WORKBOOK ANSWERS

AQA AS/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.

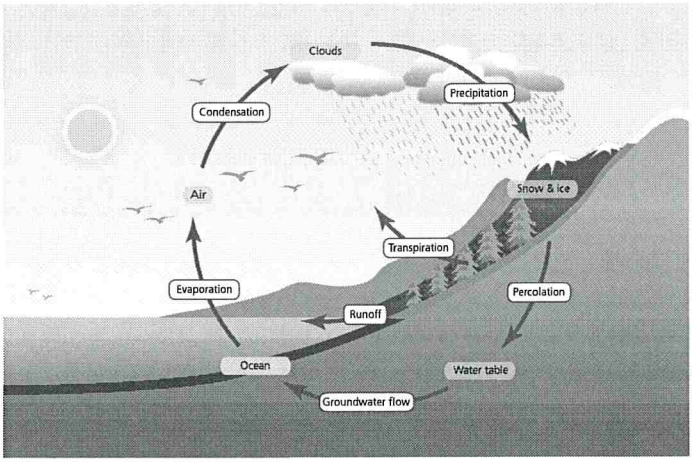
The answers given to questions within each topic area vary from being directly targeted at knowledge (AO1) and skills (AO3) to more generic answers that fulfil AO2. The levels criteria for the exam-style questions are generic. These generic descriptors are different for each of the three assessment objectives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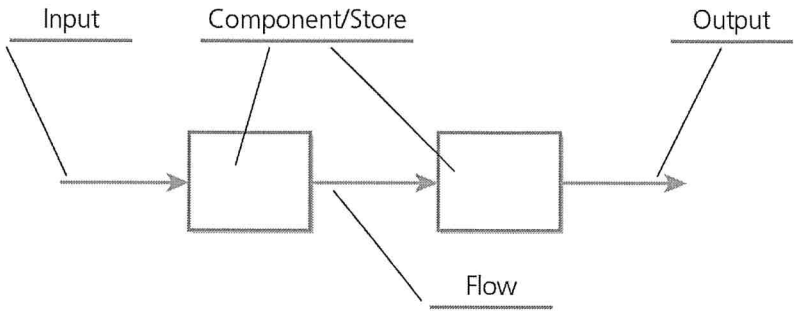
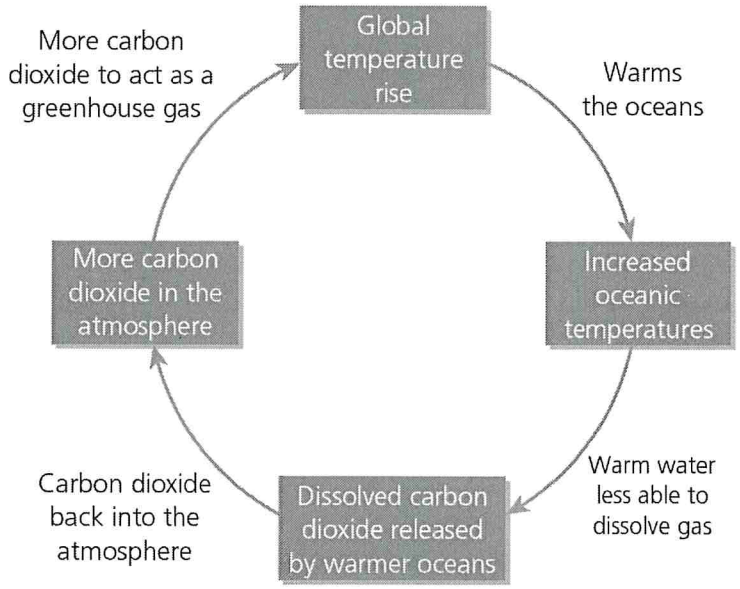


3 One example could be a coastal sediment cell or an ecosystem.

4 The global warming positive feedback system



5 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.

The water cycle

6 The vast majority of water on Earth (97%) can be found in the oceans. The remaining 3% is fresh water; this consists mostly (almost 4/5ths) of frozen water locked up in ice caps, glaciers and frozen ground as well as groundwater. Only 1% of the freshwater is easily accessible with just over half being found in lakes and freshwater inland seas. The rest is found in the soil, atmosphere biomass and rivers. Although rivers play a big part in human activity and development they only contain about 3/1,000,000s of all the water on Earth.

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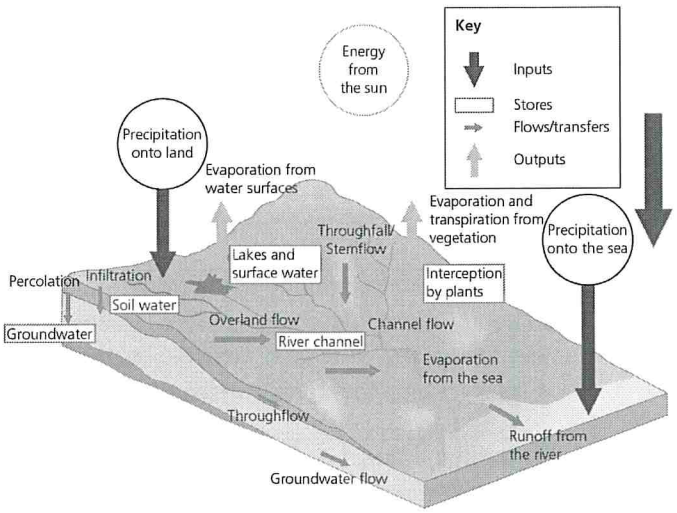

8 Water can enter a channel by:

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

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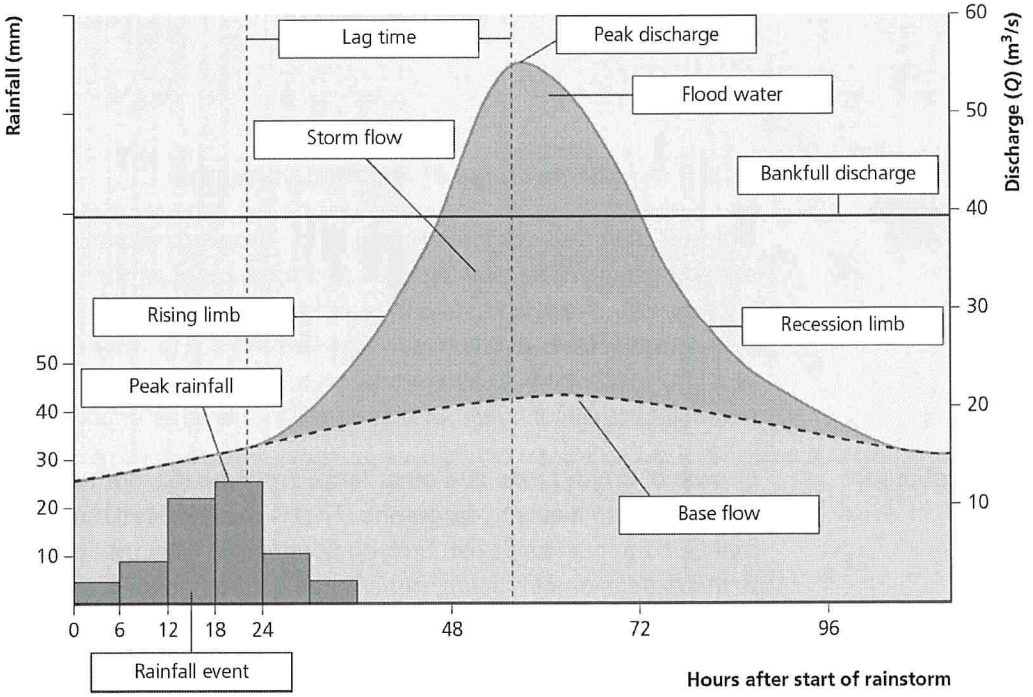

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Physical factor	How it affects the shape of a storm hydrograph
Impermeable underlying rock	Reduces the rate of percolation into the groundwater, meaning that the soil becomes more rapidly saturated. This leads to overland flow. Overland flow is rapid 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 tend to have flashier hydrographs than gently sloped river basins. This is because 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. Again, peak discharge is higher, resulting in a flashy hydrograph.
A densely forested drainage basin	Thick vegetation cover in drainage basins will have a significant effect on a storm hydrograph. Vegetation intercepts the 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	Drainage basins that are more circular in shape 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 such as roads leads to flashy hydrographs. This is exacerbated by the very fact that settlements have been built on floodplains. This urban growth leads to the expansion of built-up, impermeable surfaces such as roads, car parks, shopping centres etc. 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. Any changes in the storm hydrograph will be as a result of rainfall in the part of the drainage basin between the dam and the gauging station.
Ploughing up of grassland	Ploughing breaks up the topsoil and allows greater infiltration, subduing hydrographs. This can be enhanced by contour ploughing. Where furrows are created that run directly downslope they can act as small stream channels and lead to flashier hydrographs. Ploughing wet soils can cause impermeable smears in the subsoil called plough pans. These inhibit percolation, leading to greater surface flows.

The carbon cycle

12 a Carbon dioxide is a colourless and odourless gas vital to life on Earth. This naturally occurring chemical compound is composed of a carbon atom covalently double bonded to two oxygen atoms. Carbon dioxide can be found mainly in air, but also in 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 and is found throughout the world. Its most common natural forms are chalk, limestone and marble, produced by the sedimentation of the shells of small fossilised snails, shellfish 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. Calcium carbonate is one of the most useful and versatile materials known to humankind.

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. It is formed by hydrocarbons (a hydrocarbon is a compound made up of carbon and hydrogen) with the addition of certain other substances, primarily sulphur. Petroleum in its natural form when first collected is usually named crude oil, and can be clear, green or black and may be either thin like gasoline or thick like tar.

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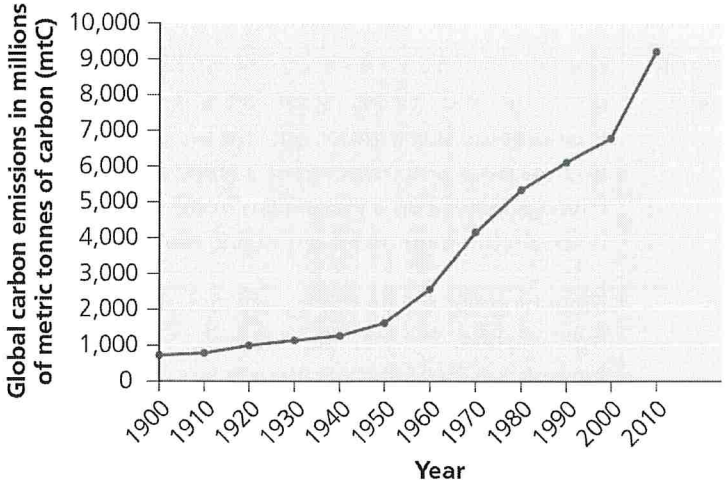

14 From 1900 to 1950 the emissions increased slowly, rising by 1,000 million metric tonnes in 50 years. Between 1950 and 2000, they rose more rapidly, rising by 5,250 million metric tonnes. From 2000 onwards the rate of increase grew again, rising by 2,350 million metric tonnes in just 10 years.

Carbon dioxide acts as a greenhouse gas and is increasing so extensively that the Earth's climate is changing because the temperatures are rising. It is suspected that global warming may cause increases in storm activity as well. Increasing carbon dioxide emissions cause about 50–60% of the global warming.

Exam-style questions (AS)

1 Allow 1 mark for each valid point with additional marks for developed points. (3 marks)

Humans affect the carbon cycle through the exhalation of carbon dioxide, the burning of fossil fuels, deforestation and other poor agricultural practices. Burning fossil fuels and deforestation lead to a disruption in the balance of the carbon cycle.

