A- LEVEL

Biology

BIOL4 – Populations and environment
Mark scheme

2410
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Version: 1 Final Mark Scheme

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.

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Question	Marking Guidance	Mark	Comments
1(a)(i)	Birth rate and death rate fall and then level out/remain low/fluctuates/stabilises;	1	
1(a)(ii)	Population increases then levels out/falls/fluctuates/stabilises;	1	
1(b)(i)	1. 79/80 and 84 / (indicates difference of) 5 or 4; 2. 4.76(%) / 4.8(%) / 5(%) / 5.9(%) / 5.95(%) / 6(%) / 6.3(%);	2	Note: answers must show working (as indicated in rubric) to obtain full marks. 2. Accept: all answers which would round up/down to give equivalent answers e.g. 6.329%
1(b)(ii)	Named disease / named risk factor which may cause higher death rate e.g. heart disease/ prostate cancer / obesity / stress / exercise / driving / war / smoking / alcohol / less likely to visit doctor;	1	Accept: sex-linked disease Neutral: unqualified answers e.g. 'females have better health/fitness/life style/genetics', 'males have dangerous/physical jobs', 'drink more', 'poor diet'

Question	Marking Guidance	Mark	Comments
2(a)	R;	1	
2(b)	1. Protein/amino acids broken down (to ammonium ions/ammonia); 2. By saprobionts / saprobiotic (microorganisms);	2	1. Accept: nucleic acids/RNA/DNA/urea/any named nitrogen containing compound as an alternative to protein/amino acids 1. Accept: saprophytes/saprotrophs 2. Neutral: decomposers 2. Reject: answers where incorrect type of bacteria given as saprobionts e.g. Nitrogen fixing bacteria
2(c)	1. (Fertility increased as) more nitrate formed / less nitrate removed/broken down; 2. Less/no denitrification / process P is decreased / fewer denitrifying bacteria;	2	1. Accept: Nitrate remains 2. Accept: more nitrification / more nitrifying bacteria / process R is increased
2(d)	1. Grow crops/plants with nitrogen-fixing (bacteria); 2. (Different crops use) different minerals/salts/nutrients/ions (from the soil); 3. (Different crops have) different pests/pathogens/diseases;	2 max	1. Accept: grow legumes / named example e.g. peas, beans, clover 1. Accept: fallow year 1. Accept: use different amounts of ions/nutrients

Question	Marking Guidance	Mark	Comments
3(a)(i)	Unit of energy/mass, per area, per year;	1	
3(a)(ii)	1. Less light / more shading / more competition for light; 2. Reduced photosynthesis;	2	Neutral: references to animals Accept: no photosynthesis
3(b)	1. Pioneer species; 2. Change in abiotic conditions / less hostile / more habitats/niches; 3. Increase in number/amount/diversity of species/plants/animals;	3	2. Accept: named abiotic change or example of change e.g. formation of soil/humus / organic matter / increase in nutrients 2. Neutral: reference to change in environment unqualified 2. Neutral: more hospitable / habitable / homes / shelters 3. Accept: other/new species (colonise)
3(c)	1. Net productivity = gross productivity minus respiratory loss; 2. Decrease in gross productivity/photosynthesis / increase in respiration;	2	
3(d)	1. Conserving/protecting habitats/niches; 2. Conserving/protecting (endangered) species / maintains/increases (bio)diversity; 3. Reduces global warming/greenhouse effect/climate change / remove/take up carbon dioxide; 4. Source of medicines/chemicals/wood; 5. Reduces erosion/eutrophication;	1 max	Accept: tourism / aesthetics / named recreational activity

