Mark scheme - Ecosystems

Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	**1**	
2			B	1	
			Total	**1**	
3			C ✓	1	
			Total	**1**	
4			C ✓	1	
			Total	**1**	
5			A)	1	**ALLOW** B **Examiner's Comments** Almost two-thirds of candidates were correct about pioneer communities.
			Total	**1**	
6			B ✓	1 (AO1.1)	**Examiner's Comments** Most responses were correct. There was evidence that some candidates expected to see the term 'energy' rather than 'biomass' and so opted for D. However, 'biomass' is the term used in the specification and so the statement associated with D was true.
			Total	**1**	
7			B ✓	1 (AO 2.1)	
			Total	**0**	
8			A ✓	1 AO2.1	
			Total	**1**	

9			C ✓	1 AO1.2	
			Total	**1**	
10			D ✓	1 AO1.2	
			Total	**1**	
11	a	i	lay tape measure out from edge of pond ✓ place quadrat beside tape measure ✓ identify species of buttercup in quadrat ✓ count number of plants of each species (in quadrat) ✓ repeat for positions of quadrat along tape ✓	Max 3	**ACCEPT** measure % cover of each species **ACCEPT** count squares containing plants of each species
		ii	three columns with clear headings ✓ quadrat number / distance from pond in left hand column ✓ number of plants / % cover in right hand column(s) ✓	Max 2	**ACCEPT** two columns where second column is divided into two forseparate species
	b		predation / herbivory ✓ competition ✓ correct ref to organisms living in soil ✓	Max 1	
			Total	**6**	
12	a	i	have significant effect on ecosystem✓ many other species rely on activity of beavers✓	2	
		ii	*created dams* flooded areas upstream / reduced flow rate downstream creating still / slow moving water for aquatic species✓ *felled trees* opened up tree canopy allowing light to ground level✓ *built lodges*	Max 3	**ALLOW** any other valid point

			creates sheltered habitat for insect species / beaver parasites✓		
		ii i	ecotourism / education / scientific study✓ water quality improved as silt is held back by dams✓	Max 1	
	b		species diversity will rise as more species live in the new habitats✓ genetic diversity will increase as species have a wider range of conditions in which to live ✓	2	
	c		loss of farmland due to flooding ✓ strength of argument depends on area affected ✓ (probably) not a strong argument as relatively small areas affected✓ trees cut down✓ (of concern to foresters) likely to occur only in area near water – so not a strong argument ✓ damage to river bank needing costly repairs ✓ cost should be shared by all who benefit (including those downstream) so not a strong argument ✓	max 4	
			Total	**12**	
1 3		i	**FIRST CHECK ON ANSWER LINE** **If answer 91 ± 1or 90.7 ± 1 (%) award 2 marks** 215 000 – 20 000 = 195 000 195 000/215 000 = 0.907 ✓ x 100 = 90.7 ✓	2 AO2.8	*Max 1 if answer not given to 2 or 3 s.f.* *If answer incorrect …* **ALLOW** 195 000/215 000 **or** 0.907 for 1 mark
		ii	*idea* of changes over time ✓ figs with units to illustrate population change ✓	2 AO2.8	**ALLOW** calculated change / ref to answer to part (i)
		ii i	**1** no data shown for , winter months / Dec / Jan / Feb ✓ **2** no data shown about temperature or light ✓ **3** *idea* of fluctuations / dips during summer months ✓ **4** another , biotic / abiotic , factor could be causing the increase ✓	3 max AO3.2	**4 ALLOW** e.g. increased nutrient availability / reduction in predators / increased CO_2 / qualified reference to pollution **4 ALLOW** correlation does not imply causal link
			Total	**7**	

