

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS

CONTROL OF HEART RATE IN MAMMALS

SCORE

/121

PERCENTAGE

%

STEMUP

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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.

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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.

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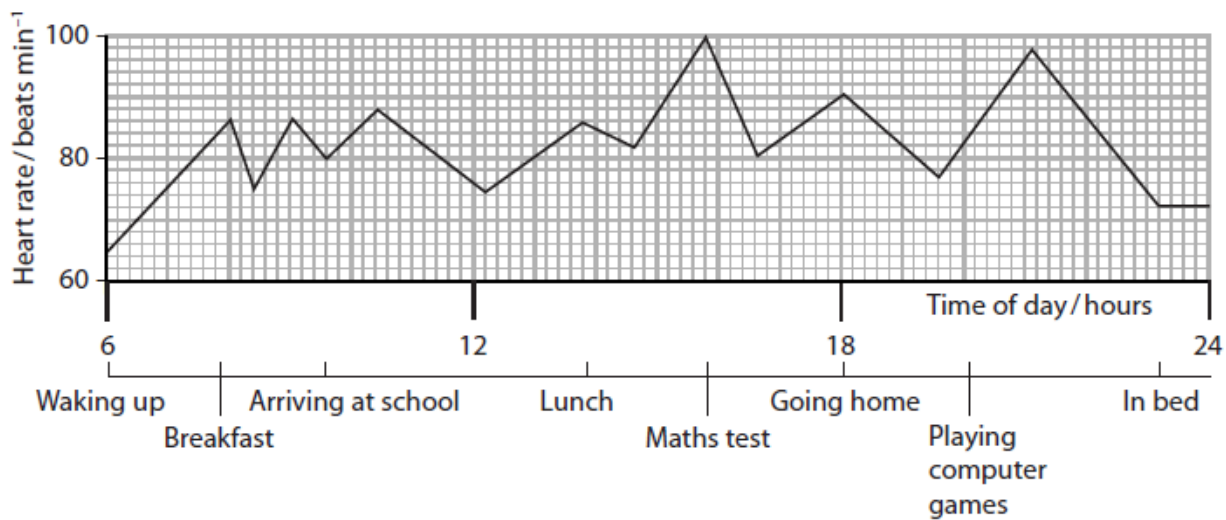
(Total for question = 8 marks)

Q2.

A student was interested to find out how his heart rate would vary throughout the day.

He wore a heart rate monitor from the time he woke up until the time he went to bed.

The graph shows the data collected and some of the student's activities during the day.



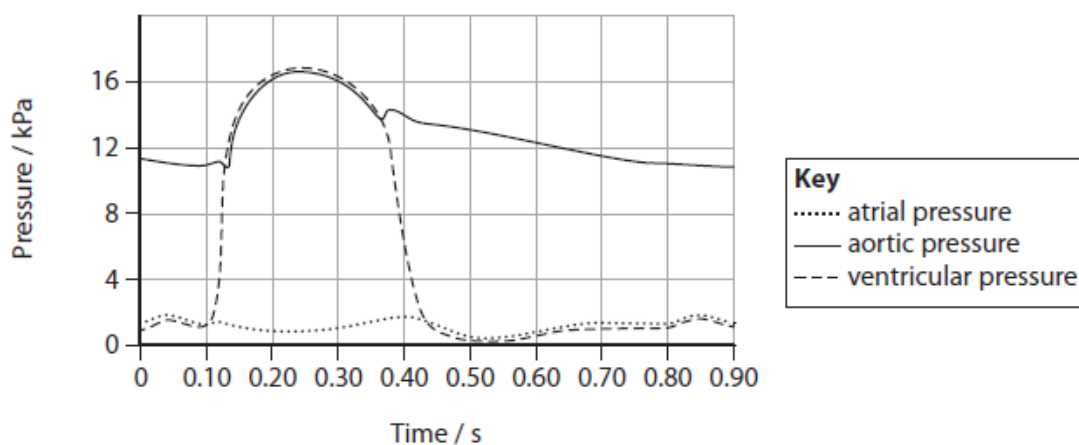
Calculate the rate of increase in the student's heart rate between 6 am and 8 am.

(2)

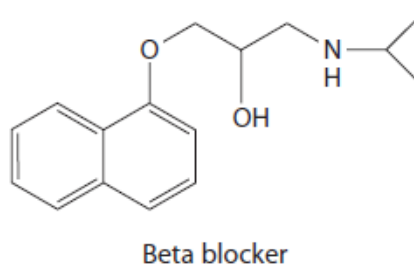
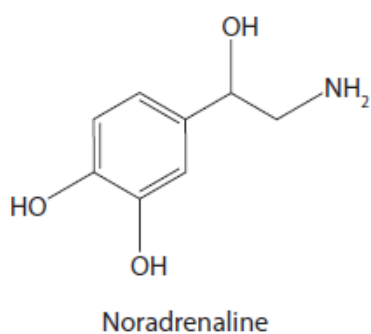
Answer

Q3.

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



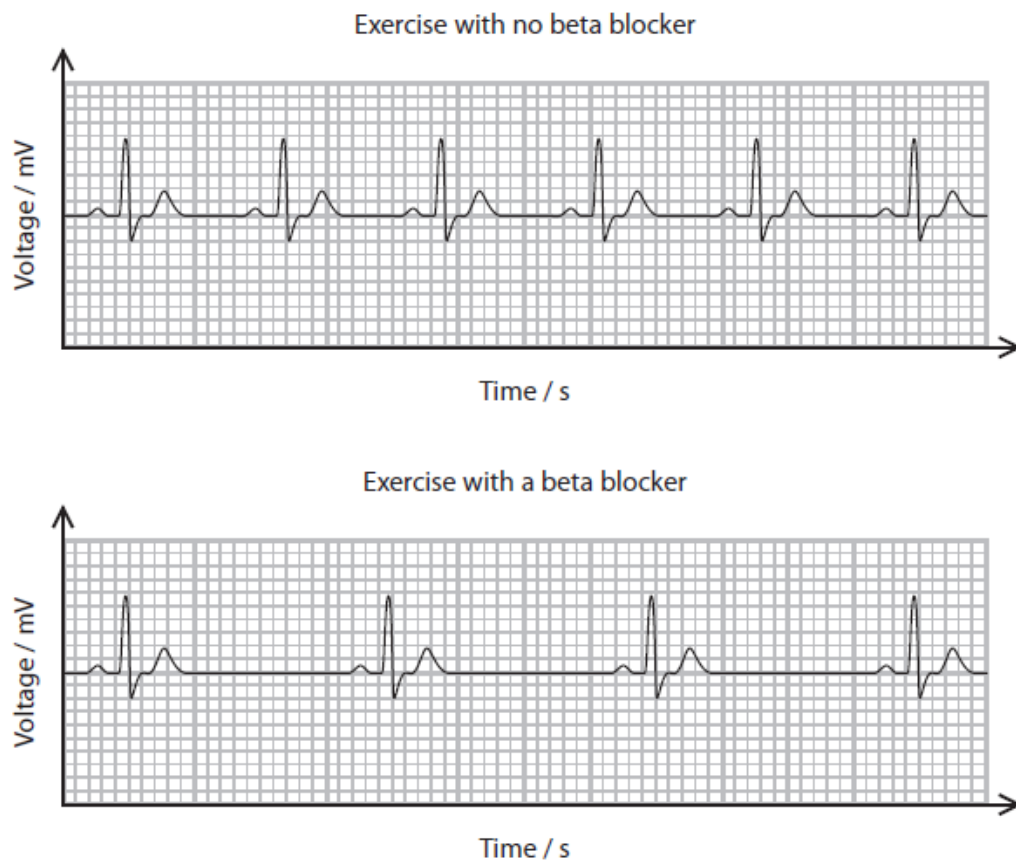
The diagram shows two chemicals that affect the human heart rate.



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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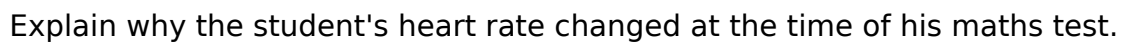
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(Total for question = 3 marks)

A student was interested to find out how his heart rate would vary throughout the day. He wore a heart rate monitor from the time he woke up until the time he went to bed. The graph shows the data collected and some of the student's activities during the day.

[illegible]

Q5.

Describe how the cardiac centre brings about a change in heart rate when the activity level of a person increases.

(4)

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(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 ☐.

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)

Q7.

Physiological changes occur when a person carries out a period of exercise, such as running 800 metres.

(a) One physiological change will be an increase in cardiac output.

One physiological change will be an increase in cardiac output.

