



Mark Scheme (Results)

October 2022

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

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Question number	Answer	Additional guidance	Mark
1 (a)(i)	<p>C is the correct answer</p> <ul style="list-style-type: none"> • A is not correct as three of the statements are correct • B is not correct as three of the statements are correct • D is not correct as three of the statements are correct 		Computer (1)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	<p>D is the correct answer</p> <ul style="list-style-type: none"> • A is incorrect as blood does not become less acidic • B is incorrect as muscles do not become less fatigued • C is incorrect as pH of blood does not increase 		Computer (1)

Question number	Answer	Additional guidance	Mark
1(b)	<p>A description that includes two of the following points:</p> <ul style="list-style-type: none"> • accept explanation of how proton gradient set up (1) • {protons / hydrogen ions} move through {membrane protein/ protein channel /ATP synthase/ ATPase} (1) • {conversion of ADP + Pi to ATP / phosphorylation of ADP} (1) 	<p>can piece together reference to movement of electrons along electron carriers releasing energy to {pump protons into intermembrane space / create electrochemical gradient}</p> <p>accept protons move down electrochemical gradient</p> <p>accept ADP + Pi -> ATP</p>	<p>Expert</p> <p>(2)</p>

Question number	Answer	Additional guidance	Mark
1(c)	<p>D is the correct answer</p> <ul style="list-style-type: none"> • A is not the correct answer as ATP is not the first molecule to contain the radioactive oxygen • B is not the correct answer as carbon dioxide is not the first molecule to contain the radioactive oxygen • C is not the correct answer as reduced NAD is not the first molecule to contain the radioactive oxygen 		<p>Computer</p> <p>(1)</p>

Question number	Answer	Additional guidance	Mark
2(a)(i)	<p>B is the correct answer</p> <ul style="list-style-type: none"> • A is not the correct answer as actin does not join bone to bone • C is not the correct answer as muscle does not join bone to bone • D is not the correct answer as tendon does not join bone to bone 		Computer (1)

Question number	Answer	Mark
2(a)(ii)	<p>D is the correct answer</p> <ul style="list-style-type: none"> • A is not the correct answer as actin does not join muscle to bone • B is not the correct answer as ligament does not join muscle to bone • C is not the correct answer as myosin does not join muscle to bone 	Computer (1)

Question number	Answer	Mark
2(a)(iii)	<p>D is the correct answer</p> <ul style="list-style-type: none"> • A is not the correct answer as actin and myosin are not made of carbohydrates • B is not the correct answer as actin and myosin are not made of fatty acids • C is not the correct answer as actin and myosin are not made of nucleic acids 	Computer (1)

Question number	Answer	Additional guidance	Mark
2(b)(i)	<p>An explanation that includes two of the following points:</p> <ul style="list-style-type: none"> • muscles are in antagonistic pairs / have extensor and flexor muscles (1) • the muscles contract (with equal strength) (1) • ligaments hold the joint in place (1) 	<p>muscles if named - rectus femoris and gastrocnemius / fibialis accept muscles work antagonistically</p> <p>ignore one contracts and the other relaxes</p> <p>accept ligaments hold the bones in place</p>	Expert (2)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	<p>A description that includes three of the following points:</p> <ul style="list-style-type: none"> • ATP binds to the myosin head (1) • {releasing the myosin head from the actin strand/breaking the cross-bridge} (1) • ATP is hydrolysed (1) • (providing energy) to change the myosin head {shape / position}(1) • allowing myosin to bind to actin / form actin-myosin cross bridge (1) 	<p>steps need to be in logical order to gain credit</p> <p>ACCEPT ATP broken down into ADP and Pi</p> <p>Do not accept the power stroke</p>	Expert (3)

Question number	Answer	Additional guidance	Mark										
3(a)(i)	An answer that includes the following points	all correct 2 marks 1 or 2 or 3 correct 1 mark 0 correct 0 marks accept dendrite / dendron accept axon terminal do not accept synapse(s)	Graduate (2)										
	<table border="1"> <thead> <tr> <th>Label</th> <th>Part</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>dendrites</td> </tr> <tr> <td>M</td> <td>cell body / centron</td> </tr> <tr> <td>N</td> <td>axon</td> </tr> <tr> <td>O</td> <td>(pre)synaptic {endings /knob/bulb}</td> </tr> </tbody> </table>			Label	Part	L	dendrites	M	cell body / centron	N	axon	O	(pre)synaptic {endings /knob/bulb}
	Label			Part									
	L			dendrites									
	M			cell body / centron									
N	axon												
O	(pre)synaptic {endings /knob/bulb}												

