PEARSON EDEXCEL A-LEVEL BIOLOGY A · 9BN0

BIOLOGY



MARK SCHEME

TOPIC 5: ON THE WILD SIDE

SCORE	PERCENTAGE
/394	%

STEMUP

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(Total for question = 3 marks)

Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	An explanation that makes reference to the following: • antibiotics target { organelles / structures / processes } found in bacteria (1) • viruses therefore unaffected by antibiotics (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	An explanation that makes reference to the following: • survivors will have antibodies specific to the virus in their plasma (1) • antibodies given to individuals infected with Ebola will provide passive immunity (1) • the antibodies provided will		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
	therefore { agglutinate / opsonise } the virus particles (1)		

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	An explanation that makes reference to the following: • vaccine stimulates immune response to make antibodies specific to viral proteins (1) • mutations in the virus nucleic acid (1) • results in a change in the shape of the viral proteins (1) • therefore antibodies can no longer bind to the virus (1)	Accept reference to antigens Ebola is an RNA virus but allow reference to mutations in DNA	**(4)**

Q2.

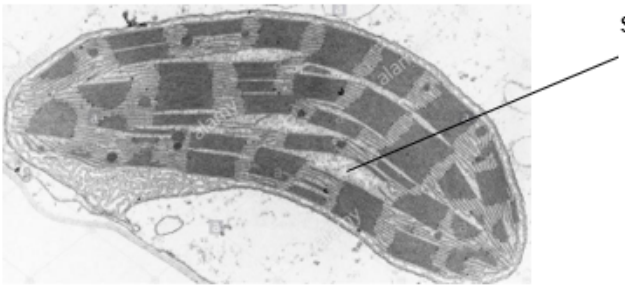
Question Number	Acceptable Answer	Additional guidance	Mark
(a)	NPP = GPP – R (1)		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	A description that makes reference to the following: • use of several quadrats of stated area placed at random (1) • heather placed in drying oven until constant mass (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	• (gradient) 46.875 (g m^{-2} yr^{-1}) x 22.186 (kJ) = 1039.97 (g kJ m^{-2} yr^{-1}) (1) • (1037.97 ÷ 3 144 000) x 100 =	Example 750 g m^{-2} ÷ 16 years = 46.875 g m^{-2} yr^{-1}	**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to the following: • moss not all removed by burning so quickly re-grows (1) • mat grass colonises after 1 year and outcompetes moss for {light / minerals / water} so is the dominant plant after 5 years (1) • both decrease as heather colonises and becomes dominant as the heather outcompetes them both for {light / minerals / water} (1)		**(3)**

Q3.

Question number	Answer	Additional guidance	Mark
(i)		ALLOW location of carbon fixation IGNORE unqualified letters	Expert (1)

Question number	Answer	Additional guidance	Mark
(ii)	• granum	ALLOW stack of thylakoids / thylakoid / grana	Graduate (1)

Question number	Answer	Additional guidance	Mark
(iii)	A description that makes reference to three of the following: • large surface area (1) • containing {chlorophyll / photosystems / photosynthetic pigments} (1) • to absorb as much light as possible (1) • the membrane (contains) electron transport chain / (contains) ATP synthase for the synthesis of ATP (1)	ALLOW PSII IGNORE to absorb light unqualified ALLOW ATP-ase	Expert (3)

Question number	Answer	Additional guidance	Mark
(iv)	A description that makes reference to the following: • (the enzyme) RUBISCO (1) • combines carbon dioxide with RuBP (1) • unstable {6 carbon / 6C} molecule breaks down into (two) GP (1)	ALLOW five carbon molecule / 5C molecule / ribulose bisphosphate ALLOW glycerate phosphate	Expert (2)

Q4.

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)**

Q5.

Question Number	Answer
* **(i)**	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. • feeding behaviours • anatomy • genetic differences • no information on whether they can interbreed to produce fertile offspring • different locations do not indicate that they are different species • no information on number of elephants used for DNA analysis • GBA alleles K and L are exclusive to one type of elephant / genetic isolation

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.	Makes reference to one of behavioural, phenotypic, anatomical or genetic differences
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of more than one pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.	Makes reference to more than one of behavioural, phenotypic, anatomical or genetic differences Also includes an interpretation of allele data **or** considers reasons why may not be different species
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 all pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Also includes an interpretation of allele data **and** considers reasons why may not be different species

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • two populations are geographically isolated from each other (1) • therefore reduced gene flow between the two populations (1) • which leads to allopatric speciation (1) • different selection pressures leading to natural selection (1)	ALLOW description of populations separated by a geographical feature ALLOW description of natural selection in context of selection pressures	**3**

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• appropriate x and y axis values identified (1) • correct answer 4.5 (1)	Example of Calculation: (1800 – 900) ÷ 200 = 4.5 Allow full marks for correct answer with no working	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to two of the following: • maize produce more above ground dry mass for a particular amount of incident radiation (1) • maize fix more carbon for a particular leaf nitrogen concentration (1) • maize will grow in less optimum conditions so better for biofuel production (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • { select / plant } a field of sugar cane (1) • sample, at suitable time intervals, using randomly placed quadrats (1) • measure light intensity (1) • harvest, dry and weigh sugar cane (1) • { monitor / record } other abiotic factors (1)		**(5)**

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • use of buffers of different pH (1) • control other variables e.g. temperature (1) • { compare / measure } diameter of clear zone (1)		**(3)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	1. idea that carbon dioxide dissolves (in the water / in the oceans) ; 2. for {carbon fixation / light-independent reaction / eq} ; 3. by {photosynthesis / eq} of {seaweed / algae / (phyto) plankton / autotrophs / eq} ;	**1 ACCEPT** absorbed / reacts with /diffuses into / becomes carbonic acid **3 ACCEPT** plants (that live in the sea) **IGNORE** organisms	**(2)**

Q9.

