

Question 1

Question	Marking Guidance	Mark	Comments
08.1	1. Affects/damages <u>basement membrane</u> OR More protein channels/carriers in <u>basement membrane</u> ; 2. Proteins can pass into the (glomerular) filtrate/tubule;	2	2. Ignore nephron.
08.2	Box 4 The non-homologous section of an X chromosome	1	
08.3	1. Effective as D has lower protein (than B/C); 2. Not fully effective as D has higher protein than A; 3. Do not know all results for other mice in D OR Only shows results for 68% of mice; 4. Some of D mice may have been cured OR Some of D may have died; 5. Do not know actual/numerical quantity of protein; 6. (Investigation) only on mice OR (Investigation) not on humans; 7. Rejection may occur; 8. Only shows results for 20 weeks/short-time period OR Long-term effects not known;	4 max	Accept descriptions of each group e.g. A = wild type mice. B = AS mice. C = AS mice that received AS stem cells. D = mice that received wild type stem cells. Accept 'healthy' or 'without AS' for 'wild type'. 6. Accept 'rats' for 'mice'. 7. Accept 'immune response' for rejection. Ignore answers relating to sample size or statistical test.
08.4	1. (Transplanted stem cells) differentiate/specialise; 2. Reduce loss of protein at the glomerulus OR Prevents protein moving into filtrate;	2	2. Accept Bowman's/renal capsule.

Question 2

Question	Marking Guidance	Mark	Comments
03.1	1. Volume of (stock) bacteria (culture); 2. Concentration of (stock) bacteria (culture); 3. Concentration of glucose OR Concentration of (respiratory) substrate; 4. Volume of ammonium chloride; 5. Time (bacteria/culture left to divide); 6. Concentration/volume of oxygen; 7. Concentration/volume of nitrogen;	2 max (2 x AO2)	Accept vol. for volume and conc. for concentration. 1 and 2. If neither credited accept number/mass of bacteria for 1 mark. 1 and 2. Ignore volume/concentration of liquid culture. 3. Accept concentration of ion/named ion but ignore ammonium chloride. Ignore 'same bacteria/species/type'. 1, 2, 3, 4, 6. and 7. Ignore amount. 3. Ignore 'sugar'. 3 and 4. Ignore nutrients. 6 and 7. Ignore availability/access/exposure.

Question	Marking Guidance	Mark	Comments
03.2	(For) 1. Nitrogenase activity decreases with increase in ammonium chloride (concentration); 2. Nitrogenase activity zero with high (concentration of) ammonium chloride OR Ammonium chloride remains (in medium) when nitrogenase activity zero; (Against) 3. Only used one species; 4. (Inhibition/results) may be due to chloride (ions)	3 max (3 x AO3)	1 and 2. Accept ammonia for ammonium chloride. 1. Accept negative correlation between nitrogenase activity and ammonium chloride (concentration). 2. Accept nitrogenase activity zero at 80/100/120/above 60 ($\mu\text{g cm}^3$ of ammonium chloride). 2. Accept 'stops' for zero. 3. Accept only <i>Azotobacter</i> / <i>A. chroococcum</i> / <i>chroococcum</i> / one nitrogen-fixing bacterium / one type/strain used.
	OR (Investigation) uses ammonium chloride not ammonia;		4. Reject 'chlorine'. Ignore reference to statistical tests.
Question	Marking Guidance	Mark	Comments

03.3	1. Less/no ATP/energy required/used OR More ATP/energy available; 2. ATP/energy can be used for growth/synthesis/replication OR Lower (rate of) respiration required OR ATP for phosphorylation;	2 (2 x AO2)	2. Accept ATP can be used for 'other reactions', 'movement', 'active transport' or correctly named reaction. 2. Ignore 'aerobic', 'anaerobic' in context of respiration. 2. Reject ATP/energy used for/in respiration. 2.Reject mitosis.
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Question	Marking Guidance	Mark	Comments
04.1	Automarked question – ☒ Reduction of pyruvate (Box 3)	1 (AO1)	

Question 3

Question	Marking Guidance	Mark	Comments
04.1	Genome 1. (The) complete set of genes in a cell/organism OR (All) the DNA in a cell/organism; Proteome 2. Range of proteins that a cell/organism can produce OR Range of proteins the genome/DNA can code for;	2 (2 x AO1)	1. Accept (all) the genes/alleles/genetic material/genetic code in a cell/organism 1. Accept the total number of DNA bases in a cell/organism 1. Reject all the DNA/genes within a species/population 2. Do not accept number of proteins unqualified 2. Ignore range of proteins that a species/population can produce
Question	Marking Guidance	Mark	Comments
04.2	1. (The) genetic/DNA code is universal OR The same triplets/codons code for the same amino acids (in all species); 2. (The mechanism of) transcription is universal; 3. (The mechanism of) translation is universal;	2 max (2 x AO1)	1. Do not accept 'DNA is universal' unqualified 1. Reject the genetic code is degenerate 1. Ignore anything after 'genetic/DNA code is universal' unless incorrect 2. and 3. Accept descriptions of universal, eg transcription/translation are the same in humans and bacteria 2. and 3. If neither is stated, accept '(the mechanism of) protein synthesis is universal' for 1 mark 3. Accept bacteria have ribosomes, and so could translate (human mRNA)
Question	Marking Guidance	Mark	Comments

04.3	Cannot splice (pre-mRNA), so cannot remove introns OR Do not have Golgi (apparatus), so cannot process/modify (proteins) OR Do not have transcriptional factors (required), so cannot carry out transcription/produce mRNA;	1 (AO2)	Accept do not have spliceosomes/spliceosome for cannot splice Accept 'rough endoplasmic reticulum' for 'Golgi' Accept (human protein) is too complex and bacteria do not have Golgi (apparatus)
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Question	Marking Guidance	Mark	Comments
04.4	1. (Region M) promoter; 2. (Region N) terminator;	2 (2 x AO2)	Accept phonetic spellings

Question	Marking Guidance	Mark	Comments
04.5	Shows that the (antithrombin) gene has been taken up (by cells/embryos/goats) OR Shows transgenic/transformed goat cells/goat embryos/goats OR Allows detection of genetically modified cells/organisms/mammals/goats;	1 (AO1)	Accept 'GM' for 'genetically modified'

Question	Marking Guidance	Mark	Comments
04.6	1. Milk/protein/antithrombin is easy to extract from a goat OR Extracting milk/protein/antithrombin from a goat does it no harm; 2. If (antithrombin was produced) in their blood, could prevent/affect clotting OR (Antithrombin) could damage other cells;	2 (2 x AO3)	

Question 4

Question	Marking Guidance	Mark	Comments
03.1	1. Tip produces IAA; 2. Affects concentration of IAA OR Affects (shoot) length/growth/elongation; 3. Mitosis/division occurs in shoot tips; 4. Affects (shoot) length/growth/elongation;	2 max	Mark in pairs 1 and 2 or 3 and 4. 1 and 2. Accept auxin for IAA. 1. Ignore contains/stores IAA. 1. Accept affects amount of IAA. 2. Accept affects independent variable. 2 and 4. Ignore affects results.
03.2	1. For respiration; 2. Provide ATP/energy (for growth);	2	1. Ignore photosynthesis. 1. Ignore aerobic/anaerobic (respiration). 1. Reject glucose used in photosynthesis. 2. Reject produce energy. 2. Do not credit photosynthesis provides ATP.
03.3	1. To prevent/reduce evaporation; 2. (Which) alters concentration of (IAA) solution OR (Which) alters water potential;	2	1. Accept evaporation of (IAA/glucose) 'solution'. 2. Accept auxin for IAA. 1. Ignore contamination.
03.4	1. Increase in IAA <u>concentration</u> the higher/greater the <u>mean</u> (change in) length; 2. (High) IAA stimulates <u>cell elongation</u> ; 3. In roots, growth/elongation less/inhibited;	3	1, 2 and 3. Accept auxin for IAA. 3. Accept decrease in (mean) change in length but reject 'decreases length' on its own.
			3. Accept 'opposite results or 'negative correlation'.
03.5	0.4 and 39.6;	1	Both numbers required and must be in order shown.

Question 5

Question	Marking Guidance	Mark	Comments
01.1	1. Chemoreceptors detect rise in CO_2/H^+/acidity/carbonic acid/fall in pH OR Baro/pressure receptors detect rise in blood pressure; 2. Send impulses to cardiac centre/medulla; 3. More impulses to SAN; 4. By sympathetic (nervous system for chemoreceptors/CO_2) OR By parasympathetic (nervous system for baro/pressure receptors/blood pressure);	4	1. Ignore: location of receptors. 1. Ignore: chemoreceptors detect oxygen. 2 and 3. Accept: action potentials. 2. Reject: 'messages', 'signals', 'an impulse' or an 'action potential'. 3. Ignore: messages', 'signals', 'an impulse' or an 'action potential' as emphasis here is on increase in frequency.
01.2	1. Less/no malonyl-CoA; 2. (More) fatty acids transported/moved into mitochondria; 3. Respiration/oxidation of fatty acids provides <u>ATP</u>;	3	1. 'Inhibition of malonyl-CoA' on its own is not enough but accept production of malonyl-CoA is inhibited. 2. Accept: 'transport of fatty acids into mitochondria is not inhibited'. 2. Ignore: method of entry. 3. Accept: for respiration any stage of aerobic respiration e.g. Krebs (cycle), link (reaction) etc. 3. Reject: production of energy, but accept production of energy in the form of <u>ATP</u>. 3. Accept: acetyl CoA can enter Krebs cycle/mitochondria to provide ATP.