Question number	Answer	Additional guidance	Mark
3(a)(ii)	D is the correct answer <ul style="list-style-type: none"> • A in not correct because lidocaine inhibits sodium ion channels • B in not correct because lidocaine inhibiting sodium ion channels • C in not correct because lidocaine inhibiting sodium ion channels 		Computer (1)

Question number	Answer	Additional guidance	Mark
3(b)(i)	<ul style="list-style-type: none"> (scanning) electron (microscope) /sem / em (1) 	Do not accept electric / electrical /electronic Do not accept transmission electron microscope / tem Do not accept microgram	Graduate (1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	A calculation showing the following steps <ul style="list-style-type: none"> correct measurement of X-Y in μm (1) calculation of thickness of connecting tissue (1) <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> calculation of thickness (1) conversion to μm (1) 	11 000 μm $(11\ 000 \div 3300) = 3.3 / 3.33 / 3.333 / 3\ \mu\text{m}$ 1 mark for power of 10 errors e.g. 0.33 or 0.0033 or 333 $(11 \div 3300) = 0.00333$ $(1.1 \div 3300) = 0.0333$ $(0.00333) \times 1000 = 3.3 / 3.33 / 3.333 / 3\ \mu\text{m}$ 1 mark for power of 10 errors e.g. 0.33 or 0.0033 or 333 No ECF	Expert (2)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	<p>An explanation that includes three of the following points</p> <ul style="list-style-type: none"> • myelin (sheath) acts as an insulator (1) • gaps (in myelin sheath) are called nodes of Ranvier /nodes of Ranvier have higher number of (voltage gated) sodium channels (1) • {action potentials/depolarization} can only occur at nodes on Ranvier (in myelinated neurones)(1) • (therefore) impulse jumps from one node of Ranvier to the next(1) 	<p>accept {action potentials / depolarization}occur along the whole unmyelinated neurone mp4 accept converse accept reference to saltatory conduction</p>	<p>Expert (3)</p>

Question number	Answer	Additional guidance	Mark
4(a)(i)	<p>A description that includes the following points:</p> <ul style="list-style-type: none"> • general trend the higher the (resting) heart rate the lower the life expectancy/ no clear relationship between the (resting) heart rate the life expectancy (1) • the higher the (resting) heart rate the lower the (mean) mass (1) • the higher the (resting) heart rate the lower the (mean resting) metabolic rate (1) 	<p>Statements can be either way round accept negative correlation accept converse accept converse</p>	<p>Expert (2)</p>

}

Question number	Answer	Additional guidance	Mark
4(a)(ii)	<p>A calculation with the following steps</p> <ul style="list-style-type: none"> • calculation of oxygen used per kilogram(1) • calculation of oxygen used for 4500kg elephant(1) • correct answer in standard form (1) 	<p>(1400 ÷ 5780) = 0.24 (4500 × 0.24) = 1080 1.09 × 10³ / 1.0896 × 10³ ignoring any units</p> <p>ECF for mps 2 and 3 alternate method working out: 1 mark for 1400 × 4500 = 6 300 000 for 2 marks (4500 × 1400) ÷ 5780 = 1089.96</p>	<p>Expert</p> <p>(3)</p>

1 mark	2 marks	3 marks
(1400 ÷ 5780) = 0.24	(4500 × 0.24) = 1080	1.09 × 10 ³
1400 × 4500 = 6 300 000	(4500 × 1400) ÷ 5780 = 1089.96 or 1089.97 or 1090	1.0896 × 10 ³
	6.3 × 10 ⁶ (1+3ECF)	1.08 × 10 ³
	2.4 × 10 ⁻¹ (1+3ECF)	1.1 × 10 ³
Mp1 incorrect but correct conversion to standard form		
	MP1 correct ÷ wrong denominator with correct standard form(1+3ECF)	

Question number	Answer	Additional guidance	Mark
4(b)(i)	<p>An explanation that includes the following points:</p> <ul style="list-style-type: none"> • chemoreceptors detect {lower pH of blood / increased blood CO₂ concentration}/ baroreceptors detect change in blood pressure (1) • (electrical) {impulses sent to medulla (oblongata)/cardiovascular control centre (CVC)} / chemoreceptors are located in medulla oblongata (1) • impulses travel {from the medulla oblongata / via sympathetic nervous system} to the SAN /more impulses sent to {AVN/ bundle of His / Purkyne fibres} (1) • (causing SAN) to increase frequency of depolarisation causing an increase in {heart rate / systole} (1) 	<p>Do not accept reference to signals / messages</p> <p>increased adrenaline production</p> <p>adrenaline which circulates in the blood</p> <p>mp3 adrenaline binds to receptors in {heart muscle / SAN}</p> <p>mp4 (causing SAN) to increase frequency of depolarisation causing an increase in {heart rate / systole}</p> <p>chemoreceptors in medulla oblongata detect increase in blood CO₂ = 2 marks</p>	<p>Expert</p> <p>(4)</p>

