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Pearson
Edexcel GCE

Centre Number

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Candidate Number

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Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Thursday 23 June 2016 – Morning

Time: 1 hour 45 minutes

Paper Reference

6BI05/01

You must have:

A copy of the scientific article from *Science News* (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.*

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 ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

1 Skeletal muscles contain muscle fibres and are arranged in antagonistic pairs.

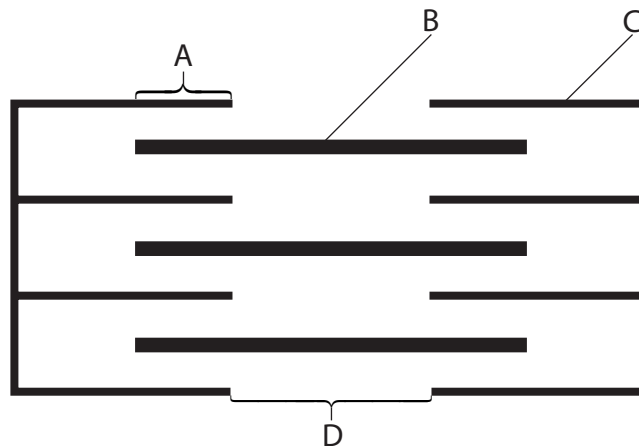
(a) Place a cross ☐ in the box to complete the statement about skeletal muscles.

(1)

When a muscle fibre contracts, the number of myosin heads

- ☐ **A** becomes zero
- ☐ **B** increases
- ☐ **C** reduces
- ☐ **D** stays the same

(b) The diagram below shows part of a muscle fibre.



Place a cross ☐ in the box to complete each statement about skeletal muscles.

(i) When a muscle fibre contracts, the labelled part that becomes shorter is

(1)

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**



(ii) The number of sarcomeres shown in the diagram is

(1)

- ☐ **A** 1
- ☐ **B** 2
- ☐ **C** 3
- ☐ **D** 4

(iii) The binding of calcium ions to troponin causes

(1)

- ☐ **A** depolarisation of the muscle membrane
- ☐ **B** myosin binding sites to be exposed
- ☐ **C** the sarcomere to widen
- ☐ **D** tropomyosin to be exposed

(iv) An enzyme that can break down ATP is found in

(1)

- ☐ **A** actin
- ☐ **B** myosin
- ☐ **C** tropomyosin
- ☐ **D** troponin

(v) Slow twitch muscle fibres contain

(1)

- ☐ **A** more mitochondria than fast twitch fibres
- ☐ **B** fewer mitochondria than fast twitch fibres
- ☐ **C** the same number of mitochondria as fast twitch fibres
- ☐ **D** no mitochondria



- (c) Suggest how tendons and antagonistic muscles cause the lower leg to move in the direction shown by the arrow in the diagram below.

(4)



(Total for Question 1 = 10 marks)



2 Carrots are root vegetables that are eaten by many organisms.

An investigation was carried out to study the respiration rate of carrots.

100 g of carrot cubes were placed in a plastic bag containing air. The bag containing the carrot cubes was stored at 1 °C for three days.

All other variables were kept constant.

The percentages of oxygen and carbon dioxide in the bag were measured at the start of the investigation and at the end.

The results are shown in the table below.

Stage of the investigation	Percentage of each gas in the bag (%)	
	Oxygen	Carbon dioxide
Start	21.0	0.04
End	5.3	8.14

- (a) (i) Suggest **two** variables, other than temperature, that need to be kept constant in this investigation so that valid results can be collected.

(2)

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- (ii) Explain the role of oxygen in the cells of the carrot cubes.

(3)

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(b) Explain how the carrots produce carbon dioxide at the start of this investigation.

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(c) The investigation was repeated at storage temperatures of 5 °C and 10 °C.

The table below shows the change in percentage of carbon dioxide in the bag at the end of the investigation compared with the start of the investigation for all three storage temperatures.

Storage temperature / °C	Change in percentage of carbon dioxide (%)
1	+ 8.1
5	+ 14.1
10	+ 16.2

Explain the effect of temperature on the change in the percentage of carbon dioxide in the bag.

(3)

(d) Suggest why the carrot tissue could survive when no oxygen was left in the bag.

(1)

(Total for Question 2 = 13 marks)



3 Human hearts contain muscle that is myogenic. Exercise and other activities can affect heart rate.

(a) Explain what is meant by the term **myogenic**.

(2)

(b) Explain how an electrocardiogram (ECG) can be used to calculate a person's heart rate.

(3)



- * (c) Workers in the brewing industry may be at risk due to the carbon dioxide released by yeast fermentation.

Atmospheric air contains between 0.03% and 0.04% carbon dioxide.

A concentration of 5% carbon dioxide in the air causes a change in the heart rate of people exposed to this concentration.

Explain why a carbon dioxide concentration of 5% causes a change in heart rate.

(5)

(Total for Question 3 = 10 marks)



4 A number of investigations have been carried out to study the effect of nature and nurture on human development.

(a) Explain how twin studies could be used to compare the effects of nature and nurture on human development.

(4)

(b) (i) Facial expressions can show different emotions.

Explain how a cross-cultural study could be used to investigate whether recognising different emotions through facial expression is due to nature or nurture.

(2)



- (ii) Suggest how this cross-cultural study could be carried out to make sure that the results are valid.

(2)

(Total for Question 4 = 8 marks)



5 Neurones are cells involved in coordination and control within an animal.

- (a) The table below shows the concentration of sodium ions and potassium ions in the cytoplasm of a neurone and in the fluid outside the neurone.

Ion	Concentration of ion / mmol dm^{-3}	
	Cytoplasm	Fluid outside the neurone
Sodium	15	150
Potassium	150	5

- (i) Using the information in the table, comment on the concentration gradients of these ions.

(2)

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- (ii) During an action potential the distribution of sodium and potassium ions changes.

Explain how proteins in the cell surface membrane of this neurone enable the concentrations of these ions to **return** to those shown in the table.

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- (b) Describe how the arrival of a nerve impulse at a synapse causes the release of neurotransmitters.

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(Total for Question 5 = 9 marks)

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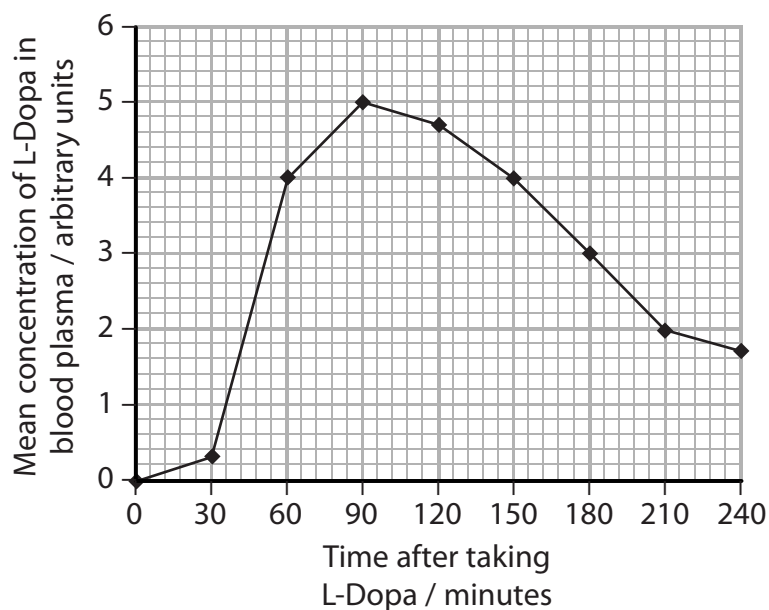
6 Humans and sea anemones have nervous systems with synapses.

(a) L-Dopa is a drug used to treat people with Parkinson's disease.

An investigation was carried out to study the uptake of L-Dopa from the gut into the blood plasma of people with Parkinson's disease.

A number of people with Parkinson's disease were each given a tablet containing 200 mg of L-Dopa. The concentration of L-Dopa in the blood plasma of each person was then recorded over a period of four hours.

The mean results are shown in the graph below.



(i) Using the information in the graph, calculate the mean rate of uptake of L-Dopa from 0 to 90 minutes.

Show your working.

(2)



- (ii) Suggest an explanation for the decrease in the mean concentration of L-Dopa in the blood plasma after 90 minutes.

(4)

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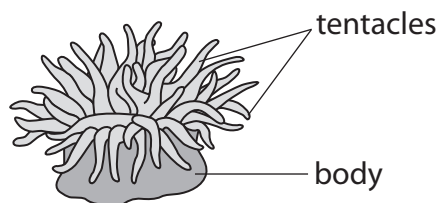
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- (b) The sea anemone, shown in the diagram below, is a marine animal with tentacles.



A student investigated habituation in a sea anemone.

He gently touched a sea anemone, causing it to withdraw its tentacles into its body. He waited and recorded the time for the tentacles to fully re-emerge.

He repeated the process until the sea anemone was fully habituated.

- (i) Suggest what the student would observe when the sea anemone was fully habituated.

(1)

- (ii) The student investigated the length of time it took sea anemones to lose their habituation.

Suggest how the student carried out this investigation.

(3)

(Total for Question 6 = 10 marks)



7 The scientific article you have studied is from *Science News*.

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

(a) Ginkgo BioWorks could engineer a bacterium to 'suck carbon dioxide out of the atmosphere' (paragraph 5).

(i) Suggest why there may be a need to 'suck carbon dioxide out of the atmosphere'.

(2)

*(ii) Suggest how Ginkgo BioWorks could engineer such a bacterium.

(6)



- (b) The bacterium *Mycoplasma* has the 'shortest known genome' (paragraph 13). This bacterium contains only 525 genes.

Calculate the mean number of bases per *Mycoplasma* gene.

Show your working.

(2)

Answer = ... bases

- (c) (i) Describe how 'building a stretch of DNA' would differ from 'building a stretch of RNA' (paragraph 21).

(3)

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- (ii) Suggest why the scientists would 'insert the whole thing into a circular strand of DNA until they need it' (paragraph 21).

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(d) Suggest how 'three genes inhibited one another in sequence, their activity cycling regularly' (paragraph 26).

(3)

(e) A metabolic pathway is a many-stepped process.

Suggest the features of a metabolic pathway 'through which bacteria convert atmospheric nitrogen to ammonia' (paragraph 32).

(4)



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- (f) Weiss and his team are 'working to harness a virus that could be used to test the idea in mice' (paragraph 40).

Suggest **two** features of the virus selected for this role.

(2)

- (g) After 'testing the idea in mice', phase 1 testing must be carried out (paragraph 40).

Explain why phase 1 testing must be carried out before using this treatment on a patient with cancer.

(3)



- (h) 'Synthetic gene circuits could steer stem cells to develop into insulin-producing cells' (paragraph 41).

Describe **three** differences between a stem cell and an insulin-producing cell.

(3)

1.

2.

3.

- (i) Suggest why it is necessary to 'keep track of exposure to things like radiation within a cell' (paragraph 45).

(1)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS



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