PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS

CONTROL OF HEART RATE IN MAMMALS

SCORE	PERCENTAGE
/121	%

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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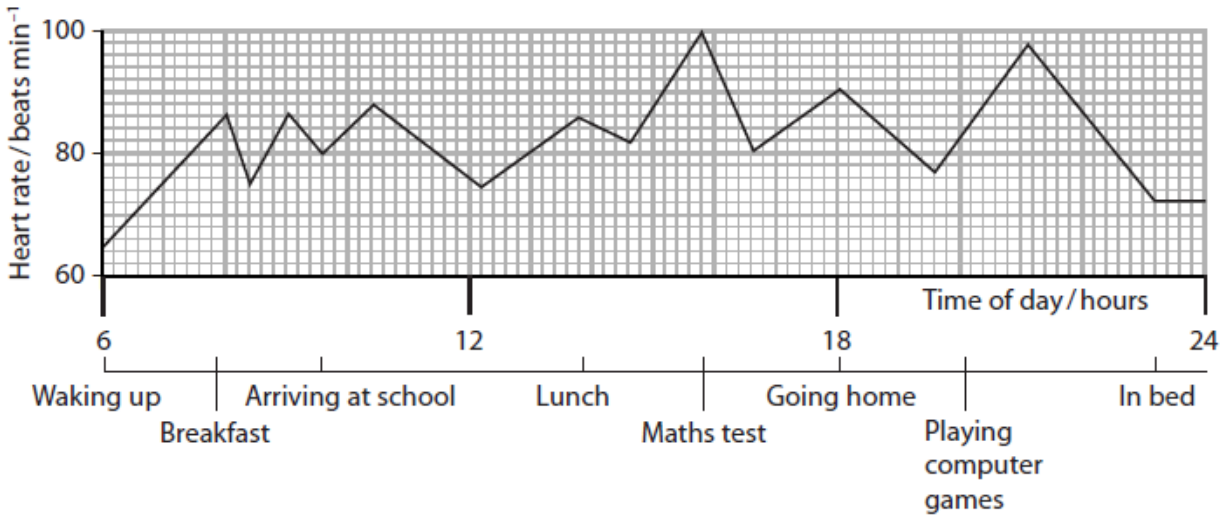
(Total for question = 8 marks)

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.



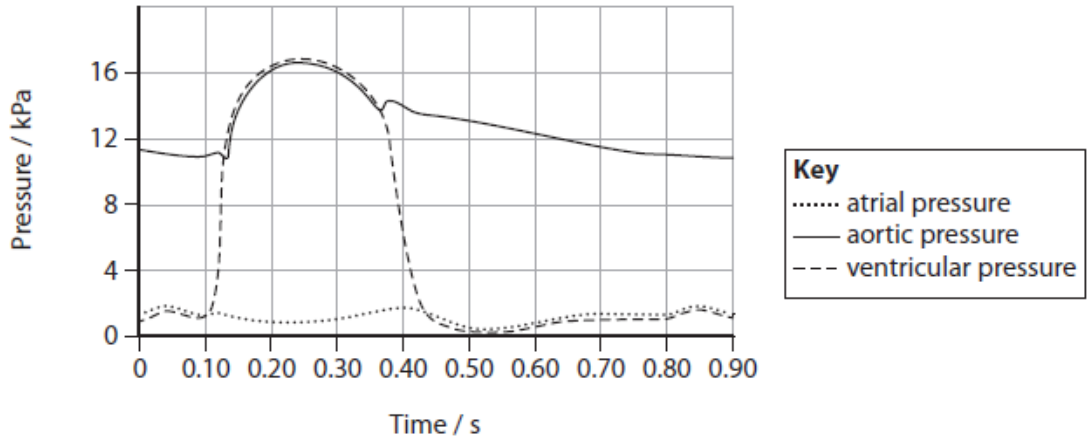
Calculate the rate of increase in the student's heart rate between 6 am and 8 am.

(2)

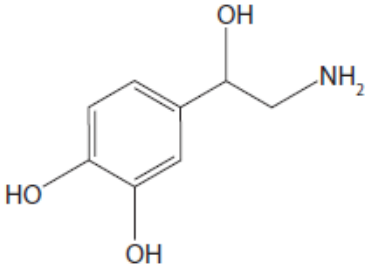
Answer .....

Q3.

