Please check the examination details below before entering your candidate information

Candidate surname | Other names

Pearson Edexcel
International
Advanced Level

Centre Number | Candidate Number

Time 1 hour 45 minutes

Paper reference **WBI15/01**

Biology
International Advanced Level
Unit 5: Respiration, Internal Environment, Coordination and Gene Technology

You must have:
Scientific article (enclosed), scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or **black** 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*.
- **Show all your working in calculations and include units where appropriate.**

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*.
- In questions marked with an **asterisk** (*****), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ▶

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

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 Aerobic respiration involves four main stages:

glycolysis, link reaction, Krebs cycle and oxidative phosphorylation.

(a) One product of all three stages shown in the table is ATP (adenosine triphosphate).

Complete the table to show one other product of each stage.

(3)

Stage	One other product
glycolysis	
Krebs cycle	
oxidative phosphorylation	

(b) An incomplete equation for the aerobic respiration of a substrate is shown below.

Complete the equation by inserting the numbers on the dotted lines to balance it.

(2)

$$C_{57}H_{104}O_6 \ + \ \text{...............} \ O_2 \ \rightarrow \ \text{...............} \ CO_2 \ + \ 52 \ H_2O$$
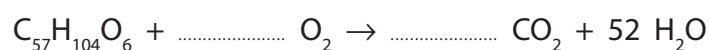
(c) One molecule of glucose contains 2867.48 kJ of energy.

One molecule of glucose generates a maximum of 38 molecules of ATP in aerobic respiration.

A molecule of ATP contains 30.51 kJ of usable energy. Usable energy is available for chemical reactions in the cell.

(i) Which reaction releases energy from ATP?

(1)

☒ **A** the conversion of ADP to ATP

☒ **B** the phosphorylation of ADP

☒ **C** the hydrolysis of ATP

☒ **D** the removal of adenosine molecules from ATP

(ii) Calculate the maximum percentage of energy in a glucose molecule that can be converted to usable energy in ATP.

(2)

Answer ....%

(iii) Describe what happens to the energy that is not converted to usable energy in a muscle cell.

(2)

....

....

....

....

....

....

(d) Describe how oxygen is involved in the production of ATP on the cristae in the mitochondria.

(2)

....

....

....

....

....

....

(Total for Question 1 = 12 marks)

2 The nervous system of an organism enables it to respond to a stimulus.

(a) A reflex action is a rapid involuntary movement in response to a stimulus. The response to a pinprick in a finger is an example of a reflex action.

(i) Which component of the nervous system continues a reflex arc immediately after the receptor has been stimulated by the stimulus?

(1)

☒ **A** motor neurone

☒ **B** relay neurone

☒ **C** Schwann cell

☒ **D** sensory neurone

(ii) Which pathway shows a reflex arc?

(1)

☒ **A** muscle ⟶ receptor ⟶ brain

☒ **B** muscle ⟶ spinal cord ⟶ brain

☒ **C** receptor ⟶ spinal cord ⟶ muscle

☒ **D** spinal cord ⟶ brain ⟶ muscle

(b) Pacinian corpuscles are pressure receptors found in the skin of the fingertip.

The effect of different pressures applied to the finger tip, on electrode potentials across the axon membrane of the neurone of a Pacinian corpuscle was investigated.

The diagram shows the structure of a Pacinian corpuscle and the location of electrodes, X and Y, used to measure axon membrane potentials.

electrode X   electrode Y

axon

layers of membranes
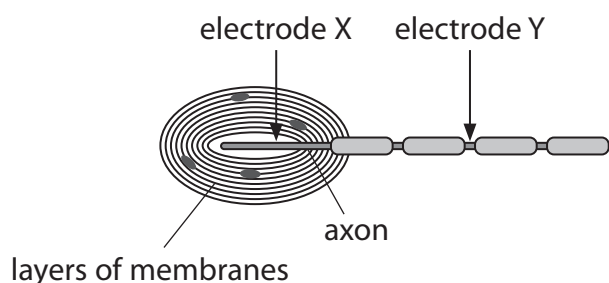
The table shows the results of the investigation.

