Write your name here

Surname	Other names

Centre Number | | | | | |

Candidate Number | | | | |

Edexcel GCE

Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Wednesday 22 June 2011 – Morning
Time: 1 hour 45 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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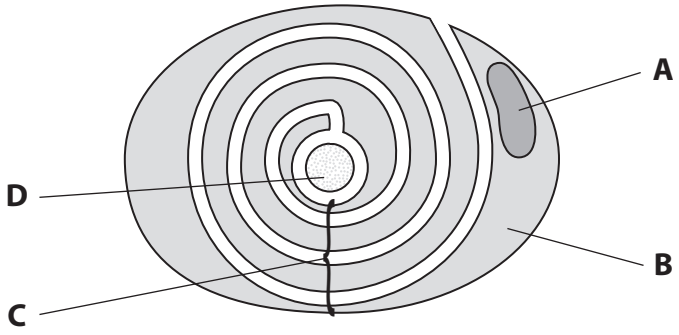
Answer ALL questions.

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 The diagram below shows a section through a motor neurone.



(a) Identify structures A, B, C and D by placing a cross ☒ in the correct box in the table below.

(4)

Structure	A	B	C	D
Axon	☒	☒	☒	☒
Cytoplasm of Schwann cell	☒	☒	☒	☒
Myelin sheath	☒	☒	☒	☒
Nucleus of Schwann cell	☒	☒	☒	☒

(b) Describe the role of the structure labelled **C** in the conduction of nerve impulses.

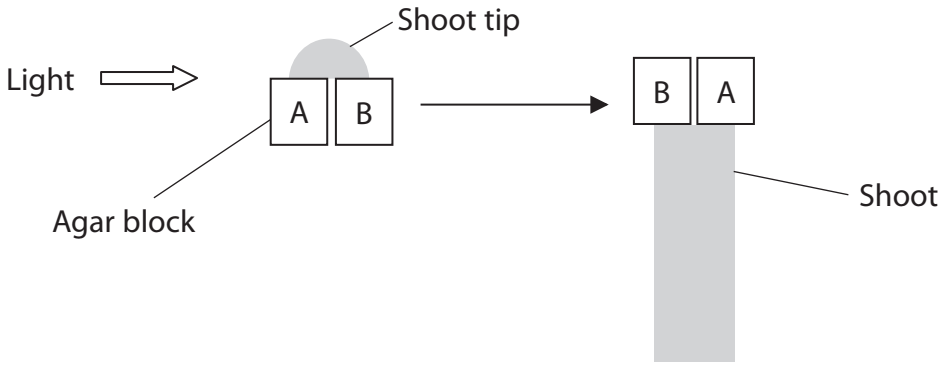
(4)

(c) Explain how the structure of the axon cell membrane is related to the conduction of nerve impulses.

(3)

(Total for Question 1 = 11 marks)

2 The tip of a plant shoot was placed on two agar blocks and light was shone from one side. The tip was removed and the agar blocks were then placed on a shoot without a tip, as shown in the diagram below.



(a) In the space below, draw a diagram to show the shoot as it would appear several hours later.

(1)

*(b) Describe the mechanism that causes the change you have drawn.

(4)

(c) Compare this response of a shoot to light with hormonal coordination in animals.

(4)

(Total for Question 2 = 9 marks)

3 When exercise begins, both ventilation rate and heart rate increase. This supplies more oxygen to muscles.

(a) (i) Describe how breathing rate and tidal volume can be determined from a spirometer trace.

(3)

(ii) Explain how you would use breathing rate and tidal volume to calculate ventilation rate.

(1)

(b) An investigation was carried out to study the changes in oxygen uptake by the blood in the lungs after the first ten seconds of exercise.

Men with artificial pacemakers agreed to exercise with their heart rate controlled at 50 beats per minute. The ventilation rate and the oxygen uptake at rest were measured. These were also measured, after the first ten seconds of exercise and the differences recorded.

This was repeated with the heart rate controlled at 100 beats per minute.

The results are shown in the table below.

Heart rate / beats per minute	Increase in ventilation rate / $dm^3\ min^{-1}$	Increase in oxygen uptake by the blood / $cm^3\ min^{-1}$
50	4.3	87
100	3.9	190

(i) State **one** factor, other than heart rate, that could have affected the rate at which blood passed through the heart.

(1)

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(ii) Using the information in the table, describe the effect of an increase in heart rate on both the ventilation rate and oxygen uptake by the blood, after the first ten seconds of exercise.

(3)

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(iii) Explain how an increased heart rate results in increased uptake of oxygen by the blood in the lungs.

(3)

(iv) What conclusions could be drawn from the results of this investigation?

(2)

(Total for Question 3 = 13 marks)

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4 In some organisms, the nervous response to a stimulus can reduce as a result of repetition. This is known as habituation.

