# Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCE in
Geography (9GE01)
Paper 1

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**General Guidance on Marking**

All candidates must receive the same treatment.

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge.

Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the Team Leader must be consulted.

**Using the mark scheme**

The mark scheme gives:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

1 / means that the responses are alternatives and either answer should receive full credit.
2 ( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
3 [ ] words inside square brackets are instructions or guidance for examiners.
4 Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
5 ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

**Quality of Written Communication**

Questions which involve the writing of continuous prose will expect candidates to:

- show clarity of expression
- construct and present coherent arguments
- demonstrate an effective use of grammar, punctuation and spelling.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated "QWC" in the mark scheme BUT this does not preclude others.

| Question number | Indicative content | Mark |
|---|---|---|
| 1 (a) | AO3 (4 marks) | |
| (i) | 1 mark for 121 | (1) |
| (ii) | $1-\frac{6 \times 121}{10^3 - 10}$<br><br>1 mark for the correct working<br>Do not credit unless the whole equation is written.<br><br>1 mark for 0.27 to two d.p | (2) |
| (iii) | The null hypothesis<br><br>Allow a follow through mark − i.e. if the answer to a(ii) is incorrect but the candidate correctly uses this incorrect answer from (iii).<br><br>No credit for a guess − i.e. if there is no answer for a(ii). | (1) |

| Question number | Indicative content<br>Assess the effectiveness of strategies used to manage the impacts of volcanic hazards. |
|---|---|
| 1(b) | AO1 (3 marks)/AO2 (9 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Responses that demonstrate only AO1 without any AO2 should be awarded marks as follows:<br>• Level 1 AO1 performance: 1 mark<br>• Level 2 AO1 performance: 2 marks<br>• Level 3 AO1 performance: 3 marks.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• Strategies to modify the event include land-use zoning, hazard – resistant design and engineering defences as well as diversion of lava flows.<br>• Strategies to modify vulnerability and resilience include hi- tech monitoring, prediction, education, community preparedness and adaptation.<br>• Strategies to modify loss include emergency, short- and longer-term aid and insurance and the actions of affected communities themselves.<br><br>AO2<br>• There are various hazards created by volcanic eruptions (lava flows, pyroclastic flows, ash falls, gas eruptions, and secondary hazards such as lahars and jökulhlaups).<br>• Yet the location of volcanoes are well established and the equipment used to monitor eruptions is portable and so often the impacts are not as great as the hazards of volcanic eruptions appear that they might be.<br>• Variations in the effectiveness of the management of such events are therefore due to a variety of reasons.<br>• A key reason in determining the effectiveness of the management of volcanic hazards is the tectonic setting of the community as this determines the nature of the volcanic hazard. Volcanic hazards at destructive plate margins have far greater magnitude of the volcanic hazards than those created at constructive plate margins or at hot spots. Thus the management of lava flows on Hawaii has been to date far more effective than that of pyroclastic flows on Mnt Merapi.<br>• Similarly the type of the volcanic hazard is a key reason in why some management strategies are more effective than others. Lava flows such as those in Eldfell, Iceland 1973 and in Mnt Etna in 1992 |

| Question number | Indicative content<br>Assess the effectiveness of strategies used to manage the impacts of volcanic hazards. |
|---|---|
| | can be diverted whilst volcanic blast waves such as those experienced at Pinatubo and Mnt St Helens cannot.<br>• Yet the level of development is also a key factor as it influences the community's vulnerability and resilience to volcanic hazards and so influences the effectiveness of the management of volcanic hazards. In Japan, the JMA monitors volcanic activity and then issues evacuation orders to vulnerable communities.<br>• Furthermore communities with a higher level of development will have better access to education, housing, healthcare and income opportunities and so reduce the community's vulnerability and increase the effectiveness of the management of the tectonic hazard. Crucially in the management of the eruption of Pinatubo it was the lack of housing and other income opportunities that was a factor in leading to the Aeta people decision to remain in the vicinity of the eruption.<br>• The level of development also influences all stages of the stages in the hazard management cycle (response, recovery, mitigation, preparedness) all of which may influence the effectiveness of the management of volcanic hazards.<br>• For instance, the level of development influences the affordability of strategies such as land-use zoning as well as hazard – resistant design and engineering defences such as the volcanic shelters on Sakurajima in Kyushu Japan.<br>• The frequency of the volcanic hazard event is also a key factor in why managing volcanic hazards varies in its effectiveness. Mount Merapi in Indonesia is a Decade Volcano and has frequent pyroclastic flows which are difficult to effectively manage.<br>• The population density of the surrounding can also be a significant factor in explaining the impacts of volcanic eruptions.<br>• Weak governance and levels of corruption are also key factors in why managing volcanic hazards varies in its effectiveness.<br>• Reward those who examine the criteria for what they understand by the term effective.<br><br>Accept other assessments of the effectiveness of strategies used to manage the impacts of volcanic hazards. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–4 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas, making limited logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited relevance and/or support. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to make unsupported or generic judgements about the significance of few factors, leading to an argument is unbalanced or lacks coherence. (AO2) |
| Level 2 | 5-8 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas logically, making some relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a partial but coherent interpretation that is mostly relevant and supported by evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to make judgements about the significance of some factors, to produce an argument that may be unbalanced or partially coherent. (AO2) |
| Level 3 | 9-12 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas logically, making relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is relevant and supported by evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to make supported judgements about the significance of factors throughout the response, leading to a balanced and coherent argument. (AO2) |

| Question number | Indicative content<br>Explain the contribution of meltwater to the movement of temperate glaciers. |
|---|---|
| 2(a) | AO1 – (3 marks)/AO2 – (3 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br><br>• Polar and temperate glaciers have different rates of movement.<br>• There are different processes that are important in the movement of glaciers (basal slip, regelation creep, internal deformation).<br>• A number of factors control the rate of movement (altitude, slope, lithology, size and variations in mass balance)<br><br>AO2<br><br>• Glaciers move downslope due to the effect of gravity.<br>• This movement is the result of basal slip, regelation creep and internal deformation.<br>• The diagram shows that the velocity of the glacier increases with distance from the base and valley sides.<br>• Meltwater is essential for basal slip as the layer of water builds up at the ice-rock interface and the reduction in friction enables the ice to move forward.<br>• Meltwater is also thought to be a key component of glacier surging thought to occur when enhanced basal sliding is triggered by the build-up of meltwater at the ice/rock interface particularly in the area of ablation where there are greater amounts of meltwater.<br>• Meltwater is also a key reason for bed deformation as the greater the amount of meltwater the greater the saturation of the underlying sediment and rock leading to a reduction in the strength of these materials and so increasing glacier flow.<br>• However, there is also basal and regelation (enhanced basal) creep which, depending upon the size of the obstacles, ice either deforms and moves around an obstacle or melts and refreezes around the obstacle.<br>• The diagram also shows that velocity increases away from the bed and valley sides. This is as a result of internal deformation where the glacier moves as a result of slippage within and between ice crystals being greater than basal slip due to friction.<br>• Glaciers can also move through kinematic waves which are bulges in the glacier surface, up to 10m high, caused by an increase in ice accumulation.<br>• Variations in the topography of the bed also causes compressive and extending flow. |

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| | • Variations in valley floor slope can also be vital in determining glacier movement.<br>• Accept many glaciers are polythermal − this is now in several textbooks.<br><br>Accept other explanations of the contribution of meltwater to the movement of temperate glaciers. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1−2 | • Demonstrates isolated or generic elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding to geographical information inconsistently. Connections/relationships between stimulus material and the question may be irrelevant. (AO2) |
| Level 2 | 3−4 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding to geographical information to find some relevant connections/relationships between stimulus material and the question. (AO2) |
| Level 3 | 5−6 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between stimulus material and the question. (AO2) |

| Question number | Indicative content<br>Explain the role of feedback in changing the size of ice sheets and sea ice. |
|---|---|
| 2(b) | AO1 (3 marks)/AO2 (3 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br><br>• The importance of positive and negative feedback (Greenland Ice Sheet).<br>• The process of accumulation (direct snowfall, avalanches and wind deposition) and the process of ablation (melting, sublimation, calving, evaporation and avalanches).<br>• The reasons for the variations in the rates of accumulation and ablation, and the impact these variations have on the mass balance over different timescales.<br><br>AO2<br><br>• The diagram shows a positive feedback loop caused by changes in atmospheric temperature.<br>• As temperatures rise there is an increase in surface melting which leads to a reduction in snow cover/ice and so a reduction in albedo.<br>• More solar energy is therefore absorbed and less reflected and so air temperatures rise causing further melting.<br>• Another feedback is the interaction of sea water with ice. As the ice sheet melts freshwater is released into the areas surrounding the outlet glaciers originating from polar ice sheet. As freshwater melts ice faster than salty water, the greater the melting of the polar ice sheets, the more the freshwater added to the sea and so the greater the subsequent melting of ice.<br>• Other positive feedback loops such as internal friction (strain) heating granular basal sliding and possible changes to the Atlantic Meridional Overturning Circulation (AMOC).<br>• The changes to the size of polar ice sheets are also due to changes in the mass balance of the ice sheets. If summer ablation exceeds winter accumulation or vice-versa there will also be changes to the polar ice sheets.<br>• Accept increased ocean area leads to increased evaporation and so increased cloudiness and so trapping more long wave radiation causing further warming and increased melting.<br>• Accept other feedback loops such as increased temperature, melting of permafrost and subsequent release of methane increasing temperatures further as well as the loss of tropical rainforests leading to increases in temperatures. |

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| | Accept other explanations of the role of feedback in changing the size of ice sheets and sea ice. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates isolated or generic elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding to geographical information inconsistently. Connections/relationships between stimulus material and the question may be irrelevant. (AO2) |
| Level 2 | 3–4 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding to geographical information to find some relevant connections/relationships between stimulus material and the question. (AO2) |
| Level 3 | 5–6 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between stimulus material and the question. (AO2) |

| Question number | Indicative content<br>Explain the role of melting and refreezing cycles in forming distinctive periglacial landforms. |
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| 2 (c) | AO1 – (8 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• Periglacial processes include nivation, frost heave, freeze- thaw weathering and solifluction as well as high winds and meltwater erosion.<br>• The formation of often unique periglacial landforms (ice wedges, patterned ground, pingos, loess) contributes towards the occurrence of distinctive periglacial landscapes.<br>• Ice wedges can be over a metre wide and between 8 and 10m deep – this takes about 100 years to reach these dimensions – they often occur in specific polygon shapes and these are visible above the surface. They are formed during the re-freezing of the active layer in winter. Once this is frozen, sub-zero temperatures cause the ground to contract and crack. These cracks extend into the permafrost below the active layer to create deep wedges.<br>• The ice wedges grow in size due to melting in the spring when water can then enter the cracks in the permafrost caused by contraction. This subsequently freezes and further contraction occurs the following winter as temperatures decline. The cracking occurs in a polygonal shape and so gives rise to the ice wedge polygons.<br>• Where stones are present, the area beneath them will heat and cool more quickly. Therefore, water beneath a stone will freeze earlier than that surrounding it, causing it to expand and push the stone to the surface whilst water freezing above it will pull the stone to the surface. This leads to patterned ground.<br>• During spring, when surface permafrost melts, the finer material collapses into the space left following melting and the stones remain near the surface. Once at the surface, where frost heave has concentrated, there is a slight doming that causes the stones to roll down the gentle gradient to form circles initially and then, as they merge, stone polygons are formed.<br>• A pingo open system or East Greenland type is identified as a dome shaped hill. These vary from 1m up to 50/60m in height and 0.5/0.6km in width. Some pingoes may show a dome that has collapsed in the middle. There is likely to be a small lake at the centre of these. An ice lens or core is formed beneath the dome shape which increases in size due to upward movement of additional water under pressure. The lens causes the doming at the surface and cracks to appear within the formation.<br>• There are also closed system pingoes. The lakes insulate the land below and prevent it from freezing. However, the lake infills as sediment is deposited in it, it loses its insulating effect and permafrost present around it begins to encroach it. This traps the sediment on |

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| | the former lakebed, between the advancing permafrost. The trapped groundwater also freezes, forming a mass of ice that pushes up the former sediment of the lake.<br>• Solifluction sheets, lobes and terraces are created by the movement of saturated earth downhill. Solifluction is the movement of waterlogged soil down a slope. If this occurs over a layer of permafrost it is termed gelifluction and if earth moves within the permafrost it is known as congelifluction.<br>• Accept nivation and nivation hollows.<br>• Accept scree formation as a preglacial process.<br><br>Accept other explanations of the role of melting and refreezing cycles in forming distinctive periglacial landforms. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Understanding addresses a narrow range of geographical ideas, which lack detail. (AO1) |
| Level 2 | 3–5 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Understanding addresses a range of geographical ideas, which are not fully detailed and/or developed. (AO1) |
| Level 3 | 6–8 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Understanding addresses a broad range of geographical ideas, which are detailed and fully developed. (AO1) |

| Question number | Indicative content<br>Evaluate the view that the management of active and relict glaciated landscapes is likely to be unsuccessful. |
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| 2(d) | AO1 (5 marks)/AO2 (15 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Responses that demonstrate only AO1 without any AO2 should be awarded marks as follows:<br>• Level 1 AO1 performance: 1 mark<br>• Level 2 AO1 performance: 2 marks<br>• Level 3 AO1 performance: 3 marks.<br>• Level 4 AO1 performance: 4–5 marks.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br><br>• Glaciated landscapes face varying degrees of challenges from human activities (leisure and tourism, reservoir construction, urbanisation).<br>• Human activity can also degrade the landscape and fragile ecology of glaciated landscapes (soil erosion, trampling, landslides, deforestation).<br>• Different stakeholders (conservationists, local and regional government, global organisations, NGOs) are involved in managing the challenges posed by glaciated landscapes, using a spectrum of approaches from protection through to sustainable management and multiple economic use.<br>• Legislative frameworks are used to protect and conserve landscapes by conservation and management at a variety of scales.<br>• Climate warming is a context risk, meaning that successful management of these unique and fragile landscapes is increasingly challenging, with a need for coordinated approaches at global, national and local scale.<br><br>AO2<br><br>• A key challenge to managing active landscapes is tourism. Arctic tourism has increased from 1 million in 1990's to over 2 million in 2017. As most arrive by ship, the Arctic landscape has been degraded by the building of new port facilities such as at Honningsvag and roads such as the E69 for visitors to see North Cape.<br>• Yet a key global management strategy that has successfully managed, although not tested, an active glaciated landscape is the Antarctic Treaty System (ATS). Through a global agreement the threats to this landscape have been effectively reduced by stopping any resource exploitation as well as freezing all sovereignty claims.<br>• Furthermore the treaty has also managed the threat of tourism in this active glaciated landscape. Although there are 40,000 visitors to Antarctica per year, due to protocols adopted in 1966 and subsequently added to in the Antarctic Treaty System there is now a |

| Question number | Indicative content<br>Evaluate the view that the management of active and relict glaciated landscapes is likely to be unsuccessful. |
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| | framework to manage tourism in Antarctica reducing the potential for damage to the landscape. Furthermore, strict protocols have meant that all waste is removed from this area, even wastewater, and so any damage is being minimized.<br>• However, there are concerns as the tourism is both spatially and temporally concentrated in Antarctica with concerns raised over the impact on the Patriot Hills area where heated tents and a runway are constructed every year.<br>• Another key challenge that active glaciated landscapes face is the threat of climate change. Recent studies showing that most glaciers are currently retreating with only maritime glaciers in Scandinavia showing glacial advances. This retreat will threaten landscapes due to the changes in the hydrological cycle that this will bring as well as the increased chance of glacial outburst floods.<br>• Yet this is being managed by the Paris Agreement Climate change accord and the COP26/27 agreement. As a result of there being no legally binding obligations as well as the fact that all signatories have pledged to reduce carbon emissions it avoids a key criticism of the Kyoto protocol that allowed some of the world's biggest polluters to avoid having to reduce their carbon emissions.<br>• Many countries have therefore initiated plans to reduce carbon emissions and so meet the agreement. This will therefore reduce the contextual threat of global warming.<br>• However, the agreement has been criticized as recent studies have shown that none of the major industrialized nations were implementing the policies they had envisioned and have not met their pledged emission reduction targets.<br>• Furthermore it has also been reported that even if all signatories kept to their pledges, it would not keep temperature rise below 2C. This is as a result of self-reinforcing feedback mechanisms which might inevitably cause temperatures to rise by 4-5 C. This would therefore have a negative impact on the mass balance of glaciers and cause both Arctic and Antarctic melting.<br>• Relict landscapes also face threats from tourism and climate change but uniquely they face threats from deforestation. Deforestation on exposed slopes has been found to cause increased damage to the landscapes such as in the Canadian Rockies whilst over cultivation and overgrazing is also thought to cause damage to the landscapes in Andean areas.<br>• Furthermore urbanization, mineral exploitation and reservoir construction also pose threats to relict glaciated landscapes with pollution and toxic waste being threats from hastily built urban areas and the damage to the landscape of glaciated areas through mineral exploitation and reservoir construction often taking decades to recover.<br>• Yet many relict areas have also been successfully managed at a regional level and local level. The LDNPA has a five-year management plan as well as initiatives such as Fix the Fells.<br>• Accept feedback loops and tipping points.<br>• Overall it depends upon the meaning of success. It is unlikely that all active and relict landscapes can be protected from the challenges and threats that they face but management at all scales can reduce the impacts of these threats. |

| Question number | Indicative content<br>Evaluate the view that the management of active and relict glaciated landscapes is likely to be unsuccessful. |
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| | Accept other evaluations of the view that the management of active and relict glaciated landscapes is likely to be unsuccessful. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–5 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding of geographical ideas, making limited and rarely logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited coherence and support from evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2) |
| Level 2 | 6–10 | • Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical ideas in order to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2) |
| Level 3 | 11–15 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical ideas in order to produce a partial but coherent interpretation that is supported by some evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2) |

| Level | Mark | Descriptor |
|---|---|---|
| Level 4 | 16–20 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is supported by evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2) |

| Question number | Indicative Content<br>Explain the contribution of erosional processes in producing sediment. |
|---|---|
| 3(a) | AO1 (3 marks/AO2 (3 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• The Sediment Cell concept (sources, transfers and sinks) is important in understanding the coast as a system of dynamic equilibrium, with both negative and positive feedback.<br>• The importance of erosion processes (hydraulic action, corrosion, abrasion, attrition) and how they are influenced by wave type, size and lithology.<br>• Mass movement (blockfall, rotational slumping, landslides) is important on some coasts with weak and/or complex geology.<br>• Wave type<br><br>AO2<br><br>• The diagram shows an idealised sediment cell.<br>• There are three main sources shown – erosion, mass movement and movement of beach through destructive waves.<br>• Expect details of erosional processes such as hydraulic action, corrosion, abrasion.<br>• The question states contribution and so expect:<br>• Details of other sources such as mass movement from the cliffs.<br>• Details of destructive waves moving sediment from the beach.<br>• Details of windblown sand from the beach.<br><br>Accept contributions from off-shore deposits.<br><br>Accept other explanations of the contribution of erosional processes in producing sediment. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |

| Level | Mark | Descriptor |
|---|---|---|
| Level 1 | 1–2 | • Demonstrates isolated or generic elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding to geographical information inconsistently. Connections/relationships between stimulus material and the question may be irrelevant. (AO2) |
| Level 2 | 3–4 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding to geographical information to find some relevant connections/relationships between stimulus material and the question. (AO2) |
| Level 3 | 5–6 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between stimulus material and the question. (AO2) |

| Question number | Indicative content<br>Explain the role of global warming in changing mean sea level since 1920. |
|---|---|
| 3(b) | AO1 (3 marks)/AO2 (3 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• Sea level change influences coasts on different timescales<br>• Contemporary sea level change from global warming<br>AO2<br><br>• From 1920 mean sea level has risen by approximately a total of 200mm.<br>• Contemporary global warming has warmed the oceans and as a result thermal expansion is now a key driver in raising sea levels accounting for much of the recorded increase particularly since the early 1990's when there has been over 71mm of recorded sea level rise.<br>• However as air temperatures rise the melting of glaciers has also accounted for the recorded sea level rise.<br>• Ice sheets will also melt due to increases in air temperature but positive feedback loops will also play a key role and so a significant proportion of the sea level rise is attributed to ice sheets.<br>• Land water storage such as the over extraction of groundwater has also estimated to have contributed to the total recorded sea level rise.<br>• The resource does not specify that it is global change and so accept other local causes of sea level change such as isostatic downwarping.<br><br>Accept other explanations of the role of global warming in changing mean sea level since 1920. |
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| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates isolated or generic elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding to geographical information inconsistently. Connections/relationships between stimulus material and the question may be irrelevant. (AO2) |
| Level 2 | 3–4 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding to geographical information to find some relevant connections/relationships between stimulus material and the question. (AO2) |
| Level 3 | 5–6 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between stimulus material and the question. (AO2) |

| Question number | Indicative content<br>Explain the role of geology in the formation of contrasting cliff profiles. |
|---|---|
| 3(c) | AO1 (8 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br><br>• Geology is a key factor in influencing cliff profiles. Bedrock lithology (igneous, sedimentary, metamorphic) and unconsolidated material (boulder clay) have a key role in the formation of contrasting cliff profiles.<br>• Cliffs consisting of resistant igneous or metamorphic rocks often have steeper and higher profiles than cliffs made up of sedimentary rocks or unconsolidated material. The vertical tall cliffs (580m) of Madeira are made from basalt whilst the terraced low cliffs of the Holderness coast are made from boulder clay.<br>• Geological structure (jointing, dip, faulting, folding) is also an important influence on the formation of cliff profiles.<br>• Columnar jointing in metamorphic rocks such as those at Drumadoon sill therefore produces a very distinctive vertical cliff profile.<br>• The influence of dip on cliff profiles can be seen in the eastern arm of Lulworth Cove. Due to tectonic movement caused when the African plate met the Eurasian plate, the Purbeck limestone dips into the sea resulting in the sloped cliff profile on the eastern arm of Lulworth cove.<br>• Folding is where the bedding planes of ductile or plastic rock can be folded. This then often creates cliff profiles at angle of 90 to the angle of the fold.<br>• Faulting is where the rock shears or faults and as a result often creates a steep cliff profile at the fault scarp such as the cliffs at Tintagel in Cornwall.<br>• Differential erosion of alternating strata in cliffs (permeable/impermeable, resistant/less resistant) also produces complex cliff profiles.<br>• Accept a wave cut notch as part of a cliff profile.<br><br>Accept other explanations of the role of geology in the formation of contrasting cliff profiles. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Understanding addresses a narrow range of geographical ideas, which lack detail. (AO1) |
| Level 2 | 3–5 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Understanding addresses a range of geographical ideas, which are not fully detailed and/or developed. (AO1) |
| Level 3 | 6–8 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Understanding addresses a broad range of geographical ideas, which are detailed and fully developed. (AO1) |

| Question number | Indicative content<br>Evaluate the view that without hard engineering there is little future for coastal communities threatened by coastal recession and flooding. |
|---|---|
| 3(d) | AO1 (5 marks)/AO2 (15 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Responses that demonstrate only AO1 without any AO2 should be awarded marks as follows:<br>• Level 1 AO1 performance: 1 mark<br>• Level 2 AO1 performance: 2 marks<br>• Level 3 AO1 performance: 3 marks.<br>• Level 4 AO1 performance: 4−5 marks.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• Economic losses (housing, businesses, agricultural land, infrastructure) and social losses (relocation, loss of livelihood, amenity value) from coastal recession can be significant, especially in areas of dense coastal developments.<br>• Coastal flooding and storm surge events can have serious economic and social consequences for coastal communities in both developing and developed countries. Climate change may create environmental refugees in coastal areas.<br>• Hard engineering approaches (groynes, sea walls, rip rap, revetments, offshore breakwaters) are economically costly and directly alter physical processes and systems.<br>• Sustainable management is designed to cope with future threats (increased storm events, rising sea levels) but its implementation can lead to local conflicts in many countries.<br>• Soft engineering approaches (beach nourishment, cliff re- grading and drainage, dune stabilisation) attempt to work with physical systems and processes to protect coasts and manage risks caused by changes in sea-level.<br>AO2<br>• In economically developed countries hard engineering such as the Thames barrier and raised embankments will be able to cope with the predicted rises in sea level and so a future exists for these communities upstream of the barrier.<br>• Yet coastal communities downstream of the barrier face an uncertain future unless existing hard defences are maintained. The Blackwater estuary highlights how once hard defences are abandoned the coastal area returns to a natural environment. |

| Question number | Indicative content<br>Evaluate the view that without hard engineering there is little future for coastal communities threatened by coastal recession and flooding. |
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| | • Similarly on the Holderness coast, hard defences at Mappleton have saved the community. The use of rock groynes and rock armour have built up the beach and protected the vulnerable boulder clay cliffs protecting the vulnerable community.<br>• Yet, the impact of not having hard defences is clearly seen at neighbouring Cowden and Aldbrough where the lack of hard defences has led to rapid coastal recession leading to a drop in the population of the community.<br>• However the use of hard engineering for some communities in some areas in economically developed countries have not always proved to have been successful.<br>• In Medmerry beach near Selsey, the hard defences of groynes and beach reprofiling proved to be unsustainable. To give the local community a future hard engineering was abandoned for a more sustainable approach of strategic realignment.<br>• This works with the natural systems and crucially can cope with rising sea levels in what is a very low lying area. As result Medemerry shows that hard engineering is not always required to guarantee a future for coastal flooding threatened by coastal flooding.<br>• Similarly on the southwest coast of the Isle of Wight rapid coastal recession threatened the coastal community of Chale. The area is unsuitable for hard defences but the use of soft defences such as the planting of vegetation has led to the stabilisation of the cliffs and given a future to these coastal communities.<br>• Hard engineering also does not always guarantee a future for coastal communities particularly in economically less developed countries such as the Maldives where either the country does not have the resources to implement hard defences for their entire coastlines or they are inappropriate for the setting due to the low-lying nature of the land or due to environmental constraints. In this case more sustainable approaches are the key to ensuring a future for the coastal community.<br>• Overall in many cases hard engineering is the only approach that will guarantee a future for coastal communities particularly where the magnitude of the threat of coastal recession or flooding is large. However, where sustainable approaches work with physical processes coastal communities can have a future.<br><br>Accept other evaluations of the view that without hard engineering there is little future for coastal communities threatened by coastal recession and flooding. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–5 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding of geographical ideas, making limited and rarely logical connections/relationships. (AO2) |

| Level | Mark | Descriptor |
|---|---|---|
| | | • Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited coherence and support from evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2) |
| Level 2 | 6–10 | • Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical ideas in order to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2) |
| Level 3 | 11–15 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical ideas in order to produce a partial but coherent interpretation that is supported by some evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2) |
| Level 4 | 16–20 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is supported by evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2) |

| Question number | Indicative content<br>Explain one possible impact on local communities by the development of onshore wind farms. | Mark |
|---|---|---|
| 4(a) | AO1 – 2 marks/AO2 – 1 marks<br><br>Award 1 AO2 mark for analysing the resource to identify the one possible impact on local communities and a further 2 AO1 marks expansion up to a maximum of 3 marks to explain one impact. For example:<br><br>• The close proximity of the wind farm to the community (1) will increase local employment (1) and so increase multiplier effects and lead to increases in the local economy (1).<br>• The low value farmland (1) will instead increase land sales/rents to local farmers (1) and so increases in the local economy (1).<br>• The wind farm is close to the community (1). This will increase noise/flicker from turbine blades (1) and so have a negative impact on house price/sales (1).<br><br>Accept other explanations of one possible impact on local communities by the development of onshore wind farms.<br>. | (3) |

| Question number | Indicative content<br>Explain how adaptation strategies, such as water conservation, may help communities cope with a changed climate. |
|---|---|
| 4(b) | AO1 (6 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br><br>Indicative content guidance<br><br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br><br>• Water conservation and management - A changed climate is likely to reduce the levels of precipitation in areas such as southeast Australia. These areas already suffer from water stress due to natural events such as ENSO and so a changed climate will increase water stress in this area. As a result in Australia they are adapting to climate warming and the predicted drop in precipitation by having water conservation methods such as the use of recycling as well as grey water.<br>• Resilient agricultural systems. Other societies have used resilient agricultural systems to adapt to climate warming and the reduction in precipitation. This is through the use of drought resistant crops and particularly GM drought resistance crops. In areas such as the South Downs, instead of growing wheat, farmers are adapting through the development of drought tolerant crops which do not need irrigation such as the developments of crops such as vines, olives and citrus fruit in the South Downs around Nyetimber. Indeed the area of vines has increased by 135% in the last ten years and the Rathfinny wine estate near Alfriston in East Sussex is one of the largest new vineyards, with up to 400 acres being cultivated.<br>• There are also drought-tolerant GM crop such as MON 87460, a maize and first planted in the United States in 2013. This has increased 5.5 since 2013.<br>• Flood risk management - Another way that people can adapt to changed climate are the new passive flood defences that have been built in Cockermouth to prevent another flood such as the one in 2009.<br>• Accept solar radiation management such as reflective glass.<br><br>Accept other explanations of how adaptation strategies, such as water conservation, may help communities cope with a changed climate. |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate. (AO1)<br>• Understanding addresses a narrow range of geographical ideas. (AO1)<br>• Understanding of geographical ideas lacks detail. (AO1) |
| Level 2 | 3–4 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Understanding addresses a range of geographical ideas. (AO1)<br>• Understanding of geographical ideas is not fully detailed and/or developed. (AO1) |
| Level 3 | 5–6 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Understanding addresses a broad range of geographical ideas. (AO1)<br>• Understanding of the geographical ideas is detailed and fully developed. (AO1) |

| Question number | Indicative content<br>Explain how water insecurity can cause both social and economic problems. |
|---|---|
| 4(c) | AO1 (8 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>• Social problems are a reduction in wellbeing which includes the problems caused by a lack of water needed for sanitation, health and food preparation.<br>• Water security is vital in providing sanitation - 3.6 billion people, nearly half the world's population, do not have access to safely managed sanitation in their home. Of those, 1.9 billion people live with basic sanitation services, and 494 million people practice open defecation.<br>• 2 billion people lack access to safely managed drinking water at home. Of those, 1.2 billion people have basic drinking water service.<br>• Water security is vital in improving hygiene - 2.3 billion people lack basic hygiene services, including soap and water at home. This includes 670 million people with no handwashing facilities at all.<br>• This results in 1.7 billion cases of diarrhoea among children younger than 5 years leading to an estimated 446,000 children younger than 5 years die from diarrhoea. There are 3 million cases of cholera and an estimated 95,000 cholera deaths and 11 million cases of typhoid fever and an estimated 129,000 typhoid fever death.<br>• Economic development includes industry, energy supply and agriculture.<br>• In industry water is required for washing raw materials, diluting chemicals or as a raw such as in brewing and beverages. Without reliable and clean water industrial production suffers resulting in lower economic activity.<br>• Water is a key component of the electricity generation process as it required for thermal power stations to create steam which drives turbines or through the creation of HEP. Industrialisation and the development of a middle class is impossible without clean reliable water supplies.<br>• The greatest use of water is through agriculture. 18% of the world productive land is irrigated producing 40% of all food produced.<br><br>Accept other explanations of how water insecurity can cause both social and economic problems. |

| Level | Mark | Descriptor |
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| | 0 | No rewardable material. |

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|---|---|---|
| Level 1 | 1–2 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Understanding addresses a narrow range of geographical ideas, which lack detail. (AO1) |
| Level 2 | 3–5 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Understanding addresses a range of geographical ideas, which are not fully detailed and/or developed. (AO1) |
| Level 3 | 6–8 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Understanding addresses a broad range of geographical ideas, which are detailed and fully developed. (AO1) |

| Question number | Indicative content<br>Assess the extent to which land use affects the shape of these storm hydrographs. |
|---|---|
| 4(d) | AO1 (3 marks)/AO2 (9 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Responses that demonstrate only AO1 without any AO2 should be awarded marks as follows:<br>• Level 1 AO1 performance: 1 mark<br>• Level 2 AO1 performance: 2 marks<br>• Level 3 AO1 performance: 3 marks.<br><br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• The shape of storm hydrographs depends on physical features of drainage basins.<br>• Physical features include size, shape, drainage density, rock type, soil, relief and vegetation.<br>• The shape of storm hydrographs depends as well as human factors land use and urbanisation.<br><br>AO2<br><br>• The resource shows two catchments which have all been affected by the same storm event.<br>• Catchment X has a flashy hydrograph with peak river height of 5.4 cumecs after 15 hours.<br>• This is as a result of the fact that approximately 30% of the drainage basin has been urbanised. This would cause a flashy hydrograph as a result of the impermeable surfaces in the urban areas as well as the roofs, gutters and drains which would move the water quickly to the river and so quickly to the measuring point causing a steep rising limb and a high peak discharge.<br>• Yet Catchment X is also a smaller with an area of 14km2. This would also speed the water to the measuring point as there as shorter distance for the water to travel and so this also contributes to the steep rising limb and high peak discharge.<br>• Finally there are impermeable rocks – this would reduce percolation and allow the soils to become saturated and so reduce infiltration and so further increase surface runoff contributing to the flashy hydrograph.<br>• Catchment Y has a longer lag time of 18 hours and the lowest peak river discharge of 3.4 cumecs.<br>• This is as a result of a dam which would regulate the flow of water in the river as it holds back the quick flow of the storm. This has led to a longer lag time and a lower peak discharge.<br>• There is also a coniferous plantation. This would increase interception and so slow the movement of water into the river and also increase the lag time and reduce the peak discharge. |

| Question number | Indicative content<br>Assess the extent to which land use affects the shape of these storm hydrographs. |
|---|---|
| | • Catchment Y is also the largest with a size of 18 km2. This would also increase the lag time as it takes longer to reach the measuring point.<br>• Finally there are permeable rocks underlying the forest − this would increase percolation and so further increase the lag time.<br>• It is therefore likely land use have had the greatest effect on the shape of the hydrograph as the urbanisation, dam and plantation all have key impacts on the shape of the hydrograph.<br><br>• Accept other assessments of how variations in land use affect the shape of storm hydrographs |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–4 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate. (AO1)<br>• Applies knowledge and understanding to geographical information/ideas, making limited logical connections/relationships. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce an interpretation that is not relevant and/or supported by evidence. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce an unbalanced argument that lacks coherence and makes judgements that are generic and/or unsupported by evidence. (AO2) |
| Level 2 | 5–8 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding to geographical information/ideas logically, making some relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce a partial but coherent interpretation that is mostly relevant and supported by evidence. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce an unbalanced, partially-supported argument that is drawn together with some coherence in order to make judgements. (AO2) |
| Level 3 | 9–12 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding to geographical information/ideas logically, making relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce a full and coherent interpretation that is relevant and supported by evidence. (AO2)<br>• Applies knowledge and understanding to geographical information/ideas to produce a balanced, fully-supported argument that is drawn together coherently in order to make rational judgements. (AO2) |

| Question number | Indicative content<br>Evaluate the view that human activities are having a greater impact on shorter term biological processes than longer term geological processes. |
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| 4(e) | AO1 (5 marks)/AO2 (15 marks)<br><br>Marking instructions<br>Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.<br>Responses that demonstrate only AO1 without any AO2 should be awarded marks as follows:<br>• Level 1 AO1 performance: 1 mark<br>• Level 2 AO1 performance: 2 marks<br>• Level 3 AO1 performance: 3 marks.<br>• Level 4 AO1 performance: 4–5 marks.<br>Indicative content guidance<br>The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:<br><br>AO1<br>• Most of the earth's carbon is geological, resulting from the formation of sedimentary carbonate rocks (limestone) in the oceans and biologically derived carbon in shale, coal and other rocks.<br>• Chemical weathering removes carbon from silicate rocks. The carbon ends up in the ocean as carbonate rock. Carbon is released via outgassing at ocean ridges, hotspot volcanoes and subduction zones.<br>• Phytoplankton sequester atmospheric carbon during photosynthesis in surface ocean waters; carbonate shells/tests move into the deep ocean water through the carbonate pump and action of the thermohaline circulation.<br>• Terrestrial primary producers sequester carbon during photosynthesis; some of this carbon is returned to the atmosphere during respiration by consumer organisms.<br>• Biological carbon can be stored as dead organic matter in soils, or returned to the atmosphere via biological decomposition over several years.<br><br>AO2<br>• On average, $10^{13}$ to $10^{14}$ grams (10–100 million metric tons) of carbon move through the slow carbon cycle every year whereas the fast carbon cycle moves $10^{16}$ to $10^{17}$ grams of carbon per year.<br>• Many scientists believe that the human activities are having the greatest impact on shorter term biological processes.<br>• In particular deforestation, afforestation and conversion of grasslands to farmland directly alters the shorter term biological processes in the carbon cycle of photosynthesis and respiration.<br>• Humans have been clearing forests for millenniums but by the end of the twentieth century the forest area in most of Europe was stable or increasing, with forests covering around one third of the total land area. |

| Question number | Indicative content<br>Evaluate the view that human activities are having a greater impact on shorter term biological processes than longer term geological processes. |
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| | • Deforestation however has generally increased in tropical rain forests especially in LIC countries; In tropical Africa - Nigeria, for example, lost more than 90 percent of its primary forest due to practices initiated in the colonial era, such as the mechanized logging of forest reserves, the establishment of state-owned agricultural plantations (such as cocoa and oil palm), and mining. All these human activities will have had a great impact on the shorter term biological processes.<br>• Others highlight the impact on the biological carbon cycle in the soil. Poor agricultural practices has led to increases in desertification. This reduces the organic content of the soil and so reduces the subsequent release of this carbon through the respiration of soil biota. It is estimated that over 75% of the earth's surface is already degraded and over 90% could be degraded by 2050.<br>• Yet in tropical areas the rate of deforestation has been reduced from 8 million hectares to 6 million hectares per year through schemes such as debt for nature swaps and so the impact on the shorter-term biological processes is reducing. Furthermore afforestation, particularly in HIC is increasing - Indeed in Europe, 35 countries recorded a net increase in forest area, totalling 21.5 million hectares. This also reduces the impact on these shorter term biological processes.<br>• The other key shorter term biological processes in the carbon cycle are found in the oceans. As CO2 levels rise due to the burning of fossil fuels and deforestation ocean temperatures rise and ocean acidification occurs.<br>• This has impacts on two pumps of the ocean.<br>• The biological pump will be impacted. Warmer conditions may reduce the abundance and primary productivity of phytoplankton due to enhanced stratification, less vertical mixing and reduced nutrient supply to the euphotic zone. This will therefore disrupt the food chain and so impact on the shorter term biological processes.<br>• Changes in ocean temperature and ocean acidification will also impact on the carbonate pump. Decreasing the amount of carbonate ions in the water makes conditions more difficult for both calcite users (phytoplankton and foraminifera) and aragonite users (corals and shellfish). This then means that the exoskeleton of these species are thinner and as a result the organisms are less healthy and so there are great impacts on the shorter term biological processes.<br>• Yet other argue that human activities are having a greater impact on longer term geological processes.<br>• Naturally the longer term geological processes are responsible for the largest stores of carbon in the carbon cycle. Only 1% of Earth's total carbon is above ground the rest is contained within the crust, mantle and core.<br>• The main longer term geological process is out-gassing of CO2 via volcanoes and through other geological processes such as the heating of limestone in mountain belts is thought to be 0.3 to 0.4 Gt.<br>• Yet through human activities of burning of fossil fuels and deforestation, anthropogenic carbon emissions are up to 100 times greater than all volcanic emissions. Indeed Since 1850 there has |

| Question number | Indicative content<br>Evaluate the view that human activities are having a greater impact on shorter term biological processes than longer term geological processes. |
|---|---|
| | been 2500 billion tonnes of CO2 released into the atmosphere and so having a great impact on the longer term geological processes.<br>• Human activity has also thought to be responsible for increases of volcanic outgassing itself. It is though that increased seasonal rainfall caused by climate change increases the eruptions of Mnt Etna as a result of changing the pore pressure build-up and so triggering the eruptive cycle.<br>• The other key longer term geological processes is weathering as ions such as calcium are released from silicate rocks and are washed to the oceans where they reacts with bicarbonate ions to create calcium carbonate. Global warming therefore increases the rate of weathering and as it increases the rate of reaction and increases precipitation levels. Studies have suggested that an increase of 7C would double the rate of chemical weathering.<br>• Yet more recent studies suggest that the importance of weathering as a longer term geological processes may be less important than the amount of land being exposed above sea level and topography of the Earth's surface.<br>• Overall although anthropogenic emissions of carbon dwarf the outgassing of carbon by volcanic processes there is little impact on the processes of longer term geological processes. Crucially the impacts of human activity have a greater impact on all aspects of the shorter term biological processes.<br><br>Accept other evaluations of the view that human activities are having a greater impact on shorter term biological processes than longer term geological processes. |

| Level | Mark | Descriptor |
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| | 0 | No rewardable material |
| Level 1 | 1–5 | • Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas, making limited and rarely logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited relevance and/or support. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2) |
| Level 2 | 6-10 | • Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2) |
| Level 3 | 11-15 | • Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a partial but coherent interpretation that is supported by some evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2) |
| Level 4 | 16-20 | • Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)<br>• Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is supported by evidence. (AO2)<br>• Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2) |