A-level
GEOGRAPHY
7037/1

Paper 1 Physical Geography

Mark scheme

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Version: 1.0 Final

2 3 6 A 7 0 3 7 / 1 / M S

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

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

Further copies of this mark scheme are available from 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 purpose of a flood hydrograph.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • The purpose of the flood hydrograph is to track the progress of a storm in a drainage basin (1). • It allows analysis of the impact of the storm upon river levels by measuring changing discharges, usually in cumecs (1). • By looking at previous hydrographs it is possible to assess the likelihood of flood or dangerous events such as high flow rates (1). • This allows for preventative action to be taken such as raising temporary barriers or declaring the river unsafe to users (such as anglers) (d). • It is also possible to compare different drainage basins to see the impact of different land uses upon flow rates in rivers after significant rainfall events (d). • This can help with planning for developments such as sustainable housing and urban drainage systems (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 evident in the resource. Analysis should consider the relationships, types of abstraction, subsequent uses and return data. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.	**6** **AO3=6**

		Notes for answers **AO3** • Finland abstracts around 2 billion m^3 of water per year from groundwater and surface water. This is for domestic (240 m^3), industrial (640 m^3) and fish farming (920 m^3) uses. Much smaller uses are noted for services and agriculture. It is interesting to note that leaks account for more losses than agriculture accounts for usage. • Some of the surface water appears to become tap water (around 50% of tap water comes from surface water). Around 2/3 of the groundwater becomes tap water and 1/3 becomes self-abstracted fresh water. • Some may calculate that surface water abstraction totals an estimated 1.68 billion m^3. Groundwater abstraction accounts for 320 million (or 0.32 billion) m^3. • Other calculations may also feature including the estimated total evaporated and / or the estimations of quantities released through different means. • It is interesting to note that all of this water goes back into rivers (surface water) whereas originally only 84% came from surface water. Credit any other valid analysis.	

01	3	**Using Figure 2 and your own knowledge, assess the challenges associated with carbon sequestration.** **AO1** – Knowledge and understanding of the concept of carbon sequestration. **AO2** – Application of knowledge to show how implementing the ideals of carbon sequestration is a challenge. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear evaluation and analysis drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions, change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic evaluation and analysis drawn from the	**6** **AO1=2** **AO2=4**

		context provided. Connections and relationships between different aspects of study are basic with limited relevance. Notes for answers **AO1** • Factors driving change in the magnitude of carbon stores over time and space, including carbon sequestration in oceans and sediments. • Human interventions in the carbon cycle designed to influence carbon transfers and mitigate the impacts of climate change. **AO2** • From 2000 to 2006, carbon sequestration was either not a priority for countries across the world or the technology was not developed enough to allow for major development of this approach to emissions reduction. • Since around 2006 there has clearly been greater ambition to sequester more carbon particularly from industrial processes. • The problem evident across the whole data set is that the ambition is clearly not matched by action. • In fact, from 2006 onwards, the commitment has continued to grow particularly through industrial and power plant sequestration of emissions. However, the actual amount has changed little relative to the ambition. It remains well short. • Some may counter the previous argument and consider scale, noting the estimated tripling of sequestration. This is mainly from gas and industrial emissions. This may be considered as evidence of progress in this area and a commitment by government to tackle the emissions problem. • The challenges to further success (possibly causing the mismatch between ambition and action) are likely to relate to costs of sequestration and availability of suitable sites. Some may suggest that the countries responsible for major emissions may not have the ability to invest in this technology. Even those that do have the means may not have the political will or desire to invest in the additional costs. Sequestration under the sea for example • There may be specific knowledge applied to the context of the question eg costs of sequestration or specific accessibility issues. Credit any other valid assessment.	

01	4	**Evaluate the potential impact of changes in the carbon budget on a tropical rainforest that you have studied.** **AO1** – Knowledge and understanding of the carbon budget. Knowledge and understanding of a specific tropical rainforest case study. **AO2** – Application of knowledge and understanding to evaluate the effect of a changing carbon budget on the chosen tropical rainforest. <u>Notes for answers</u> **AO1** • The carbon budget and the impact of the carbon cycle upon land, ocean and atmosphere, including global climate. • Factors driving change in the magnitude of carbon stores over time and space, including flows and transfers at plant, sere and continental scales. Photosynthesis, respiration, decomposition, combustion. • Case study of a tropical rainforest setting to illustrate and analyse key themes in water and carbon cycles and their relationship to environmental change and human activity. **AO2** • Some may define the carbon budget. This is the net difference between carbon storage versus the release. Rainforests can either be carbon sinks where more carbon is stored than released, or carbon producers where more is released than stored. • Expect to see the impact of production of CO_2 through burning and farming practices. Both of these human activities can add substantial quantities of both carbon and methane to the atmosphere. • For impact expect to see reference to positive and negative feedback. • Some may consider local implications of positive feedback ie the further increasing temperatures may lead to disruption to the water cycle which may in turn upset the local climate. There may be reference to desertification as local scale impact as well as species and habitat loss. • Some may consider negative feedback and the fact that increased atmospheric carbon may lead to increased availability and uptake by vegetation ie that vegetation growth might be promoted. • Another approach might be to consider to positive impact on the carbon budget of afforestation schemes to produce a net carbon sink and reclaim previously degraded area. • For the chosen case study expect to see reference to the major forested areas such as Amazonia, Borneo, Malaysia or the Congo Basin. Others may consider specific schemes or locations in support of their responses eg recent reforestation schemes in north east Australia. • Whatever the approach there should be a clear evaluation of the impact of changing carbon level on the chosen case study. It is also legitimate to consider global impacts of the changing carbon budget as long as this considers the feedback element of how this then affects the forest. Credit any other valid approach.	**20** **AO1=10** **AO2=10**

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. Interpretations are partial but do support the response in places. (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. 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 weathering processes in hot deserts.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers • Mechanical weathering – exfoliation (sometimes called 'onion skin') occurs in deserts with large temperature extremes (1). The heating and cooling causes expansion and contraction which in turn causes layers of rock to crack and break off (d). Some may consider block separation or disintegration whereby rocks crack and shatter along joints or bedding planes (d). • Freeze thaw (frost shattering) is another type of mechanical weathering whereby repeated freezing and thawing of water leads to breakdown of rock in situ (1). This is a less common type of weathering in deserts due to the low precipitation (d). • Chemical weathering eg salt crystallisation occurs when eluviation or evaporating sea water brings salt crystals into contact with porous rock (1). As the salt crystals expand they create pressure on the joint leading to cracks and eventual disintegration (d). Max 1 for listing. Max 3 for only one process. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

02	2	**Complete the table and standard deviation calculation in Figure 3 and evaluate the usefulness of the technique in analysing this data.** **AO3** – Responses should accurately calculate the standard deviation for this data set. Evaluation should follow in the written section to assess the usefulness of the technique in the context of the data provided. Mark scheme	**6** **AO3=6**

Year	**Area (million km^2)** x	$x - \bar{x}$	$(x - \bar{x})^2$
1980	8.6	–0.609	0.371
1981	8.9	–0.309	0.095
1982	9.25	0.041	0.002
1983	9.4	0.191	0.036
1984	10.0	**0.791**	**0.626**
1985	9.25	0.041	0.002
1986	9.1	–0.109	0.012
1987	9.4	0.191	0.036
1988	8.9	–0.309	0.095
1989	9.2	–0.009	0.000
1990	9.3	–0.091	0.008
	$\sum x = 101.3$		$\sum(x - \bar{x})^2 = 1.283$
	$\bar{x} = 9.209$		

1.283 / 11 = 0.117

Square root of 0.117 = 0.342 / 0.34

AO3
1 mark for completing the table accurately (allow 2 decimal places or more)
2 marks for the final calculation. 1 mark is available for correct calculation even where the final answer is incorrect.

Assessment:
Point marked (max 3 marks):
Allow 1 mark per valid point with extra mark(s) for developed points (d). For example:

The relatively small size of the standard deviation (SD) would tend to suggest that there is a strong degree of clustering around the mean (1) and further that there is a lack of extreme values within the data set (d). However, as the data represents millions of km^2, some may argue there is in fact quite a large variation in the extent of the Sahara Desert over the period in question (1).

In a normal distribution 68.2% of the data lies within 1 SD of the mean. In this case 73% of the data lies within 1 SD suggesting that the data may be normally distributed (d).

		For SD to be particularly useful, it is more effective when comparing SDs (1). The lack of anything comparable eg an earlier or later time period renders the value of the SD figure to be more limited and therefore less useful (d). With comparable data over a later time period it would be possible to assess the extent to which fluctuations in Sahara Desert size are becoming larger / smaller (d). Some may compare with other techniques such as range or interquartile range and compare SD with this technique (1). General value (usefulness) or critique of statistics in geography (1) Credit any other valid analysis.	

02	3	**Using Figures 4a, 4b, 4c and your own knowledge, assess the relative importance of physical and human factors contributing to the flash flooding events in this area.** **AO1** – Knowledge and understanding of the factors leading to flooding in hot deserts. **AO2** – Application of knowledge and understanding to show understanding of why this area is likely to be more prone to flash flooding. Mark scheme **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear evaluation and analysis drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions, 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 water: exogenous, endoreic and ephemeral; the episodic role of water; sheet flooding, channel flash flooding. • Origin and development of landforms of mid and low latitude deserts: water – wadis **AO2** • Some may note that wadis are ephemeral river beds which remain largely dry except during significant rainfall events in hot deserts. • This particular settlement appears to have been built in the river bed presumably due to the advantages created by the local relief and the wadi running through the town. Previous erosion will have flattened the river bed and banks over time. This in turn has created the obvious problem that during heavy rainfall the river will come back to life and flood the town. • Some may note the fact that the town also appears to have been built at the confluence of three wadis as evidenced by **Figure 4a**. This physical factor will concentrate the impact of any flash flooding. • The photograph in **Figure 4c** shows a typical desert landscape. Some may note the increased likelihood of compaction of sand and thin soils (duricrust) as result of the arid conditions and intense heating. Any	**6** **AO1=2** **AO2=4**

		rain which does fall is highly likely to run over overland rather than infiltrating the sand and / or soil. • The human factors are likely to relate to the effect of urbanisation on further exacerbating the lack of infiltration. **Figures 4b** and **4c** both provide evidence of the settlement being built in the wadi. • It is interesting to note that looking at the flow of water in **Figure 4b**, the area of increased flooding is before the main part of the town and not after the town. Some may speculate as to possible reasons for this eg localised flood defences causing the water to build up before it passes through the town. • In terms of relative importance responses are free to argue either way but should come to a clear position based upon preceding content. Credit any other valid assessment.	

02	4	**With reference to a hot desert that you have studied, assess the relative importance of different sources of energy in landscape development.** **AO1** • Knowledge and understanding of sources of energy in deserts. **AO2** • Application of knowledge and understanding to a chosen case study assessing the importance of different types of energy in that location. <u>Notes for answers</u> **AO1** • Systems in physical geography: systems concepts and their application to the development of desert landscapes – inputs, outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium. • The concepts of landform and landscape and how related landforms combine to form characteristic landscapes. • Sources of energy in hot desert environments: insolation, winds, runoff. • Origin and development of landforms of mid and low latitude deserts: aeolian – deflation hollows, desert pavements, ventifacts, yardangs, zeugen, barchans and sief dunes; water – wadis, bahadas, pediments, playas, inselbergs. • The relationship between process, time, landforms and landscapes in mid and low latitude desert settings: characteristic desert landscapes. • Case study of a hot desert environment setting to illustrate and analyse key themes. **AO2** • The nature of the response will depend upon the specific chosen case study location for the hot desert landscape. • The sources of energy relate to insolation, wind and water. • Where the chosen landscape is predominantly erosional and depositional features expect to see reference to wind and water as the main processes. Landscapes dominated by erosional features such as deflation hollows, desert pavements, ventifacts, yardangs and zeugen are predominantly created and shaped by the action of wind. • Similarly those that consider landscapes of deposition dominated by barchan and seif dunes, may argue that wind is the most important factor. • Those that consider landscapes dominated by the action of water are likely to suggest that this type of energy is the most important factor. • Some may consider landscapes where there is a combination of energy sources for example in the creation of inselbergs or pediments. Again, there is opportunity to compare and contrast the role of different type=s of energy in creating these landscapes. • Others might juxtapose two landscapes eg by comparing erosional depositional landscapes and make comparisons between the two.	**20** **AO1=10** **AO2=10**

		• Some may argue that ultimately it is the sun which drives all energy processes on earth (except tectonic). It is also the sun's heat, combined with ocean currents and other atmospheric factors which create pressure differentials and therefore wind. 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. Interpretations are partial but do support the response in places (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. There may be a few inaccuracies (AO1). • Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic (AO2). • Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2). • Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1). • Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Question 3 Coastal systems and landscapes

Qu	Part	Marking guidance	Total marks
03	1	**Outline processes of mass movement at the coastline.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Notes for answers There are different routes to credit depending upon the chosen type of mass movement eg • Mass movement is the gradual or sudden movement of sediment downhill under the force of gravity (1). • Rockfall occurs typically where weathering causes pieces of rock to break away from a slope of cliff and fall to the bottom (1). Some may link this to scree (d). Rock slide is a similar concept but involves the collapse of an area along a joint or bedding plane (d). • Some may legitimately consider solifluction, the slow movement of soils downslope in permafrost areas (1). The process here is linked to the melting of surface layers of soil in the active layer (d) which are then lubricated and move under gravity, usually more slowly (d). The movement is always along the plane where the active layer meets the permafrost (d). • Also allow rotational slip in the same regard (up to 4 marks for clear outline of process). Max 1 for listing. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

03	2	**Complete the table and standard deviation calculation in Figure 5 and evaluate the usefulness of the technique in analysing this data.** **AO3** – Responses should accurately calculate the standard deviation for this data set. Evaluation should follow in the written section to assess the usefulness of the technique in the context of the data provided. Mark scheme	**6** **AO3=6**

Location	**Difference between high and low tide (m)** x	$x - \bar{x}$	$(x - \bar{x})^2$
Plymouth	4.7	–0.808	0.653
Southampton	4.0	–1.508	2.274
Dover	5.9	0.392	0.154
Aberdeen	3.7	–1.808	3.269
Liverpool	8.4	**2.892**	**8.364**
Avonmouth	12.3	6.792	46.131
Belfast	3.1	–2.408	5.798
Londonderry	2.2	–3.308	10.943
St Helier	9.8	4.292	18.421
Swansea	8.4	2.892	8.364
Lowestoft	1.9	–3.608	13.018
Lerwick	1.7	–3.808	14.501
	$\sum x = 66.1$		$\sum(x - \bar{x})^2 =$ 131.890
	$\bar{x}$ =5 .508		

131.889 / 12 = 10.991

Square root of 10.991 = 3.315 / 3.32
AO3
1 mark for completing the table accurately (allow 2 decimal places or more).
2 marks for the final calculation. 1 mark is available for correct calculation even where the final answer is incorrect.

Assessment:
Point marked (max 3 marks):
Allow 1 mark per valid point with extra mark(s) for developed points (d).
For example:

The relatively large size of the standard deviation (SD) would tend to suggest that there is a little evidence of clustering around the mean (1) and further that there are some extreme values within the data set (d). This suggests that the mean is a less reliable method for analysing the data (d).
Some may consider the range and how far this extended either side of the mean to further exemplify (d).

		In a normal distribution 68.2% of the data lies within 1 SD deviation of the mean (1). In this case 58% of the data lies within 1 SD suggesting that the data may not be normally distributed. (d) For SD to be particularly useful, it is more effective when comparing SDs (1). The lack of anything comparable (eg a data set of tidal ranges in another country) renders the value of the SD figure to be more limited and therefore less useful (d). With comparable data for another country it would be possible to assess the extent of the variability with more accuracy (d). Some may compare with other techniques such as interquartile range and compare SD with this technique (1). General value (usefulness) or critique of statistics in geography (1) Credit any other valid analysis.	

03	3	**Using Figures 6a, 6b, 6c and your own knowledge, assess the sustainability of mangrove forests in coastal management.** **AO1** – Knowledge and understanding of soft engineering and sustainable approaches to coastal management. **AO2** – Application of this knowledge to the novel situation; specifically in assessing sustainability of mangrove in coastal management. <u>Mark scheme</u> **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to the novel situation offering clear 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.	**6** **AO1=2** **AO2=4**

		Notes for answers **AO1** • Human intervention in coastal landscapes. Traditional approaches to coastal flood and erosion risk: soft engineering. Sustainable approaches to coastal flood risk and coastal erosion management. **AO2** • Its benefits are clearly substantial in helping to mitigate against the risk of both flooding and erosion in storm events and as a result of sea level change. Some may use **Figure 6a** to explain how mangrove helps to dissipate wave energy and minimise the impact of storm surges by acting as a buffer between the land and sea. • Other sustainable benefits are indicated in **Figure 6b** and include the creation of natural habitats and shelter for fish. This has its own intrinsic benefit for nature but also helps local communities by creating fishing grounds. Provided that any fishing is undertaken with regulation, this is another element of sustainability. • There may also be comment in relation to reduction in CO_2 through photosynthesis so a global contribution to reducing greenhouse gases. • Others may consider the production of wood. Again, as long is this conducted with regulation, a sustainable product could be utilised indefinitely. • The only concern in the data is related **Figure 6c** and the fact that so much of the world's mangrove is unprotected and by definition, it must be under threat. Even in this concerning context, it is clear to see that countries such as Cuba, Mexico and Bangladesh have made significant progress in bringing mangrove under protection, presumably through the development of integrated coastal zone management plans. • It is hard to see how responses could conclude anything other than that mangrove is a highly versatile and sustainable method of coastal management, provided it is well managed. Credit any other valid assessment.	

03	4	**To what extent do natural processes account for the changes in a local scale coastal landscape that you have studied?** **AO1** – Knowledge and understanding of a local scale coastal case study. Knowledge and understanding of the predicted impact of sea level 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** • Eustatic, isostatic and tectonic sea level change. • Recent and predicted climatic change and potential impact on coasts. • Case study(ies) of coastal environment(s) at a local scale to illustrate and analyse fundamental coastal processes, their landscape outcomes as set out above and engage with field data and challenges represented in their sustainable management. **AO2** • There are essentially three potential lines of response depending on the focus of the coastal landscape: • Some will argue that natural processes are having a substantial effect on shaping their chosen coastline. A combination of erosion, deposition and weathering are likely to feature along with associated landscape development and or threat to local communities. Case studies such as Holderness or specific known erosion or depositional landscapes may feature. In this regard the main change is likely to be the impact of process on the landform / landscape development which if unchecked will lead to significant changes in the coastline. • Others will challenge the assertion of the question and take the view that it is climate change and associated sea level rise which accounts for major aspects of change at the chosen local scale case study coastlines. Changes to lowland coastlines and estuaries are likely to feature in this regard. Some may link this to isostatic adjustments as well as eustatic change. There may be reference to the Dalmatian Coastline or raised beaches in Scotland for example. • The third approach will be to argue that it is human interference which remains the dominant force shaping coastlines. Such arguments are likely to focus upon the impact of management decisions and policies as the dominant force. Support may consider some assessment integrated coastal management or shoreline management plans. Credit any other valid approach. Evaluation should be based upon preceding content.	**20** **AO1=10** **AO2=10**

Marking grid for Question 03.4

Level/ Mark Range	Criteria/Descriptor
Level 4 (16–20 marks)	• Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2). • Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2). • Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1). • Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1). • Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).
Level 3 (11–15 marks)	• Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2). • Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2). • Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Generally clear and relevant knowledge and understanding of place(s) and environments (AO1). • Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1). • Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).
Level 2 (6–10 marks)	• Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question. Interpretations are partial but do support the response in places (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. 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 processes by which ice moves within a glacier.** <u>Point marked</u> Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: <u>Point marked</u> **AO1** • Basal sliding occurs when the ice melts under pressure and as a result of friction (1). The pressure melting point can fall below 0 ^{o}C (1). Meltwater at the base of ice acts as a lubricant (1). This is associated with faster movement of ice in warm based glaciers (1). Surges are associated with build-up ice meltwater and rapid movement of up to 300 metres in a day (d). • Internal deformation occurs when ice crystals within the glacier orientate themselves to the direction of flow of ice (1). Even though the ice is frozen to the rock beneath it can still much but more slowly (1). This type of movement is associated with cold based glaciers (d). • Rotational flow occurs in corries when the ice rotates around a pivot point (1). This can force ice to move up hill and over the lip of the corrie (d). • Some may consider compressional and / or extensional flow. Allow one mark per valid statement. Max 3 if only one process is considered. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**

04	2	**Complete the table and standard deviation calculation in Figure 7 and evaluate the usefulness of the technique in analysing this data.** **AO3** – Responses should accurately calculate the standard deviation for this data set. Evaluation should follow in the written section to assess the usefulness of the technique in the context of the data provided.	**6** **AO3=6**

Year	**Minimum extent (millions of km^2)** x	$x - \bar{x}$	$(x - \bar{x})^2$
2002	5.95	0.779	0.607
2003	6.13	0.959	0.920
2004	6.04	0.869	0.755
2005	5.56	0.389	0.151
2006	5.91	0.739	0.546
2007	4.29	**–0.881**	**0.776**
2008	4.72	–0.451	0.203
2009	5.38	0.209	0.043
2010	4.92	–0.251	0.063
2011	4.61	–0.561	0.315
2012	3.62	–1.551	2.406
2013	5.35	0.179	0.032
2014	5.28	0.109	0.012
2015	4.63	–0.541	0.293
	$\sum x = 72.39$		$\sum(x - \bar{x})^2 = 7.123$
	$\bar{x} = 5.171$		

Mark scheme

7.123 / 14 = 0.509

Square root of 0.509 = 0.713 / 0.71

AO3
1 mark for completing the table accurately (allow 2 decimal places or more).
2 marks for the final calculation. 1 mark is available for correct calculation even where the final answer is incorrect.

Assessment:
Point marked (max 3 marks):
Allow 1 mark per valid point with extra mark(s) for developed points (d).
For example:

The relatively small size of the standard deviation (SD) would tend to suggest that there is a strong degree of clustering around the mean (1) and further that there is a lack of extreme values within the data set (d).

		However, as the data represents millions of km^2, some may argue there is in fact quite a large variation in the extent of the Antarctic ice sheet over the period in question (1). In a normal distribution 68.2% of the data lies within 1 SD of the mean. In this case 71% of the data lies within 1 sd suggesting that the data may be normally distributed. (d) For SD to be particularly useful, it is more effective when comparing SDs (1). The lack of anything comparable eg an earlier or later time period renders the value of the SD figure to be more limited and therefore less useful (d). With comparable data over a later time period it would be possible to assess the extent fluctuations in Antarctic ice sheet size are becoming larger / smaller (d). Some may compare with other techniques such as range or interquartile range and compare SD with this technique (1). General value (usefulness) or critique of statistics in geography (1) Credit any other valid analysis.	

04	3	**Using Figure 8a, Figure 8b and your own knowledge, assess the potential future for Arctic sea ice.** **AO1** – Knowledge and understanding of the development patterns of ice advance and retreat. **AO2** – Applies knowledge and understanding to the novel situation in assessing the potential future of Arctic sea ice. <u>Mark scheme</u> **Level 2 (4–6 marks)** **AO1** – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies knowledge and understanding to this novel situation offering clear evaluation and analysis drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance. **Level 1 (1–3 marks)** **AO1** – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. **AO2** – Applies limited knowledge and understanding to the novel situation offering only basic evaluation and analysis drawn from the	**6** **AO1=2** **AO2=4**

		context provided. Connections and relationships between different aspects of study are basic with limited relevance. Notes for answers **AO1** • Natural variation in ice advance and retreat. • Systems in physical geography: positive/negative feedback, dynamic equilibrium. • Concept of environmental fragility. Recent and prospective impact of climate change. Management of cold environments at present and in alternative possible futures. **AO2** • The data in **Figure 8a** suggests that substantial areas of the Arctic sea ice are freezing later in winter. Compared to the 1979 baseline, the area north of the Chukchi Sea is experiencing a later onset of freezing by up to 25 days. It is also clear, when comparing this with **Figure 8b**, that the ice is becoming younger. In other words, the older ice (5+ years) is diminishing as a proportion of the overall ice content in the Arctic. • In terms of the future, the suggestion is that ice is developing later and is younger. All this data points toward a future where the Arctic sea ice continues to shrink in the northern hemisphere summer period. • Some may link to the positive feedback of the albedo effect ie as sea ice melts, the seas absorb more heat and the temperature increase is exacerbated. • Some may suggest that this is just part of a natural cyclical change in the warming and cooling of the climate in the northern hemisphere and that the trends are not concerning. Credit has to be allowed for this as long as there is acknowledgement that the data suggests otherwise. Expect to see reference to Milanković Cycles in support. Credit any other valid assessment.	

04	4	**Analyse the relative importance of erosion and deposition in the development of fluvioglacial landscapes**. **AO1** – Knowledge and understanding of the processes in fluvioglacial landscapes. **AO2** – Applies knowledge and understanding of how the processes link directly to the formation of the fluvioglacial landscapes. <u>Notes for answers</u> **AO1** • Systems in physical geography: systems concepts and their application to the development of glaciated landscapes – inputs, outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium. The concepts of landform and landscape and how related landforms combine to form characteristic landscapes. • Fluvioglacial processes: meltwater, erosion transportation and deposition. • Fluvioglacial landforms of erosion and deposition: meltwater channels, kames, eskers, outwash plains. Characteristic fluvioglacial landscapes. **AO2** • Responses should focus on the underlying processes in fluvioglacial landscapes. There should be assessment of the importance of the link between the process and the landscape development. • Landforms are likely to feature but there should be a sense of how the underlying processes drive the development of the whole landscape rather than just creating individual landforms. Links between different landforms should emerge. • It is the meltwater which generates the major processes of erosion transport and deposition. These in term create a number of landforms which in turn creates the unique fluvioglacial landscape in cold environments. • Expect to see reference to a number of types of streams such as subglacial, englacial, supraglacial and marginal streams. Some may link to the formation of proglacial lakes. • It is the melt water which is responsible for the erosion and transport of material carried in much the same fashion as a river. • There should a clear link between the erosion and transport of sediment in meltwater, the stratification and sorting of sediments and formation of eskers, kames, outwash (sandur) plains, kettle holes and braided streams. • Case studies may feature such as the Skeidar Sandur in southern Iceland. • There should be a clear sense that the response has shown understanding of the development of whole fluvioglacial landscape as a result of the meltwater processes.	**20** **AO1=10** **AO2=10**

		• There may be some implicit links back to glacial processes for instance in explaining where sorted materials in the meltwater may have originated. There should be some explicit assessment in the context of the question. This will depend upon the focus of the supporting characteristic fluvioglacial landscape. 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 (1–5 marks)	• Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). • Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2). • Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2). • Very limited relevant knowledge and understanding of place(s) and environments (AO1). • Isolated knowledge and understanding of key concepts and processes (AO1). • Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).
Level 0 (0 marks)	• Nothing worthy of credit.

Section C

Question 5 Hazards

Qu	Part	Marking guidance	Total marks
05	1	**Outline the concept of mitigation in relation to the management of hazards.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Mitigation is action by people to reduce the potential effects of a hazard upon themselves or their property (1). • The hazard management cycle includes mitigation as part of the pre-event action to reduce the impact of the event (1). • Examples include hazard mapping whereby the intensity of past events can be mapped (1). This provides an indication of the areas most at risk and the most likely damage based on these past events (d). The idea is that by taking past events into account, planning decisions can be made prior to the next event in order to reduce its impact should a similar event occur in the future (d). • Other examples are equally credit worthy and include flood zone mapping, building code enforcement, evacuation planning etc. Max 1 for listing. The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
05	2	**To what extent does Figure 9 show that wildfires are increasing in intensity and severity?** **AO3** – There should be assessment of the information provided. This should include an awareness of the strengths and limitations of the data in helping to draw conclusions about Australian wildfires. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of a geographical issue or question. Clear evaluation of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.	**6** **AO3=6**

		Level 1 (1–3 marks) **AO3** – Basic analysis of a geographical issue or question. Basic evaluation 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. <u>Notes for answers</u> **AO3** • The first element in the data set provides a variation on proportional circles as a mechanism to indicate the scale of the wildfires in Australia over time. Whilst it does allow some rudimentary comparisons to be made, scale is absent, rendering any more granular examination to be impossible. For instance, 4 years stand out in the dataset, but this is largely explained through the annotations rather than scale provided. • The second part of the infographic provides data on the month by month variation wildfire events. Clearly January and February stand out as being particularly damaging in terms of impact with Victoria, Tasmania and Capital Territory the most badly affected. However, there is no indication or ability to identify whether events are increasing in intensity and severity over time. • The final element provides information on the seasonal variation in wildfires across different territories across Australia. Clearly wildfires affect Australia pretty much all year round. However, it is during spring and summer that most of the country is affected. • Overall it is hard to see how the dataset could be used to conclude on anything resembling increasing intensity or severity. The first graph is inconclusive and the subsequent datasets are more concerned with spatial and temporal patterns. Credit any other valid analysis.	

05	3	**Using Figure 10 and your own knowledge, discuss likely approaches to seismic hazard management in this area.** **AO1** – Knowledge and understanding of the management of seismic hazards. **AO2** – Application of knowledge and understanding to the novel situation, to assess the impacts of the data for the management of seismicity in this region. <u>Mark scheme</u> **Level 3 (7–9 marks)** **AO1** – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. **AO2** – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Discussion 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. Discussion 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. Discussion is basic and supported with limited appropriate evidence. <u>Notes for answers</u> **AO1** • The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, 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.	**9** **AO1=4** **AO2=5**

		AO2 • Liquefaction is the most obvious suggested hazard associated with the data set. Area A is comprised of soft sediments formed by rivers and coastal deposits. Similarly, Area B is comprised of ash and gravel deposits. Both of these materials are most likely to become unstable in response to the violent shaking associated with a seismic event. Essentially, younger sediments are correlated with more risk of hazards. • A significant proportion of Waikato is at risk of hazards as a result of its underlying geology. • It is hard to identify any particular patterns in relation to fault lines. Some may apply knowledge and suggest that fault lines are more likely to provide the source and epicentre for seismic events but are not necessarily then the areas most at risk of severe hazards. • The approach to hazard management should focus on building design to ensure that those on areas A and B are most able to withstand the hazards associated with any such event. Deeper foundations or more flexible building design might feature. • Some might argue that more data is needed, particularly around the impact of past events, if it is available. • Some may focus on education of the public around the most appropriate response to an event. This programme should concentrate on the areas most at risk of severe hazards ie to the swathe of territory across the centre of Waikato. Credit any other valid assessment.	

05	4	**How far do you agree that mudflows are more hazardous than nuées ardentes?** **AO1** – Knowledge and understanding of volcanic hazards. **AO2** – Application of knowledge and understanding to assess the relative impact of mudflows and nuées ardentes. <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.	**9** **AO1=4** **AO2=5**

AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.

AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

Notes for answers

AO1

- The nature of vulcanicity: forms of volcanic hazard: nuées ardentes, mudflows, pyroclastic and ash fallout. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.
- Impacts: primary/secondary; environmental, social, economic, political. Short- and long-term responses.

AO2

- The direction of the response will largely depend on the choice of supporting material and/or underpinning knowledge. Case study support is not a requirement of the question.
- Mudflows occur in very specific geomorphological situations, usually where there is ice, snow or the presence of water on a composite volcano. The debris forced out mixes with the water and flows rapidly downhill Expect reference to lahar though this is not a specification requirement. It is the rapid, uncontrolled flow which causes the flood hazard further downslope.
- In many ways a pyroclastic flow is similar, with the major difference being that it is ash, gas, rock and dust flowing downhill at great speed which poses the hazard.
- There are instances where the two hazards operate in conjunction with each other. For instance, in Armero, Columbia, following the Nevada Del Ruiz eruption in 1985. In this sense it could be argued that without the pyroclastic flow there may not have been a lahar. Nevertheless, it was the lahar which caused a loss of an estimated 20 000 people.
- Others may point to historical events such as Mount Pelee eruption in 1902 or Vesuvius in AD 79. The Pelee eruption is thought to be responsible for around 30 000 deaths.
- In terms of comparisons, the data would suggest that lahars are in fact more hazardous and deadly than pyroclastic flows.
- Most eruptions can now be predicted with a relatively high degree of accuracy (especially compared to seismic events). Some might argue that neither hazard presents a significant threat to people as a result of this.

		• Some may even argue that neither present as great a risk as tsunamis triggered by volcanic events or starvation triggered by the loss of farmland. • Whatever the argument, the position should be based upon preceding content. Credit any valid assessment.	

05	5	**With reference to a hazardous location at a local scale, assess the importance of the physical processes and factors which have contributed to the scale and nature of the hazard.** **AO1** – Knowledge and understanding of a local-scale hazardous location and the factors contributing to this. **AO2** – Application of knowledge and understanding to assess the importance of physical and human factors affecting the hazard. <u>Notes for answers</u> **AO1** • Underpinning physical processes, factors or conditions leading to a hazard. • Case study at a local scale of a specified place in a hazardous setting to illustrate the physical nature of the hazard and analyse how the economic, social and political character of its community reflects the presence and impacts of the hazard and the community's response to the risk. **AO2** • The focus of the response largely depends upon the chosen local scale hazardous setting. • Typically, the scale should be no larger than a city or equivalent sized area. Some may consider an area experiencing multiple hazards. This is an acceptable approach. • For physical factors expect to see reference to the underlying or prevailing conditions leading to the emergence of the hazard. This could include: the atmospheric conditions leading to the creation of tropical storms; the local geomorphology which might exacerbate the impact of a flood following a storm event; the tectonic situation which might account for the increased likelihood of seismic of volcanic events; the combination of atmospheric and environmental conditions which might account for increased likelihood of wildfire. • Whatever the approach there should be clear appreciation of the role of these factors in creating the scale and impact of the subsequent hazard event. • For example, in The Camp Fire of 2018 (California's most deadly wildfire) there had been several years of drought which was followed by a late spring period of rainfall. This created a ready supply of tinder as the grass dried out in the summer. Years of drought had also lowered the water table further reducing surface moisture. High winds and high temperatures also affected the area after the fire started	**20** **AO1=10** **AO2=10**

		making it impossible to control its spread. A lack of rainfall during the fire gave no assistance in helping to put it out. • Whilst a number of factors conspired to exacerbate the issue, the single most important factor was the preceding drought. 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 concept of net primary production.** Point marked Allow 1 mark per valid point with extra mark(s) for developed points (d). For example: Point marked **AO1** • Net primary production (NPP) is widely used measure to indicate the productivity of local ecosystems or biomes (1). This can be used to compare similar vegetation types in different regions in order to ascertain how 'healthy' the ecosystem is and understand how stressed the vegetation is (d). • In technical terms it is the rate at which energy is stored as biomass (1). Some may explain it in terms of NPP being gross productivity minus the rate of energy loss through metabolism (d). • The most productive biome in the world is the tropical rainforest with a figure of around 2000 g/m^2/ yr. This is compared to deserts with an average NPP of around 3 g/m^2/yr (d). The notes for answers are not exhaustive. Credit any valid points.	**4** **AO1=4**
06	2	**Analyse the data shown in Figure 11**. **AO3** – Analysis relates to identification of pattern and trends as well as anomaly. There is also opportunity to manipulate data. Mark scheme **Level 2 (4–6 marks)** **AO3** – Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence. **Level 1 (1–3 marks)** **AO3** – Basic analysis of the quantitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence. Notes for answers: **AO3** • Vertebrates (19%), invertebrates (24%) and plants (22%) are all experiencing similar degrees of threat according to the dataset.	**6** **AO3=6**

		• It is also positive to note that approximately 80% of each species group are not under threat. • Nevertheless, within the data set there are some concerning trends. Freshwater molluscs for example are a well-studied group (97.8% coverage and almost 60% are threatened). • Spain has 258 more threatened species than the lowest ranked country Kosovo. • The situation for plants is not clear as only 8% of the assessment has been completed according to the dataset. It is the same for dung beetles; clearly more assessment is needed. • In its current form it is not possible to identify which groups of species are predominantly affected in each country. • Also, it is not possible to identify which species within the sub group are critically endangered, endangered or vulnerable. Credit any other valid analysis.	

06	3	**Using Figure 12 and your own knowledge, assess the challenges in managing this local scale ecosystem.** **AO1** – Knowledge and understanding of managing a local scale ecosystem. **AO2** – Application of knowledge and understanding to assess management issues at Ainsdale Sand Dunes. <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 main characteristics of a distinctive local ecosystem. • Local factors in ecological development and change (such as agriculture, urban change, the planned and unplanned introduction of new species). • The impacts of change and measures to manage these impacts. Conservation strategies and their implementation in specific settings.	**9** **AO1=4** **AO2=5**

		AO2 • The management issue here is around the inevitable conflict between different user groups. • The area is criss-crossed by a number of paths. These include long distance paths. This indicates a potentially wide variety of users including cyclists and hikers. Ensuring that these groups come into contact with each other harmoniously will present challenges. • There are also wheelchair accessibility requirements, no doubt presenting a challenge for service providers given the nature of the sand dune terrain. • Probably the biggest challenge will be in ensuring that the very thing visitors have come to see (unique flora and fauna), remains protected, whilst still allowing visitors the opportunity to enjoy the area's beauty. • Responses are likely to note that this area is one of the few remaining strongholds for the red squirrel. Managing the habitat whilst allowing visitors will present major challenges. • It is also important that invasive species are managed. Some will note the challenge of keeping the grey squirrels out of this area whilst still allowing the red squirrels to thrive. Credit any other valid assessment.	

06	4	**Assess the relative importance of different physical factors in a region experiencing ecological change.** **AO1** – Knowledge and understanding of regions facing ecological change. **AO2** – Application of knowledge and understanding to assess the relative importance of different physical factors. <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** • Factors influencing the changing of ecosystems, including climate change. • Case study of a specified region experiencing ecological change to illustrate and analyse the nature of the change and the reasons for it. **AO2** • Most responses are likely to reference climate change as the main physical driver of ecological change. Other physical factors might include changing drainage patterns, volcanic activity, a short-term weather event such as a tropical storm etc. These are all valid physical factors.	**9** **AO1=4** **AO2=5**

		• In Bangladesh, the coastline is under considerable threat and facing major ecological change. The major physical changes are rising sea levels, increased sea temperature, coastal retreat, tectonic subsidence and arguably increased frequency and regularity of tropical storms. • Most responses are likely to argue the driving physical factor underpinning all of this change is climate change. It is the climate change which many will argue is leading to the submergence of the coastline and increased sea temperatures. • Whilst it is not the focus of the response, it is reasonable to conclude that human factors are arguably contributing a greater threat than the underlying physical factors facing the region. Credit any other valid approach. Evaluation should be based upon preceding content.	

06	5	**How far do you agree that the development pressures facing savanna grassland are more extreme than those facing tropical rainforest?** **AO1** – Knowledge and understanding of the factors leading to the development of the tropical rainforest biome and savanna grassland. **AO2** – Application of knowledge and understanding to assess the development pressures facing both biomes. <u>Notes for answers</u> **AO1** • The concept of the biome. The global distribution of major terrestrial biomes. • The nature of tropical rainforest and savanna grassland: • 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. **AO2** • Both are vast areas covering large part of their respective continents. • Whilst the development pressures facing each biome have their own individual emphasis, the root cause human exploitation of the natural landscape. • In the case of the tropical rainforest the development pressures stem from a desire to exploit the land for agricultural purposes and extraction of timber and other forest products. Mining is another major occupation in rainforest areas. Expect to see reference to the major rainforest regions of Brazil, Africa and south-east Asia. It is reasonable to expect good case study detail in explaining these developmental pressures in detail. • In the savanna, the main pressure is agricultural expansion and encroachment into the natural habitat of the big game. Population pressure in Africa generally, as well as near to the game reserves, is creating real tension. As Africa's population continues to grow rapidly, food production will inevitably have to rise in order to keep pace. • Some may consider the relative success of conservation measures in both regions as way of counter-balancing the development pressures, thus diminishing their impacts. Expect to see reference to afforestation schemes in the rainforest and the use of tourism to aid conservation in the savanna. • Both biomes are under considerable threat and so expect a variety of positions in regards to the question. Any conclusion is acceptable as long as it is evidenced in the preceding content. Credit any other valid approach.	**20** **AO1=10** **AO2=10**

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.