Question 6

Question	Marking Guidance	Mark	Comments
03.1	Increase in <u>aerobic</u> respiration OR Increase in/more mitochondria OR Increase in/more slow muscle fibres;	1 max	Ignore: reference to Krebs cycle as this in the stem of the question.
03.2	1. (More aerobic respiration) produces more <u>ATP</u> ; 2. Anaerobic respiration delayed; 3. Less or no lactate;	3	1. Accept: produces <u>ATP</u> faster. 2. Accept: aerobic respiration can continue. 2. Accept : no anaerobic respiration. 3. Accept: lactic acid.
03.3	1. Correct answer in range 84 to 84.2 = 2 marks;; 2. For one mark accept incorrect answer but shows r (radius) = 0.63 (mm) OR d (diameter) = 1.26 (mm);	2	2. Ignore: numbers after 0.63 and 1.26.
03.4	1. A numerical comparison of range = 2 marks i.e. Young (fibres) range 14/15 – 47/48 (µm) and adult (fibres) 17/18 - 86/87/88 (µm) OR Young (fibres) range 32/33/34 and adult (fibres) range 68/69/70/71; 2. Comparison of range without numbers = one mark i.e. Adult (fibres) greater range/spread/variation (of diameters) OR Young (fibres) smaller range/spread (of diameters);	2 max	1. Accept: one mark for comparison of minimum values i.e. 14/15 compared to 17/18 Allow one mark for comparison of maximum values i.e. 47/48 compared to 86/87/88. 1. Note: comparison of both maximum and minimum values = 2 marks .
	3. Comparison of mode = one mark i.e. Adult (fibres) peak/most common/frequent/mode at 50 (µm) and young (fibres) peak/most common/frequent/mode at 30 (µm);		3. Accept: adult (fibres) peaks at higher diameter or young (fibres) peak/most frequent at lower diameter. 3. Reject: reference to mean/average.

Question 7

Question	Marking Guidance	Mark	Comments
01.1	1. (Less/no) ATP; 2. (Less/no) reduced NADP;	2	2. Accept NADPH, NADPH + H, NADPH ₂ NADPH + H ⁺ 2. Reject reduced NAD, NADH etc,
01.2	1. (Less/no) carbon dioxide (reacts) with RuBP; 2. (Less/no) GP;	2	
01.3	1. Stroma (of/in chloroplast);	1	Reject: stoma Reject stroma of cytoplasm/chlorophyll Reject stroma of mitochondrion Ignore references to Calvin cycle or the light-independent reaction
01.4	1. Rubisco activity increases with temperature OR Rubisco optimum temperature is above (rubisco activase); 2. (Rubisco) activase activity decreases at high temperatures (allow any temperature above 25 °C.) OR (Rubisco) activase optimum (allow in range) 25 to 30 °C.; 3. (Results/graphs suggest) activase cannot/does not affect activity of rubisco; 4. (Results are) only for cotton; 5. (Results are) for isolated enzymes; 6. No stats test;	4 max	2. Accept denatures at high temperature (allow any temperature above 25 °C) 4. Accept may not be the same in other species/types of plant Ignore: only one study

