GCE A LEVEL MARKING SCHEME

SUMMER 2023

A LEVEL
GEOGRAPHY - COMPONENT 3
A110U30-1

INTRODUCTION

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE A LEVEL GEOGRAPHY

COMPONENT 3: CONTEMPORARY THEMES IN GEOGRAPHY

SUMMER 2023 MARK SCHEME

Guidance for Examiners

Positive marking

Learners are writing under examination conditions and credit should be given for what the learner writes, as opposed to adopting an approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

The mark scheme for this component uses banded mark schemes.

Banded mark schemes

The mark scheme is in two parts to reflect the sections (A and B in the examination paper). Section A is 38 marks and Section B is 45 marks.

The first part of the mark scheme in each section is an assessment grid advising on bands and the associated marks that should be given in responses that demonstrate the qualities needed in the three AOs; AO1, AO2 and AO3 relevant to this component. The targeted AO(s) are also indicated, for example AO2.1c.

The second part of the mark scheme is advice on the indicative content that suggests the range of likely themes and specialised concepts, processes, scales and environments that may be included in the learner's answers.

Banded mark schemes are divided so that each band has a relevant descriptor. The descriptor for the band provides a description of the performance level for that band. Each band contains marks. Examiners should first read and annotate a learner's answer to pick out the evidence that is being assessed in that question. Once the annotation is complete, the mark scheme can be applied. This is a two-stage process.

Banded mark schemes Stage 1 – Deciding on the band

Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptor for that band. Examiners should look at the descriptor for that band and see if it matches the qualities shown in the learner's answer. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance, if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content.

Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Banded mark schemes Stage 2 – Deciding on the mark

Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

The mark scheme reflects the layout of the examination paper. Mark the chosen question in Section A and the two chosen questions from Section B. If the candidate has responded to both questions in Section A or more than two in Section B mark all the answers. Award the higher marks attained for the correct number of required questions; further, possible rubric infringement will be discussed at the marking conference.

Be prepared to reward answers that give **valid and creditworthy** responses, especially if these do not fully reflect the 'indicative content' of the mark scheme.

Section A: Tectonic Hazards - Generic Mark Bands (38 marks)

	AO1 [14 marks]	AO2 [20 marks]	AO3 [4 marks]
Band	*Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change at a variety of scales*	*Apply knowledge and understanding in different contexts either to analyse or interpret or evaluate geographical issues and information*	*Use a variety of relevant quantitative and qualitative skills to construct arguments and draw conclusions*
4	**10-14 marks** Demonstrates thorough and accurate knowledge; confident understanding of relevant concepts and principles throughout the response that is wholly relevant to the question Demonstrates knowledge and understanding through the use of appropriate, accurate and well-developed examples Wholly appropriate, accurate and relevant supporting geographical terminology is well used Well-directed and well-annotated sketch maps / diagrams are included and should be credited	**16-20 marks** Demonstrates sophisticated application of knowledge and understanding either to analyse or interpret or evaluate in order to produce a full and coherent response that is supported by wholly appropriate evidence Demonstrates application of knowledge and understanding through the synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the confident application of the specialised concepts throughout the response	**4 marks** The response uses wholly relevant qualitative skills to construct clear, coherent and appropriately structured arguments and conclusions
3	**7-9 marks** Demonstrates secure factual knowledge and reasonable understanding of relevant concepts and principles for large portions of the response that is mostly relevant to the question Demonstrates knowledge and understanding through the use of appropriate, generally accurate and developed examples The use of appropriate and mostly relevant geographical terminology is evident Appropriate, basically accurate annotated sketch maps / diagrams are included and should be credited	**11-15 marks** Demonstrates accurate application of knowledge and understanding either to interpret or analyse or evaluate in order to produce a partial but coherent response that is supported by mostly appropriate evidence Demonstrates application of knowledge and understanding through the partial synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the mostly relevant application of the specialised concepts	**3 marks** The response uses mostly relevant qualitative skills to construct structured arguments and conclusions where coherence is variable

	AO1 [14 marks]	AO2 [20 marks]	AO3 [4 marks]
2	**4-6 marks** Demonstrates straightforward knowledge with some inaccuracies; some understanding of relevant concepts and principles that is linked to the question Demonstrates knowledge and understanding through the use of limited examples that may not always be appropriate or accurate The use of geographical terminology is limited Annotated sketch maps / diagrams are basic and should be credited	**6-10 marks** Demonstrates some application of knowledge and understanding either to interpret or analyse or evaluate in order to produce a response which is limited in coherence and is supported by limited appropriate evidence Demonstrates application of knowledge and understanding through the limited synthesis of the connections between different elements of the question Demonstrate application of knowledge and understanding through limited application of the specialised concepts	**2 marks** The response uses limited qualitative skills to construct argument(s) and conclusion(s)that are superficial in structure with minimal coherence
1	**1-3 marks** Demonstrates poor knowledge with errors and minimal understanding and linkage to the question Basic use of examples or if evident, lack relevance to the question asked Geographical terminology is rarely used within the response	**1-5 marks** Demonstrates application either to interpret or analyse or evaluate in order to produce a response which lacks coherence and is unsupported by appropriate evidence Demonstrates application of knowledge and understanding through the superficial synthesis of the connections between different elements of the question Demonstrate application of knowledge and understanding through superficial application of the specialised concepts	**1 mark** The response uses qualitative skills superficially to construct an argument / conclusion that is incomplete and lacks coherence
	0 marks Response not creditworthy or not attempted	**0 marks** Response not creditworthy or not attempted	**0 marks** Response not creditworthy or not attempted

Section A

Theme 1: Tectonic Hazards

1. 'Most volcanic eruptions pose little risk to life, as it is possible to predict, monitor and warn people of their hazardous impacts. Discuss.

AO1 [14] AO2(1c) [20] AO3.3 [4] [38 marks]

Focus 3.1.2 3.1.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

Disaster statistics – Volcanoes

- There are some 500 active volcanoes in the world: about 10% erupt in an average year.
- Volcanoes create far fewer deaths than do earthquakes with nearly 300 events in the last 100 years which resulted in under 100,000 deaths largely caused by Mount Pelée (1902 – 29,000 deaths and Nevado del Ruiz 1985 23,000 deaths). Other significant examples could include Pinatubo (1991) and White Island (2019).
- Historically however, huge numbers have been killed, e.g., Tambora, nearly 100,000 as a result of crop failure caused by falling ash, or Krakatoa – secondary hazard of tsunami (nearly 40,000).

This contrasts markedly with earthquakes.

Prediction, monitoring and warning

Volcanic eruptions can be predicted spatially although risk mapping is needed to predict precise direction of flows, and also time wise to some extent.
Monitoring of precursors using an array of scientific instruments to measure some of the following:

- Satellites look for infrared radiation that indicates rising magma.
- Ground instruments measure gas, chemical changes in gas emissions, ground deformation and resulting earthquake activity, hydrothermal changes.
- Videocams monitor lahars, for example, Phivolcs in the Philippines or UN 16 Decade Volcanoes, chosen for their frequent eruptions and proximity to population centres.

Monitoring can lead to prediction of possible imminent eruptions, although not always at a precise time.
Development of evacuation plans and emergency drills can be activated to ensure minimal numbers of deaths.
(In contrast, both the time and place of earthquakes are more difficult to predict as monitoring is more difficult and the lead-in time is far shorter so there is rarely time for evacuation).

AO2
Application of knowledge and understanding is deployed to consider whether the prediction, monitoring and warning strategies for volcanic activity play a significant part in leading to far fewer deaths than from earthquakes.

In support of the statement
There are many examples of successful prediction of volcanic eruptions as a result of monitoring which have led to warnings which have activated volcanic emergency plans (VEPs). Government authorities combine with vulcanologists to develop VEPs pre-crisis, at the alert phase and evacuation, and for a phased return post eruption, (successful community preparedness and education).

- Highly effective examples include Mt. Pinatubo, Philippines, (1991), Mt. St. Helens (1980), Nyiragongo, DR Congo (for 2020 eruption the plan for Goma (2016) worked very effectively). Vesuvius, Italy has a very sophisticated evacuation plan in the event of a major eruption, predicted in 2021 to be imminent. In all cases, death tolls were reduced to a minimum, usually isolated examples of risk takers, e.g., those who returned too early post-eruption or who refused to evacuate.
- The quality of prediction, monitoring and warnings has improved over time but because of cost and technology is more likely to be available in HICs and Emerging Economies. LICs may require help from HICs (**interdependence**).

However,
- Whilst scientists can provide reasonably accurate forecasts of impending eruptions, they do not always get it right. 'Cry Wolf' syndrome can occur, whereby people are forced to evacuate, but no eruption happens which reduces scientific credibility in the eyes of governments and local people, causing problems for future warnings.
- Equally, some dormant (or even considered extinct) volcanoes which are not expected to erupt, do so, e.g., Mt Lamington (1951) in Papua New Guinea which killed 5,000 people. These are not usually monitored.
- Governments do not always respond to the predictions of scientists. In 1985, despite warnings of an impending eruption from the melting of glaciers at the summit of Nevado del Ruiz in Colombia, both the national and the local governments failed to act on it, causing massive loss of life in Armero (23,000 people) as a huge lahar rushed down the Lagunillas Valley in the middle of the night. The history of the volcano was insufficiently studied and the risk mapping of the lahars was slow to be published.
- There are also a number of intrinsic and extrinsic factors which can lead to significant numbers of deaths in spite of prediction and monitoring.

Intrinsic factors concerning specific eruptions include:
- The magnitude of the eruption. Volcanoes with explosive eruptions of VEI 4 and above are far more likely to cause significant deaths. There was huge concern whether the eruption of a potential super volcano in La Palma could cause many deaths from a secondary tsunami.
- The duration of an eruption may prolong risk for a variety of reasons, but more especially to livelihoods as opposed to life. Credit potential knock-on impacts e.g., death from famine.
- The viscosity of the magma – whilst basic magma from effusive eruptions forms very fluid lava flows, it rarely kills people whereas acid rhyolitic magma leads to highly explosive eruptions with a high VEI which have greater potential to kill people (e.g., Mt Pelée).

- The materials ejected also have an impact.
  - Occasionally, when large quantities of very fluid lava are released, this can lead to crater collapse. Nyiragongo eruption in DR Congo led to huge lava flows which destroyed the city of Goma, the sheer volume killing 45 people.
  - Ash clouds can cause death by asphyxiation. In AD79 when Vesuvius erupted, this led to the death of 2,000+ people as then there was no prediction or monitoring programme to develop evacuation plans.
  - Pyroclastic flows (incandescent flows of gas, ash and rocks) can travel down the volcano flanks at speeds in excess of 200kph and reach temperatures of 800°C and are deadly.
  - The secondary hazards of lahars and subsequent tsunamis (Krakatoa) can both be major killers because of their speed of onset. The recent Tongan eruption combined explosive activity with a subsequent tsunami.

Extrinsic factors

- Proximity of population centres to volcanoes – for example, in Japan, Indonesia, Philippines and the Naples area of Italy there are dense populations nearby taking advantage of the economic opportunities (tourism, farming etc) provided by the volcano.
- Frequency of eruptions and perception of **risk** play a very important role. Volcanoes such as those in Hawaii or Indonesia erupt very frequently which lowers local population's perception of risk. This was a problem on the flanks of Mt Merapi in Indonesia as frequent eruptions bred contempt with most people refusing to evacuate as they were concerned about loss of animals if they could not look after them. Hence small numbers of deaths occurred regularly.
- Perception of **risk** played a major part in the deaths of around 30 foreign tourists in the phreatic eruption in New Zealand at White Island in 2019 where trips were marketed as volcanic tourism 'Handle with Scare'. Equally, lived experience or not of previous eruptions can influence risk perception. Many people live near Taal, an active volcano in the densely populated Philippines. The local communities are filled with recent migrants who move to the beautiful countryside from Manila and have no perception of the risk. Indeed, many live on an island in the Taal crater lake and claim to feel safe as the volcano is so well monitored by Phivolcs.

A possible conclusion may well suggest that it is certainly true that increasingly successful monitoring, prediction and warning can be very effective in most cases in avoiding large numbers of deaths from volcanic hazards, but that both intrinsic and extrinsic factors mean that this is not always the case.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the extent to which monitoring, prediction and warnings are the main reason that volcanoes kill far fewer people.
- The skill in constructing relevant diagrams (e.g., perception of risk) and tables (e.g., of disaster statistics) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to whether improved prediction, monitoring and warnings for volcanoes is the main reason for the low numbers of deaths.

2. 'Secondary not primary hazards from earthquakes generate the most severe impacts'. Discuss.

AO1 [14] AO2(1c) [20] AO3.3 [4] [38 marks]

Focus 3.1.3

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

Primary hazards which result directly from earthquakes and include ground movement and ground shaking resulting from a combination of seismic waves (P, S, R and L).

- The waves' amplitude, frequency and duration impact on the severity of the earthquake (**causality**).
- The ground surface may be displaced horizontally, vertically or obliquely depending on wave activity and geological conditions.
- The focus of an earthquake varies in depth and the epicentre is the point on the Earth's surface directly above the focus.

Secondary hazards result indirectly from the earthquakes – may occur longer-term. These include:

- Liquefaction – the process by which water saturated material can lose strength and behave as a fluid when subjected to strong ground shaking which increases pore pressure in poorly compacted sands and silts at depths less than 10 m (causality).
- Landslides, rock and snow avalanches occur where ground shaking causes natural slopes to weaken and fail.
- Tsunami are usually generated from subduction at convergent plate boundaries with 90% of damaging tsunami occurring in the Pacific Basin (space). Tsunami occur if an earthquake rupture occurs under the ocean or in a coastal zone resulting from a shallow earthquake with a magnitude of MM6+ which is large enough to create significant vertical displacement (**causality**).
- Disease and destitution can result if recovery and rescue are ineffective and/or severely hampered.

Credit knowledge of examples of both primary and secondary earthquake hazards.

Impacts

- Environmental impacts include destruction of both natural and built environments.
- Demographic impacts are linked to numbers of vulnerable people with women, the old and the young being affected disproportionately.
- Social impacts include death and injury, largely resulting from collapse of buildings, as well as subsequent illness and disease which may occur weeks or months after an event, for example, air pollution from burning fires generated by gas leaks or famine from food supply disruption e.g., Kashmir (2005) and Turkey/Syria (2023).

- Dislocation of families, with death of breadwinners leaving many orphans, (missing persons are a major tragedy in Haiti and Nepal).
- Economic impacts lead to loss of livelihood, for example, employment in agriculture, or from destruction of infrastructure such as roads/bridges or power installations (the triple whammy of Tohoku, Japan 2011 which led to a resultant nuclear disaster).
- Political impacts including destabilisation of governance.
- These impacts result from both primary (immediate consequences) and secondary longer-term effects of earthquake hazards.

AO2
Application of knowledge and understanding is deployed to evaluate the relative severity of impacts of primary and secondary earthquake hazards.

Severity can be assessed in many ways including short term deaths and damage or longer-term length of recovery period.

Secondary hazards can undoubtedly lead to a very wide range of impacts for a number of reasons related to their profiles.

- **Tsunami** are the most destructive secondary earthquake hazard. They are relatively rare but can be devastating.
  The greater the earthquake magnitude, the more widespread and destructive the tsunami. Over the last 100 years more than 200 tsunami have killed over 500,000 people (over 50% of these in the mega disaster of the Boxing Day tsunami (2004), a huge social impact.
  Locally, a number of physical factors, such as wave energy related to water depth, process of shoaling and the shape of the coastline and topography, presence or absence of natural defences (coral, mangroves) influence the environmental impact.
- Population profile (impacts on **vulnerability**), **resilience**, community preparedness and community training in emergencies and evacuation. Past experience of tsunami as well as the degree of coastal development and the presence or absence of monitoring and warning systems can influence the magnitude of social and economic impacts. Even with preparation for such events as in Tohoku, Japan 2011, which had meticulous earthquake drills, the overtopping of the 10 m protective walls by huge tsunami waves and subsequent flooding of the Fukushima nuclear power station led to a mega disaster in terms of economic impact. Recent studies of the 2004 tsunami which affected the whole of the Indian Ocean show the enormity of the social and economic impacts which had global repercussions.
  The question to be asked is how frequent are these tsunami mega events in comparison with the huge numbers of earthquakes occurring annually? – tsunami only result in small numbers of cases. Largely in the Pacific Ocean.
- **Landslides, rock and snow avalanches** can also have disastrous impacts. They can be very widespread in occurrence where physical conditions of steep topography, heavy rainfall, soil/geological type and land use (whether forested or not) add to risk in areas such as the Himalayas (Sichuan 2008, Kashmir 2005, Nepal Gorkha 2015). It is estimated that widespread landsliding can double earthquake deaths, especially from high magnitude earthquakes as they can occur over a huge area. They can hamper relief efforts (Kashmir) or lead to the formation of numerous lakes (Sichuan) which subsequently burst through, posing a further risk of flash flooding.

- **Rock avalanches** can have a massive impact although they are an unusual occurrence. In 1970 a massive earthquake generated rock slide occurred on the overhanging face of the Huascaran Mountains – a flow of mud and boulders flowed down the Santa valley at a speed of 70-1000ms¯1, burying the town of Yungay, killing 18,000 people in four minutes because of the speed of onset.
- **Liquefaction** is a very important secondary hazard and its distribution is controlled by response to geological conditions. It can lead, as in Christchurch to an almost random pattern of building destruction adding to the economic impact.

Primary Hazards
In contrast, the primary hazards of **ground movement** and **ground shaking** are always present in major earthquakes.

A number of **intrinsi**c factors related to the earthquake profile play a major part in the severity of impacts.

- The pattern of seismic waves - S (secondary waves) are responsible for a lot of earthquake damage. R (Rayleigh) and L (Love/Long) waves are both surface waves – the latter are very fast moving with larger amplitude and have vibrations solely in the horizontal plane and overall generate the greatest amount of damage (depending on the type of building).
- The way the stresses are released in the elastic rebound – stresses released in small stages may lead to a series of small earthquakes whereas stresses which build up without being released can lead to a 'big one'. Earthquakes of high magnitude have the potential to cause maximum damage.
- The amplitude and frequency of wave movements.
- The duration of the earthquake – not only of each shaking event, but also whether there are after shocks.
- The depth of the earthquake – shallow foci can cause maximum damage. 75% of earthquakes are relatively shallow (0-70 km).

Extrinsic factors are of enormous importance too as they can influence the severity of all types of impacts.

- Whether the area has a known history of seismic activity and the inhabitants have lived experience can determine the provision of coping strategies before (monitoring, provision of a risk map, emergency planning and drills), during (immediate emergency rescue) and after (speed of recovery).
- The environment – whether urban/rural, local geology and soils.
- The population profile (degree of vulnerability, resilience and density). Earthquakes in built up areas will inevitably cause very severe damage e.g., Haiti – Port au Prince 2011, Christchurch compared to Darfield or Kaikora – where even in a HIC there was a death toll of 37 and huge economic impacts on the CBD.
- The phenomena of distance decay away from the epicentre is also prevalent, but the damage and deaths frequently depend above all on building type, quality (whether aseismic) or whether regulations are in place and have been adhered to (Sichuan 2008 – collapse of schools killing children, often the only child). 'Buildings kill!'.
  All sorts of other factors, such as quality of governance, level of development can affect the severity of social and economic impacts, especially in the recovery stage – this would apply to secondary hazards too, but the primary hazard is usually more widespread and usually more severe, although the severity is influenced by the balance of intrinsic and extrinsic factors (Swiss Cheese Model).

A summary will evaluate the relative severity of secondary, often unique hazard impacts with the standard primary hazard impacts with a possible conclusion that on rare occasions the secondary hazards can have a more severe impact on their own (Boxing Day/Tohoku tsunami or the landslides of Kashmir or Gorkha) and definitely enhance the impact of the primary hazard on many occasions (for example, local liquefaction).

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments assessing the factors which influence the importance of primary and secondary earthquake hazards on the severity of impacts.
- The skill in constructing relevant diagrams (e.g., of a Swiss Cheese Model) and tables (e.g., of comparative impacts for various hazard events) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion about the relative importance of primary and secondary hazards in influencing the severity of earthquake impacts.

Section B: Contemporary Themes in Geography – Generic Mark Bands (45 marks)

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
Band	*Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change at a variety of scales*	*Apply knowledge and understanding in different contexts either to analyse or interpret or evaluate geographical issues and information*	*Use a variety of relevant 'geographical skills' to construct arguments and draw conclusions*
5	**17-20 marks** Demonstrates wide ranging, thorough and accurate knowledge with a high order of conceptual understanding throughout the response that is wholly relevant to the question Demonstrates knowledge and understanding through the use of wholly appropriate, accurate and well-developed examples Wholly appropriate, accurate and relevant supporting geographical terminology is well used Well-directed and well-annotated sketch maps / diagrams are integrated and should be credited	**17-20 marks** Demonstrates sophisticated application of knowledge and understanding either to analyse or interpret or evaluate in order to produce a full, comprehensive and coherent response that is supported by wholly appropriate, wide ranging and relevant evidence Demonstrates application of knowledge and understanding through the sophisticated synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the confident application of the specialised concepts throughout the response	**5 marks** The response uses wholly relevant qualitative skills to produce well-constructed, coherent, sophisticated and logical arguments and conclusions
4	**13-16 marks** Demonstrates accurate factual knowledge and confident understanding of relevant concepts and principles throughout the response that is relevant to the question Demonstrates knowledge and understanding through the use of appropriate, accurate and developed examples Appropriate, accurate and relevant geographical terminology is evident Appropriate, mostly accurate and relevant annotated sketch maps / diagrams are included and should be credited	**13-16 marks** Demonstrates accurate application of knowledge and understanding either to interpret or analyse or evaluate in order to produce a coherent response that is supported by appropriate evidence Demonstrates application of knowledge and understanding through the synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the relevant application of the specialised concepts	**4 marks** The response uses relevant qualitative skills to produce clear, coherent and appropriately structured arguments and conclusions

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
3	**9-12 marks** Demonstrates secure, straightforward knowledge and reasonable understanding of relevant concepts and principles throughout most of the response that is mostly relevant to the question Demonstrates knowledge and understanding through the use of mostly appropriate, mostly accurate and developed examples Mostly appropriate, accurate and mostly relevant geographical terminology is evident but is variable in its use Appropriate, basically accurate and partial use of annotated sketch maps / diagrams are included and should be credited	**9-12 marks** Demonstrates partial application either to analyse or interpret or evaluate in order to produce a partial but coherent response that is supported by mostly appropriate evidence Demonstrates application of knowledge through the partial synthesis between different elements of the question Demonstrates application of knowledge and understanding through the partial application of some specialised concepts	**3 marks** The response uses mostly relevant qualitative skills to produce a structured response but where coherence is variable
2	**5-8 marks** Demonstrates some knowledge, but limited in scope with some inaccuracies; some understanding of relevant concepts and principles Demonstrates knowledge and understanding through the use of limited examples, which are mostly accurate but un-developed Limited geographical terminology is evident, not all of which is appropriate or accurate Basic sketch maps / diagrams are used but contain inaccuracies. Credit should be given when used appropriately	**5-8 marks** Demonstrates limited application either to analyse or interpret or evaluate in order to produce a limited response where most points are generalised or of limited relevance to the question. Limited synthesis between different elements of the question Demonstrates application of knowledge and understanding through the limited application of some specialised concepts	**2 marks** The response uses some qualitative skills to produce a response with superficial structure, with minimal coherence

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
1	**1-4 marks** Demonstrates poor knowledge with errors and minimal understanding and linkage to the question No use of examples or, if evident, lack relevance to the question asked Geographical terminology is rarely used within the response	**1-4 marks** Demonstration of application either to analyse or interpret or evaluate is poor, producing a response which lacks coherence and is unsupported by appropriate evidence Synthesis between different elements of the question is poor Demonstrates application of knowledge and understanding through the superficial application of basic specialised concepts	**1 mark** The communication in the response is incomplete
	0 marks Response not creditworthy or not attempted	**0 marks** Response not creditworthy or not attempted	**0 marks** Response not creditworthy or not attempted

Section B

Theme 2: Ecosystems

3. Evaluate the impacts of physical and human factors on succession for one or more local scale ecosystems.

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.2.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

Successions

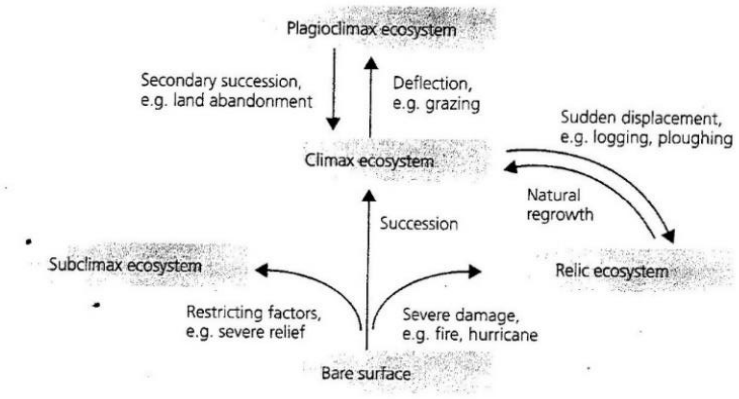
- Ecosystems are dynamic and can change constantly over **time** and **space.** The gradual and orderly replacement of species over time is called an ecological succession.
- Succession occurs in a number of **seral** stages, beginning with the **pioneer** species which can develop on bare rock, limestone pavements (**lithosere**), coastal sand dunes (**psammosere**) or alternatively in freshwater ponds (**hydrosere**) or salt water such as salt marshes (**halosere**).
- **Primary succession** is a series of plant community changes which occur on an entirely new surface which has not been colonised before.
- **Secondary succession** is a series of plant community changes which take place on a previously colonised, but disturbed or damaged habitat, (e.g., after felling trees in a woodland or as a result of a fire) and colonisation takes place at a faster rate (presence of soil etc).
- **Climatic Climax** is the end stage of a succession, an association of plants and animals which has attained a state of equilibrium within its habitat. Theoretically, in the UK this would be temperate deciduous forest.
- **Sub climax** occurs where the climax has been halted by one or more factors (arresting factors).
- **Plagioclimax** communities are determined by planned or unplanned human activity deflecting the succession before it reaches the climatic climax.

Physical factors include the 'overarching' impact of climate, altitude, relief/topography, drainage, salinity or even biota such as rabbits. Fire can sometimes be considered a physical factor. **Climate change** is an increasingly important anthropogenic factor – which is a physical change caused indirectly by human actions.

Human factors include felling trees and reafforestation, draining salt marshes and wetlands, introduction of invasive species, grazing farm animals such as goats and sheep, burning heather for shooting of grouse etc, ploughing, flooding of land.

Credit quality exemplars which may include field work based on coastal sand dunes/salt marshes or colonisations post glacially, e.g., kettle holes as well as heathlands or woodlands all at a local scale. The response could look at one or more local scale ecosystems.

Figure 1 summarises the generalised ecosystem evolutionary pathways.



AO2

Application of knowledge and understanding is deployed to evaluate the significance of both physical and human factors in ecosystem succession.

- In a **primary succession** from pioneer species to climatic climax, physical and chemical changes have an important role to play **autogenically** in developing the plant communities. For instance, in sand dunes, plants decay into humus which improves the quality and depth of the soil for a more diverse, taller plant community to grow, or when in salt marshes sediment is built up above the high tide and improving the saline conditions permits a wide range of plants.
- For a **secondary succession** to occur a number of negative human actions such as felling of trees or ploughing up of grasslands for crops must take place. Positive actions can occur such as the creation of wildlife havens by Wildlife Trusts, e.g., in Wirral, where new calcareous grassland has been created using limestone waste or drifts of coal dust have been transformed into acid grassland as a butterfly haven. Alternatively, some physical factors such as spontaneous wildfires can lead to sudden displacement of the primary succession and the re-establishment of new secondary succession often quite rapidly as both the soil quality and pre-existing seeds can accelerate the process.
- **Sub climax** ecosystems are largely created by physical factors which arrest/restrict the growth of the primary succession so the equilibrium required for the climatic climax is never reached. The key physical factors include:
  - Very steep slopes which prevent the formation of quality soils.
  - Frequent flooding or natural drainage of wetlands, all of which arrest the development of a hydrosere.
  - The natural grazing of animals such as rabbits again arrests the possible growth of young saplings.
  - In some coastal areas, widespread salt spray prevents the growth of established shrub communities except in sheltered lee slopes of sand dunes.
  - Altitude in high windy areas such as the Cairngorms prevents the growth of trees.
  - Sometimes poor-quality soils again arrest the development of the climax vegetation of deciduous woodland.

Physical factors are of prime importance in arresting the succession.

- In densely populated areas with a long history of settlement such as the UK, it is inevitable that **human factors** are of prime importance in leading to widespread plagioclimax vegetation. The natural climatic climax of temperate deciduous woodland, or pine forest in highland areas such as the Cairngorms is rarely reached. Human factors include:
  - Intensive farming, for example, the drainage of the Fens (former wetland).
  - Widespread felling of trees for wood or even the afforestation of hilly areas with quick growing conifers (Kielder Forest).
  - Grasslands can be maintained by grazing animals.
  - Heathlands are maintained by controlled burning as the fires can be beneficial in removing leaf litter and dead vegetation and allowing the young shoots of heather to regenerate for grouse.

As long as the human actions continue, the plagioclimax will be maintained, and the succession deflected from the original ecological path.

- With concerns over biodiversity loss, human factors are increasingly important in conserving, protecting and restoring local scale ecosystems, for example, removing invasive species, e.g., rhododendrons or planting to fix dune ecosystems. Humans also remove diseased or dead organisms, e.g., ash that has been affected by ash dieback to prevent the spread of the disease.

Credit detailed exemplification of evidence from ecosystems at a local scale.
In summary, both physical and human factors play a major role in influencing ecological pathways, but in densely populated areas such as the UK both the direct and indirect actions of humans play a major role as the lack of natural climatic climax vegetation shows, although many conservationists are endeavouring to reconstruct conditions appropriate for the development of the natural climatic climax.

Note that whilst AO2 analysis can apply to biomes, global scale ecosystems such as rainforest are inappropriate as exemplars unless it is a small micro unit within.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments assessing the factors which evaluate the importance of both physical and human factors.
- The skill in constructing relevant diagrams (e.g., of succession in named ecosystems such as grouse moors) or generalised diagrams to show the range of succession processes which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question, for example using detailed fieldwork in the context of the wider question.
- The skill in reaching an evidenced conclusion which evaluates the importance of physical and human factors on the succession process.

4. Evaluate the view that the growing threats to the Arctic tundra biome make its sustainable use increasingly challenging.

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.2.6 3.2.7

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

Sustainable management and use involves:
- Conserving the ecosystem for future generations, by respecting the integrity of a very fragile ecosystem, made worse by being at the forefront of climate change impact.
- Equity and Social Justice for the indigenous people (e.g., Nenets, Saami) who respect and live in harmony with the Tundra.
- Public participation in decision making – currently the sustainable future of the region is in conflict with many of the new developments.

The Arctic Tundra Biome is a cold, tree-less region found mainly pole wards of 60°North. It includes areas of Alaska, Canada, Greenland, N. Iceland, Scandinavia and Russia (8 countries in all).
Note: Credit should be limited to this core region for exemplification e.g. Exxon Valdez should not be credited as outside the tundra area as is fracking in Alberta, Canada.
- A fragile ecosystem less resilient to change.
- Low biodiversity, low NPP. Limited nutrient cycling resulting from a short growing season (3-4 months), harsh conditions (-40°C in winter), strong winds, limited moisture, physiological drought, all vegetation adapted to these conditions.

Threats to the Arctic Tundra Biome include:
- Global scale
  - Climate Change from global warming.
  - Ozone layer thinning from CFC use.
  - Transboundary pollution can lead to acidification of lakes and to PCBs being found within the ecosystem.
- Regional scale
  - Localised pollution from mineral and energy development.
  - The impact of increased population and settlement associated with the development of resources (oil in Alaska).
  - Use for military installations in North America and Siberia (initially associated with the Cold War) remain important.
  - Wilderness tourism concentrated in the summer months.
  - Recent establishment of 'Green' industrial activity e.g. in Arctic Sweden.
  All of which can threaten the flora and fauna and ecosystem and conflict with indigenous peoples and their way of life.

AO2

Application of knowledge and understanding are deployed in an evaluation of the difficulties of managing sustainable use in the face of rising threats. The arguments are complex, following a number of routes:

- **Sustainable use** is a compromise as it attempts to develop the Arctic Tundra Biome – a fragile ecosystem – in a way that uses resources for the existing community, formerly almost all indigenous communities, without destroying the environment, but at the same time conserving the resources for future generations. There are clearly tensional forces between the need to conserve fragile, vulnerable environments, yet allow some exploitation of resources for the economic wellbeing of future generations.
- The main global, overarching threat is undoubtedly **climate warming** (the world's greatest wicked problem) which is happening at a faster rate in the Arctic region than almost any area of the world with predicted temperature rises of up to 6-7°C by 2025. Global warming is shifting the limit of the tundra biome northwards at approximately 20 km per decade, causing great difficulties for migration routes for caribou, musk ox and reindeer.
- Widespread melting of permafrost (accelerated by **positive feedback loop** – release of methane, decrease of albedo, increased probability of tipping point).
- Widespread melting of sea ice which opens up the Arctic to shipping (North West Passage and Northern Sea route) which increases pressure on exploitation (e.g. for purposes of tourism and access to Arctic marine oil and gas deposits) so exacerbating management pressures.
- There are also problems with melting permafrost and the widespread development of **thermokarst** terrain which also puts pressure on the Arctic Tundra Biome with destruction of plants/soil as roads and settlements are developed.
- It could be argued that with the signing of the Montreal Protocol the problem of ozone thinning in the upper air is now being managed. The development of the ozone hole allowed more UV light through causing death and mutation of lichens.
- Evidence suggests that transboundary pollution continues to impact on the Arctic Tundra Biome with traces of chemicals found in lakes, rivers, snow, soil and lichens. Many lakes have been acidified as a result.
- One of the main problems with the Arctic region is that there is no overarching governance (unlike The Antarctica Treaty). Eight countries have territory within the Arctic Circle and whilst they work together via the Arctic Council, it lacks the ability to enforce strict environmental regulations and management. It is largely the responsibility of national governments including the superpowers of Russia and the USA who do have their own legislation (with Finnish Lapland being a standout example).
- Pollution from mineral and energy development at a regional scale, for example from the Norilsk nickel smelter where the Company has agreed attempts to reduce localised pollution of phenol and chlorine as it contaminates the surrounding air, water and land with SO^2, NOx and CO which has destroyed tundra vegetation. New legislation from 2023 should force the Company to cut pollution or risk huge financial penalties.
- Exploration for and the exploitation of oil and gas may ultimately be controlled by various global governance decisions at COP summits, but currently remains a huge challenge to environmental sustainability in both Russia and on the Alaskan North Slope. Recently, oil drilling proposals have been halted within ANWR because of the outstanding need for conservation. Whilst a number of precautions have been taken with the North Slope, including the construction of the TA pipeline – with provision for migration routes and also for combatting the impact of ground subsidence of permafrost to guard against oil spills – there are undoubtedly threats which would increase proportionately with development. Threats from oil drilling include development of roads, ports, need for quarrying ground for drilling, river pollution from oil waste, production of NOx, disruption of animal feeding areas as well as oil spills in the fragile tundra.

- With the increase in adventure tourism and off-road activity as tourists increase their pleasure periphery, the rise in tourist numbers, inevitably concentrated in a very short three months summer season, is a mega threat, with damage of lichens and fragile ecosystems from trampling and tracked vehicles, although ecotourism is a promoted sustainable option.
- The SMART tourism initiative is an example of sustainable tourism management within the Arctic. There are many isolated examples of good practice for the rising threat from tourism.
- Overall coordination is lacking as rising pressures occur from increased accessibility, with non-indigenous populations increasing rapidly.
- Inevitably as human activities develop, with the establishment of permanent settlements for mining, military use and tourism, there are increased pressures on the fragile ecosystem. For example, at Inuvik in North Alaska, development has increased the depth of the active layer, as anthropogenic activity disrupts the heat exchange balance. Carbon is also released from peat stores and ground subsidence is prevalent resulting in the need to constantly maintain roads, bridges and air strips.
- Again, technological advances have been developed to successfully offset the problems, but at a high price thus increasing the cost of exploitation of resources and building settlements. Climate warming could make development easier in many ways so putting yet more pressure on the fragile landscape.
- A major issue, which will impact on sustainable use, is the potential conflict with indigenous populations (Inuit of northern Canada and Greenland and the Saami in Lapland). Conflicts with development of all types including commercial farming, mineral exploitation and tourism will occur and will need to be managed or the indigenous peoples will lose their unique heritage and culture and their very sustainable lifestyle.

A possible conclusion will evaluate the view that development of the Arctic Tundra Biome for sustainable use has become increasingly challenging for a wide variety of reasons with some overarching rising threats such as climate warming exacerbating the difficulties in a number of ways. Yet other threats can be successfully managed for sustainable use although the lack of global governance systems does not help.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments assessing whether the threats are rising and evaluating whether sustainable use is increasingly difficult.
- The skill in constructing relevant diagrams (e.g., showing the impact of an oil spill on Arctic ecosystems or of a positive feedback loop) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates the difficulties posed by various threats in challenging the possibilities of sustainable use of the Arctic Tundra Biome.

