Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Tuesday 20 June 2017 – Morning
Time: 1 hour 45 minutes

Paper Reference
WBI05/01

You must have:
A copy of the scientific article (enclosed), calculator, HB pencil, ruler.

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 8 4 1 9 A 0 1 2 8

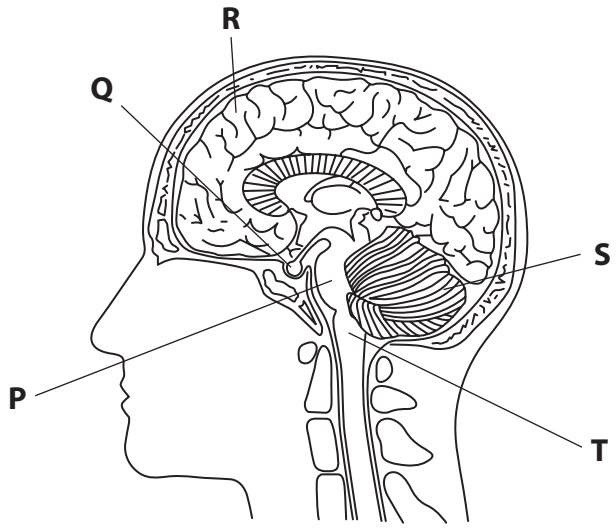
Pearson

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 The human brain controls many functions.

The diagram below shows a section through the human brain.



(a) (i) Put a cross ☒ in the box next to the part of the brain involved with thinking.

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(ii) Put a cross ☒ in the box next to the part of the brain involved with the coordination of the movement needed when writing.

(1)

☒ **A** P

☒ **B** Q

☒ **C** S

☒ **D** T

(iii) Put a cross ☒ in the box next to the part of the brain involved with the control of heartbeat.

(1)

- ☒ **A P**
- ☒ **B Q**
- ☒ **C S**
- ☒ **D T**

(b) Certain brain chemicals are essential for good health.

Explain how an imbalance of the brain chemical serotonin can contribute to ill health.

(2)

(c) Twin studies have helped scientists gain a better understanding of the contribution made by nature and by nurture to brain development.

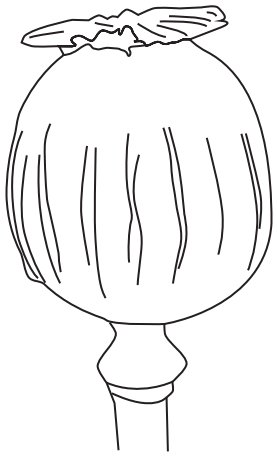
Distinguish between nature and nurture.

(2)

(Total for Question 1 = 7 marks)

2 Morphine is a drug used to reduce pain by affecting the brain.

The diagram below shows part of a poppy plant that produces morphine.



Magnification ×1

Poppy plants are grown in fields in some parts of the world.

Scientists have recently genetically modified yeast cells to produce morphine in the controlled conditions of a laboratory.

(a) Suggest **two** biotic factors that could affect the production of morphine by poppy plants grown in fields.

(2)

.....

.....

.....

.....

.....

.....

(b) The genetic modification of a yeast cell involves creating an artificial chromosome made from several genes. The artificial chromosome is then placed into the yeast cell.

Put a cross ☒ in the box to complete the following sentence.

In this process, the artificial chromosome is a

(1)

☒ **A** drug

☒ **B** plasmid

☒ **C** transcription factor

☒ **D** vector

(c) Morphine reduces the sensitivity of the brain to the concentration of carbon dioxide in the blood.

This affects breathing rate and can cause death.

Suggest why a high dose of morphine can cause death.

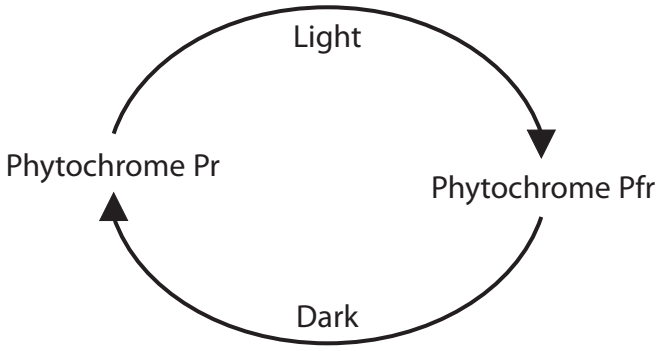
(4)

(Total for Question 2 = 7 marks)

3 Plants detect light using photoreceptors.

Phytochrome is a photoreceptor molecule found in plants.

The diagram below shows how two forms of phytochrome (Pr and Pfr) are affected by light.



Phytochrome Pfr reduces the levels of auxin (IAA) in the cells of plant shoots.

(a) Use this information, and the diagram, to explain why plant shoots grown in the dark are taller than plant shoots grown in the light.

(4)

*(b) The growth response of a plant shoot to light requires the synthesis of ATP.

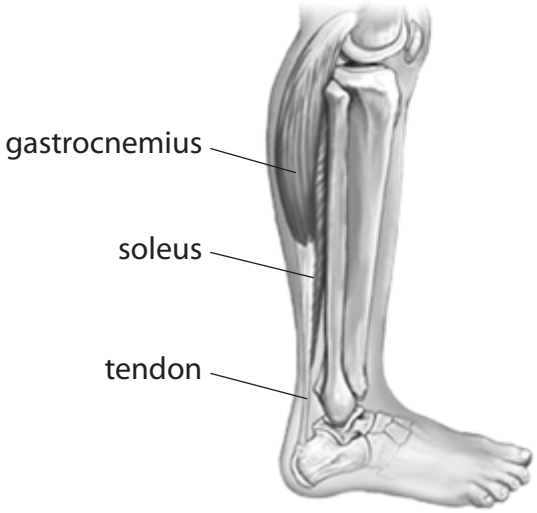
Describe the roles of glycolysis and the Krebs cycle in the synthesis of ATP.

(6)

(Total for Question 3 = 10 marks)

4 The calf muscle in the human leg is composed of two separate muscles, the gastrocnemius and the soleus.

The position of these two muscles is shown in the diagram below.



(a) (i) The soleus muscle has a higher proportion of slow twitch fibres than fast twitch fibres.

Put a cross ☒ in the box next to the row in the table that correctly identifies features of slow and fast twitch muscle fibres.

(1)

		slow twitch fibre	fast twitch fibre
☒	**A**	large diameter	small diameter
☒	**B**	few mitochondria	many mitochondria
☒	**C**	high concentration of myoglobin	low concentration of myoglobin
☒	**D**	fatigue quickly	fatigue slowly

(ii) Put a cross ☒ in the box next to the event that occurs before muscles contract.

(1)

☒ **A** calcium ions form cross bridges with muscle proteins

☒ **B** calcium ions are released from the sarcoplasmic reticulum

☒ **C** sodium ions form cross bridges with muscle proteins

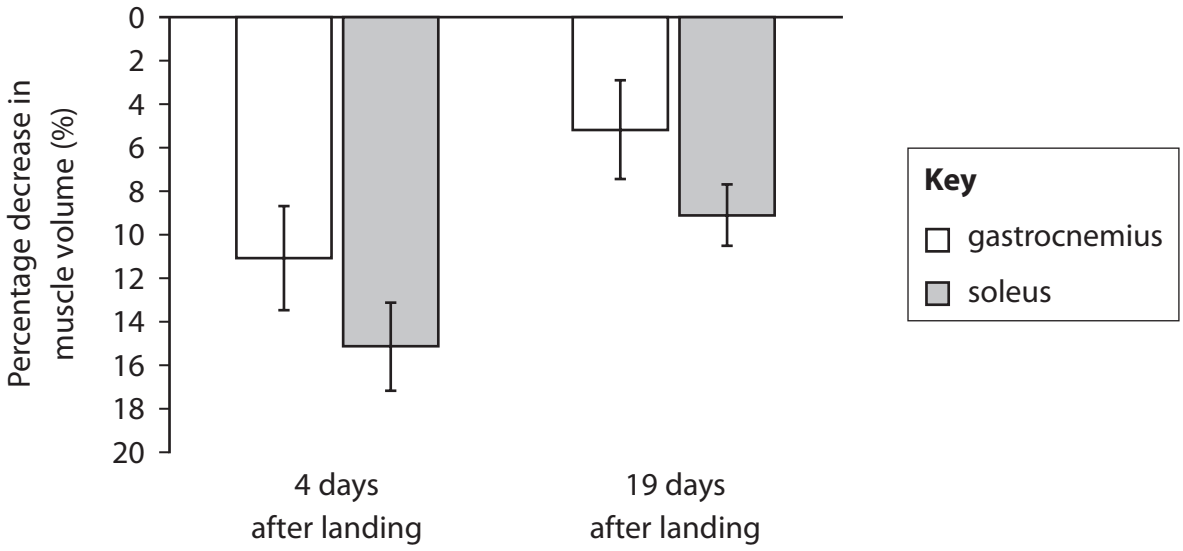
☒ **D** sodium ions are released from the sarcoplasmic reticulum

(b) Scientists investigated the change in the volume of muscle tissue in astronauts after six months spent in space.

The volume of the gastrocnemius and soleus muscles was measured before going into space and after landing back on Earth.

The percentage decrease in volume of these muscles was calculated 4 days and 19 days after landing back on Earth.

The graph below shows the results of this investigation.



(i) Using the information in the graph, describe the changes in the volume of the gastrocnemius and soleus muscles.

(2)

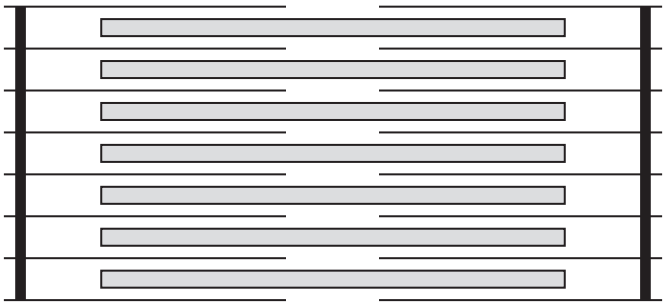
(ii) The cellular levels of messenger RNA involved in the synthesis of actin change after landing on Earth.

Suggest how this might explain the change in muscle volume between 4 days and 19 days after landing on Earth.

(2)

(iii) Actin is a structural protein found in the sarcomeres of a muscle fibre.

The diagram below shows one sarcomere.



Draw a line, labelled A, to show the location of actin in this sarcomere.

(1)

(iv) Actin has a role in muscle contraction.

Name **two** structural proteins present in a sarcomere, other than actin, that have a role in muscle contraction.

(1)

(c) The transcription of genes involved in making fast twitch and slow twitch muscle fibres is affected during six months in space.

The mean percentage of slow twitch muscle fibres is reduced by 15%.

Explain how this reduction affects the ability of astronauts to carry out exercise.

(3)

(Total for Question 4 = 11 marks)

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5 The movement of ions into and out of neurones is involved in the transmission of nerve impulses.

(a) The table below shows the concentration of some ions found inside and outside an axon in a resting neurone.

Ion	Concentration of ions / mmol dm^{-3}	
	inside axon	outside axon
potassium	400	30
sodium	50	460
organic anions	370	0

Explain how the distribution of these ions is maintained.

(3)

(b) Argentine ants (*Linepithema humile*) are common household pests in many parts of the world.

The diagram below shows an Argentine ant.

Magnification ×25

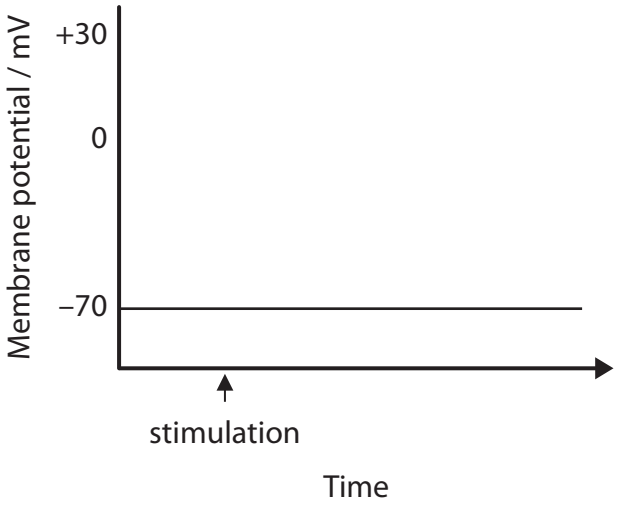
Metaflumizone is a pesticide used to control the population of these ants by making them immobile.

