

INTERNATIONAL A-LEVEL GEOGRAPHY

GG03

Paper 3 Physical Geography 2

Mark scheme

June 2025

Version: 0.1 Pre-Standardisation



2 5 6 X G G 0 3 / M S

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.

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International A-level Geography mark scheme

How to mark

Aims

When you are marking your allocation of scripts your main aims should be to:

- recognise and identify the achievements of students
- place students in the appropriate mark band and in the appropriate part of that mark band (high, low, middle) for **each** Assessment Objective
- record your judgements with brief notes, annotations and comments that are relevant to the mark scheme and make it clear to other examiners how you have arrived at the numerical mark awarded for each Assessment Objective
- ensure comparability of assessment for all students, regardless of question or examiner.

Approach

It is important to be **open-minded** and **positive** when marking scripts.

The specification recognises the variety of experiences and knowledge that students will have. It encourages them to study geography in a way that is relevant to them. The questions have been designed to give them opportunities to discuss what they have found out about geography. It is important to assess the quality of **what the student offers**.

Do not mark scripts based on the answer **you** would have written. The mark schemes have been composed to assess **quality of response** and not to identify expected items of knowledge.

Assessment Objectives

This component requires students to:

AO1	Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change, at a variety of scales.
AO2	Apply knowledge and understanding in different contexts to interpret, analyse and evaluate geographical information and issues.
AO3	Use a variety of relevant quantitative, qualitative and fieldwork skills to: <ul style="list-style-type: none">• investigate geographical questions and issues• interpret, analyse and evaluate data and evidence• construct arguments and draw conclusions.

The marking grids

Do not think of levels equaling grade boundaries.

Depending on the part of the examination, the levels will have different mark ranges assigned to them. This will reflect the different weighting of Assessment Objectives in particular tasks and across the examination as a whole.

Using the grids

Having familiarised yourself with the descriptors and indicative content, read through the answer and annotate it (as instructed below) to identify the qualities that are being looked for and that it shows. You can now check the levels and award a mark.

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 descriptors for that level. The descriptors for the level indicate the different qualities that might be seen in the student's answer for that level. If it meets all the descriptors for 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 descriptors and the answer. With practice and familiarity you will find that for better answers you will be able to skip through the lower levels of the mark scheme quickly.

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.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark.

It is often best to start in the middle of the level's mark range and then check and adjust. If there is a lot of indicative content fully identifiable in the work you need to give the highest mark in the level. If only some is identifiable or it is only partially fulfilled, then give the lower mark.

The exemplar materials used during standardisation will also help. There will be an answer in the standardising materials that 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 of 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.

In addition to the levels descriptors, question specific indicative content is provided as a guide for examiners. This is not intended to be exhaustive and you must credit other valid points.

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

Annotating scripts

You should write a summative comment at the end for each Assessment Objective and indicate the marks for each Assessment Objective being tested at the end of the answer in the margin in sequence. It is vital that the way you arrive at a mark should be recorded on the script. This will help you with making accurate judgements and it will help any subsequent markers to identify how you are thinking. Please do not write negative comments about students' work or their alleged aptitudes.

Section A – Water, Carbon and Life on Earth

Total for this section: 40 marks

Question	Part	Marking guidance	Total marks
01	1	<p>Which of the following ALL decrease the amount of carbon in the atmosphere?</p> <p>Key – C: Photosynthesis; planting trees; sequestration in oceans</p>	<p>1</p> <p>AO1=1</p>

Question	Part	Marking guidance	Total marks
01	2	<p>Which of the following does FIGURE 1 show?</p> <p>Key – D: Positive feedback</p>	<p>1</p> <p>AO1=1</p>

Question	Part	Marking guidance	Total marks
01	3	<p>Which of the following are ALL examples of stores in a drainage basin?</p> <p>Key – B: Groundwater; snow on ground; soil water</p>	<p>1</p> <p>AO1=1</p>

Question	Part	Marking guidance	Total marks
01	4	<p>Which of the following stores holds water, on average, for the LEAST amount of time?</p> <p>Key – A: Atmosphere</p>	<p>1</p> <p>AO1=1</p>

