A-LEVEL
BIOLOGY

BIOL2 – The variety of living organisms
Mark scheme

2410
June 2014

Version 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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.

Further copies of this Mark Scheme are available from aqa.org.uk

Copyright © 2014 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Although specific marks are not awarded in questions 1-7, marks will take into account the quality of written communication. Credit will only be awarded where candidates have presented information clearly and coherently and have used the specialist vocabulary indicated in the mark scheme for this unit. Specific references to the quality of written communications are marked **Q** in this mark scheme.

Question	Marking Guidance	Mark	Comments
1(a)(i)	1. Groups within groups; 2. No overlap (between groups);	2	1. Accept: idea of larger groups at the top **or** smaller groups at the bottom
1(a)(ii)	**3**;	1	
1(a)(iii)	Chordata;	1	Accept: if phonetically correct eg 'Cordata'
1(b)(i)	1. (To provide) genetic variation; 2. (Allows) different combinations of maternal and paternal chromosomes/ alleles; 3. (To produce) haploid cells/half the chromosome number; 4. (Allows) homologous chromosomes/ homologous pairs to arrange randomly (at equator/middle of cell)/separate;	2 max	1. Genetic variation must be directly stated and not implied 2. Accept: any allele of one gene can combine with any allele of another gene Reference to 'crossing over' negates the first marking point awarded
1(b)(ii)	1. (Zeedonk has) 47/odd/uneven number of chromosomes; 2. Chromosomes cannot pair/are not homologous/ chromosome number cannot be halved / meiosis cannot occur / sex cells/haploid cells are not produced;	2	1. Accept: diploid number would be odd 1. Reject: if wrong number of chromosomes is given 2. Accept: cannot have half a chromosome 2. **Q** Reject: meiosis cannot occur **in** sex cells

Question	Marking Guidance	Mark	Comments
2(a)(i)	(Humans breed) organisms with certain/chosen characteristics/alleles;	1	Accept: suitable examples of organisms possessing certain/chosen characteristics/alleles.
2(a)(ii)	1. Inbreeding / breed closely related organisms; 2. (So higher probability of) mutations being passed on / recessive alleles being expressed / health problems/example given / increase in genetic disease; 3. Reduced genetic variation/diversity / smaller gene pool / less variety of alleles; 4. (So) can be killed by/susceptible to the same/a disease / reduces ability to adapt/survive (future) environmental changes / may not be beneficial to future breeding programmes;	2 max	1. **Q** Reject: interbreeding 2. Neutral: 'inbreeding causes mutations' 3. **Q** Neutral: fewer alleles 4. Neutral: can be killed by diseases
2(b)(i)	1. Select tracking/(Large) Munsterlander; 2. (As) high (heritability) value/0.8/ closer to 1/ mainly due to genetic factors;	2	
2(b)(ii)	1. (SDs) overlap / values shared; 2. (So difference between means) is **not** significant/is due to chance;	2	2. Accept: (difference between means) is **not** real/**not** reliable 2. Award 1 mark max if candidate states that SDs do **not** overlap so (difference) **is** significant/is **not** due to chance 2. Do not award if linked to a large standard deviation only 2. Neutral: spread is not reliable

Question	Marking Guidance	Mark	Comments
3(a)	1. Lower affinity for oxygen / releases more oxygen / oxygen is released quicker / oxygen dissociates/unloads more readily; 2. (To) muscles/tissues/cells; 3. (For) high/rapid respiration;	3	1. **Q** Neutral: the organism/body has a lower affinity for oxygen/releases more oxygen 3. **Q** Reject: '**produces** more energy' on its own Neutral: reference to partial pressure 3. Accept: (for) respiration to produce more energy in the form of ATP/ release more energy
3(b)(i)	1. Small SA:VOL; 2. (So) reduces heat loss / (more) heat retained;	2	1. Neutral: small limbs/small ears/extremities 1. Neutral: small SA 1. Accept: large VOL:SA 1. Neutral: reference to fat/blubber/insulation Note: MP2 is independent of MP1
3(b)(ii)	1. Brain is the same, others fall; 2. Brain controls other organs/remains active/ needs constant supply of oxygen; 3. Lungs not used/are used less / seal is not breathing; 4. Heart rate decreases / heart pumps less; 5. Blood diverted to muscles; 6. Oxygen (in blood) will last longer / less oxygen used / oxygen is conserved;	3 max	Note: 1. might not be given in the same sentence Assume that 'other organs fall' = all three organ categories fall 1. Accept: 'blood flow is reduced to all organs except for the brain' 2. Accept: 'seal would die' = brain remains active 3. Reject: seal is not respiring