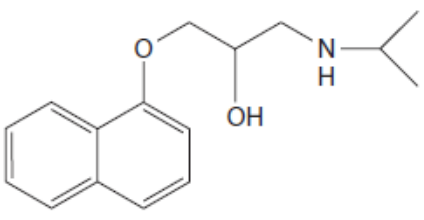
The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



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



Noradrenaline

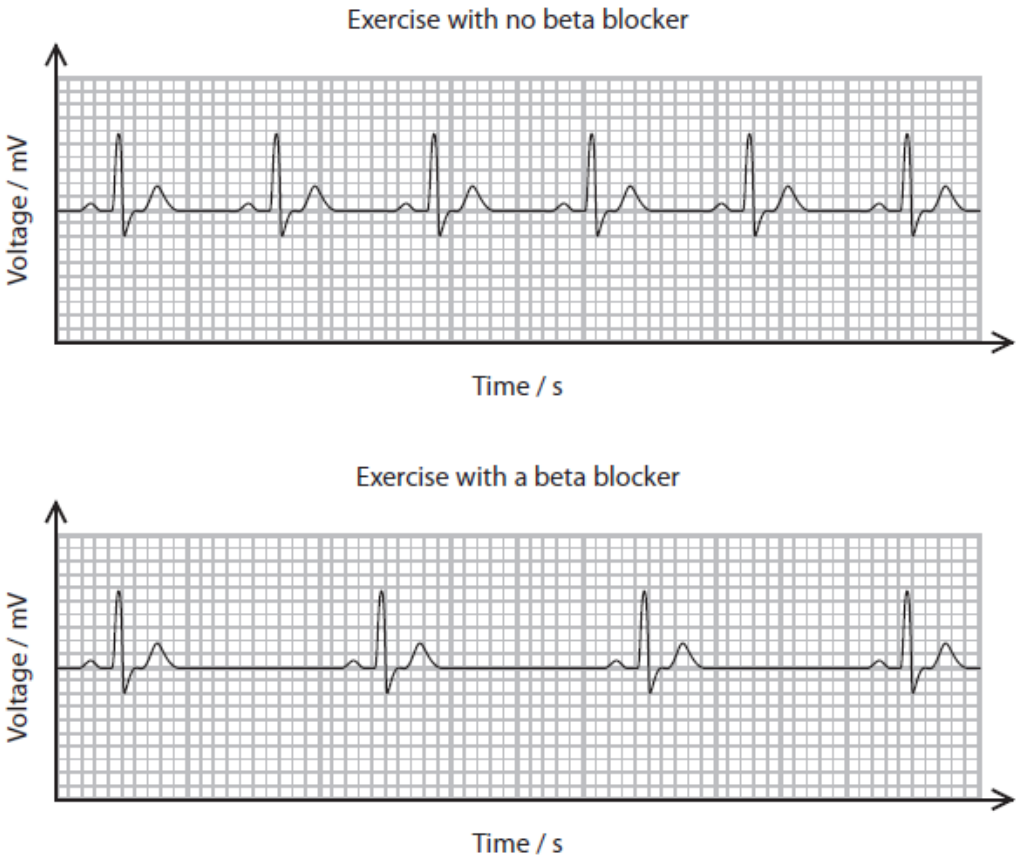


Beta blocker

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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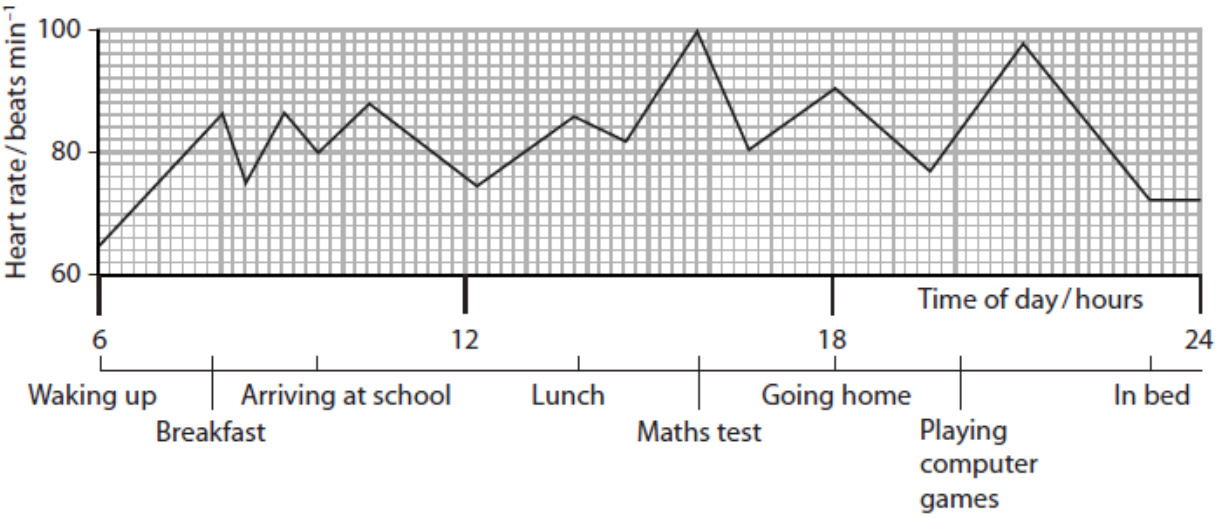
(Total for question = 3 marks)

