Biodiversity and Natural Resources -3

Name: _____

Class: _____

Date: _____

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Biodiversity and Natural Resources -3

Type: Mark Scheme

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful

Mark Scheme

Q1.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td></td><td>
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<tr><th>Description of adaptation</th><th>Type of adaptation shown by the wasp</th></tr>
<tr><td>(knocking its body to signal food)</td><td>Behavioural (1)</td></tr>
<tr><td>(the stinger)</td><td>Anatomical (1)</td></tr>
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</td><td></td><td>(2)</td></tr>
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Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • Advantage – being sustainable / {can decompose / is biodegradable} **(1)** • Disadvantage – less strong / {can decompose/ is biodegradable } **(1)**	Biodegradable / can decompose must be qualified if given as both an advantage and a disadvantage ALLOW renewable or more plants can be grown	**(2)**

Q3.

Question Number	Acceptable Answer	Additional guidance	Mark
	An answer that makes reference to four of the following: (Safer) • because pure drug used rather than extract (1) • due to pre-testing on {cells / animals} before testing on humans (1) • because regulated by legislation (1) (More valid) • because a placebo is used as a comparison (1) • because modern testing may involve double-blind trials (1) • because controlling {factors / variables / eq} tested cohort e.g. age, lifestyle (1) (More reliable) • because more people are tested (1) • because results are analysed statistically (1)	No marks awarded for safer, more valid or more reliable	**(4)**

Q4.

Question Number	Answer	Mark
(i)	**The only correct answer is A - ligaments only** ***B*** *is not correct because the tendons do not join bones to bones in the elbow joint* ***C*** *is not correct because the tendons do not join bones to bones in the elbow joint* ***D*** *is not correct because the ligaments do join bones to bones in the elbow joint*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is D rows 3 and 4** ***A*** *is not correct because the tendons showing a change is not a change in genotype* ***B*** *is not correct because the tendons also show a physiological adaptation* ***C*** *is not correct because the tendons showing a change is not a change in genotype*	**(1)**

Question Number	Answer	
* (iii)	Answers will be credited according to candidates' deployment of knowledge and understanding of materialin relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the materialwhich is relevant. Additional content included in the response must be scientific and relevant. **Indicative content Valid because:** • {sufficient replicates / 12 individuals} used and a mean calculated • All same gender • Means of both heart rate and blood lactate agree with conclusion • Spread of data (standard deviation / error bars) between cycling and running does not overlap **Not valid because:** • Insufficient / only 12 individuals involved • Insufficient detail relating to the athletes e.g. they maybe athletes that focus on different sports/have done more than one previous triathlon / more experienced • The three disciplines are always done in the same order / different distances covered • Spread of cycling data (standard deviation / error bars) for blood lactate overlaps with swimming • As no time allowed to recover between sports, some of blood lactate shown for cycling could havebeen produced during swimming • Agree or not agree with conclusion	**(6)**

Level 0	Marks	No awardable content	
Level 1	1-2	Limited scientific judgement made with a focus on mainlyjust one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolatedelements of biological knowledge and understanding butwith limited evidence to support the judgement being made.	Considers one area only e.g. comparingmean data or spread of data only Conclusion based on only one set of data or only one sport considered e.g. cycling ismost demanding
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasionalevidence to support the judgement being made.	Considers both a valid and an invalid aspect e.g. relevance of spread of data forlactate concentrations overlap in some cases or elements of the study Conclusion given that takes both valid andinvalid aspects into account
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidencefrom the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages tobiological knowledge and understanding with evidence to support the judgement being made.	Considers both a range of valid and invalidaspects A conclusion based on a range of considered evidence

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	An answer the makes reference to the following: • (use of anabolic steroids) reduces {ventricular fraction / ejection fraction /stroke volume / cardiac output } (1) • {83 % / 10 out of 12} of users have ventricular fraction below {55% / the healthy value} (1)	ALLOW less blood leaving the ventricle when it contracts ALLOW more users of anabolic steroids have a ventricular fraction below 55% than non-users ALLOW other valid quantitative values e.g. comparing mean values for each group 51.25 and 60.6%	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer the makes reference to the following: • test the drug on { healthy individuals / animals / cell cultures } (1) • (then) test on group of individuals with cancer (1) • (gradually increasing the dose) to determine dose that does not reduce ventricular ejection fraction (1)	ALLOW test on a group of patients ALLOW to determine the dose that does not cause side effects	**(3)**

Q6.

Question Number	Indicative content
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **Section of relevant data** • higher rate of mutations than in {slowly evolving fish / sticklebacks} • relatively high rate of mutations that change amino acids compared to slowly evolving fish • low rate of gene duplication in slowly evolving fish / high rate of gene duplication in cichlid fish • higher rate of mutations in regulatory sequences in cichlid fish • variety of habitats available providing different selection pressures **Consequences of data described** • more {amino acid changes / gene duplications} the greater number of alleles in gene pool • altered amino acids result in altered protein function • changes in regulatory sequences allow for different gene expression in tissues etc • duplicated genes can be used for new functions without loss of original function / polygenic phenotypes • variety of habitats provide a number of niches suitable for cichlid fish with different adaptations to exploit **Linkages made to rate of evolution** • example of an altered protein function e.g. enzymes that work at different pH / temperature tolerance • development of new phenotypes • {new enzymes/ different mouth shapes} allow new food types to be exploited • changes in {pigmentation / mouth shape} allow speciation

Level	Mark	Descriptor	Additional guidance
Level 0	Marks	No awardable content	
Level 1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	At least one relevant piece of data described e.g. higher mutation rate. A consequence described for the data – e.g. linking mutations to protein structure Basic clear conclusion attempted e.g. different proteins are produced
Level 2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	At least two pieces of relevant data referred to. Consequences of at least two pieces of data explained Linkages made to evolution of the fish e.g. changes in phenotype
Level 3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	At least three pieces of relevant data referred to Consequences of each piece of data explained Linkages to evolution discussed, e.g. the types of adaptations that may arise due to mutations

Q7.

Question Number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic information • All the treatment combinations were effective at treating TB • All treatments had some { relapses / individuals with TB } 3 years after treatment • { Group 1 / Groups 1 and 2 / Rifampicin + Pyrazinamide / Rifampicin + Isoniazid } had the lowest number of patients with TB (3 years later) Evidence for linkages made • Percentage relapse varies depending on second part of treatment • Combinations involving Rifampicin most effective • The antibiotics tested act on different targets in bacteria • Gaps in information - not all combinations tested, other combinations might be more effective • Other time scales may have been more effective Evidence for sustained scientific reasoning • Could be other reasons for infections with TB 3 years later not due to the antibiotic treatment • No information about dormant TB (only percentage of active cases) • Bacterial RNA polymerase possibly the best target for antibiotics • Antibiotics targeting synthesis of cell wall fatty acids least effective in terms of relapses • Idea of combination of antibiotics with different mode of activity most effective

Level	Mark	Descriptor	
Level 0	Marks	No awardable content	
Level 1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The answer will contain basic information with some attempt made to link knowledge and understanding to the given context.	Reference to effectiveness of different combinations of antibiotics.
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.	Reasons for differences in effectiveness considered.
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Information about action of antibiotics related to effectiveness. Evaluation of study design considered.

Q8.

Question Number	Acceptable Answer	Additional guidance	Mark
	An answer that makes reference to the following: • the drug did improve the condition of the patients more than the placebo but it was only 6 au with a concentration of 400 mg so not much of an improvement (1) • increasing the dosage by a further 200 mg doubled the improvement over the placebo (1) Plus one from: • therefore to be effective higher doses of the drug would be required (1) • statistical tests would be required in order to comment further (1)		**(3)**

Q9.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• neither patients nor {doctors /scientists / eq} know which treatment the patients were given (1)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to three of the following: • idea that SSRI works best (1) • placebo works faster than SJW (1) • SJW and placebo effect {wear off / level / end at 12 / same final score / fall then rise / eq} (1) • correct comparative manipulation of figures to support analysis (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following pairs: • use more patients / increase sample size / repeat the trial (1) • to increase reliability (1) **and/or** • consider sample selection to use same age / gender / ethnicity / lifestyle / health of patients (1) • to control biotic variables (1) **and/or** • extension of time for trial (1) • to ensure SSRIs continue to reduce HRSD score or not / SJW continue to decrease HRSD score or not (1) **and/or** • use of statistical analysis (1) • to see if the differences are significant (1)		**(4)**

Q10.

Question number	Answer	Additional guidance	Mark
	• mass of dry powdered leaf (1) • mass of wet leaf (1)	Example of calculation 5000 ÷ 501.3 = 9.97 (9.974 ÷ 0.105) = 95.0 (g) ALLOW 1 mark only for correct figures but to incorrect d.p. e.g. 9.50 ALLOW 1 mark only for 47.6 Correct answer with no working gains both marks	Expert (2)

Q11.

Question number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to the following: • solvent B (extract) has greatest (antimicrobial) activity / solvent A (extract) has the least (antimicrobial) activity (1) • {Gram negative bacteria / *Klebsiella*} are more sensitive (to both the solvent extracts) (1)	ALLOW solvent B {is more effective / increases the effectiveness} solvent A {is less effective / reduces the effectiveness} ALLOW both extracts more effective against {Gram negative bacteria / *Klebsiella*}	Expert (2)

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • prepare an agar plate with a bacterial lawn (1) • description of how extract can be added to the (agar plate) (1) • incubate at a stated temperature between 20 °C and 37 °C (1) • measure the diameter of the zones of inhibition after a (suitable) stated time (1)	ALLOW adding bacteria to agar / seeding agar plate with bacteria e.g. added to wells / on paper disks IGNORE at room temperature ALLOW time periods between 1 day and 1 week ALLOW calculate diameter	Expert (4)

Q12.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is relevant. Additional content included in the response must be scientific and relevant. Give examples of relevant biological knowledge and understanding: Evidence of isolated elements of biological knowledge: • glucose for respiration in both • starch for energy storage in plants /glycogen for energy storage in animals • cellulose for cell walls in plants Evidence of adequate biological knowledge with linkages made • starch composed of amylose and amylopectin in plants • sucrose as a transport sugar in phloem in plants, glucose in animals • lactose in milk for energy • a judgement on the importance of carbohydrates in plants and animals is made e.g. cellulose as a structural carbohydrate in plants therefore a greater proportion of carbohydrate in plants than animals or animals require more energy, therefore need more carbohydrate Evidence for comprehensive biological knowledge and understanding with sustained linkages • pentose sugars ribose and deoxyribose { in nucleic acids / DNA/ RNA / ATP} in both • ribulose as part of the Calvin cycle in plants • glycoprotein in { mucus / receptors on cell surface membranes /antibodies} • glycolipids in cell membranes • a supported judgement on the relative importance of carbohydrates in plants and animals is given e.g. animals store more energy in lipids than carbohydrate, therefore carbohydrate more important as a storage molecule in plants **or** the idea of carbohydrates as part of complex molecules **or** the proportion of carbohydrates present is not the same as importance

Level	Mark	Descriptor	Additional guidance
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Glucose for respiration Polysaccharides for energy storage Cellulose for plant cell walls Simple conclusion made
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Branched storage molecules for rapid energy release in starch Roles of sucrose, lactose A judgement on the importance of carbohydrates in plants and animals is made
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	All of the above plus discussion of carbohydrates as part of complex molecules A supported judgement on the relative importance of carbohydrates in plants and animals

Q13.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to: • no (in row two) (1) • some (in row five) (1)		(2)

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	A answer that makes reference to the following: • {alternative form / different form / version / variation} of a gene (1)	IGNORE type of gene	1

Question Number	Answer	Additional Guidance	Mark
(ii)	• correct use of Hardy-Weinberg equation (1) • correct calculation of probability of each homozygote (1) • correct answer (1)	Example of calculation $p^2+2pq+q^2= 1$ p^2= either 0.185 or 0.325 q^2= either 0.325 or 0.185 or 2pq = 0.43 x 0.57 x 2 = 0.4902 frequency = 50.98 % / 51% (which is greater than 50%) Correct answer with no working gains full marks	3

Q15.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• species found only in one geographical location		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • the variety of species (in an ecosystem / community / habitat) (1) • the variety of alleles in a { gene pool / population / species } (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to three of the following: • record the number of species of lemur and the (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
	number of individuals of each species • calculate the diversity index (for each location) (1) • so the higher the index, the greater the biodiversity (1) • DNA profiling / gel electrophoresis / molecular phylogeny / proteomics (1)		

Q16.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• correct calculation of numerator (1) • correct calculation of denominator (1) • correct calculation of diversity index / correctly plotted on the graph (1)	Example of calculation: (N(N-1) = 427 x 426 = 181 902) ÷ (Σn(n-1) =) 52 320) = 3.48 ; Allow full marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following points: • succession is the sequence of { species / communities } replacing each other with time (1) • dune 4 is older than dune 1 (1) • no species of plant inhabits all 4 dunes /example from table quoted to show one species inhabiting no more than 3 dunes (1) • plant diversity increases with time (1) • description of increasing diversity index from dune 1 to dune 4 (1)	e.g. species G only found on dunes 3 and 4	**(5)**

Q17.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to two of the following • endemic (species) that are only found in that one location (1) • protection of hotspots prevents extinction (of endemic species) (1) • the loss of these species will (significantly) reduce global biodiversity (1)		Expert (2)

Q18.

Question Number	Answer	Mark
(a)	**B** 2	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. (only) contain hydrogen, carbon and oxygen ; 2. reference to fatty acids and glycerol {joined by / eq} ester{bonds / eq} ; 3. idea of saturated and unsaturated (fatty acids / lipids);		(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. uses less fertiliser / eq ; 2. idea of not using more pesticides / eq ; 3. idea that greenhouse gas emissions are not that different ; 4. credit manipulation of figures to support marking point 3 ;	1. & 2. IGNORE comparisons between the different crops 3. ACCEPT less than corn but more than sugar cane	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. credit three correctly named ions ; 2. nitrates for {protein / amino acids / nucleic acids / named nucleic acid} ; 3. proteins used for growth ; 4. calcium ions for {other nutrients uptake / promotes cell elongation / strengthen cell walls / enzyme function / protection against heat stress / protection against diseases / eq} ; 5. magnesium ions for chlorophyll production ; 6. for photosynthesis ;	1. e.g. nitrates, calcium ions, magnesium ions, sulphates, potassium ions, phosphates ACCEPT Sulphates for amino acids Potassium ions for stomata function	(4)

Q19.

Question Number	Answer	
*expert	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic information • measure growth of plants e.g. length of leaves, mass of plants, etc. • grow wheat seedlings with either biological farming product or chemical fertiliser, several plants in each. • Control of one relevant abiotic variable e.g. temperature, soil and light. Evidence of linkages • measure growth of plants at standardised time intervals. • measure after growing the plants for a sensible period of time- reference to rate of growth • grow wheat seedlings from the same batch of seed. • same mass / volume / concentration of chemical fertiliser and biological farming product • plants grown in standardised conditions, e.g light / humidity / temperature Evidence of sustained scientific reasoning • compare health of plants e.g. development of disease • calculate mean and SD to compare the results • statistical comparison of results • use of sterilised soil so that there are no fungi in the soil for the chemical fertiliser • analyse the soil at the end of the experiment to determine moisture and mineral content	(6)

Level	Marks		Additional Guidance ?
0	0	No awardable content	
1	1-2	An explanation of how the investigation should be modified may be attempted but with limited analysis, interpretation and/or evaluation of the scientific information. Generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Use of chemical fertiliser and biological farming product A number of seedlings used Growth of plants measured Control of one abiotic variable
2	3-4	An explanation of how the investigation should be modified will be given with occasional evidence of analysis, interpretation and/or evaluation of the scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Description of how growth will be measured eg height of plant, number of leaves Measured at regular intervals/after a specific time interval Wheat seedlings from the same batch of seeds Explanation of control of abiotic variables Same volume/concentration of chemical fertiliser and biological farming product
3	5-6	An explanation of how the investigation should be modified is given which is supported throughout by evidence from the analysis, interpretation and/or evaluation of the scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.	Named statistical analysis of results Consideration of health of plants/soil analysis

Q20.

