PEARSON EDEXCEL A-LEVEL BIOLOGY A · 9BN0

BIOLOGY



MARK SCHEME

TOPIC 4: BIODIVERSITY AND NATURAL RESOURCES

SCORE	PERCENTAGE
/430	%

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Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	**The only correct answer is C G (which is the xylem)** ***A*** *is not correct because E does not contain lignin* ***B*** *is not correct because F, which is phloem, does not contain lignin* ***D*** *is not correct because H is not xylem*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is B F (this is phloem)** ***A*** *is not correct because E is not phloem* ***C*** *is not correct because G is not phloem* ***D*** *is not correct because H is not phloem*	**(1)**

Q2.

Question Number	Answer	Mark
(i)	**The only correct answer is B - sclerenchyma fibres provide support** ***A*** *is not correct because it is not phloem* ***B*** *is not correct because it is not sieve tubes* ***D*** *is not correct because it is not xylem*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is A – phloem that transports organic solutes** ***B*** *is not correct because sclerenchyma does not transport water* ***C*** *is not correct because sieve tubes do not synthesise organic solutes* ***D*** *is not correct because it is not xylem*	**(1)**

Question Number	Answer	Mark
(iii)	**The only correct answer is D - xylem vessel that transports water and mineral ions** ***A*** *is not correct because it is not phloem* ***B*** *is not correct because it is not a sclerenchyma fibre* ***C*** *is not correct because it is not a sieve tube*	**(1)**

Question Number	Answer	Additional guidance	Mark
(iv)	An answer that makes reference to the following • length of line correctly measured (1) • correct conversion to µm (1) • image size divided by actual size to give magnification (1)	Example of calculation 36mm ALLOW 37mm 36000 ALLOW 37000 36000/320 = 112.5 OR 37000/320 = 115.6 Correct answer without workinggains full marks	**(3)**

Q3.

Question Number	Answer	Mark
(i)	**The only correct answer is D - ribosome** ***A*** *is not correct because amyloplasts are only found in plant cells* ***B*** *is not correct because chloroplasts are only found in plant cells* ***C*** *is not correct because mesosomes are only found in bacterial cells*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is A-amyloplast** ***B*** *is not correct because Golgi apparatus is found in plant and animal cells* ***C*** *is not correct because mesosomes are found only in bacterial cells* ***D*** *is not correct because some animal cells also have a vacuole*	**(1)**

Question Number	Answer	Mark
(iii)	**The only correct answer is D-smooth endoplasmic reticulum** ***A*** *is not correct because amyloplasts are only found in plant cells* ***B*** *is not correct because animal cells do not have a cell wall* ***C*** *is not correct because pili are only found in bacterial cells*	**(1)**

Q4.

Question Number	Answer	Mark
	C - anatomical, behavioural and physiological *The only correct answer is **C*** ***A** is incorrect because there is also a physiological adaptation* ***B** is incorrect because there is also a behavioural adaptation* ***D** is incorrect because there is also an anatomical adaptation*	**(1)**

Q5.

Question Number	Answer	Mark
	B - Eukaryota *The only correct answer is **B*** ***A** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote* ***C** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote* ***D** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote*	**(1)**

Q6.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • magnesium is needed to make chlorophyll (1) • because chlorophyll is required for photosynthesis (1) • because shoots need (chlorophyll) to carry out photosynthesis to grow (1)	ALLOW required to replace organic moleculesstored in seed that have been used up	Choose an item. (2)

Q7.

Question Number	Answer	Additional guidance	Mark
	An answer the makes reference to five of the following: • description of how temperature will be controlled (1) • identification of another appropriate abiotic factor to control (1) • provide nutrients (for cells) (1) • use of aseptic technique (to prevent contamination of cell culture) (1) • culture for a stated period of time (1) • description of method of measuring growth (1)	e.g. set temperatures using a {water bath / incubator} e.g. pH / humidity/ carbon dioxide concentration / oxygen concentration ALLOW description of aseptic technique ALLOW times greater than 2 hours ALLOW culture at each temperature for the same period of time ALLOW e.g. measure {mass / number / area} of cells at beginning and end of culture	**(5)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • description of role in protection (1) • description of role in repopulation (1) • description of role in education (1) • description of role in research (1)	E.g. protection from poachers, hunting,vet care, administering medicines E.g. increase numbers, breeding programmes, release back into the wild E.g. conservation E.g. Improving health, discovering betternutrition, breeding cycles, developing a genetic database	**(3)**

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	A (complete mineral ion solution)		**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	D (validity)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	• Mass of one seed correctly calculated (1) • Calcium ion content for one seed calculated (1) • Correct answer (1)	<u>Example of Calculation:</u> 1 ÷ 200 = 0.005(g) (21 × 0.005) ÷ 100 or 0.00105 = 1.05 (µg) Allow full marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to the following: • seedlings not deficient in magnesium ions, chlorophyll production not affected (1) • seedlings of rice deficient in calcium ions were shorter due to less calcium ions stored in the seed (1) • seedlings of fenugreek did not suffer calcium ion deficiency due to the greater content of calcium ions in the seed (1)		**(3)**

Q10.

Question Number	Answer	Mark
(i)	The only correct answer is –A *amino acids* B is incorrect because nitrates are not found in cellulose C is incorrect because nitrates are not found in starch D is incorrect because nitrates are not found in sucrose	Computer (1)

Question Number	Answer	Mark
(ii)	The only correct answer is –C *nucleic acids* A is incorrect because phosphate is not found in cellulose B is incorrect because phosphate is not found in chlorophyll D is incorrect because phosphate is not found in sucrose	Computer (1)

Question Number	Answer	Mark
(iii)	The only correct answer is – C *chlorophyll* A is incorrect because magnesium is not found in amino acids B is incorrect because magnesium is not found in cellulose D is incorrect because magnesium is not found in starch	Computer (1)

Q11.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to three of the following • many of the elephants with tusks were killed (for their ivory) / large percentage of population do nothave tusks (1) • elephants without tusks were more likely to surviveand breed (1) • therefore passing on alleles for not having tusks (1) • increasing the frequency of homozygousrecessives in the population (1)	ALLOW converse	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description that makes reference to the following • calculate the {allele frequencies/ number of dominant and recessive alleles} (in the populationin Mozambique) (1) • (regular) sampling over a period of time (1)		**(2)**

Q12.

Question number	Answer	Mark
	The only correct answer is B - 7 | 28 | 21 ***A*** *is not correct because column 2 shows the number for a gamete and column three for a normal cell* ***C*** *is not correct because columns one and three show numbers for normal cells* ***D*** *is not correct because column one shows the number for a normal cell and column two shows the number for a gamete*	(1)

Q13.

Question Number	Answer	Additional guidance	Mark
(a)(i)	1. reference to {polymerase chain reaction / PCR} ; 2. polymerase (enzyme) {added / eq }; 3. idea of need for primers and nucleotides ; 4. {90-98} (°C) → {50-65} (°C) → {70-75} (°C) ; 5. idea that cycle needs to be repeated {several times / to make several copies of DNA / eq};	**1. Accept** as a ref to PCR machine	**(4)**

Question Number	Answer	Additional guidance	Mark
(a)(ii)	(DNA) {profiling / fingerprinting / (gel) electrophoresis} ;	**Ignore** Southern blotting, PCR **Accept** DNA profile / DNA fingerprint	**(1)**

Question Number	Answer	Additional guidance	Mark
(b)	1. idea of work appearing in a (Scientific) journal or being presented at a conference ; 2. idea that validity or reliability is considered ; 3. by other scientists / ref to peer review ;	**1. Accept** publishing a paper, scientific meeting	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(i)	1. reference to different {conditions / environments /eq} (in each region) ; 2. idea of different selection pressures ; 3. idea of {restricted gene flow / separate gene pools} ; 4. reference to reproductive isolation;	**1. Accept** appropriate named factor e.g. temperature **3. Ignore** different allele frequency	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(ii)	1. idea of different {alleles/ gene pool} ; 2. idea that this leads to {new / different} phenotypes ; 3. idea of new {allele / gene} can be {advantage / disadvantage} ; 4. reference to (advantageous) {(mutated) gene / (new) allele} passed onto offspring ;	**1. Ignore** allele frequency **2. Accept** traits / characteristics / features	**(2)**

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to two of the following: • modifies proteins (1) • forms vesicles (1) • removes (some) water from the protein / concentrates the { protein / glycoprotein } (1)	e.g. addition of carbohydrate to protein / formation of glycoprotein ALLOW processes protein IGNORE folds protein e.g. lysosomes / secretory vesicle / vesicle in synaptic knob ALLOW packages proteins into vesicles	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • (for phase 1) – to make sure the phospholipase inhibitor is not harmful (1) • (for phase 2) – to see if it is effective in { treating the condition / preventing allergic reactions to wasp venom } (1) • (for phase 3) – to gather much data / data for statistical tests / to look for rare side effects (1) • to test for side effects in { phase 1 / phase 2 } (1)	ALLOW finding safe dosage ALLOW reference to how the drug is absorbed / metabolised ALLOW double blind trials to compare effectiveness with a placebo / previous drug	(3)

Q15.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • (in the early stages of glacial retreat) the soil may lack nitrates (1) • (however) lupin plants can use the { ammonium ions / source of nitrogen } produced by the bacteria (1) • (therefore can) synthesise { amino acids / chlorophyll / nucleic acids / nitrogenous bases } (1)	ALLOW other sources of nitrogen lacking ALLOW produce for synthesise ALLOW protein	(3)

Q16.

