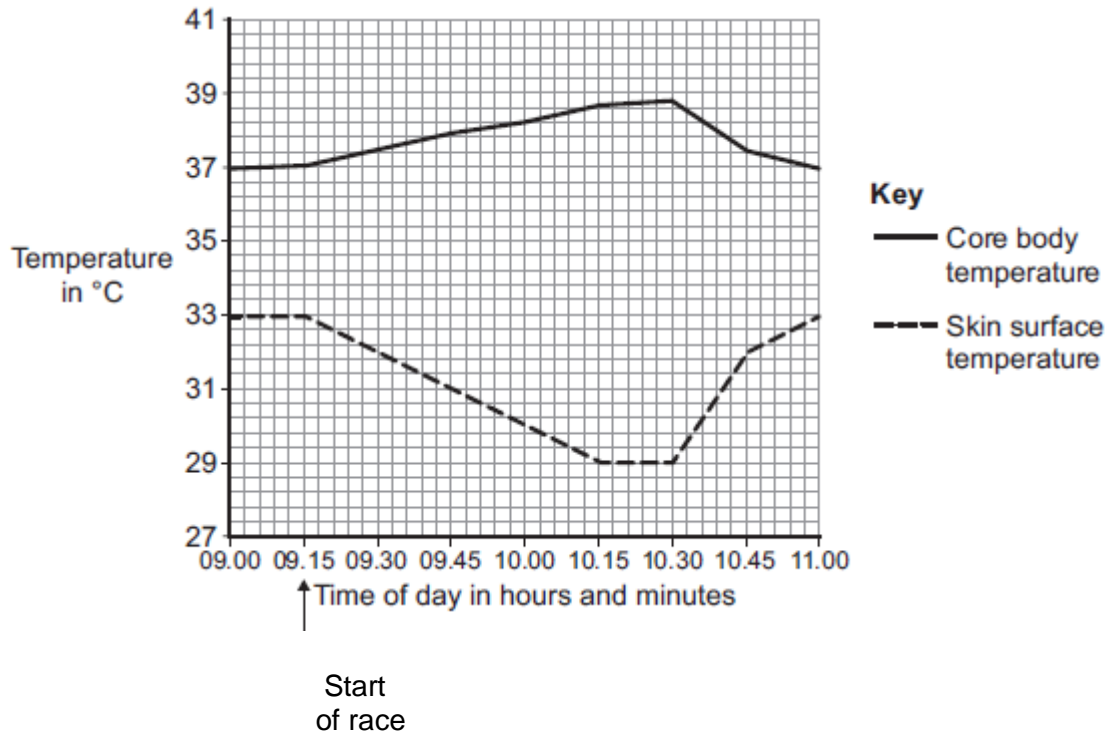
- (iii) Why should a person with diabetes **not** drink too much sports drink?

(1)

(Total 6 marks)

Q19.

The graph shows the core body temperature and the skin surface temperature of a cyclist before, during and after a race.



- (a) (i) When the cyclist finished the race, his core body temperature started to decrease.

How long did the race last?

(1)

- (ii) Describe and explain the different patterns shown in the core body temperature and skin surface temperature between 09.15 and 10.15.

(6)

- (iii) After 10.30, the core body temperature decreased.

Explain how changes in the blood vessels supplying the skin caused the skin surface temperature to increase.

(2)

- (b) During the race, the cyclist's blood glucose concentration began to decrease.

Describe how the body responds when the blood glucose concentration begins to decrease.

(3)

(Total 12 marks)

Q20.

The body controls internal conditions.

- (a) Use words from the box to complete the sentences about water loss from the body.

kidneys	liver	lungs	skin
----------------	--------------	--------------	-------------

(i) Water is lost in sweat via the _____

(1)

(ii) Water is lost in urine via the _____

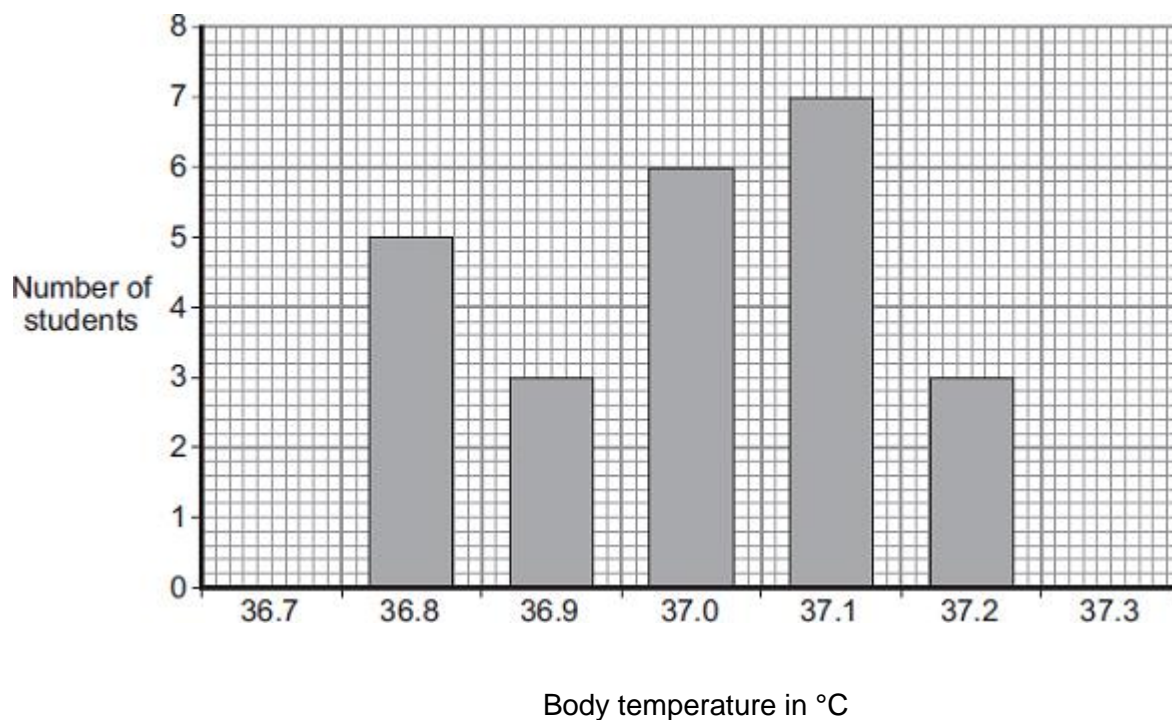
(1)

(iii) Water is lost in the breath via the _____

(1)

- (b) Students investigated body temperature in the class.

The bar chart shows the results.



