A-level

ENVIRONMENTAL SCIENCE

7447/2

Paper 2

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226A7447/2/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking guidance</th><th>Comments</th><th>Total marks</th><th>AO</th></tr>
<tr><td>01</td><td colspan="3"><table>
<tr><th>Term</th><th>Description</th></tr>
<tr><td>Rewilding</td><td>Management to allow a habitat to re-establish natural processes/biodiversity</td></tr>
<tr><td>Niche</td><td>The role a species has in an ecosystem</td></tr>
<tr><td>Plagioclimax</td><td>Habitat where human activity has prevented the ecosystem from developing further</td></tr>
<tr><td>Biological corridor</td><td>Habitat that connects populations by allowing individuals to move between different areas</td></tr>
<tr><td>Gene pool</td><td>All genetic traits/variation of gene of a population</td></tr>
</table></td><td>1
1
1
1
1</td><td>AO1 1a</td></tr>
<tr><td></td><td></td><td colspan="2">Total =</td><td>5</td><td></td></tr>
</table>

Qu	Part	Marking guidance	Comments	Total marks	AO
02	**1**	• energy per unit area/ volume/ mass		**1**	AO1 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
02	**2**	**Any two natural <u>processes</u> that operate at low energy density:** **eg** photosynthesis, respiration, evaporation, nitrogen fixation, decomposition, <u>formation</u> of wind		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
02	**3**	**One mark for low energy dense resource or feature of** eg: • renewable energy resources/ named example • promoting natural nitrogen fixation/ decomposition. **One mark for an explanation of how it reduces carbon footprint** eg: • reduce the use of fossil fuels/ no <u>fuel</u> extraction/ transportation • reduced use of Haber process.		**1** **1**	AO2
		Total =		**5**	

Qu	Part	Marking guidance	Comments	Total marks	AO
03	**1**	**Three from**: 1. to reduce the spread of disease 2. to control pests/ reduce predation of livestock 3. to reduce predation of prey species/grazing 4. to reduce competition for resources with other species 5. to maintain a healthy population 6. to reduce damage to habitat/ property 7. to reduce hybridization 8. to reduce (perceived) danger to human life. [**R**: overpopulation without impact] [**R**: Killing for sport/entertainment/food]		**3**	AO1 1b

Qu	Part	Marking guidance	Comments	Total marks	AO
03	**2**	• 8313	8750 x 0.95 or 8750/100 x 95 8750 - (8750 x 0.05) 8312.5 rounded to whole fox	**1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
03	3	**One mark from:** • high fecundity • high birth rates • reach sexual maturity quickly • disperse over wide areas. **One mark from:** • (therefore) populations increase quickly/ recover from high mortality • evidence from graph of rate of increase		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
03	4	**Two marks for named reason (r)** **Two marks for linked explanation (e)** • an increase prey/ food/ breeding site (r) • reduced (intraspecific) competition/ reduced density dependent limiting factors/ increased carrying capacity (e) • decrease in fox predators (r) • reduced density dependent limiting factors/ decreased mortality (e) • decrease disease (r) • reduced density dependent limiting factors/ decreased mortality (e) • mild winter (r) • reduced density independent limiting factor/ fewer deaths due to less extreme conditions (e) • immigration (r) • culling reduced population below carrying capacity/ movement from population at carrying capacity (e) • culling less effective than expected (r) • avoidance of traps/people culling/ culling more difficult in a lower population density (e) [**A** where reasons and explanation have been given reversed]		**4**	AO2
		Total =		**10**	

Qu	Part	Marking guidance	Comments	Total marks	AO
04	1	**One mark for how a named net design reduced bycatch:** **eg:** • escape panels/ turtle excluder device (TED) allow exit from net • increased mesh size allows smaller fish to escape • mesh shape maintains size of hole allowing escape • noise/ light devices act as deterrents • biodegradable nets reduce ghost fishing.		1	AO1 1b
		One mark for how a named fishing method reduces bycatch **eg:** • purse seining catches single shoal fish • longline uses specific hook shapes/bait • pole and line use specific hook shape/bait/ can be returned quickly • shellfish traps have specific trap shapes/bait • fishing at night so seabirds cannot see catch • use of sonar to target single species shoals.		1	AO1 1b

Qu	Part	Marking guidance	Comments	Total marks	AO
04	2	**One mark for calculation of bycatch** **One mark for evaluative statement about bycatch** **One mark for calculation of shrimp** **One mark for evaluative statement about shrimp**		**1** **1** **1** **1**	
		<u>Bycatch calculation</u> 1 mark from: 1. ratio of bycatch: shrimp TN ratio 6.78:1 **and** NN ratio 7.25:1 (or shrimp: bycatch TN 0.15:1 and NN 0.14:1) 2. bycatch per litre per trawl TN 0.62 kg **and** NN net 0.74 kg 3. % bycatch of TN net is 87.14% **and** NN is 87.87% (converse - TN 12.9% and NN 12.1% is shrimp) 4. By-catch per trawl TN: 278.81 kg **and** NN 148.56 kg **<u>Bycatch statement</u>** 1 mark from: 5. new net results in greater bycatch for the same amount of shrimp/ ratio/ %/ per litre per trawl/ if nets were the same size 6. new net results in less bycatch per trawl however does not account for net size **<u>Calculation of shrimp</u>** 1 mark from: 7. catch per litre per trawl of TN 0.09 kg **and** NN 0.10 kg 8. shrimp catch per trawl TN 41 kg and NN 20.5 kg/ 21 kg **<u>Shrimp statement</u>** 1 mark from: 9. the NN catches more shrimp per litre per trawl 10. NN catches less shrimp per trawl therefore increased number of trawls leads to more habitat damage/embodied energy. **Must be explicit about units in evaluation**	TN: 14498 / 2139 NN: 11588 / 1599 TN: 14498 / (52 × 450) NN: 11588 / (78 × 200) TN:14498/ (2139 + 14498) x 100 NN:11588/ (1599 + 11588) x 100 TN: 14498/ 52 NN: 11588 /78 Accept converse TN: 2139/ (2139+ 14498) x 100 NN: 1599/ (1599+ 11588) x 100 TN: 2139/ 52 NN: 599/ 78		AO3 1b = 2 AO3 1c = 2

Qu	Part	Marking guidance	Comments	Total marks	AO
04	3	**One mark for variable (V)** **One mark for linked explanation (E)** • duration of trawl (V) • longer trawls may catch more (E) • speed of boat (V) • faster speeds may catch more (E) • time of year (V) • change in populations with season (E) • time of day (V) • change in catch numbers with daytime (E) • location/depth trawled (V) • different numbers of catch in different location/depth (E) • same size area trawled (V) • large area may catch more (E)		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
04	4	**Two from:** • (population decline due to) overfishing • ghost fishing (from discarded equipment) • habitat damage/ named eg (from direct contact with nets) • increased sediment disturbance/ turbidity • food web impact, eg reduction of food source of another species/removal of predator. [**R** any reference to by-catch] [**R** destruction of the seabed]		**2**	AO1 1b
		Total =		**10**	

Qu	Part	Marking guidance	Comments	Total marks	AO
05	1	**Number of penguins** • **63.79** [A: 63.788, 63.8] [R: 63.80] **Estimated penguin population** • **16 267** [A: 16266 -16269] [A: 16280] Allow full marks for the correct answer without working.	(370 / 5800 × 1000 = 63.793) [A: 63.788 if 370/ 400 = 0.925, then 68.96 x 0.925] [R: 63.80 which is a rounding error from 63.793] (370 × 255 000 / 5800 = 16 267.24) or (63.7931 × 255 = 16 267.24) [A: 16280 if 255000/5800 = rounded to 44]	**1** **1**	AO3 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
05	2	**One mark for named remote sensing technique from:** • Satellite imagery • Aircraft imagery • Remotely Operated Vehicles (ROVs)/ drones. [**A**: cameras/ CCTV] [**R** any technique that does not allow for population eg thermal imaging] **One mark for linked explanation from:** • continuous monitoring • count of whole penguin colony • access to inaccessible areas • repeat counts • minimises human interference.		**1** **1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
05	3	**One from**: • increase sample area/ targeted locations where penguins live • increase sample size • multiple readings taken • repeat in different seasons.		**1**	AO3 1c

Qu	Part	Marking guidance	Comments	Total marks	AO
05	4	**Five methods with descriptions of how they protect Antarctic from:** 1. limited tourism numbers ashore/ areas visited/ boats to prevent disturbance to wildlife / erosion 2. shoe covers/ sterilisation / protective clothing/ no dogs to reduce introduction of disease/ non-native species 3. visitors with guides only to restrict disturbance/ raise awareness 4. removal of waste to prevent contamination/ pollution 5. treatment of sewage before discharge into the sea to prevent pollution 6. **no** mining/ resource exploitation to prevent habitat destruction/ pollution 7. **no** military use/ weapons testing to prevent damage to biotic and abiotic environment 8. restrictions on fishing/ monitoring of fish populations to reduce over-exploitation/ food chain impacts 9. all activities subject to Environmental Impact Analysis to mitigate damage 10. named methods to control greenhouse gas concentrations to reduce global climate change/ named impact 11. control of ODS/CFCs to reduce Antarctic ozone depletion/ reduce UV impacts to phytoplankton/ wildlife 12. freedom of scientific investigation to increase understanding of impacts/ conservation. **Allow two marks for named protocol/ organisation:** **eg** • Antarctic Treaty (1959)/ Madrid Protocol (1998/1991) • CCALMS (The Convention on the Conservation of Antarctic Marine Living Resources) (1982) • IAATO (International Association of Antarctica Tour Operators) (1990) • IWC (International Whaling Commission) • Montreal Protocol. [A: named designation eg ASMAs, ASPAs]		**5**	AO1 1a = 2 AO1 1b = 3
		Total =		**10**	

Qu	Part	Marking guidance	Comments	Total marks	AO
06	1	• production of genetically identical offspring/clones/asexual reproduction		1	AO1 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
06	2	• nitrate concentration has no impact on growth		1	AO3 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
06	3	**Four from:** • mass/height at the start **and** end • biomass/ height gained or growth rate • control of named variable • mean (of 500 plants grown in each concentration) • standard deviation/ statistical test for significance**/** appropriate named stats test.		4	AO3 1a = 3 AO3 1b = 1

Qu	Part	Marking guidance	Comments	Total marks	AO
06	4	**Two from**: • all plants will have same pests • specific pesticides make pest control easier, increasing yield or • increase risk of pest infestation, greater risk of yield loss **OR** • all plants will have same disease resistance • specific pesticides make disease control easier, increasing yield or • increase risk of disease, greater risk of yield loss **OR** • all plants will have the same nutrient needs • specific fertilisers may be used to increase yields or • competition for the same nutrients/reduction in soil fertility may reduce yields **OR** • all plants will have similar tolerance to named abiotic conditions condition • easier to control for optimum conditions eg soil pH for higher yields or • more risk to adverse environmental change, reduced yield.		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
06	5	**One mark for stated method:** **One mark for named trait:** • genetic modification/transgenics/ gene editing/ selective breeding (or description of method) • named trait (to increase yield) e.g. pest resistance, drought resistance, frost resistance, salinity tolerance.		**1** **1**	AO1 1b
		Total =		**10**	

Qu	Part	Marking guidance	Comments	Total marks	AO
07	**1**	**One** from: • increased (dissolved) metals • increased sediment/ turbidity • increased salinity.		**1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
07	**2**	**Up to two marks for more suitable** **Up to two marks for less suitable** More suitable: • within species range of tolerance • reduced competition for adapted species • food web impacts • increased nutrient availability • increased pH causes the precipitation of metals. Less suitable: • beyond species range of tolerance • denature enzymes • reduction in pH dissolves exo-skeleton/ reduces calcium uptake • damages named tissue e.g. root hairs, gills, gametes, • linked impact that reduces photosynthesis • bioaccumulation of toxic materials • food web impacts • decreased pH increases metal solubility. **Credit reference to range of tolerance/ food web impacts/ metals solubility only once**		**3**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
07	**3**	**One** from: • universal indicator **and** colour chart • using a **calibrated** pH meter. [**R**: litmus paper]		**1**	AO1 1b
		Total =		**5**	

Qu	Part	Marking guidance	Comments	Total marks	AO
08	1	**Two from**: • regular/ moderate precipitation/ wetter winters/ drier summers • no major temperature extremes/ mild summers (not very hot)/ mild winters (not very cold) • distinct/ four seasons • moderate humidity. [**R** low temperature fluctuations, low seasonal fluctuation] [**R** reference to canopy microclimates]		**2**	AO1 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
08	2	**One mark for named biotic factor** **One mark for linked explanation** e**g** • leaf litter/ faeces • increases the development of nutrientcontent/ DOM • worm activity/ burrowing/ foraging and shelter building • increases aeration/ infiltration/ drainage • root action • increases aeration in soil • detritivores/ decomposers/ bacteria • increases nutrients • tree roots/ OM • Increase aggregation of soil. [**R** soil erosion]		**1** **1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
08	3	**Four from**: • random/systematic sampling • (same) time of day/weather conditions • (same) distance above the ground • at least ten measurements at each site • repeated measurements at each point • using a calibrated thermometer.		**4**	AO3 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
08	**4**	**Two** from: • wind speed • cloud cover • humidity. [**A:** named human activity]		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
08	**5**	• 16 (0.7) • 1 (0.1) • 44.5 (sum) All three needed for one mark		**1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
08	**6**	• U_2 value (8.5) is below the critical value (13) • (reject the null hypothesis) there is a significant difference [**R** reference to U_1 value]		**2**	AO3 1b

Qu	Part	Marking guidance	Comments	Total marks	AO
08	**7**	**Two** from: • (initial) increase in infiltration • (long-term) reduced infiltration capacity • increased surface runoff • reduced interception • reduced evapotranspiration/transpiration • increased evaporation (from ground). **[A:** increased sedimentation of rivers / reduced precipitation]		**2**	AO2
		Total =		**15**	

Qu	Part	Marking guidance	Comments	Total marks	AO
09	1	**One mark for:** • deflects solar radiation/solar wind [**R**: blocks] **One mark from**: • reducing erosion of the atmosphere • reducing named impact of radiation. [**R**: UV radiation]		**1** **1**	AO1 1b

Qu	Part	Marking guidance	Comments	Total marks	AO
09	2	• **1.1° and 10 970** • **12 964.5 / 13000** ecf • **15 000** ecf If answer is 15000 but has not factored in 10900 + 70 (BP) then max 2 Allow ecf from step 1 and 2	**Stage 1** 24.5 – 23.4 = 1.1° and 10 900 + 70 = 10 970 years **Stage 2** 10 970 / 1.1 years per ° 23.4 – 22.1 = 1.3° 9972.73 × 1.3 = 12 964.5 or 1.1/10970 = 0.00010027 1.3/0.00010027= 12964.5 ° per year (or 1.3/1 x10^{-4} = 13000) **Stage 3** 2020 + 12 964.5 = and to two significant figures or 23934 – 10970 + 2020 = 14984 to two significant figures	**1** **1** **1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
09	3	• greater temperature range.		**1**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
09	4	**Indicative content:** Historic data • past records based on a lack of technology • may be intermittent (spatially and temporally). Proxy data • dendrochronology – temperature indication • pollen – a climate indicator. New techniques • radio isotope composition to date samples • oxygen isotope ratios to estimate past temperatures • air bubble analysis from ice cores • ratio of magnesium to calcium in calcite deposits to estimate temperature • satellite technology – understand ocean currents/orbital/ climatic variations/global/ continuous/large data sets. Use of computer modelling/ IT/ Data • analyse interconnections between variables • projections • models – range of outcomes (uncertainty) • internet/electronic sharing of information.		9	AO1 1a = 2 AO1 1b = 2 AO2 = 3 AO3 1b = 1 AO3 1c = 1
		Total =		**15**	

Examiners are reminded that AO1, AO2 and AO3 are regarded as interdependent. When deciding on a mark all should be considered together using the best fit approach. In doing so, examiners should bear in mind the relative weightings of the assessment objectives. More weight should therefore be given to AO1 than AO2 and AO3.

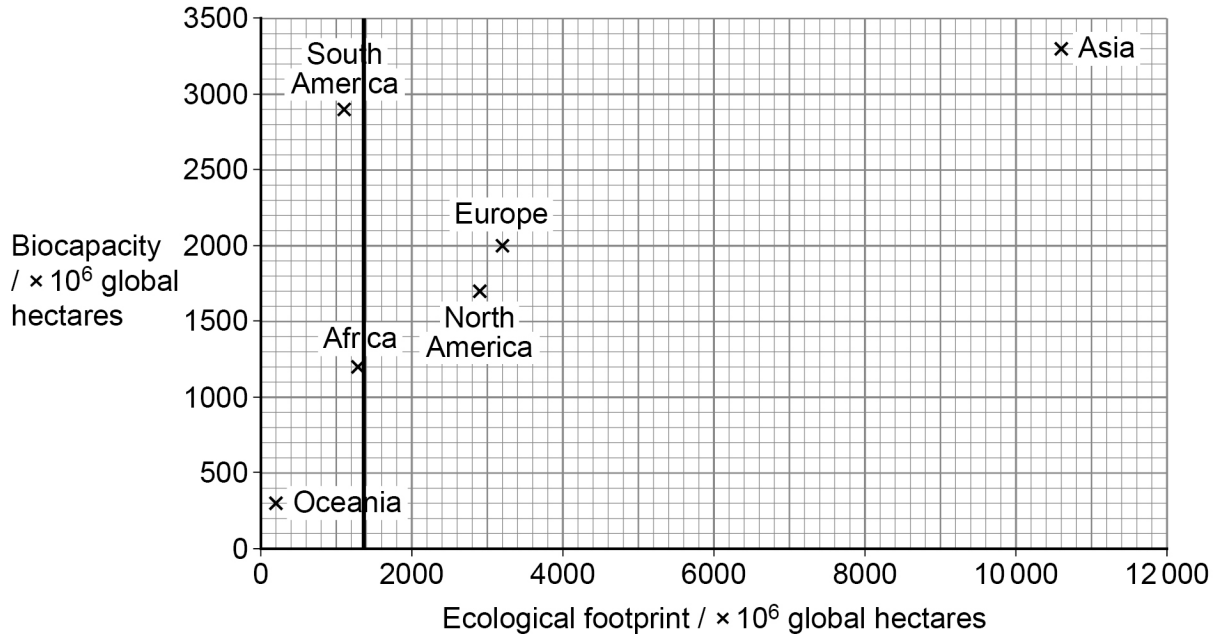
Level	Marks	Descriptor
3	7–9	A comprehensive response to the question, with the focus sustained. A conclusion is presented in a logical and coherent way, fully supported by relevant judgements. A wide range of knowledge and understanding of natural processes/systems is applied. The answer clearly identifies relationships between environmental issues. Relevant environmental terminology is used consistently and accurately throughout, with no more than minor omissions and errors.
2	4–6	A response to the question which is focused in parts but lacking appropriate depth. A conclusion may be present, supported by some judgements, but it is likely not all will be relevant. A range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there may be a few inconsistencies, errors and/or omissions. The answer attempts to identify relationships between environmental issues, with some success. Environmental terminology is used, but not always consistently.
1	1–3	A response to the question which is unbalanced and lacking focus. It is likely to consist of fragmented points that are unrelated. A conclusion may be stated, but it is not supported by any judgments and is likely to be irrelevant. A limited range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there are fundamental errors and/or omissions. The answer may attempt to identify relationship between environmental issues, but is rarely successful. Limited environmental terminology is used, and a lack of understanding is evident.
	0	Nothing written worthy of credit.

Qu	Part	Marking guidance	Comments	Total marks	AO
10	**1**	**One mark from:** • increased population • affluence • increase resource demand per capita. [**A:** decrease in 2019-20 due to COVID lockdown/ travel restrictions] **One mark for qualified link to ecological footprint** • linked environmental impact of resource extraction / production / use / consumption (per capita) [**A:** decrease carbon dioxide emissions linked to COVID]		**2**	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
10	**2**		In 1970, carbon footprint = 5million global hectares In 2019, carbon footprint = 13million global hectares		AO3 1a
		• 8	13 – 5	**1**	
		• 160%	(8 / 5) × 100	**1**	
		ecf. [**A**: 160% with no working for **two** marks] [**A:** 160% - 171%]			

Qu	Part	Marking guidance	Comments	Total marks	AO
10	**3**	• **E** (2010)		**1**	AO3 1a

Qu	Part	Marking guidance	Comments	Total marks	AO
10	4	• **3216.67 (x10^6)** • **1351 (x10^6)** ecf • **Straight line drawn from 1351on x-axis.** **Two** marks for correct answer only - 1351 **Three** marks for vertical line at 1351 on x-axis [**A**: any line between 1300 and 1400] [**R**: plot on x axis line must continue all the way to the top]	(1300 + 10 600 + 3200 + 2900 + 200 + 1100) = 19300 / 6 42% of 3216.67	**1** **1** **1**	AO2



Qu	Part	Marking guidance	Total marks	AO
10	**5**	**Two from:** • small (human) population size • named habitats eg coral reefs, tropical rainforest (with high productivity) • sustainable management of habitats • conversion of land with low productivity. [**A**: a reason why Oceania does not have low biocapacity per capita eg smaller amount of farmland/ farming in extensive]	**2**	AO2
		Total =	**10**	

Qu	Part	Marking guidance	Total marks	AO
11	**1**		**25**	AO1 = 10 AO2 = 10 AO3 = 5

Topic area / spec ref	Ecological Process	Link to Conservation
3.1.2.2	Adaptation/ Evolution to abiotic factors	range of tolerance creating conditions needed to increase desired condition of species creating conditions with high variation (edge effect) named method, (**eg** coppicing, controlled burning, manual soil disturbance, flooding, water draining, etc)
3.1.2.3 3.1.2.3.3 3.1.2.3.4	Adaptation/ Evolution to biotic factors	interdependency/symbiotic relationships synchronicity named examples, (**eg** pollination, seed dispersal, creation of habitat) food web named method, (**eg** introduction of species, biological control, removal of predators, vaccination against disease, adding food, etc)
3.1.3.3	Ecological Succession	different species in different series climax communities often have lower biodiversity then previous series plagioclimax named methods, (**eg** grazing, mowing, burning, coppicing, pollarding)
3.1.2.3.3	Desired species characteristics	large gene pool breeding programs hard/soft release dispersal methods/rates use of biological corridors
3.1.3.4 3.1.2.3.5	Population dynamics	r/k selected species surrounding populations high carrying capacity knowledge of density dependent factors ease of colonisation
3.1.2.3.4	Impact of human activity on the species	direct threats indirect threats land use change polluants (pesticides, oil, noise, etc) resource extraction.
	Total =	**25**

Qu	Part	Marking guidance	Total marks	AO
11	**2**		**25**	AO1 = 10 AO2 = 10 AO3 = 5

Topic area / spec ref	Dynamic equilibriums	Human activities	Sustainable human activities
3.1.2.3.4 3.6.1.3	Global climate - Temperature variations - Cloud cover - Albedo - Ocean circulation	- Carbon emissions - Land use change - Urbanisation - Deforestation - Pollution rates	- Carbon capture/sequestration - Legislation
3.1.2.3.4 3.2.2 3.5.1.3 3.5.3.1 3.6.1.1 3.1.2	Hydrological cycle - Evaporation rates - Precipitation rates - Runoff rates - Water storage - Infiltration/percolation rates - Melting glacial ice/permafrost	- Deforestation - Pollution of water courses - Ocean acidification - Water abstraction/exploitation of aquifers	- Flood control - Erosion control - Water treatment - Afforestation - Permeable urban surfaces - Water conservation - Inter-basin water transfer
3.1.2.2 3.1.2.3 3.1.2.3.4 3.2.4 3.5.3 3.6.4	Ecological systems - Productivity - Photosynthesis rates - Food webs - Energy transfer - Biochemical cycles	- Pollution - Increased forest fires - Erosion/denudation - Fertiliser use	- Conservation methods - Reducing pollutants/alternatives - Treatment
3.1.2.2 3.1.2.3.4 3.2.3 3.6.3 3.2.5 3.2.5.3 3.2.4.2	Mineral deposits - Geological process - Soil processes	- Extraction - Habitat loss - Spoil disposal - Overgrazing - Soil compaction - Vegetation removal	- Mine site restoration - Recycling - Contour ploughing - Terracing - Long-term cropping - Zero tillage cultivation - Wind breaks
		Total =	**25**

Level	Marks	Descriptors
5	21–25	A comprehensive response with a clear and sustained focus. Content is accurate and detailed. Relationships are identified, reflecting the holistic nature of environmental science and the answer as a whole is coherent. A wide range of relevant natural processes/systems and environmental issues are described and articulated clearly. These are applied systematically to the question, with clear relevance to the context. Where conclusions are made, these are fully supported by judgements and presented in a logical and coherent way. Relevant environmental terminology is used consistently and accurately throughout. If there are errors, these are very minor indeed and not sufficient to detract from the answer.
4	16–20	A response in which the focus is largely sustained, with content that is mainly accurate and detailed. Relationships are identified and the answer is largely coherent. A range of natural processes/systems and environmental issues are described and articulated clearly. In most cases, these are applied appropriately to the question but, in some, it is less clear why they are relevant. Where conclusions are made, these are supported by judgements which are mostly coherent and relevant. Relevant environmental terminology is used consistently and throughout, with no more than minor errors.
3	11–15	A partial response which is focused in parts. The content is mostly accurate but not always detailed. There is an attempt at identifying relationships, but the answer as a whole is not fully coherent. A range of natural processes/systems and environmental issues are described, most are articulated clearly. In some cases, these are applied appropriately to the context but, in most, it is less clear why they are relevant. Where conclusions are made, it is not always clear how they relate to the judgments given and are likely to contain errors. Relevant environmental terminology is used, but not consistently and there may be errors.

2	6–10	An unbalanced response, lacking in focus. The content may be inaccurate and lacking detail. There is some attempt at identifying relationships, but the answer is not coherent. A limited range of natural processes/systems and environmental issues are described but not articulated clearly and likely to contain errors and/or omissions. There is a limited attempt to apply them to the context. Any conclusions are likely to be asserted, with no supporting judgements and fundamental errors. Environmental terminology is used, but not always appropriately and sometimes with clear errors.
1	1–5	Fragmented points, whose relevance to the question and relationships to each other are unclear. A few natural processes/systems and environmental issues are listed, but unlikely to be described and many may be irrelevant. There is no clear attempt to apply them to the context. It is unlikely that a conclusion will be present. There is an attempt to use environmental terminology, but seldom appropriately.
	0	Nothing written worthy of credit.