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.

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	**Explain the concept of negative feedback within the carbon cycle.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Feedback is an important aspect of systems and their tendency towards dynamic equilibrium (1). • Negative feedback nullifies / returns a system towards equilibrium (1) and counteracts the impact of earlier changes in the system (1) (d) • For example, increased atmospheric CO_2 leads to both warmer temperatures and availability of CO_2 for uptake by plants (1). This promotes increased photosynthesis rates and carbon capture/storage by plants (1) (d), reducing the carbon levels back to state of balance (1) (d). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
01	2	**Analyse the changes in the terrestrial water system shown in Figure 1.** **AO3** – There should be clear analysis of the relationships evident in the resource. Analysis should consider the change in terrestrial water as a result of human activity and climate change. 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** • The changes between 2012-2016 are very mixed. Some places experienced a net loss of terrestrial water while other places	**6** **AO3=6**

		experienced gain. Very few places experienced no change. Ice sheets for example in Greenland and Antarctica both experienced substantial loss (2cm/yr) due to probable climate change. Some may note the anomaly that within and around both areas there are also increases in terrestrial water eg at the centre of the Greenland ice sheet. • Some may note that existing desert areas have largely lost terrestrial water eg in the Sahara / Middle East. • The pattern in south-east Asia is also very mixed with India and eastern China experiencing increasing terrestrial water. The causes are almost all related to probable or possible human impact with just one example of natural variation in central China. • The changes experienced in Canada are almost all related to probable or possible climate change. • Similarly the changes in central and southern parts of Africa are almost all related to natural variation with many places set to experience increased terrestrial water over the period of up to 2cm/yr. • Another anomaly appears in Siberia. It is the only region which experienced increase in terrestrial water due to possible climate change impact. Credit any other valid analysis.	

01	3	**Using Figure 2 and your own knowledge, assess the challenges arising out of the changing forest cover.** **AO1** – Knowledge and understanding of changes to the global carbon budget as a result of human activity. Awareness of deforestation, its causes and impacts. **AO2** – Application of knowledge to show how changes to global forest cover present major local, regional and international issues. <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 evaluation and analysis 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 evaluation and analysis drawn from the	**6** **AO1=2** **AO2=4**

		context provided. Connections and relationships between different aspects of study are basic with limited relevance. <u>Notes for answers</u> **AO1** • Global distribution, and size of major stores of carbon – lithosphere, hydrosphere, cryosphere, biosphere, atmosphere. • Factors driving change in the magnitude of these stores over time and space, including flows and transfers at plant, sere and continental scales. Photosynthesis, respiration, decomposition, combustion, carbon sequestration in oceans and sediments, weathering. • The carbon budget and the impact of the carbon cycle upon land, ocean and atmosphere, including global climate. **AO2** • There are a variety of potential challenges associated with this information. Most are likely to consider the challenges associated with deforestation e.g. impacts on soils, drainage basins, convection rainfall or risk of flooding and / or desertification. There are extensive areas of forest loss in Central and South America, and Easter and Southern Africa, South East Asia. Some may support this with data, though is not essential. Others may note anomalies such as Northern Africa which lost a lot of forest between 1990 and 2000 and not much since. Some are likely to consider the impact on CO_2 levels and the associated climate implications. • Others may consider the challenges associated with afforestation. East Asia, Western and Central Asia, Europe and the Caribbean have all experienced gain. Afforestation schemes are only possible where the land-use has not already been taken up by other human activity such as settlement transport or agriculture. These areas experiencing afforestation are likely to be sparsely populated. The much greater challenge is afforesting areas closer to human activity centres, hence the relatively small increases in Europe • Interestingly the Great Green Wall in Africa is not evident as an area of afforestation, but some may refer to this. Some may suggest the challenge here was in establishing a co-operative approach across many African countries, with the shared goal of limiting the process of desertification. • Others may consider in more generic terms the issues of competing demands on scarce resources. The encroachment into Amazonia may feature here for example. Political issues may also feature, such as the apparent change in policy by the Brazilian government, and the increasing evidence of rainforest exploitation, clearly evident in the resource. Credit any other valid assessment.	

01	4	**'Human activity needs to focus more on adapting to the expected negative impacts of climate change than on taking measures to restore atmospheric carbon to pre-industrial levels.'** **How far do you agree with this view?** **AO1** – Knowledge and understanding of impact of climate change, particularly regarding implications for life on earth. Knowledge and understanding of measures to mitigate the impact of climate change. **AO2** – Application of knowledge and understanding assess the extent to which mitigation is more important than adaptation in the context of climate change. <u>Notes for answers</u> **AO1** • The key role of the carbon and water stores and cycles in supporting life on Earth with particular reference to climate. The relationship between the water cycle and carbon cycle in the atmosphere. • The role of feedbacks within and between cycles and their link to climate change and implications for life on Earth. • Human interventions in the carbon cycle designed to influence carbon transfers and mitigate the impacts of climate change. • Changes in the carbon cycle over time, to include natural variation (including wild fires, volcanic activity) and human impact (including hydrocarbon fuel extraction and burning, farming practices, deforestation, land use changes). **AO2** • Responses are expected to offer a discussion around measures to mitigate against the impact of climate change as well as measures to reduce the production of CO_2 and reverse the amount of atmospheric carbon. • In terms of mitigation, expect to see reference to measures designed to restore carbon levels to pre-industrial levels. Global agreements such as the Paris Accord may feature. Investment in carbon capture and storage, sequestration technology (for example using depleted oil and gas fields as storage for CO_2) as well as fossil fuel reduction measures. Alternative energy and electric cars may also feature. Some may also consider the aviation industry and measures being taken there to reduce CO_2 emissions. There should be an awareness of the challenges associated with reducing atmospheric carbon levels, but also opportunities to use technology to solve these major challenges. • Others may consider afforestation schemes such as the Shandong ecological afforestation scheme. The purpose of this scheme is primarily to reduce the impact of desertification but also will provide the secondary benefit of acting as a carbon store, absorbing atmospheric carbon. • Adaptation is more concerned with an acceptance that climate is changing and human activity being geared towards minimising the potentially negative consequences. Examples include changes to	**20** **AO1=10** **AO2=10**

		farming practices to cope with climate change. This may also present opportunities to open up new areas to agriculture which were previously too cold to exploit. Others may consider switching to crops which may absorb more carbon, thus combining adaptation and mitigation. • In more general terms, responses may consider approaches which seek to cope with a changing climate. Candidates may bring in other aspects of study including coastal defence or even changes to alpine tourism as measures to cope with the reduced snowfall in these locations. This is a legitimate approach. • Responses are free to argue either way, though the position should be based upon preceding content. Credit any other valid 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 the sources of water in deserts.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Precipitation in the form of rainfall, fog dew, frost etc (1) Episodic event can occur due to convectional rainfall (1)(d) Credit measures to capture atmospheric moisture e.g. fog nets (1) • Exogenous rivers originate outside of the desert area (1). They carry sufficiently large quantities of water, that they continue through the desert area without drying up (1) (d) An example is the River Nile (1) (d). • Endoreic rivers flow into deserts but terminate in a lake or inland sea (1). An example is the River Jordan (1) (d). • Ephemeral rivers come to life following a storm or after snowmelt in spring (1). These are temporary rivers which dry up once the source of water disappears (1) (d). • Some may also consider underground aquifers as sources of water (1). These can sometimes reach the surface as springs or the water can be abstracted by digging a well (1) (d). A spring may form into an oasis (1) Must offer more than one source for full marks. Max 1 for listing. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

02	2	**Analyse the extent of the relationships shown in Figure 3a and Figure 3b.** **AO3** – Responses should use the two resources effectively and appropriately showing understanding of the maps and data as well as the complexity of potential inter-relationships. Expect to see analysis of patterns and identification of potential anomalies. There should be use of data manipulation in support. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of evidence in support. Clear connection(s) between different aspects of the evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of evidence in support. Basic connection(s) between different aspects of the evidence. Notes for answers **AO3** • There is some evidence of correlation between the two data sets. 2018 was clearly an unusually hot and dry year in many parts. This was a year of severe extremes in temperature and rainfall in Australia. It was also unusually wet in some western and northern parts. • As a broad generalisation, it appears to be warmer and drier towards the south east. Some may reference New South Wales as particularly hot and dry in 2018 compared to averages. In terms of extremes, the state had the highest temperatures on record and experienced record low rainfall or– very much below average rainfall. • There are other contrasting relationships of note. For example, in the south of Western Australia, temperatures were very much above average but in this case the region experienced some of the highest rainfall in record. Equally in the north of western Australia, temperatures were average, yet the rainfall was also highest on record here. • Others may note that whilst rainfall experienced both extremes of wet and dry compared to average, temperatures were not below average in any part of Australia. Credit any other valid analysis.	**6** **AO3=6**

02	3	**Using Figure 4 and your own knowledge, assess the role of wind in the development of this landscape.** **AO1** – Knowledge and understanding of the factors leading to the formation of ventifacts.	**6** **AO1=2** **AO2=4**

AO2 – Application of knowledge and understanding to show understanding of the role of wind and other factors that have contributed to the development of 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 the novel situation offering clear evaluation and analysis 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 evaluation and analysis drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance.

Notes for answers
AO1
- Sources of energy in hot desert environments: insolation, winds, runoff.
- Sediment sources, cells and budgets.
- Geomorphological processes: weathering, mass movement, erosion, transportation and deposition.
- The role of wind – erosion: deflation and abrasion; transportation; suspension, saltation, surface creep, deposition.
- Origin and development of landforms of mid and low latitude deserts: ventifacts.

AO2
- Responses should note that this is a ventifact / rock pedestal. The wind is important in the process of abrasion. These features are most typically found in arid environments where there is little vegetation to interfere with aeolian particle transport, where there are frequently strong winds, and where there is a steady supply of sand. The image indicates a lack of vegetation though the supply of sand is not wholly evident.
- Ventifacts / rock pedestal can be abraded to form these natural sculptures. In moderately tall, isolated rock outcrops, mushroom shaped pillars of rock may form as the outcrop is eroded by saltating sand grains. This occurs because sand grains bounce along the ground, rarely reaching higher than a few feet above the ground. Over time, the bouncing sand grains can erode the lower portions of a ventifact / rock pedestal, while leaving a larger less eroded cap. The results can be these unusual stone mushroom shapes. There is clear evidence that abrasion has been occurring at the base of the feature.

		• Individual stones are often found with grooved, etched, or polished surfaces where these same wind-driven processes have slowly worn away the rock. This is not evident in the image. • Expect most to suggest that wind is a vital factor in the development of the ventifact, though a supply of sand and lack of vegetation are also very important. Generic explanation of the formation of ventifacts (with no attempt to apply knowledge to the image and associated information) should be held to Level 1. Credit any other valid assessment.	

02	4	**How far can an understanding of systems in physical geography help to mitigate against the expansion of deserts into semi-arid areas?** **AO1** • Knowledge and understanding of systems operating in desert landscapes. Awareness of factors leading to the process of desertification. **AO2** • Application of knowledge and understanding to assess the extent to which systems can help with understanding factors leading to desertification. <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. The concepts of landform and landscape and how related landforms combine to form characteristic landscapes. • The global distribution of mid and low latitude deserts and their margins (arid and semi-arid). • Characteristics of hot desert environments and their margins: climate, soils and vegetation (and their interaction). Water balance and aridity index. • The causes of aridity: atmospheric processes relating to pressure, winds, continentality, relief and cold ocean currents. • 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. • 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** • Expect responses to demonstrate an understanding of systems in the context of deserts. Inputs in the form of the sun's energy, precipitation and wind are likely to be considered within the context of dynamic equilibrium. Responses are likely to argue that it is the changing inputs which are partly responsible for the development of positive feedback in the expansion of deserts into semi-arid areas. • The increasing temperatures and further reduced rainfall are certainly one factor accounting for desertification. As temperatures increase with reduced rainfall, plant species, even those highly adapted to the environment, cannot thrive. As species die off the process of photosynthesis is reduced, less carbon is taken out of the atmosphere	**20** **AO1=10** **AO2=10**

		and the positive feedback loop continues. In this sense deserts will continue to grow as semi-arid areas become increasingly inhospitable. • Some may suggest that human activity has a direct role to play in interfering with the natural systems, again creating a positive feedback loop. As population pressures increase, agricultural land is extended, this can lead to deforestation and overgrazing. This can degrade soil as carrying capacity is exceeded. Vegetation is then less able to grow and thrive following extensive soil erosion and the desert spreads. • Mitigation is likely to consider measures to generate a negative feedback and return to stability within dynamic equilibrium. Case studies may feature, such as Algeria. Here attempts have been made to reverse desertification by increasing water supply (using a system of man-made tunnels (Foggaras). These channel groundwater to the surface for the purposes of increasing vegetation cover, protecting soils and improving the land for the purposes of agriculture. • In this sense the understanding of systems in semi-arid environments has led to action which is reversing the spread of the Sahara Desert into this region. • It is now widely understood that afforestation is perhaps the most effective way to use natural systems in the fight against the desertification. • Candidates should therefore conclude that an understanding of systems in this context is essential in the fight against desertification. 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 factors leading to the formation of fjords.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Fjords are an example of coastal landforms of submergence (1). They are primarily a product of glacial erosion (1). As glaciers advanced towards coastal locations in Norway for example, they carved out vast glacial troughs (1), through processes such as abrasion and plucking (1) (d). A combination of localised isostatic re-adjustment and global eustatic sea level change has led to the flooding of these valleys (1). • An example of Sogne Fjord in Norway (1). • Reference to interglacial period is a factor leading to formation to fjords(1) The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
03	2	**Using only Figures 5a and 5b, evaluate the relative usefulness of these sources in demonstrating eustatic sea level change.** **AO3** – Analysis of the map evidence to identify patterns, anomalies and using data manipulation to support response. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of evidence in support. Clear connection(s) between different aspects of the evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of evidence in support. Basic connection(s) between different aspects of the evidence. Notes for answers **AO3** • There are clear similarities between the two sources. Both tend to show the similar information in relation to sea level change. • Some may note the variation in date range for the data collection and use this to explain the potential variation between the two sources. This is a legitimate approach.	**6** **AO3=6**

		• Both show similar swathes of ocean area experiencing similar change. For example, there is a band of ocean experiencing increasing sea levels of up to 5mm/yr north of the 50º south line of latitude. This is similar though not identical on both figures. • **Figure 5a** appears to offer a larger range of change with some areas (eg south east of South America), experiencing substantial drops in sea level (up to 6–8 mm/yr) compared to **Figure 5b** which does not show quite the same extreme with a drop of less than 5mm / yr. • Many are likely to conclude that **Figure 5b** is more current and offers much greater clarity in displaying the sea level change information. Equally though for the area around south-east Asia **Figure 5a** suggests much higher increases compared to **Figure 5b**. • There should be some specific reference to relative usefulness. Credit any other valid evaluation.	

03	3	**Using Figure 6 and your own knowledge, assess the view that deposition is the most important factor in the development of this landscape.** **AO1** – Knowledge and understanding of the processes related to the development of mudflats and saltmarshes. **AO2** – Application of this knowledge to the novel situation; specifically, in accounting for the formation coastal features such as saltmarshes and mudflats. <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 evaluation and analysis 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 evaluation and analysis drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance. <u>Notes for answers</u> **AO1**	**6** **AO1=2** **AO2=4**

		• Sources of energy in coastal environments: winds, waves (constructive and destructive), currents and tides. Low energy coasts. • Sediment sources, cells and budgets. • Geomorphological processes: transportation and deposition. • Origin and development of landforms and landscapes of coastal deposition. • Estuarine mudflat / saltmarsh environments and associated landscapes; factors and processes in their development. **AO2** • Clearly deposition is a crucial factor in the development of this landscape. Looking at the information provided, the tide is out and a mudflat is evident. Fine sands and other particles will have been transported from further upstream to be deposited as the river loses energy when it meets the incoming tide. The mudflats are likely to be submerged in large part when the tide comes back in. • In the background some should note the presence of vegetation and it is reasonable to assume that this is a saltmarsh. Here the original mudflats will have been colonised by vegetation and trapped more sediment. Over time the saltmarsh has built up so that it is consistently above the high-water mark. In this sense it is the vegetation colonisation which could be argued to be more important in the development of the saltmarsh. • Without the influence of the incoming tide, some may argue that the sediment would continue downstream and further into the estuary ie that the tide is the most important factor. • The main factors are therefore the sediment deposition, the tidal influence and the colonisation by vegetation. Responses are free to argue for the importance of any factor. Credit any other valid assessment. Generic explanation of the formation of mudflats / saltmarshes (with no attempt to apply knowledge to the resource and associated information) should be held to Level 1.	

03	4	**With reference to a coastal landscape from beyond the UK, assess the role of human intervention in shaping the physical environment.** **AO1** – Knowledge and understanding of a coastal case study from beyond the UK. Knowledge and understanding of the role of human activity in shaping the landscape. **AO2** – Application of knowledge and understanding to assess the impact of climate change upon the chosen case study.	**20** **AO1=10** **AO2=10**

		Notes for answers **AO1** • Case study of a contrasting coastal landscape beyond the UK to illustrate and analyse how it presents risks and opportunities for human occupation and development and evaluate human responses of resilience, mitigation and adaptation. • Human intervention in coastal landscapes. Traditional approaches to coastal flood and erosion risk: hard and soft engineering. Sustainable approaches to coastal flood risk and coastal erosion management: shoreline management/integrated coastal zone management. • Recent and predicted climatic change and potential impact on coasts. **AO2** • Expect many responses to consider coastal management as part of the intervention in shaping coastlines. Case studies are likely to focus on The Sundarbans and / or Odisha though others may feature. • Bangladesh lies, in large part on the Ganges Delta. This low-lying land is highly susceptible to flooding and erosion. Sea level change is a serious threat to the viability of coastal Bangladesh. Without concerted, integrated and consistent action, Bangladesh's existence would be under serious threat. • Expect to see reference to Integrated Coastal Zone Management (ICZM). This is a holistic approach which brings together all stakeholders. It sees the whole coastline as one unit rather than the more dated approach which historically failed to see that actions in one part of the coast could have devastating impacts elsewhere. • Bangladesh has the combined issues of land subsidence, sea level rise and a growing population occupying ever more marginal land. • The Bengali people have years of experience of adapting to changing environmental conditions caused by shifting river channels, land creation and erosion, and the impacts of floods, cyclones and storm surges. The country's government, too, has long experience of managing change, including measures to cope with natural disasters. Bangladesh is not helpless, therefore, against coping with sea-level rise. A number of interventions are being used to counter foreseen impacts of sea-level rise during the 21st century. • The country aims to maintain freshwater flow to western parts of the Ganges Tidal Floodplain in order to prevent the salt-water front from moving further inland. The most direct method has been to divert additional water from the Ganges River down the Gorai-Madhumati River by means of a barrage across the Ganges in Bangladesh. • Embankments have been raised and strengthened as sea-level rises. • Bangladesh has been experimenting with raised mounds or banks on which to grow crops. This adaptation is designed to retain farmland in the event of a saltwater ingress. • In the Meghna estuary, land reclamation is providing new land for cultivation and providing fresh water for domestic use. • In rural areas, work has been undertaken to raise house plinth levels above the highest predicted storm-surge levels and increase cyclone shelter capacity as population grows.	

		• For Chittagong and Cox's Bazar, the two major coastal cities most exposed to sea-level rise and to storm surges, the creation of artificial raised land using material from nearby hills is being investigated. • In the longer term, too, investigate the practicality of constructing barriers across river mouths in the south-west to prevent salt-water intrusion, as in The Netherlands. • Assessment is likely to consider cost benefit as well as effectiveness of such strategies. Any assessment is permissible provided it is based upon preceding content. Answer is partial if no wider world context. Credit any other valid approach. Evaluation should be based upon preceding content.	

Marking grid for Question 03

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 leading to the formation of kames.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • They are formed by fluvioglacial depositional processes (1). They are composed of sand and gravel (1) and form when meltwater enters a moraine dammed lake (1). Kame deltas form into mounds on the valley floor (1) (d). Kames are formed at a snout or beneath glaciers (1). Kame terraces are found along the side of glacial valleys (1). These are a product of the deposition by meltwater flowing between the glacier and valley side (1). **Allow 1 mark for valid named example (1)** The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
04	2	**Analyse the data shown in Figures 7a and 7b.** **AO3** – Responses should use the resource effectively and appropriately showing understanding of the complexity of the data. There should be an understanding of the patterns and identification of potential anomalies. There should be some data manipulation in support. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis and interpretation 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 and interpretation 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** • **Figure 7a** shows that the glaciers a situated in a linear fashion from north west to south east. Towards the south and east the glaciers tend	**6** **AO3=6**

		more towards lake terminating and debris covered compared to more clean ice glaciers in the north west. • The glaciers also appear larger in the south east compared to north west but this is by no means a clear pattern. In **Figure 7a** most of the clean ice glaciers appear to be smaller at around 3 km^2. • Stronger responses should note that the same glaciers which are overlaid on top of each other are also displayed in **Figure 7b**. More glaciers are revealed as each one has experienced different rates of mass balance change. • **Figure 7b** is dominated by clean ice glaciers and these are the only which have had a positive change in mass balance. None of these are in the south west. • The trend is that most have declined in mass balance though the range is high at up to 1.5 m w.e./year. The trend does have a lot of variability ie around 84 degrees east is the area of least change in mass balance at around -0.2 m w.e./year compared to around 82 degrees east which has around -0.7 m w.e./year as a trend – a difference of -0.5 m w.e. / year. Credit any other valid analysis.	

04	3	**Using Figure 8 and your own knowledge, assess the role of erosion in the development of this landscape feature.** **AO1** – Knowledge and understanding of the development of glacial landforms of erosion to include corries and aretes. **AO2** – Applies knowledge and understanding to the context of the question in accounting for the development of this landform. <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 this novel situation offering clear evaluation and analysis 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 evaluation and analysis drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance.	**6** **AO1=2** **AO2=4**

		Notes for answers **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. Characteristic glaciated landscapes. **AO2** • Responses should show an awareness that Striding Edge is an arete. • There are indications as to the formation in the image and text. The two steep sides either side of the ridge combined with the information about Red Tarn should clue the candidates into the fact that erosion caused by ice is the main factor in the development of the arete. Abrasion and plucking carved out the corrie leaving behind a steep backwall as evident in the photograph. • Some may refer to the evidence of scree in the background. This formed as a result of frost action whereby repeated freezing and thawing has shattered rock which has then fallen down on to the backwall of Red Tarn. This process has further accentuated the steepness of the arete. • The final indication is the more resistant igneous rocks from which Striding Edge is composed. These rock formations have resisted the weathering processes which would have otherwise reduced the overall height and steepness of Striding Edge. Credit any other valid assessment. Generic explanation of aretes (with no attempt to apply knowledge to the image) should be held to Level 1.	

04	4	**'Human activity is having a devastating impact upon cold environments with little evidence of a sustainable future emerging.'** **To what extent do you agree with this view?** **AO1** – Knowledge and understanding of periglacial landscapes. Knowledge and understanding of human impact upon periglacial landscapes. **AO2** – Applies knowledge and understanding to the context of the question in assessing the role of management in shaping alternative possible futures in the chosen landscape.	**20** **AO1=10** **AO2=10**

Notes for answers

AO1

- Fluvioglacial landforms of erosion and deposition: meltwater channels, kames, eskers, outwash plains. Characteristic fluvioglacial landscapes.
- Periglacial landforms: patterned ground, ice wedges, pingos, blockfields, solifluction, lobes, terracettes, thermokarst.
- Characteristic periglacial landscapes. The relationship between process, time, landforms and landscapes in glaciated settings: characteristic glaciated and periglacial landscapes.
- 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 glaciated landscape from beyond the UK to illustrate and analyse how it presents challenges and opportunities for human occupation and development and evaluate human responses of resilience, mitigation and adaptation.

AO2

- Cold environments could be taken to include any area which is covered by glacial, periglacial or fluvio glacial processes. Expect supporting case studies to include Alaska, Himalayas, Svalbaard or previously glaciated landscapes including the upland area of the UK. This provides significant diversity in the approaches that candidates may take. Candidates are expected to use their diverse supporting material to engage with the theme and demands of the question in order to satisfy AO2.
- Some may take a systems approach and consider the impact of warming and its potential to create a positive feedback loop. Carbon and methane locked up in permafrost for example, is increasingly being released back to the atmosphere and both warming depths increase and warming periods increase. Another factor related to this is increased rates of decomposition in the warmer temperatures. With more carbon and methane released, temperatures will only increase exacerbating the problem and driving the thawing permafrost ever deeper and further north (in the northern hemisphere).
- In terms of environmental damage, expect to see reference to increased rates of solifluction, risk of avalanche, soil erosion and wildfire. Some may reference recent examples of wildfire in both Canada and Russia.
- This is not only highly detrimental to local populations and is hampering economic development, it is also devastating for natural vegetations and the fauna which depend upon this.
- Some may take a more positive view and consider opportunities for sustainable development of such places. There may be some consideration of tourism as well as sustainable farming and other more sustainable forms of economic activity.
- There may be some consideration of traditional communities such as the Sami people of Norway, Sweden and Russia or the Inuit of

		Canada. These people have lived sustainably in these areas for thousands of years but increasingly their way of life has come under threat, not just from climate change but also the commercial exploitation of their lands eg through logging. • Most are likely to agree with the statement though any view of creditworthy provided it is evidenced in the preceding content. There should be some explicit assessment in the context of the question. 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 the factors which lead to the formation of mudflows, a volcanic hazard.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Mudflows (or lahars) are associated with the rapid melting of ice and snow following a volcanic eruption (and associated geothermal activity) (1). These only occur where there is a substantial amount of snow or ice, typically at high altitude (1) (d). Lahars can also be triggered in some locations by tropical storms following an eruption (1) (d). The debris itself is comprised of water, volcanic ash, rocks and pyroclastic slurry (1). • The lahar will typically flow down a valley side and occupy and river channel valley (1). • Some may consider force of gravity as a factor affecting speed (1) • An example was the Nevado Del Ruiz eruption which caused a lahar, killing over 20 000 people in Armero, Columbia (1) (d). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
05	2	**Analyse the data shown in Figure 9.** **AO3** – There should be analysis of the information provided to show understanding of the scale of donations relative to the wealth of the individuals and corporations. There should be some evidence of data manipulation in the response. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of a geographical issue or question. 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 a geographical issue or question. Basic analysis of the quantitative and qualitative evidence provided, which	**6** **AO3=6**

		makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence. Notes for answers **AO3** • The corporations' donations are dominated by companies based in the USA. Whilst individual donations by companies are large, in most cases these represent only a tiny proportion of each company's reserves. • When considering donations relative to the size of workforce, both Jefferies and Deutsche Bank stand out by a long way. Jefferies for example, donated almost 40 times (per employee) as much as the nearest donation by Deutsche Bank ie $1989 compared to $51. • Private individual donations were relatively much larger. When comparing individual wealth to size of donations, people such as Leonardo Di Caprio or John Mayer donated a significantly greater proportion of their wealth to support the disaster. • Some may support this with further calculations such as the difference between the largest and smallest donations eg $2.75 million in the case of Tiger Woods ($3 million) and any of the individuals who donated 0.25%. Credit any other valid analysis.	

05	3	**Using Figures 10a, 10b, 10c and your own knowledge, assess the challenges in managing flood risk associated with tropical storms in Louisiana.** **AO1** – Knowledge and understanding of impact and management issues associated with tropical storms. **AO2** – Application of knowledge and understanding to the novel situation, to assess the scale of challenge associated with managing the risk of a 1 in 100 year event such as this. 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. 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.	**9** **AO1=4** **AO2=5**

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.

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

- Scale is a significant issue. The area at risk covers hundreds of square miles. The area potentially affected is clearly extensive with multiple potential hazards. Expect to see reference to risks associated with strong winds, heavy rainfall, storm surges and associated flood risk.
- Maintaining flood defences in this area is likely to be extremely costly. Similarly establishing emergency plans including evacuation and relief will be extremely complex and costly. For example, deploying emergency services over such a wide area is likely to be a major challenge.
- Added to these challenges, there is clear evidence of social vulnerability in different districts. Type of vulnerability is not provided so any reasonable interpretation is allowed. Most will refer to poverty and a lack of mobility ie problems trying to evacuate in the event of storm. These people are likely to be the hardest hit when combined with the other data around damage band flood depth. Particularly badly affected will be communities to the south east of New Orleans.
- There is also the physical geography to consider. People on the coastline have some considerable distance to travel inland before they reach safe ground. This is only going to add to the management challenge.

Credit any other valid assessment.

05	4	**Assess the usefulness of prediction in the management of wildfire.** **AO1** – Knowledge and understanding of the cause of wildfire. Knowledge and understanding of strategies to manage wildfire. **AO2** – Application of knowledge and understanding to assess potential for predicting wildfire as a type of management. <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. <u>Notes for answers</u> **AO1** • Characteristic human responses to wildfires – fatalism, prediction, adjustment/adaptation, mitigation, management, risk sharing – and their relationship to hazard incidence, intensity, magnitude, distribution and 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. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and	**9** **AO1=4** **AO2=5**

		adaptation. Impact and human responses as evidenced by a recent wildfire event **AO2** • Any attempt to proactively plan for wildfire will inevitably involve a degree of prediction around areas most vulnerable / susceptible to an outbreak. • Prediction is not only used to predict the likelihood of fire, it is also used to predict the direction of travel and likely extent of severity. There are a number of tools which managers use to help predict the characteristics of wildfire. This helps in the response and helps in understanding where and how best to deploy resources. Crucially it helps to ascertain evacuation strategies in advance of an outbreak of fire. In the United States for example, wild fire managers use: • Fire Danger Maps - A fire danger rating map is developed using current and historical weather and fuel data. These data are transferred to models to give present condition information and predicts what may happen. Maps are developed to give a visual presentation of the potential danger of fire in each region. • Dead Fuel Moisture - Fire potential is heavily dependent on dead fuel moisture ie litter which has not experienced rain in recent days. • Live Fuel Moisture/Greenness Maps - Live fuels also play a major part in the potential of fire. Vegetative "Greenness" determines fire spread. The greener the vegetation, the lower the fire potential. • Drought Map - There are several maps that depict drought as determined by measuring soil moisture. • Atmospheric Stability Maps - The stability term is derived from the temperature difference at two atmosphere levels. The moisture term is derived from the dew point depression at a single atmosphere level. This Haines Index has been shown to be correlated with large fire growth on initiating and existing fires where surface winds do not dominate fire behaviour. • Some may consider the important response to fire is in the emergency planning once fire has broken out. Evacuation and the use of emergency services may feature in such responses. This is a legitimate approach and challenges the thrust of the question. Assessment may conclude that prediction is a vital tool in fighting wildfire, though it is not a complete science as there are so many variables at work.	

05	5	**'Seismic hazards will always be harder to manage than volcanic hazards due to their unpredictability and scale.'** **To what extent do you agree with this view?** **AO1** – Knowledge and understanding of the impact of seismic events and volcanic eruptions. **AO2** – Application of knowledge and understanding to assess the relative impact of volcanic and seismic events.	**20** **AO1=10** **AO2=10**

Notes for answers

AO1

- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases/acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and 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 a recent volcanic event.
- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Spatial distribution, randomness, 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 a recent seismic event.

AO2

- The direction of the response will largely depend upon the choice of supporting material and case study.
- Evidence suggests that seismic events present a greater threat to life than volcanic events. Recent events such as Haiti (2010), Indian Ocean Tsunami (2004), Tohoku, Japan (2011) and Sichuan, China (2008) all have death tolls in multiple thousands. Whilst this is impact and not management, it does point towards the scale of the management challenge.
- In comparison Mt Merapi Indonesia (2010), Anak Krakatoa, Indonesia (2018) and Nyiragongo, Democratic Republic of Congo (2002) all have death tolls in the hundreds.
- Managing earthquakes is arguably far less predictable than volcanoes as there are less clues to an impending event. It is now clear that events will tend to occur along plate boundaries but not when or at what magnitude. Equally, underwater earthquakes will often trigger tsunamis which can affect huge areas of coastline making then extremely difficult to respond to. Even Japan with its wealth and resources was not adequately prepared for the Tohoku event in 2011. Over 20 000 people died despite a sea wall and a warning system along this area of the coastline.
- Some may argue that it is precisely because of effective management that the number of deaths following volcanic eruptions is so relatively low. Volcanoes produce many early warning signs which are now well known to scientists. This allows for early evacuation and the setting up of exclusion zones.
- Some may consider the Eyjafjallajökull eruption in Iceland as an anomaly in terms of management. Whilst it created no deaths or serious injuries, the ash cloud grounded international air travel for a number of days, causing substantial economic loss. So, whilst the management in this case did not involve dealing with serious

		casualties, it did prove very difficult to manage and did cause substantial economic losses across Europe in particular. • Some may consider the concept of the super volcano. The Yellowstone caldera is likely to feature in such responses. Whilst there is no recent evidence of a super eruption, if one did occur, it would be a global event with global consequences. This is likely to counter the idea that seismic hazards are harder to manage. • Theoretical models are likely to feature in some responses. This is acceptable as long as such material is used to support the argument. The Park Model and the Hazard Management Cycle may feature. Credit any other valid assessment.	

Marking grid for Question 05.8

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 in vegetation succession.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Climatic climax refers to the final stage in the succession of a distinct vegetation community (1). The flora and fauna in the community have attained a state of dynamic equilibrium (1) (d). • In the UK an example is the Oak woodland or temperate deciduous biome (1). • The vegetation and fauna have reached an optimum state for the given conditions and no further changes will occur (1). • For the climax to be retained all elements must remain stable (1). • A change in the biotic or abiotic component (arresting factor) (1) will upset the equilibrium temporarily or permanently leading to a sub-climax community (1) (d). • Some may reference stages in succession that occur prior to the climatic climax (1). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
06	2	**Analyse the data shown in Figure 11a and Figure 11b.** **AO3** – There are two resources to use in conjunction with each other. The skills relate to map analysis and interpretation. 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.	**6** **AO3=6**

		Notes for answers **AO3** • **Figure 11a** shows that most of the forest clearing appears to be for the purposes of small-scale rotation and semi-permanent agriculture. In the largest country of the Congo Basin, most of the deforestation is caused by rotation and fire. • **Figure 11b** shows that in the other countries, the picture is much more mixed. Industrial logging accounts for nearly half of the deforestation in the Republic of the Congo and almost 16% more in Gabon (61.7%). • Most of the other causes of deforestation are negligible, though Cameroon semi-permanent small-scale agriculture accounts for 10.5% of the clearance. Another anomaly relates to Equatorial Guinea. It is the only country with such a high proportion of clearance attributed to road building (12.5%) • It is hard to estimate the actual scale of the clearance from the information provided but suffice to say that the DRC lost several million hectares of forest between 2000–2014 and much more than the other countries. Credit any other valid analysis.	

06	3	**Using Figure 12 and your own knowledge, assess the implications of this data for sustainability in areas of savanna grassland in east Africa.** **AO1** – Knowledge and understanding of the development issues facing savanna grasslands. **AO2** – Application of knowledge and understanding to assess the challenges facing the Serengeti. 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. Analysis 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. Analysis is evident and supported with clear and appropriate evidence.	**9** **AO1=4** **AO2=5**

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. Analysis is basic and supported with limited appropriate evidence.

Notes for answers

AO1

- The concept of the biome. The global distribution of major terrestrial biomes. The nature of the savanna grassland to include: the main characteristics of the biome; ecological responses to the climate, soil and soil moisture budget – adaptations by flora and fauna; human activity and its impact on the biome; typical development issues in the biome to include changes in population, economic development, agricultural extension and intensification, implications for biodiversity and sustainability.

AO2

- The information presented suggests a bleak outlook for the Wildebeest of the Serengeti. Human encroachment is clearly affecting the natural movement of the animals. It may also be that providing drinking water is altering their natural migrations. This will all have knock on effects to other aspects of the food chain and wider ecosystem. Species that rely on wildebeest movements will be directly impacted. This could be anything from apex predators to dung beetles.
- The idea that tourism could provide a sustainable future for the Serengenti appears to be questionable based upon this information. Rather than leading to conservation, the increased visitors appears to be causing detriment to the very thing that they are coming to experience.
- Whilst there are vast sums of money to be made from tourism, the visitors appear to be directly impacting upon wildebeest numbers.
- The other part of the problem relates to the increase in livestock which obviously graze on the same grass as the wildebeest and other species.
- The information points towards an unsustainable decline in natural species as a direct result of two main types of human activity, tourism and agriculture. It is not clear how the increase in tourist numbers are affecting wildlife. It may be indirect factors such as the building of settlements to cater for tourists or the agricultural extension which may be used to provide food for tourists.
- Whatever the reason, the evidence suggests that tourism is not necessarily the answer to the question of how to save important natural environments such as these. It also suggests that, despite

		efforts at conserving natural land, illegal grazing has directly impacted upon the wildebeest and other species. Credit any other valid assessment.	

06	4	**Analyse the interconnections between climate, vegetation and soils in the development of temperate deciduous woodland.** **AO1** –Knowledge and understanding of the characteristics of temperate deciduous woodland. **AO2** – Application of knowledge and understanding to analyse the contributing factors leading to the development of this biome. <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. <u>Notes for answers</u> **AO1** • The characteristics of the climatic climax: temperate deciduous woodland biome. • Nature of terrestrial ecosystems and the inter-connections between climate, vegetation, soil and topography which produce them.	**9** **AO1=4** **AO2=5**

		• Ecosystem responses to changes in one or more of their components or environmental controls. **AO2** • Responses should show understanding of the interconnected and contributing factors leading to the development of this biome. The climate is wet all year round. Whilst there are seasons in relation to temperature variation, the rainfall is fairly consistent at around 40-60mm per month on average. Temperatures are mild averaging between 5 and 20 ^{o}C throughout the year with four distinct seasons. • These mild conditions create strong growing conditions for plants, particularly during the spring and summer months. Productivity is high and only exceeded by the tropical equatorial rainforest. • Species are adapted to shed leaves in autumn and undergo a period of dormancy in winter. This provides litter for decomposition and supports the development of the brown earth zonal soil. The soil is rich and fertile and generally well drained. Nutrients are provided by the decomposed litter and weathered parent rock. These soils provide the necessary conditions for strong plant growth in the spring and summer. • The climate and soils provide the ideal conditions for rich and biodiverse biome to flourish. As with the tropical rainforest there are distinct layers of vegetation with each species adapted to exploit its own particular niche. The ground layer is characterised by mosses grasses, lichen and herbaceous species, surrounded by abundant decomposing litter. These species thrive in early spring before the canopy layer dominates the forest. • The shrub layer is comprised of species which rowan and hawthorn, both competing for limited light in summer. • The canopy layer is characterised by oak and tall deciduous trees such as elm and sycamore. • It is the climate and soils which allows this diverse biome to thrive. Credit any other valid approach. Analysis should be based upon preceding content.	

06	5	**With reference to an ecosystem at a local scale, evaluate the extent to which management has created a viable future for the area.** **AO1** – Knowledge and understanding of a local small scale ecosystem. Knowledge and understanding of the concept of sustainable development. **AO2** – Application of knowledge and understanding to assess approaches to sustainable management of a small scale ecosystem.	**20** **AO1=10** **AO2=10**

Notes for answers

AO1

- Case study of a specified ecosystem at a local scale to illustrate and analyse key themes set out above, including the nature and properties of the ecosystem, human impact upon it and the challenges and opportunities presented in its sustainable development.
- Conservation strategies and their implementation in specific settings.
- Ecosystems and their importance for human populations in the light of continuing population growth and economic development.
- Human populations in ecosystem development and sustainability.

AO2

- Expect responses to use an appropriate case study as support. A large-scale ecosystem is likely to be self-penalising but should be considered on its merits.
- The Sefton Coast, in north west England is a small-scale unique ecosystem. It is a refuge for the red squirrel and other unusual species such as the Natterjack Toad and Sand Lizard. It is also home to some rare plants such as the Isle of Man Cabbage.
- It is also home to an extensive dune network which stretches for miles along the coastline from Formby towards Southport.
- The area is part of the Merseyside conurbation and so is in high demand as place to visit throughout the year. This creates its challenges in terms of managing the high demand whilst conserving the local area and provide a viable future, a sustainable environment experiencing no degradation.
- The Sefton Coast Landscape Partnership has a long-term vision. They wish to: Conserve and enhance the important international, national and local network of natural and cultural sites, habitats and species; Enable local communities to benefit from sustainable economic growth and successfully adapt to coastal and climate change; and provide long term benefits for the health and wellbeing of local communities, businesses and visitors to the coast.
- They have been working towards achieving this plan by taking a number of measures around sand dune management, improving coastal defences, upgrading walkways and information boards for tourists, establishing tourist free areas particularly where there are sensitive animal species.
- Other measures are also being taken to address wider community concerns around dealing with contaminated and restricting development in the areas around the coastline.
- All of these actions continue to see the Sefton coastline improve over time, both as a natural environment and a visitor attraction. By taking a long-term view and adhering to the principles of sustainable development, the Sefton coastline does appear to have a viable and long-term future, despite the challenges it faces.

Credit any other valid approach.

Marking grid for Question 06.8

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.