Oxford Revise | Edexcel A Level Geography | Answers

Chapter 7

All exemplar answers given are likely to be in the top mark band.

Questions 1–4 are point-marked.

1 AO1 = 2 / AO2 = 1
Award 1 mark for analysing the resource to identify a consequence on the hydrological cycle from the image and a further 2 marks for expansion, up to a maximum of 3 marks.

Relevant content may include:

- Deforestation could reduce interception (1), which would increase overland flow (1) and could cause flooding (1).
- Deforestation could reduce the potential for evapotranspiration (1), which could decrease outputs (1) and increase water within the basin (1).
- Deforestation may decrease infiltration (1), as fewer trees break up the soil with roots (1), leading to lower rates of percolation (1).

Example answer: *Deforestation could lead to reduced interception. This would increase overland flow. It could then cause flooding.*

2 AO1 = 2 / AO2 = 1
Award 1 mark for analysing the resource to identify a relationship between potential evapotranspiration and soil moisture and a further 2 marks for expansion, up to a maximum of 3 marks.

Relevant content may include:

- Potential evapotranspiration creates a deficit (1) if it is higher than precipitation (1) and water has been utilised (1).
- Potential evapotranspiration creates a surplus (1) if it is lower than precipitation (1) and water is allowed to recharge (1).
- A surplus exists (1) if precipitation is higher than potential evapotranspiration (1), allowing water to recharge (1).

3 AO1 = 2 / AO2 = 1
Award 1 mark for analysing the resource to identify the strategy and a reason for the scheme being controversial, and a further 2 marks for expansion, up to a maximum of 3 marks.

Relevant content may include:

- The dam could restrict water flow (1) to areas or countries downstream (1), which could have socio-economic impacts (1).
- The dam may be being built without transboundary agreement (1), as it could affect other countries (1) if water is held back and rivers controlled (1).

- The dam could hold back water (1), which could change downstream ecosystems (1) and affect downstream economies (1).
- The dam may be expensive (1), which could cause debate over investment in poorer countries (1) as the money could be spent elsewhere (1).

4 AO1 = 2 / AO2 = 1
Award 1 mark for analysing the resource to identify one reason for the trends shown and a further 2 marks for expansion, up to a maximum of 3 marks.

Relevant content may include:

- Global warming (1) has led to an increase in drought since 1970 (1) due to a warmer climate (1).
- ENSO (1) occurs in short-term oscillations (1), which may relate to the periodic drought periods every 30 years (1).
- Over abstraction (1) may account for the rapid increase in droughts since 2000 (1), as too much water is taken, causing a deficit (1).

Questions 5–22 are level-marked.

5 AO1 = 6

Level	Marks	Description
	0	• No rewardable material.
1	1–2	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Understanding addresses a narrow range of geographical ideas. (AO1) • Understanding of geographical ideas lacks detail. (AO1)
2	3–4	• Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1) • Understanding addresses a range of geographical ideas. (AO1) • Understanding of geographical ideas is not fully detailed and/or developed. (AO1)
3	5–6	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Understanding addresses a broad range of geographical ideas. (A01) • Understanding of geographical ideas is detailed and fully developed. (AO1)

Relevant content may include:

- Changing land use such as the conversion of grasslands and forests to farmland reduces interception and storage, and reduces the lag time into rivers by increasing overland flow.
- Bare winter fields may also encourage soil to silt up rivers, reducing the storage capacity in river channels.
- Urbanisation increases impermeable surfaces and channels water directly into rivers through drains, which may increase the peak discharge.
- The creation of reservoirs increases surface storage but may increase the risk of floods in some cases (e.g. Libya 2023).

- Mismanagement of river, such as tributaries straightened (realigned) from the original meandering course or channelised rivers with concrete embankments means water enters the main channel more quickly, speeding the flow, which may affect flood risk for different areas.
- Local and national governments control planning policy for housing and land use, which can actually reduce risk. For example, the use of SuDS (sustainable drainage systems), which aim to reduce overland flow and flooding.

Example answer: *Changing previously forested areas into farmland can lead to decreased interception and an increase in overland flow, which means water gets into the river more quickly (reduces the lag time), causing floods. In the winter, bare fields allow rapid overland flow and may even encourage soil to silt up rivers, reducing the storage capacity in river channels and further flood risk.*

Urbanisation also increases risk, as it increases the amount of impermeable surfaces like tarmac and concrete, which reduces infiltration and moves water directly into rivers through drains. This increases the peak discharge and reduces lag time. Homes built recently on floodplains in Nottinghamshire have increased flood risk due to the large amounts of impermeable tarmac created.

Additionally, the mismanagement of rivers can speed the flow, which may affect flood risk for different areas. Straightened (realigned) rivers from the original meandering course or channelised rivers with concrete embankments move water to the main channel more quickly. Also, the creation of reservoirs increases surface storage but may increase the risk of floods in some cases (e.g. Libya 2023).

6 AO1 = 6

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Relevant content may include:

- The drainage basin is the area drained by a river and all its tributaries, the edge of which is marked by its watershed.
- The sequence and relationships of water movement through the system can be seen as an open system within the hydrological cycle, containing linked processes of inputs, flows (throughputs), and outputs with stores in between.
- Inputs and outputs can vary with the total amount of water in a basin affected by external factors.

- The input is precipitation. If the precipitation exceeds the outputs, then the basin will be in surplus and could lead to floods. Precipitation can be orographic, frontal, and convectional.
- Outputs can be evapotranspiration (the combined effect of evaporation from surface water with transpiration which exits the drainage basin as water vapour), channel runoff (the loss of water from a river into the sea), and possible fossil water as a sink out of the system.
- Residence times may play a role on the balance of the open system. Longer residence times may make access to freshwater difficult if inaccessible. Most residence times are short with atmospheric water vapour only lasting days.
- An equation can be used to understand the balance of water in a drainage basin, expressed by the formula: $P = E + Q + \Delta S$, where the input, precipitation (P), should balance with the outputs of evapotranspiration (E) and runoff (Q), while accounting for changes in water held as soil moisture and groundwater storage within the basin (ΔS).
- The change in the balance of inputs (precipitation) and outputs (potential evapotranspiration) on soil moisture over a year can be shown in a water budget graph for an area.

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Relevant points may include:

- Deforestation: over 20% of the Amazon rainforest has been deforested with 6% more severely degraded for logging and to make room for cattle ranches and farming. This has caused major disruption to the drainage basin to the extent that local climates have been altered. In some areas, interception has reduced with a significant decrease in evapotranspiration. This may also reduce precipitation in the long term. Overland flow has increased, taking soil and silt into rivers and washing away nutrients.
- Creating new water storage reservoirs: the creation of reservoirs increases surface storage and accelerates evaporation, while dams slow channel flow, especially upstream. Water can also be more easily removed for human use.
- Changing land use: conversion to farmland or urbanisation has huge impacts. Agricultural fields intercept less water and encourage overland flow. Urbanisation increases impermeable surfaces and creates drains, moving water directly into rivers, leading to increased rates of overland flow and channel flow.

- Abstracting water: pumping water from the ground severely reduces groundwater storage in an aquifer and lowers the water table, which can lead to rivers drying up completely. About 40% of London's water comes from chalk aquifers.

8 AO1 = 6

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Relevant content may include:

- Industries, especially chemical and electronic, require water for products, manufacturing, cleaning, and cooling, with developed countries using 59% of their total water this way. Without cheap or accessible water, many manufacturing industries couldn't function and would close.
- All thermal power stations require vast amounts of water (80% of energy use globally). Hydroelectric plants run on water alone. A reduction in supply could mean short-term blackouts and long-term closure of heavy industries.
- High crop yields are vital for food security and economic prosperity, requiring abstraction of water for irrigation. Food shortages quickly arise with a lack of water leading to famine and civil unrest.
- Clean water is required for hygiene, washing, and cleaning, and ultimately a good quality of life. Poor sanitation can lead to debilitating diseases, such as cholera, through the consumption of unsafe water.
- Clean hands, and food washed in clean water, prevents the spread of disease. Waterborne diseases affect life expectancy, education, the ability to work productively, and lead to increased poverty.

9 AO1 = 8

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Relevant content may include:

- Water stress means that people do not have accesses to water for domestic use for a period of time, as demand exceeds supply by 10% or above. Water scarcity means continuous water shortages and deficit, causing major impacts on the environment, economy, and quality of life. Physical scarcity: water supply does not meet the demand. Economic scarcity: people cannot afford potentially available water.
- Over 1.6 billion people face economic water scarcity, where people or countries lack or cannot afford access to clean water, also known as potable water. The price of water may be too high, leading to water poverty.
- Costs of obtaining water varies (e.g. the removal of water from aquifers (bore holes and wells), rivers and reservoirs for irrigation, industrial and domestic use). Water from aquifers or distant reservoirs is more expensive to access. More arid countries face higher costs in accessing water, especially areas that are beginning to suffer from climate change or increased severity of ENSO events.
- Development levels also play a role. Lack of infrastructure: rapidly growing or slum areas may exceed the capacity to keep up with demand for piped water. Water may only be accessible by tanker or in bottles (e.g. parts of Port-au Prince, Haiti).
- Privatised water companies: private services charge fees to make profit and overcharging may occur if they are a monopoly or badly governed. For example, Bolivia: the water system in Cochabamba, Bolivia, was privatised in 1999, leading to a 35% increase in price and increased water poverty. There were widespread protests against the new provider, Aguas del Tunari.
- Government policies: some governments may charge more to encourage efficiency or to reinvest in ecosystem health (e.g. Denmark).

Example answer: *The price of water can be much more expensive in areas that have physical water scarcity due to the climate of an area. Although some countries like Saudi Arabia use fossil water from boreholes, most arid countries have to spend more to obtain water for irrigation, industrial, and domestic use. For example, in Australia, the 'Big dry' drought lasted from 1996 to 2012 and affected the largest river, the Murray-Darling, with rainfall up to 20% lower than expected for this period. This led to water being a precious commodity and much more expensive.*

Climate change, affecting ENSO cycles, is also suggested to have increased the aridity of some areas with resulting impact on water supply costs by creating a deficit in the system.

Economic scarcity also helps determine the price of water. Over 1.6 billion people face economic water scarcity, where people or countries lack or cannot afford access to clean water, also known as potable water. The price of water may be too high, leading to water poverty. Developing countries tend to lack infrastructure and face rapidly growing informal settlement areas, which may exceed the capacity to keep up with demand for piped water. Water may only be accessible by tanker or in bottles and therefore is expensive (e.g. parts of Port-au Prince, Haiti).

Privatised water companies are another reason, as private services charge fees to make profit. Overcharging may occur if a monopoly exists or it is badly governed. For example, in Cochabamba, Bolivia, the water system was privatised in 1999, leading to a 35% increase in price and increased water poverty. There were widespread protests against the new provider, Aguas del Tunari.

Finally, in some countries, 'green' policies can play a role in making water more expensive as governments may charge more to encourage efficiency or to reinvest in ecosystem health (e.g. Denmark).

10 AO1 = 8

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Relevant content may include:

- Climate variability: precipitation patterns determine available water supply. High-pressure zones see low rain and snowfall although this may vary seasonally and in longer-term cycles, affected by oscillations. Climate change may reduce precipitation in some areas.
- Physical location: areas far inland will generally see low precipitation. Some areas, such as the Death Valley, USA, may experience a rain shadow and be extremely dry. The geology of an area can also determine the extent of rivers and lakes and access to groundwater aquifers.
- Saltwater encroachment at the coast: seawater can be drawn into aquifers under the ground when there is a deficit of fresh water, possibly due to over-abstraction. This reduces the available freshwater resource. For example, Florida, USA, where saltwater encroachment has occurred into the 82,000 square miles of freshwater aquifer due to over-abstraction and the building of canals directly to the sea. This pollutes natural ecosystems, such as the Everglades, and slowly poisons farmland.

- Climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts or floods. Every area may experience a different effect upon their local systems with different scenarios suggested for polar and tropical regions.
- Oscillations such as El Niño Southern Oscillation (ENSO) can change a region's climate in the short-term. ENSO events will become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain. The overall level of climate uncertainty will increase and feedback cycles may lead to greater imbalance within the system.

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Relevant content may include:

- Restoring lakes and rivers to a more natural condition reduces the need for expensive hard engineering and maintenance, and increases water stores while improving ecosystems. Restoration schemes involve restoring natural meanders to slow flows and increase water storage, reflooding large areas to recreate wetlands, sometimes also reintroducing beavers, reducing abstraction from aquifers to allow them to recharge naturally.
- Conserving water reduces demand and makes water use more efficient. Smart irrigation methods include drip irrigation rather than using sprinklers, saving water and money and hydroponics (the growing of crops without soil in greenhouses and drip-feeding water and nutrients).
- Recycling water uses 'grey water' from cities for agriculture and reduces demand. Rainwater and sewage can be purified via filtration and used as drinking water, such as in Singapore.
- Large rivers can also be managed in a holistic manner through Integrated water resource management (IWRM). This aims to coordinate the development and management of resources between the different players involved, consider the whole drainage basin and natural hydrology, maximise economic and social services in an equitable manner, and protect the sustainability of ecosystems.
- Water-sharing treaties and frameworks, such as the United Nations 'Economic Commission for Europe' (UNECE) water convention, aim to reduce the risks of conflicts and increase the efficiency of water usage. They are governed by IGOs (inter-governmental organisations).

12 AO1 = 8

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- Climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts and floods. Every area may experience a different effect upon their local systems with different scenarios suggested for polar and tropical regions.
- Oscillations such as El Niño Southern Oscillation (ENSO) can change a region's climate in the short-term. ENSO events will become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain. The overall level of climate uncertainty will increase and feedback cycles may lead to greater imbalance within the system.
- Human actions exacerbate droughts. Over abstraction: the removal of water from aquifers (bore holes and wells), rivers and reservoirs for irrigation, industrial and domestic use is unsustainable if not replaced by precipitation. This is especially significant in dry areas with low or unpredictable precipitation.
- Human actions also exacerbate droughts by desertification: the removal of vegetation in semi-desert areas this can lead to the land becoming desert due to increased erosion of soil by the wind, which further reduces the ability of remaining vegetation to grow.
- Droughts can lead to economic impacts. Impact on industries: without cheap or accessible water many manufacturing industries couldn't function and would close. A reduction in supply could mean short-term blackouts and long-term closure of heavy industries. Food shortages quickly arise, with a lack of water leading to famine and civil unrest.
- Droughts can lead to wellbeing impacts. Poor sanitation can lead to debilitating diseases, such as cholera, through the consumption of unsafe water.
- Water insecurity can lead to conflicts within a country and between countries if a drainage basin crosses international borders (transboundary conflicts). The 'fair share' of water a country deserves is controversial, especially if a country constructs dams which limit the downstream flow to other countries.

13 AO1 = 3 / AO2 = 9

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2	5–8	• Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas logically, making some relevant connections/relationships. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a partial but coherent interpretation that is mostly relevant and supported by evidence. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce an unbalanced, partially supported argument that is drawn together with some coherence in order to make judgements. (AO2)
3	9–12	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Applies knowledge and understanding to geographical information/ideas logically, making relevant connections/relationships. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a full and coherent interpretation that is relevant and supported by evidence. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a balanced, fully-supported argument that is drawn together coherently in order to make rational judgements. (AO2)

Relevant content may include:

AO1

- Physical features include size, shape, drainage density, rock type, soil, relief, and vegetation.
- The shape of storm hydrographs depends on physical features of drainage basins.
- The shape of storm hydrographs depends on human factors such as land use and urbanisation.

AO2

- The two catchments have been affected by the same storm, so inputs are the same.
- Catchment A shows peak discharge at approx. 4–5 cumecs after 4 hours. This means the lag time is shorter and the river more likely to flood as a flashy response. Catchment B shows peak discharge at approx. 2.5

cumecs after 6 hours. This means the lag time is longer and the river less likely to flood as a gentler response.

- Small basins have a shorter distance to the main river channel. Larger basins have a longer distance to the main river channel. Catchment A is smaller and more likely to flood.
- Rounder basins mean rainfall will reach the river at a similar time. Elongated basins mean rainfall will reach the river at different times. As catchment B is elongated which means water reaches the main river channel at staggered times.
- Impermeable rocks lower infiltration, leading to increased overland flow. Permeable rocks allow infiltration, leading to decreased overland flow. Also, impermeable soils like clay do not allow infiltration, leading to increased overland flow, whereas permeable soil like sand allow infiltration, leading to decreased overland flow. Catchment A is impermeable granite and so prone to less infiltration. This is perhaps the biggest factor governing the relative shape of the hydrograph.
- Steeper basins encourage faster water movement into rivers due to gravity and reduced infiltration. Basins with gentle slopes slow water movement into rivers due to gravity and increased infiltration. Catchment A is steeper with a 10-degree average slope compared to catchment B’s 5 degree. Water will run faster downslope in catchment a.
- Less vegetation, bare agricultural fields, or deciduous trees shedding leaves in winter means lower interception and infiltration. More vegetation planted crops and trees in full leaf means more interception and infiltration. Catchment B has a forested landscape whereas catchment a doesn’t, but instead has an urban area, increasing the area of impermeable surfaces and flood risk. This is also a significant factor as there are multiple instances of land use affecting the hydrograph.

Example answer: *Catchment A shows peak discharge at approx. 4–5 cumecs after 4 hours and a shorter lag time than catchment B (peak discharge at approx. 2.5 cumecs after 6 hours). A key reason is the nature of the rock type with granite in catchment A being an impermeable rock. Lower infiltration leads to increased overland flow here while permeable rocks in catchment B allow infiltration, leading to decreased overland flow. This is highly significant as impermeable bedrock controls infiltration rates across the basin and may also have an impact upon surface stores, vegetation type, and drainage density.*

The nature of the basins themselves also play a role. Catchment A is smaller and more likely to flood because small basins have a shorter distance to the main river channel. Larger basins have a longer distance to the main river channel. Also, rounder basins mean rainfall will reach the river at a similar time (like catchment A), whereas elongated basins mean rain rainfall will reach the river at different times. Additionally, the fact that catchment A is steeper with a 10-degree average slope compared to catchment B’s 5 degree means that water will run faster downslope in catchment A due to gravity, and therefore reduce infiltration, and enter the main river more quickly, decreasing lag time. Basins with gentle slopes, like B, slow water movement into rivers due to gravity and increased infiltration.

Human land use changes also affect things highly significantly as there are a number of elements in both basins. Catchment B has a forested landscape which would intercept more precipitation and store it as interception and vegetation storage. Trees also encourage higher rates of infiltration. The net effect of a longer lag time with smaller quantity of water entering a river. Catchment B also has a dam and reservoir which can be used to store excess water and to control the flow of the river. Catchment A instead has an urban area, increasing the area of impermeable surfaces and flood risk.

Catchment A is far more flashy than B due to the various factors affecting lag time. The most significant factor on catchment A is likely to be the geology as impermeable granite is spread across the whole area. Land use management is more significant on catchment B as the dam will ultimately control the river flow, and forested land and lack of urbanisation meaning a much longer lag time.

14 AO1 = 3 / AO2 = 9

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Relevant content may include:

AO1

- There are five main stores: the most important store is the oceans with water stored as liquid; as glacial ice, snow, or permafrost in the cryosphere; water vapour in the atmosphere is relatively small and precipitated quickly; as groundwater in rocks below ground; on land as surface water in lakes and rivers, or in the living organisms of the biosphere, making up a very small proportion of total water and the most accessible for human use.
- Climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts or floods.

- Every area may experience a different effect upon their local systems with different scenarios suggested for polar and tropical regions.
- The sequence and relationships of water movement through the system can be seen as an open system within the hydrological cycle, containing linked processes of inputs, flows (throughputs), and outputs with stores in between.

AO2

- In the cryosphere, snowpacks and glaciers may see a reduction in total amount of snow mass and reduced snow-forming season. Glacial retreat is significant with ice making up 69% of all freshwater. Permafrost may undergo an increased reduction through thawing, especially in northern latitudes, affecting ground water and channel flow.
- Soil moisture may see increased drying out and risk of desertification in warmer areas. This drying can cause 'forest stress' meaning trees die and shed leaves. This leads to reduced evapotranspiration which can reduce precipitation levels even further as part of a positive feedback. Drought also reduces the surface water store which makes up freshwater wetlands.
- Reservoirs and lakes will see an unclear impact due to the focus of human activity. These may be decreasing in warmer climates due to increased evaporation.
- Humans may respond to shortages through increased pressure on existing resources. The removal of water from aquifers (bore holes and wells), rivers and reservoirs for irrigation, industrial and domestic use is unsustainable if not replaced by precipitation, i.e. over-abstraction. This is especially significant in dry areas with low or unpredictable precipitation. For example, over-abstraction in Australia for rapidly expanding urban areas and unrestricted irrigation taking 70% of total water usage significantly contributed to the drought.
- Desertification also may increase with climate change affecting various stores. The removal of vegetation in semi-desert areas can lead to the land becoming desert due to increased erosion of soil by the wind which further reduces the ability of remaining vegetation to grow.
- Furthermore, oscillations such as El Niño Southern Oscillation (ENSO) can change a region's climate in the short-term and affect stores. ENSO events will become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain. The overall level of climate uncertainty will increase, and feedback cycles may lead to greater imbalance within the system.
- Also, some freshwater stored deep in the ground fell as rain millennia ago and will not be restored if used by people. This means it is non-renewable fossil water, such as the Nubian sandstone aquifer under the Sahara Desert.

15 AO1 = 3 / AO2 = 9

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2	5–8	• Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas logically, making some relevant connections/relationships. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a partial but coherent interpretation that is mostly relevant and supported by evidence. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce an unbalanced, partially supported argument that is drawn together with some coherence in order to make judgements. (AO2)
3	9–12	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Applies knowledge and understanding to geographical information/ideas logically, making relevant connections/relationships. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a full and coherent interpretation that is relevant and supported by evidence. (AO2) • Applies knowledge and understanding to geographical information/ideas to produce a balanced, fully-supported argument that is drawn together coherently in order to make rational judgements. (AO2)

Relevant content may include:

AO1

- Water insecurity occurs when areas experience a lack of fresh water due to demand exceeding supply. It is caused by an imbalance of supply and demand, and both factors are relevant here.
- Water stress means that people do not have accesses to water for domestic use for a period of time, as demand exceeds supply by 10% or above.
- Water scarcity means continuous water shortages and deficit, causing major impacts on the environment, economy, and quality of life. Physical scarcity: water supply does not meet the demand. Economic scarcity: people cannot afford potentially available water.

AO2

Physical causes:

- Precipitation patterns determine available water supply. High pressure zones see low rain and snowfall although this may vary seasonally and in longer-term cycles, affected by oscillations. Climate change may reduce precipitation in some areas.
- Areas far inland will generally see low precipitation. Some areas, such as the Death Valley, USA, may experience a rain shadow and be extremely dry. The geology of an area can also determine the extent of rivers and lakes and access to groundwater aquifers.
- Salt water encroachment at coast can reduce supply. Sea water can be drawn into aquifers under the ground when there is a deficit of freshwater, possibly due to over abstraction. This reduces the available freshwater resource.

Human causes:

- Desertification caused by human activity can exacerbate insecurity. The removal of vegetation in semi-desert areas can lead to the land becoming desert due to increased erosion of soil by the wind, which further reduces the ability of remaining vegetation to grow.
- Over abstraction can exacerbate insecurity. The removal of water from aquifers (bore holes and wells), rivers and reservoirs for irrigation, industrial and domestic use is unsustainable if not replaced by precipitation. This is especially significant in dry areas with low or unpredictable precipitation.
- Agricultural contamination reduces supply as toxic pesticides and chemical fertiliser contaminate groundwater supply. Eutrophication can occur when nitrates enter lakes and rivers, leading to the pollution of large areas. Likewise, heavy metals, such as cadmium, from mining or factories may end up in surface and groundwater, making it unfit for human consumption. Raw sewage also contaminates water supply and increases the risk of waterborne diseases, a major issue for developing countries with 840,000 people dying each year.
- Demand is increasing at the same time. The global population is growing at 0.9%, or 80 million, a year, meaning increased demand for water for domestic use. Developing countries with the highest levels of water scarcity are seeing the highest population growth.
- The increasing middle class of emerging countries demand more water through both direct use in the home with appliances such as dishwashers, as well as through the demand for industrial products and a wider variety of foods which require intensive water use.
- Increased economic development in emerging and developing countries has meant a significant demand for water for use in manufacturing processes and as coolants, with 40% of all abstraction for industry.
- Agriculture uses 70% of the world's freshwater for irrigation. Increasing populations and demand for meat had increased the demand. Many farming practises are wasteful of water and also pollute supply.
- Additionally, climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts or floods. ENSO events will become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain.

16 AO1 = 3 / AO2 = 9

Level	Marks	Description
	0	• No rewardable material.
1	1–4	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate. (AO1) • Applies knowledge and understanding of geographical information/ideas, making limited logical connections/relationships. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an interpretation that is not relevant and/or supported by evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an unbalanced argument that lacks coherence and makes judgements that are generic and unsupported by evidence. (AO2)
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Relevant content may include:

AO1

- The mismatch between water supply and demand is growing, leading to water stress (below 1700 m^3 of domestic water per person).
- Rising demand (increasing population, improving living standards, industrialisation, and agriculture) is increasingly serious.
- Physical causes of supply reduction include climate variability and salt water encroachment at the coast.
- Human causes of supply reduction include over abstraction from rivers, lakes, and groundwater aquifers, water contamination from agriculture, and industrial water pollution.

AO2

- Use the map as part of your assessment and application.
- Use the countries and data, and interpret choropleth patterns. For example, the highest rates of future withdrawal are in the Middle East and North Africa, but also significant stresses in North America and Europe.
- Over abstraction can exacerbate insecurity. The removal of water from aquifers (bore holes and wells), rivers and reservoirs for irrigation, and industrial and domestic use is unsustainable if not replaced by precipitation. This is especially significant in dry areas with low or unpredictable precipitation.
- Human actions relating to salt water encroachment at the coast can reduce supply if over abstraction of aquifers are the cause. Sea water can be drawn into aquifers under the ground when there is a deficit of freshwater, possibly due to over abstraction. This reduces the available freshwater resource.
- Desertification caused by human activity can exacerbate insecurity. The removal of vegetation in semi-desert areas can lead to the land becoming desert due to increased erosion of soil by the wind, which further reduces the ability of remaining vegetation to grow.
- Agricultural contamination reduces supply as toxic pesticides and chemical fertiliser contaminate groundwater supply. Eutrophication can occur when nitrates enter lakes and rivers, leading to the pollution of large areas. Likewise, heavy metals, such as cadmium, from mining or factories may end up in surface and ground water, making it unfit for human consumption. Raw sewage also contaminates water supply and increases the risk of waterborne diseases, which is a major issue for developing countries with 840,000 people dying each year.
- Demand is increasing at the same time. The global population is growing at 0.9%, or 80 million, a year, meaning increased demand for water for domestic use. Developing countries with the highest levels of water scarcity are seeing the highest population growth.
- The increasing middle class of emerging countries demand more water through direct use in the home with appliances such as dishwashers, as well as through the demand for industrial products and a wider variety of foods which require intensive water use.
- Increased economic development in emerging and developing countries has meant a significant demand for water for use in manufacturing processes and as coolants, with 40% of all abstraction for industry.
- Agriculture uses 70% of the world's freshwater for irrigation. Increasing populations and demand for meat had increased the demand. Many farming practises are wasteful of water and also pollute supply.
- Additionally, climate change can be deemed as a human aspect with significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts or floods. ENSO events will become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain.

17 AO1 = 5 / AO2 = 15

Level	Marks	Description
	0	• No rewardable material.
1	1–5	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Applies knowledge and understanding of geographical ideas, making limited and rarely logical connections/relationships. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited coherence and support from evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2)
2	6–10	• Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships. (AO2) • Applies knowledge and understanding of geographical ideas in order to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2)
3	11–15	• Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1) • Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships. (AO2) • Applies knowledge and understanding of geographical ideas in order to produce a partial but coherent interpretation that is supported by some evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2)
4	16–20	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is supported by evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2)

Relevant content may include:

AO1

- Water insecurity can lead to conflicts within a country and between countries if a drainage basin crosses international borders (transboundary conflicts).
- The 'fair share' of water a country deserves is controversial, especially if a country constructs dams which limit the downstream flow to other countries.
- The future of water insecurity, based on projections, is uncertain due to rates of population growth, rates of industrialisation and economic growth, possible adoption of new technologies, and climate change.
- Hard engineering can be a solution to many problems with the techno-fix of hard engineering schemes to include water transfers, mega dams, and desalination.
- Water conservation: conserving water reduces demand and makes water use more efficient and can reduce potential conflicts.
- Large rivers can be also managed in a holistic manner to include more players through integrated water resource management (IWRM).

AO2

- Climate change is a key driver of conflict and is increasing. Climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts and potential conflicts over scant resources. ENSO variations will affect this. This is a key factor which underlies the various problems and mitigation against conflict, and should be addressed.
- Arguments could be made about the general need for water with supply falling and demand rising in different areas, although 'transboundary' is the key term.
- Hard engineering has the potential to both increase and decrease conflicts. The South-North water transfer project in China could be considered transboundary if taken at catchment value. It aims to move 45 billion m^3 of water a year to the more arid north of China and its capital, Beijing. This could support the rising population and maintain economic growth there, but the transfer of water could lead to shortages in the south and cause ecosystem damage as well as the resettlement issues from submerged land.
- Clearer transboundary issues lie with the construction of hard engineered dams which restrict flow downstream and may flood areas upstream. The Turkey GAP scheme has had extremely detrimental effects on the flow of the Euphrates and Tigris rivers, which flow into arid areas. Additionally, the Nile basin has a long history of conflict, which seems to be increasing with the need for water. The Aswan dam was constructed with Sudan's agreement in 1959 to the exclusion of other countries, which have been affected by changes to the river's flow. In 2011, the Grand Renaissance Dam was built on the Blue Nile tributary, from where 85% of the Nile's waters flow; Egypt is hinting at armed conflict.
- The complex nature of drainage basin management can also be argued with the increasing numbers of players and the need for agreement. The Colorado or Murray-Darling are likely examples.
- However, arguments can be made that conflicts could decrease with more sustainable methods of managing water. For example:
  - Restoring lakes and rivers to a more natural condition reduces the need for expensive hard engineering and maintenance, and increases water stores while improving ecosystems.
  - Conserving water reduces demand and makes water use more efficient. Smart irrigation methods include drip irrigation rather than using sprinklers, saving water and money, and hydroponics (the growing of crops without soil in greenhouses and drip-feeding water and nutrients).
  - Recycling water uses 'grey water' from cities for agriculture and reduces demand. Rainwater and sewage can be purified via filtration and used as drinking water such as in Singapore.

- Large rivers can also be managed in a holistic manner through integrated water resource management (IWRM). This aims to coordinate the development and management of resources between the different players involved, consider the whole drainage basin and natural hydrology, maximise economic and social services in an equitable manner, and protect the sustainability of ecosystems. These are largely unsuccessful, although the Colorado could be seen as a mild success.
- Water-sharing treaties and frameworks (e.g. the United Nations 'Economic Commission for Europe' (UNECE) water convention) aim to reduce the risks of conflicts and increase the efficiency of water usage. They are governed by IGOs (inter-governmental organisations).

Example answer: *Transboundary conflicts occur when bordering countries share a water resource between each other, leading to conflict in the way the water is distributed. This can lead to many political issues and water insecurity, resulting in conflict. However, more sustainable projects and IWRM could mitigate the extent to which conflicts could possibly occur.*

The biggest issue that underlies all the others is the fact that water insecurity is increasing, and so the potential for conflict is also increasing, as water is a finite resource on Earth. Precipitation patterns that currently determine available water supply will reduce, and droughts will likely become longer, more severe, and affect more areas, possibly exacerbated by human activity. Additionally, oscillations such as El Niño Southern Oscillation (ENSO) may become more extreme and switch more rapidly, meaning droughts will follow floods and floods after droughts, although it is uncertain. When combined with the rapid rate of population growth and urbanisation (growing at 0.9%, or 80 million, a year), this means a rapidly increased demand for water for domestic use. This is a chronic but long-term trend and underlies all other arguments as the basic system enters deficit. The additional improving living standards and increasing middle class of emerging countries will also demand more water through direct use in the home with appliances such as dishwashers, as well as through the demand for industrial products and a wider variety of foods which require intensive water use. Therefore, even with increasing economic growth, it is likely that the fundamental potential for conflicts will increase.

Conflicts are also likely to occur on complex basins where there are multiple countries, and so they are hard to manage. The Colorado basin saw decades of conflict as original agreements shared water unfairly, leading to Mexico only receiving 10% of the basin's water and the State of California taking 20% more than its allocation. Moreover, the Nile basin sees increasing conflict due to the building of the Grand Renaissance Dam on the Blue Nile by Ethiopia in 2011, from where 85% of the Nile's waters flow. Egypt is alarmed at the possible loss of water resources when filling the mega dam (25%) and the impact on power generation at Aswan, and have hinted at armed conflict. The complexity of the issue and need for electricity is likely to cause future conflict. Perhaps another key consideration is the fact these are developing or emerging countries, and so more heavily reliant on water alongside a degree of national pride in the project. This seems to be a trend when also considering the Mekong and Turkey's GAP project.

Having said this, hard engineering can provide a degree of solutions in some areas. Desalination could be a techno-fix to problems in places like the Aral Sea or Middle Eastern countries that are especially noticing the effects of climate change. However, this would be an issue in lower income countries, as desalination, although effective, is a very expensive process. Countries in the Sahel-region suffering from water insecurity will be unable to rely on desalination due to the lack of affordability.

Perhaps a more successful way to mitigate future conflicts could be sustainable management schemes. River restoration methods of restoring lakes and rivers to a more natural condition reduces the need for expensive hard engineering and maintenance, and increases water stores, while improving ecosystems; for example, the Kissimmee River restoration project, Florida, USA. Furthermore, water could be better conserved with smart irrigation methods, such as drip irrigation rather than using sprinklers (saving water and money), hydroponics, and recycling water by using 'grey water' from cities for agriculture (reduces demand). In some developed *countries, rainwater and sewage can be purified via filtration and used as drinking water. Singapore, an island of 5.4 million people with chronic water insecurity, has developed a mix of hard engineering and sustainable methods to manage supply under its 'Four taps' policy where 'NEWater' uses filtration and membrane technology to turn sewage into clean water, meeting 12% of Singapore's needs, with use for drinking water possible. Many of these methods are low-tech, however, and perfectly possible if countries wish to adopt them. The only block would be political will and pressures of socio-economic growth.*

Therefore, perhaps the best way to mitigate future conflicts could be the use of an integrated water drainage basin system, through coordinated development and management of water, land, and related sources in order to maximise economic and social welfare. This was successfully evident with the Colorado river IWRM, where the water from this river supplies eight states in the USA and Mexico, containing 14 major dams and reservoirs, to distribute the water fairly. This has also led to positive environmental and economic impacts, as 1.4 million hectares of farmland is irrigated, and drinking water is accessible for 50 million people. IWRM has led to greater stakeholder agreement, including Native Americans who were not receiving a fair share. A 2012 agreement gives Mexico the right to some water stored in Lake Mead in the USA. A new agreement in 2007 used current climate data to share surpluses and deficits more fairly. However, successes are rare, and the Colorado has a long way to go to fully meet the aims of IWRM, making this potentially the best way to mitigate conflict, but the least successful.

Finally, the use of water treaties can reduce conflicts. For example, the Helsinki Rules is an international treaty that focuses on equitable uses and shares between countries. It applies to a whole drainage basin and looks at natural, economic, and social needs, and dependency. This treaty is relatively successful. For example, the Ganges water sharing treaty (Bangladesh and India), where both countries have received a fair amount of water depending on the Helsinki Rules. However, it is not a legal document and is largely ignored.

In conclusion, conflicts between most transboundary users will increase in the future due to climate change reducing supply. Population and economic growth will also increase demand, increasing the world's water gap. This will be especially significant in developing countries that will not be able to afford or will not have the political will to adopt water treaties and frameworks. An acute aspect for some conflicts, although small in number, will be the control of headwaters by the use of dams. In these situations, a long-term, low-level conflict could escalate quickly into a war.

18 AO1 = 5 / AO2 = 15

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Relevant content may include:

AO1

- Hard engineering provides a techno-fix solution to water insecurity by building solid structures to control rivers. These schemes are usually expensive, require high maintenance, and are not always sustainable.
- Sustainable schemes aim to ensure resources are protected for future generations by conserving supplies and reducing demands, as well as working more with natural processes.
- Water-sharing treaties and agreements based on entire drainage basins may incorporate the points above, but need political engagement and good governance to work.

AO2

- Arguments against include the issues connected to hard engineering projects. The construction of large dams to control water flow and to create reservoirs for storage. The diversion of water from an area of surplus to deficit, sometimes across huge distances, using a series of canals/canalised rivers, pumps, and pipelines. Seawater is turned into freshwater at coastal locations using salt-separating membranes and the process of reverse osmosis via desalination.
- The threat of conflict and complexity of large basin management may also be used as an argument.
- However, there are many possible arguments in favour of becoming more sustainable. Restoring lakes and rivers to a more natural condition reduces the need for expensive hard engineering and maintenance, and increases water stores while improving ecosystems. Restoration schemes involve restoring natural meanders to slow flows and increase water storage, reflooding large areas to recreate wetlands (sometimes with the reintroduction of beavers), reducing abstraction from aquifers to allow them to recharge naturally.
- Conserving water reduces demand and makes water use more efficient. Smart irrigation methods include drip irrigation rather than using sprinklers, saving water and money, and hydroponics (the growing of crops without soil in greenhouses and drip-feeding water and nutrients).
- Recycling water uses ‘grey water’ from cities for agriculture (reduces demand), and rainwater and sewage can be purified via filtration and used as drinking water, such as in Singapore.
- Large rivers can be also managed in a holistic manner through integrated water resource management (IWRM). This aims to coordinate the development and management of resources between the different players involved, consider the whole drainage basin and natural hydrology, maximise economic and social services in an equitable manner, protect the sustainability of ecosystems.
- Water-sharing treaties and frameworks (e.g. the United Nations ‘Economic Commission for Europe’ (UNECE) water convention) aim to reduce the risks of conflicts and increase the efficiency of water usage. They are governed by IGOs (inter-governmental organisations).

19 AO1 = 5 / AO2 = 15

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Relevant content may include:

AO1

- Impacts on economic development: industry, energy supply, agriculture.

- Impacts on human wellbeing: sanitation, health, and food preparation.
- Impacts on ecosystems.

AO2

Impacts on people:

- Impact on industries, as without cheap or accessible water, many manufacturing industries couldn’t function and would close. This is especially true for chemical and electronic industries, which require water for products, manufacturing, cleaning, and cooling, with developed countries using 59% of their total water this way.
- A reduction in supply could mean short-term blackouts and long-term closure of heavy industries. All thermal power stations require vast amounts of water (80% of energy use globally). Hydroelectric plants run on water alone.
- Food shortages quickly arise with lack of water, leading to famine and civil unrest. High crop yields are vital for food security and economic prosperity, requiring abstraction of water for irrigation.
- Poor sanitation can lead to debilitating diseases, such as cholera, through the consumption of unsafe water. Clean water is required for hygiene, washing and cleaning, and ultimately a good quality of life. Clean hands, and food washed in clean water, prevents the spread of disease. Waterborne diseases affect life expectancy, education, the ability to work productively, and lead to increased poverty.
- Water insecurity can lead to conflicts within a country and between countries if a drainage basin crosses international borders (transboundary conflicts). The ‘fair share’ of water a country deserves is controversial, especially if a country constructs dams that limit the downstream flow to other countries. For example, internal conflicts within Australia on the largest river catchment, the Murray and Darling rivers, which are home to 2 million people.

Impacts on environment:

- Drought reduces the surface water store which makes up freshwater wetlands. Causes may relate to reductions in seasonal rains such as those affecting the Pantanal, Brazil. It will dry out with huge impacts on all insects, fish, birds, and mammals dependent upon the biodiverse ecosystem which may become prone to fires. It will also lose its function as a filter for pollutants and sediment, further affecting ecosystems.
- Forest ecosystems: drought causes ‘forest stress’, meaning trees die and shed leaves. This leads to reduced evapotranspiration which can reduce precipitation levels even further as part of a positive feedback. Forest fires can also break out much more easily in the dry conditions, reducing vegetation even further. If a tipping point is reached, then the ecosystem will change into a new state more suited to the drier conditions (e.g. tropical rainforest in the Amazon changing to savannah).

20 AO1 = 5 / AO2 = 15

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ISBN 9781382052443

Relevant content may include:

AO1

- Water scarcity means continuous water shortages and deficit, causing major impacts on the environment, economy, and quality of life. Physical scarcity: water supply does not meet the demand. Economic scarcity: people cannot afford potentially available water.
- Hard engineering provides a techno-fix solution to water insecurity by building solid structures to control rivers. These schemes are usually expensive, require high maintenance, and are not always sustainable.
- Sustainable schemes aim to ensure resources are protected for future generations by conserving supplies and reducing demands, as well as working more with natural processes.
- Water-sharing treaties and agreements based on entire drainage basins may incorporate the points above, but need political engagement and good governance to work.

AO2

- Arguments against include the issues connected to hard engineering projects. The construction of large dams to control water flow and to create reservoirs for storage. The diversion of water from an area of surplus to deficit, sometimes across huge distances, using a series of canals/canalised rivers, pumps, and pipelines. Seawater is turned into freshwater at coastal locations using salt-separating membranes and the process of reverse osmosis via desalination.
- However, many problems exist with hard engineering, including deficits in the source region, flooding of land, and ecosystem damage.
- Perhaps a major issue is the potential for conflicts if constructing a dam on a headwater.
- There may be many arguments looking at alternatives, which may be more successful.
- Restoring lakes and rivers to a more natural condition reduces the need for expensive hard engineering and maintenance, and increases water stores while improving ecosystems. Restoration schemes involve restoring natural meanders to slow flows and increase water storage, reflooding large areas to recreate wetlands (sometime with the reintroduction of beavers), and reducing abstraction from aquifers to allow them to recharge naturally.
- Conserving water reduces demand and makes water use more efficient. Smart irrigation methods include drip irrigation rather than using sprinklers, saving water and money, and hydroponics (the growing of crops without soil in greenhouses and drip-feeding water and nutrients). Recycling water uses ‘grey water’ from cities for agriculture (reduces demand), and rainwater and sewage can be purified via filtration and used as drinking water such as in Singapore.
- Large rivers can be also managed in a holistic manner through integrated water resource management (IWRM). This aims to coordinate the development and management of resources between the different players involved, consider the whole drainage basin and natural hydrology, maximise economic and social services in an equitable manner, and protect the sustainability of ecosystems.
- Water-sharing treaties and frameworks (e.g. the United Nations ‘Economic Commission for Europe’ (UNECE) water convention) aim to reduce the risks of conflicts and increase the efficiency of water usage. They are governed by IGOs (inter-governmental organisations).

21 AO1 = 5 / AO2 = 15

Level	Marks	Description
	0	• No rewardable material.
1	1–5	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Applies knowledge and understanding of geographical ideas, making limited and rarely logical connections/relationships. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an interpretation with limited coherence and support from evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce an unsupported or generic conclusion, drawn from an argument that is unbalanced or lacks coherence. (AO2)
2	6–10	• Demonstrates geographical knowledge and understanding, which is occasionally relevant and may include some inaccuracies. (AO1) • Applies knowledge and understanding of geographical information/ideas with limited but logical connections/relationships. (AO2) • Applies knowledge and understanding of geographical ideas in order to produce a partial interpretation that is supported by some evidence but has limited coherence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, partially supported by an unbalanced argument with limited coherence. (AO2)
3	11–15	• Demonstrates geographical knowledge and understanding, which is mostly relevant and accurate. (AO1) • Applies knowledge and understanding of geographical information/ideas to find some logical and relevant connections/relationships. (AO2) • Applies knowledge and understanding of geographical ideas in order to produce a partial but coherent interpretation that is supported by some evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a conclusion, largely supported by an argument that may be unbalanced or partially coherent. (AO2)
4	16–20	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Applies knowledge and understanding of geographical information/ideas to find fully logical and relevant connections/relationships. (AO2) • Applies knowledge and understanding of geographical information/ideas to produce a full and coherent interpretation that is supported by evidence. (AO2) • Applies knowledge and understanding of geographical information/ideas to come to a rational, substantiated conclusion, fully supported by a balanced argument that is drawn together coherently. (AO2)

Relevant content may include:

AO1

- How fossil fuel combustion has altered the balance of carbon fluxes and stores, with impacts upon the climate, ecosystems, and the water cycle.
- The global atmosphere is regulated by both cycles which interlink and overlap.
- Ocean acidification may affect coral reefs and other marine ecosystems that provide vital ecosystem services. This threatens human wellbeing, especially in developing regions that depend on marine food sources, tourism, and coastal protection of coral reefs.
- Forest loss has implications for human wellbeing (environmental Kuznets' curve model).
- Climate change has significant impacts on the hydrological cycle locally and globally as the planet warms up, increasing the risks of droughts or floods. It affects stores and flows in different ways in different locations.

AO2

- The health of soils may be affected, threatening ecosystem productivity. Wetland ecosystems are likely to deteriorate and could suffer irreversible damage, affecting local people reliant on them for food security.
- Changes to the carbon cycle will impact upon ocean acidification, as the ocean is a carbon sink. This will affect the health of coral reefs and other marine ecosystems that provide vital ecosystem services and protect coastlines, as well as offer avenues for tourism and economic growth. Therefore, a significant threat. Fishing and fish sticks would also be affected with acidification, with molluscs especially affected due to their calcium shells.
- Forest health will likely deteriorate as changes to the carbon cycle increase forest stress. Forest loss impacts human wellbeing in developing countries, and impacts both cycles, but especially water at the local scale with impacts on precipitation, river regimes, water stores, and water security.
- Droughts and floods may become more common, with cycles like ENSO exacerbating these. This will further affect the two cycles and possibly lead to feedback mechanisms or tipping points coming into play.
- Various adaptation and mitigation methods may be applied and form part of counterarguments when discussing points.
- Changes to both cycles threaten human activity, and they interlink. Developed nations will be able to adapt more easily and are less exposed. Developing nations will likely compound issues by the pressures of population and economic growth. The impacts on the water cycle may be short-term and carbon cycle longer-term, unless a tipping point is reached.