Questions

Q1.

The scientific article you have studied is adapted from several sources.

Use the information from the scientific article and your own knowledge to answer the following questions.

The reward system in humans involves the neurotransmitter dopamine pathway (paragraph 7).

Describe how dopamine acts as a neurotransmitter.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q2.

Serotonin is found in the brain and is important in health and wellbeing.

An imbalance of serotonin can lead to problems such as depression. An individual with symptoms of depression may have low serotonin levels in the brain.

The use of drugs such as MDMA (ecstasy) can cause an imbalance of chemicals in the brain.

(i) Describe how the use of MDMA could affect the transmission of impulses in the brain.

(2)

.....

.....

.....

.....

.....

.....

.....

(ii) Individuals who use MDMA may develop the symptoms of depression.

Explain how the use of MDMA could result in the development of these symptoms.

(2)

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q3.

Serotonin is found in the brain and is important in health and wellbeing.

An imbalance of serotonin can lead to problems such as depression. An individual with symptoms of depression may have low serotonin levels in the brain.

Describe how low serotonin levels in an individual can affect the transmission of impulses in their brain.

(2)

.....

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q4.

The scientific article you have studied is from *Scientific American*.

Use the information from the scientific article and your own knowledge to answer the following question.

'Most drugs cannot easily penetrate the brain' (paragraph 3).

Explain how the treatment of Parkinson's disease overcomes the difficulty of drugs passing from the blood into the brain.

(2)

.....

.....

.....

.....

.....

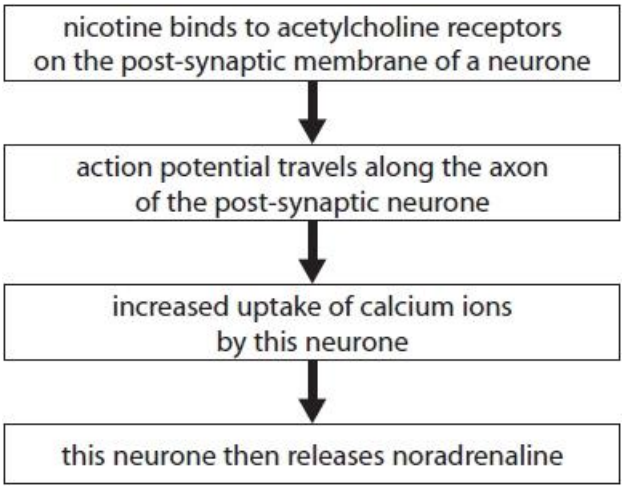
.....

(Total for question = 2 marks)

Q5.

Nicotine is a drug found in the smoke of cigarettes.

The flow diagram shows how the presence of nicotine can cause the release of noradrenaline.



(i) Explain how nicotine causes an action potential in the post-synaptic neurone that releases noradrenaline.

(3)

.....

.....

.....

.....

.....

.....

(ii) State how an increase in calcium ion uptake by the neurone leads to the release of noradrenaline.

(1)

.....

(Total for question = 4 marks)

Q6.

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)

.....

.....

.....

.....

.....

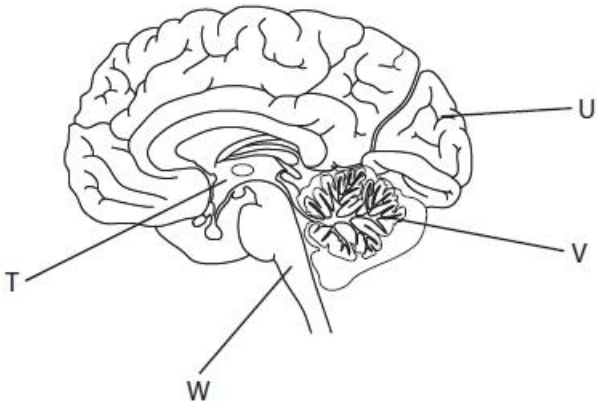
.....

.....

.....

.....

(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)

Q7.

Acetylcholinesterase is an enzyme involved in regulating the transmission of nerve impulses across some synapses.

Alzheimer's disease is associated with the loss of neurones that produce acetylcholine.

It has been suggested that inhibitors of acetylcholinesterase may be useful in the treatment of Alzheimer's disease.

(i) Explain why inhibitors of acetylcholinesterase could be useful in the treatment of Alzheimer's disease.

(3)

.....

.....

.....

.....

.....

.....