- (i) One student used the bar chart to calculate the mean body temperature of the class.
The student calculated the mean body temperature as 37.0 °C.

How did the student use the bar chart to calculate the mean?

(2)

- (ii) How many students had a body temperature higher than the mean of 37.0 °C

(1)

- (iii) Body temperature must be kept within a narrow range.

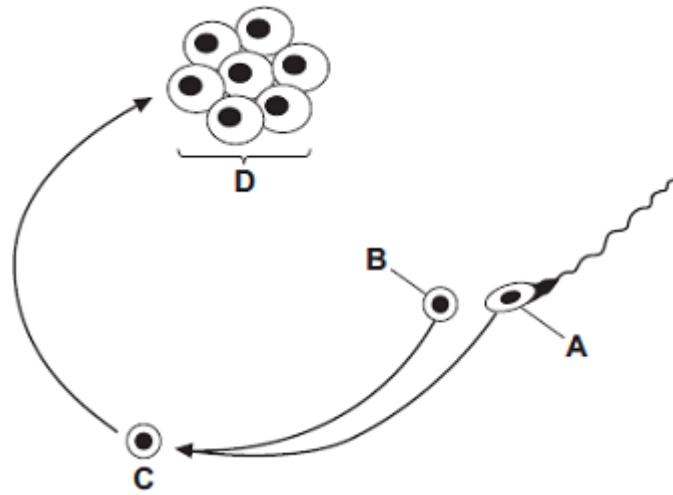
Why?

(1)

(Total 7 marks)

Q21.

The diagram shows some of the stages in IVF (in vitro fertilisation).



(a) Use words from the box to name structures **A**, **B**, **C** and **D**.

egg	embryo	fertilised egg	ovary	sperm
-----	--------	----------------	-------	-------

Structure **A** _____

Structure **B** _____

Structure **C** _____

Structure **D** _____

(4)

(b) What do doctors do next with structure **D**?

(2)

(c) The table gives statistics for an IVF clinic.

	Age of women treated			
	Below 35 years	35 – 37 years	38 – 39 years	40 – 42 years
Number of women treated	414	207	106	53
Number of women who produced one baby	90	43	17	1

Number of women who produced twins	24	8	4	1
Number of women who produced triplets	1	0	0	0

- (i) About what proportion of the treated women aged 35 – 37 years produced one or more babies?

Draw a ring around your answer.

one quarter one third half

(1)

- (ii) This clinic does **not** give IVF treatment to women over 42 years of age.

Use data from the table to explain why.

(2)

- (iii) The committee which regulates IVF treatment now advises that only one embryo is used in each treatment.

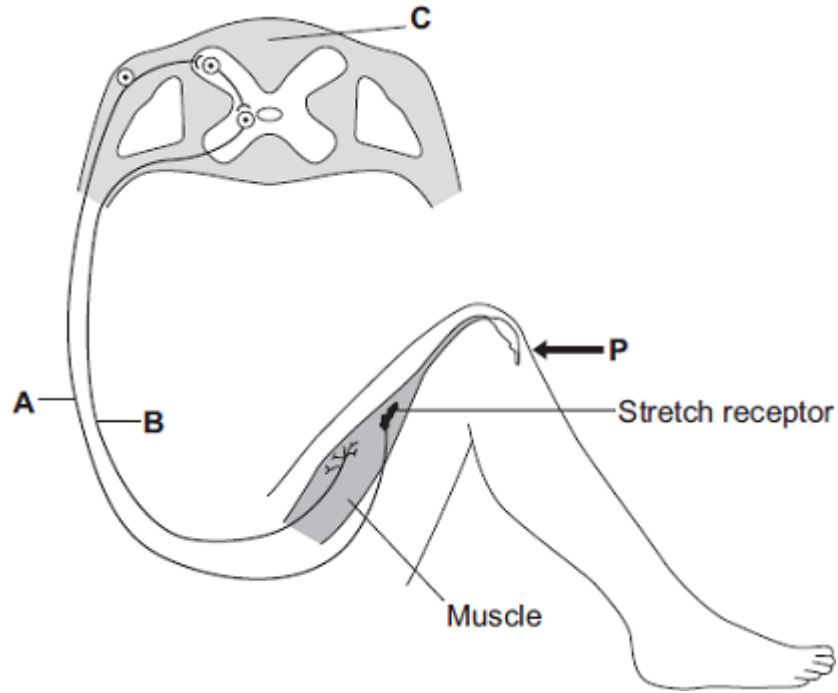
Suggest **one** reason for this.

(1)

(Total 10 marks)

Q22.

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?

(1)

(Total 5 marks)

Q23.

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.

(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)

Q24.

Penguins live mainly in the Antarctic. Penguins eat mainly fish. **Photograph 1** shows a penguin swimming underwater.

Photograph 1



© raywoo/iStock

- (a) Use information from **Photograph 1** to suggest **three** ways the penguin is adapted for catching fish.

1. _____

2. _____

3. _____

(3)

- (b) The Antarctic winter is very cold. In the winter some species of penguin huddle together as shown in **Photograph 2**.

Photograph 2

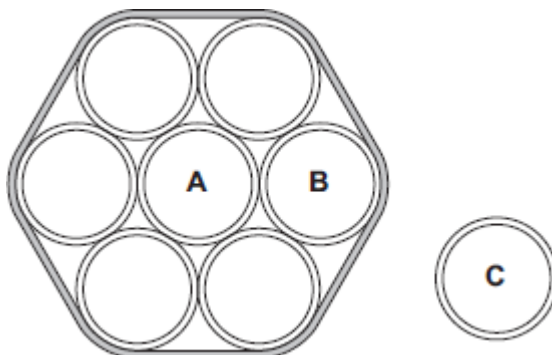


© Fuse

Suggest how the behaviour shown in **Photograph 2** helps the penguins to survive the Antarctic winter.

- (c) A student did an investigation to model the behaviour of the penguins shown in **Photograph 2**.

The diagram shows the apparatus the student used.



The student:

- held seven similar test tubes together with elastic bands as shown in the diagram
- stood a similar eighth tube in a test tube rack
- filled each of the eight tubes with hot water to the same level
- measured the temperature of the water in tubes **A**, **B** and **C** every 2 minutes for 20 minutes.

The table shows the student's results.

Time in Minutes	Temperature in °C		
	Tube A	Tube B	Tube C
0	65	65	65
2	65	65	64
4	65	64	63
6	64	64	62
8	64	63	61
10	64	63	60
12	63	62	59
14	63	62	58
16	63	61	57

18	62	61	56
20	62	60	55

(i) Give **two** variables that were controlled in the investigation.

