

Write your name here

Surname

Other names

Pearson Edexcel
International
Advanced Level

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

WBI05/01

You must have:

A copy of the scientific article (enclosed), calculator, 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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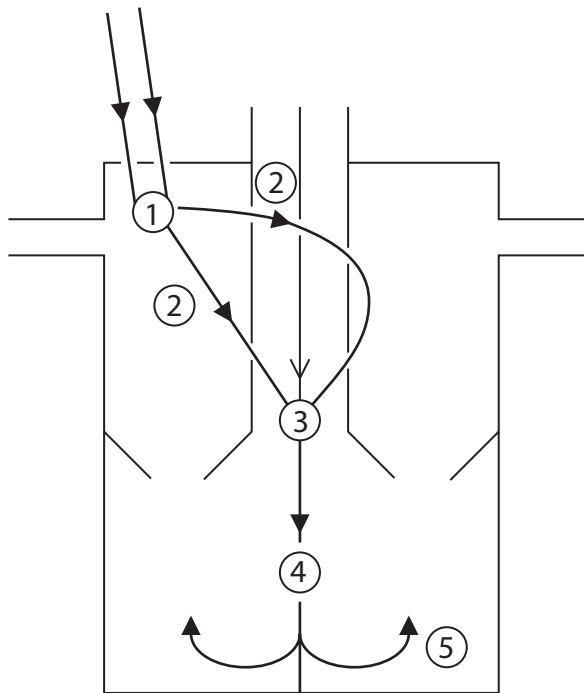
Answer ALL questions.

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 The heart rate at rest changes during exercise.

The diagram below shows different stages in the passage of electrical activity through the heart during one heartbeat.

The arrows and numbers represent the different stages.



- (a) Place a cross ☒ in the box next to the correct number or word to complete each of the following statements.

- (i) The number in the diagram that represents the bundle of His is

(1)

- ☒ A 1
☒ B 3
☒ C 4
☒ D 5



- (ii) There is a delay of 0.13 s between atrial systole and ventricular systole.
The number in the diagram that represents where this delay occurs is

(1)

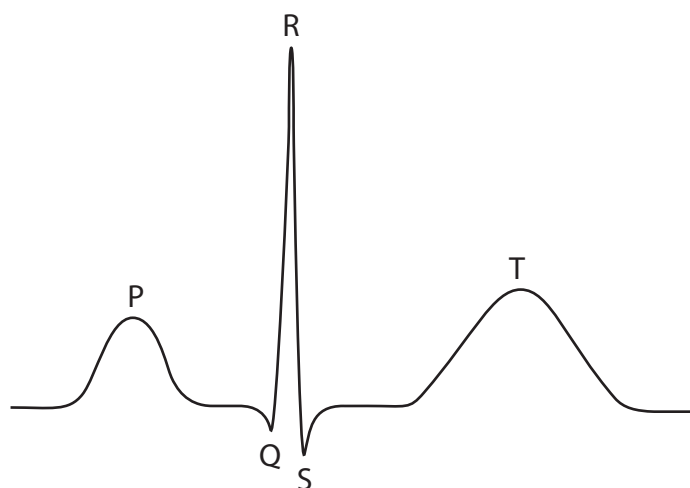
- ☐ A 1
- ☐ B 2
- ☐ C 3
- ☐ D 4

- (iii) The arrows in the diagram represent a wave of

(1)

- ☐ A depolarisation
- ☐ B hyperpolarisation
- ☐ C polarisation
- ☐ D repolarisation

- (iv) A normal electrocardiogram (ECG) is shown below.



The letter on the ECG that represents stage 2 in the diagram is

(1)

- ☐ A P
- ☐ B Q
- ☐ C R
- ☐ D T



(b) Nervous and hormonal control can increase the heart rate during exercise.

- (i) Describe how the heart rate can be increased by nervous control during exercise.

(4)

- (ii) Give **one** similarity and **one** difference between hormonal and nervous control of the heart rate.

(2)

(Total for Question 1 = 10 marks)



- 2 A scarecrow is a model of a human dressed in old clothes.

The photograph below shows some scarecrows in the middle of a field of crops.



Some farmers believe that a scarecrow will frighten birds and the crops will not be eaten.

However, some scientists believe that habituation by the birds will occur and the crops will be eaten.

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

(2)



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- (b) (i) Describe an investigation to determine whether habituation by the birds occurs in the presence of a scarecrow.

(5)

[illegible]

- (ii) In the space below, draw a sketch graph to show the data obtained if habituation by the birds occurs.

(2)

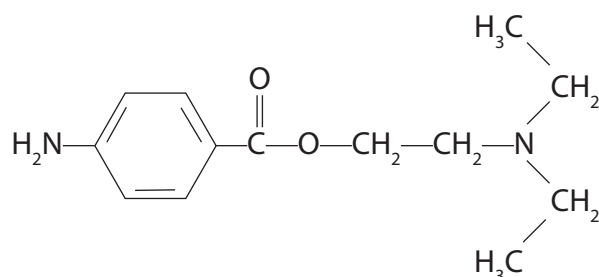
(Total for Question 2 = 9 marks)



3 Pain is felt when nerve impulses travel along neurones to the pain centre in the brain.

Dentists inject an anaesthetic drug into a patient's gum to provide pain relief.

(a) The diagram below shows the structure of an anaesthetic drug.



(i) Draw a circle around the part of this drug that is an amine group.

(1)

(ii) This anaesthetic drug works by binding to channel proteins in the axons of neurones. These neurones normally transmit impulses that the brain interprets as pain.

Explain how this anaesthetic drug prevents the patient feeling pain.

(4)

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(iii) The injection for pain relief contains the anaesthetic drug and a chemical that causes vasoconstriction.

Suggest the advantage of including a chemical that causes vasoconstriction.

(2)

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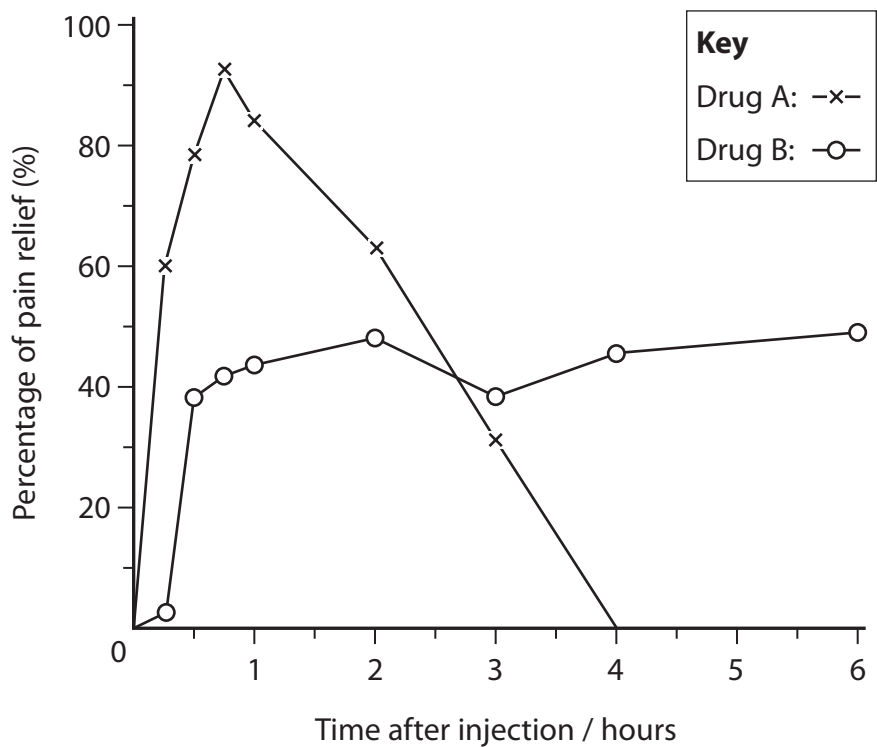
(b) A different anaesthetic drug works by binding to calcium ion channels when an impulse arrives at a synapse.

Suggest how this anaesthetic drug reduces pain.

(4)



(c) The graph below shows the pain relief provided by two different anaesthetic drugs, A and B.



Suggest how a dentist could use this data when deciding which anaesthetic drug to use. (3)

(Total for Question 3 = 14 marks)



- 4 A pupilometer is a device used to measure the pupil diameter in the eye.

Doctors use a pupilometer to assess brain damage in unconscious patients who have had accidents.

- (a) The table below shows the pupil diameter, during one second, when bright light was shone into the eye of an unconscious patient and a conscious patient.

Time / s	Pupil diameter / mm	
	Unconscious patient	Conscious patient
0.0	4.40	4.40
0.2	4.21	4.20
0.4	3.84	3.82
0.6	3.46	3.45
0.8	3.22	3.20
1.0	3.00	2.99

- (i) Explain the conclusion doctors should make about possible brain damage of this unconscious patient.

(2)

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- (ii) Place a cross ☒ in the box next to the correct phrase that completes the following statement.

The change in the pupil diameter of this unconscious patient occurs because

(1)

- ☒ **A** radial muscles relax and circular muscles relax
- ☒ **B** radial muscles contract and circular muscles contract
- ☒ **C** radial muscles relax and circular muscles contract
- ☒ **D** radial muscles contract and circular muscles relax



- * (b) Explain how bright light shone into the eye is detected by cells in the retina leading to nerve impulses being sent to the brain.

(5)

(Total for Question 4 = 8 marks)



- 5 The photograph below shows the African cheetah, *Acinonyx jubatus*.

The cheetah is the fastest land mammal. The cheetah needs to be within 50 m of its prey before starting to chase it.



Magnification $\times 0.05$

A cheetah runs at 27 m s^{-1} in an attempt to catch its prey.

- (a) Calculate the time it would take a cheetah to run 50 m at a speed of 27 m s^{-1} .
Show your working.

(2)

Answer



- (b) Table 1 below shows the activity of four different enzymes in the cells of two different leg muscles of a cheetah.

Table 1

Leg muscle	Relative activity / arbitrary units			
	Anaerobic enzymes		Aerobic enzymes	
	Lactate dehydrogenase	Pyruvate kinase	Citrate synthase	3-hydroxyacyl-CoA dehydrogenase
Gastrocnemius	15.07 ± 2.8	12.91 ± 0.8	0.06 ± 0.01	0.05 ± 0.02
Vastus lateralis	19.29 ± 1.3	15.19 ± 2.0	0.07 ± 0.01	0.04 ± 0.01

Place a cross ☒ in the box next to the correct phrase that completes each of the following statements.

- (i) The enzyme that has the fastest activity is

(1)

- ☐ A an aerobic enzyme in the gastrocnemius
- ☐ B an aerobic enzyme in the vastus lateralis
- ☐ C an anaerobic enzyme in the gastrocnemius
- ☐ D an anaerobic enzyme in the vastus lateralis

- (ii) Following anaerobic respiration, lactate dehydrogenase converts lactate to

(1)

- ☐ A carbon dioxide and oxidised NAD to reduced NAD
- ☐ B carbon dioxide and reduced NAD to oxidised NAD
- ☐ C pyruvate and oxidised NAD to reduced NAD
- ☐ D pyruvate and reduced NAD to oxidised NAD



- (c) Conservationists are concerned that keeping cheetahs in captivity may affect the percentage of slow twitch and fast twitch fibres in their muscles.

In an investigation, scientists analysed samples from the leg muscles of wild and captive cheetahs.

The results are shown in Table 2 below.

Table 2

Cheetah	Leg muscle	Percentage of muscle fibre (%)	
		Slow twitch	Fast twitch
wild	vastus lateralis	15.5 ± 3.4	84.5 ± 2.0
wild	gastrocnemius	39.4 ± 3.4	60.6 ± 3.0
captive	vastus lateralis	18.6 ± 3.0	81.4 ± 4.2

- (i) Suggest the null hypothesis the scientists were testing.

(1)

- (ii) Using the data in Table 2, suggest a conclusion that can be drawn about the effect of captivity on the composition of muscle.

Give a reason for your answer.

(2)



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(d) Explain why the muscle composition of a cheetah causes it to stop running if it fails to catch its prey within 50 m.

(5)

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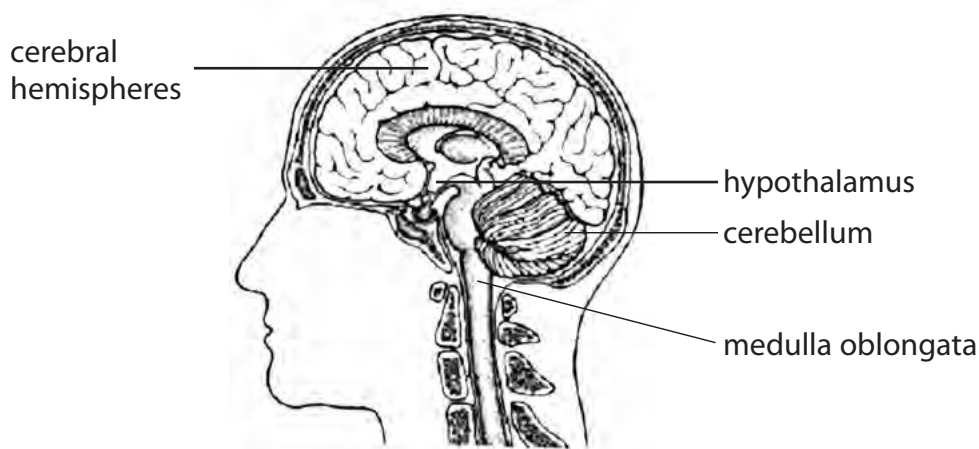
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(Total for Question 5 = 12 marks)



6 The human brain controls many functions.

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



Place a cross ☒ in the box next to the correct structure that completes each of the following statements.

(i) The part of the brain involved with the ability to see is the

(1)

- ☒ A cerebellum
- ☒ B cerebral hemisphere
- ☒ C hypothalamus
- ☒ D medulla oblongata

(ii) The part of the brain involved with the ability to coordinate movement and to control balance is the

(1)

- ☒ A cerebellum
- ☒ B cerebral hemisphere
- ☒ C hypothalamus
- ☒ D medulla oblongata



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7 The scientific article you have studied is adapted from the book called *Biology of Disease*, published by Taylor and Francis in 2007.

- (a) The article suggests that there is a relationship between ageing and the development of coronary heart disease (paragraph 1).

Describe how this relationship could be regarded as a correlation.

(1)

- (b) Suggest why a decrease in the elasticity of the lungs of older people will reduce gas exchange (paragraph 6).

(2)



- *(c) The article suggests that a loss of individual muscle fibres results in a decreased capacity for work (paragraph 5).

To perform work, the sarcomeres of a muscle fibre must be able to contract.

Explain how a sarcomere is able to contract.

(6)

- (d) Suggest **one** reason why atherosclerosis could be responsible for increased wound healing times in older people (paragraph 9).

(1)



- (e) Explain the consequences of 'a decline in the function of T lymphocytes' with age (paragraph 10).

(3)

- (f) The error-catastrophe theory suggests that random errors in transcription result in the production of abnormal proteins (paragraph 19).

Explain how random errors in transcription can result in the production of an abnormal protein.

(4)



- (g) The population in the United Kingdom is 65 million.

Calculate the **maximum** number of people who develop Alzheimer's disease between the ages of 65 and 80 as a result of genetic inheritance (paragraphs 34 to 36).

Show your working.

(2)

Answer

- (h) In Alzheimer's disease (AD), part of the brain responsible for feeling emotions does not function.

Suggest how a brain imaging technique (paragraph 39) could be used to diagnose this loss of function.

(2)

- (i) Suggest how drugs that inhibit the degradation of acetylcholine can alleviate the symptoms of Alzheimer's disease (AD) (paragraph 40).

(3)



- (j) The article describes an investigation about the effect of calorie restriction on the development of age-related diseases (paragraph 41).

The results of the investigation suggest that calorie restriction allows rats to live longer.

The description of the design of the investigation lacks the detail needed to have confidence in the validity of this conclusion.

Suggest the additional detail needed to have confidence in the validity of this conclusion.

(2)



(k) Explain why a high calorie diet lacking vitamin E is likely to promote ageing (paragraphs 16, 17 and 44).

(4)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

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