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General Certificate of Education (A-level)
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Biology BIOL4

(Specification 2410)

Unit 4: Populations and Environment

Final

Mark Scheme

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Question	Marking Guidelines	Mark	Comments
1(a)	Birth rate and death rate = 2 marks;; ***OR*** 1. Change in population / births and deaths / population at start and end; 2. In a given time;	2	Neutral: any reference to per or times by a number eg per 1000 / × 100 Neutral: ignore any reference to immigration and emigration unless context is incorrect
1(b)	1. High birth rate / high proportion/percentage/number of young/children; 2. High death rate / low proportion/percentage/number of elderly/older people/low life expectancy;	2	1 and 2. Both points must be clearly stated. Do not award other mark by implication 1 and 2. Accept appropriate use of percentage/number as alternatives 1. Accept: 'wide base' or any equivalent description of high proportion/number of young children 2. Accept: 'narrow at top' or any equivalent description of low proportion of older people 2. Accept high death rate in context of any age group

Question	Marking Guidelines	Mark	Comments
2(a)	*Ulva lactuca*;	1	Reject: *Ulva* on its own Accept: *lactuca* on its own Accept: Incorrect spelling
2(b)(i)	Difficult/too many/too many to count / individual organisms not identifiable / too small to identify / grows in clumps;	1	Neutral: easier/quicker/representative/more accurate, unless qualified
2(b)(ii)	Any described feature of concrete eg texture / flat / composition chemicals / nutrients etc;	1	Neutral: not natural / man made / are different, without further qualification
2(c)	1. Pioneer species/*Ulva* increases then decreases; 2. Principle of a species changing the conditions / a species makes the conditions less hostile; 3. New/named species better competitor / previous/named/pioneer species outcompeted; 4. *G. coulteri*/*Gelidium* increases <u>and</u> other/named species decreases;	4	1 and 4. Growth/reproduces = increases. Dies = decrease 2. Accept description of change in conditions eg soil/humus forms, nutrients increased Pioneer species grows, dies and forms humus = 2 marks *G. coulteri*/*Gelidium* outcompetes other/named species = 2 marks

Question	Marking Guidelines	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 Neutral: chromosomes
3(b)(i)	1. 3 and 4 and 9/11/affected offspring; 2. Both 3 and 4 are carriers/heterozygous; ***OR*** If dominant at least one of 3 and 4 would be affected;	2	1 Accept: 9/11 and their parents 1 Accept: unaffected parents have affected children 2 Accept: if 3 and 4 are unaffected all their children will be unaffected
3(b)(ii)	1. 11 is affected, 3 is not; 2. 3/father of 11 does not have a recessive allele on his X chromosome/ X^t; ***OR*** (If on X) 11/affected female would not receive the recessive allele on X chromosome/X^t from 3/father; ***OR*** (If on X) 3/father (of 11) would pass on the dominant allele on his X chromosome/X^T;	2	1 Accept: 3/unaffected father/parents produce an affected daughter 1 Accept: 3 and 4 would only produce unaffected females 2 Answers must be in context of alleles Reject: recessive/dominant chromosomes
3(c)(i)	Answer in range of 5.8 - 6.2% = 3 marks;;; If incorrect answer, then 2 max of following points 1. $q^2/p^2/tt$ = 0.001 or 1 divided by 1000; 2. p/q/T = 0.968 – 0.97; 3. Understanding that heterozygous = 2pq;	3 max	Answers in range of 0.058 - 0.062 = 2 marks 3. This can be shown mathematically ie 2 × two different numbers 3. Accept: answer provided attempts to calculate 2pq

3(c)(ii)	Affected individuals (usually) do not reproduce/die during childhood/do not pass on allele/genetic screening;	1	

<table>
<tr><th>Question</th><th>Marking Guidelines</th><th>Mark</th><th>Comments</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><th></th><th>Glycolysis</th><th>Link reaction</th><th>Krebs Cycle</th></tr>
<tr><td>Occurs in mitochondria</td><td></td><td>√</td><td>√</td></tr>
<tr><td>Carbon dioxide produced</td><td></td><td>√</td><td>√</td></tr>
<tr><td>NAD is reduced</td><td>√</td><td>√</td><td>√</td></tr>
</table>
Mark horizontally
</td><td>3</td><td></td></tr>
<tr><td>4(b)(i)</td><td>1. Glucose is used/broken down during glycolysis/in cytoplasm;
2. Glucose cannot cross mitochondrial membrane(s) / pyruvate can cross mitochondrial membrane(s);</td><td>2</td><td>1 Accept: glucose to pyruvate or glucose not converted to pyruvate for one mark</td></tr>
<tr><td>4(b)(ii)</td><td>1. Is a competitive inhibitor / attaches to active site;
2. Reduces/prevents enzyme-substrate/E-S complex forming;</td><td>2</td><td>1 Accept: inhibitor/malonate attaches to active site to form an enzyme-substrate complex
2 Accept: substrate/succinate cannot bind to enzyme
2 Accept mark point 2, but not mp1 in context of non-competitive inhibition</td></tr>
<tr><td>4(b)(iii)</td><td>1. Krebs cycle inhibited;
2. NAD/Coenzyme/FAD not/less reduced;
3. Hydrogens not passed to ETC;
4. Oxygen used as final/terminal (electron) acceptor;</td><td>2 max</td><td>4 Accept: oxygen combines with electrons and protons/hydrogen ions without reference to final acceptor
Neutral: oxygen is used in the Krebs cycle</td></tr>
</table>

Question	Marking Guidelines	Mark	Comments
5(a)(i)	So it/CO_2 is not a limiting factor (on growth/photosynthesis);	1	Accept: CO_2 is a limiting factor
5(a)(ii)	So any difference is due to iron (deficiency);	1	Accept: iron is the variable
5(a)(iii)	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
5(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 ie NADP with hydrogen/s attached
5(c)	1. Less triose phosphate converted to RuBP; 2. CO_2 combines with RuBP;	2	Accept: less triose phosphate so less RuBP

Question	Marking guidelines	Mark	Comments
6(a)	1. No interbreeding / gene pools are separate / geographic(al) isolation; 2. Mutation; 3. Different selection pressures / different foods/niches/habitats; 4. Adapted organisms survive and breed / differential reproductive success; 5. Change/increase in allele frequency/frequencies;	5	Accept: all marks if answer written in context of producing increased diversity of plants 1 Do not award this mark in context of new species being formed and then not interbreeding 1 Accept reproductive isolation as an alternative to no interbreeding 2 Accept: genetic variation 3 Accept: different environment / biotic/abiotic conditions or named condition 3 Neutral: different climates
6(b)	Similar/same environmental/abiotic/biotic factors / similar/same selection pressures / no isolation / gene flow can occur (within a species);	1	Accept: same environment

Question	Marking Guidelines	Mark	Comments
7(a)(i)	Reliable / representative / for statistical tests;	1	Accept: identify anomalies Neutral: accurate/valid/bias
7(a)(ii)	1. Find coordinates (on a grid) / split area into squares / number the sites; 2. Method of generating/finding random numbers eg calculator/computer/random number generator/random numbers table;	2	1. Ignore references to tape measures, metre rulers etc 2. Accept: numbers out of a hat / use of dice
7(a)(iii)	1. Breeding (of lizards); 2. Food source/prey; 3. Predator; 4. Variation in malarial infection; 5. Temperature variation; 6. Availability of water eg drought/'rainy season'	2 max	Neutral: weather / climate / hurricanes / hibernation / migration / emigration / immigration
7(b)	1. Number in sample varies; 2. Allow a (valid) comparison;	2	
7(c)	1. (Overall) positive correlation (for either/both species); 2. Reference to (site) 5 / 300 metres; 3. Limited results for *A.wattsi* / small sample/number/percentage infected for *A.wattsi*;	2 max	Neutral: only one study / no repeats
7(d)(i)	1. Fewer *A.wattsi* infected / more *A.gingivinus* infected; 2. Higher number of *A.wattsi* present when higher percentage/number of *A.gingivinus* infected; 3. No *A.wattsi* present when *A.gingivinus* has zero infection;	2 max	

7(d)(ii)	1. Reduced immunity / increased susceptibility to disease; 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; 2. That result(s)/correlation/it is due to chance; ***OR*** 3. There is a <u>probability</u> of more than 99%/0.99; 4. That result(s)/correlation/it is not due to chance;	2	1. Reject: probability is/equal to 1%/0.01; 1. Reject 0.01%/5%/0.05/0.05% 2. Allow correct interpretation using above (incorrect) figures eg there is a probability of less than 5% that the results are due to chance =1 mark Note: there is a probability of more than 5% that the results are due to chance =0 marks 3. Reject: probability is/equal to 99%/0.99; 3. Reject 0.99%/95%/0.95/0.95 % 4. Allow correct interpretation of above figures ie 0.99%/95%/0.95/0.95 % but reject if less than

Question	Marking Guidelines	Mark	Comments
8(a)	(Biological Agents) 1. Only needs one application/ reproduces; 2. Specific; 3. Keeps/maintains low population; 4. Pests do not develop resistance; 5. Can use less chemicals / reduces chemical residues / no bioaccumulation; (Chemical pesticides) 6. Acts quickly; 7. Can apply to specific area; 8. Kills all/most/greater variety of pests;	6 max	Assume advantages are in context of correct type of control (chemical or biological) unless stated otherwise 4. Reject reference to immunity
8(b)	1. Growth of algae/surface plants/algal bloom blocks light; 2. Reduced/no photosynthesis so (submerged) plants die; 3. Saprobiotic (microorganisms/bacteria); 4. Aerobically respire / use oxygen in respiration; 5. Less oxygen for fish to respire / aerobic organisms die;	5	3. Accept: Saprobiont/saprophyte/ saprotroph 3. Neutral: decomposer

8(c)	1. Slaughtered when still growing/before maturity/while young so more energy transferred to biomass/tissue; 2. Fed on concentrate /controlled diet / so higher proportion of food absorbed/digested/assimilated / used for biomass/tissue / lower proportion lost in faeces; 3. Movement restricted so less heat/energy/respiratory loss; 4. Heating/Kept warm/ inside so less heat/energy/respiratory loss/maintain body temperature; 5. Genetically selected / selective breeding (for high productivity);	4 max	**Q** 1-4 The principle here is one mark for identifying a relevant point <u>and</u> offering an explanation 2. Accept: named diets for controlled diet, eg high protein diet 2. Neutral: loss in excretion 2. Neutral: for growth Neutral: reference to predators