1. _____
2. _____

(2)

(ii) Describe the patterns the data shows.

(2)

(iii) How far does the data from the model support the suggestion you made in part **(b)**?

(2)

(d) Describe how blood vessels help control human body temperature.

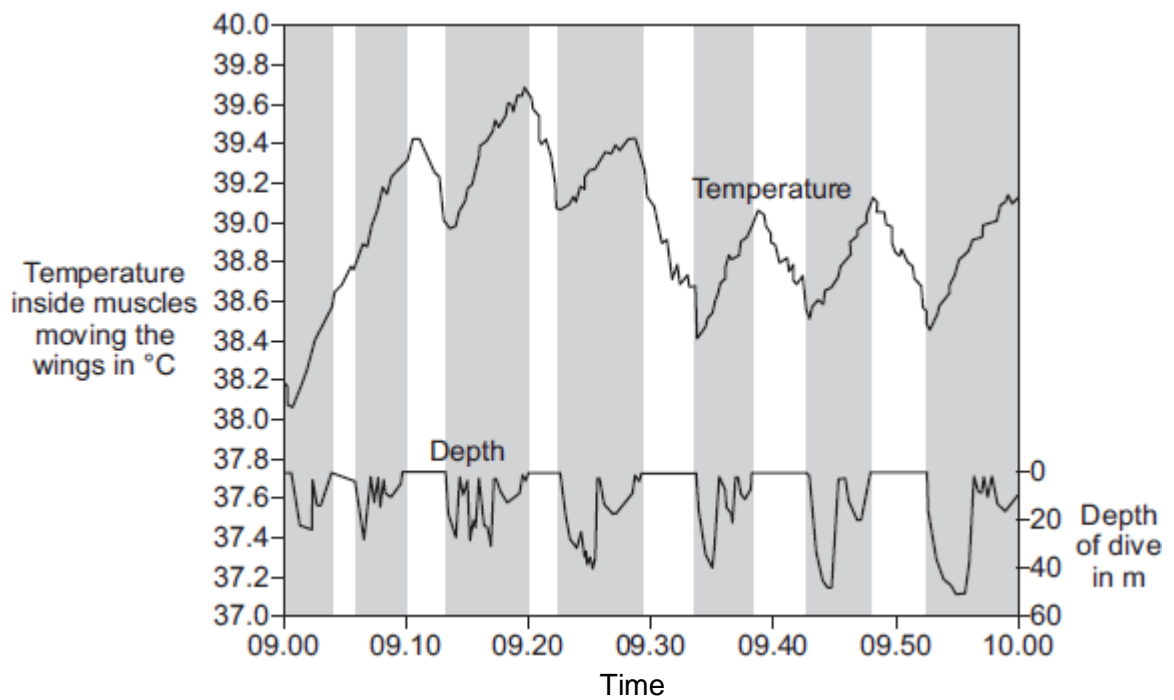
(4)

(e) Penguins control their body temperature in similar ways to humans. Scientists investigated changes in body temperature of penguins when the penguins were diving to catch fish.

(i) **Graph 1** shows the relationship between the temperature of the muscles moving a penguin's wings and diving.

The shaded areas show when the penguin was diving.

Graph 1



© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

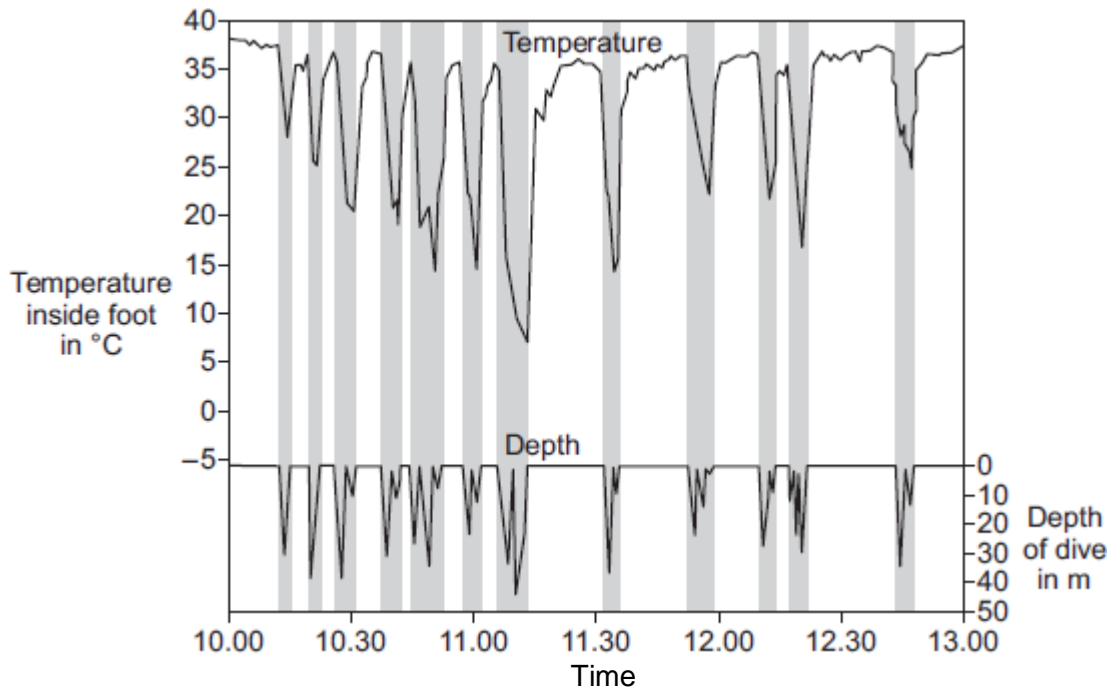
Suggest an explanation for the changes in temperature inside the muscles moving the penguin's wings.

(3)

- (ii) **Graph 2** shows the relationship between the temperature inside a penguin's foot and diving.

The shaded areas show when the penguin was diving.

Graph 2



© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

Suggest an explanation for the changes in temperature inside the penguin's foot as it dives.

(3)
(Total 22 marks)

Q25.

The photograph shows an athlete at the start of a race.



© Wavebreakmedia Ltd./Thinkstock

(a) The athlete's sense organs contain special cells. These special cells detect changes in the environment.

(i) **List A** shows changes in the environment.

List B shows some of the athlete's sense organs.

Draw **one** line from each change in the environment in **List A** to the sense organ detecting the change in **List B**.

List A Change in the environment	List B Sense organ
Sight of the finishing line	Ear
Sound of the starting gun	Nose
Pressure of the ground on the fingers	Eye
	Skin

(3)

(ii) Which cells detect changes in the environment?

Tick (✓) **one** box.

