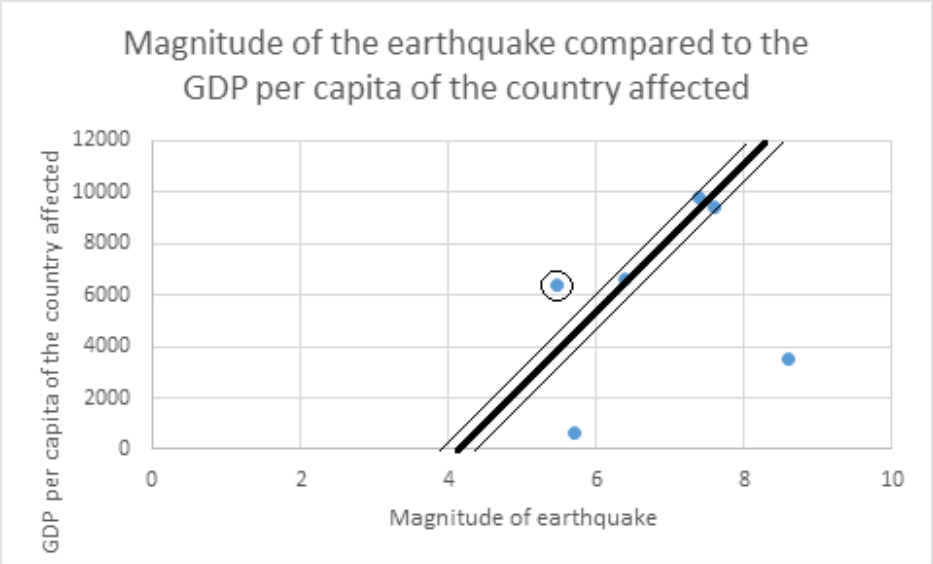
Paper 1 mark scheme

Question number	Answer	Mark
1(a)	**AO1 (1 mark)** Award **1** mark for a correctly identified scale from the following: • Modified Mercalli (MM) (accept Mercalli) • Moment Magnitude Scale (Mw) • Richter	(1)

Question number	Answer	Mark
1(b)(i)	**AO3 (2 marks)** Award **1** mark for the correctly plotted point and **1** mark for a correctly drawn line of best fit (allow within range shown). 	(2)

Question number	Answer	Mark
1(b)(ii)	**AO1 (2 marks)/AO2 (1 mark)** Award **1** mark for analysing the resource to identify a possible reason for the death toll death and a further **2** marks for justifying the possible reason, for example: • some regions where most powerful earthquakes occur might have better transport links (1) and so aid/help takes little time to arrive (1), decreasing the likelihood that injured people become fatalities (1) • some regions might be richer and more developed than average for country (1) so possibly good infrastructure because of development (1) as well as aseismic buildings decreasing fatalities (1) • some regions might have a lower population density (1) so fewer people are exposed to the primary and secondary hazards of an earthquake (1) and less chance of being trapped by landslides (1) or collapsing buildings. Accept any other appropriate response.	(3)

Question number	Answer	Mark
1(c)	**AO1 (4 marks)** For each reason, award **1** mark for identifying a reason for the increase in the number of reported earthquakes, and a further mark for an appropriate expansion. For example: • increase in the number of recording stations (1) which means more earthquakes are detected which previously might have been missed in remote areas (1) • higher population densities (1), which leads to more reporting because areas are better 'covered' (1) • better (more reliable and accurate) detection equipment (1) so smaller magnitude earthquakes are detected which previously might have been missed (1). Accept any other appropriate response.	(4)

Question number	Answer
1(d)	**AO1 (6 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: • tsunami waves are caused by the displacement of large quantities (columns) of water • earthquakes displace water when movement causes the seabed to thrust upwards undersea landslides displace water when material falls from a continental shelf on to the seabed • volcanic eruptions displace water when material ejected from the volcano falls into the sea • landslides displace water when large quantities of water are displaced by land falling into the sea • the displaced water becomes tsunami waves and as the waves reach shallower water in coastal areas (as the topography of the seabed changes) the waves become higher • in shallower water the friction between the tsunami wave and the seabed increases and the tsunami wave slows down, decreasing wavelength but increasing wave height.

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

Question number	Answer
1(e)	**AO1 (3 marks) / AO2 (9 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. Responses that demonstrate **only** AO1 without any AO2 should be awarded marks as follows: • Level 1 AO1 performance: 1 mark • Level 2 AO1 performance: 2 marks • Level 3 AO1 performance: 3 marks. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: **AO1** • hazard profiles relate to the magnitude, speed of onset, areal extent, duration, frequency and spatial predictability of earthquakes • management strategies include modifying the event through land-use zoning and hazard-resistant design • management strategies include modifying the vulnerability and resilience of a population through education and community preparedness • management strategies include modifying the loss which includes emergency, short- and longer-term aid and insurance, and the actions of affected communities themselves **AO2** • the magnitude of an earthquake can be the most important factor in determining the success of modifying the event management strategies as even in MEDC that have invested heavily, such approaches cannot cope with mega earthquake events as the Tohoku earthquake in 2011 demonstrated • in contrast, smaller earthquakes can be managed more effectively, even with basic aseismic buildings such as beams and columns, such as the reduced impacts in Chile • the areal extent of an earthquake can also be a vital factor as it not only determines the number of people affected but also, crucially, can determine the success of modifying the loss, as the larger the area the more difficult it is for the existing emergency services to reduce the loss of the earthquake event, as the Sichuan earthquake of China that devastated a large area demonstrated • conversely, a small areal extent allows the emergency services to reduce the loss by concentrating resources in a smaller area as the Christchurch earthquake of 2011 demonstrated • the frequency of earthquakes is also a key factor in determining the success of modifying the vulnerability of the population as the more frequent the earthquake the more likely the community is likely to be

Question number	Answer
	educated and aware of the hazard threat as demonstrated by the relatively low impacts of the San Francisco 1989 and Los Angles 1994 earthquake events showed • conversely, a low frequency can reduce the awareness of the hazard risk as shown in the Kobe earthquake of 1995 which was an area chosen by Japanese planners to resettle survivors of the Tokyo earthquake of 1923 due to the low number of recorded earthquakes in the area. The subsequent earthquake highlighted the failure of the management strategies in the Kobe region • the level of economic development is, however, a vital factor as it determines whether areas can afford to implement all three types of strategies as the example of Haiti 2010 shows.

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

Question number	Answer	Mark
2(a)	**AO1 (1 mark)** Award **1** mark for any correct physical or chemical weathering process from the following: • freeze-thaw (congelifraction) • exfoliation • solution • hydrolysis. Accept any other appropriate response. Do not accept non-weathering processes (e.g. landslides/slumping/solifluction etc.)	(1)

Question number	Answer	Mark
2(b)(i)	**AO3 (1 mark)** Accept any of the following: • 341 151 • 341 152 • 342 151 • 342 152	(1)

Question number	Answer	Mark
2(b)(ii)	**AO3 (1 mark)** C	(1)

Question number	Answer	Mark
2(b)(iii)	**AO1 (2 marks)/AO2 (1 mark)** Award **1** mark for analysing the resource to identify a characteristic feature of a cirque/corrie and a further **2** marks for explaining the process that has created this feature, for example: • the steep back wall could be created through cycles of freezing and melting, frost shattering (1) occurs above the ice line, creating angular material (1); this angular material is then transported via crevasses or the bergschrund to the base of the cirque glacier where it provides material for erosional process of abrasion (1) • the steep back wall could also be created by the erosional process of plucking and quarrying at the back wall of the cirque (1) and parts of the glacier freeze onto the frost-shattered rock (1) and subsequent rotational sliding 'plucks' part of the back wall creating a steep backwall (1) • the over-deepened bowl could be created through the enhanced dissolving of CO2 in cold conditions (1), the water at the base of the cirque glacier becomes acidic (1), solution/carbonation weathering then occurs at the base of the cirque glacier, preparing the rock for the erosional process of quarrying (1) • the lip could be created by the rotational sliding of the glacier (1) 'bulldozes' or 'quarries' the weathered base of the cirque, creating an over-deepened bowl (1) and the rotational sliding of the glacier entrains the frost-shattered angular material and abrades the lip of the cirque (1). Accept any other appropriate response.	**(3)**

Question number	Answer	Mark
2(c)	**AO1 (4 marks)** For each reason, award **1** mark for identifying a basic reason for the creation of ice contact depositional feature and a further mark expansion up to a maximum **2** marks each. For example: • lateral moraine – Weathering creates material that moves through mass movement (1) onto the glacier forming a lateral moraine. When ice melts it deposits this material as unsorted angular morainic material at the side of a valley (1) • medial moraines - When two glaciers meet the lateral moraines join together (1) to form a medial moraine. When ice melts it deposits this material as unsorted angular morainic material in the middle of a valley (1) • morainic material at the snout of a glacier is deposited (1) and can be reworked by further advances and retreats as a push or recessional moraine (1) • Drumlins - the advance of a glacier over till (1) molds the till into egg shaped hills known as drumlins (1).	**(4)**

