A-LEVEL

Biology

BIOL4 – Populations and environment

Mark scheme

2410
June 2016

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)	Community;	1	
1(b)	(Less) competition for food/resource;	1	Ignore: competition for niche/habitat. Accept: space/named resource. Reject: intraspecific competition.
1(c)	1. Correlation **but** does not mean a causal effect; 2. Other abiotic/biotic/named factor involved; 3. Variation in numbers of beetles species at same/similar particular pH; 4. Large sample;	3 max	1. Ignore: positive/ negative (correlation). 2. Accept: due to presence/absence of fish. 2. Reject: 'other factors' unless further qualified. 3. Accept: same number of beetles at different pHs. 3. Accept: 'scattered results' / 'anomalies' / 'spread of results'.
1(d)	Fish feed on predator/consumer of water beetle;	1	Accept: beetles feed on fish/faeces.

Question	Marking Guidance	Mark	Comments
2(a)	Stroma (of chloroplasts);	1	Reject: stoma. Reject: stroma of chlorophyll or any reference to chlorophyll. Accept: stroma of chloroplasts.
2(b)(i)	(Less) RuBP combines with carbon dioxide;	1	Accept: binds/joins.
2(b)(ii)	1. Temperature is a limiting factor/below optimum; 2. Light is a limiting factor/below optimum; 3. Limited by RuBP (available/produced); 4. Limited by enzyme;	2 max	2. Accept: limited by reduced NADP or ATP. 3. Accept: RuBP will always give 2 GP (at high CO_2). 4. Accept: limited by Rubisco.
2(c)	1. (Provides) hydrogen / protons/H^+ **and** electrons/e^-; 2. For reduction; 3. Source of electrons for chlorophyll/electron transfer chain;	2 max	1. Ignore: if water is used as source of hydrogen. 2. Reject: reduction of NAD. 2. Reject: reduction by H^+ or protons on their own. 3. Accept: electrons for photophosphorylation. 3. Ignore: photosystems. 1, 2 and 3. Reject: reference to respiration/mitochondria.

Question	Marking Guidance	Mark	Comments
3(a)	1. (Expression/appearance/characteristic) due to) genetic constitution/genotype/allele(s); 2. (Expression/appearance/characteristic due to) environment;	2	1. Accept: named characteristic. 1. Accept: homozygous/ heterozygous/genes/DNA. 1. Ignore: chromosomes.
3(b)(i)	1. (Individual) 2 has colour vision but 4 is colour blind / 10 has colour vision but 12 is colour blind **OR** 4/12 is colour blind but parents have colour vision; 2. So 2/10 must be heterozygous/carriers;	2	Accept: (1), 2 and 4 **or** 10, (11) and 12. Accept: any suitable description and explanation equivalent to points 1 and 2. 2. Reject: (both) parents heterozygous/carriers. 2. Accept: correct genotypes for 2 and 10. Accept: for 2 marks, if it was dominant the daughters (8 and 10) of individual 4 would be colour blind.
3(b)(ii)	X^BX^b **or** X^bX^B**;**	1	Reject: Bb / bB Accept: XBXb or XbXB; Accept use of other letter than B e.g. X^RX^r**,** X^HX^h**.**
3(c)(i)	2 marks for the correct answer of 0.0625 / 6.25% / $^1/_{16}$;; 1 mark for incorrect answer but shows 0.03125 / 3.125% / $^1/_{32}$;	2	Accept: 0.063 / 0.06 / 6.3% / 6% for 2 marks. Accept: incorrect answer but shows / 0.0313 / 0.031 / 0.03 / 3.13% / 3.1% / 3% / $^1/_4$ x $^1/_4$ / 0.25 x 0.25 for 1 mark. Note: If probability is calculated as a percentage but no % shown in the answer then deduct one mark. For example 6 .25 = one mark, 3.125 = zero.

3(c)(ii)	2 marks for the correct answer of 48(%);; 1 mark for an incorrect answer but shows understanding that 2pq = heterozygous or attempts to calculate 2pq;	2	1 mark maximum for the answer of 0.48.