Gland cells

Muscle cells

receptor cells



(1)

(b) During the race, the concentration of sugar in the athlete's blood decreases.

Why?

(1)

(c) Some athletes use anabolic steroids to improve performance.

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

Anabolic steroids increase

breathing rate.

growth of muscles.

heart rate.

(1)

(ii) Sporting regulations ban the use of anabolic steroids.

Suggest **one** reason why.

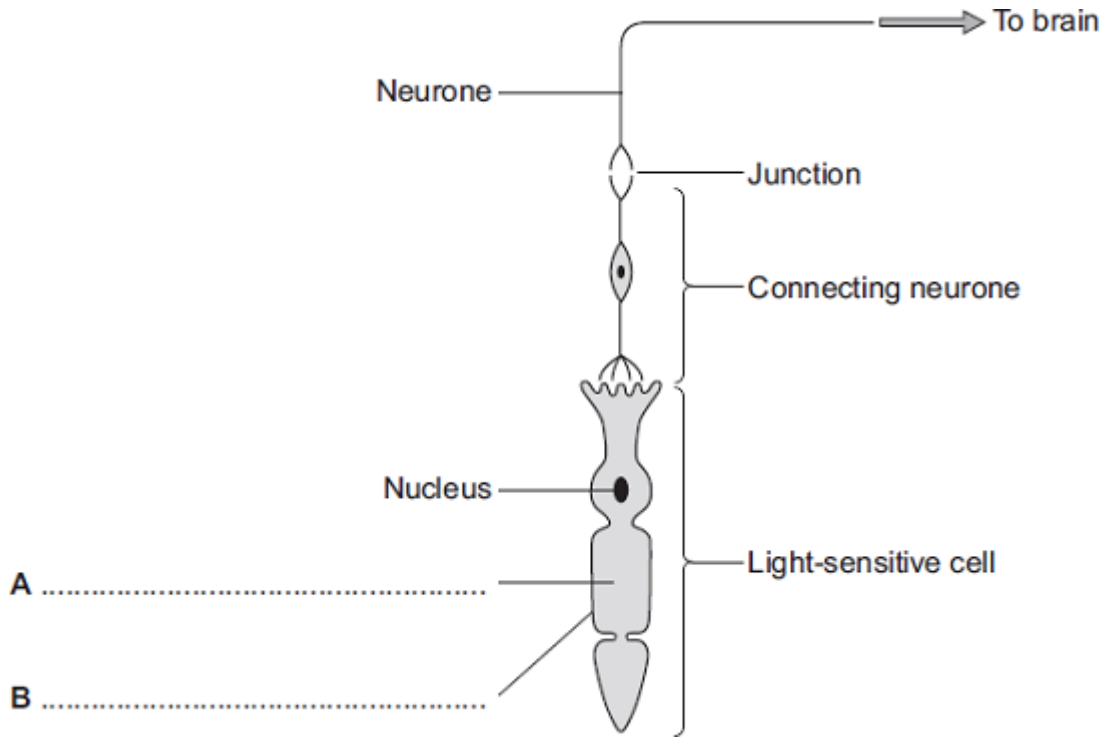
(1)

(Total 7 marks)

Q26.

Diagram 1 shows cells from the light-sensitive layer in the eye.

Diagram 1



(a) On **Diagram 1**, add labels to name part **A** and part **B** of the light-sensitive cell. (2)

(b) There is a junction between the connecting neurone and the neurone carrying the impulse to the brain.

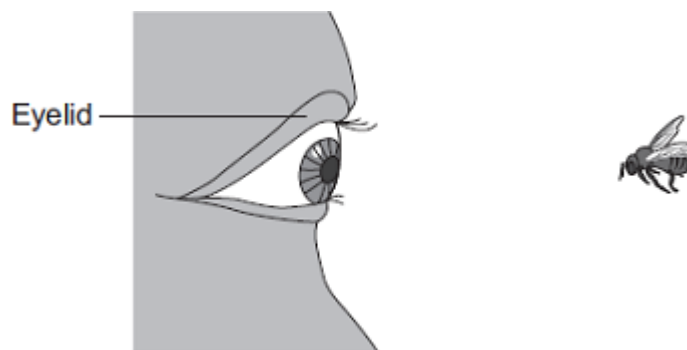
(i) What name is given to the junction?

_____ (1)

(ii) In what form is information passed across the junction?

_____ (1)

(c) **Diagram 2** shows a bee flying towards a man's eye.



In the *blink reflex*, light from the bee reaches the light-sensitive cell in the eye. The muscles in the eyelid shut the man's eye before the bee hits the eye.

Describe the pathway taken by the nerve impulse in the *blink reflex*.

(4)

(Total 8 marks)

Q27.

Humans maintain an almost constant body temperature.

- (a) Describe the role of blood vessels in the control of body temperature.

(4)

- (b) An athlete can run a marathon in 2 hours 15 minutes on a dry day in outside temperatures up to 35 °C.

If the air is dry, his body will **not** overheat.

In humid conditions the same athlete can run the marathon in the same time. However, in humid conditions, if the outside temperature goes over 18 °C then his body **will** overheat.

Suggest an explanation for the athlete overheating in humid conditions.

(3)
(Total 7 marks)

Q28.

Nicotine is a drug in tobacco smoke. Smoking tobacco is harmful.

- (a) (i) Many smokers find it difficult to stop smoking.

Complete the sentence.

It is difficult to stop smoking because nicotine is very _____ .

(1)

- (ii) Nicotine affects synapses in the brain.

What is a synapse?

(1)

- (b) A drug company has developed a new drug, Drug **A**, to help people stop smoking.

Doctors tested the drug in a double-blind trial with over 2000 volunteers who weresmokers.

The volunteers wanted to stop smoking.

The volunteers were divided into three groups. Each volunteer took a tablet once a day for 12 weeks:

- group 1 took Drug **A**
- group 2 took Drug **B** (a drug already in use to stop people smoking)
- group 3 took a placebo.

The smoking habits of each group were recorded for a year.

- (i) What is a placebo?

(1)

- (ii) Why is a placebo group used in drug trials?

(1)

(iii) Which people knew what was in each tablet, in this trial?

Tick (✓) **one** box.

Both doctors and volunteers

Doctors but not volunteers

Neither doctors nor volunteers

(1)

(iv) It is important that the three groups of volunteers should be similar.

Give **two** factors that should be similar in the groups of volunteers.

1. _____

2. _____

(2)

(c) The table shows the results of the trials.

Tablet	Percentage of volunteers who had stopped smoking	
	After 12 weeks	After 1 year
Drug A	44	23
Drug B	30	15
Placebo	18	10

A doctor looked at the results of the tests.

The doctor suggested that a smoker who wanted to give up smoking should use Drug A.

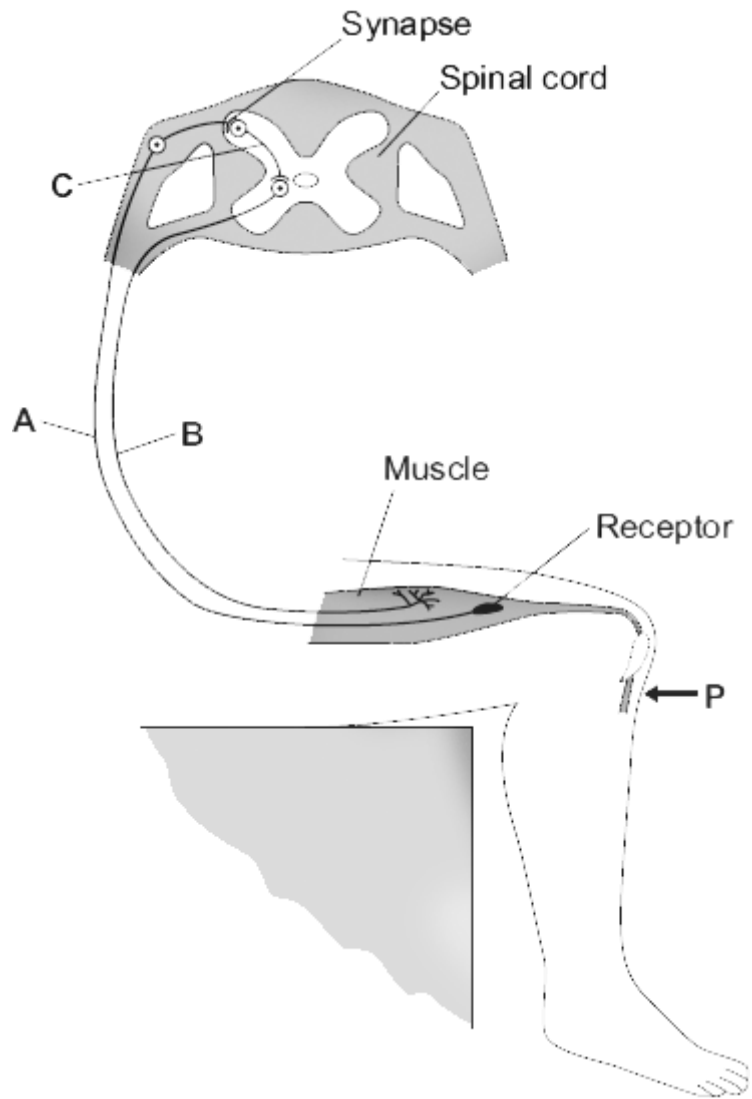
Why?

(1)

(Total 8 marks)

Q29.

The diagram shows the nervous pathway used to coordinate the knee-jerk reflex. When the person is hit at point **P**, the lower leg is suddenly raised.



(a) Name neurones **A**, **B** and **C**.

A _____

B _____

C _____

(3)

(b) The receptor in the muscle in the leg is sensitive to a stimulus.

Suggest the stimulus.

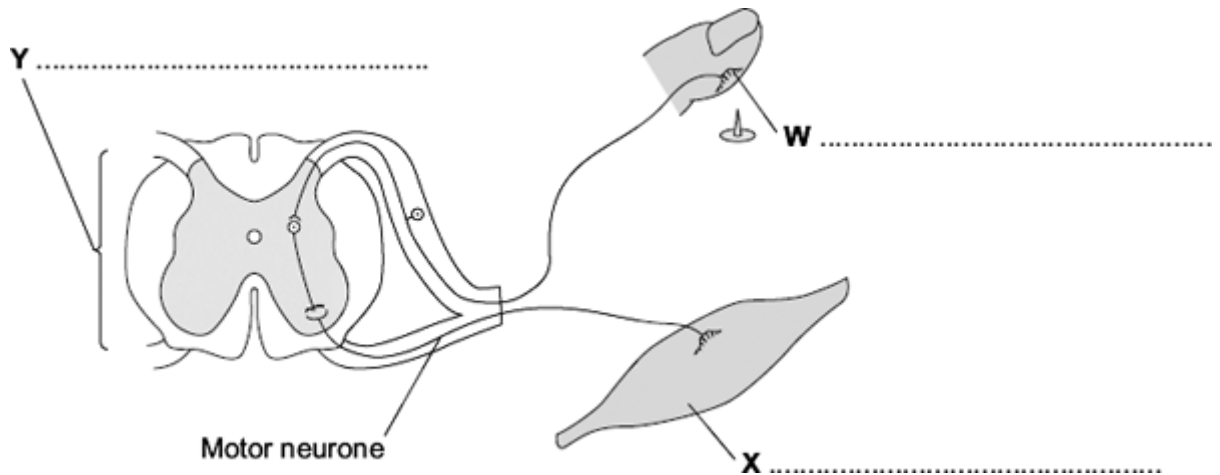
(1)

(c) Describe what happens at the synapse during this reflex.

(3)
(Total 7 marks)

Q30.

The diagram shows the structures involved in a reflex action.



(a) On the diagram, name the structures labelled **W**, **X** and **Y**.

(3)

(b) The control of blood sugar level is an example of an action controlled by hormones.

Give **two** ways in which a reflex action is different from an action controlled by hormones.

1. _____

2. _____

(2)
(Total 5 marks)

Q31.

A group of students is going on an outdoor expedition.
The students need to keep warm in windy conditions.

The table shows the effect of wind speed on how quickly someone gets frostbite at different air temperatures.

Wind speed in metres	Air temperature in °C
----------------------	-----------------------

per second	10	0	-10	-20	-30
0					
5					
10					
15					
20					

Key	
Time taken to get frostbite:	<input type="checkbox"/> No frostbite
	<input type="checkbox"/> 30 minutes
	<input type="checkbox"/> 10 minutes
	<input type="checkbox"/> 5 minutes

- (a) (i) Describe the effect of changing air temperature on the time taken to get frostbite.

(1)

- (ii) What is the longest time it is safe to stay outside when the air temperature is -20°C and the wind speed is 10 metres per second?

_____ minutes

(1)

- (b) When core body temperature begins to fall, changes may happen in the body.

Which **two** changes will happen when core body temperature begins to fall?

Tick (✓) **two** boxes.

More blood flows through skin capillaries

Muscles 'shiver'

Blood vessels supplying the skin capillaries constrict

Sweat glands release more sweat

(2)

Q32.

