



GCE A LEVEL MARKING SCHEME

SUMMER 2025

**A LEVEL
GEOGRAPHY - COMPONENT 3
A110U30-1**

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE A LEVEL GEOGRAPHY
COMPONENT 3: CONTEMPORARY THEMES IN GEOGRAPHY
SUMMER 2025 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	<i>Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change at a variety of scales</i>	<i>Apply knowledge and understanding in different contexts either to analyse or interpret or evaluate geographical issues and information</i>	<i>Use a variety of relevant quantitative and qualitative skills to construct arguments and draw conclusions</i>
4	10-14 marks Demonstrates thorough and accurate knowledge; confident understanding of relevant concepts and principles throughout the response that is wholly relevant to the question Demonstrates knowledge and understanding through the use of appropriate, accurate and well-developed examples Wholly appropriate, accurate and relevant supporting geographical terminology is well used Well-directed and well-annotated sketch maps / diagrams are included and should be credited	16-20 marks Demonstrates sophisticated application of knowledge and understanding either to analyse or interpret or evaluate in order to produce a full and coherent response that is supported by wholly appropriate evidence Demonstrates application of knowledge and understanding through the synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the confident application of the specialised concepts throughout the response	4 marks The response uses wholly relevant qualitative skills to construct clear, coherent and appropriately structured arguments and conclusions
3	7-9 marks Demonstrates secure factual knowledge and reasonable understanding of relevant concepts and principles for large portions of the response that is mostly relevant to the question Demonstrates knowledge and understanding through the use of appropriate, generally accurate and developed examples The use of appropriate and mostly relevant geographical terminology is evident Appropriate, basically accurate annotated sketch maps / diagrams are included and should be credited	11-15 marks Demonstrates accurate application of knowledge and understanding either to interpret or analyse or evaluate in order to produce a partial but coherent response that is supported by mostly appropriate evidence Demonstrates application of knowledge and understanding through the partial synthesis of the connections between different elements of the question Demonstrates application of knowledge and understanding through the mostly relevant application of the specialised concepts	3 marks The response uses mostly relevant qualitative skills to construct structured arguments and conclusions where coherence is variable

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

Section A: Tectonic Hazards

1. 'Social factors are the most important human factor influencing risk from, and vulnerability to, tectonic hazards.' Discuss.

AO1 [14] AO2.1c [20] AO3.3 [4]

[38 marks]

Focus: 3.1.4

This question requires candidates to demonstrate their ability to develop sustained lines of reasoning, which are coherent, 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 points not contained in the indicative content.

AO1

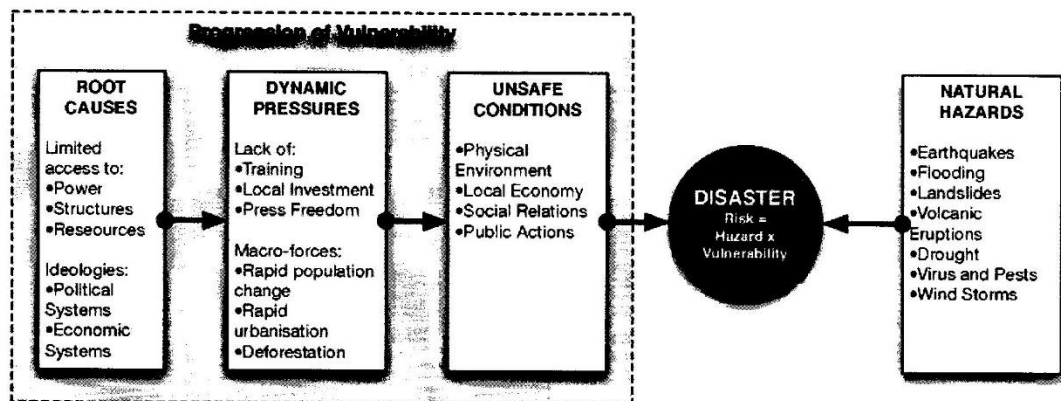
Knowledge and understanding of human factors influencing risk and vulnerability.

- Risk is the probability of a hazard occurring and creating loss of lives and livelihoods.
- Vulnerability implies a high risk of exposure to hazard combined with an inability to cope.
- Social factors include population density, population profile (age, gender, race) and levels of education and poverty, type of housing and building conditions.

Other human factors include: (see specification)

- Economic factors including level of development and technology.
- Political factors including quality of governance.
- Geographical factors including rural/urban location, degree of isolation and accessibility and time of day.
- All of these factors are extrinsic factors, i.e. not related to the hazard itself, whereas intrinsic factors are related to the hazard profile (magnitude is usually the dominating factor)
- Hazards could include primary (earthquakes and volcanoes) and secondary (landslides, tsunami and liquefaction).
- Examples of amplification could include Haiti earthquake 2010 (issues of poverty and high density of population), Indian Ocean tsunami in Aceh 2010 (gender issues), Turkey/Syrian earthquake 2023 (extreme poverty), Moroccan earthquake 2023 (population profile/race), Sichuan 2015 and Tohoku 2011 (impact of ageing population).
- Examples of the opposite circumstances (decrease) would also be very relevant where favourable social factors make populations very resilient, e.g. earthquakes in Chile or California.
- PAR model could be used to illustrate how social factors lead to dynamic pressures and the development of unsafe conditions.

Figure 1: PAR model



AO2

Application of knowledge is deployed to evaluate the importance of social factors in relation to other human factors, economic, political and geographic. Synthesis will be demonstrated by the drawing together of evidence to reach a rational conclusion.

Evidence in support of the importance of social factors could include:

- Although risk to hazards could be considered involuntary and related to tectonic activity distribution, it can also be linked to social factors including people's perception of risk and factors such as a lack of choice of risk-free locations, as people living in poverty have little choice about living in a risky area, or the economic benefits such as quality soil and the ability to benefit from incomes from tourism to live.
- Vulnerability is very closely linked to social factors.
The highest levels of vulnerability (UNDP Disaster Risk Index) occur amongst the poorest people living in environmental settings such as:
 - Urban dwellers in informal settlements and inner-city slums of the most rapidly growing cities, forced to live on steep slopes in areas liable to flood, land slipping or near dangerous industrial sites.
 - Rural dwellers (70% of the world's poor) located on marginal land, suffering from food insecurity, natural resource degradation and experiencing increasing climate extremes are also vulnerable.
- Social factors linked to population include population profile. Research has shown statistically that the very young and the very old are more likely to be killed or injured (difficulties of evacuation) as are female family members who are often poorly educated on avoiding disasters and are in their homes when the hazard occurs, a population feature of the 2010 tsunami disaster in Aceh, Indonesia or more recently in the October 2023 Afghanistan earthquake. Sometimes, it is a particular racial group within society, usually a poverty-stricken underclass that are living in the disaster zone. The Berbers formed the main group killed by the Moroccan 2023 earthquake, as did refugees in the recent Syrian earthquake of 2023.
- Population density is also clearly linked to maximum risk vulnerability as numerically it will lead to more deaths, and also high population densities are linked to poor living conditions and inadequate housing (shanty towns of Haiti earthquake of 2011). It was the city centre high density area of Christchurch in New Zealand which led to such a costly bill for damaged infrastructure, but deaths only occurred where building regulations had been downgraded.

- Whilst social factors are clearly of great importance especially for vulnerability, it is undoubtedly true that both economic and political factors are also very significant. Level of development is an overarching factor influencing many other factors such as availability and access to technology for predicting, monitoring, and warning – many researchers consider it to be the most significant as for similar magnitude event, deaths and injuries are far greater when the hazard 'strikes' in LICs, especially when insurance is not available.
- Political factors such as the quality and attitude of governance can also be extremely significant before, during and after a hazard event – illustrated by Haiti 2010 or Turkey/Syria 2023, or Myanmar 2025 in contrast to Iceland (2023) as it contributes to resilience and effective management.
- Geographical factors can also play a major part, especially issues of isolation and access, Kashmir 2005, Nepal Gorka 2015, which delay rescue and recovery and also arrival of aid. Kashmir was particularly problematic as the area was undergoing a very cold period during the earthquake, hampering survival. Other geographical factors of location (spatial) can also be crucial – although there is no definitive answer as to whether rural or urban locations are the more difficult to manage. Some earthquakes, e.g. Turkey/Syria or Kashmir, involve getting access across an international boundary which adds to the difficulties of providing access to aid.
- A surprisingly significant overlooked factor is time as this determines what people were doing when disaster struck – it certainly added to the high numbers of deaths in the eruption of Nevada del Ruiz which happened in the night and the Kobe earthquake 1995.

These extrinsic human factors may be linked to the intrinsic factors of the physical profile but this not necessary for full credit to be given.

A conclusion may link social factors to risk, but at the same time recognise that other human factors play a very significant role. There is a very strong link between social factors and vulnerability (see Risk Equation – Hazard x Vulnerability/Resilience).

Many social factors are very clearly interlinked to other human factors, especially economic ones, such as poverty, ill health, marginalisation – a reoccurring feature of many earthquakes in 2023 (Syria/Turkey, Afghanistan, Morocco) which all morphed into disasters.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the relative importance of social factors compared to other factors for both risk and vulnerability.
- the skill of constructing relevant diagrams and tables which can be annotated to support answers to questions, (Basic PAR model).
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the relative importance of social factors, supported by fact files of tectonic hazard events.

2. 'Both short- and longer-term responses are equally important for the effective management of tectonic hazards.' Discuss.

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

[38 marks]

Focus 3.1.5

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

Indicative Content

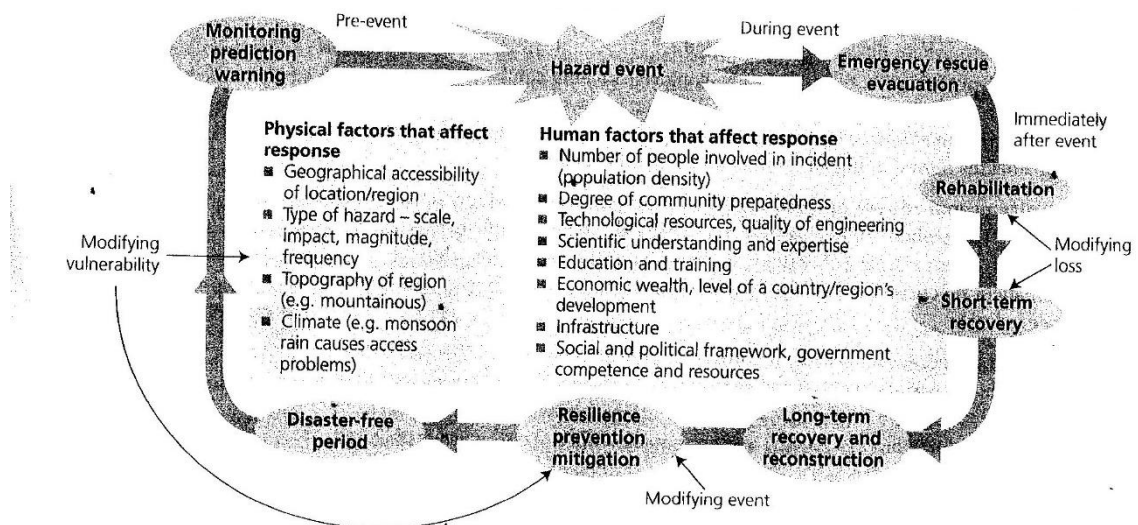
The indicative content is not prescriptive, and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding of short- and longer-term responses (time) to the effects of tectonic hazards could include:

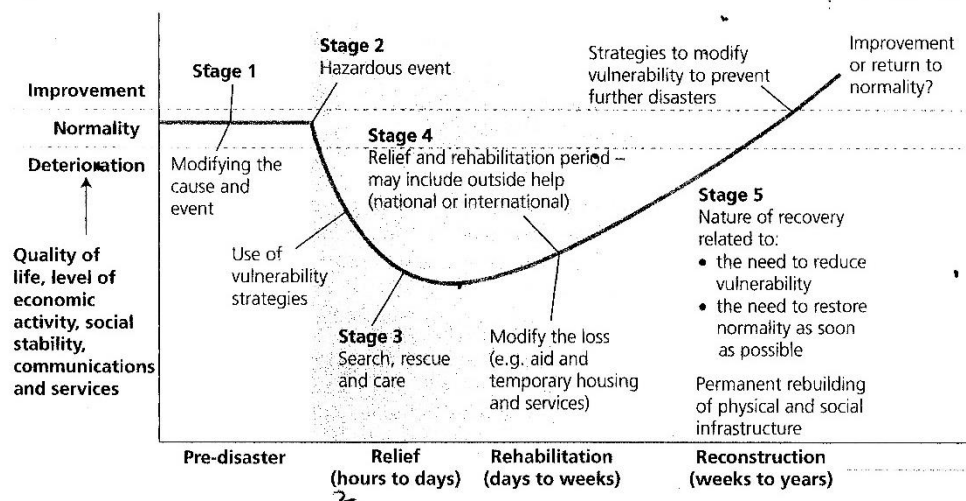
- The use of a conceptual framework – e.g. Hazard Management Cycle or Parks Disaster Response Curve (see Figure 2 and 3) – to identify a number of short- and long-term phases in the management of tectonic hazards.

Figure 2: The Hazard Disaster Management Cycle



- Use figures 2 and 3 to credit time frames.
- Short term – during and immediately after the event – rehabilitation
- Recovery and reconstruction modifying the loss via emergency aid (interdependence) temporary shelters, food, medical supplies.
- Via insurance and short-term aid to rebuild and repair.
- Developing increased resilience by community education (modifying vulnerability), mitigation and adaptation strategies for prevention (modifying the event).
- Longer term aid for provision of technology and reconstruction – e.g. of aseismic buildings to avoid the hazard.

Figure 3: Park's Disaster-Response Curve model



- Credit supporting examples across the full spectrum of hazards – earthquakes (primary, ground shaking and secondary, landslides and liquefaction) and volcanic eruptions and tsunamis across a range of time scales.
- Knowledge and understanding of the elements of effective management to include minimising deaths and injuries (short term social impacts) and longer-term restoration of livelihoods and infrastructure (economic impacts).

AO2

Application of knowledge and understanding is deployed to evaluate the importance of short- and long-term responses and the physical (intrinsic) and human factors which influence the degree of importance.

- Whilst the short- and longer- term strategies are interdependent, e.g. evacuation (short term response) is very effective e.g. for arrival of tsunami (numerous Hawaiian examples) it depends on long term monitoring and prediction, especially for volcanic eruptions/tsunami. The degree of effectiveness and the importance of the strategy depends on many factors.
 - The nature of the primary/secondary hazards, for example, managing a lava flow, liquefaction or aftershocks of an earthquake associated with risk – scale and magnitude are extremely important as this can affect level of disaster and whether short- or long-term responses are more effective.
 - The frequency of occurrence – preexisting knowledge can determine the effectiveness of short-term strategies as can community preparedness (e.g. disaster/shelter packs). The lack of knowledge (unknown/hidden faults) can lead to a lack of preparedness, e.g. Christchurch Earthquakes 2010 -2011.
 - Frequent hazards with predictable spatial occurrence often mean that there is a tradition of preparation/drills, e.g. Mt Taal in the Philippines (PHIVOLCS) contrasted with White Island New Zealand 2021.
 - Earthquakes in non-plate settings are very unlikely to be predicted (Tangshan, China 1976 which produced a very high death toll with an ineffective initial response).
 - The areal extent of the tectonic hazard can be very significant in determining whether short or long –term strategies are more effective. For example, the ash cloud associated Eyjafjallajökull, 2015 had huge impacts on aviation, especially in European air space. Whilst evacuation was very effective at a local scale, short-term, management at a wider scale proved very ineffective,

e.g. Grindavík 2023. On the other hand, the 2004 Indian Ocean tsunami which was also Pacific wide would have been managed by developing a prediction and warning system, but short-term relief and rescue proved ineffective in some countries, hence the huge death toll of over 200,000.

- In terms of extrinsic factors associated with the location of the hazard event, the isolation of the place, the density of population or the level of development play key roles in determining the importance of short- or long-term strategies. Local communities affected may not be able to afford the technology to cope with the longer-term mitigation (aseismic buildings, warning systems) and some may lack resources for scientific understanding and expertise.
- Social and political frameworks, government competence and resources can all play a part in availability of strategies for management. The geography of an area can determine how effective short-term rescue strategies are, for instance, remoteness prevents effective rescue work and the arrival of emergency aid.
- It could be argued that whilst saving lives is a top priority, resurrecting livelihoods and means of resuming normal lives is also vital.

A possible conclusion will argue for the equal importance of all strategies, but at the same time recognising that a number of factors can lead to variations in the importance and effectiveness of shorter vs longer-term strategies.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the importance of elements of the hazard management cycle.
- the skill of constructing relevant diagrams (e.g. HMC, Parks Disaster Response Curve) to identify and evaluate elements of short and long-term disaster management.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the importance of both short and long-term strategies and the degree to which they are of equal importance.

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

	AO1 [20 marks]	AO2 [20 marks]	AO3 [5 marks]
Band	<i>Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change at a variety of scales</i>	<i>Apply knowledge and understanding in different contexts either to analyse or interpret or evaluate geographical issues and information</i>	<i>Use a variety of relevant 'geographical skills' to construct arguments and draw conclusions</i>
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 and partial use of annotated sketch maps / diagrams are included and should be credited	9-12 marks Demonstrates partial application either to analyse or interpret or evaluate in order to produce a partial but coherent response that is supported by mostly appropriate evidence Demonstrates application of knowledge through the partial synthesis between different elements of the question Demonstrates application of knowledge and understanding through the partial application of some specialised concepts	3 marks The response uses mostly relevant qualitative skills to produce a structured response but where coherence is variable

	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

Ecosystems

3. To what extent is temperature the greatest influence on the functioning of ecosystems?

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

[45 marks]

Focus 3.2.2

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

Indicative Content

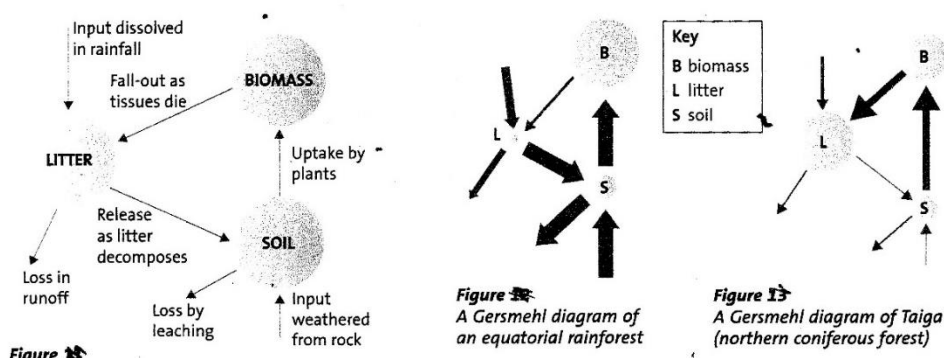
The indicative content is not prescriptive, and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding of the functioning of ecosystems.

- An ecosystem can be defined as a self-regulating, biological community in which living things (biotic component) interact with the environment (abiotic component) at any scale from global to local.
- Ecosystems have two basic functions – to redistribute energy and to recycle nutrients.
- Energy flow**
Energy from the sun is fixed by plants during photosynthesis and may:
 - be stored as chemical energy in plants or animals (biomass)
 - be passed through the ecosystem feeding levels (trophic levels) through food chains/food webs.
 - escape from the system as outputs of material, e.g. decay, excreta or heat energy from respiration
 - Primary Productivity is the rate at which energy is converted into organic matter (biomass). It depends on heat (temperature), water (controls rate of chemical reactions) nutrient availability and light (for photosynthesis).
- Nutrient Cycling**
 - Nutrients are the chemical elements and compounds organisms need to grow and function.
 - Nutrients are cycled between stores (in soil, litter and the biomass) via a number of flows. See Figure 4, A Gersmehl model.

Figure 4: Gersmehl models



- Nutrient cycling and energy flow are interdependent.
 - The rate of nutrient cycling may limit the rate that energy is trapped as plants need essential nutrients to grow and trap more energy.
 - Energy may also limit the rate of nutrient cycling. If a plant is not capturing enough energy for life processes, it may die, and its death will result in breakdown of its organic matter.

Credit reference to named ecosystems to illustrate functioning e.g. tundra, taiga, coral reefs etc.

AO2

Application of knowledge and understanding of the functioning of ecosystems is deployed to discuss the extent to which temperature has the greatest influence on the processes.

- **Temperature** controls the rate of plant metabolism which in turn controls the amount of photosynthesis and the rate of primary productivity, all of which depend on radiant energy from the sun. Biological metabolic activity occurs within the temperature range 0 – 50°C with an optimum range of 15 - 25°C (threshold). Temperatures need to reach a critical level for an ecosystem to function.
- **Primary productivity** – the rate at which energy is converted into organic matter
 - depends upon:
 - heat (temperature) which controls the rate of chemical reaction, but must be combined with: –
 - light (dependent on earth systems) for photosynthesis to occur.
 - water i.e. from rainfall, is also essential for most chemical reactions.
 - nutrient availability is also required, and this may depend on geology and the rate of weathering, which in turn depends on both temperature and water.
- When all these factors are optimum, maximum primary productivity occurs (reefs, rainforests) hence greatest biodiversity.
- If any one of these four factors is in short supply, this limits primary productivity and the processes of energy flow, so temperature is important, but not alone.
- The influence of temperature can be seen in the relationship between climatic belts and the distribution of biomes, but because of the interconnections between the factors, (for example, water is a principal requirement for photosynthesis), it makes it very difficult to isolate and examine how important temperature is (interdependence)
- The influence of temperature can be seen in a climate warming context with biome shift as the taiga belt moves poleward into the Arctic tundra zone.
- In terms of nutrient cycling, temperature and moisture both influence the rates of physical and chemical weathering and therefore nutrient availability. It is also temperature combined with rainfall that determines the rate of litter decomposition. However, it is rainfall which impacts on nutrient loss from the litter (run off) and soil leaching. This is well shown when comparing equatorial with boreal (taiga) forest. Compare different sizes of stores and flows – See Figure 5.
- Humans are increasingly influencing the functioning of ecosystems, through harvest, application of fertilisers and controlled environments (glasshouses/irrigation etc) as well as indirectly via climate warming. A general mention of human factors will be of limited value but, when linked to the functioning of ecosystems, will score more highly.

A possible conclusion might be that for both energy flow and nutrient cycling, temperature is a very important influence, but that without other factors its

importance might be diminished as it works in conjunction with other factors. Its importance may vary spatially and over time.

Credit supporting examples of ecosystem which add to the analysis of importance.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the functioning of ecosystems (energy flow/nutrient cycling).
- the skill of constructing relevant diagrams (e.g. Gersmehl nutrient cycling model) to support the argument.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the importance of both short and long-term strategies.

4. Evaluate the factors that decision makers need to consider when developing strategies to conserve biodiversity.

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

[45 marks]

Focus 3.2.4.

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

Indicative Content

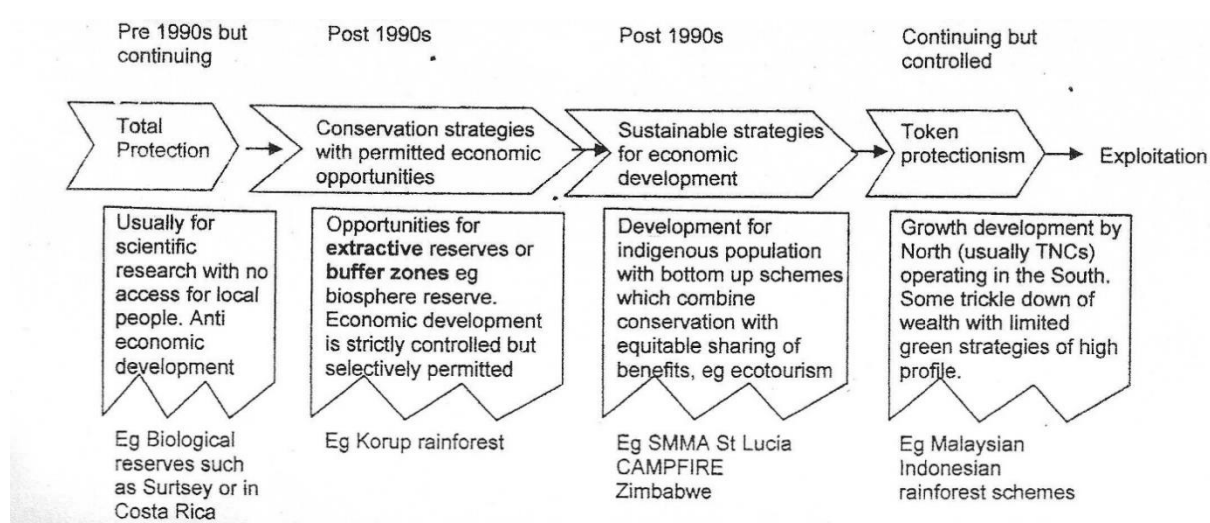
The indicative content is not prescriptive, and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding of the factors (issues) could include:

- Biodiversity can be defined as follows – ‘The variety among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes (habitats) of which they are part. It includes species, genetic and ecosystem diversity’.
- So much depends on whether biodiversity loss is viewed as a global catastrophe linked to global warming or as a manageable more localised issue, so it is necessary for decision makers to consult up to date statistics of biodiversity loss (measured in many ways (e.g. WWF, Living Planet Index) to look at spatial and temporal changes and classify the threats to establish the root causes of destruction.
- What to conserve? – hot spots (Myers areas of maximum numbers of endemics under greatest threat) or - ecoregions (representative samples of all the world's habitats).
 - Gene pool and keystone species or high-profile iconic species, e.g. panda – great for fund raising. International treaties such as CITES for highly endangered species.
- How to conserve it? – a spectrum of conservation styles and methodologies exists from total protection through to nearly total exploitation. (see Figure 5)

Figure 5: The Conservation Spectrum



- What size and design?
 - Larger size areas across international boundaries with wildlife corridors against the impact of climate change versus small style habitat areas.
 - Sloss debate – single larger reserves or several smaller areas covering a variety of species.
 - Whether to develop a buffer zone? (see Biosphere reserve).
 - Establishing the prime purpose of the reserve will determine what framework is adapted. There are numerous global frameworks developed by IGUs, UN reserves such as UNESCO Biosphere programme or UNEP responsible for GEMS and also private BINGOs e.g. WWF or WCU/IUCN which designate and categorise protected areas (see Figure 6) as well as specialist or local organisations e.g. wildlife reserves developed by Wildlife Trusts.
- What purpose and aims?

The precise aim of the conservation scheme must be agreed, depending on perception of nature, desired relationship with local people (top down or bottom up) and what are the key influential players during the scheme.
- How is it funded?

Funding has to be negotiated – note tensions between HICs and LICs as to who should pay for the conservation. In LICs the money goes much further as establishment vs running costs are lower. Many LICs argue that HICs should pay as the threats often result from exploitation (MNCs etc) as opposed to indigenous peoples living there.
- Ex- or in-situ?

In some cases, ex situ conservation in zoos or captive breeding programmes and seed banks may be preferred to in situ conservation as they play a vital role. In situ conservation may be difficult in poverty-stricken environments.
- Future proofing

A further issue is future proofing against the impact of climate change – conserving biodiversity is seen as an increasing part of managing the impacts of climate change (nature-based solutions).

AO2

Application of knowledge and understanding is deployed to evaluate the range of different factors decision makers may have to consider when carrying out conservation projects.

Evidence could include:

- A recognition that the issues faced are increasingly complex with the impact of climate change and the acceleration of threats to biodiversity as the world's population grows and becomes more demanding on the earth's resource base. With concerns about climate change and pollution, larger geographical areas (bioregions) may need to be developed.
- A recognition that there is a need for strategies to be sustainable and holistic involving local economic developments, e.g. ecotourism, Udzungwa National Park in Tanzania or SMAA, St. Lucia, in tandem with species and habitat protection. Over time, strategies have become broader to cover both environmental goals and economic objectives.
- Over time there has been decreasing reliance on total protection except for remote, isolated islands, e.g. Surtsey where scientific experiments are carried out.
- Conflicts can arise however where the balance is wrong, for example for extractive reserves, e.g. CAMPFIRE project in Zimbabwe where hunting has had a large impact.

- The need to develop transboundary approaches not based on political boundaries (place), e.g. the Yellowstone to Yukon reserve (Y2Y) ecozone linking 11 national parks, wilderness areas and ecological reserves across USA and Canada. Ecosystem boundaries are not coincident with political boundaries.
- The recognition that different environments require different conservation strategies (e.g. marine and terrestrial) and global frameworks need to be operated flexibly as opposed to the 'one size fits all'.
- Many small-scale schemes may have a narrow focus and can be difficult to upscale, but they can be more achievable, especially where the local people are involved in the scheme (bottom-up strategies).
- Two very significant interlinked issues include the funding of conservation, sometimes schemes go on too long and the threats escalate, as there is a lack of adequate or regular funding. As biodiversity losses accelerate there is a tendency for the shortfall in funding to increase. Whilst there is no debate that you get 'more ecobucks for your money' and funding goes further in LICs, there is more potential for corruption in some areas, e.g. Zimbabwe. Moreover, charitable donations may dry up if there is no 'poster child' iconic species, e.g. whales, polar bears, pandas, to generate donations and support.
- Where schemes operate in LICs, they are frequently funded by HICs, and they have to be entirely appropriate for the local environment. As COP 27 recognised, for climate change, pump priming (e.g. Debt for Nature Schemes) is essential to get conservation schemes started in LICs. Many LICs are fearful of HIC's interest in their gene pool, particularly from Big Pharma MNCs.
- Conservationists are having to adapt their approaches. Global top-down frameworks need to be combined with bottom-up schemes involving local people with local knowledge in valuing ecosystems. It is now being realised that operating at a variety of scales from global to local and a variety of methodologies is paramount for success.
- The evolution in approach is shown in sustainable forest management (SFM) or sustainable fisheries management where the ecosystem approach is now widely used as it is collaborative i.e. a partnership between governments and people.

A conclusion will evaluate how the significance of factors varies spatially and over time and has led to changes in strategy and methodology. Sustainable development is not always the 'magic bullet' as it comes with a number of challenges, namely the most diverse ecosystems (reefs and rainforests) are largely found in the poorer countries of the world and that conflicts exist between short term gain (exploitation) and long term benefits (conservation) and that, in addition to globalisation, world population growth and increased affluence, ecosystems are facing an ever greater issue – the impact of climate change. Sustainable ecosystem management can even get out of hand, e.g. Costa Rica where ecotourism is so popular it is even moving towards mass tourism.

Credit all relevant examples which support the argument.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the range of factors decision makers have to consider.
- the skill of constructing relevant, annotated diagrams (e.g. the spectrum of conservation) to support the argument.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion which evaluates the range of issues which decision makers have to face when developing conservation strategies.

5. 'Government plays the dominant role in the location and development of economic activity in India.' Discuss.

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

[45 marks]

Focus 3.3.4

The 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 location and development of economic activity in India could include:

- Economic activity consists of four sectors, primary (agriculture and mining), secondary activity (manufacturing), tertiary (service industries) and quaternary (including R&D, finance etc).
 - Although rural peasant farmers are the backbone of India, agribusiness plays an increasingly significant role with exports of a range of grains, fruits and vegetables. These huge businesses have a major impact on the food chain (seeds, fertilisers, finance, marketing). 15% of the country's GDP comes from agriculture.
 - Manufacturing is concentrated in areas such as the heavy industry areas (Damodar valley) and includes steel, textiles, pharmaceuticals, clothing and a strong, hi-tech defence and electronics sector – 29% of the country's GDP.
 - Service sector including tertiary and quaternary, includes financial services, software services as well as outsourced call centres and back-office jobs and the entertainment industry (Bollywood) dominates the Indian economy – 56% of country's GDP.
- India is the world's most populous democracy; it is a federal government with states having significant power over the development of economic activity and also in offering locational advantages and incentives to would-be investors in both rural and urban areas.
- The role of government varies both spatially and over time depending on both federal and individual state policies. The incentives generally have a positive impact.

AO2

Application of knowledge and understanding is deployed to evaluate the importance of the role of government in the location and development of economic activity in India.

- The role of government has evolved over time. After Independence and Partition in 1947, India's aim was to develop economically without the participation and influence of foreign capital, so economic policies had a strong anti-export basis and were located in economic areas.
- The socialist government ensured a high level of state control over key heavy industries such as iron and steel, and excessive bureaucracy led to very slow economic growth.
- In 1991 India faced a major economic crisis and massive debt which forced the governing Congress Party to borrow money from the IMF. As a condition of the loan India was required to open up the economy to economic globalisation to

attract FDI from numerous MNCs who have made a huge contribution to the Indian economic establishment and more often located in areas offering the greatest financial incentives.

- The government also established SEZ from 2000 onwards and there are now over 200 in which foreign investors are given very favourable terms for development. These SEZ meant that certain areas acted as magnets for new industrial development and were dispersed across India.
- The government has made other very significant contributions to industrial development by investing in improved transport systems and telecommunications as well as supporting the Defence and Space industries by huge investment and encouraging partnerships with foreign investors. This has been accelerated under the recent Nationalistic Modi government with technological achievements such as moon landings and rocket systems and development of aeronautical, satellite and nuclear technologies.
- There are, however, numerous other factors other than government which have influenced the location and development of economic activity.
- In addition to national governments, state governments play an important role as they have responsibility for agricultural and industrial policies with some adopting a free enterprise approach with business-friendly reforms and incentives. Economic development is very uneven therefore with Maharashtra (Mumbai city region) one of the most industrialised states and Bihar one of the least.
- Other factors.
 - A key factor is the growth of an urban educated middle class whose members not only spearhead investment in Indian owned companies, e.g. Infosys, but also provide a large internal market for new consumer goods (causality). They are English speaking, highly skilled with good ICT skills and contributed to the rapid expansion of offshoring, outsourced service sector, as at a global scale their costs were much lower compared to the USA or Europe. Many foreign MNCs have had a very successful relationship with the Indian government.
 - Other more localised factors play a role, for example, the availability of resources such as quality soils and access to groundwater for irrigation (river valleys of Punjab were at the heart of the Green Revolution) or iron/coal resources which led to the development of heavy industry zone of the Damodar valley, especially for the location of economic activity. As a result of largely a push from political systems (government) the Indian economy has grown from strength to strength with recent growth rates of 7-10% per annum making it the 4th largest economy in the world.