Question number	Answer	Additional guidance	Mark
4(b)(ii)	<p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> fast twitch muscles fatigue quickly / are for short distance (sprinting) / cheetah cannot get oxygen fast enough for aerobic respiration (1) (cells / muscles) respire by anaerobic respiration (1) (therefore) build up of {lactic acid / oxygen debt} (from anaerobic respiration) (1) 	<p>the sprint requires large amounts of ATP (for muscle contraction)</p> <p>accept lactate accept release of heat so body temperature goes up rapidly / homeostatic mechanisms cannot occur quick enough</p>	<p>Expert</p> <p>(2)</p>

Question number	Answer	Additional guidance	Mark
5(a)	<p>C is the correct answer</p> <ul style="list-style-type: none"> a high glomerular filtration does not enable the camel to reduce water loss a slow release of ADH does not enable the camel to reduce water loss 		<p>Computer</p> <p>(1)</p>

Question number	Answer	Additional guidance	Mark
5(b)(i)	<p>A calculation with the following steps</p> <ul style="list-style-type: none"> • calculation of water use each day for camel and buffalo (1) • correct difference in dm³ to two significant figures(1) 	<p>(57 x 850) = 48450 cm³ (150 x 697)= 104550 cm³ (104550 - 48450) ÷ 1000 = 56 (dm³) 56.1= 1 mark Power of 10 error 1 mark eg 561 150-57=93 and then dividing by 1000 to get 0.093 = 1 mark</p>	<p>Graduate (2)</p>

Question number	Answer	Additional guidance	Mark
5(b)(ii)	<p>An answer that includes the following points:</p> <ul style="list-style-type: none"> • credit one adaptation / environmental condition (1) • credit second adaptation / environmental condition (1) 	<p>accept different habitat accept different environmental condition</p>	<p>Expert (2)</p>

Question number	Answer	Additional guidance	Mark
5(c)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> • (overall) both fresh water and sea water increased (mean) mass (of kangaroo rats) (1) • fresh water increased (mean) mass (of kangaroo rats) more than sea water • credit any calculated change in mass over days/ or daily change (1) 	<p>can piece together from separate descriptions of data</p> <p>accept fresh water caused the highest increase in (mean) mass</p> <p>e.g. 6 g difference between fresh and no water / 0.5 g difference between fresh and salt water / decrease of {0.2/0.6/1.8} g after 2 days / increase of {0.5 / 1} g after 16 days</p> <p>Fresh 0.83% and sea 0.42% daily</p>	<p>Expert</p> <p>(3)</p>

Question number	Answer	Additional guidance	Mark
5(d)	<p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> • (nephron has) long(er) loop of Henle (1) • higher concentration of ions in the medulla (1) • (kidneys/tubule/ DCT and collecting duct/ loop of Henle) reabsorb {large quantities of / more} water (1) 	<p>accept reference to counter current multiplier</p> <p>accept ADH results in increased absorption of water</p> <p>accept increased permeability to water in DCT and collecting duct</p> <p>accept ADH causes insertion of {water channels / aquaporins} in DCT and collecting duct</p>	<p>Expert</p> <p>(2)</p>

Question number	Answer	Additional guidance	Mark
6(a)	<p>A is the correct answer</p> <ul style="list-style-type: none">• B is not the correct answer as Pr does not break down in the dark• C is not the correct answer as Pr does not absorb far red light• D is not the correct answer as Pr does not absorb far red light nor break down in the dark		Computer (1)

Question number	Answer	Additional guidance	Mark
6(b)	<p>An explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • auxin accumulates on shaded side (of the tip/stem/shoot/plant) (1) • {stimulating/causing} cell elongation (1) • detail of mechanism of action of auxin (1) • causing the plant to grow towards {light / sun} (1) 	<p>accept accumulates on the left of diagram accept auxins move away from the exposed light</p> <p>e.g. auxins stimulate the transport of Hydrogen ions into the cell wall or decrease pH activating {cell wall proteins / enzymes / chemicals / expansins} / {altering the hydrogen bonding within / decreasing strength of} the cell wall allowing elongation when water taken in / ref to activation of transcription factors</p> <p>accept causing positive phototropism do not accept bend towards light</p>	Expert (3)

