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Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Friday 25 June 2010 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI05/01

You must have:
A copy of the scientific article taken from New Scientist articles (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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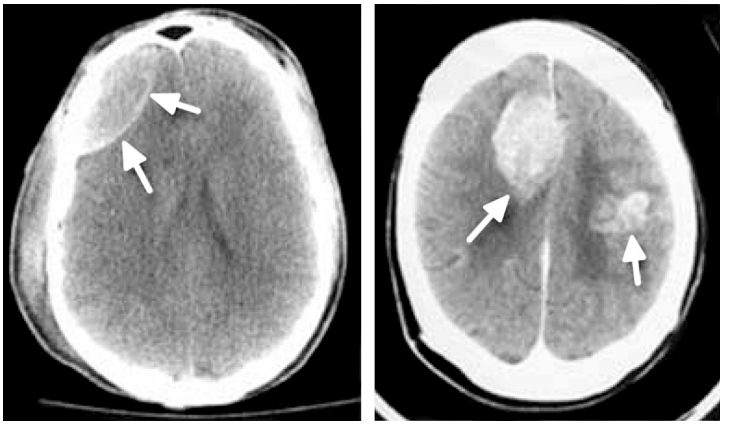
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Answer ALL questions.

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 Computed tomography (CT) and functional magnetic resonance imaging (fMRI) are used to investigate brain structure and function.
The CT scans below show two different human brains with abnormal areas. These areas are indicated by arrows.



Magnification × 0.2

(a) Describe how these images could help a doctor to determine appropriate treatment of the abnormalities.

(2)

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(b) Explain why the abnormalities in these two brains could cause different symptoms.

(2)

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(c) Describe how fMRI is used to investigate brain function.

(2)

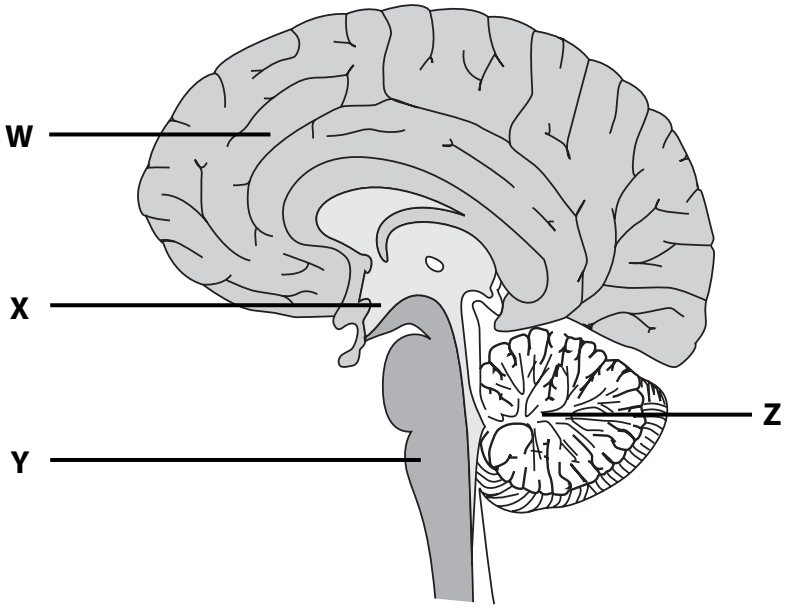
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(d) The diagram below shows a section through the human brain.



For each of the activities below, indicate the region of the brain **W**, **X**, **Y** or **Z** which will be most involved. Put a cross ☒ in the box corresponding to the correct letter.

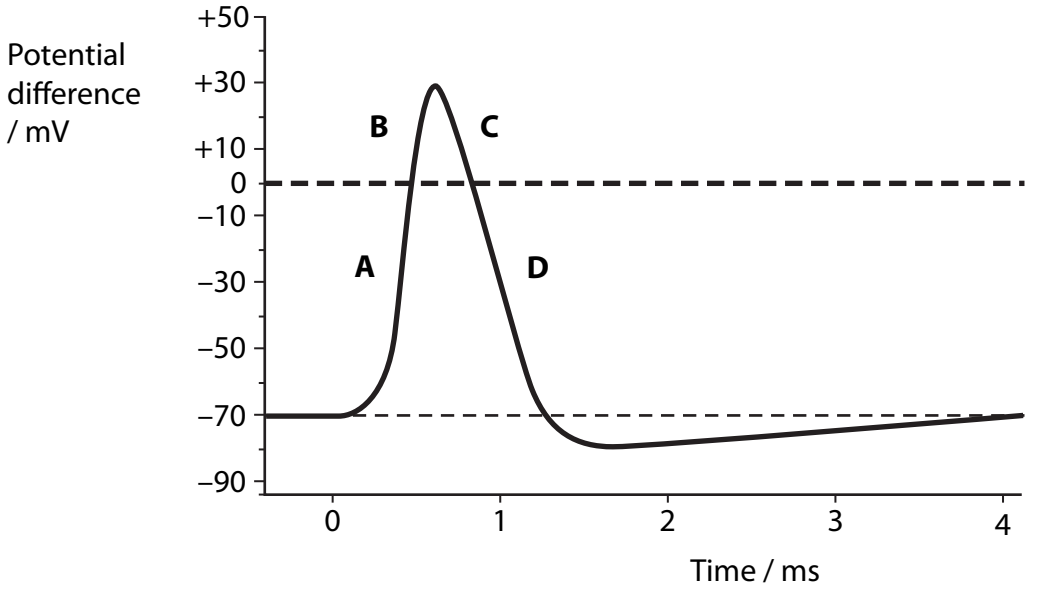
(4)

Activity	Region of brain			
	W	**X**	**Y**	**Z**
Regulating core temperature	☒	☒	☒	☒
Climbing stairs	☒	☒	☒	☒
Regulating carbon dioxide in the blood	☒	☒	☒	☒
Choosing a gift	☒	☒	☒	☒

(Total for Question 1 = 10 marks)

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2 The diagram below shows changes in potential difference across the membrane of a neurone during an action potential.



(a) Describe the events that begin the depolarisation of the membrane of a neurone.

(2)

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(b) Complete the table below to show which ions are able to move across the membrane at positions **A** and **D** shown in the diagram.

Put a cross ☒ in the box if the membrane is permeable to the ion.

(2)

Position on diagram	Permeable to sodium ions	Permeable to potassium ions
A	☒	☒
D	☒	☒

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(c) Give an explanation for the movement of ions at position **C** on the diagram.

(3)

(d) Explain how the potential difference across the membrane is returned to the resting level in the time between 1.5 ms and 4.0 ms on the diagram.

(3)

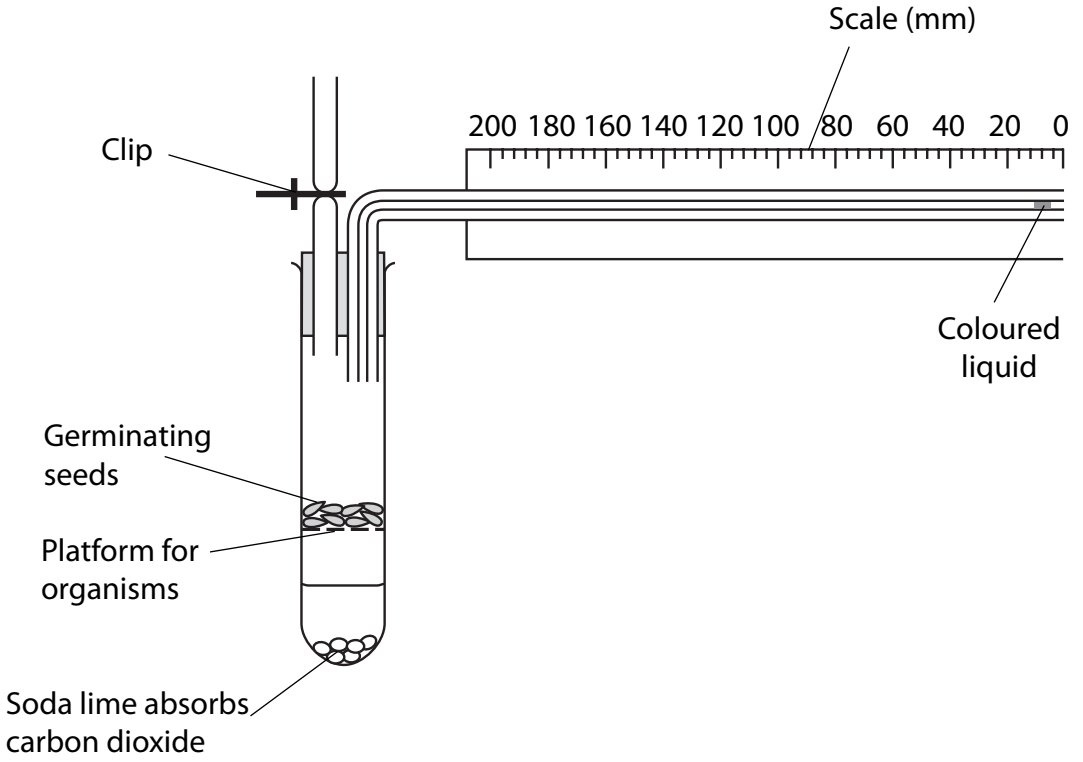
(Total for Question 2 = 10 marks)

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3 The apparatus shown in the diagram below was used to measure the rate of respiration of germinating seeds in air. The distance moved by the coloured liquid was measured at 15-minute intervals for one hour.

This was repeated with the air replaced by nitrogen gas.

The rate of respiration of small insects in air was measured using the same apparatus.



(a) Suggest reasons for absorbing carbon dioxide in this apparatus.

(2)

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N 3 7 0 9 6 A 0 6 2 0

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(b) The table below shows results recorded by a student using this apparatus.

Organism	Distance moved by liquid in 15-minute intervals / mm				Mean rate of respiration / mm min^{-1}
Germinating seeds	7	6	5	6	0.4
Germinating seeds in nitrogen gas	0	0	0	0	0
Insects	12	11	13	12	

(i) In the space below, calculate the mean rate of respiration for the insects, expressed as movement of liquid in millimetres per minute.
Show your working.

(2)

Answer ..... mm min^{-1}

(ii) The seeds in the experiment with nitrogen gas continued to germinate.
Suggest an explanation for the lack of movement of the liquid.

(2)

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(iii) Suggest **two** reasons why a valid comparison cannot be made between the mean rates of respiration of the germinating seeds in air and the insects. For each reason, suggest a modification that would allow a valid comparison.

(4)

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(Total for Question 3 = 10 marks)

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4 Electrical activity in heartbeats can be recorded using electrocardiograms (ECG). An ECG includes recording of the activity of the sinoatrial node (SAN).

(a) Describe the role of the SAN in controlling heartbeats.

(2)

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(b) Describe how the cardiovascular centre, in the medulla oblongata, affects the SAN during exercise.

(2)

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(c) ECGs can be used to diagnose abnormalities in the heartbeat. One such abnormality is a ventricular ectopic beat. This occurs when a region of the ventricle has a similar effect on the heart as the sinoatrial node (SAN).

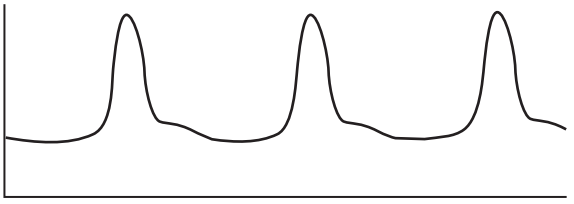
The diagrams below show a normal ECG trace and a trace that shows a ventricular ectopic beat, labelled E. The traces were recorded from left to right. Changes in blood pressure in the pulmonary artery are shown over the same period of time.

