A-LEVEL

Biology

BIOL4 – Populations and environment

Mark scheme

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Version: 1.0 Final

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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.