Theme 3:

Economic Growth and Challenge: India or China or Development in an African Context

5. 'Water availability is an increasingly serious physical constraint on economic development in India.' To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.3.1 3.3.3

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding could include:

- Water **availability** is vital for domestic, agricultural and industrial purposes which all contribute to economic development of an emerging nation. Safe affordable supplies of water are required to keep a population healthy, to provide them with food and to develop industries, both for home consumption and export.
- Water **resources** per person in India are declining. In 2018 it was estimated that an average 1,700 m^3 were available which places India into the water stress category with a possible 20% deterioration by 2025 (water scarcity).
- Theoretically, India has abundant supplies of water, from two very large rivers (Indus/Ganges Brahmaputra), large areas of groundwater supplies (Punjab), all fed by abundant rainfall and also glacial meltwater from the Himalayas.
- India's water supply comes from a combination of surface water (rivers) and ground water, both of which have issues, namely **pollution**. 70% of all India's rivers and reservoirs are highly polluted from a variety of sources from waste disposal as there is a lack of pollution legislation. Excessive extraction, largely for Green Revolution use, has concentrated river pollution. Many industries, for example, along the Ganges and Damodar valley have obsolete pollution control technology.
- **Over extraction** has also occurred in ground water supplies, often in rural areas (two thirds of India's population live in rural areas). 50% of ground water supplies e.g., in the productive aquifers of states such as Punjab, are declining more rapidly than they can be replenished and are polluted by arsenic and other toxic substances, so the water is dangerous for domestic use. Reservoir levels have fallen by 21% since 2010 and many smaller rivers have dried up completely.
- The main availability issue facing India is the uneven distribution of supplies both spatially and over time (short and longer term).
- India's water is largely supplied by the South West Monsoon (**causality**). Over 75% of rainfall is concentrated in a period of around 110 days between July and October.
- There are eight water scarce states such as Maharashtra, Karnataka, Tamil Nadu and the arid areas such as Rajasthan – i.e., nearly half the country.
- The monsoon rainfall is also unpredictable from year to year with frequent climate extremes of floods (an over intense monsoon) and droughts from a failed monsoon). Uneven distribution is the main problem with 35% of India receiving 750-1025 mm (potential drought) and 33% receiving under 750mm (drought conditions).

AO2
Application of knowledge and understanding is deployed to evaluate the severity of the constraint from water availability issues and how and why it could change with time.

The problem is getting worse
There are a number of factors which are making the water availability issue increasingly serious as by 2025, overall water availability per capita is likely to decrease from 1700 m^3 to under 1400m^3.
Physical factors – Climate change is making the arrival of the S W monsoon more unpredictable as a result of the **Indian Dipole**. Also, more extremes of drought and floods are occurring which as there is such reliance on the monsoon for annual replenishment of supplies is very serious. Climate change is also affecting the reliability of glacial meltwater from the Himalayas.
Human factors are of paramount importance. **Increasing demand** is occurring for a number of reasons:

- The Indian population is still growing with India expected to be the most populous country in the world (by 2030 – population 1.6 billion, currently 1.4 billion).
- As the population becomes more affluent and therefore demands more and cleaner water, domestic water usage (showers, baths, domestic appliances etc) per capita will increase dramatically, again exacerbating the demand issue.
- The population will urbanise with 50% expected to live in urban areas by 2050 – urban areas (e.g., Chennai in 2020 which reached Ground Zero situation) are often problematic as often very limited storage for water exists, so much of the supply can be wasted.
- At the root of the problem is **poverty** with many poor rural farmers migrating to the city edges (peri urban areas) where water has to be delivered by tanker or villagers attempt to dig shallow wells if aquifers are available, so adding to over extraction issues.
- Whilst the **Green Revolution** has stabilised famine issues with more reliable supplies of cereals to feed the people, the new agricultural methods were very intensive with water needed in large quantities for irrigation to grow the crops leading to huge demand (72% of India's water supplies are used for agriculture), squeezing availability for other purposes. Further demands are made (embedded water) as India has developed significant agricultural exports from irrigated lands.
- At the heart of the problem is quality of governance at both federal and state level. Whilst India has built some mega dams (Narmada) which supply water as part of their multi-purpose use, they have been highly controversial and not supported by adequate environmental legislation.
- Many systems in India are not working as efficiently as they could, including water storage, irrigation canals and other supply systems as well as water purification, all of which add to a huge gap between rising demand and inadequate, even dwindling supplies with many examples of industrial plants using large supplies of water unable to function at maximum capacity.

Is the problem getting better?

- The water availability issue has been recognised as a priority by the Indian government and many measures are in place to manage the situation, not least reforming governance itself.
- The federal and state governments are developing integrated ministries to bring together all the water users to develop co-ordinated plans to meet the impending water scarcity crisis.
- At a national level, plans are taking place to capture more water from the Himalayas (a region of surplus) with development and damming of the headwaters of the Ganges and the Brahmaputra. Issues include conflict with other users as well as diminishing glacial melt from climate change.

- Desalinisation is seen as a high-cost way ahead for cities such as Chennai with four desalinisation plants built on the Bay of Bengal. Recycling sewage also has great potential.
- At a federal level, schemes include an increase in reservoir storage to maximise use of monsoon rainfall. This is occurring at a variety of scales with an emphasis on rainwater harvesting repairing old disused tanks. Other measures in designated water stressed districts include schemes to reuse and recycle water, for example, at bottling plants, by using reverse osmosis at polluted wells, artificially recharging wells and watershed management with the intensive afforestation to improve ground water supplies.
- Whilst there are few truly mega schemes (a national river grid integrating rivers remains a dream) there are schemes to develop more equitable management along the Ganges and the Brahmaputra with the formation of River Basin Authorities, which, in particular, will develop best practice agriculture co-ordinating aquifer usage and promoting crops which are less water intensive.
- At a local level, there are numerous community-led schemes, often financed by NGOs to provide check dams and rainwater harvesting in states such as Rajasthan to develop more sustainable water use, which incrementally will have the opportunity to alleviate issues in water crisis areas especially when accompanied by water conservation strategies such as mending leakages or demand management. Sustainability can also be achieved, especially in the burgeoning urban areas by establishing home-based recycling schemes.

A possible conclusion would assess the growing seriousness of the demand-supply gap, which is threatening water availability, but at the same time, evaluate the plethora of schemes at all scales designed to ameliorate the impending crisis. The situation could get better longer term, subject to co-ordinated planning and successful governance.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the seriousness of the water availability problem and its impact on economic development.
- The skill in constructing relevant diagrams and tables (e.g., on changing levels of water stress) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates the seriousness of the physical constraint of water supplies on economic development, both in the present day and in the future.

6. 'Soft power is increasingly significant in enhancing the global importance of India'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.3.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- Global importance which can be enhanced not only by military (hard) power but also by geopolitical dominance, economic strength and cultural influences (all aspects of soft power).
  - Credit information on Superpower Index etc.

- Soft power, unlike hard military power is non-coercive. Nye identified several elements including:
  - Strength and complexity of foreign links via participation in global organisations and governance, conventions and treaties.
  - Importance of economic links via trade and FDI (some aspects increasingly part of hard geopolitical power).
  - Strength of cultural influences and political values.

- Participation in global organisations and governance, conventions and treaties
  - India plays a very significant role in many UN organisations, including the General Assembly with membership of G15, G24, G77 and FAO (with its experience in managing famine).
    Although it is not currently a permanent member of the Security Council, it has gained much kudos as a major supplier of soldiers for the UN Peace Keeping force.
  - India is a leading member of the Commonwealth and also the increasingly significant BRICs group.
  - India has had considerable political influence in Global Finances in shaping policy in the World Bank and IMF (the Bretton Woods Organisation).
  - India has considerable influence over World Trade policies as a founder member of GATT (forerunner of WTO) now playing a major role in trade negotiations (e.g., Doha Trade talks).
  - India also participates in UN Conventions (e.g., COP 26) where it influenced decision making on the future of coal from 'phase-out' to 'phase down'.

- Economic links via Trade and FDI
  - As a result of India's financial woes, the IMF bailed India out in 1984 and 1991, but insisted on economic liberalisation which set India on both free enterprise (SEZ) internally and making numerous free trade deals across the world.

- FDI was encouraged which led to the growth of the Indian economy and facilitated off shoring/outsourcing leading to major developments in the Indian tertiary and quaternary sectors. Many MNEs in the 'tech' field invested in India (Google, Apple, Microsoft etc). Indian owned companies began to develop (e.g., Wipro, Infosys) and they performed back-office functions for a variety of companies (e.g., the Tata group – manufacturing, steel, IT) leading to a strengthening of trade balance and a growing economy.

- Political values and cultural influences
  - India is the world's largest democracy with a commitment to democratic institutions, the rule of law and the importance of human rights.
  - The large English-speaking population share many western values and the universal language allows effective communication at a global scale.
  - The large and talented diaspora has increased India's influence not only in SE Asia, but also to most other continents including N and S America, Europe, Australasia and Africa, spreading Indian culture (film, music, dance, food).
  - India has traditionally acted as a 'geopolitical bridge' between developed and developing nations and between superpowers such as Russia and the US in Cold War times.
  - India is a culturally rich and diverse country, home to four major religions and with some cultural features well known globally, for example, the 'Bollywood' film industry, development of yoga and, of course, a range of food (balti, samosas etc.).

Note: Credit a selection from across the various aspects of soft power.

AO2
Application of knowledge and understanding are deployed in an evaluation of the importance of soft power in enhancing the global importance of India.

- Whilst India has always been considered to be a very significant Regional Power in Asia, in recent years, it has begun to be thought of as an emergent superpower for a number of reasons:
  - By 2030 it is highly likely that India will be the most populous country in the world (1.5 billion) with a population structure leading to a positive dividend of a very large, often well educated, productive English-speaking workforce.
  - India has continued to develop its key geopolitical role in global organisations and governance.
- Economic growth rates
  - Between 6% and 8% and are consistently some of the highest in the world, leading to India currently having the fourth largest economy (2021) in the world. As an advocate of economic globalisation, India is able to project its success across the world enabling it to make substantial investment (FDI) in many countries at all levels of development, for example, in HEP and infrastructure in neighbouring Bhutan.
  - Indian owned TNCs (such as the Tata group) have expanded their sphere of influence via acquisitions, for example, the steel works in Llanwern, South Wales or the JLR prestigious car factories in the English Midlands. In the UK alone there are nearly a thousand Indian owned businesses.
  - The Indian government has been very forward-thinking in promoting itself as a technological powerhouse in a variety of ways, for example, showcasing India's science and technology at expos such as the Bangalore Air Show and Delhi World Expo.

- The very well-educated diaspora has risen to the top in both government and business positions, especially in the USA, and so is very influential.
- India is a nuclear power both for civil and military purposes and also is a world leader in pharmaceuticals distributing lower cost drugs to many developing nations.
- It has developed several collaborative links, for example, playing a leading role in the Solar Alliance and the coalition for Disaster Resilient infrastructure. It was India that led the construction of the Indian Ocean Warning System, needed after the 2004 Indian Ocean tsunami. These links project India in a very positive way.
- India has begun to take part in both space and deep-sea exploration with a successful programme of satellite launches and planned space exploration.
- Thus, there is a cumulative increasing global projection of an economically successful, modern country with very rapidly developing science and technology industries which contribute considerably to its geopolitical power.

- <u>Cultural Influences</u>
  - A variety of cultural influences has developed and spread driven not only by government (national and federal strategies) but also as a result of the global diaspora (18 million worldwide).
  - The Bollywood film industry (Mumbai based) has expanded globally, though largely within the diaspora communities. There have also been some highly successful English language films, based on Indian life (Slumdog Millionaire, Best Exotic Marigold Hotel) but not always presenting it in a positive way!
  - Although India has never yet hosted the Olympic Games, it has hosted several mega events such as the Asian Games or Commonwealth Games which have been widely televised from quality facilities in Delhi. Indian sports teams have been very successful on the global stage (cricket, hockey, polo, wrestling etc) although until recently Indian women have been underrepresented in sports.
  - As a result of the diaspora, Indian cuisine has been universally popular, again presenting very positive images with growing interest in other aspects of Indian culture such as music, dance and arts and crafts.
  - With several globally recognised monuments such as the Taj Mahal and the Golden Temple of Amritsar, tourism in India has expanded with the Indian government stream-lining the visa system and many federal governments promoting the undoubted attractions such as tiger viewing as well as beach tourism (Goa).
- All these developments have cumulatively strengthened the importance of the role of soft power with a gradual increase in India's global importance. Although Indian hard power has grown considerably with its very well-equipped Air Force and nuclear capability, this has not really been instrumental in underpinning its drive towards global importance and potential superpower status.

A possible conclusion may highlight the increasing importance of soft power in enhancing India's global role but may agree that it would have been even greater if India had not had some considerable shortcomings such as a federal government structure and slowness to improve infrastructure as well as the prevalent inequalities between states and between rural and urban areas, all of which can slow progress. Some of India's perceived strengths such as democratic structures or links to UK/western values could be potential weaknesses, e.g., when trading with Africa and South America. Nevertheless, it is the growing all round influence of soft power driven by a number of factors which is increasing India's importance not only at a regional, but at a global scale.

AO3

Skills evidenced in the question content include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the extent to which the development of soft power is an increasing influence on India's growing importance.
- The skill in constructing relevant diagrams and tables of supporting data (for example, on changing size of India's economy) which can be used to support answers to the question.
- The skills in covering the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to the increasing direct and indirect influence of soft power in enhancing India's undoubtedly growing global importance.