(4)

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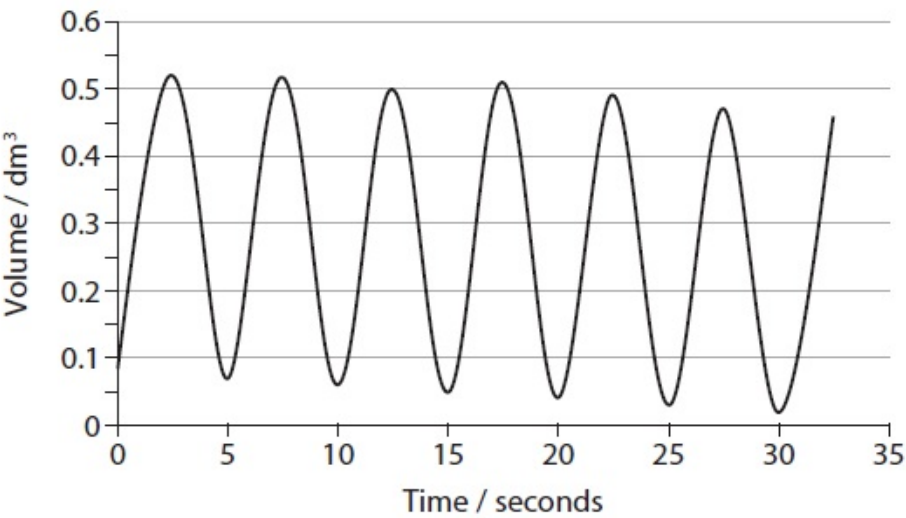
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(b) The respiratory system will also undergo physiological changes during a period of exercise.

The spirometer trace shown below was recorded when an adult was at rest. This trace can be used to calculate the resting breathing rate and tidal volume of the adult.



(i) Place a cross in the box (☒) that correctly identifies the approximate value for resting breathing rate and tidal volume for this adult.

(2)

Approximate value for	0.1 dm ³	0.5 dm ³	6 dm ³ min ⁻¹	6 breaths min ⁻¹	12 breaths min ⁻¹
Resting breathing rate	☐	☐	☐	☐	☐
Resting tidal volume	☐	☐	☐	☐	☐

(ii) The light conditions experienced by group B were similar to those found near ground level in

woodland.

Describe how a spirometer trace recorded immediately after a short period of exercise would differ from this trace.

(2)

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(c) A student used a spirometer to compare the resting breathing rate of musicians who play trumpets with musicians who play violins.

Suggest **two** variables the student should have considered when selecting the musicians, to make the study valid.

(2)

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(Total for question = 10 marks)

Q8.

A human heart can work effectively for over a hundred years but many people throughout the world have heart problems.

* The treadmill test can be used to diagnose heart problems.

This test requires a person to walk on a treadmill whilst an electrocardiogram (ECG) is recorded.

The angle of the treadmill is raised to increase the level of exercise. The photograph below shows a person carrying out the treadmill test.



Explain how the heart rate of this person is controlled as the level of exercise increases during this test.

(6)

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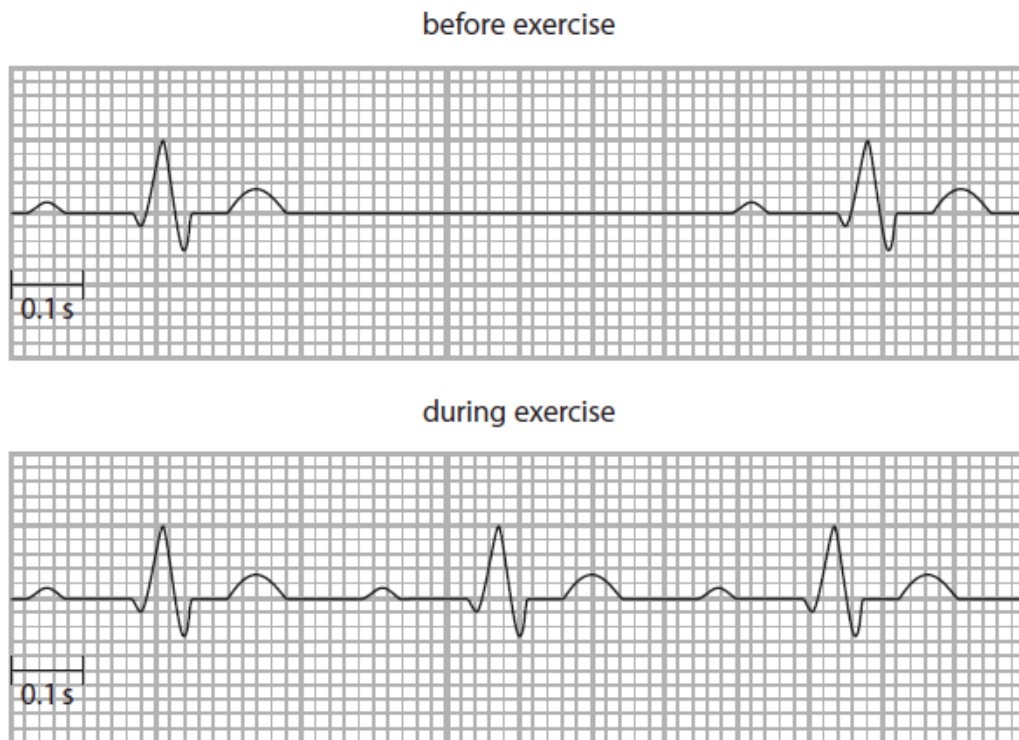
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Q9.

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)

Q10.

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.

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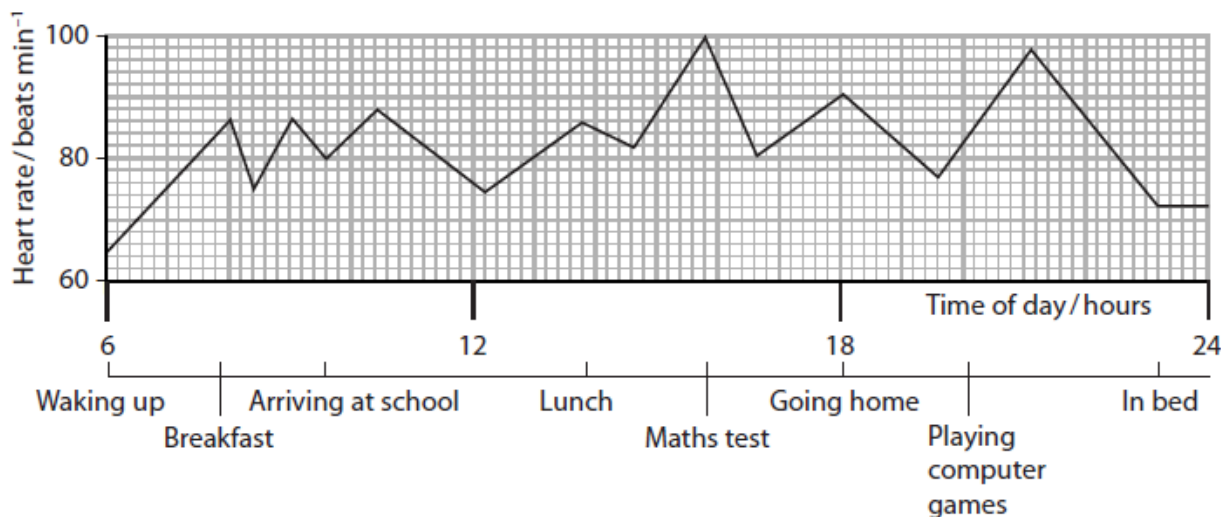
(Total for question = 5 marks)

Q11.

A student was interested to find out how his heart rate would vary throughout the day.

He wore a heart rate monitor from the time he woke up until the time he went to bed.

The graph shows the data collected and some of the student's activities during the day.



The student noticed that the graph showed a change in his heart rate while he was playing computer games.

He designed an investigation to find out how different computer games affect heart rate.

The student played one computer game and recorded the increase in his heart rate.

He then played four other different computer games and again recorded the increase in his heart rate.

He repeated this on six different occasions throughout the week.

(i) Explain how the design of the student's investigation could be improved.

(4)

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(ii) Sketch a suitable graph that the student could use to present the results of his investigation.

(2)

Q12. The scientific article you have studied is adapted from several sources.
Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in cellulose and starch.
Give **two** structural differences between cellulose and starch.

(2)

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(b) Naked mole rats show evidence of poikilothermy (paragraph 5) whilst other mammals, such as humans, maintain a nearly constant body temperature.

(i) Describe the role of the human nervous system in returning a slightly raised body temperature to its normal level.

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(ii) Explain how shivering generates heat to return a slightly reduced body temperature to its normal level.

(2)

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(c) Suggest how Buffenstein and Horsby introduced cancer-causing genes into cells from naked mole rats (paragraph 13).

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*(d) If we had to breathe the 'rank air' found in the tunnels of naked mole rats, it would leave us 'gasping for air' (paragraph 33).

Describe how the mechanism involved in the control of breathing rate in humans would respond to this 'rank air'.

(5)

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(e) Suggest how a study of the naked mole rat could help in the design of prosthetic limbs (paragraph 47).

(2)

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(f) Using the information in paragraph 48, name one hormone and state its target organ.

(1)

Hormone

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Target
organ

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(g) Suggest **two** reasons why the structure of the sperm may make it non-motile (paragraph 48).

(2)

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(h) The 'coefficient of band sharing' (paragraph 49) is a measure of the number of bands that different DNA samples have in common. The higher the coefficient the more bands the samples share. The maximum coefficient is 1.00.

Suggest why the coefficient of band sharing ranges from 0.93 to 0.99 within a colony of naked mole rats.