Question Number	Answer	Mark
	The only correct answer is B *the number of different species in a habitat* A is not correct because it is not the number of different genes in a population C is not correct because it is not the number of homozygotes in a population D is not correct because it is not the number of individuals in a population	Computer (1)

Q21.

Question number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to two of the following: • food availability (1) • interspecific competition (1) • predation (1) • disease (1)	IGNORE time of year / availability of resources ALLOW grazing / migration IGNORE competition unqualified or competition between birds	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
(ii)	• correct expected value (1) • correct values for observed minus expected squared (1) • correct answer (1)	26 ÷ 2 = 13 $(16 - 13)^2 = 9$ and $(10 - 13)^2 = 9$ 1.38 ECF for incorrect expected value ALLOW one mark for 2.25 / 3.6	Choose an item. (3)

Question number	Answer	Additional guidance	Mark
(iii)	An answer that makes reference to the following: • cutting down trees decreases the number of bird speciesin both forests (1) • the decrease is significant (at p=0.05) in forest A (1) • the decrease was not significant (at p=0.05) in forest B (1)	ALLOW decreases species richness ALLOW less than {5% / 0.05 probability}reduction in forest A due to chance ALLOW more than than {5% / 0.05 probability} reduction in forest B due tochance ALLOW 1 mark chi squared value was {greater than the critical value for forest A / less than critical value for forest B} with no reference to p value or significance	Choose an item. (2)

Q22.

Question Number	Answer	Additional guidance	Mark
	A description that makes reference to three of the following • animals are selected to prevent { breeding between closely related individuals / inbreeding depression } (1) • a stud book is used to { select individuals for mating / keep a record of all breeding events } (1) • exchange of { animals / gametes } between zoos (1)	ALLOW use of studbook to prevent inbreeding	(3)

Q23.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to: • calculate mass of calcium ions in total soft tissue (1) • calculate the mean mass of soft tissue in a human (1) • calculate mass of calcium per gram of soft tissue (human) (1)	Example of calculation: 1% of 1000 g = 10 g 96 % of 80 kg = 76.8 kg or 76 800g 130.21 ($\mu g\ g^{-1}$) ALLOW 130.2 / 130 Correct answer with no working gains full marks.	(3) Exp

Question Number	Answer	Mark
(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content ***Relating to the data*** • Data compared in humans and one plant species • Idea that concentration is not same as importance	**(6)** **Exp**
	• No evidence that more than one plant used ***Roles of calcium ions in plants and animals*** • Used for plant cell walls • Detail of how used in plant cell walls: calcium pectate • In humans used at synapse, muscle contraction, blood clotting, bone tissue • Details of how used in synapse, muscle contraction, blood clotting ***Comments on study*** • Only one plant species used / this plant species may not be representative of all plant species • Humans not necessarily representative of all animals	

Level 0	Marks	No awardable content	Additional Guidance
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths / weaknesses identified.	Basic description of role of calcium ions in plants and in animals. OR Basic conclusion or a comment on the data.
		A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Details provided for roles of calcium ions in both animals and plants Comparison of data e.g. more calcium ions in plant tissue than human tissue. Only one species of plant considered

Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Details of roles of calcium ions in animals and plants. Data compared. Higher concentration – but calculated value for humans was for soft tissue and not bones. Evaluation of data provided – only from humans, not all animals. Data compared. Higher concentration – but calculated value for humans was for soft tissue and did not include bones. Idea that concentration is not the same as importance.

Q24.