Question	Part	Marking guidance	Total marks
01	5	<p>‘As animals breathe, they release carbon dioxide into the atmosphere, oceans and soils.’</p> <p>What is this a definition of?</p> <p>Key – C: Respiration</p>	<p>1</p> <p>AO1=1</p>

Question	Part	Marking guidance	Total marks
02		Analyse the distribution of permafrost shown in FIGURES 2a, 2b and 2c.	6 AO3=6

Level	Marks	Descriptor
2	4–6	AO3 – Clear selection and analysis of the evidence that has been provided which makes appropriate use of data to support. Clear connections between different aspects of the data.
1	1–3	AO3 – Some basic selection and analysis of the evidence that has been provided which makes limited use of data to support. Basic or limited connections between different aspects of the data.
0	0	No creditable content.

Indicative Content

This question requires candidates to analyse how permafrost is distributed in each map as well as analysing how it is changing over time across the three maps. Countries, oceans and some islands and seas have been labelled to aid analysis of what is likely to be an unfamiliar context. The scale can be used to compare different parts of each map as well as comparisons across maps. There is no north sign as the maps are centred around the North Pole.

AO3

- Between 2020 and 2070 there is a significant predicted decline in the amount of permafrost around the Arctic Ocean.
- Generally, permafrost located further from the North Pole and therefore, lower latitudes is lost first.
- However, initial distribution in 2020 and the subsequent future permafrost is not uniform by latitude. Siberia has permafrost thousands of kilometres from the North Pole, whereas north Finland at a much higher latitude is almost absent of permafrost.
- Russia is predicted to see the greatest reduction in permafrost followed by Canada, Alaska and then Greenland.
- In 2020 permafrost in Russia extends at least 1200 km from the Arctic Circle and probably much more as the map does not show the full extent into Russia. However, by 2050, extensive areas (500 km x 1500 km) of Siberia and central Russia are predicted to lose permafrost. By 2070 well over 60% of the permafrost present in 2020 is predicted to be lost.
- Canada starts much less permafrost than Russia in 2020, but a far greater proportion of it, approximately 70% still remains by 2070.
- Alaska is predicted to lose around 50% of its permafrost over the 50-year period.
- Greenland's permafrost found on the periphery of the island most of it predicted to still be present in 2070.
- By 2070 very little permafrost is lost inside the Arctic Circle. For example, northern islands belonging to Canada such as Banks Island see no change in permafrost coverage by 2070.
- A clear exception to this to this would be west Russia and the nearby island of Zemlya where nearly all permafrost is lost by 2070. Conversely, regions of central and east Russia and east Canada are predicted to have permafrost up to 500 km south of the Arctic Circle.

- Rate of predicted loss of permafrost is fastest between 2020–2050 and slower between 2050–2070. Although, some candidates will note that this is loss is over 30-year period compared to the 20-year period between 2050–2070.
- There is a very clear unequal distribution of permafrost. It is far more prevalent in Russia, Alaska, Canada and Greenland and is almost absent in Norway, Sweden, Finland, Iceland, southeast Greenland and the far west of Russia even though these countries share the same latitude.
- Permafrost reaches closest to the North Pole in Greenland and north Canada by virtue that land extents nearer to the North Pole there.
- The extent of permafrost is often limited to coastal locations in islands closest to the North Pole. For example, Ellesmere Island and Greenland. The island of Franz Josef Land is the only island in the Arctic completely devoid of permafrost during this period.
- There is more permafrost to the east compared to the west of major landmasses. For example, east Canada and east Russia has more permafrost than the west of these regions.
- Accept a credible critique of the resource itself. For example, using the 2020 extent of ice for each map means that by 2070 some ice is likely to have retreated exposing permafrost.

Max Level 1 if only one figure is analysed/there are no links between the figures.

