Mark Scheme (Final)

Summer 2023

Pearson Edexcel International Advanced Subsidiary Level In Biology (WBI15)
Paper 01
Unit 5: 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)	• 91.34(%)	Accept 91 91.3 91.34	Graduate (1)

Question number	Answer	Additional guidance	Mark
1(b)(i)	Choose an item. • A is the correct answer B is not the correct answer as ADH does not cause the fight or flight response C is not the correct answer as thromboplastin does not cause the fight or flight response D is not the correct answer as uracil does not cause the fight or flight response		Computer (1)

Question number	Answer	Additional guidance	
1(b)(ii)	A description that includes the following points: • adrenaline stimulates {motor / sympathetic} neurones / impulses transmitted via {motor / sympathetic} neurones (1) • circular muscles relax (1) • radial muscles contract (1)	ignore messages and signals accept increased impulses as a result of adrenaline accept adrenaline binding to (receptors on) iris (muscle) cells	Expert (3)

Question number	Answer	Additional guidance	
2(a)(i)	Choose an item. • B is the correct answer A is not the correct answer as cytoplasm is not the site of the ETC C is not the correct answer as mitochondrial matrix is not the site of the ETC D is not the correct answer as outer mitochondrial membrane is not the site of the ETC		Computer (1)

Question number	Answer	Additional guidance	
2(a)(ii)	Choose an item. • D is the correct answer A is not the correct answer as a carbohydrate is not an enzyme in the production of ATP B is not the correct answer as a lipid is not an enzyme in the production of ATP C is not the correct answer as a phospholipid is not an enzyme in the production of ATP		Computer (1)

Question number	Answer	Additional guidance	
2(a)(iii)	A description that includes the following points: • {transports /carries / provides} {hydrogen (atoms) / electrons / hydrogen ions} (to ETC / inside mitochondria) (1) • (hydrogen ions / electrons) result in {release of energy / ATP production} (in ETC) (1)	accept protons for hydrogen ions accept for chemiosmosis to occur / to produce protons to be pumped to intermembrane space / for oxidative phosphorylation to occur / description of chemiosmosis ignore production of energy	Expert (2)

Question number	Answer	Additional guidance	Mark
2(b)(i)	An answer that includes the following points: • less ATP produced (1) • (because) haemoglobin cannot transport (as much) oxygen / {prevents / reduces} oxygen binding to haemoglobin (1) • (therefore) so cells have {no / less} final electron acceptor (1)	may give numbers 2:36 accept binds to haemoglobin instead of oxygen accept haemoglobin has a higher affinity for CO than oxygen accept aerobic respiration can't occur / less aerobic respiration do not accept anaerobic respiration on its own − it needs linking to ATP accept (more) anaerobic respiration occurs which produces fewer ATP molecules (per glucose) for 2 marks	Expert (3)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An explanation that includes the following points: • anaerobic respiration involves (just) glycolysis / ATP produced during glycolysis (1) • anaerobic respiration occurs in cytoplasm / anaerobic respiration doesn't involve the {mitochondria/ETC}	accept substrate level phosphorylation for glycolysis accept ATP is produced when glucose is converted to pyruvate	Expert (2)

Question number	Answer	Additional guidance	Mark
3(a)	An answer that includes two of the following points: • TB • Cystic Fibrosis • Asthma • COPD • Lung cancer • emphysema • bronchitis	examiners to check other alternatives Covid long covid pneumonia pulmonary fibrosis accept any named respiratory disease	Expert (2)

<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>3(b)(i)</td><td>An answer that includes three of the following points:

• as body mass increases the (mean resting) ventilation rate decreases / inverse relationship / negative correlation (1)

• comment on the small number of {animals / species/ sample size} (1)

• correlation doesn’t imply causation / other aspects affect resting ventilation rate (1)

• appropriate comment on standard deviations (1)</td><td>accept converse

accept significant (difference) between xxx and xx because SDs do not overlap
not a significant (difference) between xxx and xxx because SDs do overlap
SD values are small which indicates higher {validity/reliability}

don’t accept {overlapping / not overlapping} SDs
are (not significant / significant) unqualified
ignore not-overlapping /overlapping unqualified?

<table><tr><td>talapoin</td><td>0.45</td><td>0.54</td><td>0.63</td></tr><tr><td>lemur</td><td>0.49</td><td>0.53</td><td>0.57</td></tr><tr><td>porcupine</td><td>0.27</td><td>0.30</td><td>0.33</td></tr><tr><td>tiger</td><td>0.21</td><td>0.27</td><td>0.33</td></tr><tr><td>hippo</td><td>0.09</td><td>0.12</td><td>0.15</td></tr></table></td><td>Expert
(3)</td></tr>
</table>

Question number	Answer	Additional guidance	Mark
3(b)(ii)	A calculation showing the following steps: • calculation of number of breaths per minute (1) • calculation of tidal volume in dm^3 and answer given to 2 significant figures (1)	 (0.54 x 60) = 32.4 (32.4 x 0.04) = 1.3 dm^3 include the other way round e.g. 0.54x0.04 = 21.6 (21.6 x 60) = 1.3 dm^3 correct answer scores full marks 1.30 = 1 mark only 12960/1296/ 1.296 / 32.4 / 21.6 / (0.54 x 60) / (0.54x0.04)/ (0.54 x 40/1000) somewhere = 1 mark no ecf	Graduate (2)

Question number	Answer	Additional guidance	Mark
3(c)	A description that includes four of the following points: • (because) increase {activity/ aerobic respiration} leads to an {increase in carbon dioxide /decrease in pH}(1) • which is detected by chemoreceptors (1) • (which causes transmission of) impulses to the {respiratory centre / medulla (oblongata)} (1) • which (increases) impulses (via SNS) to increase contraction of {breathing / intercostal / diaphragm} muscles (1) • increase in ventilation rate (1)	do not accept signals or messages for impulses accept impulses to ventilation centre accept impulses (via SNS) for further contraction of {breathing / intercostal / diaphragm} muscles accept increase breathing rate	Expert (4)

Question number	Answer	Additional guidance	Mark
4(a)	Choose an item. • B is the correct answer A is not the correct answer as only one statement is correct C is not the correct answer as only one statement is correct D is not the correct answer as only one statement is correct		Computer (1)

Question number	Answer	Additional guidance	Mark
4(b)(i)	Choose an item. • B is the correct answer A is not the correct answer as P to T is not one sarcomere C is not the correct answer as Q to T is not one sarcomere D is not the correct answer as R to S is not one sarcomere		Computer (1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	A calculation showing the following steps: • calculation of magnification (1) • answer given in standard form (1)	 = 15500 (accept 15000-16000) = 1.55 x 10^4 accept 1.5x 10^4 - 1.6 x 10^4 factor of 10 error 1 mark if not in standard form 15000-16000 gains 1 mark	Graduate (2)

Question number	Answer	Additional guidance	Mark
4(b)(iii)	A description that includes four of the following points: • fast twitch have fewer {capillaries / blood vessels} (1) • fast twitch have fewer mitochondria (1) • fast twitch have less myoglobin (1) • fast twitch are {larger in diameter/ longer / have more sarcoplasmic reticulum} (1) • have more {glycogen / creatine phosphate} (1)	ALLOW converse ignore less blood supply as not structural	Expert (4)

Question number	Answer	Additional guidance	Mark
4(c)	An explanation that includes the following points: • increase in velocity of contraction decreases the force of contraction (1) • (cross bridges) are formed when myosin (head) binds to {actin / myosin binding site (on actin)} / (cross bridge) are broken when ATP binds to the myosin (head) (1) • therefore reducing the total number of cross bridges (at any one time) (1)	accept slower muscle contractions have more force / converse accept inversely proportional / negative correlation accept description of a cross bridge forming accept there are more cross bridges formed in slow contraction / there are fewer cross bridges formed in fast contractions accept converse	Expert (3)

Question number	Answer	Additional guidance	Mark
5(a)(i)	Choose an item. • B is the correct answer A is not the correct answer as glucose and prothrombin are not filtered from the blood in the renal capsule C is not the correct answer as glycogen and urea are not filtered from the blood in the renal capsule D is not the correct answer as urea and prothrombin are not filtered from the blood in the renal capsule		Computer (1)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Choose an item. • A is the correct answer B is not the correct answer as the endothelial cells do not prevent plasma proteins being filtered from the blood stream C is not the correct answer as the epithelial cells do not prevent plasma proteins being filtered from the blood stream D is not the correct answer as epithelial cells of the loop of Henlé do not prevent plasma proteins being filtered from the blood stream		Computer (1)

Question number	Answer	Additional guidance	Mark
5(a)(iii)	Choose an item: • D is the correct answer A is not the correct answer as endocytosis is not the glucose transport mechanism B is not the correct answer as exocytosis is not the glucose transport mechanism C is not the correct answer as osmosis is not the glucose transport mechanism		Computer (1)

Question number	Answer	Additional guidance	Mark
5(b)	A description that includes four of the following points: • {fluid / filtrate} (in the two limbs of the loop of Henle) moves in opposite directions (1) • (sodium / potassium / chloride) ions move out of ascending limb (into surrounding fluid) (1) • (ions move) by active transport (1) • (resulting in) increase in {(ion) concentration / decrease in water potential} (of surrounding fluid) (1) • (therefore) water leaves {the descending limb / by osmosis / through aquaporins} (1)	accept symbols for ions eg Na^+ do not accept sodium accept idea of active transport – / actively pumped / pumped / moved actively can get this even if the ions were pumped in wrong direction accept (surrounding) fluid becomes hypertonic accept a (water / ion / solute) concentration gradient formed accept there is a greater (solute) concentration outside the base of the descending limb accept diffusion of water accept (because) the descending limb is permeable to water accept the ascending limb is impermeable to water	Expert (4)

