Questions

Q1.

(a) Some research has shown that increased use of computers and other digital media can affect eyesight and reaction times.

A scientist wanted to test if prolonged use of a computer affected reaction time.

The scientist tested the reaction times of 10 people under the same environmental conditions.
These people then used a computer for three hours.
The scientist tested their reaction time again.
Give three ways that the scientist could improve this method to determine if prolonged use of a computer affects reaction time.

(3)

1 .....

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2 .....

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3 .....

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(b) Figure 9 shows the reaction times of five people.

person	1	2	3	4	5
reaction time/seconds	0.258	0.685	0.236	0.246	0.268

Figure 9

(i) Calculate the mean reaction time in milliseconds.

(2)

..... ms

(ii) Give the name of the mathematical term which is used to describe the reaction time value of person 1.

(1)

.....

.....

(Total for question = 6 marks)

Q2.

Measles is a disease caused by a virus.

A measles infection can cause inflammation of the brain.

Figure 11 shows a brain.

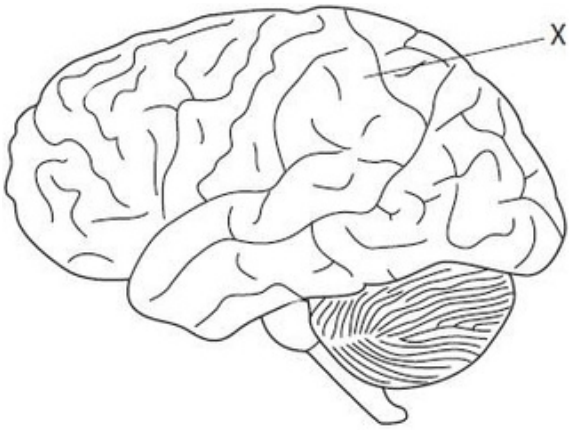

Figure 11

(i) Name the part of the brain labelled X.

(1)

.....

(ii) The death rate from measles is 0.15%.

In 2015, 134 250 people died from measles.
Calculate the number of people infected with measles in 2015.
Give your answer in standard form.

(3)

..... people

(Total for question = 4 marks)

Q3.

Eye tests can detect some brain tumours.

(i) State one other way that brain tumours can be detected.

(1)

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(ii) Describe why a brain tumour is difficult to treat.

(2)

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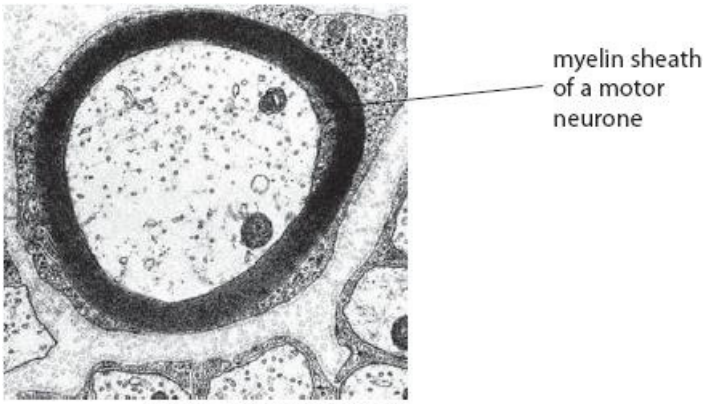
(Total for question = 3 marks)

Q4.

Figure 6 is an electron micrograph showing a cross section through a neurone.



(Source: © Dr. Donald Fawcett,
Visuals Unlimited / Science Photo Library)

Figure 6

The myelin sheath of this neurone is 250 nm in thickness.

(i) Calculate the magnification of this electron micrograph.

(3)

magnification .....

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

(ii) Which part of a motor neurone is surrounded by the myelin sheath?

(1)

☐ A nucleus

☐ B cell body

☐ C axon

☐ D receptor

(Total for question = 4 marks)

Q5.

Figure 17 shows part of a reflex arc in the spinal cord.

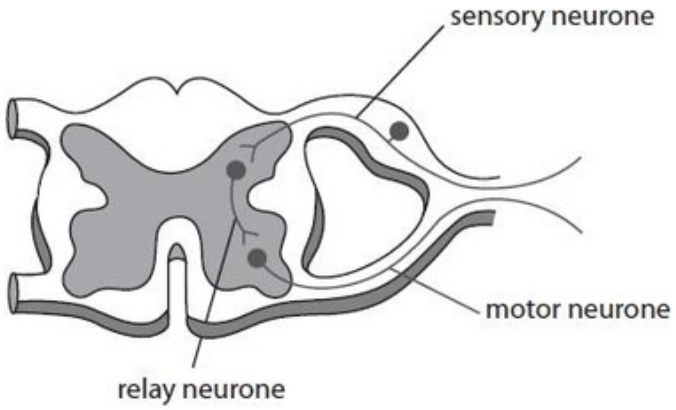


Figure 17

(i) Describe how an impulse passes from the relay neurone to the motor neurone.

(3)

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(ii) Explain the function of a reflex arc.

(2)

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(Total for question = 5 marks)

Q6.

Some myelinated motor neurones transmit impulses at speeds of approximately 100 m/s.

Figure 7 shows the technique used to measure the speed of nerve impulses in the lower leg of a person.

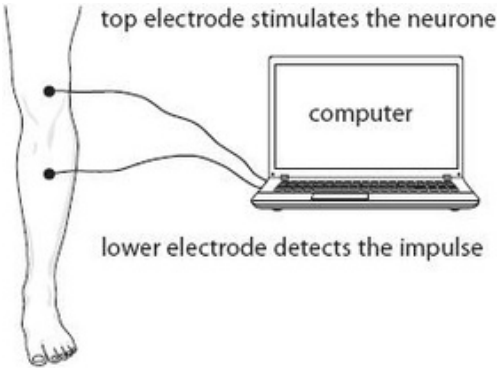

Figure 7

(i) Explain how the technique shown in Figure 7 could be used to calculate the speed of a nerve impulse.

(2)

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(ii) Guillain-Barré syndrome is a disease that causes the body to break down the myelin sheaths on motor neurones.

Explain why Guillain-Barré syndrome can cause reduced movement of the legs.

(2)

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(Total for question = 4 marks)

Q7.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A scientist investigated the reaction times of five students using a computer program.

The computer screen showed a blue square at the start.

As soon as the blue square turned yellow, each student had to press a key on the keyboard as fast as possible.

Figure 18 shows the results for the five students.

student	reaction time in milliseconds
1	245
2	200
3	210
4	215
5	225

Figure 18

(i) Which is the median result for these students?

(1)

- ☒ A 200 milliseconds
- ☒ B 210 milliseconds
- ☒ C 215 milliseconds
- ☒ D 225 milliseconds

(ii) The scientist wanted to investigate if the colours of the squares used on the computer program affected reaction time.

The computer program started with blue squares that turned into yellow squares.

Describe how the scientist could compare the reaction times of these students when they respond to red squares turning into yellow squares.

(3)

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(Total for question = 4 marks)

Q8.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Neurotransmitters are chemicals that can trigger an electrical impulse in a neurone.

(i) What is the gap between two neurones called?

(1)

☐ A dendron

☐ B synapse

☐ C membrane

☐ D nucleus

(ii) Drinking alcohol inhibits the action of some neurotransmitters.

Explain how the reactions of a person are affected by alcohol.

(2)

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(Total for question = 3 marks)

Q9.

Motor neurones are found in the nervous system.

Figure 16 shows a motor neurone.

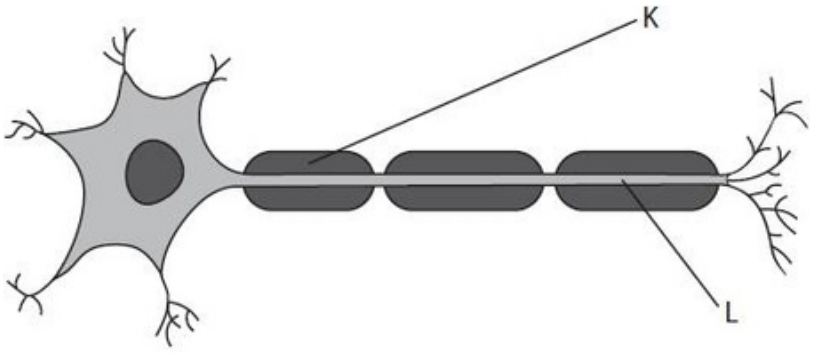

Figure 16

(i) Draw an arrow on Figure 16 to show the direction of travel of an electrical impulse along the motor neurone.

(1)

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(ii) Name both structure K and structure L.

(2)

K .....

L .....

(Total for question = 3 marks)

Q10.

Figure 16 shows the number of neurones in the brain of different animals.

animal	number of neurones in the brain
lobster	1.0×10^5
frog	1.6×10^7
rat	2.0×10^8
human	8.6×10^{10}

Figure 16

(i) Calculate the difference between the number of neurones in the brain of the rat and the brain of the frog.

Give your answer in standard form.

(2)

..... neurones

(ii) Most neurones in the brain are unmyelinated whereas motor neurones are myelinated.

Explain why myelination is needed on motor neurones but not on neurones in the brain.

(3)

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(Total for question = 5 marks)

Q11.

The reaction time of five people was tested using a computer.

These people were then given 100 cm3 of a liquid to drink.

Their reaction times were recorded 10 minutes after drinking the liquid.

Figure 9 shows the results.

person	reaction time in seconds		
	before drinking the liquid	after drinking the liquid	difference
1	0.256	0.245	–0.011
2	0.234	0.232	–0.002
3	0.268	0.259	–0.009
4	0.254	0.248	–0.006
5	0.215	0.208	–0.007

Figure 9

(i) Calculate the mean difference in reaction time.

Give your answer in milliseconds.

(2)

..... ms

(ii) The drinks manufacturer wants to advertise the effect of the drink on reaction time.

The manufacture needs to confirm the effect on reaction time by improving the investigation.
Give two improvements the manufacturer would need to make to this investigation.

(2)

1 .....

.....

2 .....

.....

(Total for question = 4 marks)

Q12.

*Some painkillers prevent neurotransmitters binding to receptors in a synapse.

Explain how a signal is transmitted at a synapse and how the painkillers reduce the pain felt by the person.

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(Total for question = 6 marks)

Q13.

Explain how impulses are transmitted at synapses.

(4)

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(Total for question = 4 marks)

Q14.

Figure 17 shows a sensory neurone.

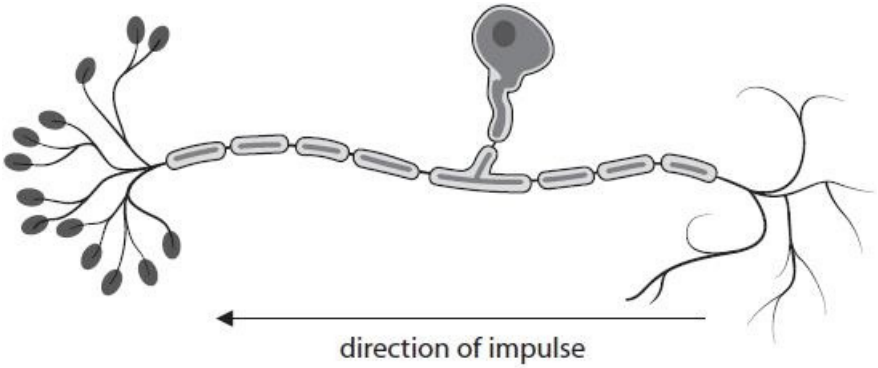

Figure 17

(i) Label the axon on Figure 17.

(1)

(ii) Describe the role of sensory neurones.

(2)

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(Total for question = 3 marks)

Q15.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 7 shows a neurone.

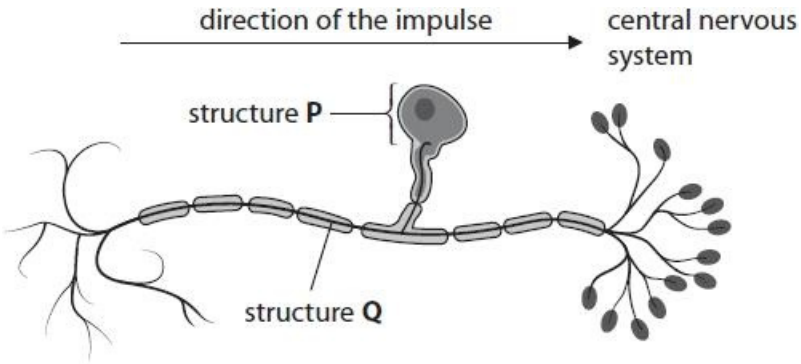

Figure 7

(i) Name the type of neurone shown in Figure 7.

(1)

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(ii) Which row identifies structure P and structure Q?

(1)

		structure P	structure Q
☒	**A**	myelin sheath	axon
☒	**B**	cell body	dendron
☒	**C**	myelin sheath	dendron
☒	**D**	cell body	axon

(Total for question = 2 marks)

Mark Scheme

Q1.

Question number	Answer		Mark
(a)	Any **three** improvements from the following: • vary the time for computer usage (1) • the activity used on the computer must be the same for each person (1) • control the intake of food/drink/drugs before and during the test (1) • repeat the test at different times of the day (1) • repeat the test using more people (1)		(3)
Question number	**Answer**	**Additional guidance**	**Mark**
(b)(i)	• $\frac{0.258+0.685+0.236+0.246+0.268}{5}$ = 0.339 (1) • 339 (ms) (1)	award full marks for correct numerical answer without working	(2)
Question number	**Answer**		**Mark**
(b)(ii)	• it is the median value		(1)

Q2.

Question number	Answer	Additional Guidance	Mark
(i)	cortex /cerebral {hemisphere/cortex} / cerebrum	accept parietal lobe reject cerebellum	**(1)** AO1(1)

Question number	Answer	Additional Guidance	Mark
(ii)	0.15 ÷ 100 = 0.0015 (1) 134 250 ÷ 0.0015 = 89 500 000 (1) 8.95×10^7 or 9.0×10^7 OR 134 250 ÷ 0.15 = 895 000 (1) 895 000 × 100 = 89 500 000 (1) 8.95×10^7 or 9.0×10^7 OR 100 ÷ 0.15 = 666.67 (1) 666.67 x 134250 = 89 500 000 (1) 8.95×10^7 or 9.0×10^7	award full marks for correct answer accept 8.9×10^7 / accept 89.5×10^6 / 89 500 000 for 2 marks accept 8.95×10^5 or 9.0×10^5 for 2 marks	**(3)** AO2(1)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	{CT / PET} scanning	accept MRI / X-ray	**(1)** **AO1 1**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description including two from: • brain is protected by skull (1) • it is difficult to access (1) • nerves do not {repair / regenerate} (1) • the risk of damage to the brain (1)	 accept bone for skull accept must not damage healthy cells/can cause side effects	(2) AO1 1

Q4.

Question number	Answer	Additional guidance	Mark
(i)	5 (mm) (1) 5 000 000 nm(1) 5 000 000 ÷ 250 = 20 000 OR 5 (mm) (1) 0.00025 mm (1) 5 ÷ 0.00025 = 20 000	accept 4 and 6 (mm) accept 4 and 6 (mm) accept 5 ÷ 250 = 0.02 (2) 4 ÷ 250 = 0.016 (2) 6 ÷ 250 = 0.024 (2) accept numbers in standard form award full marks for 20 000 without working	(3)

Question number	Answer	Mark
(ii)	C axon	(1)

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	A description including **three** from: • the impulse (in the relay neurone) triggers the release of a chemical (1) • neurotransmitter (1) • (neurotransmitter) **diffuses** (1) • across the synapse (1) • new impulse triggered in {motor neurone / next neurone} (1)	accept chemical messenger accept across the gap	**(3)** **AO1 1**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking **two** from: • a process that occurs in response to danger (1) • which bypasses the {brain / parts of the brain} / is an {involuntary process / subconscious process} (1) • so there is a faster transmission (of electrical impulses) / faster response / allows a quick reaction (1) • to protect the body from harm (1)	accept goes to the spinal cord accept react without thinking accept examples of actions to protect the body e.g. pulling hand away	**(2)** **AO1 1**

Q6.

Question number	Answer	Mark
(i)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • measure the distance between the electrodes (1) • and using the time taken for the impulse to travel (to calculate speed) (1)	(2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • impulses are conducted more slowly / fewer impulses transmitted (1) • {reduces / prevents} **muscle contraction** (needed for movement) / because the neurone is not insulated (1)	accept no impulses transmitted accept the role of myelin sheath is to insulate the neurone	(2)

Q7.

Question Number	Answer	Mark
(i)	C 215 milliseconds **The only correct answer is C** ***A*** *is not correct because the median is not 200 milliseconds* ***B*** *is not correct because the median is not 210 milliseconds* ***D*** *is not correct because the median is not 225 milliseconds*	**(1)** **AO2 1**

Question Number	Answer	Additional guidance	Mark
(ii)	A description including **three** from: • measure their reaction time using red squares (1) • keep everything else the same (as using blue squares) (1) • repeat measurements (for each student) (1) • calculate a mean reaction time (1) • control other variables (1)	 accept see how fast they react with red squares accept examples of other variables e.g. tiredness / environment / health	**(3)** **AO3 3a**

Q8.

Question number	Answer	Mark
(i)	B **synapse**	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	An answer that combines identification – application of knowledge (1 mark) and reasoning / justification – application of understanding: • slows the reactions down /increases reaction time (1) • reduces transmission across synapses/reduced neurotransmission (1)	 accept slower reaction times accept less neutrotransmitters/ neurotransmitters slower (to act) ignore electrical message crossing the synapse	 **(2)**

Q9.

Question Number	Answer	Mark
(i)	arrow showing direction of travel is from left to right	**(1)** **AO1 1**

Question Number	Answer	Mark
(ii)	K – myelin (sheath) (1) L – axon (1)	**(2)** **AO1 1**

Q10.

Question number	**Answer**	**Additional Guidance**	**Mark**
(i)	$2.0 \times 10^8 - 1.6 \times 10^7$ / 200 000 000 – 16 000 000 /184 000 000 (1) 1.84×10^8 / 1.8×10^8	award full marks for correct answer **accept 18.4×10^7 or 18×10^7 for 1 mark**	**(2)** AO2(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking: • (myelination) speeds up impulses (1) • insulates the {axon/neurone} (1) • motor neurones transmit information from the CNS / motor neurones transmit information to effectors / neurones in the brain connect to other neurones in the brain (1) • (motor neurones) transmit information over a greater distance (than neurones in the brain) (1)	accept signals/messages for impulses accept brain/spinal cord/relay neurone for CNS accept muscles/ glands for effectors accept idea that motor neurones can be part of a reflex so need quick impulses (1)	**(3)** AO2(1)

Q11.

Question number	Answer	Additional guidance	Mark
(i)	0.035 ÷ 5 = 0.007 (1) 7 / -7 (ms)	award two marks for correct answer with no working accept 0.033 ÷ 4 =0.008 for 1 mark if working shown accept 8 / -8 (ms) for 2 marks if working shown. allow ecf for incorrect mean converted into ms for 1 mark	**(2)** **AO2 1**

Question number	Answer	Additional guidance	Mark
(ii)	Any two from: • test the drink on more people / different people (1) • more repeats on the same people (1) • repeat using different volumes of the drink (1) • repeat using different times between drinking and the test (1) • repeat the experiment with just water (1) • control other environmental factors/named factors (1)	accept different amounts accept use a control/use a placebo accept tiredness/health/drug intake/food intake	(2) AO3 3b

Q12.

Question number	Indicative content	Mark
	AO2 (6 marks) **Synapse transmission** • neurones transmit electrical impulses • the synapse is a gap between 2 neurones • triggering the release of neurotransmitters • which diffuse across the synapse • as a chemical signal • neurotransmitters bind to receptors on the next neurone • triggering an electrical impulse in the next neurone **Painkillers** • prevent neurotransmitters binding to receptors in the next neurone • electrical impulse is not triggered • signal is not received by the central nervous system • person does not feel pain	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question • Line of reasoning mostly supported through the application of relevant evidence
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question • Line of reasoning are supported by sustained application of relevant evidence

Level	Mark	Descriptor
Level 1	1-2	A simple explanation of how messages are transmitted either over the synapse or along the neurone Linked to the effect of painkillers
Level 2	3-4	At least one link between how messages are transmitted between the neurone and the synapse or across the synapse Linked to the effect of painkillers
Level 3	5-6	A detailed description of how messages are passed across the synapse Linked to the effect of painkillers binding to receptors

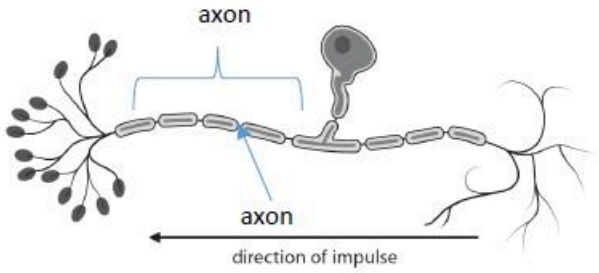
Level	Mark	Examples of possible responses
	0	• No rewardable material.
Level 1	1 2	• Messages are passed along neurones as electrical impulses • A synapse is a gap between neurones and the painkillers prevent the pain message getting through to the brain
Level 2	3 4	• Synapses are gaps between neurones. Neurotransmitters diffuse across the gap to the next neurone. • Synapses are gaps between neurones. Neurotransmitters diffuse across the gap to the next neurone. The painkillers bind to receptors stopping the message being passed on to the CNS so the person does not feel pain.

Level 3	5	• Synapses are gaps between neurones. The electrical impulse reaches the synapse and causes neurotransmitters to diffuse across the gap to the next neurone. A new impulse is initiated in the next neurone.
	6	• Synapses are gaps between neurones. The electrical impulse reaches the synapse and causes neurotransmitters to diffuse across the gap to the next neurone. A new impulse is initiated in the next neurone. The painkillers prevent the neurotransmitters binding to the next neurone, so a new impulse is not generated and the message is not passed to the CNS.

Q13.

Question number	Answer	Additional guidance	Mark
	An explanation linking the following: • synapse is a gap between neurones (1) • (electrical) impulse stimulates the release of chemical (1) • neurotransmitter (1) • (chemical/neurotransmitter) **diffuses** across the {gap/synapse} (1) • **stimulates** an (electrical) impulse in the **next neurone** (1)	accept by neurotransmission (1)	**(4)** AO1(1)

Q14.

Question number	Answer	Mark
(i)	 accept label line to any part of axon as indicated ignore lines to the myelin sheath	**(1)** AO1(1)

Question number	Answer	Additional Guidance	Mark
(ii)	An answer including: • transmit **electrical** impulses (1) • from {receptors / sense organ / named sense organ} to the {CNS /brain / spinal cord / relay neurone} (1)	 accept signals/ messages for impulses accept named receptors ignore detect stimuli	**(2)** AO1(1)

Q15.

Question number	Answer	Additional guidance	Mark
(i)	sensory (neurone)	accept phonetically correct misspellings	**(1)** **AO1 1**

Question number	Answer	Mark
(ii)	B cell body dendron **The only correct answer is B** **A** *is not correct because P is the cell body* ***C*** *is not correct because P is the cell body* ***D*** *is not correct because Q is the dendron*	**(1)** **AO1 1**