Pearson Edexcel

Mark Scheme (Results)

Summer 2025

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

Summer 2025
Question paper log number P78739A
Publications Code WBI15_01_2506_MS

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)	An answer that includes the following points: • A dendrite(s) (1) • B cell body (1) • C myelin (sheath(s) (1)	ACCEPT phonetic spelling ACCEPT dendron ACCEPT soma/ cell membrane / centron IGNORE body cell ACCEPT {fatty / lipid} sheath / Schwann cell / glial cell / axon IGNORE lipid unqualified IGNORE sheath unqualified **All 3 correct = 2 marks** **1 or 2 correct = 1 mark**	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)	A description that includes three of the following points: • vesicles {move towards / fuse with} the pre-synaptic **membrane** (1) • releasing neurotransmitters (into the synapse) (1) • (neurotransmitter) **diffuse** {**across** the synapse / to the receptors} (1) • (neurotransmitter) binds to **receptors** on **post**-synaptic {membrane} causing {sodium ion channels to open / influx of sodium ions / depolarisation/ action potential / change in action potential} to occur} (1)	NO ECF ACCEPT 'bind' for fuse ACCEPT named neurotransmitter ACCEPT exocytosis of neurotransmitter (into synapse) ACCEPT through for across IGNORE sodium ion channel as a receptor	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	• crista(e)	ACCEPT phonetic spelling eg. christae, chistae,/ cristea/ christie etc REJECT matrix, cisternae	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	**B** is the correct answer • A is not the correct answer as the conversion of glucose to pyruvate does not occur on the inner membrane but in the cytoplasm • C is not the correct answer as the production of glucose from carbon dioxide does not occur on the inner membrane but in the chloroplast • D is not the correct answer as light is not trapped on the inner membrane of the mitochondria but in the chloroplast		**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(iii)	A calculation showing the following steps: • correct actual measurement of mitochondrion and conversion to µm (1) • calculation of magnification and answer given in standard form (1)	44 (+/-1mm) = 44000 µm Accept 43 -45mm Accept conversion of 2.7 µm to mm (44000 ÷2.7) = 1.629 x 10^4 Allow 1.6 x 10^4 / 1.63 x 10^4 / 1.6296 x 10^4 Correct answer with no working gains full marks ACCEPT for 2 marks correct standard form in range of 1.59 x 10^4 to 1.7 x 10^4 1 mark only for 16296.3 /16300 ECF – 1 mark ecf for power of 10 error resulting from incorrect conversion with rest of calculation correct, given correctly in standard form	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	A description that includes three of the following points: • (at the inner membrane) {reduced NAD / NADH} gets {oxidized / releases electrons} (1) • the electrons pass {**along / down / through}** the electron transport chain, releasing energy (1) • (this energy)is used to **pump** protons **across** a {membrane / inner mitochondrial membrane}, {creating /against} an {electrochemical / proton/ concentration} gradient (1) • finally, the (enzyme) **ATP synthase (**uses this gradient) to {produce ATP / phosphorylation of ADP} (1)	ACCEPT hydrogen **ion** / H^+ for proton ACCEPT provides electrons IGNORE to electron transport chain REJECT produce energy ACCEPT actively transport protons for pump protons ACCEPT reference to protons being pumped from **matrix to the intermembrane space** {creating / against}an {electrochemical / proton / concentration} gradient REJECT ATPase ACCEPT (protons diffuse through) ATP synthase causing ADP to be phosphorylated (to ATP) IGNORE reference to ADP + Pi -→ATP without reference to ATP synthase	**(3)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	**A** is the correct answer • B is not the correct answer as the oxygen molecules accept electrons • C is not the correct answer as the oxygen molecules accept electrons D is not the correct answer as the oxygen molecules accept electrons		**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	**A** is the correct answer • B is not the correct answer as the mitochondrial matrix is not the site of the electron transfer chain • C is not the correct answer as the outer mitochondrial membrane is not the site of the electron transfer chain • D is not the correct answer as the ribosome is not the site of the electron transfer chain		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)	**A** is the correct answer • B is not the correct answer as the lidocaine does not increase the number of action potentials • • C is not the correct answer as the lidocaine does not open potassium ion channels • D is not the correct answer as the lidocaine does not open sodium ion channels		**(1)**

Question number	Answer	Additional guidance	Mark
3(b)	**D** is the correct answer • A is not the correct answer as MDMA does not damage the myelin sheath of neurones • B is not the correct answer as MDMA does not decrease the release of neurotransmitters • C is not the correct answer as MDMA does not decrease the speed of action potential transmission in neurones		**(1)**

