
A-LEVEL BIOLOGY

BIOL4 – Populations and Environment
Mark scheme

2410
June 2017

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

Question	Marking Guidance	Mark	Comments
1(a)	Number/group of/all/ (organisms/individuals) of one/a species in a habitat/area/ecosystem/same place;	1	Reference to community on its own is not equivalent to habitat/area etc.
1(b)(i)	$B + I = D + E$	1	
1(b)(ii)	$B + I > D + E$	1	
1(c)(i)	Correct answer of 121,650,540 or 121.7 million = 2 marks;; Incorrect answer but shows one of the following = 1 mark; 119,900 x 14.6 /119.9 million x 0.0146 /1,750,540 / (deaths) 575,520 <u>and</u> (births) 2,326,060;	2	
1(c)(ii)	Mexico higher birth rate than death rate <u>and</u> Italy balanced birth and death rate;	1	Accept: Mexico higher birth rate than death rate <u>and</u> Italy higher death rate than birth rate.

Question	Marking Guidance	Mark	Comments
2(a)(i)	1. Gases/correct named gases not released OR gases/correct named gases can be collected; 2. Conditions (in digester) can be controlled OR anaerobic conditions (in digester) can be maintained; 3. Named gas/open tanks associated with health risk/environmental damage;	2 max	Correct named gases include: methane, carbon dioxide, hydrogen sulfide, nitrogen oxides. 2. Accept: Oxygen cannot enter / stops aerobic respiration.
2(a)(ii)	1. <u>Respiration</u> causes temperature increase/release of heat; 2. Enzymes would be denatured/microorganisms killed;	2	
2(b)(i)	1. Growth of algae/surface plants/algal bloom blocks light; 2. Reduced/no photosynthesis so (submerged) plants die; 3. Saprobiotic (bacteria/microorganisms) respire and use oxygen; 4. Less oxygen for fish/organisms to respire / aerobic organisms die;	3 Max	3. Accept: saprobiont/saprophyte/saprotroph.
2(b)(ii)	1. Acts as soil conditioner/improves drainage/ aerates soil/increases organic content of soil; 2. Contains other elements/nutrients named elements/nutrients / wider range of elements/nutrients; 3. Production of artificial fertiliser energy-consuming; 4. Less leaching / slow release (of nutrient); 5. Qualified statement related to cost e.g. cost of producing inorganic fertiliser.	1 max	Unspecified answers relate to natural fertiliser. Ignore references to eutrophication 2. i.e. elements/nutrients other than nitrogen/nitrates, phosphorus/phosphates and potassium. 2. Accept: salts and ions for nutrients.

Question	Marking Guidance	Mark	Comments
3(a)(i)	- Animal 2 / 5 has hair but offspring do not; - So 2 / 5 parents must be heterozygous/carriers; OR 4/7/8 are hairless but parents have hair; - So 2 / 5 must be heterozygous/carriers;	2	Accept: parents as alternative to animals 2 and 5 1 + 3: Allow reference to children/offspring for animals 7 + 8 Mark points 2 and 4. Reject both parents are heterozygous.
3(a)(ii)	Hairless males have fathers with hair /4 is hairless but 1 is hairy /7 and/or 8 are hairless but 6 is hairy /only males are hairless;	1	Ignore references to other individuals Ignore reference to genotypes Allow credit for candidate who states that evidence is not conclusive/pedigree possible with autosomal character.
3(b)	- Parental genotypes $X^H X^h$ and $X^H Y$ Gametes X^H X^h X^H Y; - Genotypes of offspring $X^H X^H$, $X^H Y$, $X^H X^h$, $X^h Y$; - Phenotypes of offspring female with hair male with hair male hairless; 0.25 / $\frac{1}{4}$ / 1 in 4 / 25%;	4	Accept any letter for gene but capital letter must represent dominant allele. - Both parental genotypes and gametes must be correct - Allow for offspring genotypes correctly derived from <u>gametes</u> given by candidate; - Allow phenotypes correctly derived from offspring genotype Allow $H \equiv X^H$, $h \equiv X^h$ Reject 1:4 Ignore 1:3

Question	Marking Guidance	Mark	Comments
4(a)(i)	So it/CO ₂ is not a <u>limiting</u> factor (on growth/photosynthesis);	1	Accept: CO ₂ is a <u>limiting</u> factor
4(a)(ii)	Amount of triose phosphate/TP will be similar/same/low (at start);	1	Accept: to allow triose phosphate to stabilise / become constant Reject: so all triose phosphate is used up Reject: so no triose phosphate
4(b)	1. (Less) ATP produced; 2. (Less) reduced NADP produced; 3. ATP/reduced NADP produced during light-dependent reaction; 4. (Less) GP to triose phosphate/TP;	4	Accept: alternatives for reduced NADP i.e. NADP with hydrogen/s attached
4(c)	1. Less triose phosphate converted to RuBP; 2. CO ₂ combines with RuBP;	2	Accept: less triose phosphate so less RuBP.

Question	Marking Guidance	Mark	Comments
5(a)(i)	Two marks for correct answer of 62 / 62.4 / 62.6;; One mark for calculation involving 0.79×0.79 or 0.62;	2	
5(a)(ii)	(0.79/the frequency) remains the same;	1	Reject if wrong frequency is quoted
5(a)(iii)	1. Population is (too) small; 2. (As they live in groups) mating (unlikely) to be random; 3. (As a new population in a new environment) natural selection likely to occur;	2 max	
5(b)	1. Directional; 2. The (recessive) allele confers disadvantage/grey wolves less likely to reproduce; OR The dominant allele confers advantage/black wolves more likely to reproduce;	2	Assume 'it' to refer to the recessive allele 2. Reference to selection does not gain credit as the term is used in the question. 2. Accept: 'pass on allele' as equivalent to reproduce.

