



Examiners' Report **June 2022**

GCE Geography 9GE0 01

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June 2022

Publications Code 9GE0_01_2206_ER

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Introduction

Examiners report 9GE01 June 2022

In common with the other two written papers on this specification the June 2022 paper was unique as Advance Information had been given to centres as a response to the disruption caused by COVID – 19. Candidates were given the areas of the specification that were to be assessed in the examination so that they could focus their revision on those topics. Overall, this appeared to help the candidates as there were fewer numbers of blank answers to short answer AO1 knowledge questions which in previous series was sometimes the result of a lack of knowledge/understanding of elements of the specification. It also appeared to help the longer 20 mark essay questions as in general the quality of the AO1 was either the same or slightly better than in previous series. There was perhaps one area where AO1 knowledge was weak – that of the section on droughts. This will be discussed at greater length later on in this report.

Apart from question 1b there was also little evidence of candidates writing pre-prepared answers which also will be discussed at greater length later in this report.

This meant that, as with previous series the June 2022 paper was generally accessible to candidates across the ability range. There was evidence of high quality work in all of the high mark tariff questions. In terms of the two option questions, Question 3 ('Coasts') was again far more popular than Question 2 ('Glaciation'). Indeed, it may have been the difficulty in carrying out fieldwork due to COVID – 19 that meant that the numbers attempting the glaciation question fell slightly to around 6% of the cohort.

There continues to be a drop in the number of non-completed scripts but surprisingly given the AI that was available this year there were instances of candidates not attempting some questions in particular 4b. It was hoped that through the provision of a list of the topics coming up in the examination, centres and their candidates would ensure that they focused on those listed in the AI. It was all the more surprising as a similar question on the same part of the specification had been set in 2018.

There was however an increase in the number of candidates using extra paper in completing their responses. Again this was a particular issue with 1b – partly as a result of the fact that it is the first longer extended answer but also partly the fact that it is a popular topic that is frequently well understood by candidates.

Question 1 (a)(i)

This was a stepped question that was similar to that set in 2019. The majority of candidates were able to correctly calculate the mean as being 71.4.

Question 1 (a)(ii)

As the median was not between two values, more completed this successfully than in 2019.

Question 1 (a)(iii)

As with 2019 1aiii was found to be a challenge. Statistics of central tendency are a key tool in the analysis of geographical data and should be the starting point of the analysis of data collected either on one of the four days of statutory fieldwork or the Independent Investigation.

There is a comprehensive list of the skills at the end of each of the sections of 9GE01 and centres are reminded that the AO3 marks can come from any of skills not just the ones listed after the section on Tectonic Processes and Hazards.

Question 1 (b)

It was hoped that with the Advance Information candidates would be able to focus on the content of the specification given and not rely on learning 2 case studies and then try to 'fit' their understanding of these case studies to the question set. Unfortunately, many responses had a brief discussion of prediction and forecasting and then gave case study detail on the Tohoku earthquake of 2011 and the Haiti earthquake of 2010.

Although there are elements of the value of prediction and forecasting in reducing the vulnerability of communities to the earthquake hazard contained within these two case studies (the use of the phone app and prediction of the tsunami wave in Japan) many simply explained why the level of development was a key factor in explaining the differences in the vulnerability of the two communities. Centres are reminded that candidates should be studying a range of volcanic and seismic hazards in a range of tectonic settings.

The best responses however firstly explained what they understood by the differences in prediction and forecasting using the use of seismic gap theory such as the seismic gap studies leading to the prediction of the Mexico earthquake of 1985 as well as the Uniform California Earthquake Rupture Forecast, Version 3, or UCERF3 . They then assessed the extent to which this could reduce the vulnerability of communities to the earthquake hazard often by comparing the usefulness of these predictions and forecasting tools to other strategies such as education and the use of aseismic buildings.

^{more important}
(b) Assess the importance of prediction and forecasting in reducing the vulnerability of communities to earthquake hazards.

(12)

Predicting an earthquake is the ability to accurately identify when and where an earthquake will take place. Forecasting an earthquake is the ability to predict what type of earthquake will take place where. Vulnerability is the lack of a country's resilience or capacity to cope. Around 5% of global population likely to experience an earthquake.

Currently, it is not possible to accurately predict an earthquake. Despite this, there are various management strategies that can be put in place that act as a prediction for an earthquake, that may reduce vulnerability. This can be seen in Japan, who in 2011 had a 9.0 magnitude earthquake that resulted in a subsequent tsunami. Given the fact that Japan is on a fault line, they have the ability to predict an earthquake taking place to some extent. Therefore, this allows Japan to implement strategies that will reduce vulnerability. This can be seen by Japan being well prepared for the 2011 earthquake, with 75% of buildings being built with earthquakes in mind as well as having once a year earthquake drills. This therefore made Japan less vulnerable, which resulted in less deaths compared to a country such as Haiti with 200,000. However

to evaluate, ~~through~~ earthquakes can be ^{accurately} predicted to some extent through precursors. This can be seen by there being a 67% chance of a large magnitude earthquake occurring in ~~the~~ San Francisco in the next 30 years. As well as this, Japan wasn't less vulnerable due to impacts to Fukushima nuclear power plant, where 47,000 people were evacuated.

The ability to forecast an earthquake is much more important than predicting one as it can allow countries to reduce loss of life or property. This is because it can allow countries to mitigate the worst effects of the earthquake. Examples of mitigation include land-use zoning in Haiti. This is when people who live near the epicentre are moved out of their homes to ensure their safety. The ability to forecast an earthquake will allow countries to be aware of the magnitude of the earthquake, giving them time to move people out of their homes. ^{in this reducing vulnerability} However, to evaluate, ~~this~~ forecasting may not be as significant since in Haiti the effects were still so severe, with more than 200,000 people dying and 95% of buildings collapsing in Port-Au-Prince. Therefore, it depends on the country's development.

To conclude, I feel that the ability to forecast an earthquake is more important than the ability to predict as that can allow countries to mitigate the worst effects of the earthquake. However, ^{in the future with better technology, the ability to both predict and forecast will have great importance} (Total for Question 1 = 16 marks)



This demonstrates accurate and relevant knowledge and understanding of the extent to which prediction and forecasting can reduce the vulnerability of communities to earthquake hazards. The candidate also produces a full and coherent interpretation that is relevant and supported by evidence drawn from Japan, California and Haiti. The candidate also makes supported judgements about the significance of prediction and forecasting throughout the response leading to a balanced and coherent conclusion. Level 3 12 marks.



The candidate ensures that the key terms of the essay are defined at the start and throughout the answer relates their case study material back to the question and comes to a rational conclusion.

Question 2 (a)

This question produced a variety of answers. The best candidates recognised that the photograph showed a corrie/cirque with tarn and a characteristic steep back wall as well as an arete and a pyramidal peak. There were often good explanations of plucking, abrasion and crushing and some noted the possible glacial trough in the background. However to obtain top level marks it was essential to address the key word 'contribute'. Such landscapes have undergone thousands of years of post-glacial modifications and candidates should be aware of the contemporary processes that are occurring in such relict landscapes.

Other candidates, however, had some quite serious misunderstandings on how the tarn in the photograph had been formed. Centres are encouraged to use such resources in their teaching and clearly explain that the water in the tarn was unlikely to be from the melting of the glacier ice that created the corrie/cirque.

SECTION B

Landscape Systems, Processes and Change

Answer ONE question – EITHER Question 2 OR Question 3.

Indicate which question you are answering by marking a cross in the box . If you change your mind, put a line through the box and then indicate your new question with a cross .

If you answer Question 2 put a cross in the box .

Glaciated Landscapes and Change

You must use the Resource Booklet provided.

2 Study Figure 2a in the Resource Booklet.

(a) Explain the contribution of glacial processes to the development of these landforms.

(6)

→ The large hollow in Figure 2a is a corrie ~~that~~ which is formed by basal slip, a form of rotational abrasion that has left a hollow. When two corries back onto each other, an arete is formed such as Striding Ledge in The Penn District near Red Tarn. Ribbon lores are visible in Figure 2a from where ice has melted and left a lore in a hollow of a glaciated trough. These landforms can also be seen in the distance, and were ^{eroded} ~~worn away~~ by abrasion and planing of valley sides, making them smoother. The erosional processes at work are abrasion, and where the weight of a glacier wears away at rock and planing, where pressure increases reduce melting point and water refreezes around rocks and carries them along with the glacier. ~~The abundance of scree is ~~abundant~~ in fig 2.a.~~ suggests freeze-thaw weathering is taking place, where water enters cracks in rocks, freezes and expands by 9% and melts. The repetition of this process ~~wears~~ breaks up rocks into talus that can be seen to cover



This demonstrates accurate and relevant geographical knowledge and understanding of how glacial erosion processes contribute to the development of the landforms shown. The candidate applies this knowledge and understanding to find fully relevant connections/relationships between the photograph and the question. Level 3 6 marks.



This response was awarded the maximum as it recognises that the abundance of scree highlights the fact that the landscape was developed by both the glacial processes of erosion as well as the subsequent subaerial processes of freeze thaw weathering.

Question 2 (b)

This proved an accessible question for most candidates. Although many identified the landscape as one of an active glacier with evidence of terminal and recessional moraines as well as possibly a till plain or hummocky ground, some candidates wrote all they knew about glacial depositional features including drumlins and eskers which could not have conceivably been represented in the photograph. Centres are reminded to practice such questions by giving their candidates images of both active and relict glacial landscapes and not always rely on diagrams showing a classical landscapes of lateral/medial/terminal moraines.

Study Figure 2b in the Resource Booklet.

(b) Explain how glacial deposition contributes to the development of this landscape.

(6)

Figure 2b shows a retreating glacier, depositing moraine as it melts. There is some evidence of terminal moraine which is ~~and~~ unsorted and angular small and large rock deposited by the glacier as it melts, retreats and drops the sediment it was carrying. This is known as ablation till. Recessional moraine in figure 2b is secondary terminal moraine, deposited by a retreating glacier after it has remained stationary for long enough to do so. The moraine ridges further back in figure 2* have been laid down or potentially pushed up by this glacier. ~~and appear to be~~

Figure 2b also shows lateral moraine: material deposited at the sides of a glacier.

* are ridges of sediment that



This demonstrates accurate and relevant geographical knowledge and understanding of how glacial deposition can contribute to the development of the landscape shown and has relevant connections/relationships between the photograph and the question. Level 3 5 marks.



The candidate could have improved their answer by developing their explanation of the formation of moraines by explaining that they form where there is a regular supply of debris to the snout.

Question 2 (c)

This was found to be challenging for some candidates. Whilst the majority of candidates were secure in their understanding of the role of glaciated landscapes, few were equally as secure in their knowledge of how periglacial landscape maintained the hydrological cycle. The very best candidates also examined the impact of such landscapes on upper air movements such as jet streams and Rossby waves.

(c) Explain the role of glacial and periglacial landscapes in the maintenance of the water cycle.

(8)

Glacial and periglacial landscapes maintain the water cycle through various ways. It can change ~~inputs and outputs~~ the level of inputs to the hydrological cycle. This is because when glacier ice melts, sea levels may rise and especially if a glacial outburst takes place (sub-glacial lake bursting), flooding is deemed to occur. This adds on to deficits and inputs to the hydrological cycle and can increase the levels of evaporation in the atmosphere. As more water is released through snowmelt, the periglacial and glacial landscapes can help store the water in many ways. This can mean by storing ~~groundwater~~ or through groundwater. However, as permafrost and glacial environments are less impermeable, surface run off would increase as the water would find it hard to infiltrate. Periglacial landscapes are ~~marginal~~ marginal to glacial landscapes and ~~are~~ have less glacial elements. Therefore, it can help maintain the water cycle as water can be stored on the surface ~~and~~ or in ~~erect~~ rocks. Periglacial landscapes have many periglacial processes such as frost heave, solifluction, nivation hollow, wind erosion and freeze-thaw weathering ~~or~~ that create distinctive landscapes. Water can play a great role in these. For example, patterned ground could keep some water stored and have intercepted through its rapidly freezing soil. However, the water cycle and glacial landscapes wouldn't only mean more water resources, it could also mean that there is more risk to flooding and also higher demand on resources as Antarctica accounts for 70% of

global water and 75% freshwater. If drought was to occur in a within a water cycle, there would be some reliance on these landscapes to improve needs and accessibility-



ResultsPlus
Examiner Comments

This demonstrates accurate and relevant geographical knowledge and understanding of the role of glacial and periglacial landscapes in the maintenance of the water cycle. It has a broad range of geographical ideas, which are detailed and fully developed. Level 3 7 marks.



ResultsPlus
Examiner Tip

The response has both glaciated and periglacial landscapes but drift to the processes in periglacial areas which is not focused on the question.

Question 2 (d)

The Advance Information seemed to help candidates with this question and as a result this was generally answered well. Many candidates were able to evaluate the threat of climate change (a context threat) to both active and relict landscapes against the more local threats such as tourism. It was also pleasing to see that the very best responses considered whether global warming was a more serious threat to active or relict landscapes.

(d) Evaluate the view that global warming is the greatest threat to both active and relict glaciated landscapes.

(20)

Global warming is one of the biggest threats to glaciers among others like tourism, which also indirectly contributes to global warming. Glaciers are rapidly losing mass due to these increase in temperatures.

One example of a glacier under threat from global warming is the Mar de G Glacier. It is retreating by almost 70 m a year. Since the industrial revolution ~~the~~ glaciers have been on a rapid decline. This can also be observed by rising sea levels. Previously, water ~~that~~ ~~it~~ was stored in frozen glaciers. The melting of glaciers ~~has~~ released the water causing sea levels to rise. Temperature is vital to maintaining glaciers, because it dictates the mass balance of a glacier, which is divided into accumulation and ablation.

~~The~~ the most common form of accumulation is snow which ~~turns~~ ~~to~~ turns to glacial ice if the temperature is not cold enough then the snow will not turn into glacial ice, so the glacier will ~~lose~~ lose mass. ~~The~~ Glaciers are so fragile that a 0.5°C change in temperature has a huge effect.

The most common form of ablation is evaporation. ~~The~~ Global warming means increased temperatures and therefore increased evaporation rates, so the glacier will lose its mass. Temperature dictates the mass balance of a glacier. This demonstrates how important the factor of climate change is. When a glacier loses mass it also reveals its glacial material which can cause the albedo effect. Ice ~~reflects~~ or snow reflects 90% of sunlight preventing melting. If ~~the~~ glaciers melt as a result of global

to further melting.

Another important threat to glacial landscapes to consider is tourism. For example, the Lake District is visited by 5 million people each year, who spend around ~~£~~ £1.1 bn, ~~demo~~ demonstrating how popular the ~~the~~ Lake District is, this is a relic landscape. As a result of the increased footfall in the landscape, soil erosion has occurred. This removes the top layer of soil which is problematic. This is where all the nutrients are stored, threatening wildlife like plants, who in turn forms the basis of the ecosystem. Furthermore, the soil ~~it~~ will lose its water retention capacity. There is frequent rainfall in the Lake District which could result in flooding, eroding the landscape as a result of reduced lag time.

~~Secondly, polar landscape is a huge~~ Secondly, tourism in active glaciated landscapes, like in polar regions or the alps. The Chamonix valley is visited ~~to~~ by 5 million people each year, mostly for skiing. The construction of ski runs and chairlifts destroys wildlife and habitats. This is more problematic ~~to~~ here than in other tourist destinations because like in polar regions, the ~~environment~~ wildlife is highly adapted to suit the conditions. So a small change can have devastating impact. Wildlife are highly dependent on each other, so if one is damaged or removed it can spread through the whole food chain. Furthermore, nutrient cycles are very slow meaning wildlife are even more at risk because if a process is disrupted then that valley is starved of nutrients.

In polar regions, ~~the~~ ~~the~~ the landscape is under threat by both global warming and tourism. The pristine environment was uninhabited for millennia so is highly susceptible to human impact. Tourism has rapidly increased

in these regions. For example, in Greenland there has been a 4000% increase in tourism, again the highly adapted ecosystem is under threat. ~~to~~ The accommodation ~~is~~ to allow for tourism is also impactful. ~~For~~ In Havnag ports have been constructed as well as roads. A combination of both global warming and tourism have effected this landscape, so much so that large cruise ships ~~are~~ have been prevented from entering. ~~but~~ Also, wildlife are under threat ~~it~~ in Antarctica due a combination of ~~both~~ global warming and tourism. ~~that~~ Kill populations are declining, causing penguins to migrate, in turn affecting seal populations. This also demonstrates my previous point about how dependent species are on each other in these glaciated regions. However, we should also consider that most of the damage from tourism will only occur at hotspot sites.

In conclusion, while tourism is significant, the damage it can do is limited to specific places. Global warming effects all glaciated landscapes as the mass balance of a glacier is dictated by temperature. Tourism is more harmful for relic glaciated landscapes though, like the case of Tibet.



This demonstrates accurate and relevant geographical knowledge and understanding of the extent to which global warming is the greatest threat to both active and relict glaciated landscapes. The candidate applies this knowledge and understanding to produce a full and coherent interpretation that is supported by evidence and comes to a rational, substantiated conclusion. Level 4 16 marks.



This was a well-supported response with details on the threats faced by both active and relict glaciated landscape. The answer could have been improved if the candidate had fully considered the different impacts of global warming on active and relict landscapes.

Question 3 (a)

This question was generally answered well. Most candidates recognised that the photograph showed mainly depositional landforms with a recurved spit, sand dunes, beaches and a salt marsh. Others noted the likelihood that the sediment for these features originated from the cliff system in the top of the photograph.

Do not answer Question 3 if you have answered Question 2.

If you answer Question 3 put a cross in the box .

Coastal Landscapes and Change

You must use the Resource Booklet provided.

3 Study Figure 3a in the Resource Booklet.

(a) Explain the contribution of marine processes in the development of these landforms.

(6)

Figure 3a displays what appears to be a recurved spit. This is formed when constructive waves reach a turning in a coastline, and slow down and have less energy. This causes them to deposit sediment onto the coastline. The curve at the tip may be a result of waves travelling in the opposite direction of a prevailing wind.

Furthermore, figure 3a also shows the formation of a beach on this coastal plain landscape. Beaches are also formed by constructive waves with a strong wash and weak backwash. In areas of low relief and low energy, waves deposit sediment which may have originated from other areas of the sediment cell with destructive waves, e.g. a headland as seen in the background. The sediment may be deposited through gravity or fluxulation.



This demonstrates accurate and relevant geographical knowledge and understanding of the contribution of marine processes in the development of the landforms shown. The response applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between the photograph and the question. Level 3 5 marks.



This response correctly identified the processes of longshore drift and dominant and secondary wind directions in the formation of the recurved spit. It also stated the processes responsible for the formation of the beach. It could have explained in greater detail how gravity settling was responsible for the development of the landforms shown as well as perhaps explained the formation of the salt marsh.

Question 3 (b)

This question was not answered as well as 3a. Although many candidates identified that the landscape contained a beach and a rapidly retreating cliff some were insecure in their understanding of the key term of subaerial processes. Instead of explaining how weathering and mass movement contributed to the landscape shown, they concentrated instead on how erosion and transportation could have created the beach and the headlands. Centres are encouraged to ensure that candidates are secure in the technical language of the unit and the use or the development of a glossary is strongly recommended.

Study Figure 3b in the Resource Booklet.

(b) Explain how subaerial processes contribute to the development of this landscape.

(6)

Sub-aerial processes are forms of weathering and mass-movement. There are three types of weathering; physical, chemical and biological, whereas different types of mass movement consist of rock fall, rotational slumping and landslides. Figure 3b shows rocks spread out across the wave-cut platform. This is evidence of rock fall taking place. This is when rocks on the cliff-face are dislodged and fall down the cliff ending up near the shore ocean shore. Along the cliff-face in figure 3b, there is evidence of rotational slumping and landslides taking place, as seen through the scarring and talus scree. The rocks along the platform ~~to~~ consist of vegetation within cracks, which is an example of biological weathering taking place.



This demonstrates accurate and relevant geographical knowledge and understanding of how subaerial processes may have contributed to the development of this landscape. Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between the photograph and the question. Level 3 6 marks



This answer had a range of ideas which were accurate and relevant including weathering and mass movement and pleasing identifies the resultant features as rotational scars and talus scree.

Question 3 (c)

As with 2a this question gave a variety of responses. The best responses explained the role of both eustatic and isostatic processes in forming emergent and submergent coastlines with pleasing detail on the formation of raised beaches and fossil cliffs as well as rias, fjords and dalmatian coasts. Others took the route of explaining in great detail the causes of these processes. Both approaches allowed candidates access to all levels of the mark scheme. However, a sizeable minority of candidates were either insecure in their understanding of emergent and submergent coasts or linked submergent coasts to current rises in sea level. Centres are urged to impress upon their candidates that whilst there is contemporary sea level rise of some 210 mm since 1900 this is very small in comparison to the rise in sea levels of 145m over the last 21,000 years. Indeed contemporary isostatic down warping in some places is occurring at a faster rate than the sea level rise caused by global warming.

(c) Explain the role of sea level change in the formation of both emergent and submergent coastlines.

Submergent ^{created by eustatic change,} coastlines are ones where sea level itself changes. (8)
Around 10,000 years ago after the last ice age glaciers and ice sheets melted which in turn raises sea level. This meant that as sea level rose lands submerged under the increased volume of water. This led to the creation of submergent coastlines. This is evident in the UK from the coastlines of Devon and Cornwall where rivers have since formed. These are drowned river valleys which have changed coastlines, making them wider than expected. We can also see this globally with the creation of fjords in Norway and the creation of dalmatian coastlines.

Emergent coastlines are ones created by isostatic change where the land itself rises or falls. The relative sea level rise from eustatic change has shown to be not significant in all areas of the UK as highlighted in Scotland and the rising land levels relative to sea level creating an emergent coastline. This is evident from North of Orkney where a ~~stamp~~ ^{stamp} remains isolated in a field, as land levels have grown and risen over where the coastline used to be leaving the stamp isolated 10m away from the current coastline.

Emergent coastlines are also evident from Britain's coastlines. ~~The~~ North of Britain used to be covered by glaciers and ice sheets making this land to sink

temporarily and the south-east to rise ~~slightly~~ slightly yet with the melting of ice and glaciers isostatic recovery has taken place as the land in the north rebounded back and the coast of the south-east start to sink.



ResultsPlus
Examiner Comments

This demonstrates accurate and relevant geographical knowledge and understanding of the role of sea level change in the formation of both emergent and submergent coastlines. Understanding addresses a broad range of geographical ideas, which are detailed and fully developed. Level 3 6 marks.



ResultsPlus
Examiner Tip

A range of ideas are considered in the explanation of rias as well as fossil features in Scotland. The answer could have been improved by either developing the idea of how historic fluvial processes also contributed to the development of rias or how plate movement and a concordant coast contributed to the development of a dalmatian coast.

Question 3 (d)

As with 2d the Advance Information seemed to help candidates with this question and as a result this was generally answered well. Many candidates were able to evaluate the threat of climate change (a context threat) to coastlines against the more local threats such as isostatic downwarping and rapid coastal recession. It was also pleasing to see that the very best responses considered the threats to both coastlines and communities.

(d) Evaluate the view that global warming is the greatest threat to coastlines and their communities.

(20)

Global warming is the increase in global temperature due to the increased concentration of greenhouse gases in the atmosphere such as CO_2 and methane which trap solar radiation in the greenhouse effect. It is predicted that by 2050 global warming will cause global temperatures to rise by 2°C . And this will cause global sea levels to rise dramatically by 1m by 2100 ~~under~~ due to thermal expansion and melting of glaciers.

Many people argue that global warming is the biggest threat to coastlines and their communities because predicted sea level rise of 1m by 2100 means that many low-lying areas will be submerged. This includes the low lying islands of Tuvalu which has its highest point ^{only} 1.8m above sea level. This means by 2100 that ~~these~~ islands will be completely submerged causing deaths, ~~and~~ complete loss of livelihood ~~at~~ with 60% of those who live in the Seychelles living or working at the coast. As a result, ~~many~~ nearby countries such as Australia have granted low-lying areas such as Tuvalu 75 grants to citizenship to these environmental refugees which will be created by global warming. This is an extremely convincing argument as not only will this occur in low-lying islands, but it will also have a global impact due to the

pressures created by environmental refugees. Additionally, these impacts will last long into the future as well as the short term because sea level rise is irreversible.

However, many argue that erosion is the biggest threat to coastal areas as it destroys economically valuable land, ~~and~~ and causes loss of entire villages. This can be seen in the Netherlands coast composed of boulder clay ^{etc} which erodes at rates of ~~1-4~~ which is unconsolidated material which erodes at rates of 4-10m a year. Making Netherlands coast ~~the~~ the fastest eroding coast in Europe. To the dismay of the residents, the ^{local} government used ICZM to decide that no active intervention is the most appropriate strategy meaning that the livelihoods of the residents are unprotected as the £6 million required to protect the land is equal to the amount of money paid in insurance losses. This is a weak argument however as this occurs at a local regional scale as opposed to global warming which is affecting every country in the world.

In spite of this, many argue that storms are the most dangerous threat to coastal areas as they cause severe economic damage and loss of life. For example, the storms of 2013-2014 in the UK caused over

trillion in damage and caused the death of 17 people. This is occurring at an international scale, as seen in Hurricane Sandy of 2012 where \$36 billion was caused as a result of the 6 m wave which crashed onto the coastal surface. These examples represent not only the complete destruction of communities, but an extreme economic hit to the governments who will have to pay out these losses as well as fund future resilience strategies such as the hard engineering method of sea walls. However, although it is clear this is a global scale issue that will continue into the long term, it will only worsen in the future due to the increased frequency of abnormal weather events including prolonged rainfall and the root cause of this is global warming. Therefore, global warming poses a greater threat to coastal communities than flooding as global warming causes all these ^{events} due to climate change as well as sea level rise.

However, on the other hand, it is believed that mismanagement of the ~~the~~ sediment cycle is a greater threat to ~~the~~ coastal communities. For example, the construction of the Aswan Dam in the Nile caused sediment accumulation at coasts lower down in the sediment cycle causing erosion rates 10m/year known from multiple ~~times~~ ^{times} ~~great~~ ^{great} ~~amount~~ ^{amount}

however, as mismanagement of the sediment cycle has only occurred at a local scale and in many cases management of coasts has been successful as seen in the strategy of proactive intervention of Abbot's Hall Farm on Blackwater Estuary in Essex where the land owners receive the money for their land and a wildlife sanctuary which protected the coast from erosion. (Total for Question 3 = 40 marks)

TOTAL FOR SECTION B = 40 MARKS

In conclusion, I believe global warming is the biggest threat to coastal communities. Global warming while other dangers such as erosion and mismanagement of the sediment cycle occur, however that severe threats to the coast ~~are~~ in this way are anomalies and with appropriate management catastrophe can be avoided as seen in the case of Blackwater Estuary where everyone can be winners. In spite of this, it is evident that sea level rise and flooding poses an immense risk to the coast and these threats are underpinned by global warming which ~~causes~~ causes melting of glaciers and thermal expansion which in turn leads to coastal flooding.



This demonstrates accurate and relevant geographical knowledge and understanding of the importance of global warming as the greatest threat to coastlines and their communities. The candidate applies this knowledge and understanding to produce a full and coherent interpretation that is supported by evidence and comes to a rational, substantiated conclusion. Level 4 16 marks.



This answer tackles both global warming and other threats such as erosion, storms and coastal management. The answer could have been improved if the candidate used the information provided and to come to a justified answer.

Question 4 (a)

This was generally a question that was accessible to all candidates. Centres are reminded, however, that the use of the resource in such questions is essential if full marks are to be gained. Centres are also urged to remind their candidates to read the question carefully. In the 2022 question it was the difference in the growth of solar power – and not just which country/region had the higher amount.

The question allowed a variety of interpretations. Some candidates suggested that China had a more suitable climate than the EU whilst others argued that it was due to a government policy or the need for increasing supplies of electricity. Both ideas were accepted.

SECTION C

Physical Systems and Sustainability

Answer ALL questions. Write your answers in the spaces provided.

You must use the Resource Booklet provided.

4 Study Figure 4 in the Resource Booklet.

Development

(a) Suggest **one** reason for the differences in the growth of electricity generated from solar power.

(3)

The development of a particular country can determine the growth of their use of solar power. For instance, China is an emerging country which is developing at a fast pace so they may decide to invest in solar power and they could be taking into account ^{future} environmental concerns, whereas the European Union is slowly increasing its use for solar power as they are investing in a variety of different energy. China had started under ^{50,000} 50,000 megawatts in 2015 but it quickly increased to over ^{200,000} 200,000 in 2019 whereas the EU only increased to under 150,000 from 100,000.



The candidate receives one mark for analysing the differences in the growth of solar power between the EU and China and then a further two for explaining that this was as a result of China's rapid growth and its desire to take into account future environmental issues.



Candidates are reminded that they must read the equation carefully and make use of the data in the resource and not simply describe the trends/patterns.

Question 4 (b)

The vast majority of candidates found this an accessible question as a result of the Advanced Information as well as the fact that a similar question had been set in a previous series.

The best candidates explained the role of two or more of the 'carbon pumps' in the ocean in regulating the composition of the atmosphere.

(b) Explain how oceans regulate the composition of the atmosphere.

(6)

One way is through the carbonate pump which is where marine organisms use calcium carbonate to make their shells but once they die, the shells get carried to the deep ocean currents. Then, the shells will dissolve, releasing carbon into deep ocean currents which will be released back into the atmosphere through the thermohaline circulation carrying deep ocean currents to the surface.

Another way is through the biological pump where phytoplankton sequester carbon from the atmosphere ^{through photosynthesis} and turn it into food for zooplankton and other microorganisms. Once the organisms die and decay, the carbon is released back into the atmosphere to be reabsorbed by the phytoplankton - acting as a pump for carbon, and regulating the composition of the atmosphere.



This demonstrates accurate and relevant geographical knowledge and understanding of how oceans regulate the composition of the atmosphere. The candidate's understanding addresses a broad range of geographical ideas which are detailed and fully developed. L3 5



The answer could have been improved by explaining the carbonate pump in a little more detail by explaining how shell building organisms used the carbonate ions in the ocean and how this was related to the composition of carbon in the atmosphere.

Question 4 (c)

This was a question that appeared to challenge some of the candidates due to their lack of understanding of the key term drought. Some considered this to be aridity or in other cases water stress or water scarcity. As with question 3b centres are encouraged to ensure that candidates are secure in the technical language of the unit and the development of a glossary is strongly recommended.

(c) Explain the contribution of human activity to the risk of drought.

(8)

Humans increase the risk of drought in several ways, particularly through anthropogenic climate change and overabstraction. For example, California has a 50% chance of mega-drought and a 90% chance of decade-long drought. Oxford climate scientists estimate that anthropogenic climate change is responsible for 40% of this increased risk. Similarly, 1/3 of Californian cities and towns rely on groundwater and aquifers for its water supply. From 2011-2015, due to drought influenced by climate change, Californian water reserves fell by 30m. During this 2014 drought, the number of people admitted to hospital for heat-related illness or injury rose from 17 per 100,000 people to 28 per 100,000. But human activity is not just affecting humans, but the environment too. From 2010-2013, the number of forest fires in California increased by 150%. Anthropogenic climate change increases both the likelihood and length of drought as warming temperatures contribute to increased evaporation of groundwater stores and reducing the capacity of fragile ecosystems (like forests) to cope with rising heat. Overabstraction is also a significant contributor to drought risk. For example, in the 2014-2015 Rio drought, illegal welling was the main cause of it. It is estimated that 70% of wells in Brazil were illegal at the time of the drought, because of the high fees (it costs between US\$ 30,000 and US\$ 100,000 to drill the well, excluding the US\$ 3,000 license cost). Because of this, people were abstracting so much water that 17 of Brazil's largest reservoirs were depleted to just 1% capacity. Therefore, human activity contributes to increased risk of drought because it increases the likelihood of drought through overabstraction (lack of resources) and the length of drought through

increased temperatures.



This demonstrates accurate and relevant geographical knowledge and understanding of the contribution of human activity to the risk of drought. The response addresses a broad range of geographical ideas, which are detailed and fully developed. Level 3 6 marks



The candidate explains the role of anthropogenic climate change as well as over abstraction in increasing the risk of drought. The candidate could have developed the answer by examining other factors such as deforestation or the development of inappropriate agricultural practices.

Question 4 (d)

The Ukraine conflict and the subsequent rise in fuel prices alongside the banning of Russian oil and gas made this a very accessible question.

Centres are reminded, however, that when teaching this subject they should be clear on what they mean by energy mix. There is a clear difference on the total energy mix for a country and the way in which a country produces electricity. In some cases there was inaccurate information presented when candidates confused these two key ideas.

Despite this there were some excellent responses which assessed the role of natural resources, government policy, geopolitics and the use of renewable resources in determining energy security.

(d) Assess how successful different countries have been in achieving energy security. (12)

Energy security is having availability to reliable energy sources without causing large scale damage to the environment. In order to successfully achieve this energy security countries must sufficiently be able to provide power to their population in addition to exploring and obtaining greener methods, such as renewable energy.

A country has good energy security is Norway, which seen a large change to its energy mix, especially over the last decade. Previously in 2012, 42.5% of Norway's energy was provided by hydropower. Due to the mountainous landscape, it is possible for the now 600 HEP stations to provide reliable and constant energy, unlike solar or wind. Although this is a strong figure, in 2022 now 97.5% of energy comes from hydropower. In addition to the energy being renewable it is also produced domestically and therefore eliminates the risk of any geopolitical disagreement posing a threat to Norway's supply, unlike Germany who during the current Ukraine invasion are in a difficult due to a large majority of their gas being imported from Russia. Furthermore, Norway produces coal which is then sold and exported to different countries, as well as gas reserves in territorial waters, which are also exported. This suggests that due to ~~the~~ Norway's wide

hydropower programme, that they are in a energy surplus and ~~there~~ if needs be Norway could these energy sources domestically, ~~if~~ which only adds to the idea that Norway has achieved high energy security.

On the other hand, the UK has a lower level of energy, there is evidence of a change in energy mix, ~~with~~ 40% of energy in 1970 being produced by coal which has now been replaced with 40% being produced by gas in 2012. Both of this are non-renewables and will eventually run out. ~~with no sub~~ The gas is also importanted, as well as oil, ^(approximately 20% of energy mix in 2021) mainly from middle eastern countries, where trade may be difficult due to a constantly changing ~~geopolitical~~ geopolitical climate, presenting a risk to a comfortable flowing supply of energy. While the UK has stated that it intends to build 8 nuclear power plants by 2030, nuclear energy does not yet play a large role within the energy mix which presents the UK as a country with low energy security.

In conclusion, different countries are at different stages on energy and this doesn't ~~be~~ necessarily fall down to levels of development as both countries are well developed and has access to advanced technology. To work towards security countries must have domestically produced, reliable, renewable energy in order for them to be seen as successful.



This demonstrates accurate and relevant geographical knowledge and understanding throughout of how successful different countries have been in achieving energy security. It applies knowledge and understanding to geographical information/ideas logically, making relevant connections/relationships to produce a full and coherent interpretation that is relevant and supported by evidence that is drawn together coherently in order to make rational judgements. Level 3 9 marks.



This has sound understanding of how successful two countries are in achieving energy security but could have been improved by having better locational detail, particularly for the UK.

Question 4 (e)

This was a question that was answered well by the majority of the candidates. Many candidates were able to successfully evaluate whether land use changes were the main cause of the increasing risk of river flooding by comparing the impact of deforestation and urbanisation to the impact of future climate change. The very best explored the concept of risk and argued that population growth in vulnerable areas was as important as other factors as increasing the risk of flooding.

gov. global warm antecedent, manage

(e) Evaluate the view that land use changes are the main cause of the increasing risk of river flooding.

(20)

Land use changes are a type of human intervention and can worsen flood risk. For example types of changes may include; urbanisation, deforestation, channelisation, building on flood plains and changes in agriculture, all of which may increase the risk of river flooding.

Urbanisation is where the construction of impermeable surfaces increases run off, reduces infiltration and therefore increases flood risk. Urbanisation causes 5% deep infiltration, 5% shallow infiltration, ~~40%~~^{30%} evapotranspiration and ~~30%~~^{40%} run off. Whereas natural ground cover causes 25%

deep infiltration, 25% shallow infiltration, 40% evapotranspiration and 10% runoff, therefore natural ground cover is more efficient in reducing flood risk as more water is absorbed by the land reducing runoff, compared to urbanised land use changes, for example paving front and back gardens, and the construction of cities.

Channelisation is another human activity that can worsen flood risk as this land use change quickens the transfer of water out of an urban area by widening and straightening the channel (for example Lincoln and Lynnham flood in 1952 engendered with land use change), despite reducing flood risk in the urban area this is counterproductive as the risk of the river

removing the meanders that slowed the flow, and increases flood risk elsewhere.

Another poor land use change that increases flood risk is the building on flood plains, whereby housing is built on areas prone to flood and therefore increases the risk of river flooding by simply putting infrastructure and people in the way of the risk. Instead flood plains should be used as short term stores for flood water which helps to minimise the risk. Many councils and governments fail to realise this importance in pursuit of economic development of the selling of housing and ~~to~~ have poor building codes, for example Cumbria, Carlisle was flooded in 2005 and 600 died due ~~to~~ to the draining of the floodplain that acted as a funnel for flood risk.

On the other hand, land use changes may not be the main cause of increasing flood risk, but instead other factors such as global warming, antecedent conditions and natural factors such as the drainage basin are important in determining flood risk. For example global warming increases sea levels and therefore increases river flow from increased precipitation, as well as worsening the risk of flash flooding and slow prolonged flooding of increasing intensity, all of which increase flood risk. For example York in 2000 was flooded by slow prolonged rainfall of a massive rain in 36 ~~hrs~~ hours, never seen before.

Another factor of flood risk is antecedent conditions (the amount of water within the soil before the flood) to which high antecedent conditions increase flood risk as the land is already saturated, ~~resulting~~ increasing overland flow. For example, Boscombe in 2004 flooded at 414 million gallons due to high antecedent conditions at its source of Bottom Moor (saturated land, wetland).

Finally, the drainage basin also determines flood risk ~~to~~ along with land use changes, as steep drainage basins, such as in Cambridgeshire (Lake District to the West and Fenland to the East) increases flood risk by reducing the lag time between rainfall and peak flow (rain hydrograph).

In conclusion, land use changes are vitally important in determining increasing flood risk from human activity, however other natural factors such as global warming, antecedent conditions and the size and shape of the drainage basin are ~~other~~ other main causes of increasing flood risk. However the worsening risk of flooding is determined by the type of land, whereby if it were natural, the river would adapt and floodplains would become the temporary store of flood water, and meanders would slow the flow, although factors of urbanisation, channelisation, damming (reduces flow downstream) and bunding on floodplains

severely increase flood risk, however the causes to this are both human (land use) and natural (global warming, antecedent)

(Total for Question 4 = 49 marks)

TOTAL FOR PAPER = 105 MARKS



ResultsPlus
Examiner Comments

This demonstrates accurate and relevant geographical knowledge and understanding of the extent that land use changes are the main cause of the increased risk of river flooding. The candidate applies this knowledge and understanding to produce a full and coherent interpretation that is supported by evidence and comes to a rational, substantiated conclusion. Level 3 17 marks.



ResultsPlus
Examiner Tip

This answer tackles both a wide range of land use changes as well as other anthropogenic and natural factors. In particular there is a very strong conclusion where the candidate evaluates the information provided and comes to a justified answer.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice;

- Ensure you understand the requirements of the differences in the command words particularly the differences between explain and assess. In both 12 mark questions a substantial number of candidates **explained** how the prediction and forecasting of earthquake hazards could reduce the vulnerability of communities rather than **assessed** the extent to which it could. Similarly in 4d many candidates simply explained the varying levels of energy security that existed between different countries as opposed to assessing how successful they had been in obtaining energy security.
- In these 12 mark questions use a variety of different AO1 knowledge rather than having two large paragraphs devoted to one seismic event. – many 1b were still simply comparing the impacts of the Haiti 2010 and Tohoku 2011 seismic events.
- Ensure that you have a glossary of key terms of the specification – a substantial number of candidates were not secure on the meaning of the words subaerial, drought or energy security .
- Ensure that you read the 8 mark explain AO1 knowledge questions carefully looking for key words such as 'and' which means that for top band marks both elements in the question need to be addressed. This was particularly true for 2b and 3c.
- Ensure that in the 20 mark evaluate questions both sides of the argument are treated equally and that it is not an explanation of why one side of the argument is correct (ie the essay is balanced and coherent argument)
- In addition ensure that in the 20 mark evaluate questions you come to a conclusion that is a logical outcome of your argument (ie is rational) and has a key piece of information supporting your conclusion (ie is substantiated).

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

<https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html>