Biology A (Salters-Nuffield) Advanced Paper 3 (9BN0/03)

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	Tonoplast		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	• selection of correct points from the graph (1) • calculation of percentage (1) • difference in percentage (1)	0.17 AU , 0.23 AU , 0.26 AU Example of calculation: 35.3% ÷ 13.0% = 22.3% Allow full marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)(i)	An explanation that makes reference to the following: • interferes with { tertiary / 3-D } shape of the channel proteins (1) • therefore causes channel proteins to		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)(ii)	An answer that makes reference to four of the following: • solutions with a range of pH values (1) • pieces of beetroot of same surface area (1) • control of other named relevant variables (1) • measurement of absorbance of solution using colorimeter (1) • repeats at each pH value to calculate mean (1)	e.g. temperature / volume of solution / time left in solution /	**(4)**

Q17.

Question Number	Answer	Additional guidance	Mark
(i)	Correct completion of the table n(n-1) 2 56 0 72 6	All figures need to be correct	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	• correct calculation of N(N-1) (1) • correct calculation of D (1)	Example of calculation N(N-1) =23 x 22 = 506 **Σn(n**-1) = 136 506 ÷ 136 D = 3.72 ALLOW 3.7 ALLOW ecf from 7(a)(i) Correct answer without working gains full marks	**(2)**

Q18.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(i)	An explanation that makes reference to the following: • (small pieces) provides large surface area to volume ratio (1) • (use of ethanol for a long time means) the antibacterial substance is soluble in ethanol and more will be extracted (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	$\pi 2.15^2$ (1) 14.5 cm^2 (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	An explanation that makes reference to the following: • the *t*-test assess the significance of the difference between the means of the two treatments (1) • Chi squared not appropriate because there are no expected values (1) • correlation coefficient not appropriate because the independent variable is discontinuous / not continuous (1)		**(3)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	$2.37^2 \div 9 = 0.62$ and $3.60^2 \div 9 = 1.44$ (1) $\sqrt{(0.62 + 1.44)} = 1.44$ (1) $(27 - 25) \div 1.44 = t = 1.39$ (1)	Correct answer gains full marks	**(3)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(iii)	An answer that makes reference to the following: • there is no significant difference between the clear area caused by garlic compared with that caused by chloramphenicol (1) • $p > 0.05$ (1) • difference due to chance (1) • therefore accept null hypothesis (1)	Allow marking points for the calculated value of *t* from the candidate	**(4)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)(i)	An explanation that makes reference to the following: • suggests cedar wood oil has no anti-microbial effect on *E. coli* and all other oils do (1) • quoting at least two values from: rosemary 2%, geranium 0.5%, garlic 0.125% / manipulation of data to show relative effects (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)(ii)	An answer that makes reference to the following: • for cedar wood oil try concentrations above 4% (1) • for all the others, try concentrations below 0.0625% (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)(iii)	A description that makes reference to the following: • only one tray per species – need repeated measurements (1) • species – only used one species of bacteria / only used extracts from four plant species (1)		**(2)**

Q19.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • washing with disinfectant will kill any microorganisms (1) • drying to { reduce chance of germination / decrease enzyme action } (1) • therefore preventing { decay / infection / damage } to the seeds (1)	ALLOW bacteria and / or fungi ALLOW: for long term storage	**(3)**

Q20.

Question Number	Answer	Additional Guidance	Mark
	• correct calculation of number of seeds in the sample (1) • correct calculation of percentage that germinated (1) • therefore the remaining seeds are viable (as germination was greater than 75%) (1)	Example of calculation (1000 ÷ 50) x 3 = 60 seeds (1g = 20 seeds) (48 ÷60) x 100 = 80% (80% without working gains 2 marks)	**(3)**

Q21.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. (successful interbreeding) produces offspring; 2. (same species produce) fertile (offspring); 3. credit reason why offspring of different species might be infertile ;	**Accept** converse throughout **Ignore** viable eg genetic incompatibility, different number of chromosomes, poor quality gametes , low number of gametes	**(3)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. reference to reproductive isolation ; 2. different breeding times; 3. do not recognise {courtship displays / songs / eq} ; 4. physically incompatible eg genitalia ;		**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that the two species share the same habitat ; 2. idea that the two species experience the same environmental conditions ; 3. (therefore) the same selection pressures ; 4. idea that they are both well-adapted (to their environment) ; 5. idea that no mutations have happened that {improve / change} their {phenotypes / survival}; 6. {no / few} changes in allele frequency / gene pool is stable ; 7. idea that there has been very little change in environment (over the years) ;	**Accept** similar **NB** this needs to be in the context of both species being subjected to the same selection pressures **Accept** similar	**(3)**

Q22.