Question Number	Answer	Additional guidance	Mark
	A description that makes reference to three of the following: • find mean values (1) • use a t-test/ calculate a t-value (1) • (calculated) t-value needs to be greater than the critical value (1) • (compared to cv for) probability of { 0.05 / 5% } (1)	ALLOW use of mean values IGNORE chi-squared test ALLOW compare the t-value to the critical value	**(3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • (addition of bacteria) changes the { gut flora / gut microbes / microbiome } (1) • resulting in a change in taste perception (1) • resulting in a change to { cravings / food preferences } (1) • preventing one type of bacterium controlling { food preferences / taste perception / cravings } (1)	ALLOW (probiotics) outcompete other gut microbes ALLOW affects taste receptors	(3)

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following • {new / young / growing} trees • resulting in net uptake of carbon dioxide / more carbon dioxide taken in by photosynthesis than released by respiration • therefore reducing carbon dioxide in the atmosphere • which slows the rate of global warming	ALLOW plant more trees ALLOW trees acting as a carbon sink/store ALLOW reduces greenhouse effect	(3)

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • variation in the trypsin gene • (some variations / mutations) result in production of a calcium (ion) binding site • a calcium (ion) binding site confers a (selective) advantage • (vertebrates) survive, reproduce and pass on this (trypsin) allele / the frequency of this (trypsin) allele increases	ALLOW (random) mutations in the trypsin gene ALLOW makes the enzyme more effective	(3)

Q13.

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)

Q14.

Question Number	Answer	Additional Guidance	Mark
	1. (gradual) increase in {average / eq } temperature ; 2. (of earth's) {surface / atmosphere} (and oceans) ;	**NB IGNORE** any explanations as to the cause **1 IGNORE** warming	**(2)**

Q15.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following points • description of carbon dioxide as a limiting factor (1) • carbon dioxide is fixed to produce { GP / GALP } (1) • (therefore increased carbon dioxide) results in more { carbohydrate / polysaccharides / glucose } being produced (1) • which would lead to a greater rate of { growth / cell division } (1)	ALLOW other relevant biological molecule e.g. amino acids, lipids, nucleic acids ALLOW faster growth	**(3)**

Q16.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following: • relevant example of human activity (1) • increasing a named greenhouse gas (1) • therefore more {heat energy / infrared radiation} is trapped in the atmosphere (1) • causing a mean increase in the {surface / atmospheric} temperature (1)	e.g. burning fossil fuels / landfill / cattle ranching / deforestation e.g. carbon dioxide / methane ALLOW more heat trapped in the atmosphere	**(3)**

Q17.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference the following: • hydrolysis of ATP (1) • provides energy for the reaction (1) • provides phosphate group for phosphorylation of F-6-P (1)	ALLOW as the reaction requires energy ALLOW provides {phosphate / Pi} that is added to F-6-P	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to three of the following: • as concentration of { F-6-P / F-2,6-BP } increases so does the (initial) rate of reaction of the phosphofructokinase (1) • an increasing in the concentration of { F-6-P / F-2,6BP } will increase the rate of glycolysis (1) • up to a maximum (rate) (1) • increasing the concentration of F-2,6-BP reduces the concentration of F-6-P required to achieve the maximum rate of glycolysis (1)	ALLOW 'enzyme' for 'phosphofructokinase' ALLOW F-2,6-BP provides positive feedback to the enzyme activity	(3)

Q18.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following • not all of the light falls on the { leaves / plants / producers } (1) • some of the light is reflected (from the surface of the leaf) (1) • some of the light misses the chloroplasts (and passes through leaf) (1) • some of the light is { the wrong wavelength / not absorbed by the chlorophyll } (1)	ALLOW energy instead of light ALLOW some of the light falls on { bark/parts of the plant that do not photosynthesise} ALLOW chlorophyll / photosystem ALLOW description of not all light wavelengths being absorbed	(3)

Q19.

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)**

Q20.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(i)	An explanation that makes reference to the following: • there is no concentration gradient present between the chloroplast and the isolation solution (1) • no net loss of water from the chloroplast from osmosis (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(ii)	An explanation that makes reference to the following: • low temperature to (temporarily) slow enzyme activity (1) • pH 7.0 so enzymes not denatured (1) • so RUBISCO remains active (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(i)	There is no correlation between the concentration of DCMU and the rate of DCPIP colour change		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(ii)	7 and 49		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(iii)	• Correct calculation of numerator (1) • Correct calculation of denominator (1) • Correct calculation of correlation coefficient (1)	Example of calculation: $(\Sigma d^2 = 996) \div (n(n^2-1) = 504)$ $= (-) 0.976$ Allow all marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(iv)	An explanation that makes reference to the following: • Selection of appropriate critical value from the table (1) • calculated value is greater (than critical value) (1) • Can reject the null hypothesis / correlation is significant (1)	0.786 , 0.833 , 0.881	**(3)**

Q21.

Question Number	Answer	Additional Guidance	Mark
(i)	1. solution should contain (all) the {mineral / ions} that duckweed needs ; 2. at the minimum concentration / eq ; Any two correctly named ion and its corresponding function : e.g. {nitrate (ions) / NO_3^{2-}} for {amino acids / protein / nucleic acid / ATP /chlorophyll / eq} {magnesium ions / Mg^{++}} for chlorophyll {calcium ions / Ca^{++}} for {cell wall / pectate / middle lamella / eq } {phosphate (ions) / PO_4^{3-}} for { nucleic acid /ADP / ATP / NAD /phospholipid / eq} ; ;	**1 IGNORE** nutrients **2 ACCEPT** in excess **IGNORE** carbon dioxide and wrong formulae **NOT** nitrogen **NOT** magnesium **NOT** calcium **ACCEPT** membrane **NOT** phosphorous	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. idea of {extrapolation / drawing a line of best fit / eq} (to estimate number of fronds after 10 days) ; 2. read value from graph / eq ; 3. idea of subtracting { 50 / 10} from the number of fronds after 10 days ;	**NB** Apply this mark scheme even if they describe weighing the fronds and calculating the mass increase **2 IGNORE** time refs.	(2)

Q22.