Q4.

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.



Explain why the student's heart rate changed at the time of his maths test.

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Q5.

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

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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.

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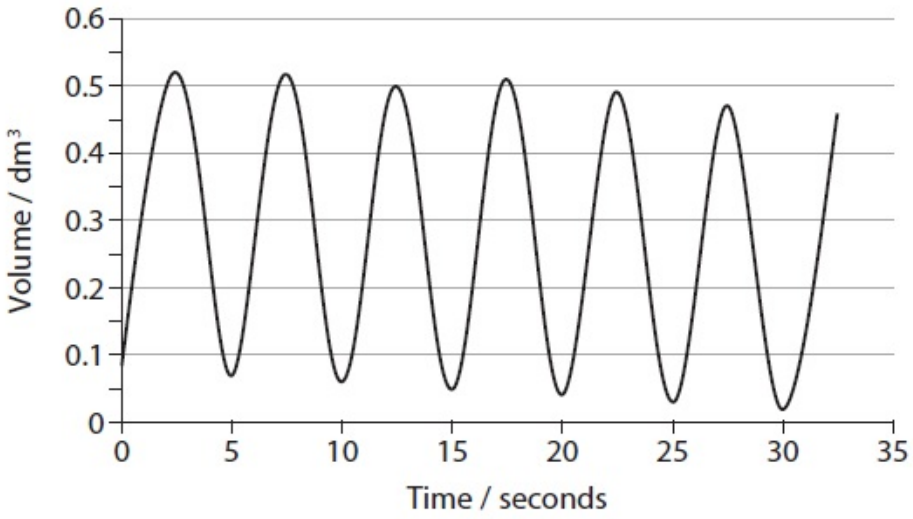
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(b) The respiratory system will also undergo physiological changes during a period of exercise.

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.

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(Total for question = 10 marks)

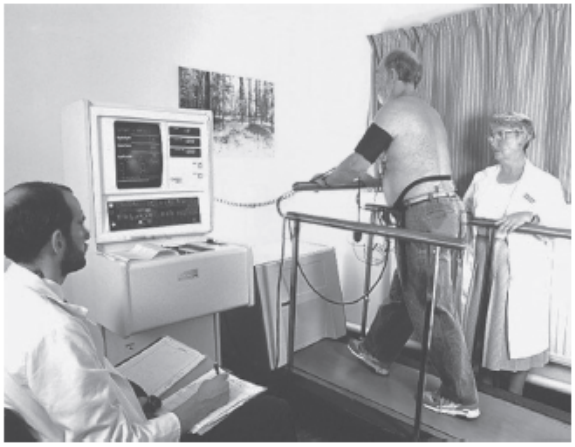
Q8.

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.

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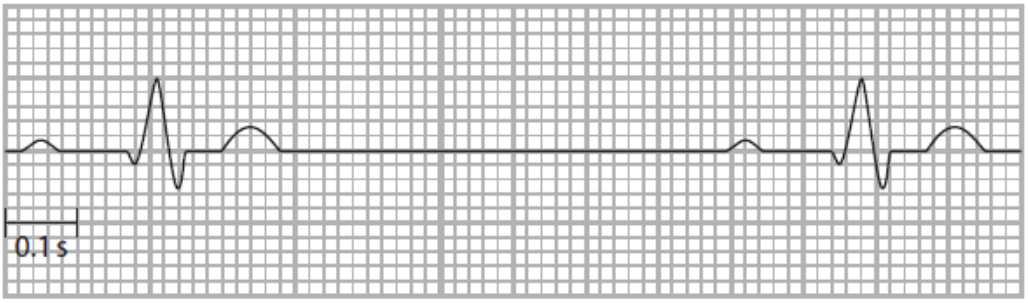
Q9.

The brain is involved in many homeostatic mechanisms.

