Oxford Revise | AQA A Level Geography | Answers

Chapter 5

Exemplar answers have been written by the author of the revision guide and are not created or approved by AQA. They do not necessarily represent the only possible solution or way to answer the question. All exemplar answers are likely to be in the top mark band.

Questions 1–6 are point-marked. Allow 1 mark per valid point with extra marks for development.

1 AO1 = 4

- Largest tephra falls near the crater (1).
- Smallest ash particles can travel for thousands of miles (1).
- Can be a primary hazard, e.g. breathed in (1).
- Can be a secondary hazard, e.g. when heavy rainfall destabilises tephra deposits to cause a mudflow (lahar) (1).

Example answer: *Tephra is sold material ejected into the air as a result of a volcanic eruption. The largest tephra falls nearest the crater, while the smallest ash particles can travel in the atmosphere for thousands of miles. These fine tephra particles can be a primary hazard when breathed in. Tephra can also form a secondary hazard when heavy rainfalls destabilise tephra deposits to cause a mudflow (lahar).*

2 AO1 = 4

- The Park model plots four stages of human responses to hazards over time (1).
- The four stages are pre-disaster, hazard event, relief, rehabilitation and reconstruction (1); a fifth stage of reflection is sometimes added to the model (1).
- The curve usually indicates quality of life, and the model illustrates the speed at which the area or country returns to normality (1).
- The steepness of the curve illustrates a) the scale of the disaster and b) the speed of response (1).

3 AO1 = 4

- Mitigation is a response to hazards and involves taking action now to reduce the impact of future hazards (1).
- In the hazard management cycle, mitigation is the stage after the response to a hazard and the recovery (1); the steps taken in mitigation then influence work on preparedness for the next disaster (1).
- An example of mitigation for earthquake hazards would be the construction of earthquake-resistant buildings (1), which would reduce the impact of future earthquakes for a population (1).
- Mitigation is a long-term response (1).

4 AO1 = 4

- People do not always have an accurate perception of the risk of hazards (1).
- Risk perception is influenced by experience (1), which can be misleading if, for example, hazards in a location only occur infrequently (1) – once per generation or less frequently, for example (1).
- Hazard perception can be influenced by education (1); educating people about hazard risk can improve the accuracy of risk perception (1).
- In some cultures, hazards are perceived as something humans can do nothing to avoid or prevent (1), e.g. seeing earthquakes as God's will or destiny (1).

5 AO1 = 4

- Processes leading to tectonic plate movement are not fully understood and are debated (1).
- Convection currents occur in magma as hotter magma rises and cooler magma sinks. These currents may drag tectonic plates with them (1).
- Gravitational sliding may be important: slab pull is when the weight of a plate sinking into the mantle pulls the rest of the plate behind it (1).
- Ridge push is another form of gravitational sliding: when mid-ocean ridges are high, magma rises up through them, cools and becomes more dense, sliding down the ridge and moving away from it (1).

6 AO1 = 4

- Volcanic activity is common at constructive margins and some destructive margins (1).
- As plates pull apart at constructive margins, magma rises to fill the gap, causing volcanoes to form (1).
- Basaltic (basic) lava eruptions are associated with constructive margins (1).
- At destructive plate margins, the Benioff Zone of melting produces less dense magma that rises through cracks and faults to form volcanoes (1).
- When no subduction occurs, e.g. at continental–continental convergence destructive plate margins, and conservative plate margins, no melting of rock takes place, so volcanoes are not formed (1).

Questions 7–16 are level-marked.

7 AO1 – Knowledge and understanding of conditions favouring wildfires, causes of wildfires, risk management of wildfire hazards.
AO2 – Application of knowledge to the novel situation; specifically in terms of understanding of factors involved in assessing wildfire risk.
AO1 = 2 AO2 = 4

Level	Marks	Description
2	4–6	• AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. • AO2 – Applies knowledge and understanding to the novel situation offering clear evaluation and analysis drawn appropriately from the context provided. Connections and relationships between different aspects of study are evident with clear relevance.
1	1–3	• AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions, change. • AO2 – Applies limited knowledge and understanding to the novel situation offering only basic evaluation and analysis drawn from the context provided. Connections and relationships between different aspects of study are basic with limited relevance.

AO1

- Nature of wildfires. Conditions favouring intense wildfires: vegetation type, fuel characteristics, climate and recent weather and fire behaviour. Causes of fires: natural and human agency. Impacts: primary/secondary, environmental, social, economic, political. Short- and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.