Question number	Answer
2(d)	**AO1 (6 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: • ice sheets scoring happens when ice sheets are moving slowly through basal sliding and deformation and so move material over large areas • this can then lead to the process of abrasion as debris is dragged over a variety of surfaces • in addition, the processes of quarrying and plucking occurs as regelation takes place • the main landforms created are basins, knock and lochan and roches mountonnées • basins are created where large ice sheets take advantage of differential rates of erosion of rock, deeply eroding the weaker rock to create basins which are subsequently filled by water, such as the Great Lakes and other lake basins on the Canadian Shield • knock and lochan topology occurs as the ice sheet advances it preferentially erodes through ice sheet, scouring areas of dense jointing more than areas without jointing, creating the ice scoured basin • harder areas of rock are left as upstanding ridges, sometimes displaying the characteristics of roches mountonnées. Accept micro features such as glacial groves, striations, chatter marks and glacial polishing.

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

Question number	Answer
2(e)	**AO1 (3 marks)/AO2 (9 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. Responses that demonstrate **only** AO1 without any AO2 should be awarded marks as follows: • Level 1 AO1 performance: 1 mark • Level 2 AO1 performance: 2 marks • Level 3 AO1 performance: 3 marks. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: **AO1** • the process of ablation include melting, calving, evaporation and avalanches • the rate of ablation is affected by temperature, altitude, aspect and rate of glacier movement, as well as tectonic processes • global warming can influence ablation rates by affecting the temperature and precipitation type and amount **AO2** • on a long-term temporal scale, recent global warming is only a small part of the change in temperatures over the last 10,000 years and can be seen as only part of the cause of a change in the rate of ablation • yet, in the last 100 years global warming is thought to have played a key role in the increased rate of ablation from both warm- and cold-based glaciers • on a world scale in temperate glaciers, temperature is the key factor with higher temperatures leading to greater ablation. Global warming is therefore a key factor in raising the temperature experienced by temperate glaciers and therefore directly increasing the rate of melting, evaporation and avalanches, leading to the retreat of many Alpine, Andinian and Himalayan glaciers • on a world scale in cold-based glaciers such as in Greenland and Antarctica, global warming is also a vital factor in indirectly affecting the rate of ablation as it increases the rate of calving, increases fracturing and loss of mass through creation of icebergs • on a meso scale, global warming will increase the altitude of the equilibrium line of a glacier and so increase the rate of ablation from the glacier system • yet on a short-term temporal scale the natural variation in winter and summer temperatures are the key factors in determining the equilibrium line and so are more important in determining the rate of ablation • similarly, on a micro-scale aspect is a key factor with north-facing northern hemisphere glaciers experiencing a slower rate of ablation than south-facing glaciers of the same altitude

Question number	Answer
	• in glacial areas underlain by volcanoes, tectonic activity plays a far more significant role as demonstrated by the ablation of some Icelandic glaciers.

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

Question number	Answer	Mark
3(a)(i)	**AO3 (1 mark)** Award **1** mark for a comparative statement about the sediment at A (lateral moraine) and B (outwash plain): • A more angular than B • B is rounder than A Accept any other appropriate response.	(1)

Question number	Answer	Mark
3(a)(ii)	**AO3 (1 mark)** Award 1 mark for the accepting the correct hypothesis. **Hypothesis**: there is a significant difference between the mean size of sediment found at site A and site B.	(1)

Question number	Answer	Mark
3(a)(iii)	**AO3 (1 mark)** Award **1** mark for a reason that identifies that the t-test score is greater than the critical value Do not accept reasons that justify the null hypothesis	(1)

Question number	Answer	Mark
3(a)(iv)	**AO3 (2 marks)** Award **1** mark for identifying a reason why deposits at site A and B are different and a further **1** mark for justification of why this is the case, for example: • A is close to the snout of the glacier/is likely to be glacial material while B is on the outwash plain/is a fluvioglacial deposit (1) and so the sediment samples for A will show evidence of freeze-thaw while those for B will show evidence of fluvial (water) processes (1). Accept any other appropriate response.	(2)

Question number	Answer	Mark
3(b)	**AO3 (4 marks)** For each way, award up to **1** mark for stating the type/nature/source of the additional data/information and a further mark for how the data/information improves the overall study, for example: • the student could return at a different time of year to collect more data (1). This would give a better context for how the glacial system might change in different seasons (1) • the student could collect more data at different sites using information from the sketch map (1). This would give improved spatial coverage and a greater number of fieldwork sites (1) • the student could use additional (primary) fieldwork approaches linked to the glacial transect (1). This would allow a greater range of primary data would improve understanding of glacial processes/movement of glaciers (1) • the student could use more secondary (published) data from additional research sources (1). This would allow a greater understanding of wider glacial processes, including relic processes particularly those linked to post glacial and fluvio-glacial deposits (1) Accept any other appropriate response.	(4)

Question number	Answer
3(c)	**AO3 (9 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. **Indicative content guidance** Content depends on students' choice of field research and the conclusions drawn. Assessment should include the following: • results should be clearly outlined with some supportive quantitative data • both primary data and secondary data should be identified • links with conclusions should be clear • conclusions should be clearly explained with appropriate links to the data gathered • qualifications should be evident about the strength of the relationship between the data. All conclusions are likely to be partial and tentative given the limited range of primary data gathered.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	**1–3**	• Shows evidence that fieldwork investigation skills used may not have been fully appropriate or effective for the investigation of the geographical questions/issue. (AO3) • Considers the fieldwork investigation process/data/evidence, with limited relevant connections and/or judgements. (AO3) • Argument about the investigation is simplistic and/or generic. (AO3)
Level 2	**4–6**	• Shows evidence that fieldwork investigation skills used were largely appropriate and effective for the investigation of the geographical questions/issue. (AO3) • Critically considers the fieldwork investigation process/data/evidence in order to make some relevant connections and valid judgements. (AO3) • Argument about the investigation may have unbalanced consideration of factors, but is mostly coherent. (AO3)
Level 3	**7–9**	• Shows evidence that fieldwork investigation skills used were appropriate and effective for the investigation of the geographical questions/issue. (AO3) • Critically considers the fieldwork investigation process/data/evidence in order to make relevant connections and judgements that are supported by evidence. (AO3) • Argument about the investigation includes balanced consideration of factors and is fully developed and coherent. (AO3)

Question number	Answer
4	**AO1 (4 marks) / AO2 (12 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. Responses that demonstrate **only** AO1 without any AO2 should be awarded marks as follows: • Level 1 AO1 performance: 1 mark • Level 2 AO1 performance: 2 marks • Level 3 AO1 performance: 3 marks • Level 4 AO1 performance: 4 marks **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: **AO1** • volcanoes cause ash falls and secondary hazards such as jökulhlaup • the process of ablation (melting, calving, evaporation and avalanches), and reasons for variation in rate of ablation • the processes of water movement within the glacial system are supraglacial, englacial and subglacial flows **AO2** • to begin with, the glacial processes of ablation is the key process explaining the discharge of the proglacial river before the volcanic eruption on 3/11 melting the overlying ice. As it is winter (November) there is little ablation due to the cold temperatures and most will be surface melting. This means that the main glacial process will be supraglacial flow with less englacial and subglacial flows • the volcanic activity that starts on the 4/11, however, acts as the trigger to enhance the rate of ablation, particularly at the base of the glacier. This means that in contrast to the flow on the 3/11, on 4/11 the increased base temperature is the key factor as it will increase the rate of ablation, particularly subglacial flows leading to a higher discharge (table and map) • yet, despite this increased ablation, it is glacial processes that are the key process in determining the lag between the eruption (4/11) and the peak flow (5/11). This is because the eruption creates a supraglacial lake (map) and this water then moves through the slower glacial processes of limited supraglacial flow and then englacial and subglacial flow, leading to the snout of the glacier (photo) • the increased water in the ice-dammed lake in the Lake Grímsvötn volcano caldera (map) is now likely to have broken and so increased the amount of meltwater and ash contained in the meltwater. This breach of the ice dam is the key process in allowing the ash that subsequently

Question number	Answer
	swells the jökulhlaup in the lowland plains • glacial processes are also the dominant process in the next stage of jökulhlaup, as the increased supraglacial flow widens the existing crevasses on the surface of the glacier and so contributes to the calving of the ice blocks (photo and table) which causes great damage to the transport infrastructure due to the density of the ice blocks • yet this latter-stage jökulhlaup is also still being affected by a combination of the volcanic processes and glacial processes as the ash created at the mouth of the volcano is mixed with the melted water and then carried supraglacially, englacially and subglacially to the snout of the glacier and the outwash plain which are key in increasing the total volume of the which then leads to the damage noted in the table • overall, although tectonic processes were the trigger for the rapid ablation, it is probably a combination of tectonic and glacial processes that then determine the subsequent jökulhlaup.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	**1–4**	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Applies knowledge and understanding of geographical information/ideas, making limited and rarely logical connections/relationships, to produce an interpretation with limited relevance and/or support. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2) • Limited synthesis of geographical ideas from across the course of study. (AO2)
Level 2	**5–8**	• Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2) • Argument partially synthesises some geographical ideas from across the course of study, but lacks meaningful connections. (AO2)
Level 3	**9–12**	• Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1) • Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships to produce a partial but coherent interpretation that is supported by some evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2) • Argument synthesises some geographical ideas from across the course of study, making some meaningful connections. (AO2)
Level 4	**13–16**	• Demonstrates accurate and relevant geographical knowledge

		and understanding throughout. (AO1) • Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships to produce a full and coherent interpretation that is supported by evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2) • Argument comprehensively and meaningfully synthesises geographical ideas from across the course of study throughout the response. (AO2)

Question number	Answer	Mark
5(a)	**AO1 (1 mark)** Award **1** mark for any correct physical, chemical or biological weathering process, from the following: • freeze-thaw (congelifraction) • solution • hydrolysis • root wedging. Accept any other appropriate response. Do not accept non-weathering processes (e.g. landslides/slumping etc.).	(1)

Question number	Answer	Mark
5(b)(i)	**AO3 (1 mark)** Accept any of the following: • 320 897 • 320 898 • 320 899	(1)

Question number	Answer	Mark
5(b)(ii)	**AO3 (1 mark)** B - 2.0 km	(1)

Question number	Answer	Mark
5(b)(iii)	**AO1 (2 marks)/AO2 (1 mark)** Award **1** mark for using map evidence to identify a difference between the sediment characteristics of A and B and a further **2** marks for explaining why this is the case. • Site A is likely to be larger (1)/or more angular (1) as it is derived from mass movement (1)/or erosion (1) from the coast and then transported along the coast through longshore drift (1)/or currents (1)/or tides (1). • Site B is likely to smaller (1) as it is a fluvial deposit (1) and so transported by a river and then deposited through flocculation (1). Accept any other appropriate response.	(3)

Question number	Answer	Mark
5(c)	**AO1 (4 marks)** For each process, award **1** mark for identifying the process and a further mark for an explaining how it forms offshore bars, for example: • offshore bars can be created when waves approach the shore and break on a submerged bar (1) depositing the larger material that they are carrying and so accrete vertically (1) • offshore bars are created when sediment being carried along the coast through longshore drift (1) enters a low-energy part of the sediment cell (1) and so is deposited in submerged bars parallel to the shore (1) • channel-mouth bars are formed where rivers enter the sea, resulting in a drop in river velocity (1) leading to the deposition of river bed load (1). Accept any other appropriate response.	(4)

Question number	Answer
5(d)	**AO1 (6 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: • geological structure can refer to concordant and discordant coasts • geological structure can also refer to the lithology and structure of rocks • concordant coasts are where the geology runs parallel to the coast and is associated with landforms such as coves as well as Dalmatian and Haff type coastlines • in some cases, such as at Lulworth Cove, the band of resistant rock can be exploited by fluvial erosion • complex depositional features such as spits are more likely to be found on concordant coasts where longshore drift can operate • discordant coasts are where the geology runs at right angles to the coast and creates landforms such as bays and headlands reflecting variations in rock resistance • the horizontal bedding of resistant rocks such as sandstone leads to vertical cliffs • the exact profile of vertical cliffs can also be determined by the joint pattern of the rock, as well-jointed granite or limestone creating blocky profiles.

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

Question number	Answer
5(e)	**AO1 (3 marks)/AO2 (9 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. Responses that demonstrate **only** AO1 without any AO2 should be awarded marks as follows: • Level 1 AO1 performance: 1 mark • Level 2 AO1 performance: 2 marks • Level 3 AO1 performance: 3 marks. **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: **AO1** • lithology (igneous, sedimentary, metamorphic) and unconsolidated material geology can determine the rate of coastal recession • lithology also affects geological structure and strata and so can determine the rate of coastal recession • lithology also affects sub-aerial processes of mass movement and weathering and so can determine the rate of coastal recession • human actions can affect both marine and subaerial processes and both increase and decrease the rate of coastal recession • rates of recession are not constant and vary in both the short- and long term **AO2** • on a macro scale, lithology is the dominant factor as metamorphic and igneous rocks have a lower rate of coastal recession than sedimentary and unconsolidated rock types because the resistance of such rocks resist marine erosion • on a meso scale, the indirect influence of lithology on geological structure and strata is key in determining coastal recession as the pattern of jointing and faulting can either promote or reduces subaerial processes such as weathering and mass movement. Similarly, the indirect effect of lithology on geological strata, such as layers of permeable/impermeable rocks, also largely determines the rate of coastal recession as it can raise pore water pressure leading to rapid mass movement • on a micro scale, humans can be the key determinate of the rate of coastal recession because they can both directly and indirectly reduce the marine and subaerial processes that cause coastal recession through a range of hard and soft engineering approaches • humans can also, however, stabilise the coastline through the

Question number	Answer
	development of vegetation such as sand dunes and salt marshes and so reduce the rate of coastal recession as well increase the rate of coastal recession through interference either intentionally or unintentionally in physical processes and systems such as in terminal groyne syndrome or dredging • yet, while humans can influence the rate of coastal recession on short timescales, lithology and marine factors such tides, seasons, weather systems and the occurrence of storms play are more important part in determining the long-term rates of coastal recession • however, lithology plays a vital role in determining whether human action is taken or is successful in determining the rate of coastal recession as some areas due to their lithology and/or their geological structure are physically or economically impossible to manage through either hard or soft engineering

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

Question number	Answer	Mark
6(a)(i)	**AO3 (1 mark)** Award 1 mark for correct identification of difference but answer must use a comparative word. Any one from: • Transect A has a steeper gradient **(1)** • Transect A has a larger area **(1).** Accept any other appropriate response.	**(1)**

Question number	Answer	Mark
6(a)(ii)	**AO3 (1 mark)** Award 1 mark for the accepting the correct hypothesis. **Hypothesis:** there is a significant difference between the mean size of sediment found at site A and site B.	**(1)**

Question number	Answer	Mark
6(a)(iii)	**AO3 (1 mark)** Award **1** mark for a reason that identifies that the t-test score is greater than the critical value Do not accept reasons that justify the null hypothesis	**(1)**

Question number	Answer	Mark
6(a)(iv)	**AO3 (2 marks)** Award **1** mark for identifying a reason for differences and a further mark for justifying why this is the case, up to a maximum of **2** marks. • A has larger sediment/pebbles (1) which will maintain a steeper angle of repose/encourage constructive waves/maintain higher percolation rate (1) • B which is more sandy/smaller sediment (1) and so has a lower angle of repose/lower percolation rate/will encourage destructive waves (1) • the groyne is selectively stopping sediment at transect A (1), which causes the larger sediment to build along the beach being trapped by the groyne (1).	**(2)**

Question number	Answer	Mark
6(b)	**AO3 (4 marks)** Award up to **1** mark for stating the type/nature/source of the additional data/information and a further mark for how the data/information improves the overall study up to a maximum of **2** marks each. • The student could return at a different time of year to collect more data (1). This would give a better context for how the beach or coastal system might change in different seasons (1). • The student could collect data at different sites along the coast using information from the sketch map (1). This would give improved spatial coverage and a greater number of fieldwork sites (1). • The student could use additional (primary) fieldwork approaches linked to the beach transect (1). This would allow a greater range of primary data would improve understanding of beach processes (1). • The student could use more secondary (published) data from additional research sources (1). This would allow a greater understanding of wider coastal processes particularly those linked to coastal management and sediment cell operation (1). Accept any other appropriate response.	(4)

Question number	Answer
6(c)	**AO3 (9 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. No marks for stating research question, but this should be used as the context for the answer. **Indicative content guidance** Content depends on students' choice of field research and the conclusions drawn. Assessment should include the following: • results should be clearly outlined with some supportive quantitative data • both primary data and secondary data should be identified • links with conclusions should be clear • conclusions should be clearly explained with appropriate links to the data gathered • qualifications should be evident about the strength of the relationship between the data. All conclusions are likely to be partial and tentative given the limited range of primary data gathered.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	**1–3**	• Shows evidence that fieldwork investigation skills used may not have been fully appropriate or effective for the investigation of the geographical questions/issue. (AO3) • Considers the fieldwork investigation process/data/evidence, with limited relevant connections and/or judgements. (AO3) • Argument about the investigation is simplistic and/or generic. (AO3)
Level 2	**4–6**	• Shows evidence that fieldwork investigation skills used were largely appropriate and effective for the investigation of the geographical questions/issue. (AO3) • Critically considers the fieldwork investigation process/data/evidence in order to make some relevant connections and valid judgements. (AO3) • Argument about the investigation may have unbalanced consideration of factors, but is mostly coherent. (AO3)
Level 3	**7–9**	• Shows evidence that fieldwork investigation skills used were appropriate and effective for the investigation of the geographical questions/issue. (AO3) • Critically considers the fieldwork investigation process/data/evidence in order to make relevant connections and judgements that are supported by evidence. (AO3) • Argument about the investigation includes balanced consideration of factors and is fully developed and coherent. (AO3)

Question number	Answer
7	**AO1 (4 marks) / AO2 (12 marks)** **Marking instructions** Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below. Responses that demonstrate **only** AO1 without any AO2 should be awarded marks as follows: • Level 1 AO1 performance: 1 mark • Level 2 AO1 performance: 2 marks • Level 3 AO1 performance: 3 marks • Level 4 AO1 performance: 4 marks **Indicative content guidance** The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include: **AO1** • rocky coastlines and coastal plains (sandy coastline and estuarine coasts) have distinct physical characteristics which can reduce or increase their vulnerability to tsunami events • the characteristics of the tsunami event can be considered through their magnitude, speed of onset and areal extent, duration, frequency, and spatial predictability • hazard events in developed countries show the interaction of physical factors and the significance of context in influencing the scale of disaster **AO2** • rocky coastlines with steep cliffs offer a natural protection against tsunami (as shown in photo 1) and as a result even though Iwate had the highest tsunami wave of 8.5 m (table) it suffered far fewer social and economic impacts than Miyagi (table) as Miyagi is a coastal plain • yet the earthquake did not produce only tsunami waves, there was also ground shaking and as a result most of the prefecture of Iwate was subjected to strong ground shaking (map) and which would have caused economic impacts as there would have inevitably been some loss of buildings • in contrast, lowland coastal plains are more vulnerable to tsunami as not only do they not have a cliffed coastline but because of their easier access to the coast they are more likely to be developed and so have a higher population density (as shown in photo 2). This means, therefore, that despite having a lower tsunami wave (table) there were far higher social and economic impacts (table) • although Japan had invested in tsunami walls in Miyagi, they were not high enough to save areas such as Kesennuma which suggest that the physical characteristic of the coastline, coupled with the characteristic of the tsunami event combined to overcome the ability of the country to modify the event in this case and so reduce the impacts • yet not all coastal plains are vulnerable to the tsunami. In Ibaraki the use of tsunami walls to modify the event (photo), coupled with the fact

Question number	Answer
	that the characteristic of the tsunami event was far lower (table) meant that the impacts were far lower (table). The population in this area, however, might also have greater time to prepare for the hazard and evacuate lowland areas as the area is further from the epifocus/centre of the earthquake (map) and so the speed of onset would have been far lower • overall, the nature of the coastline is key as cliffed coastlines are far less vulnerable than coastal plains to the tsunami hazard. Yet the characteristic of the tsunami event in terms of the magnitude and the speed of onset are vital in determining the impacts on coastal plains.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	**1–4**	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Applies knowledge and understanding of geographical information/ideas, making limited and rarely logical connections/relationships, to produce an interpretation with limited relevance and/or support. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2) • Limited synthesis of geographical ideas from across the course of study. (AO2)
Level 2	**5–8**	• Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2) • Argument partially synthesises some geographical ideas from across the course of study, but lacks meaningful connections. (AO2)
Level 3	**9–12**	• Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1) • Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships to produce a partial but coherent interpretation that is supported by some evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2) • Argument synthesises some geographical ideas from across the course of study, making some meaningful connections. (AO2)
Level 4	**13–16**	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1)

		• Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships to produce a full and coherent interpretation that is supported by evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2) • Argument comprehensively and meaningfully synthesises geographical ideas from across the course of study throughout the response. (AO2)