

Question	Marking Guidance	Mark	Comments
1(a)(i)	Centromere;	1	Accept: if phonetically correct Reject: centriole
1(a)(ii)	<ol style="list-style-type: none"> Holds chromatids together; Attaches (chromatids) to spindle; (Allows) chromatids to be separated/move to (opposite) poles / (centromere) divides/splits at metaphase/anaphase; 	2 max	<ol style="list-style-type: none"> Q Neutral: chromosomes or chromatids split/halved/divided Reject: reference to homologous chromosomes being separated Accept 'chromosomes' instead of 'chromatids' Ignore incorrect names for X
1(a)(iii)	(Homologous chromosomes) carry different alleles;	1	Accept alternative descriptions for 'alleles' eg different forms of a gene / different base sequences Neutral: reference to maternal and paternal chromosomes
1(b)(i)	(In Figure 2) <ol style="list-style-type: none"> Chromatids have separated (during anaphase); Chromatids have not replicated; Chromosomes formed from only one chromatid; 	1 max	<ol style="list-style-type: none"> Q Neutral: split/halved/divided Reject: reference to homologous chromosomes being separated 1. & 2. Accept 'chromosomes' instead of 'chromatids' Accept converse arguments for Figure 1 Ignore references to the <i>cell</i> not dividing as in the question stem Ignore: named phases
1(b)(ii)	<ol style="list-style-type: none"> Three chromosomes; One from each homologous pair; 	2	Ignore shading Only one mark for three chromosomes shown as pairs of chromatids

1(b)(iii)	Crossing over / alleles exchanged between chromosomes or chromatids / chiasmata formation / genetic recombination;	1	Accept: description of crossing over eg sections of chromatids break and rejoin Neutral: random fertilisation Reject: reference to sister chromatids Q Neutral: genes exchanged Neutral: mutation
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2(a)	1. Group of similar organisms / organisms with similar features / / organisms with same genes/chromosomes; 2. Reproduce / produce offspring; 3. That are fertile;	2 max	1. Accept: same number of chromosomes 1. Accept: smallest taxonomic group 1. Reject: genetically identical. Only allow 1 max if mentioned 1. Q Neutral: similar genes/chromosomes 2. Accept: breed/mate 3. Neutral: that are 'viable' 'Produce fertile offspring' = 2 marks
2(b)(i)	Correct answer of 6.97 to 7 = 2 marks; One mark for 6320 as numerator or 906 as denominator;	2	
2(b)(ii)	1. Decrease in variety of plants / fewer plant species; 2. Fewer habitats/niches; 3. Decrease in variety of food / fewer food sources; 4. Aspect of clearing forest (killing insects) eg machinery, pesticides;	3 max	1. Accept: reference to monoculture or description 1. Neutral: fewer plants 2. Neutral: fewer homes/less shelter 3. Neutral: less food 3. Accept: less variety of prey 4. Neutral: clearing forest unqualified

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3(a)(i)	<ol style="list-style-type: none"> Groups within groups; No overlap (between groups); 	2	<ol style="list-style-type: none"> Accept: idea of larger groups at the top / smaller groups at the bottom
3(a)(ii)	(Grouped according to) evolutionary links/history/relationships / common ancestry;	1	Neutral: closely related Neutral: genetically similar
3(b)(i)	<ol style="list-style-type: none"> (Only) one amino acid different / least differences / similar amino acid sequence / similar primary structure; (So) similar DNA sequence/ base sequence; 	2	
3(b)(ii)	<ol style="list-style-type: none"> Compared with humans / not compared with each other; Differences may be at different positions / different amino acids affected / does not show where the differences are (in the sequence); 	1 max	Accept: degenerate code / more than one triplet (codes) for an amino acid
3(b)(iii)	<ol style="list-style-type: none"> All organisms respire/have cytochrome c; (Cytochrome c structure) is more conserved / less varied (between organisms); 	1 max	Accept: converse arguments for haemoglobin <ol style="list-style-type: none"> Accept 'more' instead of 'all' Accept 'animals' instead of organisms' Neutral: cytochrome c is conserved

