

Write your name here

Surname

Other names

Pearson
Edexcel GCE

Centre Number

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Candidate Number

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Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Wednesday 17 June 2015 – Morning

Time: 1 hour 45 minutes

Paper Reference

6BI05/01

You must have:

A copy of the scientific article taken from *Nature* and *Scientific American* (enclosed).

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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P 4 4 8 7 2 A 0 1 2 4

PEARSON

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Humans have a nervous system that has a variety of neurones.

- (a) The human brain is made up of a number of areas containing many millions of neurones.

Place a cross in the box ☒ that identifies the areas of the brain associated with riding a bicycle uphill.

- (i) the decision to ride the bicycle

(1)

- ☐ **A** cerebrum
- ☐ **B** cerebellum
- ☐ **C** hypothalamus
- ☐ **D** medulla

- (ii) initiating an increase in sweating during the ride

(1)

- ☐ **A** cerebrum
- ☐ **B** cerebellum
- ☐ **C** hypothalamus
- ☐ **D** medulla



(b) Voltage-gated K^+ and Na^+ channels are involved in the transmission of impulses in sensory and motor neurones.

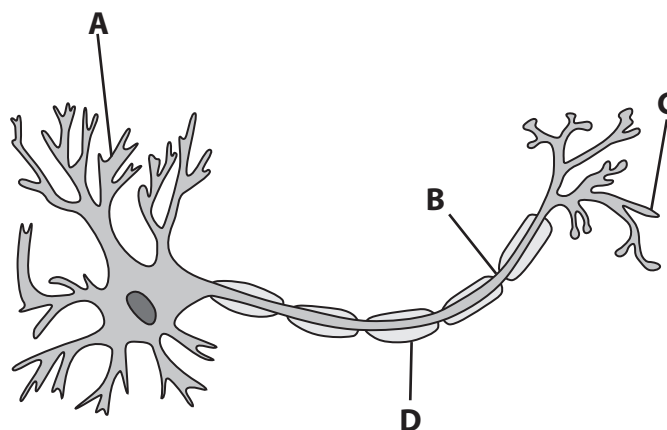
- (i) The table below identifies two stages in the transmission of an impulse in a sensory neurone.

Place a tick (✓) in each box that correctly identifies whether the channels are open or closed during these two stages.

(2)

Stage	Voltage-gated K^+ channels open	Voltage-gated K^+ channels closed	Voltage-gated Na^+ channels closed
Depolarisation			
Repolarisation			

- (ii) The diagram below shows a myelinated motor neurone.



Place a cross in the box ☒ that labels the site where neurotransmitters bind and initiate depolarisation.

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D



(iii) Describe the differences in the structure of a myelinated sensory neurone and a myelinated motor neurone.

(3)

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(Total for Question 1 = 8 marks)



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

(a) Explain how the sinoatrial node (SAN) ensures that oxygenated blood enters the aorta.

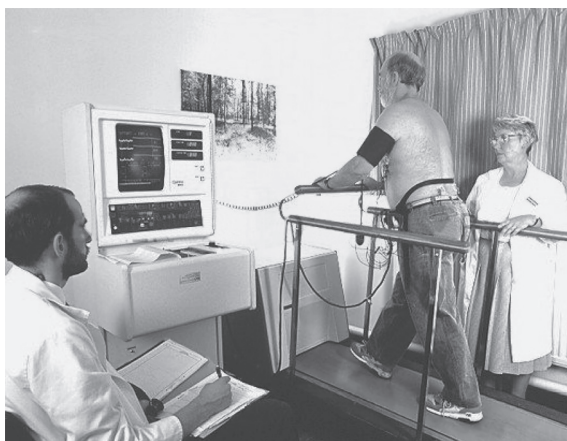
(4)

This image shows a single sheet of white paper with horizontal dashed lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no other markings or text on the page.

*(b) 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)

[illegible]

(c) The ECG below was recorded at rest.



(i) This person had a resting heart rate of 74 beats per minute.

Calculate the time taken for this ECG. Show your working.

(2)

Answer

(ii) Suggest suitable units for the vertical axis (y-axis) of this ECG.

(1)

(Total for Question 2 = 13 marks)



- 3** An investigation was carried out to study the effect of positive and negative physical and emotional experiences on humans.

The positive physical experience was a warm object placed on the arm of a person for five seconds.

The negative physical experience was a hot object placed on the arm of a person for five seconds.

All other variables were kept constant.

Two groups of people were used in this investigation. In the first group, the warm object was used before the hot object. In the second group, the hot object was used before the warm object.

After each experience, the individuals were asked to rate their feelings using the scoring system below.

Feelings	Score
Very bad	1
Bad	2
Neutral	3
Good	4
Very good	5

- (a) Suggest why one group had the warm object placed on their arm before the hot object and the other group had the hot object placed on their arm first.

(2)

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- (b) These two groups were then exposed to a positive emotional experience and a negative emotional experience.

The mean results for the investigation are shown in the table below.

Experience	Mean score for feelings and standard deviation	
	Physical	Emotional
Positive	4.5 ± 0.5	4.2 ± 0.4
Negative	1.9 ± 0.6	1.7 ± 0.4

A student concluded that the physical experiences and emotional experiences were similar.

Using information in the table, comment on the validity of this conclusion.

(4)

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(c) This investigation then used a scanning technique to study whether the same areas of the brain were involved in both physical experiences and emotional experiences.

- (i) Suggest the scanning technique required to study the brain in this investigation.
Give reasons for your choice.

(3)

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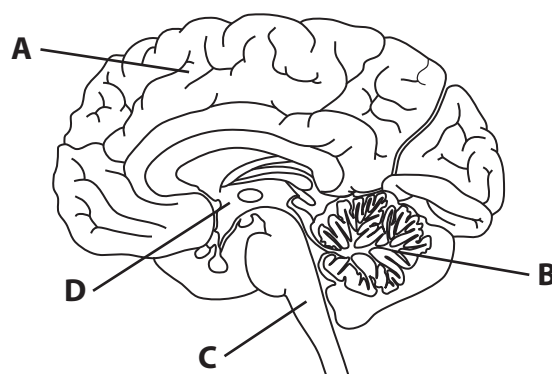
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- (ii) It was found that an area of the brain called the insula was involved in both physical experiences and emotional experiences. The insula is found just above the hypothalamus.

Using the diagram below, place a cross in the box ☒ that identifies the area of the insula.

(1)



- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 3 = 10 marks)



- (b) When the retina had recovered from bleaching, the resting potential of the bipolar neurones in the retina was found to be -43 mV.

The retina was then exposed to a range of light intensities. Each light intensity caused the bipolar neurones to depolarise. The peak voltage of the depolarisation for each light intensity was recorded.

All other variables were kept constant.

The investigation used retinas from an additional 14 rats.

The mean results are shown in the table below.

Light intensity / arbitrary units	Mean peak voltage of depolarisation / mV
1	11
3	18
6	19
9	20
12	20



- (i) Using the information in the table, describe the effect of light intensity on the mean peak voltage of depolarisation.

(2)

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- (ii) Suggest an explanation for the effect of light intensity on the mean peak voltage of depolarisation in these neurones.

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(c) Suggest **two** reasons why some people might have objections to the use of rats in this investigation.