Question	Marking Guidance	Mark	Comments
4(a)	Both alleles are expressed/shown (in the phenotype);	1	Accept: both alleles contribute (to the phenotype) Neutral: both alleles are dominant
4(b)	Only possess one allele / Y chromosome does not carry allele/gene / can't be heterozygous;	1	Accept: only possess one gene (for condition) Neutral: only 1 X chromosome (unqualified)
4(c)	1. X^GX^B, X^BX^B, X^GY, X^BY; 2. Tortoiseshell female, black female, ginger male, black male; 3. (Ratio) 1:1:1:1;	3	1. Accept: equivalent genotypes where the Y chromosome is shown as a dash e.g. X^G-, or is omitted e.g. X^G 1. Reject: GB, BB, GY, BY as this contravenes the rubric 2 and 3. Award one mark for following phenotypes tortoiseshell, black, (black) ginger in any order with ratio of 1:2:1 in any order. Allow one mark for answers in which mark points 1, 2 and 3 are not awarded but show parents with correct genotypes i.e. X^GX^B and X^BY or gametes as X^G, X^B and X^B, Y 3. Neutral: percentages and fractions 3. Accept: equivalent ratios e.g. for 1:1:1:1 allow 0.25 : 0.25 : 0.25 : 0.25
4(d)(i)	Correct answer of 0.9 = 2 marks;; Incorrect answer but shows $q^2 = 0.81$ = one mark;	2	Note: 0.9% = one mark
4(d)(ii)	Homozygous dominant increases and homozygous recessive decreases;	1	

Question	Marking Guidance	Mark	Comments
5(a)	Oxygen production/concentration <u>and</u> time;	1	Accept: oxygen volume/concentration Reject: oxygen uptake Neutral: reference to carbon dioxide uptake
5(b)	1. Intensity of light; 2. Amount/number/mass/species of algae/photosynthesising cells; 3. Carbon dioxide (concentration/partial pressure); 4. Time;	2 max	1. Accept: distance from light
5(c)	1. (pH) increases; 2. As (more) carbon dioxide removed (for photosynthesis);	2	1. Neutral: becomes more alkaline/less acidic
5(d)	1. Less absorption / (more) reflection (of these wavelengths of light); 2. (Light required) for light dependent (reaction)/photolysis 3. (Represents) green light / colour of chlorophyll;	2 max	1. Reject: no absorption or cannot absorb unless in context of green light. Note: no green light absorbed <u>or</u> green light reflected = 2 marks. 2. Accept: for excitation/removal of electrons (from chlorophyll)

Question	Marking Guidance	Mark	Comments
6(a)	1. Oxidation of/hydrogen removed from pyruvate and carbon dioxide released; 2. Addition of coenzyme A;	2	Accept: NAD reduced for oxidation
6(b)(i)	1. Change (in shape) of active site / active site moulds around the substrate; 2. (Substrate/active site) now complementary;	2	1. Reject: reference to inhibitor 1. Accept: change in tertiary structure affecting active site Neutral: references to two active sites
6(b)(ii)	1. Is a competitive inhibitor / attaches to active site; 2. Reduces/prevents enzyme-substrate/E-S complex forming;	2	1. Neutral: reference to inhibitor forming an enzyme-substrate complex 2. Accept: Reduces/prevents acetylcoenzyme A binding to enzyme/citrate synthase
6(c)(i)	1. Regenerates/produces NAD / oxidises reduced NAD; 2. (NAD used) in glycolysis;	2	2. Accept: description of glycolysis 2. Accept: glycolysis can continue/begin
6(c)(ii)	(Pyruvate used) in aerobic respiration / (lactate/lactic acid) is toxic/harmful/causes cramp/(muscle) fatigue;	1	Accept: (pyruvate) can enter link reaction Accept: reduces cramp/(muscle) fatigue Neutral: 'reduces muscle aches'

Question	Marking Guidance	Mark	Comments
7(a)	1. Increase in temperature / (global) warming; 2. Evaporation (of water from the soil) / flooding by sea water / less rainfall;	2	1. Neutral: increase in sea temp 2. Reject: evaporation of sea water 2. Accept: increase in sea level with effect on land / coastal flooding
7(b)	1. Soil has reduced/low(er) water potential / crop/plant/roots have higher water potential; 2. Osmosis from plant / diffusion of water from plant;	2	1. Reference to water potential gradient is sufficient if correct direction of gradient or water movement is outlined 2. Accept: WP or Ψ for water potential 2. Accept: plant/crop takes up less/no/not enough water by osmosis 2. Reference to movement of minerals by osmosis negates mark
7(c)(i)	1. Different strains of (fungus/cucumber) / representative (of population/strains); 2. Natural/normal conditions / (these) cucumbers grow in salinated soils / optimum for growth;	2	1 and 2. Accept: in context of fungus or cucumber 1. Accept: genetically different / different types/forms/varieties 1. Accept: grow at 1.5% Neutral: bias/reliability
7(c)(ii)	1. Mean/number (of diseased plants) decreased by all (bacteria); 2. *S. rhizophila* is most effective and *S. plymuthica* is least effective; 3. Overlap of SE of *S. plymuthica* with control (B) / overlap of SE of *S. rhizophila* with *P. extremorientalis* / no overlap of SE of *S. rhizophila/P. fluorescens/P. extremorientalis* with control (B); 4. No overlap of (2x) SE indicates	4	2. Accept: reference to figures (10 and 42) 2. Accept: equivalent terminology to effectiveness 3. Neutral: SE of all treatments overlap 3. Neutral: overlap of SE of PF and PE on its own 3. and 4. Penalise reference to SD instead of SE in context of these mark points only once

	difference is significant/not down to chance / overlap of (2x) SE indicates difference is not significant/is due to chance;		i.e. use of SD = max one for mp 3 and mp 4. Do not penalise SD in any other context 4. Accept: 'results are significant' as equivalent to difference is significant Neutral: reference to other factors or sample size

7(c)(iii)	1. Comparison / (is a) benchmark/standard/baseline: 2. To see effect of added/no fungus / (compare to) control B / (control A) shows effect of fungus in soil / shows natural/normal infection/disease;	2	1. Accept: CFRR as equivalent to fungus 1. Reject: if comparison is made to factors not part of this investigation e.g. pesticides 2. Neutral: to see effect of treatments/bacteria/biological agents/other factors 1 and 2. Note: Compare to control B = 2 marks
7(d)(i)	(Bacteria) are nitrogen fixing/nitrifying / reduce infection/pathogens / produce growth stimulating substance;	1	Accept: description of nitrogen-fixing or nitrification but not 'produce nitrate' unqualified Accept: produce antibiotics
7(d)(ii)	1. Compete for/use minerals/salts/ions/nutrients/light; 2. Would reduce/affect growth/productivity/(dry) mass of cucumber;	2	1. Accept: named example of minerals/nutrients e.g. nitrates 1. Accept: weeds may introduce/carry pathogens/disease 1. Accept: water 1. Neutral: food/space/resource

Question	Marking Guidance	Mark	Comments
8(a)	1. Geographic(al) isolation; 2. Separate gene pools / no interbreeding/gene flow (between populations); 3. Variation due to mutation; 4. Different selection pressures / different abiotic/biotic conditions/ environments/habitats; 5. Different(ial) reproductive success / selected organisms (survive and) reproduce; 6. Leads to change/increase in allele frequency;	6	2. Accept: reproductive isolation 2. This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred. 4. Neutral: different conditions/ /climates if not qualified 4. Accept: named abiotic/biotic conditions 5. Accept: pass on alleles/genes to next generation as equivalent to reproduce 6. Accept: increase in proportion/percentage as equivalent to frequency
8(b)	1. Capture/collect sample, mark and release; 2. Method of marking does not harm lizard/make it more visible to predators; 3. Leave sufficient time for lizards to (randomly) distribute (on island) before collecting a second sample; 4. (Population =) number in first sample × number in second sample divided by number of marked lizards in second sample/number recaptured;	4	
8(c)	1. High concentration of/increase in carbon dioxide linked with respiration at night/in darkness; 2. No photosynthesis in dark/night / photosynthesis only in light/day; 3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration; 4. Decrease in carbon dioxide concentration with height;	5	2. Neutral: less photosynthesis 4. More carbon dioxide absorbed higher up 4. Accept: less carbon dioxide higher up / more carbon dioxide lower down 5. Neutral: less leaves unqualified or reference to animals

	5. (At ground level) less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / / micro-organisms produce carbon dioxide;		