Normal heart

ECG



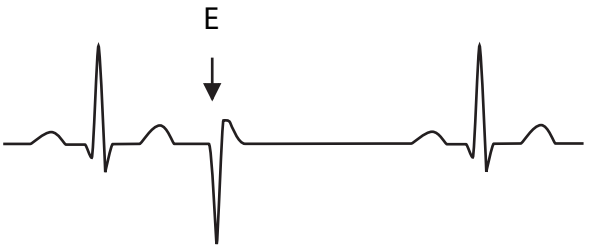
Change in blood pressure in pulmonary artery / kPa



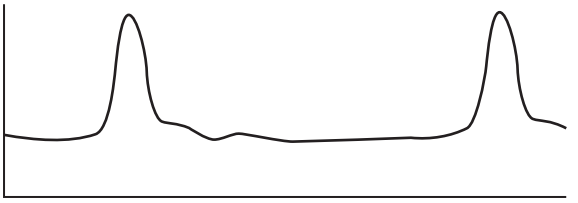
Time / seconds

Heart with ectopic beat

ECG



Change in blood pressure in pulmonary artery / kPa



Time / seconds

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*Describe the effect of the ectopic beat on heart activity and suggest an explanation for this effect.

(5)

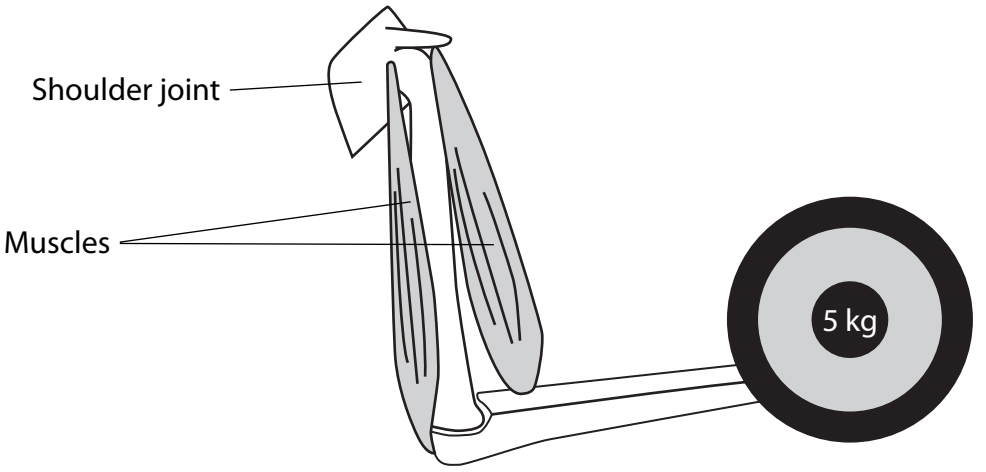
(d) Performance-enhancing drugs may affect heart activity. Outline **one** ethical position relating to whether these drugs should be banned.

(2)

(Total for Question 4 = 11 marks)

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5 The diagram below shows the arrangement of muscles and bones in an arm.
A 5 kg mass was held steady in the position shown and then lifted upwards towards the body.



(a) In the table below, show which of the muscles are contracted when holding the mass steady and when lifting it. Put a cross ☒ in the box beside muscles that are **contracted**.

(2)

Muscle	**Muscle contracted when**	
	Holding steady	**Lifting upwards**
Extensor	☐	☐
Flexor	☐	☐

(b) Name the structures that connect muscles to bones.

(1)

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(c) Explain why muscles occur in antagonistic pairs.