Question	Marking Guidance	Mark	Comments
4(a)	1. No interbreeding / gene pools are separate / geographic(al) isolation; 2. Mutation linked to (different) markings/colours; 3. Selection/survival linked to (different) markings/colours; 4. Adapted organisms breed / differential reproductive success; 5. Change/increase in allele frequency/frequencies;	5	1. Accept: reproductive isolation as an alternative to no interbreeding. 4. Note: 'passed on to offspring' on its own is not sufficient for reproduction.
4(b)	1. (Compare DNA) base sequence / base pairing / (DNA) hybridisation; 2. Different in six (species) /different in different species / similar in three (subspecies) /similar in same species/subspecies;	2	1 and 2. Ignore: compare chromosomes / 'genetic make-up'. 1. Accept: (compare) genes / introns / exons. 1. Note: reference to **only** comparing alleles is 1 max. 2. Reject: '<u>same</u> alleles/ <u>same</u> DNA bases in three species/subspecies'. 2. Note: mark point 2 can be awarded without mark point 1.

Question	Marking Guidance	Mark	Comments
5(a)	1. Respiration/metabolism/ammonification; 2. (Releases/produces) heat;	2	2. Reject: 'produces energy'.
5(b)	1. SD is spread of data around the mean; 2. (SD) reduces effect of anomalies/ outliers; 3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance;	2 max	1. Accept: variation around the mean. 1. Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers. 2. Reject: (SD) removes anomalies/outliers. Ignore: reliability/accuracy/validity.
5(c)	1. Distributes heat / prevents 'hot' spots; 2. Distributes microorganisms; 3. More enzyme-substrate complexes; 4. Increases rate of decomposition; 5. Aeration/provides oxygen;	2 max	4. Accept: increases nitrification/ammonification or 'breaks down waste faster'.
5(d)	1. Microorganisms change the abiotic conditions/temperature/organic waste /provide nutrients; 2. Less <u>hostile</u> conditions; 3. Decline in Cocci **and** increase in rods; 4. Gram positive outcompete / better competitors;	3 max	1. Must refer to microorganisms or bacteria/named bacteria causing the change. 1. Ignore: change the environment. 3. Accept: 'decrease in cocci, others are going up'. 3. Accept: decrease in cocci and increase in either rod type or increase in both types. 4. Accept: rods outcompete (cocci) / better competitors.

Question	Marking Guidance	Mark	Comments
6(a)(i)	Cytoplasm/cytosol;	1	
6(a)(ii)	1. Regenerates/produces NAD / oxidises reduced NAD; 2. NAD reduced in stage 1/glycolysis / NAD accepts hydrogen in stage 1/glycolysis;	2	Note: penalise use of NADP for first marking point obtained. Do not accept NAD accepts only protons but allow accepts protons and electrons.
6(b)(i)	1/one/1.0;	1	
6(b)(ii)	1. Aerobic and anaerobic respiration occurring; 2. More carbon dioxide produced than oxygen uptake;	2	1. Accept: some/mainly anaerobic respiration occurring.
6(c)	1. Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons; 2. (Aerobic respiration) oxidative phosphorylation / electron transfer chain ; 3. Anaerobic (respiration) only glycolysis occurs / no Krebs / no link reaction;	2 max	Ignore: number of ATP produced. 3. Accept: without oxygen. 3. Ignore: converse.