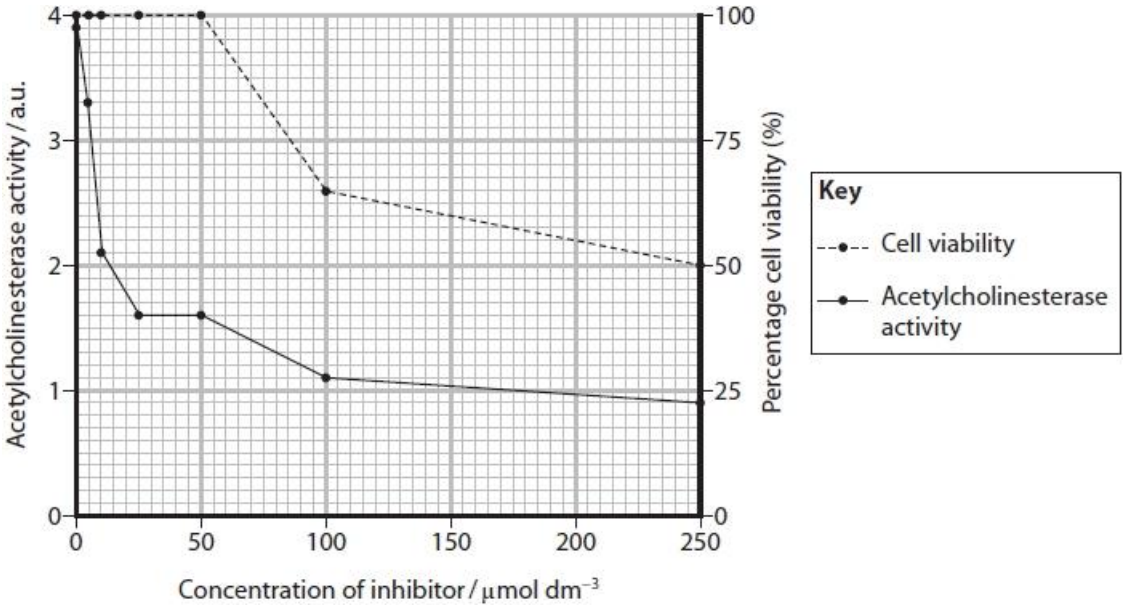
.....

.....

.....

(ii) Trials of a new inhibitor were carried out using tissue cultures.

The effect of the concentration of the inhibitor on acetylcholinesterase activity and cell viability was measured.
Percentage cell viability was measured as the percentage of cells that were not killed by the inhibitor.
The graph shows the results for this inhibitor.



State and justify a suitable concentration of inhibitor to use in clinical trials.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

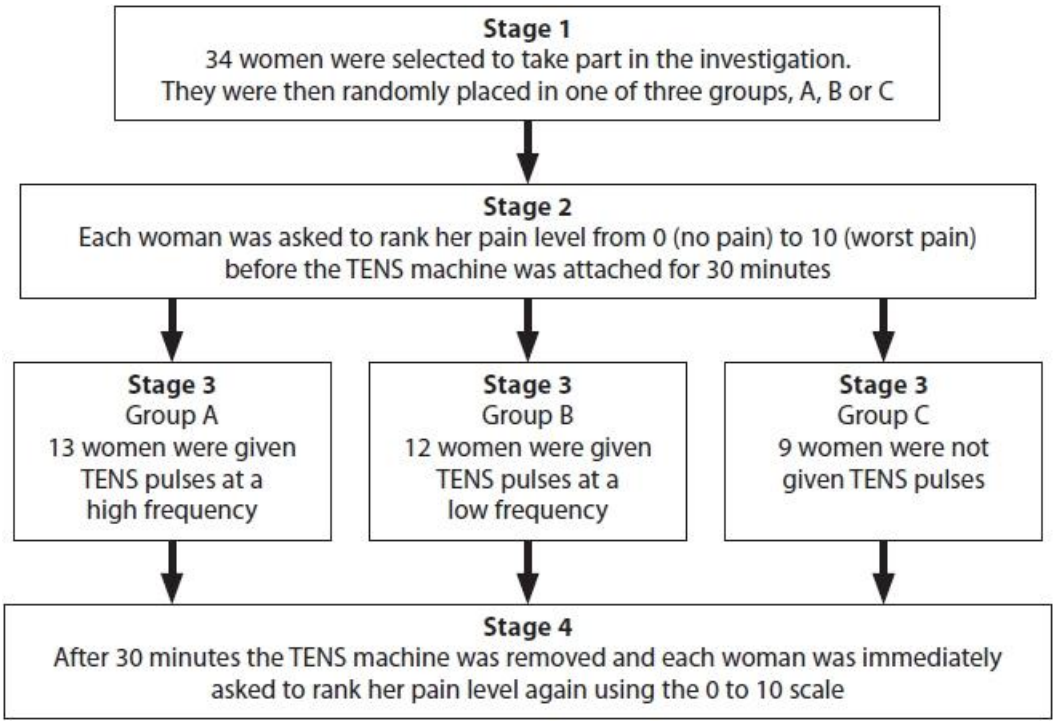
Q8.

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.

(4)

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • (dopamine) released { from presynaptic membrane / from the synaptic knob / into the synaptic cleft } / diffuses across synaptic gap (1) • binds to receptors on post-synaptic membrane (1) • alters permeability of post-synaptic membrane / opens { sodium ion channels / channel proteins } (in the post synaptic membrane) (1) • initiating { depolarisation / action potential } in the post-synaptic neurone (1)	ALLOW dopamine diffuses across the synapse ALLOW influx of Na^+ ALLOW pd / voltage	(4)

Q2.

Question number	Answer	Additional guidance	Mark
(i)	A description that makes reference to two of the following points: • MDMA { stimulates release / prevents re-uptake / increases concentration } of serotonin (1) • blocking pre-synaptic receptors / binding to post synaptic receptors (1) • nerve pathways using serotonin are more likely to be stimulated / more action potentials produced (1)	ALLOW reference to dopamine instead of serotonin ALLOW more impulses generated	(2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to two of the following points: • MDMA use results in depletion of serotonin (1) • post synaptic membrane becomes less responsive to serotonin / loss of receptors on post synaptic membrane (1) • serotonin levels affect mood / lack of serotonin associated with depression (1)	ALLOW dopamine instead of serotonin for all points	(2)

Q3.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to two of the following points: • serotonin is a neurotransmitter / there will be less neurotransmitter (1) • (less serotonin) results in fewer depolarisations of post synaptic membranes (1) • threshold not achieved / less chance of action potential being produced (in post-synaptic neurone) (1)	ALLOW no serotonin or no neurotransmitter ALLOW no depolarisations ALLOW no action potential produced	(2)

Edexcel Biology A-level - Synaptic Transmission

Q4.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • (give) {a precursor of dopamine / L-dopa} which can cross the blood brain barrier (1) • L-dopa is converted into dopamine (in the brain) (1) OR • (give) a {drug that stops the breakdown of dopamine / MAO inhibitor} (1) • that can cross the blood brain barrier (1)	ALLOW • use of {electrode / deep brain stimulation} • to stimulate basal ganglia to produce dopamine	(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • nicotine similar in shape to acetylcholine (1) • increases permeability of membrane to sodium ions / changes shape of { receptors / channel proteins } (1) • nicotine causes the depolarisation of the post-synaptic membrane (1) • depolarisation reaches threshold level (1)	ALLOW { sodium ion / Na^+ } channels open ALLOW sodium ions { diffuse / move down concentration gradient } into the neurone	(3)

Edexcel Biology A-level - Synaptic Transmission

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • (calcium ions cause) vesicles (containing noradrenaline) to fuse with { cell (surface) membrane / presynaptic membrane } (1)	ALLOW (calcium ions cause) vesicles to release noradrenaline through exocytosis	(1)

Q6.

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)

Q7.

Question number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to three of the following: • acetylcholinesterase breaks down acetylcholine (1) • inhibitor prevents break down of acetylcholine (1) • so more (acetylcholine) is available to bind to post-synaptic {membrane / receptors} (1) • therefore compensating for the {reduced production of acetylcholine / loss of acetylcholine producing neurones} (1)	ALLOW blocks acetylcholinesterase ALLOW inhibiting acetylcholinesterase maintains higher concentrations of acetylcholine (in synapse) (1)	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • concentration between 25 and 50 μmol dm^{-3} (1) • concentration having greatest inhibitory effect (1) • but having no effect on cell viability (1)	ALLOW any value between 25 and 50 ALLOW suitable description of effect e.g. reduces enzyme activity by {more than 50% / 60% / 2.4 a.u. ALLOW viability remains at 100%	Choose an item. (3)

Edexcel Biology A-level - Synaptic Transmission

Q8.

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)**