Questions

Q1.

The effect of exercise on the pH of blood plasma and heart rate was investigated.
The investigation used a sample of three people.
The table shows the results of the investigation before and after exercise.

Activity	Mean pH of blood plasma	Mean heart rate / beats min^{-1}
Rest	7.4	72
Exercise	7.2	94

(i) Analyse the data to explain how the pH of blood plasma affects heart rate.

(4)

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(ii) There were errors in the design of this investigation that reduced the validity of the data.
Explain how this investigation should have been designed to ensure the data was valid.

(4)

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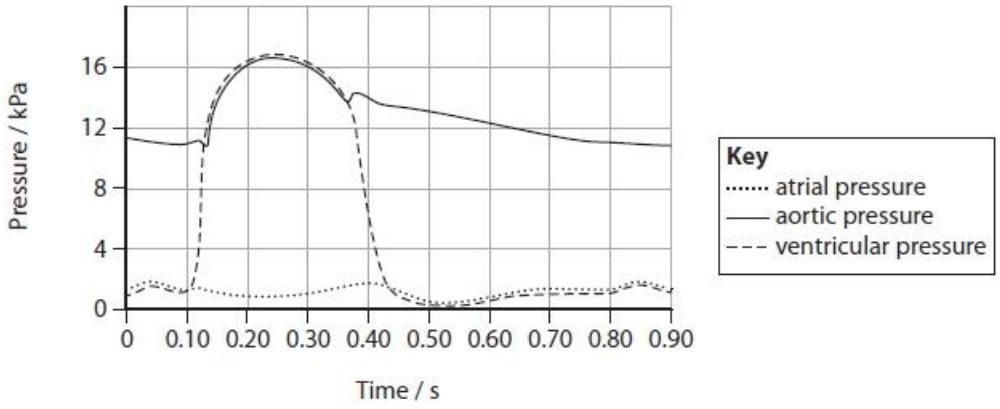
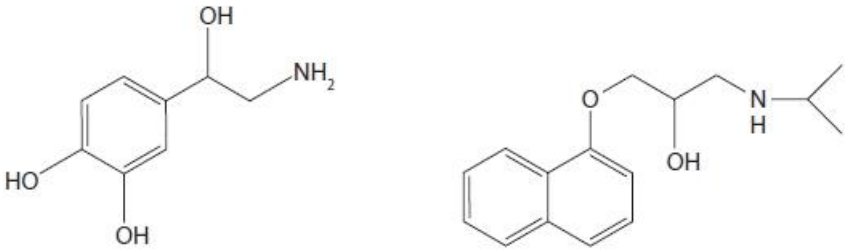
(Total for question = 8 marks)

Q2.

The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



The diagram shows two chemicals that affect the human heart rate.

