GCE A LEVEL MARKING SCHEME

SUMMER 2022

A LEVEL
GEOGRAPHY - COMPONENT 3
A110U30-1

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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 2022 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.

Where the specialised concepts are integral to knowledge and understanding, they are underlined in the indicative content.

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.

	AO1 [14 marks]	AO2 [20 marks]	AO3 [4 marks]
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.
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.

	AO1 [14 marks]	AO2 [20 marks]	AO3 [4 marks]
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: Tectonic Hazards

1. 'The characteristics of the physical hazard profile are the key factors influencing the severity of impact of volcanic hazards'. Discuss.

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

Focus: 3.1.1 and 3.1.2

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 features of the physical profile of a volcanic hazard and the environmental, demographic, economic and spatial impacts which result.

- Characteristics of the physical hazard profile which influence its impact include magnitude (measured by VEI), spatial predictability, frequency of eruption, duration of event, speed of onset and areal extent which all influence degree of risk.
- Volcanic processes produce a number of primary and secondary hazards, including pyroclastic flows, lava flows, ash/tephra falls and secondary hazards of tsunami, volcanic landslides, lahars, jökulhlaups and toxic gases.
- Type of eruption ranging from explosive to effusive and state of the volcano – active, dormant or extinct.
- Volcanic hazards have environmental, demographic, economic and social impacts on people and the built environment.
- These impacts can operate at local, regional, and global scale over a period of time.
- Severity of impact can be measured in a number of ways, environmentally, by damage to landscape, both natural and built; demographically, by the number of people killed or injured (volcanic eruptions are non-selective); scale of social impact; and economic impacts to include disruption to livelihoods and employment, and infrastructure.
- Useful examples would include a range of volcanic hazard events experienced by area, countries and contrasting contexts which illustrate the varied degree of risk and impacts of volcanic activity. Examples might include Pinatubo (1991), Merapi (almost constant), Eyjafjallajökull (2010 – economic impacts), Taal (2019-20) and White Island, New Zealand (2019-20 – elements of risk).
- Conceptual frameworks such as sample volcanic profiles, Hazard Management cycle or Chester's impacts model provide scaffolding for explanations as to key factors which may influence the severity of impact.

AO2

Application of knowledge and understanding is deployed to discuss whether the features of the physical profile are the key factors in influencing severity of impact. Synthesis will be demonstrated by drawing together evidence to reach a rational conclusion.

- Magnitude of the volcanic eruption (VEI) is likely to be a key factor in influencing the severity of impacts.
- Equally significant could be: - speed of onset, for example of phreatic eruptions (Ontake and White Island), or - areal extent (global environmental impact of Pinatubo on climate, or Eyjafjallajokull on the global economy.
- Frequency can go either way – sometimes equipping population with prior knowledge or otherwise, contempt (e.g., Mt. Merapi).
- Against this there are many other factors which can impact on severity. The Decade Volcanoes (eg. Etna, Sicily and Taal, Philippines) are all chosen as active and in areas of high population, which will influence deaths, injuries and damage, especially as the population rely on volcanic areas for their livelihoods (eg. farming and tourism).
- Frequently the quality of governance (related to level of development) has an impact as it can determine the efficiency of monitoring, prediction (risk management, training etc), evacuation and speed of recovery, (e.g., Pinatubo evacuation was very well managed). Ineffective risk management can contribute to disasters (e.g., White Island).
- The nature of the material ejected can influence severity of impacts, for example, ash can be ejected for many miles and have widespread impacts eg. Mt St Helens, compared to the more local areal extent of pyroclastic flows e.g., Montserrat
- Secondary impacts can sometimes have an adverse effect, for example, landslides generating tsunami (Anak Krakatau) or heavy rain generating lahars (Armero, Colombia) or impact of toxic gases (Lake Nyos) all of which led to anomalously high death rates and severe impacts.
- Secondary factors also play a part, for example, with Eyjafjallajokull, the jet stream and wind direction influenced the scale and spread of the ash cloud.
- Volcanic status is also significant (numerous examples) and changes over time as volcanoes considered dormant suddenly erupt (e.g., Mt. St. Helens).

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical argument concerning the relative importance of features of the physical profile compared to other factors.
- the skill of constructing relevant diagrams, (for example of physical profiles), and tables which can be annotated to support answers to 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 characteristics of the profile (to include a range of features) some of which may be of lesser importance, in influencing the severity of impact, as well as other extrinsic factors which may be of even greater influence.

2. 'The level of development is the most important factor influencing risk and vulnerability to earthquake hazards'. Discuss.

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

Focus: 3.1.3 and 3.1.4

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 risk and vulnerability and the factors influencing risk and vulnerability could include:

- Risk is the probability of harmful consequences or expected losses resulting from interactions between (earthquake) hazards and vulnerable people/conditions.
- Vulnerability – is a measure of the extent to which a community/location is likely to be damaged/disrupted by an (earthquake) hazard.
- The risk equation – $\frac{\text{Hazard x Vulnerability}}{\text{Resilience}}$
- Level of development is a key economic factor, that is important at a variety of scales from local, to regional, national and international.
- Level of development can be measured in a variety of ways using single and composite indicators to include not only the economy, but also social, political and environmental considerations.
- Level of development is an overarching factor which can have a direct impact on not only the wealth of an area, and the standard of living of people and communities, but also indirectly on the level of technology, infrastructure, health, education and quality of governance.
- Level of development can impact on an area's ability to develop earthquake management **systems** before, during and after the event so leading to a declining risk.
- Other **human** factors include further economic factors such as level of technology, social factors (population density, population profile, community **resilience**), political factors (quality of governance), and geographical factors (rural/urban location, isolation/accessibility, time of day).
- Further factors could include the physical profile of particular earthquake events including magnitude, frequency, areal extent and the occurrence of secondary hazards (tsunami).
- Useful examples would include a range of earthquake hazard events experienced by areas, countries, regions at different levels of development, for example Nepal Gorka (2015), Haiti (2010), Sichuan (2008), Christchurch (2010-2011) and Tohoku (2011).
- Conceptual frameworks such as earthquake hazard profiles, Park's disaster-response curve, PAR model of vulnerability or the Hazard Management Cycle provide scaffolding for explanations of how level of development was significant.

AO2
Application of knowledge and understanding is deployed to discuss whether level of development is the most important factor in influencing both **risk** and **vulnerability** to the earthquake hazard.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion:

- the extent to which level of development is important in influencing **risk**. Here other factors such as geographical location with respect to plate boundaries and features of the hazard profile such as magnitude are likely to be of fundamental importance as well as level of development.
- the recognition that the level of development is fundamental in influencing **vulnerability** of populations and areas as it is of overarching importance in influencing a range of social and political factors, all of which impact on vulnerability (eg. Quality of governance in Haiti 2011).
- the understanding that level of technology may be a further economic factor of key importance in developing **adaptation** and **mitigation** strategies, for management before, during and after an earthquake event, which diminish risk and vulnerability. Level of development has an indirect influence on this.
- the extent to which level of development varies in its importance in different earthquake events (**place**) which often have other unique or localised features for example occurrence of secondary hazards (tsunami/landslides), or a varied areal extent of impact (depth, pattern of seismic waves).
- the extent to which the importance of level of development can change over **time**, as countries develop **systems** for earthquake hazard management of risk and vulnerability and can vary **spatially** within an earthquake hazard zone, often linked to inequality of life chances (Nepal Gorka 2015), although this is not true in all cases eg. tsunami secondary impacts (e.g., Tohoku 2011).

AO3
Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical argument concerning the relative importance of level of development compared to other factors for both risk and vulnerability to the earthquake hazard.
- the skill of constructing relevant diagrams and tables which can be annotated to support answers to 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 level of development in influencing the degree of risk and level of vulnerability to earthquake hazards.

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.

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
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.
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 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.

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
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.
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: Contemporary Themes in Geography

3. 'Human well-being depends on the goods and services provided by ecosystems, yet humans are the main drivers of ecosystem destruction.' To what extent do you agree?

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

Focus: 3.2.1 and 3.2.3

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:

- the goods provided by ecosystems, including medicines and food which add trillions of dollars to countries GDP.
- the services provided by ecosystems such as clean water, pure air, flood protection, resilience to hazards and gene pools as well as cultural benefits.

Knowledge and understanding of:

- the direct (deforestation, pollution etc) and indirect (climate change) damage that humans are causing to ecosystems at a range of scales from local to global.
- the recognition that over time this has led to increasingly damaged and poorly functioning ecosystems in many countries such as rainforests, reefs and wetlands, as the risk of tipping points is growing in many countries as evidenced by biodiversity measurement.
- Exemplified details could include details of rainforest destruction in Brazil or decline in coral reefs by direct action such as fishing or indirectly by bleaching, or destruction of wetlands by draining and pollution more locally as well as threats to the Arctic tundra, including tourism, mineral exploitation and climate change (positive feedback).

AO2
Application of knowledge and understanding is deployed to discuss the apparent conundrum that the value of ecosystems is of paramount importance to the wellbeing of humans, yet they are the main drivers of ecosystem destruction.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- There is little argument that ecosystems are of enormous value as providers of goods and services for human wellbeing, but even here there is conflict between the needs of various groups of people, for example, those of indigenous people v. those people who exploit ecosystems commercially for economic reasons.
- There are also many instances where human activities provide both a direct threat and indirect threat (via climate warming). This can occur both globally and locally (scale).

- These threats vary spatially in their severity. There are many countries with strong governance geared towards the management of ecological resources with strategic vision on conserving them (e.g., Costa Rica).
- In some cases, natural causes of ecosystem destruction may be more important than human actions, e.g., volcanic eruptions/tsunami or tropical storms and wildfires
- The level of management within the country across a spectrum, from protection through to economic extraction of resources, means that humans become less significant as drivers of destruction if there are strong protection laws etc.
- Locally people can be a powerful force in managing ecosystems in a sustainable way to ensure that the goods and services are maximised for the benefit of humankind. Incrementally bottom-up developments can over time change the situation in a positive way.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments about the conundrum that ecosystems are vital to human wellbeing, but that humans can be agents of destruction, yet have the capacity to act in a positive way.
- the skill of constructing relevant diagrams (e.g., spectrum of conservation) and tables which can be annotated to meet the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion that there are spatial and temporal variations which challenge the validity of the statement where the value of ecosystems is conserved for future generations and that humans can be the drivers of positive change as opposed to the main agents of destruction.

4. 'Some ecosystems are at greater risk from destruction and damage than others.' To what extent do you agree?

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

Focus: 3.2.3 and 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 risk as the probability of harmful consequences or losses.

- Damage involves harm to some parts of the ecosystem to a lesser or greater degree and may be reversible over time, for example, development of 'super corals'.
- Destruction is likely to involve the complete loss of the ecosystem, for example, removal for land use changes such as rainforest for soybeans in Amazonia.
- Both damage and destruction can occur at all scales from global to local, from both natural and human causes, both directly and indirectly.
- Amounts and levels of damage and destruction vary spatially for a number of reasons, both intrinsic and extrinsic, for example, density of population, utility value of ecosystems as providers of goods, or scale and pace of environmental changes such as climate warming at a particular location.
- The scale and pace of damage and destruction can be monitored using technologies such as satellite mapping and measured using a number of indices (e.g., Red List, IUCN Ecosystem score card, WRI, or Living Planet Index, WWF).
- Exemplars are likely to come from:
  - ✓ Rainforests are at risk from acid rain, climate change and invasion by non-native species as well as their use for goods and services such as timber.
  - ✓ Coral reefs are at risk because of warming oceans which lead to bleaching and ocean acidification which affect the health of the reef as well as direct threats such as over-fishing or destructive fishing (use of cyanide dynamite, tourism, pollution/siltation, mining etc).
  - ✓ Freshwater ecosystems in rivers, lakes and wetlands are threatened by commercial development (agriculture, tourism) drainage schemes, extraction of peat, fishing etc as well as indirectly by sea level rises resulting from climate change or desiccation from droughts. These three examples are known for their very high biodiversity.
  - ✓ Tundra ecosystems have low primary productivity and biodiversity but are particularly under the threat from the scale and pace of climate change (positive feedback loops) and mineral exploitation, tourism and military activity which can alter (damage) the thermal equilibrium of permafrost and lead to environmental degradation.
  - ✓ Examples of ecosystems which are possibly at lesser risk from damage and destruction might include some forest ecosystems, tropical grasslands or desert ecosystems.
  - ✓ Local examples based on a NEA or other fieldwork would be very appropriate, eg. wetlands, sand dunes or salt marshes

AO2
Application of knowledge and understanding is deployed to discuss whether some ecosystems are at greater risk than others with a distinction to be made between total destruction and damage.

Students are likely to tackle this question in a number of ways with some opting for an in-depth approach via a number of case studies of ecosystems possibly at a variety of scales whereas others may take a wide ranging factoral approach. Yet others may exemplify these arguments at a more local scale, possibly based on their fieldwork or their NEA.

The evaluation of risk could involve both intrinsic (the ecosystem itself) and extrinsic (environment, location, governance etc) factors.

Intrinsic factors might include:

- The nature of the ecosystem itself – some ecosystems are much more fragile than others and therefore at risk.
- Rainforests are particularly fragile because of their high biodiversity and the way losses of ecological niches can have dramatic impacts on food webs, which are highly specialised.
  - ✓ They also have huge quantities of nutrients stored in the biomass so removal of this element or damage to it reduces the impacts of organic matter to litter and soil stores, thus upsetting nutrient cycles.
  - ✓ The loss of canopy, in particular the replacement by lower grade, secondary forest leads to less interception, with more rainfall reaching the forest floor leading to increased loss of nutrients through leaching and overland flow, over time setting up a deteriorating environment.
- Equally, tundra ecosystems are very fragile with low primary productivity and a very simple food web, so both damage (loss of rare Arctic plants) and destruction of permafrost put them at huge risk.
- The size of occurrence of various areas of ecosystems. Small patches of an ecosystem can increase the risk of total destruction, especially of rare components. Wetlands are particularly at risk as they comprise only 1% of global ecosystems.
- The value of potential of the ecosystem to deliver goods, which are in high demand such as timber or fish, can clearly destroy the ecosystem if goods are not sustainably harvested.

In terms of extrinsic factors there are a number of key drivers of risk. These include:

- The population and population density of the area and/or country. As countries needs to increase their food supplies for their people (fish for SE Asia from coral reefs) or grow crops to feed their people (destruction of forest to provide land for settlers in Amazonia), this will put pressure on ecosystems and increase risk.
- Higher densities of population in developing countries will increase demands for fuelwood etc, especially around large urban areas.
- Economic factors such as the desire to produce particular crops such as soya or sugar cane for biofuels, palm oil for export or HEP dams and reservoirs can impact on forest areas again leading to total destruction (Amazonia or Indonesia). There are numerous examples of the negative impacts of resource exploitation.
- Environmental factors can be global as in the case of climate warming which places a disproportionate risk on tundra ecosystems, but also leads to desiccation of tropical rainforest and also warming oceans, leading to massive amounts of bleaching and coral reef destruction and damage. Moreover, incidences of extreme weather completely destroy forest ecosystems, such as in the recent bush fires.

- Pollution also tends to be regional, for example, damage to forests caused by acid rain, taiga or rainforest, but also can be local, for example, pollution of wetlands, or sedimentation and pollution at estuary outlets on to coral reefs
- In many areas, intrinsic factors are not related to one particular ecosystem, but more to a particular location.
- Government management strategies can increase the risk of destruction and damage, essentially by development (e.g., Brazil or India) or they can put ecosystems first and decrease the risk of damage and destruction (Costa Rica). This leads to both spatial and temporal variations between countries, but also within countries, where there are many local schemes often working with indigenous people to manage risk and prevent damage and destruction.
- It is very possible to see high risk in some places and not others which have the same ecosystem (e.g., the positives of ecotourism and the negatives of timber felling by non- sustainable methods).

Synthesis will be demonstrated by drawing together evidence to reach a rational conclusion which may agree with the idea of high-risk ecosystems or could even make the point that all ecosystems are at considerable risk of damage and destruction and that more depends on a range of intrinsic factors operating at all scales.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments to evaluate the risks to ecosystems
- the skill of constructing relevant diagrams (qualitative skills) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to whether some ecosystems are at greater risk than others or whether it is the risk factors themselves which cause variations in risk.

5. 'Globalisation has been the main driver of economic growth in India.' Discuss.

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

Focus: 3.3.4 and 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 globalisation and other factors and how they generated economic growth in India could include:

- Globalisation can be defined as the growth of global systems which facilitated flows of goods, money, people and technology as a result of improved connectivity of transport and communications.
- Globalisation is a multi-strand process, which not only involves economic facets (growth of MNEs and the development of transport and ICT networks), but also political globalisation (growth of trading blocs and international financial organisations such as WB and IMF) as well as social facets (improvements in social connectivity via global media and increasing flows of international migration (impact of diaspora).
- Since 1991 India has allowed FDI from MNEs into the country, thus opening up India to economic globalisation.
- Many US and UK multinationals took the opportunity to outsource a huge variety of functions from back office to call centres – this has grown to include an increasing variety of functions, even R&D (process of offshoring) driven by improvements in technology and taking advantage of a lower cost, yet highly skilled and educated, English speaking work force.
- A global shift has not only occurred in services, but more latterly in manufacturing, including steel, textiles, cars and IT products.
- Economic growth (measures by growth of GDP or GNI per capita) has increased steadily over a fifty-year period. Whilst this has been facilitated by globalisation, a number of other factors are significant:
  - ✓ Government and individual state strategies to facilitate growth, such as encouraging joint ventures with foreign companies, building technology parks (Bangalore) and establishing 500 Special Economic Zones and empowering business support systems, for example, in finance and banking.
  - ✓ The size of India with a diverse resource base including relatively abundant energy sources and a wide range of environments for the growth of agricultural crops.
  - ✓ The positive demographic dividend with a burgeoning educated middle class has also generated a rapidly expanding internal market for goods and services and also a well-qualified workforce to support the government's encouragement of science and technology projects such as space exploration.

AO2
Application of knowledge and understanding is deployed to discuss whether globalisation was, or indeed now is, the main driver of economic growth: by evaluating the range of factors responsible for the economic growth and how they vary spatially by sector or state, over space and time.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- Globalisation has made a number of contributions to India's economic growth, especially in the service sector, with offshoring and outsourcing by MNEs. Initially it enabled and made feasible, via ICT technology and, to some extent, transport technology and trading conditions, a whole host of companies such as BT and Dell to establish accounting, financial and software operations, with particular concentrations in Bangalore, Mumbai and Delhi. Later, this applied to manufacturing companies such as TATA, an Indian MNE (joint operations), but not to the agricultural sector.
- However, whilst globalisation has facilitated economic growth, other factors have become increasingly influential.
  - ✓ The positive impact of the Indian resource base, for example, iron and coal, for establishing industrial areas such as in Damodar Valley.
  - ✓ The impact of the positive demographic dividend from a youthful population, which has not only provided a highly educated and skilled workforce, initially from the more affluent population, but a huge internal market. Whilst there are constraints caused by inequality, overall, this has been a huge driver.
  - ✓ The role of governments, national and state, has been vital in a number of ways, by directly establishing and supporting various zones and growth poles for development, especially in technology parks and SEZs, including sector specific zones, for example, aerospace, so endeavouring to create a climate for doing business by reducing 'red tape'. Nevertheless, much needs to be done by improving infrastructure.
  - ✓ The government has also been at the forefront of enhancing the quality and prestige of Indian technology around the world, including aerospace (India pioneered the Indian Ocean tsunami warning system after the devastation caused by the Boxing Day Tsunami)
  - ✓ The government has enhanced India's presence in the wider world as the world's most populous country (2021) and the largest democracy, via global organisations, and its role in peacekeeping and in governance and treaty discussions at the UN, although it is yet to achieve the status of being a permanent member of the UN Security Council.
  - ✓ Both India's hard and soft power as an Emerging Nation with potential superpower status, play a role in generating economic growth, with considerable investment regionally around the Indian Ocean. It is also a member of the BRICs group.
  - ✓ Culturally, the influence of the Indian film industry, Bollywood, has again contributed to the general enhancement of the prestige of India.
  - ✓ Whilst there have been concerns about the role of government in Agricultural Reforms internally, and in the disputes with Pakistan over Kashmir, generally the government's plans have helped to create a diverse and varied economy with increasingly impressive growth rates of up to 10%. This has the means to distribute wealth more equitably across the states and ultimately produce a more equal society, thus having a cumulative effect on growth with the growing importance of a huge internal market, which generates an accelerating demand for Indian products and self-sustained growth.

A possible conclusion might emphasise how important globalisation was as a catalyst and facilitator of economic growth, but that there are many other significant factors of growing importance. Indian MNEs such as TATA now operate in many countries of the world and are testimony to India's enhanced economic strength based on a multitude of factors.

Thus, it is debateable whether globalisation is currently the main driver of India's economic growth although it was very significant in the past.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the relative importance of globalisation as the main driver over space and time.
- the skill of constructing relevant diagrams and tables which can be annotated to support the requirements of the question (eg. a growth table or an import/export flow diagram).
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion weighing up the role of globalisation as a driver or enabler of economic growth.

6. 'It is inevitable that India's recent high rates of economic growth have resulted in considerable damage to its environment.' Discuss.

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

Focus: 3.3.5 and 3.3.6

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 how the economy has grown and the impacts that this has on the environment.

- Since 2000 the Indian economy has experienced higher growth rates than most countries, average 7-8% growth of GDP.
- Over time, the contribution of agriculture to GDP has declined and service industries have dominated with outsourcing by MNCs and offshoring. Indian innovation has attracted FDI with many successful Indian and foreign owned manufacturing companies (Tata etc).
- Over 500 Special Economic Zones have stimulated economic growth and technology parks have been established (e.g., Bangalore) with technology companies eg IBM, Hewlett Packard.
- India, (until Covid 19) was among the world's fastest growing economies.
- Economic growth has led to inequalities between states and between urban and rural areas.
- Economic growth results in greater use of resources and energy and therefore waste products.
- State governments have prioritised economic development rather than pollution controls and protection of natural habitats in order to attract companies, and national government directives to cut spending have led to the cessation of many environmental improvements, so water pollution and air pollution are major problems, especially in urban areas (Delhi).
- Rising living standards of some of the population have led to excessive demand for water and energy, all of which has impacted on the environment.

AO2
Application of knowledge and understanding is deployed to discuss whether economic growth inevitably leads to considerable damage to the environment or whether India follows the Kuznet's curve and more sustainable strategies evolve over time to mitigate the damage to the environment.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- The relationship between economic development and environmental degradation is a complex one. Whilst increased environmental damage can be linked to economic growth, especially rapid economic growth, the optimistic view suggests that, as India is modernised, it can develop the technology over time to use resources more sustainably and efficiently and generate less waste.

- Theoretically, the wealthier a country becomes, the more it can afford environmental protection (Kuznet's curve).
- Whilst there is a relatively long standing, strong, grassroots development of the need to care for the environment (Chipko Movement of 1970 for saving Himalayan forests), the reduction of carbon footprints etc requires leadership from both national and state governments who inevitably have other priorities such as taking millions of people out of poverty via economic development (e.g., the Modi Plan to provide rural dwellers with indigenous coal to fuel their houses).
- There have been many initiatives to manage environmental problems in India, including water, food and energy security and water and air pollution, but both the levels of environmental degradation and the deployment of solutions vary spatially by state. Examples include managing acute air pollution by integration of a system of hydrogen buses and enforcement of regulations – but with a workforce of only 200 staff citywide and a lack of monitoring stations or immediate plans to develop clean energy (up to 43% by 2040 in Delhi!). Whilst there are many guidelines, for example, on waste disposal, until recently these were largely ignored.
- A further example is the Sustainable Cities initiative including the National Smart Cities Mission or the Lighthouse Cities project.
- The rate of economic change and development and the sheer scale of the challenges is daunting, and corruption and self-interest of various states makes progress difficult.
- It could be argued however, that the degradation of the environment is only partially linked to recent economic development and that in India, underlying issues of poverty and inequality are the main drivers in both rural and urban environments.
- With reduced inequality at all scales the environmental impacts are likely to be reduced significantly, for instance, the need to use fuel wood as part of the energy mix.
- There are also other global issues such as transboundary transmission of pollution from climate warming.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the inevitability of the link and the possibility of mitigating the problem of considerable pollution.
- the skill of constructing relevant diagrams and tables such as the Kuznetz Curve, which can be annotated to support answers to the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the inevitability of the link and the recognition of the complexity of the relationship.

7. 'Globalisation has been the main driver of economic growth in China.' Discuss.

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

Focus: 3.3.4 and 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 globalisation and other factors and how they can generate economic growth could include:

- Globalisation can be defined as 'growth of global systems and resultant flows of goods, money, people and technology as a result of improvements in connectivity of transport and communications.
- Globalisation is a multi-strand process, which not only involves economic facets (growth of MNCs and the development of transport and ICT networks), but also political globalisation (growth of trading blocs and international financial organisations such as WB and IMF) as well as social facets (improvements in social connectivity via global media and increasing flows of international migration (impact of diaspora).
- In 1978, the Open Door Policy was introduced by the Chinese government (Deng Xiaoping) moving China towards a Socialist Market Economy which opened it to the globalised trading system for exporting its goods and attracted FDI to support economic growth, with foreign multi nationals investing in China, initially in manufacturing – hence the name 'Workshop of the World' – from 1985, spearheading a global shift.
- The impact of FDI from MNEs on Chinese State-Owned Enterprises (SOEs) made them more efficient with many examples of Joint Ventures (VW cars/Chinese Car Companies) and led to modernisation via technology transfers. Some SOEs took over international firms – Lenovo bought IBM.
- The Chinese government also established Special Economic Zones (SEZ) which were critical drivers of growth and modernisation. SEZs such as Shenzen benefited from reduced restrictions on land/planning and tax incentives.
- In the last decade, government regional policies have led to the spread of growth, initially coastally and latterly, along the Yangtse axis.
- Economic growth (measured by growth of GDP) has spectacularly and consistently increased with growth rates rarely below 10% per annum, facilitated by aspects of globalisation, but also encouraged by a number of government strategies which led to modernisation and growth, such as updating infrastructure and legislation for doing business with foreign companies.

AO2
Application of knowledge and understanding is deployed to discuss whether globalisation is the main driver of economic growth by evaluating factors responsible for the rapid growth and how they vary spatially over China and over time.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- Globalisation has undoubtedly provided the framework for China's economic growth, initially in the manufacturing sector, once Open Door policy enabled its influences to reach China.
- Chinese government policy making has enhanced its impact in that since 1985, the government has embraced the advantages offered by globalisation in a number of directions, by allowing some of the efficiencies of 'Western style' manufacturing and services provision to take hold in China via the promotion of joint ventures and development of SEZs.
- The Chinese government spent heavily on upgrading the infrastructure (ICT and transport within China eg. HST and motorway network) and providing secure energy supplies and attempting to provide secure water supplies especially in SEZs, so facilitating the benefits of globalisation over time.
- Chinese government policies have also enhanced the spatial spread of the effects of globalisation across the whole country by planned economic developments, not only in the starting point in Shenzen and the Pearl River Delta, but along the coast to the global hubs of Shanghai, Beijing, but more recently along the whole of the Yangtse basin and also to the North East of China and the Far West, two regions which have lagged behind.
- There are numerous other factors which could be mentioned which have encouraged economic growth and enhanced the impact of globalisation.
  - ✓ The positive impact of quality of health and education systems and the drive to haul the Chinese population out of poverty (14.4 million in 2015 alone) have helped to develop a very competent workforce to drive the growth.
  - ✓ The resilience and drive of the Chinese people.
  - ✓ With increased affluence the internal market of 1.3 billion people has provided Chinese manufacturing and service industries with a strong consumer base for products such as white goods and electronics and above all, underpinned by e-commerce.
  - ✓ A further very significant factor is China's drive to superpower status and to become the number one economy in the world. This has led to massive Chinese investment all around the world, especially in Asia, Africa and South America, with the aim of providing the resources which China needs for industrial development (oil, minerals, other raw materials).
  - ✓ China's drive to be a superpower has been supported not only by hard power (military might, blue water) but also by the use of soft power and wider participation in global IGOs such as the UN (especially the Security Council) and the WTO, which China joined in 2001, and also via BRICs setting up a system of finance which circumvents reliance on the US dollar.
  - ✓ The Chinese government has financed key companies and R&D and technology investment from its huge resources and developed expertise in building nuclear power stations and dams, and manufacturing solar panel and wind turbines which it can export round the world as a result of the systems established by globalisation. This is part of China's increasing drive to be the world's number one green economy in the future.
  - ✓ The Belt and Road development 2018 is indicative of China's role as a global player.

A possible conclusion may be that this growth could not have happened without globalisation, but that a multitude of other intrinsic factors have enhanced the freedoms of trade and interconnection provided by globalisation. In particular, the range of government policies and the growing internal market has had a snowball effect. This growth has been quick to recover as a result of China's management of the COVID pandemic.

Some students may make observations that the world is perhaps entering a period of deglobalisation and that the other factors will become key to driving China's economic growth in the future, in particular the handling of human rights and the management of Hong Kong and Macau.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the relative importance of globalisation as a factor over time and space.
- the skill of constructing relevant diagrams and tables which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question, e.g., an economic growth table since 1985 or an export/import flow diagram.
- the skill in reaching an evidenced conclusion weighing up the role of globalisation as the main driver or enabler of China's economic growth.

8. 'It is inevitable that China's recent high rates of economic growth have resulted in considerable damage to its environment.' Discuss.

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

Focus: 3.3.5 and 3.3.6

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 on the economy have grown and the impacts this has had on the environment.

- Since 1978, the Chinese economy has been transformed with the introduction of the Open Door policy as China began trading with the rest of the world. The Open Door policy was designed to attract FDI and technology and to open overseas markets to Chinese goods.
- Deng Xiaoping's belief in the importance of economic growth led to consistently high economic growth rates of over 10% of GDP and to China's economy becoming the fastest growing in the world in the 21st century, even maintaining growth in the 2008 financial crash and the 2019 Covid crisis.
- Many countries view China as the 'Workshop of the World' with many state-owned enterprises (SOEs) and numerous Special Economic Zones (SEZs) which are critical drivers of modernisation which also contain branch plants of overseas MNEs (e.g., Apple in Shenzhen and Pearl River which utilised the availability of a high quality, yet cheap, workforce. Growth was aided by improved infrastructure and a growing internal market.
- Recently, reforms in agriculture and an emphasis on hi-technology and science industries have continued to support high economic growth.
- Many argue that the emphasis and success of economic growth has been at 'all costs' to both the environment and people.
- Significant environmental effects include widespread environmental degradation with loss of arable land (for building) and loss of resources such as forests as well as soil erosion and desertification.
- There are many environmental issues associated with water shortages and the need to develop environmentally damaging mega-solutions such as the Three Gorges Dam or the South-North transfer scheme. Water pollution and air pollution, both resulting from economic growth, kill hundreds and thousands of people with levels of pollution some of the highest in the world.
- Even with the Hukou system, urbanisation and subsequent city sprawl resulting from migration, has led to pressures on urban environments, as people have migrated to fill jobs created by the economic explosion.

AO2
Application of knowledge and understanding is deployed to discuss whether economic growth inevitably leads to considerable damage to the environment or whether China follows the Kuznet's curve and more sustainable strategies evolve over time to mitigate the damage to the environment.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- The relationship between economic development and environmental degradation is a complex one. Increased and widespread environmental damage can be linked to the extremely rapid growth over the last 40 years, which was very heavily emphasised by the socialist government and its strategic planning – often considered to be 'economic growth at all costs'.
- An optimistic view suggests that as China modernises it can focus the political will and develop the technology over time, to use resources more sustainably and efficiently and generate less waste.
- Theoretically, the wealthier a country becomes, the more it can afford environmental protection (Kuznet's curve).
- In China, although the environmental focus has only been developed in the last 10-20 years it has become part of China's vision to become not only a superpower, but a world leader in green technology which, of course, has much export earning potential.
- Environmental concerns are now taken very seriously at all scales, although local bureaucracy and corruption tend to inhibit both the carrying out of national policies and hinder inter-regional coordination. There are many contradictory laws and regulations, so that when environmental policies hinder economic growth (e.g., pollution conflict), local leaders of communes may overlook their enforcement.
- Huge advances have been made despite the enormity of the challenge:
  - ✓ Since 2008 (Beijing Olympics) China has taken drastic steps from short-term solutions for the Games to longer-term solutions of moving from burning wood and cheap coal to ultra-super critical coal and adding scrubbers (emission controls) to all its thermal power stations.
  - ✓ China has accepted international agreements on climate change to improve its carbon footprint (still the largest emitter of CO^2, but not per capita) with a range of monitoring, and strengthening of pollution laws, and strategic energy pricing to promote green and low carbon technologies. There has also been a huge switch away from fossil fuels to recyclables (nuclear) and renewables (HEP, solar and wind).
  - ✓ In response to problems of deforestation, desertification and soil erosion, the Chinese government has instituted one of the largest forest conservation programmes in the world – the National Forest Conservation Programme – targeting sensitive regions in the upper catchments of rivers and has also pledged to decontaminate 3.33 million hectares of land too polluted for crops, with China aiming to be a global leader in conservation.
- Sustainable cities (usually new build) have been developed and, in 2014, the National New Type Urbanisation Plan called for the integration of people and culture within the economy and environment through local participation and sustainable initiative. This has mobilised literally millions of Chinese to become involved at a local level in clean up initiatives, environmental assessments and issuing pollution permits.
- Chinese and International NGOs are working on river restoration (wetlands) schemes, and water pollution and clean-up schemes.

- However, it could be argued that the scale and pace of Chinese economic development and the need for Chinese people to improve their lives (white goods and diet revolution) presents a huge challenge with much good intent and potential at all scales, but so far with variable progress spatially across China.
- The degradation of the environment is clearly linked to the phenomenal economic growth, but as the sustainable developments have shown, it is not inevitable in the future as China's government and people are so focused on a green future.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the inevitability of the link and the possibility of managing and mitigating the problem of very considerable pollution.
- the skill of constructing relevant diagrams and tables (such as the Kuznet's curve) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the inevitability of the link and the recognition of the complexity of the relationship.

**9. 'Social and cultural factors both provide more constraints than opportunities for economic development in Sub-Saharan African countries.'
To what extent do you agree?**

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

Focus: 3.3.10 and 3.3.11

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. Note it can be answered with reference to two or more SSA countries.

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 social and cultural factors include:

- Social factors include standards of education, health and welfare with details relevant to the chosen Sub-Saharan countries
- Development aid has enabled many Sub-Saharan countries to make good progress in both education and health.
- In education, whilst basic universal primary education is available, only 80% attend primary school reducing to 40% completing high school (continental average). Whilst there have been improvements in female enrolment (impact of MDGs and subsequent SDGs) girls still suffer severe disadvantages and exclusion, particularly in rural areas of poorer countries.
- In health there have been many initiatives concerning improved primary health care including for infants and mothers which has led to a decline infant and maternal mortality.
- As well as major disease eradication programmes such as malaria, typhoid/cholera, HIV/AIDS there are many initiatives for the provision of food and basic medicines and nutritional advice.
- Much of the provision of health and education is provided free which means that families have more money available for buying food etc.
- Cultural issues concern the role of women – the transformational effect of female empowerment in development removes many of its traditional constraints (Rwanda).
- Ethnic diversity and associated inequalities are a feature of many Sub-Saharan African countries as, historically, many state boundaries drawn up by colonial powers paid scant attention to the different groups. For example, in Nigeria there is a tripartite division into three regions based on Hausa, Yoruba and Igbo which has caused considerable conflicts. Many African countries such as Rwanda have experienced civil wars as a result of ethnic divisions based on tribal groupings.

AO2
Application of knowledge and understanding is deployed to discuss the degree to which social and cultural factors are a constant as opposed to an opportunity to drive development.

Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion.

- As development occurs, improvements in education and health and welfare have contributed hugely to enhancing the progress in a number of ways.
- A well-educated workforce can produce the leaders and experts needed for development to take place. If this can include empowerment of females via education this can make a major contribution to economic development. It can also lead to a fall in the rate of population growth as educated career minded women tend to have smaller families leading to a decline in fertility rates.
- A compulsory education programme enhances gender equality.
- Legislation can be passed to ensure women's rights to inherit property and ensure they become business leaders in the community.
- The provision of health care across the country can have a major impact on the efficiency and productivity of the workforce. This has been particularly true with the eradication and treatment of major diseases, eg. HIV/AIDS and malaria which initially led to orphans in many families and a loss of agricultural labour leading to food production crises.
- In 2020 the COVID pandemic exposed the fragility of many African health systems, with difficulties involved in developing vaccination programmes, even with the development of COVAX to secure supplies and this may prove to be its major constraint.
- On the other hand, in recent years ethnic divisions have led to many political struggles and even wars in countries such as Rwanda. Ethnic minority groups are frequently persecuted which inhibits progress as they need to be politically represented to ensure their future.
- The 54 countries of Sub-Saharan Africa are very diverse with different levels of wealth and economic development, political systems and histories of colonialism, so there are both spatial and temporal differences as to what conclusions can be made about the balance between constraints and opportunities caused by social and cultural factors.

Some candidates may adopt a detailed two country approach whereas others will conduct a broad, factoral analysis.

AO3
Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the degree of constraints and opportunities
- the skill of constructing relevant diagrams and tables (for example, on educational opportunities or gender inequality) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the extent to which the balance between constraints and opportunities varies spatially and will change over time.

10. 'The environmental impacts of economic development are inevitably negative in all sectors of the economies of Sub-Saharan African countries.' To what extent do you agree?

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

Focus: 3.3.10 and 3.3.12

This question requires candidates to demonstrate their ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. Note it can be answered with reference to two or more SSA countries.

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 environmental impacts of economic development on sectors of the economy includes:

- Economic sectors include primary, secondary, tertiary and possibly quaternary.
- As the economies of Sub-Saharan African countries grow, increased incomes, more spending power and aspirations for more Western style consumption by an emergent middle-class lead to increased emissions (eg. from cars) and waste, especially in urban areas of wealthier nations (Nigeria, South Africa) – risk.
- Many primary activities involve development of products and resources for export, for example, mining and forest products, which leads to environmental degradation (rainforests of Zaire, mining for diamonds in Sierra Leone or oil in the Niger Delta).
- Increasing population has put pressure on land needed for food with desertification, deforestation and soil degradation a major concern.
- Development of agri-business (eg. Kenyan cut flowers and vegetables business) has had a negative impact on environments via unsustainable use of water for irrigation with water shortages a major problem in southern Africa, use of agrochemicals and pesticides and destruction of wetlands.
- Development of manufacturing, e.g., in South Africa or Kenya, in sectors such as chemicals, metals, pharmaceuticals, leather goods, furniture, generates industrial waste and causes water (river) pollution and air pollution. Authorities frequently turn a blind eye!
- Development of tertiary industries such as tourism can have negative impacts, for example, the mass tourism of The Gambia or safari tourism in Kenya, Tanzania or Uganda, both on ecosystems such as coral reefs, and on the local people, although there are areas of good practice such as ecotourism (gorillas of Rwanda).

AO2
Application of knowledge and understanding is deployed to discuss the inevitability of environmental damage from growth of various sectors of the economy. The degree of inevitability may vary between sectors.

Synthesis will be demonstrated by drawing together evidence to reach a rational conclusion.

- Recognition that development can take many forms along a spectrum from exploitation to sustainability.
- Whilst all sectors do continue to cause environmental damage, many countries such as Kenya, Namibia or Botswana have developed managed strategies to support green growth and more sustainable economic development in most sectors. Rwanda has adopted a green growth strategy in a similar way to EU countries involving recycling and anti-plastic campaigns both for consumers and industries.
- Some of this damage, especially to soils and vegetation, may be exacerbated by physical factors.
- In response to environmental concerns, many, often MNC owned, agri-businesses are researching organic methods, improving how water resources are managed in recognition of the need for more sustainable management, eg. in the global export of flowers or vegetables, (there is, however, a concern over food miles issues and aeroplane generated pollution).
- To some extent, impacts of mining and manufacturing often by Chinese investment, invariably cause huge environmental damage still with water and pollution issues.
- The commodities provide income required for economic development with the export of gold, oil, diamonds, rare earths but can make environmental conditions worse and not better for citizens. The Resource Curse, for example, has led to conflicts in DRC and South Sudan which have led to wars and led to widespread environmental degradation.
- Some MNC generated FDI can lead to higher environmental standards in factories and mines as well as beneficial investment in local environmental schemes, but these remain exceptions rather than the rule.
- Equally, whilst there are numerous, often small scale, local investments in ecotourism, for example, in Zanzibar or Namibia (sustainability), much of the tourism has developed into mass tourism as many of the countries are desperate to attract FDI in this sector as a major way of increasing income and as a catalyst for economic development. The very substantial safari tourism industry in Kenya illustrates examples of positive improvements in the environment (investment in National Parks) thus protecting plants, animals and the natural landscape, but in many cases with leakages not actually bringing as much positive investment yet causing major environmental damage such as marine pollution or deaths of animals (extractive management of Campfire scheme in Zimbabwe).
- The 54 countries of Sub-Saharan Africa are very diverse, with varying levels of economic development and wealth, and stability of political systems, so there are very wide variations spatially and over time in the extent of environmental damage.
- Whilst environmental damage is extensive, as the countries are developing economically, it may not be inevitable. At a local level, many value their environment and do support schemes to conserve it, but often remain helpless against the emphasis of governments and big companies on development and dragging their peoples out of poverty. Moreover, there is variation in sustainability by sector with agriculture and tourism taking the lead.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the degree of inevitability across sectors.
- the skill of constructing relevant diagrams and tables (for example, the Clark Fisher model or spectrum of economic activity) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the extent to which environmental impact is inevitability negative, across and between sectors and how it varies by country (spatially) and over time as sustainable strategies multiply (green growth).