Question number	Answer	Additional guidance	Mark
3(c)	An answer that includes the following points: • (TTX) {prevents / blocks} {**sodium ion /calcium ion}** channels from opening / {prevents / blocks} movement of {sodium / calcium} ions} (1) • preventing {(initiation of) action potentials / depolarisation / **no** depolarisation}(1) • therefore **no / less / block** (transmission of) nerve impulse to the {intercostal muscles/ muscles involved in breathing/ medulla / medulla oblongata / respiratory centre / ventilation centre} (1)	ACCEPT prevents sodium voltage gated channels from opening ACCEPT blocks calcium ions which prevents release of neurotransmitters REJECT if ion movement is in wrong direction IGNORE less action potentials ACCEPT **no / less / block** (transmission of) nerve impulse from medulla / medulla oblongata / respiratory centre} ACCEPT other named muscles involved in breathing e.g. diaphragm	**(3)**

Question number	Answer	Additional guidance	Mark
3(d)(i)	An answer that includes both of the following points: • the {dose / concentration / 8.4μg Kg^{-1}} (of TTX) that causes death of {**50%/ half}**of the population(1)	**Both parts needed** ACCEPT dose (of TTX) needed for 50% of mice to die ACCEPT dose (of TTX) needed for 50% of mice to survive	**(1)**

Question number	Answer	Additional guidance	Mark
3(d)(ii)	An answer that includes three of the following points: • at {low dosage/ below 6 µg/kg / between 5 to 6 µg/kg} there are no deaths (1) • as dosage increases (above 6 µg/kg) {percentage / number} of mice dying increases (1) • at 10 µg/kg percentage of mice dying is {**100% / all the mice die}** (1) • comment on methodology (1)	units not required for mp1 and 2 accept concentration for dosage / and toxicity for % of mice dying ACCEPT no effect {until / until above} 6 µg/kg ACCEPT there is a positive correlation between dosage and number of mice deaths ACCEPT non-linear increase ACCEPT deaths increase after 6 µg/kg e.g. age / sex / strain / number of mice not given / no error bar or indication of repeats	**(3)**

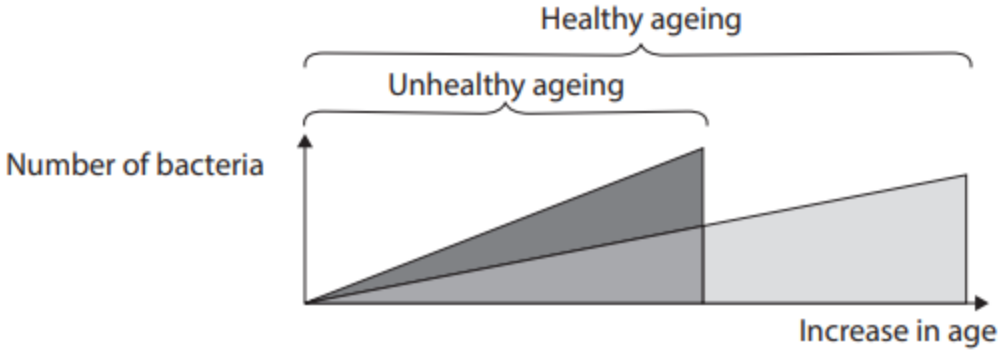
Question number	Answer	Additional guidance	Mark
4(a)	An explanation that includes the following points: • (L-DOPA) is **absorbed** into the **blood** (from the gut) (1) • (L-DOPA)crosses the blood-brain barrier (1) • it is converted into dopamine (in the brain) (1) • {replacing / increasing} (level / concentration) of dopamine lost by {destruction / death} of dopamine producing neurones (1)	IGNORE (diffusing, passing, travelling into etc) ACCEPT turns into etc Need **BOTH** parts ACCEPT subtantia nigra or cells in the brain in place of neurones ACCEPT Parkinson's is caused by {loss / death} of dopamine {producing cells / neurones}	**(4)**

Question number	Answer	Additional guidance	Mark
4(b)	**A** is the correct answer B is not the correct answer as medulla oblongata is not involved in long term memory C is not the correct answer as medulla oblongata is not involved in the release of ADH D is not the correct answer as medulla oblongata is not involved in voluntary movement		**(1)**