(3)

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(i) Suggest the importance of dispersers in naked mole rat colonies (paragraphs 50, 51 & 52).

(2)

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(j) Describe and explain **two** ways in which naked mole rats are adapted to their environment.

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(Total for Question = 30 marks)

Q13. The scientific article you have studied is adapted from several sources.

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

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in starch. Starch can be a combination of amylose and amylopectin.

Give **two** structural differences between amylose and amylopectin.

(2)

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(b) Explain why a colony of naked mole rats is considered 'a eusocial society' (paragraph 4).

(2)

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(i) Explain what is meant by the term **poikilothermic**.

(ii) Suggest how each of the following 'contribute to poikilothermic responses to changing temperature of this mammal'.

(2)

'A marked reduction in sweat glands'

(d) Suggest a mechanism that could have been used to genetically modify cells from mice with cancer-causing genes (paragraph 13).

(2)

*(e) Whilst naked mole rats are 'impervious to chemical pain' they do feel 'acute pain such as cuts and burns' (paragraph 31).

Touching something hot, which could lead to a burn, can cause nerve impulses to travel along myelinated sensory neurones very rapidly.

Explain how myelination increases the speed of transmission of nerve impulses in a sensory

neurone.

(5)

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(f) Explain how a heart attack can temporarily reduce the oxygen concentration in brain tissue (paragraph 36).

(3)

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(g) Using the information in paragraph 48, name **one** hormone **and** state its function.

(1)

Hormone:

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Function:

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(h) Suggest how a change in the mid region of the sperm may make it non-motile (paragraph 48).

(2)

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(i) Disperser naked mole rats 'are laden with fat' (paragraph 50).
Suggest why it may be advantageous for disperser naked mole rats to have high levels of fat.

(3)

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(j) Explain the statement that 'a preference by reproductively active females for unfamiliar males is interpreted as inbreeding avoidance' (paragraph 52).

(2)

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(k) 'The naked mole rat hasn't yet had its genome sequenced' (paragraph 53).

Explain what is meant by the term **genome sequenced**.

(1)

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(l) 'With so much to offer science, it is no surprise that naked mole rats are becoming more common in labs' (paragraph 53).

Using information from the article, describe **two** adaptations of naked mole rats. For each adaptation, explain why it could be of interest in a medical research laboratory.

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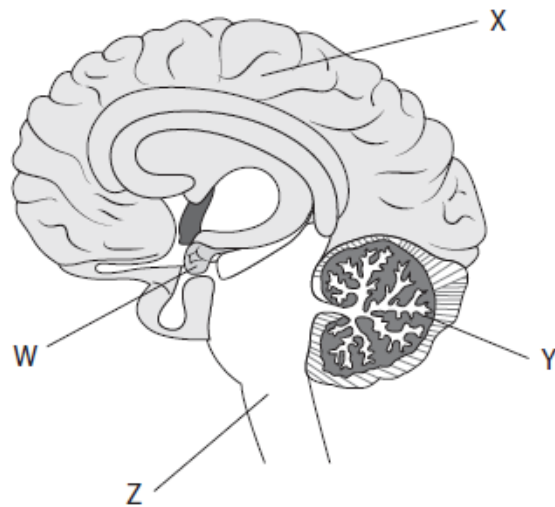
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(Total for Question = 30 marks)

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	Acceptable Answer	Additional Guidance	Mark
	- correct numerical calculation (1) - correct units (1)	<u>Example of Calculation:</u> $22 \div 120$ $=0.183$ beats per minute per minute / beats minutes ⁻²	(2)

Q3.

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)

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • { stress / fear } causes the adrenal glands to release adrenaline into the bloodstream (1) • because of impulses along sympathetic nerve (1) • from the { cardiac control centre / medulla (oblongata) } in the brain (1) • increase in heart rate caused by increased rate of depolarisation of SAN (1) • due to release of noradrenaline at SAN (1) ATP than other cells		(5)

Q5.

Question Number	Correct Answer	Additional guidance	Mark
	A description that makes reference to four of the following points: • increased pressure / CO₂ concentration / decreased pH detected by baroreceptors / chemoreceptors (1) • medulla oblongata (1) • sympathetic nerve stimulated (1) • release of noradrenaline (1) • excitation at SAN (1)		(4)

Q6.

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: • 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 Ca²⁺ Allow exocytosis	3

Q7.

Question Number	Answer	Mark
(a)	1. heart rate increases / eq ; 2. {stroke volume / eq} increases / eq ; 3. {SAN /eq} activity increases / ; 4. AVN time delay decreases / eq ; 5. idea that more blood returning (to the heart) causes {heart / muscle} to stretch ; 6. idea that ventricles contract with greater force ;	(4)

Question Number	Answer						Mark
(b) (i)							(2)
	Approximate value for	0.1 dm ³	0.5 dm ³	6 dm ³ min ⁻¹	6 breaths min ⁻¹	12 breaths min ⁻¹	
	Resting breathing rate					☐	
	Resting tidal volume		☐				

Question Number	Answer	Mark
(b)(ii)	1. more {peaks / eq} in the same time / higher frequency / distance between (consecutive) peaks would decrease ; 2. idea of distance from peak to trough would increase ;	(2)

Question Number	Answer	Mark
(c)	Any two from the following: 1. how often they play 2. age 3. body size / BMI / eq 4. gender / eq 5. fitness level / eq 6. health status / eq 7. lifestyle e.g. smoker or swimmer ; ;	(2)

Q8.

Question Number	Answer	Additional Guidance	Mark
*	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. increase in <i>respiration</i> rate in <i>muscle</i> cells ; 2. more {CO₂/carbonic acid/eq} in blood ; 3. more {lactate / lactic acid} in blood / eq ; 4. idea that <i>chemoreceptors</i> in <i>medulla</i> stimulated ; 5. ref to <i>cardiovascular</i> control centre in <i>medulla</i> ;	QWC emphasis is on spelling 2 OR 3 ACCEPT reduced blood pH 4. ACCEPT in <i>aorta</i>, <i>carotid</i>	

	6. ref to <i>autonomic nervous system</i> /<i>sympathetic nerve</i> ; 7. more <i>impulses</i> from {<i>medulla</i> / <i>cardiovascular</i> control centre} to SAN OR along neurones to SAN ; 8. More {<i>noradrenaline</i> / <i>norepinephrine</i>} released onto SAN ; 9. SAN (excitation) rate increased / eq ; 10.(causing an) increased {heart rate / eq} / eq ; 11.Comment on other mechanism e.g. presence of adrenaline, stretch receptor role ;	6. ACCEPT <i>accelerator</i> nerve 10. ACCEPT beats per min for heart rate	(6)
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Q9.

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)

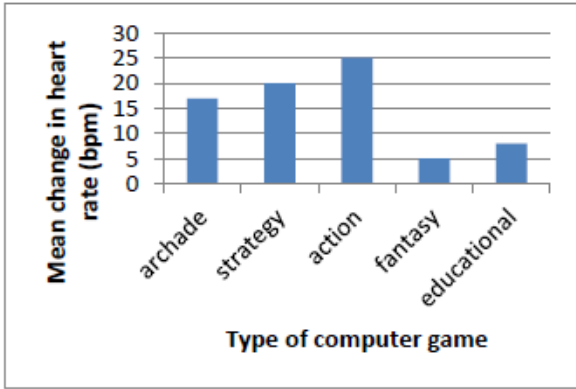
Q10.

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) <u>receptors</u> (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

Q11.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: - all games must be played for the same length of time to make a valid comparison (1) - a recovery period is needed for the heart rate to return to normal before each subsequent game (1) - repeats should be { at the same time of day / under the same conditions } to avoid effect of other variables (1) - games should be tested in a different sequence each time, to account for effects of fatigue (1) - more individuals should be tested, other than the student himself, to obtain valid results (1)		(4)

Question Number	Acceptable Answer	Additional Guidance	Mark												
(ii)	• bar chart (1) • x-axis: type of computer game and y-axis: mean change in heart rate (1)	 <table><caption>Mean change in heart rate (bpm) by Type of computer game</caption><thead><tr><th>Type of computer game</th><th>Mean change in heart rate (bpm)</th></tr></thead><tbody><tr><td>arcade</td><td>18</td></tr><tr><td>strategy</td><td>20</td></tr><tr><td>action</td><td>25</td></tr><tr><td>fantasy</td><td>5</td></tr><tr><td>educational</td><td>8</td></tr></tbody></table>	Type of computer game	Mean change in heart rate (bpm)	arcade	18	strategy	20	action	25	fantasy	5	educational	8	(2)
Type of computer game	Mean change in heart rate (bpm)														
arcade	18														
strategy	20														
action	25														
fantasy	5														
educational	8														

Q12.