When a surplus of fossil fuels are burned, a large amount of carbon dioxide is released into the air. Deforestation reduces the amount of vegetation that can reduce the atmosphere's carbon dioxide levels and creates less habitable soil for new growth. Carbon dioxide builds up due to the overuse of fossil fuels and an increasing lack of vegetation.

2 AO1, AO3: Level 2 (4–6 marks); Level 1 (1–3 marks)

There is one input into the cycle: precipitation. Depending on where this lands, it enters a store. This can be on vegetation surfaces (interception), on the surface or directly into a river channel. The interception store fills until water drips or flows towards the ground. Once on the surface, the water can be stored in puddles for a limited time. Some of this, like the interception storage, can be evaporated back to the atmosphere, but much of it sinks into the soil by infiltration. Water can travel downslope within the soil as throughflow, or it can percolate down into the solid geology below where it becomes groundwater.

If the ground becomes saturated, surface storage remains and the water moves across the surface as overland flow until it reaches a river channel. Once in the channel, water flows towards its base level (usually the sea).

3 AO1, AO2: Level 3 (7–9 marks); Level 2 (4–6 marks); Level 1 (1–3 marks)

The lithosphere: Most of the Earth's carbon is stored inertly in the Earth's lithosphere. Much of the carbon stored in the Earth's mantle was stored there when the Earth formed. Some of it was deposited in the form of organic carbon from the biosphere. It can be removed by humans through the direct extraction of kerogens in the form of fossil fuels. After extraction, fossil fuels are burned to release energy, thus emitting the carbon they store into the atmosphere.

The hydrosphere: Humans affect the oceanic carbon cycle. Current trends in climate change lead to higher ocean temperatures, which limit its ability to absorb carbon on a global scale. It can also have dramatic effects on highly sensitive ecosystems such as coral reefs, thus limiting its ability to absorb carbon on a regional scale as well as reducing oceanic biodiversity globally.

The cryosphere: In 2007 the IPCC concluded that the Antarctic ice sheet is losing ice overall. This loss was estimated to be 24 gigatonnes per year, but the margin of error on that conclusion was high. Globally, mountain glaciers are losing ice mass; one estimate is that approximately 120,000 glaciers around the world are likely to lose their ice in the next century. This melting of ice will put more water into the global water cycle.

Melting of permafrost is likely to release buried carbon dioxide and methane, leading to more atmospheric greenhouse gases.

The biosphere: Over the past several centuries, direct and indirect human-caused land use and land cover change have led to the loss of biodiversity, which lowers ecosystems' resilience to environmental stresses and decreases their ability to remove carbon from the atmosphere. More directly, it often leads to the release of carbon from terrestrial ecosystems into the atmosphere. Deforestation for agricultural purposes removes forests, which hold large amounts of carbon, and replaces them, generally with agricultural or urban areas. Both of these replacement land cover types store comparatively small amounts of carbon, so that the net product of the process is that more carbon stays in the atmosphere.

The atmosphere: carbon is stored in the atmosphere as both methane (CH_4) and carbon dioxide (CO_2); greenhouse gases which absorb and retain heat. Carbon dioxide is released into the atmosphere through the burning of fossil fuels, deforestation etc. CH_4 is released into the atmosphere through animal emissions, decomposition, and the burning of fossil fuels.

The global annual mean concentration of carbon dioxide in the atmosphere has increased by more than 40% since the start of the Industrial Revolution, from 280 ppm in the mid-eighteenth century to 407 ppm as of 2016. The present concentration is the highest in at least the past 800,000 years and probably the highest in the past 20 million years.

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 there are many smooth, sloped impermeable surfaces designed to remove water quickly, leading to a flashy hydrograph which could result in flooding downstream of the urban area.

More rural areas will depend on the land use, shape, steepness etc. of the basin. You will need to describe all the variables and then link them to the hydrograph and flood history.

Exam-style questions (A-level)

5 *Allow 1 mark per valid point with extra mark(s) for developed points. (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, meaning more carbon dioxide is absorbed by vegetation. This in turn reduces atmospheric carbon dioxide and dampens down global temperatures.

6 *AO2, 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).

7 *AO2, AO3: 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.

8 *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.