Mark Scheme (Results)

Summer 2024

Pearson Edexcel International Advanced Level In Biology (WBI15)
Paper 01 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)	The only correct answer is A bone *B is not correct because ligaments do not attach to cartilage* *C is not correct because ligaments do not attach to a muscle* *D is not correct because ligaments do not attach to a tendon*		(1)

Question Number	Answer	Additional guidance	Mark
1(a)(ii)	A description that includes the following points: • MRI uses {radio waves / magnetic field} (1) • to produce a {2D / 3D / computer} image (of the anterior cruciate ligament) (1)	ignore radio signals / photograph ACCEPT magnetic radiation / (electro)magnetic {waves / radiation} ignore image unqualified ignore high resolution image	(2)

Question Number	Answer	Additional guidance	Mark
1(a)(iii)	A calculation in which: • calculation of the number of males (1) • calculation of number of males with repairs (1)	<u>Example of calculation:</u> (67 000 000 ÷ 100) × 44 = 29 480 000 (29 480 000 x 77)÷ 100 000 = 22699 / 22700 Accept in standard form 2.27x 10^4 Correct answer with no working scores full marks also another way 77/100000 = .00077 percentage males with op 0.00077 X 44/100 x 67000000 22699.6 for 1 mark only NO ECF	(2)

Question Number	Answer	Additional guidance	Mark
1(b)(i)	flexor and extensor	Both required for the mark ACCEPT biceps and triceps mix and match flexor and tricep biceps and extensor ignore extendor	(1)

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	A description that includes two of the following points: • (more) contraction of {A / triceps / extensor} muscle and relaxation of {B / biceps / flexor} muscle (1) • would {pull on / lower / move down} the bones (of the lower arm/radius/ulna) (1) • A and B are antagonistic (pairs) (1)	ignore joint ignore {extending / straightening} the arm	(2)

Question Number	Answer	Additional guidance	Mark
2(a)(i)	The only correct answer is A P *B is not correct because the pituitary gland is not involved in the control of the heartbeat* *C is not correct because the hypothalamus is not involved in the control of the heartbeat* *D is not correct because the cerebral cortex is not involved in the control of the heartbeat*		(1)

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	The only correct answer is D T *A is not correct because the medulla is not involved in the control of balance and coordination of movement* *B is not correct because the pituitary gland is not involved in the control of balance and coordination of movement* *C is not correct because the hypothalamus is not involved in the control of balance and coordination of movement*		(1)

Question Number	Answer	Additional guidance	Mark
2(a)(iii)	The only correct answer is B (Q and R) *A is not correct because the medulla is not involved in the negative feedback control of plasma concentration* *C is not correct because the medulla is not involved in the negative feedback control of plasma concentration* *D is not correct because the cerebrum is not involved in the negative feedback control of plasma concentration*		(1)

Question Number	Answer	Additional guidance	Mark
2(b)(i)	The only correct answer is B dopamine is a neurotransmitter *A is not correct because dopamine cannot pass from bloodstream into neurones in the brain* *C is not correct because high levels of dopamine are not linked to depression, low levels of the chemical are linked to Parkinson's disease* *D is not correct because dopamine does not cause the breakdown of myelin*		(1)

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	An explanation that includes three of the following points: • depression caused by lack of serotonin (1) • SSRI's bind to {channel / proteins} which reuptake serotonin (1) • (therefore) {inhibition of / decreased / prevents} serotonin {(re-)uptake / reabsorption} (1) • serotonin (can still) bind to receptors on post-synaptic membrane (1) • (resulting in more) {depolarisation of / action potentials in} {post-synaptic membrane / relay neurone} (1)	ignore converse ACCEPT SSRIs block protein channels ACCEPT serotonin is not removed from the synapse / serotonin levels remain high in synapse ACCEPT post synaptic receptors ACCEPT opening of Na+ voltage gated channels (in post-synaptic membrane) if they refer to post-synaptic in mp4 no need to repeat in mp5	(3)

Question Number	Answer	Additional guidance	Mark
3(a)(i)	• calculation of {percentage / proportion} of rod cells (1) • correct number of rod cells in section (1)	5/6 or 0.83 or 83.3% or 83.33% or 83% 2dp's MAX 4167 Accept 4150 or 4166 or 4170 Accept in standard form 4.166 x10^3 or 4.17 x10^3 or 4.2 x10^3 ignore 4167:833 4167.8 ignore 4166.7 or 4166.6 ignore 4.16 x10^3	(2)

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation that includes three of the following points: • rod cells can detect low light intensities / cone cells require higher light intensities (for colour vision) (1) • squirrel monkey has more cones as active {during the day / when there is more light} (1) • the {grey bellied / night} monkey has {fewer cone cells / more rod cells} as it {is active at night / needs to see in dark} (1) • both monkeys need to be able to see colour (to find food) therefore both have similar order of magnitude of cone cells (1)	ACCEPT squirrel monkey has more cones as spends more time in the light ACCEPT the night monkey needs more peripheral vision ACCEPT converse for squirrel monkey	(3)

Question Number	Answer	Additional guidance	Mark
3(b)	An answer that includes three of the following points: • (seedling 2) auxin caused {growth towards the direction of light / (positive) phototropism / cell elongation on the shaded side} (1) • (seedling 2) auxin inhibited lateral bud growth (1) • (seedling 3) gibberellins caused increased {growth / length} of seedling (1) • (seedling 3) gibberellins caused growth of lateral buds (1)	ignore side shoots ignore 'bending' ACCEPT auxins cause apical dominance ACCEPT increase in internode length / stem elongation / increased height / got taller ACCEPT gibberellins cause {new lateral bud production / more leaves}	(3)

Question Number	Answer	Additional guidance	Mark
4(a)(i)	The only correct answer is C (P and R) *A is not correct because both P and R would shorten* *B is not correct because both P and R would shorten* *D is not correct because both P and R would shorten*		(1)

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	A calculation with the following answer. • 1.8 (: 1)	accept ±1mm i.e. 1.78 to 1.82 (: 1) ignore ratio as fraction ignore 2:1 max 2dp.	(1)

Question Number	Answer	Additional guidance	Mark
4(a)(iii)	• myosin (1)	Mark first word ONLY ignore tropomyosin ACCEPT phonetic spelling	(1)

Question Number	Answer	Additional guidance	Mark
4(b)	A description that includes four of the following points: • calcium ions {bind / attach} to the troponin (1) • causing troponin to change shape (1) • {moving / pulling / pushing} tropomyosin (1) • (therefore) exposes myosin binding site (1) • allowing myosin head to {bind / form crossbridge} (1)	Describe the role ACCEPT causes conformational change in troponin ignore confirmation change ACCEPT tropomyosin is removed (from binding site) ignore released ACCEPT myosin binding site is free ACCEPT {attach / join} for bind	(4)

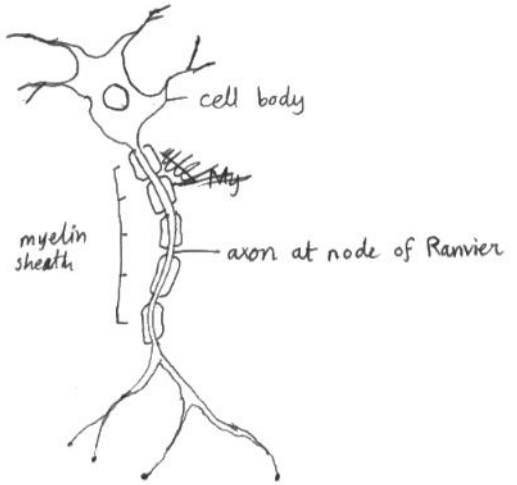
Question Number	Answer	Additional guidance	Mark
4(c)(i)	An answer that includes the following points: • correct scale added to both axes (1) • appropriate line of best fit drawn (1)	 e.g 100-200-300- (400) accept scale up to 350 Eg 0 – 60 DO NOT ACCEPT LINE OF BEST FIT THROUGH ORIGIN	(2)

Question Number	Answer	Additional guidance	Mark
4(c)(ii)	A calculation with the following step: • calculation of gradient (1)	 0.104 correct answer gains full marks Accept 0.08 – 0.14 No ecf ignore fractions ignore units	(1)

Question Number	Answer	Additional guidance	Mark
5(a)	• 9500 (%) (1)	Accept 9.5×10^3	(1)

Question Number	Answer	Additional guidance	Mark
5(b)(i)	An explanation that includes four of the following points: • ALS developed due to high {concentrations / doses / levels} of BMAA (from eating flying foxes) (1) • population of flying fox decreased (1) • decrease in number of people with ALS (could be) due to {eating fewer flying foxes / eating a different food source / men dying / fewer men} (1) • (delay in decrease in people with ALS could be due) time taken for ALS to develop (1) • (initial) increase in number of people with ALS could be due to increased {awareness / education / testing / medical diagnosis techniques} (1)	ACCEPT {BMAA / (neuro)toxin} accumulated in the people ACCEPT converse ACCEPT ALS developed due to eating flying foxes with high BMAA ACCEPT the flying fox no longer ate cycad seeds ACCEPT the population of cycad trees decreased	(4)

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that includes three of the following points: Similarity • both can produce an image (of the brain and nervous tissue) (1) • both are non-invasive procedures (1) Difference (max 2) • CT uses {x-rays / electron beams} whereas PET {uses {tracers / isotopes} / detects production of gamma rays} (1) • CT is {quicker / cheaper} (than PET scan) (1) • PET scan can show {(metabolic) activity / biochemical changes} (whereas CT scan does not) (1)	2 max for differences ignore references to 2D / 3D ACCEPT named tracer e.g. (radioactive) glucose ACCEPT PET scan {takes longer / more expensive} (than a CT scan) ACCEPT PET scan can {show which parts of the brain are active / assess brain activity / show brain function} (whereas CT does not)	(3)

Question Number	Answer	Additional guidance	Mark
5(c)(i)	An answer that includes the following points: • myelin sheath with nodes of Ranvier drawn (1) • cell body drawn at one end of the neuron and synaptic terminal at the other end (1) • two correct labels on the diagram (1) label arrows MUST BE touching − otherwise ignore it and do not mark that label accept bracket labels for cell body and {myelin sheath / axon} incorrect label negates mp3	Example of diagram  accept synaptic knobs / axon terminals for synaptic terminal accept axon if label goes along length of myelin sheaths accept soma for cell body Schwann cells for myelin max 2 if part of neuron missing eg. no synaptic terminals max 2 if {sensory / relay} neuron drawn max 2 mps 1 and 3	(3)

Question Number	Answer	Additional guidance	Mark
5(c)(ii)	An explanation that includes three of the following points: • (voltage-gated) sodium channels {do not open / are closed / are blocked} (1) • (sufficient) sodium ions cannot enter (neurone) (1) • (axon) membrane cannot be (fully) {depolarised / reach +50mV} (1) • no action potential (generated) (1)	ACCEPT {no / less} influx of Na^+ do not accept sodium unqualified. ACCEPT threshold potential is not reached ignore action potential inhibited ignore fewer action potentials ignore impulse	(3)

Question Number	Answer	Additional guidance	Mark
6(a)(i)	The only correct answer is A *B is not correct because Y is reduced NAD and Z is pyruvate* *C is not correct because W is oxidised NAD and Y is reduced NAD* *D is not correct because W is oxidised NAD, Y is reduced NAD and Z is pyruvate*		(1)

Question Number	Answer	
*6(a)(ii)	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.	
1 and 2	• blood lactate increases with increasing intensity of exercise • stroke volume increases with increasing heart rate • positive correlation between heart rate and stroke volume for athlete / little change in stroke volume for non-athlete as heart rate increases/ stroke volume always higher in athlete than non-athlete • non athletes started at a higher lactate concentration than athletes/ converse / athletes lactate always lower in non-athletes • any use of data from lactate concentration table • any use of data from stroke volume graph	
3	• blood lactate levels increase because there is anaerobic respiration occurring / insufficient oxygen available for aerobic respiration / oxygen stores used up • anaerobic respiration produces lactate / lactate converted to pyruvate / glucose → lactic acid + energy / {anaerobic respiration / lactate}causes blood pH to drop / less anaerobic respiration gives less lactate	
4	• stroke volume increases more in athlete due to {(more / stronger) {heart / cardiac} muscle present/ greater ventricular contraction force/ increased contraction of cardiac muscle} /converse • (increase in stroke volume) supplying more (oxygen / glucose) to respiring cells	
5	• athletes have larger lung capacity {for oxygen exchange due to training/ more effective gas exchange /to respire aerobically for longer} / converse. • endurance athletes have more {slow twitch muscles /stores of myoglobin / mitochondria} / sprinters will have more fast twitch muscle fibres / non athlete have {greater proportion of / less} fast twitch muscles in their musculature / accept a correct comment about slow / fast muscle fibres	
6	• in non-athletes (because stroke volume doesn't increase) less oxygen being delivered to the respiring muscle cells than in athlete / accept converse • non athletes develop larger oxygen debt than athletes (because lactate levels are higher) • drop in blood pH detected by chemoreceptors which start chain of events leading to increase in {ventilation /breathing / heart} rate	

7	• no {error bars / SDs } on stroke volume graph so cannot comment on the significant difference • no details about {age / gender / health / diet} of athletes and non-athletes in investigation (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.	aspect = graph or athlete/non-athlete 1 mark = description of one aspect (graph or person) 2 marks = description of both aspects or description of one with some explanation
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.	3 marks = description of both aspects with some explanation for one 4 marks = description of both aspects with explanation
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.	All level 2 content plus: consideration of why there is a difference in stroke volume between athlete/non-athlete and why the lactate increases are different between athlete/non-athlete

Question Number	Answer	Additional guidance	Mark
6(b)	An answer that includes four of the following points: • {cytochrome oxidase cannot be oxidised /electrons are not passed along electron transfer chain / reduced {NAD / FAD / coenzyme} are not oxidised} (1) • cells {respire anaerobically / only do glycolysis} (1) • {insufficient / less / no} {ATP / energy} for {contraction of muscles / contraction of heart / metabolic reactions} (1) • pyruvate converted to {lactate / lactic acid} (1) • (accumulation of) {lactate / lactic acid} results in a decreased pH (1) • resulting in denaturing of enzymes / change in {secondary / tertiary} structure (of proteins) (1)	ACCEPT {preventing / less} {oxidative phosphorylation / aerobic respiration} ACCEPT chemiosmosis does not occur ACCEPT {less protons / protons do not} move through ATP synthase ACCEPT examples of muscles e.g. {skeletal / intercostal / diaphragm} muscles ACCEPT named metabolic reaction	(4)

Question Number	Answer	Additional guidance	Mark
7(a)(i)	The only correct answer is A Q *A is not correct because Q transports blood to renal vein* *B is not correct because Q transports blood to renal vein* *D is not correct because Q transports blood to renal vein*		(1)

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	The only correct answer is A P, Q and U *B is not correct because only P and Q would be found in the medulla region* *C is not correct because only P and U would be found in the medulla region* *D is not correct because only P and U would be found in the medulla region*		(1)

Question Number	Answer	Additional guidance	Mark
7(a)(iii)	An answer that includes the following points: • orientation described (1) • {structure A / brush border / microvilli} gives increased surface area (1) • (more) {structure B / mitochondria}to supply ATP (1)	ACCEPT {brush border / structure A} is in the lumen of the tubule ACCEPT microvilli all along {lining of the PCT / apical side} ACCEPT {mitochondria / structure B} are located {throughout / at the base cell / basal side} ignore incorrect name / structure ACCEPT {structure B / mitochondria} for {aerobic respiration / releasing energy / producing ATP} ignore producing energy	(3)

Question Number	Answer	Additional guidance	Mark
7(b)	An answer that includes four of the following points: • mean volume of urine production peaks at {60 minutes / one hour} (1) • mean concentration of ions is lowest at {60 minutes / one hour} (1) • mean mass of urea peaks at {60 minutes / one hour} (1) • at 150 minutes {mass of urea / volume of urine / concentration of ions} was same as {at 0 mins / the start / returns to normal} (1) • mean mass of urea is greatest when volume of urine greatest (1) • there is no indication of {sample size / gender / health issues / hydrated prior to test} (1)	ACCEPT increases up to 60 mins ACCEPT concentration of ions decreases up to 60 mins ACCEPT mass of urea increases up to 60 mins ignore mass of urine ACCEPT converse ACCEPT other correct linkages e.g. highest mean volume of urine is when mean concentration of ions in urine is least / as the volume of urine increases the concentration of ions decreases / / mass of urea is lowest when concentration of ions greatest ACCEPT there are no {error bars / standard deviation} so unable to determine significance of the results	(4)