Question	Marking Guidance	Mark	Comments
6(a)(i)	1. Oxygen taken up/used (by woodlouse); 2. Carbon dioxide (given out) is absorbed by solution/potassium hydroxide; 3. Decrease/change in pressure;	3	3. Reference to vacuum negates last marking point. 3. Reject reference to pressure increasing inside tube.
6(a)(ii)	1. Distance (drop moves) and time; 2. Mass of woodlouse; 3. Diameter/radius/bore/cross-sectional area of tubing/lumen;	3	If answer refers to measuring volume using the syringe allow 2 max – one mark for measuring volume; one mark for mass of woodlouse;
6(b)	1. Less/no proton/H ⁺ gradient/movement so less/no ATP produced; 2. Heat released from electron transport/redox reactions / energy not used to produce ATP is released as heat; 3. Oxygen used as final electron acceptor/combines with electrons (and protons);	3	1. Accept: Proton/H ⁺ gradient/movement linked to ATP production. 2. Accept: Heat release/production linked to less/no ATP produced 2. Accept: Heat release/produced linked to energy from proton gradient/movement.

Question	Marking Guidance	Mark	Comments
7(a)(i)	Reliable / representative / for statistical tests;	1	Accept: identify anomalies Neutral: accurate/valid/bias
7(a)(ii)	- Find coordinates (on a grid) / split area into squares / number the sites; - Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;	2	- Ignore references to tape measures, metre rulers etc. - Accept: numbers out of a hat / use of dice
7(a)(iii)	- Breeding (of lizards); - Food source/prey; - Predator; (Variation in) malarial infection; - Temperature (variation); - Availability of water e.g. drought/'rainy season'	2 max	Ignore: weather / climate / hurricanes / hibernation / migration / emigration / immigration
7(b)	- Number in sample varies; - Allow a (valid) comparison;	2	
7(c)	(Overall) <u>positive correlation</u> (for either/both species); - Correct reference to (site) 5 / 300 metres (as an anomaly); - Limited results for <i>A. wattsi</i> / small sample/number/percentage of <i>A. wattsi</i> / no infection/results of <i>A. wattsi</i> until site 6 / 315 metres;	2 max	Ignore: only one study / no repeats.
7(d)(i)	- Fewer <i>A. wattsi</i> infected / more <i>A. gingivinus</i> infected; - Higher number of <i>A. wattsi</i> present when higher percentage/number of <i>A. gingivinus</i> infected; - No <i>A. wattsi</i> present when <i>A. gingivinus</i> has zero infection;	2 max	

Question	Marking Guidance	Mark	Comments
7(d)(ii)	1. Reduced immunity; 2. Reduced oxygen transport/uptake/respiration / reduced activity/movement;	2	1. Accept: idea that energy/ resources are used to combat malaria
7(d)(iii)	1. There is a <u>probability</u> of less than 1% / 0.01 / 5% / 0.05; 2. That <u>correlation</u> is due to chance; OR 3. There is a <u>probability</u> of more than 99% / 0.99 / 95% / 0.95; 4. That <u>correlation</u> is not due to chance;	2	1. Reject: probability is/equal to 1% / 0.01 / 5% / 0.05. 1. Reject: 0.01% / 0.05%. 3. Reject: probability is/equal to 99% / 0.99 / 95% / 0.95. 3. Reject: 0.99% / 0.95 %.

Question	Marking Guidance	Mark	Comments
8(a)	1. (Colonisation by) <u>pioneer</u> (species); 2. Change in <u>abiotic</u> environment / example of change caused by organisms present; 3. Enables other <u>species</u> to colonise/survive; 4. Change in <u>diversity/biodiversity</u> ; 5. Stability increases / less hostile environment; 6. Climax community;	5 max	2. Accept an example of change e.g. formation of soil/humus/ organic matter / increase in nutrients; 4. Do not accept genetic diversity for mark point 4.
8(b)	<u>Advantages</u> 1. Specific (to one pest); 2. Only needs one application/ reproduces; 3. Keeps/maintains low population; 4. Pests do not develop resistance; 5. Does not leave chemical in environment/on crop / no bioaccumulation; 6. Can be used in organic farming; <u>Disadvantages</u> 7. Does not get rid of pest completely; 8. May become a pest itself; 9. Slow acting/ lag phase/ takes time to reduce pest population; 10. Difficult to prevent spread;	5 max	Max 3 for advantages or disadvantages. Ignore references to leaching, eutrophication. Ignore references to cost. 4. Reject reference to immunity/immune.

Question	Marking Guidance	Mark	Comments
8(c)	1. Glycolysis / glucose to pyruvate; 2. (Yields) small amount of ATP/2 ATP; 3. Pyruvate converted to ethanol; 4. Reduced NAD converted back to NAD for glycolysis (to continue); 5. (Less ATP/energy) for uptake of ions/salts/nutrient/named ion/salt/nutrient; 6. (Less ATP/energy) for synthesis of named organic compound e.g. protein/DNA/cellulose;	5 max	2. Accept: Produces less ATP (than aerobic respiration). 4. Accept: NAD regenerated for glycolysis (to continue). 6. Ignore: Produces sugars/glucose.