Question	Marking Guidance	Mark	Comments
4(a)	1. Water and blood flow in opposite directions; 2. Maintains concentration/diffusion gradient / equilibrium not reached / water always next to blood with a lower concentration of oxygen; 3. Along whole/length of gill/lamellae;	3	Accept: diagram if clearly annotated 2. Must have the idea of 'maintaining' or 'always' in reference to concentration/diffusion gradient 2. Accept: constant concentration/ diffusion gradient 3. Accept: gill plate/gill filament
4(b)	1. (Thicker lamellae so) greater/longer <u>diffusion</u> distance/pathway; 2. (Lamellae fuse so) reduced surface area;	2	1. **Q** Neutral: 'thicker' diffusion pathway 2. Accept: reduced SA:VOL
4(c)(i)	Correct answer of **5.1** or **5.14(2857)** (dm^3) = 2 marks;; One mark for incorrect answers that show **36** or **0.4 x 90** or **90 ÷ 7**;	2	Allow 1 mark max for an answer of **5** if the correct answer of **5.1** or **5.14(2857)** is **not** shown
4(c)(ii)	1. Increased metabolism/respiration/enzyme activity; 2. Less oxygen (dissolved in water);	1 max	1. Accept: enzymes work more efficiently Neutral: references to increased kinetic energy (of water molecules)

<table>
<tr><th>Question</th><th>Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>Statement</th><th>Vertical</th><th>Horizontal</th></tr>
<tr><td>Gene is replicated</td><td>✓</td><td>✓</td></tr>
<tr><td>Gene can be passed to other species of bacteria</td><td></td><td>✓</td></tr>
<tr><td>Involves conjugation</td><td></td><td>✓</td></tr>
</table>
</td><td>2</td><td>One mark for each correct column</td></tr>
<tr><td>5(b)(i)</td><td>1. Prevents protein synthesis;

2. (So) enzymes not produced / any named process involving proteins/enzymes is inhibited;</td><td>2</td><td>1. Accept: ribosomes produce proteins/ chains of amino acids/polypeptides

1. Reject: ribosomes produce amino acids

2. Accept: no (DNA) replication

2. Accept: cannot form a cell wall

2. Reject: no mitosis

2. Neutral: no growth/ repair</td></tr>
<tr><td>5(b)(ii)</td><td>ACC GGA ACC ACG;</td><td>1</td><td></td></tr>
<tr><td>5(b)(iii)</td><td>C;</td><td>1</td><td>Accept: ‘cytosine’</td></tr>
<tr><td>5(b)(iv)</td><td>1. Different tertiary structure/tertiary shape;

2. (So tetracycline) does not fit/bind/ is not complementary / does not enter/pass through (protein/into cell);</td><td>2</td><td>Neutral: 3D structure.

2. Q Reject: any reference to ‘active site’, ‘enzyme-substrate complex’ or (tetracycline) not fitting/binding to an enzyme