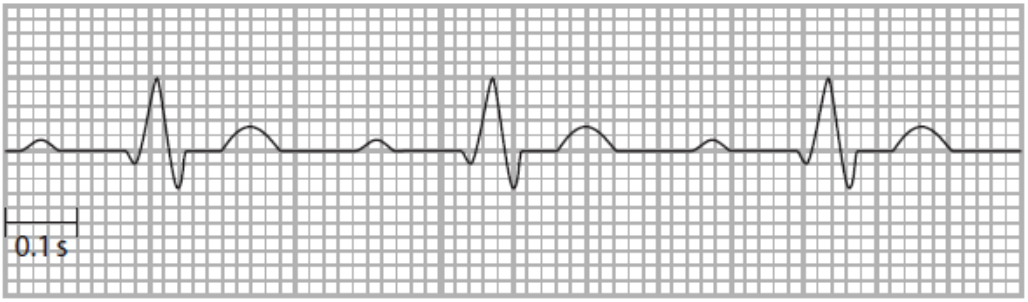
The autonomic nervous system plays a role in regulating heart rate.

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

before exercise



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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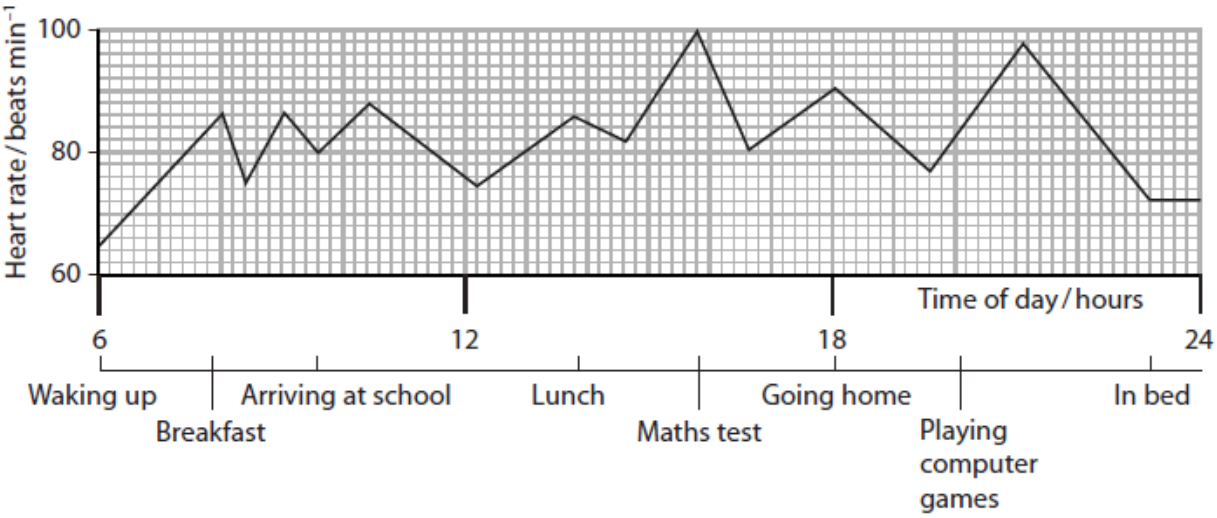
(Total for question = 5 marks)

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.

(4)

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

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

(3)

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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.

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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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(c) Naked mole rats show evidence of poikilothermy (paragraph 5).

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

(1)

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

(2)

'Lack of an insulating layer'

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'A marked reduction in sweat glands'

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

(2)

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*(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.

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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.

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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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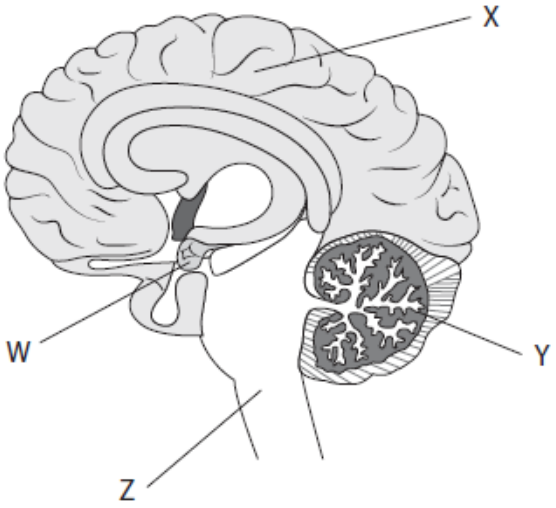
(Total for Question = 30 marks)

Q14.

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)