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4(a)	<ol style="list-style-type: none"> Separates/unwinds/unzips strands/helix / breaks H-bonds; (So) <u>nucleotides</u> can attach/are attracted / strands can act as templates; 	2	<ol style="list-style-type: none"> Q Neutral: strands/helix split Accept: unzips bases Q Neutral: bases can attach Neutral: helix can act as a template 																			
4(b)	<table border="1"> <thead> <tr> <th rowspan="2">Sample</th> <th colspan="3">Type(s) of DNA molecule present in each tube</th> </tr> <tr> <th>$^{15}\text{N}/^{15}\text{N}$</th> <th>$^{15}\text{N}/^{14}\text{N}$</th> <th>$^{14}\text{N}/^{14}\text{N}$</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>3</td> <td></td> <td>✓</td> <td>✓</td> </tr> </tbody> </table>	Sample	Type(s) of DNA molecule present in each tube			$^{15}\text{N}/^{15}\text{N}$	$^{15}\text{N}/^{14}\text{N}$	$^{14}\text{N}/^{14}\text{N}$	1	✓			2		✓		3		✓	✓	3	One mark for each correct row
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4(c)(i)	<ol style="list-style-type: none"> Similar shape/structure (to cytosine) / added instead of cytosine / binds to guanine; Prevents (complementary) base pairing / prevents H-bonds forming / prevents formation of new strand / prevents strand elongation / inhibits/binds to (DNA) polymerase; 	2	<ol style="list-style-type: none"> Accept: idea that <u>only</u> one group is different Reject: same shape Accept: prevents cytosine binding <p>Neutral: 'prevents DNA replication' as given in the question stem</p> <p>Neutral: 'competitive inhibitor' unqualified</p> <p>Neutral: inhibits DNA helicase</p>																			
4(c)(ii)	(Cancer cells/DNA) divide/replicate fast(er)/ uncontrollably;	1	Accept: converse argument for healthy cells																			

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5(a)(i)	Prevent cell wall formation / cause (cell) lysis / inhibit ribosomes / inhibit protein synthesis / prevent DNA replication / affect function of cell membrane;	1 max	Accept: weaken the cell wall Neutral: damage/break down the cell wall Q Reject: if in context of a cellulose cell wall Accept: bind to ribosomes
5(a)(ii)	(Plasmid/genes transmitted through) cell division/reproduction/replication/generations;	1	Accept: multiply Accept: binary fission Reject: within generations Reject: reference to horizontal gene transmission Reject: mitosis Ignore reference to immunity
5(b)	Representative/typical/reliable / different types of bacteria;	1	Neutral: accurate Neutral: reference to anomalies Q : Neutral: different strands of bacteria
5(c)	(Yes) 1. Largest clear zone/diameter/mean (so more bacteria killed); (No) 2. Standard deviations of <u>chlorhexidene</u> overlap/share values; 3. (Overlap means difference) is not significant / is due to chance;	3	Ignore references to methodology 2. Neutral: diameters overlap/share values 3. Can still be awarded if SD overlap or non-overlap is correctly interpreted 3. Accept: (difference) is not real/not reliable 3. Neutral: spread is not reliable
5(d)	1. <u>Mutation</u> (in bacterium); 2. <u>Gene/allele</u> for resistance;	2	1. Neutral: different strains 2. Reject: if in the context of 'immunity' 2. Accept: resistant gene/allele

Question	Marking Guidance	Mark	Comments																
6(a)	<table border="1"> <thead> <tr> <th data-bbox="316 177 523 278">Statement</th> <th data-bbox="523 177 655 278">Haemo- globin</th> <th data-bbox="655 177 807 278">Cellulose</th> <th data-bbox="807 177 920 278">Starch</th> </tr> </thead> <tbody> <tr> <td data-bbox="316 278 523 415">Has a quaternary structure</td> <td data-bbox="523 278 655 415">✓</td> <td data-bbox="655 278 807 415"></td> <td data-bbox="807 278 920 415"></td> </tr> <tr> <td data-bbox="316 415 523 552">Formed by condensation reactions</td> <td data-bbox="523 415 655 552">✓</td> <td data-bbox="655 415 807 552">✓</td> <td data-bbox="807 415 920 552">✓</td> </tr> <tr> <td data-bbox="316 552 523 653">Contains nitrogen</td> <td data-bbox="523 552 655 653">✓</td> <td data-bbox="655 552 807 653"></td> <td data-bbox="807 552 920 653"></td> </tr> </tbody> </table>	Statement	Haemo- globin	Cellulose	Starch	Has a quaternary structure	✓			Formed by condensation reactions	✓	✓	✓	Contains nitrogen	✓			3	One mark for each correct row
Statement	Haemo- globin	Cellulose	Starch																
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6(b)	16;	1																	
6(c)	<ol style="list-style-type: none"> <li data-bbox="331 778 842 812">1. Higher <u>affinity</u> / loads <u>more</u> oxygen; <li data-bbox="331 828 882 862">2. At low/same/high <u>partial pressure/pO₂</u>; <li data-bbox="331 878 858 913">3. Oxygen moves from mother/to fetus; 	2 max																	
6(d)	<ol style="list-style-type: none"> <li data-bbox="331 959 810 993">1. Low affinity / oxygen dissociates; <li data-bbox="331 1010 663 1074">2. (Oxygen) to respiring tissues/muscles/cells; 	2	Assume 'it' is adult haemoglobin <ol style="list-style-type: none"> <li data-bbox="1118 1044 1422 1141">1. Accept: converse if 'fetal haemoglobin' is clearly stated <li data-bbox="1118 1157 1302 1221">2. Q: Neutral 'respire' 																
6(e)	Enough adult Hb produced / enough oxygen released / idea that curves/affinities/Hb are similar / more red blood cells produced;	1	Neutral: 'adult Hb is also produced' as in the question stem Reject: curves/affinities/Hb are the same																

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7(a)	<ol style="list-style-type: none"> 1. Population formed by a small number of founders/people /30 people; 2. (Founders show) less genetic diversity / small(er) gene pool / less variety of alleles; 3. Individuals breed within group / do not breed with outsiders; 4. High(er) chance of inheriting <u>allele</u> (than in non-Amish population); 	3 max	<p>Accept: converse arguments for the non-Amish population</p> <ol style="list-style-type: none"> 2. Q Neutral: fewer alleles 3. Accept: inbreeding for 'individuals breed within group' 3. Accept: do not interbreed 3. Q Reject: interbreeding for 'individuals breed within group' 4. Do not award for 'allele passed on' only
7(b)	250 000;	1	
7(c)(i)	<p>Loss of 3 bases/triplet = 2 marks;; Loss of base(s) = 1 mark;</p>	2	<p>'Stop codon/code formed' = 1 mark max unless related to the last amino acid</p> <p>eg triplet for last amino acid is changed to a stop codon/code = 2 marks</p> <p>3 bases/triplet forms an intron = 2 marks</p> <p>Accept: descriptions for 'intron' eg non-coding DNA</p> <p>'Loss of codon' = 2 marks</p>
7(c)(ii)	<ol style="list-style-type: none"> 1. Change in tertiary structure/ active site; 2. (So) faulty/non-functional protein /enzyme; 	2	<p>Neutral: change in 3D shape/ structure</p> <p>Accept: reference to examples of loss of function eg fewer E-S complexes formed</p>

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8(a)	<p>(In the root)</p> <ol style="list-style-type: none"> Casparian strip blocks apoplast pathway / only allows symplast pathway; Active transport by <u>endodermis</u>; (Of) ions/salts into xylem; Lower water potential in xylem / water enters xylem by osmosis /down a water potential gradient; <p>(Xylem to leaf)</p> <ol style="list-style-type: none"> Evaporation / transpiration (from leaves); (Creates) cohesion / tension / H-bonding between water molecules / negative pressure; Adhesion / water molecules bind to xylem; (Creates continuous) water column; 	6 max	<p>Assume all points are in the correct location unless context suggests otherwise</p> <p>4. Q Neutral: 'along' a water potential gradient</p> <p>'Transpiration pull' = 2 marks (5. & 6.)</p> <p>6. Accept 'pulling'</p> <p>6. Q Neutral: 'suction'</p>
8(b)	<p>Correct answer of 342.8-343 = 2 marks;;</p> <p>Credit incorrect answers that show the numerator as 144 (or 186-42) or denominator as 42 for 1 mark;</p>	2	
8(c)	<ol style="list-style-type: none"> More air/oxygen enters / air/oxygen enters quickly/quicker; (So) maintains/greater diffusion or concentration <u>gradient</u>; 	2	<ol style="list-style-type: none"> Accept: converse for carbon dioxide Can be in any correct context eg insect, tracheoles, muscle Neutral: air/oxygen enters
8(d)	<p>Large(r) SA:VOL / short(er) <u>diffusion</u> distance (to tissues);</p>	1	Accept: thin diffusion pathway
8(e)	<p>6 / 6.6 / 6.7 / 7 / 7.5 / 8 = 2 marks;;</p> <p>Award 1 mark for incorrect answers that have divided 60 by any number;</p>	2	Different answers given for different interpretations of the graph

8(f)	Less/no water lost / (more) water retained;	1	Accept: less dehydration / less evaporation Q Reject: less 'transpiration' Q Reject: less water lost by osmosis
8(g)	1. Greater <u>surface area</u> exposed to air; 2. Gases move/diffuse faster in air than through water; 3. Increases volume/amount of air;	1 max	Neutral: shorter diffusion distance 2. Q Neutral: 'harder to diffuse' 2. Accept gases diffuse directly, rather than through water

Question	Marking Guidance	Mark	Comments
9(a)	Any two suitable suggestions eg 1. Volume/concentration of skin lipid; 2. Age/sexual maturity; 3. <u>Species</u> of snake; 4. Size of <u>male</u> ; 5. Colour; 6. Temperature; 7. Light; 8. Time of day/year/breeding season; 9. Duration/length of time observing; 10. Diet; 11. Filter paper; 12. Size of cage;	2 max	1. Accept: amount Neutral: environment / health / body mass / number of snakes
9(b)	To avoid bias;	1	
9(c)	1. To avoid change in (courtship) behaviour (due to past experience); 2. To observe a typical/general/representative (response);	1 max	Accept: ethical arguments eg causing distress to snakes Neutral: reference to anomalous results
9(d)	Filter paper without (skin) lipids / untreated filter paper / filter paper with water / (female) snakes with lipids removed;	1	Accept: filter paper qualified eg <i>only</i> filter paper Neutral: reference to using male snakes/lipids from male snakes
9(e)	1. Similar response to lipids and (whole) snakes; 2. (So males are) responding to lipids; 3. (So males are) not responding to (whole) snakes/visual clues;	2 max	Neutral: greater response to long snakes and lipids from long snakes as in the question stem

9(f)	(Parent/offspring) 1. Produce more/larger offspring/eggs; 2. Better predators / fitter / more successful at gaining food / less likely to be eaten / more able to protect offspring/eggs; 3. (More) sexually mature / fertile; 4. Have more food stores for offspring/eggs;	2 max	3. Neutral: mature
9(g)	1. (Males) respond to/sense (unsaturated) <u>fatty acids</u> ; 2. (Long females) produce/have more fatty acids / positive correlation;	2	1. Reference to courtship behaviour on its own is not sufficient Reference to 'lipids/fats' is neutral for both mark points. However, if fatty acids are mentioned for either mark point, accept lipids/fats = fatty acids for the other mark point
9(h)	1. Draw a line of best fit; 2. Extrapolation / extend line;	2	
9(i)	Results vary for a particular body size/% / values overlap / small sample size / idea of reaching maximum/100%/ a plateau;	1	Neutral: reference to inaccurate line of best fit Neutral: 'results vary'
9(j)	(Other females/species) produce different fatty acids;	1	Must refer to fatty acids rather than just 'lipids/fats' Accept: lack of receptors