A conclusion might consider generally positive relationships between the Indian and State governments with the development and location of economic activities, but recognise that it is a complex relationship and that other factors are also significant.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the factors influencing the location and development of economic activity in India.
- the skill of constructing relevant diagrams and tables.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the importance of the role of the government in location and development of economic activity.

6. To what extent are sustainable strategies essential for the future of urban communities in India?

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

[45 marks]

Focus 3.3.7

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

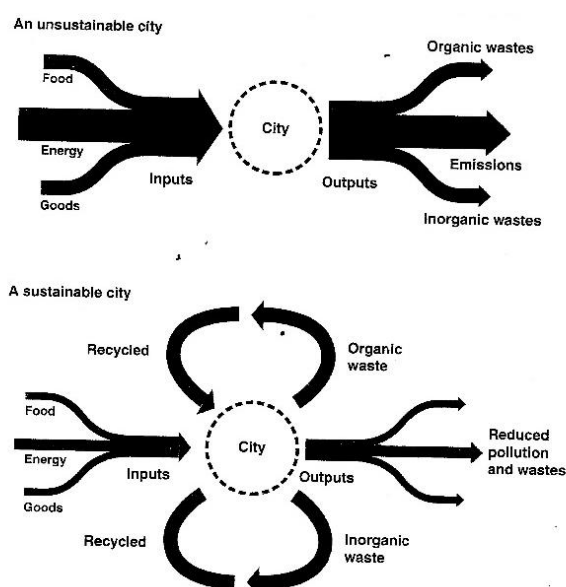
The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding of the location and development of what constitutes a sustainable urban community and the strategies developed to achieve this.

- Currently 36% of Indians live in urban communities, but by 2050 the percentage is expected to rise to as much as 70%.
- Urban sustainability can be defined as: meeting the present needs of the urban populations in such a way as to avoid harming the chances of future generations meeting their needs (Brundtland).
 - Organising cities in such a way as to minimise environmental damage and the depletion of natural resources (see Figure 6 - The Rodgers model) where the sustainable city devours fewer resources, produces less waste (efficient use or recycling) and so reduces its ecological footprint.
 - A wider definition now includes not only environmental sustainability but also economic and social sustainability (all interrelated).
 - Sustainable cities therefore are less damaging to their local and global environment and provide a higher quality urban environment and offer more opportunities and a more fulfilling life for all their citizens.

Figure 6: Rodgers model



- Strategies can be developed at all scales.
 - The UN-HABITAT/UNEP sustainable cities programme which promotes environmental, social and economic sustainability throughout the world via Environmental Planning Management (EPM) is characterised by a number of schemes involving a wide range of projects to avoid congestion, sprawl, inefficient resource use focused on 10 integrated solutions, such as integrated transport with safe roads, sustainable housing in liveable neighbourhoods, involving advice from global experts (globalisation). Since 2008 nearly 100 projects have been completed.
 - Strategies developed at the state /municipal level, such as the Bangalore (Bengaluru) Master Plan implemented by the Bangalore Development Agency which led to Bangalore being recognised as one of India's greenest cities. WIPRO has also worked with the Bangalore Transport authority to implement Transport Demand Management. Other initiatives include those in Maharashtra State, capital Mumbai, where there is a ban on single use plastics or in Rajasthan where an emphasis has been placed on rural development to stem the flow of migration to cities.
 - The National Smart Cities Mission (NIU-CIDCO Smart City lab 2016) has been set up to embed sustainability into India's Development Strategy to ensure that urban areas in India reduce urban sprawl. The top-down scheme promotes, via over 200 specific projects, the use of electronic and digital solutions including developing energy efficient transport and buildings, socially mixed neighbourhoods with healthy public open spaces and the improvement in waste management. It has resulted in an improved public transport systems in many cities including Chennai, Mumbai and Hyderabad. The Smart Cities initiative is linked to the Lighthouse Cities scheme, a global initiative from CISCO (a technology MNC) which funds experimental schemes around the world to spread knowledge and understanding of their potential. Pune is India's first Lighthouse City.
- Strategies are also implemented by NGOs at a local level, e.g. Mythri (an Indian NGO) working in slum areas to improve water, sanitation and waste management in slums in Mumbai and Bangalore to manage inequalities of opportunity.

AO2

Application of knowledge and understanding are deployed to evaluate whether the development of sustainable strategies for the development of urban communities is essential.

- The challenge is the scale and pace of the problems caused by rapid urbanisation with this causing many environmental and socio-economic problems which an emphasis on sustainable urban communities could mitigate.
- There is the potential for urban sprawl to occur with the development of large areas of slum housing where all types of pollution occur, including overcrowding, water pollution from inadequate waste disposal and air pollution from fuelwood stoves which are largely used. Moreover, much valuable agricultural land is lost.
- As the population becomes more affluent (concentrated in urban areas) they use more energy, e.g. for white goods, much of which is currently produced from fossil fuel use (especially coal). Additionally, in certain cities industrialisation has increased, and in all cities, increased vehicle use has occurred – all of this has led to the challenge of pollution and congestion problems in cities such as Delhi.
- As a result of increasing occurrence of extreme weather, Chennai as a city has reached ground zero for water supply, largely resulting from droughts and yet other urban areas have experienced very damaging floods as a result of the Indian Dipole leading to unpredictability of the monsoon rains. Schemes are also

needed to cope with other extremes of climate change such as extreme heat and coastal flooding.

- Therefore, many of these extremes can be linked to climate change – as a result of economic growth, GHG are rising overall. The contrast in economic opportunities between urban and rural areas fuels rural to urban migration, with many arguing that sustainable solutions need to be offered to rural communities.
- Many of the urban schemes rely on plans to improve energy efficiency and transportation.
- Many of the Indian sustainability schemes have struggled to be successful as there is a need for greater transparency and accountability from both National and State level governance and the need for more public participation and decision making from a workforce where many are well educated and technologically confident and competent. Projects such as the Smart City project tend to be top-down and supported by high levels of electronic surveillance.
- Some of the most successful and effective schemes operate at a local scale as they have clear objectives, well supported by local people who participate in their development and implementation. There is less reliance on coordinating a range of agencies – the problem is that these projects are very small scale and only deal with countrywide programmes at a microscale.
- A possible conclusion may be that, with so many environmental, social and economic problems facing India's urban areas, there is clearly a huge need for the drive towards sustainability and that building sustainable urban communities is essential for the future.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the strategies and the challenges posed for their development as well as the huge need for the cities to function efficiently.
- the skill of constructing relevant annotated diagrams e.g. the Rodger's model of a sustainable city
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about progress in developing urban and sustainable communities supported by detailed exemplification and an assessment as to how successful they are.

7. **‘Government plays the dominant role in the location and development of economic activity in China.’ Discuss.**

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

[45 marks]

Focus 3.3.4

The 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 location and development of economic activity in China could include:

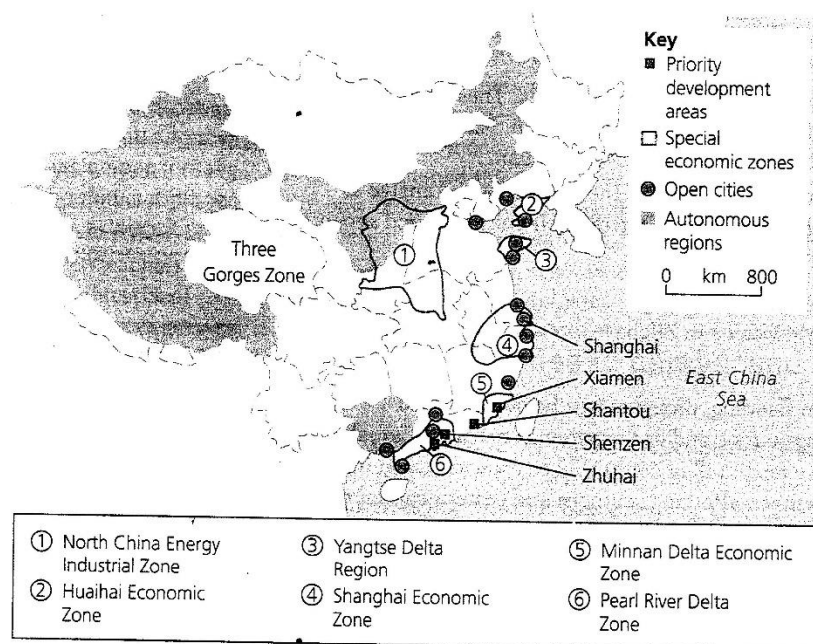
- Economic activity consists of four sectors, primary (agriculture and mining), secondary activity (manufacturing), tertiary (service industries) and quaternary (including R&D, finance etc).
 - Agriculture provides 9% of China's GDP. It was the first of China's sectors to reform after the Communist Revolution, with all land coming under communal ownership in 1949 (communes) to improve food security with the state owning all the land, but since the 1990s more flexible arrangements exist for agribusinesses.
 - Manufacturing provides nearly half of China's GDP as China became known as the 'Workshop of the World'.
 - Tertiary and quaternary industries provide a growing percentage of China's GSP and in 2023 overtook secondary as the most important sector.
 - Between 1949 and 1976 government locational decisions were dominated by classic Marxism and Leninism with associated collectives and centrally planned agenda. With the death of Mao Zedong in 1976 China's economy took a major change in direction. In 1978 Deng Xiaoping introduced the Open Door Policy which was designed to overcome China's isolation from the world's other economies. SE Asia, with the development of NICs, was increasingly leaving China behind so China moved towards a socialist market economy with the expansion of the manufacturing sector leading to rapid economic growth, especially in designated SEZs, leading from a dispersed to a concentrated coastal locational pattern.
 - Between 1949 to the late 1970s, manufacturing was undertaken almost entirely by state owned enterprises (SOEs), mainly heavy industry such as chemicals, iron and steel, dispersed across China to reduce regional disparities. After 1978, the focus on increased productivity forced SOEs towards reform. Large SOEs improved their management, often with foreign partnerships, e.g. VW, and smaller SOEs were eventually privatised.
 - In Mao's era, rural industries, called town and village enterprises (TVEs) produced heavy goods such as iron and steel, cement and fertilisers, but after 1978, these enterprises were expanded to develop a wider range of rural industries and businesses, run by the most successful peasants (the emergence of the entrepreneurial class) and now the TVEs became the backbone of development throughout rural China.
 - Since 1979, the government Open Door Policy developed five Special Economic Zones (SEZs) and 14 open cities (see Figure 7) which were designed to attract overseas MNCs, especially those involved in high

technology industries (e.g. Apple) as they offered incentives such as relaxed planning regulations. These SEZs and Open Cities had a fundamental influence on the location and therefore the distribution of Chinese industry, as they were established in accessible areas in coastal China e.g. Shenzhen, Zhuhai and Shantou in Guangdong province forming the Pearl River region.

⑥ FDI including technology transfer was combined with internal government investment.

- Government policy has been further refined under President Xi with the annexation of Hong Kong and Macau and the push towards the interior along the Yangtze corridor ③ (Three Gorges Dam) as well as attempting to revive the declining NE industrial region ②. The current government has also promoted the integration of the Autonomous Region of Tibet and other remote areas via the new HST links as well as developing the One Belt One road scheme to develop overseas links, initially along the former Silk Road. Most recently, government policy has moved towards technical innovation to become a world leader in developing HST systems, nuclear power plants, renewable energy infrastructure and even aerospace and electric cars and batteries.

Figure 7: Location of economic development areas in China



- Government policies can impact negatively on the development of economic activity, for example, restrictions during the outbreaks of SARS, Covid 19 and Sino-American trade wars over the perceived dumping of low-cost Chinese exports.

AO2

Application of knowledge and understanding is deployed to evaluate the role of government in the distribution and development of economic activity in China. Synthesis will be demonstrated by the drawing together of evidence to reach a rational conclusion. This evidence could include:

- Inevitably in a centrally planned economy, the role of government is important in the location and distribution of economic activity, but other factors play an important role (causality).
- Although established by a communist government, SEZs were deliberately located far from the centre of political power in Beijing, minimising political influences. More specifically, the original four zones were sited in coastal areas of Guangdong and Fujian that had a long history of contact with the outside world through outmigration, and at the same time were near Hong Kong, Macau and Taiwan (place/identity). The choice of Shenzhen was especially strategic because it is situated near Hong Kong, the key area from which to learn capitalist modes of economic growth (globalisation). SEZs constitute 22% of China's GDP, 40% of exports and over 30 million jobs.
- The growth in economic activity in these coastal locations which minimise costs and maximise export opportunities has been reinforced by investment decisions of MNCs (globalisation).
- The growth in economic activity in these regions has been reinforced by high levels of rural-urban migration, infrastructure improvements and the investment policies of MNCs. The result has been the emergence and dominance of economic activity in coastal areas which have received most internal investment as well as having imported capital, technology and entrepreneurial skills, at the expense of the interior (inequalities).
- To counteract the core periphery distribution the government has been instrumental in implementing the Western China Development Project (① in figure 7), created in 2000 to help the western provinces catch up with coastal areas. The main components of the strategy include the development of transport, hydropower plants, energy and telecommunications, enticement of foreign investment, increased efforts on ecological protection, promotion of education and retention of talent flowing to richer provinces. A further set of projects was developed in the Northeast of China – a backward region.
- China's physical geography also has a role to play. Agriculture is concentrated on the plains and deltas to the east. Raw materials such as coal also influence the location of manufacturing industry: although coal deposits are widely scattered (some coal is found in every province), most of the total is located in the northern part of the country (causality).
- Even allowing for some of the negatives, China's economy is now the second largest in the world with average growth rates of up to 10% per annum, largely as a result of adaptations in the role of central government over the years. Note: some candidates may comment on the problems currently facing the Chinese economy, suggesting that central government needs to be far more flexible.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the factors influencing the location and development of economic activity in China.
- the skill of constructing relevant diagrams and maps.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion about the importance of the role of the government in location and development of economic activity in China.

8. To what extent are sustainable strategies essential for the future of urban communities in China?

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

[45 marks]

Focus 3.3.7

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

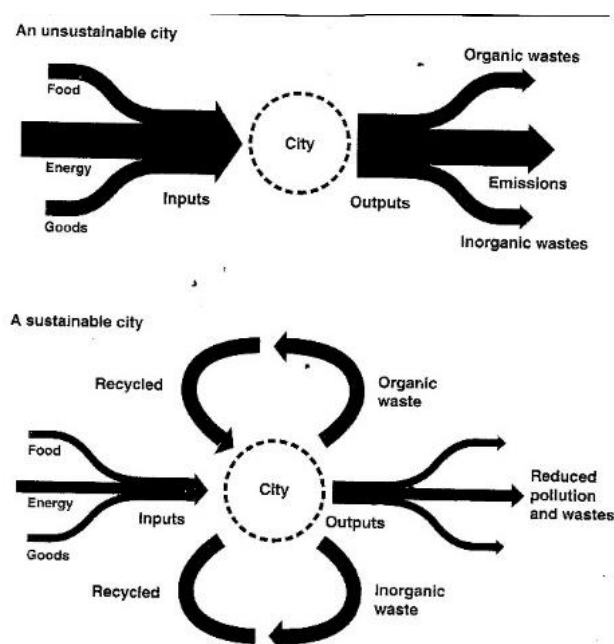
The indicative content is not prescriptive and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Knowledge and understanding of the location and development of what constitutes a sustainable urban community and the strategies developed to achieve this.

- Urbanisation has occurred very rapidly from 1980 (20% urban) to 2010 (nearly 50%). It is still rising, but at a slower rate, so by 2025 65% of China's population will live in areas classified as urban.
- Urban sustainability can be defined as: meeting the present needs of the urban populations in such a way as to avoid harming the chances of future generations meeting their needs (Brundtland).
 - Organising cities in such a way as to minimise environmental damage and the depletion of natural resources (see Figure 8 - The Rodgers model) where the sustainable city devours fewer resources, produces less waste (efficient use or recycling) and so reduces its ecological footprint.
 - A wider definition now includes not only environmental sustainability but also economic and social sustainability (all interrelated).
 - Sustainable cities therefore are less damaging to their local and global environment and provide a higher quality urban environment and offer more opportunities and a more fulfilling life for all their citizens.

Figure 8: The Rodgers model



- Strategies implemented at an international level such as the UN-HABITAT/UNEP sustainable cities programme which promotes environmental, social and economic sustainability throughout the world via Environmental Planning Management (EPM) which is a broad-based participatory decision-making process facility. Between 2008-13, 6 projects were planned in China, but most such as Dongtan went no further.
- At a national scale China has instead embraced the Eco-cities scheme which now forms a key component in China's urbanisation strategies – the cities are envisaged as models of sustainable development with sustainability to a lesser or greater extent part of urban planning, in an attempt to address the dual challenges of rapid urbanisation and environmental degradation.
- Unlike the Global Eco City programme, in China there is a high level of central government involvement, leading to a large volume of projects involving new cities built from scratch whereas globally many ecocities are retrofitted established ones.
 - Examples include Sino-Singapore Tianjin Eco City (a joint venture between China and Singapore) which is regarded as a successful model, although currently population has only reached a quarter of the planned target of 350,000 residents.
- A recent project receiving worldwide interest is the Chinese Sponge City scheme where 16 pilot cities were supported as part of Chinese National Sponge City Pilot programme 2015 including locations across China in areas where the impacts of climate extremes were most apparent including droughts leading to water shortages and flooding from storm water. Examples included Baicheng, Jilin and Qian'an. Sponge cities use nature-based solutions to promote water security and urban water management so leading to climate hazard resilience. The 16 projects will be used as 'Lighthouse cities' to promote the scheme.
 - Whilst the Hukou system was designed to manage rural to urban migration has to some extent controlled the pace of urban migration, it is being reformed to provide equal access to quality services for all citizens in rural and urban areas to reduce inequalities of opportunity.
- Smart city technology (over 200 schemes) is also a feature of many Chinese urban Communities, spearheaded by national companies noted for their technological expertise in social media systems.

AO2

Application of knowledge and understanding are deployed to evaluate whether the development of sustainable communities is essential.

- The scale and pace of the movement from rural to urban areas is very difficult to manage as urban areas have far more opportunities and services and therefore act as magnets (rural to urban migration).
- There are currently 8 mega cities in China, including Shanghai, Beijing, Guangzhou, Shenzhen and Chongqing, nearly all of which are growing very rapidly and sprawling over the farmland needed to feed the population emphasising the need for sustainability.
- These sprawling centres create huge pressures on water and air quality leading to major pollution issues. They also lead to waste and transport management issues all of which suggest a great necessity for cities to become more sustainable.
- China has huge environmental problems to solve, especially in environmental improvement and managing the impacts of climate change.
- A particular problem in China has been that much of the recent construction has been on constructing new cities so increasing the problem of sprawl and many recent cities have been poorly planned and very cheaply and hastily built, usually

large blocks of apartments with many buildings lacking insulation or double glazing or energy saving features. Speculative building has led to a widespread Chinese phenomena of unoccupied ghost towns and villages and the recent financial collapse of two of China's biggest construction companies. Whilst many of these apartments have been high density, compact settlements, they have been poorly planned with respect to services and transport as they were so hastily built. Therefore, they lack many features of sustainable urban communities.

- Whilst sustainable urbanisation programmes are very widespread in China, many remain in the planning stage and are disappointing in their rates of successful completion. Finance and technical expertise can be in short supply so many of the ambitious plans fall short in completion rates and range of projects.
- Nevertheless, huge strides are being made with China becoming a world leader in many aspects of Green Urban strategies with support at the highest level from President Xi at G20 meetings. It is estimated that over 50% of China's new urban development could be labelled 'eco', 'green', 'low carbon' with innovative transport policies and renewable energy strategies. There is however limited co-ordination between the strategies into a plan and all developments currently had to be top-down with little involvement of local people.
- The rules of sustainability are reinforced by legislation and incentives, but communities need to be taken on board and fully involved. There is a concern amongst people that 'smart' technology can lead to excessive control and surveillance.

A possible conclusion would undoubtedly recognise the improvements in many of China's existing highly polluted, contaminated and unsustainable urban areas and cite various successful strategies especially in cities such as Shenzhen (classified in 2020 as the most sustainable city in China) with provision and support for a switch to electric vehicles, but at the same time recognise the scale of the problem and challenges posed. These problems make a drive towards sustainability essential, especially in densely populated core areas.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the strategies and the challenges concerning the challenge and necessity for urban sustainable development.
- the skill of constructing relevant annotated diagrams and maps and tables e.g. of urbanisation rate.
- the skills in covering both the breadth and depth of the question.

9. **‘Both free and fair trade are equally important in the development of Sub-Saharan African countries.’ Discuss.**

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

[45 marks]

Focus 3.3.10

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 what constitutes free and fair trade.

Free Trade

- Free trade agreements are treaties that regulate the tariffs, taxes and duties that countries impose on their imports and exports and allow access to each other's markets so are designed to increase trade between two or more countries.
- Treaties between African countries and Developed nations are controversial. African countries largely export primary products such as crops and minerals which are vulnerable to fluctuating prices which respond to sudden shocks in global demand (e.g. tin from Nigeria). Their imports are largely manufactured goods (of higher value) and refined oil. Therefore, many countries have negative trade balances.
- Many African countries are concerned to protect their fledgling manufacturing industries and are often very concerned when one of the conditions of receiving loans from the WB/IMF to overcome debt is trade liberalisation as a loss of protection leads to losses in employment and possible degradation of resources.
- In agriculture many small family farms cannot compete with agribusiness in developed countries.
- MNEs outsource jobs to low cost developing countries, often without adequate labour protection.
- On the other hand, free trade could lead to increased economic growth as FDI is attracted resulting in technology transfer and lower government spending as fewer subsidies would need to be paid to their fledgling industries.
- Some trading blocs have always existed since African independence, such as ECOWAS (Economic Community of West African States) which has eased barriers and tariffs between 15 member states. Many countries also have far more important partnerships with China and EU/UK. Countries such as Sierra Leone benefit from duty free access to their goods from the EU under the EBA (Everything but Arms initiative) or access to the US markets by AGOA (African Growth Opportunity Act). One downside is that under CAP, EU farmers are subsidised to produce surpluses which flood the unprotected markets of LICs and undercut the prices of domestically produced food leading to impoverishment for indigenous farmers.
- Recently since 2019 AFCFTA (African Continental Free Trade Area) has been formed as the continent's single biggest trading bloc with 8 countries, Cameroon, Egypt, Ghana, Kenya, Mauritius, Rwanda, Tanzania and Tunisia involved, with certain products earmarked to be freely traded – tea, coffee, sugar, pasta, dried

fruit, sisal, a processed meat product and ceramic tiles among others. The agreement was designed to deepen integration, foster free trade and investment, enhance the mobility of capital and labour, support industrialisation and develop the service sector within a tariff free continent.

Fair Trade

- Fair Trade is another initiative designed to improve the terms of trade for Sub-Saharan African countries.
- The Fair Trade movement seeks to obtain a fair price for a wide variety of exported commodities. Over a million farmers and workers in 9 African countries – Ivory Coast, Ghana, South Africa, Malawi, Madagascar, Kenya, Uganda, Tanzania and Ethiopia dominate fair trade with cocoa, flowers, coffee, bananas, teas, cane sugar, wine/grapes, nuts and chocolate being the main Fair Trade products.

AO2

Application of knowledge and understanding is deployed to evaluate the importance of the role of free trade and fair trade.

- Traditionally, free trade had disadvantages for the LICs of Africa when trading to the HICs of Europe/North America/Asia as for some the cons outweighed the pros as there was a need to protect fledgling manufacturing industries so that African countries could diversify their economies. For them free trade can be considered unfair trade.
- However, with the formation of free trade links within a purely African countries to promote continent wide free trade, the picture changes to a bright future even though progress is steady.
- AFCTA provides Africa with a renewed opportunity to steer economic relations away from a reliance on external donors, foreign creditors and excessive commodity dependence. The goals of AFCTA are aligned with the UN's SDGs. An ending of extreme poverty and providing employment for the bulging youth population so cutting down on economic migration and loss of the brightest talent (nurses, doctors, teachers etc)
- Fair trade brings many benefits to farmers as a result of the guaranteed fair price for their crops it provides:
 - An additional monetary premium to invest in better equipment etc.
 - Better working conditions and protection with a guaranteed minimum price
 - It improves women's participation in farming with many becoming leaders of co-operatives.
 - Technical assistance and training in agricultural techniques is supplied.
 - Improvement of worker's rights where they are farm workers, not farmers.
 - Help with marketing to buyers, protecting biodiversity and resilience strategies against climate change and further diversification.
- As part of debt relief schemes, the World Bank/IMF imposed Structural Adjustment of the economy which had a very serious impact on the fledgling industries of many African countries (neo-colonisation).
- Conversely, the links with China, India, Brazil (Lusophone countries) have to an extent promoted trade, but not always free trade (usually exports of resources in return for development of agriculture, industry and infrastructure, or in the case of Middle Easter countries, involvement in oil and gas).
- However, fair trade may be growing method of farming, but it is still quite limited in scope in terms of countries and products in Africa. It is also dependent on

support from consumers, who for ethical reasons are prepared to pay a premium price.

A possible conclusion might be that even with some limitations, both free and fair trade have very important, but differing roles in African development. Some may argue that the scale of activity in Fair Trade is small, although it is growing. This makes it less important economically, although very significant locally. Others may argue that in terms of positive benefit, the impacts of free trade have been frequently negative.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the extent and importance of the role of free and fair trade.
- the skill of constructing relevant annotated diagrams and maps and tables e.g. of case studies of fair trade.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion as the importance will vary by country within Africa and change over time as developments take place in both free and fair trade.

10. **To what extent have political factors hindered development? Discuss with reference to two or more Sub-Saharan African countries. [45 marks]**

Focus 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.

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 political factors which can influence development in two or more named Sub-Saharan African countries could include:

- Political factors include governance, colonialism and neo-colonialism, corruption and global organisations.
- The political dynamics in Africa are complex and diverse as the continent is home to a wide range of political systems, cultures and histories.
- Strong, accountable and transparent governance should promote all aspects of development, but in many African countries, governance is weak with corruption institutionalised and widely prevalent (see Index of Transparency which measures the degree of public sector corruption as measured by business people).
- Many African countries have struggled with authoritarianism (Zimbabwe), military coups (see Sahel 2020) and civil wars (South Sudan or Sierra Leone) which have disrupted political stability. Whilst there has been some progress in democratisation and good governance, with many countries now holding regular elections and establishing more accountable and transparent governments, there have been many instances of violence and election fraud (Mali/Niger).
- Corruption has disrupted development in many African countries, for example, where government officials embezzle funds and award contracts to cronies.
- Civil wars and other forms of political violence can disrupt economic activity, displace people and destroy infrastructure – e.g. Sudan 2011 and 2023, where there has been political infighting amongst various factions within the ruling party. Zimbabwe is another example of a corrupt government as Mugabe and allies, who have ruled for more than three decades used their control over the government to enrich themselves and maintain their hold on power.
- Political inequality can also be a barrier to development, where certain groups of people such as women or minorities lack representation and therefore rights and empowerment and participation in political life.
- One major challenge is the legacy of colonialism which has left many African countries with weak institutions, limited resources and uneven development. Colonialism exploited many countries, for example, when D.R. Congo gained independence from Belgium much of the country's vast mineral wealth had been 'looted' (resource curse) and human capital had been poorly developed.
- Neo-colonialism, initially by the Chinese, but also Indians, Americans, Russians and Europeans (French) has led to a great deal of investment in Africa, in return for the provision of resources, which does guarantee an income and stimulate development.
- These powers have sought to exert influence through aid, trade and military intervention and their actions have had a major impact on the political landscape of the continent and the wider world.

- Global organisations, such as UN agencies, have had a major influence in Africa, in a variety of contexts from Peace Keeping to supporting the achievement of MDGs and subsequent SDGs.

AO2

Application of knowledge and understanding is deployed to evaluate the extent to which political factors have hindered development. So much will depend on the Sub-Saharan countries selected as there are enormous contrasts in their development progress based on past and present factors, e.g. Rwanda versus Sierra Leone.

- There is little doubt that the legacy of colonialism has left many African countries with weak institutions, limited resources and uneven development.
- One key factor that affects development is the level of political stability. When governments are able to maintain order and provide basic public services such as healthcare and education this can create a conducive environment for development. In contrast, where governments are unstable or conflict ridden, this can disrupt economic activity, displace people, destroy infrastructure and make it difficult for business to operate and for people to access basic services (e.g. South Sudan).
- Poor governance can have a knock-on effect on social and economic factors. For instance, the Mugabe controversial government policy on land expropriation which involved forcibly seizing land from white farmers and redistributing it to black farmers had the unintended consequence of disrupting agricultural production, contributing to food shortages and the decline of exports, all of which led to overall economic decline and a brake on development progress and prosperity for many years.
- There are several ways poor governance can lead to a lack of resources, which in turn leads to a lack of infrastructural development or mismanagement of projects which leads to waste and corruption further undermining development progress.
- This can also impact on education and health care provision: if a government does not have the funds to build hospital/schools, train teachers and doctors and health care workers, this can hinder the development of a skilled workforce and undermine the well-being of its citizens.
- It is against this background that the neo-colonialism of China and other countries must be evaluated. Some groups see it as exploitation, yet other groups see it as the way ahead to successful development as infrastructure such as ports, railways, schools or hospitals are built. In countries such as Kenya or Tanzania it has led to uneven development, leaving some inland regions severely underdeveloped, with ports becoming centres of economic growth (often linked to OBOR).
- Some candidates may offer counterarguments based on how political factors have facilitated development. The role of the United Nations is generally seen as favourable to development progress as UN agencies are seen as a major driver of development and has led to declining levels of poverty. However, they are seen as well meaning, but not always effective as whilst there have been successes, progress is often fragile.

The degree of hindrance of political factors varies over time and spatially. Some answers may suggest that physical, economic, social and cultural factors are more significant and that the group of factors are interdependent, so much depends on the examples selected. However, the answer must have a substantial focus on political factors to score highly.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments concerning the degree to which political factors hinder development progress.
- the skill of constructing relevant annotated diagrams and maps and tables e.g. on development progress, which can be annotated to support the answer.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion based on evidence from the chosen countries as to how much of a hindrance political factors are.

11. To what extent is the uneven distribution of oil and gas reserves the main challenge to their effective management?

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

[45 marks]

Focus 3.4.1, 3.4.4

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

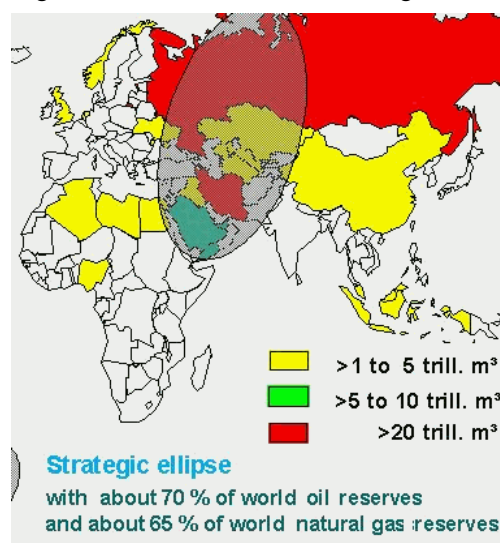
The indicative content is not prescriptive, and candidates are not expected to cover all points for full marks. Credit other valid points not contained in the indicative content.

AO1

Uneven distribution of oil and gas resources

- Oil and gas are both fossil fuels, both of which are unevenly distributed. Their deposits are a coincidence of geological history and international boundaries).
Causality
- The Middle East has the largest reserves of oil (70%) with large amounts in Venezuela; Russia has the largest reserves of natural gas, followed by Iran and Qatar. Candidates may mention OPEC who control 80% of fossil fuel reserves and / or the Strategic Ellipsis. Less well known is the GECF which is an organisation of 11 of the world's leading gas producers. Globalisation

Figure 9: Distribution of oil and gas reserves



Credit: cambridgeforecast.org

Globally areas of oil and gas resources do not always correlate with areas of consumption. Some countries have very low / no oil and gas resources of their own which presents them with significant challenges (South Korea, France, Japan). Causality

Recent discoveries have made oil and gas resources more evenly distributed than they once were...e.g. Guyana, Namibia, Bolivia.

Effective management

- There are many stages to management of oil and gas resources. Candidates do not need to cover all stages, but credit for breadth and / or depth can be awarded.
- Effective management would involve producers receiving a fair price, consumers receiving a steady supply and little / no negative impacts at any stage from exploration to use. Interdependence
- The managers are the producers (countries and supranational groups, MNCs or TNCs) and the consumers (countries, companies, individuals).
- If candidates include the difference between stocks and reserves this should be credited and may be indicative of a good answer. Stocks are fossil fuels that have been extracted and are ready for consumption / sale. Reserves are yet to be extracted and the amounts are therefore less accurate.

Exploration	Exploration is increasingly challenging as new deposits are in hard to access locations (deepwater oil) which can add to costs. A mention of the geopolitics to claim the resources of the Arctic could be included, or even maintaining sovereignty over islands such as the Falklands for access to the EEZ rich in oil reserves.
Extraction	Extraction is not always a significant challenge but can go wrong – BP Deepwater Horizon oil spill – especially as exploration is moving into harder to access areas. Nigeria and the ongoing pollution of the delta and associated social impacts could be included. <u>Sustainability</u> Some candidates may refer to unconventional means of extraction such as hydraulic fracturing (fracking) for shale gas (USA), horizontal drilling, tar or oil sands (Canada), shale oil (USA) and possibly deepwater oil (Brazil) which have increased both economic and environmental management issues. Unconventional means of extraction have also reduced the concentration of oil and gas reserves in the Middle East (strategic ellipsis).
Trade <u>Interdependence</u>	State run energy companies like Aramco (Saudi Arabia), Gazprom (Russia), Qatar Energy LNG and the Iranian government may well be mentioned in terms of managing stocks, controlling the market and affecting prices. Oil can be stored for strategic reasons for example the USA has the largest reserves in the world. OPEC aim to stabilise prices, ensure fair returns to producers and a regular supply to consumers. As oil is discovered in non-OPEC countries, government influences have increased. MNS's / TNC's (For example Shell, Gazprom and Exxon Mobil) are often heavily involved in this process as are supranational organisations like OPEC. Often there are geopolitical tensions arising from this trade. China plans to build a gas pipeline from Iran to Pakistan. The price of oil and gas is hard to manage for both producers and consumers. <u>Risk and resilience</u>
Transport	Oil spills and / or pipelines through fragile environments could be referred to – Alaska. Pipelines from Russia to Europe via Ukraine have been affected by recent political instability. <u>Sustainability</u> Oil chokepoints like the Strait of Hormuz and the Malacca strait or the geopolitics of the Red Sea would be good examples. <u>Risk</u>
Use (refining and combustion)	Using these resources produces carbon dioxide and is a significant contributor to the enhanced greenhouse effect and subsequent climate change. The world is trying to limit this to the 1.5°C tipping point and some countries are aiming to become carbon neutral. <u>Sustainability</u> Protests – Extinction rebellion is likely to be the best known of these groups, but Greta Thunberg may also be mentioned in terms of reducing use of oil and gas resources. <u>Mitigation</u> Peak oil, predicted to be around 2030 after which there will be a decline in availability and production and this also requires management.

AO2

Application of knowledge and understanding are deployed to consider how challenging the management of the uneven distribution of oil and gas reserves is, compared to other challenges.

Arguments may include:

- There is no doubting the uneven distribution of oil and gas reserves, (inequality) and it is a very important factor as it can be used as a political weapon, but trade can create more balance as can using unconventional means of extraction (USA) meaning that it is no longer the biggest challenge (adaptation) Resilience, Mitigation. Some may consider more important problems to be extraction or trade, or the impacts of climate change from the combustion of oil and gas (sustainability).
- Trade in oil and gas can have serious economic impacts for both producing countries and importing countries.; this can be a challenge for both sides. The cartels of OPEC and GCEP can also influence prices in oil and gas. Geopolitics often affects trade for example the current issues between Iran and Israel.
- The cartels of OPEC and GCEP can also influence prices in oil and gas.
- The main challenge in managing oil and gas resources is likely to vary between places. This is also true of change over time – trade became a significant challenge for Europe thanks to the Russia / Ukraine situation. There are also new discoveries of oil and gas which is changing the traditional distribution e.g. Uganda. It could be argued that the issues associated with climate change are now the biggest challenge.
- All countries want energy security as this is essential for economic and social harmony; the uneven distribution of oil and gas resources makes this more challenging for some countries.
- Peak oil (threshold) was the most significant challenge to those involved in its management, but this has now been extended to be 2050 and is therefore less pressing as a concern. Both resources are finite and therefore this is the most significant challenge. Sustainability.
- The involvement of MNCs can lead to significant environmental impacts e.g. Niger delta / Deepwater Horizon 2010 from the extraction of oil or the transport of oil can lead to spills e.g. Exxon Valdez.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments which cover how much the uneven distribution presents a challenge relative to other factors
- 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 which decides the extent of the challenge.

12. 'Alternative energy sources are completely sustainable.' Discuss.

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

- Types of alternatives that are likely to be covered are renewable, recyclable and reusable. Those who define the different types are likely to score well.
- They include solar, wind, HEP, geothermal, biomass, tidal, wave and nuclear. It is not expected that candidates cover all of these; there can be credit for both breadth and depth. Some of these are inexhaustible in human terms such as wind and tides (non-critical or everlasting), others have the potential to become depleted by mismanagement (critical or recyclable).
- Sustainability is about meeting the needs of the present without compromising the ability of future generations to meet their own needs and it covers 3 strands: environmental, economic and social. It will not be a requirement to cover all 3 of these but doing so could be indicative of a better response.
- One of the barriers to sustainable energy has been the often very high initial investment cost; but this does change as technology improves, fossil fuel prices rise or if there is political instability in fossil fuel exporting nations. Causality. Once set up many of these types of energy can provide relatively low-cost energy.

Alternative energy type	Economic	Social	Environmental
Solar China Sahel	Depends on the scale of the solar production – from a calculator to Bhadla solar park in Rajasthan India, currently the biggest in the world and cost \$1.3 billion. Currently cheaper than fossil fuels. Cost of transport from best places to most populated places.	More energy produced in some places than others due to climate. Also, temporal variation. <u>Causality</u> . Solar cookers as a form of appropriate technology could be mentioned.	Production of PV cells has environmental impacts linked with the mineral extraction and the labour exploitation in their manufacture, despite not producing greenhouse gases when used. <u>Mitigation</u>
Wind UK, Denmark	High initial investment cost. Higher maintenance costs for offshore	Offshore seen as more socially acceptable. <u>Identity</u> Temporal and spatial variation – atmospheric pressure, altitude, exposure.	Some issues with aesthetic pollution as well as birds and bats. Offshore turbines may have impacts on marine ecosystems

HEP The most mature alternative energy source	Often very high initial costs and developing countries may require loans or investments from others with unsustainable repayment costs. <u>Inequality</u>	Geopolitics associated with rivers crossing international borders such as the Grand Ethiopian Renaissance Dam on the Blue Nile which could affect water supply in Egypt. <u>Interdependence</u> Micro hydro can be seen as a form of appropriate technology. 3 Gorges dam – forced location of people <u>Causality</u>	Stop the natural flow of the river which can cause environmental damage. Fish ladders can be provided in some cases. USA removing dams due to silting up. Possible link to Sichuan earthquake 2008 due to Longmenshan fault. <u>Causality</u>
Geothermal Iceland, New Zealand	High initial set up costs	Constant supply but location specific – tectonic setting. <u>Causality</u>	Does not contribute greenhouse gases <u>Mitigation</u>
Biomass	Often the most affordable type of energy in many developing countries – biogas stoves in Nepal from manure. Can affect food production and increase costs <u>Globalisation</u> Sweden uses by products of timber industry to produce electricity.	Fuelwood often collected by women and children in developing countries <u>Inequality</u> .	Releases greenhouse gases but overall carbon neutral as carbon taken in during lifetime. <u>Equilibrium</u> . <u>Sustainability</u> depends on replanting. Can be linked with deforestation of tropical rainforest. <u>Causality</u>
Tidal La Rance / Northern Ireland.	Barrages can be very expensive. <u>Inequality</u>	Schemes are often controversial due to environmental effects.	Salt marsh damage and disruption to fish migration routes. Turbines or lagoons have lower environmental impact.
Wave	Technology is relatively new, and costs are higher than most others.	Would be location specific – coasts.	Some methods of harnessing wave power have environmental impacts.
Nuclear	Very expensive technology – spiralling costs of Hinkley Point C in Somerset. Rolls Royce developing small nuclear reactors which may be cheaper.	Regarded as the best base load supplier. Potential target for terrorist activity <u>Risk</u>	Radioactive waste <u>Risk</u> <u>Risk</u> of meltdown – 3-mile island / Chernobyl. Heated water release. No greenhouse gas emissions <u>Mitigation</u>

AO2

- A consideration of which of the alternative energy resources are more / less sustainable would be a good approach. Within this a comparison of critical and non-critical resources would make a sound argument. If only critical OR non-critical resources are covered, it is likely that it will not score highly.
- Considering the time element of sustainability – some will become more sustainable as technology improves, others less so, if not managed well. Peak oil (threshold) and global climate change mitigation is also likely to mean that alternative energy sources are increasingly used; this will link to their sustainability.
- Small scale projects are arguably more sustainable than large scale projects.
- If a source is not universally available, then can it be considered completely sustainable?
- The aspects of sustainability can be compared to each other – nuclear does not produce greenhouse gases and therefore could be seen as environmentally sustainable but the high cost of building a power station is not economically sustainable and so not many countries can afford to build these. Inequality The high cost of decommissioning of nuclear fission power stations and what to do with the radioactive waste could also be included.
- It is likely that environmental sustainability will be the focus of many responses. A comparison of the negative environmental effects of alternative energy sources, in relation to the enhanced greenhouse effect and other issues is valid, but good depth would be needed to score highly.
- Economic sustainability will almost certainly vary between countries and levels of development. There is an inequality of technology available to exploit resources.
- A consideration of the lifespan of an energy source versus its cost, resource input and production issues would be possibly indicative of a higher-level answer.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced, and logical arguments that cover whether all alternative energy sources are completely sustainable.
- 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 range of alternative energy sources covered and whether both critical and non-critical resources are included.
- the skill in reaching an evidenced conclusion which follows the main points of the essay and decides whether alternative energy sources are all completely sustainable.

13. Evaluate the view that impacts of hazards associated with low-pressure systems are increasingly difficult to manage.

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

[45 marks]

Focus 3.5.4. 3.5.5

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

Indicative content

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

AO1

Knowledge and understanding of:

- The primary hazards associated with low pressure systems.
- In tropical regions, low pressure hazards are tropical storms and cyclones with torrential rain and high winds. These climatic hazard conditions are usually created towards the end of the hot season (August to November in the Northern Hemisphere) and are generated in very deep, fast-moving depressions over the oceans offshore from the eastern margins of continents in the warm seas of the tropics/subtropics. These depressions travel westwards (Coriolis Force) and grow in size and scale, fed by ocean's heat and water evaporating from the ocean's surface.
- Secondary hazards triggered include flooding and storm surges, where very deep depressions coincide with very high tides, as well as landslides and mudflows and dangers from wind-blown debris.
- In temperate regions, primary low-pressure hazards include severe storms which can produce heavy rainfall or snowfall, ice storms and gale force winds. These conditions are generated in depressions often fast moving, driven by strong Jetstream overhead. They are most likely to occur from autumn through to spring, associated with the polar front.
- Secondary hazards triggered also include flooding and storm surges as well as landslides.

Credit named and located fact files of primary and secondary hazards with supporting details of their impacts in both temperate and tropical areas, e.g. named storms.

- Management of hazards
 - Modifying human vulnerability to hazard risk through prediction, monitoring and warning, community preparedness (resilience) and long-term planning, e.g. of escape routes and land use.
 - Modifying the hazard event and vulnerability through environmental control and management, hazard resistant design, e.g. sea defence design for storm surges or building design for storms or floodwalls/check dams (adaptation and mitigation).
 - Modifying the loss through aid, insurance and loss and damage schemes.

Credit examples of management strategies associated with particular hazards. Note – some answers may be limited to just one type of low-pressure hazard such as hurricanes. Credit depth but recognise the limitation in scope

AO2

Application of knowledge and understanding is deployed to evaluate evidence for and against the question as to whether the impacts of low-pressure hazards are becoming increasingly difficult to manage or not. Synthesis will be determined by drawing together evidence to produce a rational conclusion.

Arguments could include:

Increasing risk and challenge

- This applies especially to large scale hazards such as hurricanes and major storms and their knock-on effects of secondary hazards of coastal floods/storm surge and river flooding as short-term climate change, variations in ENSO and other oscillations and climate warming have led to more extreme weather events.
- Events are often of longer duration and greater intensity (see Hurricane Saffir Simpson scale numbers), spreading to areas (aerial extent) where people are less familiar with their occurrence and what to do in an emergency, has made management increasingly difficult and costly. Medicanes are an example, such as Hurricane Daniel, which flooded Deira in Libya in 2023.
- Fertile river valleys, often in Emerging nations and LICs have exacerbated risk, especially in LICs where many people are less resilient and able to cope. This is a major problem in very densely populated areas. It is also a problem in HICs with housing development on flood plains.
- The sheer unpredictability of many hazards associated with low-pressure leads to increased vulnerability of many people who lack safety nets of insurance and are reliant on diminishing amounts of land and are therefore at risk immediately after the disaster from famine/disease.
- In many areas disasters have been increased by the failure to maintain defences due to the high costs involved, or by their removal for economic development (for example, reefs and mangroves – both natural protectors). Severe storm disasters are the most common threat, each with its own mix of damaging conditions. Low pressure hazards can be amplified by other environmental conditions (steep slopes lead to landslides/floods).

Figure 10: Severe storms as compound hazards showing major characteristics and impacts.

Tropical storms		Mid-latitude storms		
Tropical cyclones	Tornadoes	Hailstorms	Winter cyclones	Snowstorms
Wind	Wind	Hail	Wind	Snow
Rain	Pressure drop	Wind	Rain	Ice
Storm surge and waves	Updraughts	Lightning	Flooding	Glaze
Coastal erosion	Building damage	Building damage	Landslides	Wind
Flooding	Agricultural losses	Agricultural losses	Coastal erosion	Blizzards
Landslides			Building damage	Transport disruption
Saline intrusion			Agricultural losses	Building damage
Building damage				Agricultural losses
Agricultural losses				
Transport disruption				

- Figure 10 shows the compound nature of severe storms which lead to increasing difficulties of management, especially in certain environmental settings – for tropical cyclone hazards, densely populated low-lying deltas in LICs, e.g. Bangladesh, isolated island groups, e.g. Caribbean and highly urbanised coasts in HICs are the areas of greatest risk often from compound climatic hazards.

Improved management

- On the other hand, the techno fixes and other improved management strategies have led to increasing success of both adaptation and mitigation for many of the hazards.
- A number of strategies have been developed for management of storms and their secondary hazards with meteorological offices, e.g. the UK, providing more accurate details of storms e.g. Japan or UK with hazard storms and colour coded warnings (yellow, amber, red)
- Protection can be achieved not by environmental control, but by hazard resistant design. At a basic level in Bangladesh which suffers from frequent cyclones, the low-lying topography offers little escape from high winds, storm surges or flooding and a combination of huge cyclone shelters and escape platforms and roofs can evacuate up to 5 million people away from the more dangerous areas. Digital climatic models and GIS are employed to assess coastal vulnerability to storm surges and where to locate a range of appropriate defences.
- Building codes for hazard resistant designs can be enforced to strengthen roofs and walls against wind and water e.g. storm shelters, modified roofs – i.e. mitigation.
- Adaptation can be enhanced by community preparedness and above all by forecasting and warning. Weather forecasters can monitor the development of storms using geo stationary satellites and buoys, aircraft, radiosondes and dropsondes – with data fed into computer models to forecast storm intensities (use of Doppler radar) and tracks, which can then be used to communicate warnings to allow preparation and improve evacuation procedures. International co-operation now improves the usefulness of warnings.
- Land use planning can be enforced by law to ensure some security against flooding.
- Mitigation is improved by more efficient disaster aid strategies and also by developing insurance options for all, often by governments. Similar strategies are used to protect against flooding (embankments, levees and dams and also flood proofing residential buildings) as well as adaptation strategies to prepare, forecast and warn and mitigation strategies of aid and insurance.
- It could be argued that over the years, technology and other developments have indeed led to decreasing impacts from some low-pressure hazards, especially in HICs where the finance and know-how are available. So much depends on the intrinsic features of the low-pressure hazard itself as well as extrinsic features (location, level of development, quality of governance, population density etc.).
- A possible conclusion will emphasize the increasing risk, but at the same time evaluate the impact of improved technology led management. It could also explore the concepts of increasing risk and use supporting evidence of individual hazards, both primary and secondary, to assess the role of improved management over time to come to a conclusion concerning agreement/disagreement with the statement.
- Increasing exposure to more hazards from growing populations, many with low adaptation capacity and a lack of ability to mitigate the impacts is key to increasingly difficult management.

Comparisons of similar strategies employed in different environments and with different communities/places will evaluate the arguments e.g. comparative studies of Katrina/Nargis or of severe Atlantic storms.

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the strategies and the challenges concerning the factors influencing increased difficulty in management and the extent to which improvements in protection, adaptation and mitigation strategies could counteract this.
- the skill of constructing relevant annotated diagrams and maps and tables e.g. of cyclone and flood deals 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 which evaluates the statement.

14. To what extent do all urban areas create distinctive local climates?

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 the various ways in which all urban areas generate distinctive local climates.

- Urban areas have an impact on all microclimate variables (causality)
- These variables include temperature, precipitation, pressure and winds, humidity, cloud amounts and fogs and radiation and sunshine.
- The differences result from the structure of the air above urban areas and the structure and nature of urban surfaces.
- Temperatures
Stronger heat energy retention and release, including fuel combustion, gives significant temperature increases from suburbs into the centre of built-up areas, creating urban heat 'islands'. These can be up to 8°C warmer during winter nights. Snow in rural areas increases its albedo, thereby increasing the differences between urban and rural. Heating from below increases air mass instability overhead, notably during summer afternoons and evenings. Big local contrasts between sunny and shaded surfaces, especially in the spring.
- Precipitation
Perceptively more intense storms, particularly during hot summer evenings and nights owing to greater instability and stronger convection above built-up areas. Probably higher incidence of thunder in appropriate locations. Less snowfall and less coverage when uncleared.
- Pressure and winds
Severe gusting and turbulence around tall buildings cause strong local pressure gradients from windward to leeward walls. Deep narrow streets can lead to pollution sinks due to being much calmer unless aligned with the prevailing wind which can lead to the Venturi effect / canyon effect.
- Humidity
Decreases in relative humidity occur in inner cities owing to lack of available moisture and higher temperatures there.
- Clouds and fogs
Higher incidence of thicker cloud cover in summer and radiation fogs or smogs in winter because of increased convection and air pollution respectively. Concentrations of hygroscopic particles accelerate the onset of condensation. Day temperatures are, on average, 0.6° warmer.
- Radiation and sunshine
Greater scattering of shorter-wave radiation by dust, but much higher absorption of longer waves owing to surfaces and CO₂. Hence more diffuse sky radiation with considerable local contrasts owing to variable screening by tall buildings in shaded, narrow streets. Reduced visibility arising from industrial haze.

Figure 11: Average changes in climate caused by urbanisation when compared with rural areas.

Radiation	
Global	2 – 10% less
Ultraviolet, winter	30% less
Ultraviolet, summer	5% less
Sunshine duration	5 – 15% less
Temperature	
Annual mean	1°C more
Sunshine days	2 – 6°C more
Greatest difference at night	11°C more
Winter maximum	1.5°C more
Frost-free season	2 – 3 weeks more
Wind speed	
Annual mean	10 – 20% less
Gusts	10 – 20% less
Calms	5 – 20% more
Relative humidity	
Winter	2% less
Summer	8 – 10% less
Precipitation	
Total	5 – 30% more
Number of rain days	10% more
Snow days	14% less
Cloudiness	
Cover	5 – 10% more
Fog, winter	100% more
Fog, summer	30% more
Condensation nuclei	10 times more
Gases	5 – 25 times more

AO2

Application of knowledge and understanding is deployed to consider the extent to which urban areas generate their own distinctive local microclimate. Synthesis will be demonstrated by drawing together of evidence to reach a rational conclusion as to the importance and variation of impacts which make them more or less distinctive.

Variations in the following areas.

- Three interlinked changes can occur which lead to the development of urban climates.
 - Atmospheric composition – with higher concentrations of gases such as carbon dioxide, sulphur dioxide, NOx and particulates resulting from industry and transport. This can reduce the amount of incoming solar radiation and increase the number of condensation nuclei so leading to higher frequency, duration and occurrence of fog/smog (pollution levels), higher levels of cloud and so reduced sunshine and higher levels of precipitation with thunderstorms and hail more likely.
 - Energy budget – with changes due to the urban atmosphere due to the albedo (e.g. of glass buildings) and heat storage capacity of buildings, artificial sources of heat from factories, vehicles and homes and the reduced need of energy for evaporation. Urban areas are characterised by increases in temperature with urban heat islands forming, especially during anticyclonic conditions in the night and in winter.
 - Surface roughness and composition.
 - In general wind speeds are lower, but turbulence and channelling between high rise buildings (Venturi effect) can occur.
 - The lack of large water bodies and the speedy removal of rainfall through gutters, drains and storm channels reduces the amount of water present and the lack of vegetation reduces evapotranspiration leading to lower humidity levels.

A number of factors determine the impact and the degree of the three changes which have a major influence on the elements of urban microclimate.

- The size and scale of the city plays a major influence on the existence, intensity and shape of the urban heat island, e.g. In North America urban areas with 100,000 people are at most 7°C warmer than surrounding rural areas. Cities with 1,000,000 people, 11°C warmer and megacities could be as high as 15°C warmer. As a general rule, the larger the city, the more pronounced the effects.
- Small scale variations within urban areas occur due to the distribution of lakes, parkland, vertical height of buildings, relief and occurrence and distribution of economic activity (e.g. secondary/primary) (causality) influencing the relative impact of climate elements. High rise buildings lead to increased friction, but a more pronounced Venturi effect. Critical wind speeds, e.g. London, 12 metres/second may disperse the urban heat island. They can amplify or diminish the distinctiveness.
- Location of urban areas. The relative impact of different locations (places) may decrease or intensify the effect. Heat islands are more pronounced for cities in high pressure areas or continental interiors, whereas coastal locations have a diminished heat island once winds have been drawn in from the sea (Veracruz). Critical wind speeds, e.g. London, 12 metres/second may disperse the urban heat island.
- There are a number of reasons which determine the extent to which urban heat islands may impact on precipitation, e.g. degree of convectional uplift, from heat or high-rise buildings or the impacts of aerosols on thunderstorms/hail, with precipitation levels generally high.
- The extent to which there is variation due to levels of development. Although many cities in LICs are very large and growing rapidly, urban land use is normally high density, but low rise and urban heat islands are less pronounced. However, the widespread use of fuelwood leads to very marked pollution domes rather than dense vehicle traffic with a very different mix of pollutants. However, in NICs with both rapid development and industrialisation, urban heat islands and other impacts such as fog/smog can be very marked (e.g. Delhi or Beijing).
- The extent to which changes over time influence local climates (time scales), as with the projected growth of urbanisation (70% will live in cities by 2050) there will be many mega cities which will have a profound effect on local climate. In many MEDCs building efficiency and transport efficiency measures and legislation to control emissions (vehicle use, scrubbers in chimneys of factories, clean air action etc) will have reduced the impacts of the causes of pollution etc. (resilience, mitigation) which influences occurrence of fogs, rain etc.
- At a seasonal level, the characteristics can also be amplified, e.g. heating systems in winter (fog formation) or by ambient temperature, for example, the occurrence of heat and sunshine in summer, or snow in winter are heavily influenced by location (coastal, inland, latitude etc.)
- To this variable equation of 'to what extent' must be added the contested role of climate change in exaggerating the effects of many large urban areas on local climates (causality).

A possible conclusion might suggest that all urban areas have some features of a distinctive urban climate, but the degree of distinctiveness varies as a result of a number of factors which can amplify or diminish the key features (see Figure 9).

AO3

Skills evidenced in the question context include:

- the skill in presenting well-constructed, coherent, evidenced and logical arguments about the ways in which urban areas can generate local climates.
- the skill of constructing relevant annotated diagrams and maps and tables e.g. of UHI, or supporting statistics to support the answer.
- the skills in covering both the breadth and depth of the question.
- the skill in reaching an evidenced conclusion which evaluates the statement as to the extent urban areas create their own microclimate and the reasons why this could vary.