

Questions

Q1.

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 .

Acetylcholine is a neurotransmitter released by neurones in the autonomic nervous system.

(i) Which of the following substances bind to acetylcholine receptors?

(1)

1. cobra venom

2. nicotine

3. lidocaine

A 1 and 2

B 1 and 3

C 1, 2 and 3

D 2 and 3

(ii) Which row is correct for acetylcholine?

(1)

	Type of neurone that releases acetylcholine	Effect of acetylcholine
<input type="checkbox"/> A	parasympathetic neurone	increases heart rate
<input type="checkbox"/> B	parasympathetic neurone	decreases heart rate
<input type="checkbox"/> C	sympathetic neurone	increases heart rate
<input type="checkbox"/> D	sympathetic neurone	decreases heart rate

(iii) Describe the events that lead to the release of acetylcholine at a synapse.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

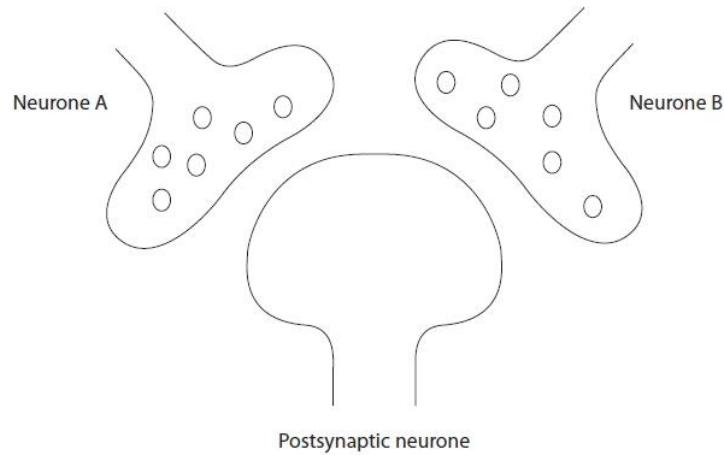
Q2.

The diagram shows the structure of a synaptic junction between three neurones.

Neurone A releases the excitatory neurotransmitter acetylcholine.

Neurone B releases the inhibitory neurotransmitter glutamate.

Glutamate causes chloride ions to move into the postsynaptic neurone.



(i) Describe the sequence of events that leads to an excitatory postsynaptic potential (EPSP) in the postsynaptic neurone after stimulation of neurone A.

(4)

.....

.....

.....

.....

.....

.....

.....

(ii) Which of the following rows correctly describes the action of each substance on this postsynaptic neurone?

(1)

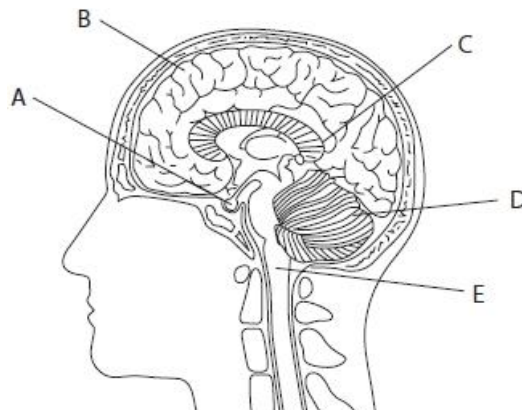
	Nicotine	Lidocaine	Cobra venom
<input type="checkbox"/> A	excitatory	excitatory	excitatory
<input type="checkbox"/> B	excitatory	inhibitory	inhibitory
<input type="checkbox"/> C	inhibitory	excitatory	excitatory
<input type="checkbox"/> D	inhibitory	inhibitory	inhibitory

(Total for question = 5 marks)

Q3.

The human brain controls many functions.

The diagram shows a section through a human brain with parts labelled A to E.



Poisons can also affect the function of neurones in the brain.

The photograph shows a pufferfish, a traditional food delicacy in Japan.



Pufferfish have to be carefully prepared by a chef to remove a poison called tetrodotoxin. This poison causes muscle paralysis.

Neurones were placed in a solution containing tetrodotoxin and in a control solution.

The neurones were stimulated and the potential difference across the axon membrane was measured.

The table shows the results.

Solution	Potential difference after stimulation / mV
tetrodotoxin	-70
control	+40

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q4.

Some chemical pesticides, such as diisopropyl fluorophosphate (DFP), affect the activity of synapses.

This pesticide acts by binding irreversibly to the R group of an amino acid in the active site of acetylcholinesterase.

(i) Explain why DFP inhibits the activity of acetylcholinesterase.

(2)

.....

.....

.....

.....

.....

(ii) Explain why a person poisoned with DFP has a slower heart rate.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	A 1 and 2 <i>B is incorrect because lidocaine binds to voltage gated sodium channels</i> <i>C is incorrect because lidocaine binds to voltage gated sodium channels</i> <i>D is incorrect because lidocaine binds to voltage gated sodium channels</i>		1
(ii)	B parasympathetic neurone reduce <i>A is incorrect because acetylcholine reduces the heartrate</i> <i>C is incorrect because acetylcholine is released by parasympathetic neurones</i> <i>D is incorrect because acetylcholine is released by parasympathetic neurones</i>		1
(iii)	An answer that makes reference to three from: <ul style="list-style-type: none"> • action potential / impulse arrives at pre-synaptic {terminal / knob}(1) • calcium channels open and calcium ions diffuse in(1) • vesicles move to membrane (1) • vesicles fuse with membrane and release acetylcholine (1) 	Allow action potential stimulates presynaptic membrane Allow Ca ²⁺ Allow exocytosis	3

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>A description that makes reference to four of the following:</p> <ul style="list-style-type: none"> • arrival of {action potential / impulse} at presynaptic {knob / terminal} (1) • calcium channels open / calcium ions enter (presynaptic knob) (1) • vesicles {move to / fuse with} presynaptic membrane (1) • acetylcholine {diffuses across / released into} the {synapse / cleft} (1) • binding to receptors on postsynaptic membrane {opening sodium channels / allowing sodium ions to enter} (1) 	<p>Accept calcium ions pass through membrane Do not accept calcium ions enter membrane</p> <p>Accept neurotransmitters for acetylcholine</p>	(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>The only correct answer is B (excitatory, inhibitory, inhibitory)</p> <p>A is not correct because lidocaine is inhibitory affecting the Na⁺/K⁺ ATPase pump, and cobra venom is inhibitory, blocking acetylcholine receptors</p> <p>C is not correct because nicotine is excitatory, mimicking acetylcholine, lidocaine is inhibitory affecting the Na⁺/K⁺ ATPase pump, and cobra venom is inhibitory, blocking acetylcholine receptors</p> <p>D is not correct because nicotine is excitatory, mimicking acetylcholine</p>		(1)

Q3.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> neurone at resting potential (1) because (voltage gated) sodium (ion) channels {closed / blocked} (1) therefore no movement of sodium (ions) into neurone / into cell / into axon / across membrane (1) therefore prevents {depolarisation / action potential} (1) 	<p>ACCEPT not open</p> <p>DO NOT ACCEPT nerve</p>	(4)

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> {charge / shape} of active site changes (1) so acetylcholine will not bind / can no longer form E/S complex (1) 		2

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">• acetylcholine (from parasympathetic neurone) is not broken down / builds up in synaptic cleft (1)• so continues to bind to (acetylcholine) <u>receptors</u> (in SA node) (1)• so fewer impulses from SA node (1)• and noradrenaline has no / less effect (1)	<p>Accept fewer depolarisations from SA node</p>	<p>3</p>