Question 8

	6. Only done at 16 to 18 metres OR Not done (on reefs) at other depths; 7. Only 34 weeks; 8. Concrete/artificial reef could affect results/growth OR Natural reef results/growth may differ; 9. Cage may allow other fish/animals to enter;		8. Accept any reference to composition of reef being different (from natural).
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10.1	1. Variation/differences due to mutation/s; 2. (Reference to) <u>allopatric</u> (speciation); 3. Smaller/different lakes have different environmental conditions OR Smaller/different lakes have different selection pressures; 4. Reproductive separation/isolation OR No gene flow OR Gene pools remain separate; 5. Different <u>alleles</u> passed on/selected OR Change in frequency of <u>allele/s</u> ; 6. Eventually different species/populations cannot breed to produce fertile offspring;	4 max	2. Ignore sympatric speciation. 3. Accept different populations for different lakes.
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Question	Marking Guidance	Mark	Comments
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10.2	1. Correct answer of $10/10.4 = 2$ marks;; 2. Working shows $14,112 = 1$ mark OR $13.09/13.1 = 1$ mark;	2	1. Ignore any numbers after 10.4
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Question	Marking Guidance	Mark	Comments
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10.3	1. (Growth/increase of) algae/surface plants/algal bloom blocks light; 2. Reduced/no photosynthesis so (submerged) plants die; 3. Saprobiotic (microorganisms) aerobically respire OR Saprobiotic (microorganisms) use oxygen in respiration; 4. Less oxygen for fish to <u>respire</u> ;	4	3. Accept: Saprobiont/saprophyte/saprotroph 3. Neutral: decomposer
Question	Marking Guidance	Mark	Comments

10.4	1. Capture/collect sample, mark and release; 2. Ensure marking is not harmful (to fish) OR Ensure marking does not affect survival (of fish); 3. Allow (time for) fish to (randomly) distribute before collecting a second sample; 4. (Population =) number in first sample $\times$ number in second sample divided by number of marked fish in second sample/number recaptured;	4	2. Accept examples e.g., marking should not be toxic.
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Question	Marking Guidance	Mark	Comments
10.5	1. Less chance of recapturing fish OR Unlikely fish distribute randomly/evenly;	1	Accept 'harder to capture marked fish' (recaptured fish) but ignore 'harder to capture fish'. Accept that fish may remain in one area. Accept fish may congregate.

Question 9

Question	Marking Guidance	Mark	Comments
10.1	1. Fat (store) used in respiration/metabolism; 2. Less energy/food (store) is required due to low respiration/metabolism OR Less energy/food (store) is required due less movement; 3. Gluconeogenesis; 4. Low surface area to volume reduces heat loss OR Fat (layer/insulation) reduces heat loss; 5. Long loop of Henle so less water lost; 6. Water provided from respiration; 7. Reduced/no urination; 8. Less evaporation;	3 max	Mark points 1 to 4 = 2 max. Mark points 5 to 8 = 2 max. 1 and 2. Reject respiration 'uses energy' or 'produces energy'. 3. Accept description in terms of using glycerol, fatty acids or amino acids. 5. Accept thick medulla (in kidney) for long loop of Henle. 8. Accept less sweating.
10.2	1. (Lower metabolism so) less/low CO₂ (in blood); 2. (Detected by) chemoreceptors; 3. (Chemoreceptors) located in aorta/medulla OR (Chemoreceptors) located in carotid artery; 4. Fewer impulses to cardiac centre; OR Fewer impulses to medulla (oblongata); 5. (More) impulses along parasympathetic/vagus pathway/neurones/nerve OR Fewer impulses along sympathetic pathway/neurones/nerve; 6. (To) SAN;	4 max	If neither mark point 1 or 2 credited = 3 max. 1. Accept increase in pH or decrease in H ions/acidity for less CO₂. Ignore baroreceptors. 2. Ignore detects oxygen, (concentration). 3. Accept carotid body or aortic body. 4 and 5. Reject (once only) reference to 'an/one impulse'. 4 and 5. Reject 'signals', 'messages' (once only) for 'impulses' 4 and 5. Accept 'action potential/s' for impulses.
10.3	1. Allow passage of protons/H⁺; 2. (Energy) released as heat;	2	1. Ignore direction of movement/diffusion/active transport. 2. Accept 'produces heat' but reject 'produces 'heat energy'.

10.4	1. Less snow so less camouflage; 2. More hares seen/eaten/killed by predators;	2	1. Accept 'snow melts' 1. Accept description of less camouflage, e.g. more hares seen. 2. Accept description of predation.
10.5	1. Hares which moult earlier (more likely to survive); 2. Hares which moult earlier (more likely to reproduce); 3. Pass on (advantageous) <u>allele</u> ; 4. Frequency of <u>allele</u> increases (in future populations);	4	1. Accept less likely to be killed for 'survive'. 1. Accept description of survival e.g. not killed/eaten. 1. Accept moult quicker/faster for earlier. 1 and 2. Answers must be in the context of moulting earlier/quicker/faster. Accept rabbits for hares. 2 and 3. Accept 'pass on allele to offspring' or 'to next generation' = 2 marks. 4. 'More alleles' is not enough for a mark.