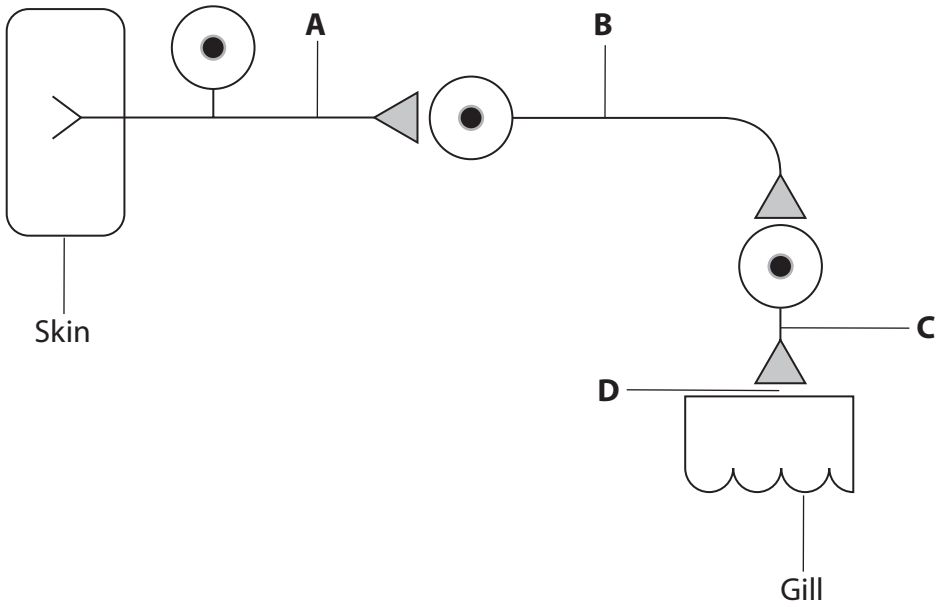
Sea slugs are marine animals which have gills for the uptake of oxygen from seawater.

Sea slug

Magnification × 1

A sea slug withdraws its gill when its skin is touched. After some time, the gill is exposed again. With repeated touches, the time taken for it to expose the gill decreases. When the skin is touched frequently, the gill is not withdrawn.

The diagram below shows some of the neurones (nerve cells) involved in this response.



(a) Place a cross ☒ in the correct box in the table below to identify where structures **A**, **B**, **C** and **D**, listed in the table, are shown on the diagram.

(3)

Structure	A	B	C	D
Motor neurone	☒	☒	☒	☒
Sensory neurone	☒	☒	☒	☒
Synapse	☒	☒	☒	☒

(b) (i) Suggest how a repeated stimulus could result in less response from the gill.

(3)

(ii) Suggest how this habituation may be of benefit to a sea slug.

(2)

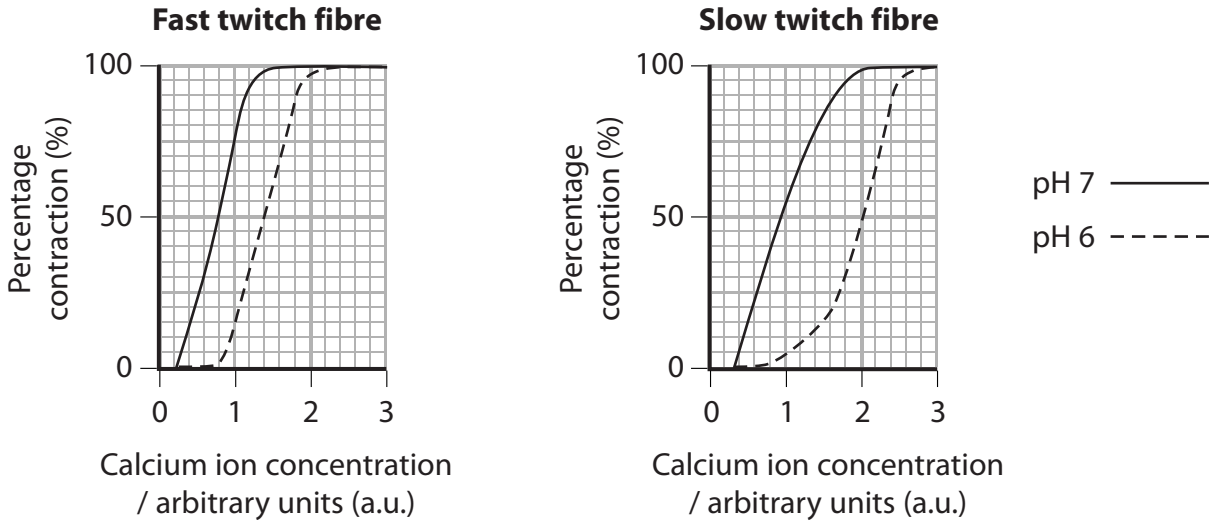
(Total for Question 4 = 8 marks)

5 An investigation was carried out into the effect of pH on the contraction of muscle fibres.

Single muscle fibres were used with their surrounding membranes removed. These fibres will contract when exposed to calcium ions in solution.

Isolated slow twitch and fast twitch fibres were tested at pH 7 and pH 6, in a range of calcium ion concentrations.

Results for both types of fibre are shown in the graphs below.



(a) The sensitivity of a muscle fibre is defined as the concentration of calcium ions required to cause 50% of full contraction.

Using the information in the graphs, complete the table below.

(2)

Type of fibre	Sensitivity		Change in sensitivity / a.u.
	Calcium ion concentration at pH 7 / a.u.	Calcium ion concentration at pH 6 / a.u.	
Fast twitch	0.8	1.4	
Slow twitch			

(b) Using the information in the graphs, compare the effect of pH on slow twitch and fast twitch fibres.

(2)

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(c) (i) Describe a circumstance that could cause a fall in pH in living muscle.

(1)

(ii) Suggest how the different responses of these two types of fibre to pH may be related to their different functions in muscle.

(2)

(d) It is possible to replace the troponin in fast twitch fibres with troponin from slow twitch fibres. Fast twitch fibres that have been treated in this way have the same sensitivity as slow twitch fibres.

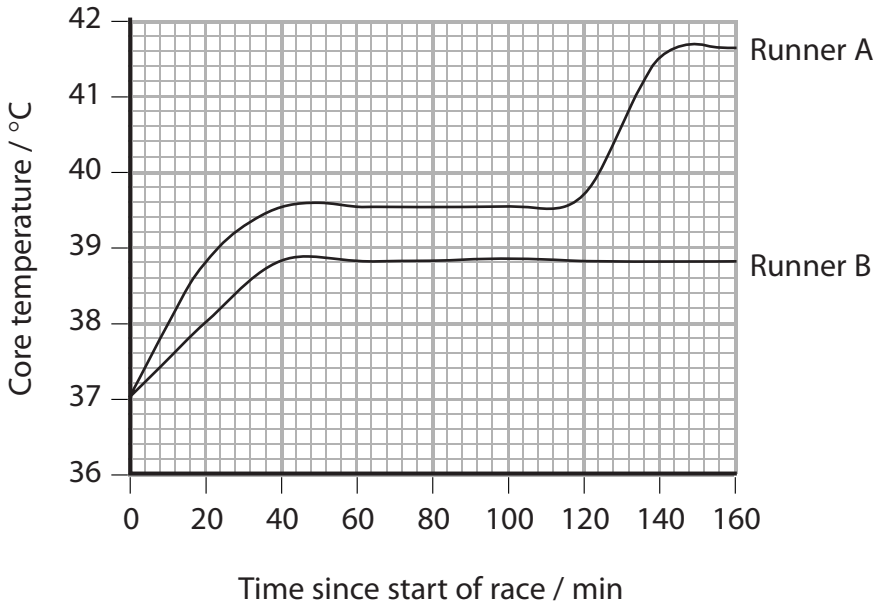
Use your knowledge of the sliding filament theory of muscle contraction to explain why this might have been predicted.

(3)

(Total for Question 5 = 10 marks)

6 Marathon runners can have difficulty with thermoregulation over the course of a 26 mile race, particularly on a hot day. Two marathon runners, A and B, had their core temperatures recorded during a race.

The graph below shows the core temperatures recorded during the race.



(a) Suggest an explanation for the change in core temperatures of both runners in the first 30 minutes of the race.

(2)

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(b) Suggest an explanation for the constant core temperatures of both runners between 60 and 100 minutes of this race.

(5)

(c) During this race, runner A lost 3.02 kg of water and runner B lost 2.43 kg of water.

Using the information in the question and your own knowledge, suggest reasons for the change in core temperature of runner A after 120 minutes.

(2)

(Total for Question 6 = 9 marks)

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

(a) Suggest how erythropoietin (epo) production might be shut down when oxygen levels in the blood are normal (page 2, paragraph 6).

(3)

*(b) Describe how adenoviruses in the blood 'are recognised and destroyed by the immune system' (page 3, paragraph 4).

(5)

(c) 'A single injection elevated hematocrits for over a year in the mice and for 12 weeks in the monkeys.' (page 3, paragraph 5)

Suggest why the injection of genes into body cells does not have a permanent effect.

(2)

(d) 'Sludge blood' (page 4, paragraph 1) can lead to high blood pressure and atherosclerosis.

Explain the connection between high blood pressure and atherosclerosis.

(3)

(e) Name the 'small vessels' (page 4, paragraph 1) that have the greatest effect in producing high blood pressure.

(1)

(f) Suggest **one** way in which one gene could result in the production of several different proteins.

(1)

(g) Use information in the article to describe **three** ways in which athletes might artificially enhance their performance.

(3)

(h) Explain why the governing bodies of sports ban the artificial enhancement of performance.

(2)

(i) A proteasome is 'a barrel-shaped multi-protein complex that chops proteins down into their component amino acids for reuse'.

Explain how muscle protein can be chopped into amino acids inside a cell.

(2)

(j) Explain what is meant by repolarisation of a cardiac muscle cell or a nerve cell.

(2)

(k) Suggest why large numbers of mitochondria are found in muscle cells.

(2)

(l) 'Schuelke discovered that the boy had a mutation in both copies of the gene coding for the muscle growth inhibitor myostatin.' (page 10, paragraph 1)

Suggest how this boy could have inherited this condition. Use a genetic diagram to illustrate your answer.

(4)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS