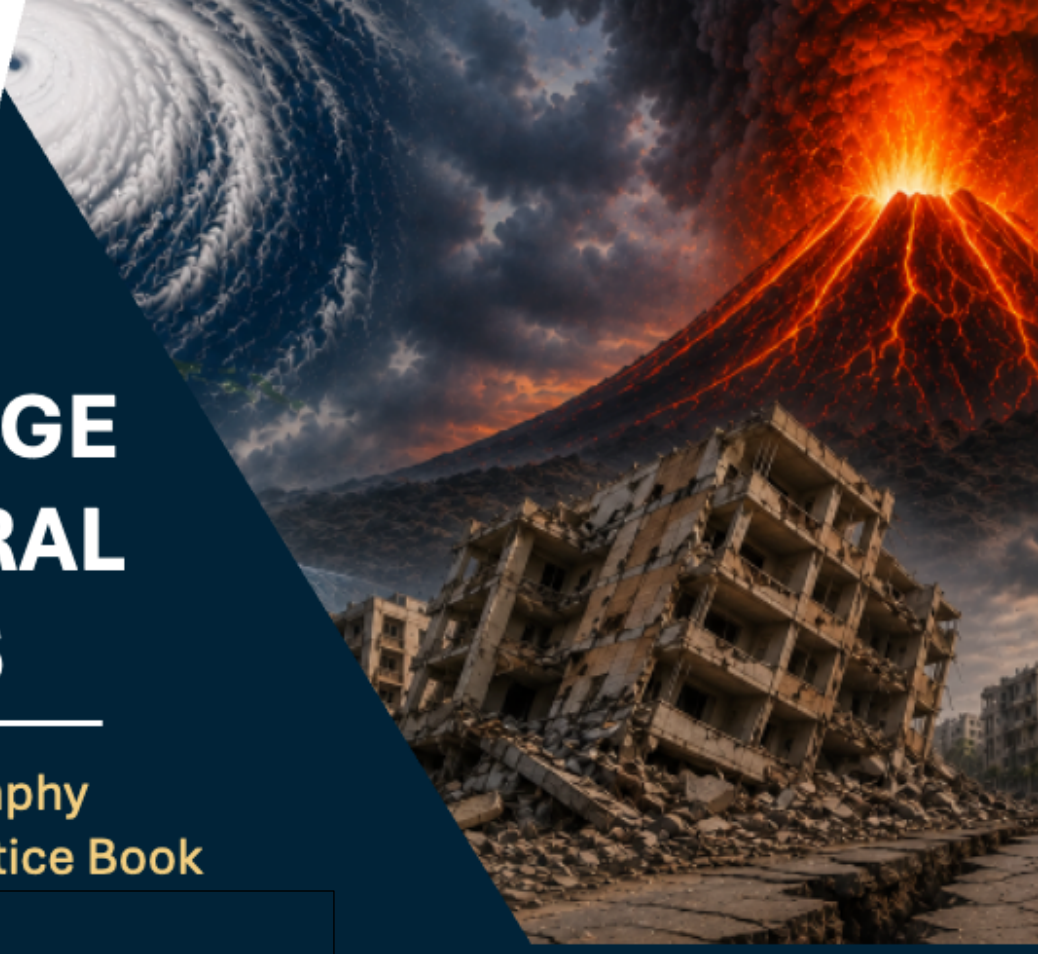
internet geography



THE CHALLENGE OF NATURAL HAZARDS

AQA GCSE Geography Revision and Practice Book

Mark Scheme

Revision Notes

Retrieval Practice

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Page 6: Exam Ready Question

Question

Outline one factor that affects hazard risk. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid factor that affects hazard risk.
Award **1 further mark** for outlining how it affects the chance of people being affected.
Accept any valid factor, including:

- population density
- location
- level of development
- climate change

Possible answers

Population density affects hazard risk. Areas with more people are at greater risk because more people could be injured, killed or affected if a hazard occurs.
Location affects hazard risk. People living close to plate boundaries, coastlines or tropical storm areas are more exposed to hazards, so the chance of being affected is higher.
Development affects hazard risk. More developed countries often have stronger buildings and better emergency services, so people may be less vulnerable to the impacts of hazards.
Climate change affects hazard risk. Rising temperatures can increase the frequency or intensity of some hazards, such as heatwaves, droughts and tropical storms.

Page 7 Activities

Page 7: 30 Second Recall Answers

Define: Natural hazard

A natural hazard is a natural event that could cause damage, injury or death.

List: Four types of hazard classification

- Tectonic
- Atmospheric
- Geomorphological
- Biological

Explain: Why population density increases hazard risk

Population density increases hazard risk because more people live in the affected area. This means more people could be injured, killed, made homeless or have their homes and services damaged if a hazard occurs.

Page 7: Blur, Build, Check

Stage 2: Build answers

1. Define natural hazard and hazard risk.

A **natural hazard** is a natural event that could cause damage, injury or death.
Hazard risk is the chance of people being affected by a natural hazard.

2. Identify examples of each natural hazard classification.

Tectonic hazards: earthquakes, volcanoes, tsunamis
Atmospheric hazards: tropical storms, droughts, heatwaves

Geomorphological hazards: flooding, landslides, mudflows
Biological hazards: disease, insect infestations, forest fires

3. Three factors affecting risk.

Three factors affecting hazard risk are:

- population density
- location
- level of development

Climate change is also a valid factor.

Page 7: Exam Builder

Step 1: Complete the sentences

Question

A natural hazard is a _____ event that can cause _____. Hazard risk is the _____ of people being affected. High population density increases _____ risk.

Answer

A natural hazard is a **natural** event that can cause **damage, injury or death**. Hazard risk is the **chance** of people being affected. High population density increases **hazard** risk.

Accept:

A natural hazard is a **natural** event that can cause **damage**. Hazard risk is the **chance** of people being affected. High population density increases **risk**.

Step 2: Explain how location can increase hazard risk. [2 marks]

Mark scheme

Award **1 mark** for identifying that some places are more exposed to hazards.

Award **1 further mark** for explaining how this increases the chance of people being affected.

Model answer

Location can increase hazard risk because some places are close to hazard zones, such as plate boundaries or tropical storm areas. This increases the chance of people being affected by earthquakes, volcanoes or extreme weather.

Step 3: Explain how physical and human factors affect hazard risk. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows a clear understanding of physical and human factors affecting hazard risk. Explanations are developed. **AO3** Demonstrates reasonable application of knowledge and understanding in explaining how factors such as location, development and population density affect the likelihood and severity of hazard impacts.
1 Basic	1–2	**AO2** Shows a limited understanding of physical and human factors affecting hazard risk. Explanations are basic. **AO3** Demonstrates limited application of knowledge and understanding in explaining how different factors influence hazard risk.

Level	Marks	Description
0	0	No relevant content.

Indicative content

Physical factors may include:

- living near plate boundaries
- tropical storm locations
- coastal locations
- climate change increasing hazard frequency or intensity

Human factors may include:

- population density
- level of development
- quality of buildings
- emergency planning
- access to healthcare and emergency services

Model answer

Physical factors affect hazard risk because some areas are more exposed to hazards. For example, people living near plate boundaries are more likely to experience earthquakes or volcanic eruptions. Human factors also affect risk. Areas with high population density have more people who may be injured or affected, while less developed countries may have weaker buildings and fewer emergency services, increasing vulnerability.

Page 7: Exam-style Questions

1.1 What is a natural hazard? [1 mark]

Mark scheme

Award **1 mark** for a valid definition.

Answer

A natural hazard is a natural event that could cause damage, injury or death.

1.2 Name one type of natural hazard. [1 mark]

Mark scheme

Award **1 mark** for naming a valid type of natural hazard.

Acceptable answers

- tectonic
- atmospheric
- geomorphological
- biological

Model answer

Tectonic.

1.3 Describe how development affects hazard risk. [2 marks]

Mark scheme

Award **1 mark** for identifying that development affects vulnerability or preparedness.
Award **1 further mark** for describing how this changes hazard risk.

Model answer

More developed countries often have stronger buildings, better infrastructure and better emergency services. This can reduce hazard risk because people are better protected and responses are quicker.

Alternative model answer

Less developed countries are often more vulnerable to hazards because buildings may be weaker and emergency services may be limited. This increases the chance of people being injured, killed or affected.

1.4 Explain why population density increases hazard risk. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows a clear understanding of how population density affects hazard risk. Explanations are developed. **AO3** Demonstrates reasonable application of knowledge and understanding in explaining how densely populated areas are more vulnerable to the impacts of hazards.
1 Basic	1–2	**AO2** Shows a limited understanding of how population density affects hazard risk. Explanations are basic. **AO3** Demonstrates limited application of knowledge and understanding in explaining how hazard impacts may be greater in densely populated areas.
0	0	No relevant content.

Indicative content

- More people live in the affected area.
- Greater numbers may be injured or killed.
- More people may be made homeless.
- More homes, businesses and infrastructure may be damaged.
- Emergency services may become overwhelmed.
- There may be greater disruption to transport, water, electricity and healthcare.

Model answer

Population density increases hazard risk because more people live in areas that may be affected by hazards. If an earthquake or tropical storm occurs, more people could be injured, killed or made homeless. Densely populated areas also contain more buildings and infrastructure, so damage and disruption are usually greater.

1.5 Suggest how climate change may affect hazard risk. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid way climate change may affect hazards.
Award **1 further mark** for developing how this changes risk.

Model answer

Climate change may increase hazard risk by making some extreme weather events more frequent or intense. For example, higher temperatures can increase the risk of heatwaves, droughts and more intense tropical storms.

Alternative model answer

Climate change can change rainfall patterns, which may increase the risk of flooding or drought. This increases the chance of people being affected by hazards.

1.6 Explain how different factors affect hazard risk. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows a detailed understanding of the different physical and human factors affecting hazard risk. Explanations are thorough and well developed. **AO3** Demonstrates detailed application of knowledge and understanding in explaining how factors such as location, population density, development and climate change influence the likelihood and severity of hazard impacts.
2 Clear	3–4	**AO2** Shows a clear understanding of factors affecting hazard risk. Explanations are developed. **AO3** Demonstrates reasonable application of knowledge and understanding in explaining how different factors increase or reduce hazard risk.
1 Basic	1–2	**AO2** Shows a limited understanding of factors affecting hazard risk. Explanations are basic. **AO3** Demonstrates limited application of knowledge and understanding in explaining how factors influence hazard risk.
0	0	No relevant content.

Indicative content

Physical factors may include:

- proximity to plate boundaries
- location in tropical storm areas
- coastal or floodplain locations
- climate change increasing the frequency or intensity of some hazards

Human factors may include:

- population density
- level of development
- quality of buildings
- emergency services
- monitoring and warning systems
- planning and preparedness

Model answer

Different factors affect hazard risk by changing how exposed and vulnerable people are to hazards. Location is important because people living near plate boundaries are more likely to experience earthquakes and volcanic eruptions. Coastal tropical regions are also more at risk from tropical storms. Population density increases hazard risk because more people and buildings are located in the hazard zone, so more damage and disruption may occur. Development also affects risk because richer countries often have stronger buildings, better warning systems and more effective emergency services. Climate change may increase the frequency and intensity of some weather hazards, such as droughts, floods and tropical storms, increasing the chance of people being affected. Therefore,

hazard risk is affected by both physical factors, such as location and climate, and human factors, such as population density and development.

Page 8 Activities

Page 8: Exam Ready Question

Question
Outline one difference between oceanic and continental crust. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid difference between oceanic and continental crust.
Award **1 further mark** for outlining that difference clearly.
Accept differences related to:

- density
- thickness
- rock type
- location
- behaviour at destructive plate margins

Possible answers
Oceanic crust is denser than continental crust. This means older oceanic crust is more likely to sink beneath continental crust at destructive plate margins.
Oceanic crust is thinner than continental crust. Oceanic crust is usually about 5–10 km thick, whereas continental crust is usually about 30–70 km thick.
Oceanic crust is mainly made of basalt, while continental crust is mainly made of granite. Basalt is denser than granite.
Oceanic crust forms the ocean basins, while continental crust forms the continents.

Page 9 Activities

Page 9: 30 Second Recall Answers

Define: Lithosphere
The lithosphere is the rigid outer layer of the Earth, made up of the crust and the uppermost part of the mantle. It is broken into tectonic plates.
List: The layers of the Earth

- Crust
- Mantle
- Outer core
- Inner core

Accept also:

- lithosphere
- asthenosphere

where students are referring to layers or sections of the upper Earth structure.
Explain: Why oceanic crust is more likely to subduct
Oceanic crust is more likely to subduct because it is denser and heavier than continental crust. At destructive plate margins, the denser oceanic crust sinks beneath the less dense continental crust into the mantle.

Page 9: Blur, Build, Check

Stage 2: Build answers

1. The layers of the Earth

Students should sketch and label the main layers in the correct order from the outside to the centre:

1. **Crust**
2. **Mantle**
3. **Outer core**
4. **Inner core**

A stronger answer may also include:

- the crust is the thin, solid outer layer
- the mantle is the thickest layer and is made of hot, solid rock that can flow slowly
- the outer core is liquid iron and nickel
- the inner core is solid iron and nickel

---

2. Lithosphere and asthenosphere

Students should identify and annotate:

Lithosphere:

The rigid outer layer made up of the crust and uppermost mantle. It is broken into tectonic plates.

Asthenosphere:

A hot, weak, ductile layer beneath the lithosphere. The tectonic plates move over it.

A stronger answer may explain that the asthenosphere is solid but can flow slowly over time.

---

3. Oceanic and continental crust

Students should identify and annotate the key differences:

Oceanic crust:

- thin, usually about 5–10 km thick
- denser
- mainly basalt
- forms ocean basins
- older, denser oceanic crust can subduct at destructive plate margins

Continental crust:

- thicker, usually about 30–70 km thick
- less dense
- mainly granite
- forms continents
- does not subduct easily

Page 9: Exam Builder

Step 1: Complete the sentences

Question

The Earth has a _____ structure.

The lithosphere is made of the _____ and _____.

The asthenosphere is _____ but ductile.

Answer

The Earth has a **layered** structure.

The lithosphere is made of the **crust** and **uppermost mantle**.

The asthenosphere is **solid** but ductile.

Accept:

The asthenosphere is **hot, weak and solid** but ductile.

Step 2: Explain what the asthenosphere is. [2 marks]

Mark scheme

Award **1 mark** for identifying the asthenosphere as a layer beneath the lithosphere.

Award **1 further mark** for explaining a characteristic of the asthenosphere.

Model answer

The asthenosphere is a hot, weak layer beneath the lithosphere. It is solid but ductile, so it can flow slowly and allows tectonic plates to move over it.

Step 3: Explain the difference between the lithosphere and the asthenosphere. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the lithosphere and asthenosphere. Identifies accurate characteristics of both layers. **AO2** Shows clear understanding of the difference between the lithosphere and asthenosphere, including how their properties affect tectonic plate movement. Explanations are developed.
1 Basic	1–2	**AO1** Shows limited knowledge of the lithosphere and/or asthenosphere. Some information may be accurate but incomplete. **AO2** Shows limited understanding of the difference between the lithosphere and asthenosphere. Explanation is basic or partially developed.
0	0	No relevant content.

Indicative content

- The lithosphere is the rigid outer layer of the Earth.
- The lithosphere is made of the crust and uppermost mantle.
- The lithosphere is broken into tectonic plates.
- The asthenosphere lies beneath the lithosphere.
- The asthenosphere is hot, weak and ductile.
- The asthenosphere is solid but able to flow slowly.
- Tectonic plates move over the asthenosphere.

Model answer

The lithosphere is the rigid outer layer of the Earth. It is made up of the crust and the uppermost part of the mantle and is broken into tectonic plates. The asthenosphere is below the lithosphere. It is hot, weak and ductile, meaning it is solid but can flow slowly. This allows the rigid tectonic plates of the lithosphere to move over it.

Page 9: Exam-style Questions

1.1 Name one layer of the Earth. [1 mark]

Mark scheme

Award **1 mark** for naming a valid layer of the Earth.

Acceptable answers

- crust
- mantle
- outer core

- inner core

Accept also, where appropriate:

- lithosphere
- asthenosphere

Model answer

Mantle.

1.2 What is the asthenosphere? [1 mark]

Mark scheme

Award **1 mark** for a valid definition or description.

Answer

The asthenosphere is a hot, weak, ductile layer beneath the lithosphere.

Accept:

The layer below the lithosphere that plates move over.

1.3 Describe the characteristics of the mantle. [2 marks]

Mark scheme

Award **1 mark** for a valid characteristic of the mantle.

Award **1 further mark** for a second valid characteristic or developed description.

Indicative content

- It is the thickest layer of the Earth.
- It is made of hot, solid rock.
- It is ductile.
- It can flow slowly over time.
- It lies between the crust and the outer core.

Model answer

The mantle is the thickest layer of the Earth. It is made of hot, solid rock that is ductile and can flow slowly over time.

1.4 Explain one difference between oceanic and continental crust. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid difference.

Award **1 further mark** for explaining or developing the difference.

Model answer

Oceanic crust is denser than continental crust. This means it is more likely to sink beneath continental crust at destructive plate margins.

Alternative model answer

Continental crust is thicker than oceanic crust. Continental crust is usually about 30–70 km thick, while oceanic crust is usually only about 5–10 km thick.

1.5 Describe the characteristics of the asthenosphere. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the characteristics of the asthenosphere. Identifies accurate features such as its position, temperature, weakness and ductility.

Level	Marks	Description
		AO2 Shows clear understanding of the role of the asthenosphere in allowing tectonic plates to move. Description is developed.
1 Basic	1–2	**AO1** Shows limited knowledge of the characteristics of the asthenosphere. May identify one or two simple features. **AO2** Shows limited understanding of the role or importance of the asthenosphere. Description is basic.
0	0	No relevant content.

Indicative content

- It is beneath the lithosphere.
- It is part of the upper mantle.
- It is hot.
- It is weak.
- It is ductile.
- It is solid but can flow slowly.
- Tectonic plates move over it.

Model answer

The asthenosphere is a hot, weak layer beneath the lithosphere. It is part of the upper mantle and is solid but ductile, meaning it can flow slowly over time. This allows the rigid tectonic plates of the lithosphere to move over it.

1.6 Explain the differences between oceanic and continental crust. [6 marks]

Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO1** Shows detailed knowledge of the characteristics of oceanic and continental crust. Accurate differences are identified, such as density, thickness, rock type, location and behaviour at plate margins. **AO2** Shows detailed understanding of how these differences affect the behaviour of crust, including why oceanic crust is more likely to subduct. Explanations are thorough and well developed.
2 Clear	3–4	**AO1** Shows clear knowledge of the differences between oceanic and continental crust. Several accurate characteristics are identified. **AO2** Shows clear understanding of how these differences affect the behaviour of crust. Explanations are developed.
1 Basic	1–2	**AO1** Shows limited knowledge of oceanic and/or continental crust. May identify simple differences such as one being thicker or denser. **AO2** Shows limited understanding of how differences affect the behaviour of crust. Explanation is basic or undeveloped.
0	0	No relevant content.

Indicative content

Oceanic crust:

- forms ocean basins
- thinner, usually about 5–10 km thick
- denser
- mainly basalt
- old, dense oceanic crust can subduct at destructive plate margins

Continental crust:

- forms continents
- thicker, usually about 30–70 km thick
- less dense
- mainly granite
- does not subduct easily
- tends to sit higher on the mantle

Model answer

Oceanic and continental crust are different in several ways. Oceanic crust forms the ocean basins and is thinner, usually about 5–10 km thick. Continental crust forms the continents and is much thicker, usually about 30–70 km thick. Oceanic crust is mainly made of basalt, whereas continental crust is mainly made of granite. Oceanic crust is also denser than continental crust, so at destructive plate margins it is more likely to sink beneath continental crust in a process called subduction. Continental crust is less dense, so it tends to sit higher on the mantle and does not subduct easily.

Page 10 Activities

Page 10: Exam Ready Question

Question

Explain one piece of evidence for the theory of plate tectonics. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid piece of evidence for plate tectonics.

Award **1 further mark** for explaining how it supports the theory that continents or plates have moved.

Accept evidence such as:

- jigsaw fit of continents
- identical fossils on continents now far apart
- similar rocks or mountain ranges on separate continents
- evidence of past glaciation in places that are now warm
- sea-floor spreading at mid-ocean ridges

Possible answers

The continents appear to fit together like a jigsaw. For example, South America and Africa have matching coastlines, suggesting they were once joined and have moved apart.

Identical fossils have been found on continents now far apart. This suggests the continents were once joined because the same plants or animals could not easily have crossed wide oceans.

Similar rocks and mountain ranges are found on separate continents. This suggests the continents were once joined before moving apart.

Evidence of past glaciation is found in places that are now warm. This suggests the continents have moved from different climate zones over time.

New crust forms at mid-ocean ridges and moves away. This supports plate tectonics because it shows the ocean floor is spreading as plates move apart.

Page 11 Activities

Page 11: 30 Second Recall Answers

Define: Plate tectonics

Plate tectonics is the theory that the Earth's lithosphere is broken into plates that move over the ductile asthenosphere and interact at plate margins.

List: Three pieces of evidence for plate tectonics

Any three from:

- continents fit together like a jigsaw
- identical fossils found on continents now far apart
- similar rocks and mountain ranges on separate continents
- evidence of past glaciation in places that are now warm
- new crust forms at mid-ocean ridges and moves away

Explain: Why slab pull is a driver of plate movement

Slab pull is a driver of plate movement because cold, dense oceanic lithosphere sinks at a subduction zone. As it sinks into the mantle, it pulls the rest of the plate behind it.

Page 11: Blur, Build, Check

Stage 2: Build answers

1. Sketch and annotate the three tectonic plate margins and reasons for plate movement.

Students should include the following information.

Constructive plate margin

- Plates move apart.
- Magma rises from the mantle.
- Magma cools and solidifies to create new crust.
- New crust forms at mid-ocean ridges.
- Ridge push helps move plates away from the ridge.

Destructive plate margin

- Plates move towards each other.
- Denser oceanic lithosphere sinks beneath another plate at a subduction zone.
- This is linked to slab pull.
- Slab pull occurs when the sinking oceanic plate pulls the rest of the plate behind it.
- Destructive margins can produce earthquakes and volcanoes.

Conservative plate margin

- Plates slide past each other.
- Friction causes the plates to lock.
- Pressure builds and is released suddenly.
- This causes earthquakes.
- No crust is created or destroyed.

Reasons for plate movement

Ridge push:

New magma rises at mid-ocean ridges and creates new crust. Gravity causes the elevated ridge to slide downwards, pushing older lithosphere away from the ridge.

Slab pull:

Cold, dense oceanic lithosphere sinks at subduction zones and pulls the rest of the plate behind it.

Convection currents:

An older idea that mantle currents drag plates along. This is now thought to play a minor role compared with ridge push and slab pull.

---

2. From memory, outline the evidence for plate movement.
Students should include evidence such as:

- Africa and South America appear to fit together like a jigsaw.
- Identical fossils are found on continents now far apart.
- Similar rocks and mountain ranges are found on separate continents.
- Glacial evidence is found in places that are now warm.
- New crust forms at mid-ocean ridges and moves away from the ridge.

A developed answer may mention Alfred Wegener and continental drift, including the idea that the continents were once joined as **Pangaea**.

Page 11: Exam Builder

Step 1: Complete the sentences
Question
Alfred Wegener proposed the theory of _____ drift.
The continents were once joined as _____.
New crust forms at _____ ridges.
Answer
Alfred Wegener proposed the theory of **continental** drift.
The continents were once joined as **Pangaea**.
New crust forms at **mid-ocean** ridges.

Step 2: Explain one piece of evidence for the theory of plate tectonics. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid piece of evidence.
Award **1 further mark** for explaining how it supports plate tectonic theory.
Model answer
The continents of Africa and South America appear to fit together like a jigsaw. This suggests they were once joined together and have moved apart over time.
Alternative model answer
Identical fossils have been found on continents that are now far apart. This supports plate tectonic theory because it suggests the continents were once joined before moving apart.

Step 3: Explain how ridge push and slab pull move tectonic plates. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of ridge push and slab pull as processes that move tectonic plates. Accurate terms are used, such as mid-ocean ridge, new crust, subduction zone and dense oceanic lithosphere. **AO2** Shows clear understanding of how ridge push and slab pull cause plate movement. Explanation is developed and links both processes to plate movement.
1 Basic	1–2	**AO1** Shows limited knowledge of ridge push and/or slab pull. Some accurate terms may be used but detail is limited. **AO2** Shows limited understanding of how these processes move plates. Explanation is basic or only one process is explained clearly.

Level	Marks	Description
0	0	No relevant content.

Indicative content

Ridge push:

- magma rises at mid-ocean ridges
- new lithosphere is created
- the ridge is elevated
- gravity causes lithosphere to slide away from the ridge
- older lithosphere is pushed away

Slab pull:

- oceanic lithosphere cools and becomes denser
- dense oceanic plate sinks at a subduction zone
- sinking slab pulls the rest of the plate behind it
- slab pull is considered the main driver of plate movement

Model answer

Ridge push happens at mid-ocean ridges where magma rises and creates new lithosphere. The ridge is elevated, so gravity causes the plate to slide away from the ridge, pushing older lithosphere outwards. Slab pull happens at subduction zones. Cold, dense oceanic lithosphere sinks into the mantle and pulls the rest of the plate behind it. Slab pull is thought to be the main driver of plate movement.

Page 11: Exam-style Questions

1.1 Who proposed continental drift? [1 mark]

Mark scheme

Award **1 mark** for the correct named person.

Answer

Alfred Wegener.

1.2 Name one piece of evidence for plate tectonics. [1 mark]

Mark scheme

Award **1 mark** for identifying a valid piece of evidence.

Acceptable answers

- jigsaw fit of continents
- identical fossils on different continents
- similar rocks or mountain ranges on separate continents
- evidence of past glaciation
- new crust forming at mid-ocean ridges

Model answer

Identical fossils have been found on continents now far apart.

1.3 Outline one piece of evidence for continental drift. [2 marks]

Mark scheme

Award **1 mark** for identifying one piece of evidence for continental drift.

Award **1 further mark** for outlining how it supports the idea that continents have moved.

Model answer

South America and Africa appear to fit together like a jigsaw. This suggests they were once joined and have moved apart over time.

Alternative model answer

Similar fossils have been found on continents now far apart. This suggests the continents were once joined because the same organisms could not have crossed wide oceans.

1.4 Explain one piece of evidence for the theory of plate tectonics. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid piece of evidence.

Award **1 further mark** for explaining how it supports plate tectonic theory.

Model answer

New crust forms at mid-ocean ridges and moves away from the ridge. This supports plate tectonic theory because it shows that plates are moving apart and the ocean floor is spreading.

Alternative model answer

Identical fossils have been found on separate continents. This supports plate tectonic theory because it suggests the continents were once joined and have moved apart.

1.5 Explain how slab pull moves tectonic plates. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of slab pull as a process that moves tectonic plates. Accurate terms are used, such as oceanic lithosphere, dense, subduction zone and sinking slab. **AO2** Shows clear understanding of how slab pull causes plate movement. Explanation is developed and links the sinking oceanic plate to the movement of the rest of the plate.
1 Basic	1–2	**AO1** Shows limited knowledge of slab pull. May identify that a plate sinks or is pulled down but detail is limited. **AO2** Shows limited understanding of how slab pull moves tectonic plates. Explanation is basic or partially developed.
0	0	No relevant content.

Indicative content

- Oceanic lithosphere cools and becomes denser.
- At a subduction zone, the dense oceanic plate sinks into the mantle.
- As it sinks, it pulls the rest of the plate behind it.
- Slab pull is the main driver of plate movement.

Model answer

Slab pull happens when oceanic lithosphere cools and becomes denser. At a subduction zone, the dense oceanic plate sinks into the mantle. As the slab sinks, it pulls the rest of the plate behind it. This causes the tectonic plate to move towards the subduction zone.

1.6 Explain how different processes cause tectonic plates to move. [6 marks]

Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO1** Shows detailed knowledge of different processes that cause tectonic plates to move, such as ridge push, slab pull and convection currents. Accurate terminology is used throughout. **AO2** Shows detailed understanding of how these processes move tectonic plates. Explanation is thorough and well developed, with clear links between each process and plate movement.
2 Clear	3–4	**AO1** Shows clear knowledge of processes that cause tectonic plates to move. At least two processes are described accurately. **AO2** Shows clear understanding of how these processes cause plate movement. Explanations are developed but may be uneven.
1 Basic	1–2	**AO1** Shows limited knowledge of processes that cause tectonic plates to move. May identify one or more processes, but detail is limited. **AO2** Shows limited understanding of how plates move. Explanation is basic or may rely on simple statements.
0	0	No relevant content.

Indicative content

Ridge push:

- magma rises at mid-ocean ridges
- new lithosphere forms
- the ridge is elevated
- gravity causes older lithosphere to slide away from the ridge
- this helps push plates apart

Slab pull:

- oceanic lithosphere cools and becomes denser
- dense oceanic plate sinks at a subduction zone
- the sinking slab pulls the rest of the plate behind it
- this is now considered the main driver of plate movement

Convection currents:

- heat from the core warms mantle material
- warmer material rises and cooler material sinks
- older idea that currents drag plates along
- now thought to play a minor role compared with ridge push and slab pull

Model answer

Tectonic plates are mainly moved by ridge push and slab pull. Ridge push happens at mid-ocean ridges where magma rises and creates new lithosphere. The ridge is raised, so gravity causes the plate to slide away from the ridge, pushing older lithosphere outwards. Slab pull happens at subduction zones. Oceanic lithosphere cools, becomes denser and sinks into the mantle. As it sinks, it pulls the rest of the plate behind it, making slab pull the main driver of plate movement. Convection currents were once thought to move plates because warm mantle material rises and cooler material sinks, dragging plates along. However, this process is now thought to have a smaller role than ridge push and slab pull.

Page 12 Activities

Page 12: Exam Ready Question

Question

Explain why volcanic eruptions occur at a destructive plate margin. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of processes at destructive plate margins, including subduction, partial melting and magma formation. Accurate terminology is used. **AO2** Shows clear understanding of why these processes lead to volcanic eruptions. Explanation is developed and links plate movement to magma rising and pressure building.
1 Basic	1–2	**AO1** Shows limited knowledge of destructive plate margins. May identify that plates move together or that one plate sinks beneath another. **AO2** Shows limited understanding of why volcanic eruptions occur. Explanation is basic or only partly linked to magma formation.
0	0	No relevant content.

Indicative content

- Plates move towards each other.
- The denser oceanic plate subducts beneath another plate.
- Water is released from the subducting plate.
- This lowers the melting point of the mantle.
- The mantle partially melts to form magma.
- Magma rises through cracks in the crust.
- Pressure builds up.
- Explosive eruptions can occur.
- Composite volcanoes are commonly found at destructive plate margins.

Model answer

Volcanic eruptions occur at destructive plate margins because plates move towards each other and the denser oceanic plate is forced beneath another plate. This is called subduction. As the oceanic plate sinks, water is released, lowering the melting point of the mantle. The mantle partially melts to form magma. The magma rises through the crust and pressure builds up, eventually causing a volcanic eruption.

Page 13 Activities

Page 13: 30 Second Recall Answers

Define: Plate margin
A plate margin is the boundary where two tectonic plates meet.
Accept:
A plate margin is the edge of a tectonic plate where it interacts with another plate.
List: Three types of plate margin

- Constructive plate margin
- Destructive plate margin
- Conservative plate margin

Explain: Why earthquakes occur at all plate margins
Earthquakes occur at all plate margins because tectonic plates are moving. Friction can cause plates to lock together, so pressure builds up. When the pressure is released suddenly, seismic waves are produced, causing an earthquake.

Page 13: Blur, Build, Check

Stage 2: Build answers
1. Constructive plate margin
Students should include:

- Plates move away from each other.
- Magma rises from the mantle to fill the gap.
- Magma cools and solidifies.
- New crust is formed.
- Shield volcanoes can form.
- Eruptions are usually gentle because the lava is runny.
- Shallow earthquakes can occur.

2. Destructive plate margin
Students should include:

- Plates move towards each other.
- The denser oceanic plate subducts beneath another plate.
- Water is released from the subducting plate.
- The mantle partially melts to form magma.
- Magma rises and pressure builds.
- Composite volcanoes can form.
- Eruptions are often explosive.
- Powerful earthquakes can occur.

3. Conservative plate margin
Students should include:

- Plates slide past each other.
- The plates may move in opposite directions or at different speeds.
- Friction causes the plates to lock.
- Pressure builds up.
- Pressure is released suddenly.
- This causes earthquakes.
- Volcanoes do not form because no magma is produced.

Page 13: Exam Builder

Step 1: Complete the sentences
Question
At constructive margins, plates move _____.
At destructive margins, one plate is _____.
At conservative margins, plates _____ past each other.
Answer
At constructive margins, plates move **apart**.
At destructive margins, one plate is **subducted**.
At conservative margins, plates **slide** past each other.
Accept:

- At destructive margins, one plate is **forced beneath another plate**.
- At conservative margins, plates **move** past each other.

Step 2: Explain what happens to plates at a constructive plate margin. [2 marks]
Mark scheme
Award **1 mark** for identifying that plates move apart.
Award **1 further mark** for explaining what happens as a result.
Model answer
At a constructive plate margin, plates move away from each other. Magma rises from the mantle to fill the gap, then cools and solidifies to form new crust.

Step 3: Explain why volcanic eruptions and earthquakes occur at destructive plate margins. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of processes at destructive plate margins, including subduction, magma formation and earthquake generation. Accurate terminology is used. **AO2** Shows clear understanding of why these processes cause both volcanic eruptions and earthquakes. Explanation is developed and clearly links plate movement to hazards.
1 Basic	1–2	**AO1** Shows limited knowledge of destructive plate margins. May identify that plates move together, one plate sinks, or magma is formed. **AO2** Shows limited understanding of why volcanic eruptions and/or earthquakes occur. Explanation is basic or only one hazard is explained clearly.
0	0	No relevant content.

Indicative content
Volcanic eruptions:

- Plates move towards each other.
- The denser oceanic plate subducts.
- Water is released from the subducting plate.
- Mantle partially melts.
- Magma rises through the crust.

- Pressure builds, leading to eruptions.

Earthquakes:

- Plates can lock due to friction.
- Pressure builds as the plates continue to move.
- Pressure is released suddenly.
- Seismic waves are produced.
- Powerful earthquakes can occur.

Model answer

At destructive plate margins, plates move towards each other and the denser oceanic plate is subducted beneath another plate. As the plate sinks, water is released, lowering the melting point of the mantle. This causes partial melting and magma forms. The magma rises through the crust and pressure builds, causing volcanic eruptions. Earthquakes also occur because the plates can lock due to friction. Pressure builds until it is released suddenly, producing seismic waves.

Page 13: Exam-style Questions

1.1 Name one type of plate margin. [1 mark]

Mark scheme

Award **1 mark** for naming a valid type of plate margin.

Acceptable answers

- constructive
- destructive
- conservative

Model answer

Constructive.

1.2 What happens at a conservative plate margin? [1 mark]

Mark scheme

Award **1 mark** for a valid statement about conservative plate margins.

Acceptable answers

- Plates slide past each other.
- Plates move laterally past each other.
- Earthquakes occur.
- No volcanoes form.

Model answer

Plates slide past each other.

1.3 Describe what happens at a constructive plate margin. [2 marks]

Mark scheme

Award **1 mark** for identifying that plates move apart.

Award **1 further mark** for describing what happens as a result.

Model answer

At a constructive plate margin, plates move apart. Magma rises from the mantle, cools and solidifies to form new crust.

1.4 Explain why earthquakes occur at conservative plate margins. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of conservative plate margins, including plates sliding past each other, friction, locking and sudden release of pressure. **AO2** Shows clear understanding of why these processes cause earthquakes. Explanation is developed and links plate movement to seismic waves.
1 Basic	1–2	**AO1** Shows limited knowledge of conservative plate margins. May identify that plates slide past each other or get stuck. **AO2** Shows limited understanding of why earthquakes occur. Explanation is basic or only partly linked to pressure release.
0	0	No relevant content.

Indicative content

- Plates slide past each other.
- Movement is not smooth.
- Friction causes plates to lock.
- Pressure or stress builds up.
- Pressure is released suddenly.
- Energy travels as seismic waves.
- This causes earthquakes.
- No volcanoes form because there is no subduction or magma movement.

Model answer

Earthquakes occur at conservative plate margins because plates slide past each other. Their movement is not smooth because friction causes the plates to lock together. Pressure builds up as the plates continue to try to move. When the pressure is released suddenly, energy travels as seismic waves, causing an earthquake.

1.5 Explain why volcanic eruptions occur at destructive plate margins. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of destructive plate margin processes, including subduction, partial melting and magma formation. Accurate terminology is used. **AO2** Shows clear understanding of why these processes lead to volcanic eruptions. Explanation is developed and links plate movement to magma rising and pressure building.
1 Basic	1–2	**AO1** Shows limited knowledge of destructive plate margins. May identify that plates move together, one plate sinks, or magma is formed. **AO2** Shows limited understanding of why eruptions occur. Explanation is basic or only partly linked to magma and pressure.
0	0	No relevant content.

Indicative content

- Plates move towards each other.
- Denser oceanic plate subducts.
- Water is released from the subducting plate.

- The mantle partially melts.
- Magma forms and rises.
- Pressure builds.
- Composite volcanoes and explosive eruptions are common.

Model answer

Volcanic eruptions occur at destructive plate margins because the denser oceanic plate is forced beneath another plate in a process called subduction. As it sinks, water is released, which lowers the melting point of the mantle. This causes partial melting and magma is produced. The magma rises through the crust and pressure builds up, eventually causing a volcanic eruption.

1.6 Explain why volcanoes and earthquakes occur at destructive plate margins. [6 marks]

Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO1** Shows detailed knowledge of processes at destructive plate margins, including plate movement, subduction, magma formation and earthquake generation. Accurate terminology is used throughout. **AO2** Shows detailed understanding of why both volcanoes and earthquakes occur at destructive plate margins. Explanation is thorough and well developed, with clear links between plate processes and both hazards.
2 Clear	3–4	**AO1** Shows clear knowledge of destructive plate margin processes. Describes plate movement and at least one process linked to volcanoes or earthquakes accurately. **AO2** Shows clear understanding of why volcanoes and/or earthquakes occur. Explanation is developed, though one hazard may be explained more clearly than the other.
1 Basic	1–2	**AO1** Shows limited knowledge of destructive plate margins. May identify that plates move together, one plate sinks or hazards occur. **AO2** Shows limited understanding of how destructive plate margins cause volcanoes and earthquakes. Explanation is basic or may focus on only one hazard.
0	0	No relevant content.

Indicative content

Volcanoes:

- A destructive plate margin is where plates move towards each other.
- Usually, denser oceanic crust subducts beneath less dense continental crust or another oceanic plate.
- Water is released from the subducting plate.
- This lowers the melting point of the mantle.
- Partial melting produces magma.
- Magma rises through the crust.
- Pressure builds.
- Composite volcanoes and explosive eruptions may occur.

Earthquakes:

- Plates may lock due to friction.
- Stress or pressure builds as plates continue moving.
- The pressure is released suddenly.

- Energy travels as seismic waves.
- Earthquakes can be powerful at destructive margins.

Model answer

Volcanoes and earthquakes occur at destructive plate margins because plates move towards each other. The denser oceanic plate is forced beneath another plate in a process called subduction. As the oceanic plate sinks, water is released, lowering the melting point of the mantle. This causes partial melting and magma forms. The magma rises through the crust, pressure builds and a volcanic eruption can occur. Earthquakes also happen because the plates do not move smoothly. Friction can cause them to lock together, so pressure builds up. When this pressure is released suddenly, seismic waves are produced, causing an earthquake.

Page 14 Activities

Page 14: Exam Ready Question

Question

Outline two characteristics of the global distribution of the Earth's volcanoes and earthquakes. [4 marks]

Mark scheme

Award **1 mark** for identifying each valid characteristic of the global distribution of earthquakes and volcanoes.
Award **1 further mark** for developing each characteristic.
Maximum **2 marks** for each outlined characteristic.

Indicative content

Students may refer to:

- earthquakes and volcanoes are not randomly distributed
- they are mainly found along plate margins
- they occur in long, narrow belts
- many are found around the Pacific Ring of Fire
- earthquakes occur at all types of plate margin
- volcanoes are common at constructive and destructive plate margins
- volcanoes are not found at conservative plate margins
- some volcanoes occur away from plate margins at hotspots
- destructive margins have frequent earthquakes and explosive volcanoes
- constructive margins have shallow earthquakes and gentler volcanoes

Possible answer

Earthquakes and volcanoes are mainly found along plate margins. This is where tectonic plates interact, so plate movement can produce earthquakes and magma can form volcanoes.
They are often found in long, narrow belts, such as around the Pacific Ring of Fire. This area has many destructive plate margins, so earthquakes and volcanoes are very common.

Page 15 Activities

Page 15: 30 Second Recall Answers

Define: Global distribution

Global distribution means the pattern or spread of something across the world.

List: Three features of the distribution of earthquakes and volcanoes

Any three from:

- They are not randomly distributed.

- They are mainly found along plate margins.
- They occur in long, narrow belts.
- Many are found around the Pacific Ring of Fire.
- Earthquakes occur at all types of plate margin.
- Volcanoes are common at destructive and constructive plate margins.
- Volcanoes can also occur at hotspots away from plate margins.
- Volcanoes are not found at conservative margins.

Explain: Why earthquakes and volcanoes are not randomly distributed

Earthquakes and volcanoes are not randomly distributed because they are linked to plate margins. This is where tectonic plates move and interact. Earthquakes occur when pressure builds and is released, while volcanoes form where magma rises at constructive margins, destructive margins or hotspots.

Page 15: Blur, Build, Check

Stage 2: Build answer

Draw a diagram to show the formation of volcanoes at a hotspot.

Students should include and label:

- a stationary hotspot or mantle plume
- magma rising from deep within the mantle
- a tectonic plate moving over the hotspot
- an active volcano above the hotspot
- a chain of older volcanoes away from the hotspot
- older volcanoes becoming extinct as the plate moves away from the magma source

Suggested written explanation

A volcanic hotspot forms where hot magma rises from deep within the mantle. The hotspot stays in the same place while the tectonic plate moves over it. A volcano forms above the hotspot. As the plate continues to move, the volcano is carried away from the magma source and becomes extinct. A new volcano may then form above the hotspot, creating a chain of volcanoes over time.

Page 15: Exam Builder

Step 1: Complete the sentences

Question

Earthquakes and volcanoes occur mainly along _____ margins.
The Pacific Ring of Fire is located around the _____ Ocean.
Volcanic hotspots occur _____ plate margins.

Answer

Earthquakes and volcanoes occur mainly along **plate** margins.
The Pacific Ring of Fire is located around the **Pacific** Ocean.
Volcanic hotspots occur **away from** plate margins.
Accept:

- Volcanic hotspots occur **within plates**.
- Volcanic hotspots occur **not at** plate margins.

Step 2: Explain what a volcanic hotspot is. [2 marks]

Mark scheme

Award **1 mark** for identifying that a hotspot is an area where magma rises.
Award **1 further mark** for explaining that this can happen away from plate margins or that it can form volcanoes as plates move over it.

Model answer

A volcanic hotspot is an area where magma rises from deep within the mantle. It can occur away from plate margins and form a chain of volcanoes as a tectonic plate moves over it.

Step 3: Explain why earthquakes and volcanoes are found in long, narrow belts. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the global distribution of earthquakes and volcanoes, including their link to plate margins. Accurate terminology is used, such as plate margins, constructive margins, destructive margins, conservative margins or Pacific Ring of Fire. **AO2** Shows clear understanding of why earthquakes and volcanoes are found in long, narrow belts. Explanation is developed and links the pattern to tectonic plate movement and interaction.
1 Basic	1–2	**AO1** Shows limited knowledge of the distribution of earthquakes and/or volcanoes. May identify that they occur at plate margins. **AO2** Shows limited understanding of why they occur in long, narrow belts. Explanation is basic or only partly linked to plate movement.
0	0	No relevant content.

Indicative content

- Earthquakes and volcanoes are mainly found at plate margins.
- Plate margins form long boundaries between tectonic plates.
- Earthquakes occur where plates move, lock and release pressure.
- Volcanoes form where magma rises at constructive or destructive margins.
- The Pacific Ring of Fire is a major belt of earthquakes and volcanoes.
- Earthquakes occur at all plate margins.
- Volcanoes are common at constructive and destructive margins, but not conservative margins.
- Hotspots are an exception because some volcanoes form away from margins.

Model answer

Earthquakes and volcanoes are found in long, narrow belts because they mostly occur along plate margins. Plate margins are long boundaries where tectonic plates meet and interact. Earthquakes happen where plates move, lock and then release pressure. Volcanoes form at constructive margins where magma rises, and at destructive margins where subduction causes magma to form. This creates belts of activity, such as the Pacific Ring of Fire.

Page 15: Exam-style Questions

1.1 What is the Pacific Ring of Fire? [1 mark]
Mark scheme

Award **1 mark** for a valid definition or description.

Acceptable answers

- A zone of high volcanic and earthquake activity around the Pacific Ocean.
- A horseshoe-shaped belt around the Pacific Ocean where many earthquakes and volcanoes occur.
- An area around the Pacific Ocean where many plates meet, especially at destructive margins.

Model answer

The Pacific Ring of Fire is a horseshoe-shaped zone around the Pacific Ocean where many earthquakes and volcanoes occur.

1.2 Name one location where earthquakes are common. [1 mark]

Mark scheme

Award **1 mark** for naming a valid location where earthquakes are common.

Acceptable answers

- Pacific Ring of Fire
- Japan
- Indonesia
- Philippines
- New Zealand
- west coast of North America
- west coast of South America
- San Andreas Fault
- North Anatolian Fault
- East African Rift
- any valid plate margin location

Model answer

Japan.

1.3 Describe the global distribution of earthquakes. [2 marks]

Mark scheme

Award **1 mark** for a valid statement about the global distribution of earthquakes.

Award **1 further mark** for a developed statement or example.

Indicative content

- Earthquakes are not randomly distributed.
- They are mainly found along plate margins.
- They often occur in long, narrow belts.
- They are common around the Pacific Ring of Fire.
- They occur at destructive, constructive and conservative plate margins.
- Some earthquakes occur in areas such as Japan, Indonesia, the San Andreas Fault and the East African Rift.

Model answer

Earthquakes are mainly found along plate margins, where tectonic plates interact. They often occur in long, narrow belts, such as around the Pacific Ring of Fire.

1.4 Explain why volcanoes are found along plate margins. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of plate margin processes that form volcanoes. Accurate terminology is used, such as constructive margin, destructive margin, magma, subduction and partial melting. **AO2** Shows clear understanding of why these processes cause volcanoes to form along plate margins. Explanation is developed and links plate movement to magma formation or magma rising.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of volcanoes at plate margins. May identify that volcanoes occur where plates move or where magma rises. **AO2** Shows limited understanding of why volcanoes form along plate margins. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Constructive margins:

- plates move apart
- magma rises from the mantle
- magma cools and solidifies
- volcanoes can form along mid-ocean ridges or rift zones
- eruptions are often gentler

Destructive margins:

- plates move towards each other
- denser oceanic plate subducts
- water lowers the melting point of the mantle
- partial melting forms magma
- magma rises and erupts
- volcanoes are often explosive

Conservative margins:

- plates slide past each other
- no magma is produced
- volcanoes do not usually form

Model answer

Volcanoes are found along some plate margins because plate movement allows magma to form or rise. At constructive margins, plates move apart and magma rises from the mantle to fill the gap, forming volcanoes. At destructive margins, the denser oceanic plate subducts beneath another plate. Water released from the subducting plate lowers the melting point of the mantle, producing magma. This magma rises through the crust and can erupt at the surface.

1.5 Explain how volcanic hotspots form. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of volcanic hotspots, including magma rising from deep within the mantle and hotspots occurring away from plate margins. Accurate terminology is used, such as mantle plume, magma, tectonic plate and extinct volcano. **AO2** Shows clear understanding of how a hotspot forms a chain of volcanoes over time as a plate moves over a stationary magma source. Explanation is developed.
1 Basic	1–2	**AO1** Shows limited knowledge of volcanic hotspots. May identify that magma rises away from a plate margin.

Level	Marks	Description
		AO2 Shows limited understanding of how hotspots form volcanoes. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

- Hotspots occur away from plate margins.
- Magma rises from deep within the mantle.
- The magma source or plume remains relatively stationary.
- A tectonic plate moves over the hotspot.
- A volcano forms above the hotspot.
- As the plate moves, the volcano is carried away and may become extinct.
- A new volcano can form above the hotspot.
- This creates a chain of volcanoes over time.

Model answer

Volcanic hotspots form where magma rises from deep within the mantle, away from plate margins. The hotspot remains in one place while the tectonic plate above it moves. A volcano forms above the hotspot where magma reaches the surface. As the plate continues to move, the volcano is carried away from the magma source and becomes extinct. New volcanoes then form above the hotspot, creating a chain of volcanoes over time.

1.6 Outline two characteristics of the global distribution of earthquakes and volcanoes. [4 marks]

Mark scheme

Award **1 mark** for identifying each valid characteristic of the global distribution of earthquakes and volcanoes.
Award **1 further mark** for developing each characteristic.
Maximum **2 marks** for each characteristic.

Indicative content

Students may refer to:

- earthquakes and volcanoes are not randomly distributed
- they are mainly found along plate margins
- they occur in long, narrow belts
- the Pacific Ring of Fire is a major area of activity
- earthquakes occur at all types of plate margin
- volcanoes occur at constructive and destructive margins
- volcanoes do not occur at conservative margins
- hotspots can produce volcanoes away from plate margins

Model answer

Earthquakes and volcanoes are mainly found along plate margins. This is because plate margins are where tectonic plates interact, causing earthquakes and allowing magma to form or rise.
They are also common around the Pacific Ring of Fire. This is a horseshoe-shaped zone around the Pacific Ocean where many plates meet, especially at destructive margins, causing frequent earthquakes and volcanoes.

Page 16 Activities

Page 16: Exam Ready Question

Question

Immediate responses to tectonic hazards are more important than long-term responses. To what extent do you agree with this statement? [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of immediate and long-term responses to tectonic hazards. Response includes accurate knowledge of what each type of response involves and why they are important. **AO3** Demonstrates detailed evaluation of the relative importance of immediate and long-term responses. A clear judgement is made and supported with developed reasoning.
2 Clear	3–4	**AO2** Shows clear understanding of immediate and/or long-term responses to tectonic hazards. Response includes some accurate explanation of their purpose. **AO3** Demonstrates reasonable evaluation of the importance of immediate and/or long-term responses. A judgement may be present but may not be fully developed.
1 Basic	1–2	**AO2** Shows limited understanding of responses to tectonic hazards. May identify simple examples of immediate or long-term responses. **AO3** Demonstrates limited evaluation. Statements may be basic, one-sided or unsupported.
0	0	No relevant content.

Indicative content

Immediate responses may include:

- search and rescue
- emergency shelter
- food, clean water and medical aid
- warnings about aftershocks, tsunamis or further hazards
- temporary camps for displaced people

Long-term responses may include:

- rebuilding homes, businesses and infrastructure
- stricter building regulations
- earthquake-resistant designs
- education and community drills
- improved monitoring and early warning systems
- land-use planning in high-risk areas

Students may argue that immediate responses are more important because:

- they save lives in the hours and days after the hazard
- they meet urgent needs such as shelter, food, water and medical care
- they reduce the risk of disease, exposure or further injury

Students may argue that long-term responses are more important because:

- they reduce the impacts of future hazards

- they help communities recover socially and economically
- they improve resilience through better buildings, planning and education

Model answer

Immediate responses are very important because they save lives in the hours and days after a tectonic hazard. Search and rescue teams can find survivors trapped in collapsed buildings, while food, clean water, shelter and medical aid help people who have been injured or made homeless. Without these responses, secondary effects such as disease or exposure could become worse. However, long-term responses are also very important because they reduce future risk. Rebuilding homes and infrastructure helps communities recover, while stricter building regulations and earthquake-resistant designs can reduce damage in future earthquakes. Education, drills and warning systems also help people prepare. Overall, I partly agree. Immediate responses are most important immediately after the event because they save lives, but long-term responses are equally important because they reduce vulnerability in the future.

Page 17 Activities

Page 17: 30 Second Recall Answers

Define: Primary effects

Primary effects are the direct impacts caused by the earthquake or hazard itself.

List: Three immediate responses to an earthquake

Any three from:

- search and rescue
- emergency shelter
- food aid
- clean water supplies
- medical aid
- warnings about aftershocks or tsunamis
- temporary camps for displaced people

Explain: The difference between immediate and long-term responses

Immediate responses happen in the hours or days after an earthquake and focus on saving lives and meeting urgent needs. Long-term responses happen over weeks, months or years and focus on rebuilding, recovery and reducing future risk.

Page 17: Blur, Build, Check

Stage 2: Build answers

1. Primary effects

Primary effects are the direct impacts caused by the shaking of the ground.

Examples include:

- people are injured or killed
- buildings and homes collapse or are damaged
- roads, bridges and railways are damaged
- water, electricity, gas and communication services are cut off

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2. Secondary effects

Secondary effects are indirect impacts that happen after the earthquake because of the primary effects.

Examples include:

- fires caused by damaged gas or electrical lines

- landslides, rockfalls or avalanches
- contaminated water supplies leading to disease
- homelessness
- loss of jobs and income
- damage to the economy and loss of livelihoods

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3. Immediate responses
Immediate responses happen in the hours and days after an earthquake.
Examples include:

- search and rescue teams looking for survivors
- emergency shelters being provided
- food, clean water and medical aid being supplied
- warnings about aftershocks or tsunamis
- temporary camps being set up for displaced people

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4. Long-term responses
Long-term responses happen over weeks, months or years after an earthquake.
Examples include:

- homes, businesses and infrastructure being rebuilt
- stricter building regulations being introduced
- earthquake-resistant designs being used
- education and community drills improving preparedness
- monitoring and early warning systems being improved
- land-use planning reducing risk in high-hazard areas

Page 17: Exam Builder

Step 1: Complete the sentences
Question
Primary effects are _____ impacts caused by the earthquake. Secondary effects are _____ impacts that happen _____. Immediate responses happen within _____ or _____.
Answer
Primary effects are **direct** impacts caused by the earthquake. Secondary effects are **indirect** impacts that happen **after**. Immediate responses happen within **hours** or **days**.
Accept:
Primary effects are **direct** impacts caused by the earthquake. Secondary effects are **indirect** impacts that happen **later**. Immediate responses happen within **hours** or **days**.

Step 2: Explain one immediate response to an earthquake. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid immediate response.
Award **1 further mark** for explaining how it helps people after an earthquake.
Indicative content
Immediate responses may include:

- search and rescue
- emergency shelter
- food, clean water and medical aid
- warnings about aftershocks or tsunamis
- temporary camps

Model answer

Search and rescue is an immediate response after an earthquake. It helps people because rescue teams search collapsed buildings and pull survivors from the rubble.

Alternative model answer

Emergency shelters may be provided after an earthquake. This helps people who have lost their homes by giving them somewhere safe to stay.

Step 3: Explain the difference between primary and secondary effects of an earthquake. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of primary and secondary effects of earthquakes. Accurate examples are used, such as deaths, building collapse, fires, landslides, disease or homelessness. **AO2** Shows clear understanding of the difference between direct impacts caused by the earthquake and indirect impacts that happen afterwards. Explanation is developed.
1 Basic	1–2	**AO1** Shows limited knowledge of primary and/or secondary effects. May identify simple examples. **AO2** Shows limited understanding of the difference between primary and secondary effects. Explanation is basic or partially developed.
0	0	No relevant content.

Indicative content

Primary effects:

- direct impacts caused by earthquake shaking
- people injured or killed
- buildings collapse or are damaged
- roads, bridges and railways damaged
- water, electricity, gas and communication services cut off

Secondary effects:

- indirect impacts occurring after the earthquake
- fires caused by damaged gas or electrical lines
- landslides, rockfalls or avalanches
- water supplies contaminated, leading to disease
- homelessness
- loss of jobs, income and livelihoods
- wider economic damage

Model answer

Primary effects are the direct impacts caused by the earthquake itself. For example, the shaking may cause buildings to collapse, people to be injured or killed and roads or bridges to be damaged. Secondary effects happen after the earthquake because of the primary effects. For example, damaged gas or electrical lines may cause fires, and damaged water supplies may become contaminated, leading to disease.

Page 17: Exam-style Questions

1.1 What is a primary effect? [1 mark]
Mark scheme
Award **1 mark** for a valid definition.
Answer
A primary effect is a direct impact caused by an earthquake or hazard.
Accept:
A direct impact caused by the event itself.

1.2 Give one example of a secondary effect. [1 mark]
Mark scheme
Award **1 mark** for a valid example of a secondary effect.
Acceptable answers

- fires
- landslides
- rockfalls
- avalanches
- contaminated water
- disease
- homelessness
- loss of jobs
- loss of income
- economic damage
- loss of livelihoods

Model answer
Disease caused by contaminated water.

1.3 Describe one immediate response to an earthquake. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid immediate response.
Award **1 further mark** for describing what happens or how it helps.
Model answer
Search and rescue teams look for survivors in collapsed buildings. This helps people who are trapped and may still be alive after the earthquake.
Alternative model answer
Emergency shelters are provided for people who have lost their homes. This gives displaced people somewhere safe to stay.

1.4 Explain why secondary effects can be more damaging than primary effects. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of secondary effects and how they develop from primary effects. Accurate examples are used, such as disease, fires, landslides, homelessness or economic damage. **AO3** Demonstrates reasonable application of knowledge and understanding in

Level	Marks	Description
		explaining why secondary effects may cause longer-lasting or wider impacts than the initial earthquake damage.
1 Basic	1–2	**AO2** Shows limited understanding of secondary effects. May identify simple examples of secondary effects. **AO3** Demonstrates limited application of knowledge and understanding in explaining why secondary effects can be damaging. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may explain that secondary effects can be more damaging because:

- they can last longer than the initial shaking
- damaged water supplies can cause disease
- damaged gas or electrical lines can cause fires
- landslides may block roads, isolate communities or destroy buildings
- homelessness can expose people to weather, disease or lack of sanitation
- loss of jobs and income can increase poverty
- economic damage and loss of livelihoods can slow recovery
- damaged infrastructure can delay aid and rescue

Model answer

Secondary effects can be more damaging than primary effects because they may last for much longer after the earthquake. For example, if water supplies are damaged, they may become contaminated and lead to disease, affecting many people even after the shaking has stopped. Landslides can also block roads, making it harder for rescue teams and aid to reach affected areas. This can increase deaths, homelessness and economic damage.

1.5 Explain the difference between immediate and long-term responses. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of immediate and long-term responses to earthquakes. Accurate examples are used for both types of response. **AO2** Shows clear understanding of the difference between responses that happen in the hours/days after the event and responses that happen over weeks/years to support recovery and reduce future risk. Explanation is developed.
1 Basic	1–2	**AO1** Shows limited knowledge of immediate and/or long-term responses. May identify simple examples. **AO2** Shows limited understanding of the difference between the two types of response. Explanation is basic or only one type is covered clearly.
0	0	No relevant content.

Indicative content

Immediate responses:

- happen in the hours or days after an earthquake
- focus on saving lives and meeting urgent needs

- search and rescue
- emergency shelter
- food, clean water and medical aid
- warnings about further dangers
- temporary camps

Long-term responses:

- happen over weeks, months or years
- focus on recovery and reducing future risk
- rebuilding homes, businesses and infrastructure
- stricter building regulations
- earthquake-resistant designs
- education and community drills
- monitoring and early warning systems
- land-use planning

Model answer

Immediate responses happen in the hours or days after an earthquake and focus on saving lives and meeting urgent needs. For example, search and rescue teams look for survivors, while food, clean water, medical aid and emergency shelter are provided. Long-term responses happen over weeks, months or years and focus on recovery and reducing future risk. For example, homes and infrastructure may be rebuilt, building regulations improved and warning systems developed.

1.6 To what extent are immediate responses more important than long-term responses? [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of immediate and long-term responses to tectonic hazards. Accurate examples are used to explain the purpose and importance of both types of response. **AO3** Demonstrates detailed evaluation of the relative importance of immediate and long-term responses. A clear judgement is made and supported with developed reasoning.
2 Clear	3–4	**AO2** Shows clear understanding of immediate and/or long-term responses. Some accurate examples are used. **AO3** Demonstrates reasonable evaluation of the importance of responses. A judgement may be present but may not be fully developed or may focus more strongly on one side.
1 Basic	1–2	**AO2** Shows limited understanding of responses to tectonic hazards. May identify simple examples of immediate or long-term responses. **AO3** Demonstrates limited evaluation. Response may be one-sided, generalised or unsupported.
0	0	No relevant content.

Indicative content

Immediate responses may be seen as more important because:

- they save lives in the hours and days after an earthquake

- search and rescue can free trapped survivors
- medical aid treats injuries
- food, clean water and shelter meet urgent needs
- warnings about aftershocks or tsunamis reduce further danger
- temporary camps protect displaced people

Long-term responses may be seen as more important because:

- they help communities recover
- rebuilding restores homes, businesses, roads and services
- stricter building regulations reduce future damage
- earthquake-resistant designs reduce risk in future events
- education and drills improve preparedness
- monitoring and early warning systems reduce future impacts
- land-use planning can reduce exposure in high-risk areas

Possible judgements:

- Immediate responses are more important in the short term because they save lives.
- Long-term responses are more important for reducing future risk.
- Both are important at different stages of recovery.
- The importance depends on the scale of the hazard and the vulnerability of the affected area.

Model answer

Immediate responses are very important because they save lives in the hours and days after an earthquake. Search and rescue teams can find people trapped in collapsed buildings, while medical aid treats the injured. Emergency shelter, food and clean water are also essential because many people may have lost their homes or access to basic services.

However, long-term responses are also very important because they help communities recover and reduce future risk. Rebuilding homes, roads and services allows people to return to normal life. Stricter building regulations and earthquake-resistant designs can reduce deaths and damage in future earthquakes. Overall, I partly agree. Immediate responses are more important straight after the hazard because they save lives, but long-term responses are just as important for recovery and future protection.

Page 18 Activities

Page 18: Exam Ready Question

Question

Explain how the responses to the 2024 Taiwan earthquake helped to reduce the impacts of the hazard. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of responses to the 2024 Taiwan earthquake. Accurate examples are used, such as search and rescue, emergency shelters, tsunami alerts, road clearance, restoring power or rebuilding to earthquake-resistant standards. **AO2** Shows clear understanding of how these responses reduced the impacts of the hazard. Explanation is developed and clearly links responses to reduced deaths, injuries, disruption or future risk.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of responses to the Taiwan earthquake. May identify one or more basic responses. **AO2** Shows limited understanding of how responses reduced impacts. Explanation is basic, generalised or only partly linked to the hazard.
0	0	No relevant content.

Indicative content

Students may refer to:

- search and rescue teams arrived quickly
- military, fire service and volunteers helped
- people trapped in collapsed buildings were rescued
- emergency shelters were set up in schools and community centres
- food, water and basic supplies were provided
- hospitals coped with demand
- emergency services restored power
- blocked roads were cleared
- tsunami alerts and information were issued
- aftershock warnings helped people stay safe
- damaged buildings and infrastructure were rebuilt to strict earthquake-resistant standards
- planning controls restrict building in high-risk areas
- earthquake monitoring, early warning systems and public education reduce future risk

Model answer

The responses to the 2024 Taiwan earthquake helped to reduce impacts because emergency services arrived quickly, including search and rescue teams, the military, fire service and volunteers. This meant people trapped in collapsed buildings could be rescued, reducing the number of deaths. Emergency shelters were also set up in schools and community centres, providing safe places for displaced people. Warnings about aftershocks and tsunami alerts helped people avoid further danger, while rebuilding to strict earthquake-resistant standards will reduce future risk.

Page 19 Activities

Page 19: 30 Second Recall Answers

Define: Epicentre

The epicentre is the point on the Earth's surface directly above the focus of an earthquake.

List: Three primary effects of the Taiwan earthquake

Any three from:

- at least 17 people died
- over 1,100 people were injured
- buildings collapsed or were damaged
- older buildings and some hotels near Hualien were damaged
- roads and tunnels were damaged
- rockfalls blocked routes
- bridges and railway lines were affected
- power was cut in parts of Hualien
- water supplies were interrupted
- mobile phone services were briefly affected
- estimated cost of the earthquake was $28 billion

Explain: Why the impacts were reduced in Taiwan
The impacts were reduced because Taiwan is a HIC with strict building codes, effective preparation and well-organised emergency services. Buildings are designed to better withstand earthquakes, while search and rescue teams, warnings, shelters and public education helped people respond quickly and safely.

Page 19: Blur, Build, Check

Stage 2: Build answers
1. Causes
Students should include:

- The earthquake occurred on **3 April 2024**.
- It had a magnitude of **7.4**.
- The epicentre was near **Hualien**, eastern Taiwan.
- Taiwan lies at a **destructive plate margin**.
- The **Philippine Sea Plate** is forced beneath the **Eurasian Plate**.
- This process is called **subduction**.
- Stress built up as the plates locked together.
- When the stress was released suddenly, the plates slipped.
- This caused strong seismic waves.
- The earthquake struck at a depth of about **15 km**.

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2. Primary effects
Students should include examples such as:

- At least **17 people died**.
- Over **1,100 people were injured**.
- Many buildings collapsed or were damaged.
- Older buildings and some hotels near Hualien were badly affected.
- Roads and tunnels in mountainous areas were damaged.
- Rockfalls blocked routes.
- Some bridges and railway lines were affected.
- Power was cut in parts of Hualien.
- Water supplies were interrupted in some areas.
- Mobile phone services were briefly affected.
- The estimated cost was **$28 billion**.

---

3. Secondary effects
Students should include examples such as:

- Landslides and rockfalls occurred in steep mountainous areas.
- Roads and buildings were damaged further.
- Some villages were isolated.
- A small tsunami of up to **0.3 m** was recorded along parts of the coast.
- Tourism on the east coast was disrupted.
- Some businesses closed temporarily and suffered economic losses.
- Aftershocks caused fear and stress.
- Some people were reluctant to return home immediately.
- Daily life and schooling were disrupted.

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4. Responses
Students should include both immediate and long-term responses.
Immediate responses:

- Search and rescue teams arrived quickly.
- The military, fire service and volunteers helped.
- People trapped in collapsed buildings were rescued.
- Emergency shelters were set up in schools and community centres.
- Food, water and basic supplies were provided.
- Hospitals coped with demand.
- Emergency services restored power.
- Blocked roads were cleared.
- The Central Weather Administration issued tsunami alerts and information.
- Aftershock warnings helped people stay safe.

Long-term responses:

- Damaged buildings and infrastructure are being rebuilt.
- Roads, bridges and railways were repaired.
- Buildings are being rebuilt to strict earthquake-resistant standards.
- Building regulations continue to be enforced and improved.
- Planning controls restrict building in high-risk areas such as steep slopes.
- Taiwan continues to invest in earthquake monitoring, early warning systems and research.
- Regular drills and public education improve preparedness.

Page 19: Exam Builder

Step 1: Complete the sentences
Question
The earthquake occurred on _____ 2024.
It had a magnitude of _____.
It was caused by _____ at a destructive plate margin.
Answer
The earthquake occurred on **3 April** 2024.
It had a magnitude of **7.4**.
It was caused by **subduction** at a destructive plate margin.
Accept:
The earthquake occurred on **3 April** 2024.
It had a magnitude of **7.4**.
It was caused by **the Philippine Sea Plate being forced beneath the Eurasian Plate** at a destructive plate margin.

Step 2: Explain one primary effect of the Taiwan earthquake. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid primary effect.
Award **1 further mark** for explaining or developing the effect.
Indicative content
Primary effects may include:

- deaths
- injuries
- collapsed or damaged buildings
- damaged roads, tunnels, bridges or railway lines
- power cuts
- interrupted water supplies
- briefly affected mobile phone services
- economic cost

Model answer

One primary effect of the Taiwan earthquake was that buildings collapsed or were damaged, especially some older buildings and hotels near Hualien. This directly affected people because some were injured or trapped in damaged buildings.

Alternative model answer

Roads and tunnels in mountainous areas were damaged by the earthquake. This disrupted transport and made it harder for people and emergency services to move around affected areas.

Step 3: Explain how the responses to the Taiwan earthquake reduced its impacts. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of responses to the 2024 Taiwan earthquake. Accurate examples are used, such as search and rescue, shelters, food and water, road clearance, tsunami alerts, aftershock warnings, strict building standards or public education. **AO2** Shows clear understanding of how these responses reduced impacts. Explanation is developed and links responses to reduced deaths, injuries, disruption or future vulnerability.
1 Basic	1–2	**AO1** Shows limited knowledge of responses to the Taiwan earthquake. May identify one or more responses but with limited detail. **AO2** Shows limited understanding of how responses reduced impacts. Explanation is basic or only partly linked to reduced impacts.
0	0	No relevant content.

Indicative content

Immediate responses:

- search and rescue teams arrived quickly
- people trapped in buildings were rescued
- emergency shelters were set up
- food, water and basic supplies were provided
- hospitals coped with demand
- power was restored
- blocked roads were cleared
- tsunami alerts were issued
- aftershock warnings helped people stay safe

Long-term responses:

- buildings and infrastructure are being rebuilt to strict earthquake-resistant standards
- roads, bridges and railways were repaired
- building regulations continue to be enforced and improved
- planning controls restrict building in high-risk areas
- monitoring, early warning systems, research, drills and education improve preparedness

Model answer

The responses to the Taiwan earthquake reduced impacts because search and rescue teams arrived quickly and rescued people trapped in collapsed buildings. This helped reduce deaths and injuries. Emergency shelters were also set up in schools and community centres, giving displaced people somewhere safe to stay. Tsunami alerts and aftershock warnings helped people avoid further danger.

In the longer term, rebuilding to strict earthquake-resistant standards will reduce the risk of future earthquakes causing similar levels of damage.

Page 19: Exam-style Questions

1.1 What was the magnitude of the Taiwan earthquake? [1 mark]
Mark scheme
Award **1 mark** for the correct magnitude.
Answer
7.4

1.2 Name one primary effect of the earthquake. [1 mark]
Mark scheme
Award **1 mark** for naming one valid primary effect of the Taiwan earthquake.
Acceptable answers

- at least 17 people died
- over 1,100 people were injured
- buildings collapsed or were damaged
- roads were damaged
- tunnels were damaged
- bridges were affected
- railway lines were affected
- power was cut
- water supplies were interrupted
- mobile phone services were briefly affected

Model answer
Over 1,100 people were injured.

1.3 Describe one secondary effect of the earthquake. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid secondary effect.
Award **1 further mark** for describing or developing the effect.
Indicative content
Secondary effects may include:

- landslides and rockfalls
- roads and buildings damaged further by rockfalls
- villages isolated
- small tsunami up to 0.3 m
- tourism disrupted
- businesses closed temporarily
- economic losses
- aftershocks caused fear and stress
- disruption to daily life and schooling

Model answer
Landslides and rockfalls occurred in steep mountainous areas. These blocked roads and isolated some villages, making it harder for people to travel and for help to reach them.
Alternative model answer
Tourism on Taiwan's east coast was disrupted after the earthquake. This caused some businesses to close temporarily and led to economic losses.

1.4 Explain how one immediate response helped people. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of one immediate response to the Taiwan earthquake. Accurate detail is used, such as search and rescue, emergency shelters, supplies, medical care, road clearance or warnings. **AO2** Shows clear understanding of how the response helped people. Explanation is developed and links the response to reducing deaths, injuries, homelessness, disruption or further danger.
1 Basic	1–2	**AO1** Shows limited knowledge of one immediate response. The response may be identified but lacks detail. **AO2** Shows limited understanding of how the response helped people. Explanation is basic or generalised.
0	0	No relevant content.

Indicative content

Students may explain one response, such as:

- **Search and rescue:** rescued people trapped in buildings, reducing deaths and injuries.
- **Emergency shelters:** gave displaced people somewhere safe to stay.
- **Food, water and basic supplies:** helped meet urgent needs.
- **Hospitals coped with demand:** injured people received treatment.
- **Road clearance:** improved access for emergency services and supplies.
- **Tsunami alerts/aftershock warnings:** helped people avoid further danger.

Model answer

Search and rescue was an important immediate response because teams arrived quickly after the earthquake. They searched collapsed buildings and rescued people who were trapped. This helped people because it reduced the risk of trapped survivors dying from injuries, dehydration or further collapse during aftershocks.

1.5 Explain how long-term responses reduce future risk. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of long-term responses to earthquakes. Accurate examples are used, such as earthquake-resistant rebuilding, improved building regulations, planning controls, monitoring, early warning systems, research, drills or public education. **AO2** Shows clear understanding of how long-term responses reduce future risk. Explanation is developed and links responses to reduced vulnerability, better preparation or lower future impacts.
1 Basic	1–2	**AO1** Shows limited knowledge of long-term responses. May identify one or more responses but with limited detail.

Level	Marks	Description
		AO2 Shows limited understanding of how long-term responses reduce future risk. Explanation is basic or only partly linked to future hazards.
0	0	No relevant content.

Indicative content

Long-term responses may include:

- rebuilding damaged buildings to strict earthquake-resistant standards
- repairing roads, bridges and railways
- enforcing and improving building regulations
- planning controls restricting building in high-risk areas such as steep slopes
- investment in earthquake monitoring
- early warning systems
- research
- regular drills
- public education

Students may explain that these reduce risk by:

- making buildings less likely to collapse
- reducing deaths and injuries in future earthquakes
- improving preparedness
- helping people know how to respond
- reducing exposure in high-risk areas
- allowing warnings before or during future events

Model answer

Long-term responses reduce future risk by making people and places less vulnerable to future earthquakes. In Taiwan, damaged buildings and infrastructure are being rebuilt to strict earthquake-resistant standards, which means buildings are less likely to collapse in future events. Building regulations are also enforced and improved, while monitoring, early warning systems, drills and public education help people prepare and respond safely.

1.6 For an earthquake you have studied, explain how economic development influenced the impacts. [6 marks]

Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO1** Shows detailed knowledge of a named earthquake in a HIC, such as the 2024 Taiwan earthquake. Accurate place-specific detail is used, including facts about effects, responses and levels of development. **AO2** Shows detailed understanding of how economic development influenced the impacts of the earthquake. Explanation is thorough and well developed, linking development to building quality, preparedness, emergency services, infrastructure, warnings or recovery.
2 Clear	3–4	**AO1** Shows clear knowledge of a named earthquake. Some accurate place-specific detail is used. **AO2** Shows clear understanding of how economic development influenced

Level	Marks	Description
		impacts. Explanation is developed but may not be fully detailed or may have limited place-specific support.
1 Basic	1–2	**AO1** Shows limited knowledge of an earthquake. May include simple or generalised information. **AO2** Shows limited understanding of how economic development influenced impacts. Explanation is basic and may lack clear links to the named example.
0	0	No relevant content.

Indicative content

For the 2024 Taiwan earthquake, students may include:

- Taiwan is a HIC.
- It has strict building codes.
- It has effective preparation.
- The earthquake occurred on 3 April 2024.
- It had a magnitude of 7.4.
- The epicentre was near Hualien.
- At least 17 people died and over 1,100 were injured.
- Buildings collapsed or were damaged, especially older buildings and some hotels.
- Roads, tunnels, bridges and railway lines were damaged.
- Power and water supplies were disrupted in some areas.
- Search and rescue teams arrived quickly.
- Hospitals coped with demand.
- Emergency shelters were set up.
- Tsunami alerts and aftershock warnings were issued.
- Buildings and infrastructure are being rebuilt to earthquake-resistant standards.
- Monitoring, early warning systems, drills and public education improve preparedness.

Students may explain that economic development reduced impacts because:

- stricter building codes reduced building collapse
- stronger infrastructure limited disruption
- emergency services could respond quickly
- hospitals were able to cope with casualties
- warnings reduced further danger
- recovery and rebuilding could begin more effectively
- education and drills improved public preparedness

Model answer

The 2024 Taiwan earthquake shows how economic development can influence the impacts of an earthquake. Taiwan is a HIC with strict building codes and effective preparation. Although the earthquake had a magnitude of 7.4, the death toll was relatively low, with at least 17 people killed and over 1,100 injured. Economic development helped reduce the impacts because many buildings are designed to be more earthquake-resistant, so they are less likely to collapse than weaker buildings in poorer countries.

Taiwan's level of development also helped the response. Search and rescue teams, including the military, fire service and volunteers, arrived quickly and rescued people from collapsed buildings. Hospitals coped with demand, emergency shelters were provided, and warnings about aftershocks and tsunamis helped people stay safe. In the longer term, damaged buildings and infrastructure are being rebuilt to strict standards, while monitoring, early warning systems and public education continue to reduce future risk. This shows that higher economic development did not prevent the earthquake, but it reduced the number of deaths, limited disruption and improved recovery.

Page 20 Activities

Page 20: Exam Ready Question

Question

Primary effects outweigh the impact of secondary effects of tectonic hazards in NEEs/LICs. To what extent do you agree with this statement? Refer to an example you have studied. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of primary and secondary effects of tectonic hazards in an NEE/LIC. Accurate knowledge of a named example is used, such as the 2023 Turkey/Syria earthquake. **AO3** Demonstrates detailed evaluation of whether primary effects outweighed secondary effects. A clear judgement is made and supported with developed reasoning.
2 Clear	3–4	**AO2** Shows clear understanding of primary and/or secondary effects of tectonic hazards in an NEE/LIC. Some accurate example detail is used. **AO3** Demonstrates reasonable evaluation of the relative importance of primary and/or secondary effects. A judgement may be present but may not be fully developed.
1 Basic	1–2	**AO2** Shows limited understanding of primary and/or secondary effects. May identify simple effects of an earthquake. **AO3** Demonstrates limited evaluation. Response may be one-sided, generalised or unsupported.
0	0	No relevant content.

Indicative content

Primary effects of the 2023 Turkey/Syria earthquake may include:

- Over **50,000 people died**.
- Thousands more were injured, including around **107,000 in Turkey**.
- Buildings collapsed in many cities and towns.
- Roads, bridges and airports were damaged.
- Power, water and gas supplies were cut.
- Communication networks were disrupted.
- Around **1.5 million people were made homeless in Turkey** and **5.3 million in Syria**.

Secondary effects may include:

- Landslides blocked roads and buried villages.
- Liquefaction caused further damage in some areas.
- Limited access to clean water led to disease outbreaks.
- Hospitals were damaged and overwhelmed.
- Businesses and farms were destroyed.
- There were huge economic losses, including about **$34.2 billion damage in Turkey** and **$81.5 billion recovery costs**.
- Many people experienced trauma and mental health problems.
- Extreme winter weather made conditions worse.

Students may argue that primary effects outweighed secondary effects because:

- the death toll and injuries were extremely high
- widespread building collapse caused immediate destruction
- homelessness was caused directly by building failure
- damage to roads, airports and services disrupted rescue efforts immediately

Students may argue that secondary effects were also very significant because:

- they made the disaster worse after the shaking stopped
- disease, trauma and homelessness created longer-term suffering
- damaged hospitals and roads slowed recovery
- economic damage and loss of livelihoods affected people for months or years

Model answer

I partly agree that the primary effects outweighed the secondary effects in the 2023 Turkey/Syria earthquake. The primary effects were extremely severe because over 50,000 people died and thousands more were injured. Buildings collapsed across many cities and towns, and roads, bridges, airports, power, water and gas supplies were damaged. These direct impacts caused huge loss of life and left millions of people homeless.

However, the secondary effects also made the disaster much worse, especially because Turkey and Syria had areas of high vulnerability. Landslides blocked roads, clean water was limited, and disease outbreaks became a risk. Hospitals were damaged and overwhelmed, making it harder to treat injured people. The economic impacts were also long-lasting, with major damage to homes, businesses and farms. Overall, I agree to some extent because the primary effects caused the greatest immediate loss of life, but the secondary effects were also very important because they increased suffering and slowed recovery.

Page 21 Activities

Page 21: 30 Second Recall Answers

Define: Secondary effect

A secondary effect is an indirect impact that happens after a hazard because of the primary effects.

List: Three primary effects of the Turkey/Syria earthquake

Any three from:

- over 50,000 people died
- thousands of people were injured
- around 107,000 people were injured in Turkey
- buildings collapsed in many cities and towns
- roads were damaged
- bridges were damaged
- airports were damaged
- power supplies were cut
- water supplies were cut
- gas supplies were cut
- communication networks were disrupted
- people were made homeless

Explain: Why the impacts were severe in Turkey and Syria

The impacts were severe because the earthquake was very powerful, with a magnitude of **7.8**, and had a shallow focus of about **17–18 km**, which made the shaking very destructive. Many buildings collapsed, and some areas were highly vulnerable due to weaker buildings, limited preparedness, conflict in Syria and difficulties getting aid to affected areas.

Page 21: Blur, Build, Check

Stage 2: Build answers

1. Causes

Students should include:

- The earthquake occurred on **6 February 2023**.
- It had a magnitude of **7.8**.
- It struck near **Gaziantep** in south-eastern Turkey.
- The earthquake occurred on the boundary of the **Anatolian and African tectonic plates**.
- Turkey lies on a destructive plate margin where the Anatolian Plate is forced westwards by the African and Arabian Plates.
- Stress built up along faults.
- When stress was released suddenly, the plates slipped.
- This caused powerful seismic waves.
- The earthquake had a shallow focus of about **17–18 km**, making shaking very destructive.

---

2. Primary effects

Students should include examples such as:

- Over **50,000 people died**, including about **44,000 in Turkey** and **6,000 in Syria**.
- Thousands more were injured, including around **107,000 in Turkey**.
- Buildings collapsed in many cities and towns.
- Roads, bridges and airports were damaged.
- Power, water and gas supplies were cut.
- Communication networks were disrupted.
- Around **1.5 million people were made homeless in Turkey** and **5.3 million in Syria**.
- Extreme winter weather, including snow and freezing temperatures, made conditions worse.

---

3. Secondary effects

Students should include examples such as:

- Landslides blocked roads and buried villages.
- Liquefaction in some areas caused further damage.
- Limited access to clean water led to disease outbreaks.
- Hospitals were damaged and overwhelmed.
- Businesses and farms were destroyed.
- There were huge economic losses and loss of livelihoods.
- Damage in Turkey was estimated at **$34.2 billion**.
- Recovery costs were estimated at **$81.5 billion**.
- Many people experienced trauma and mental health problems.
- Long-term impacts affected communities.

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4. Responses

Students should include both immediate and long-term responses.

Immediate responses:

- Search and rescue teams reached affected areas.
- The military helped with the response.
- People were pulled from the rubble.
- Emergency shelters and tents were set up.
- Food, clean water, blankets and medical aid were provided.
- Field hospitals were established.
- International aid sent medical teams and supplies.
- Authorities issued warnings about aftershocks.

- Donations and volunteers helped with relief efforts.

Long-term responses:

- Rebuilding of homes, schools, hospitals and infrastructure is ongoing.
- New homes are being built to safer standards.
- Building regulations are being reviewed and strengthened.
- Enforcement of earthquake-resistant designs is being improved.
- Disaster preparedness plans are being improved.
- Early warning systems and monitoring are being upgraded.
- Mental health and livelihood support continues.
- International aid and funding are supporting recovery and reconstruction.

Page 21: Exam Builder

Step 1: Complete the sentences

Question

The earthquake occurred on _____ 2023.
It had a magnitude of _____.
The earthquake had a _____ focus, making it more destructive.

Answer

The earthquake occurred on **6 February** 2023.
It had a magnitude of **7.8**.
The earthquake had a **shallow** focus, making it more destructive.
Accept:
The earthquake occurred on **6 February** 2023.
It had a magnitude of **7.8**.
The earthquake had a **shallow focus of about 17–18 km**, making it more destructive.

Step 2: Explain one secondary effect of the Turkey–Syria earthquake. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid secondary effect.
Award **1 further mark** for explaining or developing the effect.

Indicative content

Secondary effects may include:

- landslides
- liquefaction
- disease outbreaks
- hospitals overwhelmed
- businesses and farms destroyed
- economic losses
- loss of livelihoods
- trauma and mental health problems

Model answer

One secondary effect was that landslides blocked roads and buried villages. This made it harder for emergency services and aid to reach affected communities.

Alternative model answer

Limited access to clean water led to disease outbreaks. This increased the impact of the earthquake because people were at risk of becoming ill after the shaking had stopped.

Step 3: Explain why the impacts of the Turkey–Syria earthquake were severe. [4 marks]

Assessment objectives

- **AO1 = 2 marks**

- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the Turkey/Syria earthquake. Accurate detail is used, such as magnitude, shallow focus, building collapse, death toll, homelessness, damaged infrastructure, winter weather or vulnerability. **AO2** Shows clear understanding of why the impacts were severe. Explanation is developed and links physical and/or human factors to deaths, injuries, homelessness, disruption or slow recovery.
1 Basic	1–2	**AO1** Shows limited knowledge of the Turkey/Syria earthquake. May identify simple effects or causes. **AO2** Shows limited understanding of why the impacts were severe. Explanation is basic, generalised or only partly developed.
0	0	No relevant content.

Indicative content

The impacts were severe because:

- the earthquake had a high magnitude of **7.8**
- the focus was shallow, about **17–18 km**
- strong shaking caused widespread building collapse
- many buildings were vulnerable or poorly constructed
- roads, bridges and airports were damaged, slowing rescue and aid
- power, water, gas and communication networks were disrupted
- winter weather made survival and rescue harder
- parts of Syria were already vulnerable due to conflict and limited services
- hospitals were damaged and overwhelmed
- landslides and liquefaction caused further damage
- homelessness was widespread

Model answer

The impacts of the Turkey/Syria earthquake were severe because it had a high magnitude of **7.8** and a shallow focus of about **17–18 km**, which made the shaking very destructive. Many buildings collapsed in towns and cities, causing over **50,000 deaths** and thousands of injuries. The impacts were made worse because roads, bridges and airports were damaged, making it harder for rescue teams and aid to reach affected areas. Winter weather, homelessness and limited access to clean water also increased people's vulnerability after the earthquake.

Page 21: Exam-style Questions

1.1 What was the magnitude of the earthquake? [1 mark]

Mark scheme

Award **1 mark** for the correct magnitude.

Answer

7.8

1.2 Name one primary effect of the earthquake. [1 mark]

Mark scheme

Award **1 mark** for naming one valid primary effect of the Turkey/Syria earthquake.

Acceptable answers

- over 50,000 people died

- thousands of people were injured
- around 107,000 people were injured in Turkey
- buildings collapsed
- roads were damaged
- bridges were damaged
- airports were damaged
- power supplies were cut
- water supplies were cut
- gas supplies were cut
- communication networks were disrupted
- people were made homeless

Model answer

Buildings collapsed in many cities and towns.

1.3 Describe one secondary effect of the earthquake. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid secondary effect.

Award **1 further mark** for describing or developing the effect.

Indicative content

Secondary effects may include:

- landslides blocked roads and buried villages
- liquefaction caused further damage
- limited access to clean water led to disease outbreaks
- hospitals were damaged and overwhelmed
- businesses and farms were destroyed
- economic losses and loss of livelihoods
- trauma and mental health problems

Model answer

Landslides blocked roads and buried villages after the earthquake. This made some areas harder to reach and delayed the arrival of rescue teams and aid.

Alternative model answer

Limited access to clean water led to disease outbreaks. This increased suffering after the earthquake because people were more likely to become ill.

1.4 Explain how one immediate response helped people. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of one immediate response to the Turkey/Syria earthquake. Accurate detail is used, such as search and rescue, emergency shelters, tents, food, water, blankets, medical aid, field hospitals, international aid or aftershock warnings. **AO2** Shows clear understanding of how the response helped people. Explanation is developed and links the response to reducing deaths, injuries, exposure, homelessness, illness or further danger.
1 Basic	1–2	**AO1** Shows limited knowledge of one immediate response. The response may be identified but lacks detail.

Level	Marks	Description
		AO2 Shows limited understanding of how the response helped people. Explanation is basic or generalised.
0	0	No relevant content.

Indicative content

Students may explain one response, such as:

- **Search and rescue:** pulled people from rubble, reducing deaths and injuries.
- **Emergency shelters and tents:** protected homeless people from winter weather.
- **Food, clean water and blankets:** met urgent needs and reduced illness/exposure.
- **Medical aid and field hospitals:** treated injured people when hospitals were damaged or overwhelmed.
- **International aid:** provided extra medical teams and supplies.
- **Aftershock warnings:** helped people avoid further danger.

Model answer

Search and rescue was an important immediate response because teams reached affected areas and pulled people from the rubble. This helped people because some survivors were trapped in collapsed buildings and needed urgent help. Rescuing them quickly reduced the risk of death from injuries, cold weather or further collapse during aftershocks.

1.5 Explain why secondary effects increased the impacts of the earthquake. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of secondary effects of the Turkey/Syria earthquake. Accurate examples are used, such as landslides, liquefaction, disease, damaged hospitals, economic losses, loss of livelihoods or trauma. **AO3** Demonstrates reasonable application of knowledge and understanding in explaining how secondary effects increased the severity of impacts after the earthquake.
1 Basic	1–2	**AO2** Shows limited understanding of secondary effects. May identify simple examples. **AO3** Demonstrates limited application of knowledge and understanding in explaining how secondary effects increased impacts. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Secondary effects increased the impacts because:

- landslides blocked roads, delaying rescue and aid
- liquefaction caused further damage to buildings and infrastructure
- limited clean water increased the risk of disease
- damaged and overwhelmed hospitals reduced treatment capacity
- businesses and farms were destroyed, causing loss of income
- economic losses made recovery harder
- trauma and mental health problems affected communities for longer
- winter weather made homelessness and exposure worse

- disruption continued after the initial shaking

Model answer

Secondary effects increased the impacts of the Turkey/Syria earthquake because they made conditions worse after the shaking had stopped. Landslides blocked roads and buried villages, which delayed rescue teams and aid. Limited access to clean water led to disease outbreaks, putting more people at risk. Hospitals were also damaged and overwhelmed, so it was harder to treat the injured. These secondary effects increased suffering and slowed recovery.

1.6 For an earthquake you have studied, explain how economic development influenced the impacts. [6 marks]

Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO1** Shows detailed knowledge of a named earthquake in an NEE/LIC, such as the 2023 Turkey/Syria earthquake. Accurate place-specific detail is used, including facts about effects, responses and vulnerability. **AO2** Shows detailed understanding of how economic development influenced the impacts of the earthquake. Explanation is thorough and well developed, linking development to building quality, preparedness, infrastructure, emergency response, aid, vulnerability or recovery.
2 Clear	3–4	**AO1** Shows clear knowledge of a named earthquake. Some accurate place-specific detail is used. **AO2** Shows clear understanding of how economic development influenced impacts. Explanation is developed but may not be fully detailed or may have limited place-specific support.
1 Basic	1–2	**AO1** Shows limited knowledge of an earthquake. May include simple or generalised information. **AO2** Shows limited understanding of how economic development influenced impacts. Explanation is basic and may lack clear links to the named example.
0	0	No relevant content.

Indicative content

For the 2023 Turkey/Syria earthquake, students may include:

- The earthquake occurred on **6 February 2023**.
- It had a magnitude of **7.8**.
- It struck near **Gaziantep** in south-eastern Turkey.
- It had a shallow focus of about **17–18 km**.
- Over **50,000 people died**.
- Around **107,000 people were injured in Turkey**.
- Buildings collapsed in many cities and towns.
- Roads, bridges and airports were damaged.
- Power, water, gas and communication networks were disrupted.
- Around **1.5 million people were made homeless in Turkey** and **5.3 million in Syria**.
- Hospitals were damaged and overwhelmed.
- Search and rescue teams and international aid responded.
- Emergency shelters, tents, food, water, blankets and medical aid were provided.

- Rebuilding is ongoing.
- Building regulations are being reviewed and strengthened.

Students may explain that economic development influenced impacts because:

- weaker or poorly enforced building regulations increased building collapse
- some communities were more vulnerable due to poverty or conflict
- damaged infrastructure slowed rescue and aid
- hospitals had limited capacity or were overwhelmed
- emergency response was more difficult in less developed or conflict-affected areas
- homelessness and winter conditions increased vulnerability
- international aid was needed to support rescue and recovery
- recovery is slower where resources and funding are limited

Model answer

The 2023 Turkey/Syria earthquake shows how economic development can influence the impacts of an earthquake. The earthquake had a magnitude of **7.8** and a shallow focus, so the shaking was very destructive. However, the impacts were made worse by vulnerability in affected areas. Many buildings collapsed in cities and towns, causing over **50,000 deaths** and thousands of injuries. This suggests that building quality and the enforcement of earthquake-resistant design were important factors in the scale of the disaster.

Economic development also affected the response and recovery. Roads, bridges and airports were damaged, making it harder for rescue teams and aid to reach some areas. Hospitals were damaged and overwhelmed, while many people were left homeless, including around **1.5 million in Turkey** and **5.3 million in Syria**. Syria was especially vulnerable because conflict had already weakened services and infrastructure. International aid, field hospitals, shelters, food, clean water and medical supplies were needed to support the response. Overall, lower levels of development and vulnerability increased the impacts by making buildings weaker, emergency response harder and recovery slower.

Page 22 Activities

Page 22: Exam Ready Question

Question

Explain why people live in areas that are at risk from a tectonic hazard. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of why people live in areas at risk from tectonic hazards. Several accurate reasons are explained, such as fertile soils, jobs, resources, geothermal energy, settlement history, family ties, culture and confidence in risk management. **AO3** Demonstrates detailed application of knowledge and understanding by explaining how these factors influence people's decisions to remain in hazardous areas. Explanation is well developed and may use relevant examples.
2 Clear	3–4	**AO2** Shows clear understanding of reasons why people live in areas at risk from tectonic hazards. More than one valid reason is explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking these reasons to people's choices or ability to manage risk.

Level	Marks	Description
1 Basic	1–2	**AO2** Shows limited understanding of why people live in areas at risk. May identify one or more reasons but with little development. **AO3** Demonstrates limited application of knowledge and understanding. Links to people's decisions or risk are basic or generalised.
0	0	No relevant content.

Indicative content

Students may refer to:

- Volcanic ash creates fertile soils.
- Fertile soils support farming and high crop yields.
- Tourism creates jobs in hotels, restaurants and guiding.
- Volcanoes attract visitors due to scenic landscapes.
- Geothermal energy can provide electricity and heating.
- Volcanic areas may contain valuable minerals and building materials.
- Towns and cities may have grown in hazardous areas over many years.
- Coastal or flat land may provide good transport links and access to services.
- People may have strong family, community, cultural or spiritual connections.
- People may believe a hazard is unlikely to happen in their lifetime.
- Monitoring, early warning systems, evacuation plans and building codes may increase confidence.
- The benefits of living in these areas may be seen as outweighing the risks.

Model answer

People live in areas at risk from tectonic hazards because these places can provide important benefits. Volcanic ash can break down into very fertile soil, which supports farming and high crop yields. This means people may stay because farming provides food and income. Tectonic areas can also create economic opportunities. Volcanoes attract tourists, creating jobs in hotels, restaurants and guiding, while geothermal energy can provide electricity and heating.

Some people also stay because of social and cultural reasons. Families may have lived in the area for generations, so people have strong community and cultural ties. In some places, people may also believe the risk is low because eruptions or earthquakes are rare. In richer areas, monitoring, building codes and evacuation plans can increase confidence. Overall, people continue to live in hazardous areas because the economic, social and environmental benefits may outweigh the perceived risk.

Page 23 Activities

Page 23: 30 Second Recall Answers

Define: Tectonic hazard

A tectonic hazard is a natural hazard caused by the movement of the Earth's tectonic plates.

Accept:

A hazard linked to plate movement, such as an earthquake, volcanic eruption or tsunami.

List: Three reasons why people live in high-risk areas

Any three from:

- fertile volcanic soils
- jobs and economic opportunities
- tourism
- access to resources

- minerals and building materials
- geothermal energy
- transport links
- settlement history
- family connections
- cultural or spiritual ties
- perceived low risk
- confidence in monitoring, warning systems, building codes or evacuation plans

---

Explain: Why people may underestimate the risk of living in areas at risk
People may underestimate the risk because tectonic hazards can be rare and may not happen during a person's lifetime. People may also trust monitoring, early warning systems, building codes and evacuation plans, so they believe they will be safe if a hazard occurs.

Page 23: Blur, Build, Check

Stage 2: Build answers
Six reasons why people live in areas at risk from tectonic hazards
Students should include six reasons and classify them as social, economic or environmental.

Reason	Classification	Explanation
Fertile volcanic soils	Environmental / economic	Volcanic ash breaks down into fertile soil, helping crops grow well and supporting farming livelihoods.
Jobs and economic opportunities	Economic	Tourism, geothermal energy, mining and farming can provide employment and income.
Access to resources	Economic / environmental	Volcanic areas may contain minerals such as gold, silver, copper and sulphur, as well as building materials such as rock, sand and ash.
Geothermal energy	Economic / environmental	Heat from volcanic areas can be used to generate electricity or provide heating.
Transport links and settlement history	Social / economic	Settlements may have grown over time because of trade, access to services and established infrastructure.
Cultural and family connections	Social	People may stay because family, community, traditions and spiritual links to the land are important.
Perceived low risk and confidence in safety	Social	People may think an eruption or earthquake is unlikely, or trust monitoring, building codes and evacuation plans.

Students only need six reasons, but any valid classification should be credited if justified.

Page 23: Exam Builder

Step 1: Complete the sentences
Question
Volcanic ash creates _____ soil.
Tourism provides _____ opportunities.
People may stay due to _____ and family connections.
Answer

Volcanic ash creates **fertile** soil.
Tourism provides **job** opportunities.
People may stay due to **cultural** and family connections.
Accept:
Volcanic ash creates **fertile** soil.
Tourism provides **economic/employment** opportunities.
People may stay due to **community/cultural** and family connections.

Step 2: Explain one economic reason why people live in areas at risk. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid economic reason.
Award **1 further mark** for explaining how this encourages people to live in an area at risk.
Indicative content
Economic reasons may include:

- jobs from tourism
- farming on fertile volcanic soils
- mining minerals
- use of building materials
- geothermal energy
- trade and transport links
- established businesses and services

Model answer
One economic reason is tourism. Volcanoes can attract visitors because of their dramatic landscapes, which creates jobs in hotels, restaurants and guiding, so people may stay despite the risk.
Alternative model answer
Fertile volcanic soils can support farming. This gives people food and income, so they may continue to live near volcanoes even though eruptions are possible.

Step 3: Explain why people continue to live in areas at risk from tectonic hazards. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of why people continue to live in areas at risk from tectonic hazards. Accurate reasons are explained, such as fertile soils, jobs, resources, geothermal energy, transport links, family ties, culture or confidence in safety measures. **AO3** Demonstrates reasonable application of knowledge and understanding by linking these reasons to people's decisions to stay despite the hazard risk.
1 Basic	1–2	**AO2** Shows limited understanding of why people live in areas at risk. May identify one or more simple reasons. **AO3** Demonstrates limited application of knowledge and understanding. Links to people's decisions or risk are basic or generalised.
0	0	No relevant content.

Indicative content
Students may refer to:

- volcanic ash creates fertile soil for farming
- tourism creates jobs
- geothermal energy provides electricity and heating
- minerals and building materials provide income
- towns and cities may already be established
- transport links and services encourage people to stay
- family and cultural ties make moving difficult
- people may think the risk is low
- monitoring, building codes and evacuation plans increase confidence

Model answer

People continue to live in areas at risk from tectonic hazards because these places can provide benefits. Volcanic soils are often fertile, so farming can provide food and income. Tectonic areas can also create jobs through tourism, geothermal energy or mining. Some people stay because their family and community have lived there for generations, so they have strong social and cultural ties. Others may believe the risk is low or trust monitoring and evacuation plans, so they feel the benefits outweigh the danger.

Page 23: Exam-style Questions

1.1 Give one reason why people live near volcanoes. [1 mark]

Mark scheme

Award **1 mark** for one valid reason.

Acceptable answers

- fertile soil
- farming
- tourism
- jobs
- geothermal energy
- minerals
- building materials
- family ties
- cultural or spiritual connections
- confidence in monitoring or evacuation plans
- perceived low risk

Model answer

Volcanic ash creates fertile soil for farming.

1.2 Name one resource found in volcanic areas. [1 mark]

Mark scheme

Award **1 mark** for naming a valid resource found in volcanic areas.

Acceptable answers

- gold
- silver
- copper
- zinc
- sulphur
- rock
- sand
- ash
- geothermal energy
- building materials

Model answer
Geothermal energy.

1.3 Describe one benefit of living in a tectonically active area. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid benefit.
Award **1 further mark** for describing how it helps people.
Indicative content
Benefits may include:

- fertile soils support farming
- tourism creates jobs and income
- geothermal energy provides heating/electricity
- minerals can be mined and sold
- building materials can be used or sold
- established transport links and services support trade and daily life

Model answer
One benefit is fertile soil created by volcanic ash. This helps farmers grow crops successfully, providing food and income for local people.
Alternative model answer
Tourism can be a benefit because volcanoes attract visitors. This creates jobs in hotels, restaurants and guiding.

1.4 Explain how economic opportunities encourage people to stay. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of economic opportunities in tectonically active areas. Accurate examples are explained, such as tourism, farming, mining, geothermal energy, building materials or trade. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how these opportunities encourage people to remain in high-risk areas despite the hazard.
1 Basic	1–2	**AO2** Shows limited understanding of economic opportunities in tectonically active areas. May identify one or more simple examples. **AO3** Demonstrates limited application of knowledge and understanding. Explanation of why people stay is basic or generalised.
0	0	No relevant content.

Indicative content
Students may refer to:

- fertile volcanic soils support farming
- high crop yields provide food and income
- volcano tourism creates jobs in hotels, restaurants and guiding
- geothermal energy can provide electricity and heating
- mining provides jobs and income
- minerals such as gold, silver, copper, zinc and sulphur may be extracted
- building materials such as rock, sand and ash may be used or sold

- established settlements may provide services, transport links and markets
- people may stay because livelihoods depend on these opportunities

Model answer

Economic opportunities encourage people to stay in tectonically active areas because they provide jobs and income. For example, volcanic ash creates fertile soil, so farmers can grow crops and earn a living. Volcanoes can also attract tourists, creating work in hotels, restaurants and guiding. Some areas also provide geothermal energy or minerals that can be used or sold. These opportunities mean people may choose to stay because their livelihoods depend on the area, even though there is a risk from earthquakes or eruptions.

1.5 Explain why people may underestimate the risk of hazards. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of why people may underestimate tectonic hazard risk. Accurate reasons are explained, such as rarity of events, perceived low risk, confidence in warning systems, building codes, evacuation plans or previous experience. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how these perceptions influence people's decisions to stay in areas at risk.
1 Basic	1–2	**AO2** Shows limited understanding of why people may underestimate hazard risk. May identify simple reasons, such as "they think it will not happen". **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or generalised.
0	0	No relevant content.

Indicative content

Students may refer to:

- earthquakes or eruptions may be rare
- people may believe a hazard is unlikely in their lifetime
- people may become used to living with risk
- past events may have been small or caused limited damage
- monitoring systems may increase confidence
- early warning systems may make people feel safer
- building codes and stronger buildings may reduce perceived danger
- evacuation plans may make people believe they can escape safely
- economic and social benefits may make people downplay the risk

Model answer

People may underestimate the risk of hazards because large earthquakes or volcanic eruptions can be rare. If a major event has not happened for many years, people may believe it is unlikely to happen in their lifetime. They may also feel safer if there are monitoring systems, evacuation plans and stronger buildings. This confidence can make people think the risk is lower than it really is, so they continue living in hazardous areas.

1.6 Explain why people live in areas that are at risk from tectonic hazards. [6 marks]

Assessment objectives

- **AO2 = 3 marks**

- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of why people live in areas at risk from tectonic hazards. Several accurate reasons are explained, such as fertile soils, jobs, tourism, resources, geothermal energy, settlement history, family ties, culture and confidence in safety measures. **AO3** Demonstrates detailed application of knowledge and understanding by explaining how these factors influence people's decisions to remain in hazardous areas. Explanation is developed and may use relevant examples.
2 Clear	3–4	**AO2** Shows clear understanding of why people live in areas at risk from tectonic hazards. More than one valid reason is explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking these reasons to people's choices or ability to manage risk.
1 Basic	1–2	**AO2** Shows limited understanding of why people live in areas at risk. May identify one or more reasons but with little development. **AO3** Demonstrates limited application of knowledge and understanding. Links to people's decisions or risk are basic or generalised.
0	0	No relevant content.

Indicative content

Students may refer to:

- Volcanic ash creates fertile soils.
- Fertile soils support farming and high crop yields.
- Farming provides food, jobs and income.
- Tourism creates jobs in hotels, restaurants and guiding.
- Volcanoes attract visitors because of scenic landscapes.
- Geothermal energy can provide electricity and heating.
- Volcanic areas may contain minerals and building materials.
- Towns and cities may have grown in hazardous areas over many years.
- Transport links may support trade and access to services.
- People may have strong family, community, cultural or spiritual connections.
- People may believe a hazard is unlikely to occur in their lifetime.
- Monitoring, early warning systems, evacuation plans and building codes may increase confidence.
- The benefits of living in these areas may outweigh the perceived risks.

Model answer

People live in areas at risk from tectonic hazards because these places can provide important economic benefits. Volcanic ash can create very fertile soil, which allows farmers to grow crops and earn an income. Volcanoes can also attract tourists, creating jobs in hotels, restaurants and guiding. Some tectonic areas provide valuable resources, such as minerals, building materials and geothermal energy, which can be used for electricity and heating.

Social factors are also important. Many settlements have existed in hazardous areas for a long time, so people may have strong family, community and cultural ties. Moving away may mean losing jobs, land or support networks. People may also believe the risk is low if a major eruption or earthquake has not happened for many years. In some places, monitoring systems, building codes and evacuation plans increase confidence. Overall, people often stay because the benefits of living in these areas are seen as greater than the risks.

Page 24 Activities

Page 24: Exam Ready Question

Question

State two ways that planning might help to reduce the damaging effects of an earthquake or a volcanic eruption. [4 marks]

Mark scheme

Award **1 mark** for each valid way that planning can help reduce the damaging effects of an earthquake or volcanic eruption.

Award **1 further mark** for each developed statement explaining how the planning strategy reduces damage, deaths, injuries or disruption.

Maximum **2 marks** for each stated way.

Indicative content

Students may refer to:

- hazard maps showing high-risk areas
- avoiding building in high-risk locations
- land-use planning keeping homes and services away from faults, steep slopes or volcanic danger zones
- evacuation plans
- evacuation drills
- education and awareness
- people knowing what to do before, during and after a hazard
- emergency services being better prepared
- stockpiling supplies or preparing shelters
- warning systems linked to planning

Possible answer

Hazard maps can show areas most at risk from earthquakes or volcanic eruptions. This helps planners avoid building homes, schools and hospitals in the most dangerous places.

Evacuation plans and drills can also reduce damage and deaths. They help people know where to go and what to do, so they can move away from danger more quickly.

Page 25 Activities

Page 25: 30 Second Recall Answers

Define: Monitoring

Monitoring means detecting and measuring hazards or signs that a hazard may occur.

Accept:

Monitoring is the use of equipment and observations to detect hazards and measure changes, such as tremors or ground movement.

List: Two ways hazards are predicted or warnings are given

Any two from:

- seismometers detecting tremors
- GPS monitoring ground movement
- monitoring volcanoes for signs of eruption
- early warning systems detecting P-waves
- sirens
- SMS messages

- radio alerts
- smartphone apps
- alerts issued by scientists or authorities

Explain: How planning reduces hazard risk
Planning reduces hazard risk by preparing people and places before a disaster happens. Hazard maps and land-use planning can keep homes and services away from high-risk areas, while evacuation plans, drills and education help people know what to do during an earthquake or volcanic eruption. This can reduce deaths, injuries and damage.

Page 25: Blur, Build, Check

Stage 2: Build answers
Students should write four headings and add detail.
1. Monitoring
Monitoring involves detecting and measuring hazards or signs that a hazard may occur.
Students may include:

- seismometers detect tremors and measure earthquake strength
- GPS monitors ground movement
- volcanoes can be monitored for signs of eruption
- monitoring helps scientists issue alerts
- close monitoring can identify potential hazards before they occur

---

2. Prediction and early warning
Prediction and early warning give people time to act before the strongest effects arrive.
Students may include:

- early warning systems detect **P-waves**
- P-waves arrive before the stronger **S-waves**
- alerts can be sent by sirens, SMS, radio or smartphone apps
- warning time may be only seconds to minutes
- warnings allow people to take cover, stop trains or evacuate buildings

---

3. Protection
Protection means making buildings and infrastructure safer so they suffer less damage.
Students may include:

- buildings are designed to earthquake-resistant standards
- flexible materials reduce the chance of collapse
- seismic isolators help buildings absorb shaking
- retrofitting strengthens older buildings
- roads and bridges can be built to higher standards
- stronger buildings and infrastructure protect lives

---

4. Planning
Planning means being prepared before a disaster strikes.
Students may include:

- hazard maps show high-risk areas
- land-use planning keeps homes and services away from faults and steep slopes
- evacuation plans prepare people to leave dangerous areas
- drills help people practise what to do
- education and awareness help people respond quickly and safely
- good planning means fewer people and assets are in danger

Page 25: Exam Builder

Step 1: Complete the sentences
Question
Monitoring helps detect _____ before they occur.
Early warning systems detect _____ waves.
Planning helps people _____ before a disaster.
Answer
Monitoring helps detect **hazards** before they occur.
Early warning systems detect **P-waves**.
Planning helps people **prepare** before a disaster.
Accept:
Monitoring helps detect **potential hazards** before they occur.
Early warning systems detect **primary/P** waves.
Planning helps people **know what to do** before a disaster.

Step 2: Explain how monitoring helps reduce hazard risk. [2 marks]
Mark scheme
Award **1 mark** for identifying that monitoring detects hazards or warning signs.
Award **1 further mark** for explaining how this reduces risk.
Indicative content
Monitoring may include:

- seismometers detecting tremors
- GPS measuring ground movement
- monitoring volcanoes for signs of eruption
- scientists issuing alerts
- allowing people or authorities to prepare

Model answer
Monitoring helps reduce hazard risk because equipment such as seismometers and GPS can detect tremors or ground movement. This can help scientists issue alerts, giving people time to prepare or move away from danger.

Step 3: Explain how one strategy reduces the impacts of a tectonic hazard. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of one strategy used to reduce tectonic hazard impacts. Accurate examples are used, such as monitoring, early warning systems, earthquake-resistant buildings, retrofitting, hazard maps, land-use planning, evacuation plans or education. **AO2** Shows clear understanding of how the chosen strategy reduces impacts. Explanation is developed and links the strategy to reduced deaths, injuries, damage, disruption or future risk.
1 Basic	1–2	**AO1** Shows limited knowledge of one strategy used to reduce tectonic hazard impacts. May identify a valid strategy but with little detail.

Level	Marks	Description
		AO2 Shows limited understanding of how the strategy reduces impacts. Explanation is basic, generalised or only partly developed.
0	0	No relevant content.

Indicative content

Students may choose one strategy:

Monitoring

- detects tremors, ground movement or signs of eruption
- helps scientists issue alerts
- gives authorities time to prepare

Prediction and early warning

- P-waves are detected before stronger S-waves
- alerts are sent by sirens, SMS, radio or apps
- people can take cover, evacuate buildings or stop trains
- reduces deaths and injuries

Protection

- earthquake-resistant buildings reduce collapse
- flexible materials and seismic isolators absorb shaking
- retrofitting strengthens older buildings
- stronger roads and bridges reduce disruption
- protects lives and reduces damage

Planning

- hazard maps show high-risk areas
- land-use planning avoids building in dangerous locations
- evacuation plans and drills prepare people
- education helps people know what to do
- reduces exposure and improves response

Model answer

One strategy is protection. Buildings can be designed to earthquake-resistant standards using flexible materials and seismic isolators. These help buildings move with the shaking rather than collapse. Older buildings can also be strengthened through retrofitting. This reduces the impacts of an earthquake because fewer buildings collapse, so fewer people are killed or injured and less damage is caused.

Page 25: Exam-style Questions

1.1 What is monitoring? [1 mark]

Mark scheme

Award **1 mark** for a valid definition or description.

Acceptable answers

- detecting and measuring hazards
- using equipment to detect signs of a hazard
- tracking changes that may show a hazard is developing
- monitoring volcanoes or earthquakes for warning signs

Model answer

Monitoring is detecting and measuring hazards or signs that a hazard may occur.

1.2 Name one way people are warned about hazards. [1 mark]

Mark scheme

Award **1 mark** for naming a valid warning method.

Acceptable answers

- sirens
- SMS messages
- radio alerts
- smartphone apps
- official alerts
- evacuation warnings

Model answer

SMS messages.

1.3 Describe one way buildings are protected from earthquakes. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid method of building protection.
Award **1 further mark** for describing how it reduces earthquake damage.

Indicative content

Students may refer to:

- earthquake-resistant design
- flexible materials
- seismic isolators
- retrofitting older buildings
- stronger foundations
- stronger roads, bridges or infrastructure

Model answer

Buildings can use seismic isolators, which allow the building to move during shaking. This reduces the chance of the building collapsing during an earthquake.

Alternative model answer

Older buildings can be retrofitted. This means they are strengthened so they are less likely to collapse when the ground shakes.

1.4 Explain how early warning systems reduce risk. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of early warning systems for tectonic hazards. Accurate detail is used, such as detecting P-waves, sending alerts by sirens, SMS, radio or smartphone apps, and warning before stronger S-waves arrive. **AO2** Shows clear understanding of how early warning systems reduce risk. Explanation is developed and links warning time to people taking protective action, evacuation, stopping trains or reducing deaths and injuries.
1 Basic	1–2	**AO1** Shows limited knowledge of early warning systems. May identify that warnings are given before a hazard or by sirens/messages. **AO2** Shows limited understanding of how warnings reduce risk. Explanation is basic or only partly linked to people being safer.
0	0	No relevant content.

Indicative content

- Early warning systems detect P-waves.

- P-waves arrive before stronger S-waves.
- Alerts can be sent by sirens, SMS, radio or smartphone apps.
- Warning time may be seconds to minutes.
- People can take cover.
- Buildings can be evacuated.
- Trains and machinery can be stopped.
- Emergency services can prepare.
- This reduces deaths, injuries and disruption.

Model answer

Early warning systems reduce risk by detecting P-waves, which arrive before the stronger S-waves that cause more damage. Alerts can then be sent through sirens, SMS, radio or smartphone apps. Even a few seconds or minutes of warning can allow people to take cover, evacuate buildings or stop trains. This reduces the chance of people being injured or killed.

1.5 Explain how planning helps reduce the impacts of hazards. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of planning strategies used to reduce tectonic hazard impacts. Accurate examples are used, such as hazard maps, land-use planning, evacuation plans, drills, education and awareness. **AO2** Shows clear understanding of how planning reduces hazard impacts. Explanation is developed and links planning to reduced exposure, better preparation, faster response or fewer deaths, injuries and damage.
1 Basic	1–2	**AO1** Shows limited knowledge of planning strategies. May identify one or more valid examples but with little detail. **AO2** Shows limited understanding of how planning reduces impacts. Explanation is basic, generalised or only partly linked to reduced risk.
0	0	No relevant content.

Indicative content

- Hazard maps identify high-risk areas.
- Land-use planning keeps homes, schools, hospitals and services away from faults, steep slopes or volcanic risk zones.
- Evacuation plans show people where to go.
- Drills help people practise safe responses.
- Education helps people know what to do.
- Planning improves the speed and effectiveness of emergency response.
- Fewer people and assets are exposed to danger.
- This reduces deaths, injuries, damage and disruption.

Model answer

Planning helps reduce the impacts of hazards because it prepares people and places before a disaster happens. Hazard maps show high-risk areas, so homes and important services can be kept away from faults or steep slopes. Evacuation plans and drills help people know where to go and what to do if an earthquake or eruption occurs. This can reduce deaths and injuries because people respond more quickly and fewer people are exposed to danger.

1.6 Evaluate which strategy is most effective in reducing hazard risk. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of strategies used to reduce tectonic hazard risk, such as monitoring, prediction and early warning, protection and planning. Accurate knowledge of how these strategies work is used. **AO3** Demonstrates detailed evaluation of which strategy is most effective. A clear judgement is made and supported with developed reasoning, including comparison between strategies.
2 Clear	3–4	**AO2** Shows clear understanding of more than one strategy used to reduce tectonic hazard risk. Some accurate explanation is included. **AO3** Demonstrates reasonable evaluation of the effectiveness of strategies. A judgement may be present but may not be fully developed or may not compare strategies in detail.
1 Basic	1–2	**AO2** Shows limited understanding of one or more strategies used to reduce hazard risk. May identify simple strategies such as warnings or stronger buildings. **AO3** Demonstrates limited evaluation. Response may be descriptive, one-sided or unsupported.
0	0	No relevant content.

Indicative content

Students may evaluate:

Monitoring

- useful because it detects hazards and supports warnings
- can identify signs of volcanic eruptions or ground movement
- limited because earthquakes cannot be predicted exactly

Prediction and early warning

- useful because warnings allow people to take cover, stop trains or evacuate buildings
- even seconds to minutes can reduce injuries
- limited because warning time is short and not all places have advanced systems

Protection

- earthquake-resistant buildings and retrofitting reduce collapse
- stronger roads and bridges reduce disruption
- often very effective at reducing deaths and damage
- limited by cost, especially in poorer areas or older settlements

Planning

- hazard maps and land-use planning reduce exposure
- evacuation plans, drills and education improve response
- cost-effective and useful before a hazard occurs
- limited if people ignore advice or if a hazard is very sudden

Possible judgements:

- Protection may be most effective for earthquakes because building collapse causes many deaths.
- Planning may be most effective overall because it reduces exposure and improves response.

- Monitoring and early warning are highly effective where technology is available, but cannot prevent damage.
- The best approach is to combine strategies because each reduces risk in a different way.

Model answer

Protection is one of the most effective strategies for reducing tectonic hazard risk because many deaths in earthquakes are caused by building collapse. Earthquake-resistant buildings use flexible materials and seismic isolators so they are less likely to collapse during shaking. Retrofitting can also strengthen older buildings. This reduces deaths, injuries and economic damage.

However, protection is not the only useful strategy. Early warning systems can detect P-waves before stronger S-waves arrive, giving people seconds or minutes to take cover, stop trains or evacuate buildings. Planning is also important because hazard maps, evacuation plans, drills and education help people prepare before a disaster happens. Overall, protection is probably the most effective for reducing earthquake deaths and damage, but the best way to reduce hazard risk is to combine protection with monitoring, early warning and planning.

Page 26 Activities

Page 26: Exam Ready Question

Question

Using the diagram above, describe the link between air pressure and surface winds. [2 marks]

Mark scheme

Award **1 mark** for identifying that surface winds move from areas of high pressure to areas of low pressure.

Award **1 further mark** for using the diagram to describe this link clearly, such as referring to winds moving from the subtropical high towards the equatorial low, or being deflected by the Coriolis effect.

Possible answers

Surface winds move from areas of **high pressure** to areas of **low pressure**. For example, trade winds move from the subtropical high-pressure areas around 30° north and south towards the low-pressure area at the Equator.

Surface winds are created when air moves from **high pressure** to **low pressure**. The diagram shows this between pressure belts, with winds also being deflected by the Coriolis effect due to the Earth's rotation.

Page 27 Activities

Page 27: 30 Second Recall Answers

Define: Global atmospheric circulation

Global atmospheric circulation is the worldwide movement of air that transfers heat from the Equator towards the poles and creates pressure belts and wind systems.

Accept:

The large-scale movement of air around the Earth caused by unequal heating.

List: Three pressure belts

Any three from:

- Equatorial low pressure
- Subtropical high pressure
- Subpolar low pressure
- Polar high pressure

Explain: Why high pressure leads to dry weather
High pressure leads to dry weather because air is sinking. As it sinks, it warms, so condensation is less likely to occur. This means fewer clouds form and rainfall is low.

Page 27: Blur, Build, Check

Stage 2: Build answers
Students should draw and label the three atmospheric cells, pressure belts and surface winds.
1. Three atmospheric cells
Students should include:
Hadley Cell
- found between **0° and 30°**
- warm, moist air rises at the Equator
- air moves through the upper atmosphere
- air sinks around 30° north and south
- linked to trade winds at the surface

Ferrel Cell
- found between **30° and 60°**
- air moves between the Hadley and Polar cells
- associated with westerly winds
- contributes to variable weather in mid-latitudes, such as the UK

Polar Cell
- found between **60° and 90°**
- cold air sinks at the poles
- air moves towards lower latitudes at the surface
- associated with polar easterlies

2. Pressure belts
Students should label:
- **Equatorial low pressure** at **0°**
- **Subtropical high pressure** around **30° north and south**
- **Subpolar low pressure** around **60° north and south**
- **Polar high pressure** around **90° north and south**

Students should understand that:
- rising air creates **low pressure**
- sinking air creates **high pressure**

3. Surface winds
Students should label:
- **Northeast trade winds** between 30°N and the Equator
- **Southeast trade winds** between 30°S and the Equator
- **Westerlies** between 30° and 60° in both hemispheres
- **Polar easterlies** between 60° and 90° in both hemispheres

Students may also add that surface winds are deflected by the **Coriolis effect** because of the Earth's rotation.

Page 27: Exam Builder

Step 1: Complete the sentences
Question
Warm air _____ at the Equator creating _____ pressure.
At 30° air _____ creating _____ pressure.
Answer
Warm air **rises** at the Equator creating **low** pressure.
At 30° air **sinks** creating **high** pressure.
Accept:
Warm air **rises** at the Equator creating **low** pressure.
At 30° air **descends** creating **high** pressure.

Step 2: Explain why the Equator experiences low pressure. [2 marks]
Mark scheme
Award **1 mark** for identifying that the Equator is heated strongly by the Sun.
Award **1 further mark** for explaining that warm air rises, creating low pressure.
Model answer
The Equator experiences low pressure because it receives intense insolation, so the air is heated strongly. This warm air rises, leaving lower pressure at the surface.

Step 3: Explain how global atmospheric circulation creates areas of high and low pressure. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of global atmospheric circulation, including unequal heating, rising air, sinking air and pressure belts. Accurate terminology is used, such as Equator, 30°, low pressure, high pressure, Hadley Cell or atmospheric cell. **AO2** Shows clear understanding of how global atmospheric circulation creates areas of high and low pressure. Explanation is developed and clearly links rising air to low pressure and sinking air to high pressure.
1 Basic	1–2	**AO1** Shows limited knowledge of global atmospheric circulation. May identify simple ideas such as warm air rises or cool air sinks. **AO2** Shows limited understanding of how areas of high and low pressure are created. Explanation is basic or only partly linked to global circulation.
0	0	No relevant content.

Indicative content
Students may refer to:

- unequal heating of the Earth
- strongest heating at the Equator
- warm, moist air rises at the Equator
- rising air creates low pressure
- rising air cools, condenses and forms clouds/rainfall
- air moves through the upper atmosphere
- air sinks around 30° north and south

- sinking air creates high pressure
- sinking air warms, reducing condensation and rainfall
- pressure belts form around the Earth
- atmospheric cells transfer heat from the Equator towards the poles

Model answer

Global atmospheric circulation creates pressure belts because the Earth is heated unevenly. At the Equator, intense insolation heats the surface and warms the air above it. This warm, moist air rises, creating low pressure at the surface. As the air moves away from the Equator in the upper atmosphere, it cools and becomes denser. Around 30° north and south, air sinks, creating high pressure. This sinking air warms, so there is little condensation and dry weather is common.

Page 27: Exam-style Questions

1.1 What is the name of the atmospheric cell between 0° and 30°? [1 mark]

Mark scheme

Award **1 mark** for the correct atmospheric cell.

Answer

Hadley Cell.

1.2 Describe the typical weather conditions found at 30° north and south. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid weather condition at 30° north and south.

Award **1 further mark** for developing the description or explaining that these conditions are linked to sinking air/high pressure.

Indicative content

Students may refer to:

- dry weather
- clear skies
- low rainfall
- hot desert conditions
- high pressure
- sinking air
- limited cloud formation

Model answer

At 30° north and south, the weather is usually dry with low rainfall. This is because air sinks here, creating high pressure and reducing cloud formation.

1.3 Explain why low pressure is found at the Equator. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of conditions at the Equator, including intense insolation, warm moist air and rising air. Accurate terminology is used, such as Equator, insolation, rising air, condensation and low pressure. **AO2** Shows clear understanding of why these conditions create low pressure. Explanation is developed and links strong heating to rising air and reduced surface pressure.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of conditions at the Equator. May identify that it is hot or that air rises. **AO2** Shows limited understanding of why low pressure forms. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- the Equator receives intense insolation
- the Sun's rays are more concentrated at the Equator
- the surface is strongly heated
- air above the Equator becomes warm
- warm air becomes less dense
- warm, moist air rises
- rising air leaves lower pressure at the surface
- as air rises it cools and condenses, producing cloud and heavy rainfall

Model answer

Low pressure is found at the Equator because the Sun's energy is most concentrated there, so the surface is heated strongly. This heats the air above the surface, making it warmer and less dense. The warm, moist air rises, which reduces the amount of air pressing down on the surface. This creates low pressure. As the air rises, it cools and condenses, producing clouds and heavy rainfall.

1.4 Name the winds that blow from 30° north towards the Equator. [1 mark]

Mark scheme

Award **1 mark** for the correct wind system.

Answer

Northeast trade winds.

Accept:

Trade winds.

1.5 Suggest a reason why winds blow from 30° south towards the Equator. [2 marks]

Mark scheme

Award **1 mark** for identifying the pressure difference between 30° south and the Equator.

Award **1 further mark** for explaining that air moves from high pressure to low pressure.

Model answer

Winds blow from 30° south towards the Equator because there is high pressure at 30° south and low pressure at the Equator. Air moves from high-pressure areas towards low-pressure areas, creating surface winds.

1.6 Explain differential heating. [2 marks]

Mark scheme

Award **1 mark** for identifying that differential heating means the Earth is heated unevenly.

Award **1 further mark** for explaining why this happens or giving a consequence.

Model answer

Differential heating means the Earth is heated unevenly by the Sun. The Equator receives more concentrated solar energy than the poles, so it is heated more strongly, helping to drive global atmospheric circulation.

Alternative model answer

Differential heating is the uneven heating of the Earth's surface. It happens because the Sun's energy is more concentrated at the Equator and spread over a larger area at the poles.

Page 28 Activities

Page 28: Exam Ready Question

Question

Explain the formation of a tropical storm. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the conditions and processes needed for tropical storm formation. Accurate terminology is used, such as warm ocean, 26.5°C, low pressure, condensation, latent heat, low wind shear and Coriolis effect. **AO2** Shows clear understanding of how these processes lead to the development of a tropical storm. Explanation is developed and links warm ocean water, rising air, latent heat and rotation to storm growth.
1 Basic	1–2	**AO1** Shows limited knowledge of tropical storm formation. May identify simple conditions such as warm water or rising air. **AO2** Shows limited understanding of how a tropical storm forms. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- Tropical storms form over warm tropical oceans.
- Sea temperatures need to be at least **26.5°C**.
- Warm water should extend to a depth of about **50 m**.
- Warm, moist air rises.
- Rising air creates low pressure.
- More moist air is drawn in to replace rising air.
- Air cools and condenses.
- Condensation releases latent heat.
- Latent heat provides energy and strengthens the storm.
- Cumulonimbus clouds form.
- Low wind shear allows the storm to build vertically.
- The Coriolis effect causes the storm to rotate.
- Tropical storms form between about **5° and 30° north and south**, not at the Equator.

Model answer

Tropical storms form over warm tropical oceans where sea temperatures are at least **26.5°C**. Warm, moist air rises from the ocean surface, creating an area of low pressure. As the air rises, it cools and condenses, forming cumulonimbus clouds and releasing latent heat. This latent heat provides energy, causing more air to rise and winds to strengthen. Low wind shear allows the storm to build, while the Coriolis effect makes the winds spiral.

Page 29 Activities

Page 29: 30 Second Recall Answers

Define: Tropical storm
A tropical storm is a large rotating storm that forms over warm tropical oceans.
Accept:
A powerful low-pressure storm that forms over warm ocean water in tropical regions.

List: Three conditions needed for formation
Any three from:

- warm ocean water of at least **26.5°C**
- warm water to a depth of about **50 m**
- warm, moist rising air
- low pressure
- low wind shear
- enough Coriolis effect to make the storm spin
- formation between about **5° and 30° north and south**
- condensation releasing latent heat

Explain: Why warm oceans are important
Warm oceans are important because they provide the heat and moisture needed for tropical storms to form. Warm, moist air rises from the ocean surface, creating low pressure. As the air cools and condenses, latent heat is released, giving the storm energy and helping it strengthen.

Page 29: Blur, Build, Check

Stage 2: Build answers
1. Tropical storm formation stages
Students should draw and label the key formation stages.
Stage 1: Ingredients and uplift

- Tropical storms form over warm ocean water of at least **26.5°C**.
- Warm water should extend to a depth of around **50 m**.
- Warm, moist air rises from the ocean surface.
- Rising air creates an area of **low pressure**.
- More moist air is drawn in to replace the rising air.
- Storms form in tropical regions, usually between **5° and 30° north and south**.

Stage 2: Condensation, energy and spin

- Rising air cools and condenses.
- Condensation releases **latent heat**.
- Latent heat provides energy to strengthen the storm.
- Cumulonimbus clouds form.
- The **Coriolis effect** causes the winds to spiral.
- Low wind shear allows the storm to grow vertically.

Stage 3: Mature tropical storm structure

- Strong low-level inflow of air feeds the storm.
- The storm develops spiral rainbands.
- The eyewall forms around the centre.
- The eye is calm and low pressure.
- Air flows out at the top of the storm.
- The storm loses energy when it reaches land or cooler water.

2. The structure of a tropical storm
Students should draw and label:

- **Eye:** calm centre of the storm with very low pressure.
- **Eyewall:** area around the eye with the strongest winds and heaviest rain.
- **Rainbands:** bands of heavy rain and thunderstorms spiralling around the storm.
- **Low-level inflow:** warm, moist air drawn into the storm near the surface.
- **Outflow:** air spreading out at the top of the storm.
- **Cumulonimbus clouds:** tall storm clouds producing heavy rain.
- **Rotating winds:** caused by the Coriolis effect.

Page 29: Exam Builder

Step 1: Complete the sentences
Question
Warm, moist air _____ creating _____ pressure.
As air rises it _____ and _____ releasing _____ heat.
Low wind shear allows the storm to _____.
Answer
Warm, moist air **rises** creating **low** pressure.
As air rises it **cools** and **condenses**, releasing **latent** heat.
Low wind shear allows the storm to **build**.
Accept:
Warm, moist air **rises** creating **low** pressure.
As air rises it **cools** and **condenses**, releasing **latent** heat.
Low wind shear allows the storm to **strengthen/develop**.

Step 2: Explain why tropical storms form over warm oceans. [2 marks]
Mark scheme
Award **1 mark** for identifying that warm oceans provide heat and/or moisture.
Award **1 further mark** for explaining how this supports storm formation.
Model answer
Tropical storms form over warm oceans because warm water provides heat and moisture. This causes warm, moist air to rise, creating low pressure and releasing latent heat when the air condenses, which gives the storm energy.

Step 3: Explain how a tropical storm develops. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the processes involved in tropical storm development. Accurate terminology is used, such as warm ocean, low pressure, condensation, latent heat, cumulonimbus clouds, low wind shear and Coriolis effect. **AO2** Shows clear understanding of how these processes allow a tropical storm to develop and strengthen. Explanation is developed and clearly links rising air, energy release and rotation to storm growth.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of tropical storm development. May identify simple ideas such as warm ocean water, rising air or wind. **AO2** Shows limited understanding of how a storm develops. Explanation is basic or only partly linked to storm growth.
0	0	No relevant content.

Indicative content

Students may refer to:

- tropical storms form over warm ocean water of **26.5°C or more**
- warm, moist air rises
- low pressure is created
- more air is drawn in
- rising air cools and condenses
- latent heat is released
- this provides energy and strengthens the storm
- cumulonimbus clouds form
- low wind shear allows the storm to build
- Coriolis effect causes rotation
- winds spiral and intensify

Model answer

A tropical storm develops when warm, moist air rises from an ocean that is at least **26.5°C**. This creates low pressure at the surface, so more warm, moist air is drawn in. As the rising air cools, it condenses to form cumulonimbus clouds and releases latent heat. This gives the storm more energy, making the air rise faster and the winds strengthen. Low wind shear allows the storm to build, while the Coriolis effect makes the winds spiral.

Page 29: Exam-style Questions

1.1 What latitude do tropical storms form at? [1 mark]

Mark scheme

Award **1 mark** for the correct latitude range.

Answer

5°–30° north and south.

Accept:

Between **5° and 30° north/south of the Equator**.

1.2 Describe the conditions needed for a tropical storm to form. [2 marks]

Mark scheme

Award **1 mark** for identifying one valid condition.

Award **1 further mark** for identifying a second valid condition or developing the description.

Indicative content

Students may refer to:

- ocean temperature of at least **26.5°C**
- warm water to a depth of around **50 m**
- warm, moist air
- low pressure
- low wind shear
- Coriolis effect
- formation between **5° and 30° north and south**

- condensation releasing latent heat

Model answer

Tropical storms need warm ocean water of at least **26.5°C** so there is enough heat and moisture. They also need low wind shear so the storm can build vertically without being broken apart.

1.3 Explain how latent heat helps a tropical storm develop. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of latent heat in tropical storm formation. Accurate terminology is used, such as warm moist air, condensation, cumulonimbus clouds, low pressure and energy. **AO2** Shows clear understanding of how latent heat helps a tropical storm develop. Explanation is developed and links condensation and energy release to stronger uplift, lower pressure and stronger winds.
1 Basic	1–2	**AO1** Shows limited knowledge of latent heat. May identify that heat or energy is released. **AO2** Shows limited understanding of how latent heat helps a storm develop. Explanation is basic or only partly linked to storm growth.
0	0	No relevant content.

Indicative content

- Warm, moist air rises from the ocean.
- Rising air cools.
- Water vapour condenses.
- Condensation releases latent heat.
- Latent heat provides energy to the storm.
- This warms the air and causes more uplift.
- Low pressure deepens.
- More moist air is drawn in.
- Winds strengthen.
- Cumulonimbus clouds build.
- The storm intensifies.

Model answer

Latent heat helps a tropical storm develop because it provides energy. Warm, moist air rises from the ocean and cools as it rises. Water vapour then condenses to form clouds, releasing latent heat. This heat warms the surrounding air, causing it to rise further and strengthening the low pressure. More moist air is drawn into the storm, so winds become stronger and the storm intensifies.

1.4 Name the force that causes tropical storms to rotate. [1 mark]

Mark scheme

Award **1 mark** for the correct force.

Answer

The **Coriolis effect**.

Accept:

Coriolis force.

1.5 Suggest why tropical storms weaken over land. [2 marks]
Mark scheme
Award **1 mark** for identifying that tropical storms lose their warm ocean energy source.
Award **1 further mark** for explaining how this weakens the storm.
Model answer
Tropical storms weaken over land because they are cut off from warm ocean water, which provides heat and moisture. Without this energy source, less latent heat is released and the storm loses strength.
Alternative model answer
Tropical storms weaken over land because there is more friction from the land surface. This slows the winds and disrupts the storm's structure.

1.6 Explain how climate change may affect tropical storms. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid effect of climate change on tropical storms.
Award **1 further mark** for explaining how this affects storm risk or impacts.
Indicative content
Students may refer to:

- warmer oceans may provide more energy
- storms may become more intense
- rainfall may increase
- storm surges may become higher due to sea-level rise
- storm zones may expand to higher latitudes
- frequency is uncertain

Model answer
Climate change may make tropical storms more intense because warmer oceans provide more energy for storms. This could lead to stronger winds, heavier rainfall and greater damage.
Alternative model answer
Climate change may increase the impact of storm surges because sea levels are rising. This means coastal flooding during tropical storms could become more severe.

Page 30 Activities

Page 30: Exam Ready Question

Question
Suggest why some tropical storms have severe primary and secondary impacts. [6 marks]
Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of why tropical storms can create severe primary and secondary impacts. Accurate knowledge of storm hazards, exposure and vulnerability is used. **AO3** Demonstrates detailed application of knowledge and understanding in explaining why impacts vary in severity. Explanation is well developed and links primary impacts, such as deaths and infrastructure damage, to secondary impacts, such as disease, shortages and delayed aid.

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of why tropical storms can have severe impacts. Some accurate examples of primary and/or secondary impacts are used. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining why impacts may become severe. Links between primary and secondary impacts may be present but not fully developed.
1 Basic	1–2	**AO2** Shows limited understanding of tropical storm impacts. May identify simple impacts such as deaths, damage or flooding. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or not clearly linked to severity.
0	0	No relevant content.

Indicative content

Students may refer to:

- Tropical storms can have severe impacts because of strong winds, heavy rainfall, storm surges and flooding.
- People may be injured or killed.
- Buildings and infrastructure may be destroyed.
- Transport links may be damaged.
- Energy and water supplies may be cut off.
- Roads may be blocked, so aid cannot reach affected areas.
- Water supplies may become contaminated, causing illness.
- Food and clean water shortages may develop.
- Businesses may shut down.
- Impacts may be more severe where population density is high.
- Impacts may be more severe where people live in low-lying coastal areas.
- Impacts may be worse in LICs or NEEs because buildings may be weaker and emergency services may be limited.
- Impacts may be worse where warning systems, evacuation plans or shelters are poor.
- Severe primary impacts can create secondary impacts, such as damaged water supplies leading to disease.

Model answer

Some tropical storms have severe primary and secondary impacts because they bring powerful winds, heavy rainfall and storm surges. These can directly injure or kill people and destroy buildings, roads, power lines and water supplies. If a storm affects a densely populated coastal area, more people and property are exposed, so the primary impacts are likely to be more severe.

Secondary impacts can also become severe because the direct damage makes recovery difficult. For example, if roads are blocked, emergency aid may not reach affected communities quickly. If water supplies are damaged or contaminated by floodwater, people may suffer from illness and shortages of clean water. Businesses may also shut down, causing loss of income. Impacts are often worse in poorer countries where buildings may be weaker, warning systems less effective and emergency services more limited.

Page 31 Activities

Page 31: 30 Second Recall Answers

Define: Primary effect
A primary effect is an initial impact caused directly by the tropical storm.
Accept:
A direct impact caused by the storm itself.

List: Two immediate responses
Any two from:

- evacuating people before the storm hits
- setting up shelters for those at risk
- rescuing people affected by the storm
- providing emergency aid
- providing food and clean water
- providing medical help
- temporary shelter

Explain: Why secondary effects can be severe
Secondary effects can be severe because they happen after the storm and can last longer than the initial impact. For example, damaged water supplies may lead to contaminated water and illness, while blocked roads can prevent aid from reaching affected areas. Food and clean water shortages can increase suffering after the storm has passed.

Page 31: Blur, Build, Check

Stage 2: Build answers
1. Four primary effects
Students may include:

- people injured or killed
- buildings destroyed or damaged
- infrastructure destroyed or damaged
- transport links damaged
- roads blocked or damaged
- bridges damaged
- energy supplies cut off
- water supplies cut off
- homes flooded or destroyed

---

2. Three secondary effects
Students may include:

- illnesses from contaminated water
- food shortages
- clean water shortages
- aid unable to reach affected areas because roads are blocked
- businesses shut down
- loss of income
- homelessness
- longer-term disruption to schools, healthcare or services

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3. Three immediate responses
Students may include:

- evacuating people before the storm hits
- setting up shelters for those at risk
- rescuing people affected by the storm
- providing emergency aid
- providing food, water and medical help
- clearing routes for emergency access

---

4. Three long-term responses
Students may include:

- repairing homes
- rehousing people
- improving flood defences
- rebuilding key infrastructure
- boosting the economy
- rebuilding key industries
- planning for future storms
- improving warning systems or evacuation plans

Page 31: Exam Builder

Step 1: Complete the sentences
Question
Primary effects are _____ impacts caused _____ by the storm. Secondary effects are _____ impacts that happen _____. Immediate responses happen _____, while long-term responses happen _____.
Answer
Primary effects are **initial** impacts caused **directly** by the storm. Secondary effects are **indirect** impacts that happen **afterwards**. Immediate responses happen **during or just after the storm**, while long-term responses happen **weeks, months or years later**.
Accept:
Primary effects are **direct** impacts caused **directly** by the storm. Secondary effects are **after-effects/indirect** impacts that happen **after the storm**. Immediate responses happen **immediately**, while long-term responses happen **later**.

Step 2: Describe two secondary effects of tropical storms. [2 marks]
Mark scheme
Award **1 mark** for each valid secondary effect described.
Indicative content
Students may refer to:

- illness from contaminated water
- food shortages
- clean water shortages
- aid delayed because roads are blocked
- businesses shut down
- loss of jobs or income
- homelessness after homes are destroyed
- longer-term disruption to services

Model answer

One secondary effect is illness from contaminated water after floodwater damages water supplies. Another secondary effect is that food and clean water shortages may develop after transport links are damaged.

Step 3: Explain how tropical storms create both primary and secondary effects. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of primary and secondary effects of tropical storms. Accurate examples are used, such as deaths, injuries, buildings destroyed, transport damage, contaminated water, shortages, blocked roads or businesses shutting down. **AO2** Shows clear understanding of how tropical storms create both direct impacts and after-effects. Explanation is developed and links primary effects to secondary effects.
1 Basic	1–2	**AO1** Shows limited knowledge of primary and/or secondary effects of tropical storms. May identify simple impacts such as damage, deaths or flooding. **AO2** Shows limited understanding of how tropical storms create effects. Explanation is basic or only one type of effect is covered clearly.
0	0	No relevant content.

Indicative content
Primary effects may include:

- people injured or killed
- buildings and infrastructure destroyed
- transport links damaged
- energy and water supplies cut off

Secondary effects may include:

- illness from contaminated water
- food and clean water shortages
- aid delayed because roads are blocked
- businesses shut down
- loss of jobs or income

Students may explain that:

- strong winds, heavy rain, storm surges and flooding directly damage people, buildings and infrastructure
- damage to roads, water supplies and energy supplies creates later secondary impacts
- blocked roads delay aid and rescue
- damaged water supplies can lead to disease
- damaged businesses and infrastructure can affect livelihoods and recovery

Model answer
Tropical storms create primary effects because strong winds, heavy rainfall, storm surges and flooding directly affect people and property. For example, people may be injured or killed, buildings may be destroyed and transport links may be damaged. These primary effects can then lead to secondary effects. If water supplies are damaged, people may have to use contaminated water, which can cause illness. If roads are blocked, emergency aid may not reach affected areas quickly, leading to shortages of food and clean water.

Page 31: Exam-style Questions

1.1 What is meant by a primary effect? [1 mark]

Mark scheme

Award **1 mark** for a valid definition.

Answer

A primary effect is an initial impact caused directly by the storm.

Accept:

A direct impact caused by the tropical storm itself.

1.2 Describe two primary effects of tropical storms. [2 marks]

Mark scheme

Award **1 mark** for each valid primary effect described.

Indicative content

Students may refer to:

- people injured
- people killed
- buildings destroyed or damaged
- infrastructure destroyed or damaged
- transport links damaged
- roads damaged
- bridges damaged
- energy supplies cut off
- water supplies cut off
- homes flooded or destroyed

Model answer

People may be injured or killed by strong winds, flooding or storm surges. Buildings and infrastructure may also be destroyed by powerful winds and heavy rainfall.

1.3 Explain how one primary effect can lead to secondary effects. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of the difference between primary and secondary effects of tropical storms. Accurate examples are used. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how one direct impact of a tropical storm can lead to later indirect impacts. Explanation is developed and clearly linked.
1 Basic	1–2	**AO2** Shows limited understanding of primary and/or secondary effects. May identify simple examples. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly shows how one effect leads to another.
0	0	No relevant content.

Indicative content

Students may explain:

- damaged water supplies can lead to contaminated water and illness

- damaged roads can stop aid reaching affected areas, causing shortages
- destroyed buildings can lead to homelessness and need for shelters
- damaged businesses can lead to loss of jobs and income
- damaged energy supplies can disrupt hospitals, water treatment and communication
- flooding can contaminate crops or farmland, causing food shortages

Model answer

One primary effect of a tropical storm is damage to water supplies. This can lead to secondary effects because floodwater may contaminate drinking water. If people do not have access to clean water, illnesses can spread after the storm. This can make the overall impact more severe and increase pressure on medical services.

1.4 Give one example of an immediate response. [1 mark]

Mark scheme

Award **1 mark** for a valid immediate response.

Acceptable answers

- evacuating people before the storm hits
- setting up shelters
- rescuing people affected
- providing emergency aid
- providing food and clean water
- providing medical help

Model answer

Rescuing people affected by the storm.

1.5 Suggest why some tropical storms have severe impacts. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason why impacts may be severe.
Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- high wind speeds
- heavy rainfall
- storm surges
- coastal flooding
- high population density
- people living in low-lying coastal areas
- weak buildings
- poverty
- limited warning systems
- limited evacuation plans
- poor emergency response
- damaged roads delaying aid

Model answer

Some tropical storms have severe impacts because they produce storm surges and heavy rainfall, which can cause major coastal flooding. This can destroy homes and contaminate water supplies, increasing the number of people affected.

Alternative model answer

Impacts may be severe in poorer countries because buildings may be weaker and emergency services may be less effective. This can increase deaths, injuries and damage.

1.6 Explain the difference between immediate and long-term responses. [2 marks]

Mark scheme
Award **1 mark** for explaining what immediate responses are.
Award **1 mark** for explaining what long-term responses are.
Model answer
Immediate responses happen during or just after the storm and include actions such as rescue, shelters and emergency aid. Long-term responses happen weeks, months or years later and include repairing homes, rehousing people, improving flood defences and planning for future storms.

Page 32 Activities

Page 32: Exam Ready Question

Question
Both immediate and long-term responses are required after a tropical storm. Using an example, discuss this statement. [9 marks]
Assessment objectives

- **AO1 = 3 marks**
- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	7–9	**AO1** Shows detailed knowledge of immediate and long-term responses to a named tropical storm, such as Typhoon Haiyan. Accurate place-specific evidence is used, including facts about impacts and responses. **AO2** Shows detailed understanding of why different responses are needed at different stages after a tropical storm. Explanation clearly links immediate responses to survival and long-term responses to recovery and future resilience. **AO3** Demonstrates detailed evaluation of the statement. A clear, supported judgement is made about the relative importance of immediate and long-term responses.
2 Clear	4–6	**AO1** Shows clear knowledge of immediate and/or long-term responses to a named tropical storm. Some accurate place-specific evidence is used. **AO2** Shows clear understanding of why responses are needed after a tropical storm. Explanation links responses to reducing impacts or supporting recovery. **AO3** Demonstrates reasonable evaluation of the statement. A judgement may be present but may not be fully developed or may focus more strongly on one type of response.
1 Basic	1–3	**AO1** Shows limited knowledge of responses to a tropical storm. Some information may be generalised or lack clear place-specific detail. **AO2** Shows limited understanding of why responses are needed. Explanation is basic or descriptive. **AO3** Demonstrates limited evaluation. Response may be one-sided, unsupported or lack a clear judgement.
0	0	No relevant content.

Indicative content

Students may refer to Typhoon Haiyan:

- Typhoon Haiyan made landfall in the **Philippines** on **8 November 2013**.
- It was a **Category 5** storm.
- Wind speeds reached up to **314 km/h**.
- **280 mm** of rain fell in 24 hours.
- A **5 m storm surge** struck Tacloban.
- Over **6,300 people were killed**.
- Around **29,000 people were injured**.
- Around **1 million homes were destroyed**.
- About **1.9 million people were made homeless**.
- **600,000 hectares** of farmland were flooded.
- Water supplies were contaminated by salt water.
- Damage cost about **$12 billion**.
- Landslides blocked roads and delayed aid.
- About **5.6 million people lost jobs**.
- Disease outbreaks such as cholera were a risk.
- Power supplies were cut off for months.

Immediate responses may include:

- PAGASA issued warnings **two days before landfall**.
- Around **800,000 people were evacuated**.
- Fishermen were warned not to go to sea.
- Emergency aid was provided.
- The UN appealed for over **$300 million** to help with relief and rebuilding.

Long-term responses may include:

- **Build Back Better** was launched by the government.
- Damaged buildings were upgraded to protect against future disasters.
- Cash for work programmes helped people earn money during recovery.
- Rebuilding supported longer-term recovery and resilience.

Students may argue that immediate responses were required because:

- people needed urgent evacuation, food, water, shelter and medical help
- warnings and evacuation reduced loss of life
- emergency aid was needed after homes, power and water supplies were damaged
- blocked roads and contaminated water increased the need for urgent support

Students may argue that long-term responses were required because:

- homes, livelihoods and infrastructure needed rebuilding
- many people lost jobs and homes
- long-term programmes helped reduce vulnerability to future storms
- recovery from such widespread damage took months or years

Model answer

Both immediate and long-term responses were needed after Typhoon Haiyan because the storm caused severe short-term and long-term impacts. Haiyan made landfall in the **Philippines** on **8 November 2013** as a **Category 5** storm, with winds of up to **314 km/h** and a **5 m storm surge**.

Immediate responses were essential because people's lives were at risk. PAGASA issued warnings two days before landfall and about **800,000 people were evacuated**, which helped move people away from danger. Emergency aid was also needed because over **6,300 people were killed**, around **29,000 were injured**, and water supplies were contaminated by salt water.

However, long-term responses were also required because the damage lasted well beyond the storm itself. Around **1 million homes** were destroyed and about **1.9 million people** were made homeless, so rebuilding was essential. About **5.6 million people lost jobs**, meaning people needed help to recover their livelihoods. The government's **Build Back Better** programme aimed to upgrade damaged

buildings and reduce vulnerability to future disasters. Cash for work programmes also helped people earn money during recovery.
Overall, I agree with the statement. Immediate responses are vital in the hours and days after the storm because they save lives and meet urgent needs. However, long-term responses are equally important because they help communities rebuild, recover economically and become better prepared for future tropical storms.

Page 33 Activities

Page 33: 30 Second Recall Answers

Define: Storm surge
A storm surge is a rise in sea level caused by strong winds and low pressure during a tropical storm, which can flood coastal areas.

List: Two primary effects
Any two from:

- over **6,300 people were killed**
- about **29,000 people were injured**
- around **1 million homes were destroyed**
- about **1.9 million people were made homeless**
- **600,000 hectares** of farmland were flooded
- water supplies were contaminated by salt water
- about **$12 billion** of damage was caused

Explain: Why the storm surge caused severe damage
The storm surge caused severe damage because a **5 m wall of water** struck low-lying coastal areas, including **Tacloban**. This flooded homes, roads and farmland, destroyed buildings, contaminated water supplies with salt water and increased deaths and homelessness.

Page 33: Blur, Build, Check

Stage 2: Build answers
1. Key facts
Students should include:

- Typhoon Haiyan occurred in the **Philippines**.
- It made landfall on **8 November 2013**.
- It was a **Category 5** tropical storm.
- Wind speeds reached up to **314 km/h**.
- Around **280 mm** of rain fell in 24 hours.
- A **5 m storm surge** struck Tacloban.
- It originated in the **north-west Pacific Ocean**.
- Ocean temperatures were around **30°C** where the storm formed.

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2. Three primary effects
Any three from:

- Over **6,300 people were killed**.
- Around **29,000 people were injured**.
- Around **1 million homes were destroyed**.
- About **1.9 million people were made homeless**.

- **600,000 hectares** of farmland were flooded.
- Water supplies were contaminated by salt water.
- Damage cost about **$12 billion**.

---

3. Three secondary effects
Any three from:
- Landslides blocked roads and delayed aid.
- About **5.6 million people lost jobs** as businesses were destroyed.
- Disease outbreaks such as cholera were a risk.
- Fishing waters and mangroves were contaminated when an oil tanker ran aground.
- Looting was rife.
- Power supplies were cut off for months.

---

4. Two immediate responses
Any two from:
- PAGASA issued warnings two days before landfall.
- Around **800,000 people were evacuated**.
- Fishermen were warned not to go to sea.
- Emergency aid was provided.
- The UN appealed for over **$300 million** to help provide relief and rebuilding support.

---

5. Two long-term responses
Any two from:
- The government launched **Build Back Better**.
- Damaged buildings were upgraded to protect against future disasters.
- Cash for work programmes helped people earn money during recovery.
- Rebuilding took place to restore homes and infrastructure.
- Long-term recovery programmes supported livelihoods.

Page 33: Exam Builder

Step 1: Complete the sentences
Question
Typhoon Haiyan made landfall on _____ in the _____. It had wind speeds of _____ and a storm surge of _____. Around _____ people were left homeless.
Answer
Typhoon Haiyan made landfall on **8 November 2013** in the **Philippines**. It had wind speeds of **314 km/h** and a storm surge of **5 m**. Around **1.9 million** people were left homeless.
Accept:
Typhoon Haiyan made landfall on **8 November 2013** in the **Philippines**. It had wind speeds of **up to 314 km/h** and a storm surge of **5 metres**. Around **1.9 million** people were left homeless.

Step 2: Outline one primary effect of Typhoon Haiyan. [2 marks]
Mark scheme
Award **1 mark** for identifying one valid primary effect of Typhoon Haiyan.
Award **1 further mark** for developing it with detail or data.
Indicative content
Primary effects may include:
- over 6,300 people killed
- around 29,000 injured
- around 1 million homes destroyed

- about 1.9 million made homeless
- 600,000 hectares of farmland flooded
- water supplies contaminated by salt water
- about $12 billion damage

Model answer

One primary effect of Typhoon Haiyan was that around **1 million homes were destroyed**. This meant about **1.9 million people were left homeless**.

Alternative model answer

One primary effect was the loss of life. Over **6,300 people were killed** by the storm, with many deaths linked to the storm surge and flooding.

Step 3: Explain how Typhoon Haiyan caused both primary and secondary effects. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the primary and secondary effects of Typhoon Haiyan. Accurate place-specific evidence is used, such as deaths, injuries, homes destroyed, farmland flooded, landslides, disease risk, jobs lost or power cuts. **AO2** Shows clear understanding of how the tropical storm caused direct impacts and how these led to later indirect impacts. Explanation is developed and clearly links primary effects to secondary effects.
1 Basic	1–2	**AO1** Shows limited knowledge of effects of Typhoon Haiyan. May identify simple effects such as deaths, flooding or damage. **AO2** Shows limited understanding of primary and secondary effects. Explanation is basic or only one type of effect is covered clearly.
0	0	No relevant content.

Indicative content

Primary effects:

- strong winds, heavy rain and storm surge directly damaged people, homes, infrastructure and farmland
- over 6,300 killed
- 29,000 injured
- 1 million homes destroyed
- 1.9 million homeless
- 600,000 hectares of farmland flooded
- water supplies contaminated by salt water
- $12 billion damage

Secondary effects:

- landslides blocked roads and delayed aid
- businesses destroyed, leaving 5.6 million people without jobs
- disease outbreaks such as cholera
- oil tanker ran aground, contaminating fishing waters and mangroves
- looting
- power supplies cut off for months

Model answer

Typhoon Haiyan caused primary effects because powerful winds, heavy rain and a **5 m storm surge** directly damaged people and places. Over **6,300 people were killed**, around **29,000 were injured** and about **1 million homes** were destroyed. These direct impacts then led to secondary effects. For example, landslides blocked roads, which delayed aid reaching affected communities. Businesses were destroyed, so about **5.6 million people lost jobs**, and contaminated water increased the risk of disease such as cholera.

Page 33: Exam-style Questions

1.1 Where did Typhoon Haiyan take place? [1 mark]
Mark scheme
Award **1 mark** for the correct country.
Answer
The **Philippines**.

1.2 Describe two primary effects of Typhoon Haiyan. [2 marks]
Mark scheme
Award **1 mark** for each valid primary effect described.
Indicative content
Students may refer to:

- Over **6,300 people were killed**.
- Around **29,000 people were injured**.
- Around **1 million homes were destroyed**.
- About **1.9 million people were made homeless**.
- **600,000 hectares** of farmland were flooded.
- Water supplies were contaminated by salt water.
- Damage was estimated at about **$12 billion**.

Model answer
Over **6,300 people were killed** by Typhoon Haiyan. Around **1 million homes were destroyed**, leaving about **1.9 million people homeless**.

1.3 Explain how one primary effect led to secondary effects. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of the link between primary and secondary effects in Typhoon Haiyan. Accurate example detail is used, such as water contamination, farmland flooding, home destruction, road blockage, job losses, disease or delayed aid. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how one direct impact of Typhoon Haiyan caused later indirect impacts. Explanation is developed and clearly linked.
1 Basic	1–2	**AO2** Shows limited understanding of primary and/or secondary effects. May identify a simple primary or secondary effect. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly shows how one effect led to another.

Level	Marks	Description
0	0	No relevant content.

Indicative content

Students may explain links such as:

- Water supplies contaminated by salt water led to disease risk such as cholera.
- Farmland flooding damaged crops, reducing food supply and income.
- Homes destroyed led to homelessness and need for shelter.
- Roads blocked by landslides delayed aid and rescue.
- Businesses destroyed led to job losses for about 5.6 million people.
- Power supplies being damaged led to power cuts lasting for months, disrupting services.

Model answer

One primary effect of Typhoon Haiyan was that water supplies were contaminated by salt water from the storm surge. This led to secondary effects because people had limited access to safe drinking water. As a result, there was a greater risk of disease outbreaks such as cholera. This made recovery harder because people needed clean water, medical support and emergency aid after the storm.

1.4 Give one immediate response to Typhoon Haiyan. [1 mark]

Mark scheme

Award **1 mark** for one valid immediate response.

Acceptable answers

- PAGASA issued warnings two days before landfall.
- About **800,000 people were evacuated**.
- Fishermen were warned not to go to sea.
- Emergency aid was provided.
- The UN appealed for over **$300 million** to support relief and rebuilding.

Model answer

About **800,000 people were evacuated** before the storm.

1.5 Suggest why recovery took a long time after the storm. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason recovery took a long time.

Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- around **1 million homes** were destroyed
- about **1.9 million people** were made homeless
- power supplies were cut off for months
- roads were blocked by landslides, delaying aid
- businesses were destroyed
- about **5.6 million people lost jobs**
- farmland was flooded
- water supplies were contaminated
- damage cost about **$12 billion**
- rebuilding needed significant funding and time

Model answer

Recovery took a long time because around **1 million homes were destroyed**, leaving about **1.9 million people homeless**. This meant large-scale rebuilding was needed before people could return to normal life.

Alternative model answer

Recovery took a long time because landslides blocked roads and delayed aid. This made it harder to reach affected areas and slowed the delivery of food, water and medical supplies.

1.6 Explain how long-term responses reduced the impacts of future storms. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of long-term responses after Typhoon Haiyan. Accurate examples are used, such as Build Back Better, upgrading damaged buildings, rebuilding, cash for work programmes or longer-term recovery support. **AO2** Shows clear understanding of how long-term responses reduced the impacts of future storms. Explanation is developed and links responses to improved resilience, stronger buildings, recovery of livelihoods or reduced vulnerability.
1 Basic	1–2	**AO1** Shows limited knowledge of long-term responses after Typhoon Haiyan. May identify a simple response such as rebuilding. **AO2** Shows limited understanding of how long-term responses reduce future impacts. Explanation is basic or generalised.
0	0	No relevant content.

Indicative content

Long-term responses may include:

- **Build Back Better** programme
- upgrading damaged buildings
- rebuilding stronger homes and infrastructure
- protecting people from future disasters
- cash for work programmes
- support for livelihoods
- longer-term rebuilding and recovery

Students may explain that these reduced impacts by:

- making buildings less likely to collapse in future storms
- improving community resilience
- helping people recover livelihoods and income
- reducing long-term vulnerability
- supporting safer reconstruction rather than simply replacing damaged buildings

Model answer

Long-term responses reduced the impacts of future storms by helping communities become more resilient. The **Build Back Better** programme upgraded damaged buildings so they were stronger and better able to withstand future tropical storms. This means fewer homes and buildings are likely to be destroyed in later events. Cash for work programmes also helped people earn money during recovery, reducing vulnerability by helping households rebuild their lives and livelihoods.

Page 34 Activities

Page 34: Exam Ready Question

Question

Suggest why some tropical storms have severe primary and secondary impacts. [6 marks]

This question appears to repeat the exam-ready question from the previous section on effects and responses. It can still be marked using the management focus of this page by allowing students to discuss storm severity, exposure, vulnerability and preparedness.

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of why tropical storms can have severe primary and secondary impacts. Accurate understanding of storm hazards, exposure, vulnerability and levels of preparation is shown. **AO3** Demonstrates detailed application of knowledge and understanding in explaining why impacts become severe, including how limited monitoring, prediction, protection or planning may increase deaths, damage and longer-term disruption.
2 Clear	3–4	**AO2** Shows clear understanding of why tropical storms can have severe impacts. Some accurate reference is made to storm hazards, exposure, vulnerability or preparedness. **AO3** Demonstrates reasonable application of knowledge and understanding in explaining why impacts may be worse in some places than others.
1 Basic	1–2	**AO2** Shows limited understanding of tropical storm impacts. May identify simple reasons such as strong winds, heavy rain, poverty or weak buildings. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or not clearly linked to severity of impacts.
0	0	No relevant content.

Indicative content

Students may refer to:

- Strong winds, heavy rainfall, flooding and storm surges can cause severe primary impacts.
- Primary impacts may include deaths, injuries, damaged buildings, damaged infrastructure and loss of power or water.
- Secondary impacts may include disease, food shortages, clean water shortages, delayed aid and loss of income.
- Impacts are often worse in densely populated coastal areas.
- Low-lying coastal areas are vulnerable to storm surges and flooding.
- Less developed countries may have weaker buildings and fewer coastal defences.
- Limited monitoring and prediction can reduce warning time.
- Poor planning can mean evacuation is slower or less effective.
- Limited protection, such as weak buildings, few shelters or poor coastal defences, can increase damage.
- Blocked roads and damaged infrastructure can delay aid and increase secondary impacts.

Model answer

Some tropical storms have severe primary and secondary impacts because they bring strong winds, heavy rainfall, flooding and storm surges. These can directly injure or kill people, destroy buildings and damage transport, energy and water supplies. If a storm hits a densely populated low-lying coastal area, many people and buildings are exposed, so the primary impacts are likely to be severe. Secondary impacts can become worse if a country is poorly prepared. If monitoring and prediction systems are weak, people may not receive warnings in time to evacuate. If buildings are not reinforced and there are few storm shelters or coastal defences, damage and deaths may increase. Damaged roads can also delay emergency aid, while contaminated water can lead to disease. This means limited planning, prediction and protection can make both primary and secondary impacts more severe.

Page 35 Activities

Page 35: 30 Second Recall Answers

Define: Monitoring
Monitoring is tracking the development of a tropical storm using satellites, radar and aircraft.
Accept:
Monitoring means observing and measuring a storm so scientists can track how it develops.

List: The four management strategies

- Monitoring
- Prediction
- Protection
- Planning

Explain: How planning reduces loss of life
Planning reduces loss of life by preparing people and places before a tropical storm happens. Evacuation plans show people where to go, education helps people understand the risks, and stockpiled food and water help people survive after the storm. Early warning systems also allow people to move to safer places before the storm arrives.

Page 35: Blur, Build, Check

Stage 2: Build answers
1. The four management strategies
Students should identify:

- **Monitoring**
- **Prediction**
- **Protection**
- **Planning**

2. Examples of each strategy

Strategy	Examples
Monitoring	Satellites, radar, aircraft, continuous data collection by scientists
Prediction	Computer models, hurricane forecasts, predicting path, timing and intensity
Protection	Reinforced concrete buildings, window shutters, raised storm shelters, sea walls, mangroves

Strategy	Examples
Planning	Education, evacuation plans, early warning systems, NGO support, stockpiling food and water

3. How each strategy reduces impacts

Monitoring

Monitoring helps identify storms early by using satellites, radar and aircraft to track storm development. Aircraft can measure wind speed, air pressure and temperature, which helps scientists understand how strong the storm is becoming.

Prediction

Prediction uses computer models to forecast the storm's path, timing and intensity. This allows warnings to be issued so people can prepare and evacuate.

Protection

Protection reduces damage by making buildings and places safer. Reinforced buildings, window shutters, raised shelters, sea walls and mangroves can reduce physical damage, flooding and loss of life.

Planning

Planning prepares communities before storms happen. Education, evacuation plans, warning systems and stockpiled supplies help people act quickly and safely, reducing deaths and injuries.

Page 35: Exam Builder

Step 1: Complete the sentences

Question

Monitoring uses _____ and _____ to track storms. Prediction uses _____ to forecast _____ and _____. Protection reduces _____ damage, while planning reduces _____.

Answer

Monitoring uses **satellites** and **radar** to track storms. Prediction uses **computer models** to forecast **path** and **intensity**. Protection reduces **physical** damage, while planning reduces **loss of life**.

Accept:

Monitoring uses **satellites** and **aircraft** to track storms. Prediction uses **computer models** to forecast **timing** and **strength**. Protection reduces **storm** damage, while planning reduces **deaths/injuries/risk**.

Step 2: Explain how prediction helps reduce the impacts of tropical storms. [2 marks]

Mark scheme

Award **1 mark** for identifying that prediction forecasts the storm's path, timing or strength.

Award **1 further mark** for explaining how this reduces impacts, such as by allowing warnings, evacuation or preparation.

Indicative content

Students may refer to:

- computer models analyse data
- forecasts predict path, timing and intensity
- early warnings can be issued
- people can evacuate
- emergency services can prepare
- food and water can be stockpiled
- shelters can be opened
- deaths and injuries may be reduced

Model answer
Prediction helps reduce impacts because computer models can forecast the path, timing and strength of a tropical storm. This allows warnings to be issued so people can evacuate, prepare shelters and stockpile supplies before the storm arrives.

Step 3: Explain how management strategies reduce the effects of tropical storms. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of tropical storm management strategies. Accurate examples are used, such as monitoring, prediction, protection, planning, satellites, radar, computer models, reinforced buildings, shutters, sea walls, evacuation plans or education. **AO2** Shows clear understanding of how management strategies reduce the effects of tropical storms. Explanation is developed and links strategies to reduced deaths, injuries, physical damage or disruption.
1 Basic	1–2	**AO1** Shows limited knowledge of tropical storm management strategies. May identify one or more simple strategies, such as warnings or evacuation. **AO2** Shows limited understanding of how strategies reduce effects. Explanation is basic, generalised or only partly linked to reducing impacts.
0	0	No relevant content.

Indicative content
Students may refer to:

- Monitoring uses satellites, radar and aircraft to track storm development.
- Aircraft measure wind speed, air pressure and temperature.
- Prediction uses computer models to forecast path, timing and intensity.
- Early warnings allow people to prepare and evacuate.
- Protection includes reinforced buildings, window shutters, raised shelters, sea walls and mangroves.
- Protection reduces physical damage and loss of life.
- Planning includes education, evacuation plans, early warning systems and stockpiling food and water.
- NGOs such as the Red Cross can provide support.
- Planning reduces deaths and injuries by improving preparedness.

Model answer
Management strategies reduce the effects of tropical storms in different ways. Monitoring uses satellites, radar and aircraft to track storm development, helping scientists identify storms early. Prediction uses computer models to forecast the storm's path, timing and intensity, so warnings can be issued and people can evacuate before the storm arrives. Protection also reduces impacts because reinforced buildings, shutters, sea walls and mangroves can reduce physical damage. Planning, such as education, evacuation plans and stockpiling food and water, helps communities respond quickly and safely, reducing deaths and injuries.

Page 35: Exam-style Questions

1.1 Name one method used to monitor tropical storms. [1 mark]

Mark scheme
Award **1 mark** for naming one valid monitoring method.
Acceptable answers
- satellites
- radar
- aircraft
- continuous data collection by scientists

Model answer
Satellites.

1.2 Describe how protection reduces the impacts of tropical storms. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid protection method.
Award **1 further mark** for describing how it reduces impacts.
Indicative content
Students may refer to:
- reinforced buildings are less likely to collapse
- window shutters reduce damage from high winds and flying debris
- storm shelters protect people from wind and flooding
- raised shelters protect people from floodwater
- sea walls reduce coastal flooding from storm surges
- mangroves absorb wave energy and reduce coastal flooding
- protection reduces physical damage, deaths and injuries

Model answer
Protection reduces impacts by making buildings and coastal areas safer. For example, reinforced buildings and window shutters reduce damage from strong winds, while sea walls and mangroves can reduce flooding from storm surges.

1.3 Explain how monitoring and prediction help reduce loss of life. [4 marks]
Assessment objectives
- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of monitoring and prediction of tropical storms. Accurate examples are used, such as satellites, radar, aircraft, computer models, forecasting path, timing and intensity, or early warnings. **AO2** Shows clear understanding of how monitoring and prediction reduce loss of life. Explanation is developed and links early identification and forecasting to warnings, preparation and evacuation.
1 Basic	1–2	**AO1** Shows limited knowledge of monitoring and/or prediction. May identify simple examples such as satellites or warnings. **AO2** Shows limited understanding of how monitoring and prediction reduce loss of life. Explanation is basic or only partly linked to safety.
0	0	No relevant content.

Indicative content
Students may refer to:
- monitoring uses satellites, radar and aircraft

- monitoring tracks storm development
- aircraft measure wind speed, air pressure and temperature
- monitoring identifies storms early
- prediction uses computer models
- models forecast path, timing and intensity
- early warnings are issued
- people can prepare or evacuate
- shelters can be opened
- emergency services can prepare
- this reduces deaths and injuries

Model answer

Monitoring helps reduce loss of life because satellites, radar and aircraft track tropical storms as they develop. This helps scientists identify storms early and collect data on wind speed, air pressure and temperature. Prediction then uses computer models to forecast the storm's path, timing and intensity. This allows early warnings to be issued so people can evacuate, move to shelters and prepare before the storm arrives, reducing deaths and injuries.

1.4 Give one example of planning for tropical storms. [1 mark]

Mark scheme

Award **1 mark** for one valid example of planning.

Acceptable answers

- evacuation plans
- education about risks
- early warning systems
- stockpiling food and water
- preparing shelters
- NGO support
- community drills
- government preparation

Model answer

Evacuation plans.

1.5 Suggest why some countries are better prepared for tropical storms. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason why some countries are better prepared.

Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- higher level of economic development
- more money for satellites, radar and computer models
- better emergency services
- stronger buildings
- better coastal defences
- more effective warning systems
- better education and evacuation planning
- more reliable communication systems
- more experience of frequent tropical storms
- government organisation and investment

Model answer

Some countries are better prepared because they are more economically developed and can afford advanced monitoring and prediction systems, such as satellites, radar and computer models. This allows warnings to be issued earlier so people can evacuate before the storm arrives.

Alternative model answer

Some countries are better prepared because they have stronger buildings, coastal defences and organised evacuation plans. This reduces damage and helps people respond more safely.

1.6 Explain how protection and planning work together to reduce impacts. [2 marks]

Mark scheme

Award **1 mark** for explaining how protection reduces impacts.
Award **1 mark** for explaining how planning reduces impacts.
For full marks, the answer should show how both strategies work together.

Model answer

Protection reduces impacts by making buildings and coastal areas safer, for example through reinforced buildings, shutters, shelters, sea walls or mangroves. Planning reduces impacts by making sure people know what to do, such as following evacuation plans and warnings, so fewer people are exposed to danger.

Alternative model answer

Protection can reduce physical damage from strong winds and flooding, while planning helps people evacuate and reach shelters before the storm arrives. Together, they reduce both damage and loss of life.

Page 36 Activities

Page 36: Exam Ready Question

Question

Outline one example of extreme weather experienced in the UK. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid example of extreme weather experienced in the UK.
Award **1 further mark** for outlining the nature of the hazard or one impact.

Indicative content

Students may refer to:

- storms
- heavy rainfall
- flooding
- heatwaves
- drought
- extreme cold
- snow
- ice
- strong winds

Possible answers

One example of extreme weather experienced in the UK is a **storm**. Storms bring strong winds and heavy rainfall, which can damage buildings and disrupt transport.
One example is **heavy rainfall**. This can increase surface runoff and river discharge, leading to flooding.
One example is a **heatwave**. Heatwaves occur during prolonged high pressure in summer and can cause health risks, water shortages and crop failure.
One example is **extreme cold and snow**. This can cause transport disruption, school closures, accidents and increased risk of death.

Page 37 Activities

Page 37: 30 Second Recall Answers

Define: Weather hazard
A weather hazard is an atmospheric event that has the potential to cause damage, disruption, injury or death.
Accept:
A type of extreme weather that can affect people, property or the environment.

List: Three UK weather hazards
Any three from:

- storms
- heavy rainfall
- flooding
- heatwaves
- drought
- extreme cold
- snow
- ice
- strong winds

Explain: Why the UK experiences a range of weather hazards
The UK experiences a range of weather hazards because it is affected by different air masses from different directions. Its maritime climate and position between the Atlantic Ocean and continental Europe mean it can experience low-pressure storms, heavy rainfall, heatwaves during high pressure and extreme cold from polar continental air masses.

Page 37: Blur, Build, Check

Stage 2: Build answers
1. Four types of UK weather hazard
Students may include:

- storms
- heavy rainfall
- heatwaves
- extreme cold and snow

Also accept:

- flooding
- drought
- strong winds
- ice

---

2. One cause of each hazard

Weather hazard	Cause
Storms	Low pressure systems, also called depressions
Heavy rainfall	Frontal rainfall linked to depressions, or convectional rainfall in summer storms

Weather hazard	Cause
Heatwaves	Prolonged high pressure in summer
Extreme cold and snow	Polar continental air masses, often from Siberia or eastern Europe

Accept any valid causal link.

---

3. Two impacts of weather hazards
Students may include any two from:

- flooding
- damage to homes
- damage to infrastructure
- power cuts
- transport disruption
- school closures
- increased accidents
- deaths or injuries
- water shortages
- crop failure
- health risks, especially for elderly or vulnerable people
- landslides
- increased river discharge
- damage to buildings
- disruption to businesses

Page 37: Exam Builder

Step 1: Complete the sentences
Question
Storms are caused by _____ systems and bring _____ and _____. Heatwaves occur during _____ pressure, leading to _____ conditions. Extreme cold is caused by _____ air masses.
Answer
Storms are caused by **low pressure** systems and bring **strong winds** and **heavy rain**. Heatwaves occur during **high** pressure, leading to **hot, dry** conditions. Extreme cold is caused by **polar continental** air masses.
Accept:
Storms are caused by **depression/low pressure** systems and bring **strong winds** and **heavy rainfall**. Heatwaves occur during **prolonged high** pressure, leading to **clear, hot and dry** conditions. Extreme cold is caused by **polar continental** air masses.

Step 2: Describe two weather hazards experienced in the UK. [2 marks]
Mark scheme
Award **1 mark** for each valid described weather hazard.
For each mark, the hazard must be named or clearly identifiable and described with a relevant feature.
Indicative content
Students may refer to:

- Storms bring strong winds and heavy rainfall.
- Heavy rainfall may be intense or prolonged and can lead to flooding.
- Heatwaves involve very high temperatures during prolonged high pressure.

- Drought develops when rainfall is below average over time.
- Extreme cold involves snow, ice and freezing temperatures.

Model answer

Storms are a weather hazard in the UK because they bring strong winds and heavy rainfall. Heatwaves are another hazard because they involve very high temperatures during prolonged high pressure in summer.

Step 3: Explain how weather hazards can impact people and the environment in the UK. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how UK weather hazards can affect people and the environment. Accurate examples of impacts are used, such as flooding, transport disruption, power cuts, health risks, crop failure, landslides, damage to homes or impacts on wildlife. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how specific UK weather hazards lead to social, economic or environmental impacts.
1 Basic	1–2	**AO2** Shows limited understanding of impacts of UK weather hazards. May identify simple impacts such as damage, flooding or disruption. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to people or the environment.
0	0	No relevant content.

Indicative content

Students may refer to impacts on people:

- storms can damage homes and infrastructure
- strong winds can cause power cuts
- heavy rainfall can lead to flooding
- flooding can damage homes and businesses
- transport disruption can affect work, school and emergency services
- extreme cold can cause deaths, accidents and school closures
- heatwaves can cause health risks, especially for elderly or vulnerable people
- drought can cause water shortages

Students may refer to environmental impacts:

- heavy rainfall can increase surface runoff and river discharge
- flooding can damage habitats
- landslides can be triggered
- drought and heatwaves can cause crop failure
- extreme cold can affect wildlife
- storms can damage trees and coastal environments

Model answer

Weather hazards can affect people in the UK by damaging homes, infrastructure and services. For example, storms bring strong winds and heavy rainfall, which can cause power cuts, damage buildings and disrupt transport. Heavy rainfall can also increase surface runoff and river discharge, leading to flooding of homes and businesses. Weather hazards can affect the environment too.

Heatwaves and drought can cause crop failure and water shortages, while heavy rainfall can trigger landslides and damage habitats.

Page 37: Exam-style Questions

1.1 Name one weather hazard experienced in the UK. [1 mark]

Mark scheme

Award **1 mark** for naming one valid UK weather hazard.

Acceptable answers

- storms
- heavy rainfall
- flooding
- heatwaves
- drought
- extreme cold
- snow
- ice
- strong winds

Model answer

Storms.

1.2 Describe the conditions associated with storms. [2 marks]

Mark scheme

Award **1 mark** for identifying one valid condition associated with storms.

Award **1 further mark** for a second condition or developed description.

Indicative content

Students may refer to:

- low pressure systems/depressions
- strong winds
- heavy rainfall
- most common in autumn and winter
- can trigger flooding
- frontal rainfall is linked to depressions

Model answer

Storms are associated with low pressure systems called depressions. They bring strong winds and heavy rainfall, especially in autumn and winter.

1.3 Explain why heavy rainfall can lead to flooding. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of heavy rainfall and flooding processes. Accurate terminology is used, such as prolonged rainfall, intense rainfall, infiltration, saturation, surface runoff, river discharge and river capacity. **AO2** Shows clear understanding of why heavy rainfall can lead to flooding. Explanation is developed and clearly links rainfall to increased runoff, rising river levels and water overflowing onto surrounding land.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of heavy rainfall and flooding. May identify that too much rain causes rivers to rise. **AO2** Shows limited understanding of why flooding occurs. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- heavy rainfall may be intense or prolonged
- soil can become saturated
- infiltration decreases when the ground is saturated
- more water flows over the surface as surface runoff
- water reaches rivers quickly
- river discharge increases
- rivers may exceed bankfull capacity
- water overflows onto the floodplain
- impermeable surfaces in urban areas can increase runoff

Model answer

Heavy rainfall can lead to flooding because large amounts of water reach the ground in a short time or over several days. If the soil becomes saturated, less water can infiltrate into the ground, so more water flows over the surface as runoff. This runoff quickly reaches rivers, increasing river discharge. If the river cannot hold the extra water, it overflows its banks and floods the surrounding land.

1.4 Give one cause of extreme cold weather in the UK. [1 mark]

Mark scheme

Award **1 mark** for a valid cause of extreme cold weather in the UK.

Acceptable answers

- polar continental air mass
- cold air from Siberia or eastern Europe
- easterly winds from Russia/continental Europe
- Arctic maritime air mass
- high pressure drawing in cold air

Model answer

A polar continental air mass.

1.5 Suggest why the UK experiences a range of weather hazards. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason why the UK experiences a range of weather hazards.
Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- the UK is affected by a range of air masses
- the UK has a maritime climate
- it is influenced by the Atlantic Ocean
- low pressure systems bring storms and rainfall
- polar continental air can bring extreme cold
- tropical continental air can bring heatwaves
- climate change may make weather more extreme and unpredictable
- the UK is located between oceanic and continental influences

Model answer
The UK experiences a range of weather hazards because it is affected by different air masses from different directions. For example, polar continental air can bring extreme cold, while low pressure systems from the Atlantic can bring storms and heavy rainfall.

1.6 Explain how high pressure leads to heatwaves. [2 marks]
Mark scheme
Award **1 mark** for identifying that heatwaves occur during prolonged high pressure.
Award **1 further mark** for explaining how high pressure creates hot, dry conditions.
Model answer
High pressure leads to heatwaves because air sinks, creating stable conditions with clear skies. In summer, this allows strong sunshine to heat the ground for several days, causing temperatures to rise and remain high.
Alternative model answer
Heatwaves occur during prolonged high pressure because sinking air prevents cloud formation and rainfall. This creates clear, dry conditions, allowing temperatures to increase over time.

Page 38 Activities

Page 38: Exam Ready Question

Question
Suggest how extreme weather in the UK can have economic and social impacts. [6 marks]
Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of how extreme weather in the UK can create economic and social impacts. Accurate examples are used, such as business closures, transport disruption, school closures, deaths, cancelled NHS operations or people being stranded. **AO3** Demonstrates detailed application of knowledge and understanding by explaining how an extreme weather event, such as the Beast from the East, caused disruption to people, services, businesses and the wider economy.
2 Clear	3–4	**AO2** Shows clear understanding of economic and/or social impacts of extreme weather in the UK. Some accurate examples are used. **AO3** Demonstrates reasonable application of knowledge and understanding by linking extreme weather to disruption, costs or impacts on people.
1 Basic	1–2	**AO2** Shows limited understanding of impacts of extreme weather. May identify simple impacts such as deaths, closures or damage. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or not clearly linked to economic and social impacts.
0	0	No relevant content.

Indicative content
Students may refer to economic impacts such as:

- The Beast from the East cost the UK around **£1 billion per day**.
- Businesses lost income due to closures.
- Transport disruption affected trade and supply chains.
- Flights and trains were cancelled across the UK.
- NHS non-urgent operations were cancelled, affecting services and costs.
- Roads, railways and airports were disrupted.
- Energy demand increased.

Students may refer to social impacts such as:

- **10 people died**.
- Thousands of schools closed.
- People were stranded in cars and on trains.
- Vulnerable people faced greater risk from cold temperatures.
- Transport disruption affected journeys to work, school and healthcare.
- Emergency services and the army rescued trapped drivers.
- Freezing temperatures, snow and blizzards disrupted daily life.

Model answer

Extreme weather in the UK can have social impacts because it affects people's safety, health and daily routines. During the Beast from the East in February and March 2018, temperatures fell to around **−12°C** in some rural areas and up to **50 cm of snow** fell. Around **10 people died**, thousands of schools closed, and people were stranded in cars and on trains. The NHS also cancelled non-urgent operations, which affected people waiting for treatment.

Extreme weather can also have economic impacts. The Beast from the East cost the UK around **£1 billion per day** because businesses were forced to close and transport disruption affected trade and supply chains. Flights and trains were cancelled across the UK, making it harder for people to get to work and for goods to be delivered. This shows that extreme weather can affect both people's lives and the wider economy.

Page 39 Activities

Page 39: 30 Second Recall Answers

Define: Extreme weather event

An extreme weather event is weather that is unusual or severe for a particular place and time, and which can cause damage, disruption, injury or death.

Accept:

A period of unusually severe weather that can affect people, property, services or the environment.

List: Three social effects of the Beast from the East

Any three from:

- **10 people died**
- thousands of schools closed
- people were stranded in cars
- people were stranded on trains
- NHS cancelled non-urgent operations
- vulnerable people faced greater risk from cold temperatures
- travel disruption affected daily life
- people were affected by snow, blizzards and freezing temperatures

---

Explain: The cause of the Beast from the East

The Beast from the East was caused by a polar continental air mass from Siberia moving westwards across Europe. A sudden stratospheric warming weakened the jet stream, allowing freezing easterly winds to reach the UK. High pressure over Scandinavia helped pull in the cold air. Conditions became more severe when the cold air collided with Storm Emma, which brought moist air and heavy snowfall.

Page 39: Blur, Build, Check

Stage 2: Build answers

1. Causes of the Beast from the East

Students should include:

- It was caused by a **polar continental air mass** from **Siberia/Russia**.
- The air mass moved from the **east** across Europe towards the UK.
- A **sudden stratospheric warming** weakened or disrupted the **jet stream**.
- High pressure over **Scandinavia** helped pull in freezing easterly winds.
- The cold air combined with **Storm Emma**, a tropical maritime air mass from the Azores.
- The collision of the Beast from the East and Storm Emma caused blizzards and heavy snowfall.

---

2. Three weather conditions

Any three from:

- heavy snow
- strong winds
- freezing temperatures
- blizzards
- deep snowdrifts
- temperatures down to around **−12°C** in rural areas
- up to **50 cm** of snow in some places
- prolonged severe winter weather

---

3. Three impacts

Any three from:

- **10 people died**
- thousands of schools closed
- people were stranded in cars and on trains
- NHS cancelled non-urgent operations
- businesses lost income due to closures
- transport disruption affected trade and supply chains
- flights and trains were cancelled across the UK
- cost the UK around **£1 billion per day**
- wildlife affected by food shortages
- rivers and waterfalls froze, such as High Force
- energy demand increased
- vulnerable people faced greater risk from cold temperatures

---

4. Two responses

Any two from:

- red weather warnings were issued
- over **4,000 gritters and snowploughs** cleared roads
- the army rescued trapped drivers on the M62
- flood warnings were issued by the Environment Agency
- emergency services supported affected people

- road gritting and snow clearance helped reopen transport routes

---

Page 39: Exam Builder

Step 1: Complete the sentences
Question
The Beast from the East was caused by _____ air from _____. It brought _____ and _____ conditions. Transport was affected because _____.
Answer
The Beast from the East was caused by **polar continental** air from **Siberia**. It brought **snow** and **freezing** conditions. Transport was affected because **roads and railways were closed**.
Accept:
The Beast from the East was caused by **cold easterly/polar continental** air from **Russia/Siberia**. It brought **heavy snow** and **strong winds/freezing temperatures**. Transport was affected because **snow and ice closed roads, railways and airports**.

Step 2: Describe two impacts of the Beast from the East. [2 marks]
Mark scheme
Award **1 mark** for each valid impact described.
Indicative content
Students may refer to:

- **10 people died**
- thousands of schools closed
- people were stranded in cars and on trains
- NHS cancelled non-urgent operations
- businesses lost income
- transport disruption affected trade and supply chains
- flights and trains were cancelled
- wildlife suffered food shortages
- rivers and waterfalls froze
- cost the UK around **£1 billion per day**
- energy demand increased

Model answer
Thousands of schools closed because snow and freezing conditions made travel unsafe. Businesses also lost income because many were forced to close during the extreme weather.

Step 3: Explain how the Beast from the East caused disruption in the UK. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the Beast from the East. Accurate detail is used, such as heavy snow, freezing temperatures, strong winds, blizzards, school closures, stranded drivers, train cancellations, business closures or NHS disruption. **AO2** Shows clear understanding of how the weather conditions caused disruption in the UK. Explanation is developed and links snow, ice, cold or wind to impacts on transport, services, people or the economy.

Level	Marks	Description
1 Basic	1–2	**AO1** Shows limited knowledge of the Beast from the East. May identify simple conditions or impacts, such as snow, cold weather or school closures. **AO2** Shows limited understanding of how the event caused disruption. Explanation is basic or only partly linked to impacts.
0	0	No relevant content.

Indicative content

Students may refer to:

- heavy snow and blizzards blocked roads
- ice and snow made travel dangerous
- flights and trains were cancelled
- people were stranded in cars and on trains
- thousands of schools closed
- businesses closed and lost income
- transport disruption affected trade and supply chains
- NHS cancelled non-urgent operations
- vulnerable people were at greater risk in freezing temperatures
- energy demand increased
- emergency services and the army were needed to rescue people

Model answer

The Beast from the East caused disruption because it brought heavy snow, strong winds and freezing temperatures to the UK. Snow and ice made roads dangerous and blocked some routes, so people were stranded in cars and trains. Flights and trains were also cancelled, which disrupted travel and affected trade and supply chains. The extreme weather also led to thousands of school closures and businesses lost income because many people could not get to work.

Page 39: Exam-style Questions

1.1 When did the Beast from the East occur? [1 mark]

Mark scheme

Award **1 mark** for the correct time period.

Answer

February–March 2018.

Accept:

February 2018 / **March 2018** / **late February to early March 2018**.

1.2 Describe the weather conditions during the Beast from the East. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid weather condition.

Award **1 further mark** for a second condition or developed description.

Indicative content

Students may refer to:

- heavy snow
- strong winds
- freezing temperatures
- blizzards
- deep snowdrifts
- up to **50 cm of snow**
- temperatures fell to around **−12°C** in rural areas

- prolonged severe winter weather

Model answer

The Beast from the East brought heavy snow, strong winds and freezing temperatures. In some places up to **50 cm of snow** fell and temperatures dropped to around **−12°C** in rural areas.

1.3 Explain how the Beast from the East was caused. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of the causes of the Beast from the East. Accurate detail is used, such as polar continental air mass, Siberia/Russia, sudden stratospheric warming, weakened jet stream, high pressure over Scandinavia, easterly winds or Storm Emma. **AO2** Shows clear understanding of how these causes led to severe winter weather in the UK. Explanation is developed and clearly links the movement of cold air and interaction with Storm Emma to snow, blizzards or freezing temperatures.
1 Basic	1–2	**AO1** Shows limited knowledge of the causes of the Beast from the East. May identify cold air from the east or Siberia. **AO2** Shows limited understanding of how the event was caused. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- sudden stratospheric warming weakened or disrupted the jet stream
- this allowed freezing air from Siberia/Russia to move westwards
- the air mass was polar continental
- high pressure over Scandinavia pulled in freezing easterly winds
- cold air moved west across Europe
- Storm Emma brought warm, moist air from the south-west
- when the cold air and Storm Emma collided, this caused heavy snowfall and blizzards
- the result was prolonged severe winter weather

Model answer

The Beast from the East was caused by a polar continental air mass from Siberia moving west across Europe. A sudden stratospheric warming weakened the jet stream, allowing freezing air to move towards the UK. High pressure over Scandinavia helped pull in cold easterly winds. Conditions became worse when the cold air met Storm Emma, which brought moist air from the south-west. Where the two air masses collided, heavy snow and blizzards developed.

1.4 Give one impact on transport. [1 mark]

Mark scheme

Award **1 mark** for one valid transport impact.

Acceptable answers

- roads were closed
- railways were closed
- flights were cancelled
- trains were cancelled

- people were stranded in cars
- people were stranded on trains
- trade and supply chains were disrupted
- drivers were rescued by the army on the M62
- journeys were delayed or cancelled

Model answer

Flights and trains were cancelled across the UK.

1.5 Suggest why the event caused widespread disruption. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason why disruption was widespread.

Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- the event affected large parts of the UK
- heavy snow and blizzards made travel unsafe
- snow and ice closed roads and railways
- freezing temperatures increased health risks
- schools and businesses closed
- transport disruption affected trade and supply chains
- the UK is not always well adapted to prolonged severe winter weather
- Storm Emma increased the severity of snowfall and blizzards
- high levels of dependence on transport networks meant disruption spread quickly

Model answer

The event caused widespread disruption because heavy snow, strong winds and freezing temperatures affected large parts of the UK. Snow and ice closed roads and railways, so people could not travel to school or work and businesses lost income.

1.6 Explain how responses helped reduce the impacts. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid response.

Award **1 further mark** for explaining how it reduced impacts.

Indicative content

Students may refer to:

- red weather warnings informed people about danger
- gritters and snowploughs cleared roads
- emergency services supported affected people
- the army rescued trapped drivers on the M62
- flood warnings issued by the Environment Agency helped people prepare
- warnings helped people avoid unnecessary travel
- road clearance helped reopen transport routes

Model answer

Red weather warnings helped reduce impacts by warning people about dangerous conditions, so some avoided unnecessary travel. Gritters and snowploughs also cleared roads, helping emergency services reach people and reducing transport disruption.

Page 40 Activities

Page 40: Exam Ready Question

Question

Outline two ways the UK's weather is becoming more extreme. [4 marks]

Mark scheme

Award **1 mark** for identifying each valid way the UK's weather is becoming more extreme.
Award **1 further mark** for developing each point with evidence or explanation.
Maximum **2 marks** for each outlined way.

Indicative content

Students may refer to:

- heavy rainfall events are becoming more frequent
- heavy rainfall events are becoming more intense
- increased risk of flooding as a secondary hazard
- UK climate has warmed since the 1980s
- recent years include some of the warmest on record
- heatwaves are becoming more frequent
- heatwaves are becoming more intense
- hot extremes are increasing faster than average temperatures
- more record temperatures are being broken
- more record rainfall totals are being broken
- UK winters are becoming wetter overall
- some studies show a large increase in extreme rainfall events over time
- cold extremes, frost days and severe cold events are becoming less frequent or less severe

Possible answer

One way the UK's weather is becoming more extreme is that heavy rainfall events are becoming more frequent and intense. This increases the risk of flooding because more rain can fall in a short period of time.
Another way is that temperature extremes are increasing. The UK climate has warmed since the 1980s, and heatwaves are becoming more frequent and intense, with more record temperatures being broken.

Page 41 Activities

Page 41: 30 Second Recall Answers

Define: Extreme weather

Extreme weather is weather that is unusual or severe for a particular place and time, and which may cause damage, disruption, injury or death.
Accept:
Unusual or severe weather events.

List: The types of extreme weather increasing in the UK

Students may list:

- heavy rainfall
- flooding events
- heatwaves
- hot temperature extremes
- more intense storms

- record rainfall totals
- record temperatures

Accept also:

- wetter winters
- more intense rainfall

Explain: Why evidence for change can be uncertain

Evidence for change can be uncertain because weather is naturally variable from year to year, so short-term changes do not always show a clear long-term trend. Some types of extreme weather are increasing, such as heatwaves and heavy rainfall, while others, such as very cold events and snowfall, are decreasing. Future frequency and intensity are also difficult to predict exactly.

Page 41: Blur, Build, Check

Stage 2: Build answers

1. Three weather events increasing

Students may include any three from:

- heavy rainfall events
- flooding events
- heatwaves
- storm intensity
- record temperatures
- record rainfall totals
- hot extremes
- wetter winters

---

2. Two weather events decreasing

Students may include:

- very cold events
- frost days
- severe cold events
- snowfall overall

---

3. One reason why trends are uncertain

Students may include:

- weather is naturally variable
- the UK has year-to-year variation in weather
- it is difficult to identify long-term trends from short periods of data
- not all extreme weather types are changing in the same direction
- future frequency and intensity are uncertain
- climate change affects different types of extreme weather in different ways

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Page 41: Exam Builder

Step 1: Complete the sentences

Question

Heavy rainfall has _____ in the UK.

Extreme cold events have _____.

It is difficult to identify trends because _____.

Answer

Heavy rainfall has **increased** in the UK.
Extreme cold events have **decreased**.
It is difficult to identify trends because **weather is naturally variable**.
Accept:
Heavy rainfall has **become more frequent/intense** in the UK.
Extreme cold events have **become less frequent/less severe**.
It is difficult to identify trends because **weather varies from year to year**.

Step 2: Describe one piece of evidence that UK weather is becoming more extreme. [2 marks]
Mark scheme
Award **1 mark** for identifying one valid piece of evidence.
Award **1 further mark** for describing or developing the evidence.
Indicative content
Students may refer to:

- heavy rainfall events are becoming more frequent
- heavy rainfall events are becoming more intense
- flooding events have increased
- heatwaves are becoming more frequent
- heatwaves are becoming more intense
- average temperatures have increased
- recent years include some of the warmest on record
- more record temperatures are being broken
- more record rainfall totals are being broken
- hot extremes are increasing faster than average temperatures
- UK winters are becoming wetter overall

Model answer
One piece of evidence is that heavy rainfall events are becoming more frequent and intense in the UK. This suggests the weather is becoming more extreme because heavier rainfall increases the risk of flooding.
Alternative model answer
Another piece of evidence is that heatwaves are becoming more frequent. Recent years have included some of the warmest on record, showing that hot weather extremes are increasing.

Step 3: Explain why it is difficult to be certain that UK weather is becoming more extreme. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of why evidence about changes in UK extreme weather can be uncertain. Accurate reasons are used, such as natural variability, short-term fluctuations, different trends for different types of weather, and uncertainty about future frequency and intensity. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining why these factors make it difficult to reach a fully certain judgement about whether UK weather is becoming more extreme.
1 Basic	1–2	**AO2** Shows limited understanding of uncertainty in weather trends. May identify a simple reason such as weather changes from year to year.

Level	Marks	Description
		AO3 Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to uncertainty about extreme weather trends.
0	0	No relevant content.

Indicative content

Students may refer to:

- weather is naturally variable
- one extreme event does not prove a long-term trend
- long-term data is needed to identify patterns
- some extremes are increasing, while others are decreasing
- heatwaves and heavy rainfall appear to be increasing
- cold extremes, frost days and snowfall are decreasing
- future frequency and intensity are uncertain
- climate change affects different types of weather in different ways
- changes may vary between regions of the UK

Model answer

It is difficult to be certain that UK weather is becoming more extreme because weather is naturally variable. One year may be very wet or very hot, but this does not prove a long-term trend. Long-term climate records are needed to show whether changes are really happening over time. It is also difficult because not all types of extreme weather are increasing. Heatwaves and heavy rainfall are becoming more common or intense, but very cold events, frost days and snowfall are decreasing overall. This means the evidence is not the same for every type of extreme weather.

Page 41: Exam-style Questions

1.1 Name one type of extreme weather that is increasing in the UK. [1 mark]

Mark scheme

Award **1 mark** for naming one valid type of extreme weather that is increasing in the UK.

Acceptable answers

- heavy rainfall
- flooding events
- heatwaves
- hot extremes
- storm intensity
- record temperatures
- record rainfall totals

Model answer

Heatwaves.

1.2 Describe how UK weather has changed in recent years. [2 marks]

Mark scheme

Award **1 mark** for identifying one valid change.

Award **1 further mark** for identifying a second valid change or developing the first.

Indicative content

Students may refer to:

- average temperatures have increased
- the UK climate has warmed since the 1980s
- recent years have included some of the warmest on record
- heavy rainfall events have become more frequent or intense

- flooding events have increased
- heatwaves have become more frequent
- storm intensity has increased
- cold extremes have become less frequent or less severe
- frost days have decreased
- snowfall has decreased overall
- UK winters are becoming wetter overall

Model answer

UK weather has become warmer, with recent years including some of the warmest on record. Heavy rainfall events and heatwaves have also become more frequent and intense.

1.3 Explain the evidence that suggests UK weather is becoming more extreme. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of evidence that suggests UK weather is becoming more extreme. Accurate evidence is used, such as increased heavy rainfall, increased flooding events, more frequent heatwaves, higher average temperatures, more broken temperature/rainfall records or wetter winters. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how the evidence supports the view that UK weather is becoming more extreme.
1 Basic	1–2	**AO2** Shows limited understanding of evidence for increasing UK weather extremes. May identify simple changes such as more rain, more heatwaves or higher temperatures. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to the idea of more extreme weather.
0	0	No relevant content.

Indicative content

Students may refer to:

- UK climate has warmed since the 1980s
- recent years include some of the warmest on record
- heatwaves are becoming more frequent and more intense
- hot extremes are increasing faster than average temperatures
- heavy rainfall events are becoming more frequent and intense
- flooding events have increased
- wetter winters increase flood risk
- more record temperatures and rainfall totals are being broken
- the Met Office has described extreme weather as becoming the “new normal”
- some studies show an increase in extreme rainfall events over time

Model answer

Evidence suggests UK weather is becoming more extreme because temperatures have increased and recent years include some of the warmest on record. Heatwaves are becoming more frequent and more intense, which shows that hot extremes are increasing. There is also evidence that heavy rainfall events are becoming more frequent and intense. This increases flood risk, especially as UK winters

are becoming wetter overall. More temperature and rainfall records are also being broken, suggesting that extreme weather is becoming more common.

1.4 Give one example of extreme weather that is decreasing. [1 mark]

Mark scheme

Award **1 mark** for naming one valid type of extreme weather that is decreasing.

Acceptable answers

- very cold events
- cold extremes
- severe cold events
- frost days
- snowfall overall

Model answer

Frost days.

1.5 Suggest why it is difficult to predict future weather trends. [2 marks]

Mark scheme

Award **1 mark** for identifying a valid reason why future weather trends are difficult to predict.
Award **1 further mark** for developing the reason.

Indicative content

Students may refer to:

- weather is naturally variable
- climate systems are complex
- future greenhouse gas emissions are uncertain
- future human action is uncertain
- different types of weather may change in different ways
- regional differences make predictions harder
- short-term weather fluctuations can hide long-term trends
- frequency and intensity of future extremes are uncertain

Model answer

It is difficult to predict future weather trends because weather is naturally variable and can change greatly from year to year. Future greenhouse gas emissions are also uncertain, so it is difficult to know exactly how frequent or intense future extremes will be.

1.6 Explain whether the UK's weather is becoming more extreme. [2 marks]

Mark scheme

Award **1 mark** for making a valid judgement about whether UK weather is becoming more extreme.
Award **1 further mark** for supporting the judgement with evidence.

Model answer

The UK's weather does appear to be becoming more extreme because heavy rainfall events and heatwaves are becoming more frequent and intense. However, not all extremes are increasing, as very cold events, frost days and snowfall have decreased overall.

Alternative model answer

Yes, there is evidence that the UK's weather is becoming more extreme because more temperature and rainfall records are being broken, and heavy rainfall events are becoming more frequent. This increases the risk of flooding and heatwave impacts.

Page 42 Activities

Page 42: Exam Ready Question

Question

Explain how evidence from the Quaternary period shows that climate has changed over time. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of evidence for climate change during the Quaternary period. Accurate evidence is used, such as glacial and interglacial cycles, ice cores, tree rings and historical records. **AO2** Shows clear understanding of how this evidence demonstrates climate change over time. Explanation is developed and links evidence to changing temperatures, gases, rainfall or climate conditions.
1 Basic	1–2	**AO1** Shows limited knowledge of evidence for climate change. May identify one source of evidence, such as ice cores or tree rings. **AO2** Shows limited understanding of how the evidence shows climate change. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- The Quaternary period began around **2.6 million years ago**.
- Climate has fluctuated between colder **glacial** periods and warmer **interglacial** periods.
- There have been around **50–60 glacial/interglacial cycles**.
- We are currently in an interglacial period called the **Holocene**.
- The last glacial period ended around **10,000 years ago**.
- Ice cores contain layers of ice built up year by year.
- Air bubbles in ice cores contain past gases such as **CO_2**.
- Ice cores show temperature and gas changes over up to **800,000 years**.
- Tree rings show year-by-year climate changes.
- Thick tree rings suggest warmer or wetter conditions.
- Thin tree rings suggest colder or drier conditions.
- Historical records, such as diaries, paintings and photographs, provide evidence of past weather and climate.
- The Little Ice Age, around **1300–1850**, provides historical evidence of cooler conditions.
- Different sources support the same pattern that climate changes over time.

Model answer

Evidence from the Quaternary period shows that climate has changed because the Earth has gone through repeated glacial and interglacial cycles. The Quaternary began about **2.6 million years ago**, and there have been around **50–60 cycles** of colder and warmer periods. Ice cores provide long-term evidence because trapped air bubbles show past greenhouse gas levels, such as carbon dioxide, while the ice layers show past temperature changes. Tree rings and historical records also show shorter-term changes, such as warmer, wetter years or colder periods like the Little Ice Age.

Page 43 Activities

Page 43: 30 Second Recall Answers

Define: Interglacial period
An interglacial period is a warmer period between colder glacial periods.
Accept:
A warm period in Earth's climate when temperatures are higher and ice sheets retreat.

List: Three sources of evidence for climate change
Any three from:

- ice cores
- tree rings
- historical records
- diaries
- written records
- paintings
- photographs

Explain: How tree rings show climate change
Tree rings show climate change because trees usually grow one ring each year. Thick rings often show warm or wet conditions when growth was stronger, while thin rings show cold or dry conditions when growth was limited. This means tree rings can show year-by-year climate variations over time.

Page 43: Blur, Build, Check

Stage 2: Build answers
1. Draw a simple glacial/interglacial cycle
Students should include:

- alternating colder **glacial** periods and warmer **interglacial** periods
- a line or wave showing temperature rising and falling over time
- labels showing **glacial = cold** and **interglacial = warm**
- the idea that climate fluctuates naturally over time
- the current interglacial period, the **Holocene**, if included
- the last glacial period ended about **10,000 years ago**

A simple labelled sketch could show:
glacial → interglacial → glacial → interglacial
or a wave pattern with peaks labelled **interglacial** and troughs labelled **glacial**.

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2. List three types of evidence
Students should list:

- **ice cores**
- **tree rings**
- **historical records**

Accept examples of historical records, such as diaries, written records, paintings and photographs.

---

3. Add one key feature of each

Evidence type	Key feature
Ice cores	Air bubbles trap past gases such as CO_2 and show long-term temperature/gas changes.

Evidence type	Key feature
Tree rings	One ring usually represents one year and shows year-by-year climate variation.
Historical records	Diaries, paintings, photographs and written records show human evidence of past climate and extreme weather.

Additional acceptable features:

- Ice cores can provide evidence going back up to **800,000 years**.
- Deeper ice is older.
- Thick tree rings suggest warm or wet conditions.
- Thin tree rings suggest cold or dry conditions.
- Historical records can show evidence from the last few thousand years.
- The Little Ice Age is an example of historical evidence.

Page 43: Exam Builder

Step 1: Complete the sentences
Question
The Quaternary period began _____ years ago.
Glacial periods are _____, while interglacial periods are _____. Ice cores contain trapped _____ from the past.
Answer
The Quaternary period began **2.6 million** years ago.
Glacial periods are **cold**, while interglacial periods are **warm**. Ice cores contain trapped **gases** from the past.
Accept:
The Quaternary period began **about 2.6 million** years ago.
Glacial periods are **colder periods**, while interglacial periods are **warmer periods**. Ice cores contain trapped **air bubbles/gases such as CO_2** from the past.

Step 2: Explain how ice cores provide evidence for climate change. [2 marks]
Mark scheme
Award **1 mark** for identifying that ice cores contain layers of ice and/or trapped air bubbles from the past.
Award **1 further mark** for explaining how these show past climate change, such as changes in temperature or greenhouse gas levels.
Indicative content
Students may refer to:

- layers of ice build up year by year
- deeper ice is older
- air bubbles trap gases such as carbon dioxide
- ice cores show temperature changes
- ice cores show greenhouse gas changes
- ice cores provide long-term evidence over up to **800,000 years**

Model answer
Ice cores provide evidence for climate change because layers of ice build up over time and deeper ice is older. Air bubbles trapped in the ice contain gases such as carbon dioxide, which can show how greenhouse gas levels and temperatures changed in the past.

Step 3: Explain how different sources of evidence show that climate has changed over time. [4 marks]
Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of different sources of evidence for climate change. Accurate examples are used, such as ice cores, tree rings and historical records. **AO2** Shows clear understanding of how different sources show climate change over time. Explanation is developed and links the evidence to changing temperatures, gas levels, rainfall or past climate conditions.
1 Basic	1–2	**AO1** Shows limited knowledge of evidence for climate change. May identify one or more sources but with limited detail. **AO2** Shows limited understanding of how the evidence shows climate change. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- Ice cores show long-term trends over hundreds of thousands of years.
- Ice cores contain trapped air bubbles with gases such as CO_2.
- Ice cores can show changes in temperature and atmospheric gases.
- Tree rings show year-by-year climate variation.
- Thick tree rings suggest warmer or wetter conditions.
- Thin tree rings suggest colder or drier conditions.
- Historical records include diaries, written records, paintings and photographs.
- Historical records can show evidence of extreme weather, farming changes and settlement patterns.
- The Little Ice Age is an example of a cooler historical period.
- Different sources support the same pattern that climate changes over time.

Model answer

Different sources of evidence show that climate has changed over time because they record past climate conditions in different ways. Ice cores provide long-term evidence because air bubbles trapped in the ice show past gases such as carbon dioxide, while the ice layers can show temperature changes over hundreds of thousands of years. Tree rings show shorter-term climate variation because thick rings suggest warm or wet years, while thin rings suggest cold or dry years. Historical records, such as diaries, paintings and photographs, also show evidence of past weather and climate, including cooler periods such as the Little Ice Age.

Page 43: Exam-style Questions

1.1 What is a glacial period? [1 mark]

Mark scheme

Award **1 mark** for a valid definition.

Answer

A glacial period is a cold period when global temperatures are lower and ice sheets expand.

Accept:

A cold period in Earth's climate.

1.2 Name one source of evidence for climate change. [1 mark]

Mark scheme

Award **1 mark** for naming one valid source of evidence.

Acceptable answers

- ice cores
- tree rings
- historical records
- diaries
- written records
- paintings
- photographs

Model answer

Ice cores.

1.3 Describe how tree rings show climate change. [2 marks]

Mark scheme

Award **1 mark** for identifying that tree rings show annual growth or climate conditions.

Award **1 further mark** for describing how ring thickness indicates climate variation.

Indicative content

Students may refer to:

- one ring usually represents one year
- rings show year-by-year climate variation
- thick rings indicate warm or wet conditions
- thin rings indicate cold or dry conditions
- tree rings can show short-term climate changes

Model answer

Tree rings show climate change because one ring usually represents one year of growth. Thick rings suggest warm or wet conditions, while thin rings suggest cold or dry conditions, so they show how climate varied over time.

1.4 Explain how historical records provide evidence of climate change. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of historical records used as evidence for climate change. Accurate examples are used, such as diaries, written records, paintings, photographs, extreme weather records, farming records or settlement records. **AO2** Shows clear understanding of how historical records provide evidence of climate change. Explanation is developed and links records to past temperatures, weather extremes, farming conditions or periods such as the Little Ice Age.
1 Basic	1–2	**AO1** Shows limited knowledge of historical records. May identify a simple example such as diaries or paintings. **AO2** Shows limited understanding of how historical records show climate change. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- Diaries and written records can describe weather conditions.

- Paintings and photographs can show snow, ice, floods, droughts or landscape changes.
- Records may describe extreme weather events.
- Farming records can show crop failures or successful harvests linked to climate.
- Settlement records may show how people adapted to climate conditions.
- Historical records provide human evidence from the last few thousand years.
- The Little Ice Age from about **1300–1850** is an example of a cooler period shown through historical evidence.
- Historical records are useful for more recent climate changes but are less long-term than ice cores.

Model answer

Historical records provide evidence of climate change because people recorded weather and environmental conditions in diaries, written documents, paintings and photographs. For example, records of harsh winters, frozen rivers, poor harvests or floods can show that climate conditions were different in the past. Paintings and written records from the Little Ice Age show cooler conditions between about **1300 and 1850**. This evidence helps show that climate has changed over time, although it usually covers a shorter period than ice cores.

1.5 Explain how ice cores provide long-term climate evidence. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of ice cores as evidence for past climate change. Accurate detail is used, such as annual ice layers, trapped air bubbles, gases such as CO_2, temperature changes and records going back up to 800,000 years. **AO2** Shows clear understanding of why ice cores provide long-term climate evidence. Explanation is developed and links older/deeper ice and trapped gases to evidence of past atmospheric and temperature changes.
1 Basic	1–2	**AO1** Shows limited knowledge of ice cores. May identify that ice cores contain layers or air bubbles. **AO2** Shows limited understanding of how ice cores provide evidence. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- Ice cores are cylinders of ice drilled from ice sheets.
- Layers of ice build up year by year.
- Deeper ice is older.
- Air bubbles trapped in the ice contain past atmosphere.
- These bubbles include gases such as CO_2.
- Ice cores show changes in greenhouse gases.
- They also show past temperature changes.
- Ice core records can go back up to **800,000 years**.
- This makes them useful for showing long-term climate trends and glacial/interglacial cycles.

Model answer

Ice cores provide long-term climate evidence because layers of ice build up year by year in ice sheets. Scientists can drill down into the ice, and the deeper layers are older, so they show climate conditions

from further back in time. Air bubbles trapped in the ice contain gases from the past atmosphere, such as carbon dioxide. These gases, along with evidence from the ice itself, show how temperatures and greenhouse gas levels changed over hundreds of thousands of years, with records going back up to around **800,000 years**.

1.6 Explain how evidence from the Quaternary period shows that climate has changed over time. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of evidence from the Quaternary period. Accurate detail is used, such as glacial/interglacial cycles, ice cores, tree rings, historical records, 2.6 million years ago, Holocene or the last glacial period ending around 10,000 years ago. **AO2** Shows clear understanding of how this evidence shows climate has changed over time. Explanation is developed and links evidence to changing temperatures, atmospheric gases or alternating warm and cold periods.
1 Basic	1–2	**AO1** Shows limited knowledge of climate change evidence from the Quaternary period. May identify glacial periods, ice cores, tree rings or historical records. **AO2** Shows limited understanding of how evidence shows climate change. Explanation is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- The Quaternary period began around **2.6 million years ago**.
- Climate has alternated between glacial and interglacial periods.
- Glacial periods were colder; interglacial periods were warmer.
- There have been around **50–60 cycles**.
- The current interglacial is the **Holocene**.
- The last glacial period ended around **10,000 years ago**.
- Ice cores show long-term trends in temperature and greenhouse gases.
- Tree rings show year-by-year climate variations.
- Historical records provide human evidence from the last few thousand years.
- Different sources support the same conclusion that climate changes over time.

Model answer

Evidence from the Quaternary period shows that climate has changed over time because the Earth's climate has alternated between cold glacial periods and warmer interglacial periods. The Quaternary began around **2.6 million years ago**, and there have been about **50–60 cycles**. Ice cores provide long-term evidence because trapped gases such as carbon dioxide and ice layers show changes in atmospheric gases and temperature over hundreds of thousands of years. Tree rings and historical records also support this by showing shorter-term changes, such as warmer, wetter years, cold or dry years, and cooler periods like the Little Ice Age.

Page 44 Activities

Page 44: Exam Ready Question

Question

Explain how natural and human factors cause climate change. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of how both natural and human factors cause climate change. Accurate processes are explained, such as orbital changes, volcanic activity, solar output, greenhouse gases, fossil fuels, agriculture and deforestation. **AO3** Demonstrates detailed application of knowledge and understanding by explaining how these factors alter global temperatures over different timescales. Clear links are made between human activity, increased greenhouse gases and recent rapid warming.
2 Clear	3–4	**AO2** Shows clear understanding of natural and/or human causes of climate change. Some accurate processes are explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking causes to changes in global temperature or greenhouse gas levels.
1 Basic	1–2	**AO2** Shows limited understanding of causes of climate change. May identify simple causes such as fossil fuels or volcanoes. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or only partly linked to climate change.
0	0	No relevant content.

Indicative content

Natural causes may include:

- **Orbital changes**
  - Earth's orbit changes shape.
  - Tilt and wobble vary.
  - This alters the amount of solar energy received.
  - Orbital changes help trigger glacial and interglacial periods over thousands to millions of years.
- **Volcanic activity**
  - Eruptions release ash and gases, including sulphur dioxide and carbon dioxide.
  - Ash can reflect sunlight back into space.
  - This can cause short-term global cooling.
  - Effects may last for several years after major eruptions.
- **Solar output**
  - The Sun's energy output varies over time.
  - More sunspots can mean more energy reaches Earth.
  - This can increase global temperatures slightly.
  - Solar output has a smaller effect compared with recent human causes.

Human causes may include:

- **Burning fossil fuels**
  - Coal, oil and natural gas release large amounts of carbon dioxide.
  - Carbon dioxide is a greenhouse gas.
  - More greenhouse gases increase the enhanced greenhouse effect.
  - This is the main cause of recent rapid warming.
- **Agriculture**
  - Livestock produce methane.
  - Rice farming releases methane.
  - Fertilisers release nitrous oxide.
  - Methane and nitrous oxide are powerful greenhouse gases.
- **Deforestation**
  - Fewer trees means less carbon dioxide is absorbed by photosynthesis.
  - Burning trees releases carbon dioxide.
  - Carbon storage is reduced.
  - This increases greenhouse gas levels in the atmosphere.

Model answer

Natural and human factors can both cause climate change. Natural factors include orbital changes, volcanic activity and changes in solar output. Orbital changes affect the amount of solar energy the Earth receives because the shape of the Earth's orbit, its tilt and its wobble vary over time. These changes can help trigger long-term glacial and interglacial periods. Volcanic eruptions can also affect climate because ash and gases are released into the atmosphere. Ash can reflect sunlight back into space, causing short-term cooling.

Human factors are the main cause of recent rapid warming because they increase greenhouse gas levels. Burning fossil fuels such as coal, oil and gas releases carbon dioxide, which strengthens the greenhouse effect and traps more heat in the atmosphere. Agriculture also contributes because livestock and rice farming release methane, while fertilisers release nitrous oxide. Deforestation increases climate change because fewer trees absorb carbon dioxide, and burning trees releases stored carbon. Overall, natural factors can change climate over different timescales, but human activity is driving recent global heating.

Page 45 Activities

Page 45: 30 Second Recall Answers

Define: Climate change

Climate change is a long-term change in the Earth's average weather conditions, including temperature, rainfall and extreme weather patterns.

Accept:

A long-term change in global or regional climate patterns.

List: Three human causes of climate change

Any three from:

- burning fossil fuels
- energy production from coal, oil and gas
- transport using petrol and diesel
- industry
- agriculture
- livestock farming
- rice farming
- fertiliser use

- deforestation
- burning trees

Explain: How volcanic eruptions affect global temperatures
Volcanic eruptions can affect global temperatures by releasing ash and gases, such as sulphur dioxide, into the atmosphere. Ash and sulphate particles can reflect sunlight back into space, reducing the amount of solar energy reaching the Earth's surface. This can cause short-term global cooling for several years after a major eruption.

Page 45: Blur, Build, Check

Stage 2: Build answers
1. Outline the human causes of climate change
Students should include:
Fossil fuels
- Coal, oil and natural gas are burned for energy, transport and industry.
- This releases large amounts of **carbon dioxide**.
- Carbon dioxide is a greenhouse gas.
- More greenhouse gases strengthen the enhanced greenhouse effect.
- This traps more heat and causes global warming.

Agriculture
- Livestock, such as cattle, produce **methane**.
- Rice farming also releases methane.
- Fertilisers release **nitrous oxide**.
- Methane and nitrous oxide are powerful greenhouse gases.
- Farming therefore increases greenhouse gas levels.

Deforestation
- Trees absorb carbon dioxide through photosynthesis.
- Removing trees means less carbon dioxide is taken out of the atmosphere.
- Burning or decomposing trees releases stored carbon dioxide.
- This reduces carbon storage and increases greenhouse gas levels.

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2. Outline the natural causes of climate change
Students should include:
Orbital changes
- The shape of the Earth's orbit changes.
- The Earth's tilt and wobble also vary.
- These changes alter the amount and distribution of solar energy received.
- They can trigger long-term glacial and interglacial cycles.

Volcanic activity
- Volcanic eruptions release ash and gases.
- Ash and sulphur dioxide can reflect sunlight back into space.
- This reduces incoming solar radiation.
- Major eruptions can cause short-term global cooling.

Solar output
- The Sun's energy output varies over time.
- Periods with more sunspots can slightly increase the amount of energy reaching Earth.
- This may cause small changes in global temperature.
- Solar output has a smaller effect on recent climate change than human activity.

Page 45: Exam Builder

Step 1: Complete the sentences
Question
Orbital changes affect the amount of _____ energy reaching Earth. Volcanic eruptions can cause _____ in the short term. Burning fossil fuels releases _____ into the atmosphere.
Answer
Orbital changes affect the amount of **solar** energy reaching Earth. Volcanic eruptions can cause **cooling** in the short term. Burning fossil fuels releases **carbon dioxide** into the atmosphere.
Accept:
Orbital changes affect the amount of **solar** energy reaching Earth. Volcanic eruptions can cause **short-term cooling** in the short term. Burning fossil fuels releases **greenhouse gases/CO_2** into the atmosphere.

Step 2: Explain one natural cause of climate change. [2 marks]
Mark scheme
Award **1 mark** for identifying a valid natural cause of climate change.
Award **1 further mark** for explaining how it causes climate change.
Indicative content
Natural causes may include:

- orbital changes
- volcanic activity
- solar output

Model answer
One natural cause of climate change is orbital change. Changes in the shape of the Earth's orbit, its tilt and its wobble alter the amount of solar energy received, which can help trigger colder glacial periods and warmer interglacial periods.
Alternative model answer
One natural cause is volcanic activity. Major eruptions release ash and gases into the atmosphere, which can reflect sunlight back into space and cause short-term cooling.

Step 3: Explain how human activities contribute to climate change. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how human activities contribute to climate change. Accurate examples are used, such as fossil fuel use, agriculture, deforestation, carbon dioxide, methane, nitrous oxide and the enhanced greenhouse effect. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how these activities increase greenhouse gas levels and lead to global heating.
1 Basic	1–2	**AO2** Shows limited understanding of how human activities contribute to climate change. May identify simple activities such as burning fossil fuels or cutting down trees. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to greenhouse gases or warming.

Level	Marks	Description
0	0	No relevant content.

Indicative content

Students may refer to:

- burning coal, oil and gas releases carbon dioxide
- carbon dioxide is a greenhouse gas
- greenhouse gases trap heat in the atmosphere
- increased greenhouse gases strengthen the enhanced greenhouse effect
- livestock and rice farming release methane
- fertilisers release nitrous oxide
- deforestation reduces carbon dioxide absorption
- burning trees releases carbon dioxide
- reduced carbon storage increases atmospheric greenhouse gases
- human activity is the main cause of recent rapid warming

Model answer

Human activities contribute to climate change by increasing the amount of greenhouse gases in the atmosphere. Burning fossil fuels such as coal, oil and gas releases carbon dioxide, which traps heat and strengthens the enhanced greenhouse effect. Agriculture also contributes because livestock and rice farming release methane, while fertilisers release nitrous oxide. Deforestation makes climate change worse because fewer trees absorb carbon dioxide, and burning trees releases stored carbon. This increases global heating.

Page 45: Exam-style Questions

1.1 Name one natural cause of climate change. [1 mark]

Mark scheme

Award **1 mark** for naming one valid natural cause of climate change.

Acceptable answers

- orbital changes
- volcanic activity
- solar output

Model answer

Orbital changes.

1.2 Name one human cause of climate change. [1 mark]

Mark scheme

Award **1 mark** for naming one valid human cause of climate change.

Acceptable answers

- burning fossil fuels
- agriculture
- livestock farming
- rice farming
- fertiliser use
- deforestation
- industry
- transport
- energy production

Model answer

Burning fossil fuels.

1.3 Describe how solar output affects climate. [2 marks]

Mark scheme

Award **1 mark** for identifying that solar output is the amount of energy released by the Sun.
Award **1 further mark** for describing how a change in solar output can affect global temperatures.

Indicative content

Students may refer to:

- solar output is the Sun's energy output
- solar output varies over time
- more sunspots can mean more energy reaches Earth
- increased solar output can slightly increase global temperatures
- reduced solar output can slightly reduce global temperatures
- solar output has a small impact compared with human causes of recent warming

Model answer

Solar output is the amount of energy released by the Sun, and it varies over time. When solar output increases, more energy reaches the Earth, which can slightly increase global temperatures.

1.4 Explain how volcanic eruptions can affect global temperatures. [4 marks]

Assessment objectives

- **AO1 = 2 marks**
- **AO2 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO1** Shows clear knowledge of how volcanic eruptions affect climate. Accurate terminology is used, such as ash, sulphur dioxide, carbon dioxide, sunlight, reflection and short-term cooling. **AO2** Shows clear understanding of how volcanic eruptions affect global temperatures. Explanation is developed and links ash/gases to reduced incoming solar radiation and temporary cooling.
1 Basic	1–2	**AO1** Shows limited knowledge of volcanic eruptions as a cause of climate change. May identify ash or gases being released. **AO2** Shows limited understanding of how eruptions affect temperature. Explanation is basic or only partly linked to cooling or warming.
0	0	No relevant content.

Indicative content

Students may refer to:

- volcanic eruptions release ash and gases
- sulphur dioxide can form particles/aerosols in the atmosphere
- ash and particles reflect sunlight back into space
- less solar energy reaches the Earth's surface
- this can reduce global temperatures
- effect is usually short term
- cooling may last for several years after major eruptions
- eruptions also release carbon dioxide, but the short-term effect of major eruptions is usually cooling

Model answer

Volcanic eruptions can affect global temperatures by releasing ash and gases such as sulphur dioxide into the atmosphere. Ash and particles can reflect sunlight back into space, so less solar energy reaches the Earth's surface. This can cause global temperatures to fall for a short time after a major

eruption. The cooling effect may last for several years, although eruptions can also release carbon dioxide.

1.5 Explain how deforestation contributes to climate change. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how deforestation contributes to climate change. Accurate processes are explained, such as reduced photosynthesis, less carbon dioxide absorption, burning trees, carbon release and reduced carbon storage. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how these processes increase greenhouse gas levels and strengthen global warming.
1 Basic	1–2	**AO2** Shows limited understanding of deforestation as a cause of climate change. May identify that trees are cut down or that carbon dioxide increases. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to greenhouse gases or warming.
0	0	No relevant content.

