OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL
GEOGRAPHY
GG03

Paper 3 Physical Geography 2

Mark scheme

June 2022

Version: 1.0 Final

2 2 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.

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

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: • 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	**'Water changes from a liquid state to a gaseous state through a transfer from Earth surfaces and from within vegetation into the atmosphere' is the definition of:** Key – C: evapotranspiration.	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
01	2	**In which of the following is most of the Earth's carbon stored?** Key – D: Lithosphere	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
01	3	**Cryospheric processes on a hill slope include:** Key – C: snow turning to ice and moving as a glacier.	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
01	4	**Which of the following <u>all</u> increase the amount of carbon in the atmosphere?** Key – B: Combustion; decomposition of plant material; wildfires	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
01	5	**Which of the following are <u>both</u> human interventions designed to mitigate the impacts of climate change?** Key – D: Reducing the rate of greenhouse gas emissions **and** increasing the use of public transport	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
02		**Figure 1** shows the average rainfall and flow volume for three rivers in the Murray–Darling drainage basin in Australia. Flow volume is the amount of water flowing down the river. **Analyse the data shown in Figure 1.**	**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 pattern of rainfall and flow volume along rivers in the Murray–Darling Basin in Australia.

AO3

- There are two rainfall peaks, one in June/July at about 39 mm and a larger one in December at about 49 mm giving a difference of only 10 mm.
- The rainfall is fairly consistent throughout the year with a total of about 310 mm. Accept between 300 and 320 mm.
- The river flow volumes do not coincide with the peaks of rainfall or with each other.
- The Murray shows the greatest range over the year with around 600 000 ml, whereas the Ovens river shows the smallest at about 250 000 ml and some months when the river dries up (March to May). The Darling has a significant peak in March at about 450 000 ml.
- The Murray river has a greater fluctuation with at least three peaks, whereas the Ovens river has only two peaks with much less fluctuation.
- In September the Darling and Ovens rivers have a matching peak at about 250 000 ml and the Murray and Darling rivers have a matching peak, but with different flow volumes.
- The flow volume for the Ovens river declines steadily from September from 250 000 ml to almost zero whereas the other rivers increase until March to reach 600 000 ml in the Murray river and 500 000 ml in the Darling river.
- The duration of the flow volumes are not the same so this may cause variations, eg Murray is 50 years whereas the Ovens is only 12 years.

Credit should be given for any comparisons between the rivers which are accurate and quantified.

Question	Part	Marking guidance	Total marks
03		**Evaluate the impact of land use on drainage basin stores and transfers in a river catchment you have studied at a local scale.** **AO1** – Knowledge and understanding of the impact that land use has on drainage basin stores and transfers in the river catchment studied. Knowledge and understanding of the impact that other factors, such as geology, have on drainage basin stores and transfers. **AO2** – Application of knowledge and understanding to evaluate the relative importance of land use on drainage basin stores and transfers compared to other factors. Application of knowledge and understanding to show how all factors may be linked through space and time.	**9** **AO1=4** **AO2=5**

Level	Marks	Descriptor
3	**7 – 9**	**AO1** – Demonstrates detailed knowledge and understanding of the impact of land use and other factors on drainage basin stores and transfers in the river catchment studied. **AO2** – Applies detailed knowledge and understanding to assess the relative importance of land use and other factors and how they are linked through space and time.
2	**4 – 6**	**AO1** – Demonstrates clear knowledge and understanding of the impact of land use and other factors on drainage basin stores and transfers in the river catchment studied. **AO2** – Applies clear knowledge and understanding to assess the relative importance of land use and other factors and how they are linked through space and time.
1	**1 – 3**	**AO1** – Demonstrates basic knowledge and understanding of the impact of land use and other factors on drainage basin stores and transfers in the river catchment studied. **AO2** – Applies limited knowledge and understanding to assess the relative importance of land use and other factors.
0	**0**	No creditable content.

Indicative Content

At Level 3 the candidate will refer to specific features of the river catchment they have studied such as precipitation figures, type of geology and land use. They will use figures and place specific detail to illustrate their points.

AO1

- Knowledge and understanding of the context of the drainage basin in terms of its geographical location, its climate zone and its characteristics related to the country it is in.
- Knowledge and understanding of the processes generating precipitation in the chosen river catchment and how these affect drainage basin stores and transfers, eg intense heat and advected moisture causing convectional rainfall and therefore intense precipitation which may not have time to infiltrate and so will cause flash floods such as in a wadi in a desert environment.
- Knowledge and understanding of the impact of land use. Land use will probably include different farming methods, urban areas, possible dam structures and natural vegetation. The impact on stores and transfers will depend upon the type of land use, eg urban areas with their impermeable surfaces and drainage systems will lead to large volumes of runoff transferring water to river courses and possibly contributing to flooding. Farming impact will depend upon the crops grown, some will require irrigation water reducing groundwater stores such as cotton and others will intercept precipitation and allow more time for infiltration into the soil, eg a tea plantation.
- Knowledge and understanding of the other factors that impact drainage basin stores and transfers. This might include changes caused by geological variation, relief, global warming, dam construction, water abstraction and the development level of the area, eg the geology will determine infiltration rates depending on the permeability of the rock, this will affect groundwater stores and this might affect the type of crops grown. The development level may mean that subsistence food crops are grown instead of cash crops. Flood management might affect transfers.

AO2

- Evaluation of the relative importance of the impact of land use on the drainage basin stores and transfers compared to other factors, such as geology.
- Evaluation of other sources of water such as groundwater flow on the drainage basin stores and transfers.
- Evaluation of the importance of land use change in determining run off into the rivers and the ways in which that affects the water balance. This could include building a dam which would store water and reduce river flows and flooding, but more water will evaporate and possibly seep in groundwater and therefore the efficient use of water might be reduced.
- Evaluation of the seasonal changes within the drainage basin and how that affects stores, transfers and land use, eg deciduous trees losing their leaves reducing evapotranspiration and interception leading to a higher runoff which could increase the risk of flooding and soil erosion. The harvesting of crops could expose the soil to erosion in the event of a sudden rainstorm.
- Evaluation of the relative importance of the management of the river catchment both through time and in different parts of the drainage basin and how that affects stores and transfers. This could involve the construction of a dam. The sustainability of the human influence in the river catchment could be assessed.

Question	Part	Marking guidance	Total marks
04		**'Human factors have a greater impact on the carbon cycle than natural factors.'** **Evaluate the extent to which you agree with this statement.** **Use examples you have studied to support your answer.** **AO1** – Knowledge and understanding of how human factors cause an impact on the carbon cycle. Use examples such as carbon emissions from power stations. Knowledge and understanding of how natural factors cause an impact on the carbon cycle. Use examples such as carbon dioxide emissions from volcanic eruptions. **AO2** – Application of knowledge and understanding to evaluate the relative importance of human factors as opposed to natural factors. Application of knowledge and understanding to evaluate how the impact of human and natural factors may vary at different times and in different places. Application of knowledge and understanding to evaluate the interaction of human and natural factors such as global warming.	**20** **AO1=10** **AO2=10**

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

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

Indicative Content

The candidate needs to refer specifically to both human and natural factors with detailed evidenced examples to enter Level 4 of the mark scheme. At level 1 this will be vague and generalised and could be applied to most catchments.

AO1

- Identify that there are both natural and human causes of increased atmospheric carbon.
- Natural causes, such as volcanic eruptions, can put variable amounts of carbon into the atmosphere usually over shorter time frames.
- Solar cycles affect solar radiation which in turn can affect the efficiency of photosynthesis and respiration which can change the net production of carbon into the atmosphere, but this is smoother and often over longer time frames.
- Photosynthesis varies seasonally in the different hemispheres owing to the distribution of land, the day length and the angle of the sun's rays.
- The absorption of carbon into the oceans through sedimentation and diffusion depends on a range of natural factors such as the temperature and acidity of the water.
- Humans cause enhanced global warming through the production of pollutant gases such as carbon dioxide from power stations and vehicle exhausts. Human causes are also linked to deforestation and destruction of coral reefs and mangrove swamps. These are happening continually and in most cases escalating and all reduce the carbon absorbed.
- Melting of permafrost leading to an increase in methane production, which has a positive feedback effect on carbon through global warming.
- Some causes such as volcanic eruptions have happened throughout history whereas industrial emissions have only been significant since the industrial revolution.
- Carbon capture is attempting to return carbon from the atmosphere store to the rock store.

AO2

- Recognising that some causes are more important than others, eg solar cycles can have an effect at a global level over longer time frames, whereas volcanic eruptions vary from local effects to global effects over shorter time frames, such as Krakatoa.
- The recent increase of carbon dioxide since the industrial revolution suggests that this is the main factor in increasing atmospheric carbon as it is progressive.
- Deforestation reduces sequestration and emits carbon dioxide if the forest is burnt. These changes could be caused by human activities such as clearance for cattle ranching or natural factors such as drought leading to lightning storms and forest fires.
- The accuracy of measurements of carbon in the atmosphere. Measurements are made in Hawaii in the middle of the Pacific Ocean to enable background carbon to be measured without them being tainted by local pollution. However, the measurements are taken near to erupting volcanoes.
- The rate of increase has accelerated since the industrial revolution suggesting that human sources such as power stations are responsible. However, there have been large volcanic eruptions, such as Pinatubo, which create large quantities of carbon dioxide over the same period.
- The oceans absorb carbon dioxide through diffusion, but this is affected by the temperature of the water which is linked to global warming.
- In the context of the earth's history then there have been higher concentrations of carbon dioxide in the past, such as in the time of the dinosaurs when it is believed there were no ice caps.
- The interaction and balance of the different processes creating carbon dioxide and absorbing carbon dioxide are complex and not fully understood, but the net effect at present is an increase.
- An evidenced conclusion to show whether human or natural factors cause the greatest impact on the carbon cycle with a realisation that the interaction of the two is important too, such as global warming.

Section B – Ecosystems Under Stress **Total for this section: 40 marks**

Question	Part	Marking guidance	Total marks
05	1	**The definition of biodiversity in an ecosystem is:** Key – D: the variety of flora and fauna.	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
05	2	**Which of the following trophic levels receives the highest energy flow from the sun?** Key – D: Producers	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
05	3	**Which of the following <u>all</u> damage the health and threaten the survival of coral reefs?** Key – B: Increasing water temperature; ocean acidification; sewage affecting sunlight levels	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
05	4	**The climatic climax of a succession is when:** Key – D: the interaction of plants and animals with their environment reach equilibrium.	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
05	5	**An example of an <u>unplanned</u> introduction of a new species to a local ecosystem is:** Key – A: an insect carried on imported wood kills the local trees.	**1** **AO1=1**

Question	Part	Marking guidance	Total marks
06		**Figure 2** shows the global seasonal patterns of land surface temperature and vegetation density in June 2019. **Figure 3** shows the global seasonal patterns of land surface temperature and vegetation density in December 2019. **Analyse the data shown in Figure 2 and Figure 3, on pages 12 and 13.**	**6** **AO3=6**

Level	Marks	Descriptor
2	**4 – 6**	**AO3** – Clear description and assessment 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 description and assessment 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.

<u>Indicative Content</u>

AO3

- There is a clear seasonal difference in temperature as the area around the Tropic of Cancer is hottest in June at 30–45 °C whereas the Tropic of Capricorn in Australia is hottest in December at 30–45 °C.
- In June the hottest area is about twice the land area of that in December.
- Antarctica does not vary as much as the Arctic, it is always below freezing. Asia and northern North America are much colder in December from 15 °C to well below freezing. In December the cold spreads much further South from the Arctic to the 10 °C isotherm than it does in the Antarctic.
- Central Asia and the western side of South America have the greatest contrasts. Central Asia 40–45 °C in June to –20 °C in December. The western side of South America 0 °C in June to 40–45 °C in December.
- Vegetation growth is far greater in the Northern hemisphere than the Southern hemisphere.
- In the Northern Hemisphere vegetation growth expands to over twice the area in June than in December despite the total lack of growth north of the Arctic Circle in December. The darkest areas with around 0.9 on the index are found around the tropics. South America and Australia change the least remaining around 0.3. North America and northern Asia change the most from 0.7 in June to 0.3 in December (0.4 difference).
- The hottest areas in Africa and Australia have the lowest vegetation and this does not change with the seasons. Also the equatorial areas maintain a fairly high temperature 25–30 °C and a high index of vegetation density at 0.8–0.9. The greatest variation in both temperature (20 °C to –10 °C) and vegetation (0.4–0.7) is found in Northern Asia and North America. Europe's changes are more moderate around 15–20 °C and 0.3–0.6 vegetation density.

Question	Part	Marking guidance	Total marks
07		**Explain how human activity disrupts a succession reaching a climatic climax.** **Use an example of a succession you have studied (psammosere, halosere, hydrosere or lithosere) to support your answer.** **AO1 –** Knowledge and understanding of the succession chosen. A description of the changes across the seral stages linked to living and non-living changes with an explanation of why these changes occur. Knowledge and understanding of the human activities than can disrupt the succession and lead to a plagioclimax. **AO2 –** Application of knowledge and understanding to show that the theoretical text book examples of climatic climax vegetation do not always match the real life examples and why this is. Application of knowledge and understanding to show how human activities lead to arresting factors that can change the succession to a plagioclimax. Understanding that different activities have different effects in scale and time, with some delaying the succession and others reversing it.	**9** **AO1=4** **AO2=5**

Level	Marks	Descriptor
3	**7 – 9**	**AO1** – Demonstrates detailed knowledge and understanding of the structure and functioning of the succession chosen to include how both living and non-living factors affect the seral stages. A cross-section diagram or a map would be helpful here. A case study may be referred to for clarity. Demonstrates detailed knowledge and understanding of the seral stages and ways in which human activity might lead to arresting factors. **AO2** – Applies knowledge and understanding to critically assess the progression to a climatic climax, but also the different arresting factors and how they change the succession so that a plagioclimax is achieved. A wide range of arresting factors should be considered. Connections and relationships between these different factors are thorough and relevant and ideally applied to a place context.
2	**4 – 6**	**AO1** – Demonstrates clear knowledge and understanding of the structure and functioning across the succession chosen to include some living and non-living factors that affect the seral stages. A diagram might be used, but a case study is less likely. Demonstrates clear knowledge and understanding of the seral stages and the ways in which human activity might lead to arresting factors and how these vary in scale and duration. **AO2** – Applies knowledge and understanding to assess the progression to a climatic climax, but also the different arresting factors and how they change the succession so that a plagioclimax is achieved. A range of arresting factors should be considered. Some connections and relationships between these different factors may be thorough and/or relevant.

1	**1 – 3**	**AO1** – Demonstrates basic knowledge and understanding of the living and non-living changes across a succession. Diagrams and a case study are unlikely. Vague idea of the meaning of a plagioclimax and a climatic climax. Demonstrates basic knowledge and understanding of the ways in which human activity affects the seral stages of the succession. Mainly generic points. **AO2** – Applies limited knowledge and understanding to state the different arresting factors and the changes they bring. Little reference to the climatic climax state. The factors will probably be treated in isolation or their connections 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 lithosere. The psammosere (sand dune succession) is most likely so this will be considered here in more detail with references to the others.

AO1

- A simplified cross-section diagram or possibly a map may be used to show the changes in living and non-living factors from the coast to the climatic climax, usually a pine forest for a psammosere.
- The changes inland are governed by non-living factors such as temperature, wind speed, type of sand, humus content of the soil and water table and living factors such as the type of plants and the animals that are associated with them. The main changes from the sea inland are an increasing complexity shown by increased biodiversity and a more complex soil able to support taller plants. This pattern applies to the psammosere and lithosere, which is on bare rock, often created by a volcanic eruption to form an island. In the case of the hydrosere (fresh water succession) or halosere (salt water succession), the changes may be measured from the lake edge or shoreline into the deeper water. The non-living factors will include the salinity of the water, the water temperature and light penetration affected by water translucence. The nutrient status of the water is also important.
- Examples of flora and fauna should be used: flora, such as, for the psammosere, Marram grass on the mobile dunes as it can withstand dry conditions with variable temperatures and being covered by sand. Its roots will hold the sand in place and it can withstand some wave action and saline conditions. Fauna, such as, rabbits as they can burrow into the sand to create their warrens. Examples of flora in aquatics environments might include reeds which can withstand wind and water movements and salt marsh which can withstand inundation by the tide. Fauna might include wading birds such as the curlew.
- Arresting factors for psammoseres that create a plagioclimax could be the managed use of fire or fires from barbecues, the use of herbivores to graze the land or the impact of invasive species such as rabbits burrowing. In the case of aquatic environments, changes in water level through drainage or sea level rise. Grazing is an arresting factor that can be used over large areas and regularly using herbivores to maintain the succession at a certain seral stage. Fire will reverse the succession to an earlier seral stage and may not cover the whole ecosystem. It could promote a different path to the climatic climax by destroying some species and promoting others.

AO2

- The text book example of a climatic climax psammosere succession is usually not reflected in real life owing to arresting factors which create a plagioclimax, some of which are natural and others from human influence, eg storms may erode the mobile dunes or fire may burn flora, but increase humus.

- Human influence could include animal grazing, especially sheep or goats and of course rabbits which are often introduced. It could also be trampling from tourists causing blow outs or barbecue fires. In aquatic (hydrosere and halosere) environments changes in water level could halt succession such as sea level rise. Also harvesting of reeds from hydroseres on the Norfolk Broads removes bank protection increasing erosion and sedimentation in the water changing water translucence.
- The arresting factors will inhibit the progression to a climatic climax. Some of the arresting factors are transitory such as storms and so the succession may recover and go on to reach the climatic climax.
- Often human intervention prevents further progression so a plagioclimax is achieved and sustained. This is often a deliberate management policy, but could be unintentional such as global warming. In aquatic environments water level rise could be due to global warming via sea level rise or flooding. A psammosere case study, such as Braunton Burrows in Devon, UK may be used here where sheep grazing and a golf course arrest the progression of the seral stages to a plagioclimax of scrub heath. An aquatic case study could be the Norfolk Broads, where the lakes were created by peat excavation and succession is now managed by boat traffic and reed harvesting as well as nature reserves. Examples are likely to be from their own country or the text book. A halosere example could be mangrove swamps where hurricane damage or clearance for tourist resorts could lead to a plagioclimax.
- In some cases succession is carefully managed to enable a sustainable situation whereby the climatic climax is conserved whilst tourist activities continue to generate revenue, eg Everglades in the USA. This preservation of a plagioclimax through active management may be more valuable to local activities than the climatic climax ecosystem.

Question	Part	Marking guidance	Total marks
08		**'Climate change causes a greater impact on biomes than changes caused by human exploitation.'** **To what extent do you agree with the statement?** **AO1 –** Knowledge and understanding of the impact that climate change has on biomes. Knowledge and understanding of the impact that human exploitation has on biomes. Knowledge and understanding of changes to biomes caused by both climate change and human exploitation. Global warming would be a factor here. **AO2** – Application of knowledge and understanding to assess the relative impact of climate change compared to human exploitation in a global context. Application of knowledge and understanding to assess, in the context of specific biomes, the changes that take place and the role that climate change and human exploitation play. Application of knowledge and understanding to show an appreciation of the complex interaction of climate change and human exploitation and how other factors have a role to play too such as volcanic eruptions.	**20** **AO1=10** **AO2=10**

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

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

Indicative Content

The scale is global so candidates can either look at a range of impacts over many different biomes or focus on a more detailed analysis of impacts in a few biomes (more than one). Most candidates will probably adopt a mixture of these approaches. They must clearly show the impact of climate change and human exploitation such as deforestation. It is likely they will refer to the tropical rainforest, the savanna biome and the coral reef biome as a marine system.

AO1

- Knowledge and understanding of the impact of climate change through rising sea levels and increasing ocean temperatures which have a large impact on coral reefs causing bleaching, eg Great Barrier Reef has been affected by water temperatures well over 25°C for three successive years causing nearly half of the reef to be bleached.
- Knowledge and understanding of the impact of climate change on rainfall patterns and land temperatures. Hurricanes or the monsoon may intensify as ocean temperatures rise causing widespread flooding in the Gulf of Mexico and in India. Drought can lead to fires devastating rainforest in areas such as Indonesia. The smog can also affect air quality disrupting human activities and causing respiratory problems.
- Knowledge and understanding of the impact of climate change through increases in temperature allowing invasive species to move North in the Northern Hemisphere. These can be disease vectors, such as mosquitoes in tropical rainforest or fungal diseases, such as ash dieback affecting the deciduous forest. These changes affect the food webs of these biomes and human activity.
- Knowledge and understanding of the impact of human exploitation which may be through the testing of nuclear bombs on coral atolls contaminating reefs for many generations with nuclear radiation or deforestation of the tropical rainforest for timber or oil palm or oil spillages such as the Exxon Valdez to the tundra coastline. An explanation of the impact of tropical rainforest deforestation such as reduction of interception leading to increased runoff and flooding.
- Knowledge and understanding of the impact of human exploitation through population growth and the spread of farming with livestock or crops. This leads to loss of the natural habitat and the threat of extinction of vulnerable species such as the Orangutan in the tropical rainforests of Borneo. In the savanna, wildlife is cornered into ever smaller areas which leads to conflict with local people, leading to poaching and disruption of food chains. The planned or unplanned introduction of invasive species by human activities also has an impact on food webs.
- Knowledge and understanding of these changes could be in a range of settings such as different biomes or focused on a few contrasting biomes. In each biome human exploitation may be different with, for example, overgrazing and over cultivation in the Savannah and deforestation in the rainforest.

AO2

- Critical assessment of the fact that climate change has been enhanced by human exploitation through the increasing production of greenhouse gases. Consequently, climate change and human exploitation are linked.
- Critical assessment of the positive feedback effects of climate change such as permafrost melting in the tundra leading to the production of methane during decay, which acts as a potent greenhouse gas further enhancing global warming. These impacts are linked to human exploitation as fossil fuel resources are extracted for energy which requires deforestation in, for example, Nigeria and this also enhances greenhouse gas production as the forests are often burnt. The Australian fires in 2019 also represented a positive feedback effect as they were caused by prolonged drought, maybe from climate change. Fire was triggered by arsonists, lightning and farmers burning the bush. These fires increased the carbon dioxide production which will further enhance global warming and intensify the droughts. Fire can also be positive as it can destroy the old biomass and release nutrients and trigger dormant seeds to create new growth, which can then absorb more carbon dioxide creating a negative feedback effect. This happens annually in the savanna.

- Critical assessment of the differences in the rate and scale of the impacts from climate change and human exploitation. Climate change is a slower process, but at a global scale and so its effects are more difficult to control, once ice has melted it can't be refrozen. The changes in the seasons and the advance of invasive species. Human exploitation tends to be a much faster process, but usually on a smaller scale, however the cumulative effect of many types of human exploitation add up, eg clearing rainforest for a gold mine is rapid, but small scale. However, cattle ranching and logging require much larger areas of land and are also rapid. This is not just going on in one country, but many countries simultaneously so there is a cumulative effect, eg in the Tropical Rainforest biome deforestation has caused rapid change through loss of interception for water conservation and loss of stored carbon in the trees affecting the carbon cycle.
- Critical assessment of the interaction of climate change and human exploitation in an example of a biome or maybe comparing two biomes. Fire is a major threat to the arctic and rainforest biomes. Fires are often started by people to clear vegetation, but in the arctic can be caused by drought and lightning storms.
- Critical assessment of the future changes that may occur. Global warming is likely to be the biggest threat to global biomes with the cold environments threatened more than the tropical ones as temperature increases of 10 °C over the last 50 years in the Arctic and yet only 2 °C in the rainforest. Tundra temperatures in 2020 reached 30 °C in some places. Climate change is therefore a greater impact than human exploitation. Also it isn't possible to reverse climate change as it is already escalating beyond our control.
- A justified conclusion of the evidence that climate change has a greater impact than human exploitation on biomes. The overall conclusion that biomes naturally are in a state of dynamic equilibrium, but human exploitation threatens to create a positive feedback effect through deforestation, urbanisation and marine pollution that will be irreversible and climate change intensifies leading to the demise of life on earth.
- *Some students may also make cross topic links, which should also be credited.*

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