Question	Part	Marking guidance	Total marks
03		<p>Assess the extent to which the extraction and burning of hydrocarbon fuels causes changes in the carbon cycle.</p> <p>AO1 – Knowledge and understanding of the changes in the carbon cycles caused by hydrocarbon fuel extraction and burning.</p> <p>AO2 – Application of knowledge and understanding to assess the importance of hydrocarbon fuel extraction and burning in contributing to the changes in the carbon cycles. Application of knowledge and understanding to assess the contribution from other factors that change the carbon cycle.</p>	<p>9</p> <p>AO1=4 AO2=5</p>

Level	Marks	Descriptor
3	7–9	<p>AO1 – Demonstrates detailed knowledge and understanding of the changes to the carbon cycle brought about by hydrocarbon fuel extraction and burning.</p> <p>AO2 – Applied detailed knowledge and understanding to assess the relative importance of hydrocarbon fuel extraction and burning and other factors in bringing about changes in the carbon cycle.</p>
2	4–6	<p>AO1 – Demonstrates clear knowledge and understanding of the changes to the carbon cycle brought about by hydrocarbon fuel extraction and burning.</p> <p>AO2 – Applied knowledge and understanding to assess the importance of hydrocarbon fuel extraction and burning and other factors in bringing about change in the carbon cycle.</p>
1	1–3	<p>AO1 – Demonstrates basic knowledge and understanding of the changes to the carbon cycle brought about by hydrocarbon fuel extraction and burning.</p> <p>AO2 – Applies limited knowledge and understanding to assess the importance of hydrocarbon fuel extraction and burning and/or other factors bringing about change in the carbon cycle.</p>
0	0	No creditable content.

Indicative Content

AO1

- Knowledge of hydrocarbon fuel, namely oil coal, gas and shale gas.
- Knowledge and understanding of ways that hydrocarbon fuel is extracted.
- Understanding of how hydrocarbon fuel extraction and burning causes rapid changes in the carbon cycle.
- Understanding how extraction causes changes in the carbon cycle.
- Knowledge and understanding of hydrocarbon fuel burning, including complete and incomplete combustion.
- Knowledge and understanding of how mitigation through carbon capture at point source can limit or eliminate carbon transfer from the lithosphere to the atmosphere.

- Knowledge and understanding of how the rate of extraction of hydrocarbon fuel and burning has changed significantly over time and how this determines the rate of transfer from lithosphere to atmosphere.
- Knowledge and understanding of the impact of other factors such as farming practices, volcanic eruptions, and wildfires.

AO2

- Awareness that extraction and burning of hydrocarbon fuel is by far the largest contributor of carbon into the atmosphere at around 70%. The next largest contributor is deforestation at 12% then agriculture at 10% and finally peatland destruction at 5%. Volcanic eruptions and wildfires both physical factors account for significantly less. This shows the important role hydrocarbon fuel extraction and burning plays in changes in the carbon cycle.
- Recognition that hydrocarbon extraction and burning is solely a human activity. Therefore, the impact on the carbon cycle through time is wholly dependent on humans' activity.
 - Pre-industrial times, extraction and combustion of hydrocarbons would have minimal impacts on the global carbon cycle due to small scale use.
 - Since industrial times the carbon atmospheric store has seen rapid growth, with exponential levels of transfer from the lithosphere to atmosphere during the 20th century and into the 21st century.
 - Today emission rate of growth has now slowed but it continues to result in record annual amounts of carbon transferred from the lithosphere to atmosphere.
 - Future extraction and burning is likely to decline as renewable energy sources are utilised, at which point hydrocarbon's impact on the carbon cycle will be significantly reduced. However, the carbon already transferred will remain in the atmosphere, unless carbon sequestration on a global scale is implemented.
- Awareness that when the rate of change is too great the dynamic equilibrium in the carbon cycle may be lost, and a series of positive feedback loops can occur within the carbon cycle. For example, increased concentration of carbon dioxide in the atmosphere can result in atmospheric warming which then can lead to more extreme weather events such as droughts and higher temperatures. This in turn can lead to increased likelihood of wildfires which in turn leads to more atmospheric carbon.
- These positive feedback loops can result in profound and possibly permanent changes to the carbon cycle that cannot be mitigated by natural negative feedback loops, such as increased rates of photosynthesis when atmospheric carbon is high.
- Even though global capacity of carbon capture at source (for example, adsorption, membrane separation and oxyfuel combustion) is growing rapidly it remains miniscule at 0.1% of total carbon emissions. Therefore, the impact of hydrocarbon extraction and burning still significantly impacts the carbon cycle.
- Some may show awareness that depending on how efficiently fuel is combusted will impact the amount of carbon transferred. Inefficient or partial combustion will result in solid carbon remaining as soot or charcoal.
- Some may understand that the way hydrocarbon is extracted can determine the size of the impact on the carbon cycle. For example, open pit mining may result in extensive deforestation which will lead to a reduction in photosynthesis and thus impacting atmospheric and biomass stores, whereas underground mining may have less impact on the surrounding landscape.
- Any brief conclusion is acceptable if supported by valid evidence presented within the answer, however, it is likely that candidates will conclude that hydrocarbon extraction and burning has had a profound impact on the carbon cycle.

Question	Part	Marking guidance	Total marks
04		<p>‘Assess the factors that may impact the flood hydrograph of a river catchment you have studied.</p> <p>AO1 – Knowledge and understanding of the flood hydrograph and factors impacting the nature of it. Knowledge and understanding of a chosen case study of a river catchment.</p> <p>AO2 – Application of knowledge and understanding to critically assess the range of potential factors impacting the flood hydrograph in a river catchment.</p>	<p>20</p> <p>AO1=10 AO2=10</p>

Level	Marks	Descriptor
4	16–20	<p>AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout.</p> <p>AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout.</p> <p>AO1 – Full and accurate knowledge and understanding of key concepts and processes throughout.</p> <p>AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.</p>
3	11–15	<p>AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding.</p> <p>AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments.</p> <p>AO1 – Generally clear and accurate knowledge and understanding of key concepts and processes.</p> <p>AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.</p>
2	6–10	<p>AO2 – Some sense of an evaluative conclusion partially based upon knowledge</p>

		<p>and understanding which is applied to the context of the question.</p> <p>AO2 – Some partially relevant analysis and evaluation in the application of knowledge and understanding.</p> <p>AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant.</p> <p>AO1 – Some knowledge and understanding of key concepts, processes and interactions and change.</p> <p>AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.</p>
1	1–5	<p>AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence.</p> <p>AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Very limited relevant knowledge and understanding of place(s) and environments.</p> <p>AO1 – Isolated knowledge and understanding of key concepts and processes.</p> <p>AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.</p>
0	0	No creditable content.

Indicative Content

AO1

- Knowledge and understanding of changes in the water cycle over time. Natural variations including storm events, seasonal changes and human impact including farming practices, land use change and water abstraction.
- Knowledge and understanding of drainage basins as open systems with inputs, outputs, transfers, and stores.
- Understanding that a rainfall event will result in changes in the volume of both flows and stores. The interaction of several factors will determine the extent of change in stores and flows for individual river catchments.
- Knowledge and understanding of the features of a flood hydrograph, such as peak rainfall (mm), peak discharge (cumecs) and lag time (hours) as well as rising and falling limb.
- Knowledge and understanding that each river will have its own unique flood hydrograph in terms of its discharge response to a rainfall event and that it may change over time.
- Knowledge and understanding that hydrographs are often categorised as either being 'flashy' or 'flat' (alternatively called 'subdued' or 'delayed'). The former exhibits short lag times and high peak discharge, the latter a longer lag time and a lower peak discharge.
- Knowledge and understanding that the shape of the discharge curve in a flood hydrograph is determined by two variables following a rainfall event: the speed at which water reaches the river channel, the volume of water that reaches the river channel.
- Knowledge and understanding of the factors that can have on the character of the flood hydrograph. This could include:
 - shape and size of the river catchment
 - topography
 - geology
 - soil depth
 - antecedent conditions
 - rainfall intensity
 - time of year
 - agriculture
 - farming intensification
 - urbanisation
 - use of reservoirs
 - deforestation and afforestation
 - human induced climate change can lead to more intense storms, more precipitation, and prolonged heatwaves.
- Knowledge and understanding of a river catchment to illustrate and analyse the key themes above and consider the impact of precipitation upon drainage basin stores, transfers output as discharge.

AO2

- Critical assessment of the potential factors impacting the flood hydrograph in their chosen catchment.
- Evaluation of the relative temporal importance of these factors in impacting the flood hydrograph in their chosen catchment.
- Appreciation that temporal importance of potential factors may change over time in their chosen river catchment. This can be because the nature of the factor itself changes, for example, an afforested area will exert more influence on the hydrograph as it matures.
- Evaluation of the relative spatial importance of these potential factors in impacting the flood hydrograph in their chosen catchment. In the case of the River Eden, 97% of the land is used for agriculture, this will have a profound impact on stores and flows following a rainfall event due to its prevalence across the catchment.

- Appreciation that spatial importance of potential factors may change. For example, spatially geology will stay the same, but its impact on the flood hydrograph may decline as the catchment becomes more urbanised.
- Appreciation that factors do not work in isolation and that a combination of factors, such as steep slopes and urbanisation, can create a 'flashier' flood hydrograph, with very short lag times and high peak discharges, whereas others could counteract each other, such as afforestation and steep slopes.
- A conclusion may appreciate the complex interaction between a range of factors in impacting the flood hydrograph and therefore the difficulty in determining the exact importance each plays. It may consider how relative importance may change in the future. It should, however, be reasoned and based on the evidence given in the answer.

Section B – Ecosystems Under Stress

Total for this section: 40 marks

Question	Part	Marking guidance	Total marks
05	1	Which ONE of the following defines ‘fauna’? Key – A: The animals that are characteristic of an area.	1 AO1=1

Question	Part	Marking guidance	Total marks
05	2	Which list correctly orders the stages along a food chain? Key – B: Primary producer, primary consumer, secondary consumer, tertiary consumer	1 AO1=1

Question	Part	Marking guidance	Total marks
05	3	Where are ALL terrestrial ecosystems found? Key – D: On land	1 AO1=1

Question	Part	Marking guidance	Total marks
05	4	Which of the following are ALL flows/transfers in mineral nutrient cycling? Key – B: Decomposition; precipitation; uptake by plants	1 AO1=1

Question	Part	Marking guidance	Total marks
05	5	Where are MOST coral reefs located? Key – B: Between 30° north and 30° south of the equator	1 AO1=1

Question	Part	Marking guidance	Total marks
06		Analyse the data shown in FIGURE 3a and FIGURE 3b.	6 AO3=6

Level	Marks	Descriptor
2	4–6	AO3 – Clear selection and analysis of the evidence that has been provided which makes appropriate use of data to support. Clear connections between different aspects of the data.
1	1–3	AO3 – Some basic selection and analysis of the evidence that has been provided which makes limited use of data to support. Basic or limited connections between different aspects of the data.
0	0	No creditable content.

Indicative Content

The question requires the candidate to analyse the global variation of threatened mammals and birds and then make links between the two maps.

AO3

- Overall, the number of threatened species varies considerably.
- In some cases the countries with the highest levels of threatened birds and mammals are found in the largest countries, for example China, USA and Brazil. However, this is not always the case, see Peru and Madagascar.
- Accept a credible critique of the resource itself. For example, Antarctica is omitted.

Threatened Mammals

- Most European countries, Greenland, New Zealand, Suriname and Uzbekistan have 10 or less threatened mammal species.
- Most African, Middle Eastern and Central Asian countries have 40 or fewer threatened mammal species. The anomaly being Madagascar with over 100 threatened mammal species.
- Most North and South American countries have 40 or fewer threatened mammal species. Anomalies being Mexico, Brazil and, to a lesser extent, Peru.
- Only 9 countries have more than 60 threatened mammal species per country, with over half of these clustering in South Asia and Oceania.
- South-East Asia has the greatest variation between countries of threatened mammal species. For example, North Korea has 10 or fewer threatened species, whereas Indonesia has at least 10 times more threatened species, with over 100.

Threatened Birds

- Europe, the Middle East, Central Asia, and Africa have similar numbers of threatened bird species with no country having more than 60 threatened bird species.
- Libya and Greenland have some of the lowest threatened bird species, with 10 or fewer. This contrasts with five countries, including Brazil, Indonesia and Peru that have at least 10 times more, with over 100 threatened bird species.
- Four out of five (80%) countries with over 100 threatened bird species are found in South America.

- South America has the greatest variation between countries for threatened bird species. For example, Suriname has 10 or fewer threatened bird species, whereas Brazil has at least 100 threatened bird species.
- Two out of three (66%) countries with between 80 – 99 threatened species are found in Asia.

Similarities between threatened species

- There is a positive correlation between the two figures. Many countries who have high levels of threatened species in **Figure 3a** also have high levels of threatened species in **Figure 3b**. This also applies to countries with low levels of threatened species.
- Europe, Greenland, the Middle East, Africa and Central Asia are areas that have relatively low numbers of threatened bird and mammal species.
- Greenland, Suriname and Libya are named examples of countries with 10 or fewer threatened species for both birds and mammals.
- Europe is the only continent with all countries having 40 or fewer threatened bird and mammal species respectively.
- South America and South-East Asia are regions with several countries with over 60 threatened bird and mammal species. Indonesia is the only country with over 100 threatened bird and mammal species. An example of a named anomaly is Suriname, in South America.

Contrasts between threatened species

- There are far fewer countries with fewer than 10 threatened bird species compared to threatened mammal species.
- There are two and a half times more countries with over 100 threatened bird species compared to mammal species.
- Some countries score high on one map and low on the other map. For example, the USA has up to four times more threatened bird species than mammal species, whereas New Zealand has at least six times more threatened mammal species. Madagascar is opposite, with over twice as many threatened mammal species compared to bird species.

Max Level 1 if only one map analysed and/or no specific data used.

Question	Part	Marking guidance	Total marks
07		<p>Explain reasons why a vegetation succession may stop at a sub-climax.</p> <p>Refer to ONE OR MORE examples of succession that you have studied (psammosere, halosere, hydrosere or lithosere) to support your answer.</p> <p>AO1 – Knowledge and understanding of the chosen succession, including the seral stages that lead to climatic climax. Knowledge and understanding of the interconnections between climate, vegetation, soil, and topography. Knowledge and understanding of the factors that can arrest a succession and keep it at sub-climax.</p> <p>AO2 – Application of knowledge and understanding to explain how and why a succession may stop at any seral stage and form a sub-climax. Understanding that factors may impact succession differently and that this may change over time, some successions may be stopped temporarily others permanently.</p>	<p>9</p> <p>AO1=4 AO2=5</p>

Level	Marks	Descriptor
3	7–9	<p>AO1 – Demonstrates detailed knowledge and understanding of the characteristics across the chosen succession and the role biotic and abiotic factors play. A case study may be referred to for clarity and exemplification. Demonstrates detailed knowledge and understanding of the ways in which factors may arrest the succession spatially and temporally, resulting in a sub-climax.</p> <p>AO2 – Applies knowledge and understanding to critically assess the progression towards climatic climax and halting to form a sub-climax. Connections and relationships between different factors are thorough and relevant and ideally applied to a place context.</p>
2	4–6	<p>AO1 – Demonstrates clear knowledge and understanding of the characteristics across the chosen succession and the role biotic and abiotic factors play. A case study may be referred to. Demonstrates clear knowledge and understanding of the ways in which factors may arrest the succession spatially or temporally, resulting in a sub-climax.</p> <p>AO2 – Applies knowledge and understanding to assess the progression towards climatic climax and halting to form a sub-climax. Some connections and relationships between different factors are thorough and/or relevant.</p>
1	1–3	<p>AO1 – Demonstrates basic knowledge and understanding of the characteristics across the chosen succession and the role biotic and abiotic factors play. Diagrams or case study unlikely. Vague idea of the meaning of a sub-climax, possible confusion with plagio-climax. Demonstrates basic knowledge and understanding of the ways in which factors may arrest the succession spatially and temporally, resulting in a sub-climax. Mainly generic points.</p> <p>AO2 – Applies limited knowledge and understanding to state the progression towards climatic climax and halting to form a sub-climax. One or more arresting</p>

		factors are considered and treated in isolation or connections are vaguely alluded to with no place context.
0	0	No creditable content.

Indicative Content

The answer will depend on the succession chosen, this can be a psammosere, halosere, hydrosere or a lithosphere and this is likely to dictate which arresting factors may be present to result in a sub-climax.

AO1

- A simplified cross-section diagram, map or written description of their named succession and location may be used to outline the changes in living and non-living components of a named succession. Examples of named flora and fauna should be used.
- Knowledge and understanding that whilst biomass continues to increase with distance/time from pioneer community, species diversity is likely to peak and then decline towards climatic climax.
- Knowledge and understanding that changes with each sere are a result of the complex interaction between abiotic (air temperature, water temperature, water translucence, water depth, wind speed, tidal regime, salt prevalence, oxygen availability, aspect, altitude, geology, sediment type, humus content, water table level) and biotic factors (plant and animal species present and their prevalence).
- Where this complex interaction between biotic and abiotic is disrupted, succession may halt and form a sub-climax. This can be a permanent or temporary halt in succession.
- A sub-climax community results from human and/or environmental factors that prevent a succession from reaching climatic climax. An arrest of the succession will either maintain the current level of biodiversity or see a reversal depending on the arresting factor.
- Knowledge and understanding that a lack of time can mean that a climatic climax is not yet reached. This preceding stage or sere is also a sub-climax.
- Knowledge and understanding that a range of factors can cause a sub-climax. These can include environmental factors such as geology, changes in water table, season flooding, river currents, natural barriers such as width of spit, sea level change, tsunamis, increased storminess, increased windiness, drought, wildfires, angle of slope, altitude, and dominance of fauna species. These can include human factors such as controlled burning, agriculture, logging, afforestation, trampling, pollution, introduction of non-native species and urban sprawl.

AO2

- Applying understanding to explain how specific factors in their chosen succession(s) and location(s) halt the succession and what the sub-climax looks like as a result.
- Applying understanding to explain how some factors are transitory such as storms and so the succession may recover and go on to reach climatic climax, whereas, some factors may be more permanent, such as geology, or urban sprawl, resulting in a permanent sub-climax.
- Applying understanding to explain how spatially some areas in a named location may reach climatic climax but other areas are prevented from doing so due to human or environmental factors. For example, a psammosere on a spit may reach climatic climax where the spit connects to the land, but due to regular breaches further along the spit the climatic climax is prevented.
- Applying understanding to explain how different factors may arrest a succession at different seral stages along a succession. For example, dominance of rabbits causing dune blow-outs may prevent a psammosere from developing much further than yellow or grey dunes. Whereas controlled burning on heathland halts succession once soil is established. Similarly, chalk geology in the UK allows for succession to reach forest level but due to thin dry soils, oak is not able to dominate.
- Some candidates may explain the relative importance of the specific arresting factors present in their chosen location on the succession.
- Examples could include a halosere where hurricane damage stopped succession in mangrove swamps or a lithosere that was stopped following a volcanic eruption eg Iceland or Hawaii.

Max Level 2 if no named location or succession.

Question	Part	Marking guidance	Total marks
08		<p>‘Economic development in the tropical rainforest biome will result in a decline in its biodiversity.’</p> <p>To what extent do you agree with this statement?</p> <p>AO1 – Knowledge and understanding of the concept of biodiversity. Knowledge and understanding of economic development in tropical rainforests and its impact on biodiversity.</p> <p>AO2 – Application of knowledge and understanding to assess the extent that economic development leads to a decline in biodiversity in tropical rainforests. Application of knowledge and understanding to show the importance of the scale and nature of economic development in determining its impact on biodiversity.</p>	<p>20</p> <p>AO1=10 AO2=10</p>

Level	Marks	Descriptor
4	16–20	<p>AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Detailed, coherent, and relevant analysis and evaluation in the application of knowledge and understanding throughout.</p> <p>AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Detailed, highly relevant, and appropriate knowledge and understanding of place(s) and environments used throughout.</p> <p>AO1 – Full and accurate knowledge and understanding of key concepts and processes throughout.</p> <p>AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.</p>
3	11–15	<p>AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Generally clear, coherent, and relevant analysis and evaluation in the application of knowledge and understanding.</p> <p>AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments.</p> <p>AO1 – Generally clear and accurate knowledge and understanding of key concepts and processes.</p>

		AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.
2	6–10	<p>AO2 – Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Some partially relevant analysis and evaluation in the application of knowledge and understanding.</p> <p>AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant.</p> <p>AO1 – Some knowledge and understanding of key concepts, processes and interactions and change.</p> <p>AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.</p>
1	1–5	<p>AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question.</p> <p>AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence.</p> <p>AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts.</p> <p>AO1 – Very limited relevant knowledge and understanding of place(s) and environments.</p> <p>AO1 – Isolated knowledge and understanding of key concepts and processes.</p> <p>AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.</p>
0	0	No creditable content.

Indicative Content

The focus of the response is economic development and its impact upon biodiversity. Narrative into the broader environmental fragility of tropical rainforests is not being assessed here.

AO1

- Knowledge and understanding of the concept of biodiversity including local and global trends.
- Knowledge and understanding of the causes of declining biodiversity. Primary drivers include habitat loss, habitat fragmentation, climate change, pollution, and overexploitation.
- Knowledge and understanding of the nature of the tropical rainforest biome. It is structurally intricate and complex. Many species are endemic to specific tropical rainforests or specific regions of a specific rainforest.
- Knowledge and understanding of tropical rainforest's importance for human populations in the light of economic development. Most tropical rainforests grow in less developed economies or emerging major economies and provide valuable resources for the population.
- Knowledge and understanding of the range of economic activities enabling economic development in tropical rainforests. These could include, logging, selective logging, settlement growth, hunting, road construction, mining, monoculture (palm oil), cattle ranching, oil exploration, hydroelectric power, agroforestry, payment for ecosystem services (PES) and ecotourism.

AO2

- Critical assessment of how a range of economic activities directly impact the environment in a range of ways that can then result in a decline in biodiversity. This could include:
 - deforestation depletes biodiversity by both removing habitats or fragmenting remaining habitats. This can impact pollination of flora and reproduction in fauna. Overtime this can lead to a decline in biodiversity in that area of the rainforest. Fragmentation also produces 'edge' environments that species adapted to deep forest will not survive in and are often outcompeted by more tolerant coloniser species
 - selective logging removes some of the canopy layer, which normally protects fragile flora below from heavy rainfall and direct sunlight light. Without this protection some flora struggles and dies. The loss of the canopy also leads to loss of fauna who live in the canopy layer. Larger mammals may migrate to untouched forest such as the Burmese brown tortoise did in a study following deforestation in Malaysia
 - gold mining uses mercury to extract gold from alluvium. The mercury is vaporised in the process but returns to the rainforest as rainwater, which eventually reaches streams and rivers. This enters the food chain via phytoplankton. The mercury accumulates in the tissue and becomes increasingly concentrated further up the food chain. This can lead to a range of serious health issues in those consuming the mercury. These can include reproductive issues and death, both of which will impact biodiversity in the long term. In the case of the Amazon, 90% of fish caught by villagers along the Tapajos River were found to be contaminated with mercury from a nearby mine
 - commercial agriculture, deforestation and indirectly population growth from such industries will result in increased water consumption which will break the convective storm water cycle. This can lead to drier conditions which will stress water-loving species leading to either outmigration of some species or extinction.
- Awareness that economic development can indirectly impact biodiversity by contributing to climate change, through the addition of greenhouse gases to the atmosphere and by reducing the rainforest's capacity for photosynthesis. Atmospheric warming can destabilise the delicate equilibrium and lead to extinction of species incapable of tolerating these changes. This could include drought or wildfires.
- Critical understanding that if economic activity occurs in areas where endemic species are limited to a small geographical area extinction is wholly possible. Studies have shown that some endemic flora species on the western extent of the Amazon reside in an area no greater than 2 km².

- Critical evaluation whether all forms of economic development result in biodiversity loss. This could assess ecotourism, payment for ecosystem services, agroforestry, and selective logging. An awareness that these economic activities are tiny in comparison to other forms of commercial activity.
- Candidates are free to form their own conclusions based upon valid content. However, it is likely that most will agree with the statement as posed.

Max Level 3 if no conclusion.

Assessment Objective grid

	AO1	AO2	AO3	Total
Section A				
01.1	1			1
01.2	1			1
01.3	1			1
01.4	1			1
01.5	1			1
02			6	6
03	4	5		9
04	10	10		20
Section B				
05.1	1			1
05.2	1			1
05.3	1			1
05.4	1			1
05.5	1			1
06			6	6
07	4	5		9
08	10	10		20
Unit total	38	30	12	80