A-LEVEL
BIOLOGY

BIOL4 – Populations and environment
Mark scheme

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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

Question	Marking Guidance	Mark	Comments
1(a)	1. Higher mean/average number of children (per female) in 1700; 2. Higher life expectancy in 2010 / higher proportion/percentage of older people in 2010; 3. Greater range/spread/variation of life expectancies in 2010;	2 max	Accept: converse answers for all mark points. Accept: use of figures for all mark points. Neutral: birth rate / death rate.
1(b)	Two suitable suggestions e.g. 1. Medical/health care / vaccination / antibiotics / lower infant mortality; 2. Diet / nutrition / food availability; 3. Sanitation / water supply / sewage treatment; 4. Contraception / birth control; 5. Work related example / occupation / education; 6. Financial considerations of having children; 7. Government/state policy; 8. War;	2 max	Neutral: better living conditions / improved economy.
1(c)	The following answers = 2 marks;; 60,175,920 / 60.1759 million / 60.176 million / 60.18 million;; Incorrect answer with following working = 1 mark 60 200 × 0.4 / 24 080 / 583 940 / 559 860;	2	Reject: 60,199,600 and reject 60.2 million if rounded up from 60,199,600. Accept: 60.2 million for two marks if rounded up from correct answer shown in working. 60.2 million without indication if derived from correct or incorrect answer = 1 mark. Accept: 60.18 / 60.176 for one mark. Accept: 60.175 million for one mark but 60.175 = no marks.

Question	Marking Guidance	Mark	Comments
2(a)(i)	1. Amino acid/protein/enzyme/urea/nucleic acid/chlorophyll/DNA/RNA//ATP/ADP/AMP/ NAD/NADP; 2. DNA/RNA/nucleic acid/ATP/ADP/AMP/ NADP/TP /GP/ RuBP /phospholipids;	2	1. and 2. Accept any named equivalent examples e.g. nucleotides. Neutral: ammonia/nitrite /nitrate/ phosphate.
2(a)(ii)	1. Saprobiotic (microorganisms/bacteria) break down remains/dead material/protein/DNA into ammonia/ammonium; 2. Ammonia/ammonium ions into nitrite and then into nitrate; 3. (By) Nitrifying bacteria / nitrification;	3	1. Accept: saprobionts /saprophytes/saprotrophs 1. Neutral: decomposer 2. Allow correct chemical symbols. 2. Accept: correct answers which use incorrect bacteria e.g. nitrogen-fixing but then reject m.p. 3.
2(b)	1. Nitrate/phosphate/named ion/nutrients for growth of/absorbed/used by plants/algae/producers; 2. More producers/consumers/food **so** more fish / fish reproduce more / fish grow more / fish move to area;	2	2. Must have idea of more plants related to some increase in fish.

Question	Marking Guidance	Mark	Comments
3(a)	Succession;	1	Ignore any word in front of succession e.g. secondary/ecological succession. Neutral 'forestation'
3(b)	1. Greater variety/diversity of plants/insects / more plant/insect species; 2. More food sources / more varieties of food; 3. Greater variety/more habitats/niches;	3	1. Neutral: more plants 2. Neutral: more food / more/greater food source (singular) 3. Accept: more nesting sites 3. **Q** Neutral: more homes/shelters.
3(c)(i)	Temperature and carbon dioxide;	1	Neutral: water, chlorophyll
3(c)(ii)	Shows (gross) photosynthesis/productivity minus respiration / more carbon dioxide used in photosynthesis than produced in respiration;	1	1. Correct answers are often shown as: net productivity = (gross) photosynthesis – (minus) respiration.
3(c)(iii)	1. (Shade plant) has lower (rate of) respiration/ respiratory losses; 2. (Shade plant) less CO_2 released at 0 light intensity/in dark; 3. Greater (net) productivity / less sugars/glucose used / more sugars/glucose available;	2	1. Accept use of figures. 1. Accept: lower compensation point. Neutral: any references to rate of photosynthesis.