Question Number	Answer	Additional guidance	Mark
7(c)	An explanation that includes three of the following points: • ADH binds to receptors {on distal convoluted tubules/ collecting ducts} (1) • (causing) aquaporin channels to move (from cytoplasm) into the (apical) membrane of the tubules (1) • (allowing) water to be reabsorbed out of {the collecting ducts / distal convoluted tubules} (1) • (the water) is reabsorbed into blood / the blood (sodium) ion concentration reduces (1)	ACCEPT water channels for aquaporins ACCEPT more {aquaporin / water channels} in membrane ACCEPT {collecting duct /distal convoluted tubules} becomes more permeable to water ACCEPT the blood {becomes more dilute / has increased water potential}	(3)

Question Number	Answer	Additional guidance	Mark
8(a) A B	An explanation that includes three of the following points: • determining {DNA base sequences / genome sequence} for whitefly (1) • (data collated) using bioinformatics (1) • compare {DNA base sequence / genome} of whitefly with genomes of plants to see if they are the same (1) • {BtPMaT1 sequence / gene} was only found in plants and not in other species of whitefly (1) Alternative • use of PCR (1) • cut DNA using same restriction enzyme (1) • use of gel electrophoresis (1) • show bands from gel electrophoresis of whitefly with genomes of plants are the same (1)	please don't mix and match ACCEPT use of (DNA) microarrays ACCEPT compare database of whitefly and plant DNA to see if they are the same	(3)

Question Number	Answer	Additional guidance	Mark
8(b)	An explanation that includes four of the following points: • {BtPMaT1 / the gene} allows whitefly to avoid being poisoned (when it eats the plant) (1) • accept having this gene gives them a (selective) advantage(1) • (only) whitefly with the {BtPMaT1 / gene} will survive (1) • to (reproduce) and pass {BtPMaT1 /gene / advantageous allele} to offspring (1) • (as a result) these whitefly have no competition for this food source (from other insects) (1)	ACCEPT allele for gene anywhere ACCEPT flies without the gene will {die / be poisoned} (if they eat the plant) ACCEPT the whiteflies can eat the plants without being poisoned ACCEPT correct ref to selection pressure ACCEPT reach the age of reproduction	(4)

Question Number	Answer	Additional guidance	Mark
8(c)	An explanation that includes four of the following points: • {isolate / cut} gene from coral (1) • insert gene into {zebrafish / embryos / zygotes} (1) • suitable method to insert gene (inserted into zebrafish) (1) • shine UV light on (adult) fish (as only the modified fish will glow) (1) • {red /glowing red / shining / fluorescing} fish are selected for breeding (1)	ignore cDNA e.g. vector, plasmid, micropipette, heat shock, liposomes, gene gun ACCEPT remove the fish that don't glow red	(4)

Question Number	Answer	Additional guidance	Mark
8(d)	An answer that includes three of the following points:	Maximum two marks for benefits Maximum two marks for risks ACCEPT allele for gene	
	Benefits (max 2)		
B	• medical research (1)		
	• study tissue regeneration (1)	ACCEPT study cell regeneration / differentiation	
	• track how skin cells move (1)		(3)
	• unique pets (1)	ACCEPT tourism at aquarium	
	• financial benefit of selling (1)		
	Risks (max 2)		
R	• the fish are more visible to predators / negative effect on ecosystem (1)		
	• the gene affecting the health of the zebrafish (1)	ACCEPT do not know long term effects	
	• the gene getting into other {populations of zebrafish / animals / species} (1)	e.g. mating with other species / crossbreeding / horizontal gene transfer	
	• the gene getting into (marine) food chains (1)		
	• affecting the health of the coral (1)		
	• encouraging illegal pet trade (1)		

Question Number	Answer	Additional guidance	Mark
8(e)	An answer that includes three of the following points: • increase in {volume / size of cytoplasm / membrane size} (1) • (due to) increase in permeability of membrane to water (1) • (more) water entered by osmosis (to increase cell size) (1) • increased blood flow to the wound (1) • inflammatory response (1) • resulting in {cell division / mitosis} (1)	ACCEPT inflammation occurs	(3)

Question Number	Answer	Additional guidance	Mark
8(f)	An explanation that includes three of the following points: • (embryo cells) divide by mitosis (1) • (cell) differentiation occurs (1) • gene is {switched on / activated by transcription factors} (in skin cells) (1) • {transcription / translated / protein synthesis} occurs (1) • (resulting in) production of red {pigment / protein} (1)	 ACCEPT cell division ACCEPT specialisation ACCEPT active mRNA (of colour producing gene) produced	(3)

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