

Examiners' Report

June 2025

GCE Geography 9GE0 01

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Introduction

In general, the June 2025 paper was 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'). The numbers attempting the glaciation question has plateaued at below 10% of the cohort.

There was, however, another increase in the number of candidates using extra paper in completing their responses. As with 2024 this may have been the result of 1b allowing answers on a range of tectonic hazards and a topic (vulnerability) that many of the candidates felt comfortable with.

Question 1(a)

This was a stepped question that tested their understanding of central tendency. The majority of candidates were able to correctly calculate the square of -1.2 as well as the sum of the squares. Most then were able to correctly calculate the standard deviation.

Common errors included not realising the square of a negative is a positive, errors in totalling the squares and not taking the square root in 1a(iii).

Centres are again encouraged to ensure that their candidates are confident in handling the named statistical tests in the specification as well as being accurate in their understanding of rounding.

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 these skills not just the ones listed after the section on Tectonic Processes and Hazards.

Question 1(b)

Candidates found this question accessible, probably because, as with 2024, it allowed them to use a range of the case studies for both earthquakes and volcanoes. Centres are reminded that this may not always be the case, and they should ensure that their candidates are capable of answering questions solely using either earthquakes or volcanic case study material. Most answers could explain how community preparedness could reduce vulnerability (or a lack of preparedness) increases vulnerability.

The very best answers outlined at the start of the essay what they understood by the term vulnerability and then used this definition in their assessment of the extent to which community preparedness could affect this vulnerability. In particular those obtaining the very highest marks went beyond a two case study approach (often Haiti 2010 and Tohoku 2011) and instead explained how community preparedness was a factor in determining vulnerability as well as other physical (often magnitude) and human (often level of development/governance) factors also played a significant role. Unfortunately, many answers did not fully explore community preparedness beyond 'education' and only a few responses sought to compare preparedness between different communities within the same tectonic event.

(b) Assess the importance of community preparedness in influencing the vulnerability of people to tectonic hazards.

(12)

~~Vulnerability is the~~ Vulnerability is an important factor to consider when it comes to hazard management.

As the Deegs model shows, a disaster can only exist where a hazard and a vulnerable population intersect. Vulnerability can be reduced through preparedness.

Community preparedness is an aspect of this, and a highly significant one as it is a crucial part of mitigating the vulnerability and can reduce social costs of a disaster especially effectively. This is clearly illustrated in the case of the 2004 Indian Ocean Tsunami, where in some communities in Thailand ~~the~~ the ocean withdrawing was recognised by community leaders as a sign of the approaching tsunami, allowing people to evacuate to safety ~~of~~ on higher ground, death tolls were higher in places which lacked this community memory of the event, especially where people went to collect fish in the deeper parts of the tsunami. Therefore, it can be seen that community preparedness is a key part of an effective disaster response, though other factors also affect vulnerability.

One of these factors is environmental vulnerability, as shown by the Sichuan earthquake. People in the remote Sichuan province are vulnerable to disasters as

As in the case of the 2008 earthquake or ~~the~~ disasters such as this one can cut off access by roads and ^{some} response teams had to reach the epicentre by foot, slowing down the response during the most ~~at the most~~ crucial hours - these ^{immediately} ~~directly~~ following the event. Another aspect of environmental vulnerability is the resilience of infrastructure to earthquakes - this was shown by poor building quality in the Sichuan province as local governance was weak and officials took bribes to allow planning laws to be broken. A much lower nonetheless count was seen following the 2011 Tohoku earthquake as strong governance by Japan ~~was~~ seen ensured that over 70% of buildings ^{incorporated} ~~were~~ earthquake resilient design. Therefore, ^{environmental} ~~community~~ vulnerability also plays a key role, along with community preparedness in influencing vulnerability.

The importance of community preparedness is more social than economic, unlike strategies to reduce physical vulnerability to ^{building} ~~life~~ planning laws. Both are key aspects in minimising a disaster though promoting community preparedness is vital for ^{reducing} ~~giving~~ vulnerability by enabling people to make a ^{well-rehearsed} ~~a~~ decisive and effective response. It is also a strategy more freely available for low income countries than other strategies like earthquake resistant engineering so can ~~form~~ ^{be} an important part of any countries disaster management plans alongside other strategies more suited to reducing ~~the~~ economic loss (Total for Question 1 = 16 marks)



The response defines vulnerability and then has detailed case study support although there is some mis-identification in the location for the community knowledge, which is more likely to be the Andaman and Nicobar Islands. The candidate then examines the impact of accessibility in influencing vulnerability using the China 2008 earthquake in support and also examines the impact of governance by comparing the China earthquake to Japan 2011. The candidate finishes with a sophisticated argument of the value of community preparedness particularly in low income countries. Level 3 11 marks.



