**General Certificate of Education (A-level)
June 2013**

Biology **BIOL2**

(Specification 2410)

Unit 2: The Variety of Living Organisms

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Question	Marking Guidance	Mark	Comments
1(a)(i)	Centromere;	1	Accept: if phonetically correct Reject: centriole
1(a)(ii)	1. Holds chromatids together; 2. Attaches (chromatids) to spindle; 3. (Allows) chromatids to be separated/move to (opposite) poles / (centromere) divides/splits at metaphase/ anaphase;	2 max	3. **Q** Neutral: chromosomes or chromatids split/halved/divided 3. 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**) 1. Chromatids have separated (during anaphase); 2. Chromatids have not replicated; 3. Chromosomes formed from only one chromatid;	1 max	1. **Q** Neutral: split/halved/divided 1. Reject: reference to homologous chromosomes being separated 1. & 2. Accept 'chromosomes' instead of 'chromatids' Accept converse arguments for **Figure 1** Ignore references to the *cell* not dividing as in the question stem Ignore: named phases
1(b)(ii)	1. Three chromosomes; 2. 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

Question	Marking Guidance	Mark	Comments
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

Question	Marking Guidance	Mark	Comments
3(a)(i)	1. Groups within groups; 2. No overlap (between groups);	2	1. 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)	1. (Only) one amino acid different / least differences / similar amino acid sequence / similar primary structure; 2. (So) similar DNA sequence/ base sequence;	2	
3(b)(ii)	1. Compared with humans / not compared with each other; 2. 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)	1. All organisms respire/have cytochrome c; 2. (Cytochrome c structure) is more conserved / less varied (between organisms);	1 max	Accept: converse arguments for haemoglobin 1. Accept 'more' instead of 'all' 1. Accept 'animals' instead of organisms' 2. Neutral: cytochrome c is conserved

Question	Marking Guidance	Mark	Comments
4(a)	1. Separates/unwinds/unzips strands/helix / breaks H-bonds; 2. (So) <u>nucleotides</u> can attach/are attracted / strands can act as templates;	2	1. **Q** Neutral: strands/helix split 1. Accept: unzips bases 2. **Q** Neutral: bases can attach 2. Neutral: helix can act as a template
4(b)	<table><tr><td rowspan="2">Sample</td><td colspan="3">Type(s) of DNA molecule present in each tube</td></tr><tr><td>¹⁵N/¹⁵N</td><td>¹⁵N/¹⁴N</td><td>¹⁴N/¹⁴N</td></tr><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></table>	3	One mark for each correct row
4(c)(i)	1. Similar shape/structure (to cytosine) / added instead of cytosine / binds to guanine; 2. Prevents (complementary) base pairing / prevents H-bonds forming / prevents formation of new strand / prevents strand elongation / inhibits/binds to (DNA) polymerase;	2	1. Accept: idea that <u>only</u> one group is different 1. Reject: same shape 2. Accept: prevents cytosine binding Neutral: 'prevents DNA replication' as given in the question stem Neutral: 'competitive inhibitor' unqualified Neutral: inhibits DNA helicase
4(c)(ii)	(Cancer cells/DNA) divide/replicate fast(er)/ uncontrollably;	1	Accept: converse argument for healthy cells

Question	Marking Guidance	Mark	Comments
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><tr><td>Statement</td><td>Haemo-globin</td><td>Cellulose</td><td>Starch</td></tr><tr><td>Has a quaternary structure</td><td>✓</td><td></td><td></td></tr><tr><td>Formed by condensation reactions</td><td>✓</td><td>✓</td><td>✓</td></tr><tr><td>Contains nitrogen</td><td>✓</td><td></td><td></td></tr></table>	3	One mark for each correct row
6(b)	16;	1	
6(c)	1. Higher affinity / loads more oxygen; 2. At low/same/high partial pressure/pO₂; 3. Oxygen moves from mother/to fetus;	2 max	
6(d)	1. Low affinity / oxygen dissociates; 2. (Oxygen) to respiring tissues/muscles/cells;	2	Assume 'it' is adult haemoglobin 1. Accept: converse if 'fetal haemoglobin' is clearly stated 2. **Q**: Neutral 'respirate'
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

Question	Marking Guidance	Mark	Comments
7(a)	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	Accept: converse arguments for the non-Amish population 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)	Loss of 3 bases/triplet = 2 marks;; Loss of base(s) = 1 mark;	2	'Stop codon/code formed' = 1 mark max unless related to the last amino acid eg triplet for last amino acid is changed to a stop codon/code = 2 marks 3 bases/triplet forms an intron = 2 marks Accept: descriptions for 'intron' eg non-coding DNA 'Loss of codon' = 2 marks
7(c)(ii)	1. Change in tertiary structure/ active site; 2. (So) faulty/non-functional protein /enzyme;	2	Neutral: change in 3D shape/ structure Accept: reference to examples of loss of function eg fewer E-S complexes formed

Question	Marking Guidance	Mark	Comments
8(a)	(In the root) 1. Casparian strip blocks apoplast pathway / only allows symplast pathway; 2. Active transport by <u>endodermis</u>; 3. (Of) ions/salts into xylem; 4. Lower water potential in xylem / water enters xylem by osmosis /down a water potential gradient; (Xylem to leaf) 5. Evaporation / transpiration (from leaves); 6. (Creates) cohesion / tension / H-bonding between water molecules / negative pressure; 7. Adhesion / water molecules bind to xylem; 8. (Creates continuous) water column;	6 max	Assume all points are in the correct location unless context suggests otherwise 4. **Q** Neutral: 'along' a water potential gradient 'Transpiration pull' = 2 marks (5. & 6.) 6. Accept 'pulling' 6. **Q** Neutral: 'suction'
8(b)	Correct answer of 342.8-343 = 2 marks;; Credit incorrect answers that show the numerator as 144 (or 186-42) or denominator as 42 for 1 mark;	2	
8(c)	1. More air/oxygen enters / air/oxygen enters quickly/quicker; 2. (So) maintains/greater diffusion or concentration <u>gradient</u>;	2	1. Accept: converse for carbon dioxide 1. Can be in any correct context eg insect, tracheoles, muscle 1. Neutral: air/oxygen enters
8(d)	Large(r) SA:VOL / short(er) <u>diffusion</u> distance (to tissues);	1	Accept: thin diffusion pathway
8(e)	6 / 6.6 / 6.7 / 7 / 7.5 / 8 = 2 marks;; Award 1 mark for incorrect answers that have divided 60 by any number;	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 *only* 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