

Workbook answers

AQA A-level Geography

Physical Geography

This Answers document provides suggestions for some of the possible answers that might be given for the questions asked in the workbook. They are not exhaustive and other answers may be acceptable, but they are intended as a guide to give teachers and students feedback.

The answers given to questions within each topic area vary from being directly targeted at knowledge (AO1) and skills (AO3) to more generic answers that fulfil AO2. The levels criteria for the exam-style questions are generic. These generic descriptors are different for each of the three assessment objectives (AO1, AO2 and AO3). The appropriate descriptors for each level of each of the assessment objectives can be found on the AQA website.

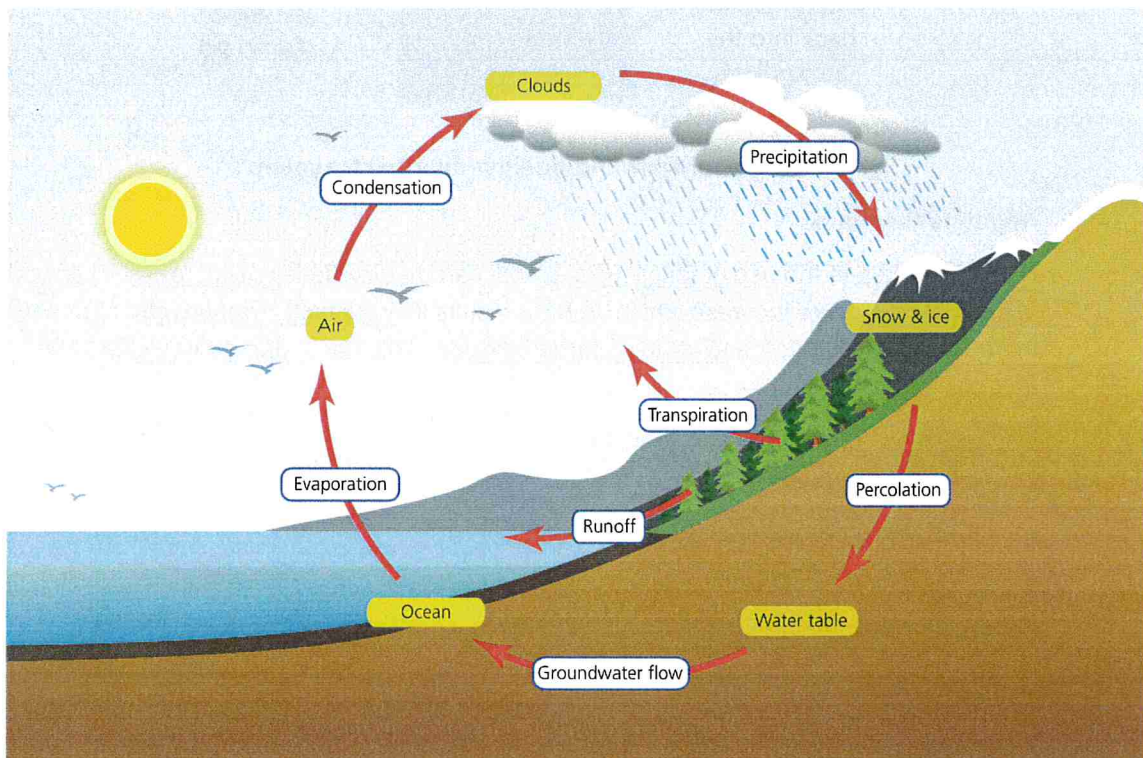
The notes given for the exam-style questions are suggestions as to what should be included. They are not model answers and do not necessarily include all the material that would be relevant. All your answers in the longer, extended prose-type questions should be supported by examples and case study material.

Topic 1

Water and carbon cycles

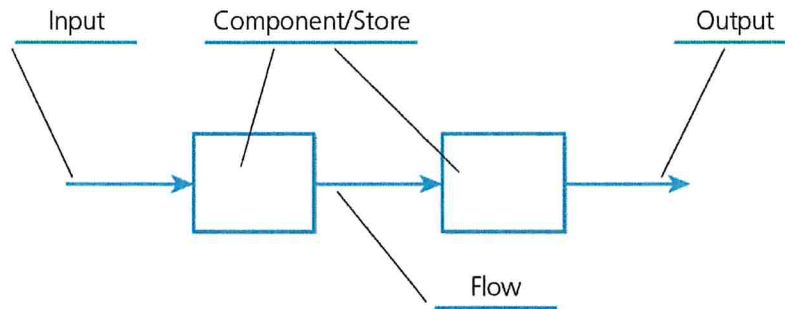
Water and carbon cycles as natural systems

- 1 One example is the global hydrological cycle:

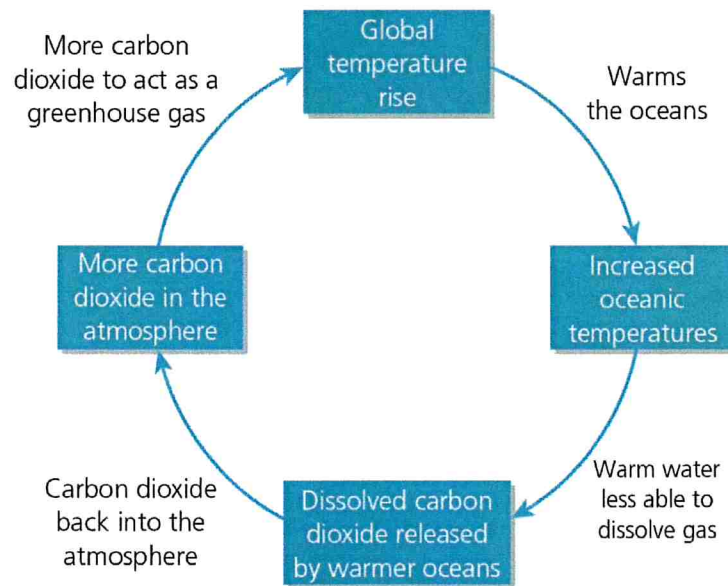


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3



The global warming positive feedback system

4 **Negative feedback**

Following a rise in the use of fossil fuels, global carbon dioxide levels increase. This leads to a global temperature increase which, in turn, results in increased plant growth, meaning that there is an increase in the take-up of carbon dioxide. This has a dampening effect and reduces global temperatures.

5 Depends on which is chosen. Could be:

- the movement of labour
- the movement of remittances
- the flow of knowledge-intensive goods, e.g. research and development

For each there must be named inputs, components and outputs.

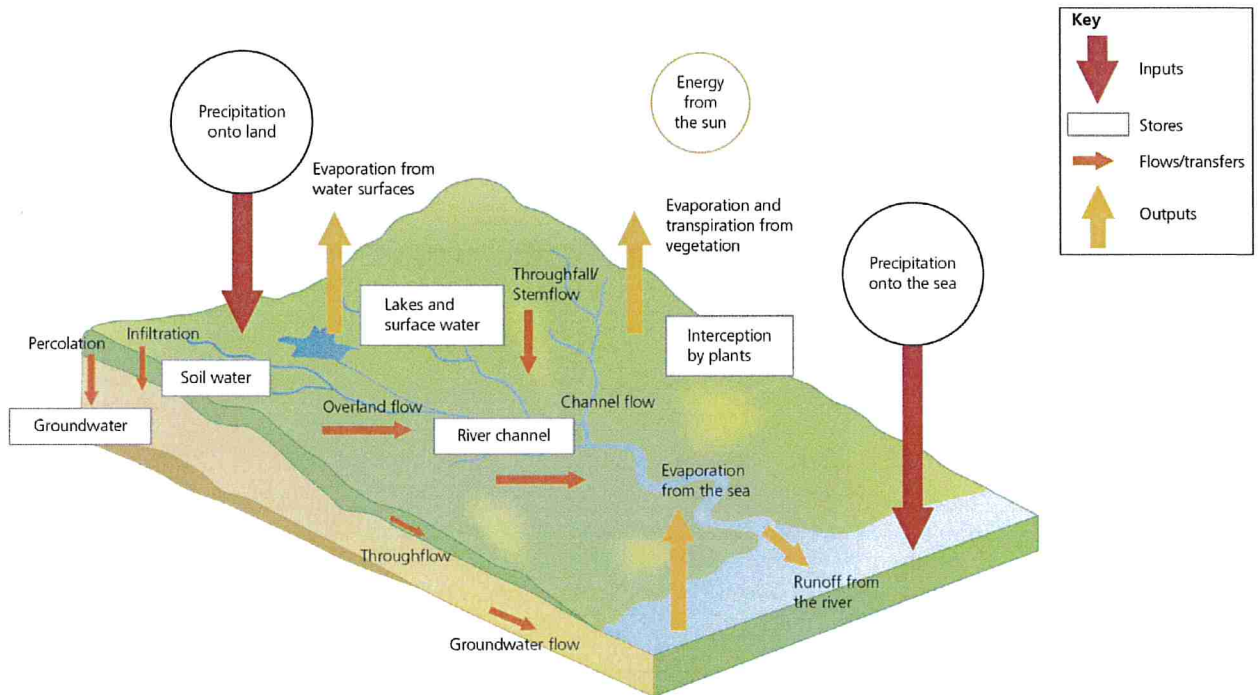
The water cycle

6 The majority of water on Earth (97%) can be found in the oceans. The rest is fresh water; this consists mostly (almost four fifths) of frozen water locked up in ice caps, glaciers and frozen ground, and also includes groundwater (one fifth). Only 1% of the fresh water is easily accessible, with just over half being found in lakes and freshwater inland seas. The rest is

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found in the soil, atmosphere, biomass and rivers. Rivers only contain about 3/1,000,000 of all the water on Earth.

7



8 Water can enter a channel:

- by direct precipitation
- by overland flow
- by soil throughflow
- by groundwater flow
- from tributaries

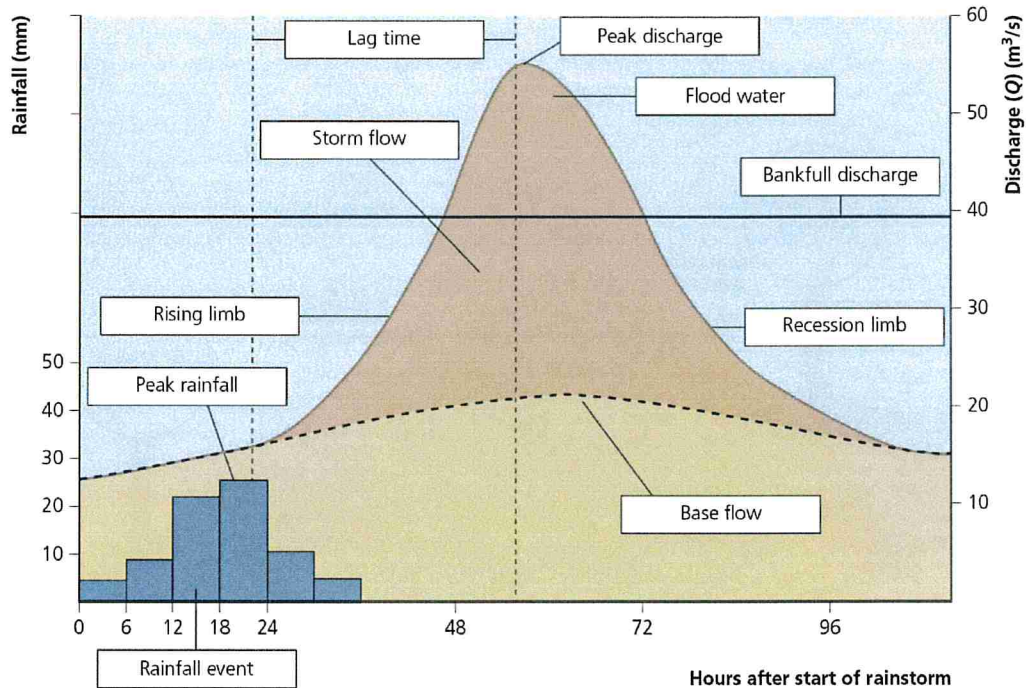
9 a Evaporation: Liquid water is heated by the sun and changes to gas (water vapour). Rate depends upon temperature and humidity. Linked to transpiration.

- b Condensation: Change of state where water vapour turns to liquid water. Temperatures drop and relative humidity increases until it reaches 100% (dew point). Only occurs on surfaces or condensation nuclei.

10 A worked answer can be found in your Workbook.

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11



12

Physical factor	How it affects the shape of a storm hydrograph
Impermeable underlying rock	Reduces the rate of percolation into the groundwater, meaning that the soil becomes more rapidly saturated. This leads to overland flow. Overland flow is rapid and so water reaches the river more quickly. This gives a flashier hydrograph with steep rising and falling limbs and a shorter lag time.
Steep sides to the drainage basin	Drainage basins with steep sides have flashier hydrographs than gently sloped river basins. Water flows more quickly on the steep slopes, whether as throughflow or as overland flow, and so gets to the river more quickly.
A period of wet weather followed by intense rainfall	If the drainage basin is already saturated by antecedent rainfall, then overland flow increases because infiltration capacity has been reached. Since overland flow is the fastest of the transfers, the lag time is reduced and peak discharge is higher, resulting in a flashy hydrograph.
A densely forested drainage basin	Vegetation intercepts precipitation, holding the water on its leaves; this slows the movement of rainwater to the ground and so to river channels. Water is also lost due to evaporation and transpiration from vegetation surfaces, reducing how much gets to the river. This subdues the storm hydrograph, increasing lag time and reducing peak discharge.
The shape of a drainage basin	Circular drainage basins lead to more flashy hydrographs than those that are long and thin because each point in the drainage basin is roughly equidistant from the measuring point on a river.

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Human factor	How it affects the shape of a storm hydrograph
Deforestation	Deforestation reduces interception rates, allowing rainwater to hit the surface directly. The lack of vegetation roots reduces the infiltration rate into the soil. These both lead to rapid overland flow and flashy hydrographs. Deforestation also exposes the soil to greater rates of erosion, which leads to sedimentation in the channel. This reduces the bankfull capacity of a river and can lead to a greater chance of flooding.
Growth of urban areas	Growth of urban areas and other large impermeable surfaces leads to flashy hydrographs. This is exacerbated because settlements have been built on floodplains. Most settlements are designed to transfer water as quickly as possible away from human activity to the nearest river. This is achieved through road camber, building design and drainage systems.
Dam construction in the upper drainage basin	Dam construction will subdue storm hydrographs, reducing the peak discharge and increasing the lag time. When it rains in the upper part of the drainage basin, water will flow until it reaches the dam. Here it will be held back and released at a steady rate.
Ploughing up of grassland	Ploughing allows greater infiltration, subduing hydrographs. This is enhanced by contour ploughing. If furrows are created that run directly downslope, they act as small stream channels and lead to flashier hydrographs. Ploughing wet soils can cause plough pans. These inhibit percolation, leading to greater surface flows.
Water abstraction	This reduces the base flow and so storm flow reaches a lower peak.

- 14 The highest discharge is in winter, reaching a level of about 60 cumecs. It stays like that until early February and then falls by 50 cumecs by late April. It stays at just over 10 cumecs until the start of summer, reaching a minimum of 5 cumecs in late summer. The river flow increases by 55 cumecs by late December.

The carbon cycle

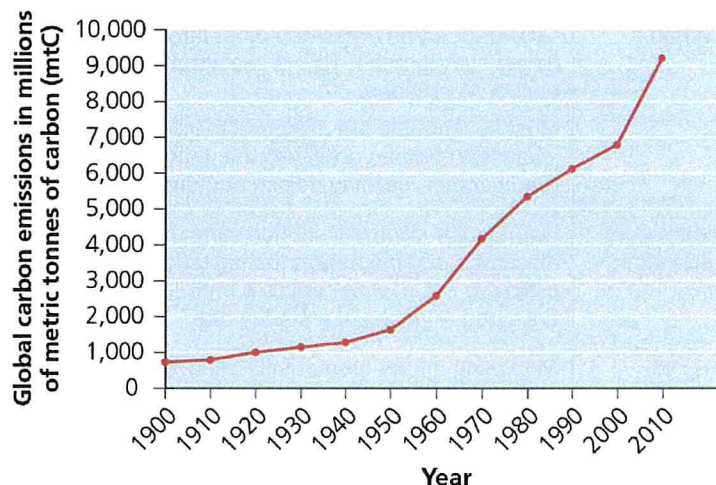
- 15
- a Carbon dioxide is a colourless and odourless gas vital to life on Earth. It is composed of a carbon atom covalently double-bonded to two oxygen atoms. Carbon dioxide can be found in air, and water as a part of the carbon cycle. It plays an important part in vital plant and animal processes, such as photosynthesis and respiration.
 - b Calcium carbonate, or CaCO_3 , comprises more than 4% of the Earth's crust. Its most common natural forms are chalk, limestone and marble, produced by the sedimentation of the shells of small fossilised molluscs and coral over millions of years. Although all three forms are identical in chemical terms, they differ in many other respects, including purity, whiteness, thickness and homogeneity.
 - c Liquid petroleum, along with oil and coal, is classified as a fossil fuel. Fossil fuels are formed when sea plants and animals die and the remains become buried under several thousand metres of silt, sand or mud. Fossil fuels take millions of years to form and therefore petroleum is also considered to be a non-renewable energy source. Petroleum in its natural form when first collected is usually named crude oil. It can be clear, green or black and may be either thin like gasoline or thick like tar.
- 16
- a Photosynthesis occurs when plants use energy from sunlight to turn carbon into organic matter. $\text{CO}_2 + \text{H}_2\text{O} + \text{sunlight} \rightarrow \text{CH}_2\text{O} + \text{O}_2$
 - b Respiration occurs where plants and animals take oxygen from the atmosphere, combine it with carbohydrates and liberate stored energy.

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- c Decomposition includes physical, chemical and biological mechanisms that transform organic matter into increasingly stable forms.

17 Weathering is the breakdown of rocks *in situ* by a combination of weather, plants and animals. The carbon residue is eventually carried to the ocean where it can become precipitated and eventually form more rocks.

18



19 A worked answer can be found in your Workbook.

Water, carbon, climate and life on Earth

20 The energy mix for the UK is projected to be dominated by renewables from the early 2020s, making up close to half of the electricity generated by 2025. Coal is expected to be phased out in the early 2020s. Gas is slowly reducing, while nuclear generation is expected to reach a low point in 2024 but then rise after that. The UK is also committed to improving the use of renewable energy sources. In 2017, almost 28% of the UK's energy came from renewable generation. Of this 50% was from both onshore and offshore wind, followed by plant biomass, solar photovoltaics and hydroelectric power. There has been massive funding (£900 million) for research and innovation to reduce the cost of the renewables. Despite this, projections show the UK missing its legally binding carbon budgets for 2023–2032 by even wider margins than expected. The fifth carbon budget, for 2028–2032, is now set to be missed by as much as 20%, according to the new energy and emissions projections from the Department for Business, Energy and Industrial Strategy.

21 **One of the options below.**

CCS, or carbon capture and storage, is a low-carbon technology which captures carbon dioxide from the burning of coal and gas for power generation, and from the manufacturing of steel and cement and other industrial facilities. The carbon dioxide is then transported, by either pipeline or ship, for safe and permanent underground storage, preventing it from entering the atmosphere and contributing to human-generated climate change. It has the potential to decarbonise the economy and maximise economic opportunities for the UK because it has a vast potential for carbon storage. However, it is currently expensive and cost reductions are necessary in order to deploy CCS cost-effectively in the UK, providing value for money for both the taxpayer and consumers.

Globally, in 2019, the number of large-scale CCS facilities was 51. Of these 19 were operating, 4 were under construction and 28 were in development.

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or

Changing agricultural practices: Agriculture contributes roughly a fifth of global greenhouse gas emissions when one considers the full life cycle of production including agriculture's role in deforestation.

In grassland areas there is a mitigation potential of 810 million tonnes of CO₂ (in the period up to 2030). It can be improved by avoidance of overstocking of grazing animals and adding manures and fertilisers that have a direct impact on soil organic carbon (SOC) levels through the added organic material. Other techniques include revegetation, irrigation, mulching, crop rotation and reducing ploughing. Silviculture and orchards can reduce CO₂ emissions if they are grown as a renewable source of fuel. There is an increasing amount of work being done on the reduction of enteric methane in cattle.

or

Improved aviation practices: Globally, flights in 2019 produced 915 million tonnes of CO₂ which is around 2% of all human-induced CO₂. Alternative, sustainable aviation fuels have been identified, such as algae, jatropha or waste products, which have been shown to reduce the carbon emissions by 80% over their full life cycle. There is an ongoing renewal of aircraft, with older machines being scrapped and replaced by fuel-efficient planes.

According to the Air Transport Action Group, they have set a target of a 50% net reduction in carbon emissions by 2050.

Exam-style questions

Exam-style set 1

1

Allow 1 mark per valid point with extra mark(s) for developed points. (AO1) (4 marks)

You must choose two from the following:

- throughfall
- stemflow
- overland flow
- infiltration
- percolation
- groundwater flow
- river flow

E.g.: Overland flow occurs on surfaces that are either saturated or impermeable. The water is unable to enter the soil and flows downhill either in micro-channels or as sheets of water. It is the fastest way for water to reach a river channel.

2

AO3: Level 2 (4–6 marks); Level 1 (1–3 marks)

1995	0.5	5	361	6	-1.0	1.0
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$$\sum d^2 = 10.5$$

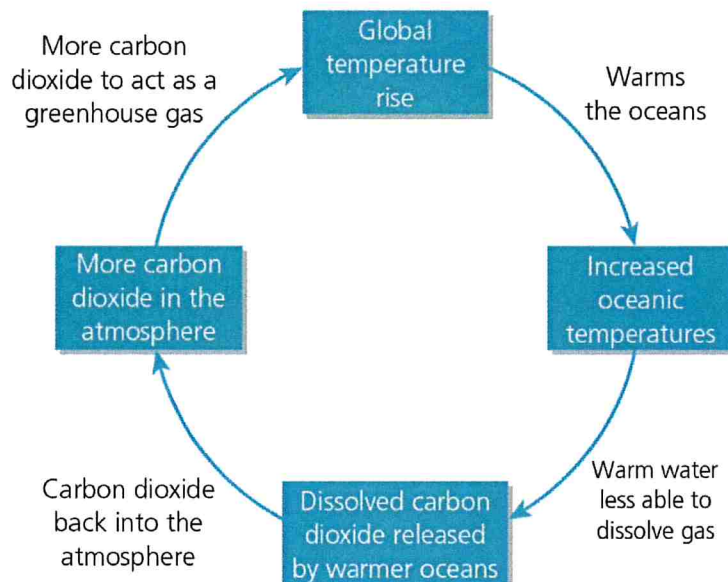
$$R_s = 0.95$$

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Interpretation: The result shows that we can be confident at a 1% significance level. This means we are almost sure that there is a correlation between the two. This means that the null hypothesis has to be rejected.

3

AO1, AO2: Level 2 (4–6 marks); Level 1 (1–3 marks)



This shows a positive feedback system where carbon dioxide builds up in the atmosphere and acts as a greenhouse gas. The atmosphere warms by radiative forcing. This in turn warms the ocean by conduction. Since warmer liquids are unable to hold as much dissolved gas, carbon dioxide is emitted into the atmosphere causing further warming.

4

AO1, AO2: Level 4 (16–20 marks); Level 3 (11–15 marks); Level 2 (6–10 marks); Level 1 (1–5 marks); Level 0 (0 marks)

This depends on the drainage basin you have studied. It is likely that if you have studied an urban drainage basin, you will have noted that the many smooth, sloped impermeable surfaces, designed to remove water quickly, lead to a flashy hydrograph which could result in flooding downstream of the urban area. Thus it is dominated by human factors.

More rural areas will also depend on the land use but physical factors such as shape, steepness etc. of the basin will play a larger role. You will need to describe all the variables and then link them to the river regime and the local rainfall patterns.

You need to reach a conclusion which assesses the relative importance of natural variation and human activity. This conclusion must be fully supported by your case study.

Exam-style set 2

1

Allow 1 mark per valid point with extra mark(s) for developed points. (AO1) (4 marks)

Negative feedback is where the effects of an action are nullified by the subsequent knock-on effects.

An example would be where an increased use of fossil fuels adds greenhouse gases to the atmosphere. This causes the atmosphere to warm up. Globally, more vegetation can grow,

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meaning more carbon dioxide is absorbed by vegetation. This in turn reduces atmospheric carbon dioxide and dampens down global temperatures.

2

AO3: Level 2 (4–6 marks); Level 1 (1–3 marks)

About 75% of the potential is caused by tropical and temperate afforestation. This is much greater than the boreal afforestation and reflects the speed at which vegetation can grow in warmer areas as well as the total area covered by these vegetation types.

Agroforestry is the growing of both trees and agricultural/horticultural crops on the same piece of land. It is designed to provide tree and other crop products and at the same time protect, conserve, diversify and sustain vital economic, environmental, human and natural resources. Agroforestry is not a permanent solution because it involves the removal of a percentage of the vegetation. It is also not available in the colder regions of the Earth (boreal).

3

AO1, AO2: Level 2 (4–6 marks); Level 1 (1–3 marks)

The vast majority of the land surface is predicted to have a greater intensity of precipitation. In the northern hemisphere this seems to be on the western side of the two main landmasses. In the southern hemisphere there is greater intensity in the east of Australia and East Africa, but not South America. The subtropical regions seem to stay mostly the same except for the western fringe of North Africa and Patagonia in southwest South America.

The consequences of this could be flooding in Europe and North America, but drought in desert margins.

4

AO1, AO2: Level 4 (16–20 marks); Level 3 (11–15 marks); Level 2 (6–10 marks); Level 1 (1–5 marks); Level 0 (0 marks)

Half the marks for this question are based on knowledge and understanding alone. These can be gained by giving information about the ways in which human activity mitigates the impacts.

One way is to reduce the emissions and reduce the amount of carbon in the atmosphere. This will slow down climate change. The sorts of activity could be:

- a reduction in the use of fossil fuels by use of renewables
- carbon sequestration and capture
- etc.

The other half of the marks are for your assessment of how far you agree with the statement. You must state whether you agree, and the strength of that agreement (or otherwise). Then this should be supported by evidence.

Evidence could include, for example, the following point: it is estimated that, because of a drop in industrial and transport activity during the Covid-19 pandemic, the cumulative global carbon emissions for 2020 could drop by anything from 4–7%, which would represent the largest drop since the Second World War. This shows that it is possible to reduce emissions and benefit from that drop.

You are asked for 'examples' and so you need more than one piece of evidence/example to support your argument.

In order to gain the higher levels, you must include a summative statement, rounding off the answer.

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Additional extended prose questions

1

AO1, AO2: Level 4 (16–20 marks); Level 3 (11–15 marks); Level 2 (6–10 marks); Level 1 (1–5 marks); Level 0 (0 marks)

Half the marks for this question are based on knowledge and understanding alone. These can be gained by giving information about the relevant global systems (e.g. the United Nations Framework Convention on Climate Change) and/or ways to mitigate climate change.

The other half of the marks are for your assessment of the extent to which your stated laws and institutions have been successful in the mitigation of climate change. This should be supported by evidence.

Evidence could include initiatives like the Climate Action Summit, which convened in 2019 and brought together representatives of governments, businesses and civil society, resulting in an array of plans to further climate action. You must, at some stage, offer evidence that there has, or has not, been a reduction in the impacts of climate change.

Finally, in order to gain the higher levels, you must include a summative statement, rounding off the answer.

2

AO1, AO2: Level 4 (16–20 marks); Level 3 (11–15 marks); Level 2 (6–10 marks); Level 1 (1–5 marks); Level 0 (0 marks)

Half the marks for this question are based on knowledge and understanding alone. These can be gained by giving information on natural factors that cause variations in the water cycle over time and/or the ways in which human activity may change the water cycle.

The other half of the marks are for your assessment of how far you agree with the statement. You must state whether you agree, and the strength of that agreement (or otherwise). This should be supported by evidence.

The evidence could include the ways in which storms, seasonal climates or natural climatic cycles change the water cycle at a variety of scales. This should be compared to the changes wrought by human-induced climate change or human activities such as agriculture or water abstraction.

Finally, in order to gain the higher levels, you must include a summative statement, rounding off the answer.