The response could have been improved if the candidate had considered how vulnerability varied between different community groups.

Question 2(a)

Most candidates found this question accessible with the best responses explaining how glacial movement developed the glacial trough as well as identifying post glacial features such as the scree slopes. However, some candidates found this question challenging. Although the Nant Ffrancon valley is often the focus of centres case studies as well as being the focus of field work, a number of candidates were unable to identify the main feature of the photograph – a glacial trough. Instead of analysing the photograph, some candidates instead wrote about corries/cirques, aretes and pyramidal peaks. Although it is feasible that there may have been an arete in the image, there was no evidence for corries/cirques or pyramidal peaks. Centres are advised to always use contemporary images of the features that they are teaching to aid the understanding of all glacial features.

2 Study Figure 2a in the Resource Booklet.

Scree Slope

(a) Explain the role of valley glaciers in the formation of this landscape.

(6)

Valley glaciers erode and carve distinct features on the landscape, the image shows a U shaped valley as a glacial trough. This has been created by the slow movement of a glacier through abrasion, plucking and crushing it has eroded its way through the valley leaving a wide trough. To the right of the image scree slopes represent the areas glacial past. Brown rock and debris cover the sides of the mountains. In the bottom of the valley there is a misfit river, the small stream of water left behind after the glacier retreated and melted. The image also shows erratics in the bottom of the valley dropped by the retreating ice these out of place boulders show the effect valley glaciers have had in forming this relict glacial landscape.



The response identifies various landforms in the landscape. Level 3, 5 marks.



To obtain level 3-6 marks the candidate should explain the glacial processes (such as plucking or ablation) as opposed to just listing a series of processes.

Question 2(b)

Many candidates found this question challenging despite the landscape being identified as a knock and lochan landscape and that a key factor in the development of such a landscape was geology. The best responses identified that these landscapes were developed due to ice sheet scouring and then related this to differential erosion with areas of greater scouring creating the lochan and lower levels of scouring forming the raised hills. Geology is thought to be important as these landscapes are often found in areas of gneiss or granite where weathering exploits joints and fractures in these rocks allowing subsequent differential rates of scouring.

Some have suggested that these knocks could also be roche moutonne or whalebacks and explanations of these were also accepted.

Others, however, displayed rather muddled thinking and confused the post-glacial landscape with meltwater features. Centres are reminded that any landscape/landform listed in the specification can be a focus for a low (6 mark) tariff question.

Study Figure 2b in the Resource Booklet.

(b) Explain the influence of geology in the formation of this knock and lochan landscape.

(6)

Knock and lochans are alternating small rock hills (knocks) and hollows that contain small lakes (lochans) which are formed as the glacier moves over large lands of alternating hard and soft rock. The softer rock is less resistant to erosion through plucking and abrasion than the harder rock, so ~~the harder rock is left standing higher above the soft rock~~ the harder rock is left standing higher above the soft rock. When the glacier encounters areas of high pressure such as the upward side of slopes on the lee side of obstacles of hard rock, the ice is compressed causing compressing flow to occur and the glacier pressure melting points reached at the base due to this high pressure. The subglacial meltwater produced lubricates the glacier base and allows the glacier to move by basal sliding, allowing more erosion to occur. This increases the abrasion on the softer rocks which is when subglacial debris is dragged under pressure which smooths the rocks and can lead to the formation of striations.

When the glacier enters low pressure areas such as small hollows, plucking occurs especially on which pulls rocks away from the bedrock ^{leading} to a jagged surface.

The difference in geology means that the ~~granite~~ bedrocks eroded at differential rates allowing the softer rock to form ~~the~~ deep hollows which after glaciation fill with lakes forming the landscape shown in figure 2b.



The response shows a good understanding of the role of geology in the formation of the knock and lochan landscape with sound explanation of erosional processes. Level 3, 5 marks.



To be secure and obtain 6 marks the candidate needed to reference ice sheets or scouring.

Question 2(c)

This was a question found accessible by most candidates who were able to demonstrate their knowledge and understanding of why glacial meltwater creates distinctive fluvio-glacial landscapes. The best candidates linked meltwater process (such as hydrostatic pressure in stagnant or retreating glaciers) to the distinctive landforms produced (eskers). Some, however, simply explained all glacial depositional features including moraines and till plains and were therefore self-penalising.

Kames, eskers, outwash plains, moraine

(c) Explain why meltwater creates distinctive depositional fluvio-glacial landforms.

(8)

Meltwater shows that the glacier which was present must have had a negative mass balance as the glacier temperature must have dropped to cause these ~~glacial~~ meltwater landforms to deposit material. The first fluvio-glacial landform which it has created is a kame. This has been created as ~~meltwater~~ deposition collects on top of a retreating glacier. As the glacier melts it builds up into a depression mound and deposited once the glacier has melted away. Another way in which meltwater creates distinctive landscapes is through eskers. This occurs when a sinuous winding ridge deposits material. This happens as the subglacial meltwater channel loses its energy which it drops the material but due to the hydrostatic pressure it retains the sinuous shape. The final distinctive fluvio-glacial landform which is created is an outwash plain. This occurs when a glacier deposits fine material as the temperature rises causing the glacier to melt and deposit this material.



The response shows a good range of relevant landforms i.e. kame, eskers and outwash plain with sound explanations. Level 3, 6 marks.



To get level 3-8 marks the candidate should have explained why they are distinctive perhaps in size/orientation or in their orientation.

Question 2(d)

This was found accessible by most candidates. The key to a successful response was to evaluate whether management should **always** prioritise the environment over economic exploitation. Many successfully argued that for some glaciated landscapes this was true but if there was sustainable management in place then the environment could be preserved but at the same time allow some economic opportunities.

Some candidates unfortunately ignored the word management and wrote only about the damage that economic exploitation may cause to glaciated landscapes. These responses were self-penalising.

(d) Evaluate the view that the management of glaciated landscapes should always prioritise preservation over economic exploitation. (20)

Alaska, Antarctica, Greenland, Antarctic Treaty, Tourism, Fishing, Oil

Glaciated landscapes have many uses, including economic value and cultural value, however increasing demands on these landscapes are having huge negative impacts, ~~for example by~~ if we do not take action ^{to preserve them} by 2050 over half of today's ice coverage will be gone which will have further negative impacts, causing a positive feedback loop.

the management of

Taking this into consideration, I think that ^{the management of} glaciated landscapes should always prioritise preservation over economic development. This includes treaties, such as the Antarctic treaty which states that no country can exploit Antarctica of its huge oil reserves. ~~If~~ If this treaty was not in place the Antarctic would be drilled into for oil. This would decrease ice coverage, which decreases the albedo effect. This will lead to an increased heating of global temperatures, which has global effects. ~~If the~~ Other ways glaciated landscapes have had preservation prioritised, is through making the land a national park. For example, Alaska

A National park has been created to defer exploitation of the unique landscape. This means that the diverse ecosystems are not harmed or interrupted, but also the Gwich'en tribe is not disturbed, or have their homes taken away from them as they live sustainably and do not harm the natural environment. These players would agree that glaciated landscapes should always be preserved. However more recently the younger generations of this tribe have started to work for oil extraction plants in ~~Produce~~ area 1002 in order to generate income.

However, on the other hand, different players such as OPEC (which owns 80% of the world's oil) will have the view that glaciated landscapes should be used for economic exploitation, because it will generate income for many countries and the oil reserves should be used. Other players with this view would be Donald Trump who is trying to buy Greenland in order to exploit its plentiful natural gas resources to enhance his ~~econom~~ the USA's economic development and gain more power over the rest of the world by supplying oil. Glaciated landscapes don't only provide natural oil, they can also provide ~~fishing grounds~~ ~~space~~ a place for fishing which can be beneficial to a country's economic development or food scarcity. However environmental organisations such as the WWF will have the view that this

should not be allowed, because the effect of trawling and over fishing will decrease bio diversity and damage fragile ecosystems forever.

Furthermore glaciated landscapes ~~are huge~~ have huge economic benefits of tourism with more than 12 cruise companies offering cruises to Antarctica and ski resorts in the Alps. These tourist hubs create huge incomes for the surrounding areas, which otherwise would have little ways of creating income, therefore many may view this as a positive effect.

Overall it is my judgement that ~~at~~ the management of glaciated landscapes should mostly ~~be~~ prioritize preservation over economic exploitation, because if global warming due to decreasing albedo effects and ~~ex~~ more release of carbon dioxide reaches the tipping point, the consequences will be global and unreversable. However in the future glaciated places can use a mixture of both, an example of this would be the Sagarmatha National Park in the Himalayas surrounding Mount Everest, this is a positive management

processes it is protecting the area through being a National park and only allowing a certain number of people up to base camp each year, however profit is still generated through tourism which is supporting the local economy.



The response develops both sides of the argument with sound case study support, comes to an overall judgement and suggests a possible sustainable way forward. Level 4, 16 marks.



The candidate could have improved their response by concentrating more on management as on stakeholders.

Question 3(a)

As with question 2a the resource depicted a 'classic' coastal landscape (in this case the Old Man of Hoy, Orkney). Most candidates were able to explain how the characteristics of destructive waves contributed to the development of this landscape as well as examining the role of wave refraction and geological structure. Some also examined the role of subaerial processes. All of these approaches were accepted. The best candidates noted not only the stack but also the pebble beach and gave convincing explanations of the role of destructive waves in the development of this feature. Credit was also given to those who identified that sea level change might also be responsible for the development of this landform.

Some candidates, however, merely listed erosional processes and did not explain the role of destructive waves. These responses were self-penalising.

3 Study Figure 3a in the Resource Booklet.

(a) Explain the role of destructive waves in the formation of this landscape.

(6)

Figure 3a shows a stack which has been formed from a headland. Destructive waves play a massive role in the formation of this landscape as destructive waves are high energy and have a strong backwash compared to its surge this means it erodes more sediment. A stack is created when a headland has joints which develop into a cove through processes such as abrasion and hydraulic action which comes from the destructive wave. The cove then hollows out becoming an arch which later collapses due to further hydraulic action or weathering and this creates the stack shown in Figure 3a. This is evident from the scree present at the foot of the stack.



The candidate identifies features in the landscape (Stack/scree slope) and relates this to the characteristics of destructive waves. Level 3, 5 marks.



The response could have been improved if there had been explanation of the erosional processes listed or the role of geological structure.

Question 3(b)

As with question 3a this question was found accessible by the majority of candidates who were successfully able to explain how constructive waves contributed to the formation of this landscape. As noted in last year's report, candidates must explain the processes of sediment transport such as traction or saltation as well as the processes of deposition such as gravity settling or flocculation and not just list them. They must also explain the process of longshore drift.

The best answers realised that there were more features than just a bar and were able to successfully explain how constructive waves helped create a broad flat sandy beach or how vegetation succession stabilised the bar. Credit was also given to those who suggested that behind the bar there was a ria.

Study Figure 3b in the Resource Booklet.

(b) Explain the influence of constructive waves in the formation of this landscape.

(6)

The landscape in figure 3b is a ~~base~~ bar - where two headlands are connected via a sand formation. This is a depositional landform - constructive waves are associated with this feature due to its low energy meaning more material is deposited than eroded. Constructive waves can be drift aligned (angled) or swash aligned (straight). In the case of this formation (bar) ~~the~~ the process of longshore drift would have moved sediment from the northern coastline and where the headland begins ^{wave} energy is lost due to decreased ocean depth a spit would begin to form where the sand deposition hooks to build up. This would occur from North and South in figure 3b to create a bar - joining the two headlands. Longshore drift is a process associated with constructive waves where material is deposited at an angle on the beach and backwash removes it straight - to move material along the beach over time. The bar, once fully enclosing the bay, will form a lagoon - which if high evaporation occurs - could create a salt marsh.



The response explains the processes leading to the formation of beaches and bars with links to constructive waves. Level 3, 5 marks.



In the response there are some insecurities in bar formation and the process of longshore drift. To gain six marks always explain the processes of sediment transport such as saltation or traction and be accurate in your explanations.

Question 3(c)

I am pleased to report that having set a question on the role of mass movement in the development of landforms, many candidates were secure in their understanding of the term subaerial processes.

The best answers explained how subaerial processes (both weathering and mass movement) influenced the rate of coastal recession giving good explanations on how weathering processes such as freeze/thaw weathering led to block fall and so influenced the rate of coastal recession. Often this was accompanied by the use of named examples as well as the rates of coastal recession. Others gave excellent explanations of rotational slumping by examining the role of porewater pressure and shear strength in leading to arcs of failure and so rotational sliding.

Some however only explained erosional processes found at the foot of cliffs and so were self penalising.

MCQ → weathering → mm → rock fall → slumping

(c) Explain why subaerial processes influence the rate of coastal recession.

(8)

The first subaerial process is weathering, this can be mechanical e.g. freeze/thawing where cracks in rock fill with water and when below 0°C freeze expanding and cracking the rock. It can be chemical so acidic rain erodes carbonate soft rock or biological like tree roots or animals burrowing. Weathering can create rocky cliffs but is really a secondary process and just loosens sediment to be taken by erosion rather than actually retreat the coastline. Another subaerial process is mass movement. Mass movement is the movement/recession of a large volume of sediment all at once. For example, rock fall can occur on cliffs over 45° where the steep angle along with weathering causes blocks to separate from the cliff causing huge gaps of erosion in the cliff face and the formation of a scree slope. Mass movement can also be in the form of slumping which is when pore water volume/pressure is high in a soft sedimentary/consolidated cliff causing gravity to pull it down creating a terraced profile. This is then removed by erosion from waves (abrasion, attrition, solution and hydraulic action) leading to huge amounts of recession. So in conclusion, subaerial processes weaken large amounts of the cliff face leading to an increase in sediment taken away by destructive waves so creates lots of recession. But I would also say the recession from weathering + mass movement alone wouldn't influence recession as it ~~isn't~~ only really loosens

sediment as opposed to erosion and removal. So with other processes like marine erosion and geology (bedrock lithology eg sedimentary or metamorphic) also play huge factors in coastal recession when at the same time as subaerial processes.



The response shows a comprehensive range of processes for mass movement and weathering linked to the rate of coastal recession. Level 3, 6 marks.



The use of named places in these 8 mark questions are often a useful way of ensuring top band marks.

Question 3(d)

As with the paired question 2d, the key word for candidates to recognise was **always**. As with 2d the key to a successful response was to evaluate whether management should always prioritise the environment over economic exploitation. Many successfully argued that for some coastal landscapes this was true but if there was sustainable management in place then the environment could be preserved but at the same time allow some economic opportunities.

Some candidates unfortunately ignored the word management and wrote only about the damage that economic exploitation may cause to coastal landscapes. These responses were self-penalising.

There was also the issue of trying to fit their (only?) case study to a question that for a large part was unsuitable. Some candidates wrote only about the Holderness coast and although the defences at Bacton are a good example of economic priorities the reasons for the management of Mableton does not have much to do with environmental considerations.

Maldives

(d) Evaluate the view that coastal management should always prioritise the environment over economic considerations.

Namibia,
 Blackwater estuary

→ Hoppiburgh, Bangladesh

(20)

Coastal management can involve hard, soft or sustainable management in order to reduce coastal erosion, recession and flooding, even type of management creates winners and losers and often times conflict between environmental and economic priorities.

Prioritising the environment is essential because ultimately erosion, recession and flooding are worsening because of global warming and climate change as a result of ~~setting~~ human action based on prioritising ~~the~~ the economy. In Namibia in 2013, they initiated their vision 2030 programme in order to improve the governance of their coastlines and improve the lives of coastal ecosystems while prioritising the protection of coastal ecology, protecting important marine ecosystems. Equally, in the Blackwater Estuary in Essex, they decided on a managed realignment scheme to protect their salt marsh, breaching the sea wall in 5 places to allow for new salt marshes to form naturally coastal flood risk reducing the natural flood defence, creating improved water quality as the reeds filter the water and also providing essential protection for many bird and aquatic species. Using coastal protection that prioritising the environment is essential for ultimately mitigating sea level rise and the risk for more coastal

protection, by supporting ecology that helps to reduce sea level rise.

In the Maldives, they have dredged thousands of tons of sediment and corals to moor their ~~ports~~ ports with economic priorities, they have used this to build a new artificial island Hulhulé, 1.6 miles from Male' in order to promote urban tourism to generate economic gains. By doing this, the removal of coral impacts ocean health, leading to the suffering of native ecosystems essential for fishing activities, and ~~also~~ limited the capacity of the oceans to absorb carbon, leading to sea level rise, coral reef exposure, and further sea level rise, further impacting the Maldives and entraining their need for further coastal management.

Bangladesh has also prioritised economic development over its focus on managing their coasts. They have removed 71% of their mangroves to promote tourism, halting locally caught sea turtles and easier access. Noting by this distribution of the coastline, mangroves essential for binding sediment, absorbing storm surge, reducing wave height (by 60% in the first 100m) and reducing friction between waves and water helping to reduce erosion, they also are essential for fish populations and so the reduction in fish will impact the fishing industry in Bangladesh, including on their economy. Also, their costs are now exceeding 200m per year as a result of the social, economic and environmental impacts.

