



Mark Scheme (Results)

October 2021

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	
1(a)	<p>A description that includes two of the following points:</p> <ul style="list-style-type: none"> • calcium ions bind to troponin (1) • causing tropomyosin to move (1) • allowing the myosin (head) to bind (1) 	<p>ACCEPT change in shape</p> <p>ACCEPT exposing the myosin binding site / allowing actomyosin bridges to form</p>	(2)

Question number	Answer	Additional guidance	
1(b)	<p>An explanation that includes the following points:</p> <ul style="list-style-type: none"> • many mitochondria allows more (aerobic) respiration(1) • many myoglobin molecules allows greater (store)of oxygen (1) • larger capillary network ensures good supply of {oxygen/ glucose} (1) • slow sustained contraction allows longer periods ofexercise / race for longer(1) 	<p>ACCEPT more ATP produced</p> <p>ACCEPT in context endurance events / decrease in {fatigue / tiredness}</p>	(4)

Question number	Answer	Additional guidance	
1(c)	<p>An answer that includes the following points:</p> <ul style="list-style-type: none"> • exercise increases the rate of heat loss (1) • (eventually) the rate of heat loss reaches its maximum (1) 	ACCEPT the rate of heat loss levels off	(2)

Question number	Answer	Additional guidance	Mark
2(a)	<p>A description that includes four of the following points:</p> <ul style="list-style-type: none"> • {identify / isolate} gene(s) involved in making beta-carotene in bacteria (1) • cut {DNA sequence / extract (beta carotene) gene} using restriction {endonuclease / enzyme} (1) • insert (beta carotene) gene into vector (1) • method of inserting vector into rice described (1) • grow rice and select for modified rice plants with high yields of beta carotene (1) 	<p>ACCEPT obtain gene by reverse transcriptase from mRNA synthesize gene (from a database)</p> <p>ACCEPT gene isolated using restriction enzyme = 2 marks (mp1 and 2)</p> <p>ACCEPT a named vector eg plasmid, liposomes e.g. heat shock, gene gun. micro-injection</p>	(4)

Question number	Answer	Additional guidance	Mark
2(b)(i)	<p>A description that includes three of the following points:</p> <ul style="list-style-type: none"> • accumulation of genetically engineered material in the environment / other species (1) • cross breeding with other species (1) • unknown long term effects of eating GMOs (1) • allows production of superpests (1) 	<p>ACCEPT accumulate in non-target organisms altered gene is found in other species ACCEPT pollen transfer to related species,</p> <p>ACCEPT Named symptom e.g. yellowing of skin, joint pain, dizziness, bleeding, beta carotene is a gene inhibitor, ref allergies</p> <p>credit idea of superweeds/superpests</p>	(3)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	<p>An answer that includes the following points:</p> <ul style="list-style-type: none"> • appropriate suggestion to reduce risk (1) 	<p>accept grow in secure greenhouses, growseparately GM and non GM crops</p>	(1)

Question number	Answer	Mark
3(a)(i)	<p>The only correct answer is D</p> <p>A is not the correct answer as <i>cis retinal is changed by light</i></p> <p>B is not the correct answer as <i>phytochrome is a photoreceptor in plants</i></p> <p>C is not the correct answer as <i>rhodopsin is a photoreceptor found in rod cells</i></p>	(1)

Question number	Answer	Mark
3(a)(ii)	<p>The only correct answer is B</p> <p>A is not the correct answer</p> <p>C is not the correct answer</p> <p>D is not the correct answer</p>	(1)

Question number	Answer	Additional guidance	Mark
3(b)(i)	<p>A description that includes two of the following points:</p> <ul style="list-style-type: none"> as light intensity increases up to 12 a.u. mean potential difference increases (1) mean potential difference stays constant at 12 a.u. and above (1) 	<p>both mps may be in one sentence</p> <p>Accept maximum potential difference reached at 12 a.u.</p>	(2)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	<p>A calculation showing the following steps:</p> <ul style="list-style-type: none"> • calculation of change in mean potential difference (1) • calculation of percentage change (1) 	<p>$20 - 17 = 3$</p> <p>$3/17 \times 100 = 17.6 / 17.65 \%$</p> <p>correct answer = 2 marks</p>	2

Question number	Answer	Additional guidance	Mark
3(b)(iii)	<p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> • removing retina (from mammals) cause {blindness/harm} (1) • using anaesthetic causes harm to mammals (1) • not ethical/ unethical (1) 	<p>do not accept killing</p> <p>ACCEPT benefits do not outweigh harm caused/animals cannot give consent</p>	2

Question number	Answer	Mark
3(c)	<p>The only correct answer is C</p> <p>A is not the correct answer B is not the correct answer D is not the correct answer</p>	1

Question number	Answer	Additional guidance	Mark
4(a)	<p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> • positive feedback results in an increase in the change (of the variable) (1) • negative feedback results in a decrease in the change (of the variable) (1) 	can be phrased in many ways eg. change from normal	2

Question number	Answer	Additional guidance	Mark
4(b)	<p>The only correct answer is D</p> <p>A is not the correct answer as thermoregulation is continually required.</p> <p>B is not the correct answer as the body continually generates heat</p> <p>C is not the correct answer as more heat being gained than lost means body is not in equilibrium.</p>		1

Question number	Answer	Additional guidance	Mark
4(c)(i)	<p>An explanation that includes the following points:</p> <ul style="list-style-type: none"> • creatinine is a small molecule (1) • therefore can be forced through the {pores / basement membrane} (1) • as a result of high pressure in the glomerulus (1) 	<p>ACCEPT ultrafiltration occurs for mp1 / ignore any RMM figures</p> <p>allow through fenestrations</p>	3

Question number	Answer	Additional guidance	Mark
4(c)(ii)	<p>A calculation showing the following step:</p> <ul style="list-style-type: none"> correct answer given to 3 significant figures (1) 	<p>accept $1960/15 \times 60 = 2.18 \text{ mg min}^{-1}$</p> <p>$1960/15 = 131$</p>	1

Question number	Answer	Additional guidance	Mark
4(d)(i)	<p>An answer that includes three of the following points:</p> <ol style="list-style-type: none"> general comment about all patients after surgery comment on difference in 2 groups - can use figures comment using SD comment on largest change after surgery 	ACCEPT ref to error bars	3

Question number	Answer	Additional guidance	Mark
4(d)(ii)	<p>A calculation showing the following steps:</p> <ul style="list-style-type: none"> calculation of difference surgery makes for non-diabetic and type II diabetic (1) correct number calculated (1) 	<p>0.32</p> <p>0.7</p> <p>$0.7 - 0.32 = 0.38$</p> <p>correct answer gains 2 marks</p>	2

Question number	Answer	Mark
5(a)(i)	The only correct answer is B A is not the correct answer C is not the correct answer D is not the correct answer	1

Question number	Answer	Mark
5(a)(ii)	The only correct answer is B A 0.7 is not the correct answer C 1.3 is not the correct answer D 2.2 is not the correct answer	1

Question number	Answer	Mark
5(a)(iii)	The only correct answer is B A is not the correct answer as lactate production does not decrease C is not the correct answer as lactate production does not decrease D is not the correct answer as oxygen consumption does not increase.	1

Question number	Answer	Additional guidance	Mark
5(b)	A calculation showing the following steps: <ul style="list-style-type: none"> calculation of mouse and seal metabolic rate (1) quotient calculated (1) 	$20/10 = 2 \text{ cm}^3\text{g}^{-1}\text{h}^{-1}$ $18200/5000000 = 0.0036 \text{ cm}^3\text{g}^{-1}\text{h}^{-1}(0.00364)$ $2/0.0036 = 555.56/556/549.45/549/549.5$ Correct answer gains all 2 marks	2

Question number	Answer	Additional guidance	Mark
5(c)	<p>An answer that includes the following points:</p> <p>Indicative content</p> <ul style="list-style-type: none"> • No direct relationship between body mass and lactate production • The larger the size of the crocodile the lower the rate of lactate production • Highest rate of lactate production in 20kg crocodiles • Smallest crocodiles have same rate of lactate production as 50kg crocodiles • Comment on the link between aerobic and anaerobic respiration <p>Description of named responses</p> <ul style="list-style-type: none"> • As crocodiles were exercising vigorously the aerobic pathway cannot keep up. • ATP generated anaerobically in glycolysis using glycogen stores in the muscle. • Energy used to allow the crocodile to move very rapidly, if only for a short time. <p>Chemical nature of responses</p> <ul style="list-style-type: none"> • 1 mol of glucose from glycogen generates 3 mols of ATP and 2 mols of lactate • Detailed description of anaerobic pathway in glycolysis • Detailed description of aerobic pathways <p>Detailed mechanism of responses</p> <p>Level 1: Description of (a minimum of 2 specific) results from experimental data.</p> <p>Level 2: All of level 1 plus reference to chemical nature of anaerobic or aerobic respiration</p> <p>Level 3: All of level 2 plus detailed mechanism for anaerobic and aerobic respiration</p>		6

Question number	Answer	Mark
6(a)(i)	<p>The only correct answer is A</p> <p>B is not the correct answer as tRNA does not identify a base and transport it to a ribosome</p> <p>C is not the correct answer as tRNA does not form a template for DNA polymerase</p> <p>D is not the correct answer as tRNA does not form a template for RNA polymerase</p>	1

Question number	Answer	Mark
6(a)(ii)	<p>The only correct answer is A</p> <p>B is not the correct answer as ribosomes do not process cytokine proteins</p> <p>C is not the correct answer as the smooth endoplasmic reticulum does not process cytokine proteins</p> <p>D is not the correct answer as vesicles do not process cytokine proteins</p>	1

Question number	Answer	Additional guidance	Mark
6(b)	<p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> • adds complementary nucleotides/bases (to template strand) (1) • reference to phosphodiester bond formed (1) • proofreads the DNA (1) 	<p>Accept description of formation of H bonds between bases in old and new strand.</p>	2

Question number	Answer	Additional guidance	Mark
6(c)	<p>An explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • (activation) results in {production of / activation of} transcription factors (1) • (transcription factors) binds to the promotor region (of/for cytokine genes) (1) • (cytokine genes) are transcribed / mRNA produced (1) 	<p>ACCEPT secondary messenger systems are activated</p> <p>ACCEPT description of transcription</p>	3

Question number	Answer	Additional guidance	Mark
6(d)	<p>An explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • cytokines have a specific/ different shape (1) • (cytokines) bind to specific receptors / protein molecule on cell membrane (1) • therefore these cytokines initiate {gene transcription / protein synthesis} in T killer or B cells (1) 	<p>ACCEPT tertiary structure</p> <p>ACCEPT cytokines only act on cells with complementary receptors/ complementary binding sites</p> <p>ACCEPT reference to signalling cascade</p>	3

Question number	Answer	Additional guidance	Mark
6(e)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> gene for CD45 protein transcribed into pre mRNA (1) {spliceosome / enzyme} remove {non coding regions / introns} from (pre) mRNA (1) translation of (different) mRNA molecules (1) to produce CD45 protein with a different primary structure (1) 	<p>accept ref to post transcriptional modification Do not accept reference to DNA splicing</p> <p>accept rearrangement of exons to produce mRNA</p> <p>accept different 3D/ tertiary structure</p>	3

Question number	Answer	Additional guidance	Mark
7(a)	<p>A calculation showing the following steps:</p> <ul style="list-style-type: none"> identification of heart rate at 5 and 12.5 minutes for drug B (1) calculation of percentage change for drug B correct answer 	<p>accept calculation of percentage decrease</p> <p>HR at 5= 30/31 HR at 12.5 = 57/57.5/58</p> <p>57-30/30 x100 = 57.5-30/30 x100= 57-31/31 x100= 58-30/30 x100= 58-31/31 x 100=</p> <p>90.0/91.67/83.87/93.3/87.09</p> <p>Correct answers gain all 3 marks</p>	3

Question number	Answer	Additional guidance	Mark
7(b)	<p>An answer that includes three of the following points:</p> <p>Similarity</p> <ul style="list-style-type: none"> • both drugs have an effect on the heart rate over the time period (1) • with both the greatest effect in first 3 minutes (1) <p>Difference</p> <ul style="list-style-type: none"> • change in heart rate with drug A levels off (between 7-10mins) drug B still increasing at 15mins (1) • drug B reduces heart rate more than drug A 	<p>do not piece together</p> <p>accept increase</p> <p>drug B has greater effect than drug A</p>	3

Question number	Answer	Additional guidance	Mark
7(c)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> • stress increases heart rate (1) • because cardiovascular centre stimulates the SAN (1) • (both) drugs decrease frequency of impulses from SAN (1) • inhibiting the (change/ increase) in heart rate (1) • drug B has a greater effect (on the SAN)(1) 	<p>accept converse</p>	3

Question number	Answer	Additional guidance	Mark										
8(a)	<p>An answer that includes the following points:</p> <table border="1" data-bbox="474 391 1252 901"> <thead> <tr> <th data-bbox="474 391 848 456">Part of Brain</th> <th data-bbox="848 391 1252 456">Function</th> </tr> </thead> <tbody> <tr> <td data-bbox="474 456 848 593">cerebellum</td> <td data-bbox="848 456 1252 593">co-ordination of (voluntary) movement</td> </tr> <tr> <td data-bbox="474 593 848 695">cerebral hemispheres</td> <td data-bbox="848 593 1252 695">interpretation of information from retina</td> </tr> <tr> <td data-bbox="474 695 848 834">medulla oblongata</td> <td data-bbox="848 695 1252 834">regulation of (cardiovascular / respiratory system)</td> </tr> <tr> <td data-bbox="474 834 848 901">(posterior) Pituitary</td> <td data-bbox="848 834 1252 901">secretion of ADH</td> </tr> </tbody> </table>	Part of Brain	Function	cerebellum	co-ordination of (voluntary) movement	cerebral hemispheres	interpretation of information from retina	medulla oblongata	regulation of (cardiovascular / respiratory system)	(posterior) Pituitary	secretion of ADH	<p>Accept posture, balance, muscular activity accept if answers are descriptive</p> <p>accept cerebrum / visual cortex / occipital lobe/ cerebral cortex</p> <p>Accept hypothalamus</p> <p>Two correct cells = 1 mark All four cells = 2 marks</p>	2
Part of Brain	Function												
cerebellum	co-ordination of (voluntary) movement												
cerebral hemispheres	interpretation of information from retina												
medulla oblongata	regulation of (cardiovascular / respiratory system)												
(posterior) Pituitary	secretion of ADH												

Question number	Answer	Additional guidance	Mark
8(b)	<p>An answer that includes four of the following points:</p> <p>Similarity</p> <ul style="list-style-type: none"> • both are (neuro-imaging) methods giving high resolution (1) • both give images of areas with plaques in the brain (1) <p>Differences</p> <ul style="list-style-type: none"> • fMRI expensive CT cheaper (1) • fMRI will show {metabolism / oxygen uptake / brain activity} CT only shows structures (1) • fMRI uses magnetic resonance CT uses X rays (1) 	<p>2 marks max for similarities, 2 marks for differences needs to be compare and contrast.</p> <p>ACCEPT fMRI 45 mins CT 5-10 mins</p> <p>fMRI does not use ionising radiation CT does (so increased risk of cancer developing)</p> <p>ignore fMRI has higher resolution than CT</p>	4

Question number	Answer	Additional guidance	Mark
8(c)	<p>An answer that includes four of the following points:</p> <ul style="list-style-type: none"> • amyloid protein will cause bacteria to stick together(1) • enhancing phagocytosis of the bacteria / stimulates activity of white blood cells (1) • acts as an antibiotic / anti-microbial (1) • amyloid protein could disrupt ability of bacteria to adhere directly to host cell (1) • prevents entry of bacteria into cells (1) 	<p>ACCEPT agglutinate / sticks to the surface of the bacteria</p> <p>ACCEPT description of phagocytosis do not accept trigger immune response.</p>	4

Question number	Answer	Additional guidance	Mark
8(d)	<p>An answer that includes the following points:</p> <ul style="list-style-type: none"> • bacteria carried in blood from (infected) gums (1) • bacteria penetrate the blood-brain barrier (1) • bacteria /bacterial products cause the release of {histamine/ chemicals / cytokines} (1) • resulting in vasodilation (1) • consequence of vasodilation (1) 	<p>ACCEPT bacteria can invade white blood cells which cross the blood brain barrier</p> <p>eg increased blood flow / oedema / increase in wbc in brain/increased oxygen.</p>	4

Question number	Answer	Additional guidance	Mark
8(e)	<p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> gingipains are enzymes (that break down proteins in membranes) (1) degrading/break down cell membranes (1) resulting in loss of (active) brain tissue (in the cerebrum) (1) leads to reduction in memory (especially short-term memory) (1) 	<p>ACCEPT reference to an effect on transport channels within membrane</p> <p>ACCEPT in context effect on nerve impulses / action potentials</p>	3

Question number	Answer	Additional guidance	Mark
8(f)	<p>A description that includes three of the following points:</p> <ul style="list-style-type: none"> extraction of infected part of cerebral cortex (1) use microarray (to identify mRNAs in sample) (1) (analysis of mRNA) to identify genetic material from <i>Porphyrromonas</i> (1) use of bioinformatics / algorithms to analyse the (enormous quantity of) data (from the microarray) (1) 	<p>ACCEPT use of specific microarray eg oligo- nucleotide microarray</p>	3