Question Number	Answer	Additional Guidance	Mark
(a)	idea of organisms that breed to produce fertile offspring ;	**Ignore** reproductively isolated **Ignore** viable	(1)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea of geographical isolation ; 2. idea of different {environmental conditions / habitats / eq} ; 3. reference to different selection pressures ; 4. idea that mutation resulted in {adaptation / increased survival} ; 5. idea of {decrease in gene flow / different alleles} ; 6. ref to reproductive isolation ; 7. credit suitable example e.g. different songs, incompatible genitals ;		(4)

Question Number	Answer	Additional Guidance	Mark
(c)	1. idea of descending from common ancestor ; 2. idea of living in similar habitats ; 3. idea of similar (environmental) {conditions / factors} ; 4. idea of similar selection pressures ; 5. idea that both well-adapted ; 6. idea that mutations have not changed appearance ; 7. idea of similar gene pool ;	**Accept** same for similar throughout **2. Accept** place / environment / area	(3)

Q23.

Question Number	Answer	Mark
(i)	The only correct answer is B the number of different species in one area *A is incorrect because species richness does not measure alleles* *C is incorrect because it is not the number of individuals of one species* *D is incorrect because it is not the number of individuals of one species and it is not different habitats*	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to five of the following • random sampling in each woodland using suitable method of generating co-ordinates (1) • use of a quadrat to sample at least 10 times in each woodland (1) • count the number of different species in each quadrat (1) • take measures to ensure validity of investigation / measure named abiotic variables (1) • for each woodland, calculate {the total number of species present / number of species / given area} (1) • use a suitable statistical test to compare the data from the two woodlands (1)	e.g. random number tables e.g. carry out the investigation at the same time of year / forests in similar locations / same climate /measure temperature/pH e.g. mean and standard deviation for each woodland / t-test ALLOW Mann-Whitney U test DO NOT ALLOW diversity index	(5)

Q24.

Question Number	Answer	Additional guidance	Mark
	• a group of organisms that can interbreed to produce fertile offspring	ALLOW 'breed', 'reproduce', 'mate' for 'interbreed'	**(1)**

Q25.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	C		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	B		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	B		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(d)	An answer that makes reference to one of the following points: • virus has a non-cellular structure whereas bacteria has a cellular structure (1) • a virus has a protein capsid whereas a bacterium has a polysaccharide cell wall (1) • viruses have one type of nucleic acid whereas a bacterium has two (1)		**(1)**

Q26.

Question Number	Answer	Additional Guidance	Mark
(a)	1. idea that as the {distance from the front edge of the glacier / time} increases, the {complexity / biodiversity / size / eq } of the organisms increases ; 2. reference to (primary) succession ; 3. idea that {algae / lichens / pioneer species} are (the first) organisms to colonise bare rock / eq; 4. idea that {algae / lichen / pioneer species} improve conditions for plants ; 5. idea of competition (limiting species present) ;	1. ACCEPT idea that climax community only reached at distance from glacier edge 2. NOT secondary succession 4. including e.g. change rock into soil / increase humus content of soil / increase water content 5. e.g. newer species outcompete previous species	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. the {role / interaction / eq} of an { *Epilobium latifolium* / organism / species} within its { ecosystem / habitat / environment } ; 2. (*Epilobium latifolium*) is a producer ; 3. idea that *Epilobium latifolium* provides {food / energy} for other organisms (herbivores / primary consumers / decomposers) ; 4. idea that *Epilobium latifolium* improves soil e.g. holds soil structure together, increases nutrients ; 5. idea that *Epilobium latifolium* provides {shelter / (micro) habitat} for organisms ;	1. IGNORE community 3. NOT prey 4. IGNORE food in soil ACCEPT adds organic matter, humus 5. ACCEPT named organism e.g. insects	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. idea of using a transect (from front edge of glacier); 2. credit method of sampling (along transect) ; 3. credit appropriate method of selecting sample sites (along transect) ; 4. description of estimate of abundance e.g. number of plants, percentage cover ; 5. idea of using more than one transect ; 6. credit appropriate method of recording quantitative data ;	2. e.g. clumps touching transect, quadrat (on transect), number of plants along perpendicular 3. e.g. set distance, regular, systematic, flip-flop quadrats NOT random 5. IGNORE references to repeating investigation 6. e.g. tally chart, table, graph	**(4)**

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. credit appropriate named abiotic factor; 2. credit appropriate method of measurement of factor ; 3. credit appropriate description of where reading should be taken ; 4. idea of taking several readings and getting an average / eq ;	1. e.g. light, soil pH, water content, mineral content, temperature, salinity, wind IGNORE CO_2, O_2, rainfall, humidity 2.CE applied e.g. light {probe / sensor / meter / data logger}, {water gauge / drying out soil samples} 3. CE applied e.g. reading taken at height of plant, soil sample around roots, quadrat	**(3)**

Q27.

Question Number	Answer	Additional guidance	Mark
(a)	1. reference to increase in {metabolic rate / enzyme activity / eq} as temperature rises ; 2. reference to increase in {kinetic / eq} energy of molecules (as temperature rises) / eq ; 3. reference to increase in {enzyme-substrate complexes / energy of collisions / eq} (as temperature rises) ; 4. idea of {inactivation at lower temperatures/ denaturation at higher temperatures} of enzymes ; 5. idea that temperature affects {differentiation / growth /division / eq} ;	**1. Accept** converse argument for mp 1 – 3 **2. Accept** movement **4.Accept** the idea that enzyme-substrate complexes cannot be made if denaturing	**(3)**

Question Number	Answer	Additional guidance	Mark
(b)	1. idea that temperature affects {survival / development / growth / metabolism / cell division / eq} ; 2. idea that enzymes affect {development / growth / metabolism / cell division/ eq} ; 3. idea that temperature affects enzymes ; 4. idea that different frogs have different enzymes ;		**(2)**

Question Number	Answer	Additional guidance	Mark
(c)	*sylvatica*, *pipiens*, *palustris*, *clamitans* ; ;	if order correct but reversed = 1 mark	**(2)**

Question Number	Answer	Additional guidance	Mark
(d)	1. idea that different species are reproductively isolated ; 2. idea of different breeding {times / seasons / eq} ; 3. idea of different {breeding / courtship / eq} {behaviour / rituals / displays / colour / songs / croaks / eq} ; 4. idea that population at {northerly / southerly} limit of range may not develop (to adulthood) ; 5. idea that breeding between different species results in infertile offspring ;	**3. Accept** idea of incompatible {genitalia / gametes}	**(3)**

Question Number	Answer	Additional guidance	Mark
(e)	1. idea that global warming will increase the temperature (at the latitudes) ; 2. idea that temperatures (at these latitudes) may become too high for any of the species ; 3. idea that new temperature may be above the maximum to complete development or above the upper lethal limit ; 4. idea that species move {north / to cooler regions / eq} ; 5. ref to change in {food source / predators / competition / eq} ;	**2.Accept** become extinct	**(3)**

Q28.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • the (pulling) force the fibre can withstand before breaking **(1)**	ALLOW mass or weight instead of force	**(1)**

Q29.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct values for p and q (1) • value for 2pq calculated (1) • correct number of people calculated (1)	Example of calculation p = 0.9975 and q = 0.0025 OR p= 0.9976 and q = 0.0024 ALLOW opposite values for p and q 2pq = 0.0048 to 0.0050 319 200 to 332 500 Correct answer with no working gains full marks	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • because the allele for LGMD2A may undergo mutation (1) • because gene flow may cause alleles to be lost or gained from the population (1) • due to { natural selection / (changed) selection pressure } (1) • because people with the condition may not have children (1)	ALLOW random mutations to allele ALLOW: immigration / emigration ALLOW confers an advantage / disadvantage	(3)

Q30.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference the following: • sclerenchyma (fibres) on the outer side of the {vascular bundle / phloem} **(1)** • xylem (vessels) on the {inner side / inside} of the vascular bundle **(1)**	ALLOW correctly labelled diagram ALLOW sclerenchyma outside vascular bundle ALLOW xylem in the vascular bundle	**(2)**

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to • (counting) the number of different species (1) • (counting) number of individual per species (1)	 ALLOW measure species richness ALLOW determined population sizes	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to • appropriate calculation e.g. percentage of world {plants / vertebrates / total} found in Madagascar or percentage of {plants / vertebrate } in Madagascar that are endemic to Madagascar e.g. or percentage of world {plant / vertebrates / total} endemic to Madagascar or density of {plant / vertebrates / total} on {Madagascar / Earth} • species density of {animals / plants} in Madagascar is higher than for the Earth • many of the species found in Madagascar are not found anywhere else	 4% of plants, 3.6% of vertebrates or 4% of the combined total 80.9% plants 78.1% of vertebrates endemic 3.2% of plants, 2.8% of vertebrates or 3.2% of the combined total ALLOW a large number of species relative to the area	**(3)**

Q2.

Question Number	Answer	Mark
(a)	**A** bacteria and fungi	(1)

Question Number	Answer	Mark
(b)(i)	**A** none	(1)

Question Number	Answer	Mark
(b)(ii)	**D** validity	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. 2. ref to hydrolysis ; 3. by {enzymes / cellulase} / eq ; 4. produced by microorganisms / eq ; 5. into(β) glucose ; 6. uptake of glucose into microorganisms / eq ; 7. idea that glucose is used in {respiration / fermentation} ; 8. releasing carbon dioxide into the atmosphere / eq ; 9. idea that some of glucose (solution) soaks into ground ;		(4)

Question Number	Answer	Additional Guidance	Mark
(b)(iv)	1. to make investigation valid ; 2. idea that {temperature / heat energy} affects {rate of enzyme reactions / enzyme activity / rate of decomposition} ; 3. increase in {heat / kinetic} energy results in more {collisions / energetic collision / enzyme-substrate complexes / eq} ; 4. idea that high temperature results in enzyme {denaturing / becoming denatured} ; 5. (so) decomposition would stop / eq ;	4. ACCEPT bacteria killed / eq	**(4)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to two of the following: • increase in cross sectional area with testosterone (and not with placebo) • greatest increase with testosterone and exercise • significant difference for { testosterone plus exercise / group D } as the SDs (for start and after 10 weeks) do not overlap	ALLOW increase in size (of triceps muscle)	**(2)**

Question Number	Answer	Mark
(ii)	**D** - show that testosterone has an effect *The only correct answer is **D*** ***A** is incorrect because a placebo does not make measurements more accurate* ***B** is incorrect because placebos do not make data more reproducible* ***C** is incorrect because the placebo does not show that exercise has an effect*	**(1)**

Q4.

Question number	Answer	Additional guidance	Mark
	An answer that makes reference to the following: • (species) found only in one particular location (1)		Choose an item. (1)

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	• correct calculation of loss of area from 2010 to 2012 (1) • correct calculation of rate with relevant units (1)	<u>Example of calculation</u> 1160 - 700 = 460 (460÷2) x 1000 = 230 000 Ha yr^{-1} ALLOW Ha per year Correct answer without working gains full marks ALLOW ECF(1) eg 1160-680=240000 Ha yr^{-1} (1) 1160-690=235000 Ha yr^{-1} (1) 1160-710=225000 Ha yr^{-1} (1) 1160-720=240000 Ha yr^{-1}(1) 220 000 to 240 000 Ha yr^{-1} with no working gains 1 mark	**(2)**

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 Basic information • captive breeding will increase population size • deforestation is reducing the habitat • captive animals will be protected from hunters Evidence of linkages • orangutan numbers are declining and captive breeding will increase population size • as loss of habitat is a major reason for the decline, animals should be released into areas of forest in protected areas • more of the forest needs to be protected to reduce the rate at which habitat is being lost • captive bred animals show behaviour that may make them unable to compete in the wild • loss of habitat would lead to increased competition due to reduced food availability Evidence of sustained scientific reasoning • it is important to restrict passage of disease from humans to the wild population by minimising contact and releasing animals away from wild populations • if deforestation is not reduced – or protected areas increased – there will not be enough habitat left in which to release captive-bred orangutans • judgement on relative importance of captive breeding and habitat protection taking into account rate of deforestation and loss of suitable habitat • releasing animals if there is insufficient habitat could lead to an increased vulnerability to predation and poaching	(6)

Level 0	Marks	No awardable content	
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Captive breeding will increase numbers of orangutans Habitat loss is increasing
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.	Discussion of benefits of both captive breeding and habitat protection. Separate discussions of habitat loss and captive breeding. Linkages made for each aspect but not compared.
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.	Conclusion that without habitat protection, captive breeding is limited as there is less suitable habitat in which to release the animals Comparative evaluation of the benefits of habitat protection and captive breeding. Reference made to the data.

Q6.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • two GALP used to produce a glucose molecule • (glucose molecules are) joined together by glycosidic bonds to form starch • by condensation reactions • producing amylose and amylopectin	ALLOW triose phosphate instead of GALP ALLOW maltose / polysaccharide	**(4)**

Q7.

Question Number	Answer	Additional guidance	Mark
	A description that makes reference to three of the following: • cut a {strip / ring} of aorta (1) • record thickness of the piece of aorta (1) • hang masses on the (strip / ring) until aorta splits (1) • tensile strength determined by dividing force by cross sectional area (1)	ALLOW 'take a section of aorta' ALLOW repeats with same dimensions, e.g. length and { width / thickness} ALLOW 'breaks' or 'snaps' for 'splits' ALLOW 'weights' for 'masses'	**(3)**

Q8.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following: • description of production of agar plates with bacteria (1) • description of method used to add plant extract to plates (1) • extracts used separately and in combination (1) • incubate for at 37 °C for an appropriate period of time (1) • measure and compare the sizes of zones of inhibition (1)	ALLOW plates { inoculated / seeded} with bacteria, production of bacterial lawn or streak plates e.g. on filter paper discs or in wells ALLOW time from 24 to 72h and a temperature from 35-38°C e.g. diameter or area ALLOW comparative statements such as the larger the area, the more effective the antimicrobial properties	**(4)**

Q9.

Question number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to three of the following: • the frequency of the different shell patterns in different habitats is an example of adaptation (1) • provides camouflage (appropriate to the habitat) (1) • reducing predation (in different habitats) / providing protection from predators (1) • therefore increasing the chance of (surviving to) reproduce (1)	ALLOW other reasonable suggestions e.g. temperature regulation IGNORE increasing survival rate	**(3)**

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • use a statistical test such as the (Student) t-test (1) • if the test value is greater than the {critical / table} value at p=0.05 the difference is significant (1)	ALLOW using a critical value of p = 0.05 and a suitable number of degrees of freedom	**(2)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	A answer that makes reference to the following: • the area inhabited by a particular { species / organism } (1)		**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • biodiversity {measured / compared} using a diversity index (1) • species richness (assessed) (1) • genetic diversity of {populations / species} (1) • presence of any {endemic / rare} species (1)	ALLOW count the number of differentspecies in an area ALLOW endangered species / speciesat risk of extinction	(4)

Q11.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • pieces of rope of same length and {width / diameter } **(1)** • (stored at) a range of temperatures above and below 18°C **(1)** • humidity at 60% / ropes stored for same period of time **(1)** • {masses / force / weights} applied until rope breaks **(1)** • calculate change in tensile strength **(1)**		**(4)**

Q12.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • North American population is more genetically diverse (therefore more likely to adapt) (1) • (more different alleles) therefore more likely to have an allele that gives advantage (1) • the individuals with an advantageous allele are more likely to survive and breed (1) • the frequency of that allele will increase (1)		Expert (4)

Q13.

Question Number	Answer	Additional guidance	Mark
	• found only in one geographical location (1)	ALLOW one area of the world	**(1)**

Q14.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: • utilitarian argument, better to test on animals than on humans (1) • the benefits to humans must outweigh harm done to other animals (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • to determine safe dose (1) • to determine side effects (1) • to determine how the drug is metabolised (1)		**(2)**

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to three of the following: • percentage germination decreases as length of time stored increases (for both varieties) (1) • correct calculation of decrease for both varieties (1) • { little change / 1 or 2 % } in percentage germination when stored for up to 48 hours for both varieties (1) • greatest decrease in percentage germination occurred { later for P than Q / from 72 hours for P and from 48 hours for Q } (1)	ALLOW correct reference to negative correlation e.g. (from 0 to 120 hours) 40% decrease for P and a 36% decrease for Q	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • allowed a comparison between { the two varieties / stored seeds and seeds that had not been stored }(1) • to see the effect of seeds being stored at { 80% humidity / 42°C } (1) • data showed that the percentage germination success was { high / not 100% } in the control seeds (1)	ALLOW wheat seeds were viable or suitable for this investigation	(2)

Q16.

Question number	Answer
	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. Indicative content: Benefits Described: • crops have increased yield due to pest control or resistance to disease • reduced need to use pesticides • crops can be grown in a wider range of conditions, e.g. harsh conditions, drought etc Discussed: • hybridisation could allow crop plants to have genes for tolerance to harsh conditions from genome D • crops have higher nutrient content, or produce a greater range of useful chemicals e.g. pharmaceutical products • genetic modification can be beneficial if crops are resistant to herbicides - crops can be sprayed with herbicide without { being harmed / causing reduction in yield } Risks Hybridisation: • hybridisation can lead to pest species which have ability to grow in wide range of conditions • hybridisation could allow genes for tolerance to harsh conditions from genome D to enter pest species GM: • genetic modification may result in genes entering pest species, making control difficult or into food chains • GM can introduce antibiotic resistant genes to other species Selective breeding • selective breeding reduces { genetic diversity / size of gene pool }, or causes genetic drift • leading to loss of useful alleles / reducing the ability of the crops to adapt to environmental change

Level	Mark	Descriptor	Additional Guidance
0	0	No awardable content	
1	1-2	Limited scientific judgement made with a focus on **one** side of the argument only. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Only considered one benefit **or** one risk without further explanation beyond a brief description.
2	3-4	A scientific judgement is made through the application of relevant evidence to **both** sides of the argument. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Considers at least one risk **and** one benefit with some discussion.
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.	Benefits generally described and specific risks discussed. Conclusions described for each of the three methods – hybrids, GM and selective breeding.

Q17.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to five of the following: • as a result of a mutation **(1)** • (cyanobacteria) produce proteins containing the amino acid cysteine **(1)** • (cysteine rich proteins) produce {heat stable enzymes / proteins resistant to unfolding} **(1)** • other adaptations such as {enzymes with large hydrophobic cores / simpler protein folds / amino acids that do not bond to metal ions } **(1)** • high temperatures act as a selection pressure **(1)** • allowing them to {survive / replicate} and pass advantageous allele to next generation **(1)**	ALLOW 'pass alleles for heat tolerance to next generation'	**(5)**

Q18.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of thefollowing: • *Aedes aegypti* mosquito occupies its own niche (1) • if this species is eliminated the niche it occupied willbecome vacant (1) • other species (of mosquito) may evolve to occupythe niche (1) • these species may carry the virus (1)	ALLOW each species ALLOW other organisms / insects ALLOW Aedes aegypti is a vector / is not the disease causing organism	Choose an item. (3)

Q19.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to • determine the sequence of amino acids (for trypsin) • determine the number of {differences / similarities} in sequences (of amino acids) between species • the greater the number of differences the less closely related the species are	 ALLOW differences and similarities in primary structure ALLOW more similarities more closely related ALLOW greater difference in sequence longer the time from a common ancestor	**(3)**

Q20.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to four of the following: • mutation leads to { variation within the population of grass snakes / (snakes with) different colour or markings } (1) • (natural selection led to) those snakes which were better camouflaged surviving to reproduce (1) • (therefore) giving rise to two populations with differing allele frequency (1) • (as the result of natural selection) the two populations became reproductively isolated (1) • sympatric speciation (in the context of new species developing in the same habitat) (1)	 ALLOW separate gene pools develop or a change in allele frequency ALLOW can no longer breed with each other	**(4)**

Q21.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • {control / placebo} **(1)** • to allow a comparison with {A and B / the other groups} **(1)**		**(2)**

Q22.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • { warm conditions / water / glucose / amino acids / ideal pH } available Plus 2 of the following: • suitable { temperature / pH } for bacterial enzymes (1) • glucose used for {respiration / energy} • amino acids used for growth	ALLOW 37°C ALLOW optimum	**(3)**

Q23.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • drugs not delivered to { other / healthy} tissues (1) • overall dosage needed is less (1)	ALLOW drug does not {affect / reach} other tissues, drug not delivered to the whole body ALLOW converse ALLOW {higher concentration / more of the drug} delivered to area where needed	**(2)**

Q24.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to two of the following points: • there is an odd number of chromosomes (1) • therefore it does not have homologous pairs of chromosomes (1) • therefore meiosis cannot take place / meiosis requires chromosome pairs (1)	ALLOW uneven number ALLOW non-homologous chromosomes	(2)

Q25.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • presence of different stimuli (1) • (therefore resulting in) different genes being { activated / deactivated / transcribed / expressed } (1) • so different proteins are made (1) • proteins produced determine { structure / function } of cells (1)	e.g. transcription factors, chemical stimulus ALLOW different genes are switched {on / off} ALLOW 'tissues' for 'cells'	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • xylem identified as { hollow / thick-walled / lacking cytoplasm } / stain used to identify { xylem tissue / lignin } (1) • sizes of cells measured using { eye piece graticule / stage micrometer } (1) • {length / width} of cells from both areas measured / several measurements made and then the means compared (1) • correct calculation by dividing image size by magnification (1)	e.g. stained with toluidine blue, safranin or phloroglucinol	(3)

Q26.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	A		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • mosquitoes are geographically isolated in the tunnels (1) • random genetic mutations cause variation in the population which allows some individuals to feed on rats, mice and humans (1) • these individuals {will be selected for / are more likely to survive and reproduce} (1) • the proportion of individuals in the population with this mutation will change over time (1) • over many generations these populations become genetically distinct from the above ground population (1)		**(5)**

Q27.

Question Number	Answer	Additional Guidance	Mark
(i)	• amylopectin contains alpha glucose and cellulose contains beta glucose (1)	ALLOW { α / a } glucose and { β / b } glucose OR H and OH have been reversed on carbon 1	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	• hydrogen / H (bond)		(1)

Q28.

Question Number	Answer	Mark
(i)	The only correct answer is D *there is no significant difference in allele richness between the two populations.* A is not correct because it should not state that allele richness in Finland is higher B is not correct because it should not state that allele richness in the USA is higher C is not correct because the null hypothesis does not concern genetic diversity	Computer (1)

Question Number	Answer	Additional guidance	Mark
(ii)	• correct completion of table (1) • correct substitution into the equation (1) • correct calculation of chi- squared value (1)	5 / 25 / 2.78 1 / 1 / 0.25 16.50 / 16.5 Correct answer with no working gains full marks ALLOW ecf for 2 marks 16.49 if 2.77, if 2.8 16.52, 16.42 if 2.7 in the table	Expert (3)

Question Number	Answer	Additional guidance	Mark
(iii)	An answer that makes reference to three of the following • {little / no} effect of small founder population on allele richness (1) • degrees of freedom value is 9 / critical value is 16.919 (1) • therefore stated chi-squared value is below the critical value (16.919) (1) • therefore { there is no significant difference in allele richness between the two populations/ null hypothesis can be accepted} at 0.05 probability (1)	ALLOW converse answer for a stated chi-squared value above the cv if incorrectly calculated ALLOW there is a significant difference at 0.10 probability	Expert (3)

Q29.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to the following • Hardy-Weinberg equation stated (1) • correct calculation of frequency of homozygous recessiveindividuals (1) • correct calculation of frequency of dominant and recessivealleles (1)	Example of calculation $p^2 + 2pq + q^2 = 1.0$ $q^2 = 102 \div 200 = 0.51$ Dominant allele = 0.29 Recessive allele= 0.71 **Correct answer with no workinggains full marks**	**(3)**

Q30.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • mate {males and females / individuals} fromdifferent populations (1) • if they do not produce fertile offspring the parentsare different species (1)	ALLOW converse argument ALLOW they cannot breed togetherto produce fertile offspring gets both marks	Choose an item. (2)

Mark Scheme

Q1.

Question Number	Answer		Additional Guidance	Mark
	Description of adaptation	**Type of adaptation shown by the wasp**		
	(knocking its body to signal food)	Behavioural (1)		
	(the stinger)	Anatomical (1)		**(2)**

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)**

			Additional Guidance
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	<u>Example of calculation</u> 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 test for 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)**