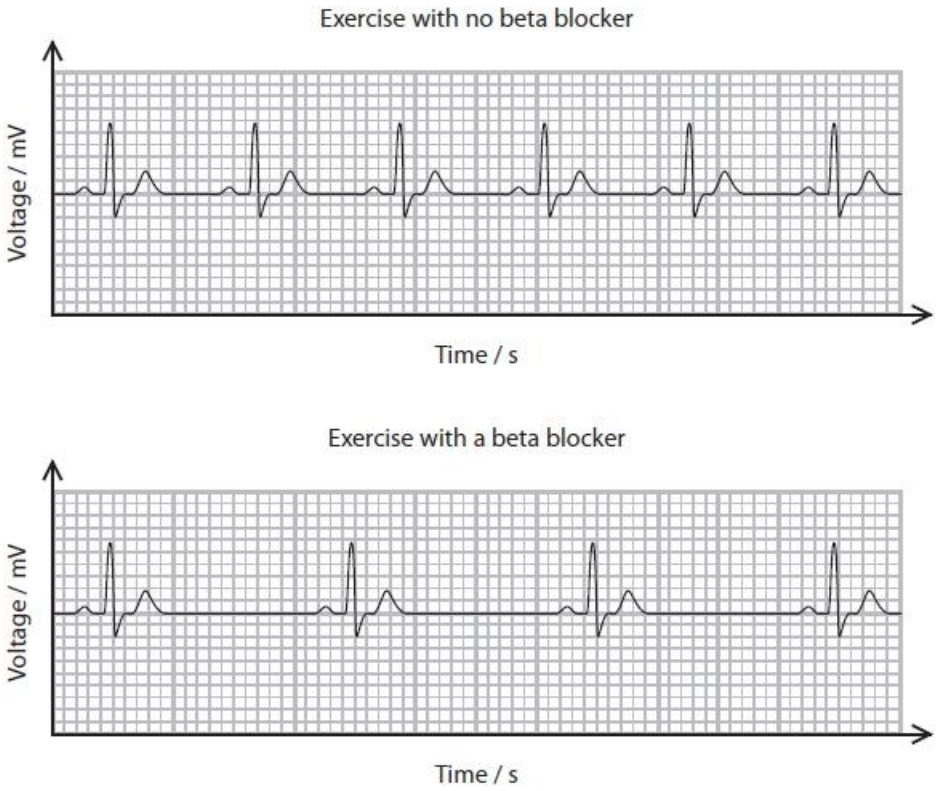


Noradrenaline Beta blocker

Beta blockers are drugs used to regulate the heart rate of some patients.

The effect of beta blockers on the heart rate during exercise was investigated.

The ECG traces show the heart rate of a person exercising before and after taking a beta blocker.



Analyse the information to explain the results of this investigation.

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(Total for question = 3 marks)

Q3.

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
☒ **A**	parasympathetic neurone	increases heart rate
☒ **B**	parasympathetic neurone	decreases heart rate
☒ **C**	sympathetic neurone	increases heart rate
☒ **D**	sympathetic neurone	decreases heart rate

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

(3)

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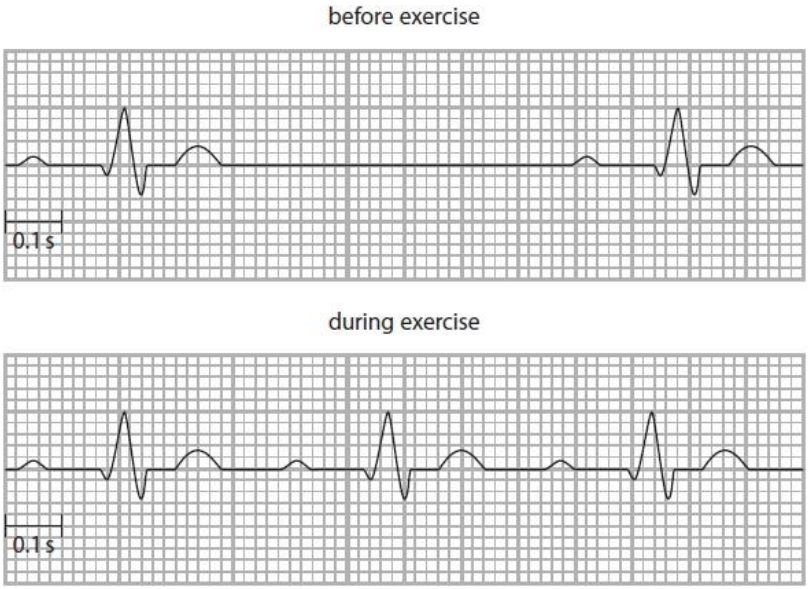
(Total for question = 5 marks)

Q4.

The brain is involved in many homeostatic mechanisms.

The autonomic nervous system plays a role in regulating heart rate.

The diagram shows an ECG trace from a student before and during exercise.



(i) Calculate the heart rate of this student during exercise.

(1)

Answer .....

(ii) Describe how exercise results in an increased heart rate.

(4)

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(Total for question = 5 marks)

Q5.

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)

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

(3)

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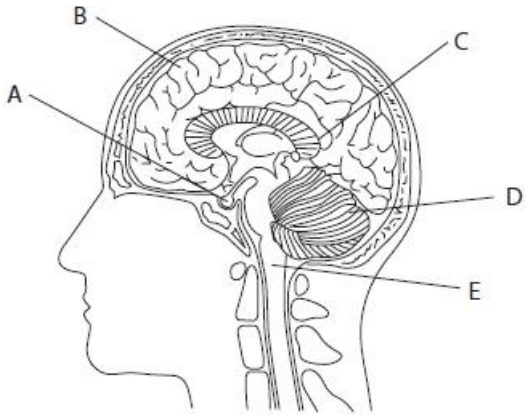
(Total for question = 5 marks)

Q6.

The human brain controls many functions.

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



Which letter labels the part of the brain that controls heart rate?

