A-Level Edexcel

# BIOLOGY

## UNIT 5(IAL)

2020 — 2023

**1** - ((WBI11)/5(IAL)_Summer_2020_Q1) - *Respiration, Internal Environment, Coordination And Gene Technology*

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

(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)

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

(5)

**2** - ((WBI11)/5(IAL)_Summer_2020_Q2) - *Respiration, Internal Environment, Coordination And Gene Technology*

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.
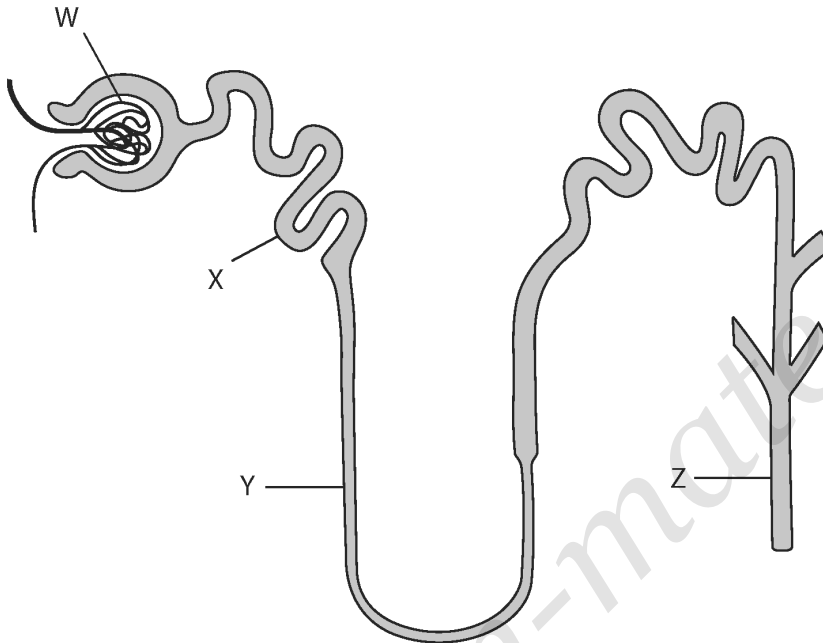


(i) In which part of the kidney are structures W and X located?

(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

(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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**3** ‑ ((WBI11)/5(IAL)_Summer_2020_Q3) ‑ *Respiration, Internal Environment, Coordination And Gene Technology*

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.
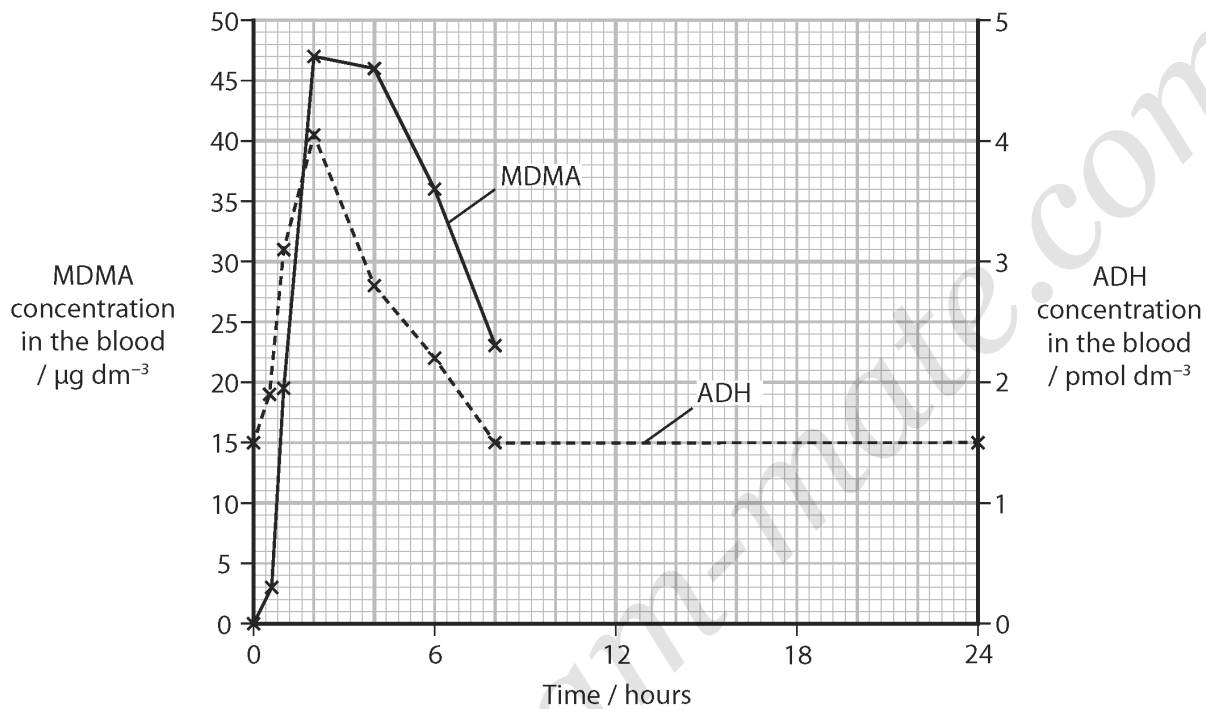


(i) Estimate how long it takes the MDMA concentration in the blood to become 0.0 µg dm⁻³.

**(1)**

Answer ............................................... hours

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

**(2)**

Answer .................................................

*(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 |

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)

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# ANSWERS

**1** - ((WBI11)/5(IAL)_Summer_2020_Q1) - *Respiration, Internal Environment, Coordination And Gene Technology*

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(i) | B     phosphorylation of hexoses | | **Computer** <br><br> (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(ii) | C     increases, causing a decrease in blood pH | | **Computer** <br><br> (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(i) | A     as molecules containing 2 carbon atoms produced by the link reaction | | **Computer** <br><br> (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(ii) | An answer that includes the following points: <br><br> • double membrane structure with cristae (1) <br><br> • (mitochondrial) matrix identified as location of Krebs cycle reactions (1) | <br><br><br><br> ALLOW Krebs cycle if arrow points to correct location. Allow without arrow labelled | **Graduate** <br><br> (2) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(iii) | A description that includes five of the following points: <br><br> • hydrogen atoms are transported to the electron transport chain (1) <br><br> • by (the coenzymes) NAD **and** FAD (1) <br><br> • electrons pass along the electron transport chain releasing energy (1) <br><br> • that is used to move protons to the intermembrane space (1) <br><br> • protons diffuse (back into the mitochondrial matrix) through ATP **synthase** (1) <br><br> • (catalysing) the formation of ATP from ADP and Pi (1) | ALLOW hydrogen ions and electrons <br><br> ALLOW reduced NAD/NADH/NADH₂ and reduced FAD/FADH/ FADH₂ <br><br><br><br> ALLOW H⁺/Hydrogen ions <br><br><br><br> IGNORE ATPase <br><br> ALLOW Phosphorylating ADP <br> ALLOW correct equation | **Expert** <br><br> (5) |

**2** - ((WBI11)/5(IAL)_Summer_2020_Q2) - *Respiration, Internal Environment, Coordination And Gene Technology*

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(i) | A     cortex | | **Computer** (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(ii) | A     W | | **Computer** (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(iii) | C     Y only | | **Computer** (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b) | An answer that includes the following points: <br><br> • (urea) forced out by high pressure (of the blood) (1) <br><br> • caused by afferent blood vessel greater diameter than efferent blood vessel in the glomerulus (1) <br><br> • through pores in the (basement) membrane (1) | IGNORE any other mechanism other than ultrafiltration <br><br> ALLOW arteriole NOT artery | **Expert** (2) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (c) | An explanation that includes the following points: <br><br> • less water available in deserts (1) <br><br> • (Kangaroo rat conserves water) by producing more concentrated urine (1) <br><br> • needs to actively transport more sodium ions into ( the extracellular fluid of) medulla (1) <br><br> • therefore needs more mitochondria to produce more ATP (1) | ALLOW Less water available for kangaroo rat <br> ALLOW {more water reabsorbed / filtered out} producing more concentrated urine <br><br> IGNORE sodium | **Expert** (3) |

**3** - ((WBI11)/5(IAL)_Summer_2020_Q3) - *Respiration, Internal Environment, Coordination And Gene Technology*

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(i) | An answer between 8 and 18 (hours) (1) | | **Graduate** (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(ii) | An answer showing the following steps: <br><br> • correct values read from y axis and subtracted (1) <br><br> • gradient calculated and appropriate units given (1) | 2.8 -1.5=1.3 <br><br> $1.3 \div 4 = 0.325$ pmol dm$^{-3}$ hour$^{-1}$ <br> ALLOW 0.33 <br><br> Conversion to other units will also need checking <br> ALLOW 325fmol in place of 0.325pmol h$^{-1}$ / H$^{-1}$ for hour$^{-1}$ | **Expert** (2) |

| Question number | Answer | Mark |
|---|---|---|
| (b) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>**Indicative content**<br><br>Graph shows<br><br>• as MDMA concentration in blood increases ADH concentration increases<br><br>Table shows<br>• after 9 hours of taking MDMA ADH levels still high / 3x that at 96 hours<br><br>• as ADH concentration increases sodium ion concentration in the blood decreases<br><br>• brain swelling is associated with lower sodium ion concentration in the blood<br><br>From own knowledge<br><br>ADH increases water reuptake by the kidney<br><br>Deduction<br><br>Increased water retention is to dilute the blood<br>More water leaves blood by osmosis into brain tissue | **Expert**<br><br>**(6)** |
| | Resulting in swelling of the brain | |

**4** - ((WBI11)/5(IAL)_Summer_2020_Q4) - *Respiration, Internal Environment, Coordination And Gene Technology*

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a) | A description that includes two of the following points:<br><br>• as intensity increases heart rate increases (1)<br><br>• smaller effect at {low intensity / high intensity} (1) | Positive correlation<br><br>ALLOW Stated comparative effect eg. Largest increase between 6-8 au | **Graduate**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b) | An answer showing the following steps:<br><br>• calculation of heart rates (1)<br><br>• calculation of change in heart rate (1)<br><br>• correct number of decimal places and units (1) | **ECF for mp1** correct calculation in $cm^3$<br>Example of calculation:<br>$4.43 \div 0.0744 = 59.543$<br>$4.21 \div 0.0584 = 72.089$<br><br>$72.1 - 59.5 = 12.546$<br>**ECF mp2** subtraction ( from mp1) and correct number of d.p<br>Answer= 12.55 (b)pm<br><br>Correct answer with units – 3 marks | **Expert**<br><br>**(3)** |