Question	Marking Guidance	Mark	Comments
4(a)	(Recessive) allele is always expressed in females / females have one (recessive) allele / males need two recessive alleles/ males need to be homozygous recessive / males could have dominant and recessive alleles/be heterozygous/carriers;	1	Accept: Y chromosome does not carry a dominant allele. Other answers must be in context of allele not chromosome or gene.
4(b)(i)	1. 1, (2) and 5; 2. 1 must possess/pass on the recessive allele / 1 must be a carrier / heterozygous / if slow (feather production) is recessive all offspring of (1 and 2) would be slow (feather production) / if rapid (feather production) was dominant 1 would have rapid (feather production);	2	1. Accept: for 1 mark that 1 and 2 have slow (feather production) but produce one offspring with rapid (feather production). Neutral: any reference to 3 being offspring of 1. 2. Reject: both parents must be carriers / possess the recessive allele. 2. Reject: one of the parents (i.e. not specified) must be a carrier/heterozygous.
4(b)(ii)	5 = X^fY / X^fY^- / f / f- / fY ; 7 = X^FX^f **and** X^FX^F (either way round) / **or** X^fX^F**and** X^FX^F (either way round) / **or** X^FX^f**,** X^fX^F **and** X^FX^F(in any order)**;**	2	Note: allow 5 = X^fY, X^fY. Accept: for both 5 and 7 a different letter than F. However, lower case and capital letter must correspond to that shown in the answer. For example accept 7 = X^RX^r and X^RX^R.
4(b)(iii)	X^FX^f **and** X^fY **or** X^fX^F **and** X^fY **or** X^FX^f **and** X^fY^- **or** X^fX^F **and** X^fY^- / **or** Ff **and** fY / **or** Ff **and** fY^- / **or** Ff **and** f- / **or** Ff **and** f;	1	Accept: a different letter than F. However, lower case and capital letter must correspond to that shown in the answer. Accept: each alternative either way round.

4(c)	Correct answer of 32 (%) = 3 marks;;; If incorrect answer, allow following points 1. p^2/q^2 = 4%/0.04/ or p/q = 0.2; 2. Shows understanding that 2pq = heterozygotes / carriers;	3	Accept: 0.32 = 2 marks 2. Accept: answer provided attempts to calculate 2pq. This can be shown mathematically i.e. 2 x two different numbers.

Question	Marking Guidance	Mark	Comments
5(a)	1. Allows (valid) comparison; 2. Number/sample size may vary;	2	
5(b)	1. Increased chance of (severe malaria) with blood group A / decreased chance of (severe malaria) with sickle cell; 2. One mark for one of the following: almost equal chance with blood group O /slightly greater chance of mild malaria with O /slightly lower chance of severe malaria with O /2.5 x/2.48 x/more than twice the chance of severe with blood group A /(almost) 50%/half the chance of severe malaria with sickle cell /twice the chance of mild malaria with sickle cell;	2	1. Accept: converse for mild malaria i.e. increased chance of mild malaria with sickle cell / decreased chance of mild malaria with blood group A. 1. Accept: if answer is comparative e.g. greatest risk of severe malaria with blood group A. 2. Neutral: answers which only refer to or use ratios.
5(c)	1. Individuals with the **Hb^C** (allele) reproduce; 2. Pass on **Hb^C** (allele) which increases in frequency; 3. **Hb^A Hb^A** individuals less likely to survive/reproduce / frequency of **Hb^A** (allele) decreases;	3	

Question	Marking Guidance	Mark	Comments
6(a)	Prevents <u>oxygen</u> being taken up/entering/being absorbed;	1	Accept: any idea of no contact with oxygen. Neutral: for anaerobic respiration / anaerobic conditions. Neutral: prevents entry of air. Reject: prevents entry of oxygen and another named gas.
6(b)(i)	0.0155 / 0.016 = 2 marks;; 0.0775 / 0.077 / 0.078 / 0.08 = 1 mark / 0.62 = 1 mark	2	
6(b)(ii)	Glucose decreases/is a limiting factor / increase in ethanol / yeast/cells die / toxins build up;	1	Accept: glucose is used up.
6(b)(iii)	1. (Stays the) same/level/(relatively) constant; 2. Same volume/amount of oxygen uptake and carbon dioxide release;	2	Note: if m.p.1 is awarded m.p 2 can be obtained without referring to 'same volume/amount'
6(c)	1. Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons; 2. Oxidative phosphorylation / electron transport chain provides ATP; 3. Only glycolysis occurs without oxygen / no Krebs / no link reaction;	2 max	