7. 'Water availability is an increasingly serious physical constraint on economic development in China'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.3.1 3.3.3

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding could include:

- **Water availability** is vital for domestic, agricultural and industrial purposes which all contribute to economic development in an emerging nation. China currently has a population of 1.44 billion, but this is expected to stabilise by 2030, although demands for water for agriculture and industry will increase.
- Overall, water resources per person are declining in China and in 2018 were around 1980 m^3 per person which is just below the threshold of 2000 m^3 where water stress starts.
- Increasing amounts, up to 20% of supply, is used for industrial development, 10% for domestic use and the rest (70%) for agriculture (feeding China's people) with demands increasing in all sectors.
- Water availability is one of China's most serious economic and environmental challenges. Overall, China has the second lowest per capita amount of water resources in the world with 20% of the global population, but only 7% of its freshwater resources.
- Potentially China has abundant and varied supplies of water from some very large river systems (Hwang Ho, Yangtse) as well as some areas of abundant groundwater supplies.
- The main issue facing China is **water distribution**. The 7% of global supply is unevenly distributed. In the north where 50% of the population live, there is just 15% of the country's water. 80% of China's supply lies in the south and west (3000 m^3 per person in Shangxi or Yunnan) whereas in the crowded north-east, water availability can be as low as 300 m^3 per capita). Shanghai and Beijing use over 400% of the annual renewable resource, putting huge pressure on the large rivers flowing into the region, such as the Hwang Ho, or on aquifers whose water table is dropping by 3 m per year. Moreover, the Tibetan plateau in the far west is the source of almost 50% of all major river systems in China, and as a result of climate change there is less glacier ice to feed them (approximately 80 sq km per year is lost). Equally 40% of rivers have no outlet and drain through western areas of China forming deep underground reserves for these less populated agricultural areas.

- A further constraint is **pollution**, i.e., the quality of the water which again reduces the availability of supply. High levels of domestic, agricultural and industrial effluent make many of the country's large rivers (e.g., the Huai River) unusable as evidenced by nitrogen pouring into it leading to eutrophication. There is currently a lack of treatment plants so all manner of poisonous materials (cyanide, arsenic and heavy metals) flow directly into the rivers making over 20% unfit for use. A growing number of urban areas have problems with sewage treatment. Whilst the Environmental Protection Board collect fines, they are too low to be a deterrent. The result is that 320 million people lack access to clean drinking water, especially in rural areas in the north.
- Eight northern provinces suffer from acute water scarcity. The eight provinces account for 38% of China's agriculture and 46% of its industry as well as containing 41% of its population – clearly a major constraint.

AO2
Application of knowledge and understanding is deployed to evaluate the severity of the constraints of the water problem and how and why this is changing with time.

The problem is getting worse as water security is declining.
- Water availability problems give rise to social, environmental and political conflicts at provincial, national and even international **scale**, as China's plans to divert water for its own use from rivers such as the Mekong, so impacting on many countries in South-East Asia.
- The fact that the main rivers are very long exacerbates the provincial situation as authorities have no incentive to conserve water, but every incentive to use it for local economic development.
- There is also the national issue of marked inequality between the highly prosperous North East, home of much of China's population and industrial development. Here. 440 cities suffer from water shortages with an estimated loss of industrial output of US$1.60 billion. Although low precipitation is the root cause (**causality**) and leads to low river flows, low reservoir levels (Miyun reservoir for Beijing) and falling supplies from ground water as a result of over extraction at unsustainable levels for the growing urban population, the problem is exacerbated by increasing levels of water pollution. This has proved a major constraint on the many small farms which supply the urban markets of the northeast. In contrast, the southern region of China is well endowed with abundant rainfall and many large rivers.
- Anthropogenic climate change has not only led to glacier melt at the headwaters, but also climate extremes have exacerbated the occurrence of both droughts and floods (2020).

The problem is getting better? Will this ease the constraints?
- The Chinese government is taking a number of steps to address water security issues and the uneven distribution of water resources including the mega scheme – China's South-North Water Transfer Project which drains water from the southern rivers and supplies it to the dry north. Planned for completion in 2050, substantial parts have already been completed on the eastern route. It will eventually divert 44.8 billion m^3 of water annually to the populated centres of the north e.g., Beijing and Tianjin. It is a massive project, a huge feat of engineering and many question its cost-benefit ratio. Other mega schemes include dam building and the diversion of water supplies in the Himalayas as well as the massive reservoir behind the mega scheme of the Three Gorges Dam.

- At a local scale, the 'sponge city' initiative offers solutions to both water scarce and waterlogged cities. 'Sponge Cities' (**sustainability**) use rain gardens, green roofs, constructed wetlands and permeable pavements to capture, slow down and filter storm water (should it occur) to replenish ground water aquifers. Sponge Cities include Beijing and Shanghai.

Clearly water availability is a huge constraint for economic development which the Chinese government is attempting to address, but is it the most serious physical constraint?

Other constraints which could be discussed include the impacts of climate and climate variability (floods and droughts) which underpin water availability problems.

A possible conclusion would involve an assessment of the seriousness of the water availability constraints, spatially and over time, and the impacts that this can have with conflicts between the users of a diminishing resource (from falling output to disrupted food supplies). Arguments could look into the future to explain how China is managing the issues of water availability and making use of opportunities.

AO3
Skills evidenced in the question context include:
- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the seriousness of the water availability problem and its impact on economic development.
- The skill in constructing relevant diagrams and tables (e.g., South-North transfer scheme) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates the seriousness of the physical constraint of water supplies on economic development, and whether it will increase in the future.

8. 'Soft power is increasingly significant in enhancing the global importance of China'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- Global importance which can be enhanced not only by military (hard) power but also by geopolitical dominance, economic strength and cultural influences (all aspects of soft power).
  - Credit information on Superpower Index etc.

- Soft power, unlike hard military power is non-coercive. Nye identified several elements including:
  - Strength and complexity of foreign links via participation in global organisations and governance, conventions and treaties, importance of economic links via trade and FDI (some aspects increasingly part of hard geopolitical power).
  - Strength of cultural influences and political values.

- Participation in global organisations and governance, conventions and treaties
  - China plays a very significant role in many UN organisations, including the General Assembly, G20 and, most significantly, is a permanent member of the Security Council.
  - In 2001, China joined the WTO which cemented its entry into the global trading network.
  - China leads the Asian Investment Infrastructure Bank (AIIB) driving investment policies in many areas, including the BRICs in which China plays a leading role. It increasingly represents an alternative Yuan Based system, bypassing $ systems.
  - China participates in many UN conventions and treaties. Although its leader Xi did not attend COP 26 (2021) it nevertheless is keen to participate in environmental treaties and protocols, e.g., Montreal Protocol for management of ozone issues to increase its green credentials. China therefore is gaining kudos as a keen supporter of green technology policies.

- Economic links via Trade and FDI
  - It could be argued that in 2022 China has achieved superpower status in terms of economic links and importance.
    By 2028 (maybe earlier because of a more rapid recovery post-Covid) China is expected to have the world's largest economy. Credit details on progress (1976 124th in world, 1995 8th).

- As a result of development as the 'Workshop of the World', China accumulated a huge trading surplus with manufacturing often concentrated in Government developed SEZ, e.g., Shenzen in the Pearl River area which were developed during the Economic Reforms associated with Deng Xiaoping's Open Door Policy. This policy was also associated with the development of many joint venture companies, e.g., in the car industry, and allowed access to many foreign companies, e.g., Apple, McDonalds.
- Chinese economic growth rates have consistently averaged around 8% (even as high as 10%) over the last 40 years which has led to such a strong economy, increasingly diversifying into hi-tech, high value products. It has even weathered the 2008 financial crisis.
- Many Chinese owned companies e.g., SINOPEC, Huawei, Lenovo (formed from the acquisition of IBM). With some such as Lenovo or Huawei becoming global brands.
- China's economic surpluses have led to considerable FDI investments around the world since 2000 both by large corporations, but especially by Chinese government, supporting several sovereign wealth funds to direct investment in overseas projects in countries at all levels of development, ranging from USA, Australia, Canada, UK (Hinkley Point) to many countries in Africa in order to secure supplies of mineral and energy resources for growing industrial development.
- The latest initiative, China's Belt and Road Initiative (BRI/OBOR) is a large infrastructure and economic development plan to increase connectivity between China, rest of Asia, the Middle East, Africa and Europe (begun 2013, completion due 2049) affecting 60% of the world's population, estimated cost up to US$10 trillion – a truly global project.

- <u>Political values and cultural influences</u>
  - China is currently the world's largest country (2022 population 1.4 billion)
  - It has the largest diplomatic service in the world.
  - Described as a cultural juggernaut with setting up of Confucius Institutes around the world to spread Chinese communist values.
  - It has the largest two-way student exchange programme in the world – with Chinese students attending top schools to develop their scientific, engineering and technical expertise, and many students from developing nations attending Chinese universities on scholarships/cultural exchanges.
  - China has a very significant talented diaspora with these communities playing a leading role in many parts of the world, (e.g., California, Peru) who again have spread Chinese traditions/culture such as cuisine, festivals and music.
  - As host country, to both Summer and Winter Olympics in Beijing, China's success as both organiser and very successful participant has been 'beamed' around the world (see medals tables).
  - China has a very significant tourist industry supported by airlines of global significance e.g. Air China, China Eastern and Southern, with outstanding global attractions such as the Great Wall, Terracotta Warriors, Xian, or Tiananmen Square, Beijing which again allows for positive images to be formed with well managed tourism using China's developing infrastructure of high-speed trains and selfies/photos instagrammed around the world.

- Note: Credit a selection from across various aspects of soft power.

AO2

Application of knowledge and understanding are deployed in an evaluation of the importance of soft power in enhancing the global importance of China.

- Whilst China has been a superpower in its historic past (between 1600 and 1850 China had the world's largest economy) it is now considered by most people to have successfully challenged the unipolar world with USA as the sole superpower for a number of reasons.
- Any developments in the importance of soft power have been accompanied by continued growth in PRC military budget (2nd largest spender after the US) with increased development of new technologies and capabilities (intercontinental missiles allow China to strike anywhere in the globe). World's largest navy with Blue Water Capability and drone technology and fighter aircraft power to match the US all supporting growing geopolitical ambitions, even as far as the Poles.
- China has also had a very successful space programme with a worldwide satellite network, space exploration and the Tiangong space station. In the Xi regime, whilst steps have been taken to regulate/control Chinese media internally, e.g. Actions against Alibaba, WeChat (owned by Ten Cent) and Didi (ride sharing), the 'aim' has been to help unify the country by reducing dissent and developing internal stability in order to extend soft power more effectively externally to promote Chinese interests and to concentrate on core technologies, e.g. AI, robotics, satellites, quantum power.
- Ruled by the Chinese Communist Party, without frequent elections, China can take a very long-term view in planning the most effective use of soft power to underpin its geopolitical ambitions (e.g., BRI – a huge investment over 40 years).
- China's soft power has increased dramatically via the BRI – which interestingly does not involve or include India but does include Pakistan. BRI also reinforces the economic and geopolitical ties between China and Russia, with other agreements such as the Shanghai Cooperation Organisation (SCO) emphasising this.
- Many of China's recipients of FDI including countries in Africa and in the BRI see FDI investment as a huge bonus for their development, and in general see the investment as a way ahead as opposed to neo-colonialism. Chinese investment is considered to be positive compared to that from former colonial powers, e.g., the success of recent COVID vaccine supply by China.
- The economic success of China reinforces the importance of soft power, which is also supported by the successful images created by China via a range of sporting and cultural events which are broadcast globally.
- Educational strategies such as cultural student exchanges and activities at the Confucius Institutes are very well planned, again contributing to favourable impressions of China and increased friendship.

A possible conclusion would be that China has been highly successful in using its soft power to reinforce and enhance its global importance as a superpower by its well-planned developments across the whole power spectrum. The soft power is backed by huge hard power resources which China has used to support its claims for Spratly Islands. Equally it may be regarded as a high-cost strategy with regional instability and potential conflicts within Asia if Chinese dominance were perceived as too great, or if reduced innovation and economic growth results from Xi's crackdown on consumer tech which could impinge on people's lives.

Moreover, the global involvement of Chinese FDI in sensitive communication networks and nuclear industries has been opposed by several major countries (USA, UK) for strategic reasons (e.g., Huawei and 5G).

AO3

Skills evidenced in the question content include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the extent to which the development of soft power is an increasing influence on China's growing importance.
- The skill in constructing relevant diagrams and tables of supporting data (for example, of BRI or the soft power spectrum) which can be used to support answers to the question.
- The skills in covering the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to the increasing direct and indirect influence of soft power in enhancing China's undoubtedly growing global importance as a potential superpower.

9. 'Mineral and energy resources are vital for the development of many Sub-Saharan African countries, but they can lead to the resource curse and conflict'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.3.9

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- The **resource base**, which in the African continent (shield area) is dominated by a wide range of very valuable minerals including gold, silver, diamonds and many rare earths so vital for electric/electronic industry. Additionally, oil and gas are found in increasing quantities in North African countries, but more recently, along the Gulf of Guinea, Angola and South Sudan and provide valuable exports to provide funds for development.
  Additionally, the large rivers (Congo, Zambezi and Nile) are realising their huge HEP potential.
  The Sub-Saharan African countries which are well endowed with resources include Nigeria (oil in the Niger delta), South Africa. Angola, Equatorial Guinea, Gabon. South Sudan (oil), Sierra Leone (diamonds), Zambia (copper), Botswana (diamonds) and DR Congo (rare earths and HEP), but deposits are being found all the time (e.g., Uganda oil).
  They include Sub-Saharan Africa's richest countries, South Africa (member of BRICs) and Nigeria. In Ethiopia, enormous dams on the Blue Nile are expected to revolutionise Ethiopia's economy.
- The **Resource Curse** (also known as the 'paradox of poverty') refers to the failure of many of these resource-rich countries to benefit fully from their natural resource wealth and allow governments to respond effectively to provide public welfare (health and education) to empower their people, drag them out of poverty and to develop all sectors of their economies. The resource-rich countries tend to have higher rates of conflict, both internal civil wars (Nigeria) and internationally (e.g., South Sudan vs Sudan and, potentially, Ethiopia and downstream water wars).

AO2

Application of knowledge and understanding is deployed to explain the paradox of greater wealth from the resource base, but lower states of economic stability and rates of economic growth, with frequent conflicts.

- Resources can lead to economic wealth in a number of ways as the revenues from exports can be taxed – (D.R. Congo - Cobalt) to improve the trade balance which can then be invested in a number of ways such as start-up capital for other small businesses, e.g., in agriculture.
- Energy resources can be used as a basis for developing the whole country (Ethiopia, until the recent war, has had rapid economic growth), as a lack of home-produced energy is a major constraint on Sub-Saharan African countries' socio-economic progress.
- Although it is debateable, with China-led mega projects, often referred to as neo-colonialism, whether China invests in Sub-Saharan African countries, there are well documented examples of Chinese reinvestment, for example, in infrastructure (transport networks, schools and hospitals).
- Botswana is an example where the wealth from mineral resources has been wisely invested in the country's development as a result of stable governance.
- There are, however, many circumstances when wealth from the mineral and energy resources does not promote economic development but leads to conflict and the resource curse.
- Oil and gas and mineral wealth is distinct from other types of wealth as it has large up-front costs which require FDI (Foreign Direct Investment) from governments or Transnational Companies (where leakage can occur) as the production is very capital intensive and often large scale. There are often big production time lines before profits can be taken, again stressing the need for FDI, but it is debateable how much profit goes to the country's government. Many TNCs have caused enormous environmental problems (e.g., oil in the Niger delta).
- Whilst prices for oil and gas and minerals are generally high (especially since 2021 for rare earths such as coltan, lithium etc) as they will power the green post-carbon industry, the prices can be extremely volatile.
- The resources are also finite and so can be used up.
- There are also many site-specific issues which can make the enterprises less successful which include a range of damaging environmental issues such as pollution, the management of which leads to increased investment costs. Resource development also creates conflict with local communities.
- Many African countries are landlocked, and the resources are found in remote enclaves which adds to export costs – South Sudan's oil needs to be exported via Sudan.
- There are many social impacts of mining enclaves as often there is little benefit to local people. Many mining areas attract male migrant labour from across 'porous' borders. For instance, in N.E. Congo, the mines have attracted the Lord's Resistance Army of migrants from Uganda, which led to conflicts with local people and, over the last ten years, many people fleeing across the borders into centres such as C.A.R or Uganda as refugees.
- Mining enclaves are rarely gender friendly and there are often localised social issues between migrant workers and local women.
- At the root of many of the Resource Curse issues is the poor governance in many countries. Many governments are corrupt and not accountable to their people. They get locked into boom-bust cycles, as a result of not managing unpredictable revenues, often over-spending when revenues are high and then experiencing debt crises when revenues are low, very much a feature of petro-stress (Nigeria 1980s).

- Natural resources can, and often do, provoke and sustain internal conflicts as different groups fight for control of the resources, or if there are underlying tribal conflicts, natural resources are used to finance their fights. Petro-aggression is particularly prevalent, for example, in the Niger Delta and also Angola.
- There are also governance issues at a more local scale as many resource exploiting areas are remote and illegal activities such as smuggling of gold/diamonds take place 'secretly' as there is a lack of regulation, so with lower revenues for governments. Much of the mining is artisanal, so again, largely unregulated.

Credit either factoral accounts (breadth) or two in-depth studies such as Sierra Leone (diamond mining) or Ethiopia (HEP) or Nigeria (oil).

A possible conclusion will depend largely on the choice of examples but will explore the balance between the benefits and costs of developing mineral and energy resources and may include examples of countries where development has been successful for a variety of other reasons e.g., tourism in Tanzania.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the benefits and costs of mineral and energy resources.
- The skill in constructing relevant diagrams (e.g., the development of the resource curse)) and tables which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to whether development of the conflicts and the resource curse outweigh the advantages and benefits mineral and energy resources can bring to a country's economy.

10. 'Strategies to address both the causes and consequences of desertification in Sub-Saharan African countries have met with limited success'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.3.13

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- Desertification can be seen in many Sub-Saharan and semi-arid countries, but most notably as a belt of countries in the Sahel, stretching from Mauritania to Ethiopia as well as in South Africa and also south-west Madagascar. Mauritania, Mali, Niger, Burkina Faso all have 40% of their land affected.
- Desertification is defined as a condition of 'human-induced land degradation'.
- It affects 37% of the African continent and over 100 million people.

Causes
Desertification results from a combination of natural and socio-economic causes (**causality**).
The **primary** causes of desertification are related to **physical factors**

- Climate variability in semi-arid areas. Where climate change is associated with low precipitation, rainfall has become less reliable seasonally and annually with periods of intense drought developing.
- Average annual departures from normal rainfall increase progressively from south to north in the Sahel, with drought periods of up to a decade in the 1970s, 1980s and in recent years.
- Vegetation is increasingly water stressed and begin to die off, exposing bare soil.
- With the development of more extreme weather events from both climate warming and ENSO oscillations, short intense precipitation as well as droughts result in a reduction of soil moisture and compaction and deterioration of soils.
- Bare dry soil is vulnerable to wind and water erosion so encouraging desertification.

Human factors interact with and reinforce physical factors to intensify and spread further areas of desertification (**positive feedback loops**).

- **Overgrazing** by goats, sheep and cattle which destroys vegetation, as herd sizes exceed the carrying capacity of the available land.
- Vegetation changes into drought resistant varieties which again leads to pasture deterioration.
- **Over cultivation** also occurs on a larger scale, more mechanised agriculture develops in order to produce irrigated cash crops to feed urban dwellers. This again causes soil compaction (ploughing) and salinisation.
- **Deforestation** results from the use of trees for fuel wood and construction which leads to fewer roots to bind the soil together. It reduces interception and shade and leads to greater soil desiccation and increased erodibility.

- **Population growth** (up to 3% per annum) is a driver of desertification as it forces rural dwellers on to more marginal lands and into urban areas.
- Changes from nomadic to sedentary agriculture for a number of socio-economic reasons, e.g., access to healthcare and education, again leads to over cultivation and soil deterioration as areas of land are continuously used, with an absence of crop rotation.
- In some countries, such as South Sudan, or CAR, or Ethiopia, civil war can intensify the problem.

Consequences of desertification

- The consequences of desertification are complex and result from interactions between a number of causes, which exacerbate and accelerate the process making management extremely difficult.
- The practices listed as causes are interlinked and are not carried out in ignorance, with villagers understanding the consequences of over grazing, over cultivation and deforestation. However, a lack of government financial assistance or technical aid means that villagers have little long-term security or stake in the land and so may be unable to address the consequences.

Therefore, the consequences of the various actions have:

- impacts on the ecosystems, deterioration of soils/erosion, reduced fertility and dust storms.
- impacts on populations – drought and famine, lack of food security which can lead to forced migration, loss of land and culture.
- Impact on the landscape with increased salinity, increased areas of treeless zones and encroachment by areas of dunes.

AO2

Application of knowledge and understanding is deployed to analyse why and whether the strategies to manage the cause and consequences of desertification have met with limited success.

- Desertification has been tackled in many areas in Africa often learning from success in other parts of the world (N. China, Rajasthan) in a variety of ways and scales – local, national and international.
- **Livestock management**: - improvement of quality of animals by selective breeding and disease control, providing funds to purchase livestock in drought-stricken areas, reducing livestock populations to below carrying capacity yet at the same time providing cash incentives for farmers to develop small businesses such as beekeeping. Improving infrastructure by roads to markets, subsidising the reseeding and regeneration of pastures.
- **Crop production:** development of drought resistant varieties, subsidising the use of organic fertilisers and rebuilding irrigation systems by improved **techniques of water and land management**, including measures which increase rainwater harvesting.
- **Forestry management**: protect existing trees, plant new varieties of trees such as Kad to provide specially designed forests, improve household stoves to reduce wood consumption and use alternative energy sources such as micro solar and wind power.
- **Socio-economic** issues which can be addressed to drive the improvements at a community local scale can include guaranteed tenure or ownership of land which will encourage investment, the use of community education to teach villagers the skills to combat desertification and provide capital and technology and resources for people to carry out sustainable farming schemes.

There are however a number of reasons why many of the measures have been less than successful and these include:

- The increasing severity of the problem, which is exacerbated by climate change, and also the impact of numerous factors combining (positive feedback loop) which accelerate the process of desertification once it has started making the consequences difficult to address.
- The lack of technical knowledge and the use of non-local techniques e.g. the Eastern Refugee Reforestation Project in Sudan in the 1980s where only 28% of the wind breaks were successfully established due to incorrect planting is an example of limited success in addressing causes.
- The need for national governments to liaise with the local areas, many of which were marginal, containing many poverty-stricken people. However, the Dryland Development programme (DryDev) has been unusually successfully in Kenya and Ethiopia supporting communities and farmers to address land degradation by a huge range of small scale, appropriate technology solutions (stone terraces, small check dams, planting trees and protecting the trees and vegetation from animal grazing). Since its introduction the project's yields have doubled and the irrigation system of check dams and soakage pits has expanded. The project concluded in 2018.
- More intense cropping can be practised with higher, more secure food prices. A national framework, applied at a local scale.
- Measures did not always take local cultural and socio-economic needs into account, alienating local communities, e.g., the sinking of new wells led to tribes migrating into the area (Niger) and bringing their herds to use the wells so increasing pressure on resources.
- Aid from donor countries was not always appropriately directed and so often the projects were unfinished as they were poorly planned.
- In one very large scheme in 2007 an African led initiative was launched with the ambition to grow an 800 km **'Great Green Wall'** across the entire width of Africa to address consequences. By 2020, over a decade on, it was roughly 20% underway and so far, the initiative seems to be successful, bringing life back to the degraded landscape at a large scale, providing greater food security, jobs, and a reason to stay for the millions living on its route. The aims are huge: to address the combined threats of climate change, drought, famine, conflict and migration. As with many long-term mega projects, the capital and technology requirements are enormous, and opinions vary as to its progress and success.

A possible conclusion could argue that addressing the causes of desertification requires fundamental change in the social fabric of the communities and that the consequences require huge investments of capital and technology as desertification is a process which is getting worse and therefore very difficult to halt. The causes can be addressed at a local /national level, but the consequences may need mega scale international projects. For the hard-won successes there are undoubtedly many failures – for instance, in Tigray, Ethiopia, the civil war has obliterated much of the impact of successful strategies.

Where answers lack balance between causes/consequences or do just one, credit the approach, especially when linked to evaluation of success.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning how the causes and consequences of desertification are managed.
- The skill in constructing relevant diagrams (e.g., on the positive feedback loop of desertification, or a flow diagram of the causes and consequences) and tables which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to the degree of success in managing both causes and consequences of desertification.

Theme 4: Energy Challenges and Dilemmas

11. 'In recent years, the use of fossil fuels has posed greater environmental problems than political or economic ones.' Discuss.

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.4.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

Fossil fuels are carbon-based fuels formed in previous geological times from buried organic materials. This includes coal (the dirtiest of fossil fuels), oil, gas (the cleanest of fossil fuels) and peat.

Environmental problems associated with fossil fuels.

Coal

- Coal is the most polluting source of energy (**causality**).
- Underground coal mines can lead to subsidence and produce toxic waste and water.
- Opencast pits scar the landscape and cause huge amounts of dust leading to atmospheric pollution. Whilst legislation may require restoration of sites, the new ecosystems are of low biodiversity and quality.
- The burning of coal to generate energy has led to an increase in carbon output, contributing to climate warming. Burning of coal can also lead to acid rain and contribute to smog.

Oil

- Oil infrastructure from large oil fields visually pollutes a wide area. Oil spills at production sites can be ecologically devastating (Gulf of Mexico, Deep Water Horizon or Niger Delta disaster).
- The transport of oil via pipelines or tanker can lead to ecologically disastrous spills (1989 Exxon Valdez, South Alaska). Decades later, oil can be found on beaches and the ocean food web has been very slow to recover.
- The burning of oil can also lead to disastrous pollution, e.g., particulates from dirty diesel in urban areas.
- Unconventional sources of oil such as tar sands or shale oil by fracking, or from within oil shales may lead to water contamination and the threat of earthquakes and widespread environmental degradation.
- As **peak oil** threatens, the exploration for oil in environmentally sensitive areas such as those in the Arctic or in sea areas off the Falklands or Greenland introduces the **risk** of ecological disasters for whole food webs.

Natural gas

- Gas is generally perceived as the cleanest of fossil fuels in greenhouse gas terms, but there are issues of methane and flare off as a waste product from oil can cause major pollution problems.

Peat

- Peat is a very important carbon sink and destruction of large areas of peat bogs (for burning) has a disastrous impact on its role in both carbon and water cycles.

Political problems associated with fossil fuels

- There are many political problems associated with fossil fuels, especially oil.
- **Coal** is a widely distributed resource, but a major problem concerns voters. Miners such as in N.E. England, UK or West Virginia, USA, live in tightly knit communities and any effort to close mines has major political repercussions as it can lead to structural unemployment. Equally, the opening of a new mine, usually open cast, generates political protests.
- **Oil** is very much a geopolitical issue as the price and production is largely controlled by cartels such as OPEC (**globalisation**) and prices can be volatile, and, in times of political unrest from Middle East wars (Iraq/Libya), high (**risk**). The bulk of the resources are concentrated in the Middle East. 78% of oil and 69% of gas is found in the energy strategic ellipse, an area stretching from the Arabian Peninsula to Western Siberia.
- Political instability in areas where oil and gas reserves are concentrated such as Libya/Crimea creates challenges for managing transfer, storage and pricing of oil and gas. Unconventional oil and gas have created a lot of public protests which can delay planning permission (anti-fracking campaigns in N. Lancashire).
- Pathways including ocean based pinch points and pipelines are also volatile pathways – for example, from Russia (oil and gas superpower) across Ukraine to the EU. They can also be dangerous with the threat of accidental or deliberate explosions.
- All these factors mean that energy security issues can develop, especially as Peak Oil could be reached as early as 2030.

Economic problems associated with fossil fuels

- All fossil fuels are finite, and this particularly applies to oil with a much shorter period, as until recently, for many of its uses, e.g., petrochemicals, there were limited obvious replacements.
- For countries which are energy poor with few fossil fuel resources, such as Japan, this can pose supply problems, although HICs have the capacity or technological expertise to develop alternatives. For some energy poor LICs, where cost is a vital influence, this poses problems (e.g., the Guyanas in South America).

AO2

Application of knowledge and understanding are deployed to consider whether the environmental problems associated with fossil fuels have become more significant in recent years than economic or political ones.

- Traditionally, the problems associated with oil and gas have been both political and economic, generated by the issue of peak oil, and the concentration of production in the strategic ellipse which has allowed oil, and gas, to a lesser extent, to be used as a political weapon which has a knock-on impact on their pricing.

- However, this has hastened exploration by TNCs, especially in politically stable areas such as the North Sea and has also promoted the development of unconventional supplies of oil and gas. The USA is a classic example with the possible development of new indigenous resources (e.g. in ANWR) as well as widespread unconventional supplies (Tar sands in Canada, deep wells offshore in the Gulf of Mexico and fracking over much of the USA as well as shale oil in the mountainous west), so releasing it from the fear of a lack of energy security and of dependence on the Middle East – admittedly with some political repercussions. Political concerns for energy security have overridden environmental concerns.
- In contrast, environmental problems have become such a major global issue related to the wicked problem of climate warming, largely anthropogenically driven by the continuing use of fossil fuels, especially coal.
- As COP summits, especially Paris and Glasgow have shown, the latter with a written summary where it was agreed all countries have to work to phase down the use of coal (the environmentally dirtiest of the fuels), a recognition of major environmental problems (i.e., decarbonise).
- It could be argued that coal's environmental problems were interdependent with political problems, with governments from nearly 200 nations struggling to manage for the foreseeable future without coal. For India, coal is a vital stop gap to provide energy after biogas for many rural homes, where failure to do so could make the government unpopular with its electorate. For China, coal is a vital driver of industrial development. Also, it means a loss in the global business in developing new mines and oil fields in countries in Africa as it was argued that there should be no further exploitation of new fossil fuel resources.
- The G77 nations would struggle to meet the increased cost in developing new, more environmental alternatives, so financial support from HICs was a vital part of the package.
- The technological difficulties in developing clean (CCS) or cleaner (gasification) coal emphasises the importance of the environmental problems of fossil fuels.
- As more supplies of oil have been discovered, (improved technology), both conventional and unconventional, the economic problems associated with peak oil may diminish, possibly limiting the geopolitics and OPEC dominance.

A possible conclusion would emphasise the extent to which recent environmental concerns about fossil fuels, especially coal, have been embedded in global governance, and this is likely to lead to impacts at all scales. As the world moves towards a major shift in energy development strategies with cleaner, greener fuels (nuclear and renewables), this may release political and economic pressures on oil and gas, but it is unlikely that these will disappear and will still have major significance – the problems are interlinked as the environmental problems caused by fossil fuel use are increasingly political. The Ukraine conflict has led to the increasing importance of political and economic factors. This may influence the thrust of the answer.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments assessing the relationships between environmental, political and economic problems facing fossil fuels.
- The skill in constructing relevant diagrams and tables (e.g., details of COP agreements) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion as to whether the relative magnitude of the environmental, political and economic problems has changed in recent years.

12. 'Although the level of development has a major impact on a country's choice of energy mix, there are many other influencing factors'. Discuss.

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.4.6

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- **Energy mix** refers to the combination of energy sources used to meet a country's energy demands. This varies from country to country (**space**) according to a number of factors.
- Energy mixes change as a country develops economically as shown in the **Energy Transition Model** (**time**) (Figure 1). It shows increasing diversity of supply, decreasing use of traditional fuels and ultimately fossil fuels, at the expense of 'greener' fuels (**sustainability**) against a background of rising demand, showing the importance of a country's level of development.

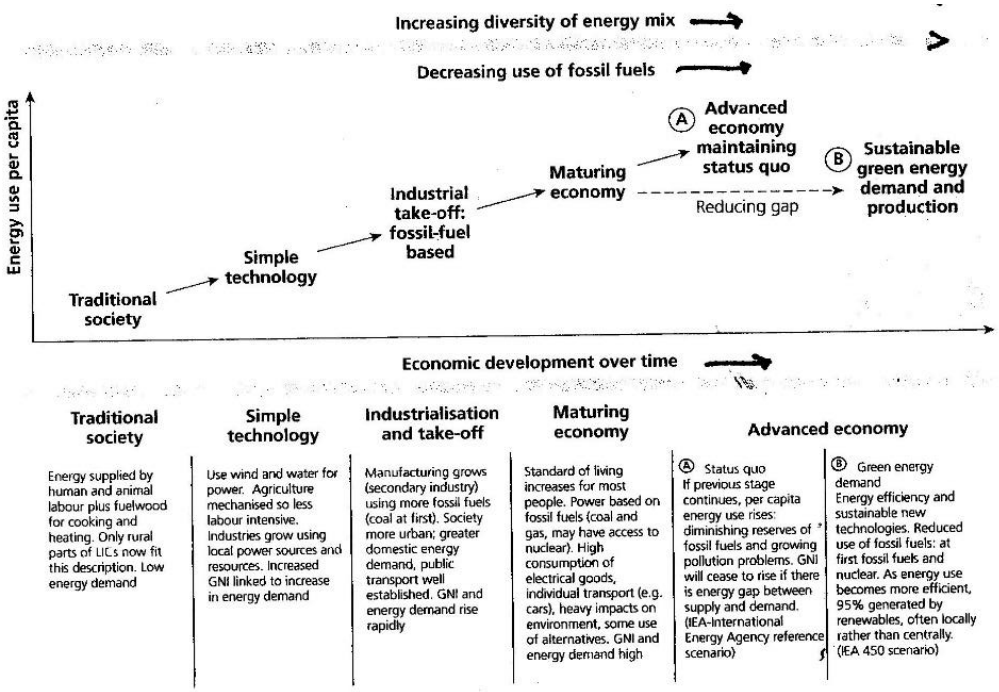


Figure 1: The Energy Transition Model

Other factors include:

- **Availability** as to the type and range of indigenous (home produced) resources available which is heavily dependent on physical factors, for example, deposits of coal and wind and sun for wind and solar power, so location is important.
- The need for **security of supply**. Countries can be categorised according to their Energy Security Index (ESI) which varies over **time** and can be enhanced by countries strategic policy decisions, USA, for example dramatically increased its ESI by increasing its indigenous supply of oil and gas using unconventional methods (fracking, oil shales, offshore deep-water oil) to avoid dependence on OPEC supplies, (largely from the Middle East, a politically volatile region).
- Equally, the EU has moved to cut dependence on Russian oil and gas supplies (issues of pipelines being closed as a political weapon) by looking towards friendly countries such as Norway. The need for security of supply was a driver in France's switch to nuclear powered electricity generation.
- Availability of **technology** and capital and expertise to both develop the resources and the infrastructure to transport them. Building LNG terminals or nuclear power stations can require huge amounts of Foreign Direct Investment (FDI) and technology transfer, often from specialist energy corporations who need to be convinced about the viability of any investment.
- **Affordability** of supplies is another issue. The price of oil is largely controlled by OPEC and the future issue of **peak oil** can have a major impact on the amount of imports for many countries. Equally, as technologies develop, this can bring down the cost of alternatives to fossil fuels, such as wind or solar. Many LICs rely on low-cost supplies such as fuelwood or biofuels or even coal.
- **National and international legislation** can have a huge impact on energy mixes. A history of UN COP conferences, and subsequent emission targets have shifted many countries towards cleaner fuels, initially towards cleaner fossil fuels and latterly towards alternatives, both recyclable and renewable. COP26 Glasgow has taken this even further as countries need to declare a date for 'Zero Carbon' emissions and move towards green energy generation.
- National policies underpin international legislation with a plethora of 'carrot and stick' strategies for example to promote and facilitate electric car use or place a carbon tax on coal use. The policies can trickle down to a local level through community grants and subsidies, e.g., for small scale wind generation – Germany (**mitigation**). In Brasil, national government strategies have promoted the development of biofuels. Some strategies are at regional level such as EU legislation.
- **Social and cultural preferences** can also slow down the adoption of modern, cleaner energy resources, for example, in Poland, many people prefer the concept of a 'living fire' or the middle classes in the UK have seized the opportunity to buy a wood burning stove as opposed to using gas or electric fires.
- **Political considerations** are sometimes very significant. For instance, in some countries such as Germany or Sweden with strong Green Parties, there is a definite move away from nuclear power, in spite of its partially green credentials, towards renewable sources such as solar and wind.

Credit exemplar support of the factors

AO2

Application of knowledge and understanding is deployed to evaluate and analyse the interplay of factors which influence a country's energy mix and the extent to which level of development is of major significance.

- The importance of level of development can be clearly evidenced with reference to a number of countries at various stages along the energy transition model (which is strongly linked to Rostow's Model of Economic Development).
- Level of development is an overarching factor which underpins several others, such as the economic cost of energy, especially where imported (oil and Gas) which impacts on affordability or the availability of technology to develop alternatives to fossil fuels, such as solar, or possibly nuclear power. Political considerations such as FDI from governments, such as Chinese neo-colonialism in Africa, or TNCs who will only invest in areas of comparatively stable government can also be linked to the factor of level of development. Many developing countries have to rely on micro-generation of solar, wind, biogas or hydro power promoted and aided by international agencies and NGOs (interdependence).
- Classic exemplars could include LICs (Haiti), MICs (such as Botswana), Emerging countries (e.g., India or China) or HICs (USA).
- However, over **time**, certain other events have had a major impact on the choice of energy mix.
- The various oil crises such as in 1973, and the fluctuations in oil price against the background of concerns not only about security of supply, but also the cost of supplies.
- For many countries coal remains a ubiquitous, easily available energy supply of which they have large quantities, e.g., South Africa, USA, China, India.
- **Peak oil** has been a major concern as countries develop as this increases the demands (e.g., BRICs). Equally, technological developments have meant that both oil and gas (LNG) can be transported around the world at a fraction of previous costs either by pipelines or super tankers, in spite of various 'pinch points' such as Suez Canal or the Straits of Hormuz.
- Oil and, to some extent, gas have become geopolitical weapons which have encouraged countries to rank energy security as a key factor either by changing their pattern of fossil fuel use or moving to alternatives (Brasil – biofuels, France – nuclear).
- The desire to manage the wicked problem of climate change at all scales from global to local and to cut both the CO^2 emissions (decarbonise) and methane emissions (gas issues) and the need to prevent deforestation (biofuels) mean that environmental considerations only partially related to level of development now dominate in the 21st Century. BRICs, all emergent nations, have issues in signing up to contribute to '1.5°C to stay alive' and will meet zero carbon status, but much later than 2030, as they need to buy time to convert to alternatives, both recyclables and renewables.
- Further world events have been the various nuclear accidents at Fukushima or Chernobyl which have highlighted the safety problems associated with the use of nuclear power. Additional considerations include the possibility of this power being used for military purposes and the nuclear waste issues. Whilst there is always hope for technological developments (smaller scale nuclear plants) the cost and lead time to build nuclear power stations remain huge obstacles for LICs.
- Specialised locational factors will always play a strong part in determining a country's energy mix. For example, the lack of wind or hours of sunshine may be negative factors when determining the energy mix or geology and the availability of geothermal energy is an example of a positive.

A possible conclusion could be that whilst the level of development is a key factor in enabling a country to develop its energy mix, preferably a diverse one, there are numerous other extremely important factors/events that change over time. These may (for example, security or safety or the need to manage global environmental problems – possibly the most significant at present) become more dominant as sustainability becomes a key requirement, especially where a country has the ability to choose.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments assessing whether the level of development is still the key influencing factor for a country's choice of energy mix.
- The skill in constructing relevant diagrams (e.g., pie charts of countries' energy mix or the Energy Transition Model) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates how the level of development has a major impact spatially and over time in influencing a country's energy mix.

Theme 5 Weather and Climate

13. 'Variations in the jet stream are the most important influence on weather in the UK'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3 [5] [45 marks]

Focus 3.5.3

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

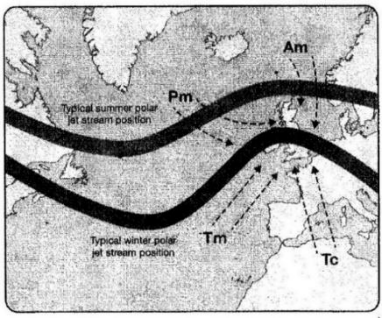
Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

- Weather concerns short term variations in atmospheric conditions such as temperature, precipitation, air pressure, wind speed and direction, humidity and cloud cover.
- Jet streams are fast moving ribbons of wind (average speeds of 160km/hour) which blow along the boundary of the atmospheric cells in the upper air.
- They are driven west to east by Rossby (planetary) waves, the position of which varies seasonally.
- The UK is affected by the Polar (front) jet stream which forms between the Ferrel (Tropical) and Polar cells. The temperature difference between the Tropical and Polar cells influences the speed of the jet stream.
- The position, pattern and amplitude of the jet stream all have a major impact on changing surface weather as they control the formation, survival and decay of lower level weather systems and also influence the pattern of air masses, both of which have a direct influence on the weather.
- The exact position of the jet stream and the Rossby wave belt is very dynamic and not only varies seasonally as a result of the annual migration of the heat equator (**causality**), but also short term from day to day.
- Other local weather-related factors e.g., air masses, weather systems (depressions and anticyclones), and possibly urban influences e.g., UHI, relief/altitude and climate change. Do not credit climate-related factors e.g., Gulf Stream, latitude, maritime location.

AO2
Application of knowledge and understanding is deployed to consider how the position, pattern and amplitude of the jet stream contribute to influence the weather of the UK and the extent to which this is the most important influence.



Position – see Figure 1
Figure 1: Winter and summer jet stream positions which explain the seasonal pattern of UK weather.

- In winter, the usual location of the jet stream and therefore the Polar/ Tropical boundary is over the UK so allowing Pm and Pm(r) and Am air masses to bring cooler and wetter conditions.

- In summer, a more northerly position of the jet stream allows Tm and Tc air to move north over the UK bringing warmer and sometimes drier Tc with settled more sunny conditions (Tc air mass).
- Anomalies in the general position can occur, for example, in summer, the position can be found very far north over Iceland leading to tropical conditions – heatwaves (Tc air masses) or in winter, very far south over mainland Europe which can lead to Arctic blasts or 'Beast from the East' conditions (Am or Pc air masses)

Pattern and Amplitude – see Figure 2

- The troughs and ridges of the Rossby waves explain how the upper air (tropospheric) convergence leads to a downwards spiral of air to cause high pressure at the surface and how upper air (tropospheric) divergence sucks up air to lead to surface low pressures – so controlling weather systems.

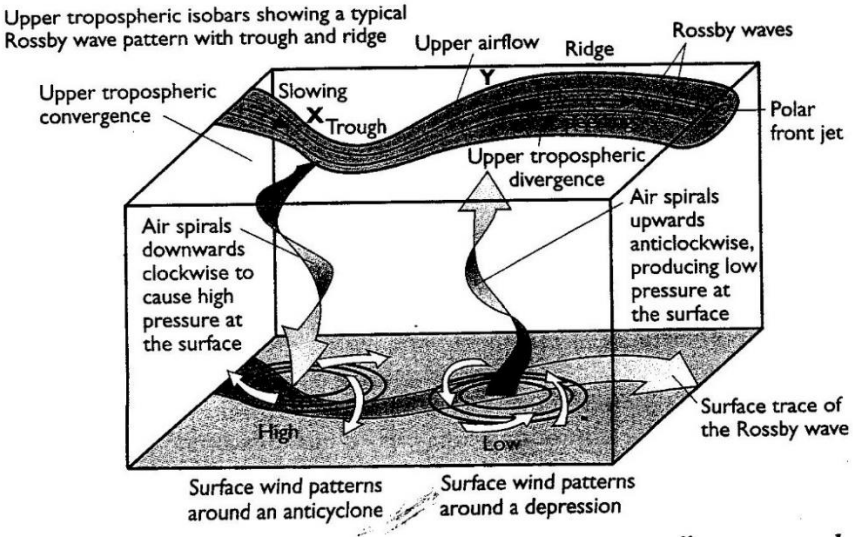


Figure 2: The impact of the jet stream on surface systems

- A strong jet stream where there is a marked differential of temperature between the polar and tropical air results in a mobile, fast-moving pattern of west to east weather (for example, a series of winter depressions).
- A weaker jet stream allows more incursions of cold air southwards (or warm air northwards) giving rise to more extreme conditions with the probability of blocking anticyclones or deep stationary lows with potential for flooding (known as Omega blocks).
- Rossby waves form sinuous large meander loops, which can either lead to very warm conditions as tropical air moves northwards over the UK and prevents incursion of Pm air, or, if the Omega block is located west of the UK, this can allow Am or Pc air masses to move in leading to a period of long-term cold conditions.

A possible conclusion may be that other factors e.g., air mass direction and track and the occurrence of weather systems (anticyclones and depressions) are key direct influences on the UK weather. Detail on the impact of these factors is a legitimate and creditworthy part of the argument. In some cases, their link with the jet stream and its underlying influence is a vital part of the discussion, and in other cases they have a very important influence on weather. Do not credit to maximum answers that underplay the importance of the jet stream.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the degree of importance of the jet stream's influence on UK weather.
- The skill in constructing relevant diagrams (e.g., of how the jet stream's position influences air mass patterns or operates as a control on weather systems).
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates the statement as to the extent of the influence of the jet stream on the UK's weather.

14. 'The impacts of hazards associated with high-pressure systems are increasingly difficult to manage'. To what extent do you agree?

AO1 [20] AO2.1c [20] AO3.3 [5] [45 marks]

Focus 3.5.4 3.5.5

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

Indicative content

The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1
Knowledge and understanding of:

The primary hazards associated with high pressure systems

- In tropical regions high pressure hazards are associated with the anticyclonic conditions resulting from the subtropical high pressure over continental areas [convergence zone – descending air (causality)]. The combination of low rainfall and high evaporation rates can lead to drought conditions, for example in the Horn of Africa.
- In temperate regions, primary (high pressure) hazards include summer droughts and winter frost and fogs. These hazards are associated with persistent stationary 'blocking' anticyclones (causality) again leading to lengthy periods without rainfall.
- Extreme heat is an increased high-pressure hazard in many parts of the world.
- Frost is a hazard in temperate regions when persistently low temperature conditions occur.
- Secondary hazards which in all areas result from droughts include wildfires, falling water tables and degradation of vegetation and farmland. A further secondary hazard is smog in areas of high atmospheric pollution (Delhi, Beijing, Los Angeles) which results when temperature inversions lead to extreme stability (**causality**).

Credit exemplars of primary and secondary hazards with supporting details of their impacts

Management of hazards

- Modifying human vulnerability to hazard risk through prediction, warning, community preparedness (**resilience**) and long-term planning.
- Modifying the hazard event and vulnerability through environmental control and management (e.g., for drought – cloud seeding) and building design (e.g., against bush fires), farming practices (e.g., against droughts) (**adaptation and mitigation**).
- Modifying the loss through aid and insurance (**mitigation/adaptation**)

Credit examples of these management strategies

AO2
Application and knowledge is deployed to evaluate evidence for and against the question as to whether the impacts of the hazard are becoming increasingly difficult to manage. Synthesis will be demonstrated by the drawing together of this evidence to reach a rational conclusion.

The rational argument could include:

Increased risk

- This applies especially to large scale hazards such as droughts and the secondary knock-on hazard of wildfires and famine as short-term climate change, ENSO and climate warming have led to more extreme weather.
- More frequent events, often of longer duration and greater intensity, spreading to areas (areal extent) where people are less familiar with their occurrence and therefore, especially in LICs, less resilient and able to cope – thus making management increasingly difficult and costly.
- Rising populations, especially in tropical areas have exacerbated **risk**.
- At a smaller scale, fogs have become more frequent and denser as a result of rapid urbanisation and industrialisation, leading to high levels of air pollution in many cities in emerging countries (Beijing, Delhi) in addition to traditional areas of occurrence such as Los Angeles (smogs).
- Extremely hot weather can increasingly lead to heat stress with deaths of vulnerable people occurring in many parts of the world.
- Extremely cold weather in temperate zones of North America and Russia has led to widespread and extreme frosts whose impacts on environments and people are difficult to manage.
- The sheer unpredictability of the extreme weather hazards increases management issues and leads to increasing vulnerability of many people who lack safety nets of insurance and are reliant on diminishing amounts of aid and are therefore at risk of famine/disease in LICs.

On the other hand, the techno-fix has improved management strategies of adaptation and mitigation in a number of ways for the various hazards.

Droughts in general have a slow onset period. To be effective drought forecasts need to be available many months ahead. However, drought hazards remain difficult to defeat.

- Various drought monitoring agencies exist (e.g., ICPAC) and UN sponsored systems (GIEWS for drought and FEWS NET (for early warning of famine). Therefore, use of satellite data has increased success at a regional scale of prediction/forecasting (adaptation).
- Community preparedness for crisis management and longer-term strategies for water conservation at all levels of technology (magic stones etc) have also been widely developed.
- Land use planning has led to improvements in both nomadic and pastoral farming with strategies to combat drought.
- Techno fixes for protection include artificial cloud seeding and the development of additional water supplies (via reservoir storage) as well as second generation GM drought resistant crops.
- Mitigation via well targeted disaster aid can have benefits for both emergencies and long-term improvements. Nevertheless, the sheer scale of the drought hazard and the famines which can result in LICs make it a very difficult hazard to manage.

Wildfires have increased in intensity and severity and areal extent for a number of reasons including greater prevalence of 'fire weather'. Although human actions and the amount and moisture status of vegetation (also drought related) are significant causal factors.

A range of management strategies including protection (e.g., fire lighting bans), mitigation (e.g., disaster aid) and adaptation (community preparedness, forecasting, warning and land use planning for improved fire safety) all contribute with varying success to hazard management. Wildfires in California, South Australia or southern Europe, all in HICs, have proved very difficult to control and extinguish even with improvements in management over time. Other high-pressure hazards such as fogs and frosts are more localised and, in both cases, management strategies can have a major impact, for example, in prevention of air pollution by legislation and environmental management to control the formation of urban fogs or even employing stay at home orders (Delhi 2021) or closing down factories (Beijing Olympics 2012). In cities such as London, Clean Air Acts have been very successful in reducing fogs.

So much depends on the intrinsic features of the hazard itself as well as extrinsic features (location, governance, level of development, population density and vulnerability of people). The answers may be limited to just one type of hazard e.g., drought, so will be limited in scope (especially on AO1) and are unlikely to reach the top mark band.

A possible conclusion would explore the concept of increasing risk and use supporting exemplar evidence of individual hazards, both primary and secondary, to assess the role of improved management over time to come to a conclusion concerning agreement/disagreement with the statement.

Increasing exposure to more hazards of growing populations, many with low adaptive capacity (resilience) is key to increasing management difficulty.

Comparisons of similar strategies employed in different environments and with different communities (place) will enhance the arguments.

AO3

Skills evidenced in the question context include:

- The skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the factors influencing increasing difficulty in management and the extent to which improvements in protection, adaptation and mitigation strategies could counteract this.
- The skill in constructing relevant diagrams (e.g., of complex causes of droughts or wildfires) which can be annotated to support answers in the question.
- The skills in covering both the breadth and depth of the question.
- The skill in reaching an evidenced conclusion which evaluates the statement as to whether management of the hazards is increasingly difficult.