Question number	Answer	Additional guidance	Mark
5(c)(i)	A calculation showing the following steps: • correct readings from the graph for the three sets of females put into a ratio (1) • calculation of ratio to 1 significant figure (1)	100:840:440 in working = 1 mark 1:8:4 = 2 marks 1:8.4:4.4 = 1 mark	Graduate (2)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	A description that includes the following points: • {drinking leads to higher urine production / not drinking leads to least urine production} (1) • {urine production is higher in females when they have had a drink / the increase in females is greater than in males}(1)	either water or salt solution or just drinking applies to both males and females or neither NOT just one of them ignore females produce more urine than males (unqualified) accept converse for males accept group letters B and C for drinking	Expert (2)

Question number	Answer	Additional guidance	Mark
5(c)(iii)	An explanation that includes two of the following points: • increased water {potential / concentration} (of blood) (1) • ADH not released / less ADH released (1) • decreased permeability of walls of {distal convoluted tubule / collecting duct} to water (1) • less reabsorption of water (into blood) (1)	ALLOW reference to detected by osmoreceptors allow increased water in blood ignore loop of Henle	Expert (2)

Question number	Answer	Additional guidance	Mark
6(a)	An explanation that includes three of the following points: • ions are {charged / polar / hydrophilic} and cannot (diffuse / pass / travel) through {phospholipid bilayer / hydrophobic membranes / non-polar membranes} (1) • (therefore cross the cell membrane) using {channel / carrier} proteins (1) • by {facilitated diffusion / active transport} (1) • correct reference to concentration gradient (1)	 allow voltage-gated channels / sodium potassium pump ignore simple diffusion accept actively {pumped /moved} e.g. ions are pumped against the concentration gradient (in active transport)	Expert (3)

Question Number	Answer	
*6(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. 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. (If in doubt about role PLEASE CHECK)	
1	• consideration of concentration or distribution of one ion using the graph /data	
2	• consideration of concentration or distribution of two or more ions using the graph / data	
3,	• consideration of role of Na^+ in the human body (linked to comment about relative concentration) • role in muscle contraction /role in nerve impulse /role in water balance as an electrolyte accept any correct stated role for Na^+	
4	• consideration of role of K^+ in the human body (linked to comment about relative concentration) • role in nerve impulse / role in muscle contraction / role in active transport / role in protein synthesis / role in activation of some enzymes accept any correct stated role for K^+	
5	• consideration of role of Cl^- in the human body (linked to comment about relative concentration) • role in body fluid balance / osmotic regulation / role in chloride shift / role in production of HCl in stomach / role in neuronal hyperpolarisation /role in activation of enzymes / role in resting potential maintenance in neurones accept any correct stated role for Cl^-	
6	• consideration of role of $HCO3^-$ in the human body (linked to comment about relative concentration) • role in pH buffering / role in carbon dioxide transport in blood accept any correct stated role for $HCO3^-$	
		(6)

			Additional guidance
Level 0	0	No awardable content	
Level 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. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	limited consideration of two or of the following using data from the graph. eg. Na^+ higher in tissue fluid and blood plasma than cytoplasm (with comparative figures) Na^+ lower in cytoplasm than K^+ Na^+_ higher in tissue fluid and blood plasma than K^+ -
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	limited consideration of roles of two ions in the human body. If only one ion max 3
Level 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. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	detailed science behind role of two ions in the human body If only one ion max 5

Question number	Answer	Additional guidance	Mark
7(a)	Choose an item: B is the correct • A is not the correct answer as only one statement is correct. • C is not the correct answer as only one statement is correct. • D is not the correct answer as only one statement is correct.		Computer (1)

Question number	Answer	Additional guidance	Mark
7(b)	A description that includes four of the following points: • reference to activation of (different) genes by {chemicals / hormones / transcription factor} (in specific areas of the nervous system) (1) • transcription of (three) genes to produce pre-mRNA (1) • post transcriptional (mRNA) modification (to produce 14 types of mRNA (1) • causing translation (to produce receptors that bind serotonin) (1) • with different amino acid sequences (outside the receptor) (1)	accept ref to differential gene expression accept rearrangement of exons /alternative splicing / removal of some exons accept RNA splicing / mRNA isoforms produced accept different primary structure /polypeptide chain /tertiary structure	Expert (4)

