OCR GCSE GATEWAY BIOLOGY A · J247

BIOLOGY



EXAM QUESTION PACK

B3.1 COORDINATION AND CONTROL: THE NERVOUS SYSTEM

SCORE	PERCENTAGE
/141	%

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Gateway Biology A (9-1)

Coordination and control - the nervous system

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

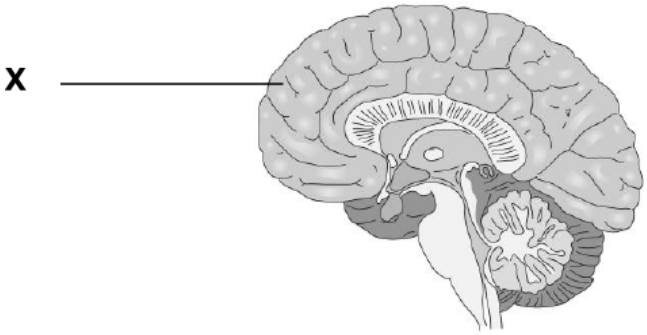
- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **141**.
- The total number of marks may take into account some 'either/or' question choices.

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1 The diagram shows the brain.
What is the name of part **X**?



A cerebellum
B cerebrum
C hypothalamus
D medulla

Your answer ☐

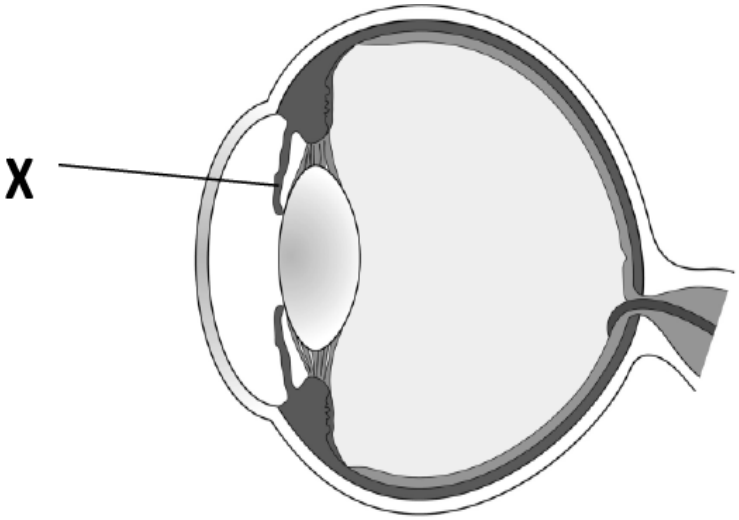
[1]

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2 The diagram shows the eye.
What is the name of part **X**?



A cornea
B iris
C lens
D pupil

Your answer

[1]

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3(a) A boy picks up a hot plate and quickly drops it.

This is a reflex action.

Describe the sequence of events that happens in his nervous system during this reflex action.

---

[5]

(b) Explain why it is important that this response is a reflex and **not** controlled consciously by the brain.

---

[3]

4 Which part of the brain automatically controls heart rate and breathing rate?

A cerebellum
B cerebrum
C hypothalamus
D medulla

Your answer ☐

[1]

5 Which eye defect can be overcome by using spectacles containing concave lenses?

A colour blindness
B eye ball too short
C long sight
D short sight

Your answer ☐

[1]

6(a) A boy picks up a hot plate and quickly drops it.

This is a reflex action.

Describe the sequence of events that happens in his nervous system during this reflex action.

[5]

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(b) The table shows information about different types of neurons.

Type of neurone	Diameter ($x10^{-3}$ mm)	Is myelin sheath present?	Speed of impulse (m/s)
A	13-20	yes	80-120
B	6-12	yes	33-75
C	5-8	yes	4-24
D	1-5	yes	3-15
E	0.2-1.5	no	0.5-20

(i) Discuss the effect of diameter on the speed of impulse.

---

[2]

(ii) Explain how strong a conclusion, if any, you can make from the data about the effect of the myelin sheath on the speed of impulse.

---

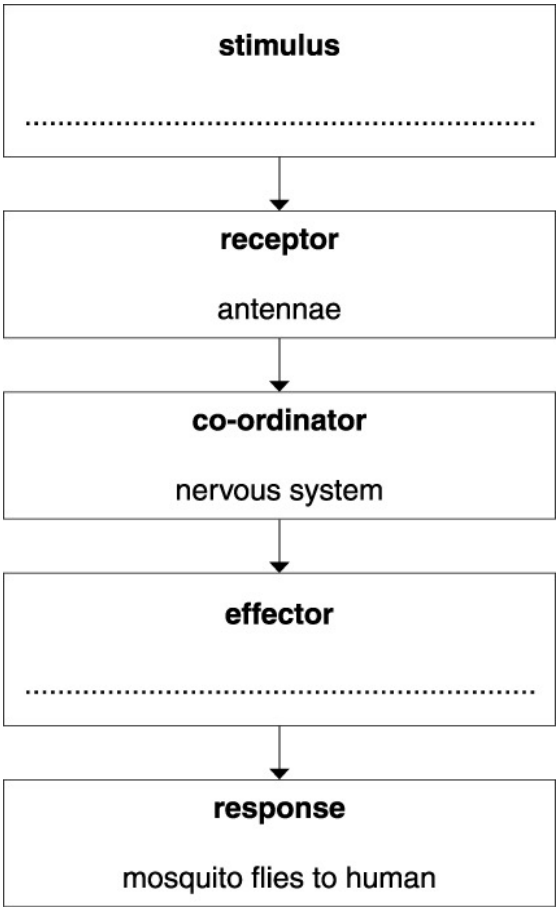
[2]

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7 Mosquitoes use their sense of smell to detect humans.

Mosquitoes detect the smell with receptors on their antennae.

Complete the flow chart to show how a mosquito detects, and responds to, the smell of a human.



[2]

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8 Look at the picture of a cat.



The cat has a blink reflex. Reflex actions protect the body from harm.

Write down **two other** features of reflex actions.

---

[2]

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9 Read this article about a disease that occurs in South America.

Doctors concerned about spread of disease

Zika is a disease that is caused by a virus.
It is spread by mosquitoes.
In most people the disease is quite mild.
However, there is evidence that in pregnant women it can slow the growth of the baby's brain.
The disease cannot be treated by antibiotics.
Scientists are trying to develop a vaccine for the zika virus.

The article says that the virus can cause damage to the brain of unborn babies.

Which part of the baby includes the brain?

Put a tick (3) next to the correct answer.

peripheral nervous system ☐

sense organs ☐

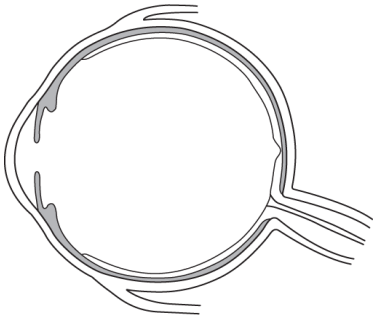
central nervous system ☐

circulatory system ☐

[1]

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10 The diagram shows a section through the human eye.



Complete the diagram by drawing the **lens** in its correct place.

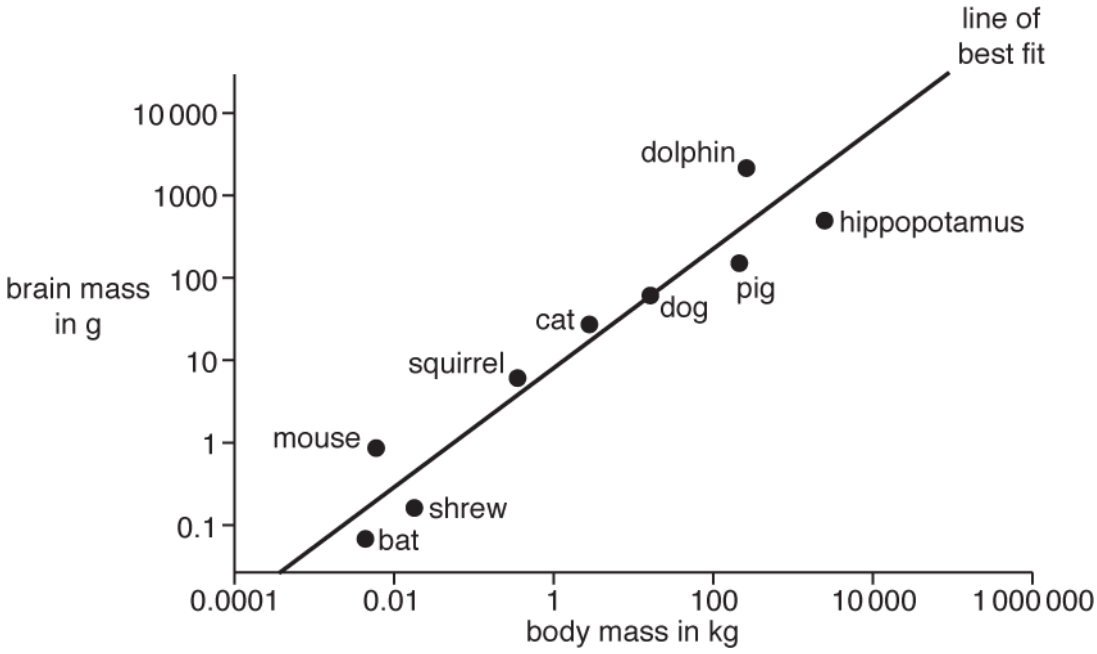
[1]

11(a)

Look at the graph.

It shows the brain mass and body mass of some different animals.

A student has drawn a line of best fit on the graph.



(i) Which animal has the smallest brain mass?

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---------- [1]

(ii) Which animal has the largest body mass?

---------- [1]

(iii) Has the student drawn a correct line of best fit?
Explain your answer.

---------- [2]

(b) Look at the table about some different animals.

It shows the mean (average) body mass, brain mass and **relative** brain mass.

The **relative** brain mass is the percentage (%) that the brain mass is of the body mass.

Animal	Body mass in g	Brain mass in g	Relative brain mass (% of body mass)
marmoset monkey	320		2.5
rhesus monkey	7 750	93	1.2
chimpanzee	48 750	390	0.8
gorilla	100 000	500	0.5
elephant	4 148 000	4148	0.1

(i) For the marmoset monkey, its brain mass is 2.5% of its body mass.
Calculate its brain mass.
Use information from the table.
You should show your working.

answer = ---------- g

[2]

(ii) Look at the information in the table.

What patterns can you see between body mass, brain mass and **relative** brain mass?

---

[2]

(iii) The mean (average) body mass, brain mass and **relative** brain mass of a human is shown in this table.

Animal	Body mass in g	Brain mass in g	Relative brain mass (% of body mass)
human	66 500	1330	2.0

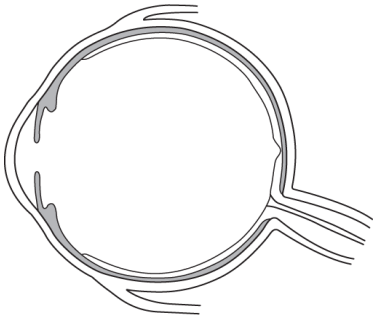
Do humans fit the patterns shown by the other animals?

Explain your answer.

---

[2]

12 The diagram shows a section through the human eye.



Some humans and animals have an inherited condition called cornea plana.

It causes the cornea to be less curved than normal. This can lead to long-sight in humans.

(i) Label the diagram with an **X** to show the position of the cornea.

[1]

(ii) What are the symptoms of long-sight in humans?

---

[2]

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13(a) Look at the table about some different animals.

It shows the mean (average) body mass, brain mass and **relative** brain mass.

The **relative** brain mass is the percentage (%) that the brain mass is of the body mass.

Animal	Body mass in g	Brain mass in g	Relative brain mass (% of body mass)
marmoset monkey	320	8	2.5
rhesus monkey	7750	93	1.2
chimpanzee	48 750	390	0.8
gorilla	100 000	500	0.5
elephant	4 148 000	4148	0.1

(i) Look at the information in the table.
What patterns can you see between body mass, brain mass and **relative** brain mass?

--- [2]

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(ii) The mean (average) body mass, brain mass and **relative** brain mass of a human is shown below.

Animal	Body mass in g	Brain mass in g	Relative brain mass (% of body mass)
human	66 500	1330	2.0

Do humans fit the patterns shown by the other animals?
Explain your answer.

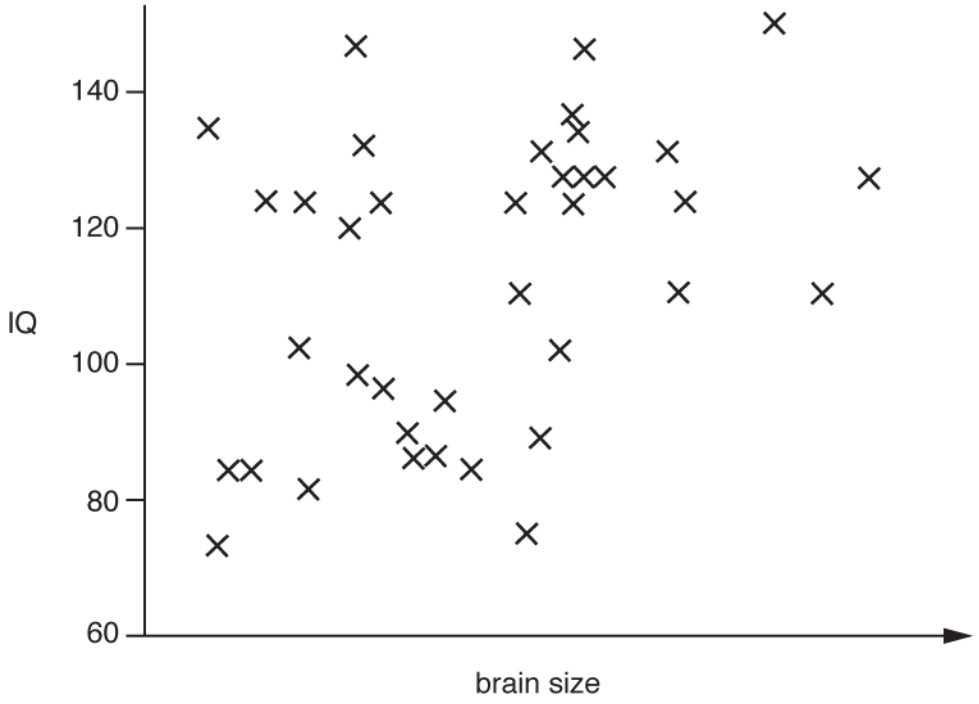
[2]

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(b) IQ is one way of measuring intelligence.

Scientists investigated whether there is a link between brain size and IQ for university students.

The scatter graph shows their results.



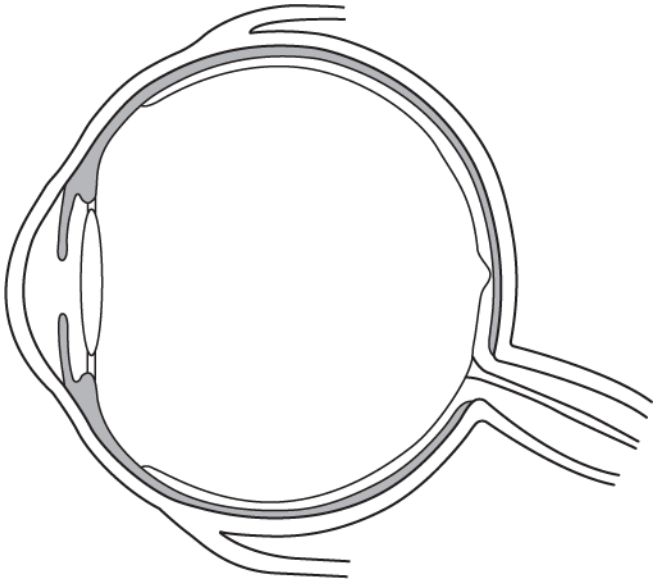
Does the graph show a link between brain size and IQ?

Explain your answer.

---

[2]

14(a) The diagram shows a section through the human eye.



Label the diagram with an **X** to show the part of the eye that controls how much light enters the eye. **[1]**

(b) Some humans and animals have an inherited condition called cornea plana.

It causes the cornea to be less curved than normal.

This can lead to long-sight in humans.

Explain why cornea plana causes long-sight in humans.

--- **[2]**

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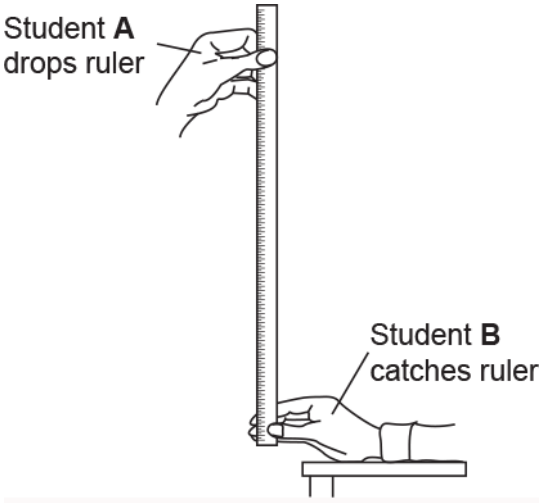
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15(a) A class of students investigate reaction time.

Student **A** drops a ruler while student **B** catches it.

They then measure the position of student **B**'s thumb on the ruler, this is the drop distance.

The diagram shows how the measurements were taken.



The drop distance is converted into a reaction time. The reaction time in seconds for each hand is recorded.

The table shows the results for ten **right-handed** students in the class.

Reaction time(s)	
Left non-dominant hand	Right dominant hand
0.22	0.28
0.23	0.25
0.27	0.23
0.24	0.24
0.25	0.24
0.25	0.25
0.25	0.26
0.25	0.26
0.25	0.26
0.27	0.23
Mean = 0.25	Mean = 0.25

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(i) Calculate the **mode** for the right dominant hand.

Answer = ---------- seconds **[1]**

(ii) The mean and mode for the left non-dominant hand are identical.

What **other** conclusions can be made about reaction times in these ten students?

---**[2]**

(b) How could these students improve the recording of their results?

---**[2]**

(c) The students want to investigate reaction times to see if left-handed people are faster than right–handed people.

How could they develop the experiment to test this?

---[3]

(d) The reaction in the experiment involves a **stimulus.**

What is the stimulus in the reaction involving catching the ruler?

---[1]

(e) Complete the sequence of a reflex arc.

Stimulus →	---	Sensory neurone→	CNS→	--- ---	Effector→	Response

[2]

16

Finish these sentences to explain what is happening in the body of a female during the menstrual cycle.

The pituitary gland in the ---------- releases the hormone FSH.

FSH causes an ---------- releases the hormone FSH.

FSH also causes the follicle to release the hormone ---------- .

After ovulation, the empty follicle releases another hormone called ---------- .

[4]

17(a) A girl walks from a sunny beach into a dark café

Diagram **A** shows the girl's left eye on the beach.



A



B

Diagram B shows the girl's left eye after she enters the café.

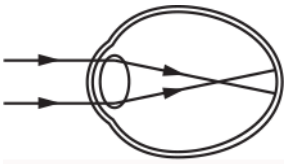
Explain how you can tell this and how this change happens.

---**[3]**

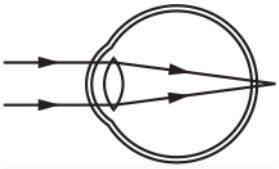
(b) Look at the diagrams.

They show how light is focused in people with different eye defects.

Person **X**



Person **Y**



(i) Name the eye defect in each person.

Person **X** ----------

Person **Y** ----------

---[2]

(ii) Identify the type of corrective lens needed by person **X** and **Y** and explain how the lenses work.

---[3]

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18 Retinitis pigmentosa is a genetic condition.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

If people have retinitis pigmentosa then the cells in their retina are damaged.

If a person has two alleles for retinitis pigmentosa, they will not be able to see properly.

(i) Why does a person need two affected alleles to have the condition?

---

[1]

(ii) Why does the condition affect the ability to see properly?

---

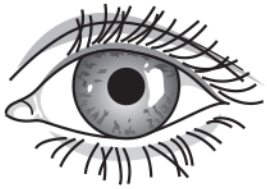
[1]

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19(a) Diagram A shows the girl's left eye on the beach.



A



B

Diagram **B** shows the girl's left eye after she enters the café.

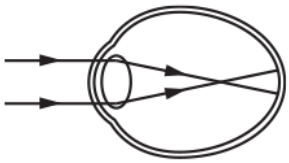
Explain how you can tell this and how this change happens.

--- [3]

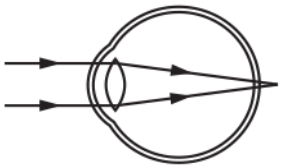
(b) Look at the diagrams.

They show how light is focused in people with different eye defects.

Person X



Person Y



(i) Name the eye defect in each person.

Person X ----------

Person Y ----------

[2]

(ii) Identify the type of corrective lens needed by person X and Y and explain how the lenses work.

---

[3]

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20(a) A class of students investigate if right handed people are faster with their dominant right hand.

Student **A** drops a ruler while student **B** catches it.

They then measure the position of student **B**'s thumb on the ruler, this is the drop distance.

The diagram shows how the measurements were taken.

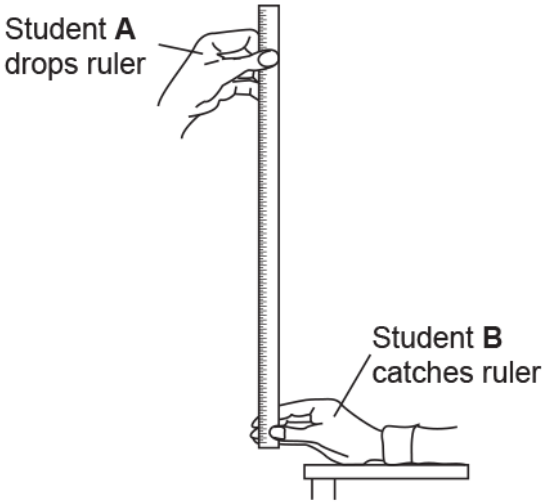


Fig. 19.1

The drop distance is converted into a reaction time. The reaction time in seconds for each hand is recorded in a table.

(i) Identify **two** possible sources of error in this method of measuring reaction time.

1 ----------

---

2 ----------

---

[2]

(ii) A second method of measuring reaction time involves a computer reaction time program shown in Fig. 19.2.

Each student is asked to click the “Start” button. After a 3-second delay a number randomly flashes up. The student moves the mouse to click on the flashing number.

Left hand is used first then the right hand.

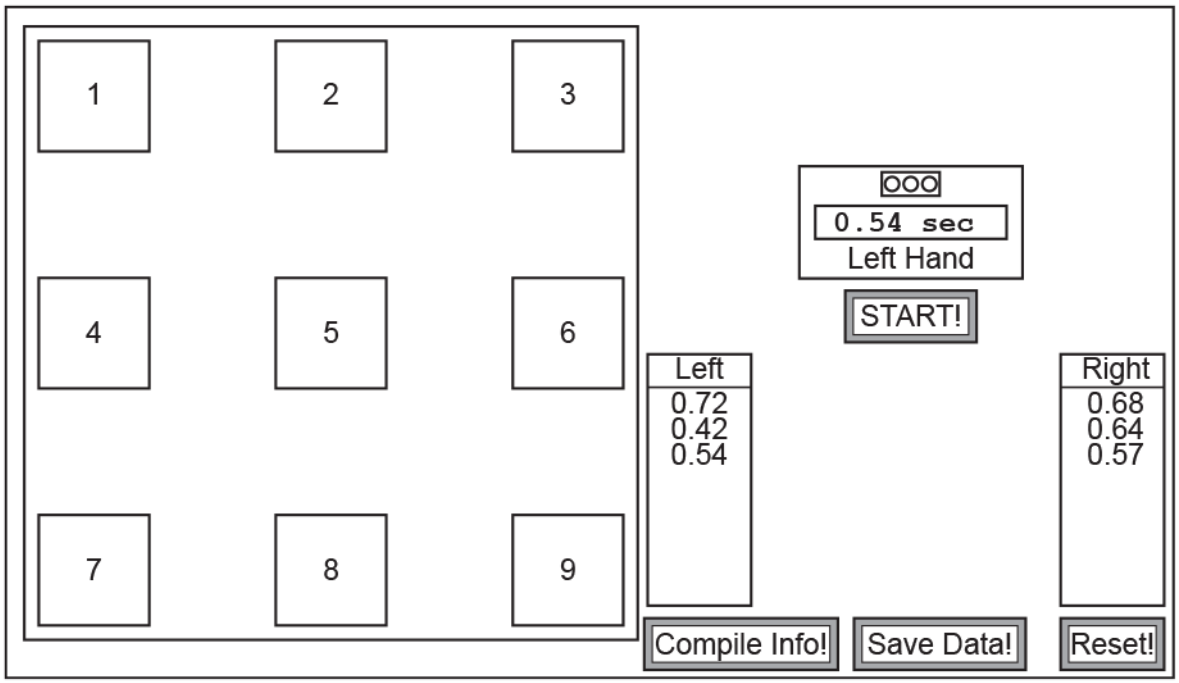


Fig. 19.2

This second method is a better design than the first method but it could still be improved.

Explain why it is a better designed experiment than the first method and suggest how this second method could be improved.

---

[3]

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(b) The table shows the results for ten **right handed** students in the class.

Reaction time (seconds)	
Left non-dominant hand	**Right dominant hand**
0.22	0.21
0.23	0.25
0.27	0.23
0.24	0.24
0.25	0.24
0.25	0.25
0.25	0.26
0.25	0.26
0.25	0.26
0.25	0.26
0.27	0.28
Mean = 0.25	Mean = 0.25

(i) Calculate the **median** for the right dominant hand.

Answer = _____mg **[2]**

(ii) The mean and median for the left non-dominant hand are identical.

What **other** conclusions can be made about reaction times in these ten students?

_____

_____

_____ **[2]**

(c)

(i) Motor neurone disease (MND) is a condition that affects reaction times. MND affects the speed of nerve impulse in motor neurones.

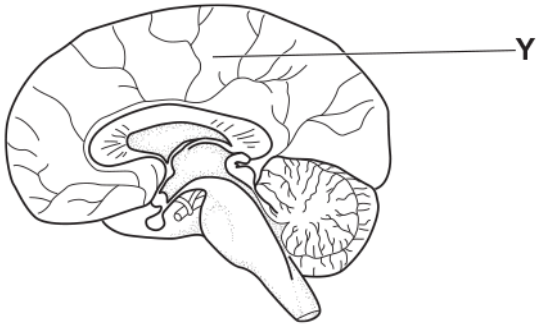
Stem cells taken from the skin of people with MND are used in research. The stem cells can be grown in the lab and used to measure the speed of the nerve impulse.

Which special feature of stem cells makes this possible?

---

[1]

(ii) The diagram shows the brain.



Name part **Y** and explain why it is an important area of the brain in the research of MND.

Part **Y**: ---

Explanation: ---

[2]

(iii) Measuring the speed of the nerve impulse in the brain is more difficult than using stem cells.

Suggest **two** reasons why.

---

[2]

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21 Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

(i) Two people who are heterozygous for retinitis pigmentosa are expecting a baby.

Draw a genetic diagram to calculate the probability that the baby will have the condition.

Use R for the normal allele and r for the allele for retinitis pigmentosa.

Answer = ---------- **[3]**

(ii) If the baby has retinitis pigmentosa, it will have normal colour vision but will not be able to see well in dim light.

Explain why.

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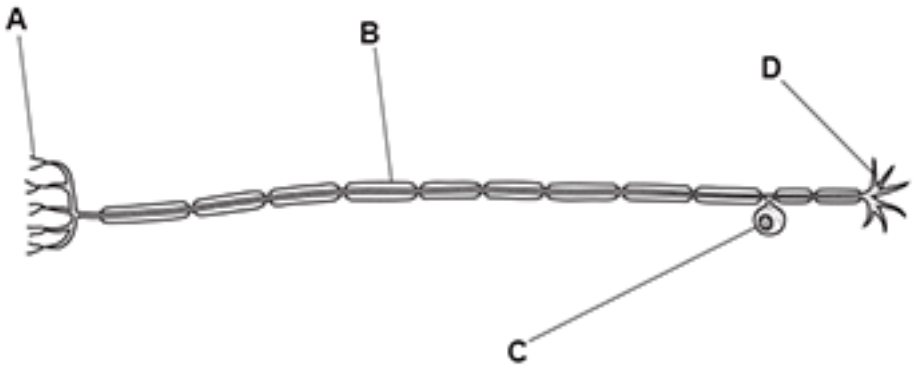
[3]

22 Which part of the eye does not function correctly in colour blindness?

A Cornea
B Iris
C Lens
D Retina

Your answer ☐ [1]

23 Which label is pointing to the myelin sheath in a motor neurone?



Your answer ☐ [1]

24 What is the name of the gap between two neurones?

A Axon
B Dendrite
C Lumen
D Synapse

Your answer ☐ [1]

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25 Light travels through different parts to reach the back of the eye.

Which structure does light pass through first when it enters the eye?

A Cornea
B Lens
C Pupil
D Retina

Your answer [1]

26 Which part of the brain controls the heartbeat and breathing?

A Cerebrum
B Hypothalamus
C Medulla
D Pituitary

Your answer [1]

27 Which condition can be caused by a lens in the eye that is too thick?

A Long-sightedness
B Colour blindness
C Diabetes
D Short-sightedness

Your answer [1]

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28 The eye switches from focusing on a distant television to focusing on a close up newspaper.

Which change happens to the suspensory ligaments and to the lens during this switch?

	Suspensory ligaments	Lens
A	slack to tight	thicker
B	slack to tight	thinner
C	tight to slack	thicker
D	tight to slack	thinner

Your answer [ ] [1]

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29(a) Investigating brain function may involve the following techniques:

- External recording of the brain using EEG.
- Scanning techniques such as CAT and MRI.
- Case studies of humans with accidental damage.
- Deliberate damage in animal experimentation.

(i) Understanding of brain function has increased in recent years. However, there are still problems that scientists face that are preventing a complete understanding.

Evaluate the reasons why understanding has increased but also why problems still exist.

[4]

(ii) When scientists complete their research they usually publish it in journals or online.

Give **two** reasons why scientists publish their results.

1

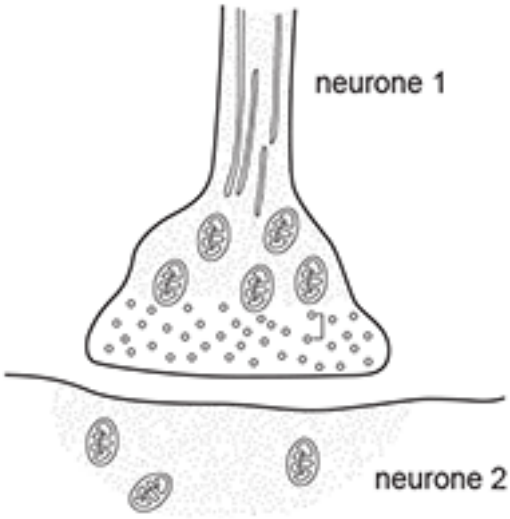
2

[2]

(b) Alzheimer's disease involves damage to nerve transmission.

Symptoms include difficulties in judging distance, concentrating and making decisions.

The diagram shows a synapse between two neurones in the brain.



Acetylcholine is a neurotransmitter in the brain. It diffuses across the 32 nanometre synaptic gap.

In a brain from a person with Alzheimer's disease, the time for acetylcholine to diffuse between neurones is 6.4×10^{-7} s.

1 metre = 10^9 nanometres

(i) Calculate the speed of diffusion in a person with Alzheimer's disease.

Use this formula: speed = distance ÷ time

Give your answer in metres per second.

Speed of diffusion = ... metres per second **[3]**

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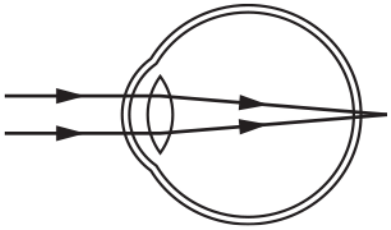
(ii) In the brain of a healthy person the speed of diffusion is 0.2 metres per second.

How does the result obtained in part (i) account for the symptoms of Alzheimer's disease?

---

[2]

30 Look at the diagram showing an eye defect.



What is the defect and which lens could be used to correct it?

A Long-sightedness, corrected with a concave lens
B Long-sightedness, corrected with a convex lens
C Short-sightedness, corrected with a concave lens
D Short-sightedness, corrected with a convex lens

Your answer ☐ [1]

31 Anaesthetics used during operations slow down breathing and heart rate.

Which part of the brain do anaesthetics act on to do this?

A Cerebrum
B Cerebellum
C Medulla
D Pituitary

Your answer ☐ [1]

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32 Fig. 20.1 shows a section through the skin on the back of the hand.

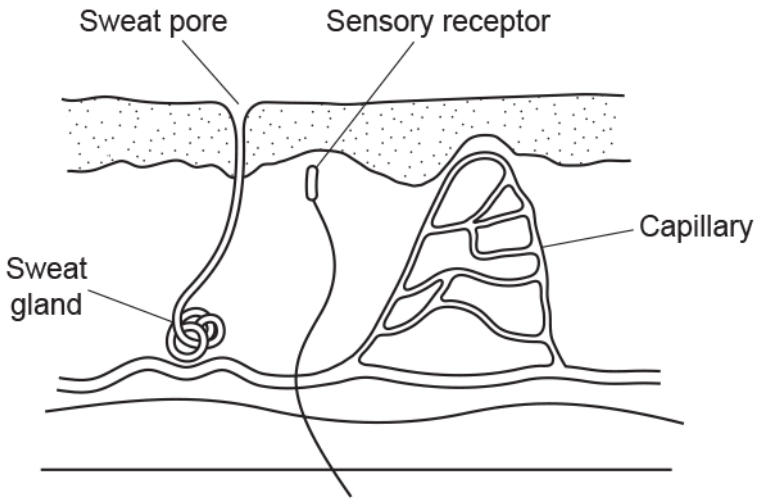


Fig. 20.1

(i) Which part of the skin detects something touching the back of the hand?

[1]

(ii) The body responds when something touches the back of the hand.

Complete the sentences to explain how this happens.

The ..... receives impulses from the skin along sensory neurones.

These impulses are processed and other impulses are sent along

..... neurones to bring about responses.

[2]

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33 Anaesthetics used during operations slow down breathing and heart rate.

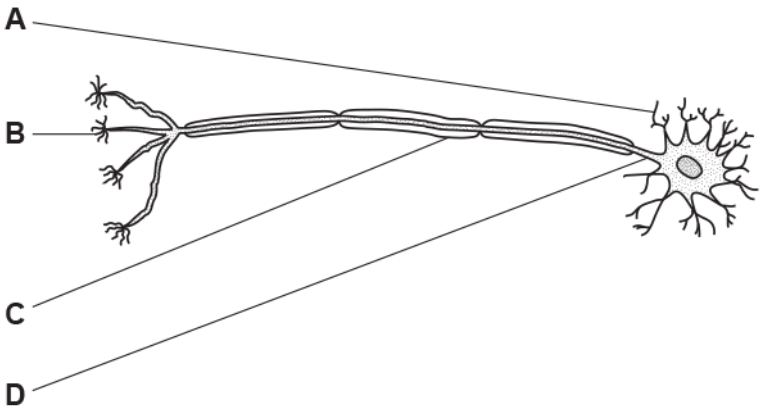
Which part of the brain do anaesthetics act on to do this?

A Cerebrum
B Cerebellum
C Medulla
D Pituitary

Your answer ☐ [1]

34 A motor neurone is usually stimulated by a relay neurone.

Which part of the motor neurone is first stimulated by a relay neurone?



Your answer ☐ [1]

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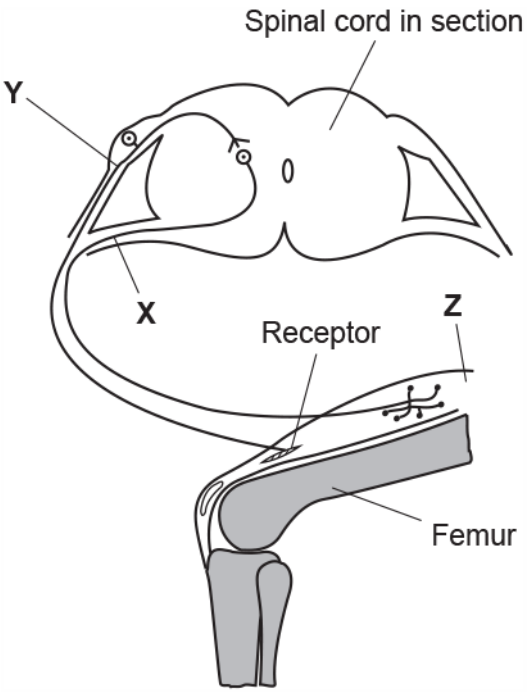
35 Which row in the table represents the eye when a person is in a dark room?

	Front view of iris and pupil	Circular iris muscles
A		contracted
B		relaxed
C		relaxed
D		contracted

Your answer ☐ [1]

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36 The diagram shows a reflex arc.



A patient needs treatment for a leg injury.

An anaesthetic is injected to block nerve impulses to prevent pain but still allow movement of the leg.

Where was the anaesthetic injected in this patient?

A At **X**
B At **Y**
C At **Z**
D At **X**, **Y** and **Z**

Your answer ☐ [1]

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37(a) This question is about coordination.

Parts of the body, such as the fingers, are moved by the contraction of muscles.

In a voluntary movement the brain sends nerve impulses to muscle fibres along motor neurones.

Name the part of the brain that controls voluntary movement.

[1]

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(b) A nerve to a muscle contains many motor neurones.

Fig. 21.1 shows two motor neurones supplying a muscle that moves the fingers. Fig. 21.2 shows the force of contraction of the muscle when the neurones are stimulated separately or both together.

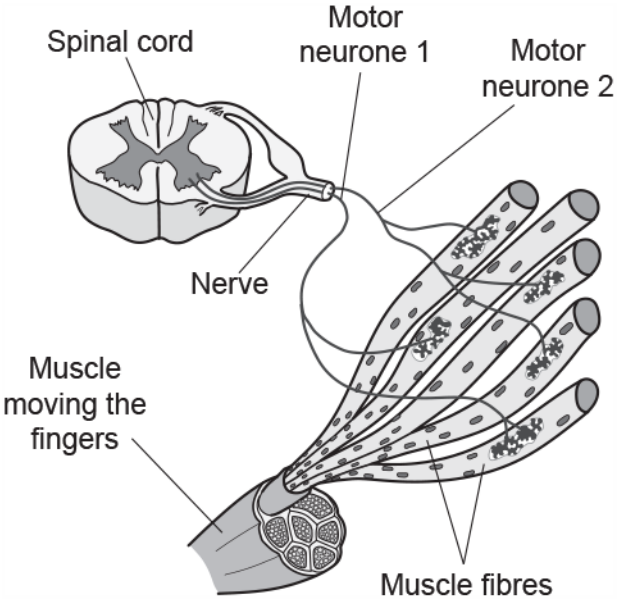


Fig. 21.1

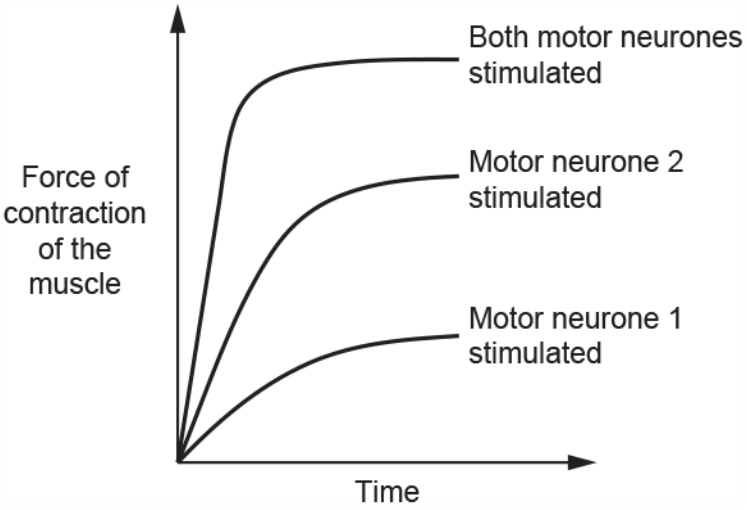


Fig. 21.2

(i) Suggest how the brain can finely control the force of contraction in the muscles controlling the fingers.

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[2]

(ii) **Fig. 21.3** shows a motor neurone supplying a muscle that moves the leg.

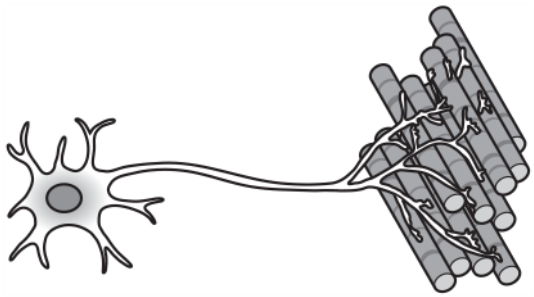


Fig. 21.3

Explain the reason for the difference in the neurone supplying this muscle compared to the neurones supplying the muscle that moves the fingers.

[3]

(c) * Dart players use their fingers to throw darts at a dart board.

Dart players **A** and **B** have different throwing styles. **Fig. 21.4** shows the throwing styles of the two players.

The release window is the area where the dart is released.

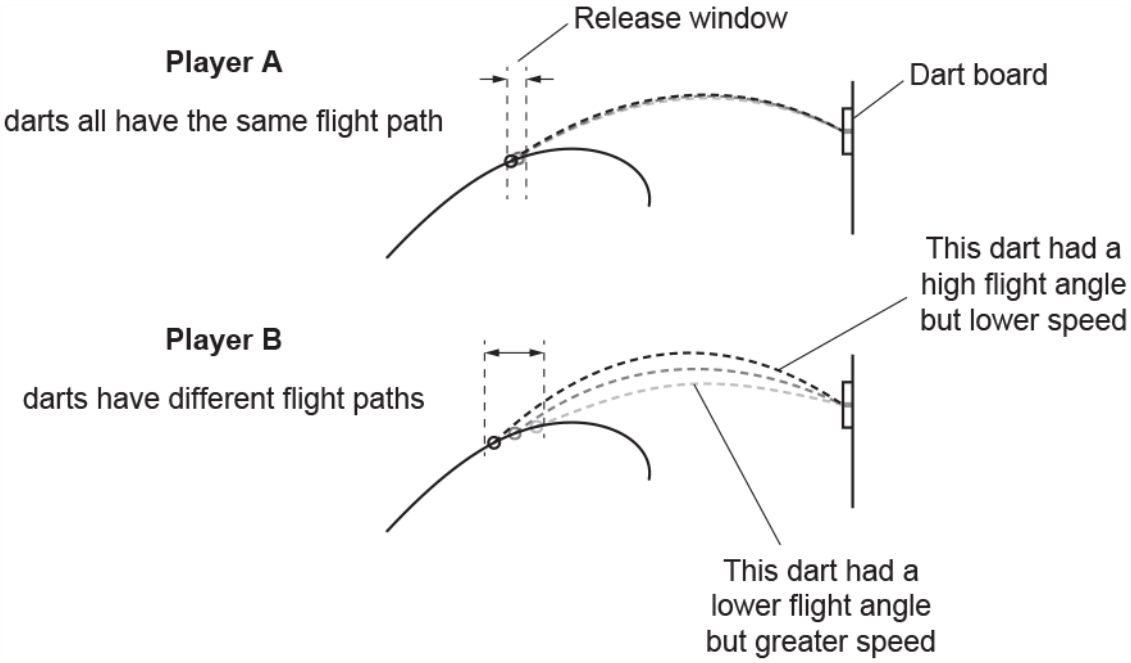


Fig. 21.4

To throw a dart accurately at the centre of a dart board involves coordination. The brain needs to coordinate the actions of sense organs and muscles.

Explain the function of the nervous system and muscles in the throwing of a dart at the centre of the dart board and why this process is more complicated in **Player B** than in **Player A**.

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[6]

END OF QUESTION PAPER