



Mark Scheme (Results)

January 2023

Pearson Edexcel International Advanced
Subsidiary Level in Biology (WBI15/01)
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)	Choose an item. • C is the correct answer A is not the correct answer as bone does not contain actin and myosin. B is not the correct answer as ligament does not contain actin and myosin. D is not the correct answer as tendon does not contain actin and myosin.		(1)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	Choose an item. • A is the correct answer B is not the correct answer as the triceps is not a flexor when attached to the radius. C is not the correct answer as the triceps is not a ligament when attached to the radius. D is not the correct answer as the triceps is not a tendon when attached to the radius.		(1)

Question number	Answer	Additional guidance	
1(b)(i)	An explanation that includes two of the following points: • (joins / attaches) the upper arm bone to the lower arm bone (1) • therefore maintaining joint stability (1)	accept humerus as upper arm bone accept radius / ulna as lower arm bone accept joins bone to bone accept structural support accept elastic (fibres) allow some movement of joint	(2)

Question number	Answer	Additional guidance	
1(b)(ii)	An answer that includes the following point: • stated injury that causes damage to the ligament (1)	e.g.falling with arm outstretched, dislocating elbow, named sports injury eg. in a tackle, accept tear of ligament due to sports / {lifting /using }heavy weights / overstretching accept overextending joint ignore injury unqualified / breaking ligament or bone	(1)

Question number	Answer	Additional guidance	
2(a)	Choose an item. • C is the correct answer A is not the correct answer as CT does not show changes in brain function as they happen. B is not the correct answer as ECG does not show brain function. D is not the correct answer as PCR does not show brain function.		(1)

Question number	Answer	Additional guidance	Mark
2(b)	An answer that includes three of the following points: • advantage of MRI (1) • • advantage of PET (1) • disadvantage of MRI (1) • disadvantage of PET (1)	if factors refer to both and one wrong and one right ignore wrong one e.g MRI gives detailed image, 3D image, no(ionizing) radiation, good soft tissue contrast, high resolution, can see diseased tissue uses magnetic field so safe for pregnant women ignore safe for all individuals e.g. PET detects biochemical changes in brain, can observe cancer growth, used to diagnose dementia, shows which parts of brain are {active/ metabolizing} PET scan 3D e.g. difficult for people who dislike enclosed spaces, long time, some need sedation, expensive, doesn't show activity of brain, limiting accessibility in some countries? noisy/cant be used on patient with pacemaker or metal implant e.g. exposure to (gamma / beta) radiation, uses radioactive tracer, lower resolution, expensive, 2D image	(3)

Question number	Answer	Additional guidance	Mark
2(c)	Choose an item. • stated function cerebellum (1) • stated function of cerebral hemisphere (1) • stated function of hypothalamus (1)	(coordination of voluntary) movements, posture/ balance and speech ignore co-ordination unqualified (control of) voluntary behaviour / site of intelligence/ memory / learning / thinking/ emotions / imagination / voluntary response/ motor skills interpreting language, spatial and visual perception, control of voluntary movements homeostasis/ correctly named hormone production/thermoregulation/ controls pituitary gland accept osmoregulation	(3)

Question number	Answer	Additional guidance	Mark
3(a)(i)	Choose an item • C is the correct answer A is not the correct answer as the action potential is not caused by the movement of K^+ ions into the axon. B is not the correct answer as the action potential is not caused by the movement of K^+ ions out of the axon. D is not the correct answer as the action potential is not caused by the movement of Na^+ ions out of the axon.		(1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	Choose an item. • A is the correct answer B is not the correct answer C is not the correct answer D is not the correct answer		(1)

Question number	Answer	Additional guidance	Mark
3(b)	A description that includes three of the following points: • receptor cells synapse with the sensory neurone (1) • (sensory neurone) synapses with relay neurone in grey matter of spinal cord (1) • (relay neurone) synapses with motor neurone (1) • motor neurone synapses with effector for response (1)	accept correctly labelled diagram	(3)

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that includes four of the following points: • voltage gated (calcium) ion channels open (in pre synaptic membrane) causing calcium ions to (diffuse in / enter) (1) • causing vesicles (of neurotransmitter) to fuse with (pre synaptic) membrane (1) • {exocytosis/ release} of neurotransmitter (into synaptic cleft) (1) • which diffuses across and binds to receptors (on post synaptic membrane) (1) • causing {sodium channels to open / allowing sodium ions to enter} resulting in {depolarisation / impulse/action potential} (in post-synaptic neurone) (1)	ignore if the calcium ions are going into the wrong structure accept binds as eq fuse accept release of {neurotransmitter / correctly named neurotransmitter } into synapse	(4)

Question number	Answer	Additional guidance	Mark
4(a)(i)	An answer that includes: the change in the base sequence of {a gene /DNA/genetic material / allele/genome} (1)	do not accept genetic information accept genome accept ref to change in chromosome{ structure / number} accept RNA	(1)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An answer that includes the following point: mitosis	do not accept cell division do not accept hybrid mitosis/meiosis	(1)

Question number	Answer	Additional guidance	Mark
4(b)	Choose an item. C is the correct answer A is not the correct answer as three statements are correct. B is not the correct answer as three statements are correct. D is not the correct answer as three statements are correct.		(1)

Question number	Answer	Additional guidance	Mark
4(c)	An answer that includes four of the following points: • moves through the cell membrane /enters the nucleus (1) • oestrogen attaches to (specific){ protein/receptor}(to form a complex) /acts as a transcription factor(1) • which binds to promotor region of {DNA/gene} / allows RNA polymerase to bind to promoter region(1) • which causes (expression / activation/transcription) of a gene that stimulates (cell division/mitosis)(1) • production of a protein involved in {cell division / mitosis}(1)	accept oestrogen enters cell by diffusion ignore receptors cell surface membrane ignore proliferation ignore proliferation	(4)

Question number	Answer	Additional guidance	Mark
4(d)	An answer that includes two of the following points: - acetylation leads to change in {ionic charges / structural change} in histone /DNA (1) - DNA becomes {less/loosely}wrapped (around histones) (1) - transcription can occur(1)	accept neutralizes +ve charges on lysine / histone increases spaces between histones accept RNA polymerase can bind ignore genes are exposed ignore increased gene expression	(2)

Question number	Answer	Additional guidance	Mark
5(a)	choose an item: • B is the correct answer A is not the correct answer as the reduction of carbon does not produce water C is not the correct answer as the phosphorylation of ADP does not produce water D is not the correct answer as the phosphorylation of glucose does not produce water		(1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	Choose an item: B is the correct answer A is not the correct answer as 1.3 is not the rate of carbon dioxide production at 60 mins C is not the correct answer as 2.5 is not the rate of carbon dioxide production at 60 mins D is not the correct answer as 3.08 is not the rate of carbon dioxide production at 60 mins		(1)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation that includes two of the following points: - the respiratory quotient decreased (during the exercise) (1) (switching to) {lipid/fat/triglyceride} being used (rather than carbohydrate)	accept suitably named compounds ignore ref to anaerobic respiration occurring? ignore ref to change in CO₂ production?	(2)

Question number	Answer	Additional guidance	Mark
5(c)(i)	A calculation showing the following steps: • calculation of total number of 80-year-olds (1) • calculation number of 80-year-olds who have cancer and are non-smokers with COPD and given in standard form (1)	$(105500 + 158600 =) 264100$ $(264100 \times 7.5/100 =)$ 1.98×10^4 should be a whole number	(2)
	2		
	1		
	1.9 x 10 ⁴ to 2.1 x 10 ⁴		
	19015 to 20600		
	264100		

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An answer that includes four of the following points: • ventilation and heart rate increase (1) • to deliver sufficient oxygen to body cells for aerobic respiration (1) • (because damage to walls of alveoli/COPD) will reduce surface area for {diffusion/gas exchange} (1) • (thicker) mucus will increase diffusion distance (1) • (resulting in) reduced rate of oxygen diffusion into blood / lower oxygen content of blood} (1)	can piece together mp1 only accept descriptions of breathing rate and heart rate increasing accept anaerobic respiration occurs due to low oxygen accept to prevent anaerobic respiration occurring (due to insufficient oxygen) reduced elasticity of alveoli decreases concentration gradient for {diffusion / gas exchange} less oxygen entering into blood	(4)

Question number	Answer	Additional guidance	Mark
6(a)	An answer that includes the following points: - slow twitch fibres are more important to long-distance athletes/10000m runner /marathon runner (1) - they have more mitochondria (1) - and {larger capillary network/ more myoglobin} to supply oxygen (1) - allowing {aerobic respiration/more ATP production} (1)	accept converse accept as the distance run increases so the % of slow twitch muscle fibres increase can run for longer distances without fatigue ignore reference to anaerobic respiration	(3)

Question number	Answer	Additional guidance	Mark
6(b)	Choose an item. sarcomere	accept phonetic spelling	(1)

Question number	Answer	Additional guidance	Mark
6(c)(i)	A calculation showing the following step: - calculation of cardiac output (1) - conversion of cardiac output into $\text{dm}^3 \text{ min}^{-1}$ (1)	$(65 \times 57) = 3705 \text{ cm}^3$ $(65 \times 0.057 \text{ or } 0.065 \times 57)$ 3.71 accept 3.70 accept 3.7 accept 3.705 units not needed as in stem	(2)
	2	1	
	3.71	3705	
	3.705	$0.057 \text{ or } 5.7 \times 10^{-3}$	
	3.7	$0.065 \text{ or } 6.5 \times 10^{-3}$	

Question number	Answer	Additional guidance	Mark
6(c)(ii)	The correct answer is B		(1)

Question number	Answer	Additional guidance	Mark
6(c)(iii)	A calculation showing the following step: Correct calculation of the ratio (1)	$(1.54:2.39) = 1:1.55 \text{ / } 0.64:1$ accept $1:1.6 \text{ \textbackslash } 1:1.5$ accept $0.644:1$ accept $0.64 \text{ / } 0.644$ (no need for :1)	(1)

Question number	Answer	Additional guidance	Mark
6(d)(i)	An answer that includes two of the following points: - as the running speed increases the cardiac output increases (1) - at speeds over 10 mph cardiac output {decreases/ levels off }(1)	accept linear relationship (up to 10 mph) accept positive correlation accept at 12mph cardiac output has decreased accept cardiac output decreases after 11mph ignore highest cardiac output at 11mph	(2)

Question number	Answer	Additional guidance	Mark
6(d)(ii)	An explanation that includes three of the following points: - increase in carbon dioxide in blood/ decrease in blood pH (1) - detected by chemoreceptors (1) {medulla /CVC} sends (more) impulses {via sympathetic nervous system/ to SAN} (1) - SAN {depolarises more frequently / causes increased rate of heart muscle contraction} (1)	ignore ref to increased oxygen demand ignore muscles unqualified	(3)

Question number	Answer	Additional guidance	Mark
6(d)(iii)	A description that includes two of the following points: - transported to the liver (1) - converted to {pyruvate / glucose} (in the liver) (1) {pyruvate / glucose} used in {link reaction / Krebs cycle/aerobic respiration} (1)	ignore lactate used in aerobic respiration / link reaction / Krebs cycle no if IT is used in link reaction	(2)

Question number	Answer	Additional guidance	Mark
7(a)(i)	An answer that includes four of the following points: - increase in sucrose concentration leads to increase in dopamine release (1) - so leading to increase in desire of rats to eat (1) {relatively few results to make conclusion / overlapping error bars so results not significant} (1) - the results show a correlation not necessarily causation (1) - relevant comment about methodology of study(1)	accept positive correlation {no significant difference / decreased confidence in conclusion} due to overlapping {error / SD} bars low {reliability / validity} of data due to large error bars e.g. number of rats / gender / age / time / how did they test desire to eat	(4)

Question number	Answer	Additional guidance	Mark																								
7(a)(ii)	A calculation showing the following steps: • correct calculation of $\sum(x_1 - \bar{x})^2$ (1) • correct calculation of s to 2 significant figures (1)	<table><tr><th>result (x_1)</th><th>$x_1 - \bar{x}$</th><th>$(x_1 - \bar{x})^2$</th></tr><tr><td>45</td><td>-15</td><td>225</td></tr><tr><td>63</td><td>3</td><td>9</td></tr><tr><td>74</td><td>14</td><td>196</td></tr><tr><td>58</td><td>-2</td><td>4</td></tr><tr><td></td><td>$\sum(x_1 - \bar{x})^2 =$</td><td>434</td></tr><tr><td></td><td>$n - 1 =$</td><td>3</td></tr><tr><td></td><td>$S =$</td><td>12</td></tr></table>	result (x_1)	$x_1 - \bar{x}$	$(x_1 - \bar{x})^2$	45	-15	225	63	3	9	74	14	196	58	-2	4		$\sum(x_1 - \bar{x})^2 =$	434		$n - 1 =$	3		$S =$	12	(2)
result (x_1)	$x_1 - \bar{x}$	$(x_1 - \bar{x})^2$																									
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	$S =$	12																									

Question number	Answer	Additional guidance	Mark
7(b)	A description that includes the following points: - released into the blood from the adrenal glands/ binds to receptors on target organs(1) - named physiological effect(1) - second named physiological effect(1)	accept binds to receptors on named target organ e.g. increased heart rate/vasodilation/ increased respiratory rate/ dilation of pupils/relaxation of muscle fibres in wall of gut/ glycogen to glucose in liver /	(3)

Question number	Answer	Mark
7(c)	Description of diagram or graph • correct description from diagram e.g. pancreas secretes {insulin / glucagon} / control of blood glucose involves pancreas, liver and tissue cells • correct description of graphs linking concentration to either a specific time period or meal e.g. glucose concentration increases after a meal / insulin increases after a meal / glucose concentration decreases during the night ----- Explanation / interpretation (max 3) • normal function of the body is dependent on tight controls of blood glucose levels example of what happens when glucose conc out of sync./ diabetes • (chemo)receptors detect a change in blood {glucose/sugar} levels • neural control of pancreatic hormones release • beta cells secrete insulin • {insulin / glucagon} secreted into the blood which travel to {target organ / liver cells / muscle cells} • {insulin/ glucagon} act as transcription factors • {insulin / glucagon} released which attaches to receptors on specific cell membrane • insulin results in {(increased) uptake of glucose (by cells) which is converted to glycogen / glycogenesis /uptake by GLUT4/ increased respiration} • alpha cells secrete glucagon • (glucagon results in) glycogenolysis / hydrolysis of glycogen/breakdown of glycogen to glucose which is released into the blood / gluconeogenesis / other molecules converted into glucose • blood glucose level returns to {set point / normal} 1 statement with an explanation – this must be included if a response is to access the 6th mark • a correct description of reducing {insulin/glucagon} secretion once blood glucose levels have returned to normal / decreased stimulation of pancreas by nerves	(6)

	L1 2 Ds simple descriptions from graph and /or diagram [most using graphs] L2 level 1 plus 2 statements with basic explanations (or 2 statements with 1 basic and 1 detailed explanation) L3 level 2 plus 2 statements with detailed explanation (eg good use of biological terms) To get 6 there has to be one explanation using negative feedback in control of blood glucose concentration	
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Question number	Answer	Additional guidance	Mark
8(a)	An answer that includes three of the following points: - mitochondria {damaged / destroyed/reduced in number} (by ROS) (fewer mitochondria) results in reduced energy production(1) - damage to {nerve cells/neurones /synapses / dendrites}(1) - named change in brain chemistry(1)	accept {increase in / accumulation of} {ROS/ oxidative stress/peroxide/calcium} aging causes changes in the brain {size / blood flow} accept reduced {nerve impulses/depolarization} ignore nerve tissues / neurodegeneration eg. loss of {dopamine/serotonin}	(3)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that includes three of the following points: - hydrogen (atoms from reduced co-enzymes) split into {H⁺ / protons} and electrons (1) (electrons release) energy to pump {H⁺ / protons} into intermembrane space (1) {protons / hydrogen ions} move through {membrane protein/ ATP synthase/ ATPase} (1) {conversion of ADP + Pi to ATP / phosphorylation of ADP} (1)	accept in equation form accept protons move down {electrochemical//concentration} gradient accept ADP + Pi -> ATP accept the energy in glucose is transferred to ATP ignore reference to oxygen as final electron acceptor	(3)

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that includes three of the following points: • {ROS / peroxide}are produced i(n the mitochondria) by oxidative phosphorylation (1) • (ROS causes) {breaks in/ mutations in /oxidation of} {(mt)DNA /gene/allele}(1) • (due to) {hydrogen / phosphodiester} bonds {breaking / not being able to form} (1) • resulting in changes to {enzymes / proteins} which repair (mt)DNA((1)	accept causes a change to the base sequence / removes electrons from (mt)DNA ignore damage to mtDNA accept changes charges on (mt)DNA / removes electrons from DNA	(3)

Question number	Answer	Additional guidance	Mark
8(d)	A description that includes three of the following points: • {specialisation / differentiation} of stem cells (in the brain) (1) • due to {transcription factors / hormones / chemicals} (1) • differential gene expression (1) • active genes are transcribed and translated (1) • producing proteins that determine {structure / function / location} of {brain cell / neurons} (1)	accept epigenetic modification accept some (specific) genes are {switched on / activated} /some are switched off accept specific proteins synthesised	(3)

Question number	Answer	Additional guidance	Mark
8(e)	An explanation that includes two of the following points: - these are the proteins (1) - that are {found/made/used} in the mitochondria (1)	do not give mp2 unless mp1 correct as not in correct context ignore protein singular accept proteins unique to the mitochondria for 2 marks accept protein unique to mitochondria for 1mark	(2)

Question number	Answer	Additional guidance	Mark
8(f)	An answer that includes the following points: - synapses have higher {energy/ATP} requirements (than other parts of the neurone) (1) - therefore, leads to greater{ ROS/peroxide / metabolite} production (1)	accept synaptic mitochondria {have higher rate of / do more} {(aerobic) respiration / oxidative phosphorylation} accept synapses do a lot of {active transport / exocytosis / synthesis of neurotransmitters} ignore synaptic mitochondria are used more? accept accumulation/increase of ROS/peroxide/metabolite	(2)

Question number	Answer	Additional guidance	Mark
8(g)	A description that includes three of the following points: • because mtDNA has genes (needed for mitochondrial function) (1) • which code for proteins (in the ETC) (1) • correct role of protein in oxidative phosphorylation(1)	accept genes in the mtDNA accept named examples of proteins e.g {ATP synthase/protein pumps} e.gs movement of protons into / out of intermembrane space/chemiosmosis/ ADP + Pi→ATP / movement of e-down ETC	(2)

Question number	Answer	Additional guidance	Mark
8(h)	An answer that includes two of the following points: • formation of vesicle around mitochondrion (1) • {fusion of / action by} lysosomes (1) • leading to {enzyme/lysozyme} digestion (of the mitochondrion) (1)	ignore ref to formation of phagosome accept mitophagy ignore in context of fusing with cell membrane lysosomes may digest the damaged mitochondrion for 1 mark? ignore digestion of cell	(2)

