A-level
GEOGRAPHY
7037/1

Paper 1 Physical Geography

Mark scheme

June 2020

Version: 1.0 Final Mark Scheme

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	**Outline the process of decomposition in the carbon cycle.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Decomposition refers to the breakdown / decay of organic matter by bacteria or fungi (1). • Animals (such as worms), bacteria and fungi are collectively termed decomposers (1)(d). • During decomposition carbon dioxide is released (1). • Most of the carbon released into the atmosphere is as a result of decomposition (1)(d). • Decomposition is heavily temperature dependent (1). Warmer temperatures are characterised by much higher rates of decomposition as there is more microbial activity (1)(d). However the presence of water is an equally key component in the rate of decomposition and the release of carbon (1)(d). The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
01	2	**Analyse the data shown in Figure 1.** **AO3** – There should be clear analysis of the relationships between rainfall at the two observatories and how this varies over time. Analysis should consider the annual data and the moving average. There should also be data manipulation to support the analysis. 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	**6** **AO3=6**

		AO3 • Both graphs show substantial fluctuation in terms of annual rainfall data and the moving 5-year average. The Royal Observatory has a range from 350 to around 950 – a range of 600 mm. In 2009–2011 that range and variation is strongly exemplified. The range is much higher for the Dwarsberg station. Here the range is from 1800 to 4500 – a range of 2700 mm. • Rainfall at the Dwarsberg Observatory is generally much higher than the Royal Observatory. The lowest rainfall at Dwarsberg appears to be just under 2000 mm in 2014, whereas the highest rainfall at the Royal Observatory is around 950 mm in 2009. This is a difference of over 1000 mm. Similarly peak rainfall is around 4500 at Dwarsberg. This is over 3500 mm higher than the peak at the Royal Observatory. • In relative terms, the peaks and troughs are in both locations. So whilst the figures are very different, both locations do appear to show similar wet and drier periods. An exception occurs around 2003 to 2009. The relative variation on the 5-year moving average is narrowed. Credit any other valid analysis.	

01	3	**Using Figure 2 and your own knowledge, assess the predicted impact of climate change upon life in this region.** **AO1** – Knowledge and understanding of changes of the water cycle and how changes to the water cycle affect the ability of a region to sustain itself. **AO2** – Application of knowledge to show how the changing rainfall characteristics are likely to affect the ability of the region to sustain life. <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>	**6** **AO1=2** **AO2=4**

		AO1 • Changes in the water cycle over time to include natural variation including storm events, seasonal changes and human impact including farming practices, land use change and water abstraction. • The key role of water stores and cycles in supporting life on Earth with particular reference to climate. The implications for life on Earth. **AO2** • It is clear from the evidence that the west is set to experience an increase in area where plant growth days are low. Apart from the coastal region there is almost a 50/50 in coverage where there is precipitation facilitating less than 60 days' plant growth. • Responses are likely to connect the reduced plant growth days in the west to increased challenges in farming. A typical growing season is around 3–5 months depending on the crop. With growing days of less than 60 days, this is sure to impact on farming yields, affecting crop growth but also livestock. Expect reference to food shortage and increased reliance on the importation of food supplies. • The local environment is also likely to suffer with less natural vegetation growth which supports local habitats. • Water supply is also likely to be considered. Whilst this information is not provided it is implicit that there must be less rainfall predicted by 2050. This is likely to impact negatively upon reservoirs and water storage for human consumption. Some may connect this to the rationing of water and the negative impact of this upon quality of life. Credit any other valid assessment.	

01	4	**Assess the impact of farming practices on the carbon budget.** **AO1** – An understanding of farming practices within the context of water and carbon. An awareness of the impact of human activity upon the carbon budget. **AO2** – Application of knowledge and understanding to show how farming practices can alter/affect carbon stores and transfers at local, regional and global scales. <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. • Changes in the carbon cycle over time, to include natural variation (including wild fires, volcanic activity) and human impact (including burning, farming practices, deforestation, land use changes). • The carbon budget and the impact of the carbon cycle upon land, ocean and atmosphere, including global climate. • 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. **AO2** • Responses are most likely to focus upon the damage caused by farming practices, particularly in tropical rainforests. • Some may refer to traditional slash-and-burn techniques and the small-scale nature of this approach to farming. Whilst small-scale rotation is more sustainable, there is still a localised increase in carbon emission associated with the burning. • Ranching may also feature in candidate responses. For example, cattle ranching is now the biggest cause of deforestation in the Amazon, and nearly 80 per cent of deforested areas in Brazil are now used for pasture. The cattle industry has grown rapidly since the 1970s, giving Brazil the largest commercial cattle herd in the world. Since 2003, the country has also topped the world's beef export charts and the government planned to double its share of the market by 2018. The impact this is having on the forest is huge – between 1996 and 2006, an area the size of Portugal was carved out for cattle ranching. Large-scale forest clearance removes a major carbon store and reduces the intake of carbon by photosynthesis. There is also the issue of methane release as a result of cattle farming. Some may link this to the carbon dioxide issue and concerns about increased greenhouse gases. This is an acceptable line of argument in the context of the question.	**20** **AO1=10** **AO2=10**

		• In the state of Acre in western Brazil, farms and pastures are surrounded by large, undisturbed areas of Amazon rainforest. Since January 2005, many areas in the state have been experiencing severe drought, and the forests have become tinder dry. Experts attribute the drought to at least in part be caused by the disruption to convection rainfall. The tinder-dry conditions have led to forest fires, releasing even more carbon into the atmosphere. • Soil erosion is another issue. As the areas are over-cultivated, nutrients and minerals become depleted, rendering the area useful for farming but also, at least in the short term, recolonisation by vegetation. In this sense the store for carbon is reduced and emissions carbon in the atmosphere is not reduced thus maintaining a high budget. • Some may refer to recent forest fires in places such as Amazonia. Provided this is linked to farming, ie deliberately set fires to clear woodland, this is a valid approach. • Some may consider more positive and sustainable farming practices which are having a more positive impact on the carbon budget. The Great Green Wall in the Sahel is an attempt to reverse the impact of desertification and the extension of arid lands in the region. The benefits of this initiative directly relate to opportunities for soil preservation, agricultural extension as well as forestry. It is the forestry which is increasing the store of carbon both above and below ground, with the newly accumulated biomass. • Expect to see some reference to feedback systems. Some may argue that current farming practices are leading to a positive feedback loop with an imbalance moving further and further away from equilibrium. Others may suggest that more sustainable practices can produce a negative feedback which returns the carbon budget to equilibrium. Either approach is valid but 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 role of cold ocean currents as a cause of aridity.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Where a cold ocean current meets a coastline this is more likely to result arid conditions (1). This is particularly the case in the mid-latitudes (1) (d), where for example wind blowing over the Humbolt Current is chilled (1). Condensation occurs leading to precipitation, cloud and fog off-shore (1). As the dry air meets warmer air on land a temperature inversion is created (1). This inhibits cloud formation and precipitation (1)(d). • Allow additional mark for exemplification e.g. Atacama Desert in South America (1). Allow 1 + 1 if appropriately explained and elaborated. • Some may refer to El Nino and La Nina as examples of episodic changes in sea surface temperature which can lead to temporary periods of aridity. Allow 1 + 1 if appropriately explained and elaborated. The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
02	2	**Analyse the relationship between landscape type and risk of desertification shown in Figure 3.** **AO3** – Responses should use the resource effectively and appropriately showing understanding of the map and data as well as the complexity of potential interrelationships. 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.	**6** **AO3=6**

		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** • The whole region is at risk of some degree of desertification. • There is a link between different land use and propensity for desertification, though the relationship is by no means predictable. • The northern region has a large swathe of territory which is at very high risk of desertification. In the area where crop and grasslands dominate, 71% of the land is at very high risk. This is over 65% higher than the Type 4 region to the south, grassland plains. • The Type 7 region in the south west is also experiencing very high risk of desertification. Looking at the coverage on the map, it appears higher than the 57% suggested by the data. • There is a swathe of territory across the centre of the region in Type 5 and 6 regions where cropland expansion and urban expansion has occurred. • Some may theorise that areas affected by human activity (settlement, road, crop land) are more at likely to be experiencing very high risk of desertification. However Type 1 and 7 areas both appear to be more natural environments and yet are severely affected by risk of desertification. Credit any other valid analysis.	

02	3	**Using Figure 4 and your own knowledge, assess the view that low precipitation is the most important factor leading to the development of this landscape.** **AO1** – Knowledge and understanding of the factors leading to the formation of desert pavements. **AO2** – Application of knowledge and understanding to understanding of how low precipitation, weathering and the role of wind 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.	**6** **AO1=2** **AO2=4**

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change.

AO2 – Applies limited knowledge and understanding to the novel situation, offering only basic 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.
- Sources of water: exogenous, endoreic and ephemeral; the episodic role of water; sheet flooding.
- Origin and development of landforms of mid- and low-latitude deserts: desert pavements.

AO2

- Most will argue that wind is the most important factor in the creation of desert pavements. Deflation leads to the concentration of unconsolidated rock fragments at the surface of the land.
- The foreground of the image shows a barren landscape with no obvious soil structure, with rock fragments covering the ground. In between the rock fragments there are finer sediments which suggests that the process of deflation is still ongoing.
- In the background there is some vegetation coverage. Some may link this to the presence of water. However intermittent that the water supply may be, its presence will allow vegetation to colonise, a soil structure to form and the deflation process will be reduced. In fact the vegetation will most likely trap sediment further, supporting the development of the ecosystem.
- Clearly there is not enough water to support vegetation in the foreground, this combined with the deflation has led to the development of the landscape.
- Some may go further and consider the diurnal temperature variation and insolation as a factor leading to weathering and the breakup of the rocks in the foreground. This is a legitimate approach.
- Some may argue that intermittent rainfall over mountains may result in sheet wash in the foreground, potentially removing finer debris.

Generic explanation of the formation of desert pavements (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	**'Desertification trends are entirely a product of human-induced climate change as opposed to naturally occurring phenomena'.** **To what extent do you agree with this view?** **AO1** • Knowledge and understanding of a variety of factors leading to the process of desertification. **AO2** • Application of knowledge and understanding to assess the extent to which human activity is exacerbating the process. <u>Notes for answers</u> **AO1** • 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. Predicted climate change and its impacts; alternative possible futures for local populations. • Case study at a local scale of a landscape where desertification has occurred to illustrate and analyse key themes of desertification, causes and impacts, implications for sustainable development. Evaluation of human responses of resilience, mitigation and adaptation. **AO2** • Expect to see a definition of desertification which is a process whereby semi-arid regions become increasingly dry and bereft of vegetation coverage. It is often characterised not just by a loss of vegetation, especially tree species, but also soil erosion and a general degrading of the land. Soils are rendered useless for agriculture and natural habitats also tend to rapidly deteriorate. • Responses should recognise that desertification is inherently a natural phenomenon. For thousands of years, deserts have grown and shrunk in response to regional variation in climate. Expect many responses to focus on the Sahel region of sub-Saharan Africa, though other deserts such as Namib, Kalahari, Atacama and Australian deserts might feature. North Africa, for example, has experienced significant changes in climate over recent millennia. Fossil, archaeological and even cave paintings all point towards a much wetter climate. This in turn substantially reduced the extent of the Sahara and increased the areas covered by vegetation.	**20** **AO1=10** **AO2=10**

		• Some may take a systems approach in explaining the growth and retreat of deserts. Positive feedback may be used to argue for the increasing extent of desertification as a natural phenomenon. • Human-induced climate change is likely to feature in most responses as a legitimate cause for the extension of deserts and areas at risk of desertification. Some may point to evidence of temperature rise and an increase in the frequency and severity of drought events in semi-arid areas. In the Sahel for example, since the 1970's there have been around 40 years of below average rainfall in that region. This is without doubt contributing to the desertification issue. • Expect responses to go on to consider other human factors contributing to the desertification issue. The general population increase in the Sahel region is creating significant pressure to open up more land for cultivation. The population is estimated to be around 260 million with a 3% rate of natural increase. As natural habitat is converted to arable / pastoral farmland, trees are removed and soils are placed under pressure to provide grass for livestock or nutrients for crops. The removal of natural vegetation cover increases the likelihood of soil erosion through the action of both wind and water. Expect to see knowledge of these processes in some responses. This is legitimate AO2. • Some may refer to the carrying capacity of the land. This is a theoretic concept associated with the maximum number of livestock an area can support sustainably, without land degradation. • There is also likely to be reference to fuelwood gathering, salinization (caused by some irrigation techniques) and the impact of tourism. Provided that there is a clear link to desertification, this is appropriate. This approach is likely to be used to offer a counter-position to human-induced climate change as the only factor affecting the increase in the process of 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 the process of sub-aerial weathering in the development of coastal landscapes.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Sub-aerial weathering involves the action of rainwater and insolation upon landforms in the coastal landscape (1). • Here material is broken in situ, rocks are weakened and can contribute to sudden large-scale movements (1). • Chemical weathering occurs when weak carbonic acid in rainwater attacks limestone cliffs (1). This leads to the formation of karst landscapes (d). • Mechanical weathering occurs when repeated freezing and thawing of water absorbed in pervious rock leads to the breakdown of rocks and the emergence of pronounced cracks in the bedding plain and rock strata (1). • Biological weathering refers to the burrowing of plants and animals into the rock at the coast. This can lead to the break-up of rock as well as the weakening of the rock by species which attach to rock (1). Some may refer to processes such as hydration, oxidation, hydrolysis and carbonation. The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
03	2	**Analyse the relationship between isostatic adjustment and the 2010 melting day anomaly in Greenland as shown in Figure 5.** **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.	**6** **AO3=6**

		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. <u>Notes for answers</u> **AO3** • There appears to be some correlation between the 2010 melting day anomaly and uplift. • In places where melting is higher than the 1979–2009 average, there has been more uplift in 2010. Reference to isostatic rebound may feature and, as this is implied by the key, it is accepted. • In the southwest, the melt anomaly is at its strongest, with a large north-south swathe is ice experiencing more than 60 days above average melting. In senu for example, this coincides with around 20 mm of uplift. • The pattern is by no means consistent though. At grok for example there is a relatively small variation from the 1979–2009 average (+20 days), but this also has around 9–10 mm of uplift. Similarly at kely, this area (to the east) experiences the highest concentration of melt anomaly but only around 5–6 mm of uplift. • The uplift is all coastal according to the data, with neither melting nor uplift taking place inland. • The south of the island is generally experiencing more uplift than the north. Credit any other valid analysis.	

03	3	**Using Figure 6 and your own knowledge, assess the view that rock type is the most important factor in the development of this landscape.** **AO1** – Knowledge and understanding of the processes related to the development of erosional coastal landscapes. **AO2** – Application of this knowledge to the novel situation; specifically, in accounting for the formation of coastal features such as caves, arches stacks and stumps. <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.	**6** **AO1=2** **AO2=4**

		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** • Distinctively coastal processes: marine: erosion – hydraulic action, wave quarrying, corrosion / abrasion, cavitation, solution, attrition; sub-aerial weathering. • High-energy coasts. • Origin and development of landforms and landscapes of coastal erosion: cliffs and wave cut platforms, cliff profile features including caves, arches and stacks; factors and processes in their development. **AO2** • Clearly rock type will be a factor in shaping this landscape. Less resistant rocks would already have been removed by the action of erosion. Some may identify the limestone in the image and suggest that this rock must be able to withstand the constant pounding by the sea over many thousands of years. • Others will recognise that this is a landscape in transition and the feature will almost certainly have started out as an expanded join gradually forming into a cave, until the headland was broken through to leave the arch. In the sense rock type has been integral to shaping the changing landscape. • Others may consider sub-aerial processes which appear to be impacting upon the limestone further supporting the idea that rock type is a key factor shaping the landscape. • Responses should go on to recognise that this is a high-energy environment. There is evidence of undercutting and therefore destructive waves. This is likely to be linked to strong winds and a large fetch as well as deep enough water to sustain the orbital motion of the waves. Credit any other valid assessment. Generic explanation of the formation of arches (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 environment at a local scale, assess the predicted impact of climate change upon the landscape.** **AO1** – Knowledge and understanding of a local scale coastal case study. Knowledge and understanding of the predicted impact of climate change. **AO2** – Application of knowledge and understanding to assess the impact of climate change upon the chosen case study. <u>Notes for answers</u> **AO1** • Recent and predicted climatic change and potential impact on coasts. • Eustatic, isostatic and tectonic sea level change: major changes in sea level in the last 10 000 years. • Coastlines of emergence and submergence. Origin and development of associated landforms: raised beaches, marine platforms; rias, fjords, Dalmatian coasts. • 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. • Case study(ies) of coastal environment(s) at a local scale to illustrate and analyse fundamental coastal processes, their landscape outcomes and engage with field data and challenges represented in their sustainable management. **AO2** • Expect to see the impacts categorised into three main areas: the impact on likelihood of flooding, increased erosion and damage to local habitats. In the assessment some may consider attempts to mitigate the predicted impact of climate change through management. This is a valid approach. • E.g. The Norfolk coastal town of Great Yarmouth is around 30 km from Norwich, situated on the mouth of the River Yare. It provides access to the Norfolk Broads from the sea and one of its main industries is tourism (it has been a resort since 1760). More recently it has become an important servicing point for the offshore natural gas rigs. In the past Great Yarmouth was an important herring fishing port. Breydon Water and Halvergate Marshes, located at the rear of the town, are European-designated Special Protection Areas (SPA) and the North Denes area of the beach is home to a dune system, designated a Site of Special Scientific Interest (SSSI). Great Yarmouth (borough) has a population of approximately 93 400. • Existing evidence suggests the main climate risks as related to fluvial and coastal flooding. This is an ongoing issue as evidenced by the four flooding events in 2006, the North Sea flood of 1953 and a 'near miss' in November 2007 when a tidal surge and high tides resulted in limited flooding. Longer, wetter winters that are forecast to arise as a result of climate change also pose a risk to the town in light of the orientation of the local economy. There may also be the possibility of increasing heatwave events.	**20** **AO1=10** **AO2=10**

		• In terms of indirect effects of climate change, Great Yarmouth may suffer reputational damage due to media reports on flooding as well as its prolonged wet winters. This may cause considerable economic damage. • Halvergate Marshes is also under threat from sea level change. • The Local Authority have responded to these threats. One scheme is to lay an 877-metre long revetment of about 1,300 gabions – stone-filled and crushed concrete-filled cages – from the existing rock berm at Little Scratby Crescent, northwards across Scratby Beach to reach Newport. • The three-metre-high gabions are being positioned at the toe of the soft, sandy cliffs, protecting the low dunes, which are their natural buffer from lapping waves. If left unprotected, these dunes take some years to recover once hit in a storm, meaning they are less effective at reducing erosion to the cliffs if there is another storm soon after. • The added protection aims to delay the rate of erosion, giving the community time to adjust to coastal change, using the findings of the Government-funded Pathfinder Project, which identified the properties and areas at risk, and potential options, such as displacement land further back from the cliff which householders and businesses could relocate to. • The scheme is designed to help protect 35 homes which are nearest to the cliff edge, over a 25-year period, and there are another 100 homes, further back which are at risk over a 100-year period. • Any assessment is likely to consider the costs of such management. This scheme cost £600 000 for example. Credit any other valid approach. Evaluation should be based upon preceding content.	

Marking grid for Question 03.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2). • Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2). • Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1). • Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).

Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2). • Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2). • Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places. • Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2). • Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1). • Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).
Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic (AO2). • Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2). • Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1). • Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies. (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 4 Glacial systems and landscapes

Qu	Part	Marking guidance	Total marks
04	1	**Outline the geomorphological process of nivation.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Nivation is a weathering and erosional process associated with cold environments (1). The main process is freeze thaw action (1). Snow is compacted as a result of the freeze-thaw cycle forming firn or névé (1) (d). These are particularly common on south-facing slopes in the northern hemisphere (1). • The freeze-thaw cycle leads to weathering of rock and the formation of nivation hollows (1). These are often a precursor to cirques once enlarged (1) (d). • Erosion from meltwater in thawing periods can wash sediments out of the hollow (1) and supports other processes such as solifluction (1) (d). The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
04	2	**Analyse the data shown in Figure 7.** **AO3** – Responses should use the resource effectively and appropriately showing understanding of the complexity of the graph. There should be an understanding of complexity of the inter-relationships. Expect to see analysis of 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.	**6** **AO3=6**

		Notes for answers **AO3** • Prior to 1970 there were only two years where the mean specific mass balance exceeded zero. Similarly, since 1970 there was also only two years where the mean mass balance exceeded zero. For all other years the glaciers have been losing mass. • Whilst the decline in mass is not consistent, the process of ablation/ melting appears to be showing an overall acceleration over the period in question. • There are some significant anomalies. For instance, in 1987 the mass balance of the measured glaciers was 500 mm w.e. less than the 1970 average and by the following years there had been accumulation of around plus 200 mm w.e., a difference in 700 mm w.e. in just one year. • Whilst there are periods of recovery (eg between 2006–9) the overall trend is declining mass balance with acceleration evident. For example between 2007–12 5000 mm w.e. was cumulatively lost from the glaciers whereas from 1992–1997 only around 2500 mm w.e. was lost from the referenced glaciers. • Some may legitimately note that the data is not quite comparing like with like. The number of measured glaciers fluctuates from around 10 to 40 over the study period. Credit any other valid analysis.	

04	3	**Using Figure 8 and your own knowledge, assess the view that temperature variation is the most significant factor in the development of this vegetation.** **AO1** – Knowledge and understanding of the relationship between climate soils and vegetation in cold environments. **AO2** – Applies knowledge and understanding to the context of the question in accounting for the development of this vegetation. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to this novel situation offering clear 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.	**6** **AO1=2** **AO2=4**

		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** • Climate, soils and vegetation (and their interaction) in cold environments. • Characteristic periglacial landscapes. **AO2** • Responses may suggest that this is a landscape dominated by tundra vegetation. The image suggests a summer season as the only evidence of snow is the upland area. • The vegetation is characterised by a lack of trees and the presence of smaller shrubs and dwarf species. • Expect responses to acknowledge that a significant factor in determining this type of vegetation is the temperature. The very low temperatures in winter combined with the short growing season combine to create an inhospitable environment for trees to colonise. • Response should go further and suggest that the reason for the sparseness of the vegetation cover is related to the poor soil quality and lack of nutrients. The colder temperatures inhibit microbial action to break down dead plant matter. In this sense the nutrient cycle has a slow transfer rate. • Some may also refer to the lack of available precipitation, which is locked in ice during winter, again limiting plant growth. • Expect most to argue that temperature is clearly a factor, though it's variation (ie summer melting) is a contributor to create more hospitable conditions for plants to grow and thrive during the short growing season. Credit any other valid assessment. Generic explanation of the development of periglacial landscapes (with no attempt to apply knowledge to the image) should be held to Level 1.	

04	4	**With reference to a glaciated landscape beyond the UK, assess the role of management in shaping alternative possible futures.** **AO1** – Knowledge and understanding of a case study of a glaciated landscape from beyond the UK. Knowledge and understanding of impact of management in shaping alternative possible futures for glaciated 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. <u>Notes for answers</u> **AO1** • Glacial systems including glacial budgets. • Ablation and accumulation – historical patterns of ice advance and retreat. • Fluvioglacial processes: meltwater, erosion transportation and deposition. • Origin and development of glaciated landscapes. • Characteristic glaciated 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 contrasting 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** • The thrust of the response will largely depend upon the chosen glaciated environment. Expect to see reference to The Alps, Svalbard (Norway) and the Athabasca Glacier (USA). Some may also consider cold environments such as Alaska. • The Alps is under threat from a variety of human activity but also climate change is affecting the region. • For every 1 ºC increase in temperature, the snowline rises by about 150 metres. As a result, less snow will accumulate in the lower lying land. Nearly half of all ski resorts in Switzerland, and even more in Germany, Austria and the Pyrenees, will face difficulties in attracting tourists and winter sport enthusiasts in the future. • Plant species are also on the move northward and uphill. Plants that have adapted to the cold are dying out. Estimates suggest up to 60% of mountain plant species may face extinction.	**20** **AO1=10** **AO2=10**

		• Observed and projected reductions in permafrost are also expected to increase natural hazards and damage to high altitude infrastructure. The 2003 heatwave across Europe demonstrated the potentially severe impacts of higher temperatures and drought on human wellbeing and water-reliant economic sectors (such as power generation). Melting reduced the mass of the Alpine glaciers by one-tenth in that single year. This affected the natural environment but also lead to a significant human impact. • The Alpine Convention is an international territorial treaty for the sustainable development of the Alps. The objective of the treaty is to protect the natural environment of the Alps while promoting its development. This Framework Convention involves the European Union and eight states (Austria, Germany, France, Italy, Liechtenstein, Monaco, Slovenia, and Switzerland). Opened to signature in 1991 and consisting of a Framework Convention, various implementation protocols and declarations, it entered into force in 1995, contributing to reinforce the recognition of special qualities and specific characteristics of the Alps, going beyond national boundaries and seeking international action. • Coping with climate change is almost certainly the greatest challenge facing the people and natural environment of The Alps. • Farmers have adapted their practice to working in these mountains by diversifying their techniques and using technology to move away from transhumance. As the valleys have become more heavily populated through tourism, the space available to farmers has decreased. They have been diversifying in recent years by introducing vineyards or providing campsites for tourists to help boost their income. • The greater overall usage of the Alps has meant that communication links, eg roads, has been improved making it easier to move around the Alps and ensure people can live and work more effectively. • Locals have developed new ways of supporting tourism from building new resorts to offering different types of activities in the summer and winter, all to try and encourage people to visit the area. This provides jobs year-round and a considerable income for the area. Some will argue that this is part of the problem. Human adaptation to cope with change in the Alps often means finding new ways of coping with the change whilst still attracting more people to live, work or spend leisure time in the region. This is creating a vicious circle of continued increasing pressure. • Energy companies have used the steep-sided valleys to build dams, reservoirs and HEP plants to provide energy, using the region's natural topography to provide more efficient forms of energy. Whilst this inevitably causes a loss of valuable habitat and farmland, the sustainable energy derived is arguably worth the loss. • Industry uses natural resources, particularly trees, to provide wood for a variety of uses. Deforested trees are replanted to preserve the resource and in doing so, long-term employment is provided. In this sense there appears to be greater understanding of the importance of sustainability.	

		• Most are likely to focus upon mitigation and adaption in shaping alternative possible futures. For many responses, the future will almost certainly suggest a landscape with less snow and ice, with adaption a key focus to remain sustainable as the world's temperatures continue to increase. There should be some explicit assessment in the context of the question. Credit any other valid assessment.	

Marking grid for Question 4.4

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	• 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).

(1–5 marks)	• 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 process of liquefaction.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Liquefaction occurs when compacted sediments loses strength and stiffness in response to an applied stress such as shaking during an earthquake (1). Material that is ordinarily a solid behaves like a liquid (1) (d). Liquefaction requires a degree of soil saturation to occur (1) (d). • The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils (1). This is because a loose sand has a tendency to compress when a load is applied (1) (d). The loss of soil structure causes it to lose its strength (the ability to transfer shear stress), and it may be observed to flow like a liquid (1) (d). • Liquefaction can cause buildings and infrastructure to collapse as well as a significant risk to life as it acts like quick sand (1). The Notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
05	2	**Analyse the data shown in Figure 9a and Figure 9b.** **AO3** – There are two resources to use in conjunction with each other. The skills relate to graph interpretation. 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 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** • In terms of the number of reported disasters, there is no overall pattern or trend. The lowest number recorded is around 210 in 1992 with a peak of 430 in 2005. Whilst the range is large, it is not possible to suggest a trend of increasing numbers of natural disasters. Some may suggest that the 2000's and 2010's saw an increase compared to the 1990's. A longer time period would really be needed to test the idea of increasing hazards over time. • Typically, economic losses appear to be around $40 – $200bn, with the exception of 4 years where losses were much higher. These same four years appear to be dominated by a small number of extreme events. In all four events damage was in excess of $250bn. • In the breakdown for 2017, floods dominated by occurrence (38%), loss of life (35%) and number of people affected (59%). However, it was storms which generated the huge proportion of the economic losses (85%). These storms costs appear to be dominated by Harvey, Irma and Maria, using the data in the graph above. Credit any other valid analysis.	

05	3	**Using Figures 10a, 10b, 10c and your own knowledge, assess the potential issues associated with managing this event.** **AO1** – Knowledge and understanding of impact and management issues associated with hurricanes. **AO2** – Application of knowledge and understanding to the novel situation, to assess the scale of challenge associated with managing an event of this magnitude. 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. **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.	**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. 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

- The area 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 hinted at in **Figure 10b.**
- Scale is a significant issue. **Figure 10a** shows that the hurricane passed Cuba on 8 October and gathered momentum becoming an even more powerful wind as it struck the south coast of the USA on 10 October. It then passed over 5 states before moving east into the Atlantic. Deploying emergency services over such a wide area is likely to be a major challenge.
- Evacuation is also likely to pose huge challenges. It is reasonable to assume that candidates will be aware that the hurricane is passing through some potentially dense areas of population. Safely managing evacuation on a such a scale is likely to present many challenges, not least in traffic management.
- Some may refer to the challenge associated with predicting the path and intensity of the hurricane in the days leading up to the event. Whilst satellite technology can provide a very accurate current picture of the situation, modelling the path of such a large hurricane is still problematic and can lead to problems if the path changes.
- There are also issues associated with managing the impact of the event itself. **Figure 10c** shows some considerable damage from the hurricane. The coastal settlement appears to have been completely devastated. There may well have been loss of life and serious injury, placing immense pressure on local emergency services. Similarly, the infrastructure will almost certainly have been damaged. Electricity supply, fresh water supply, sewage systems and roads networks are almost certain to have been disrupted. This presents a longer-term challenge of restoring the local community to the normal standard of living once the hurricane has passed.

		• The cost will almost certainly be borne by local residents themselves, but also insurance companies and the local authority. Paying for the damage will take years and will no doubt affect local people and businesses for many years to come. Credit any other valid assessment.	

05	4	**'Seismic activity offshore will always present a greater threat to people than seismic activity on land.'** **To what extent do you agree with this view?** **AO1** – Knowledge and understanding of the impacts of seismic activity. **AO2** – Application of knowledge and understanding assessing the contrasting impact of tsunamis compared to seismic events on land. <u>Mark scheme</u> **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence. **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. **AO2** – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. **AO2** – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.	**9** **AO1=4** **AO2=5**

Notes for answers

AO1

- 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

- Candidate responses are likely to be heavily influenced by the exemplification and case study material. Clearly the answer to the question depends upon the event. Responses are free to argue either way, but assessment should be based upon evidence presented. Some may take a more theoretical approach without detailed reference to case study for either type of event. This is a legitimate approach.
- Some may refer to events such as the Indian Ocean tsunami (December 26, 2004) or the the Japanese tsunami of 2011 (Tohoku).
- For the seismic event, there are many potential case studies which candidates may draw from. Haiti (2010) and Christchurch, New Zealand (2011) may feature as contrasting LIC/HIC events.
- The 2004 Indian Ocean tsunami was thought to result in a final death toll of 283 000, spread across at least eight countries. Around 1.7 million people were displaced. Indonesia was most badly affected. Coastal communities were decimated with many dying in the aftermath due to poor medical care and preventable illness and disease. It also travelled as far as 3000 miles to Africa and still arrived with enough force to kill people and destroy property.
- The risk of famine and epidemic diseases is extremely high immediately following a tsunami – bodies rotting in the tropical heat, contaminated food and water sources as well as the longer term issues of crop destruction.
- In contrast an event such as Haiti 2010 killed a similar number of people at around 230 000. A number of factors were responsible for such a high death toll. The main issues was the inadequate design of many of the old decaying buildings in Haiti.
- Around 3 million people were directly affected by the earthquake with 1 in 5 people losing their jobs because so many buildings were destroyed. Haiti's largest industry, clothing, was one of the worst affected.
- 250 000 homes and 30 000 other buildings, including the President's Palace and 60% of government buildings, were either destroyed or badly damaged. The large number of deaths meant that hospitals and morgues became full and bodies then had to be piled up on the streets.

		• Transport and communication links were also badly damaged by the earthquake. The large number of bodies meant that diseases, especially cholera, became a serious problem. • Hospitals (50+) and schools (1300+) were badly damaged, as was the airport's control tower. It was difficult getting aid into the area because of issues at the airport and generally poor management of the situation. • Clearly this event caused widespread, short- and long-term damage. However, it was not just the event, it was also the economic status of the country which exacerbated the impact. • Some may argue that tsunamis occur less frequently than seismic events on land; also that the areas they can affect are always relatively narrow coastal belts. Others may point to the coastal defences and early warning systems now in place since some of the major events in recent years. Sea walls and public address systems can help to mitigate the worst impacts of tsunamis. Nevertheless in 2018 another tsunami hit Indonesia and the early warning system failed to alert authorities to the tsunami which killed approximately 500 people. Either position is acceptable as long as it is coherently argued.	

05	5	**How far do you agree that storms and wildfire are increasing in frequency and intensity, presenting an increasing threat to people?** **AO1** – Knowledge and understanding of the cause of storms and wildfire. **AO2** – Application of knowledge and understanding to assess the changing threat of wildfire and storms on people and place. <u>Notes for answers</u> **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. • Nature of wildfires. Conditions favouring intense wild fires: vegetation type, fuel characteristics, climate and recent weather and fire behaviour. • Causes of fires: natural and human agency. • Impacts: primary/secondary, environmental, social, economic, political. Short- and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. • Impact and human responses as evidenced by a recent wild fire event.	**20** **AO1=10** **AO2=10**

		• Characteristic human responses – fatalism, prediction, adjustment/adaptation, mitigation, management, risk sharing – and their relationship to hazard incidence. **AO2** • Response should acknowledge that wildfire is a natural phenomenon which is often exacerbated by human activity. It is the direct and indirect human activities, which may have contributed to create favourable conditions for the spread of wildfire. The question is whether these activities are contributing to an increase in the phenomena. • Some may reference data to support argument e.g. research suggests that large wildfires in the United States burn more than twice the area they did in 1970, and the average wildfire season is 78 days longer. Responses which argue in favour of the question may suggest that either human activity has contributed to this or that changes in local / global climate may have exacerbated the issues. • Research shows that climatic factors, especially earlier snowmelt due to warming in the spring and summer, have led to hot, dry conditions that boost this increase in fire activity in some areas. For much of the US West for example, projections show that an average annual 1 degree Celsius temperature increase would increase the median burned area per year as much as 600 percent in some types of forests. • Land use and firefighting tactics can play a role in lowering or raising risks and this human activity may feature in some responses. • Wildfire risk depends on a number of factors, including temperature, soil moisture, and the presence of trees, shrubs, and other potential fuel. All these factors have strong direct or indirect ties to wildfire. • Once a fire starts (data suggests that more than 80 percent of US wildfires are caused by people) temperatures and dry conditions can help them spread and make them harder to put out. Warmer, drier conditions also contribute to the spread of the mountain pine beetle and other insects that can weaken or kill trees, building up the fuels in a forest. • Others may consider changes in agriculture practice as causal factors. The recent wildfires in Amazonia have a direct causal link to slash burn techniques combined with a drier summer period. • With hurricanes, there is similar evidence in support of the question. Sea temperature is generally accepted as being a major contributor to the increasing intensity and arguably frequency of events. • Although scientists are uncertain whether climatic factors will lead to an increase in the number of hurricanes, candidates can reasonably argue that warmer ocean temperatures and higher sea levels are expected to intensify their impacts. • Recent analyses suggests that the strongest hurricanes occurring in the North Atlantic have increased in intensity over the past two to three decades. For the United States for example, models project up to a 90% increase in the frequency of Category 4 and 5 hurricanes. • Hurricanes are subject to two main climate influences: warmer sea surface temperatures could intensify tropical storm wind speeds, potentially delivering more damage if they make landfall. Scientists expect up to an 11% increase in average maximum wind speed, with	

		more occurrences of the most intense storms. Warmer seas also mean more precipitation. Rainfall rates during these storms are projected to increase by about 20 percent and, as Hurricane Harvey showed in 2017, this can sometimes be the more destructive impact. • Some may consider local factors such as coastal geology as well as spring high tides, which when combined with low pressure systems, can exacerbate impacts. There is some evidence that heightened sea levels intensified the impact of Hurricane Sandy, which caused an estimated $65 billion in damages in New York, New Jersey, and Connecticut in 2012. Much of this damage was related to coastal flooding. • The notion of increased hurricane frequency is debatable. • Globally, about 70 to 110 tropical storms form each year, with about 40 to 60 reaching hurricane strength. But records show large year-to-year changes in the number and intensity of these storms. • Frequency and intensity vary from basin to basin. In the North Atlantic Basin, the long-term (1966–2009) average number of tropical storms is about 11 annually, with about six becoming hurricanes. More recently (2000–2013), the average is about 16 tropical storms per year, including about eight hurricanes. Credit any other valid assessment.	

Marking grid for Question 5.5

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2). • Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2). • Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1). • Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2). • Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2). • Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts and processes (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). • Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2). • Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1). • Some knowledge and understanding of key concepts, processes and interactions and change (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).
Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). • Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2). • Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1). • Isolated knowledge and understanding of key concepts and processes (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 6 Ecosystems under stress

Qu	Part	Marking guidance	Total marks
06	1	**Outline the process of succession in a lithosere.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • The first stage of succession is characterised by pioneer species colonising bare rock (1). Species such as moss and lichen are able to find enough nutrients and water without any soils structure present (1) (d). • Once the pioneers have colonised, decay eventually occurs (1). This, along with weathered rock creates the beginnings of the necessary materials for a soil to start to form (1) (d). • The soil is then colonised by species which can outcompete the mosses and lichens e.g. grasses (1). • Decomposers and other fauna start to colonise the area (1). • Birds (and the wind) bring seeds to the area (1). These potentially more complex, larger species require a soil structure to be able to colonise (1). • Climatic climax occurs, when the largest species that the area can accommodate, takes hold and colonises (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 anomalies. 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	**6** **AO3=6**

		AO3 • **Figure 11a** suggests that there are still large swathes of territory across the world which have a low global human footprint. Some may point to North Africa (apart from the coast), east Russia, much of Canada, the interior of Australia and the northern part of South America. There are distinct patterns for those areas which are experiencing a high global footprint in 2009. These include the whole of India, Bangladesh, Europe, east Asia, sub-Saharan Africa and North Eastern USA. Some may suggest that coastal areas are more likely to have a higher global human footprint. • The change in global human footprint shows a very different pattern. Europe for example (particularly north and western), had a high global human footprint but there is clear evidence of improvement over the period 1993–2009. This suggests that whilst the global human footprint is still high, the situation must have been much worse in recent decades. • Some areas such as Indonesia are still degrading looking at **Figure 11b**, but not highly degrading. Southern Europe and North Africa have been highly degrading over the period in question. • It is also interesting to note that places such as North Australia are highly degrading between 1993–2009 but in absolute terms still have a low global human footprint. Credit any other valid analysis.	

06	3	**Using Figures 12a, 12b, 12c and your own knowledge, assess the scale of the threat facing this coral reef.** **AO1** – Knowledge and understanding of the factors affecting the health of coral. Awareness of the measures to conserve coral. **AO2** – Application of knowledge and understanding to assess the scale of the threat to the Great Barrier Reef. <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. 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. **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. <u>Notes for answers</u> **AO1** • The distribution and main characteristics of coral reef ecosystems. Environmental conditions associated with reef development. • Factors in the health and survival of reefs: o Natural: water temperature, acidity, salinity, algal blooms. o Human activity and its impact: major drainage basin schemes, onshore development, desalination, pollution, tourism, fishing. • Future prospects for coral reefs.	**9** **AO1=4** **AO2=5**

		AO2 • A large area of coral is facing a range of threats. Responses should show understanding of the factors which lead to coral bleaching. There is evidence that coral can recover quickly from bleaching events (eg **Figure 12a** in 2017 shows some areas which must have recovered in the north), particularly north of Cairns. Some may apply knowledge by considering the potential causes of the coral bleaching, the loss of the symbiotic algae (pollution, sedimentation, dynamite fishing, sea temperature change and acidification). • Further evidence is shown by **Figure 12b**. The increasing acidification of the sea around Australia could be argued to be a contributing factor to the bleaching event in 2017. Under such conditions, the zooxanthellae may lose substantial amounts of their photosynthetic pigmentation, which decreases rates of photosynthesis and produces bleaching effect. • There is also clear evidence that sea temperatures are increasing. Whilst a longer time period would provide more conclusive evidence, responses should show that higher temperatures and increased solar radiation can have a devastating impact upon coral. • Some may go further and suggest the link between increased temperature and more severe tropical storm events. Tropical storms / tropical cyclones can cause extensive damage to individual corals and to the structure of the Reef, and can affect large areas. The impacts can last for decades, if not centuries. Powerful waves generated during cyclones can seriously damage habitats and landforms, particularly coral reefs and shorelines. Cyclonic winds can also cause substantial changes in the shape of islands and coastlines, affect ocean currents and increase inshore ocean turbidity through suspension of sediments. • Some responses may also consider natural predators and the impact that these can have on coral. The Crown of Thorns starfish may feature in some responses. Credit any other valid assessment.	

06	4	**Assess the impact of declining biodiversity upon a major terrestrial biome that you have studied.** **AO1** – Knowledge and understanding of the concept of biodiversity. Knowledge and understanding of a major terrestrial biome. **AO2** – Application of knowledge and understanding to assess the damage which falling biodiversity can cause in a named 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 concept of the biome. The global distribution of major terrestrial biomes. • The nature of one biome: tropical rainforest or savanna grassland to include: the main characteristics of each biome; ecological responses to the climate, soil and soil moisture budget – adaptations by flora and fauna; human activity and its impact on each biome; typical development issues in each biome to include changes in population, economic development, agricultural extension and intensification, implications for biodiversity and sustainability.	**9** **AO1=4** **AO2=5**

		• The concept of biodiversity. Local and global trends in biodiversity. Causes, rates and potential impacts of declining biodiversity. **AO2** • Responses are likely to consider either tropical rainforest or savanna grassland. Other biomes may be considered such as temperate deciduous woodland or tundra for example. • The loss of biodiversity has many potential consequences. • Losses in biodiversity in rainforests cause significant changes in ecosystem functioning. The particular species making up an ecosystem determine its productivity, they affect nutrient cycles and soil constituents, and they influence environmental conditions such as water cycles, weather patterns, climate and other abiotic aspects such as soil formation. • Some may argue that in some ecosystems it is possible that many species can disappear without serious degradation of most of the functional aspects of the ecosystem. Many ecologists nevertheless feel that the total number of species has a great effect on ecosystem functioning. Reducing biodiversity may lead to a reduction in productivity because of the loss of some niche roles. • Reduced biodiversity affects soil processes, decomposition, water retention and many other ecosystem functions. For example increasing the diversity of plants, herbivores, and decomposing organisms, may increase net primary productivity (NPP). Areas with greater numbers of species tend to have a greater above- and below-ground plant biomass, higher rates of nitrogen fixation. Data suggests for a 50% reduction in biodiversity, there will be a 10%–20% loss of productivity. There are suggestions that loss of species richness may affect many ecosystem processes (nutrient cycling, increased uptake of carbon, and others) in addition to productivity. • Another unintended impact of reduced biodiversity relates to fire hazards and wider impact upon local climate. In Hawaii for example, grasses were introduced to improve cattle grazing, but since these grasses are flammable, they have caused a significant increase in fires in the forests into which they spread. Most woody plants are damaged or destroyed by fires, while grasses generally are not, since their deep root systems are maintained even when the superficial portions of the plant are lost. This in turn reduces evapotranspiration and rainfall. If tropical forest trees are removed and their place is taken by savannah grasses, the evapotranspiration is reduced, decreasing rainfall (and reducing the possibility of forest regeneration). • Trophic interactions may be altered as biodiversity declines: Ecosystem functions depend greatly upon trophic interactions among species within that system. For instance, if carnivores are removed, prey species populations may grow tremendously, leading to a series of uncontrolled changes in the system. Credit any other valid approach. Evaluation should be based upon preceding content.	

06	5	**With reference to a region experiencing ecological change, assess the role of human activity in securing a sustainable future.** **AO1** – Knowledge and understanding of a region experiencing ecological change. Knowledge and understanding of the concept of sustainable development. **AO2** – Application of knowledge and understanding to assess approaches to sustain management of ecological regions under threat. <u>Notes for answers</u> **AO1** • Case study of a specified region experiencing ecological change to illustrate and analyse the nature of the change and the reasons for it, how the economic, social and political character of its community reflects its ecological setting and how the community is responding to change. • 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** • The direction of the response will largely depend upon the chosen case study. Some may consider mitigation measures taken to offset the negative impacts of a human action or natural event / process. • In the tropical rainforest for example there are a number of threats to a sustainable future. This is not the focus of the question but expect responses to set the scene by outlining the threats. Deforestation, soil erosion, flooding, effects of mining, settlement and road building are all likely to feature. Some may also consider the impact of agriculture on the local environment and climate. • The thrust of the response should consider strategies to mitigate these negative impacts and bring about a sustainable situation in the chosen location. Most responses are likely to acknowledge that a sustainable future does involve continued exploitation of the forest. Population pressures as well as the vast resources in these areas, are both factors which will guarantee continued exploitation long into the future. • One clear strategy to mitigate the impact of deforestation is selective logging and replanting. Malaysia, for example, has one such approach which assesses the resources available before any forest clearance takes place. Felling is only undertaken by licence holders so there is a degree of control of the scale of deforestation. Some will point out that this does not address the illegal logging challenge. Malaysia does pursue prosecution of illegal loggers where evidence exists. Replanting arrangements are put in place within two years of deforestation. Every 40–50 years the cycle is repeated. The issue with this approach is that it often leads to secondary succession and a subclimax community of vegetation. This is because the damage created leaves the area	**20** **AO1=10** **AO2=10**

		incapable of reaching the full climax community with the diversity and density of forest coverage. • Rainforest can be protected in areas such as national parks or nature reserves. These areas can be used for education, scientific research and tourism. A recent trend is large international businesses supporting conservation projects in exchange for carrying out scientific research or the provision of raw materials. An example is the Swiss company Givaudian (perfume company). It works with Conservational International and aims to protect 148 000 hectares of the rainforest in Venezuela in exchange for using Tonka beans, used in the production of perfume. • Several charities (NGO's – non-governmental organisations), including the WWF, Birdlife International and Fauna International support conservation and education programmes, training conservation officers and supporting rainforest conservation in schools. • WWF-Malaysia's protected areas (PA) programme is divided into two areas: Peninsular Malaysia is the establishment and maintenance of a network of protected areas based on Peninsular Malaysia's most threatened and biologically significant ecosystems, that contributes to human well-being and species conservation. • International agreements on hardwood use may also feature. There are two key international agreements to control the use of hardwoods. This is important because it can take over 150 years for a mahogany tree to reach maturity. The Forest Stewardship Council (FSC) is an international organisation that promotes sustainable forestry and only products sourced sustainably carry the FSC mark. The FSC try to educate manufacturers and consumers about the need to buy sustainable hardwoods like mahogany (which takes 150 years to reach maturity) and it aims to reduce the demand for rare and valuable hardwoods. • The International Tropical Timber Agreement (2006) restricts trade in hardwoods by ONLY marking timber with a registration mark if it is from a sustainably managed forest. • Ecotourism Malaysia have promoted their rainforests for ecotourism. Ecotourism aims to introduce people to the natural world, to benefit local communities and protect the environment for the future. Through income generated by ecotourism, local people and governments benefit from retaining and protecting their rainforest trees – a more sustainable option than cutting down trees for short-term profit. • Eg Sungai Yu Forest Reserve, Pahang: as part of a conservation project, visitors can camp with the semi-nomadic Batek tribe, join a local cave excursion team, trek across the jungle and witness beautiful mountain views. • Most countries with tropical rainforests are less developed (LIC's or NEE's). Some HIC's have agreed to write off debts in return for the rainforests being protected. For example, in 2010 the USA agreed to convert a Brazilian debt of £13.5 million into a fund to protect areas of the rainforest – this is called 'debt for nature swapping'.	

		• Whatever the approach there should be a clear link between the human activity and the sustainability of the actions. • Assessment should consider the extent to which the chosen region experiencing change has a secure future as a result of human action. Credit any other valid approach.	

Marking grid for Question 6.5

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

	• Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2). • Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1). • Isolated knowledge and understanding of key concepts and processes (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.