Pressure applied to the fingertip	Membrane potential at electrode X / mV	Membrane potential at electrode Y / mV
None	−70	−70
Low	−60	−70
Medium	+20	+40
High	+40	+40

(i) Describe how the resting potential of −70mV is maintained in the axon when no pressure is applied.

(3)

....

....

....

....

....

....

....

....

....

(ii) Suggest how a change in pressure at the Pacinian corpuscle causes an action potential in the axon.

(3)

....

....

....

....

....

....

....

(iii) Explain why the membrane potential at electrode Y was the same when medium or high pressure was applied to the fingertip.

(3)

....

....

....

....

....

....

....

....

(Total for Question 2 = 11 marks)

3 Many neurones in the human nervous system are myelinated.

(a) A myelinated axon conducts impulses faster than a non-myelinated axon of the same diameter.

Explain this difference.

(3)

....

....

....

....

....

....

....

....

(b) Polyneuropathy is a disorder that damages the myelin sheath of neurones throughout the body.

One symptom is muscle weakness. Muscle weakness is the reduced strength in one or more muscles.

Suggest how damage to the myelin sheaths of neurones can lead to muscle weakness.

(2)

....

....

....

....

....

....

....

(c) Dementia is a condition associated with the ongoing decline of brain functioning. There are many types of dementia.

The relationship between myelin in brain tissue and types of dementia has been investigated.

The mean quantity of myelin in samples of brain tissue from groups of people with types of dementia and from a control group was measured.

The table shows the results of this investigation.

Group	Mean quantity of myelin in a brain tissue sample / a.u.	Standard deviation
Control (no dementia)	52	± 3.2
Patients with vascular dementia	25	± 5.9
Patients with Alzheimer's dementia	32	± 4.1
Patients with Lewy Body dementia	42	± 5.0

A student concluded that there was a relationship between the quantity of myelin in the brain of a person and whether or not they had dementia.

Comment on the validity of this conclusion.

(2)

....

....

....

....

....

....

(Total for Question 3 = 7 marks)

4 The kidney is involved in the process of homeostasis in a mammal.

(a) Antidiuretic hormone (ADH) is required for homeostasis.

How many of these parts of the kidney respond to ADH?

- Bowman's capsule
- collecting duct
- loop of Henle
- proximal tubule

(1)

☒ **A** 1

☒ **B** 2

☒ **C** 3

☒ **D** 4

(b) The electron micrograph shows a transverse section of part of a proximal tubule.

(Source: https://veteriankey.com/solute-reabsorption/)
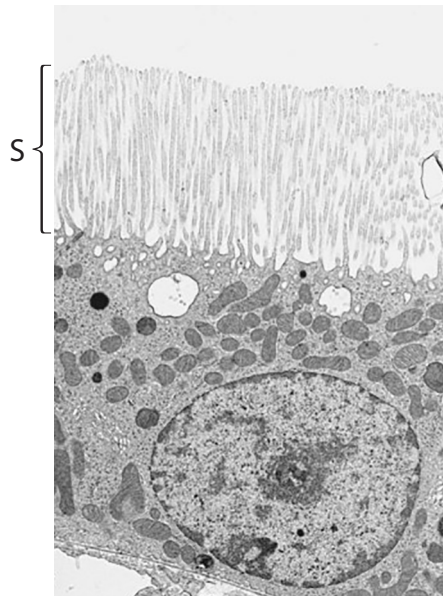
(i) Name the process by which the fluid moves from the plasma into the renal tubule (nephron).

(1)

....

(ii) Name the structures labelled S.

(1)

....

(c) A student compared the left renal veins of two individuals.

(i) The diameter of the left renal vein of one individual was 4.71 mm.

Calculate the cross-sectional area of this vein.

(2)

Answer .... mm^2

(ii) The cross-sectional area of the left renal vein of the second individual was 0.194 cm^2.

Calculate the difference in the cross-sectional area in the left renal vein of these two individuals.

(1)

Answer ....

(d) The table shows the concentration of glucose and urea in the blood plasma, glomerular filtrate and urine of an individual.

Substance	Concentration in blood plasma / g dm⁻³	Concentration in glomerular filtrate / g dm⁻³	Concentration in urine leaving collecting duct / g dm⁻³
glucose	1.50	1.50	0.00
urea	0.30	0.30	21.00

Explain the concentration of glucose and urea in the urine.

Use the information in the table to support your answer.

(3)

....

....

....

....

....

....

....

....

(e) An individual produced $0.83\,cm^3$ of urine each minute.

Calculate the volume of urine produced by this individual in 24 hours.

Assume the urine production is at a constant rate.

Give your answer in dm^3, to two significant figures.

(2)

Answer .... dm^3

(Total for Question 4 = 11 marks)

P 6 7 8 1 7 A 0 1 3 3 2

BLANK PAGE

5 (a) The body length of the medicinal leech decreases when touched.

(Source: © Mit Kapevski/Shutterstock)

The body length of the leech decreases less each time the leech is touched.

(i) What is the name of this effect?

(1)

- ☒ **A** absorption
- ☒ **B** adaptation
- ☒ **C** habituation
- ☒ **D** sensitivity

(ii) Why is it an advantage for the leech to respond in this way?

(1)

- ☒ **A** it filters out what is important and what is not important to react to
- ☒ **B** it enables the animal to react more quickly to the stimulus
- ☒ **C** it keeps the habitat of the animal protected
- ☒ **D** it helps the animal find food more easily

(b) The photograph shows a fiddler crab.

(Source: © Jay Gao/Shutterstock)

In an experiment, the fiddler crab was used to investigate responses to a predator. The responses by females and males were compared.

A predator approached a group of female crabs from one direction.

The percentage of crabs running home was recorded. This was repeated 20 times.

This experiment was repeated with a group of male crabs.

The graphs show the percentage of crabs running home for both groups of crabs against the total number of times each group of crabs encountered a predator.
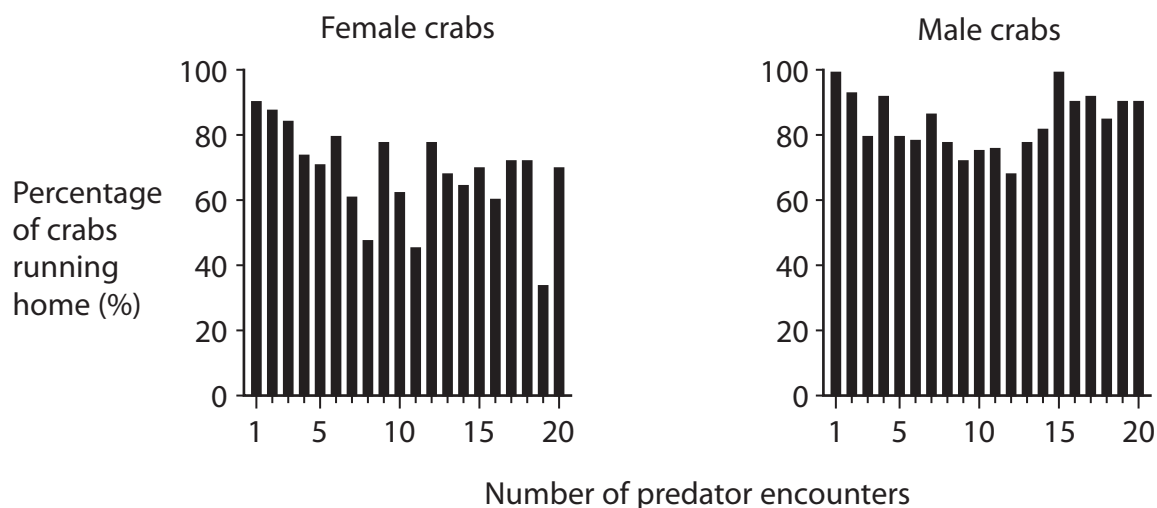
(i) Comment on the results of this experiment.

(3)

....

....

....

....

....

....

....

....

....

(ii) Which statistical test would be used to analyse the effect of the increase in the number of predator encounters on the percentage of crabs running home?

(1)

☒ **A** correlation coefficient

☒ **B** Hardy-Weinberg

☒ **C** index of diversity

☒ **D** Student's t-test

(Total for Question 5 = 6 marks)

6 In humans the sinoatrial node, atrioventricular node and bundle of His are involved in regulation and coordination of the cardiac cycle.

(a) The diagram shows a human heart.
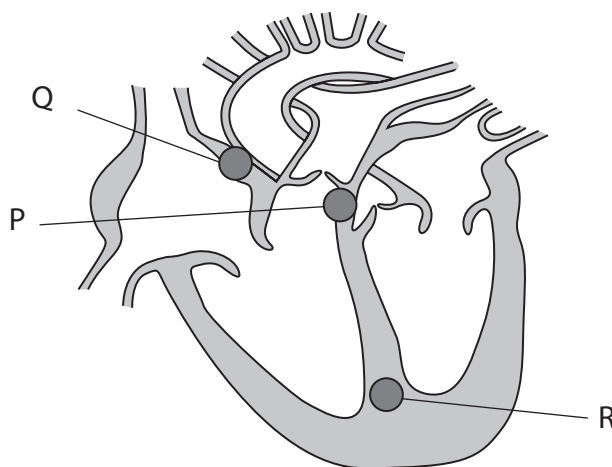
(i) Which **one** of the following statements is correct?

(1)

☒ **A** Q is the sinoatrial node (SAN) and R is the atrioventricular node (AVN)

☒ **B** Q is the sinoatrial node (SAN) and P is the atrioventricular node (AVN)

☒ **C** Q is the bundle of His and R is the sinoatrial node (SAN)

☒ **D** R is the sinoatrial node (SAN) and P is the Purkinje fibres

(ii) The electrical impulse that initiates the cardiac cycle begins without the need for a nerve impulse.

What is the term for this process?

(1)

☒ **A** diastole

☒ **B** myogenic

☒ **C** polarisation

☒ **D** systole

P 6 7 8 1 7 A 0 1 8 3 2

(b) A football player undertook regular exercise as part of a training programme.

During exercise there is a change in the duration of the cardiac cycle.

(i) Explain why there is a change in the cardiac cycle during this exercise.

(3)

....

....

....

....

....

....

....

....

(ii) The table shows the effect of the training programme on the cardiac output and resting heart rate of this football player.

When measurements were made	Cardiac output / cm³ min⁻¹	Resting heart rate / bpm
Before training	4500	72
After training	4500	51

Calculate the stroke volume of this football player, after training.

(1)

Answer .... cm³

(iii) After training, the footballer had an ECG.

This ECG trace is shown in the diagram.

Time / s
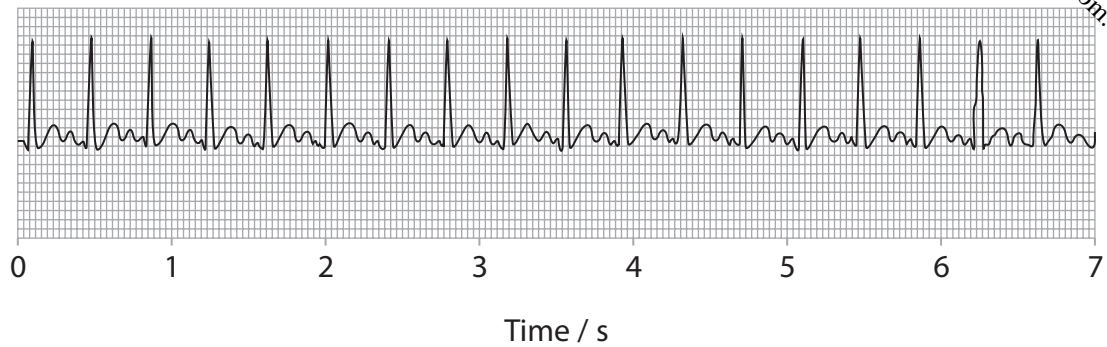
Calculate the heart rate of the footballer using the ECG in this diagram.

(1)

Answer ....

(iv) Two hours later a second ECG was recorded.

Time / s
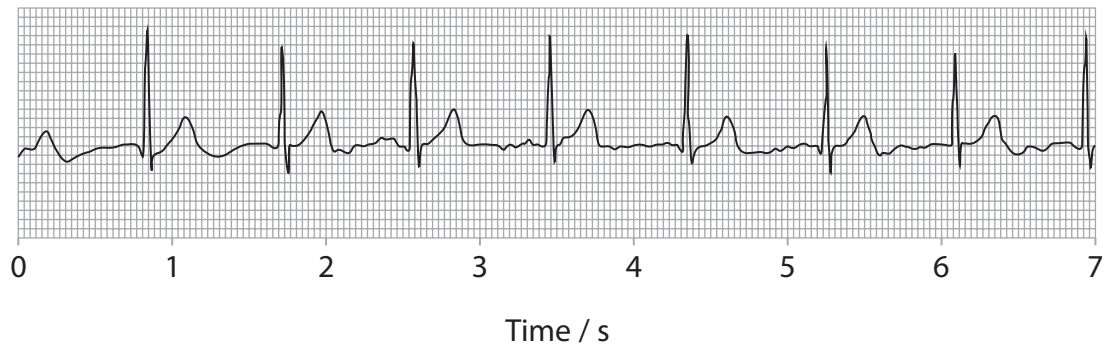
Comment on the changes that have occurred in the activity of the heart as shown in these two ECG traces.

(3)

....

....

....

....

....

....

....

....

(Total for Question 6 = 10 marks)

7 Animals and plants can respond to light.

(a) The photograph shows the front of a human eye.
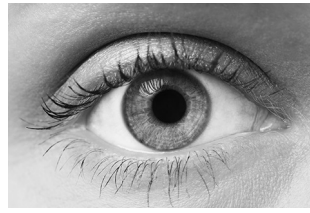
(Source: © SCIENCE PHOTO LIBRARY)

(i) The size of the pupil changes when moving from dim to very bright light.

Explain how this change occurs.

(3)

....

....

....

....

....

....

....

....

(ii) Describe the role of rhodopsin in causing changes in the polarisation of rod cells.

(4)

....

....

....

....

....

....

....

....

....

....

....

*(b) Exposure to light controls the germination of seeds and the direction of growth of plants.

In an investigation the seeds of plantains were exposed to light.

The seeds were first exposed to red light and then to far-red light.

The percentage of seeds that germinated when exposed to different periods of red and far-red light was recorded.

The results are shown in the table.

Exposure to red light / min	Percentage germination (%)						
	Exposure to far-red light /seconds						
	1	5	10	15	30	60	960
32	100	20	14	6	4	6	10
16	92	30	40	28	30	33	20
8	100	62	50	57	44	47	56
4	100	67	60	57	40	37	92

Comment on the effect of red and far-red light on the germination of these seeds and the processes that occur in their cells.

Use the information in the table to support your answer.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

(Total for Question 7 = 13 marks)

8 The scientific document you have studied is adapted from an article in Journal of Cachexia, Sarcopenia and Muscle entitled *Skeletal muscle performance and ageing* (Tieland, 2018).

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

(a) Describe the structure of a skeletal muscle fibre (paragraph 2).

(3)

....

....

....

....

....

....

....

....

(b) Explain how myokines may exert endocrine effects on organs such as the liver (paragraph 3).

(3)

....

....

....

....

....

....

....

....

....

(c) Explain why the changes that occur to muscle structure and composition in the elderly can affect their ability to rise from a chair (paragraph 4).

(4)

....

....

....

....

....

....

....

....

....

....

....

(d) Explain why Ca^{2+} binding to troponin C allows muscle fibres to contract (paragraph 5).

(3)

....

....

....

....

....

....

....

....

(e) Explain how the 'high-energy phosphates' provide the energy necessary for muscle activity (paragraph 11).

(2)

....

....

....

....

....

....

(f) Suggest explanations for the effects that a 'reduction in tendon stiffness' resulting from ageing could have on the movement at a joint (paragraph 12).

(3)

....

....

....

....

....

....

....

....

....

....

(g) Suggest how myostatin might act as a negative regulator of muscle growth (paragraph 13).

(2)

....

....

....

....

....

....

(Total for Question 8 = 20 marks)

TOTAL FOR PAPER = 90 MARKS

BLANK PAGE

BLANK PAGE

BLANK PAGE