Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 13 June 2019

Morning (Time: 1 hour 45 minutes) | Paper Reference **WBI05/01**

Biology

Advanced

Unit 5: Energy, Exercise and Coordination

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 5 6 1 4 5 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 heart pumps blood through the circulatory system.

(a) Put a cross ☒ in the box next to the phrase that completes each of the following statements.

(i) The term myogenic means

(1)

☒ **A** contraction initiated in a muscle cell

☒ **B** contraction initiated in a nerve cell

☒ **C** nerve impulse initiated by a muscle cell

☒ **D** nerve impulse initiated by a nerve cell

(ii) The greatest force of contraction in the heart takes place in the wall of the

(1)

☒ **A** left atrium

☒ **B** left ventricle

☒ **C** right atrium

☒ **D** right ventricle

(iii) Cardiac output is the

(1)

☒ **A** volume of blood ejected from the left ventricle in each beat divided by the heart rate

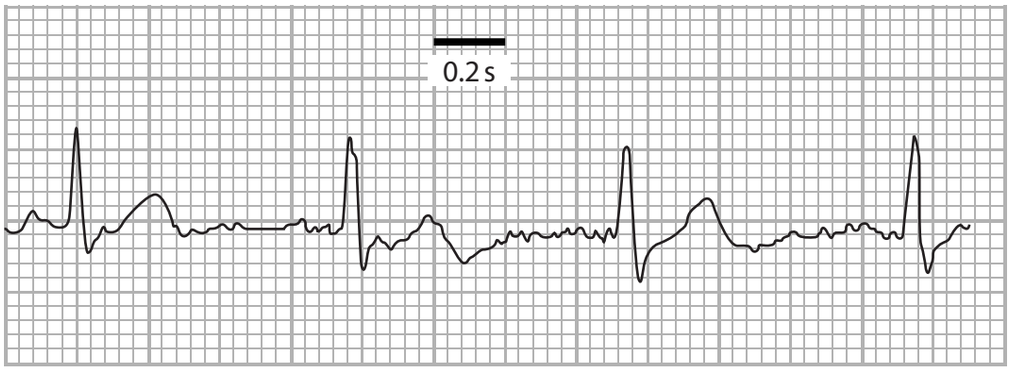
☒ **B** heart rate divided by the volume of blood ejected from the left ventricle in each beat

☒ **C** volume of blood ejected from the left ventricle in each beat multiplied by the heart rate

☒ **D** number of breaths per minute multiplied by the breathing rate

(b) Electrocardiograms (ECGs) provide useful information about heart function.

The trace below shows the ECG for a healthy person.



(i) Calculate the **mean** heart rate for this person.

(2)

..... beats per minute

(ii) State how the ECG for a person with a very fast heart rate would differ from the ECG shown.

(1)

.....

.....

(c) Describe the role of the sinoatrial node (SAN) in controlling heart rate.

(3)

(Total for Question 1 = 9 marks)

2 A torn anterior cruciate ligament (ACL) is a common knee injury in athletes.

Keyhole surgery can be carried out, using part of a tendon from the patient.

(a) Explain the advantage of using a tendon from the patient rather than a tendon from a donor.

(2)

(b) State **two** advantages of using keyhole surgery compared with conventional surgery to repair a torn ACL.

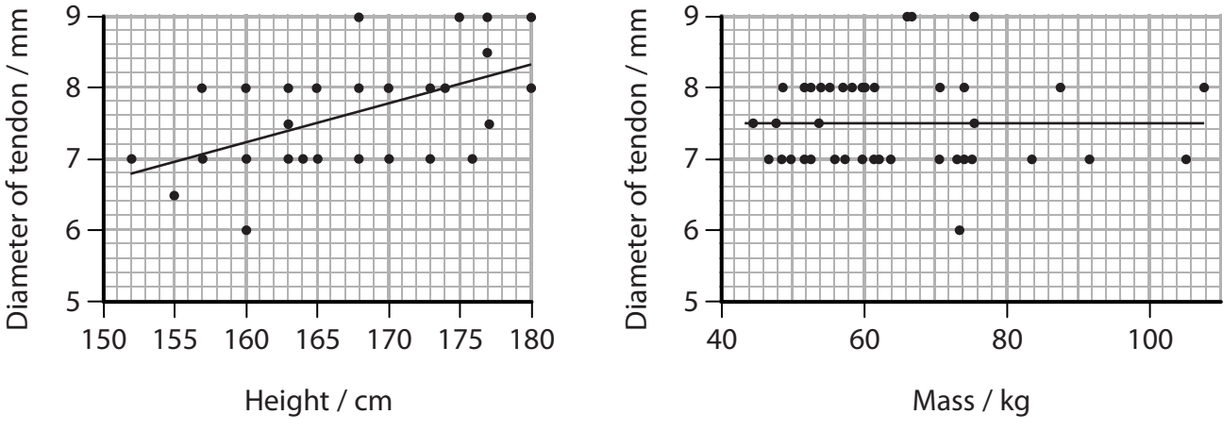
(2)

(c) In one procedure, a tendon is removed from the hamstring muscle of a patient to repair the ACL.

The height or mass of the patient may affect the diameter of the tendon used for the repair.

A study was carried out to compare the diameter of the tendons used in this procedure with the height and mass of a group of female patients.

The graphs below show the results of this study.



(i) A student made the following conclusions from these graphs:

- there is a correlation between the diameter of the tendon selected and gender
- there is no correlation between the diameter of the tendon selected and body mass
- there is a correlation between the diameter of the tendon selected and the height of the patient.

Put a cross ☒ in the box next to the correct number of conclusions that are supported by these graphs.

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(ii) From the results of this study, surgeons concluded that the optimum tendon diameter for the successful repair of ACL in these patients is 7 mm.

Describe a further study that could be carried out to support this conclusion.

(3)

(Total for Question 2 = 8 marks)

3 Homeostasis is the maintenance of a steady internal environment.

(a) Negative feedback mechanisms are involved in controlling the internal environment of an organism.

Place a cross ☒ in the box that describes a negative feedback mechanism.

(1)

	When internal body conditions change, sensors detect	Effectors carry out responses that
☒ **A**	increases or decreases in the condition	amplify the change
☒ **B**	increases or decreases in the condition	reverse the change
☒ **C**	only increases in the condition	amplify the change
☒ **D**	only decreases in the condition	reverse the change

(b) Describe the role of the hypothalamus in maintaining the internal body temperature during exercise.

(4)

(c) Homeostasis can involve both hormonal and nervous coordination.

Compare the mechanisms used in hormonal and nervous coordination in mammals.

(3)

(Total for Question 3 = 8 marks)

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4 Plants can detect light and respond to environmental cues.

(a) The photoreceptors used by plants have been identified.

Put a cross ☒ in the box next to the photoreceptor pigment in plants.

(1)

☒ **A** IAA (auxin)

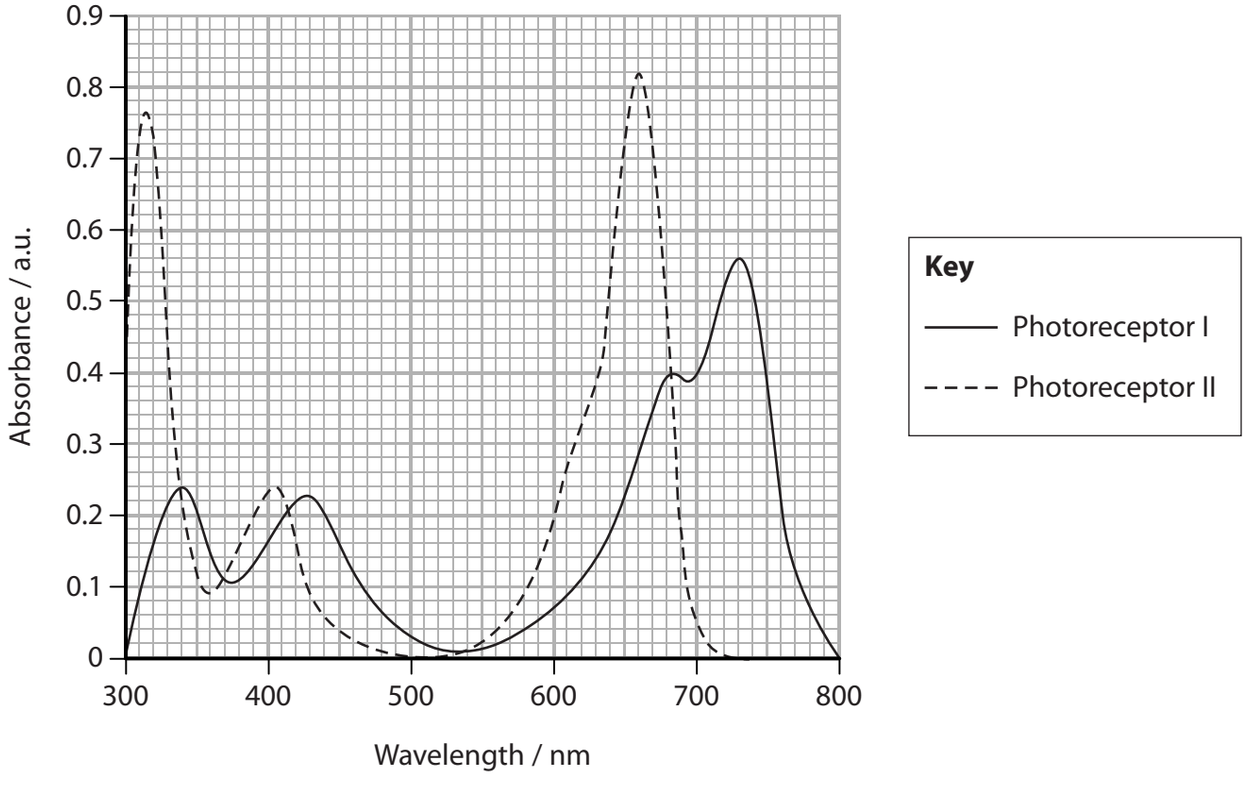
☒ **B** phytochrome

☒ **C** retinal

☒ **D** rhodopsin

(b) Absorbance is a measure of the amount of light absorbed at each wavelength by the photoreceptors.

The graph below shows the absorbance for two plant photoreceptors at a range of wavelengths.



Put a cross ☒ in the box next to the difference in the maximum absorbance between these two photoreceptors.

(1)

☒ **A** 0.26 a.u.

☒ **B** 0.26 nm

☒ **C** 70 a.u.

☒ **D** 70 nm

(c) The role of photoreceptors in the germination of lettuce seeds has been investigated.

In one experiment, three batches of seeds, **A**, **B** and **C**, were kept in the dark for seven days.

All three batches of seeds were exposed to a short flash of far red light one hour after the start of the experiment.

Seeds in batch **A** were exposed to short flashes of red light of different intensities at three hours.

Seeds in batch **B** were exposed to a short flash of red light of different intensities at 48 hours.

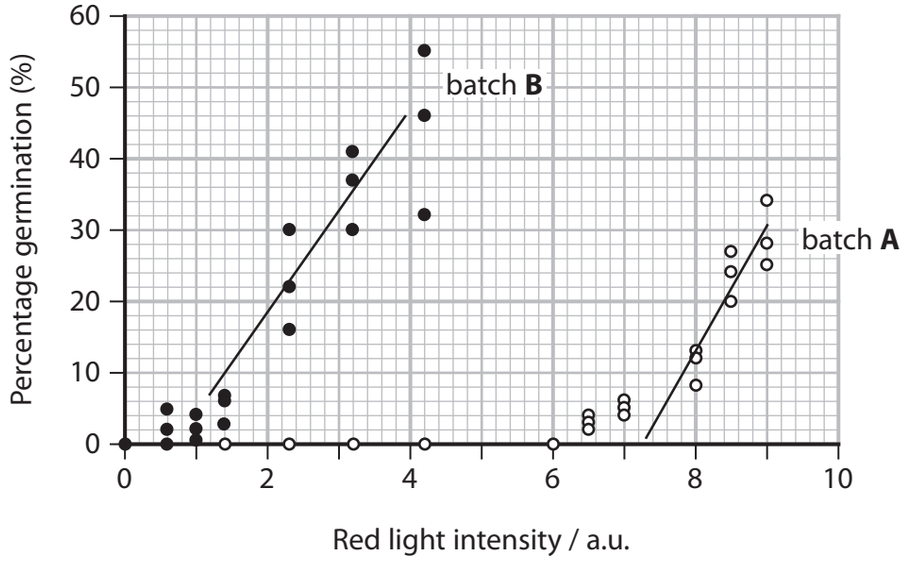
Seeds in batch **C** were exposed only to far red light at one hour.

The table below shows the treatment of each batch of seeds.

Batch of seeds	Treatment		
	Far red light at one hour	Red light of different intensities at three hours	Red light of different intensities at 48 hours
A	✓	✓	
B	✓		✓
C	✓		

After seven days the percentage germination of each batch of seeds was determined. Seeds in batch **C** did not germinate.

The graph below shows the results of this experiment.



(i) Using the trend lines drawn on the graphs, determine the percentage difference in red light intensity required to stimulate 30% germination in batches **A** and **B**.

(2)

..... %

(ii) Describe the effect of light exposure on the germination of these seeds.

(3)

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(iii) Using your knowledge of photoreceptors, suggest an explanation for the results of this experiment.

(4)

(Total for Question 4 = 11 marks)

5 Energy can be released from organic molecules by cellular respiration.

(a) Cellular respiration involves a number of chemical reactions.

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

(i) The energy stored in ATP is released by

(1)

☒ **A** hydrolysis of ADP

☒ **B** hydrolysis of ATP

☒ **C** phosphorylation of ADP

☒ **D** phosphorylation of ATP

(ii) In cellular respiration

(1)

☒ **A** NAD accepts electrons in glycolysis and in the Krebs cycle

☒ **B** reduced NAD accepts electrons in glycolysis and in the Krebs cycle

☒ **C** NAD accepts electrons in the Krebs cycle only

☒ **D** reduced NAD accepts electrons in the Krebs cycle only

(b) The photograph below shows an alligator.

© Patrick Lynch / Alamy Stock Photo

Magnification ×0.05

Alligators use anaerobic respiration as their main source of energy during short periods of activity.

An investigation was carried out to study respiration in an alligator.

The table below shows the data collected in this investigation.

Duration of activity / s	Rate of lactate production / mmol kg^{-1} min^{-1}	Rate of ATP production / mmol kg^{-1} min^{-1}	Mass of glycogen used / g kg^{-1}
10	34.6	51.8	0.5
30	11.8	17.7	0.9
60	10.7	16.0	1.4
120	6.4	9.5	1.9
270	0.3	0.4	2.0

*(i) Describe and explain the results of this investigation.

(6)

(ii) After stopping exercise the oxygen consumption of the alligator increases.

Explain why the oxygen consumption of an alligator increases after a short period of activity.

(3)

(iii) During prolonged periods of work the alligator can use aerobic respiration.

Describe the role of the Krebs cycle in the production of ATP.

(3)

(Total for Question 5 = 14 marks)

6 A study was carried out to investigate the critical window in the development of the ventilation centre in rats.

(a) In this study, groups of newborn rats were exposed to a five-day period of low oxygen concentration, beginning on day 1, day 11 or day 21 after birth.

A control group was also included, in which newborn rats were not exposed to a low oxygen concentration.

The rats were allowed to grow to adulthood. They were then tested for their change in breathing after they were exposed to a low oxygen concentration.

The table below shows the results of this study.

Group	Mean increase in breathing rate / breaths min^{-1}	Mean change in tidal volume / $cm^3\ 100\ g^{-1}$
control	27	+0.10
low oxygen concentration for days 1 to 5	24	+0.07
low oxygen concentration for days 11 to 15	11	−0.24
low oxygen concentration for days 21 to 25	29	+0.15

(i) Explain what is meant by the term **critical window** in this study.

(2)

(ii) Describe the results of this study.

(2)

(b) Describe the role of the ventilation centre in controlling the breathing response to a short period of low oxygen concentration in the control rats.

(4)

(c) This study could provide useful information about the development of the ventilation centre in humans.

Give **two** reasons that could be given to justify the use of rats in this study.

(2)

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(Total for Question 6 = 10 marks)

7 The scientific article you have studied is adapted from *Venom: The secrets of nature's deadliest weapon*, R Jenner and E Undheim, The Natural History Museum, 2017.

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

(a) Suggest why targeting the neuromuscular system is the quickest way of deterring or debilitating an adversary or potential prey (paragraph 4).

(2)

(b) Explain how a neurotoxin could act on a neurone to cause 'uncontrollable muscle contraction' (paragraph 5).

(3)

(c) Explain the role of the primary structure in the production of a water soluble venom protein (paragraphs 8 and 9).

(2)

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*(d) Describe how the antimicrobial properties of scorpion haemolymph could be compared with an antibiotic such as penicillin (paragraph 11).

(5)

(e) Explain why blocking potassium channels in neurones causes continuous nerve impulses (paragraph 12).

(2)

(f) Suggest how resistance to the neurotoxin of the African tarantula evolved in the American cockroach but not in the German cockroach (paragraph 14).

(4)

(g) Explain how alpha-latrotoxin causes the release of neurotransmitters (paragraph 22).

(3)

(h) Suggest how the release of serotonin can cause pain (paragraph 23).

(3)

(i) Some venoms cause a 'lingering pain' (paragraph 25).

Describe how the effects of one of these venoms on the brain could be observed.

(2)

(j) The honeybee sting is painful (paragraph 26).

Animals can learn to recognise the sound of honeybees, and can avoid being stung.

Suggest how this learning could be investigated.

(4)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS