

INTERNATIONAL A-LEVEL GEOGRAPHY GG03

Paper 3 Physical Geography 2

Mark scheme

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same, correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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International A-level Geography mark scheme

How to mark

Aims

When you are marking your allocation of scripts your main aims should be to:

- recognise and identify the achievements of students
- place students in the appropriate mark band and in the appropriate part of that mark band (high, low, middle) for **each** Assessment Objective
- record your judgements with brief notes, annotations and comments that are relevant to the mark scheme and make it clear to other examiners how you have arrived at the numerical mark awarded for each Assessment Objective
- ensure comparability of assessment for all students, regardless of question or examiner.

Approach

It is important to be **open-minded** and **positive** when marking scripts.

The specification recognises the variety of experiences and knowledge that students will have. It encourages them to study geography in a way that is relevant to them. The questions have been designed to give them opportunities to discuss what they have found out about geography. It is important to assess the quality of **what the student offers**.

Do not mark scripts based on the answer **you** would have written. The mark schemes have been composed to assess **quality of response** and not to identify expected items of knowledge.

Assessment Objectives

This component requires students to:

AO1	Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change, at a variety of scales.
AO2	Apply knowledge and understanding in different contexts to interpret, analyse and evaluate geographical information and issues.
AO3	Use a variety of relevant quantitative, qualitative and fieldwork skills to: • investigate geographical questions and issues • interpret, analyse and evaluate data and evidence • construct arguments and draw conclusions.

The marking grids

Do not think of levels equaling grade boundaries.

Depending on the part of the examination, the levels will have different mark ranges assigned to them. This will reflect the different weighting of Assessment Objectives in particular tasks and across the examination as a whole.

Using the grids

Having familiarised yourself with the descriptors and indicative content, read through the answer and annotate it (as instructed below) to identify the qualities that are being looked for and that it shows. You can now check the levels and award a mark.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptors for that level. The descriptors for the level indicate the different qualities that might be seen in the student's answer for that level. If it meets all the descriptors for the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptors and the answer. With practice and familiarity you will find that for better answers you will be able to skip through the lower levels of the mark scheme quickly.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best-fit approach for defining the level and then use the variability of the response to help decide the mark within the level.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark.

It is often best to start in the middle of the level's mark range and then check and adjust. If there is a lot of indicative content fully identifiable in the work you need to give the highest mark in the level. If only some is identifiable or it is only partially fulfilled, then give the lower mark.

The exemplar materials used during standardisation will also help. There will be an answer in the standardising materials that will correspond with each level of the mark scheme. This answer will have been awarded a mark by the lead examiner. You can compare the student's answer with the example to determine if it is of the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the lead examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

In addition to the levels descriptors, question specific indicative content is provided as a guide for examiners. This is not intended to be exhaustive and you must credit other valid points.

An answer that contains nothing of relevance to the question must be awarded no marks.

Annotating scripts

You should write a summative comment at the end for each Assessment Objective and indicate the marks for each Assessment Objective being tested at the end of the answer in the margin in sequence. It is vital that the way you arrive at a mark should be recorded on the script. This will help you with making accurate judgements and it will help any subsequent markers to identify how you are thinking. Please do not write negative comments about students' work or their alleged aptitudes.

Section A – Water, Carbon and Life on Earth

Total for this section: 40 marks

Question	Part	Marking guidance	Total marks
01	1	‘Water vapour in the air turns into water droplets, forming clouds.’ Which of the following processes does this describe? Key – A: Condensation	1 AO1=1

Question	Part	Marking guidance	Total marks
01	2	Which of the following is the smallest global store of water? Key – A: Atmosphere	1 AO1=1

Question	Part	Marking guidance	Total marks
01	3	‘A small increase in global atmospheric carbon dioxide (CO₂) increases rates of photosynthesis, which results in faster plant growth and more carbon stored in the biosphere. This removes some of the CO₂ in the atmosphere.’ This is an example of which of the following? Key – B: Negative feedback	1 AO1=1

Question	Part	Marking guidance	Total marks
01	4	What does a flood hydrograph represent? Key – A: The change in river discharge over time following a storm event	1 AO1=1

Question	Part	Marking guidance	Total marks
01	5	Which of the following is an example of the relationship between the water cycle and carbon cycle in the atmosphere? Key – D: Carbon dioxide released into the air regulates air temperatures and affects the rate of evaporation.	1 AO1=1

Question	Part	Marking guidance	Total marks
02		Analyse the data shown in FIGURE 1.	6 AO3=6

Level	Marks	Descriptor
2	4–6	AO3 – Clear analysis of the quantitative evidence provided which makes appropriate use of data to support. Clear connections between different aspects of the data.
1	1–3	AO3 – Basic analysis of the quantitative evidence provided which makes limited use of data to support. Basic or limited connections between different aspects of the data.
0	0	No creditable content.

Indicative Content

This question requires analysis of the relationship between GDP per capita and CO₂ emissions per capita. There is also a spatial pattern of areas, as well as patterns shown in population by region to analyse. Links should also be made between the data provided. For maximum marks, all 3 elements (GDP, emissions and population size) should be used as well as use of specific data. There is no credit for explanation.

AO3

- Overall, a strong positive correlation exists between CO₂ emissions and income levels. Candidates may exemplify this relationship eg *At \$50 000 GDP per capita, emissions per capita are approximately 10 times higher for every 50-fold increase in annual income, indicating that wealthier countries tend to emit more CO₂.*
- A spatial pattern is evident in the data. South America shows high clustering of countries with very similar GDP and per capita emissions in the middle income range, while European countries are concentrated at the top end of income and emissions.
- Most North American countries are clustered between \$5000 and \$20 000 GDP per capita, with emissions ranging from 1t to 6t, candidates may note the exception to this pattern.
- Africa displays the largest range of countries spread across the graph and exhibits the greatest number of nations deviating from the line of best fit.
- Asia also has a large number of nations deviating from the line of best fit.
- Candidates may draw on numerous anomalies eg North Korea, Democratic Republic of Congo, Qatar and Norway etc.
- The Democratic Republic of Congo and North Korea are outliers when a line of best fit is drawn. DRC has lower-than-expected emissions per income, while North Korea emits significantly more CO₂ (approximately 1t more) than anticipated based on its GDP per capita compared to similar low-income countries in the \$1500–\$2000 per capita range. Conversely, Norway demonstrates lower emissions than expected for their income levels.
- The relationship between CO₂ emissions and population size appears less clear. Major population centres, such as India and China (over 1 billion population), fall within the middle range, while both small and medium-sized populations (approximately 300 million) are found at opposite ends of the

spectrum. However, there is a noticeable number of medium-sized populations above the 1t CO₂ emissions line, suggesting a potential positive correlation between GDP per capita, CO₂ emissions per capita, and population size.

- Difficult to draw useful comparisons within the region.
- Using proportional circles on the graph leads to data overlapping, hindering clear interpretation.

Credit any other valid response.

Level 2 candidates should demonstrate analytical skills. They also need to be able to demonstrate links between the data provided. For maximum marks, all three elements should be used.

Question	Part	Marking guidance	Total marks
03		Assess the impact(s) of changes in the carbon cycle on oceans. AO1 – Knowledge and understanding of the changes in the carbon cycle and the impact on the oceans, linked to knowledge and understanding of factors affecting flows in the carbon cycle. AO2 – Application of knowledge and understanding to the scale or significance of the impact of the changes to the oceans.	9 AO1=4 AO2=5

Level	Marks	Descriptor
3	7–9	AO1 – Demonstrates detailed knowledge and understanding of the impact(s) of changes in the carbon cycle on oceans. AO2 – Applies knowledge and understanding to the novel situation, offering detailed examination, drawn appropriately from the context provided. Connections and relationships between different aspects of study are thorough and relevant.
2	4–6	AO1 – Demonstrates clear knowledge and understanding of the impact(s) of changes in the carbon cycle on oceans. AO2 – Applies knowledge and understanding to the novel situation, offering clear examination, drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident and relevant.
1	1–3	AO1 – Demonstrates basic knowledge and understanding of the impact(s) of changes in the carbon cycle on oceans. AO2 – Applies limited knowledge and understanding to the novel situation, offering some basic examination. Connections and relationships between different aspects of study are basic with limited relevance. Analysis and evaluation are basic and of limited relevance.
0	0	No creditable content.

Indicative Content

AO1

- Ocean acidification: increased atmospheric CO₂ levels have led to a 30% rise in ocean acidity since the pre-industrial era, causing the absorption of CO₂ by seawater and resulting in a decrease in pH levels.
- Coral reefs, which support 25% of marine species, are experiencing declining calcification rates due to acidification.
- Warming of ocean waters: rising CO₂ concentrations contribute to global warming, resulting in a 0.14 °C increase in ocean temperatures per decade since 1981. Elevated ocean temperatures contribute to coral bleaching events.
- Changes in ocean circulation: climate change, linked to increased CO₂ emissions, has altered ocean circulation patterns, affecting global currents. Changes in ocean circulation patterns have implications for marine ecosystems, influencing the distribution of species and affecting fisheries. These changes contribute to the increased intensity and frequency of extreme weather events such as hurricanes.
- Sea level rise: warming temperatures have led to a global sea level rise of approximately 21–24 cm since the late 19th century, with a rate of 3.5 mm per year since 1993.
- Shifts in marine biodiversity and ecosystems: changes in ocean conditions, including temperature and acidity, have led to shifts in the distribution and abundance of marine species. Approximately 700 marine species are at risk of extinction due to climate change.
- Impacts on carbon sequestration: changing ocean conditions affect the capacity of marine ecosystems to sequester carbon, impacting processes like photosynthesis and calcium carbonate formation. The Southern Ocean absorbs the most CO₂.

AO2

- Ocean acidification poses a significant threat to marine life, especially organisms with calcium carbonate structures.
- Over 75% of the world's coral reefs experiencing prolonged high temperatures, a significant threat to the survival of diverse marine ecosystems.
- Shifts in biodiversity have long term, wide scale, cascading effects on marine ecosystems, influencing food webs and ecosystem services.
- Altered carbon sequestration contributes to a positive feedback loop, further exacerbating climate change impacts. This could be considered the most significant impact as it creates further change in the carbon cycle.
- Of all the oceans, the Southern Ocean is experiencing the most reduced efficiency in carbon uptake due to warming.
- Negative feedback loops resultant from global warming, such as warmer oceans, result in less CO₂ that can be absorbed.
- Sea level rise, driven by thermal expansion and melting ice caps, has global implications, with coastal communities worldwide facing increased risks of flooding and erosion.
- Rising sea levels pose threats to coastal ecosystems, with low-lying areas and estuaries facing increased vulnerability. Coastal communities and habitats, including mangroves and tidal marshes, are at risk of submersion and salinization.
- On a larger scale, alterations in ocean circulation patterns can affect the distribution and abundance of marine species, impacting fisheries and ocean productivity.
- Even if carbon emissions are reduced and atmospheric CO₂ levels stabilised, the effects of ocean acidification and sea level rise may continue for centuries due to the inertia of the Earth's climate system and the slow response of oceans to changes in atmospheric conditions.

Question	Part	Marking guidance	Total marks
04		‘Natural factors are more important than human factors in driving change in the stores and flows of the carbon cycle.’ To what extent do you agree with this statement? AO1 – Knowledge and understanding of the natural and human causes of change in the carbon cycle. Knowledge and understanding of the stores and flows in the carbon cycle. AO2 – Application of knowledge and understanding to explain the importance of the natural and human factors driving change over time. The response should come to a view with regard to the strength and importance of those changes.	20 AO1=10 AO2=10

Level	Marks	Descriptor
4	16–20	AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. AO2 – Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout. AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout. AO1 – Full and accurate knowledge and understanding of key concepts and processes throughout. AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.
3	11–15	AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. AO2 – Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding. AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments. AO1 – Generally clear and accurate knowledge and understanding of key concepts and processes.

		AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.
2	6–10	AO2 – Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question. AO2 – Some partially relevant analysis and evaluation in the application of knowledge and understanding. AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant. AO1 – Some knowledge and understanding of key concepts, processes and interactions and change. AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.
1	1–5	AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence. AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Very limited relevant knowledge and understanding of place(s) and environments. AO1 – Isolated knowledge and understanding of key concepts and processes. AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.
0	0	No creditable content.

Indicative Content

AO1

Stores include:

- The atmosphere acts as a reservoir for carbon in the form of greenhouse gases. Carbon dioxide, a key component, plays a significant role in the Earth's climate system.
- Oceans are a major carbon sink, absorbing atmospheric CO₂ as dissolved carbon dioxide, bicarbonate ions, and carbonate ions. Carbon is also present in the form of dissolved inorganic carbon and marine organisms.
- Pedosphere/Soil Store: soil stores a large amount of carbon, mainly in the form of organic matter. Decomposition of organic material contributes to the cycling of carbon within the soil.
- Biosphere: living organisms including plants, animals, and microorganisms store and exchange carbon as part of their metabolic processes and life cycles.
- Lithosphere store: fossil fuels are a reservoir of carbon that can be released into the atmosphere when burned for energy, contributing to anthropogenic carbon emission. Carbon is stored in sediments as a result of processes like the accumulation of marine organisms' remains and precipitation of carbonate minerals.
- Cryosphere store: permafrost stores carbon in a frozen state, but climate change can lead to thawing, releasing stored carbon into the atmosphere as greenhouse gases.
- Biosphere store: organic carbon in plant tissues including leaves, stems, and roots. Plants sequester carbon through photosynthesis, storing it in their tissues. Deforestation and land-use changes can impact the carbon stored in vegetation.

Flows include:

- Photosynthesis: plants and other photosynthetic organisms use sunlight to convert atmospheric carbon dioxide into organic carbon compounds, releasing oxygen as a byproduct.
- Respiration: living organisms break down organic carbon compounds to release energy for cellular activities, producing carbon dioxide as a byproduct.
- Decomposition: decomposers such as bacteria and fungi break down dead organic matter, releasing carbon dioxide and other nutrients back into the soil.
- Combustion: burning fossil fuels or biomass releases carbon dioxide into the atmosphere, contributing to the greenhouse effect.
- Ocean absorption: oceans act as carbon sinks, absorbing carbon dioxide from the atmosphere. Dissolved carbon compounds undergo chemical reactions to form bicarbonate and carbonate ions.
- Weathering: rocks break down over time, releasing carbonate minerals. Chemical weathering converts these minerals into dissolved carbon compounds.
- Burial and sedimentation: dead organic matter accumulates and can be buried, forming sedimentary rocks over geological time, locking away carbon.
- Deforestation and land-use change: cutting down trees and converting land for agriculture or other purposes releases stored carbon in vegetation, contributing to increased atmospheric carbon dioxide levels.
- Over the past 200 years, volcanic emissions have contributed to approximately 0.26 gigatons of carbon dioxide per year on average, a minor fraction compared to anthropogenic emissions.
- Biotic processes eg respiration, decomposition, and photosynthesis. Earth's vegetation and soils store an estimated 2300 gigatons of carbon, with photosynthesis absorbing about 120 gigatons annually.
- Climate variability, influenced by natural phenomena like El Niño and La Niña, can alter temperature, precipitation and ecosystem dynamics.
- Weathering processes, a fundamental geological factor, contribute to long-term carbon sequestration.

- Since the Industrial Revolution, human activities have released over 2100 gigatons of carbon dioxide, primarily from burning fossil fuels.
- The annual CO₂ emissions from fossil fuel combustion reached approximately 36.8 gigatons in 2022, marking a significant departure from pre-industrial levels.
- Industrial processes, such as cement production and chemical manufacturing contribute to greenhouse gas emissions releasing methane and nitrous oxide, contributing to the enhanced greenhouse effect.
- Land-use changes, driven by deforestation and urbanisation, contribute to the alteration of carbon storage in vegetation and soils. Land-use changes have released an estimated 240 gigatons of carbon into the atmosphere.

AO2

- Human factors, particularly fossil fuel combustion and land-use changes, have become dominant drivers of recent changes in the carbon cycle.
- The rapid increase in atmospheric CO₂ levels since the Industrial Revolution is primarily attributed to human activities. While natural factors remain important, their influence is often amplified or altered by anthropogenic drivers.
- The unprecedented rate of change in the carbon cycle observed in recent decades underscores the significance of human-induced alterations and the need for mitigation strategies to address the associated environmental impacts.
- Volcanic activity, a natural contributor to atmospheric carbon, plays a role in short-term variations. While volcanic eruptions release substantial amounts of carbon dioxide, the overall impact is episodic.
- Biotic processes have maintained a dynamic equilibrium, ensuring a balance between carbon sources and sinks.
- El Niño and La Niña variations contribute to short-term fluctuations in carbon exchange but their long-term impact is modulated by other factors. Extreme events, however, can have pronounced effects, as seen in the Amazon rainforest where droughts led to increased carbon emissions.
- Over geological timescales weathering removes CO₂ from the atmosphere through the breakdown of rocks. While this process operates on extended temporal scales, it plays a critical role in regulating atmospheric CO₂ levels.
- Fossil fuel combustion stands out as a dominant factor in recent carbon cycle changes.
- The conversion of forests to agricultural land and other land-cover changes has substantially impacted the carbon cycle.
- Industrial processes individual contributions are smaller compared to fossil fuel combustion.
- Agricultural practices, particularly livestock production and rice cultivation, release substantial amounts of methane and nitrous oxide. These agricultural emissions have increased significantly, contributing to approximately 20% of global greenhouse gas emissions.
- Candidates are likely to conclude that it is predominantly human factors that have driven changes in stores and flows of carbon. Any evaluation is acceptable, so long as it is supported by the points discussed.

Max L2 if only natural OR human factors considered.

Section B – Ecosystems Under Stress**Total for this section: 40 marks**

Question	Part	Marking guidance	Total marks
05	1	Which of the following is an adaptation to high precipitation in tropical rainforests? Key – B: Plants have leaves with pointed tips.	1 AO1=1

Question	Part	Marking guidance	Total marks
05	2	Which of the following describes a characteristic of the climate of savanna grassland? Key – A: Both a wet and a dry season in the year	1 AO1=1

Question	Part	Marking guidance	Total marks
05	3	In a food web, which organism occupies the lowest trophic level? Key – C: Primary producers	1 AO1=1

Question	Part	Marking guidance	Total marks
05	4	Which of the following all describe an ideal ocean condition for coral reef development? Key – D: Water temperatures between 23 °C and 29 °C, low acidity levels and a high salt content	1 AO1=1

Question	Part	Marking guidance	Total marks
05	5	Which of the following defines ‘seral stage’ in a succession? Key – A: A phase in the development of the ecosystem as it continues towards climatic climax.	1 AO1=1

Question	Part	Marking guidance	Total marks
06		Analyse the data shown in FIGURE 2.	6 AO3=6

Level	Marks	Descriptor
2	4–6	AO3 – Clear analysis of the quantitative evidence provided which makes appropriate use of data to support. Clear connections between different aspects of the data.
1	1–3	AO3 – Basic analysis of the quantitative evidence provided which makes limited use of data to support. Basic or limited connections between different aspects of the data.
0	0	No creditable content.

Indicative Content

This question requires analysis of the relationship between percent of Earth's surface area, average net primary productivity and percent of Earth's net primary production for each biome. Links should also be made between the data provided. For maximum marks, all three elements should be used as well as use of specific data. There is no credit for explanation.

AO3

- Land-based (terrestrial and freshwater) biomes each occupy much smaller areas, but in total coverage the land biomes are about 29% of the Earth's surface, while marine areas cover the other 71%.
- The most productive biomes by average net production per unit area are the tropical rain forests on land, and the shallow beds and reefs in the ocean. Swamps and marshes on land (but in some cases along the coast) come third in primary productivity.
- The rate of production is greatest in tropical forests, wetlands, coral reefs, and estuaries.
- Tropical rainforests represent a small percentage of the earth's surface but high production (2.3% surface area but approximately 2200 g/m²/year) – opposite for open ocean (65% surface area but 130 g/m²/year). The open ocean has a relatively small productivity, but its global production is large.
- Tropical rainforests are 16.9 times more productive per year than open ocean but are 28 times smaller in surface area.
- NPP percentage (%) open ocean differs from other ecosystems.
- NPP in algal beds and coral reefs is high but very small (0.1% percent of surface area by 25 000 g/m²/year) ecosystem – algal beds and reefs constitute the most productive ecosystem per unit area.
- Terrestrial ecosystems have more productivity with the exception of the tundra.
- Aquatic ecosystems are more varied eg open ocean vs estuary, and algal beds/coral reefs.
- Freshwater (lake and stream/swamp and stream) high NPP.

Question	Part	Marking guidance	Total marks
07		Assess the impact of fishing on the health and survival of a coral reef you have studied. AO1 – Knowledge and understanding of the impact of fishing on the health and survival of coral reefs. AO2 – Application of knowledge and understanding to the scale or significance of the impact of different fishing activities on a coral reef.	9 AO1=4 AO2=5

Level	Marks	Descriptor
3	7–9	AO1 – Demonstrates detailed knowledge and understanding of the impact of fishing on the health and survival of coral reefs. AO2 – Applies knowledge and understanding to the novel situation, offering detailed examination, drawn appropriately from the context provided. Connections and relationships between different aspects of study are thorough and relevant.
2	4–6	AO1 – Demonstrates clear knowledge and understanding of the impact of fishing on the health and survival of coral reefs. AO2 – Applies knowledge and understanding to the novel situation, offering clear examination, drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident and relevant.
1	1–3	AO1 – Demonstrates basic knowledge and understanding of the impact of fishing on the health and survival of coral reefs. AO2 – Applies limited knowledge and understanding to the novel situation, offering some basic examination. Connections and relationships between different aspects of study are basic with limited relevance. Analysis and evaluation are basic and of limited relevance.
0	0	No creditable content.

Indicative Content

AO1

- Live reef fish have long been traded around Southeast Asia as a luxury food item, and in recent decades such trade has rapidly expanded. As much as 50% of reef fish are taken from the water before they have had an opportunity to reproduce.
- The capture of non-target species, known as bycatch, is a common issue such as sea turtles and juvenile fish and can have severe consequences for their populations.
- Destructive fishing practices eg bottom trawling and blast fishing have left a visible impact on the reefs. Areas subject to bottom trawling show a higher incidence of physical damage to coral structures, contributing to habitat degradation and loss.

- The use of cyanide to stun and capture live fish for the aquarium trade: the chemicals used in cyanide fishing can have severe impacts on coral health, as they harm coral polyps and reduce the resilience of the reef.
- Fishing for the aquarium trade: the extraction of ornamental fish for the aquarium industry has resulted in the removal of key species essential to the reef's ecological balance.
- Ghost fishing: abandoned or lost fishing gear, such as nets and traps, can continue to trap and kill marine life.
- Oil spills from boats can have devastating effects on coral reefs, posing significant threats to these fragile and vital marine ecosystems. Oil slicks on the water surface can cover coral colonies, reducing the penetration of sunlight. This affects the process of photosynthesis in coral zooxanthellae, essential for their survival. Oil contains toxic compounds that can directly harm coral tissues and interfere with their metabolic processes. Adhesion of oil to coral surfaces can impede the corals' ability to filter-feed and capture prey.
- Fishing has exerted a substantial toll on the Great Barrier Reef, significantly affecting its health and survival.
- Overfishing leads to depletion of critical fish species within the reef.
- Great Barrier Reef – key species such as the coral trout have experienced a significant decline, disrupting the intricate balance of the food web and jeopardising the overall biodiversity of the reef.
- The Mesoamerican Barrier Reef – overfishing has led to a notable decline in key fish species. For instance, studies reveal that commercially important species such as snappers and groupers have declined with three out of four countries now reporting critically low biomass, threatening the ecological balance within the reef.
- Overfishing in the Indonesia Coral Triangle has led to a significant decline in fish populations. The Wildlife Conservation Society reported that numbers of certain commercially important fish species, including groupers and snappers have been reduced.
- The Indonesia Coral Triangle faces challenges from illegal, unreported, and unregulated (IUU) fishing.
- Indonesia Coral Triangle – an estimated 10% of the coral reefs in the region are damaged annually due to destructive fishing methods. This damage not only affects the corals directly but also diminishes the overall habitat quality for a myriad of marine species. The extensive use of destructive gear has led to a notable decline in coral cover, with some areas experiencing reductions of 20% or more.

AO2

- Some fishing practices, such as large-scale commercial bottom trawlers, blast fishing and the use of cyanide are more destructive than others.
- Illegal activity exacerbates the overfishing problem and undermines conservation efforts.
- The removal of keystone species has far-reaching consequences, not only on the targeted fish populations but also on the broader marine ecosystem that relies on them for ecological stability. E.g. fishing leading to the surge in COTS (Crown of Thorns Starfish).
- Ghost fishing can result in the destruction of coral colonies and negatively impact reef structure over time.
- The WWF have implemented strategies to reduce the impact of fishing on coral reefs – promoting alternative fishing hooks to reduce bycatch, protecting marine turtles with education programmes and creating protected areas. This is having a global impact.
- Addressing these numerical realities is crucial for the long-term health and survival of the Indonesia Coral Triangle, necessitating effective management strategies, international collaboration and sustainable fishing practices.

- The delicate corals, essential for providing habitat and shelter for numerous marine species, are vulnerable to destructive fishing practices. As a result coral cover is reduced and the overall health and resilience of the reef are compromised.
- Harmful capture methods such as cyanide, underscore the need for more stringent regulations and conservation efforts.
- Conservation efforts have been implemented along the Mesoamerican reef, including the establishment of marine protected areas covering a limited region (less than 10%) of the entire reef, therefore not very effective protection against fishing. However ongoing challenges persist. In 2020 the failures of the conservation initiative were highlighted: most of the 286 sites monitored (46%) now rank poor vs 37% two years earlier. Good sites declined from 13% (2016) to 8%, emphasising the need for intensified measures to combat overfishing and mitigate the associated threats to this critical marine ecosystem.
- Oil spills can disrupt the symbiotic relationship between corals and their zooxanthellae, leading to coral bleaching. Long-term ecological consequences: the stress induced by oil exposure can result in the expulsion of zooxanthellae from coral tissues, causing coral bleaching and prolonged exposure may weaken corals, making them more susceptible to diseases and reducing their ability to recover.
- Some candidates may make an assessment that in their given examples or case studies there are more significant factors at play than fishing – credit this argument.

Max L2 if no case study.

Question	Part	Marking guidance	Total marks
08		To what extent have attempts to manage the impacts of change in an ecosystem at a local scale been successful? Use one or more examples to support your answer. AO1 – Understanding of how ecosystems change over time including responses to changes in components or environmental controls in ecosystems. Awareness of impacts of change and measures to manage these impacts in local ecosystems, including conservation strategies. AO2 – Application of knowledge and understanding to assess the success of measures to manage impacts of change on a specified ecosystem at a local scale.	20 AO1=10 AO2=10

Level	Marks	Descriptor
4	16–20	AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. AO2 – Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout. AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout. AO1 – Full and accurate knowledge and understanding of key concepts and processes throughout. AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.
3	11–15	AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. AO2 – Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding. AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments. AO1 – Generally clear and accurate knowledge and understanding of key concepts and processes.

		AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.
2	6–10	AO2 – Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question. AO2 – Some partially relevant analysis and evaluation in the application of knowledge and understanding. AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant. AO1 – Some knowledge and understanding of key concepts, processes and interactions and change. AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.
1	1–5	AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence. AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. AO1 – Very limited relevant knowledge and understanding of place(s) and environments. AO1 – Isolated knowledge and understanding of key concepts and processes. AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.
0	0	No creditable content.

Indicative Content

AO1

- Characteristics of ecosystems.
- Responses of ecosystems to alterations in one or more components or environmental factors.
- Local strategies in ecological evolution and transformation.

Including:

- Planting native vegetation in degraded areas can restore ecosystems and improve biodiversity. Marine Protected Areas (MPAs): designating specific marine zones where human activities are regulated or restricted helps protect marine ecosystems, allowing them to recover and thrive.
- Fisheries Management regulations and seasonal closures help maintain fish populations and support overall ecosystem health.
- Adopting sustainable agricultural methods, such as agroforestry and organic farming, minimises the use of harmful chemicals and reduces soil erosion.
- Identifying and removing invasive species in a timely manner helps prevent their spread and protects native flora and fauna.
- Introducing natural predators or pathogens to control invasive species can be an effective and environmentally friendly approach.
- Designing and implementing infrastructure that can withstand the impacts of climate change, such as sea-level rise and extreme weather events, helps protect ecosystems and human communities.
- Involving local communities in decision-making processes and ecosystem management fosters a sense of ownership and encourages sustainable practices.
- Raising awareness about the importance of ecosystems, their functions, and the impacts of human activities, helps build a conservation-oriented mindset within communities.
- Implementing measures to protect watersheds, such as reforestation and erosion control, helps maintain water quality and supports aquatic ecosystems.
- Proper treatment of wastewater before discharge prevents pollution and degradation of water bodies.
- Regularly assessing the health and dynamics of ecosystems helps detect changes early and informs adaptive management strategies.
- Ongoing research provides valuable insights into the specific challenges faced by ecosystems and informs evidence-based management decisions.
- Incorporating green spaces, parks, and natural corridors into urban planning helps maintain ecological connectivity and supports biodiversity within urban areas.
- Implementing green infrastructure in urban settings, such as green roofs and permeable surfaces, contributes to local ecosystem health and resilience.
- Controlled and prescribed burns can mimic natural fire regimes, promoting ecosystem health and reducing the risk of catastrophic wildfires.
- Implementing measures like dam removal and channel restoration can help restore natural river processes, benefiting aquatic ecosystems.
- Implementing and enforcing laws and regulations that promote conservation and sustainable resource use provide a legal framework for ecosystem protection.
- Establishing zoning regulations that guide land use in a way that preserves critical habitats and minimises human impact helps protect ecosystems.

AO2

- Ecosystems' systemic approach – significance of comprehending the exchanges and movements within ecosystems and the repercussions of modifying one element on others, including components and environmental factors.
- Examination of transformations at a local level is likely to encompass climate, vegetation and soil, considering both natural and human stimuli.
- Local factors affecting ecological progression and change encompass agriculture, urbanisation, and the introduction of new species (planned and unplanned).
- Success in mitigating impacts of change on the ecosystem is likely to concern biodiversity. This can be gauged using indicator species, such as the presence of stonefly nymphs in streams, indicating well-oxygenated water. Species richness, reflecting the number of species in a location, is also a valuable measure of biodiversity.
- The query invites evaluation, which should permeate the response by consistently contemplating the success and limitations of measures to manage change in the ecosystem.
- A well-informed public is more likely to support and adhere to ecosystem management initiatives. Education campaigns raise awareness about the value of ecosystems, the consequences of human activities, and the benefits of conservation.
- Communities that feel a sense of ownership and responsibility for their local ecosystems are more likely to actively participate in conservation efforts and report illegal activities.
- Shared responsibility enhances the effectiveness of conservation measures.
- Companies that engage in CSR activities, including environmental conservation initiatives, contribute positively to ecosystem management and community well-being.
- Ongoing scientific research provides the data necessary for informed decision-making. Regular monitoring of ecosystems helps detect changes, assess the effectiveness of management strategies and adapt approaches as needed.
- Leveraging technological advancements, such as remote sensing, GIS (Geographic Information System), and data analytics, enhances the efficiency and precision of ecosystem monitoring and management.
- A long-term vision and strategic planning are essential for sustainable ecosystem management. Adaptive management approaches allow for flexibility in adjusting strategies based on evolving conditions and new information.
- Concluding remarks are likely to assess the overall success of management and may refer back to specific strategies. Emphasis on choosing management strategies harmonising with nature in the selected location may be underscored, acknowledging that these strategies may not yield the same level of success elsewhere. Recognition that strategies may need adaptation in the future due to pressures on ecosystems, such as climate change, may also be acknowledged.

Max L2 if no example or not at the local scale.

Assessment Objective grid

	AO1	AO2	AO3	Total
Section A				
01.1	1			1
01.2	1			1
01.3	1			1
01.4	1			1
01.5	1			1
02			6	6
03	4	5		9
04	10	10		20
Section B				
05.1	1			1
05.2	1			1
05.3	1			1
05.4	1			1
05.5	1			1
06			6	6
07	4	5		9
08	10	10		20
Unit total	38	30	12	80