In an investigation, an ant neurone was placed in a solution containing metaflumizone and another ant neurone was placed in a control solution.

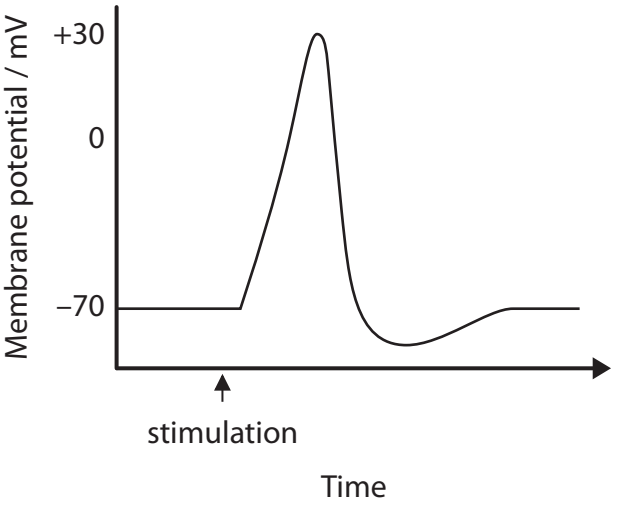
The membrane potential of these neurones was measured before, during and after stimulation.

The graphs below shows the results of this investigation.

neurone in metaflumizone



neurone in control solution



(i) Using the information in the graphs, suggest how metaflumizone makes ants immobile.

(3)

(ii) Describe a valid laboratory investigation to find the minimum concentration of metaflumizone needed to make these ants immobile.

(4)

(iii) Some Argentine ants are resistant to metaflumizone.

Suggest how these ants become resistant to metaflumizone.

(3)

(Total for Question 5 = 13 marks)

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6 Core body temperature in a person is kept constant by mechanisms of thermoregulation.

(a) Put a cross ☒ in the box next to the part of the brain that controls body temperature. **(1)**

☒ **A** cerebellum

☒ **B** cerebral hemispheres

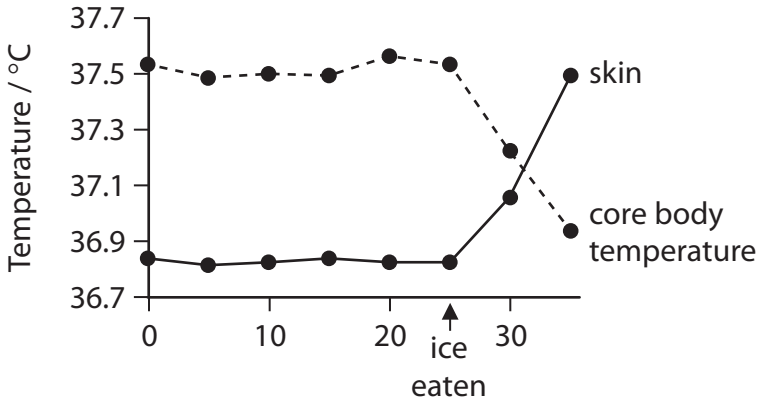
☒ **C** hypothalamus

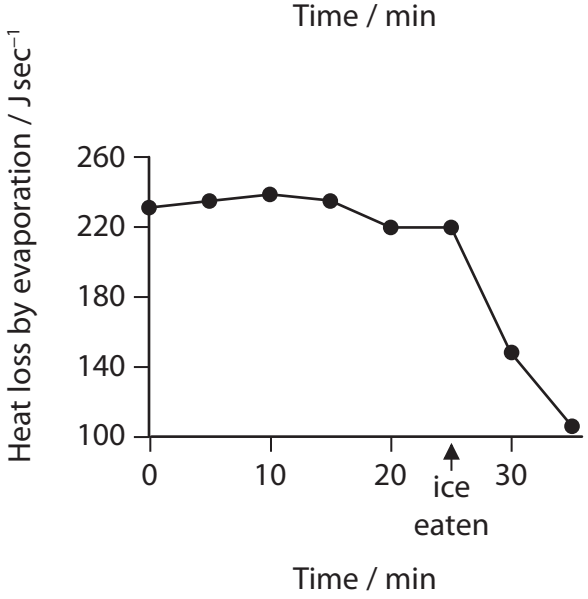
☒ **D** medulla oblongata

(b) In an investigation, the core body temperature, skin temperature and heat loss by evaporation of a person was measured for 25 minutes.

The person then ate some ice and the measurements were repeated for a further 10 minutes.

The graphs below show the results of this investigation.





(i) Using the information given, compare the changes in the core temperature and the skin temperature.

(2)

(ii) Explain the change in heat loss by evaporation after eating the ice.

(4)

(c) Prolonged exposure to cold temperatures causes hypothermia.

Hypothermia lowers the core body temperature which reduces the rate of metabolic processes, such as chemiosmosis, in cells.

Explain how hypothermia reduces the synthesis of ATP by chemiosmosis.

(5)

(Total for Question 6 = 12 marks)

7 The article you have studied has been adapted from two websites, sciencedaily.com and journal.frontiersin.org.

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

(a) The article states that there have been studies that have examined the use of e-cigarettes in helping people to quit smoking normal cigarettes (paragraph 8).

State a null hypothesis these studies were testing.

(1)

(b) The article states that 'the lack of long-term randomized placebo-controlled studies has been problematic' (paragraph 9).

These studies are needed to assess the effectiveness of e-cigarettes in helping people to quit smoking normal cigarettes.

Suggest why long-term randomised placebo-controlled studies are needed.

(3)

*(c) Nicotine is known to stimulate heart rate (paragraph 40).

(i) Nicotine increases heart rate by stimulating adrenaline secretion from cells in the adrenal gland.

The sequence of events leading to this adrenaline secretion involves a similar sequence of events that lead to the release of neurotransmitters at a synapse.

Use this information and your own knowledge to suggest how nicotine stimulates an increase in heart rate.

(6)

(ii) The article states that nicotine increases the risk of developing atherosclerosis (paragraph 14).

Explain how nicotine increases the risk of developing atherosclerosis.

(3)

(d) Conklin stated that there are 'limitations of one experiment performed on mice' (paragraph 15).

Suggest why Conklin made this statement.

(2)

(e) The article states that cinnamaldehyde-containing e-liquids 'compromise the function of immune cells such as macrophages' (paragraph 21).

Explain how reducing the function of these cells might affect the health of an e-cigarette smoker.

(3)

(f) Using the information in paragraph 34, calculate the number of students that were aware of e-cigarettes who had actually tried e-cigarettes.

Show your working.

(2)

Answer .....

(g) Suggest why nicotine from e-cigarettes may be less addictive than nicotine from burned tobacco products (paragraph 45).

(3)

(h) The article states that nicotine may have an ameliorating effect on Parkinson's disease (paragraph 43).

It is thought that nicotine stimulates the release of the neurotransmitter involved with Parkinson's disease.

Suggest how this might reduce the symptoms of Parkinson's disease.

(3)

(i) The article refers to FEV1, FVC and FEV1 / FVC ratio (paragraph 48).

FEV1 is the volume of air that can forcibly be blown out in one second, after full inspiration.

FVC is the maximum volume of air that can be forced out of the lungs, after full inspiration.

(i) Put a cross ☒ in the box to complete the following sentence.

The FVC for a person includes the

(1)

☒ **A** air left in the lungs after full expiration

☒ **B** breathing rate during inspiration

☒ **C** concentration of carbon dioxide

☒ **D** tidal volume during expiration

(ii) The FEV1 / FVC ratio is expressed as a percentage.

The normal ratio is 70 to 80%.

The FVC value is less likely to change in people who smoke.

Using the information in paragraph 50, suggest why the FEV1 / FVC ratio is significantly reduced after smoking tobacco.

(2)

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(j) Sketch a graph to show the relationship between hESC cytotoxicity, and the concentration of chemicals used to flavour e-cigarette refill fluids (paragraph 53).

(1)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

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