14		i	110 000 / 1.1 × 10^5 (1) kJ km^{-2} y^{-1} (1)	2	**ALLOW** the word or any reasonable symbol for year **ALLOW** kJ y^{-1} km^{-2}
		ii	2.5 (1)(1)	2	**ALLOW** correct answer in the working if the answer line is left blank. If answer is incorrect, **award 1 mark** for 0.005 ÷ 0.2 × 100
			Total	**4**	
15		i	8550 (kJ m^{-2} yr^{-1}) ✓✓	**2**	**AWARD** one mark for 8 550 000 (J m^{-2} yr^{-1}) **OR** **AWARD** one mark for 9 x 950 000 **OR** **AWARD** one mark for 7600 (kJ m^{-2} yr^{-1}) **Examiner's Comments** A small proportion of candidates were awarded full marks for this question. Many gained one mark for an answer of 7600, for incorrectly multiplying 950 000 by 8, instead of 9, and then correctly converting it to kJ. The remainder were awarded no marks due to an incorrect calculation or giving an answer of 7,600,000 and not converting it to kJ.
		ii	11 (%) ✓	**1**	**ACCEPT ECF from c (i)** (look for 950(000) divided by answer to c(i)and a correct calculation to 2 sig figs) e.g. if calculated 7600 (kJ m^{-2} yr^{-1}) then answer would be 13(%) **Examiner's Comments** The majority of candidates were awarded one mark here for either a fully correct answer or ECF from Q4(c)(i). Where not awarded, this was

					mainly due to students not giving their answers to the correct number of significant figures.
			Total	**3**	
16	a		(Habitat B =) 0.61 ✓ Habitat with the greatest biodiversity = A ✓	**2**	**DO NOT ALLOW mp 2 if value of D not calculated** **ALLOW ECF** if B has been identified as the habitat with greatest biodiversity, (if value of D calculated for habitat B greater than 0.71) **Examiner's Comments** Most candidates gained both marks here. Candidates who showed clear working and an understanding of the method to calculate Simpson's index scored well, but without clear workings, answers were often wrong. Some candidates forgot to take their calculated number from 1. Most candidates who had correctly calculated the biodiversity for habitat B understood the significance of the result and stated that habitat A had a greater biodiversity.
	b	i	climax community ✓	**1**	**Examiner's Comments** Many candidates gained credit by making reference to the climax community. Unsuccessful responses often indicated that the candidate had not understood the question and their response related to the beginning of the process of primary succession. Common errors included

					pioneer species and climax population.
		ii	belt / line, transect / described **or** stratified sampling / described ✓ random selection of transect sites **or** systematic sampling / place quadrats at, set / pre-determined, intervals along the transect **or** random sampling using quadrats in, selected areas / strata ✓ pooter / sweep nets / pitfall traps / light traps / tree-beating ✓	**3**	e.g. ' lay tape from edge of lake and sample along it' (N.B. only allow random sampling in context of stratified sampling) **ALLOW** any suitable method of trapping insects **IGNORE** capture mark recapture **Examiner's Comments** Successful responses referred to the use of a belt or line transect to sample stages of succession and a few referred to the use of stratified sampling. Candidates were less successful in describing how to minimise sampling bias, the most common error was to refer to random sampling without stating in what context this would be used. Contradictory statements referring to the use of random sampling along a transect, lost many candidates marks. Candidates showed a good understanding of methods to sample insect biodiversity, the most frequent successful

					responses referred to the use of pooters, sweep nets or pitfall traps.
		ii i	Woodland = (k)g m^{-2} yr^{-1} / (k)J m^{-2} yr^{-1} **AND** Lake = (k)g m^{-3} yr^{-1} / (k)J m^{-3} yr^{-1} ✓	**1**	**ALLOW** (k)g h^{-1} yr^{-1} / (k)J h^{-1} yr -1 / tonnes h^{-1} yr^{-1} / (k)g (k)m^{-2} yr^{-1} / (k)J (k)m^{-2} yr^{-1} **ALLOW** (k)g (d)m^{-3} yr^{-1} / (k)J (d)m^{-3} yr^{-1} / (k)g (k)m^{-3} yr^{-1} / (k)J km^{-3} yr^{-1} **ALLOW** hectare $^{-1}$ for h^{-1} **ALLOW** y for yr **DO NOT ALLOW** 'per' **ALLOW** '/' instead of $^{-1}$ **Examiner's Comments** This was a high level question, and as expected, only the most able candidates answered this question correctly. Very few understood the idea of mass/energy +area/volume + time, make up the unit.
			Total	**7**	
17		i	*the scientists need to know whether…* tomato plants produce methyl jasmonate ✓ natural concentrations are as high as experimental ones / AW ✓ methyl jasmonate increases, growth (rate) / cell division (rather than reducing herbivory) ✓ other plants respond in the same way (as tomatoes) ✓ the effect on the armyworm **population** / AW ✓ other insects respond in the same way ✓	2 max(AO3.3)	**IGNORE** descriptions of improvements to method e.g. same growing conditions / effects of other herbivores / constant number of larvae **ALLOW** 'whether more methyl jasmonate produced after herbivory than before' **ALLOW** 'need to carry out the investigation on other plant species' **ALLOW** how many

					herbivores died **Examiner's Comments** Successful candidates avoided describing improvements in the method, since this is not required by the question. Many recognised the need to know if methyl jasmonate was produced naturally by plants and if the concentrations used in the investigation were close to those produced by plants. A smaller number of candidates recognised the need to understand if methyl jasmonate increased biomass as a result of increasing the plant's growth rate rather than reducing herbivory. Candidates who stated that scientists need to know whether other herbivores respond in same way, rather than specifying other insects, did not gain credit.
		ii	methyl jasmonate increases the (final) mass (of tomato plants) ✓	1(AO3.2)	**ALLOW** description of relationship e.g. 'as more methyl jasmonate applied mass of tomato plant increases' 'there is a positive correlation between methyl jasmonate and final mass' **Examiner's Comments** This was answered well by most candidates, who used the terms from Fig. 5.1 in their answers. A few candidates wanted to expand their answer to include reasons, which often lost them the mark since they were concluding

					something they could not validly obtain from the graph.
		ii i	methyl jasmonate (causes) increased cannibalism (among larvae above 0.1 mmol dm^{-3}) / AW ✓	1(AO3.2)	**ALLOW** description of relationship e.g. 'as more methyl jasmonate larvae eat each other more' / 'there is a positive correlation between methyl jasmonate and cannibalism' **ALLOW** methyl jasmonate does not increase cannibalism below 0.1 mmol dm^{-3} **ALLOW** larvae have a tendency towards cannibalism even when no methyl jasmonate applied **Examiner's Comments** Most candidates gained this mark. Some attempted to explain the cause of the increase in cannibalism (rather than describe the correlation), which is not what the question required.
			Total	**4**	
18		i	**FIRST CHECK ON ANSWER LINE** **If answer = 8.85 × 10^9 award 2 mark** ✓ 8.94 × 10^9 − 9.08 × 10^7 correct ✓	2(AO 2.6)	*If answer incorrect...* **ALLOW** max 1 mark for 8.8492 × 10^9 / 8.84 × 10^9 / correct answer not in standard form **Examiner's Comments** Many candidates achieved both marks. Most candidates converted the numbers given in standard form into whole numbers and performed the calculation correctly. Although the question did not instruct candidates to answer in standard form, this was the most appropriate format so full marks were not given

					if responses were written out in full. A minority of candidates also gave answers to too many significant figures, which was inconsistent with the resolution of the numbers they had been presented with.
		ii	measuring changes in dry mass over time / AW ✓	1(AO3.3)	**ALLOW** e.g, dry leaves after 24h and weigh them then repeat at different times of year.
		ii i	misses , chloroplasts / parts that photosynthesize ✓ (rate of photosynthesis) limited by another factor ✓	1 max (AO 1.1)	**ALLOW** transmitted
		i v	*idea that* heather is less easily digested ✓**ora** (because of) cellulose (cell walls) / lignin (in woody parts) ✓	2(AO 2.5)	**ALLOW** only part of the plant is eaten
			Total	**6**	
19	a		(pond community is) final / stable / not subject to further succession	1	**IGNORE** 'permanent', it is in the rubric.
	b		light microscope (1) graticule (1)	2	
	c	i	urea / uric acid	1	**ALLOW** ammonia, ammonium (ions).
		ii	Nitrosomonas (1) nitrite (1) Nitrobacter (1) nitrate (1)	4	
			Total	**8**	

20	a				4	**AWARD** one mark per correct column **IGNORE** references to oxygen in the reactant and product columns. **DO NOT ACCEPT** incorrect formulae or charge **ACCEPT** NH_3 /ammonia for *Nitrosomonas* reactant **Examiner's Comments** A low percentage of candidates (<10%) achieved four marks on this question and many had zero or only one mark awarded. Common mistakes included: • Column 1 – not being specific in saying that the location for Rhizobium is in the root nodules or leguminous **roots**. • Columns 2 and 3 – missing the charge on NO_2^- or incorrectly expressing it as a positive ion NO_2^+ OR putting ammonia as a positive ion NH_3^+. • Column 4 – mixing up oxidation and reduction. A surprising number of candidates also left blank spaces on this question, suggesting a lack of understanding of the nitrogen cycle.

Type of bacteria	Location	Reactant	Product	Oxida o reduc o nitrog
Rhizobium	root nodules / leguminous roots	N_2 and H^+ ions	NH_3	reduc
Nitrosomonas	soil	NH_4^+ / ammonium , ions / compounds	NO_2^- / nitrites	oxida
Nitrobacter	soil	NO_2^- / nitrites	NO_3^-	oxida
Denitrifiying bacteria	soil	NO_3^-	N_2 / nitrogen gas	reduc
	✓	✓	✓	✓

	b	i	1. cluster / iron / molybdenum / sulfur , are, cofactors / prosthetic groups ✓ 2. H_2 is a, competitive inhibitor / end product inhibitor ✓ 3. CO is a <u>non-competitive</u> inhibitor ✓ 4. (CO binds to allosteric site and) causes change in shape of active site ✓ 5. energy required (from ATP) ✓ 6. acidic conditions, are tolerated / increase reaction rate ✓	**4 max**	**DO NOT ACCEPT** coenzyme 2. **ACCEPT** H_2, competes / AW, with N_2 for the active site **OR** 'increase in H_2 will reduce the activity of the enzyme' 3. **ACCEPT** CO acts as a cofactor (as candidates may be unfamiliar with CO) 5. **ACCEPT** ATP required as process is active **Examiner's Comments** It was pleasing to see that the majority of candidates were awarded two or three marks for this question accessing marking points 2, 3 and 4, for identifying H_2 as a competitive inhibitor and CO as a non-competitive inhibitor (and then going on to add how this affects the shape of the enzyme's active site). The other two marking points for this question were rarely mentioned, but sometimes the marks for these were missed when candidates did not expressly say that as ATP is needed, the process is active/energy requiring or for saying that acidic conditions are tolerated or increase reaction rate. In addition, some marks were lost for marking points 3 and 4 as students mistake CO for CO_2.
		ii	transport of oxygen, for respiration / to generate ATP (in *Rhizobium*)✓	**2**	

			removes(excess) oxygen so less inhibition (of enzyme / reaction)✓ removes CO to prevent inhibition (of nitrogenase) ✓		**ACCEPT** removes oxygen / creates anaerobic conditions, for nitrogen fixation **IGNORE** removes H_2 so more N_2 can bind (to active site) **Examiner's Comments** Few candidates obtained full marks on this question. Those that did talked about the removal of oxygen and CO and therefore removal of inhibition of the enzyme. Some common errors/omissions on this question included: • Candidates mentioned the removal/ binding of CO/oxygen by leghaemoglobin but did not then mention how this affects the enzyme. • Candidates talked about how leghaemoglobin provides the Iron (from the haem group) for the enzyme's prosthetic group or protons/electrons for the reaction.
			Total	**10**	
2 1	a	i	A = combustion ✓ F = respiration ✓	2 AO2.1	**ALLOW** burning **IGNORE** aerobic / anaerobic
		ii	more combustion / less photosynthesis ✓	1 AO2.6	**ALLOW** more burning (of fuel)

	b		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1, Level 2*** *or* ***Level 3****, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • **The science content determines the level.** • **The Communication Statement determines the mark within a level.** **Level 3 (5–6 marks)** Describes in detail the main similarities between the carbon and nitrogen cycles. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes some of the key similarities between the carbon and nitrogen cycles, at least one similarity is discussed in detail. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Mentions some similarities between the carbon and nitrogen cycles. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*	6 AO 2.5	**Indicative points include** *AO2.5 Apply knowledge and understanding of scientific processes in a theoretical context when handling qualitative data* • inorganic gases ○ CO_2 and N_2 • in atmosphere • elements fixed to organic compounds ○ C and N both form proteins / nucleic acids • incorporated into plants (producers) then animals (consumers) • animals obtain element by feeding on plants • decomposing microorganisms • break down organic macromolecules in living things • release inorganic molecules ○ carbon dioxide and ammonium ions • microorganisms return element to atmosphere ○ CO_2 released during decomposition ○ N_2 released by denitrifying bacteria

			Total	**9**	
22			***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** **Level 3 (5–6 marks)** Describes some stages of succession with reference to general principals and key terms **AND** explains why heather moorland is deflected succession. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes some stages of succession with reference to general principles **OR** describes one stage of succession with reference to general principles **AND** explains why heather moorland is deflected succession **OR** describes some stages of succession **AND** explains why heather moorland is deflected succession. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Mentions some stages of succession **OR** outlines the general principles **OR** explains why heather moorland is deflected succession. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6(AO1.2 2.5)	**Indicative points may include** *AO1.2* *Stages* Pioneer community • begins with bare rock • arrival as seeds or spores • pioneer species have certain adaptations, e.g. nitrogen-fixation Intermediate community • herb species, including grasses • followed by shrubs and trees Climax community • dominance by a few tree species • little change over time *General principles* • seral stages • community and decomposition changes composition of soil • increased organic, nitrate or water content

					AO2.5 Heather moorland is deflected succession because… • climax community is prevented from developing As a result… • plagioclimax • heather is a shrub
			Total	**6**	
23		i	estimate will be inaccurate (because of low numbers) ⟩ dangerous (for collector or jaguar) ⟩	**2**	**IGNORE** refs to conspicuousness of tags **ALLOW** catching one more jaguar will make a big difference to the calculated number **ALLOW** the technique only works well with large populations **IGNORE** difficult to catch **ALLOW** the jaguars might die **IGNORE** inhumane / cruel / stressful **Examiner's Comments** Just under half of candidates gained one mark for (a)(i) for alluding to the dangerous nature of capturing jaguars but very few gained a second mark. Many candidates did not notice the reference to the capture-recapture technique and answered in terms of the inappropriateness of camera traps, which did not gain credit.

		ii	**1** appropriate calculation of, observed / expected, population density ⟩ **2** lower than estimate ⟩ **3** so does not support ⟩ **4** low / unknown, repeatability / reproducibility (of results) ⟩ **5** (some) support because, figure / 3, is close (enough) to, estimate / 5 ⟩ **6** some individuals not photographed ⟩ **7** *idea that* if many individuals not trapped population could be higher than estimate ⟩	**4 max**	**1 CREDIT** e.g. • 3.3 / 3 (jaguars per 100 km^2) • 13.55 / 13 / 14 (est. pop. in 271 km^2) • 0.05 and 0.033 / 0.03 (jaguars per km^2) • 20 and 30.1 / 30 (mean area per jaguar) **1 IGNORE** significant figures **2 ALLOW** ecf from candidate's calculation **3** Must be in context of mp 1 or 2 **4 ALLOW** low reliability **4 ALLOW** ref. to one-off study / should be repeated **4 IGNORE** accurate / valid **6 ALLOW** some not caught by camera **Examiner's Comments** The strongest candidates coped with the evaluative nature of this question well and achieved full marks – usually for the first three points on the mark scheme plus marking point 4, 5 or 6. The majority of candidates focused only on the extent to which the data did not support the conclusion and often scored three marks. The fourth marking point was seen regularly but candidates often used the term 'reliability' which is not encouraged because of its

					ambiguous nature. Centres should refer to the OCR Practical Skills Handbook for a list of terms used to describe investigative results and their agreed definitions. Although the candidates were not explicitly directed to complete a calculation for this question, almost all did and the vast majority of these were correct.
		ii i	*human sightings* *idea of any one of the following* misidentification seeing the same individual twice exaggeration / lying poor recollection jaguars likely to be in, places / times, humans are not method unlikely to spot cubs (as still in den) ⟩ *footprints* *idea of any one of the following* misidentification might disappear (before recording) multiple prints in same spot makes counting difficult same print might be counted on different occasions many prints made by the same individual hard to distinguish individual jaguars footprints not always left ⟩	**2**	**IGNORE** hard to spot **IGNORE** misidentification if given in human sighting **Examiner's Comments** This was generally well answered. Candidates who thought that jaguars lived alongside tigers or cheetahs were not penalised for incorrect general knowledge.
			Total	**8**	
24		i	large heath butterfly 1405 **and** 1153 ✓ bog hoverfly 30 **and** 20 ✓	2 (AO2.8)	**Answers must be rounded to nearest whole number**
		ii	*idea of* Chapman gives a lower estimate / Lincoln gives a higher estimate ✓ *idea that* difference between the estimates is (proportionally), greater for small populations / smaller for large populations ✓	2 (AO3.1)	*Read as prose* **ALLOW ECF** from bi
			Total	**4**	