Mark Scheme (Results)

October 2022

Pearson Edexcel International Advanced Level in Biology (WBI15)

Paper 01: Respiration, Internal Environment, Coordination and Gene Technology

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

October 2022
Question Paper Log Number P71871A
Publications Code WBI15_01_2210_MS

Question number	Answer	Additional guidance	Mark
1 (a)(i)	C is the correct answer • 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)	D is the correct answer • 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)	A description that includes two of the following points: • 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)	can piece together reference to movement of electrons along electron carriers releasing energy to {pump protons into intermembrane space / create electrochemical gradient} accept protons move down electrochemical gradient accept ADP + Pi -> ATP	Expert (2)

Question number	Answer	Additional guidance	Mark
1(c)	D is the correct answer • 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		Computer (1)

Question number	Answer	Additional guidance	Mark
2(a)(i)	B is the correct answer • 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)	D is the correct answer • 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)	D is the correct answer • 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)	An explanation that includes two of the following points: • 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)	muscles if named - rectus femoris and gastrocnemius / fibialis accept muscles work antagonistically ignore one contracts and the other relaxes accept ligaments hold the bones in place	Expert (2)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	A description that includes three of the following points: • 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)	mps need to be in logical order to gain credit ACCEPT ATP broken down into ADP and Pi Do not accept the power stroke	Expert (3)

Question number	Answer	Additional guidance	Mark
3(a)(i)	An answer that includes the following points Label / Part L – dendrites M – cell body / centron N – axon O – (pre)synaptic {endings /knob/bulb}	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)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	D is the correct answer • 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)	• (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 • correct measurement of X-Y in µm (1) • calculation of thickness of connecting tissue (1) OR • calculation of thickness (1) • conversion to µm (1)	 11 000 µm (11 000 ÷ 3300)= 3.3 /3.33/3.333/ 3 µm 1 mark for power of 10 errors e.g. 0.33 or 0.0033 or 333 (11÷ 3300)= 0.00333 (1.1÷ 3300)= 0.0333 (0.00333) x 1000 = 3.3 /3.33/3.333/ 3 µm 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)	An explanation that includes three of the following points • 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)	accept {action potentials / depolarization}occur along the whole unmyelinated neurone mp4 accept converse accept reference to saltatory conduction	Expert (3)

Question number	Answer	Additional guidance	Mark
4(a)(i)	A description that includes the following points: • 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)	Statements can be either way round accept negative correlation accept converse accept converse	Expert (2)

{

Question number	Answer	Additional guidance	Mark
4(a)(ii)	A calculation with the following steps • calculation of oxygen used per kilogram(1) • calculation of oxygen used for 4500kg elephant(1) • correct answer in standard form (1)	(1400 ÷ 5780) = 0.24 (4500 x 0.24) = 1080 1.09×10^3 / 1.0896×10^3 ignoring any units ECF for mps 2 and 3 alternate method working out: 1 mark for 1400 x 4500 = 6 300 000 for 2 marks (4500 x 1400) ÷ 5780 = 1089.96	Expert (3)

1 mark	2 marks	3 marks
(1400 ÷ 5780) = 0.24	(4500 x 0.24) = 1080	1.09×10^3
1400 x 4500 = 6 300 000	(4500 x 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)	An explanation that includes the following points: • chemoreceptors detect {lower pH of blood / increased blood CO_2 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)	Do not accept reference to signals / messages increased adrenaline production adrenaline which circulates in the blood mp3 adrenaline binds to receptors in {heart muscle / SAN} mp4 (causing SAN) to increase frequency of depolarisation causing an increase in {heart rate / systole} chemoreceptors in medulla oblongata detect increase in blood CO_2 = 2 marks	Expert (4)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that includes two of the following points: • 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)	the sprint requires large amounts of ATP (for muscle contraction) accept lactate accept release of heat so body temperature goes up rapidly / homeostatic mechanisms cannot occur quick enough	Expert (2)

Question number	Answer	Additional guidance	Mark
5(a)	C is the correct answer • 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		Computer (1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	A calculation with the following steps • calculation of water use each day for camel and buffalo (1) • correct difference in dm3 to two significant figures(1)	(57 x 850) = 48450 cm^3 (150 x 697)= 104550 cm^3 (104550 - 48450) ÷ 1000 = 56 (dm^3) 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	Graduate (2)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that includes the following points: • credit one adaptation / environmental condition (1) • credit second adaptation / environmental condition (1)	accept different habitat accept different environmental condition	Expert (2)

Question number	Answer	Additional guidance	Mark
5(c)	An answer that includes three of the following points: • (overall)l 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)	can piece together from separate descriptions of data accept fresh water caused the highest increase in(mean) mass 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 Fresh 0.83% and sea 0.42% daily	Expert (3)

Question number	Answer	Additional guidance	Mark
5(d)	An answer that includes two of the following points: • (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)	accept reference to counter current multiplier accept ADH results in increased absorption of water accept increased permeability to water in DCT and collecting duct accept ADH causes insertion of {water channels / aquaporins} in DCT and collecting duct	Expert (2)

Question number	Answer	Additional guidance	Mark
6(a)	A is the correct answer • 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)	An explanation that includes three of the following points: • 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)	accept accumulates on the left of diagram accept auxins move away from the exposed light 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 accept causing positive phototropism do not accept bend towards light	Expert (3)

Question number	Answer	Additional guidance	Mark
6(c)	An explanation that includes four of the following points: • (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)	ignore amylose transcription factor binding to promotor region of gene cause the inactivation of (amylase) gene {inhibitor protein/repressor molecule} ignore monomers activates gene that produces amylase = mps 2 and 3	Expert (4)

Question number	Answer	Additional guidance	Mark
6(d)	An answer that includes four of the following points: • 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 (µmol dm^{-3}) was the most effective at increasing {growth / cell number} (1) • 1 (µmol 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)	can piece together both natural and synthetic auxin are better than the control at all concentrations IAA gives a greater increase in number of cells than NAA Accept most cell number Accept most cell number Accept higher concentrations of auxin(IAA) {had lower increase in growth / had lower increase in number of cells} Accept converse Accept negative correlation	Expert (4)

Question number	Answer	Additional guidance	Mark
7(a)(i)	A description that includes four of the following points: • {identify/isolate/ cut out} the (human) rHE gene (1) • Cut {DNA sequence / gene} using restriction {endonuclease / enzyme} (1) • insert the gene into a vector (1) • inserting vector into suitable target (sheep) {cell / tissue} (1)	gene coding for rHE is isolated using restriction enzymes = 2 marks accept named vector e.g. plasmid, virus ignore bacteria e.g. udder cells / milk (protein) producing cells /fertilized sheep egg cell / embryo /zygote	Expert (4)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	• 77.5 (%)	accept 77 or 78	Graduate (1)

Question number	Answer	Additional guidance	Mark
7(a)(iii)	A description that includes four of the following points: • 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)	accept antigen recognized as foreign accept B cells present antigen to themselves. accept T helper cells cause the production / formation of B effector cells and B memory cells	Expert (4)

Question number	Answer Additional guidance	Mark
7(b)	An answer that includes the following points: Indicative content - description from graphs and experimental data • (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 --- explanation of benefits • 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 --- discussion of risks • 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)	An explanation that includes four of the following points: • 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)	accept rhodopsin absorbs light and forms opsin /light hits rhodopsin and bleaches it accept membrane permeability to sodium ions decreases do not accept (opsin) blocks Na^+ channel	Expert (4)

Question number	Answer	Additional guidance	Mark
8(b)	An answer that includes three of the following points: • 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) OR • extraction of mRNA(1) • use of reverse transcriptase to form cDNA(1) • use of PCR(1) • use of gel electrophoresis and compare banding(1)	Do not pick and mix accept reference to samples of mRNA [ignore marker gene]	Expert (3)

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that includes three of the following points: • (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)	accept TRPV1 as named receptor accept named ion channel do not accept if in motor neurone	Expert (3)

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that includes three of the following • (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)	ignore potassium ions accept calcium ions cause release of neurotransmitters accept if it goes above threshold level	Expert (3)

Question number	Answer	Additional guidance	Mark
8(e)	A explanation that includes three of the following points: • {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)	accept stretches membrane ignore potassium ions	Expert (3)

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that includes two of the following points: • 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)	accept a second protein / amino acid with a similar {structure / DNA base sequence} was identified accept pressure makes them both open accept respond to mechanical stimuli accept respond the same to stimuli	Expert (2)

Question number	Answer	Additional guidance	Mark
8(g)	An answer that includes three of the following points: • 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)		Expert (2)

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom