



A-level ENVIRONMENTAL SCIENCE 7447/2

Paper 2

Mark scheme

June 2025

Version: 1.0 Final



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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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

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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 typical 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.

The notes for answers provide indicative content. Students' responses may take a different approach in relation to that which is typical or expected. It is important to stress that examiners must consider all a student's work and the extent to which this answered the question, irrespective of whether a response follows an expected structure. If in doubt the examiner should contact their team leader for advice and guidance.

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.

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
01	1	planets further away receive less solar radiation/ energy A converse		1	AO2 3.1.1.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
01	2	high concentration of greenhouse gases/ named example of ghg/ low albedo		1	AO2 3.1.1.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
01	3	- slow (rotation) - long duration with/ without solar energy		2	AO2 3.1.1.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
01	4	too cold for liquid water/ water is frozen A too cold for enzyme activity		1	AO2 3.1.1.1

Question 01 total =				5
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
02	1	One from: - size of the population does not change/ no births/ deaths/ migration (during study) - marked individuals mix with the rest of the population - being trapped/ marked does not affect survival/ chances being re-trapped - all individuals have equal chance of being caught - marks do not fall/ wear off A greater proportion of recaptured sample equals smaller population		1	AO1 1b 3.7.2.1 PS2.1 KII

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
02	2	Accept any valid sequence of calculation. <u>One mark calculation of % from</u> 193 ecf 386 ecf 772 ecf 1158 ecf 10.21 ecf <u>One mark calculation of density from</u> /18.9 ecf 51.06... ecf A 50, 51.1 <u>One mark for range from</u> 40.8... to 61.... ecf 20.4...ecf 386 A 41 A 20.5, 20 Allow max two marks for two ecf Three marks for correct answer	Stages in no particular order 20% of 965 40% of 965 965 -20% and 965+20% 20% of 51.06... Any valid data/area 965/18.9 772/18.9 and 1158/18.9 40.846560 - 61.269841 or 386/18.9 20.423280	3	AO2 MS0.3 MS1.10 PS3.2 PS3.3

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
02	3	Two from: - competition for named resource eg food/ nesting sites/ light/ nutrients - spread of disease - alteration of physical habitat/ named example eg river bank erosion A hybridisation	Ignore space as named resource Ignore predation.	2	AO1 1b 3.1.2.2

Qu	Part	Marking guidance		Total marks	AO / spec
02	4	• <u>Wildlife and Countryside Act</u> (1981) Or other correctly named legislation eg - The Invasive Alien Species (Enforcement and Permitting) Order (2019) - The Conservation of Habitats and Species Regulations (2017) - The Alien and Locally Absent Species in Aquaculture (England and Wales) Regulations (2011)	Date is not needed	1	AO1 1a 3.1.2.3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
02	5	• r-selected have high reproduction potential/ k-selected have low reproduction potential • r / invasive have a competitive advantage • k/ threatened slow to recover from population decline	Accept named factors of high productive potential eg high birth rate	3	AO1b x1 AO2 x2 3.1.3.4

Question 02 total =				10
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
03	1	Two marks for pH: - universal indicator - compare to a colour chart OR - pH probe - calibrated R litmus paper Two marks for nitrate: - test strips/ tablets - compare to colour chart OR - photometer/ colorimeter/ titration - reactant/ reagent/ named chemical eg cadmium OR - nitrate/ ion electrode - calibrated		4	AO1 1a 3.7.2.1 PS4.1 ST1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec	
03	2				3	AO1 1a KII 3.5.1.1 3.2.4.3 3.2.4.4
		Nutrient	Chemical symbol	Importance for plant growth		
				Amino acids / proteins / ATP / DNA		
				ATP / DNA / cell membranes / roots		
		Potassium				

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
03	3	Method 1 302.11 and 285.16 16.95 Ecf A 17, 17.0 Method 2 16.8 16.95 Ecf A 17, 17.0	Two marks for correct answer with no workings Mean growth rate multiplied by duration added to the mean starting mass (for both pH) $(4.95 \times 60) + 5.11 = 302.11$ and $(4.67 \times 60) + 4.96 = 285.16$ Difference in end mean mass $302.11 - 285.16 = 16.95$ Difference in mean growth rate: $4.95 - 4.67 = 0.28$ Multiplied by duration $0.28 \times 60 = 16.8$ Added to difference in mean starting mass $5.11 - 4.96 = 0.15$ $16.8 + 0.15 = 16.95$	2	AO3 1a PS3.2 MS0.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
03	4	One mark for a reason linked to a direction change in pH from: - enzymes denature at low pH - root (cells) are damaged at low pH - reduced nutrient/ increased metal availability at low pH A converse		1	AO2 3.5.1.1 3.1.2.2 PS1.3