2. Accept: (so) more tetracycline pumped out of cell</td></tr>
</table>

Question	Marking Guidance	Mark	Comments
6(a)	1. Antibody and haemoglobin/blood (of different primates) mixed/added/bind; 2. Precipitate/complex/band formed; 3. Amount of precipitate/complex/ thickness of band shows relationship/similarity (in protein/DNA);;	3	**Note**: MP3 is worth **2 marks outright** on its own as it subsumes MP2. If MP3 is awarded, do **not** also award MP2 for a total of 3 marks. 1. Neutral: methodology of how the human antibody would be obtained 1. Neutral: mix antibody and plasma/serum 1. Neutral: reference to mixing antibody with **human** haemoglobin /blood 1. Reject: idea of injecting (human) antibody into primates 3. Reject: incorrect relationship eg more precipitate = less closely related
6(b)(i)	(Largest decrease in separation temperature) – no mark 1. (So) few(er) hydrogen/H bonds; 2. (So) few(er) complementary bases/ few(er) base pairs;	2	Accept: 'not many' for 'few' Note: 'fewer hydrogen bonds between complementary bases/base pairs' = 2 marks 2. Neutral: fewer bases 2. Neutral: fewer similar base sequences
6(b)(ii)	(Same species) have different alleles/different base sequences/ (different) mutations/introns/ non-coding DNA/multiple repeats;	1	**Q** Reject: different genes Neutral: different bases Neutral: base sequences

			are not complementary **Q** Neutral: 'junk DNA' Neutral: intraspecific variation/genetic differences Reject: interspecific variation
6(b)(iii)	Correct answer in range of **9.69** to **9.71(4286)** = 2 marks;; One mark for incorrect answers that show any of the following: (1^{o}C =) **5.7(14286)** (million years) OR: **20 000 000 ÷ 3.5** OR: **20 ÷ 3.5**	2	Accept: **9 690 000** to **9 714 286** for 2 marks If **10** is shown **and** an answer in the range of **9.69** to **9.71(4286)**, award **2 marks** If **10** is shown and an answer in the range of **9.69** to **9.71(4286)** is **not shown**, award **1 mark**
7(a)	1. Number of (individuals of) each species; 2. Total number of individuals / number of species;	2	1. Accept: 'population' for 'number' 2. Accept: 'species richness' MP2 allows for other types of diversity index
7(b)(i)	1. (Shows) results are due to the herbicide/ are not due to another factor; 2. (To) compare the effect of using and not using the herbicide / shows the effect of adding the herbicide;	1 max	Neutral: allows a comparison Neutral: ensures results are due to the independent variable Reject: 'insecticide' Accept: 'pesticide'
7(b)(ii)	1. (More) weeds killed **so** more crops/plants survive/higher yield/less competition; 2. High concentrations (of herbicide)	2	2. Accept: 'pesticide' 2. Neutral: 'insecticide'

	harm/damage/kill/are toxic to crops/plants;		2. Accept: use of figures (eg 400+)
7(b)(iii)	1. Reduced plant diversity / fewer plant species / fewer varieties of plant; 2. Fewer habitats/niches; 3. Fewer food sources/varieties of food;	3	Accept: 'weed' for 'plant' 1. Neutral: fewer plants 1. Accept: only one crop species remains 2. **Q** Neutral: fewer homes/shelters 3. Neutral: less food

Question	Marking Guidance	Mark	Comments
8(a)	1. Sugar-phosphate (backbone)/double stranded/helix **so** provides strength/stability /protects bases/protects hydrogen bonds; 2. Long/large molecule **so** can store lots of information; 3. Helix/coiled **so** compact; 4. Base sequence allows information to be stored/ base sequence codes for amino acids/protein; 5. Double stranded **so** replication can occur semi-conservatively/ strands can act as templates; 6. Complementary base pairing / A-T <u>and</u> G-C **so** accurate replication/identical copies can be made; 7. (Weak) hydrogen bonds **for** replication/ unzipping/strand separation; 8. Many hydrogen bonds **so** stable/strong;	6 max	Must be a direct link/obvious to get the mark Neutral: reference to histones 3. Accept: can store in a small amount of space for 'compact' 4. Accept: base sequence allows transcription Accept: 'H-bonds' for 'hydrogen bonds' 8. Must convey the idea of 'many'
8(b)	1. (Mutation) in **E** produces highest risk/1.78; 2. (Mutation) in **D** produces next highest risk/1.45; 3. (Mutation) in **C** produces least risk/1.30;	3	Must be stated directly and not implied **E**>**D**>**C** = 3 marks Accept: values of 0.78, 0.45 and 0.30 for MP1, MP2 and MP3 respectively If no mark is awarded, a principle mark can be given for the idea that all mutant alleles increase the risk

8(c)	**180**;	1	
8(d)	**(Similarities)**: 1. Same/similar pattern / both decrease, stay the same then increase; 2. Number of cells stays the same for same length of time; **(Differences)**: (Per unit volume of blood) 3. Greater/faster decrease in number of healthy cells / more healthy cells killed / healthy cells killed faster; 4. Greater/faster increase in number of healthy cells / more healthy cells replaced/divide / healthy cells replaced/divide faster;	3 max	2. Ignore: wrong days stated 3. & 4. Accept: converse for cancer cells 3. Accept: greater <u>percentage</u> decrease in number of cancer cells / greater <u>proportion</u> of cancer cells killed For **differences**, statements made must be comparative
8(e)	1. More/too many healthy cells killed; 2. (So) will take time to replace/increase in number; 3. Person may die/have side effects;	2 max	2. Neutral: will take time to 'repair'

Question	Marking Guidance	Mark	Comments
9(a)(i)	1. (Scientists) can't show bias/influence/ may have a vested interest/work for the company developing the vaccine; 2. (Volunteers) can't show psychological/mental effects/ 'placebo effect'/expectations;	2	1. Relates to the scientists 2. Relates to the volunteers 2. Accept: reduces the 'Hawthorne effect'/demand characteristics 2. Neutral: so they have no idea what they are taking
9(a)(ii)	Any **two** suitable suggestions, eg 1. Amount of nicotine in cigarettes; 2. Amount inhaled/absorbed / time since last cigarette; 3. (Different) amounts excreted/ metabolism/rate of binding (of nicotine) to protein; 4. (Different) blood volumes; 5. Nicotine from passive smoking/other smokers/other sources; 6. Some volunteers received the vaccine/placebo;	2 max	Neutral: refs.to age and health 1. Neutral: different types of cigarette/ different ways/ frequency of smoking 2. Neutral: absorption by gut/ digestion 2. Accept: absorption by mouth 3. Accept: broken down (differently) 4. Neutral: different body masses 6. Accept: some volunteers would have/would not have the antibodies
9(b)(i)	1. Antibodies to nicotine produced / antibodies bind to nicotine; 2. (So) nicotine does not bind to protein/does not reach the brain; 3. (So) cigarettes/smoking does not satisfy addiction/reward smokers/ release (reward) chemicals;	3	1. **Q** Reject: vaccine contains/ produces antibodies 1. **Q** Neutral: antibodies digest/ kill/fight nicotine 2. **Q** Reject: any reference to 'active site' 2. Neutral: idea that the antibodies bind to the protein
9(b)(ii)	**(Agree):** 1. People choose to smoke/know the risks;	3 max	

	2. Should spend this money on education/preventing people from starting to smoke/treating other health problems/ vaccines are expensive; **(Disagree):** 3. Unethical not to treat; 4. Less money needed to treat the effects of smoking/cancer / smokers pay taxes so are entitled to treatment;		

9(c)	1. High antibody responders have a high % to stop smoking/are more likely to stop smoking; 2. Only a few may be high antibody responders/ no numbers on how many are high/medium/low antibody responders; 3. Percentage who stopped smoking is similar for placebo group and low/medium responders / some/% of placebo group (still) stopped smoking / placebo has the lowest value/% to stop smoking; 4. Large sample size/double blind **so** reliable/representative; 5. Antibody levels peak at/drop after <u>5 months</u> / boosters may be needed at/after 5 months; 6. May start smoking again after 5/6 months / do not know the percentage who stopped smoking after 5/6 months; 7. <u>Nicotine</u> is not the only factor responsible for making people smoke;	5 max	1. 'People producing a high concentration of antibodies' is equivalent to 'high antibody responders' 2. Neutral: not all people are high antibody responders Accept: reference to values from the table for 1. & 3. 7. Must mention nicotine 7. Do not accept: correlation does not mean causation / could be due to other factors