Question	Marking Guidance	Mark	Comments
7(a)	1. No/few consumers/pests/pathogens; 2. Outcompetes/better competitor for resources/light/CO_2/abiotic factor / ideal niche;	2	1. Accept: No/few predators. 1. Accept: description of competition for a named resource with reference to 'other species'. 1. Accept: More resistance to disease 2. Neutral: competition for food.
7(b)	1. (Cost of) control/removal; 2. (Cost of) restoring habitat / conservation; 3. (Loss of income) from fishing; 4. (Loss of income) from boating/tourism/recreation;	2 max	4. Accept: any valid recreational activity e.g. canoeing.
7(c)(i)	1. Removes water; 2. Water content can vary in sample/plant;	2 max	Note: Reweighing/constant mass indicates all water removed = 2 marks. ;
7(c)(ii)	1. 0.5 is not effective/has little effect / 1.0 is less effective (than 5.0) /concentrations below 5.0 less effective; 2. At 5.0 biomass/growth is reduced; 3. Small difference between using 5.0 and 25.0; 4. Using 5.0 is cost effective / using 25.0 is expensive; 5. 25.0/high concentrations may affect the environment / other organisms / chemical may remain in habitat / bioaccumulation;	4 max	Accept: for first 3 mark points effect on growth/biomass as a measure of effectiveness. Accept: references to 'this concentration' = 5.0. 1. Accept: 5.0 is the minimum effective concentration. 1. and 2. 5.0 is the minimum effective concentration that reduces growth = 2 marks. 5. Accept: any impact on the habitat e.g. contaminate water supply.

7(d)(i)	To compare/see effect with/without fungus/fluridone/control agent/s;	1	Neutral: for comparison on its own. Neutral: to see effect of variables/results/treatments /factors without further qualification.
7(d)(ii)	1. Is specific / grows/survives in Hydrilla/habitat; 2. Can reproduce / only one application required; 3. Does not become a pest;	2	1. Accept: 'known to work'
7(d)(iii)	1. Fluridone/chemical acts quickly / quickly reduces Hydrilla; 2. Fungus/biological control keeps Hydrilla in low numbers; 3. Fungus/biological control works over a long time/can reproduce 4. Resistance does not develop against fungus/biological control;	2 max	3. Neutral: only one application as not always valid for integrated pest management.

Question	Marking Guidance	Mark	Comments
8(a)	1. Carbon dioxide combines with ribulose bisphosphate/RuBP; 2. Produces two glycerate (3-)phosphate/GP; 3. GP reduced to triose phosphate/TP; 4. Using reduced NADP; 5. Using <u>energy</u> from ATP; 6. Triose phosphate converted to glucose/hexose/RuBP/ ribulose bisphosphate/named organic substance;	6 max	2. Accept: any answer which indicates that 2 x as much GP produced from one RuBP. 3. Must have idea of reduction. This may be conveyed by stating m.p. 4. 4. **Reject**: Any reference to reduced NAD for m.p.4 but allow reference to reduction for m.p. 3. 5. Must be in context of GP to TP.
8(b)	1. Carbon dioxide is a greenhouse gas; 2. Deforestation/trees removed so less carbon dioxide removed by photosynthesis; 3. Burning/combustion releases/produces carbon dioxide; 4. Methane is a greenhouse gas; 5. Any valid reference to source of methane, e.g. rice fields, landfills, cattle;	4 max	1. Accept: carbon dioxide contributes to greenhouse effect. 4. Accept: methane contributes to greenhouse effect. Neutral: any references to other gases.
8(c)	1. Use a grid / split area into squares/sections; 2. Method of obtaining random coordinates / numbers, e.g. calculator/computer/random numbers table/random number generator; 3. Count number/frequency of plants in a quadrat; 4. Calculate mean/average number (per quadrat/section); 5. Valid method of calculating total number of bluebells/plants. e.g. mean number of plants per quadrat/section/m^2 multiplied by number of quadrats/sections/m^2 in wood;	5	Neutral: any reference to using belt/line transects. 1. Accept: use of tape measures/map/area with coordinates. 3. Accept: determine percentage cover. 4. Accept: method of calculating mean. 5. Neutral: 'scale up' without further qualification.