Hard engineering prioritised the economy as the protection of manmade defences is undoubtedly protecting, however, their ^{or} positive. For example, the sea wall ^{and seawall} in Bridlington is protecting a community of 35,000 people and a booming tourism industry from being lost to the sea. Protection here as the holderness coast is essential due to the rapid rate of coastal erosion. Without hard engineering, the value of the land, housing and infrastructure lost would have impacts ~~the~~ greater than potentially. The environmental loss with people being forced to relocate, losing homes and livelihoods and the ^{local} government suffering financially from a fall in tourism and infrastructure damage, meaning less can be spent on the local economy. ~~the~~ Also, in the decelerating current then already dealt with a 3m sea wall and dredging came to build artificial islands, the impacts of coastal flooding would be catastrophic. A 50cm sea level rise (as projected by 2100) would flood 77% of their island, ~~substantially reducing~~ causing significant socio-economic costs. Ultimately, there are things which prioritising the economy and society over the environment is absolutely essential.

In conclusion, although at times prioritising the environment is essential, I would argue overwhelmingly it should be the environment that is prioritised. When it comes down to conflicts

between the environmental and social considerations, the answer is probably less clear cut due to the social damage that can result from environmental priorities, however, when it comes down to choosing between protecting the environment and protecting the economy, I believe protecting the environment should most frequently be prioritised because ignoring the environment has much an impact on the economy anyway, and protecting the environment helps to mitigate the need for more coastal management, for example, protecting coasts not only reduces sea level rise by generating carbon but also helps to stop every resulting erosion and coastal recession.

(Total for Question 3 = 40 marks)



The candidate uses both conceptual and locational exemplification with a good range of ideas which are well argued. Level 4, 16 marks.



To obtain 20 marks the essay should also strive for balance (in this case between economic and environmental in case studies). Another trait of a 20 mark response is that the conclusion is clear on the candidate's view of the essay title.

Question 4(a)

This question was answered well by most of the candidates. Most were able to use the resource to suggest a reason why the global water budget limits water availability for human use. The best answers used the data from the resource and explained either why saline water could not be used for irrigation, industry or domestic purposes or why as so much of the world's water is saline it was too expensive or environmentally damaging to use by utilising desalinisation.

Some candidates did not use the resource and so were not able to assess all of the marks as one mark is reserved for use of data from the resource.

4 Study Figure 4 in the Resource Booklet.

- (a) Explain **one** reason why the global water budget limits water availability for human use.

(3)

One reason why the global water budget limits availability for human use is due to the fact that the majority of water present is unsuitable for consumption. 97.5% of the planet is saline with only 2.5% fresh water. Of that small 2.5% only 3.0% is accessible with the other 70% being locked away in the cryosphere. This makes most water unusable or costly to use, with sea water harmful and frozen water difficult to tap into, limiting overall potential use.



The candidate has been awarded 1 mark for the use of the resource and 2 extra marks for explaining why this is unusable as it is salt water or ice and so costly to use.



Always use the resource in these 3 mark questions and ensure that if the question asks for one reason you must only develop one answer.

Question 4(b)

Most candidates found this question accessible with many giving excellent answers on how climate change may have impacts on river discharge using rivers such as the Yukon or Amazon as case study material. In particular the best responses explained why river discharge may vary not only in annual totals but also how it would vary over the year.

Some unfortunately went down a hydrograph route and although in some cases they were able to relate hydrograph shape/type to changing river discharge others found it difficult to relate how shorter lag times and steeper rising limbs would affect river discharge.

(b) Explain the possible impacts of climate change on river discharge.

(6)

One possible impact is that river discharge will increase as global rising temperatures increase snow cover melt. meaning this means that there is a greater volume of water at the source which is run-off and overall increases discharge. An example where this may be seen is in the Ganges river, as peak discharge is already increased due to snow melt on the Himalayas during warmer seasons. This will only increase with greater temperatures.

Conversely, a possible impact could be the reduction in river discharge, as glaciers melt and retreat ~~they may~~ meltwaters may no longer feed the rivers and drainage basin, significantly reducing discharge. This has already been seen in the Asian region as the Silt river disappeared, due to glacial retreat. This was the first ever reported case of river drying as a direct influence of human actions accelerating climate change.



This response covers both increases and decreases of river discharge with case study support. Level 3, 5 marks.



To obtain full marks for these six mark questions always explain fully the concepts – to get 6 on this answer the causes of glacial melt needed to be explained in greater depth.

Question 4(c)

This was found accessible by the majority of candidates. The principal examiner was pleased that in many cases, candidates had a good knowledge of the costs and benefits of developing unconventional fossil fuel energy resources with good case study detail on Canadian tar sands, as well as the impacts of fracking in the USA.

Some candidates, however, misunderstood the exact nature of unconventional fossil fuel energy resources and explained that tar sands and oil shales would reduce the need for fossil fuels, and so reduce global warming. These responses were self-penalising.