Question 03 total =	10
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
04	1	- critically endangered so greatest risk of <u>extinction</u> - endemic so more at risk from threat/ threat impacts entire population or endemic so more likely to be evolutionary unique - habitat fragmentation so greater risk of genetic isolation/ inbreeding/ cannot access new mates or habitat fragmentation so restricted access to resources for population increase/ escape predation/ threats	Must have both information from table and explanation for one mark Answers must be applied to why feature is important in conservation. Do not allow sole definitions of endemic.	3	AO2 3.1.2.3.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
04	2	One from: - flagship species raise conservation funding for other species - habitat protection for a flagship species will protect other species in the habitat - reducing/eliminating a threat to a flagship species will benefit others facing the same - may provide a named resource relied upon by another species	Must have both information from table and an explanation for one mark	1	AO2 3.1.2.3.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
04	3	keystone species provide a niche/ resources/ services that supports the ecological community/ structure/ function	Must have both information from table and explanation for one mark	1	AO2 3.1.2.3.1

Question 04 total =				5
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
05	1	B1 + R + G – F – N B1 + R + G – (F + N)	In any lay out	1	AO3 1b 3.5.2.2 MS2.4 MS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
05	2	- F recorded when catches are weighed/ measured - N/R/G estimated/ sampled data	Must include a method of measuring biomass data	2	AO2 3.5.2.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
05	3	One from: - number of days at sea - size of nets - power/ size of boat - size of area fished - technology - named fishing method A named economic/ legislative factor		1	AO2 3.5.2.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
05	4	19800 and 3200 6.2 ecf A 6.19, 6.188, 6.1875 Max one mark for ecf	Two marks for correct answer with no workings Total catch and effort data from the graph Catch/ effort 19800/ 3200 = 6.1875 Allow any number of decimal places, but rounding must be correct.	2	AO3 1a MS 3.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
05	5	Four marks for explanations of decreased sustainability from decrease in CPUE 1. sustainability decreases (linked to a valid reason) 2. (indicates) fish stock is low/ currently overfished/ fish are smaller 3. (may lead to) increased fishing effort/named factor of fishing effort 4. leading to (further) overfishing/ >MSY/ reduced recruitment 5. population decline/ impact on inter-species relationships 6. more energy used/ named fishing impact / habitat impact (per unit fish) 7. (increased) ghg emissions / impact on climate / loss of biodiversity (per unit fish) Max three marks for subsequent actions that may lead to increased sustainability 8. restrictions placed on fishing effort (due to indication of low population) 9. allows populations to recover 10. reduced named fishing impact 11. sustainability increases Max two marks for incorrect understanding of CPUE		4	AO2 3.5.2.2

Question 05 total =	10
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
06	1	the growth of a single type of crop/species		1	AO1 1a KII 3.5.1.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
06	2	Indicative mark scheme		9	AO1 4 AO2 3 AO3 2 3.5.1.2, 3.1.2.1.2

Details of asexual reproduction and eggs of named methods	Advantages asexual reproduction	Comparison with sexual breeding methods
Produce genetically identical offspring/ clones Cloning Cuttings grafting Micropropagation Vegetative propagation Runners/ bulbs/ tubbers/ self-seeding Strawberries/ potatoes/ onions/ apples	Predictable traits Uniform qualities of product for sale Desired trait remains in population/ beyond the life of the individual Quick No reliance on pollinators Energy efficient	Asexual more predictable/ uniform compared to sexual meaning easier to market Asexual used more for plants than animals Asexual quicker than sexual
Details of sexual reproduction and eggs of named methods	Advantages sexual reproduction	Comparison with asexual reproduction
Combine genetic material of two parents leading to variation in offspring Selective breeding/ inbreeding Cross breeding/ outbreeding Non-selective eg use of pollination	Characteristics improved over time Introduce useful new traits e.g. Disease resistance/ drought tolerance Artificial insemination improves fertilisation efficiency Can increase gene pool size Combines multiple desired characteristics Can increase hybrid vigour May be low effort/ cheap	Sexual is a well-established method whereas cloning still being developed Qualities gained through sexual do not deteriorate through time like asexual Sexual can be used to increase the gene pool whereas asexual does not which may be useful in producing offspring with traits to better cope with changing environmental conditions Currently used in both crops and livestock

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 focussed 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.

Question 06 total =	10
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
07	1	One from: - predation/ competition with cultivated/ conservation species - spread of disease - fear of attack	Reference to pest is not enough – must be qualified. Accept other valid reasons	1	AO1 1a KII 3.1.2.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
07	2	One from: - tag/ ring/ microchip/ radio-collar/ GPS/ satellite trackers - unique markings (from photos/ CCTV) - image database - DNA analysis R sound monitoring (species specific only)		1	AO2 3.7.2.3 PS4.1 ST5

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
07	3	One mark for reading data from the graph 39 and 64 One mark for calculating % and rounding 61 Max one mark for ecf	Two marks for correct answer with no workings wild-bred: $54 - 15 = 39$ $39/64 \times 100 = 60.9\dots = 61 (\%)$ Allow error carried forward if incorrect values read from the graph or incorrect difference calculated but correct %	2	AO3 1a MS0.3 MS3.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
07	4	One mark in support: - released pairs are the most frequent to have the highest number of chicks Or any valid alternative statement that supports this Two marks against: - Mixed pairs also have the highest/two chicks - wild pairs have the highest number of chicks in less experienced birds (<9years) - mixed pairs have the highest number of chicks in mid-range experience birds (10-15 years) - different number of pairs from each origin so data not comparable - different number of pairs with years of experience so data not comparable - no information on the number of pairs in each mean so data not comparable A released pairs are the most frequent with no/fewest chicks		3	AO3 1bc MS3.1 PS2.1 PS3.1

Qu	Part	Marking guidance	Total marks	AO / spec
07	5	Three from: - avoid human contact to reduce trust in humans - taught skill to avoid predator/ find food - vaccination to reduce disease - release genetically diverse individuals to avoid inbreeding/ tolerate environmental change - release pairs/ male: female ratio for breeding soft release to provide food/ control predators/ acclimatise to new environment - provision of nesting sites/food to increase breeding - biological corridors for access to new resources/ increase population <u>designate</u> habitat to reduce threats - monitoring to inform further release/ manage of health/ habitat management A education/ awareness for support by local human population	3	AO2 3.1.2.3.3 3.1.2.3.4
Question 07 total =			10	

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
08	1	- greater variability - different species/ named abiotic /named biotic conditions eg temperature, light, pests R density for mp2 Ignore increases reliability/ reduces anomalies	Ignore more accurate	2	AO1 1b AO2 3.7.1 Me4 PS1.3 PS2.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
08	2	C - Rhizophora mucronata and Ceriops tagal	Multiple choice	1	AO3 1a Me6 PS3.2 PS3.3 MS1.10

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
08	3	21.639... 0.0257252... Ecf 21.66... Ecf 21.7 Ecf A 21.6 Max three marks ecf	$67.3 \times 0.699 \times 0.46 = 21.639$ $0.199 \times 0.6990^{0.899} \times 0.46^{2.22} = 0.0257252...$ $21.639 + 0.0257252 = 21.66$ Accept any rounding on the first three mark points Rounding to 3 significant figures Award four marks for correct answer with no workings Marks for correct application of the formula	4	AO3 1a MS0.5 MS1.1 MS2.3 MS2.4 PS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
08	4	Three from: • carbon sequestration reduces greenhouse effect/ temperature increase • coastal erosion protection from storms/ sea level rise • area for flooding from increased precipitation/ sea level rise • decrease sediment/ turbidity caused by increased run off/ precipitation • shade reduces impact of increased temperatures/ maintains habitat within range of tolerance • genetic resources for adaptation of crops to named change in climate		3	AO1 1b 3.1.2.3.4 3.1.1.2 3.2.4.2 3.5.3.3 3.6.1.1

Question 08 total =	10
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	1	Two from: - sweep nets - suction samplers - pheromone traps - beating trays A sugaring		2	AO1 1b 3.7.2.1 ST5 PS4.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	2	Two from: - wavelength not attractive to all species - height of trap not placed where moths found - small number sampling locations/ light might not reach all of the sampling area - may be at caterpillar stage - some not active at night/ in all seasons		2	AO2 3.7.2.1 ST5 PS4.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	3	frequency/counted /discrete data and categoric/grouped/nominal data Must have both elements for one mark		1	AO2 3.7.1 MS1.9 Me6 PS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	4	$\frac{102 + 76 + 92 + 95 + 67 + 91}{6}$	Must show full calculation 523/6 is not enough	1	AO3 1a MS1.9 Me6 PS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	5	14.67 0.17 9.76 Max two marks for ecf for any shown answer in $(O - E)^2$ added to 9.59	$(91 - 87.17)^2 = 14.668$ $14.67/87.17 = 0.1682\dots$ $2.52 + 1.43 + 0.27 + 0.70 + 4.67 + 0.17 = 9.76$ Accept first two marks to any number of decimal places	3	AO3 1a MS1.9 Me6 PS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	6	One from: there is no <u>significant</u> difference in the <u>number</u> of moths caught at any of the (woodland) locations A association		1	AO2 MS1.9 PS3.2 Me6

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	7	11.07 (critical value at $p = 0.05$) - Chi sq. value is greater than the critical value so null hypothesis is rejected/ $12.48 > 11.07$ so null hypothesis is rejected Ecf		2	AO3 1b MS1.9 MS1.4 Me6 PS2.2 PS3.2

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
09	8	- mixed Two from: - increased variety of food sources - increased availability of food throughout the year - increased variety of shelter/ protection from predator/ bark to camouflage upon - increased range of egg laying sites - increased variety/ number of niches - increased range of named abiotic factor eg light, temperature		3	2 AO2 1 AO3 1a MS1.6 PS3.2 3.7.2.1, 3.5.3.3, 3.1.2.3.4

Question 09 total =				15
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
10	1	Three from: - reduces waste/ time to breakdown so less harm to organisms - named harm to organisms, eg choking/ hormone deficiency impact of waste disposal e.g ghg/ landfill leachate (monomers) can be re-used/ recycled to make new plastic materials/ polymers - reduces demand for new plastic production, reducing extraction/ processing impacts - named extraction/ processing impact, eg greenhouse gas emissions/ habitat loss from oil extraction		3	AO2 3.1.2.2, 3.6.3.1, 3.6.3.2, 3.6.4.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
10	2	- as temperature increases, increased enzyme activity / PET broken down until 79°C (after 79°C), decrease enzyme activity / PET broken down	Must reference 79°C at least once for two marks One mark if the correct relationship given both before and after peak but the wrong value used	2	AO3 1a MS3.1 PS3.1

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
10	3	8.4	10.9/1.3 = 8.4	1	AO2 PS3.1 PS3.2 MS3.1 MS1.8

Qu	Part	Marking guidance	Comments	Total marks	AO / spec
10	4	Two from: - less energy needed for lower temperatures - reduced extraction of fossil fuels/ greenhouse gas emissions - enzyme activity still high		2	AO3 1b MS3.1 PS3.1

		A converse for mp1 and mp2		
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Qu	Part	Marking guidance	Comments	Total marks	AO / spec
10	5	Two from: • biomimicry leads to improved designs/ inventions • chemicals found in nature could become new medicines/ resources • study of animal physiology may improve understanding of human physiology • genetic resource for breeding programme /GMO/ crops • wildlife species used as biological control/ companion crops A correct named examples		2	AO1 1a 3.1.2.1.2

Question 10 total =				10
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Qu	Part	Marking guidance	Total marks	AO
11	1	Students must cover both agricultural energetics and environmental impacts, and make direct comparative statements about intensive and extensive for Level 5	25	AO1 = 10 AO2 = 10 AO3 = 5

	Intensive agriculture	Extensive agriculture
	High inputs to artificially control the environment	Minimal inputs often within a more natural habitat
Agricultural energetics Productivity - Yield per unit area Energy subsidies - Artificial energy inputs Energy ratios & efficiency - Outputs/inputs - measure efficiency and sustainability	High yields per unit area, results in less land used and food security High energy subsidies due to: mechanised farm processes eg fuel used in ploughing, spraying, harvesting. High inputs of artificial chemical fertiliser needed to sustain high nutrient demand of high crop density. High inputs of chemical pesticides due to risk of pest infestation associated with monoculture/ high crops density Embodied energy in agrochemicals from Haber process / mining / manufacturing Energy used to produce feed Energy used in control of temperature / light intensity / duration in glasshouses / barns Energy used in pumped irrigation Lower energy ratio due to high inputs Lower energy efficiency due to high artificial energy inputs Less sustainable due to named impacts associated with fossil fuel use & resource extraction/ production	Low yield per unit area results in more land used and less food produced Low energy subsidies due to low control of limiting factors - less fossil fuel use and associated impacts. Greater reliance on natural energy inputs Reduced need for artificial fertilisers as lower nutrient demand from crops grown at lower density/ waste organic fertilisers used Reliance on natural pest predators/ habitats/ other named pest control methods. Reliance on natural livestock food sources Crops chosen to tolerate ambient temperatures/ seasonal conditions/ rainfall Higher energy ratio due to low inputs Higher energy efficiency due to low artificial energy inputs More sustainable
Environmental impacts Habitat impacts:	More overall	Less overall Production within existing habitat or in a less modified habitat

	High degree of modification from existing habitat – reduced biodiversity Higher productivity means less land needed to produce same amount of food Ploughing / soils left bare results in soil degradation and erosion. Use of GM crops can lead to genetic contamination	Large land areas required may lead to more habitat change results in reduced biodiversity / carbon sequestration
Pollution - From energy use - CH₄, CO₂, N₂O - Pesticides - nutrients	High energy subsidies using fossil fuels leads to extraction / processing / transportation impacts / emissions of greenhouse gases / GCC Use of chemical pesticides due to high density monocultures can kill non target species & reduce biodiversity High crop density / growth rates increases the demand from the soil resulting in N₂O, eutrophication	Greater reliance on natural energy inputs reduces the inputs of fossil fuel energy Greater reliance on natural predator reduced the need for high intensity pest control. Lower crop density reduces demand / use of organic fertilisers which breakdown more slowly, bind soil
Changes to the hydrological cycle: - unsustainable irrigation - changes in evapotranspiration	High water inputs for crop production/ high stocking density can lead to unsustainable abstraction leading to reduction in river levels & impacts to aquatic communities / lowering of water tables & loss of resource / subsidence / salt water intrusion. Greater degree of habitat change may result in reduced evapotranspiration. Greater irrigation may result in increased evapotranspiration affecting microclimate and rainfall downwind	Low water inputs due to low crop/stock density / reliance on natural rainfall inputs Lower degree of habitat change and less irrigation leads to less change.

Qu	Part	Marking guidance	Total marks	AO
11	2	Students must include expanded content on both tropical rainforests and Antarctica making direct comparative statements about both areas for Level 5	25	AO1 = 10 AO2 = 10 AO3 = 5

	Tropical rainforests	Antarctica
Importance		
Biodiversity	High due to constant high temperatures and high rainfall. Provision of new resources, potential new biomimetics, medicines, genes etc	Low terrestrial biodiversity due to highly seasonal light availability and constant low temperatures, frozen water, limited soil exposed. High marine biodiversity due to upwellings.
Resource provision	High due to high biomass eg timber	Low from land due to low biomass, productive fishing areas
Climate regulation	High plant biomass provides high rates of carbon sequestration	High coverage of ice creates high albedo regulating temperatures. Phytoplankton sequester carbon to ocean sediments
Hydrological cycle	High evapotranspiration rates regulating regional rainfall. Moderation of throughflow to river regulating river flow	water store as ice maintaining sea levels
Erosion control	High levels of interception and root binding reduce erosion regulating water turbidity and impacts to river community	Limited interception and roots, but limited exposure of soil since covered by ice
Research	Important due to high biodiversity	Important due to limited human influence, ice cores provide information on past climates, ozone hole. Species adaptations to extreme conditions.
Threats		
Exploitation of resources	Logging for timber and fuel wood at a rate >MSY Clearence of land for mineral extraction	Overfishing, future mineral exploitation
Global climate change	Forest fires, shifting biomes and rates of species migration	Melting ice increasing sea levels
Ozone depletion	Less important unless depletion continues.	Hole over Antarctica due to relationship with CFCs and polar stratospheric clouds.
Tourism	Clearence of forest for development	Disturbance, introduction of invasive species
Invasive species	Less important due to high biodiversity and existing competitive conditions	Introduced by tourists, research scientists, shipping. Increasing threat as climate and currents change and more soil exposed.
Habitat destruction	For agriculture, urban development, mineral extraction, reservoirs etc	Limited currently due to legislation,

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.

Question 11 total =	25
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