(1)

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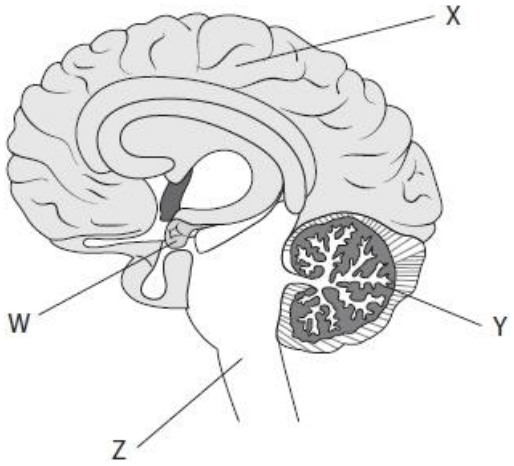
(Total for question = 1 mark)

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 autonomic nervous system controls the heart rate.

The diagram shows a human brain.



(i) Which region of the brain controls the heart rate?

(1)

- ☐ **A** W
- ☐ **B** X
- ☐ **C** Y
- ☐ **D** Z

(ii) Which one of the following would lead to an increase in heart rate?

(1)

- ☐ **A** release of acetylcholine by the sympathetic nervous system
- ☐ **B** release of acetylcholine by the parasympathetic nervous system
- ☐ **C** release of noradrenaline by the sympathetic nervous system
- ☐ **D** release of noradrenaline by the parasympathetic nervous system

(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • {low pH / carbon dioxide / lactic acid / lactate} detected by {chemoreceptors / aortic body / carotid body} (1) • affects {cardiac centre / medulla oblongata / cardiovascular centre} (1) • sympathetic nerve is stimulated / sends impulse / action potential (1) • noradrenaline at SAN (1) • therefore {more } {impulses / depolarisation / waves of excitation} which increase heart rate (1)	**DO NOT ACCEPT** message / signals	**(4)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • use larger sample to identify anomalies (1) • people have same {lifestyle / health / diet / fitness level / sex / ethnicity / age / mass} (1) • control {intensity / type} of exercise / same exercise (1) • control {duration / length} of exercise (1)	**DO NOT ACCEPT** calculate mean / SD / use statistics **ACCEPT** 10 mins	**(4)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • the heart rate is slower (1) • because noradrenaline and beta blocker are similar {shapes / structures} (1) • so beta blocker binds to noradrenaline receptors (1) • therefore {prevents / blocks} binding of noradrenaline (to receptors) (1)	**DO NOT ACCEPT** same shape	**(3)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	**A** 1 and 2 *B is incorrect because lidocaine binds to voltage gated sodiumchannels* *C is incorrect because lidocaine binds to voltage gated sodiumchannels* *D is incorrect because lidocaine binds to voltage gated sodiumchannels*		**1**
(ii)	B parasympathetic neurone reduce *A is incorrect because acetylcholine reduces the heartrate* *C is incorrect because acetylcholine is released byparasympathetic neurones* *D is incorrect because acetylcholine is released byparasympathetic neurones*		**1**
(iii)	An answer that makes reference to three from: • 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 stimulatespresynaptic membrane **Allow** Ca^{2+} **Allow** exocytosis	**3**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	127.6 – 130.4 beats per minute / bpm	**Accept** any number between and including 127.6 and 130.4 beats per minute / bpm	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to four of the following: • exercise {increases carbon dioxide / lowers pH / increases H^+ / increases lactate} in blood (1) • detected by chemoreceptors in the {carotid artery / aorta / aortic body / carotid body} (1) • impulses sent to {medulla / cardio acceleratory centre / cardiac control centre} (1) • impulses along sympathetic {nervous system / nerve / neurone} (1) • noradrenaline {is released onto / stimulates} SA node (1)	**Do not accept** signal / message **Do not accept** signal / message **Accept** adrenaline stimulates SA node	(4)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • {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)	An explanation that makes reference to three of the following: • acetylcholine (from parasympathetic neurone) is not broken down / builds up in synaptic cleft (1) • so continues to bind to (acetylcholine) receptors (in SA node) (1) • so fewer impulses from SA node (1) • and noradrenaline has no / less effect (1)	**Accept** fewer depolarisations from SA node	3

Q6.

Question Number	Answer	Additional Guidance	Mark
	• E		(1)

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	The only correct answer is: **D** *A is incorrect because W is the hypothalamus* *B is incorrect because X is the cerebrum* *C is incorrect because Y is the cerebellum*		1 comp

Question Number	Answer	Additional Guidance	Mark
(ii)	The only correct answer is: **C** release of noradrenaline by the sympathetic nervous system *A is incorrect because acetylcholine decreases the rate* *B is incorrect because acetylcholine decreases the rate* *D is incorrect because noradrenaline is released by the sympathetic nervous system*		1 comp