Question Number	Answer	Additional guidance	Mark
(a)	1. alpha glucose in starch and beta glucose in cellulose; 2. only {starch / amylopectin} can be branched / cellulose only a linear molecule ; 3. starch contains two types of molecule, cellulose only one ; 4. alternate monomers rotated through 180° in cellulose only ; 5. only {amylopectin / starch} can have 1-6 glycosidic bonds / cellulose has 1-4 glycosidic bonds only ;	ACCEPT 3 - the two named molecules of starch – amylose and amylopectin ACCEPT 5 – starch can have 1-6 & 1-4 glycosidic bonds but cellulose only 1-4	(2)

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. thermoreceptors in hypothalamus / eq ; 2. detect the increase in (core) blood temperature / eq ; 3. reference to heat loss centre activated ; 4. reference to autonomic nervous system ; 5. reference to impulses down motor neurones ; 6. to {effectors / named effector} / eq ; 7. detail of method of heat loss / eq ;	ACCEPT 5 - effector neurone for motor neurone ACCEPT 7 – vasodilation of blood vessels, sweat released, heat loss from blood through radiation	(4)

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. (shivering) is muscle contraction ; 2. which uses {respiration / ATP / eq} ; 3. which release heat (to warm body) / eq ;	ACCEPT 2 - oxidative phosphorylation, ATP being converted to ADP and Pi	(2)

Question Number	Answer	Additional guidance	Mark
(c)	1. (cancer causing) gene identified / eq ; 2. gene {cut / isolated / eq} from DNA / eq ; 3. using a {restriction / eq} enzyme / eq ; 4. gene in {vector / named vector} ; 5. mechanism for getting {gene / vector} into host cells (of naked mole rats) / eq ;	ACCEPT 4 – named examples including retrovirus, virus, liposome ACCEPT 5 - reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler	(3)

Question Number	Answer	Additional guidance	Mark
* (d)	QWC – Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence) 1. idea that this air has higher CO₂ content ; 2. {CO₂ level in blood increases / pH of blood falls / eq} ; 3. change detected by chemoreceptors in {carotid body / carotid artery / aortic body / aorta / medulla} ; 4. reference to {ventilation centre / eq} (in medulla) ; 5. sends more impulses along neurones / eq ; 6. to intercostal muscles / diaphragm / eq ; 7. causing an increased {ventilation rate / rate of breathing / depth of breathing} / eq ;	ACCEPT 2 – high, higher (for CO₂) ACCEPT 4 – respiratory centre, inspiratory centre for ventilation centre ACCEPT 5 – impulses sent more often	(5)

Question Number	Answer	Additional guidance	Mark
(e)	1. naked mole rat's {incisors / eq} grow through {skin / lip} without {damage / eq} ; 2. lead to new {coatings / permanent seal /eq} at {skin / bone / metal} interface ; 3. so soft tissue is {not damaged / eq } (by the prosthetic) / eq ;		(2)
Question Number	Answer	Additional guidance	Mark
(f)	gonadotrophin-releasing (hormone) and anterior pituitary / gonadotrophins and {ovaries / testes} ;	ACCEPT – testosterone and testes ACCEPT – gonads for testes or ovaries	(1)

Question Number	Answer	Additional guidance	Mark
(g)	1. idea of irregularity of flagellum ; 2. Idea of irregularity associated with mid-region ;	ACCEPT 1 – no or more than one flagellum ACCEPT 2 – not enough mitochondria	(2)

Question Number	Answer	Additional guidance	Mark
(h)	1. idea of high levels of inbreeding ; 2. low level of genetic diversity / eq ; 3. idea that there is some variation because more than one male is involved in ; 4. unfamiliar males used as mates (by queen) / eq ; 5. fusion of colonies / eq ; 6. arrival of a dispersal phenotype (from a different colony) ; 7. mutations / eq ;	ACCEPT 1 – accept idea in context of only one queen/female breeds ACCEPT 2 – restricted gene pool, low genetic variation	(3)

Question Number	Answer	Additional guidance	Mark
(i)	1. reduces inbreeding (depression) / eq ; 2. increases outbreeding / outbreeding qualified ; 3. (leading to) increase in genetic diversity ; 4. idea of colony size regulation ; 5. idea of increase in fecundity ; 6. idea of increased chance of survival ;	ACCEPT 1 - less genetic drift ACCEPT 2 – disperser/new comer more likely to breed ACCEPT 3 – increased genetic variation, increase in variety of alleles ACCEPT 6 – appropriate ref to natural selection, due to environmental changes	(2)

Question Number	Answer	Additional guidance	Mark
(j)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. high CO₂ in air (of tunnels) ; 3. haemoglobin has higher affinity for oxygen / brain can tolerate eq ; 4. low O₂ levels (in tunnels) / eq ; 5. increased number of oxytocin receptors in brain ; 6. overcrowding / eq ; 7. non-pigmented ; 8. lack of UV light ; 9. outbreeding mechanisms such as disperser; 10. low genetic diversity ; 11. hairless/ naked/ reduction of sweat gland / loose skin / no insulating layer / poikilothermic ; 12. due to nature of its temperature environment / eq ; 13. teeth arrangement / eq ; 14. for digging underground ; 15. keen sense of smell/reduce eyesight / ref to circadian rhythms ; 16. dark conditions ; 17. division of labour ; 18. for the survival of the eusocial colony ;	ACCEPT1 - lack of receptor for chemical pain ACCEPT 3 – ref to brain's hypoxia response, neurones or brain resistance to hypoxia ACCEPT13 - forward of lips or long	(4)

Q13.

Question Number	Answer	Additional Comments	Mark
(a)	1. only (alpha) 1-4 glycosidic bonds in amylose / (alpha) 1-6 only found in amylopectin ; 2. only amylopectin has side branches / only amylose is {coiled / eq} ; 3. Amylopectin is a {larger / eq} molecule than amylose ;	1. ACCEPT 1-6 and 1-4 in amylopectin	(2)

Question Number	Answer	Additional Comments	Mark
(b)	1. Different individuals in the {colony / eq} take on specific {roles / jobs / eq} ; 2. Example given e.g. queen produces offspring ;	1. Accept division of labour 2. Accept dominance by queen, {few of the males / kings} involved in breeding	(2)

Question Number	Answer	Additional Comments	Mark
(c) (i)	Idea that body temperature of animal mimics the ambient temperature ;	Accept body temp follows environmental temperature	(1)

Question Number	Answer	Additional Comments	Mark
(f)	1. idea of heart working less efficiently ; 2. idea of less oxygen absorbed at lungs / eq ; 3. less blood pumped to brain ; 4. concentration gradient (for oxygen) at brain reduced / eq ; 5. less oxygen in blood (in brain) diffuses into brain tissue / eq ; 6. idea of less oxygen in brain tissue due to continual (aerobic) respiration ;		(3)

Question Number	Answer	Additional Comments	Mark
(g)	gonadotrophin-releasing (hormone) stimulates gonadotrophin release / gonadotrophin stimulates ovulation / testosterone stimulates {sperm production / (male) secondary sexual characteristics / other named example} ;		(1)

Question Number	Answer	Additional Comments	Mark
(h)	1. Idea of effect on mitochondria ; 2. (therefore) reduced {energy / ATP / eq} for flagellum movement ;	1. Accept less efficient / fewer / none 2. Accept tail for flagellum	(2)

Question Number	Answer	Additional Comments	Mark
(i)	1. idea that fat is an energy store ; 2. reduces dependence on external food source / eq ; 3. enables disperser to travel / eq ; 4. (metabolic) water is released (on oxidation) / eq ; 5. acts as a thermal insulator / eq ;	Accept energy-rich	(3)

Question Number	Answer	Additional Comments	Mark
(j)	1. idea that unfamiliar males are likely to be genetically different ; 2. idea that this is outbreeding ; 3. idea that this increases genetic diversity ;	3. Accept producing offspring that are genetically different	(2)

Question Number	Answer	Additional Comments	Mark
(k)	the order of the {bases / genes and non-coding sequences / eq} in the DNA (of the naked mole rats) is found / eq ;	Accept exons and introns Ignore genes unqualified	(1)

Question Number	Answer	Additional Comments	Mark
(I)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. Idea of pain relief e.g. dealing with post traumatic pain, post surgical pain, joint pain after a knee operation ; 3. haemoglobin has higher affinity for oxygen ; 4. Idea of dealing with reduced oxygen situations such as due to a heart attack or stroke ; 5. Naked mole rat {incisors / eq } grow through skin (of lip) without damage ; 6. Idea of better prosthesis e.g. new {coatings / permanent seal} at {skin / bone / metal} interface, soft tissue not damaged, avoid infection ; 7. High protein stability / does not (easily) lose 3D shape ; 8. (so) reduced effect of oxidative {damage / stress} / reduced effect of oxygen-containing free radicals / live healthily into old age ; 9. Cell overcrowding early warning gene / ref. to two tiered contact inhibition / presence of gene p16 ; 10. Idea of cancer prevention e.g. cancer resistance, future cancer therapy ; 11. Naked mole rat neurones display immature {characteristics / physiological properties} / brain cells that cope with {low oxygen / hypoxia} ; 12. To treat people with temporary loss of oxygen to brain e.g. heart attack, stroke, drowning / to prevent permanent brain damage ; 13. High levels of oxytocin receptors in {brain / nucleus ~~accumbens~~} ; 14. Idea of links to autism ; 15. Naked mole rats do not experience menopause ; 16. Ref to osteoporosis {treatment / prevention} (without side effects) ; 17. circadian rhythms / sleep patterns of naked mole rats ; 18. Idea that may help with sleep disorders ;	9. Accept anticancer mechanism	

Q14.

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

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