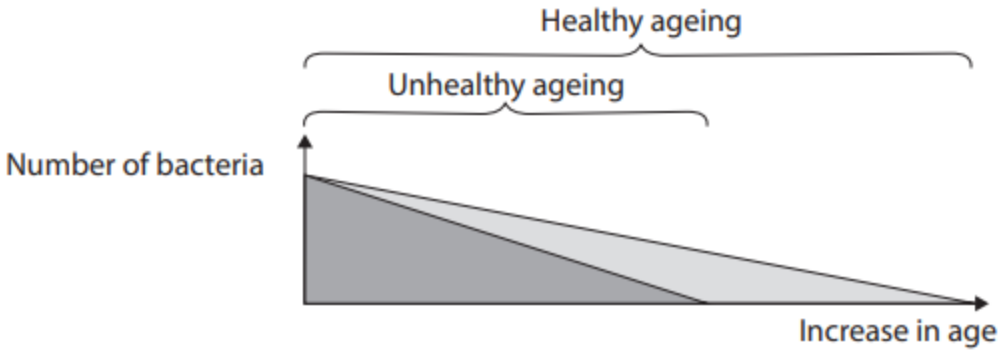
Question number	Answer
*4(c)	**Indicative content**
1	**Graph 1 and graph 2** • as age increases the numbers of pathogenic bacteria increase (D) • in unhealthy ageing the numbers of pathogenic bacteria {increase faster / reach higher levels in younger people} accept converse(D) as age increases the numbers of protective bacteria decrease (D) • in unhealthy ageing the numbers of protective bacteria {decrease faster / reach lower levels in younger people} accept converse(D)
2	**Graph 3** • as age increases the inflammation increases (D) • in unhealthy ageing inflammation {increases faster / reach higher levels in younger people} accept converse (D)
3	Explanation aspect PATHOGENIC / PROTECTIVE BACTERIA ○ named unhealthy / pathogenic bacteria e.g. TB (E) • infections with pathogenic bacteria increase use of antibiotics which causes change in gut flora(E) ○ comment on competition / relationship between protective and pathogenic bacteria • protective bacteria are found naturally {on skin / gut flora} (E) • which inhibit the growth of pathogens by competition for food / space / release of toxins (E) • description of effect of taking antibiotics on (skin / gut / protective) bacteria
4	INFLAMMATION • inflammation is in response to {named disease / damage / infection} Ignore lifestyle factor eg smoking • inflammation can {weaken a person / disrupt named organ function/ cause premature death} • details of immune response leading to inflammation • inflammation leading to negative impact on {lifestyle / named organ / system} (E)

5 and **6**	• **Impact of infection, or lifestyle on systemic health** • pathogenic bacteria cause disease which may {weaken the immune system / kill the person/ premature death} (E) • damage caused by pathogenic bacteria leading to negative impact on lifestyle • damage caused by pathogenic bacteria leading to negative impact on ONE {organ / system} • damage caused by pathogenic bacteria leading to negative impact on SECOND {organ / system} • linkage of named lifestyle factor that increase risk of CVD / stroke e.g. diet high is saturated fats leading to atherosclerosis / (E) • linkage of named lifestyle factors to respiratory problems e.g. smoking causing emphysema (E) • linkage of named lifestyle factor that increase risk of {nervous / brain} problems e.g. {smoking / drug abuse} causing plaques leading to dementia • linkage of named lifestyle factor that increase cancer e.g. exposure to radiation • immune disorders e.g. MS, Crohn's disease, RA • effect of drugs used to treat other disorders e.g. radiotherapy, anti-inflammatories, steroids, L dopa, immunotherapy
7	**Methodology OR Statistical** • accept relevant comment about methodology – no indication of gender / sex / sample size / ethnic origin/ species of bacteria analysed • accept relevant comment about statistical data—no indication of error bars so no comment on significant difference

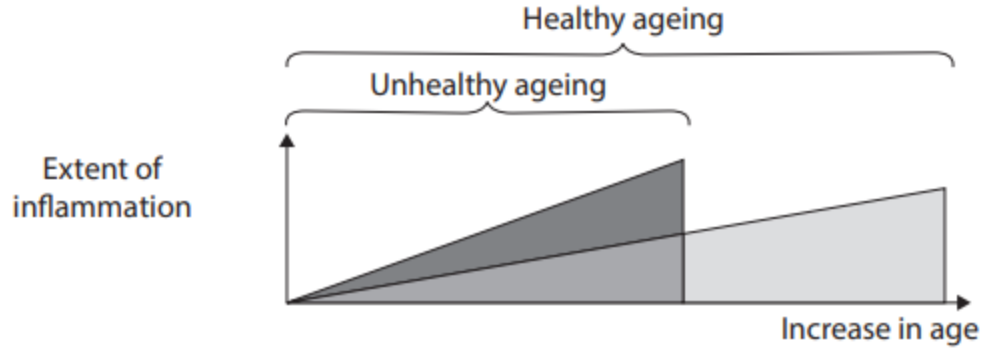
Graph 1 Changes in pathogenic bacteria



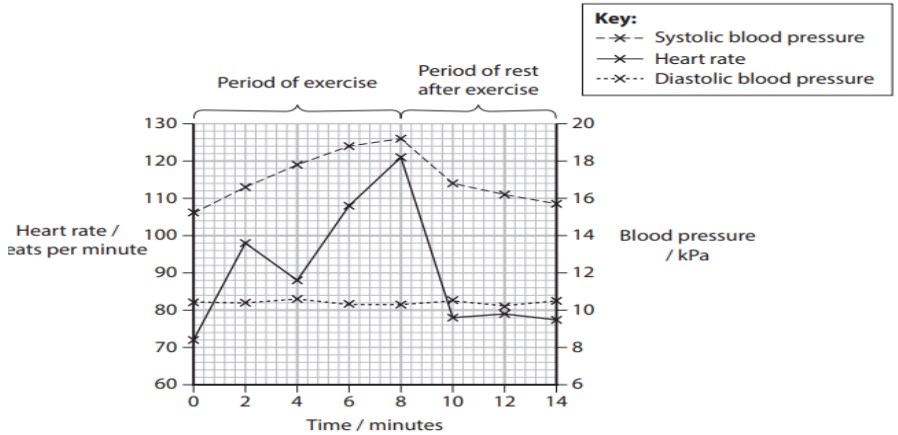
Graph 2 Changes in protective bacteria



Graph 3 Changes in inflammation



Level	Marks	Requirement	Additional guidance
0	0	No awardable content	
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	**Level 1 : description of data** 1 mark = description of one aspect 2 marks = description of two aspects
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	**Level 2 : some discussion of data** 3 marks = discussion of one aspect 4 marks = discussion of two aspects
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	**Level 3 : extended discussion of data** 5 marks = linkage of one aspect 6 marks = explanation of at least two aspects that includes links between them / methodology comments

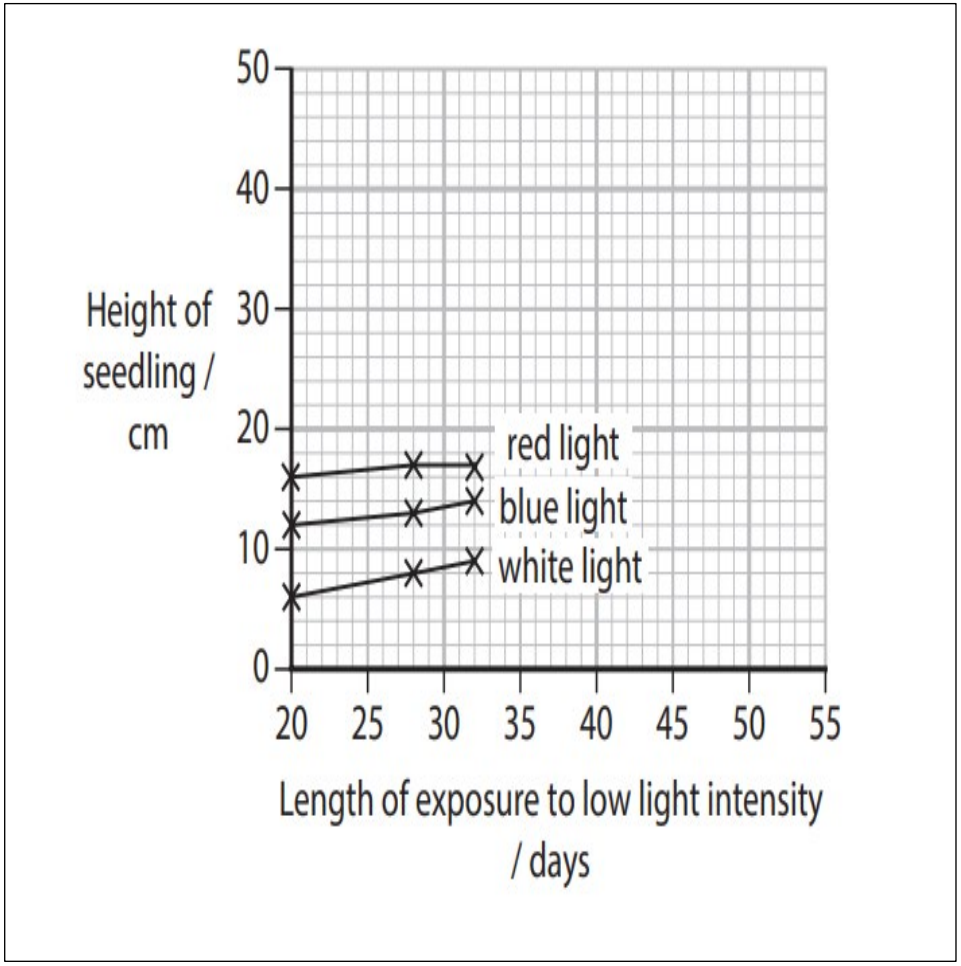
Question number	Answer	Additional guidance	Mark
5(a)(i)	A description that includes three of the following points: • systolic blood pressure increases with exercise (time) **and** decreases after exercise during recovery (1) • diastolic blood pressure is unaffected by exercise and recovery(1) • heart rate increases with exercise (time) **and** decreases after exercise during recovery(1)	Must refer to exercise and rest peiods ACCEPT {period of rest / after exercise} for recovery ACCEPT DBP remains constant at all times / throughout 14mins ACCEPT heart rate follows same pattern as the systolic blood pressure **PROVIDING** they have stated the pattern for mp1 first (accept converse if Heart pattern given first) DO NOT ACCEPT heart rate {increases, decreases and increases again / fluctuates} during exercise ACCEPT mps 1 and 3 in the same sentence	**(3)**
		

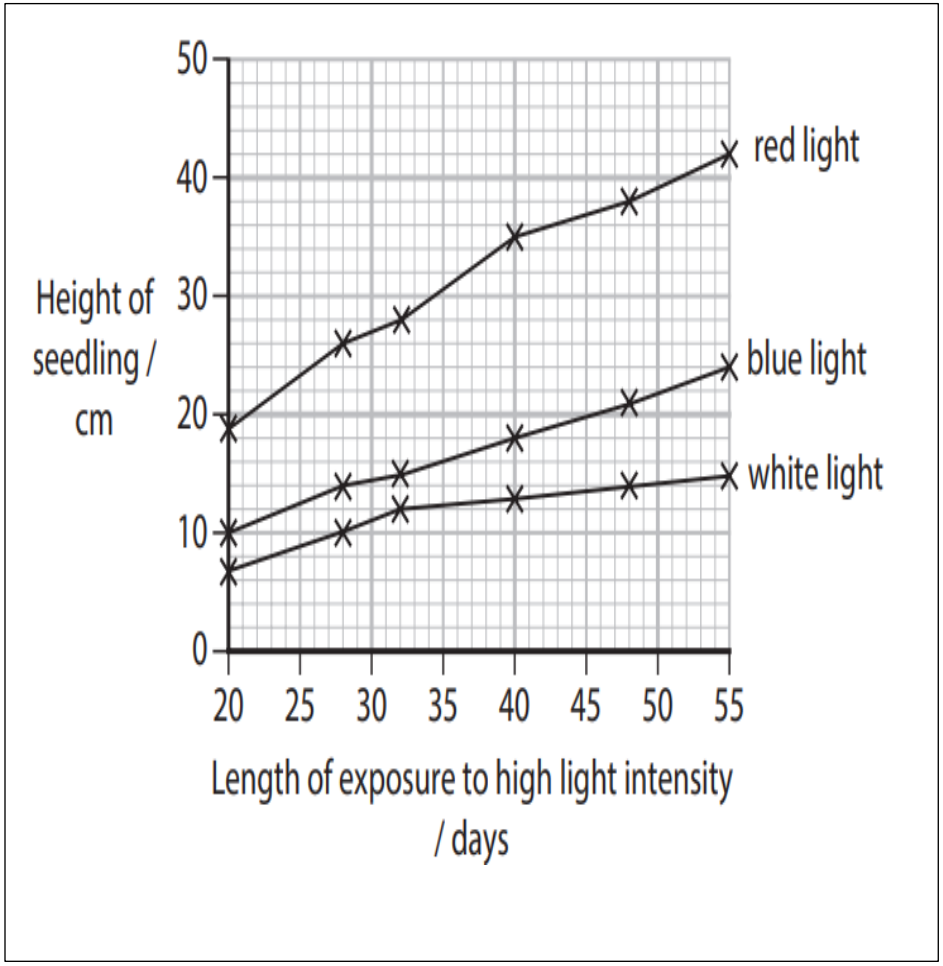
Question number	Answer	Additional guidance	Mark
5(a)(ii)	A description that includes four of the following points: • (exercise) {increases **blood** carbon dioxide concentration/decreases **blood** pH} (1) • detected by chemoreceptors in the {cardiovascular centre / CVC / medulla/carotid or aortic bodies } (1) • **increased** impulses along {motor neurones/ sympathetic nervous system /SNS} to **SAN** (during systole)(1) • leading to increased {**force** of contraction of {cardiac/ heart} muscle / **ventricular contraction**}(1) • diastolic blood pressure remains constant because cardiac muscle is relaxing (1)	REJECT contradiction about blood carbon dioxide and pH ACCEPT chemoreceptors send impulse to { medulla/CVC / medulla oblongata} ACCEPT {cardiac muscle / heart muscle / ventricles} contracts more frequently ACCEPT increased ventricular systole	**(4)**

Question number	Answer	Additional guidance	Mark
5(b)	A calculation showing the following steps: • conversion of volume to cm^3 (1) • calculation of stroke volume and answer given to two significant figures (1)	$(5 \times 1000) = 5000\ cm^3$ / 5×10^3 $(5000 \div 72) = 69.44$ $= 69\ cm^3$ 69.44 / 69.4 / 69.4r gains 1 mark IGNORE 69.0 ACCEPT 5 = 72 x SV so SV = (5 ÷ 72) X 1000 = 69.44 = 69 to 2 sf 0.0694 x 1000 = 69.4 = 1 mark Correct answer with no working gains full marks ecf for power of 10 error resulting from incorrect conversion with rest of calculation correct, given correctly to 2 significant figures eg 0.069, 6.9, 69000, 6.9×10^{-5}	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)	**B** is the correct answer • A is not the correct answer as chlorophyll is not the photoreceptor that detects light during germination of seeds, it absorbs light in photosynthesis • C is not the correct answer as retinal is not the photoreceptor that detects light during germination of seeds as it is pigment found in the eye • D is not the correct answer as rhodopsin is not the photoreceptor that detects light during germination of seeds as it is pigment found in the eye		**(1)**

Question number	Answer	Additional guidance	Mark
6(b)	An answer that includes four of the following points: **THREE** from: • {growth occurs / height increases} in both (low and high) light **intensities** (1) • {growth/height} greater in {high / increasing} light intensity (1) • {growth / height} is lowest in white light / white light has the least effect (1) • {growth / height} is greatest in red light / red light has greatest effect(1) **AND (FOR THE FOURTH MARK)** • appropriate **rate or percentage increase** calculated (1)	IGNORE references to length of light exposure ACCEPT {growth/height increases} occurs in red, blue and white light / all **colours** of light Need a clear statement Need clear statement ACCEPT converse Need a clear statement ACCEPT The effect of light on {growth / height} – red light > blue light > white light = mps 1 4 AND 3 IGNORE data just read off the graph examples of calculations LOW RED 0.03 cm day^{-1} BLUE 0.06 cm day^{-1} WHITE 0.09 cm day^{-1} HIGH RED 0.42 cm day^{-1} BLUE 0.25 cm day^{-1} WHITE 0.15 cm day^{-1} Increase in Red – 121%	**(4)**


Height of seedling / cm
50
40
30
20
10
0
red light
blue light
white light
20 25 30 35 40 45 50 55
Length of exposure to low light intensity / days


Height of seedling / cm
50
40
30
20
10
0
red light
blue light
white light
20 25 30 35 40 45 50 55
Length of exposure to high light intensity / days

Question number	Answer	Additional guidance	Mark
6(c)	An explanation that includes four of the following points • auxin molecules bind to a {receptor / protein}(1) • (causes) hydrogen ions to be {**pumped / released }** (from the cytoplasm) **into the cell wal**l(1) • hydrogen ions lowers the pH in the cell wall (1) • {reducing breaking} the **hydrogen** bonding between {microfibrils / cellulose molecules} (1) • uptake of potassium ions reduces the water potential of the cell (1) • causing water to enter by osmosis (1) • (increase in cell water content / water absorption) leads to cell **elongatio**n(1)	. ACCEPT auxin stimulates ATPase proton pumps ACCEPT uptake of potassium ions gives higher solute concentration	**(4)**

Question number	Answer	Additional guidance	Mark
6(d)(i)	A calculation showing the following steps: • correct percentage germination difference subtracted (1) • 60 % **decrease** (between 200ppm and 400ppm) (1)	No ECF (114 – 46) = **68** ACCEPT **-60%** correct answer scores full marks 60 without (-) or decrease = 1 mark ECF 1 mark for 148% **INCREASE** or **+**148% (between (400 and 200ppm)	**(2)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td rowspan="2">6(d)(ii)</td><td>An explanation that includes the following points:

• increase in gibberellin concentration gives {increase in germination up to 200ppm/ decrease in germination after 200ppm} (1)

• (gibberellin stimulate germination) by {activation of transcription factors / activation of genes /transcription of genes} (1)</td><td>ACCEPT 200ppm has the highest germination

ACCEPT {DNA / alleles} for genes

IGNORE gibberellin acts as a transcription factor</td><td rowspan="2">(2)</td></tr>
<tr><td>The table shows the results of this investigation.