Question Number	Answer	Additional Guidance	Mark
	• correct use of Hardy-Weinberg equation (1) • correct calculation of allele frequencies (1) • correct probability of heterozygote frequency calculated (1)	Example of calculation $p^2+2pq+q^2= 1$ q = 0.020 and p = 0.980 2pq = 2 x (0.98 x 0.02) 3.92% / 3.9% / 0.0392 / 0.039 ALLOW $\frac{49}{1250}$ as a fraction for probability Correct answer with no working gains full marks ALLOW 2 marks for correct allele frequencies alone	(3)

Q25.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct measurements from the photograph (1) • correct answer	Example of calculation Starch grain 27mm and width of chloroplast 60mm 27000 ÷ 22 = 12 273 60000 ÷ 12 273 = 4.889 (µm) ALLOW 4.9 / 4.89 / 4.8 recurring (µm) (ALLOW one mark for correct calculation from different measurements)	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • (granum) is formed from many layers of thylakoid membranes to increase surface area (for absorbing light) • thylakoid membranes contain chlorophyll to absorb light • electron carrier molecules in thylakoid membrane involved in ATP production	ALLOW stacks of thylakoids provide a large surface area ALLOW photosystems / photosynthetic pigments in place of chlorophyll ALLOW for light dependent reaction in place of absorb light ALLOW ATP synthase / photophosphorylation	**(3)**

Q26.

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	• N(N-1) = 3540 (1) • Σ n(n-1) = 704 (1) • = 3540 ÷ 704 = 5.028 / 5.03 (1)		**(3)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	An answer that makes reference to the following: • middle shore has higher diversity (1) • even though there are fewer individuals (1)	Allow converse argument.	**(2)**

Q27.

Question Number	Answer	Additional guidance	Mark
(i)	The only correct answer is C – no correlation *A is incorrect because it is not inverse* *B is incorrect because it is not negative* *D is incorrect because it is not positive*		**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	• correct calculation of $\sum(x-\bar{x})^2$ (1) • value divided by n-1 (1) • correct calculation of SD (1)	<u>Example of calculation</u> $\sum(x-\bar{x})^2 = 31.49$ ÷9 = 3.499 Answer= (±) 1.87 Correct answer without working gains full marks	**(3)**

Q28.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of thefollowing: • (because) there are {more similarities / fewer differences} between the Archaea and the Eukaryota (1) • (because) there are {fewer similarities / more differences} between the Archaea and the Bacteria (1) • two similarities between Archaea and Eukaryota(from table) described (1) • (so) the more recently they have evolved from a common ancestor (1)	ALLOW correct number of similarities / differences for Archaea and Eukaryota ALLOW correct number of similarities / differences for Archaea and Bacteria e.g. not inhibited by streptomycin/ methioninerequired for starting protein synthesis / transcription factors required for transcription	**(3)**

Q29.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to three of the following • (small groups of) healthy volunteers are given the vaccine to testfor side effects (1) • (healthy volunteers) tested for presence of antibodies to the virus (following vaccination) (1) • a group of people at risk of contracting the disease is given the vaccine (1) • the number of people who develop the viral disease (following vaccination) are monitored (1)		(3)

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to four of the following • large numbers of people died from the disease (1) • health workers are in close contact with people suffering from the disease (1) • the side effects of the vaccine will not be worse than contracting Ebola(1) • vaccinating immediate family will help to reduce the spread of disease(1) • if health workers were vaccinated they could care for more people (1)	ALLOW disease is (usually) fatal ALLOW health workers and family most likely to be exposed to the virus ALLOW risk from the disease is much greater than the risk from the vaccine	(4)

Q30.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to three of the following: <u>Similarities</u> • both have glycosidic bonds (1) • description of every other monomer being inverted (1) <u>Differences</u> • (the monomers of) chitin have eight carbon atoms whereas in cellulose there are six carbon atoms (1) • chitin { has an additional side chain / contains nitrogen but cellulose does not } (1)	IGNORE 1,4 and 1,6 ALLOW every other glucose ALLOW only chitin contains nitrogen / chitin has an amide group	**(3)**