Question number	Answer	Additional guidance	Mark
6(c)	<p>An explanation that includes four of the following points:</p> <ul style="list-style-type: none"> • (gibberellin) binds to receptor / carrier molecule in the cell / acts as a transcription factor(1) • (amylase) {transcription factor/gene is activated} (1) • allowing {(amylase gene) transcription / production of (amylase) mRNA / translation mRNA / production of amylase} (1) • amylase (hydrolyses/ converts) starch into {maltose / glucose} (1) 	<p>ignore amylose</p> <p>transcription factor binding to promotor region of gene cause the inactivation of (amylase) gene {inhibitor protein/repressor molecule}</p> <p>ignore monomers</p> <p>activates gene that produces amylase = mps 2 and 3</p>	<p>Expert</p> <p>(4)</p>

Question number	Answer	Additional guidance	Mark
6(d)	<p>An answer that includes four of the following points:</p> <ul style="list-style-type: none"> • both natural and synthetic auxin cause an increase (in cell number) (1) • {natural auxin/ IAA} greater effect on growth than {synthetic auxin / NAA} (1) • IAA at 0.1 ($\mu\text{mol dm}^{-3}$) was the most effective at increasing {growth / cell number} (1) • 1 ($\mu\text{mol dm}^{-3}$) was the most effective NAA concentration at increasing {growth / cell number} (1) • IAA is {better / more effective / has more cells} at lower concentrations(1) 	<p>can piece together both natural and synthetic auxin are better than the control at all concentrations</p> <p>IAA gives a greater increase in number of cells than NAA</p> <p>Accept most cell number</p> <p>Accept most cell number</p> <p>Accept higher concentrations of auxin(IAA) {had lower increase in growth / had lower increase in number of cells}</p> <p>Accept converse</p> <p>Accept negative correlation</p>	Expert (4)

Question number	Answer	Additional guidance	Mark
7(a)(i)	<p>A description that includes four of the following points:</p> <ul style="list-style-type: none"> • {identify/isolate/ cut out} the (<u>human</u>) rHE gene (1) • Cut {DNA sequence / gene} using restriction {endonuclease / enzyme} (1) • insert the gene into a vector (1) • inserting vector into suitable target (<u>sheep</u>) {cell / tissue} (1) 	<p>gene coding for rHE is isolated using restriction enzymes = 2 marks</p> <p>accept named vector e.g. plasmid, virus ignore bacteria</p> <p>e.g. udder cells / milk (protein) producing cells / fertilized sheep egg cell / embryo / zygote</p>	<p>Expert</p> <p>(4)</p>

Question number	Answer	Additional guidance	Mark
7(a)(ii)	<ul style="list-style-type: none"> • 77.5 (%) 	accept 77 or 78	Graduate (1)

Question number	Answer	Additional guidance	Mark
7(a)(iii)	<p>A description that includes four of the following points:</p> <ul style="list-style-type: none"> • rHE acts as an antigen (1) • {(phagocyte /macrophage / APC} presents antigen to (B/T) lymphocyte (1) • T helper cells activate the B cells (1) • differentiate into plasma cells (1) • plasma cells {release/ produce} (anti-rHE) antibodies (1) 	<p>accept antigen recognized as foreign</p> <p>accept B cells present antigen to themselves.</p> <p>accept T helper cells cause the production / formation of B effector cells and B memory cells</p>	Expert (4)

Question number	Answer Additional guidance	Mark
7(b)	<p>An answer that includes the following points: Indicative content - description from graphs and experimental data</p> <ul style="list-style-type: none"> • (many) crops have been engineered to provide resistance to pests or herbicides eg. soybean, corn • soybean will not be killed by (glycophosphate) herbicides • corn will not be eaten by the core borer • ----- • herbicide tolerant soybean went from 7% of planted area in 1996 to 95% in 2017 • insect resistant corn went from 6% in 1996 to 88% in 2017 • increase in planting of both GM soybean and GM corn • more GM soybean planted (than GM corn) • general increase in production of genetically modified crops <p>-----</p> <p>explanation of benefits</p> <ul style="list-style-type: none"> • higher yields / less damage by pests • more appealing colour / useful feature • GE foods having longer shelf life • more predictable food supplies for ever growing population • ----- • improved nutritional content • ‘medication’ provided through GE foods • can help prevent {malnutrition / disease} • ----- • (reduced use / cost) of herbicides and pesticides • withstand environmental conditions • ----- <p>discussion of risks</p> <ul style="list-style-type: none"> • increasing demand agricultural resources and land • reducing land available to grow other crops • ----- • increasing monoculture • ----- • declining biodiversity / stated effect on (stated local ecosystem) • ----- • unknown consequences of foreign gene expression / long term effect unknown • horizontal gene transfer to other organisms and species eg antibiotic resistance, weeds becoming herbicide 	Expert (6)

resistant

To go in published MS

Level 1:

1 mark - table or graph commented on

2 marks - both graph and table commented on

Level 2:

all level 1 plus:

basic discussion of both benefits and risks (only 1 section)

OR detailed discussion of EITHER benefits OR risks

Level 3:

all level 2 plus:

detailed discussion of BOTH benefits AND risks

selective and concise and logical

Question number	Answer	Additional guidance	Mark
8(a)	<p>An explanation that includes four of the following points:</p> <ul style="list-style-type: none"> • rhodopsin (in rod cells) absorb light and {splits into retinal and opsin / becomes bleached}(1) • cis-retinal converted to trans-retinal(1) • sodium ion channels (in surface membrane) close (1) • {rod cell / membrane} becomes hyperpolarised (1) • no glutamate transmitter {released/produced} (into synaptic cleft) (1) 	<p>accept rhodopsin absorbs light and forms opsin /light hits rhodopsin and bleaches it</p> <p>accept membrane permeability to sodium ions decreases</p> <p>do not accept (opsin) blocks Na⁺ channel</p>	<p>Expert</p> <p>(4)</p>

Question number	Answer	Additional guidance	Mark
8(b)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> • extraction of mRNA (1) • use of (specific) microarray (1) • use of fluorescent {dyes /marker/ probe}(1) • (comparing stimulated and un-stimulated neurones) {use of bioinformatics/ algorithms to analyse data} (1) <p>OR</p> <ul style="list-style-type: none"> • extraction of mRNA(1) • use of reverse transcriptase to form cDNA(1) • use of PCR(1) • use of gel electrophoresis and compare banding(1) 	<p>Do not pick and mix accept reference to samples of mRNA</p> <p>[ignore marker gene]</p>	<p>Expert (3)</p>
Question number	Answer	Additional guidance	Mark
8(c)	<p>An explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • (capsaicin){activates/binds to} a receptor (1) • opens ion channels in neurons (1) • results in {depolarization / action potential / impulse} (in neuron (1) • relay neuron transmits {action potential/ impulse} (to the brain where) it is perceived as pain (1) 	<p>accept TRPV1 as named receptor</p> <p>accept named ion channel</p> <p>do not accept if in motor neurone</p>	<p>Expert (3)</p>

Question number	Answer	Additional guidance	Mark
8(d)	<p>An explanation that includes three of the following</p> <ul style="list-style-type: none"> • (stimulus causes) ion channel to change shape (1) • (which causes) ion channels {to / are} open(1) • allowing influx of (sodium / calcium) ions (1) • initiates {depolarization/ action potential} (1) 	<p>ignore potassium ions accept calcium ions cause release of neurotransmitters</p> <p>accept if it goes above threshold level</p>	<p>Expert</p> <p>(3)</p>

Question number	Answer	Additional guidance	Mark
8(e)	<p>A explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • {mechanical stimulus / pressure} changes shape of the membrane (1) • causes {ion channel / protein} to {change shape / activated/ open} (1) • allowing influx of (sodium / calcium) ions (1) • initiates {depolarization/ action potential} (1) 	<p>accept stretches membrane</p> <p>ignore potassium ions</p>	<p>Expert</p> <p>(3)</p>

Question number	Answer	Additional guidance	Mark
8(f)	<p>An explanation that includes two of the following points:</p> <ul style="list-style-type: none"> • by comparing {DNA base/amino acid} sequences (1) • piezo 2 has similar structure to piezo 1(1) • both Piezo1 and Piezo 2(gene) could be inactivated in the same way (1) • both (Piezo1 and Piezo2) are activated by pressure (on cell membrane) (1) 	<p>accept a second protein / amino acid with a similar {structure / DNA base sequence} was identified</p> <p>accept pressure makes them both open accept respond to mechanical stimuli accept respond the same to stimuli</p>	<p>Expert</p> <p>(2)</p>

Question number	Answer	Additional guidance	Mark
8(g)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> • TRPV1 channels are sensitive to temperature (of the blood) (1) • impulse transmitted to {CNS / ANS / hypothalamus/brain} (1) • credit description of what (hypothalamus does) to maintain core body temperature (1) 		<p>Expert</p> <p>(2)</p>