Unconventional fossil fuel energy resources include tar sands, shale gas, shale oil and deepwater oil.

(c) Explain the costs and benefits of developing unconventional fossil fuel energy resources.

(8)

There are potential environmental costs involved with extraction. Tar sands in Canada produce 3 barrels of toxic waste for each barrel of oil produced, hence resulting in groundwater pollution and posing threats to wildlife. However this also provides much investment and jobs in isolated areas where economic activity is generally low.

Developing unconventional fossil fuels also provides an alternative to buying oil from politically unstable regions. Shale gas in the US provided 25% of America's energy in 2015 and increased energy security for the US, meaning they didn't have to rely on imports. However drinking water quality has been impacted and areas in the US have experienced minor ~~harmful~~ tremors from underground drilling.

Deepwater oil has significantly lowered oil prices since 2015. Offshore drilling in the Gulf of Mexico has allowed the US to exploit

run all necessary, lowering costs for consumers.
However there are environmental costs involved such
as the ~~2000~~ 2010 gulf of Mexico oil
spill which costs nearly \$5 billion to
clean up.



The response has a range of balanced costs and benefits for three of the unconventional energy resources with sound case study evidence for support. Level 3, 6 marks.



It is always good practice to use case study material to develop your answers to such 8 mark AO1 questions.

Question 4(d)

This was a question many candidates found accessible but unfortunately a minority largely ignored the key word sustainable and wrote instead about large scale (and mainly unsustainable) approaches such as dams and reservoirs. Whilst responses can propose other ways in which the future demand for water can be met, they must explain what they understand by sustainable approaches and explain why these sustainable approaches are unable to meet future demands for water.

The best responses assessed sustainable approaches supplying domestic water such as in Singapore as well as those utilising new irrigation techniques in the USA, Israel and Australia.

(d) Assess the extent to which future demand for water can be met using sustainable approaches.

(12)

It may be argued that future water demands can be met using sustainable approaches. Technological improvements such as reverse osmosis have allowed for desalination to become more cost effective, producing ~~600~~ 600 tonnes of drinking water an hour. Furthermore, low cost sustainable schemes have been effective in developing countries such as magic stones on the Sahel that ~~a~~ conserve soil moisture and prevent excessive irrigation. Therefore as technology improves, increasing water demand can be managed effectively, however rising population growth puts increasing pressure on ~~water~~ water resources.

It may also be argued that water agreements and rules can lead to sustainability. For example the Colorado river agreement was updated in 2007 using climate data and information on population growth to allocate water fairly. The agreement also allowed Mexico to use water stored in Lake Mead USA to prevent water scarcity in the long term and provide water security. However these approaches often create more conflict ~~than~~ ~~sim~~, for example California has taken 20% more of its water allocation, reducing available water allocation and therefore

without strict enforcement, such a measure may be argued to not be a sustainable way of meeting future demands.

However, meeting future demands may result in the ~~use~~ use of unsustainable approaches. For example overabstraction of groundwater may lower the water table and increase saltwater intrusion. Furthermore, ^{the} rising middle classes means that per capita water consumption is increasing, and demand for water intensive products is increasing. The Murray Darling is under increased pressure, particularly from around pumps extracting 330 L of water per second for 18 hours a day. Therefore as consumption rises, less sustainable approaches are being used which will have long term impacts on future generations due to the desertification of rivers and overabstraction of aquifers.



The response has a range of sustainable approaches such as magic stones and water treaties and also considers the future and the extent to which sustainable approaches can meet future demands. Level 3, 9 marks.



In all 12 mark questions it is essential that key words (in this case sustainable) are defined at the start of the essay and that they then become the focus of a substantiated conclusion.

Question 4(e)

This question rather divided the cohort into those who had accurate knowledge and understanding of the two key climate change treaties Kyoto (1997) and Paris (2015) and those who were insecure in their knowledge and understanding. All too often candidates mixed up these two treaties and were insecure in their understanding of what the countries signing the treaties were obliged to do. Common incorrect assertions were that the Paris Agreement was not legally binding and that the Kyoto agreement was responsible for the current net zero policies in a variety of countries such as the UK.

Some responses examined other global treaties such as UNCLOS and the Montreal protocol. Whilst these could be credited if they were being used to show how global treaties could be effective, many responses that examined these treaties were only tangentially related to the question.

The best responses started with an examination of the value of global agreements (with accurate case study support) and then evaluated whether regional, national or even individual actions were more important in reducing future planetary warming. Crucially they then concluded whether global treaties were therefore **essential**.

^{Kyoto Protocol}
^{/ COP21, energy}
(e) Evaluate the view that global agreements are essential in order to reduce further planetary warming.

(20)

Global agreements play a large role in the global contribution to reduce climate change, with treaties like COP21 (Paris Agreement) influencing the international capacity to work together. Planetary warming is being enhanced by anthropogenic activities sparked by fossil fuel usage in the Industrial Revolution. Although, it is an ^{ubiquitous} ~~international~~ problem that does require global agreements to successfully ^{reduce} ~~mitigate~~ ~~the~~ ^{improvement} Climate Change, ^{independent} nations also possess large responsibilities to adjust their energy mixes, as well as local actions.

To begin, international treaties are significant as political collaboration allows for universal goals to be coordinated. This may include goals to reduce greenhouse gas emissions like carbon dioxide and methane, to allow the ^{carbon} ~~climate~~ cycle to restore equilibrium. Treaties like COP21 aim for the ~~reduction~~ ^{rising} global temperature to be maintained ~~at~~ ^{at} $1.5^{\circ}\text{C} - 2^{\circ}\text{C}$, in level with emissions pre-industry. It aims to limit planetary warming by converting to ^{renewable energy} ~~fossil fuels~~ (wind/solar), reducing dependancy on fossil fuels (coal, oil, gas), to hopefully be carbon free by 2030. Although this is an ambitious goal, geopolitical ~~is~~ ^{hinders} the successes of treaties, as ~~the~~ ^{the} recent election of Donald Trump has provided uncertainties, with an withdrawal from COP21 possible. As a superpower, the participation of the USA in this agreement is essential in worldwide participation. Therefore, although

Treaties provide collaboration between nations to meet a common goal, they are ultimately flawed dependent on political situations which may on an international scale, impact other nations contributions significantly, therefore, not reducing emissions at a necessary rate.

However, the responsibility of individual nations are also imperative to reduce emissions, where a greener energy mix can act more successfully to reduce planetary warming than a treaty. Renewable energy and recyclable energy is largely significant in reducing further warming, as it not only supports the reduction in warming, but also supports energy security. The more diversified an energy mix, the greater more secure a country will be. Converting to nuclear energy has been essential for France's role in reducing climate change, with 70% of their energy being supplied from nuclear energy. This is recyclable ~~water~~ which also makes it cost efficient as it produces little-to-no emissions, despite local fears over the safety due to events like Chernobyl. ~~However,~~ Though, it is important to note that renewable energy schemes are often only possible for HICs, whereas fossil fuel consumption in LICs is still essential for basic economic development. Renewable ^{recyclable} energy is essential to reduce emissions from the combustion of fossil fuels though many developing nations cannot access the infrastructure technology needed.

Finally, local action may be taken to reduce individual carbon footprints + carbon emissions. Individuals may choose to take

public transport to reduce vehicles on the road, and thus emissions. Individuals + communities also have the power to put pressure on ~~international companies~~ TNCs + governments who do not make environmentally respectful decisions. Fines can also be used in busy + congested areas like London, where ULEZ zones provide fines for carbon emitting vehicles to deter usage. These fines are then funnelled back into the economy for renewable technology. Although however, as these factors usually operate on small local scales, the impact they have on reducing planetary warming are highly controversial, as many believe it is the responsibilities of TNCs + governments to act in reducing national emissions.

In conclusion, although ~~international~~ international agreements lay the foundations for climate goals, like Net Zero, they are ultimately flawed in ~~their~~ the way they are carried out. They do not directly reduce planetary warming, but rather advise. However the roles and responsibilities of governments to act upon their own terms will likely prove essential in reducing Climate Change, in a scale suitable to the development of a country.



The response has a strong analysis of global agreements as well as examining renewables and recyclables and assessing the role of local action. It also comes to a sound conclusion that directly answers the question. Level 4, 20 marks.



A key reason for the high marks gained by the candidate was the constant ongoing evaluation after each point made which was then drawn together in the conclusion. This is a hallmark of a strong response.

Paper Summary

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

- 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 knock and lochan and sustainable water approaches.
- Use the resources that are given to you to substantiate the points that you are making. In particular, study carefully any charts/diagrams and be able to extract data to support your explanations.
- Ensure that when the 6 mark resource question has key words such as contribute there are likely to be other factors or processes that are relevant to the answer.
- Ensure that in the 20 mark evaluate questions you come to a conclusion that is a logical outcome of your argument (i.e. is rational) and has a key piece of information supporting your conclusion (i.e. is substantiated) and is substantiated in the essay.

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