Indicative content

Students may refer to:

- trees absorb carbon dioxide through photosynthesis
- cutting down trees means less carbon dioxide is removed from the atmosphere
- trees store carbon in biomass
- burning trees releases carbon dioxide
- decomposition of felled trees can also release carbon dioxide
- reduced carbon storage increases atmospheric carbon dioxide
- carbon dioxide is a greenhouse gas
- more carbon dioxide strengthens the enhanced greenhouse effect
- this increases global temperatures

Model answer

Deforestation contributes to climate change because trees absorb carbon dioxide from the atmosphere through photosynthesis. When forests are cut down, less carbon dioxide is removed from the air. Trees also store carbon, so when they are burned or left to decay, carbon dioxide is released. This increases the amount of greenhouse gases in the atmosphere, strengthening the enhanced greenhouse effect and causing global temperatures to rise.

1.6 Explain how natural and human factors cause climate change. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of how natural and human factors cause climate change. Accurate processes are explained, such as orbital changes, volcanic activity, solar output, fossil fuel use, agriculture and deforestation.

Level	Marks	Description
		AO3 Demonstrates detailed application of knowledge and understanding by explaining how these factors alter global temperatures over different timescales. Clear links are made between human activity, increased greenhouse gases and recent rapid warming.
2 Clear	3–4	**AO2** Shows clear understanding of natural and/or human causes of climate change. Some accurate processes are explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking causes to changes in global temperature or greenhouse gas levels.
1 Basic	1–2	**AO2** Shows limited understanding of causes of climate change. May identify simple causes such as fossil fuels, deforestation or volcanoes. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or only partly linked to climate change.
0	0	No relevant content.

Indicative content

Natural causes:

- orbital changes alter the amount of solar energy received
- changes in orbit, tilt and wobble can trigger glacials and interglacials
- volcanic eruptions release ash and gases
- ash and sulphur dioxide reflect sunlight, causing short-term cooling
- solar output varies over time
- more sunspots can slightly increase energy reaching Earth

Human causes:

- burning fossil fuels releases carbon dioxide
- carbon dioxide increases the greenhouse effect
- agriculture releases methane and nitrous oxide
- methane comes from livestock and rice farming
- fertilisers release nitrous oxide
- deforestation reduces carbon dioxide absorption
- burning trees releases carbon dioxide
- human activity is the main cause of recent rapid warming

Model answer

Climate change can be caused by both natural and human factors. Natural causes include orbital changes, volcanic activity and solar output. Orbital changes happen when the shape of the Earth's orbit, its tilt and its wobble vary. This changes how much solar energy the Earth receives and can trigger long-term glacial and interglacial cycles. Volcanic eruptions can also affect climate because they release ash and gases into the atmosphere. Ash can reflect sunlight back into space, causing short-term cooling.

Human factors are the main cause of recent rapid warming because they increase greenhouse gas levels. Burning fossil fuels releases carbon dioxide, which traps heat in the atmosphere and strengthens the enhanced greenhouse effect. Agriculture releases methane from livestock and rice farming, as well as nitrous oxide from fertilisers. Deforestation also contributes because fewer trees absorb carbon dioxide, while burning trees releases stored carbon. This increases global temperatures by trapping more heat in the atmosphere.

Page 46 Activities

Page 46: Exam Ready Question

Question

Explain how climate change affects people and the environment. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of how climate change affects both people and the environment. Accurate effects are explained, such as sea level rise, melting ice, extreme weather, ecosystem change, food supply, water supply, health, displacement and economic impacts. **AO3** Demonstrates detailed application of knowledge and understanding by linking climate change to specific consequences for people and the environment. Explanation is well developed and may recognise that impacts are unevenly distributed.
2 Clear	3–4	**AO2** Shows clear understanding of how climate change affects people and/or the environment. Some accurate effects are explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking climate change to environmental or human impacts.
1 Basic	1–2	**AO2** Shows limited understanding of climate change impacts. May identify simple effects such as higher temperatures, melting ice, flooding or drought. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or only partly linked to impacts on people or the environment.
0	0	No relevant content.

Indicative content

Environmental effects may include:

- global temperatures are increasing
- more frequent heatwaves
- increased evaporation
- changing rainfall patterns
- more intense rainfall in some areas
- drought in other areas
- glaciers retreating
- ice caps and ice sheets shrinking
- loss of polar habitats
- sea level rise
- coastal flooding
- loss of land
- increased coastal erosion
- more storms and flooding
- increased wildfire risk
- ecosystems disrupted

- species forced to migrate
- coral bleaching
- increased extinction risk

Human effects may include:

- reduced crop yields in some areas
- changing growing conditions
- risk of food shortages
- increased drought
- water shortages
- greater demand for water
- coastal flooding damaging homes
- displacement of people
- increased migration
- heat-related illness
- spread of tropical diseases such as malaria
- malnutrition risk
- damage to infrastructure
- increased insurance costs
- disruption to industries

Benefits may include:

- longer growing seasons in some regions
- reduced heating costs
- new crops in some areas

Model answer

Climate change affects the environment because global temperatures are rising. This can lead to more frequent heatwaves, increased evaporation and changing rainfall patterns. In some areas, rainfall may become more intense, increasing flooding, while other areas may experience more drought. Melting glaciers and ice sheets add water to the oceans, causing sea level rise. This increases coastal flooding, coastal erosion and loss of land. Ecosystems are also affected because species may be forced to migrate, coral reefs may bleach, and some species face a greater risk of extinction.

Climate change also affects people. Changing rainfall and higher temperatures can reduce crop yields in some areas, increasing the risk of food shortages. Drought and greater demand can put pressure on water supplies. Sea level rise and flooding can damage homes and force people to migrate from low-lying areas. Climate change can also affect health through heat-related illness, malnutrition and the spread of tropical diseases. Although there may be some limited benefits, such as longer growing seasons in some areas, the overall effects are mainly negative and unevenly distributed.

Page 47 Activities

Page 47: 30 Second Recall Answers

Define: Sea level rise

Sea level rise is the increase in the average level of the world's oceans.

Accept:

A rise in ocean levels caused by factors such as melting land ice and thermal expansion.

List: Three environmental effects of climate change

Any three from:

- rising temperatures

- more frequent heatwaves
- changing rainfall patterns
- more intense rainfall in some areas
- drought in other areas
- melting glaciers
- shrinking ice caps or ice sheets
- loss of polar habitats
- sea level rise
- coastal flooding
- increased coastal erosion
- more storms and flooding
- increased wildfire risk
- ecosystem disruption
- species migration
- coral bleaching
- increased extinction risk

Explain: Why climate change affects food supply
Climate change affects food supply because rising temperatures and changing rainfall patterns alter growing conditions. Some areas may experience drought, heat stress or water shortages, which can reduce crop yields. Extreme weather and flooding can also damage crops and farmland, increasing the risk of food shortages.

Page 47: Blur, Build, Check

Stage 2: Build answers
1. Outline the human effects of climate change
Students should include effects such as:
Food supply
- Rising temperatures and changing rainfall patterns affect agriculture.
- Crop yields may fall in some areas.
- Drought, heat stress or flooding can damage crops.
- This increases the risk of food shortages.
- Malnutrition risk may increase in vulnerable areas.

Water supply
- Increased drought can reduce available water.
- Higher temperatures increase evaporation.
- Demand for water may rise.
- Water shortages may become more common.

Settlements
- Sea level rise and coastal flooding can damage homes.
- People may be displaced from low-lying coastal areas.
- Increased migration may occur from high-risk areas.

Health
- Heatwaves can cause heat-related illness and deaths.
- Warmer conditions may allow tropical diseases such as malaria to spread.
- Food shortages can increase malnutrition.

Economic impacts
- Extreme weather and flooding can damage infrastructure.
- Insurance costs may increase.

- Industries may be disrupted by water shortages, flooding or storms.

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2. Outline the environmental effects of climate change
Students should include effects such as:
Rising temperatures
- Global temperatures are increasing.
- Heatwaves may become more frequent.
- Increased evaporation can affect rainfall and water availability.

Melting ice sheets and glaciers
- Glaciers retreat.
- Ice caps and ice sheets shrink.
- Polar habitats are lost.

Sea level rise
- Melting land ice adds water to the oceans.
- Coastal flooding becomes more likely.
- Land may be lost.
- Coastal erosion may increase.

Extreme weather
- Storms and flooding may become more intense or frequent.
- Droughts may become more common in some areas.
- Wildfire risk may increase.

Ecosystem change
- Ecosystems are disrupted.
- Species may be forced to migrate as climate conditions change.
- Coral bleaching may increase.
- Some species face a greater risk of extinction.

Page 47: Exam Builder

Step 1: Complete the sentences
Question
Global temperatures are _____.
Melting ice contributes to _____ level rise.
Climate change increases the frequency of _____ weather events.
Answer
Global temperatures are **increasing**.
Melting ice contributes to **sea** level rise.
Climate change increases the frequency of **extreme** weather events.
Accept:
Global temperatures are **rising**.
Melting ice contributes to **sea** level rise.
Climate change increases the frequency of **extreme/severe** weather events.

Step 2: Explain one environmental effect of climate change. [2 marks]
Mark scheme
Award **1 mark** for identifying one valid environmental effect of climate change.
Award **1 further mark** for explaining or developing the effect.
Indicative content
Students may refer to:
- rising temperatures
- more frequent heatwaves

- changing rainfall patterns
- melting ice sheets and glaciers
- sea level rise
- loss of polar habitats
- coastal flooding
- coastal erosion
- more storms or flooding
- drought
- wildfire risk
- ecosystem disruption
- species migration
- coral bleaching
- extinction risk

Model answer

One environmental effect of climate change is sea level rise. This happens partly because glaciers and ice sheets melt, adding water to the oceans, which increases coastal flooding and erosion.

Alternative model answer

Climate change can disrupt ecosystems. As temperatures rise, some species are forced to migrate to cooler areas, while others may face a greater risk of extinction.

Step 3: Explain how climate change affects people. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how climate change affects people. Accurate human impacts are explained, such as food shortages, water shortages, displacement, migration, health impacts, damage to homes and economic costs. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how climate change leads to consequences for people, settlements, health or livelihoods.
1 Basic	1–2	**AO2** Shows limited understanding of how climate change affects people. May identify simple impacts such as flooding, drought or illness. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to people.
0	0	No relevant content.

Indicative content

Students may refer to:

- food supply affected by lower crop yields
- changing growing conditions
- drought and flooding damaging crops
- water shortages caused by drought and higher demand
- sea level rise and flooding damaging homes
- displacement and migration from high-risk areas
- heat-related illness from heatwaves
- spread of tropical diseases such as malaria
- malnutrition linked to food shortages

- damage to infrastructure
- increased insurance costs
- disruption to industries and livelihoods

Model answer

Climate change affects people by increasing pressure on food and water supplies. Higher temperatures and changing rainfall patterns can reduce crop yields in some areas, increasing the risk of food shortages and malnutrition. Drought and greater demand for water can also lead to water shortages. People living in coastal areas may be affected by sea level rise because flooding can damage homes and force people to move. Climate change can also affect health through heat-related illness and the spread of tropical diseases.

Page 47: Exam-style Questions

1.1 Name one environmental effect of climate change. [1 mark]

Mark scheme

Award **1 mark** for naming one valid environmental effect.

Acceptable answers

- rising temperatures
- melting glaciers
- melting ice sheets
- sea level rise
- coastal flooding
- coastal erosion
- ecosystem disruption
- species migration
- coral bleaching
- increased extinction risk
- drought
- storms
- flooding
- wildfire risk
- changing rainfall patterns

Model answer

Sea level rise.

1.2 Name one human impact of climate change. [1 mark]

Mark scheme

Award **1 mark** for naming one valid human impact.

Acceptable answers

- food shortages
- reduced crop yields
- water shortages
- displacement
- migration
- heat-related illness
- spread of tropical diseases
- malnutrition
- damage to homes
- damage to infrastructure
- increased insurance costs
- disruption to industries

Model answer
Water shortages.

1.3 Describe how sea level rise affects coastal areas. [2 marks]
Mark scheme
Award **1 mark** for identifying one effect of sea level rise on coastal areas.
Award **1 further mark** for describing or developing the effect.
Indicative content
Students may refer to:

- coastal flooding
- land loss
- increased coastal erosion
- damage to homes and infrastructure
- displacement of people
- saltwater intrusion into freshwater or farmland
- damage to coastal ecosystems

Model answer
Sea level rise increases the risk of coastal flooding. This can damage homes and infrastructure in low-lying coastal areas and may force people to move away.
Alternative model answer
Sea level rise can increase coastal erosion because higher sea levels allow waves to attack further inland. This can lead to land loss and damage to coastal settlements.

1.4 Explain how climate change affects ecosystems. [4 marks]
Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how climate change affects ecosystems. Accurate impacts are explained, such as changing climate conditions, species migration, coral bleaching, habitat loss and extinction risk. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how rising temperatures, changing rainfall or melting ice disrupt ecosystems.
1 Basic	1–2	**AO2** Shows limited understanding of ecosystem impacts. May identify simple effects such as animals move, habitats change or species die. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to climate change.
0	0	No relevant content.

Indicative content
Students may refer to:

- rising temperatures change habitat conditions
- changing rainfall patterns alter water availability
- species may migrate to cooler or wetter areas
- some species cannot adapt or move quickly enough
- increased extinction risk
- coral bleaching caused by warmer seas

- melting ice causes loss of polar habitats
- drought and wildfire risk can damage ecosystems
- food webs may be disrupted

Model answer

Climate change affects ecosystems because rising temperatures and changing rainfall patterns alter the conditions species need to survive. Some species may be forced to migrate to cooler or wetter areas, but others may not be able to move or adapt quickly enough, increasing the risk of extinction. Warmer seas can also cause coral bleaching, which damages coral reefs and affects the many species that depend on them.

1.5 Explain how climate change affects water supply. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of how climate change affects water supply. Accurate processes are explained, such as changing rainfall patterns, drought, increased evaporation, increased demand and water shortages. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how climate change creates pressure on water availability for people, farming or industry.
1 Basic	1–2	**AO2** Shows limited understanding of climate change and water supply. May identify drought or water shortages. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to water supply.
0	0	No relevant content.

Indicative content

Students may refer to:

- rainfall patterns may change
- some areas may receive less rainfall
- drought may become more frequent or severe
- higher temperatures increase evaporation
- water stores such as rivers, reservoirs and groundwater may fall
- water demand may increase during hotter periods
- agriculture, households and industry may face shortages
- food production may be affected by lack of irrigation water

Model answer

Climate change affects water supply because rainfall patterns are changing and some areas may experience more frequent drought. Higher temperatures increase evaporation, which can reduce water in rivers, reservoirs and soils. At the same time, demand for water may increase during hotter periods, especially for households and farming. This can lead to water shortages and put pressure on agriculture, industry and settlements.

1.6 Explain how climate change affects people and the environment. [6 marks]

Assessment objectives

- **AO2 = 3 marks**
- **AO3 = 3 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	5–6	**AO2** Shows detailed understanding of how climate change affects both people and the environment. Accurate effects are explained, such as sea level rise, melting ice, extreme weather, ecosystem change, food supply, water supply, health, displacement and economic impacts. **AO3** Demonstrates detailed application of knowledge and understanding by linking climate change to specific consequences for people and the environment. Explanation is well developed and may recognise that impacts are unevenly distributed.
2 Clear	3–4	**AO2** Shows clear understanding of how climate change affects people and/or the environment. Some accurate effects are explained. **AO3** Demonstrates reasonable application of knowledge and understanding by linking climate change to environmental or human impacts.
1 Basic	1–2	**AO2** Shows limited understanding of climate change impacts. May identify simple effects such as higher temperatures, melting ice, flooding or drought. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic, generalised or only partly linked to impacts on people or the environment.
0	0	No relevant content.

Indicative content

Environmental effects:

- rising global temperatures
- more frequent heatwaves
- changing rainfall patterns
- melting glaciers and ice sheets
- loss of polar habitats
- sea level rise
- coastal flooding and erosion
- more intense extreme weather
- droughts, storms, flooding and wildfires
- ecosystem disruption
- species migration
- coral bleaching
- increased extinction risk

Human effects:

- reduced crop yields in some areas
- changing growing conditions
- risk of food shortages
- increased drought
- water shortages
- greater demand for water
- coastal flooding damaging homes
- displacement and migration
- heat-related illness
- spread of tropical diseases
- malnutrition

- damage to infrastructure
- increased insurance costs
- disruption to industries

Benefits:

- longer growing seasons in some areas
- reduced heating costs
- new crops in some areas

Model answer

Climate change affects the environment by increasing global temperatures. This causes glaciers and ice sheets to melt, adding water to the oceans and contributing to sea level rise. Sea level rise can increase coastal flooding, coastal erosion and loss of land. Climate change also affects ecosystems because warmer temperatures and changing rainfall patterns may force species to migrate. Coral bleaching may become more common, and some species face a greater risk of extinction.

Climate change also affects people. Higher temperatures and changing rainfall patterns can reduce crop yields in some areas, increasing the risk of food shortages. Drought and increased demand can put pressure on water supplies. Sea level rise and extreme weather can damage homes and infrastructure, causing displacement and migration. Climate change can also affect health through heat-related illness, the spread of tropical diseases and malnutrition. Although there may be limited benefits in some regions, such as longer growing seasons, the impacts are mainly negative and unevenly distributed.

Page 48 Activities

Page 48: Exam Ready Question

Question

Managing climate change requires both mitigation and adaptation strategies. To what extent do you agree? [9 marks]

Assessment objectives

- **AO2 = 4 marks**
- **AO3 = 5 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	7–9	**AO2** Shows detailed understanding of mitigation and adaptation strategies used to manage climate change. Clear understanding is shown of how mitigation reduces the causes of climate change and how adaptation reduces the impacts of climate change. **AO3** Demonstrates detailed evaluation of the need for both mitigation and adaptation. The answer compares the value of both approaches and reaches a clear, well-supported judgement.
2 Clear	4–6	**AO2** Shows clear understanding of mitigation and/or adaptation strategies. There is some understanding of how these strategies help manage climate change. **AO3** Demonstrates reasonable evaluation of the need for mitigation and/or adaptation. A judgement may be present, although it may not be fully developed or may be uneven.
1 Basic	1–3	**AO2** Shows limited understanding of mitigation and/or adaptation. Strategies may be identified but explanation is basic.

Level	Marks	Description
		AO3 Demonstrates limited evaluation. The answer may be mainly descriptive, one-sided or lack a clear judgement.
0	0	No relevant content.

Indicative content

Mitigation strategies may include:

- alternative energy, such as wind, solar and tidal power
- reducing fossil fuel use
- carbon capture and storage
- afforestation
- international agreements to reduce emissions

Adaptation strategies may include:

- changing crop types
- using drought-resistant crops
- adjusting planting times
- storing water in reservoirs
- improving water efficiency
- reducing water waste
- sea walls and flood defences
- improved drainage
- planning controls
- managed retreat from high-risk coastal areas

Students may evaluate that:

- mitigation is essential because it tackles the causes of climate change by reducing greenhouse gas emissions
- adaptation is essential because some climate change impacts are already happening
- mitigation can reduce future warming but may take time to have an impact
- adaptation helps people cope now but does not stop climate change becoming worse
- both approaches are needed because they work at different timescales and manage different parts of the problem

Model answer

I agree that managing climate change requires both mitigation and adaptation strategies because they manage different parts of the problem. Mitigation reduces the causes of climate change by lowering greenhouse gas emissions. For example, alternative energy such as wind, solar and tidal power reduces the need to burn fossil fuels, so less carbon dioxide is released. Afforestation also helps because trees absorb carbon dioxide from the atmosphere and store carbon through photosynthesis. Carbon capture can reduce emissions from power stations by capturing carbon dioxide before it is released and storing it underground.

However, adaptation is also needed because some impacts of climate change are already happening and will continue in the future. For example, farmers may need to change crop types, use drought-resistant crops or adjust planting times to maintain food supply. Water management, such as storing water in reservoirs and reducing waste, helps people cope with drought and changing rainfall patterns. Coastal areas may also need sea walls, flood defences, improved drainage or managed retreat to reduce the impacts of sea level rise.

Overall, I strongly agree with the statement. Mitigation is essential because it slows future climate change, but adaptation is also essential because people and environments must cope with the impacts already being experienced. Adaptation without mitigation would mean impacts keep getting worse, while mitigation without adaptation would leave people vulnerable to current and future climate risks.

Page 49 Activities

Page 49: 30 Second Recall Answers

Define: Climate change mitigation
Climate change mitigation means reducing the causes of climate change, mainly by cutting greenhouse gas emissions or increasing carbon storage.
Accept:
Actions that reduce the causes of climate change.
Define: Climate change adaptation
Climate change adaptation means reducing the impacts of climate change by adjusting to expected or existing changes.
Accept:
Actions that help people and places cope with the impacts of climate change.
List: Three adaptation strategies
Any three from:

- changing crop types
- using drought-resistant crops
- adjusting planting times
- storing water in reservoirs
- improving water efficiency
- reducing water waste
- building sea walls
- building flood defences
- improving drainage
- planning for sea level rise
- managed retreat from high-risk areas

Explain: Why both mitigation and adaptation are needed
Both mitigation and adaptation are needed because they do different jobs. Mitigation reduces the causes of climate change by lowering emissions, which helps slow future warming. Adaptation reduces the impacts of climate change by helping people cope with problems such as drought, flooding, sea level rise and food insecurity.

Page 49: Blur, Build, Check

Stage 2: Build answers
1. Outline climate change mitigation strategies
Mitigation strategies reduce the causes of climate change.
Alternative energy

- Wind, solar and tidal power can replace fossil fuels.
- This reduces carbon dioxide emissions from energy production.
- Renewable energy is more sustainable than coal, oil and gas.

Carbon capture

- Carbon dioxide can be captured from power stations before it is released.
- The captured carbon dioxide is stored underground.
- This reduces the amount of greenhouse gas entering the atmosphere.

Afforestation

- Afforestation means planting trees.
- Trees absorb carbon dioxide through photosynthesis.
- Forests store carbon and act as carbon sinks.
- This reduces greenhouse gas levels in the atmosphere.

International agreements

- Countries can agree to reduce emissions.
- The Paris Agreement is an example.
- Global cooperation is needed because climate change is a global issue.

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2. Outline climate change adaptation strategies

Adaptation strategies reduce the impacts of climate change.

Agriculture

- Farmers can change crop types.
- Drought-resistant crops can be used.
- Planting times can be adjusted.
- This helps maintain food supply as temperatures and rainfall patterns change.

Water management

- Water can be stored in reservoirs.
- Water efficiency can be improved.
- Water waste can be reduced.
- These strategies help people cope with drought and changing rainfall patterns.

Sea level rise management

- Sea walls and flood defences can be built.
- Drainage can be improved.
- Planning can keep development away from high-risk areas.
- Managed retreat can move people or assets away from areas at greatest risk.

Page 49: Exam Builder

Step 1: Complete the sentences

Question

Mitigation reduces the _____ of climate change.
Adaptation reduces the _____ of climate change.
Afforestation helps absorb _____ from the atmosphere.

Answer

Mitigation reduces the **causes** of climate change.
Adaptation reduces the **impacts** of climate change.
Afforestation helps absorb **carbon dioxide** from the atmosphere.
Accept:
Mitigation reduces the **causes/emissions** of climate change.
Adaptation reduces the **effects/impacts** of climate change.
Afforestation helps absorb **CO_2** from the atmosphere.

Step 2: Explain one mitigation strategy used to manage climate change. [2 marks]

Mark scheme

Award **1 mark** for identifying one valid mitigation strategy.
Award **1 further mark** for explaining how it reduces the causes of climate change.

Indicative content

Mitigation strategies may include:

- alternative energy
- carbon capture
- afforestation
- international agreements
- reducing fossil fuel use
- reducing greenhouse gas emissions

Model answer

One mitigation strategy is using alternative energy such as wind, solar or tidal power. This reduces the need to burn fossil fuels, so less carbon dioxide is released into the atmosphere.

Alternative model answer

Afforestation is a mitigation strategy because planting trees increases carbon storage. Trees absorb carbon dioxide through photosynthesis, reducing the amount of greenhouse gas in the atmosphere.

Step 3: Explain how one adaptation strategy reduces the impacts of climate change. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of one adaptation strategy used to manage climate change. Accurate examples are used, such as drought-resistant crops, changing planting times, reservoirs, improving water efficiency, sea walls, flood defences, drainage, planning or managed retreat. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how the chosen strategy reduces the impacts of climate change on people, the environment or the economy.
1 Basic	1–2	**AO2** Shows limited understanding of an adaptation strategy. May identify one strategy but explanation is simple or generalised. **AO3** Demonstrates limited application of knowledge and understanding. Link to reducing impacts is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may choose one adaptation strategy:

Agricultural adaptation

- changing crop types
- using drought-resistant crops
- adjusting planting times
- maintains food supply
- helps farmers cope with changing rainfall and higher temperatures

Water management

- storing water in reservoirs
- improving water efficiency
- reducing water waste
- helps cope with drought
- reduces risk of water shortages for homes, farming and industry

Sea level rise management

- sea walls and flood defences
- improved drainage
- planning controls
- managed retreat
- reduces coastal flooding
- protects homes and infrastructure
- moves people or assets away from high-risk areas

Model answer

One adaptation strategy is water management. Reservoirs can be used to store water during wetter periods, so it is available during droughts. Improving water efficiency and reducing waste can also help water supplies last longer. This reduces the impacts of climate change because people, farmers and businesses are less likely to experience severe water shortages as rainfall patterns change.

Page 49: Exam-style Questions

1.1 What is mitigation? [1 mark]
Mark scheme
Award **1 mark** for a valid definition.
Answer
Mitigation is reducing the causes of climate change.
Accept:
Reducing greenhouse gas emissions.

1.2 Name one adaptation strategy. [1 mark]
Mark scheme
Award **1 mark** for naming one valid adaptation strategy.
Acceptable answers

- changing crop types
- drought-resistant crops
- adjusting planting times
- water management
- reservoirs
- improving water efficiency
- reducing water waste
- sea walls
- flood defences
- improved drainage
- planning
- managed retreat

Model answer
Building sea walls.

1.3 Describe how carbon capture reduces climate change. [2 marks]
Mark scheme
Award **1 mark** for identifying that carbon capture removes or captures carbon dioxide before it enters the atmosphere.
Award **1 further mark** for describing how this reduces climate change.
Indicative content
Students may refer to:

- carbon capture captures carbon dioxide from power stations
- captured carbon dioxide is stored underground
- reduces the amount of carbon dioxide released into the atmosphere
- reduces the enhanced greenhouse effect

Model answer
Carbon capture reduces climate change by capturing carbon dioxide from power stations before it is released. The carbon dioxide is stored underground, reducing greenhouse gas emissions into the atmosphere.

1.4 Explain how afforestation helps reduce climate change. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of afforestation as a mitigation strategy. Accurate processes are explained, such as planting trees, photosynthesis, carbon dioxide absorption, carbon storage and carbon sinks. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how afforestation reduces greenhouse gas levels and helps limit global warming.
1 Basic	1–2	**AO2** Shows limited understanding of afforestation. May identify that trees are planted or absorb carbon dioxide. **AO3** Demonstrates limited application of knowledge and understanding. Explanation is basic or only partly linked to reducing climate change.
0	0	No relevant content.

Indicative content

Students may refer to:

- afforestation means planting trees
- trees absorb carbon dioxide from the atmosphere
- carbon dioxide is absorbed during photosynthesis
- trees store carbon in their biomass
- forests act as carbon sinks
- reducing atmospheric carbon dioxide reduces the enhanced greenhouse effect
- this helps slow global warming

Model answer

Afforestation helps reduce climate change because it involves planting trees. Trees absorb carbon dioxide from the atmosphere during photosynthesis and store carbon in their trunks, branches, roots and leaves. This means forests act as carbon sinks. By reducing the amount of carbon dioxide in the atmosphere, afforestation helps reduce the enhanced greenhouse effect and slows global warming.

1.5 Explain how water management helps people adapt to climate change. [4 marks]

Assessment objectives

- **AO2 = 2 marks**
- **AO3 = 2 marks**

Levelled mark scheme

Level	Marks	Description
2 Clear	3–4	**AO2** Shows clear understanding of water management as an adaptation strategy. Accurate examples are used, such as storing water in reservoirs, improving water efficiency and reducing waste. **AO3** Demonstrates reasonable application of knowledge and understanding by explaining how water management helps people cope with climate change impacts such as drought, changing rainfall patterns, higher evaporation and water shortages.
1 Basic	1–2	**AO2** Shows limited understanding of water management. May identify reservoirs or saving water.

Level	Marks	Description
		AO3 Demonstrates limited application of knowledge and understanding. Link to adapting to climate change is basic or only partly developed.
0	0	No relevant content.

Indicative content

Students may refer to:

- climate change may alter rainfall patterns
- drought may become more frequent or severe in some areas
- higher temperatures increase evaporation
- reservoirs store water for dry periods
- improving efficiency reduces waste
- reducing demand helps supplies last longer
- water management supports households, agriculture and industry
- it reduces the impacts of water shortages

Model answer

Water management helps people adapt to climate change because rainfall patterns are changing and drought may become more common in some areas. Reservoirs can store water during wetter periods so it is available during dry periods. Improving water efficiency and reducing waste also help supplies last longer. This means households, farmers and businesses are less likely to face severe water shortages.

1.6 Managing climate change requires both mitigation and adaptation strategies. To what extent do you agree? [9 marks]

Assessment objectives

- **AO2 = 4 marks**
- **AO3 = 5 marks**

Levelled mark scheme

Level	Marks	Description
3 Detailed	7–9	**AO2** Shows detailed understanding of mitigation and adaptation strategies used to manage climate change. Clear understanding is shown of how mitigation reduces the causes of climate change and how adaptation reduces the impacts of climate change. **AO3** Demonstrates detailed evaluation of the need for both mitigation and adaptation. The answer compares the value of both approaches and reaches a clear, well-supported judgement.
2 Clear	4–6	**AO2** Shows clear understanding of mitigation and/or adaptation strategies. There is some understanding of how these strategies help manage climate change. **AO3** Demonstrates reasonable evaluation of the need for mitigation and/or adaptation. A judgement may be present, although it may not be fully developed or may be uneven.
1 Basic	1–3	**AO2** Shows limited understanding of mitigation and/or adaptation. Strategies may be identified but explanation is basic. **AO3** Demonstrates limited evaluation. The answer may be mainly descriptive, one-sided or lack a clear judgement.
0	0	No relevant content.

Indicative content

Mitigation strategies:

- alternative energy: wind, solar and tidal power reduce fossil fuel use
- carbon capture: captures carbon dioxide from power stations and stores it underground
- afforestation: trees absorb and store carbon dioxide
- international agreements: countries agree to emissions targets

Adaptation strategies:

- agricultural change: changing crop types, drought-resistant crops, changing planting times
- water management: reservoirs, improving efficiency, reducing waste
- sea level rise management: sea walls, flood defences, drainage, planning, managed retreat

Evaluation:

- mitigation tackles the causes by reducing greenhouse gas emissions
- adaptation tackles the impacts by building resilience
- mitigation is needed to limit future warming
- adaptation is needed because impacts are already happening
- mitigation can take a long time to have an effect
- adaptation does not stop climate change from worsening
- both are needed at global and local scales

Model answer

I strongly agree that managing climate change requires both mitigation and adaptation strategies because they deal with different parts of the problem. Mitigation reduces the causes of climate change. For example, using alternative energy such as wind, solar and tidal power reduces fossil fuel use, so fewer greenhouse gases are released. Afforestation also helps because trees absorb carbon dioxide from the atmosphere through photosynthesis and store carbon. International agreements are important because climate change is a global issue, so countries need to work together to reduce emissions.

However, adaptation is also essential because climate change is already affecting people and environments. Farmers may need to change crop types, use drought-resistant crops or adjust planting times to maintain food supply. Water management, such as reservoirs and reducing waste, helps people cope with drought and changing rainfall patterns. Sea walls, flood defences, improved drainage and managed retreat can also reduce the impacts of sea level rise on coastal communities.

Overall, both strategies are needed. Mitigation is important because it slows future climate change, but it may take time to reduce global warming. Adaptation is needed now because people already face impacts such as drought, flooding and sea level rise. Adaptation alone is not enough because climate change would continue to get worse, while mitigation alone would not protect people from impacts that are already happening.