Question	Marking Guidance	Mark	Comments
7(a)	1. (Use) coordinates / number the rocks/sites/squares; 2. Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;	2	1. Ignore: references to grid, tape measures, metre rulers etc. 2. Accept: numbers out of a hat / use of dice.
7(b)	Difficult/too many to count / individual organisms not identifiable / too small to identify/count / grows in clumps;	1	Ignore: easier/quicker/representative/ more accurate, unless qualified.
7(c)	Any suitable factor with valid explanation = 1 mark 1. Wave action - firmer grip on rock is necessary (at either site); 2. Wind/air movement/less humid - more evaporation at site A / more (physical) damage; 3. Light – (linked to) photosynthesis (at either site); 4. Temperature – (linked to) photosynthesis/respiration/enzymes/ evaporation (at either site); 5. pH – (linked to) enzymes/proteins;	2 max	Note: other common factors include salt (salinity) linked to water potential / named nutrient e.g. nitrate linked to protein/DNA. Ignore: carbon dioxide /oxygen/pollution/rainfall/food /nutrients. Reject: biotic factors e.g. predation.
7(d)	1. Greater variety of food / more food sources; 2. More/variety of habitats/niches;	2	1. Ignore: more food. 2. Ignore: homes/shelters. 2. Accept: different habitats.
7(e)(i)	1. (So they were) hungry/not full; 2. (Allows) comparison;	2	1. Accept: description of hunger e.g. appetite / 'empty stomach'/'so they eat'.
7(e)(ii)	1. Alga without consumer/named consumer/animal; 2. (Find change in mass) in dark; 3. For 50 hours;	3	1. Accept: repeat experiment without consumer. 1. Accept: in separate tank / in tank where not eaten. 3. Accept: 'same time as in experiment'. 3. Accept: For lower time period then scaled up to 50.

7(e)(iii)	1. For *Laurencia pacifica* **and** *Cystoseira osmondacea* (difference in results) significant /reject null hypothesis / not due to chance / less than 5%/0.05 probability due to chance; *2.* For *Egregia leavigata* **and** *Microcystis pyrifera* no significant (difference in results)/accept null hypothesis / is due to chance/more than 5%/0.05 probability due to chance; 3. (Difference in results) for *Laurencia pacifica* is the most significant;	3	1, 2 and 3. Accept: abbreviations for all species. 1. Accept: for *Laurencia pacifica* 'less than 1%/0.01 probability'. 2. Accept: 'insignificant' for 'no significant difference'. 3. Note: reference to probabilities on their own is not sufficient.

Question	Answers	Mark	Comments
8(a)	1. Excites electrons / electrons removed (from chlorophyll); 2. Electrons move along carriers/electron transfer chain releasing energy; 3. Energy used to join ADP and Pi to form ATP; 4. Photolysis of water produces protons, electrons and oxygen; 5. NADP reduced by electrons / electrons and protons / hydrogen;	5	1. Accept: higher energy level as 'excites'. 2. Accept: movement of H^+/protons across membrane releases energy. 2. and 3. Reject: 'produces energy' for either mark but not for both. 3. Accept energy used for phosphorylation of ADP to ATP 3. Do not accept P as Pi but accept phosphate. 5. Accept NADP to NADPH (or equivalent) by addition of electrons/hydrogen. 5. Do not accept NADP reduced by protons on its own.
8(b)	(Advantages) 1. Acts quickly; 2. Can apply to particular area; 3. Kills all/most/wide variety of pests; (Disadvantages) 4. Needs to be re-applied; 5. Not specific; 6. Pests can develop resistance; 7. (Bio)accumulation;	5 max	Max 3 for advantages or disadvantages. Ignore: references to cost or chemicals being specific. Ignore: references to organic farming/crops. 5. Accept: kills non-target/beneficial insects. 5. Ignore: affects food chain/s. 7. Ignore: references to leaching, eutrophication.

8(c)	1. Protein/amino acids/DNA into ammonium compounds / ammonia; 2. By saprobionts; 3. Ammonium/ammonia into nitrite; 4. Nitrite into nitrate; 5. By nitrifying bacteria/microorganisms;	5	1. Accept: any named nitrogen containing compound e.g. urea. 2. Accept: saprophytes. 1, 3 and 4. Accept: marks for conversion even if incorrect type of bacteria named as being involved. 2 and 5. Reject: marks for type of bacteria if linked to incorrect process e.g. nitrite converted to nitrate by saprobionts. 3 and 4. Accept: for one mark ammonia/ammonium into nitrate if neither mark point 3 or 4 awarded. Note: there are no marks for the role of nitrogen-fixing bacteria as the question refers to producing a source of nitrates from the remains of crops. 5. Reject: nitrifying bacteria in root nodules.