(2)

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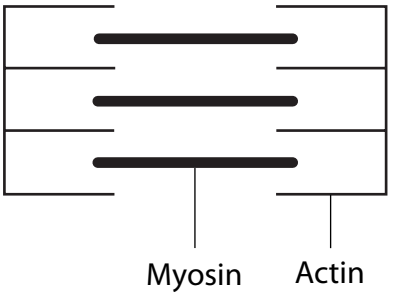
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(d) The diagram below shows the arrangement of actin and myosin myofilaments in part of an extended muscle.



Complete the diagram below to show accurately the arrangement of actin and myosin when the muscle is contracted.

(3)



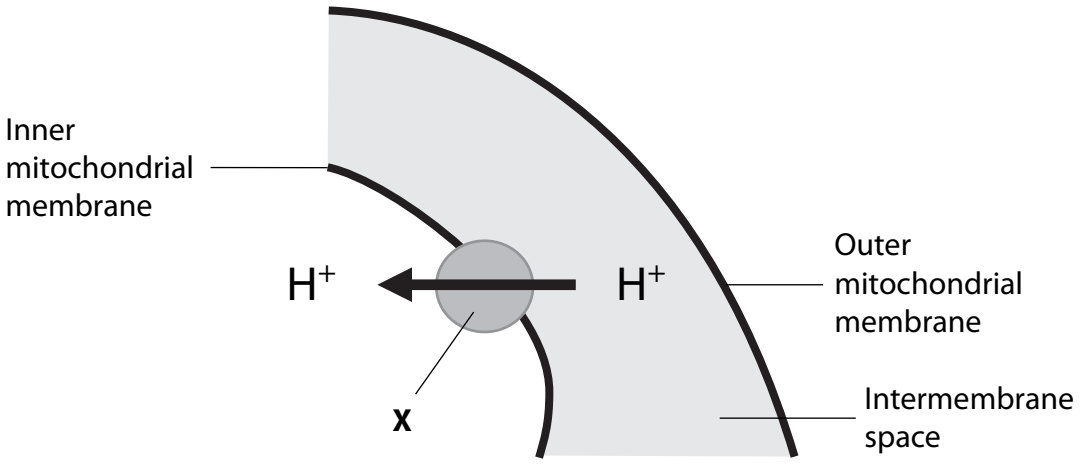
*(e) Describe and explain the role of calcium ions and ATP in muscle contraction.

(5)

(Total for Question 5 = 13 marks)

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6 The diagram below shows part of the process of chemiosmosis in a mitochondrion.



(a) Name the enzyme labelled **X** involved in chemiosmosis.

(1)

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(b) Explain how a high concentration of hydrogen ions (H^+) is maintained in the intermembrane space.

(3)

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(c) Describe the role of the hydrogen ion concentration gradient in making available an accessible supply of energy for biological processes.

(2)

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(Total for Question 6 = 6 marks)

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7 The scientific document you have studied is adapted from articles in New Scientist. Use the information from the article and your knowledge to answer the following questions.

(a) Outline the process by which 'more molecules of the enzymes' are produced (last paragraph on page 7).

(4)

(b) Explain how the fluid mosaic model of membrane structure makes it possible to change the number of adrenoceptors (first paragraph on page 9).

(2)

(c) Explain, using examples from the text, how scientific opinion can be 'deeply divided' when based on the same evidence.

(3)

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*(d) (i) Discuss the treatments for Parkinson's disease described in the article. Include particular benefits and any ethical issues and possible problems associated with these treatments.

(7)

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(ii) Compare the changes in brain chemistry that are linked to Parkinson's disease with those that are linked to depression.

(2)

(e) Suggest similarities between nerve cells in *Caenorhabditis elegans* expressing the ChR2 gene and cells of the mammalian retina.

(3)

(f) Using an example from the text, explain how a virus can introduce genes into specific cells.

(3)

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(g) Suggest how the presence of bradykinin could affect tissues.

(2)

(h) Suggest the factors that need to be accounted for in the design of drug trials of painkillers.

(4)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS