GradeMax



# Mark Scheme (FINAL COPY)

## October 2020

Pearson Edexcel International Advanced Level
In Biology (WBI15/01)
Paper 1: Respiration, Internal Environment, Coordination and Gene Technology

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**General Marking Guidance**

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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

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

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

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(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) | ALLOW Krebs cycle if arrow points to correct location. Allow without arrow labelled | **Graduate**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(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/$NADH_2$ and reduced FAD/FADH/ $FADH_2$<br><br>ALLOW $H^+$ /Hydrogen ions<br><br>IGNORE ATPase<br><br>ALLOW Phosphorylating ADP<br>ALLOW correct equation | **Expert**<br><br>**(5)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(i) | A cortex | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(ii) | A W | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(iii) | C Y only | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(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**<br><br>**(2)** |

| | | | |
|---|---|---|---|
| | | ALLOW reference to podocytes /glomerular fenestrations | |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(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**<br><br>**(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(a)(i) | An answer between 8 and 18 (hours) (1) | | **Graduate**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(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) | <br><br>2.8 -1.5=1.3<br><br>1.3 ÷ 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<br>$h^{-1}$ / $H^{-1}$ for $hour^{-1}$ | **Expert**<br><br>**(2)** |

| Question number | Answer | Mark |
|---|---|---|
| 3(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 | |

| **Level** | **Marks** | **Descriptor** |
|---|---|---|
| | 0 | No awardable content. |
| 1 | 1-2 | Limited number of the most important or relevant scientific factors from the data/information provided are synthesised.<br>No judgement is made. |
| 2 | 3-4 | Some of the most important or relevant scientific factors from the data/information provided are synthesised.<br>A straightforward but accurate judgement is made. |
| 3 | 5-6 | Most of the important or relevant scientific factors from the data/information provided are synthesised.<br>A detailed and accurate judgement is made. |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(a) | A description that includes two of the following points:<br>• as intensity increases heart rate increases (1)<br>• smaller effect at {low intensity / high intensity} (1) | Positive correlation<br>ALLOW Stated comparative effect eg. Largest increase between 6-8 au | **Graduate**<br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(b) | An answer showing the following steps:<br>• calculation of heart rates (1)<br>• calculation of change in heart rate (1)<br>• correct number of decimal places and units (1) | **ECF for mp1** correct calculation in $cm^3$<br>Example of calculation:<br>4.43 ÷ 0.0744 = 59.543<br>4.21 ÷ 0.0584 = 72.089<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>Correct answer with units – 3 marks | **Expert**<br>**(3)** |

| Question number | Answer | Mark |
|---|---|---|
| 4(c) | 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>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>The first table shows<br>• as exercise intensity increases heart rate increases<br><br>The second table shows<br>• regular exercise increases stroke volume<br>• regular exercise has little effect on resting cardiac output<br>• meaning heart rate is slower<br><br>Own knowledge<br><br>• during exercise muscles use energy / ATP<br>• most of this energy is produced via aerobic respiration<br>• reference to increased carbon dioxide from increased cell respiration<br>• effect of increased carbon dioxide in blood eg. – pH sensors in carotid arch<br>• heart (and circulation) provides bulk transport of oxygen and {nutrients / glucose}<br>• increased demand requires increased blood circulation<br>• stroke volume and rate of beating determine volume of blood moved<br>• regular exercise increases stroke volume so greater capacity to respond by increasing heart rate | **Expert**<br><br>**(6)** |

| Level | Marks | Descriptor |
|---|---|---|
| | 0 | No awardable content. |
| 1 | 1-2 | An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information.<br><br>The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context. |
| 2 | 3-4 | An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows some linkages and lines of scientific reasoning with some structure. |
| 3 | 5-6 | An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured. |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a)(i) | A description that includes the following points:<br><br>• as light intensity increases pupil diameter decreases (1)<br><br>• LED lights cause a greater reduction in pupil diameter than incandescent light (1) | <br><br>ALLOW negative correlation<br><br>ALLOW explained using data from table | **Graduate**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a)(ii) | An answer showing the following steps:<br><br>• find the area of the pupil in ($mm^2$) (1)<br><br>• convert to $m^2$ (1)<br><br>• multiple the intensity by the area (1) | Example of calculation:<br><br>$A = \pi r^2 = 3.14 \times 8^2 = 201\ mm^2$<br><br>$A = 0.000201\ m^2$<br><br>Answer = 0.000201 x 1400 = 0.2814/0.28/0.281<br><br>ALLOW 28/281/2814 for 2mps<br><br>Correct answer 3 marks | **Expert**<br><br>**(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a)(iii) | A description that includes the following points:<br><br>• light is detected by {rods / cones} in the retina (1)<br><br>• reflex arc formed from {sensory neurones, relay neurones and motor neurones} (1)<br><br>• (transmit) impulses to muscles in the iris (1)<br><br>• radial muscles relax and circular muscles contract constricting the pupil (1) | <br><br>ALLOW effect on rhodopsin described.<br><br>ALLOW reflex pathway correctly described | **Expert**<br><br>**(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(b)(i) | An answer that includes the following points:<br><br>• {self-renewing/ continuously dividing} cell (1)<br><br>• that can give rise to {many / most} of the different cell types (1) | <br>IGNORE Hayflick limit<br>ALLOW cell that can undergo mitosis<br><br>IGNORE can give rise to all<br>ALLOW all cell types apart from extra embryonic tissue | **Expert**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(b)(ii) | An answer that includes the following points:<br><br>• stem cells could continue to divide (1)<br><br>• stem cells could differentiate into other cell types (1) | <br><br>ALLOW could form a tumor / a cancer | **Expert**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a)(i) | C Schwann cell | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a)(ii) | A faster at nodes of Ranvier | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(b) | An answer that includes four of the following points:<br><br>• active transport by sodium potassium (ion) pump (1)<br><br>• of sodium ions out of the axon and potassium ions into the axon (1)<br><br>• (passive) diffusion of potassium ions out of the axon (1)<br><br>• so that inside of the membrane is negatively charged (compared with outside) (1)<br><br>• so that the membrane voltage stays at the same value (1) | ALLOW passive diffusion described<br><br>ALLOW axon for membrane<br>ALLOW converse<br><br>ALLOW maintains potential difference | **Expert**<br><br>**(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(c) | An answer that includes three of the following points:<br><br>• binds to (voltage dependent) sodium ion channels (1)<br><br>• blocking the (rapid) diffusion of sodium ions into the axon (1)<br><br>• reducing depolarisation (of the membrane) (1)<br><br>• below the threshold to trigger an action potential (1) | ALLOW blocks / inhibits<br><br>IGNORE no depolarisation | **Expert**<br><br>**(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(a)(i) | B L-DOPA crosses the blood brain barrier and is then converted to dopamine in the brain | | **Computer**<br><br>**(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(a)(ii) | An answer that includes three of the following points:<br><br>• fewer dopamine molecules to bind to the {ligand gated sodium channels/receptors} (1)<br><br>• on the **post**-synaptic membrane (1)<br><br>• initiating fewer action potentials in (post-synaptic neurone) (1)<br><br>• fewer impulses sent to parts of brain controlling {motor function / muscles} (1) | ALLOW fewer impulses sent to muscles / effectors | **Expert**<br><br>**(3)** |
| | | | |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(b) | An answer that includes the following points:<br><br>• {reduced / stop} influx of calcium ions into pre-synaptic neurone (1)<br><br>• No fusion of (secretory) vesicles with the pre-synaptic membrane (1)<br><br>or<br><br>• changes to {pre-synaptic / vesicle} membrane proteins (1)<br><br>• prevents fusion of vesicles with the pre-synaptic membrane (1) | ALLOW fewer vesicles fuse with pre-synaptic membrane. | **Expert**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(c) | A description that includes the following points:<br><br>• microarrays allow identification of {active genes / gene transcription} (1)<br><br>• the activity of many genes can be analysed in a single sample (1)<br><br>• by collecting information about genetic differences from many individuals (with or without Parkinson's) (1)<br><br>• bioinformatics /computers/databases /algorithms used to analyse the data (1)<br><br>• (key) differences between healthy and Parkinson's disease individuals can be identified (1) | ALLOW Develop algorithms to identify genomes / gene sequences | **Expert**<br><br>**(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(a) | An explanation that includes the following points:<br><br>• {alternative versions / alleles} of a gene (1)<br><br>• due to changes in the base sequence of the DNA (1) | ALLOW sections of DNA<br><br>ALLOW differences in exons / introns of a gene<br>ALLOW change in nucleotide sequence of DNA | **Expert**<br><br>**(2)** |

| | | | |
|---|---|---|---|
| | | | |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(b) | An explanation that includes four of the following points:<br><br>• (more) mutations change the shape of (more) proteins (1)<br><br>• when these are membrane proteins (1)<br><br>• (more of these) proteins are recognised as antigens when presented on antigen presenting cells (1)<br><br>• triggering an immune response (1)<br><br>• that includes production of T killer cells (that will recognise and destroy more cancer cells) (1) | Accept non self proteins<br><br>ALLOW description of an immune response<br><br>ALLOW cytotoxic T cells<br>IGNORE lymphocytes | **Expert**<br><br>**(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(c) | An explanation that includes two of the following points:<br><br>• CT uses x-rays to produce a (low resolution) image (of soft tissue structures) (1)<br><br>• the tumor is a soft tissue/ has a different density (from other tissues) (1) | | **Expert**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(d) | An answer that includes two of the following points:<br><br>• cancer cells produce proteins that act as checkpoints (1)<br><br>• checkpoint inhibitors stop the checkpoint proteins from blocking immune cell activation (1)<br><br>• allowing the (tumor-infiltrating) lymphocytes to be activated to kill the tumor cells (1) | ALLOW checkpoint inhibitors allow activation of immune cells | **Expert**<br><br>**(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(e) | An explanation that includes the following points:<br><br>• the gene variant has an altered DNA base sequence (1)<br><br>• produces a {polypeptide/protein} with a different primary structure (1)<br><br>• enzyme produced will be folded differently (1)<br><br>• therefore the enzyme's active site will no longer fit clopidogrel (1) | ALLOW different 3D shape / arrangement/tertiary structure<br><br>ALLOW substrate if in context of clopidogrel<br>ALLOW fewer enzyme – substrate complexes formed | **Expert**<br><br>**(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(f) | An explanation that includes three of the following points:<br><br>• capillaries allow for mass transport (1)<br><br>• to overcome limitations of diffusion (1)<br><br>• ensure (sufficient) {nutrients / oxygen} delivered to spinal cord tissue / stem cells (1)<br><br>• named function of spinal cord tissue (1) | ALLOW correctly named nutrient in context<br><br>ALLOW spinal cord cells / tissues need to respire | **Expert**<br><br>**(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(g) | An answer that includes three of the following points:<br><br>• {growth factors / proteins} bind to receptors (on pluripotent stem cells) (1)<br><br>• activating transcription factors (1)<br><br>• causing the stem cell to proliferate/divide (1)<br><br>• and differentiate (to carry out a particular function) (1) | ALLOW proteins act as transcription factors | **Expert**<br><br>**(3)** |

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