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(Total for Question 4 = 13 marks)

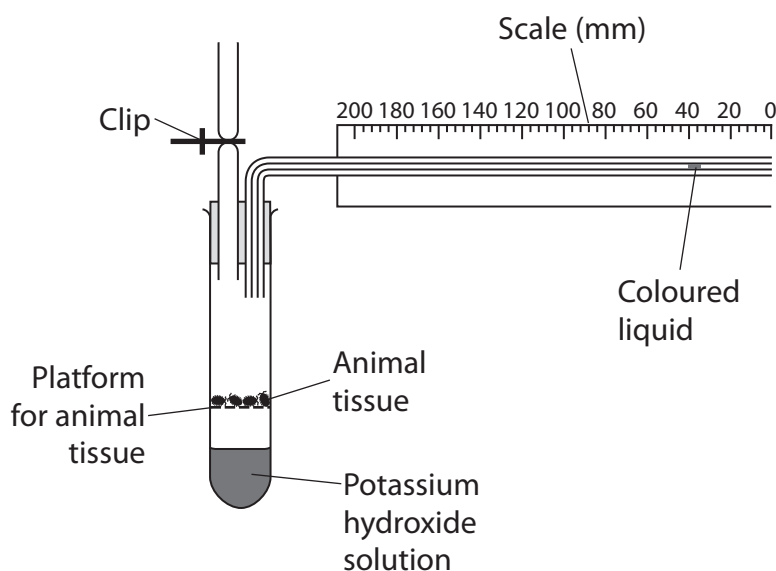


5 The tissues of some animals can carry out anaerobic and aerobic respiration.

(a) Three investigations were carried out to study respiration in an animal tissue, using the apparatus shown below.

The tissue used glucose as the respiratory substrate.

All other variables were kept constant.



The table below shows the three investigations that were carried out and the result for investigation 1.

Investigation	Type of respiration	Potassium hydroxide solution absent or present	Coloured liquid moved to the left	Coloured liquid moved to the right	Coloured liquid did not move
1	Anaerobic	Absent	☒	☒	☒
2	Aerobic	Absent	☒	☒	☒
3	Aerobic	Present	☒	☒	☒

(i) Complete the table by placing a cross in one box ☒ for each of investigations 2 and 3 to show the response of the coloured liquid.

(2)



(ii) Explain why the coloured liquid did not move in investigation 1.

(3)

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(iii) Reduced NAD ($\text{NADH} + \text{H}^+$) would be formed in investigations 2 and 3.

Describe the fate of reduced NAD in aerobic respiration.

(4)

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(b) Explain how investigation 3, shown in the table, could be used to compare the rate of respiration of two different tissues.

(2)

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(Total for Question 5 = 11 marks)



P 4 4 8 7 2 A 0 1 7 2 4

6 A number of drugs, including EPO, have been used by athletes.

EPO is a drug that stimulates the formation of red blood cells. EPO has been used to enhance the performance of certain types of athlete.

- (a) Sprinters usually have more fast twitch fibres in their leg muscles than long distance runners.

Suggest why EPO may have less of an effect on the performance of a sprinter than on a long distance runner.

(3)

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- (b) Suggest **two** ethical reasons why the use of drugs, such as EPO, should be banned from sport.

(2)

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(Total for Question 6 = 5 marks)



7 The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

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

- (a) Rabies is a 'nasty infection' caused by a virus (paragraph 5).
Explain how scientists would be able to determine that the rabies pathogen is a virus.

(2)

- *(b) Suggest how researchers had genetically modified the pathogen to 'provoke an effective immune response' (paragraph 12).

(6)



- (c) Octopamine is a neurotransmitter (paragraph 24). Libersat and his team believe that wasp venom probably blocks octopamine receptors in the central nervous system of the cockroach.

Suggest **two** ways that the 'compound that reactivates octopamine receptors' (paragraph 25) could work.

(2)

- (d) Suggest how scientists, such as Hughes, could have estimated that ants comprise 'half of all insect biomass worldwide' (paragraph 31).

(3)



- Suggest how fungal genes may be expressed and affect the behaviour of these ants.

[illegible]

(f) Suggest what is meant by the term **clock genes** (paragraph 35).

(2)

(g) Suggest how a lack of 'signals' (paragraph 36) could lead to muscle atrophy.

(4)



- Suggest how these could have been identified as separate species.

[illegible]

- Suggest the advantages to the zombie fungus of this ant behaviour.

TOTAL FOR PAPER = 90 MARKS

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