The nervous system allows humans to react to their surroundings.

- (a) Sense organs have receptors. Receptors detect *changes in the environment*.

Which word describes *a change in the environment*?

Draw a ring around **one** answer.

an effector a neurone a stimulus

(1)

- (b) The photograph shows a baby.
Labels **A**, **B**, **C**, **D** and **E** show some of the baby's sense organs.

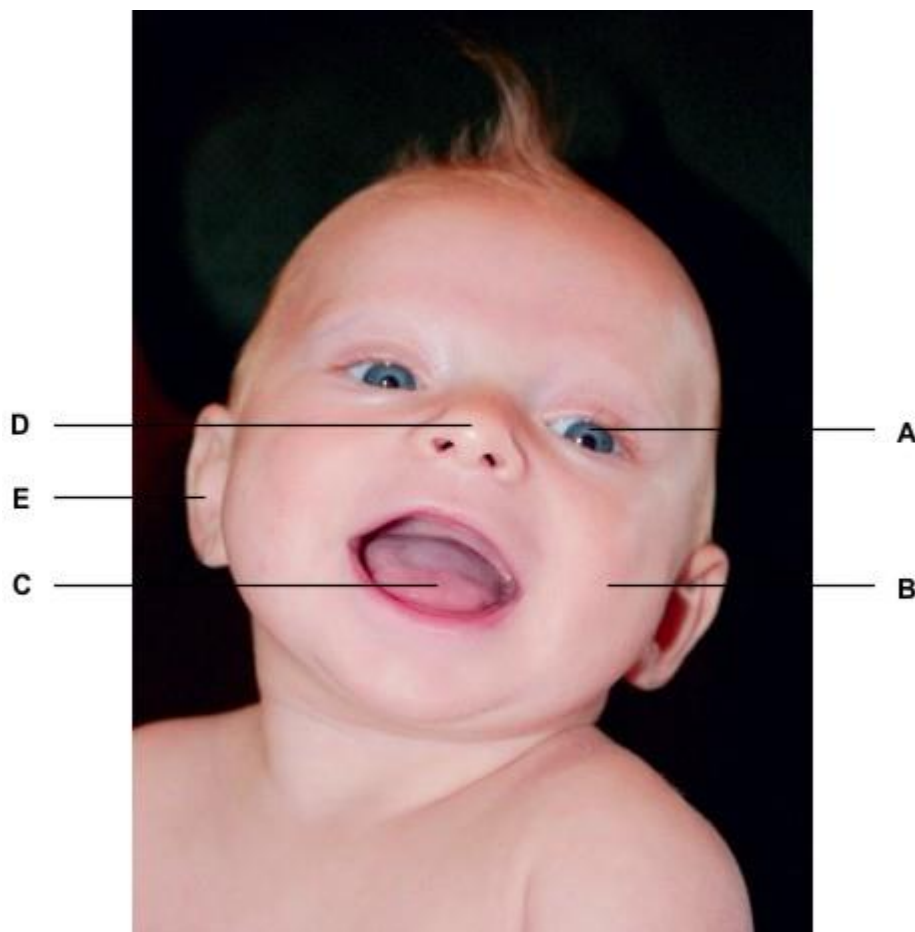


Photo by D. Sharon Pruitt [CC-BY-2.0], via Wikimedia Commons

Answer each question by writing **one** letter, **A**, **B**, **C**, **D** or **E**, in each box.

- (i) Which sense organ has receptors sensitive to light?

(1)

- (ii) Which **two** sense organs have receptors sensitive to chemicals?

and

(2)

(iii) Which sense organ has receptors sensitive to changes in the baby's position?

(1)

- (c) Information from sense organ **A** is passed along nerve cells. The information is coordinated to produce a response.

Which organ in the body coordinates the information?

(1)

(Total 6 marks)

Q33.

- (a) **List A** gives the names of three stages in trialling a new drug.

List B gives information about the three stages.

Draw a line from each stage in **List A** to the correct information in **List B**.

List A Stage

List B Information

Tests on humans including a placebo

Used to find if the drug is toxic

Tests on humans using very small quantities of the drug

The first stage in the clinical trials of the drug

Tests on animals

Used to find the optimum dose of the drug

Used to prove that the drug is effective on humans

(3)

(b) Read the passage.

Daily coffee dose delays development of Alzheimer's in humans.

Alzheimer's is a brain disease that causes memory loss in elderly people. Scientists studied 56 mice that had been genetically engineered to develop Alzheimer's.

Before treatment all the mice did badly in memory tests.

Half the mice were given a daily dose of caffeine in their drinking water. The dose was equivalent to the amount of caffeine in six cups of coffee for a human.

The other mice were given ordinary water.

After two months, the caffeine-drinking mice did better in memory tests than the mice drinking ordinary water.

The headline for the passage is not justified.

Explain why as fully as possible.

(3)
(Total 6 marks)

Q34.

One group of scientists is working in a hot desert and another group is working in a tropical rainforest.

The table shows information about the scientists and the conditions in the desert and the rainforest.

Information	Hot desert	Rainforest
Mean core body temperature of scientists in °C	37.3	38.9
Air temperature in °C	36.0	35.5

Mean percentage concentration of moisture in the air	9.0	92.0
Mean wind speed at ground level in metres per second	12.0	3.0

- (a) Both groups of scientists are doing similar jobs. The jobs cause the scientists to sweat a lot.

Use information from the table to explain the difference in the mean core body temperature of the two groups of scientists.

(2)

- (b) Changes to blood vessels in the skin help to decrease body temperature.

Explain how.

(2)

(Total 4 marks)

Q35.

The temperature in a sauna is much hotter than core body temperature.

A woman sits in a sauna.

The high temperature of the sauna causes the woman's core body temperature to rise.

- (a) When the woman's core body temperature rises, the woman's rate of sweating increases.

Explain why.

(2)

- (b) The woman comes out of the sauna.
The woman's skin looks redder than when she went into the sauna.

Describe what happened to the blood circulation in her skin to cause this change in colour.

(2)

- (c) After coming out of the sauna the woman gets into a bath of icy water.
This makes the woman shiver.

- (i) What process brings about shivering?

(1)

- (ii) Shivering increases body temperature.

Explain how.

(2)

(Total 7 marks)

Q36.

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

Helps the baby to hold on to the mother

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

Prevents the baby from choking

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

Helps to protect some of the baby's receptors

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

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)

Q37.

Caffeine is a *recreational* drug found in drinks such as coffee and cola.

(a) What is meant by a *recreational drug*?

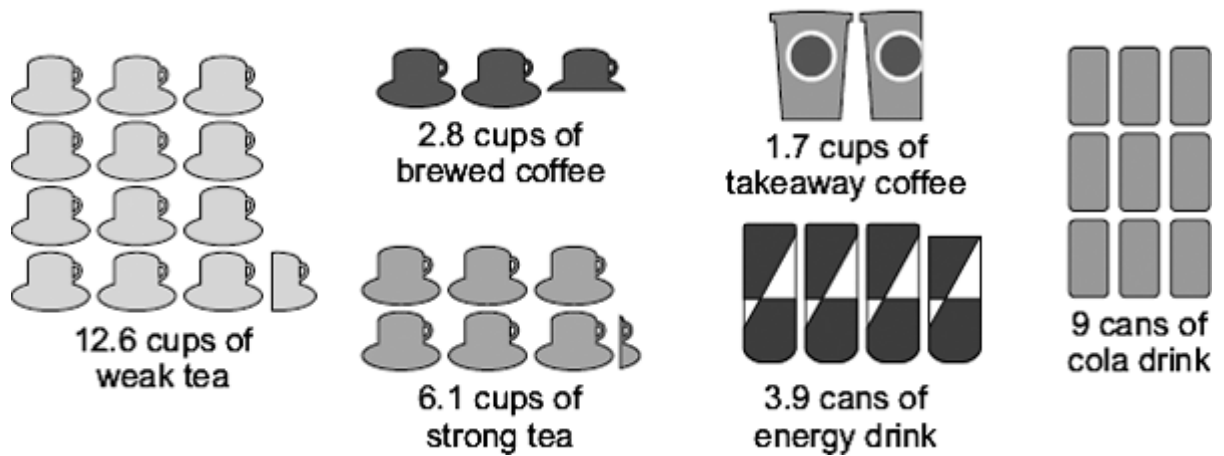
(1)

(b) Scientists investigated the effect on the brain of drinking large amounts of caffeine.

They chose students whose drinks contained caffeine equal to at least seven cups of instant coffee each day.

The diagram compares the amount of caffeine in different drinks.

Seven cups of instant coffee a day equals:



(i) Seven cups of instant coffee contain 315 mg of caffeine.

How much caffeine is there in **one** cup of instant coffee?

Amount of caffeine _____ mg

(1)

(ii) Which drink in the diagram contains the highest amount of caffeine?

Tick (✓) **one** box.

A cup of weak tea



A cup of takeaway coffee

A can of cola

(1)

(c) Caffeine may cause hallucinations.

One example of a hallucination is hearing voices that are not there.

The scientists found that students who drank more than seven cups of instant coffee per day were three times more likely to have hallucinations than students who drank one cup or less.

Which is the best conclusion?

Tick (✓) **one** box.

Drinking caffeine causes hallucinations.

It is dangerous to drink caffeine.

There is a link between drinking caffeine and hallucinations.

(1)

(Total 4 marks)

Q38.

A walker falls through thin ice into very cold water.



The walker's core body temperature falls. He may die of hypothermia (when core body temperature falls too low).

(a) (i) Which part of the brain monitors the fall in core body temperature?

(1)

(ii) How does this part of the brain detect the fall in core body temperature?

(2)

(b) While in the water the walker begins to shiver.

Shivering helps to stop the core body temperature falling too quickly.

Explain how.

(2)

(c) The walker had been drinking alcohol.

Alcohol causes changes to the blood vessels supplying the skin capillaries, making the skin look red.

(i) Describe the change to the blood vessels.

(1)

(ii) The walker is much more likely to die of hypothermia than someone who has not been drinking alcohol.

Explain why.

(2)

(Total 8 marks)

Conditions inside the body must be kept constant.

(a) Urea must be removed from the body.

(i) Name the organ which makes urea.

_____ (1)

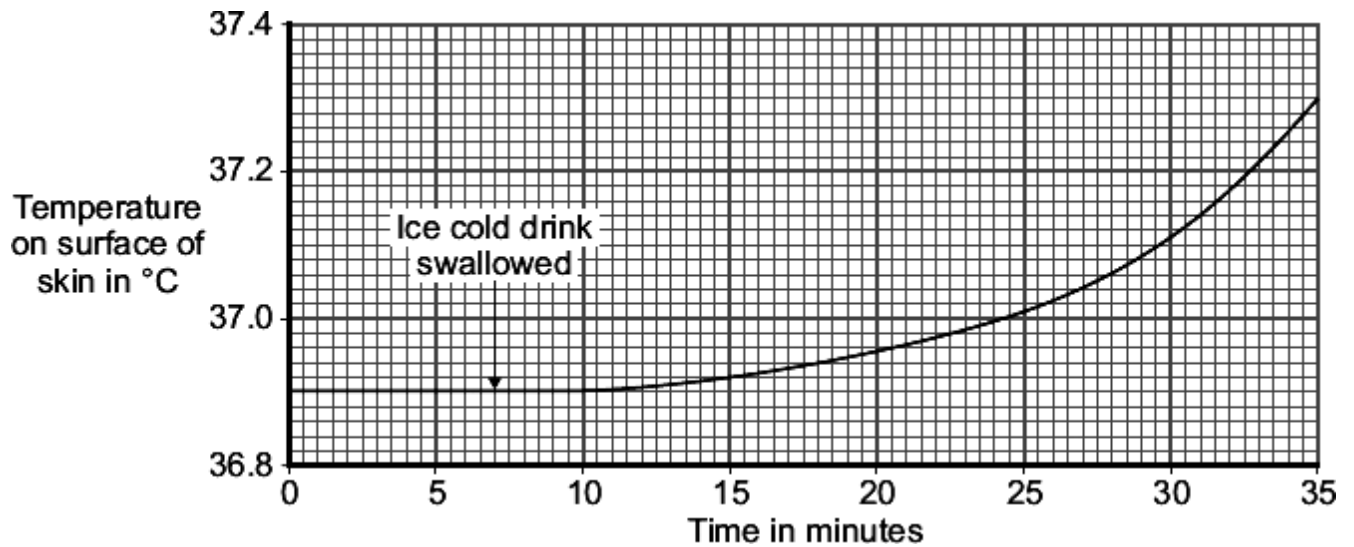
(ii) Which organ removes urea from the body?

_____ (1)

(iii) What is urea made from?

_____ (1)

A man sat in a room where the temperature was maintained at 40 °C. The temperature on the surface of his skin was monitored for 35 minutes. He swallowed an ice cold drink at the time indicated on the graph.



(b) The sweat glands contribute to the change in the temperature on the surface of the skin shown on the graph.

Explain how.

(2)

(c) The blood vessels near the surface of the skin also contribute to the changes in skin

temperature shown on the graph.

- (i) How do the blood vessels in the skin change when the core body temperature falls?

(1)

- (ii) How does this change in the blood vessels explain the change in the skin temperature shown on the graph?

(1)

(Total 7 marks)

Q40.

The photograph shows a girl waiting to cross a road.



© Lionel Lassman

- (a) Name **two** different sense organs she would use to detect when it is safe to cross the road.

1. _____

2. _____

(2)

- (b) Which sense organ contains receptors that help the girl to keep her balance?

(1)

- (c) (i) Complete the sentence.

A car driver automatically brakes if a child dashes out into the road.

This is called a _____ action.

(1)

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

In the nervous system, information passes along cells called

- | |
|-----------|
| effectors |
| neurones |
| synapses |

(1)

(Total 5 marks)

Q41.

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)

Q42.

During exercise an athlete's core body temperature may rise.

- (a) What causes this rise in core body temperature?

(1)

- (b) During a long race one athlete did not drink any liquid. Towards the end of the race the amount of sweat he produced began to fall.

- (i) This athlete's core body temperature increased more than that of other similar athletes who had drunk enough liquid during the race.

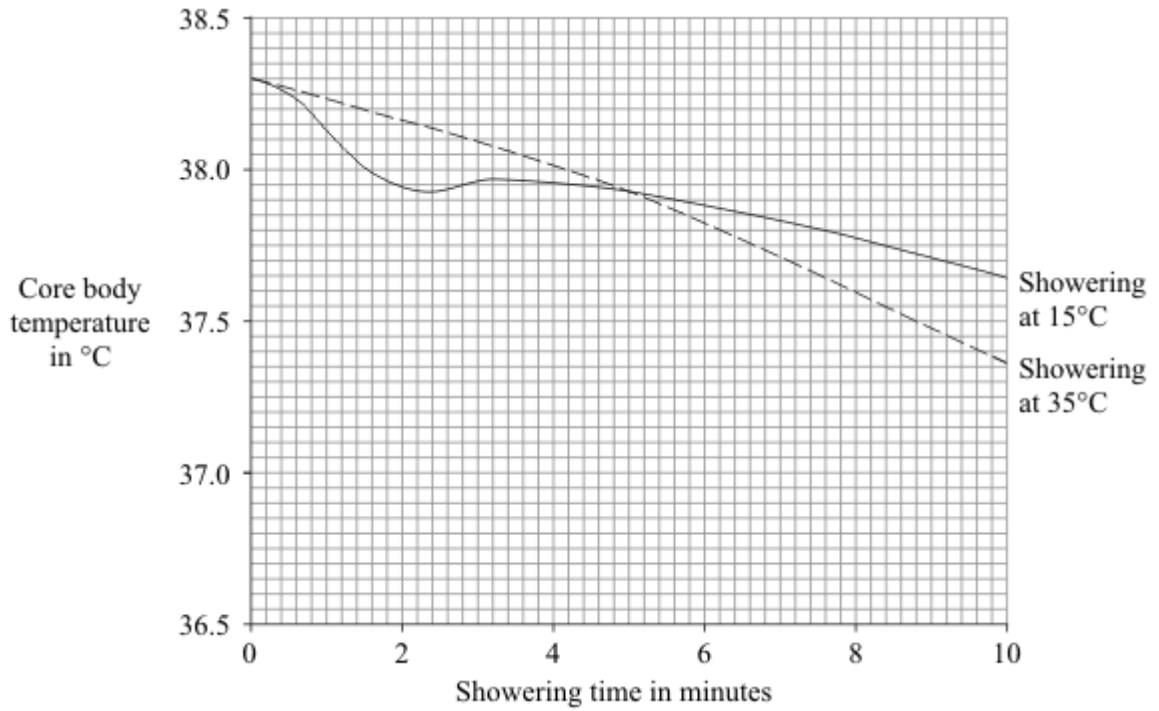
Explain why.

(2)

- (ii) Describe **one** other way in which this athlete's body would respond in order to reduce core body temperature.

(2)

- (c) The graph shows the effects of showering for ten minutes at 15 °C and at 35 °C on core body temperature after a long race.



Suggest an explanation for the differences in core body temperature:

- (i) between 0 and 2 minutes

(1)

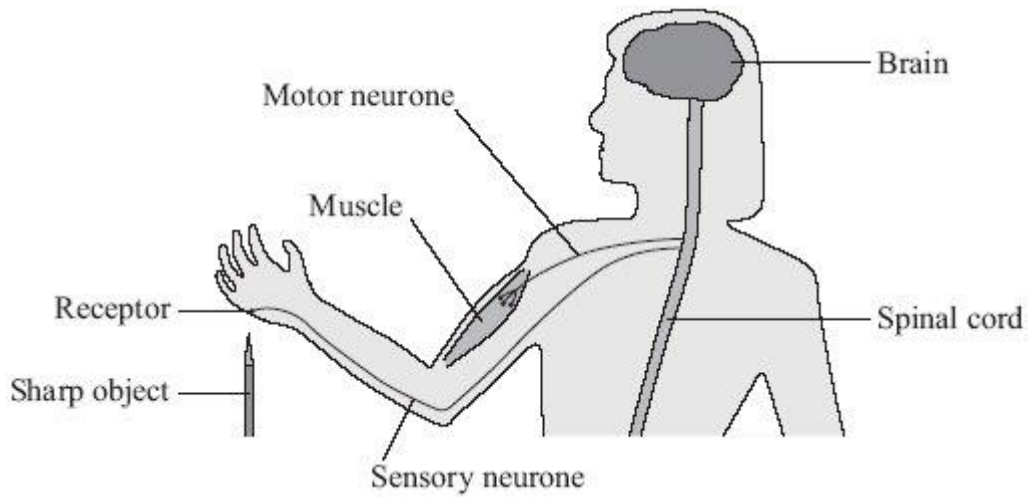
- (ii) between 4 and 10 minutes.

(2)

(Total 8 marks)

Q43.

A student accidentally touches a sharp object.
 Her hand is immediately pulled away from the object.
 The diagram shows the structures involved in this response.



- (a) Use the correct word or phrase **from the diagram** to complete each sentence.
- (i) The stimulus is detected by the _____ (1)
- (ii) Impulses travel to the central nervous system along a cell called a _____ (1)
- (iii) Impulses travel from the central nervous system to the effector along a cell called a _____ (1)
- (iv) The hand is pulled away from the sharp object by the _____ (1)
- (b) Where in the body are there cells sensitive to:
- (i) light _____ (1)
- (ii) sound _____ (1)
- (iii) changes in position? _____ (1)
- (Total 7 marks)**