<table><tr><th>Gibberellin concentration / ppm</th><th>Number of seeds germinating</th></tr><tr><td>0</td><td>26</td></tr><tr><td>100</td><td>92</td></tr><tr><td>200</td><td>114</td></tr><tr><td>300</td><td>66</td></tr><tr><td>400</td><td>46</td></tr></table></td></tr>
</table>

Question number	Answer	Additional guidance	Mark
7(a)(i)	**A** is the correct answer • B is not the correct answer as it part of the cerebral hemisphere • C is not the correct answer as it is part of the medulla • D is not the correct answer as it is the cerebellum		**(1)**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	An explanation that includes three of the following points: • GH binds to receptor on {muscle cell membrane / sarcolemma} (1) • {activate / forms} a second messenger / activating a transcription factor (1) • which {binds to promotor region / enables RNA polymerase to bind} (1) • leading to transcription of muscle protein {genes / alleles} (1)	ACCEPT activates enzymes / cAMP / named secondary messenger ACCEPT named muscle protein genes e.g. actin, myosin ACCEPT transcription of muscle protein {genes / alleles} leading to formation of mRNA which is translated into muscle protein	**(3)**

Question number	Answer	Additional guidance	Mark
7(b)	An answer that includes three of the following points: • As age increases the GH concentration decreases (1) • rapid decline of GH (in blood) {between 10 – 30 years /up to 30 years / slower decline as age increases (1) • appropriate comment on stated error bars (1) • appropriate comment on lack of experimental method (1)	ACCEPT {negative / inverse} {relationship / correlation} / inversely proportional} (between age and GH concentration) ACCEPT numbers in that range ACCEPT non-linear decrease e.g. there is no significant difference between xxx and xxx as the error bars overlap / the error bar at age {28/34/73} Ho is very large decreasing the validity **IGNORE if no age reference** e.g unknown sample size / lifestyle factors / other diseases	**(3)**

mp

Q7b

Error Bars do not overlap	Error Bars overlap
18 and (32/43/60/61/73/86) Bod 24 and 86	18 and (24/30) All bars between 24 and 86

Question number	Answer	Additional guidance	Mark
7(c)	**A** is the correct answer • B is not the correct answer as amylopectin is not a hormone released by stimulation of the adrenal medulla • C is not the correct answer as cholesterol is not a hormone released by stimulation of the adrenal medulla • D is not the correct answer as statin is not a hormone released by stimulation of the adrenal medulla		**(1)**

Question number	Answer	Additional guidance	Mark
7(d)(i)	A description that includes the following points: • gene(s) for **GH** isolated (from human DNA) (1) • using {restriction / endonuclease} enzyme (1) • method of inserting gene(s) into {plasmid / virus / vector} (1) • which is inserted into mouse cells by appropriate named method (1) • • then **culture** the (mouse) cells (1)	 ACCEPT extract / cut out /removed ACCEPT RE enzyme e.g. same restriction enzyme used to cut **plasmid** / use of ligase to bind **complementary** sticky ends / removal of virus genetic information e.g. heat shock, electroporation, viruses infection genetic material, gene gun, **micro**-injection , liposomes, infect mouse cell with bacteria / plasmid	**(4)**

Question number	Answer	Additional guidance	Mark
7(d)(ii)	An answer that includes the following points: • one advantage (1) • one disadvantage (1)	IGNORE mouse {cells / organs} are more similar to human {cells / organs} e.g. (specific) activity of the GH is higher / more effective / mice GH is more similar in structure / less chance of {rejection / immune response} e.g. GH can be produced efficiently – cost effective e.g. similar {genome / DNA sequences} e.g. simpler to purify e.g. increases half-life of GH e.g. unethical / ethics over use of mouse cells e.g. mouse cells {divide more slowly / more expensive (to maintain}} e.g. lower yield e.g. greater risk of contamination with mammalian pathogens Advantage of E coli = disadvantage of mouse cell - CONVERSE NOTE – {time / cost / yield} could be an advantage or disadvantage depending on their reasoning	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	An answer that includes the following point: • (scanning) electron (microscope)(1)	IGNORE electronic, electric, electrical, E , high resolution ACCEPT SEM ACCEPT transmission electron microscope / TEM ACCEPT high resolution electron microscope If list please mark the first answer	**(1)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	A calculation showing the following steps: • correct measurement of the lengths of X and Y chromosome (1) • ratio calculated and given in the correct format (1)	NO ECF X = 94 mm Y = 39 mm accept in cm (accept +/-1mm) (94÷39) = 2.4 : 1 ACCEPT 2.5 : 1 - 2.3 :1 correct answer gains full marks	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)	An answer that includes two of the following points: • (loss of Y chromosome) means loss of genes / because (most)women can't lose a Y chromosome/ women do not have Y chromosome (1) • (loss of Y chromosome) genes) cause { changes/ mutations} {in cells / macrophages / named organ} (1) • which leads to {scarring to heart / damage to heart / cancer / Alzheimer's disease }(1)	ACCEPT genes still present on X chromosome in women ACCEPT Y chromosome genes have a negative effect on the heart that are not present in women who lack the {genes / Y chromosome} IGNORE loss of Y chromosome unqualified as in stem of question ACCEPT reduced immune function / malfunction of phagocytes / causes (increased) inflammation / causes (increased) {atherosclerosis / atheromas} ACCEPT Y chromosome contains genes that may prevent inflammation / fibrosis ACCEPT cardiac muscle for heart	**(2)**