11. Evaluate the importance of physical factors in determining both the distribution and use of energy supplies.

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

Focus: 3.4.2 and 3.4.3

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 the physical factors determining the supply of energy.

- Distribution can be considered at a variety of scales from global, regional to national.
- Energy use is self-explanatory and can be explored at any scale from local to global, with national being the likely choice.
- Geological factors play a major part in the distribution of fossil fuel supplies. The formation of deltaic swamps allowed coal to form and oil and gas are concentrated in specific locations where geological conditions allow oil and gas traps to form.
- Geological factors also influence the location of geothermal sources in areas of tectonic activity such as thermal areas in North Island, New Zealand and Iceland.
- Sources of uranium for nuclear power occurs in specific locations such as by-products from former gold spoil heaps in South Africa.
- Geology can also have an indirect impact, for example, large nuclear power stations are best located on geologically and seismically stable foundations/areas (risk).
- Climatic factors are very significant for some renewables, and these vary globally. Wind power relies on high, constant wind speeds in mid latitude, westerly, wind belt areas on exposed hillsides or offshore. Solar power requires areas with high insolation rates such as desert areas and HEP operates most efficiently in areas of high, all year-round precipitation (New Zealand). Conversely, climate factors constrain the use of HEP or solar.
- Physical factors which occur globally but operate at a regional or local scale include:
  - ✓ Waves require areas with strong wave movement and tidal power stations are linked to relatively few estuaries with a very large tidal range such as the Bay of Fundy.
  - ✓ Relief factors are also an important consideration for HEP generation which relies on either a head of water to drive turbines, for example, in glaciated valleys, or a large volume of water from a major river, eg. the River Rhone. Lakes also provide natural reservoirs for HEP and there are many potential sites for reservoir building in the narrow, relief rainfall facing windward sites of mountain areas.
- Ecological factors can provide fuel for biomass production.
- In many cases, the lack of optimum physical factors provides a constraining influence, but technology has increased the distribution of potential supplies, for example of HEP and solar.

- The use of energy supplies globally is strongly influenced by the decisions or connections with the climate emergency and the need to move away from fossil fuels, especially coal and oil.
- The use of nuclear power may be constrained globally too, over concerns about the dangers of its use (potential for military transfer and dangers globally of meltdowns).
- The Development Gap (inequality) also has a major influence on use of energy sources in terms of both costs and access to technology and the choice of fuel. In developing countries (LICs) local, low-cost resources such as dung and fuelwood are often most used.
- National energy policies may provide a framework for use of energy mix via energy security strategies.
- Globally, the climate emergency is a major factor in the drive against fossil fuels.

AO2
Application of knowledge and understanding is deployed to consider the extent to which physical factors determine the influence of distribution and use of energy supplies.

Synthesis will be demonstrated by the drawing together of evidence to reach a rational conclusion.

- There are clearly very strong links to a range of physical factors in determining the distribution of global energy supplies (see AO1). Some physical factors lead to more widely distributed supplies spatially than others, for example, when comparing coal to geothermal energy. Coal is almost ubiquitous whereas geothermal energy is very limited in its distribution. The lack of suitable physical factors can lead to constraints as to whether certain sources of energy are developed nationally. Regionally, physical factors have led to the geopolitical concentration of oil in OPEC countries which has a global impact.
- When considering the use of energy supplies the situation is far more complex.
- A further factor is the economic costs of development. For instance, with peak oil occurring within thirty years there is an incentive to develop unconventional supplies where geological conditions are sub-optimal (oil shales, deep water oil, tar sands). So much of development is linked to geopolitical considerations and the price of oil as set by OPEC policies.
- Oil, gas and, to an extent, coal supplies are global commodities transferred around the world in specially designed shipping VLCCs, tankers, pipelines etc, so whilst the physical factors are initially significant, other economic factors become very significant.
- Technological considerations, especially for newer sources of alternative energy become very significant. Most developing nations will rely on expertise from developed nations for developing supplies, for example, building dams and nuclear power stations. For some newer sources the technology is still in the process of development so supplies are not yet fully used, for example, wave or tidal power.
- Political considerations also become significant as many countries need to have energy security based on developing reliable sources of supply, for example, USA is decreasing reliance on imported oil from OPEC countries by building up its ‘fracking’ industry. In some cases, political considerations determine whether a country develops a significant nuclear power stream (not especially linked to physical factors at a national scale). Germany for instance, has phased out nuclear power stations compared to France where 75% of electricity is generated from nuclear power.

- Environmental considerations have now begun to dominate as the use of fossil fuels, especially coal and oil, has a major impact on CO^2 emissions. The drive towards sustainable sources and green power and the need to fulfil pledges for the reduction of greenhouse gases has led to a major development of wind, HEP and solar energy, often in sub-optimal locations as improving technology enables this to occur. The UK for instance currently has no working coal mines, in spite of there being plentiful supplies still available, although one specialist one is planned in Cumbria for use in the steel industry. India, on the other hand, plans to develop huge supplies of low-grade coal for use by the rural poor to provide them with much needed energy.
- In conclusion, physical factors are clearly a major factor in determining the distribution of energy supplies, especially globally, but the way and extent to which they are used involves a complex web of other factors which can operate globally but trickle down to national and ultimately, local scales.
- At national scale, whilst physical factors can be important, other factors such as economics or politics are increasingly significant.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the importance of physical factors and their influence on global and regional (Middle East) scales and the extent to which the distribution is linked to use of these resources, with many other significant factors which vary spatially and over time.
- the skill of constructing relevant diagrams and tables which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the close link between physical factors and the distribution of energy supplies and the more complex links to global energy use.

12. 'Increased efficiency of energy use is the only sustainable solution to the energy crisis.' To what extent do you agree?

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

Focus: 3.4.7

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 solutions – ie:
  - Solutions which are 'green' and conserve the environment for future generations.
  - Solutions which are affordable for all countries and governments around the world
  - Choices of solutions which enable the world's peoples to pursue a living which enables them to have an acceptable quality of life and be involved as a community in decision making (Environmental, social and economic sustainability). Credit ideas related to the stool of sustainability or the sustainability quadrant.
- The energy crisis has two main facets
  - The inequality of availability to provide all countries of the world with energy for their rising demands (globally a 40% increase in demand from 2010 by 2030) especially in emerging or developing nations.
  - The need to uncouple energy use from the reliance on fossil fuels because of the consequences for global warming (CO2 and methane emissions).
- Increased efficiency can be achieved in a number of ways, including developing eco-homes (design of roofs, insulation provision, heat pumps etc), or more energy efficient transport (electric cars, hydrogen buses), or more efficient appliances, by technological improvements.
- Policies to reduce demand can lead to increased efficiency of use. In HICs installation of smart meters encourages companies and individuals to conserve energy. A number of savings can be made by lifestyle changes, for example, transport usage (walk, cycle, use fuel efficient public transport) as well as using IT to cut down on commuting (widespread during the COVID 19 pandemic), or even by changing diet and spending patterns.
- Note: In LICs, reducing energy demand is more problematic as most people in LICs use less energy per capita, although there are problems with the mushrooming economies of emergent nations.
- Making fossil fuels, especially coal, less dirty – ie. clean technologies for fossil fuels, including carbon capture, carbon sequestration and beneficiation/gasification of coal (a strategy pursued by Modi's India).
- Using alternative energy sources
  - Recyclable or critical sources (nuclear and biomass)
  - Renewable or non-critical sources, including wind, solar power, HEP, geothermal, wave and tidal power are all everlasting as they depend on wind, sunshine, running water, waves and tides.

AO2

Application of knowledge and understanding is deployed to consider whether increased energy efficiency is the only truly sustainable solution or whether it should be used in tandem with managing and reducing demand and also developing fossil fuel alternatives and clean technologies for fossil fuels themselves.

- Energy efficiency has many attractions, as it can be applied to all sources of energy, including fossil fuels.
- It can also operate at all scales, from global to local (scale) and access nations at all levels of development (spatial). It would have some environmental benefits and save on economic costs and be supported socially by nations and communities.
- Energy efficiency can be closely linked to reduction in demand, but with demand reduction there are issues with equity and social justice as with LICs, they use less energy compared to HICs, and as their economies emerge, they will need more energy to raise living standards and develop their economies over time
- There are also issues of lack of capital and technology in LICs for achieving strategies to reduce demand.
- All alternatives to fossil fuels will clearly contribute to the solution of the environmental crisis (climate warming) and prove beneficial to the CO2/ methane emission budget to a lesser or greater extent. In their favour, they emit less CO2, although many, such as HEP, nuclear, wind or biomass, have substantial carbon footprints in their construction and/or development phases.
- Wind power has great potential but is location specific to areas of consistently high wind in mid-latitudes and locally (higher altitudes, exposed locations, coasts) and is often highly contested in areas of high scenic values, e.g., Mid Wales, where power lines cross the countryside. There are concerns about unpredictability of supply with technological work needed to 'store' the power. There are major ecological concerns about the offshore wind farms. Huge wind farms will be needed for the power to be produced in sufficient quantity so magnifying potential environmental impacts.
- HEP is the most mature of the alternative sources and because of its large scale is relatively cost-effective. The mega-dams needed have huge ecological and environmental impacts and, in some cases, where the river resource is shared, have the potential to lead to water wars, GERD on the River Nile (Ethiopia and Egypt). The supplies may be adversely affected by extreme climate events such as droughts.
- Solar power is the third most important source in terms of global stored capacity. It is pollution free, relatively efficient, requires little maintenance and in theory provides a limitless supply of energy. Technology developments have led to a recent rise in cost effectiveness, but its efficiency varies spatially and temporally. Many major potential sites are remote from heavily populated areas, e.g., Sahara desert.
- Geothermal power provides a constant supply of energy and is extremely cost effective in suitable areas of tectonic activity such as Iceland, but these are spatially limited.
- Waves or tides have high potential, but the technology is still being developed, especially for waves, and this leads to currently high costs and also concern over its environmental effects (eg. proposed Swansea Bay or Severn Barrage).
- Nuclear energy is a major baseload supplier but generates political debates because of potential explosions and dangerous long-lasting waste and also the overlap with nuclear weapon technology has restricted its availability for countries such as Iran. There are also concerns over terrorist activity and meltdown (Fukushima and Tohoku tsunami in Japan). Otherwise, nuclear produces clean energy at a large scale, albeit with a very long lead-in and high costs for power station construction.

- Biomass can reduce dependence on fossil fuels but can lead to rainforest destruction and compromise food production. Biofuels such as maize and sugar cane can require irrigation and the production, harvesting and transport of biofuels means that it is not carbon neutral and creates a significant carbon footprint. However, there are many sources of biomass which are readily available from dedicated second generation biofuel sources, (algae) to biomass from cow dung (India).
- An evaluation of the problems may suggest that future developments will over time eradicate some of the problems by cutting economic costs and mitigating environmental impacts.
- Many of the major GHG emitters, largely the BRICs group, are heavily reliant on fossil fuels. They have made huge strides in developing alternative sources (especially HEP, wind and solar) although they need more effective grid systems to fully utilise these sources of energy across large areas. Target dates of 2050 (China), 2070 (India) have been set for achieving Zero Carbon status.
- For countries such as India or China, their very large supplies of fossil fuels, especially coal, are in the short term, essential for their economic development and improving the lives of their people in spite of the huge environmental problems such as pollution, in addition to the CO2. They have huge demands of energy, therefore they may favour the use of clean technologies such as Carbon Capture Sequestration to justify their use of fossil fuels.
- Long term, CCS is seen as the 'magic bullet' as power plants could continue to operate with vastly reduced emissions (up to 80% decrease), whilst research into carbon capture continues, cost and reliability of storage remain huge issues, so this may be a long-term option. Other lower cost measures for cleaner (but not clean) coal include beneficiation and using PC (pulverised coal) and gasification (India's 5-year plans).
- A possible conclusion is that the energy crisis is multi-faceted and is happening now with climate warming the world's most wicked problem. It therefore follows that, whilst increasing energy efficiency is the most sustainable environmental option, it cannot be the only one, as how to develop sustainable energy is such a complex issue and there is considerable debate concerning its economic, social and political sustainability.
- Environmental sustainability can only be achieved by global co-operation, as solutions must be equitable for all areas of the world, yet tailor made to the needs of individual communities and nation states.
- A future which suggests energy efficiencies will work in tandem with other technological developments as in the use of alternatives to fossil fuels and making fossil fuels cleaner which could be an interim shorter-term option.
- For countries experiencing high energy demands, multiple solutions may be needed with energy efficiencies not the only solution.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments evaluating the role of energy efficiency in relation to the other strategies spatially and over time
- the skill of constructing relevant diagrams and tables (for example, of comparative cost or the energy transition model) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the importance of energy efficiency as the only way ahead.

13. To what extent can the damaging impacts of atmospheric pollution be managed and reduced in urban areas?

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

Focus: 3.5.6

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 atmospheric pollution sources in urban areas and its damaging impacts.

- Particulate pollution arises from road traffic emissions, especially HGV diesels and also from thermal coal fired power stations and from residential and commercial combustion, including wood burners and possibly from dust from quarrying and building works, or surrounding bush fires. Accept mention of increased concentrations of CO_2.
- Acid rain can also occur in industrial towns locally as rain is contaminated by chemicals especially SO_2 through fossil fuel combustion, again from power stations and paper mills, chemical works and smelters and incineration of refuse.
- Photochemical smog forms where intense sunlight, high concentrations of volatile organic compounds and nitrous oxides from diesel emissions combine to form a poisonous smog containing low level ozone, liquid particulates and other pollutants leading to a brown haze.
- Damaging impacts include destruction of limestone buildings from carbonation and also both photochemical smog and acid rain cause damage to humans, especially the very young and elderly, including brain damage, lung and heart function, as well asthma attacks.
- There are a number of technological solutions, which largely tackle the **source** of the urban air pollution (measured by monitoring) to reduce atmospheric pollution. For example:
  - ✓ Controlling particulates from car's catalytic converters
  - ✓ Encouraging shift from using petrol and diesel cars to electric cars
  - ✓ Using scrubbers to decrease harmful emissions from power stations and industrial plants
  - ✓ Developing alternative energy sources especially alternatives to coal and wood.
- These solutions can be supported by political solutions through legislation (Clean Air Act, Smokeless zones), ways of managing flows of cars entering cities (congestion charge) and monitoring pollution levels and attitudinal fixes by educating and rewarding urban dwellers for changing their energy use.
- Examples of urban areas which have very poor air quality include many large cities in the developing world (Delhi, Beijing, Mexico City) and developed cities (London, Los Angeles etc).
- Levels of urban air pollution vary **spatially** within cities, and over **time,** short-term, daily, seasonally and longer time scales (decades) as impacts are managed and ultimately reduced.

AO2

Application of knowledge and understanding to consider to what extent the damaging impacts of atmospheric air pollution can be managed and reduced.

- When considering the extent that the damage can be reduced and managed, so much depends on the physical site of the city (for example, Los Angeles is in a bowl) and also the morphology (lay-out) as urban settlements often extend along valleys. Equally the strength and direction of wind can have either beneficial or detrimental effects.
- The improvement of levels of air pollution comes at an economic and political and even social cost. It is easier for improvements to be made in Developed Cities as they have the finance to develop city-wide strategies and in many cases these cities are not growing in population and extent, in contrast to the rapid population and economic growth in developing urban areas in developing countries where people have to rely on fuel wood for heating especially in the huge squatter settlements.
- Many of the solutions proposed in these cities would potentially be very unpopular as they affect poverty-stricken people's livelihoods, and the damaging impacts are more severe because of restricted access to quality health care and treatment for conditions such as asthma.
- Evidence suggests that technological solutions outlined in AO1 for reduction can over time be very successful, especially dealing with point pollution issues associated with specific factories or power stations or developing alternative heating and energy sources for residential areas. The results can clearly be seen in cities such as London where until the 1960s, pea soupers (fogs) were the norm.
- For successful adoption, technological solutions need to be supported by stick and carrot solutions, such as legislation to develop Clean Air Acts and also charging vehicles to enter the city area (congestion charges) while at the same time giving people grants and incentives to change (taxation perks such as for purchased electric cars or new heating systems or subsidies for solar panels, provision of widespread charging facilities or scrappage payments for getting rid of old, 'dirty diesel cars').
- City decision makers can also manage the daily and seasonal weather-based variations in pollution levels more effectively with extensive monitoring.
- Equally attitudinal fixes are required to educate urban dwellers about the causes of the problem and how to develop sustainable solutions such as walking and cycling.
- Some planning strategies such as Cities for People can encourage green cities (eg. Freiburg or Copenhagen) by establishing comprehensive and affordable transport systems, and land use designs, which limit journeys to work.
- Solutions are also likely to be far more difficult in developing World Cities, because of the lack of finance to support legislation, or to give inhabitants grants to adopt green heating strategies, or even to transfer from fuel wood stoves to cleaner charcoal burning stoves. The sheer number of polluting vehicles makes solutions very difficult. In some countries, such as China, solutions are made easier by the power of the State to legislate and override the people's view. (e.g., Beijing Olympics 2008).

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the extent to which damaging impacts can be managed and reduced, recognising the importance of spatial variations related to level of development and the importance of time.
- the skill of constructing relevant diagrams and tables (for example, a league table of pollution events in mega-cities) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the success in managing the extent to which the damaging impact of atmospheric pollution in urban areas can be reduced and managed.

14. 'Both adaptation and mitigation strategies have important roles to play in coping with the impacts of climate change.' To what extent do you agree?

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

Focus: 3.5.4, 3.5.7

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 adaptation and mitigation strategies to manage climate change.

- Adaptation refers to how people and societies change their lifestyles, livelihoods and environments to cope with the risks from climate change. Adaptation tends to happen at a local scale because the actions are tailored to specific, local impacts.
- Adaptations use all levels of technology and largely tackle the risks from climate change such as extreme weather events or rising sea levels.
- Examples include:
  - ✓ Development of wildlife corridors
  - ✓ Investing in water storage to provide safe and clean water and irrigation for crops during more frequent droughts.
  - ✓ Using GM technology to grow drought resistant crops
  - ✓ Enhance resilience of buildings and structures against flooding, both river and coastal flooding
  - ✓ Managing rising sea levels or flood risk, for example, by planting mangroves, building bunds or sustainable options of coastal defences such as managed realignment (natural retreat) as well as hard engineering schemes (sea walls etc).
- Mitigation tries to tackle the causes of climate change by reducing the output of greenhouse gases and/or increasing the amount of greenhouse gas storage.
- Mitigation needs to operate at all scales - personal, local, regional, national, global and can involve all levels of technology and frequently operates on a longer-term time scale.
- Examples include:
  - ✓ A huge range of emission-cutting strategies
  - ✓ Setting targets to reduce greenhouse gas emissions using developing global frameworks, at COP conferences such as Kyoto, Paris or Glasgow, which can then be translated into national and, ultimately, local strategies
  - ✓ Switching from fossil fuels to recyclable and renewable alternatives, i.e., sustainable energy
  - ✓ Geoengineering
  - ✓ Capturing carbon emissions and/or storing them, for example, in old oil wells.
  - ✓ Green transport strategies, fuel efficiency, new fuels, car parking, working patterns, effective public transport and promotion of walking and cycling.
  - ✓ Planting new forests to provide more stores.

AO2

Application of knowledge and understanding to show that adaptation and mitigation have different functions and how they need to operate in tandem to manage the 'wicked' problem of climate change.

- Mitigation and adaptation are not alternatives as the strategies are designed for different purposes.
- Adaptation operates in response to impacts, usually at a local scale (community level) and is largely designed to manage risks as tipping point threatens (ecosystems and environments).
- Coastal flooding from sea level rise and melting sea ice is increasingly manifested by extreme weather.
- Adaptation can be carried out using all levels of technology, often by local communities using intermediate technology, such as for housing design to provide resilience against flooding or building water tanks for storage during drought conditions (as in Sri Lanka). It is therefore suitable for countries at all levels of development.
- Some adaptations are carried out at national scale, for example, the three-stage plan for the Maldives to combat the increasing risk from rising sea levels:
  - ✓ small scale coastal defences, mangrove planting,
  - ✓ raising and building up artificial islands
  - ✓ and finally, evacuation to a pre-arranged location in another country.
- Some transfers, such as GM drought resistant crops, will be transferred to many countries by MNCs specialising in GM technology.
- Mitigation can take a number of forms including modifying the causes, as well as mitigating (ie. diminishing) and managing the effects.
- Modifying the causes has to take place initially at a global level because international agreement is needed to control the emissions of greenhouse gases – this is a global, trans-boundary problem which crosses international frontiers. Global action needs to be supported by regional, national and local, and even personal levels (think local, act global).
- Managing the effects is necessarily, national, regional and local.
- Globally, countries struggle to agree on strategies to reduce greenhouse gas emissions as climate change is a challenge for global governance. Scientific uncertainty in the 1980s and 1990s about the cause of global warming gave policy makers an excuse to 'kick the can down the road' for future governments and an excuse for climate change sceptics (US Republican Party) to avoid action for political reasons. As the impacts of climate warming have accelerated, this has led to countries such as Bangladesh, Tuvalu or the Maldives to rely on local adaptation measures.
- Currently there are tensions between developing/emerging nations and developed countries as most solutions require huge capital investments to provide technology fixes for mitigation and, as richer countries contribute to the bulk of the emissions, poorer countries are 'bearing the brunt' of the impacts.
- Globally, Kyoto in 1997 (which developed international carbon trading, clean development and clean technology mechanisms, (for example, planting trees to create global sinks) and, latterly, Paris in 2015 have been landmark treaties with 195 countries developing pledges to set their own targets for the global increase of GHG to be within 2°C of the pre-industrial level.
- Since then, in 2018, the IPCC published a report (The Final Call) where 1.5°C was proposed as a new target for the upper limit of liveability.

- Many mitigation strategies, such as the development of emission cutting strategies have to be supported by national planning with a plethora of measures across the whole spectrum from energy policies for sustainable use, strategies for waste, agricultural practices, green transport strategies, planning regulations (compact cities) to emissions cutting technology, which cumulatively contribute to a decline in GHG.
- These need to be mirrored at a local scale to cumulatively contribute and also need the support of the media for an 'attitudinal fix' so that the population are involved in the movement to 'save the planet' and believe in the severity of the climate emergency.
- These mitigation programmes are extremely comprehensive and far-reaching and go well beyond adaptation measures as they are proactive rather than reactive. As many measures are expensive and involve economic and social costs, for example, in abandoning fossil fuel use, as well as technology, the strategies have to be underpinned by a global governance framework.
- Currently, the disagreements of nations such as US and Brazil as to the importance of climate warming as a problem have a major impact on mitigation success, as mitigation is a very political strategy.
- As a conclusion the purposes and scale of adaptation and mitigation strategies are very different with mitigation concentrated on the future and adaptation more on the present short term, but both are needed and have an important part to play because of the scale and complexity of the climate problem. clearly mitigation is a much more comprehensive strategy which can operate at all scales and over a long time period.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments concerning the importance of both adaptation and mitigation.
- the skill of constructing relevant diagrams and tables (for example, a timeline of global COP conferences) which can be annotated to support the requirements of the question.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as to the importance of both adaptation and mitigation strategies, and how they play different, but interlinked roles in coping with the impacts of climate change.