Question Number	Answer	Additional Guidance	Mark
	1. idea that light is reduced by the deeper water ; 2. idea that carbon dioxide levels might be lower deeper down ; 3. idea that temperature might be lower deeper down ; 4. idea that {photosynthesis / eq} will be reduced ; 5. idea that less {glucose / hexose / GALP / GP / eq } produced to convert into {biomass / NPP / eq} ; 6. idea that GPP goes down but respiration {stays the same / increases} ;	**NB ACCEPT** converse of mp 1 - 5 if in context of shallow water **5 IGNORE** energy	

Q23.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to five of the following: • variable {heights / altitude} **(1)** • {collecting / growing} plants for each sample **(1)** • standardising plant material to be analysed **(1)** • other abiotic factors taken into account **(1)** • method of extraction of pigment **(1)** • method to measure pigment **(1)**	ALLOW reference to plant material in place of plants e.g. same mass / same part of plant e.g. humidity, wind speed, soil moisture, soil pH e.g. use of solvent e.g. use of colorimeter	**(5)**

Q24.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following • succession has occurred (1) • alder and spruce were the first species of tree to colonise (1) • slowest increase in abundance was spruce (1) • (interspecific) competition occurs between the three species (1) • example of resources competed for (1)	IGNORE primary or secondary ALLOW either alder or spruce ALLOW description of increase and decrease of abundance of each species over time ALLOW spruce and hemlock compete with alder / hemlock competes with spruce and alder e.g. water, mineral ions, light, etc.	**(4)**

Q25.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • the bare rock was colonised by pioneer species (1) • (these pioneer species) break up the rock (1) • dead plants add {humus / organic matter} (as they decompose) (1) • (eventually trees will be able to grow) as the soil {becomes deeper / can retain more water} (1)	ALLOW algae or lichen	(3)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to the following: • treatment of seeds with sodium chloride or sodium chloride and gibberellin has no effect on the number of seeds that germinate (1)		(1)

Question number	Answer	Additional guidance	Mark
(ii)	Choose an item. • correct expected value calculated (1) • $(O - E)^2$ values calculated (1) • Sum of $(O - E)^2$ values divided by expected value (1)	Example of calculation: = 42 36, 81 and 9 126 ÷ 42 = 3 ALLOW calculations based on E value of 48 or 50 Obs Exp $(O - E)^2$ $(O - E)^2/E$ 48 **42** **36** 0.857143 33 42 **81** 1.928571 45 42 **9** 0.214286 **3** 48 **50** **4** 0.08 33 50 **289** 5.78 45 50 **25** 0.5 **6.36** 48 **48** **0** 0 33 48 **225** 4.6875 45 48 **9** 0.1875 **4.875** Correct answer with no working gains full marks	(3)

Question number	Answer	Additional guidance	Mark
(iii)	An answer that makes reference to the following: • calculated value is significant at p = 0.05 (1) • at 2 degrees of freedom (1)		(2)

Q2.

Question Number	Answer	Additional Guidance	Mark
(a)	1. (rate of) { energy incorporated into / production of / eq} {biomass / organic material} ; 2. in {plants / producers} ;	**2. Accept** from photosynthesis	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. very little GPP in seagrass / majority present in {microphytobenthos and phytoplankton / phytoplankton} ; 2. (roughly) equal distribution (of GPP) between microphytobenthos and phytoplankton ;	**1. Accept** only 2.5 to 5% in seagrass, 95% in micro and phyto, more than 50% or about 55% of phyto 2. **Accept** about 50% in each **Accept** idea that GPP in microphytobenthos is slightly lower than in phytoplankton	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. idea of obtaining a value from the chart e.g. percentage, area, degrees, ratio ; 2. idea of how to use this to calculate GPP ;	**Ignore** units **1. Accept** appropriate figures in range 50 – 55 % **2. Accept e.g. (**percentage) multiplied by 8.4 x 10^6 **NB** $\frac{\text{angle} \times 840 \times 10^6}{360}$ = 2 marks $\frac{\text{area of segment} \times 840 \times 10^6}{\text{area of circle}}$ = 2 marks	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. {more / fast / high / eq} photosynthesis ; 2. water less {cloudy / churned up } / shallow water / high light penetration / eq ; 3. high {nutrient / carbon dioxide} levels in the sea / eq ; 4. {high / optimum} temperatures ; 5. high light intensity (in this area) / eq ; 6. idea of less respiration ;	**2. Accept** less current, less tidal	**(2)**
Question Number	**Answer**	**Additional Guidance**	**Mark**
(c)	1. NPP = GPP – R / eq ; 2. energy lost as heat / eq ; 3. named use of energy (released by respiration);	**1. Accept** correct description in words **3. Accept** e.g. movement, opening of flowers, glycolysis, metabolic processes	**(2)**

Q3.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to three of the following • because plants produce {organic compounds/biomass} from photosynthesis (1) • plants remove carbon dioxide (from the atmosphere) (1) • because animals produce (more) carbon dioxide by respiration (1) • because (some) animals produce methane (1)	ALLOW named biological molecule e.g. starch, sugar ALLOW plants are carbon neutral ALLOW converse for plants	Expert (3)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following • (deforestation cuts down) trees which are carbon sinks (1) • {burning / decomposition} of these trees releases carbon dioxide into the atmosphere (1) • without trees there is {less/no} photosynthesis to remove carbon dioxide (from the atmosphere) (1)	ALLOW trees are stores of carbon	Expert (3)

Q4.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to four of the following: • select two fields with similar {pests / abiotic} factors (1) • spray one field with a high concentration of pesticide and one with the {minimum / low} concentration of pesticide (1) • using a random sampling method to count pests in each field (1) • repeat sampling over a period of time (1) • description of how results would demonstrate competitive release (1)	ALLOW select patients with similar {cancer / tumours} ALLOW different doses of chemotherapy or cancer-treating drugs ALLOW measurement of size of tumour e.g. if number of pests in field sprayed with high concentration of pesticide show greater number of pests then it will prove the effect of competitive release OR If the cancer responds better to low dose of drugs proves competitive release	Expert (4)

Question number	Answer	Additional guidance	Mark
	A description that makes reference to four of the following: • suitable study group selected (1) • treat one group with high dose and a second group with {minimum / lower} dose (1) • suitable sampling method (1) • repeat sampling over a period of time (1) • description of how results would demonstrate competitive release (1)	e.g. (two) groups of patients with same cancer (two) similar fields (two) flasks of bacteria e.g. chemotherapy agent pesticide antibiotic e.g. scanning random quadrats zones of inhibition e.g. (demonstrates competitive release if eventually) number of pests in field sprayed with high concentration of pesticide greater than number in field sprayed with lower concentration the cancer responds better to low dose of drugs than high dose only the low dose treated group remain sensitive to the antibiotic	Expert (4)

Q5.

Question Number	Answer	Mark
	B light-independent reaction	**(1)**

Q6.

Question Number	Answer	Mark
(i)	**C** – humidity *The only correct answer is **C*** ***A** is not correct because resistance to infection is a biotic factor* ***B** is not correct because pathogens are biotic factors* ***D** is not correct because ocean pH is an abiotic factor but not one relevant to plants and their pathogens*	**(1)**

Question Number	Answer	Mark
(ii)	**B** – global warming *The only correct answer is **B*** ***A** is not correct because increase CO_2 to 1080 ppm does not decrease photosynthesis* ***C** is not correct because increased CO_2 to 1080 ppm does not increase plant respiration* ***D** is not correct because increased CO_2 to 1080 ppm does not cause ozone depletion*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following • carbon dioxide (is a greenhouse gas and) causes global warming • a relevant description of a change in the distribution of ash trees (with increasing CO_2 concentrations) • (because increased CO_2) would result in a change in the range for *H. fraxineus* (1) • and ash trees will be found in regions without *H. fraxineus* • change in range of { *H. fraxineus* / ash trees } linked to a relevant aspect of climate change	e.g. an increase to 430 ppm leads to more ash trees in the east or an increase to 1080 ppm leads to more ash trees in the north e.g. temperature increase, change in humidity, change in rainfall patterns	**(5)**

Q7.

Question Number	Answer	Additional Guidance	Mark
	reaction A = phosphorylation ; reaction B = hydrolysis ;		**(2)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	B carbon dioxide and water		**(1)**

Q9.

Question Number	Answer	Mark
	C kJ m^{-2} $year^{-1}$	**(1)**

Q10.

Question Number	Answer	Mark
(i)	**The only correct answer is D thylakoids** ***A*** *is not correct because the cristae are not found in the chloroplast* ***B*** *is not correct because the matrix is not found in the chloroplast* ***C*** *is not correct because the stroma is not the site of the light-dependent reactions*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is D reduced NADP, ATP and oxygen** ***A*** *is not correct because carbon dioxide is not a product of photosynthesis* ***B*** *is not correct because glucose is the end product of the light independent reactions* ***C*** *is not correct because reduced NAD is not a product of the light-dependent reactions*	**(1)**

Question Number	Answer	Mark
(iii)	**The only correct answer is D water** ***A*** *is not correct because glucose is not the source of hydrogen in the light-dependent reactions* ***B*** *is not correct because reduced NAD is not the source of hydrogen in the light-dependent reactions* ***C*** *is not correct because reduced NADP not the source of hydrogen in the light-dependent reactions*	**(1)**

Q11.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following • fewer seeds will lead to a decrease in the plant population(1) • fewer seeds means that there is less {food / energy} (1) • lipids and carbohydrates contain (large amounts) of stored energy(1) • the monkeys will not be able to generate enough heat to survive the cold winters(1) • the monkey population will decrease in size (1)	ALLOW lipids needed for insulation/less respiration to generate heat	**(4)**

Q12.

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. 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. • standardisation of composition of compost heaps • identification of species • abundance of each species of organism in the sample • determination of C:N / set up compost heaps with different C:N ratios • time e.g. days / intervals / repetition of sampling • other factors to monitor or control e.g. water / gases / humidity / temperature / aeration / mass • sampling technique e.g. location of sample within compost heap / repetition of sampling

Level	Mark	Descriptor	
0	Marks	No awardable content	
Level 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.	Measure / set up compost heaps with different C:N ratios Observe species present over time
Level 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.	Recording species present / numbers of each species / measuring C:N ratio Monitoring changes over time Control of relevant factors
Level 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.	Description of a suitable sampling technique Linking species present or species density to C:N measurements Use of a statistical test to compare changes of time / C:N ratio Use information on numbers of species and population sizes to demonstrate succession

Q13.

Question Number	Answer	Additional guidance	Mark
	An answer the makes reference to four of the following: • use pH buffers at a range of pH values below 7 (1) • provide an excess of ATP (1) • (use) F-6-P at an appropriate concentration (1) • suitable variable controlled (1) • measure quantity of F-2,6-BP produced per unit time (1)	e.g. 2 mmol dm^{-3} (values between 1 and 2.5 mmol dm^{-3}) e.g. {enzyme / phosphofructokinase } concentration / temperature ALLOW measure change in concentration of F-2,6-BP / phosphate incorporated	**(4)**

Q14.

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)**

Q15.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(i)	An answer that makes reference to the following: • {cold / buffered} to stop enzyme denaturation (1) • sucrose to stop osmotic loss of water from chloroplasts (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	• tube 3 is a control to show DCPIP does not change colour over time (1)		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(iii)	An explanation that makes reference to the following: • set up tubes identical to tube 1 so that chloroplasts are available (1) • set up several tubes to ensure data is reliable (1) • tubes exposed to light of different wavelengths for same time because time affects number of electrons released / tubes exposed to light of same intensity because intensity affects number of electrons released (1) • use a colorimeter with a red filter to measure absorbance (1)		**(4)**

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

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

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	• (symmetrical) bell-shaped curve drawn **(1)**		**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• specimen 7 = 1.277 **AND** $\Sigma x_1^2 = 12.198$ **(1)**		**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	• Top line of formula correctly calculated **(1)** • correct answer to two significance figures **(1)**	<u>Example of calculation</u> 9.055 – 9.006 = 0.0054 / 0.00544 / 5.4×10^{-3}	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iv)	• top line of formula correctly calculated **(1)** • bottom line of formula correctly calculated **(1)** • correct answer to between three and five significant figures **(1)**	Example of calculation 0.153 0.0336 (0R 0.0337 if 0.00544 used) = 4.55 (OR 4.54 if 0.00544 used) ALLOW answer between 4.5510 and 4.5540 Correct answer with no working gains full marks	**(3)**

Question Number	Answer	Additional Guidance	Mark
(v)	An explanation that makes reference to the following: • there was a significant difference between {the 3% and the 5% salt solution / groups} **(1)** • at the 5% significance level **(1)**	IGNORE significant correlation / significant relationship ALLOW 95% probability there is a difference e.g. '5% chance that the difference is due to chance' or with 95% certainty' IGNORE p = 0.05	**(2)**

Q17.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • thylakoid membrane / grana / granum **(1)**	ALLOW phonetic spelling ALLOW lamella	**(1)**

Q18.

Question Number	Answer	Additional Guidance	Mark
(a)	C ; nucleus and large (80S) ribosomes		(1)

Question Number	Answer	Additional Guidance	Mark
(b)	A ; algae have chloroplasts, the fungi do not		(1)

Question Number	Answer	Additional Guidance	Mark
(c)	1. (advantage of sexual reproduction / meiosis) {genetically different / greater gene pool / greater genetic diversity /eq} ; 2. (advantage of asexual reproduction / mitosis) faster / one of each organism needed / conserves advantageous alleles ;	**2. Accept** don't need a mate	(2)

Question Number	Answer	Additional Guidance	Mark
(d)(i)	C ; area exposed to bright sunlight and protected from the wind		(1)

Question Number	Answer	Additional Guidance	Mark
(d)(ii)	1. idea of using a quadrat ; 2. idea of {random / systematic} sampling (of wall) ; 3. {count number of squares/ determine area} containing lichen /eq ; 4. credit an indication of how the percentage was calculated ;	**1. Accept** description of quadrat, use of photo and a grid **3. NB** reference to measuring percentage cover only is too vague as it is repeating stem of question	(3)

Question Number	Answer	Additional Guidance	Mark
(d)(iii)	1. ref to use of light {probe / sensor /eq} ; 2. idea of taking several measurements ;	**1 Accept** description of a light sensor 2. Accept ref to places or times of day	(2)

Question Number	Answer	Additional Guidance	Mark
(d)(iv)	1. plot a (scatter) graph of light intensity against lichen / eq ; 2. reference to looking for a correlation ; 3. reference to use of statistics test ; 4. appropriate named test eg Spearman's rank, Pearson ;	**2. Accept** ref to line of best fit, ref to correlation coefficient also gets Mp 3	(3)

Q19.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • deforestation results in (geographical) isolation of the populations of Aye-ayes (1) • resulting in reduced gene flow between the populations (1) • different selection pressures leading to natural selection (1) • leading to sympatric speciation (1)		**(3)**

Q20.

Question Number	Answer	Additional Guidance	Mark
	• peer review (1)	ALLOW reviewed by other scientists IGNORE peer assessment	**(1)**

Q21.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following: • there was isolation of (populations) of finches (1) • there were different selection pressures (at the different locations) (1) • (different / random) mutations in (different) populations of finches (1) • therefore allowing populations to adapt to different selection pressures (1)	ALLOW finches in different locations ALLOW different food sources act as a selection pressure ALLOW different beak shapes due to mutations DO NOT ALLOW selection pressures caused mutations ALLOW finches with better adapted beaks passed on their (favourable) alleles resulting in a change in the {allele frequency / gene pool}	Expert (3)

Q22.

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)**

Q23.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to two of the following: • GPP – R = NPP (1) • {organic molecules / glucose} used in respiration to provideenergy (1) • because the more {organic molecules / glucose } used inrespiration, the less is available for the production of biomass (1)	ALLOW word equation or rearranged equation ALLOW more respiration results inless biomass	**(2)**

Q24.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	NPP = 4680 ; R = 5720 ;	**NB** If there are no answers in the box, look for answers in the space below question If answers are the wrong way round, award 1 mark If both answers are wrong, **accept** R = 10168.9 / 10169	**(2)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. NPP = GPP – R / eq; 2. 55% (GPP energy) is lost / eq ; 3. energy lost as heat / eq ; 4. to provide energy for {active transport / any other named energy-requiring process} ; 5. NPP is {(stored) energy / energy available for next trophic level / eq} ;	**Accept** correct description in words eg movement (opening of flowers, turning of leaves), glycolysis **Ignore** idea that energy is **used** for respiration unqualified **Accept** biomass	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. cattle {are primary consumers / herbivores / eat grass / eat plants / eq} ; 2. (therefore) gain energy (available as NPP) ; 3. idea of grazing capacity of the grassland ; 4. idea of affect on yield of {meat / milk / eq} ; 5. idea of changing to a more {efficient / NPP yielding} crop ;	**Accept** idea that farmer is ensuring that there is enough NPP available for his cattle **Accept** growth rate	**(3)**

Question Number	Answer	Additional Guidance	Mark
(c)	1. idea of variation over short periods of time; 2. idea that whole year gives an {average / overall / eq} value ; 3. idea that biomass includes {all / undigestible / inedible / eq} organic material ; 4. idea that rate of productivity may influence how much grazing is possible ;	eg more NPP on a sunny day, seasonal	**(2)**

Q25.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following points • (difference in number of species) not due to temperature and soil moisture content as they are the {same/similar} in the two woodlands (1) • the light intensity is the most likely reason for the greater number of species as it is higher in the deciduous woodland (1) • description of the effect of light intensity on plant growth (1) • the pH of the soil in the coniferous woodland is acidic so this may also reduce the number of species found (1) • only plant species considered and not other organisms (1)	e.g. high light intensity allows a greater rate of photosynthesis / more photosynthesis or plants need to be adapted to low light intensities	**(4)**

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • methane is a greenhouse gas **(1)** • greenhouse gases {absorb / trap} {heat / infra red / long wave} energy **(1)** • (anaerobic oxidation of methane results in) less methane in the atmosphere **(1)** • (the breakdown of methane) could {reduce the greenhouse effect / result in less heat being trapped / reduce global warming} **(1)**		**(3)**

Q2.

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

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	1. idea that bacteria are resistant to fewer {antibiotics / antibiotic combinations} (in 2006 than 2007) ; 2. in both years there are resistant strains to {streptomycin / INH + rifampicin + ethambutol / INH } ; 3. idea that there are resistant strains to INH + rifampicin in 2006 but not in 2007 ; 4. idea that there are resistant strains to {ethambutol / rifampicin} in 2007 but not in 2006 ;	**ACCEPT** clear abbreviations to the names of the antibiotics throughout **1 ACCEPT** a description e.g. new resistances, resistant to 4 in 2006 and 5 in 2007 **3 ACCEPT** idea that {resistance decreased to zero / no longer resistant} **4 ACCEPT** idea of resistance developing **NB** development of new resistances to {ethambutol / rifampicin} = Mp 1 and 4	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	1. bacteria have a mutation in {DNA / gene / eq } ; 2. idea that the {presence / usage of} {antibiotic (INH) / INH} acts as a selection pressure ; 3. idea that the allele (for resistance) is passed on ; 4. idea that bacteria {divide by asexual reproduction / divide by binary fission / produce clones / eq} ; 5. idea of increasing the allele frequency ;	**3 NOT** gene **4 ACCEPT** divide by mitosis / conjugation / transduction / transformation / eq	

Question Number	Answer	Additional Guidance	Mark
	6. idea that the more resistant bacteria there are, the more likely new strains will acquire the (resistance) gene ;		**(3)**

Question Number	Answer	Additional Guidance	Mark
(iii)	1. reference to codes of {practice / conduct / eq } ; 2. idea that appropriate {antibiotics / named example} should be given to patients ; 3. idea of {educating patients about taking antibiotics / taking the full course of antibiotics ; 4. credit another appropriate procedure e.g. hand washing, screening ;	**1 ACCEPT** named policy /code **NB** Mp5 is for named practice **2 ACCEPT** not giving antibiotics if not necessary / not using antibiotics for prophylactic treatment / using narrow spectrum antibiotics / rotate antibiotic use	**(2)**

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(i)	net (primary) productivity = gross (primary) productivity - respiration	Allow NPP = GPP - R	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(ii)	correctly plotted value	2.3 at 0 1.4 at 6 0.9 at 18	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(iii)	An explanation that makes reference to three of the following: • there will be a large decrease in net productivity as depth increases (1) • (due to) large decrease in gross productivity as depth increases (1) • lower light intensity results in less photosynthesis (1) • and (only a) small decrease (in utilisation of carbon) in respiration as depth increases (1)		**(3)**

Question Number	Indicative content
* **(b)**	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. • burning fossil fuels increases atmospheric concentrations of CO_2, a greenhouse gas leading to rising sea levels, increased surface temperatures and increased CO_2 concentration in oceans • small changes in sea level have limited effect on the crustose coralline algae • algae are adversely affected by increased carbon dioxide concentrations • there is a greater effect of increased carbon dioxide at higher temperatures • continued burning of fossil fuels may reduce productivity of crustose coralline algae • reefs will grow more slowly, become more susceptible to damage resulting in loss of habitat

Level	Mark	Descriptor
Level 0	Marks	No awardable content
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.
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.
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.

Q5.

Question Number	Answer	Mark
	The only correct answer is B *3* Global warming is not caused by a reduction in greenhouse gases Global warming is not affecting only the ice caps	Computer (1)

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An answer that makes reference to the following points: • systematic sampling (1) • quadrats used at the tops and in between dunes (1) • details of method used for measuring percentage cover (1) • repeats to make a valid comparision (1) • a named relavent statistical test (1)		**(5)**

Q7.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • negative correlation described (1) • polar bears eating fewer seals (1) • as the length of time that ice is present decreases more polar bears are seen on land (1) • (because polar bears are on land more often) more eggs are eaten (1)	e.g. as presence of ice decreases the number of eggs taken increases ALLOW hunting / feeding on / catching ALLOW polar bears seen more often on land	**(4)**

Q8.

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

Q9.

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)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(a)	A ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
*(b)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. idea that biofuel production may (overall) results in more carbon dioxide in the atmosphere ; **OR** idea that carbon neutral means that the carbon dioxide produced equals the carbon dioxide used ; 2. idea of forests as carbon {sinks / eq} ; 3. idea that {clearing land / deforestation} results in (net) increase in carbon dioxide (in atmosphere) ; 4. (less plants means) less carbon dioxide {removed / used / eq} by photosynthesis ; 5. {burning / eq} trees produces carbon dioxide ; 6. idea that (increased) decomposition produces carbon dioxide; 7. idea of using {(fossil) fuels / petrol / diesel} by {lorries / machinery / eq}produces carbon dioxide ; 8. {burning /eq} of biofuels produces carbon dioxide ;	**QWC emphasis is clarity of expression** **Accept** stores / sumps	**(5)**

Question Number	Answer	Additional Guidance	Mark
(c)	1. reference to production of {greenhouse gases / named greenhouse gas} ; 2. idea that these gases {build up/ remain / form a layer} in (upper) atmosphere; 3. which {absorb / trap / eq} {heat energy / infra-red / IR / eq} ; 4. reflected from earth's surface ; 5. idea that increased levels of these gases increase the greenhouse effect ; 6. idea that (mean) temperature of earth's {surface / atmosphere} is increasing ;	**Accept** carbon dioxide, water vapour, sulphur dioxide, oxides of nitrogen **Not** methane **Accept** long wavelength light	**(4)**

Q11.

Question Number	Answer	Mark
(a)(i)	**A** carbon dioxide and methane	**(1)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. idea that {using / burning} {fossil fuels / petrol / diesel} releases carbon dioxide ; 2. reference to {carbon dioxide / CO_2} as a greenhouse gas ; 3. idea that carbon dioxide is taken in for {photosynthesis / light-independent reaction / carbon fixation / eq} (during production of plants for biofuels) ; 4. idea of no net change of carbon dioxide in the atmosphere when biofuels are burnt / eq ;	1. NOT methane Ignore burning biofuels releases carbon dioxide 4. ACCEPT biofuels are carbon neutral	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	(plant) fibres / woody parts / xylem (vessels / tissue) / sclerenchyma (fibres / tissue) / lignified tissue / eq ;	ACCEPT vascular bundles / tissue	**(1)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. idea that bacteria cannot breakdown cellulose fast enough ; 2. idea that {enzymes / cellulase} needed to break down cellulose into (β) glucose ; 3. by hydrolysing (1,4) glycosidic bonds / eq ; 4. idea of {respiration / fermentation} of {glucose / eq} (by bacteria) ;	2. NOT hydrogen bonds 3. ACCEPT breaking	**(2)**

Question Number	Answer	Additional Guidance	Mark
(c)	1. idea that production of first generation biofuel increases until 2016 and then level off ; 2. idea that production of second generation biofuel will continue to increase ; For second generation biofuels: 3. idea that second generation biofuels do not affect food supply ; 4. idea that made using the non-edible components ; 5. cheaper ; 6. idea that people are becoming more responsible for their environment ;	Piece mp 1 and2 together ACCEPT the converse of mps 3, 4 and 5 in context of first generation biofuel production 4. ACCEPT (cellulose and) lignin idea of less waste	**(4)**

Q12.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	**C** ; The number of fires in Mato Grosso each year is always higher than other areas ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
* (a)(ii)	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. reference to {fires / burning / eq} produces carbon dioxide ; 2. which is a greenhouse gas ; 3. idea that these gases {build up / remain / form a layer / increase} in (upper) atmosphere ; 4. which {absorb / trap / eq} {heat energy / infra red / IR / eq} ; 5. reflected from earth's surface ; 6. idea that increased levels of these gases increase the greenhouse effect ; 7. idea that (mean) temperature of earth's {surface / atmosphere} is increasing ; 8. idea that less carbon dioxide {removed / used / eq} by photosynthesis ;	**QWC emphasis clarity of expression** **1. Accept** carbon dioxide, water vapour, sulphur dioxide, oxides of nitrogen **Not** methane **2. NB** do not penalise ref to methane twice **4. Accept** long wavelength light	**(5)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. reference to biofuels being (possibly)carbon neutral ; 2. idea that {plants / crops} are used for biofuels ; 3. idea that carbon dioxide used for photosynthesis (by plants / in production of biofuels) ; 4. idea of using biofuels to replace fossil fuels ;	**Ignore carbon unqualified** **1. Accept** idea of no (net) change in carbon dioxide levels in atmosphere	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. land has to be cleared to grow plants for biofuels / eq ; 2. burning produces carbon dioxide / the plants growing there would have been {photosynthesising / using carbon dioxide} / machinery uses fossil fuels / loss of habitat ; OR 3. decomposition of dead plant material (after clearing) / eq ; 4. produces carbon dioxide / eq ; OR 5. idea that the land could have been used for food production ; 6. less food produced / eq ; OR 7. ref to use of fertilisers ; 8. idea of eutrophication OR use oil-based products ;	**Mark as pairs** **1 Accept** reference to deforestation of land to grow plants for biofuels **6 Accept** shortage of food, contributes to world hunger, idea of causing starvation	**(2)**

Q13.

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)

Q14.

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)

Q15.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to • correct method for calculation the change in value (1) • correct answer (1)	<u>Example of calculation</u> 405 ÷ 1.46 277.4 (ppm) ALLOW 277 Correct answer without workinggains full marks	**(2)**

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct answer to four significant figures **(1)**	<u>Example of calculation</u> 6.44 ÷ 10 = 0.644 (mm)	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • divide change in mean length by time **(1)** • comparison between the rate for 3% and 5% **(1)**	ALLOW (growth) rate = change in mean length ÷ time ALLOW grow faster in 5%	**(2)**

Q17.

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)**

Q18.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • transfer carbon from an {inorganic source / CO_2} into organic compound **(1)** • that becomes part of the mass of that organism **(1)**	ALLOW correct named organic compound e.g. cellulose / protein ALLOW description of light independent reactions of photosynthesis ALLOW part of biomass	**(2)**

Q19.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • carbon dioxide produced by burning wood replaces thatabsorbed by the trees (1) • trees absorb carbon dioxide (from the atmosphere) forphotosynthesis (1) • new trees are grown to replace those that are cut down (1) • therefore no net increase in carbon dioxide (1)	ALLOW converse ALLOW fix carbon ALLOW carbon neutral	**(4)**

Q20.

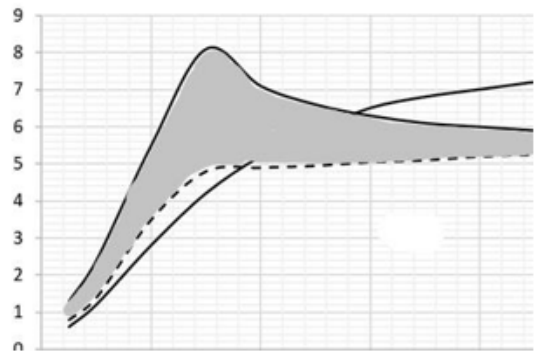
Question Number	Answer	Additional Guidance	Mark
(i)	• correct values for carbon released by boreal forest and deciduous forest respiration (1) • correct use of values to calculate percentage increase (1) • correct answer (1)	<u>Example of calculation</u> 1013 – 322 = 691 (Boreal) 2165 – 1301 = 864 (Deciduous) = 173 ÷ 691 deciduous release 25% (25.04%) more than boreal Correct answer with no working gains full marks	**3**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • the ratio of NPP to GPP is higher in deciduous forests (1) • NPP is higher / more of the carbon (fixed) is used to produce biomass (1) • (in deciduous forests) more carbon (dioxide) removed (by photosynthesis) than returned by respirat ion (1)	ALLOW converse for boreal forests for all points	3

Q21.

Question Number	Answer	Mark
	The only correct answer is A absorbs infrared radiation reflected by the surface of the Earth ***B*** *is incorrect because it does not absorb ultraviolet* ***C*** *is incorrect because it does not reflect infrared* ***D*** *is incorrect because it does not reflect ultraviolet*	**(1)**

Q22.

Question number	Answer	Additional guidance	Mark
(i)	Choose an item.  	ALLOW solid or hatched shading Shading must be complete (e.g. not stop at biomass line)	Graduate (1)

Question number	Answer	Additional guidance	Mark
(ii)	A description that makes reference to the following: • change in communities (1) • (taking place) over time (1)	ALLOW change in species ALLOW a description of succession as a change from pioneer species to climax communities	Expert (2)

Question number	Answer	Additional guidance	Mark
(iii)	An answer that makes reference to three of the following: • (the energy lost in) respiration {levels off / stops increasing} (1) • accumulation of (the energy incorporated into) biomass continues (1) • therefore, with succession more carbon dioxide is fixed (1) • reduces the amount of carbon dioxide (in the atmosphere) (1)	ALLOW more carbon sinks ALLOW more photosynthesis to remove carbon dioxide ALLOW (with succession) carbon dioxide released from respiration is less than the carbon dioxide fixed (by RUBSCO)	Expert (3)

Q23.

Question Number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to the following • species D (1) • correct calculation of percentage change as {43.3/ 43} % (1)	Example of calculation (215-150) ÷150 x 100	graduate (2)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to four of the following • the rate of growth increases as rate of photosynthesis increases (1) • growth rate is higher for plants grown at a higher light intensity (1) • role of light in light-dependent reactions described (1) • more photosynthesis means more {glucose/carbohydrate} produced (1) • (more carbohydrate produced) means more glucose for {energy/respiration } (1)	ALLOW correlation between rate of growth and rate of photosynthesis e.g. photolysis / photophosphorylation – production of ATP or reduced NADP ALLOW other named product of photosynthesis	Expert (4)

Q24.

Question Number	Answer	Mark
	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 • Use shade tolerant and shade intolerant plants • Plants grown in the same conditions e.g. temperature, humidity • Plants grown in either 5% light or 25% light or a range of light intensities • Take same masses of leaf • Add to equal volume of isolation medium • Homogenise (e.g. blend / grind in pestle and mortar) for same length of time • Filter suspensions of plant material (through muslin) or centrifuge to concentrate chloroplasts • Resuspend pellet of chloroplasts if centrifuged • Expose suspensions to 5% and 25% light intensity • Keep temperature controlled • Add DCPIP and record time for DCPIP to decolourise • Carry out repeats to calculate mean time to decolourise the DCPIP • If the difference is due to the light dependent reaction, shade tolerant plants would decolourise more quickly at lower light intensity	Expert (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.	Compare shade tolerant and shade intolerant plants (allow A and C from the table) Control of at least one relevant variable Reference to different light intensities
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.	Growing plants at different light intensities Use of DCPIP to measure rate of photosynthesis Correct description of methodology Sensible number of repeats Correct change in DCPIP/use of colorimeter to measure colour change
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.	Link between change in DCPIP and rate of photosynthesis Link with light dependent reaction How this would support the difference between shade tolerant and shade intolerant plants Use of a named statistical test eg T test

Q25.

Question Number	Answer	Additional guidance	Mark
	Chloroplast		**(1)**