Question number	Answer	Additional guidance	Mark
8(c)	A description that includes the following points: • using {gRNA / RNA sequences} complementary to (specific) {gene / DNA sequence} (on Y chromosome) (1) • which enables {Cas(9) / endonuclease enzyme} to {cut / delete} {gene(s) / section of DNA / at specific sequence} (1)	IGNORE nucleic acids unqualified ACCEPT gRNA guides {Cas(9) / endonuclease enzyme} ACCEPT gRNA {stimulates / activating} Cas9 / enzyme ACCEPT use of restriction enzymes / RE (in correct context) IGNORE enzymes unqualified REJECT plasmid ACCEPT Cas9 cut the Y chromosome	**(2)**

Question number	Answer	Additional guidance	Mark
8(d)	A description that includes the following points: • use a (screening) questionnaire (1) • using a named physiological measurement/ or techniques (1) • using a second named physiological measurement / or technique (1) • comparison with **national data** / perform named statistical test on data (1)	e.g. lifestyle factor questionnaire e.g. ECG /heart rate/ cardiac output/ blood pressure / (blood) cholesterol level / BMI / angiogram / ultrasound of heart / PET / MRI / stress test / specific blood markers e.g.CRP / blood test to detect numbers of cells without Y chromosome / {genetic / blood} screening to identify cells without Y chromosome ACCEPT compare with people {with Y chromosome / loss less than 40% of Y chromosome} IGNORE compare with healthy people	**(3)**

Question number	Answer	Additional guidance	Mark
8(e)	An explanation that includes two of the following points: • (antibody) binds to {ISM / ISM receptor/ growth factor / the molecule} (1) • causing inhibition of {enzyme / signalling pathway} (1) • {inhibiting / prevents stimulation of} inflammatory response (1)	ACCEPT opsonisation / agglutination ACCEPT blocks ISM receptor on cells ACCEPT prevents {growth factor / ISM} binding to target cells / causes phagocytosis of {growth factor / ISM} preventing ISM from binding to other cells and causing inflammation = mp2 &3	**(2)**

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that includes two of the following points: • temperature acts as a stimulus (1) • causing the activation of genes for {steroid / protein /enzyme / sex hormones} (1) • which bind to {membrane / nuclear} receptors (1) • initiating sexual {differentiation / development / growth / development of (sex) organs / genitalia} (1)	ACCEPT reference to epigenetic changes /named epigenetic changes ACCEPT affects activity of an enzyme (aromatase) / allow enzymes work faster / allow description of increase/ decrease enzyme activity IGNORE denaturing of enzyme ACCEPT which converts {testosterone / androgen} to oestrogen / change {T/O} balance ACCEPT production of oestrogen IGNORE determine the sex of an animal as this is the wording from the question stem	**(2)**

Question number	**Answer**	**Additional guidance**	**Mark**
8(g)	• 87 (%) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
8(h)	An explanation that includes the following points: • X chromosome {inactivation / silencing} in one of the female XX sex chromosomes (1) • named example of epigenetic modification (1)	ACCEPT **All** the genes on the X chromosome ACCEPT DNA methylation / DNA demethylation / histone modification / histone acetylation / demethylation of repressor gene Non coding RNA {coating / wrapping round} one of the sex XX chromosomes and deactivates it / forms stable Barr body For mps 1 and 2	**(2)**

Question number	Answer	Additional guidance	Mark
8(i)	An explanation that includes three of the following points: • bone marrow contains stem cells that differentiate into immune cells (1) • some men lose their Y chromosomes in their bone marrow (cells)(1) • resulting in an impaired immune system (1) • therefore no destruction of the cancer cells (1)	ACCEPT gives rise to for differentiate ACCEPT less immune cells / fewer named immune cell / reduced release of cytokines / disrupted function of named immune cell ACCEPT less {destruction / killing} of {mutated / cancer} cells	**(3)**