Question number	Answer	Additional guidance	Mark
7(c)(i)	An answer that includes: • as the dose of MDMA increases the serotonin level increases (1) • calculation using data from graph (1)	ALLOW positive correlation accept as and with if they start with serotonin levels LOBF actual 0 – 5 mdma = 25 +/- 5 70 +/- 5 0 -10 mdma = 70 +/-5 65 +/- 5 0 –15 = mdma =105 +/-5 125 +/- 5 5 – 10 mdma = 45 +/-5 -5 +/- 5 5 – 15 mdma = 80 +/-5 55 +/- 5 10 – 15 mdma = 35+/-5 60 +/- 5	Expert (2)

Question number	Answer	Additional guidance	Mark
7(c)(ii)	A calculation showing the following steps: • correct extrapolation from graph (1) • correct conversion to g cm^{-3} (1)	400 ±4 0.4 (g cm^{-3}) accept 0.396 – 0.404 (g cm^{-3}) units are not needed	Graduate (2)

Question number	Answer	Additional guidance	Mark
7(c)(iii)	An answer that includes three of the following points: • (digested) MDMA absorbed into blood (in mouth / gut/ intestinal tract) (1) • {carried in blood to brain /crosses blood brain barrier} (1) • (MDMA) binds to {neurones / receptors / proteins} • {stimulating the release of / increasing} serotonin (in CSF or brain) (1)		Expert (3)

Question number	Answer	Additional guidance	Mark
8(a)	An answer that includes three of the following points: • {complex polysaccharides /they} cannot be digested by human (enzymes) (1) • microorganisms release enzymes that {digest / ferment} (the complex polysaccharides) (1) • release {molecules / glucose/ monosaccharide} (that can be absorbed into the blood and) used in {respiration / metabolism} (1)	accept cellulose/hemicellulose/ pectin/ ignore starch / glycogen accept hydrolysis of glycosidic bond accept named enzyme that digests CHOs eg amylase, cellulase accept {molecules / glucose} are source of energy do not accept produce energy mp3 either for microbes or human	Expert (3)

Question number	Answer	Additional guidance	Mark
8(b)	A description that includes four of the following points: • role of {chemo / baro / thermo} receptors (in the blood) (1) • impulses (from receptors) to {cardiovascular control centre / medulla (oblongata)} (1) • (medulla / brain) sends impulses (to heart / SAN) {via PNS / vagus} (1) • (slowing / reducing) the rate of depolarisation of the SAN (1)	do not accept signal / message unless talking about receptors do not get mps 1 and 2 chemo receptors − increase in CO_2 / decrease in pH baro receptors − blood pressure thermoreceptors − core temperature accept CVC accept reducing rate of contraction	Expert (4)

Question number	Answer	Additional guidance	Mark
8(c)	An answer that includes three of the following points: • (microorganism/T helper cells) release {chemicals/ metabolites} (1) • activating T killer cells (1) • stimulating {clonal expansion/ proliferation} (of T cells) (1) • T killer cells release (chemicals / perforins) which destroy the (tumour) cells (1)	accept cytokines accept cytotoxic T cells accept stimulates mitosis (of T cells)	Expert (3)

Question number	Answer	Additional guidance	Mark
8(d)	A description that includes the following points: • use of fMRI scan {whilst /after} being fed probiotics (1) • to compare (activity) (in regions of the brain controlling memory and sensation) (1)	answers may be in terms of two groups or the same individual accept (named) food containing probiotics description of how active areas can be shown by fMRI scan e.g. active areas will be {lighter / white} accept description of compare	Expert (2)

Question number	Answer	Additional guidance	Mark
8(e)	An answer that includes three of the following points: • (different diet) changes in the gut {flora /bacteria/microbes} (1) • change in the chemicals released (in the gut) (1) • chemicals carried in the blood and passes to the brain through the blood brain barrier (1) • {stimulating / damaging} neurones to release (different) neurotransmitters (1)	 accept {stimulation / transmitted} via vagus nerve to brain accept synthesis and availability of {neurotransmitter / serotonin}	Expert (3)

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that includes the following points: • loss of nodes of Ranvier / loss of myelin (1) • slowing the rate of conduction of nerve impulses (1)	 accept loss of insulating layer (around neurones) accept loss of Schwann cells accept nerve impulses travel slower accept reduced saltatory conduction accept description of reduced saltatory conduction accept fewer impulses transmitted	Expert (2)

Question number	Answer	Additional guidance	Mark
8(g)	A description that includes three of the following points: • extract (mRNA/LPS receptor gene) from white blood cells (1) • reference to use of (specific) microarray/ DNA probe (1) • collection of data from the microarray analysis (1) • reference to use of bioinformatics to analyse the data (1)	go down both routes and take highest score. Use of cDNA use of PCR gel electrophoresis use of fluorescent {dyes/tags} /DNA probes/ Western blotting / radiolabelled blotting	Expert (3)

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