Questions

Q1.

There are various ways to scan the brain.

Describe how positron emission tomography (PET) scans can be used to investigate brain structure.

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(Total for question = 2 marks)

Q2.

The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

This was repeated with the child being shown a cheeseburger on eight occasions, at five minute intervals.

The results in the table show the change in mass of saliva produced compared with the mass of saliva produced before the child being shown a cheeseburger.

Occasion	Change in mass of saliva produced / g
1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

(i) Describe the effect on saliva production shown by these results.

(2)

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(ii) Name the type of learning behaviour shown by the child as they were repeatedly shown a cheeseburger.

(1)

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(iii) Explain what happens at the synapse to cause a decrease in saliva production when the child was shown a cheeseburger on more than six occasions.

(4)

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(Total for question = 7 marks)

Q3.

Visual development requires exposure of the visual cortex to environmental signals during a critical period.

Describe the role of visual stimulation on the development of the visual cortex during the critical period.

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(Total for question = 3 marks)

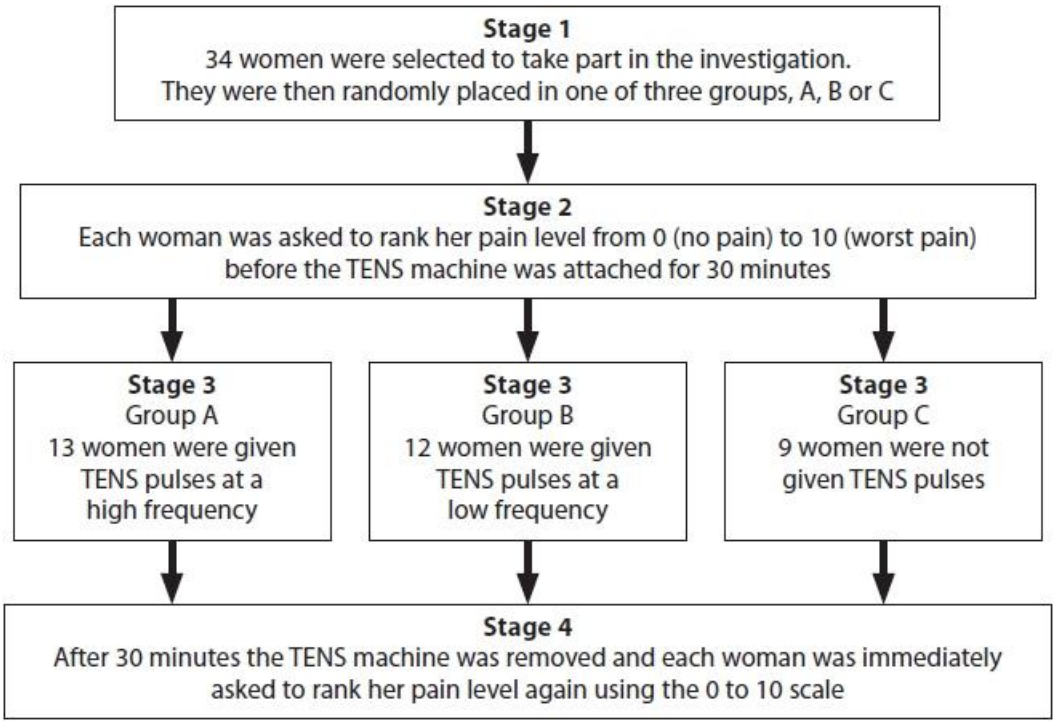
Q4.

Some women need to have surgery to aid childbirth. This can lead to pain after surgery.

A TENS (transcutaneous electrical nerve stimulation) machine releases regular pulses of electricity onto the skin surface and can be used in pain relief.

An investigation was carried out to study whether the frequency of the pulses from a TENS machine could help these women with their pain relief.

The diagram shows how the investigation was carried out.



This investigation used only one 30-minute session of TENS pulses. This was done to reduce the risk of habituation.

Describe the process that occurs at a synapse that leads to habituation.

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(Total for question = 4 marks)

Q5.

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

There are various ways to scan the brain.

(i) Brain tumours are dense masses of cells. The presence of brain tumours can be detected using several types of scanning method.
The table shows two types of scan. Place a tick [✓] in the box if the scan can identify the size and location of a large brain tumour or a cross [✗] in the box if the scan cannot identify the size and location of a large brain tumour.

(2)

Type of scan	Can be used to identify the tumour
CT	
MRI	

(ii) Functional MRI (fMRI) measures brain activity by detecting changes in

(1)

- ☐ **A** blood flow
- ☐ **B** bone density
- ☐ **C** dopamine release
- ☐ **D** lactic acid production

(iii) Which of the following types of scanner uses X-rays?

(1)

- ☐ **A** CT
- ☐ **B** fMRI
- ☐ **C** MRI
- ☐ **D** PET

(Total for question = 4 marks)

Q6.

The muscles of the earthworm (*Lumbricus terrestris*) contract when it is touched. This is known as the withdrawal response.

Which of the following terms describes a change in response as a result of repeated stimulation?

(1)

- ☒ **A** co-ordination
- ☒ **B** habituation
- ☒ **C** inhibition
- ☒ **D** reduction

(Total for question = 1 mark)

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 ☒.

The retina of the human eye contains rod cells.
These cells detect light energy as photons.
The light energy is converted to a nerve impulse that is interpreted by the brain.

(i) The transmission of an impulse between a neurone in the optic nerve and a cell in the brain involves ions and neurotransmitter molecules.

Describe how these ions and neurotransmitter molecules are involved in the transmission of an impulse.

(4)

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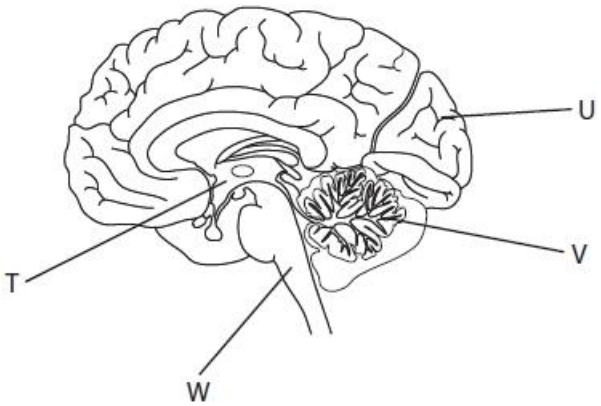
(ii) The diagram shows a human brain.



Which label on the diagram identifies the area of the brain where an image is interpreted?

(1)

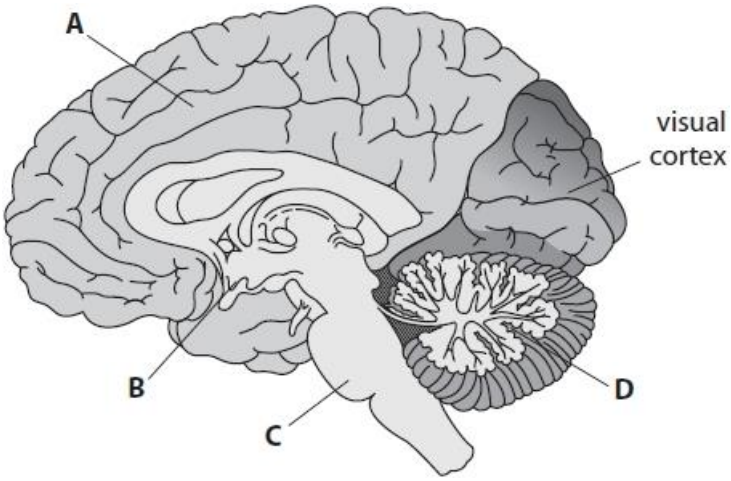
☒ **A** T
☒ **B** U
☒ **C** V
☒ **D** W

(Total for question = 5 marks)

Q8.

Visual development requires exposure of the visual cortex to environmental signals during a critical period.

The diagram shows parts of the brain, including the visual cortex.



The visual cortex processes information received from the retina.

(i) The non-protein part of the light-absorbing pigment in the rod cells of the retina is called

(1)

☒ **A** IAA

☒ **B** opsin

☒ **C** retinal

☒ **D** rhodopsin

(ii) The part of the brain involved in interpreting the information processed in the visual cortex is

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(iii) Explain how fMRI can be used to identify the part of the brain involved in interpreting information from the visual cortex.

(3)

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(Total for question = 5 marks)

Q9.

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 ☒.

There are many reasons why humans may lose muscle mass.

Two known causes are hip replacement surgery and some genetically inherited conditions.

Muscles can be scanned using magnetic resonance imaging (MRI) to investigate the loss of muscle mass.

It is safer to use MRI than computed tomography (CT) because

(1)

- ☐ **A** CT uses X-rays that can cause mutations in the DNA of muscle fibres
- ☐ **B** CT uses X-rays that can cause mutations in the protein in the muscle fibres
- ☐ **C** CT uses magnets that can cause mutations in the DNA of muscle fibres
- ☐ **D** CT uses magnets that can cause mutations in the protein in the muscle fibres

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to two of the following: • (PET makes use of) radioactive { tracers / markers / glucose } (1) • (PET scan detects) { emission of positrons / production of gamma rays } (1) • provides 3D image (1)	ALLOW radionuclides	(2)

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to two of the following: • being shown a cheeseburger increases saliva production (1) • repeated occasions results in less saliva production (1) • after six or more occasions there is less saliva produced than before being shown a cheeseburger (1)	ALLOW negative correlation appropriately qualified	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	• habituation		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • reduced permeability of presynaptic membrane to calcium ions / fewer calcium ions enter the pre-synaptic neurone (1) • (so fewer) vesicles { move towards / fuse with } the presynaptic membrane (1) • (therefore) less neurotransmitter binds to receptors on the post-synaptic membrane (1) • action potential may not occur in the post-synaptic neurone / membrane may not be depolarised (1)	ALLOW Ca^{2+} for calcium ions ALLOW calcium ion channels become less responsive ALLOW less exocytosis occurs at the presynaptic membrane ALLOW sodium ion channels not opening	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • ocular dominance columns (develop in visual cortex) (1) • neurones form synapses with these { cells / columns } (1) • { stimuli / action potentials / impulses } along neurones required to strengthen connections (with cells of ocular dominance columns) • stimulation during the critical period is needed to form (effective) connections in the visual cortex	ALLOW columns of (target) cells ALLOW more synapses for stronger connections OR connections become weaker if stimuli not received	(3)

Q4.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to four of the following: • (repeated stimulus) decreases {sensitivity / permeability} of pre-synaptic membrane / calcium channels not opening **(1)** • so {fewer / no} Ca^{2+} ions move into pre-synaptic neurone **(1)** • so {fewer / no} vesicles {move towards / fuse with} (pre-synaptic) membrane **(1)** • so {less / no} neurotransmitter {released / can diffuse across gap} **(1)** • {action potential / depolarisation} less likely to occur in post-synaptic neurone **(1)**	ALLOW calcium channels less or not responsive	**(4)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	<table><tr><th>Type of scan</th><th>Can be used to identify the tumour</th></tr><tr><td>CT</td><td>✓</td></tr><tr><td>MRI</td><td>✓</td></tr></table>	DO NOT ACCEPT HYBRID tick/cross	**(2)**

Question Number	Answer	Mark
(ii)	**The only correct answer is A** - blood flow ***B*** *is incorrect because fMRI does not measure brain activity by detecting bone density* ***C*** *is incorrect because fMRI does not measure brain activity by detecting dopamine release* ***D*** *is incorrect because fMRI does not measure brain activity by detecting lactic acid production*	**(1)**

Question Number	Answer	Mark
(iii)	***The only correct answer is A*** - CT ***B*** *is incorrect because fMRI does not use X-rays* ***C*** *is incorrect because MRI does not use X-rays* ***D*** *is incorrect because PET does not use X-rays*	**(1)**

Q6.

Question number	Answer	Mark
	The only correct answer is B – habituation ***A*** *is not correct because co- ordination is a general term not restricted to changes given* ***C*** *is not correct because inhibition does not describe a change in response* ***D*** *is not correct because it is not a term with meaning in the context of change of response*	(1)

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to the following: • calcium ions enter presynaptic neurone so vesicles with neurotransmitter can {move towards / fuse withpresynaptic membrane} (1) • neurotransmitter molecules diffuse across thesynapse (1) • neurotransmitter to bind with receptors on postsynaptic membrane (on the brain cell) (1) • sodium ions diffuse into {brain cell / post-synaptic cell}leading to {a depolarisation / an action potential } (1)	ALLOW calcium ions enter presynaptic neurone leading to exocytosis of neurotransmitter from vesicles ALLOW named neurotransmitter such as acetylcholine, dopamine, noradrenaline ALLOW enter for diffuse	**(4)**

Question Number	Answer	Mark
(ii)	**The only correct answer is B - U – This is the site in the brain where the image is interpreted** ***A*** *is not correct because* T is not the site in the brain where the image is interpreted ***C*** *is not correct because V* is not the site in the brain where the image is interpreted ***D*** *is not correct because* W is not the site in the brain where the image is interpreted	**(1)**

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Q8.

Question Number	Answer	Mark
(i)	**C** - retinal *The only correct answer is **C*** ***A** is incorrect because IAA is auxin* ***B** is incorrect because opsin is the protein part and not the non-protein* ***D** is incorrect because rhodopsin is the pigment*	**(1)**

Question Number	Answer	Mark
(ii)	**A** *The only correct answer is **A*** ***B** is incorrect because it is the hypothalamus* ***C** is incorrect because it is the medulla oblongata* ***D** is incorrect because it is the cerebellum*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • (fMRI) detects { blood flow / oxygen use } in the brain • increased brain activity results in increased { blood flow / demand for oxygen / aerobic respiration } in the area of activity • oxyhaemoglobin absorbs fewer radio waves / fMRI detects areas where less signal absorbed	ALLOW signal reflected by oxyhaemoglobin	**(3)**

Q9.

Question Number	Answer	Mark
	The only correct answer is **A** – CT uses X-rays that can cause mutations in the DNA of muscle fibres ***B** is incorrect because mutations do not occur in protein* ***C** is incorrect because CT does not use magnets* ***D** is incorrect because CT does not use magnets and mutations do not occur in protein*	**(1)**