A-level GEOGRAPHY 7037/1

Paper 1 Physical geography

Mark scheme

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

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

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

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

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

Level of response marking instructions

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

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

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

Step 1 Determine a level

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

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

Step 2 Determine a mark

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

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

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

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

Section A

Question 1 Water and carbon cycles

Qu	Part	Marking guidance	Total marks
01	1	**Outline characteristic features of a drainage basin.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • This is the area of land drained by a major river and its tributaries (1). • A drainage basin acts as a catchment area for one river system with all the precipitation falling within a single drainage basin potentially ending up within that one single river system (1). • It is bordered by a watershed which is usually a ridge of land separating two basins (1). This may also be a lake or coastline (1) (d). • Drainage basins comprised of impermeable rock will speed up the flow of water into the river (1). Those drainage basins covered by human developments such as settlements will also generally have a faster flow of water into the river (d). Dams are also a feature of some drainage basins (1) • Slope and vegetation cover also affect the speed of flow of water across or through the drainage basin (1). For example, gentle slopes with high levels of vegetation cover will tend to hold more water and only release this slowly to the river (1) (d). • Drainage patterns can be dendritic (resembling the branches of a tree) (1) or trellis patterns, whereby tributaries join at sharp angles (1). • Accept reference to rectangular and radial patterns as long as these are clearly outlined. (1 mark per valid outline). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

01	**2**	**Analyse the data shown in Figure 1.** **AO3** – There should be clear analysis of the relationships evident in the resource. Analysis should consider the variation in the contribution to reducing GHG emissions by various groups and individual countries. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • There is a very large variation in the contributions by countries and groups of countries in this dataset. • Most are projected to reduce their emissions, with the exception of Mexico and Turkey. • China and the USA are each responsible for around 600–800 $MtCO_2e$ reduction in emissions. These represent the largest changes for individual countries. This represents around 30% of the overall expected reduction by 2030. • The other major contributors are the EU and non G20 countries which together represent around 1500 $MtCO_2e$ reduction in GHG emissions. • Most of the individual countries listed are forecast to make relatively small contributions to the overall reduction. Credit any other valid analysis.	**6** **AO3=6**

01	**3**	**Using Figure 2 and your own knowledge, assess the relative importance of physical and human factors in achieving a sustainable water supply.** **AO1** – Knowledge and understanding of the water cycle applied to an urban context. **AO2** – Application of knowledge and understanding to show how different human and physical factors impact upon the water cycle. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear assessment drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions, change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic assessment drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance. Notes for answers **AO1** • Drainage basins as open systems – inputs and outputs, to include precipitation, evapo-transpiration and runoff; stores and flows, to include interception, surface, soil water, groundwater and channel storage; stemflow, infiltration overland flow, and channel flow. Concept of water balance. • Changes in the water cycle over time to include natural variation including storm events, seasonal changes and human impact including farming practices, land use change and water abstraction. • Case study of a river catchment(s) at a local scale to illustrate and analyse the key themes above, engage with field data and consider the impact of precipitation upon drainage basin stores and transfers. **AO2** • The question is about the extent to which human and physical factors (hinted at in the resource) help to achieve the definition of sustainable water supply as set out in the note. • Precipitation is the single most important physical factor in achieving a sustainable water supply. Without this, supply is unlikely to meet demand.	**6** **AO1=2** **AO2=4**

		• Similarly rates of evaporation will impact supplies of water. For example, high rates of evaporation in an area relying on lakes and reservoirs, would point towards an unsustainable supply. • Some may reference the importance of groundwater supply and abstraction from rivers and lakes as important factors in the supply of water. The abstraction itself is clearly a human factor but the presence of groundwater and sustainable supplies from rivers and lakes are physical factors. This itself is related to the permeability of the underlying rock in the drainage basin. • Wastewater treatment is clearly a human factor. This points towards a sustainable supply based on human intervention. • Some may provide comparative information from case studies. • In terms of relative importance, candidates are free to argue either position as long as this is based on preceding content. Credit any other valid assessment.	

01	**4**	**Analyse factors driving change in the magnitude of carbon stores in a tropical rainforest that you have studied.** **AO1** – Knowledge and understanding of stores and transfers in the carbon budget. Knowledge and understanding of a specific tropical rainforest case study. **AO2** – Application of knowledge and understanding to analyse the factors driving change in the carbon of the chosen tropical rainforest. <u>Notes for answers</u> **AO1** • The size of major stores of carbon – lithosphere. • The carbon budget and the impact of the carbon cycle upon land. • Factors driving change in the magnitude of carbon stores over time and space, including flows and transfers at plant, sere and continental scales. Photosynthesis, respiration, decomposition, combustion. • Changes in the carbon cycle over time, to include natural variation (including wildfires, volcanic activity) and human impact (including hydrocarbon fuel extraction and burning, farming practices, deforestation, land use changes). • Human interventions in the carbon cycle designed to influence carbon transfers. • Case study of a tropical rainforest setting to illustrate and analyse key themes in water and carbon cycles and their relationship to environmental change and human activity. **AO2** • There are many factors driving change in the magnitude of carbon. In the context of a tropical rainforest these are arguably more physical than human in nature. • Expect to see reference to the core processes operating in carbon cycling eg photosynthesis, respiration, decomposition, combustion, weathering.	**20** **AO1=10** **AO2=10**

		• Climate change is likely to feature in many responses. The impacts on the forest are likely to be expressed negatively. For example, increased temperatures and reduced precipitation are linked to reduced productivity / reduced photosynthesis, ie a reduction in the store of carbon. • Similarly, these same circumstances increase the likelihood of forest wildfires again destroying the carbon store and also reducing uptake of CO_2. • Some may argue that increased temperature, precipitation and increased atmospheric CO_2 may itself operate as a negative feedback, accelerating plant growth and increasing the size of the carbon store of the biomass. • The thrust of most responses is likely to be on the human factors driving change in the magnitude of carbon stores. Expect to see references to the role of farming, mining, forestry and road building. In all cases the biomass store is reduced. This has a knock-on impact on the litter and soil stores as the cycle is disrupted. • Some may point towards positive human activity which is restoring the biomass store eg afforestation schemes or ecotourism conservation. Debt for nature schemes may also feature. • Case studies are likely to be used to exemplify both human negative impacts and measures to restore rainforest carbon stores. Credit any analytical approach.	

Marking grid for Question 01.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (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 (AO2). • 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, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (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 (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places. • 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 (AO2). • 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. There may be a few inaccuracies (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).
Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic (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 (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1).

	• Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Section B

Question 2 Hot desert systems and landscapes

Qu	Part	Marking guidance	Total marks
02	1	**Outline sources of sediment in hot deserts.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Weathering processes such as exfoliation release sediment when repeated heating and cooling causes layers of rock to break off (1). • Mass movement such as a rockfall whereby weakened rock strata fail and fall at great speed under gravity (1). • Erosional processes such as the action of wind which has an abrasive effect on the landscape (1). • Wind itself can provide sediment transported in dust storms for example, usually suspended in the air or via saltation (1). • Water can provide sediment to new areas, transported in ephemeral or episodic events (1). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

02	**2**	**Using Figure 3, analyse the relationship between annual precipitation and temperature in central Chile.** **AO3** – Responses should accurately analyse the temperature and rainfall data, showing clear understanding of the relationships evident between the two data sets. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of a geographical issue or question. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of a geographical issue or question. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • There is a general north to south decrease in temperature. There is also a general west to east decrease in temperature. In a relatively short space (around 120 km), eg just north of Valparaíso, the temperature range is that of the full extent of the data set. • Rainfall is a little more complex in terms of pattern. There is certainly a north to south increase in rainfall, but also inland to the south (from about 34°S) precipitation starts to increase west to east. The full extent of this is seen in the far south around Los Ríos where precipitation increases to 3000 mm pa. There is also an anomaly just south of 40°S. Here coastal precipitation is also around 3000 mm, significantly more than anywhere else in the data set. • There is a general negative correlation between temperature and precipitation. Where mean annual temperatures are at their highest (13.6–16 °C) eg in the north inland from Coquimbo, precipitation levels are at their lowest. However, even when moving inland, temperatures drop significantly to between 0–5 °C but there is still very little rainfall, ie between 0–100 mm per year. Credit any other valid analysis.	**6** **AO3=6**

02	**3**	**Using Figure 4 and your own knowledge, assess the challenges in responding to desertification.** **AO1** – Knowledge and understanding of the human responses to desertification. **AO2** – Application of knowledge and understanding to assess the likely challenges in the Sahel region. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear assessment drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic assessment drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance. Notes for answers **AO1** • The changing extent and distribution of hot deserts over the last 10 000 years. The causes of desertification – climate change and human impact; distribution of areas at risk; impact on ecosystems, landscapes and populations. Predicted climate change and its impacts; alternative possible futures for local populations. • Case study at a local scale of a landscape where desertification has occurred to illustrate and analyse key themes of desertification, causes and impacts, implications for sustainable development. Evaluation of human responses of resilience, mitigation and adaptation. **AO2** • One obvious challenge relates to the sheer scale of the project. Spanning over 8000 km and covering at least a dozen countries, this is a vast project. Co-ordinating communication and action across such a vast area is no doubt an enormous challenge. • Monitoring progress and holding individual countries to account is no doubt extremely difficult. • Furthermore, the progress made to date is of concern. Whilst reforesting 15 million hectares by 2020 should be considered a huge achievement, this had taken 12 years. With 85 million still to be reforested there must be a huge acceleration or else the project will risk not meeting its original aims.	**6** **AO1=2** **AO2=4**

		• It is not clear why Ethiopia has made so much progress compared to the other countries. Whilst all countries vary in size, it does suggest a range of commitments. Some huge countries such as Chad and Sudan do not even feature in the pie chart. • Convincing locals of the need to give up grazing or agricultural land in favour of planting forest will no doubt be another challenge. This may require some compensation or other incentive and may account for the lack of progress by some of these extremely low-income countries. • Local challenges may also feature, eg where the land is so degraded that trees cannot be planted, what action can be taken to restore this type of land? • Some may consider political instability and war as factors hindering the development of the Great Green Wall. Credit any other valid assessment.	

02	**4**	**To what extent do you agree that weathering is the most important geomorphological process shaping desert landscapes?** **AO1** – Knowledge and understanding of the processes shaping deserts. **AO2** – Application of knowledge and understanding to a chosen case study assessing the importance of different types of energy in that location. <u>Notes for answers</u> **AO1** • Systems in physical geography: systems concepts and their application to the development of desert landscapes – inputs, outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium. • Geomorphological processes: weathering, mass movement, erosion, transportation and deposition. • Distinctively arid geomorphological processes: weathering (thermal fracture, exfoliation, chemical weathering, block and granular disintegration). • The role of wind – erosion: deflation and abrasion; transportation; suspension, saltation, surface creep, deposition. • Sources of water: exogenous, endoreic and ephemeral; the episodic role of water; sheet flooding, channel flash flooding. • Origin and development of landforms of mid and low latitude deserts: aeolian – deflation hollows, desert pavements, ventifacts, yardangs, zeugen, barchans and sief dunes; water – wadis, bahadas, pediments, playas, inselbergs. **AO2** • The direction of the response will depend upon the choice of supporting material. • Weathering processes such as mechanical, chemical, frost shattering and thermal fracture are clearly important in the breakdown of desert rocks. Desert pavements are clearly a product of weathering, but more sophisticated answers should note that other processes have a role in fully exposing these weathered surfaces. Expect to see reference to the role of wind and water. • Other landforms associated with weathering may also feature. The inselberg Uluru (Australia), is a product of weathering but also erosion of surrounding softer younger sedimentary rocks leaving this 350-metre-tall 3 km long rock protruding from the landscape. There should also be recognition that these features developed in very different climatic conditions to that found today. The predominant theory is that chemical weathering was the dominant process shaping this landform. • Those who focus on landscapes dominated by erosional features such as yardangs, ventifacts or zeugen are more likely to suggest that erosion is the dominant natural process shaping the landscape. However, even here there should be some recognition that weathering as well as deflation will almost certainly have played some role.	**20** **AO1=10** **AO2=10**

		• Those considering the development of landscapes shaped by water (episodic, endoreic and ephemeral) will most likely focus on erosion and deposition as the most dominant processes. Badlands are likely to feature in such responses as will the role of the Colorado River in creating the mesas and buttes of the Grand Canyon landscape. Even here though, weathering continues to shape the landscape, though it would be hard to argue that it is the dominant process. • Finally, those considering the sandy desert landscape and the development of seif and barchan dunes, will no doubt conclude that wind transport is the dominant process. However, the sand must have been supplied as a result of erosion and weathering processes. Without this supply of material, there would be no landscape. • Whatever the approach there should be some acknowledgement that weathering processes are significant in the formation in most if not all desert landscapes. Any conclusion is acceptable, though should relate to preceding content.	

Marking grid for Question 02.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (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 (AO2). • 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, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (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 (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places. • 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 (AO2). • 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. There may be a few inaccuracies (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).
Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic (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 (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1).

	• Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 3 Coastal systems and landscapes

Qu	Part	Marking guidance	Total marks
03	1	**Outline processes leading to the formation of sand dunes.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Sand dunes can only develop where there is a steady supply of sediment, ie a large sandy beach (1). • On beaches with a large tidal range (1) the sand dries at low tide (1) (d). Onshore wind is required to blow the sand inland (1). Transport processes such as traction or saltation move the sand (1) (d). It is only where the sand meets an obstacle such as a dead tree or a rocky outcrop that the sand starts to collect and the early embryo dune is formed (1). Mature dunes receive an ongoing supply sediment from the embryo dune (1). They become colonized by vegetation and become more stable features (1). More sand is trapped by the vegetation eg marram grass (1) (d). These dunes change to a grey colour as more humus is added (1). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
03	2	**Analyse the information shown in Figure 5.** **AO3** – Responses should accurately analyse the connections and relationships shown in the data in **Figure 5**. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of a geographical issue or question. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of a geographical issue or question. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • In simple terms, the level of risk increases for all locations as global sea level rises from the low emission scenario to the high emission scenario. • The level of risk also increases as the location types move from left to right. In all cases the maximum possible response leads to a decline	**6** **AO3=6**

		in risk in each location. This is most notable for the high-income coastal cities and the large tropical agricultural deltas. • Even in the low emissions scenario (0.3–0.58 m sea level rise) most places are forecast to experience moderate to high impacts. • At the low emission scenario, there is some decrease in risk between r and R for any location. • The small urbanised islands face the greatest threat and even in the maximum potential response, high significant and widespread risks are expected. Credit any other valid analysis.	

03	**3**	**Using Figure 6 and your own knowledge, assess the sustainability of management strategies in reducing risk of coastal flooding.** **AO1** – Knowledge and understanding of sustainable approaches to coastal flood risk. **AO2** – Application of this knowledge to the novel situation; specifically in assessing the sustainability of flood risk management <u>Mark scheme</u> **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear assessment drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions, change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic assessment drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance. <u>Notes for answers</u> **AO1** • Human intervention in coastal landscapes. Traditional approaches to coastal flood and erosion risk: soft engineering. Sustainable approaches to coastal flood risk. • **Case study(ies)** of coastal environment(s) at a local scale to illustrate and analyse fundamental coastal processes, their landscape outcomes as set out above and engage with field data and challenges represented in their sustainable management.	**6** **AO1=2** **AO2=4**

		AO2 • The direction of the response will depend upon the supporting material. • The idea of restoring wetlands is certainly sustainable in principle and few would argue with the sustainable principles of building green infrastructure. However, in practice, the viability of such an approach depends heavily upon the location. In Hornsea (Holderness) for example, the settlement is built up to the coastline. There is no physical capacity to restore wetlands and it is not a practical idea. • The barriers and embankments do apply in Holderness. However, most would argue that the construction of sea walls, groynes and the use of rip rap boulders are not part of a sustainable solution, eg those found in Hornsea. These hard engineering solutions are often heavily criticised due to a lack of affordability and because they simply do not work with natural processes. • Set back lines as part of managed retreat would also not be a viable solution without substantial loss of developed land which is built up to the coastline. Managed retreat may be more successful further along the coast. The caravan park at Hornsea for example is already in a very precarious position. • Few could argue with the importance of hazard mapping, evacuation plans and early warning systems though it is not clear how this would work in practice. • In mitigating risk, the likely cost of insurance for properties built on vulnerable coastlines is likely to be a major barrier to living in these areas. For example, Fairborne is due to receive no further investment in coastal defences. Plans are in place to return Fairborne to a tidal saltmarsh. This may achieve some other sustainable goals, but local people would simply not agree that this was a sustainable solution for them. • The steps of the plan presented in **Figure 6** are coherent and logical. However, the implementation of such a plan would be fraught with challenges when balanced against the existing situation in most coastal settlements, certainly in the UK. Credit any other valid assessment.	

03	**4**	**With reference to one or more coastal environment(s) that you have studied, analyse factors and processes leading to the development of a high energy, erosional coastal landscape.** **AO1** – Knowledge and understanding of factors leading to a high energy coastline. **AO2** – Application of knowledge and understanding to analyse factors and processes leading to a high energy, erosional landscape. <u>Notes for answers</u> **AO1** • Sources of energy in coastal environments: winds, waves (constructive and destructive), currents and tides. Low energy and high energy coasts. • Sediment sources, cells and budgets. • Geomorphological processes: weathering, mass movement, erosion, transportation and deposition. • Distinctively coastal processes: marine: erosion – hydraulic action, wave quarrying, corrasion/abrasion, cavitation, solution, attrition; transportation: traction, suspension (longshore/littoral drift) and deposition; sub-aerial weathering, mass movement and runoff. • A variety of landscapes from beyond the UK or may include UK examples. • Origin and development of landforms and landscapes of coastal erosion: cliffs and wave cut platforms, cliff profile features including caves, arches and stacks; factors and processes in their development. **AO2** • There are a variety of approaches which candidates may take. The direction of the response will depend on the choice of supporting material. • For high energy coastlines it is a combination of factors which has created the condition for the predominantly erosional landscapes which dominate. The west coast of Ireland, exposed Atlantic shores of Norway, Iceland, Greenland and Maritime Canada are some of the harshest high energy coastal environments in the world. • Expect to see reference to a range of factors in creating such environments: large fetch, consistent regular wind direction and local coastal conditions such as deeper water in close proximity to the coast itself. Some may consider atmospheric factors such as low-pressure systems. A large tidal range is another contributing factor to high energy coasts. • These factors produce the conditions for high energy, maximum erosion and risk of flooding. • In terms of landscape development expect to see reference to the factors / processes leading to the formation of cliffs, headlands, wave cut platforms, caves, arches, stacks and stumps. • The response should be supported by appropriate exemplar material taken from one or more coastal landscapes. Credit any other valid approach. Analysis should be logical, sequential and well supported.	**20** **AO1=10** **AO2=10**

Marking grid for Question 03.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (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 (AO2). • 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, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (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 (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places. • 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 (AO2). • 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. There may be a few inaccuracies (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).
Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic (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 (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1).

	• Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 4 Glacial systems and landscapes

Qu	Part	Marking guidance	Total marks
04	1	**Outline processes which lead to the formation of solifluction lobes.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers **AO1** • The active layer (in a region experiencing permafrost) undergoes a period of melting in the summer months (1). • The active layer starts to slip under the force of gravity (1). This can occur on gradients as low as 1 degree (1) (d). • Daily frost heave also plays a role in the early summer months (1). Here the soil particles are thrust towards the surface by the expansion of the ice during cycles of freezing and thawing (1) (d). • On some slopes a combination of these processes causes the formation of terracettes (1). • The lobe is formed when the front of the material slows when the gradient lessens (1). • The material behind the front continues to move causing a build of material at the front and lobe shape forms (1) (d). Max 3 if only one process is considered. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
04	2	**Analyse the data shown in Figure 7.** **AO3** – Responses should analyse the two data sets accurately, including manipulation data, showing awareness of trends and relationships between the two datasets. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.	**6** **AO3=6**

		Notes for answers **AO3** • Interior Alaska is both warmer and has a narrower range of data compared to Northern Alaska. • There is clear evidence of warming across the two data sets. For interior Alaska, the strong evidence is found in Old Man which has warmed from around −3.1 °C to around −1.7 °C over a period of around 36 years. This is an increase of temperature of around 1.4 °C. • Livengood represents something of an anomaly for Interior Alaska. The permafrost temperature remains at around 0.7 from 1983 to 2020 with very little discernible variation. • There is limited evidence to suggest any acceleration in the warming more recently for Interior Alaska, with the exception of Old Man. • When comparing the two data sets, most show a very slight cooling between 2000 and 2002. • The rate of increase in temperature is more noticeable for Northern Alaska. For example, West Dock has an increase from −10 °C in 1978 to −7 °C in 2018, an increase of 3 °C. • The biggest increase is found in Deadhorse, from −8.5 °C to −5.1 °C, an increase of 3.4 °C over 32 years. Dead Horse also shows the most fluctuation, particularly between 1978–1990 with four years showing a decline in temperature. West Dock also experiences some significant dips between 1983 and 1995. • The overwhelming evidence is that the permafrost has become warmer over the period for both data sets. Credit any other valid analysis.	

04	**3**	**Using Figure 8 and your own knowledge, assess the challenges that climate change is likely to pose in these alpine tundra regions.** **AO1** – Knowledge and understanding of the impact of climate change on cold environments. **AO2** – Applies knowledge and understanding to the novel situation in assessing the challenges of climate change on this landscape. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to this novel situation offering clear assessment drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance.	**6** **AO1=2** **AO2=4**

		Level 1 (1–3 marks) **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic assessment drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance. <u>Notes for answers</u> **AO1** • Physical characteristics of cold environments. Climate, soils and vegetation (and their interaction). • Concept of environmental fragility. Human impacts on fragile cold environments over time and at a variety of scales. Recent and prospective impact of climate change. Management of cold environments at present and in alternative possible futures. • Case study of a contrasting glaciated landscape from beyond the UK to illustrate and analyse how it presents challenges for human occupation. **AO2** • The temperature increase will effectively raise the tree line further up the slope. This means that existing tundra vegetation species will effectively be outcompeted over time. Those environmental niches which exist on the upper slopes in the Alps, Pyrenees and Scandes will be at risk of serious disruption. The Pyrenees, for example, is expected to see a 74% decline in its tundra with a warming of just 1 °C which is arguably already occurring. • Warming further downslope will allow for the introduction of new species including non-native species well acclimatised to the new environment. This may lead to new invasive species colonising the area. Those further affect the ecology and food webs particularly if virulent pests colonise. • Spring snowmelt is likely to be reduced. This recharge of freshwater for the environment downslope will affect both aquatic life and the supply of freshwater for people dependent on this annual event. HEP schemes may also experience a detriment. • Increased slope instability may result in damage to wildlife and greater risks to people. • Recreational activities such as skiing will be at risk of collapse in some traditional locations. • Assessment may consider scale of challenge or potential severity. Credit any other valid assessment.	

04	**4**	**With reference to a glaciated landscape that you have studied, to what extent has erosion been the dominant process shaping the landscape?** **AO1** – Knowledge and understanding of the processes and landscapes in glacial environments. **AO2** – Applies knowledge and understanding to show how the processes link directly to the creation of the glaciated landscape. <u>Notes for answers</u> **AO1** • Geomorphological processes – weathering: frost action, nivation; ice movement: internal deformation, rotational, compressional, extensional and basal sliding; erosion: plucking, abrasion; transportation and deposition. • Erosional and depositional landforms: corries, arêtes, glacial troughs, hanging valleys, truncated spurs, roches moutonnées. Characteristic glaciated landscapes. • Origin and development of landforms and landscapes of glacial deposition: drumlins, erratics, moraines, till plains. Characteristic glaciated landscapes. • Case study(ies) of glaciated environment(s) at a local scale to illustrate and analyse fundamental glacial processes, their landscape outcomes as set out above and engage with field data. **AO2** • The direction of the response will depend on the choice of supporting material. • Expect to see some definition of terms such as abrasion and plucking as these are the main tools of erosion by glaciers. • These processes combined with the sheer force of the moving ice are responsible for the formation of a large number of interlinked landforms such as corries, ridges, pyramidal peaks, glacial troughs hanging valleys and truncated spurs. Within the valley there is also likely to be reference to roche moutonnées. All of these are clearly products of glacial erosion. • However, during the development of these landforms, more sophisticated responses should point towards other processes. For instance, most agree that the corrie starts out as a nivation hollow and cannot develop into a corrie without ice compression and then movement under gravity. Processes such as basal sliding, internal deformation and rotation are therefore essential in forming a corrie and later, a valley glacier. • Furthermore, the role of glacial transport and deposition is vital in explaining a host of other characteristic features of the glaciated landscape. Drumlins, erratics, moraines and till plains are all formed by the action of the melting ice as it reaches warmer temperatures in either lower lying land or lower latitudes. Expect to see some	**20** **AO1=10** **AO2=10**

		reference to the moraine dammed ribbon lakes which are characteristic features of the glaciated valley floor. • The role of weathering should also be considered not least in the formation of scree slopes. • Some may even consider eustatic sea level change and its importance in shaping the landscapes of the fjords and / or Dalmatian coastlines. • Whatever the argument there should be some awareness that it is not just erosion which has led to the formation of these highly distinctive landscapes. Credit any other valid assessment.	

Marking grid for Question 04.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• 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 (AO2). • 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 (AO1).
Level 3 (11–15 marks)	• 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 (AO2). • 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 (AO1).
Level 2 (6–10 marks)	• 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 (AO2). • 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 (AO1).
Level 1 (1–5 marks)	• 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 (AO2). • 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 (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Section C

Question 5 Hazards

Qu	Part	Marking guidance	Total marks
05	1	**Outline processes involved in the formation of island arcs.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers **AO1** • Island arcs tend to form at destructive (convergent) plate boundaries (1). • Convection currents are the process involved in the creation of island arcs (1). Some may reference ridge push / slab pull (or gravitational sliding) as an associated theory (1) (d). • When oceanic crust descends into the mantle along the lithosphere it folds, crumples and is forced up (1). This is most likely to occur at oceanic / oceanic plate boundaries (1) (d). • Intense heating occurs along the subduction zone (1). Some may reference the role of friction or the presence of water in causing the mantle to reach melting point and forming magma (1) (d). • The less dense magma rises to the surface forming volcanoes, often in the shape of an arc (1). • Examples include the Ryuku Islands, south of Japan (1). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
05	2	**Interpret the data shown in Figure 9.** **AO3** – There should be interpretation of the information provided. This should include an awareness of the patterns and relationships as well as an awareness of any anomalies. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of a geographical issue or question. Clear interpretation of the quantitative evidence provided, which makes appropriate use of data and evidence in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of a geographical issue or question. Basic interpretation of the quantitative evidence provided, which makes limited	**6** **AO3=6**

		use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • Northern California appears to be less at risk of extreme seismic events compared to Southern California looking at the map data. However, the probability of >6.7 in a 30-year period is similar and almost certain to occur, according to the table (93% v 97% and just a 4% difference). Also, the table indicates that Southern California is at much greater risk of >7.0 and >7.5. For instance, at >7.5 the risk is 22% higher. • Broadly speaking there are two swathes of land at greater risk of a >6.7 event across the whole of California. The first area is in a series of relatively thin strips running almost parallel to the coast and extending inland around 80 km–100 km. These thin strips are where the highest risks are found in California. • The second area of increased risk of seismic activity is more of a zone extending from the north down to the southeast in a wider band, again around 80–100 km wide. The risk is much lower here though at only 0.1 to 10%. • Much of the interior of California has no significant risk of such a seismic event. • The logarithmic colour spectrum scale could be argued to be a little unclear. For example, the thin strip extending northwest to southeast just above Los Angeles and San Diego is the most active area on the map. The percentage appears to be around 50%, but it is not possible to be definitive or to compare areas easily. • It is also hard to see how the percentages in the table correlate with the map evidence for >6.7 events in a 30-year period. Considering that risk in the table is so high, the map should include more colours towards the top end of the spectrum. • Allow critical evaluation of the resource's usefulness. Credit any other valid interpretation.	

05	**3**	**Using Figure 10 and your own knowledge, assess the challenges in responding to an event such as this.** **AO1** – Knowledge and understanding of the management of tropical storms. **AO2** – Application of knowledge and understanding to the novel situation, to assess the impacts of the data for the management of tropical storms in this region. <u>Mark scheme</u> **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Assessment is detailed and well supported with appropriate evidence. **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. **AO2** – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Assessment is evident and supported with clear and appropriate evidence. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. **AO2** – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Assessment is basic and supported with limited appropriate evidence.	**9** **AO1=4** **AO2=5**

		Notes for answers **AO1** • The nature of tropical storms and their underlying causes. Forms of storm hazard: high winds, storm surges, coastal flooding, river flooding and landslides. Spatial distribution, magnitude, frequency, regularity, predictability of hazard events. • Impacts: primary/secondary, environmental, social, economic, political. Short and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. • Impacts and human responses as evidenced by two recent tropical storms in contrasting areas of the world. **AO2** • The storm appears to have hit the northern part of the south and central Philippines over 3-day period (10–12 April, 2022). At its worst, over 500 mm of rainfall fell in an 4-day period. This will almost certainly have caused widespread flooding. Trying to provide evacuation routes as well as accessing the area to provide emergency relief will have proven extremely difficult. No doubt the delays will have caused unnecessary hardship and contributed to the loss of life. • Considering the size of the Eastern Visayas Islands, 107 rescue centres does not seem adequate given that it bore the brunt of the storm in terms of loss of life and missing persons. Western Visayas for example had 226 rescue centres but only 17 dead and 6 missing. The focus of the rescue operation needed to be on Eastern Visayas. • Another issue is scale of area affected. Given the sheer size of the archipelago, emergency services would have found accessing the number of sites requiring support to be extremely difficult. Even as far south as Davao, there were still deaths and missing people. • Added to this was the multi-hazard nature of the event. For example, the storm surge appears to have affected the whole country. Some parts may have been relatively well protected but others not. • Prioritising which areas to help would have been hampered by the scale but also inevitable communication issues. No doubt telephone lines, Internet services and TV communications were affected to at least some degree. This would have made it harder to both receive and send vital messages. • In the longer term, reconstruction would have been a major challenge. Nearly 500 000 had to leave their homes and over 11 000 houses were damaged in some way. Depending on levels of insurance, government may also have needed to step in and provide emergency assistance. • Some may go further and consider challenges such as ruined farmland /crops and the implications of other aspects of infrastructure damage. This is creditable. • Others may compare this event with their learned case study material. Lengthy consideration of this is only creditable under AO1. Credit any other valid assessment.	

05	**4**	**Evaluate the role of economic development in the management of wildfires.** **AO1** – Knowledge and understanding of how levels of development relate to the human response to wildfires. **AO2** – Application of knowledge and understanding to evaluate the role of economic development in the management of wildfires. <u>Mark scheme</u> **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence. **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. **AO2** – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. **AO2** – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.	**9** **AO1=4** **AO2=5**

		Notes for answers **AO1** • Characteristic human responses – fatalism, prediction, adjustment/adaptation, mitigation, management, risk sharing – and their relationship to level of development. • Nature of wildfires. Conditions favouring intense wildfires: vegetation type, fuel characteristics, climate and recent weather and fire behaviour. Causes of fires: natural and human agency. Impacts: primary/secondary, environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. • Impact and human responses as evidenced by a recent wildfire event. **AO2** • Irrespective of the level of development there are measures that communities can take to protect themselves from the most severe impacts of wildfires. For those with only intermediate technology the key is education and communication. Once individual families and communities know they are at risk, they can undertake controlled burning in advance of an event to create a protective ring around whatever they deem valuable. Families can use flame resistant building materials. Early warning systems can be put in place, in even the most remote and undeveloped locations. Using high points on the land and establishing spotters will certainly help. • However more developed countries generally have greater resilience to wildfires due to the access to better technology. Weather mapping can identify which areas are more likely to be affected. This combined with early warning and a combination of protecting property and evacuation will save lives. Emergency services are more likely to be equipped with the necessary skills, training and equipment tackle the fire. This includes creating fire breaks and using flame retardants as well as aircraft to deliver high volumes of water. Insurance is likely to be much more prevalent as level of development improves. Whilst this does not help with the management of the fire, it certainly helps with recovery. • Case studies may feature as a comparison, and if clearly used to support the answer can be credited for AO2. Credit any valid assessment.	

05	**5**	**Assess the future prospects for sustainable human occupation of a multi-hazardous environment that you have studied.** **AO1** – Knowledge and understanding of a multi-hazard environment location and the responses to this hazard. **AO2** – Application of knowledge and understanding to assess the extent to which the chosen location has a sustainable future. <u>Notes for answers</u> **AO1** • Case study of a multi-hazardous environment to illustrate and analyse the nature of the hazards and the social, economic and environmental risks presented, and how human qualities and responses such as resilience, adaptation, mitigation and management contribute to its continuing human occupation. **AO2** • The direction of the response will depend on the choice of supporting material. • By any definition Haiti fits the definition of a multi-hazard environment. It lies on a fault line between the Caribbean and North American plate. In 2010 it was hit by a shallow focus 7.0 Richter Scale earthquake near the capital Port Au Prince. Most of the estimated 260 000 deaths were caused by the impact of the earthquake, but there was also a tsunami triggered by underwater landslides. Added to this, a secondary impact caused by the insanitary conditions was cholera. An additional 9000 died between 2010 and 2017 with hundreds of thousands still at risk of the disease. Haiti is also vulnerable to tropical storms, as evidenced by the 2016 Hurricane Matthew event. Prior to this and not long after the earthquake of 2010, it was hit by Hurricane Tomas. It lies in the location of regular tropical storms fuelled by high water temperatures in the Caribbean Sea. These tropical storms have created a number of additional hazards such as landslides, coastal floods and river floods. • Haiti has been severely damaged by these repeated events over a relatively short space of time. Added to this Haiti was already one of the poorest countries in the western hemisphere. The underlying challenges of a low literacy (representing a poor inaccessible education system), poor healthcare (evidenced by low life expectancy) as well as alleged government corruption and mismanagement have produced a dire outlook for Haiti in terms of a sustainable future. • The country could be described as being in a repeating cycle of disaster and only partial recovery before the next disaster strikes. Some estimates suggest that the earthquake alone has pushed Haiti's development back by 100 years. • International support has not been strong in recent years. Some argue that this is due to 'disaster fatigue' ie charitable donations have dried up due to the repeated issues facing the country. This is quite the opposite of what the country needs but there may be evidence of this occurring. However, debt cancellation has taken place and the UN donated $21 million to help with the refugee and cholera crisis. Other attempts have been made to train local doctors and rebuild	**20** **AO1=10** **AO2=10**

		communications infrastructure in Haiti. Nevertheless, Haiti's international debt once again exceeds $400 million. • Internally, there are serious issues around political instability, inflation, crime and gang warfare. • It is very hard to see how this multi-hazard environment has anything resembling a sustainable future without substantial, immediate and long-term international support. Even this small hope is predicated on the country remaining disaster free, which does not seem likely. • Others may consider multi-hazardous locations which are more sustainable in terms of human occupation. Expect to see reference to Japan for example, in this regard. Credit any other valid assessment.	

Marking grid for Question 05.5

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (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 (AO2). • 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, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• 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 (AO2). • 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 (AO1).
Level 2 (6–10 marks)	• 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 (AO2). • 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 (AO1).
Level 1 (1–5 marks)	• 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 (AO2). • 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 (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 6 Ecosystems under stress

Qu	Part	Marking guidance	Total marks
06	1	**Outline the concept of climatic climax.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers **AO1** • This is the final stage of succession in an area where the dominant vegetation has reached equilibrium with the surrounding environment (1). No further changes will occur unless the environment changes or a new more suitably adapted species is introduced (1) (d). Any new species would need to outcompete the existing dominant vegetation in the community (1) (d). This vegetation community is best adapted to the prevailing climatic conditions of the area (1) (d). • To reach this stage pioneers initially colonise the area requiring nothing more than light, heat, water and the most basic nutrients found on bare rock (1). Examples includes moss and lichen (1) (d). • When these pioneers die (and with some weathering of parent rock) a very basic soil forms allowing other species to colonise (1). The addition of organisms (decomposers) also aids this process (1) (d). • New species continue to hold the niche but they themselves are outcompeted (succession) until the climax is achieved (1). • Max 1 for example e.g. temperate deciduous woodland (1). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

06	**2**	**Analyse the data shown in Figure 11.** **AO3** – Analysis relates to identification of pattern and trends as well as anomaly. There is also opportunity to manipulate data. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • Tropical wet and moist store most of their carbon in the biomass compared to the other biomes. For example, Tropical moist stores over 150 gigatonnes of carbon in its biomass compared to 25 gigatons for warm temperate moist, a difference of over 125 gigatons. • In terms of total biomass, Tropical moist may at first glance appear to be the biggest store at around 300 gigatons (155 biomass, 75 topsoil and 70 subsoil). However, this is comfortably exceeded by the Boreal moist biome which has around 365 gigatons stored in total (25 in biomass, 160 in topsoil and 190 in subsoil). This is a difference of 65 gigatons. • Tropical wet and moist also represent an anomaly in that they are the only two biomes with more carbon in the biomass than the combined soils total, e.g. tropical wet has around 140 gigatons in biomass compared to a combined 125 gigatons in the two soil types. • There are three biomes with more carbon in the topsoil compared to the subsoil. The difference appears to be around 5-10 gigatons. • Boreal moist has the largest differential between topsoil and subsoil; a difference of around 30–35 gigatons. Credit any other valid analysis.	**6** **AO3=6**

06	**3**	**Using Figure 12 and your own knowledge, assess impacts of human activity on the cycling of nutrients in a temperate deciduous woodland.** **AO1** – Knowledge and understanding of nutrient cycling. Awareness of ecosystem responses to changes in one or more of their components. **AO2** – Application of knowledge and understanding to assess the impact of human activity on nutrient cycling. Mark scheme **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Assessment is detailed and well supported with appropriate evidence. **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. **AO2** – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Assessment is evident and supported with clear and appropriate evidence. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. **AO2** – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Assessment is basic and supported with limited appropriate evidence. Notes for answers **AO1** • Mineral nutrient cycling. • Ecosystem responses to changes in one or more of their components or environmental controls. • Factors influencing the changing of ecosystems including human exploitation. • Succession and climatic climax as illustrated by lithoseres. • The characteristics of the climatic climax: temperate deciduous woodland biome.	**9** **AO1=4** **AO2=5**

		AO2 • Deforestation is one obvious activity which would impact on mineral nutrient cycling. This would immediately remove the biomass store and also remove the transfer to the litter. • Afforestation would have the opposite effect to the above but this depends on the species planted. An orchard or a plantation for the timber industry would inevitably change the size of the biomass store depending upon what was planted. • Similarly, if trees are planted for specific purposes, such as Christmas trees (fir and spruce conifers), these are likely to have negative impacts on the litter as they are evergreen. Needles are less easy to decompose and release fewer nutrients into the soil. • If trees are removed and nothing is replanted, the area becomes at risk of increased loss by leaching, thus increasing the size of that pathway out of the system. Similarly, loss by run off is likely to increase with no canopy to protect the soil underneath. • Input from dissolved nutrients in rainfall may increase with no canopy to intercept vegetation. With more water reaching the ground there may be more infiltration and percolation. This may possibly increase the input of nutrients from weathered rock. • Knowledge of specific nutrients are not required but some reference to nitrogen, phosphorus and potassium etc. Credit any other valid assessment.	

06	**4**	**Assess the potential impact of climate change upon people living in savanna grasslands.** **AO1** – Knowledge and understanding of pressures facing the savanna grasslands. **AO2** – Application of knowledge and understanding to assess the potential impact of climate change on this region for people, plants and animals. <u>Mark scheme</u> **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Assessment is detailed and well supported with appropriate evidence. **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. **AO2** – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Assessment is evident and supported with clear and appropriate evidence. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. **AO2** – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Assessment is basic and supported with limited appropriate evidence.	**9** **AO1=4** **AO2=5**

		Notes for answers **AO1** • The concept of the biome. The global distribution of major terrestrial biomes. • Savanna grassland to include: o the main characteristics of the biome o ecological responses to the climate, soil and soil moisture budget – adaptations by flora and fauna o human activity and its impact on the biome o typical development of issues in the biome to include changes in population, economic development, agricultural extension and intensification, implications for biodiversity and sustainability. **AO2** • The climate of the savanna is considerably varied depending on location. It is characterised by a wet and dry season, but within this both precipitation and temperature show considerable variation. • Species are highly adapted to these conditions: the baobab and acacia are two examples of species adapted to cope with the high temperature and lack of all-year-round water; grasses are well adapted to cope with drought and fire. • Most agree that temperatures are set to increase generally across the savanna and rainfall will become less reliable and predictable in terms of volume and timeliness. • The ramifications of this for people are expected to be substantial. • The grasses provide the basis of the food chain, whilst the rains provide the water for the arable farmers in the savanna. This has implications for both the pastoralists and arable farmers. • Similarly, the wildlife is wholly dependent on the seasonal rains for food from grass or water for drinking. Those species further up the food chain have little chance of surviving if there is no water and their food source is under threat. • Other industries such as tourism are also totally (albeit indirectly) reliant on a reliable climate. Hotels require substantial quantities of water for guests and most tourists are in these areas to visit the wildlife of the game reserves. • It is hard to see anything other than a very challenging future for the people and ecosystem of the savanna grasslands. Credit any other valid approach. Assessment should be based upon preceding content.	

06	**5**	**With reference to a coral reef that you have studied, assess the sustainability of human activity within the area.** **AO1** – Knowledge and understanding of the pressures facing coral reefs. **AO2** – Application of knowledge and understanding to assess the sustainability of coral reef exploitation. <u>Notes for answers</u> **AO1** • The distribution and main characteristics of coral reef ecosystems. • Environmental conditions associated with reef development. The following aspects should be examined with reference to a named, located coral reef: o factors in the health and survival of reefs o natural: water temperature, acidity, salinity, algal blooms o human activity and its impact: major drainage basin schemes, onshore development, desalination, pollution, tourism, fishing o future prospects for coral reefs. **AO2** • The direction of the response will depend on the choice of supporting material. • Most are likely to argue that current practices exploiting coral reefs are unsustainable. There are many threats facing the reef systems. Pollution (from factories on land and boats at sea), overfishing (particularly dangerous practices include dynamite fishing as well as the use of cyanide), souvenir hunting as well as coral extraction for use in industries such as construction. • Probably the biggest threat is from climate change. Though the human activity has a limited link to the area itself, the impacts certainly are within the area. Coral bleaching occurs when the temperatures become too high for the coral. The algae dies and the mutually dependent symbiotic relationship is destroyed. • Natural predators such as the crown of thorns starfish may be increasing in number due to certain human activities. Offshore dredging for example is thought to increase the amount of phytoplankton which the starfish larvae feed off. • Finally, increased frequency and intensity of tropical storms may also be indirectly attributable to human activity through climate change. Whilst coral protects coastlines from the worst impacts of tropical storms, the associated storm surges can do enormous damage to the coral once they strike the coast. • There are a number of success stories in sustainable coral management. In Australia, work has been undertaken to promote the growth of algae on corals which are more tolerant to increased global temperatures, surviving in temperatures up to 31 °C. • Corals in the Gulf of Aqaba, in the northernmost region of the Red Sea, are capable of withstanding ocean temperature fluctuations that normally cause coral bleaching elsewhere. Identifying the durability of the reef may be key to maintaining the protection of coral reefs in other	**20** **AO1=10** **AO2=10**

		regions of the world with vulnerability to ocean temperature increases. In 2020, experts applied to UNESCO to designate the 2500-mile coral reef of the Red Sea a Marine World Heritage Site. • Dense root systems of mangrove trees capture sediments moving down rivers. Mangrove helps to protect the coastline and prevents tides and hurricanes from eroding. The trees also shield coral reefs and seagrass meadows from being smothered in sediment. Protecting mangrove is increasingly becoming seen as having an associated positive impact on coral as often they occupy adjacent locations in the same places. • Overall, the future is not looking positive but there are measures in place to try to improve this outlook. Credit any other valid approach.	

Marking grid for Question 06.5

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (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 (AO2). • 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, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• 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 (AO2). • 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 (AO1).
Level 2 (6–10 marks)	• 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 (AO2). • 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 (AO1).
Level 1 (1–5 marks)	• 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 (AO2). • 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 (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.