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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 11 June 2020

Morning (Time: 1 hour 45 minutes) | Paper Reference **WBI15/01**

Biology

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

You must have:
A copy of the scientific article (enclosed), scientific 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.*
- **Show all your working 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.

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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 In cells, energy can be released from substrates by anaerobic and aerobic respiration.

(a) Most eukaryotic cells can respire anaerobically.

(i) Which of the following describes a step in the process of anaerobic respiration?

(1)

☒ **A** decarboxylation of lactate

☒ **B** phosphorylation of hexoses

☒ **C** oxidation of pyruvate

☒ **D** removal of phosphate groups from glucose

(ii) What happens to the lactate concentration during a period of anaerobic respiration?

(1)

☒ **A** decreases, causing a decrease in blood pH

☒ **B** decreases, causing an increase in blood pH

☒ **C** increases, causing a decrease in blood pH

☒ **D** increases, causing an increase in blood pH

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(b) Most eukaryotic cells are also able to respire aerobically.

(i) How do respiratory substrates enter the Krebs cycle?

(1)

- ☒ **A** as molecules containing 2 carbon atoms produced by the link reaction
- ☒ **B** as molecules containing 3 carbon atoms produced by the link reaction
- ☒ **C** as molecules containing 2 carbon atoms produced by RUBISCO
- ☒ **D** as molecules containing 3 carbon atoms produced by RUBISCO

(ii) Draw a diagram of a mitochondrion.

Label only the part of the mitochondrion where the Krebs cycle occurs.

(2)

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(iii) Describe the role of chemiosmosis in the synthesis of ATP.

(5)

(Total for Question 1 = 10 marks)

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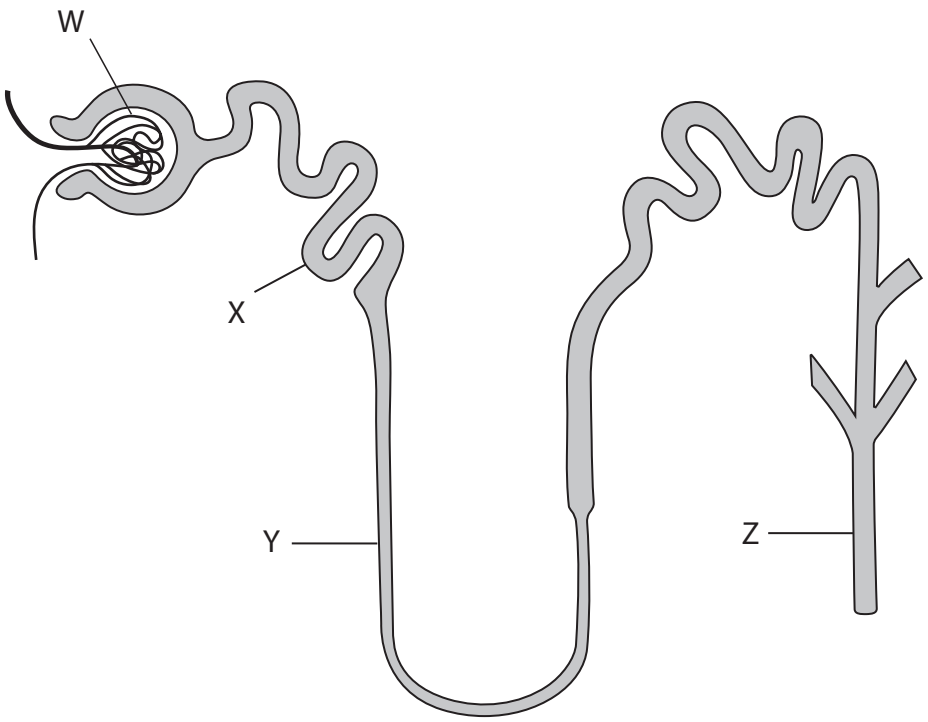
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2 The kidney is an organ involved in the excretion of waste materials and in the regulation of blood volume and plasma concentration.

(a) The functional unit of the kidney is the nephron.

The diagram shows a single nephron.



(i) In which part of the kidney are structures W and X located?

(1)

☒ **A** cortex

☒ **B** inner medulla

☒ **C** outer medulla

☒ **D** renal pelvis

(ii) In which structure does ultrafiltration take place?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

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(iii) Which structures form part of the loop of Henle?

(1)

- ☒ **A** X only
- ☒ **B** X and Y
- ☒ **C** Y only
- ☒ **D** Y and Z

(b) Urea is a toxic substance that is excreted from the body.

Explain how ultrafiltration removes urea from the blood.

(2)

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(c) The kidney controls blood volume and plasma concentration by regulating the loss of water in urine.

Some mammals have adaptations to their kidneys that enable them to live in different habitats.

The table shows information about two small mammals.

Mammal	Urine concentration / mOsmol dm^{-3}	Relative number of mitochondria in the thick ascending loop of Henle	Sodium ion concentration of extracellular fluid in the medulla / mmol dm^{-3}
brown rat	2900	3.6	45
kangaroo rat	5500	5.5	95

Deduce why the kangaroo rat is more successful than the brown rat at living in desert habitats.

(3)

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(Total for Question 2 = 8 marks)

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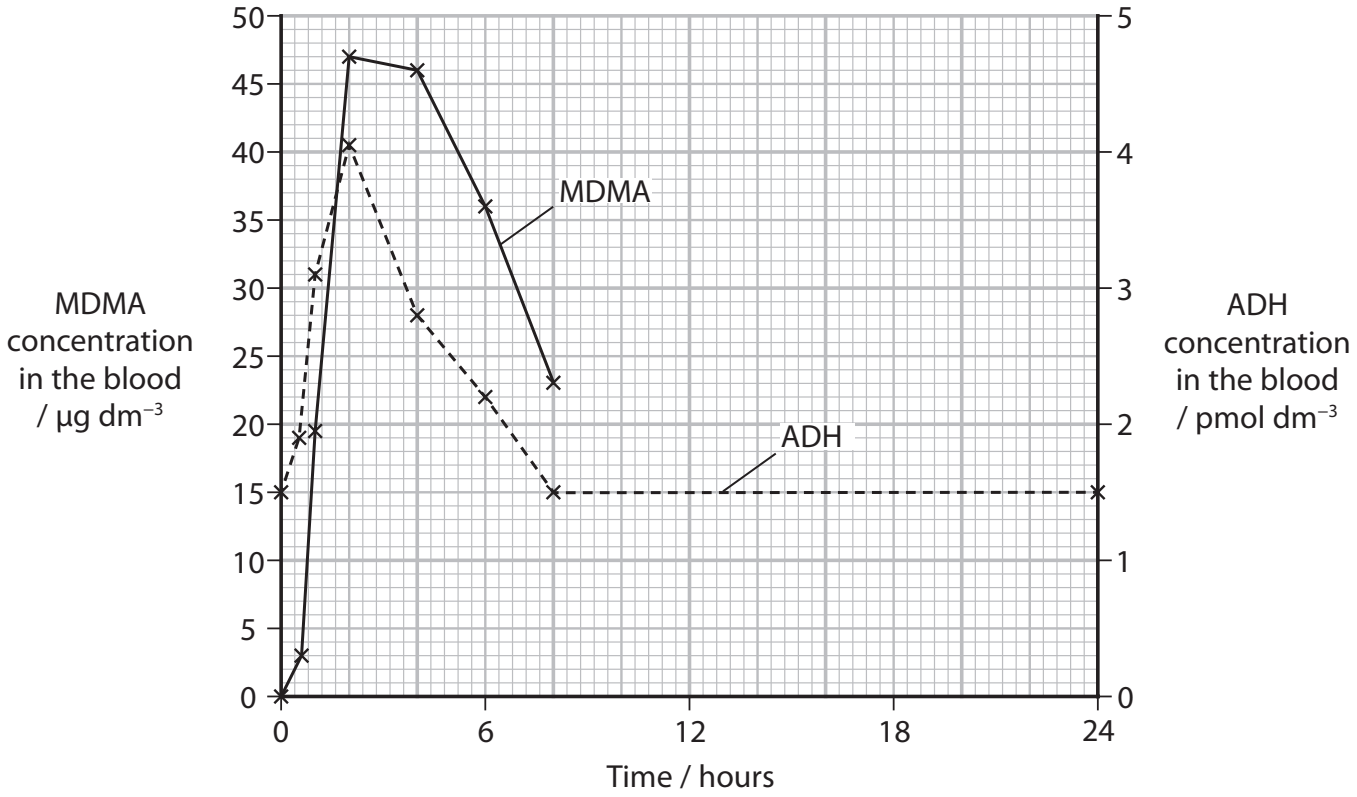
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3 Ecstasy (MDMA) is a recreational drug that can have serious toxic effects.

(a) The effect of MDMA on ADH concentration in blood has been studied.

In one study, each person in a group of volunteers was given MDMA. The MDMA and ADH concentrations in the blood were measured.

The graph shows the results of this study.



(i) Estimate how long it takes the MDMA concentration in the blood to become 0.0 µg dm^{-3}.

(1)

Answer ..... hours

(ii) Calculate the rate of removal of ADH from the blood between 4 and 8 hours.

(2)

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*(b) Taking MDMA causes a person to be very thirsty. This can lead to swelling of the brain, which can be fatal.

The table shows some laboratory results for one case in which a person suffered swelling of the brain.

Time since taking MDMA / hours	ADH concentration / pmol dm^{-3}	Sodium ion concentration in the blood / mmol dm^{-3}	Appearance of the brain in computed tomography (CT)
9	4.5	112	Swollen
96	1.2	131	Normal

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Comment on the role of ADH in MDMA-induced brain swelling.

Use the information in the graph and table as well as your own knowledge to support your answer.

(6)

(Total for Question 3 = 9 marks)

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4 Many people swim as part of their regular exercise.

(a) The table gives some information about the effect of the intensity of exercise on heart rate.

Intensity of exercise / a.u.	Heart rate / bpm
4	118
6	120
8	138
10	150
12	155
14	160

Describe the relationship between the intensity of exercise and heart rate.

(2)

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(b) Regular swimming affects resting heart rate and cardiac output.

cardiac output = stroke volume × heart rate

The table shows the mean resting cardiac output and mean resting stroke volume for a group of regular swimmers and a control group.

Group	Mean resting cardiac output / $dm^3\ min^{-1}$	Mean resting stroke volume / cm^3
Regular swimmers	4.43	74.40
Control	4.21	58.40

Using the data in the table, calculate the difference in resting heart rate between these two groups.

Give your answer to 2 decimal places with appropriate units.

(3)

Answer .....

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*(c) Explain the role of the heart in responding to regular exercise.

Use the information in **both** tables and your own knowledge to support your answer.

(6)

(Total for Question 4 = 11 marks)

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5 The eye is a sense organ specialised for detecting light stimuli.

(a) Pupils of the eye react to light.

The effects of different light intensities from two light sources have been investigated.

The table shows the results of this investigation.

Light intensity / a.u. per m^2	Mean pupil diameter / mm	
	Incandescent light	LED light
0	25.5	25.5
75	24.0	22.0
150	24.0	18.5
200	23.0	17.5
300	21.5	16.0
650	17.5	12.0
1400	16.0	9.5

(i) Describe the relationship between light intensity and pupil diameter.

(2)

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(ii) Calculate the amount of incandescent light that can pass through the pupil when the light intensity is 1400 a.u. per m^2.

Use a value of pi (π) = 3.14

(3)

Answer .....

(iii) Describe how light entering the eye causes the pupil to respond.

(4)

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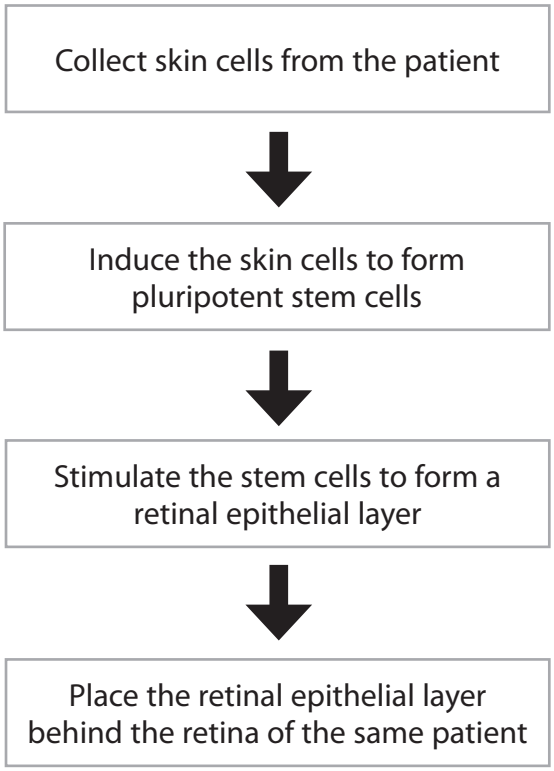
(b) Age-related macular degeneration (AMD) is a common cause of blindness in older people.

In AMD the epithelial layer behind the retina is damaged.

A new treatment for AMD uses induced pluripotent stem cells. These cells are grown in a culture to produce a retinal epithelial layer.

This retinal epithelial layer can then be used to replace the damaged layer of cells.

The procedure is outlined in the flow chart.



(i) State what is meant by the term **pluripotent stem cell**.

(2)

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(ii) The epithelial layer is checked to ensure that there are no stem cells present before it is placed in the eye of the patient.

Suggest why this check is carried out.

(2)

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(Total for Question 5 = 13 marks)

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6 Many predatory animals produce toxins to disable their prey. Some of these toxins inhibit nervous communication.

(a) Nerve impulses are transmitted along axons. Some axons are myelinated.

(i) Which type of cell produces myelin?

(1)

☒ **A** neurone

☒ **B** rod cell

☒ **C** Schwann cell

☒ **D** lymphocyte

(ii) Which row correctly compares the conduction of an impulse along a myelinated neurone with conduction along a non-myelinated neurone?

(1)

	Compared with a non-myelinated neurone the speed of conduction in a myelinated neurone is	Because membrane depolarisation only takes place in the axon membrane
☒ **A**	faster	at nodes of Ranvier
☒ **B**	faster	in between nodes of Ranvier
☒ **C**	slower	at nodes of Ranvier
☒ **D**	slower	in between nodes of Ranvier

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(b) Describe the role of ion transport in maintaining the resting potential of a neurone.

(4)

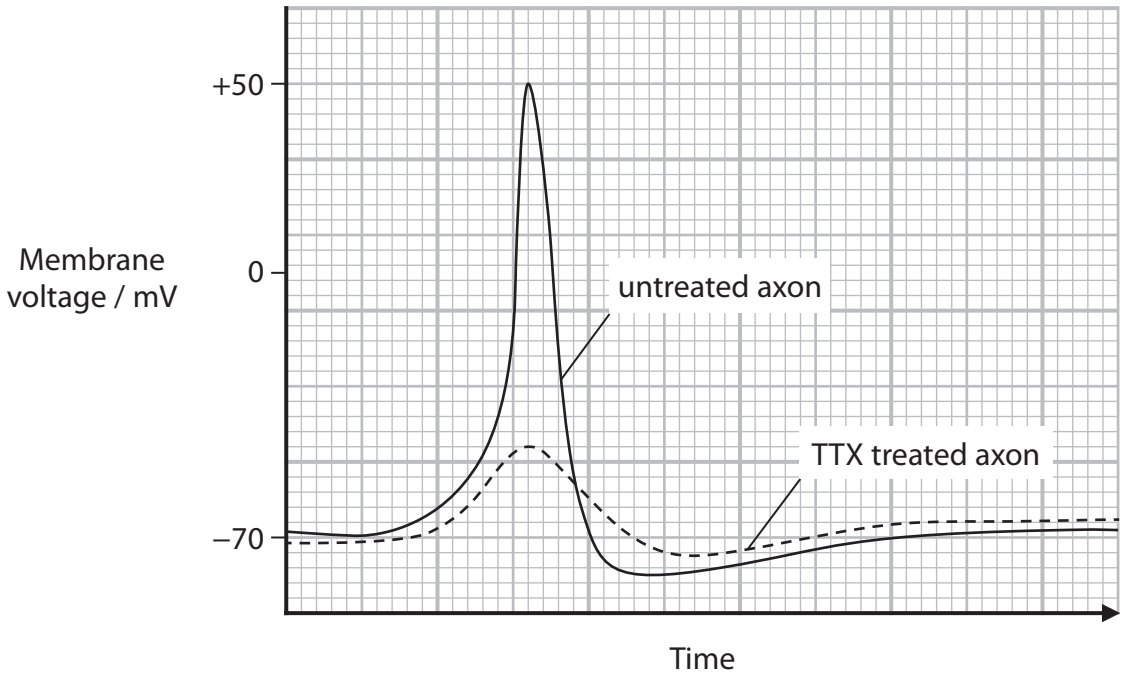
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(c) The pufferfish produces a neurotoxin called tetrodotoxin (TTX).

The graph shows the effect of TTX on the nerve impulse in an axon.



Deduce how TTX inhibits nerve impulses in an axon.

(3)

(Total for Question 6 = 9 marks)

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7 Parkinson's disease occurs when dopamine-producing neurones die.

(a) The most obvious motor symptoms of Parkinson's disease include muscle tremors and muscle rigidity.

These motor symptoms are linked to the loss of dopamine-producing neurones in the brain.

(i) One drug used to treat Parkinson's disease is L-DOPA.

Which of the following statements explains why L-DOPA can be used to treat Parkinson's disease?

(1)

☒ **A** L-DOPA acts on a different post-synaptic receptor to dopamine

☒ **B** L-DOPA crosses the blood-brain barrier and is then converted to dopamine in the brain

☒ **C** L-DOPA is converted to dopamine in the blood and then crosses the blood-brain barrier

☒ **D** L-DOPA is identical to dopamine

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(ii) Explain why the release of reduced quantities of dopamine by presynaptic neurones could result in motor symptoms.

(3)

(b) It has been suggested that in Parkinson's disease dopamine-producing neurones die because of a failure to release dopamine.

Suggest how the release of dopamine from presynaptic neurones could be inhibited.

(2)

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(c) Describe how microarrays and bioinformatics could be used to investigate the genetic basis of Parkinson's disease.

(4)

(Total for Question 7 = 10 marks)

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8 The scientific document you have studied is adapted from an article in *National Geographic*: How personalized medicine is transforming your health care.

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

(a) Explain what is meant by the phrase 'gene variants' (paragraph 4).

(2)

(b) Explain why 'tumors ... riddled with different mutations' are good candidates for immunotherapies (paragraph 6).

(4)

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(c) Explain why a CT scan was used to show that Judy Perkins was free of tumours (paragraph 10 and Figure 1).

(2)

(d) Checkpoints are a type of protein that prevent the activation of immune cells.

Explain why a checkpoint inhibitor was given with the lymphocytes in the immunotherapy used to treat Judy Perkins (paragraph 10).

(2)

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(e) Explain how 'a gene variant that produces a defective form of an enzyme' reduces the effectiveness of clopidogrel (paragraph 16).

(4)

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(f) Researchers have used stem cells to produce spinal cord tissue from individuals with amyotrophic lateral sclerosis.

These functioning tissues contain motor neurones and blood vessels.

Suggest why blood vessels are required to form functioning spinal cord tissue (paragraph 31).

(3)

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(g) Suggest how 'a brew of growth factors and other proteins' can stimulate induced pluripotent stem cells to produce a functioning tissue (paragraph 33).

(3)

(Total for Question 8 = 20 marks)

TOTAL FOR PAPER = 90 MARKS

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