AO2

- Answers should show understanding of causes of wildfires, e.g. by humans, either accidentally through cigarettes, sparks, disposable barbecues, etc., or on purpose (arson), or as a natural process (lightning, volcanic activity).
- In terms of causes, Figure 1 is very useful in categorising ignition risk for different areas: the high hazard areas are high risk in terms of being wildland areas with proximity to development or natural sources of ignition from lava or lightning.
- The rating of risk in terms of past history of wildfires is useful as conditions that increase ignition risk can change from year to year, e.g. clearing dry undergrowth reduces ignition risk. For people making choices about places to live, therefore, Figure 1 presents very useful information.
- There are factors affecting fire risk that are not included in Figure 1, reducing its usefulness: e.g. climate and recent weather, topography (steep slopes) and fuel supply. Other sources of information would be more useful for gaining a more detailed and potentially more current assessment of risk.
- Some users might need a more detailed and local source of information, which would make Figure 1 less useful.
- Most of the land area covered by Figure 1 is not categorised for ignition risk, possibly because Figure 1 only assesses risk for residential areas. This could reduce its usefulness for people seeking information on fire risk when hiking or travelling, for example.

Example answer: *The cause of a wildfire can be human (either accidentally through cigarettes, sparks, disposable barbecues, etc., or through arson) or as a natural process (lightning, volcanic activity). Figure 1 categorises ignition risk for different areas: the high hazard areas are high risk in terms of being wildland areas with proximity to development or natural sources of ignition from lava or lightning. The rating of risk in terms of past history is useful as conditions that increase ignition risk can change from year to year, e.g. clearing dry undergrowth reduces ignition risk. For people making choices about places to live, therefore, Figure 1 presents very useful information.*

However, there are factors affecting fire risk that are not included, reducing its usefulness, such as climate and recent weather, topography (steep slopes) and fuel supply. The map is relatively small scale with no background detail. A larger scale map may give an indication of whether, for example, the wildfires follow any transport or natural corridors such as roads, railways, valleys. Most of the land area covered by Figure 1 is not categorised for ignition risk, possibly because Figure 1 only assesses risk for residential areas. This could reduce its usefulness for people seeking information on fire risk when hiking or travelling, for example.

8 AO3 – Analysis of the data of the number of worldwide deaths from earthquakes 1818–2017 to identify patterns, anomalies and using data manipulation to support response.
AO3 = 6

Level	Marks	Description
2	4–6	• Clear analysis of the quantitative evidence provided, which makes appropriate use of evidence in support. • Clear connection(s) between different aspects of the evidence.
1	1–3	• Basic analysis of the quantitative evidence provided, which makes limited use of evidence in support. • Basic connection(s) between different aspects of the evidence.

- The graph shows an increasing trend in global deaths from earthquakes, with the highest death count before 1850 being approximately 25,000 people compared to approximately 320,000 in the first decade of the twenty-first century.
- In terms of the frequency of years with large numbers of deaths, an increasing trend is also evident, though less marked. For years with over 50,000 deaths, the first half of the nineteenth century has none, the second half shows only one (late 1860s), the periods 1900–1950 and 1951–2010 have seven each.
- There are also clusters of years with high death tolls from earthquakes: around 1908, in the 1970s and in the 2000s.
- Throughout the time period, the graph shows periods of years in which few or no deaths from earthquakes are recorded. In total, out of the 200-year period 1818–2017, deaths from earthquakes are recorded for 112 years (56 per cent).
- The increased trend in global deaths from earthquakes is more likely to be because of increasing human population than an increased incidence of earthquakes, particularly an increased number of humans living in areas at risk of earthquake. There may also have been more deaths from earthquakes in previous centuries that were not recorded, and records in the past may have been less accurate.

9 AO3 – Analysis of the data evidence of recorded deaths and economic losses to identify patterns, anomalies and using data manipulation to support response.
AO3 = 6

Level	Marks	Description
2	4–6	• Clear analysis of the quantitative evidence provided, which makes appropriate use of evidence in support. • Clear connection(s) between different aspects of the evidence.
1	1–3	• Basic analysis of the quantitative evidence provided, which makes limited use of evidence in support. • Basic connection(s) between different aspects of the evidence.

- The graph of reported deaths due to natural disasters shows a downwards trend, with variations, from 556,175 in the 1970s to 184,436 in the 2010s. Conversely, the graph of reported economic loss from natural disasters shows a clear increasing trend over the same period: from $183.9 billion in the 1970s to $1476.2 billion in the 2010s.
- The period 1980–1989 is an anomaly in the graph of reported deaths, with approximately 550,000 deaths due to drought. This is five times as many as in the 1970s, and in the 1990s to 2010s, deaths from drought are much lower: perhaps under 10,000 people in the 1990s and 2000s.
- Interestingly, economic losses from drought remain relatively low throughout the period. In fact, the 1980s losses from drought are less than in the 2000s, where perhaps only 5000 people died of drought.
- Storms were the biggest killer worldwide in the 1970s, 1990s and the 2000s, making up over half of all deaths from natural disasters in those decades.

- In terms of economic losses from storms, there is a clear trend of increasing losses, from around $90 billion in the 1970s to around $900 billion in the 2010s.
- The highest economic loss from storms came in the 2010s, when the number of deaths from storms was the lowest on record for the period – around 20,000 people. Economic losses go up in wealthy areas, so this suggests that storms are impacting on more developed areas than in the 1970s, where perhaps measures are in place to reduce loss of life, e.g. evacuation measures.
- While extreme temperatures are not yet showing as a cause of heavy economic losses, they are showing an increase this century in the numbers of people killed by them. This is likely to be connected to the increase in extreme weather events because of climate change.

10 AO1 – Knowledge and understanding of impact and management issues associated with volcanoes.
AO2 – Application of knowledge and understanding to the novel situation, to assess the scale of challenge associated with predicting volcanic eruptions.
AO1 = 4 AO2 = 5

Level	Marks	Description
3	7–9	• AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. • AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.
2	4–6	• AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. • AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.
1	1–3	• AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. • AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

AO1

- Spatial distribution, magnitude, frequency, regularity, and predictability of hazard events.
- Impacts: primary/secondary, environmental, social, economic, political. Short- and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention, and adaptation.

AO2

- Figure 4 shows that measuring radiative power is a good indication of an eruption – the readings from January to May show high levels of thermal energy while there are just a few, low measurements after the eruption on 3 June. So, increases in thermal energy from a volcano are a strong predictor of an eruption.
- The increase in thermal energy will be related to magma rising in the volcano. Expansion of the magma chamber can also be monitored by measuring ground deformation using tiltmeters and GPS.

- However, the graph shows high levels of thermal energy throughout January to May. February shows a spike higher than the ones recorded just before the eruption, and there are similar clusters of readings in February, late March and May.
- Accurate prediction is therefore a challenge. An evacuation for a long period of time would be very disruptive to people's lives.
- Other issues not evident from Figure 4 add to the challenges of predicting volcanic eruptions, such as the nature of the eruption, its extent, and the areas likely to be at highest and lowest risk. Other measurements assist with predictions, such as gas emission monitoring and records of past eruptions, which adds to the challenge. Again, such measurements are indicative only, i.e. they indicate possible outcomes of the additional challenge of what the risks will be and what areas will be affected.

Example answer: *Figure 4 shows that increased readings of radiative power (levels of thermal energy) from a volcano is a strong predictor of an eruption because the readings from January to May show high measurements which drop off completely after the eruption (3 June), with only a few low measurements. This increase in thermal energy will be related to magma rising in the volcano – pre-eruption process. Tiltmeters and GPS can also be used to measure ground deformation caused by expansion of the magma chamber.*

However, Figure 4 also shows that there is no certainty in predicting eruptions. The graph shows very high levels of thermal energy from January to May. February shows the highest spike in readings including those before and during the eruption, and there are clusters of readings in February, late March, and May, which may have given the false indication that an eruption is extremely imminent.

The challenge of accurate prediction is not just in identifying whether an eruption will happen, but when it will happen. An evacuation from January to June would be very disruptive to people's lives and possibly lead to social unrest and economic instability.

Other issues not evident from Figure 4 add to the challenges of prediction, such as the nature of the eruption, its extent, and the areas likely to be at highest and lowest risk. Other measurements, such as gas emission monitoring and records of past eruptions, can help with prediction but they only indicate possible outcomes. Together with the challenge of knowing when a volcano will erupt is therefore added the challenge of what the risks will be and what areas will be affected.

11 AO1 – Knowledge and understanding of impact and management issues associated with seismic hazards.
AO2 – Application of knowledge and understanding to the novel situation, to assess the scale of challenge associated with managing earthquake hazards, specifically tsunami.
AO1 = 4 AO2 = 5

Level	Marks	Description
3	7–9	• AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. • AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.
2	4–6	• AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy.

		• AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.
1	1–3	• AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. • AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

AO1

- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Spatial distribution, randomness, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary/secondary; environmental, social, economic, political. Short- and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.

AO2

- Figure 5b shows that Okitsu's location increases the risk of tsunami – not only is the settlement coastal but it is sited within a bay that narrows as it reaches Okitsu. A tsunami caused by an earthquake offshore would then experience a funnelling effect as it moved towards the coast, amplifying the height of the tsunami as it reached Okitsu.
- A narrow inlet to the east of Okitsu would increase this risk further: Figure 5a shows how high land either side of the inlet would intensify this funnelling effect. Having water inundating Okitsu from both the south and east would also add to the management challenge. Topography in this case is an important challenge for managing tsunami risk in this location.
- Figure 5b also indicates that there is only one road out of/into Okitsu which could hamper rescue operations and short-term responses for the settlement in the event of a tsunami. For example, landslides caused by earthquake or debris from a tsunami could easily block this road, given the mountainous terrain that it winds through. Making sure that short-term responses are effective would be a major challenge for managing tsunami risk in Okitsu.
- Figure 5a shows that the majority of Okitsu would be inundated with flooding of over 10 m. Tsunamis in Japan have reached heights of 25 m. A key challenge would be providing quick access to shelters at a high enough altitude to escape inundation.
- Evacuation centres located on the hillsides overlooking Okitsu are numbered 1–6. Shelters 1 and 2 have an altitude of over 30 m, making them safe locations from even the most extreme tsunami. They also have the largest capacity. However, they are out of town and not all residents might be able to reach them quickly enough, especially as a third of residents are over the age of 75.
- Towers 7, 8 and 10 in the town centre are 15 m above sea level. This height is presumably built to deal with all but the most extreme tsunami, perhaps without being visually overwhelming. Their central location means many residents would be able to reach them quickly, if there was little time to react. An effective tsunami warning system would be needed as part of managing earthquake risk to give people time to reach the hillside shelters.

12 AO1 – Knowledge and understanding of impact and management issues associated with storm hazards.
AO2 – Application of knowledge and understanding assessing usefulness of prediction in the management of storm hazards.
AO1 = 4 AO2 = 5

Level	Marks	Description
3	7–9	• AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. • AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.
2	4–6	• AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. • AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.
1	1–3	• AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. • AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

AO1

- The nature of tropical storms and their underlying causes. Forms of storm hazard: high winds, storm surges, coastal flooding, river flooding and landslides. Spatial distribution, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary/secondary, environmental, social, economic, political. Short- and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention, and adaptation.

AO2

- Prediction involves forecasting when and where a hazard will occur using science, e.g. using data from early warning systems and weather monitoring satellites. Putting this data together with historical data allows computer modelling to predict the likely track of the storm and its severity.
- Predictions can provide the necessary lead time to evacuate populations at risk, potentially saving lives. This is crucial in densely populated coastal areas.
- Predictions can also trigger emergency services to prepare and respond more effectively, reroute flights and shipping away from danger areas and ensure that critical infrastructure services (power, water) are protected or backed up.
- Preparedness as well as prediction is critical in the management of storm hazards. For example, people need to have places to evacuate to, safe routes to travel to reach them, and to know about/have practised this evacuation in advance for it to be effective.
- The speed and effectiveness of emergency responses to storm hazards that have not been predicted accurately will depend on preparedness, which, together with mitigation measures to deal with expected

and unexpected impacts from a hazard, will enable communities to manage the risk from storm hazards even if prediction turns out to be inaccurate.

13 AO1 – Knowledge and understanding of impact and management issues associated with wildfire hazards.
AO2 – Application of knowledge and understanding assessing threats to the successful management of wildfire hazards.
AO1 = 4 AO2 = 5

Level	Marks	Description
3	7–9	• AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout. • AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.
2	4–6	• AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy. • AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.
1	1–3	• AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy. • AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

AO1

- Nature of wildfires. Conditions favouring intense wildfires: vegetation type, fuel characteristics, climate and recent weather and fire behaviour. Causes of fires: natural and human agency. Impacts: primary/secondary, environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention, and adaptation.
- Impacts: primary/secondary, environmental, social, economic, political. Short- and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention, and adaptation.

AO2

- Most wildfires occur during or after prolonged dry periods when vegetation (the fuel for wildfires) has become dry and combustible.
- Although other conditions also favour wildfires (e.g. vegetation supply, topography, fuel supply, wind direction and human activity), this key criterion of dry weather means that where climate change increases the duration and severity of droughts, then climate change will be a substantial threat to the successful management of wildfires.
- The successful management of wildfire events relies on weather monitoring, fuel monitoring, satellite surveillance (for hot spots at increased risk of wildfire), mitigation (clearing dead vegetation, controlled burning) and prevention (e.g. laws restricting campfires or barbeques). These measures are all effective

and their effectiveness is not challenged by climate change itself, however what climate change does is increase the scale of the challenge and its cost – monitoring, mitigation and prevention need to be over much larger areas and over much longer time periods.

- Mitigation may be where opportunities exist to counter the increased risks of wildfires as a result of climate change-induced droughts since removing the fuel for wildfires through controlled burning outside the wildfire season would significantly reduce risks.
- Similar wildfire events can have very different outcomes depending on where they are in the world, which suggests that other factors may also be important in successful management of wildfire events, in particular the cost of preparedness and mitigation measures. As a result, low levels of investment, government corruption or ineffective communication may also be considered as significant threats to successful management globally, alongside climate change.

14 AO1 – Knowledge and understanding of impact and management issues associated with hazards.
AO2 – Application of knowledge and understanding assessing usefulness of prediction in the management of hazards.
AO1 = 10 AO2 = 10

Level	Marks	Description
4	16–20	• AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent. • AO2 – Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout. • AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout. • AO1 – Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout. • AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.
3	11–15	• AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects. • AO2 – Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding. • AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments. • AO1 – Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change. • AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.
2	6–10	• AO2 – Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question. • AO2 – Interpretations are partial but do support the response in places. Some partially relevant analysis and evaluation in the application of knowledge and understanding.

		• AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant. • AO1 – Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies. • AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.
1	1–5	• AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic. • AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence. • AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Very limited relevant knowledge and understanding of place(s) and environments. • AO1 – Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies. • AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.
0	0	• Nothing worthy of credit.

AO1

- Spatial distribution, randomness, magnitude, frequency, regularity and predictability of hazard events.
- Impacts: primary/secondary; environmental, social, economic, political. Short- and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Case study of a multi-hazardous environment beyond the UK to illustrate and analyse the nature of the hazards and the social, economic, and environmental risks presented, and how human qualities and responses such as resilience, adaptation, mitigation and management contribute to its continuing human occupation.

AO2

- Prediction involves forecasting when and where a hazard will occur using science, e.g. using data from seismographs (to detect earthquakes), tiltmeters and GPS (to measure ground deformation), meteorological data that is used in computer modelling (to predict landfall of storm events, storm surge heights, etc).
- Prediction can provide the necessary lead time to evacuate populations at risk, potentially saving lives.
- Prediction can also trigger emergency services to prepare and respond more effectively.
- Predictions are not static: each disaster or occurrence of a natural hazard provides information that is used in future predictions or to improve modelling of hazard risks.
- Prediction is imperfect. For example, we can predict where seismic hazards are likely to occur (along plate margins), but not when, exactly where, or at what magnitude they will occur. Volcanic eruptions are a little easier to predict – signs can be monitored that show an eruption is imminent, but when, and at what magnitude, is not currently predictable.

- An example is the Eyjafjallajökull eruption, Iceland April 2010 – eruption was preceded by a series of earthquakes and small fissure eruptions, but the ash cloud produced, and the 39-day duration of the eruption were both unpredicted, causing disruption to flights across Europe, and economic loss.
- Managing the response to natural hazards is crucial: effective, efficient evacuation to safe places; preparedness of the emergency responses for swift and effective response.
- Mitigation measures to deal with expected and unexpected impacts from a hazard will enable communities to manage the risk from hazards even if prediction turns out to be inaccurate.
- Examples could be given in which the response to hazards was inadequate. For example, 6190 people died in Typhoon Haiyan (8 November 2013) despite predictions giving 48 hours warning of the tropical storm and 800,000 people being evacuated. The evacuation shelters were not all built far enough inland to save people from drowning in the 5 m storm surge. Hurricane Katrina (29 August 2009) caused the deaths of 1200 people in New Orleans, partly because the levees protecting the city were not built to deal with a Category 5 storm. Accurate prediction meant one million people had been evacuated, but 60,000 poorer residents did not evacuate, some because of lack of transport, others to stay to protect their property from looters.
- Prediction and management need to work together to feed into preparedness for the next hazard. For example, following the Eyjafjallajökull eruption, research has taken place into the impacts of volcanic ash on jet engines to establish safe thresholds for flying in the event of another ash cloud over Europe, and Europe's airspace is now split into nine blocks which can be closed individually rather than all having to be shut at once.

Example answer: *Prediction involves forecasting when and where a hazard will occur using science, e.g. using seismographs (earthquakes), tiltmeters and GPS (ground deformation), meteorological data (landfall of storm events, storm surge heights). Accurate prediction can provide the time for evacuations to take place, and to prepare emergency services to be able to respond more effectively. Each natural hazard event provides information that is used in future predictions or to improve modelling of hazard risks.*

Prediction is imperfect. For example, with seismic hazards, while we can predict where hazards are likely to occur (along plate margins), we cannot predict when they will occur or at what magnitude as they can happen without warning. Volcanic eruptions can be monitored for signs that show an eruption is imminent, but predicting exactly when and at what magnitude is not currently possible. Eyjafjallajökull in Iceland had been dormant for 200 years when it erupted in April 2010. The eruption was preceded by a series of earthquakes and small fissure eruptions giving some warning, and 800 people were evacuated with no loss of life. The long duration (39 days) of the eruption was not predicted, nor was the huge ash cloud, which caused the cancellation of 10,000 flights across Europe, and a $5 billion loss to the European economy.

So, as there are many aspects of natural hazards that are not predictable, managing the response to an event is crucial – practising evacuation to safe places via safe routes. The preparedness of emergency services affects the speed and effectiveness of their response, and this, together with mitigation measures to deal with expected and unexpected impacts from a hazard, will enable communities to manage the risk from hazards even if prediction turns out to be inaccurate.

There are many examples in which the response to hazards was inadequate. For example, Typhoon Haiyan killed 6190 people in 2013 despite predictions giving 48 hours warning of the tropical storm and 800,000 people being evacuated. One reason was that evacuation shelters were not built far enough inland to save people from drowning in the 5 m storm surge. Similarly, 1200 people died in 2005 in New Orleans as a result of the Category 5 Hurricane Katrina, because levees protecting the city had been built to deal with a Category 3 storm. Accurate prediction meant one million people were evacuated, but 60,000 poorer residents were not, either because of lack of transport, or to stay to protect their property from looters.

In conclusion, prediction and management need to work together to feed into effective preparedness for the next hazard. For example, following the Eyjafjallajökull eruption, research has taken place into the impacts of volcanic ash on jet engines to establish safe thresholds for flying in the event of another ash cloud over Europe, and Europe's airspace is now split into nine blocks which can be closed individually rather than all having to be shut at once.

15 AO1 – Knowledge and understanding of plate tectonic theory and how it relates to seismic hazards, knowledge and understanding of responses to seismic hazards.
AO2 – Application of knowledge and understanding to assess the extent to which plate tectonic theory has influenced human responses to seismic hazards.
AO1 = 10 AO2 = 10

Level	Marks	Description
4	16–20	• AO2 – Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent. • AO2 – Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout. • AO2 – Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout. • AO1 – Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout. • AO1 – Detailed awareness of scale and temporal change which is well integrated where appropriate.
3	11–15	• AO2 – Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects. • AO2 – Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding. • AO2 – Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Generally clear and relevant knowledge and understanding of place(s) and environments. • AO1 – Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change. • AO1 – Generally clear awareness of scale and temporal change which is integrated where appropriate.
2	6–10	• AO2 – Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question. • AO2 – Interpretations are partial but do support the response in places. Some partially relevant analysis and evaluation in the application of knowledge and understanding. • AO2 – Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Some relevant knowledge and understanding of place(s) and environments which is partially relevant.

		• AO1 – Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies. • AO1 – Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies.
1	1–5	• AO2 – Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question. Interpretation is basic. • AO2 – Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence. • AO2 – Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts. • AO1 – Very limited relevant knowledge and understanding of place(s) and environments. • AO1 – Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies. • AO1 – Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies.
0	0	• Nothing worthy of credit.

AO1

- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.
- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Spatial distribution, randomness, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary/secondary; environmental, social, economic, political. Short- and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Impacts and human responses as evidenced by a recent seismic event.
- Hazard perception and its economic and cultural determinants. Characteristic human responses – fatalism, prediction, adjustment/adaptation, mitigation, management, risk sharing – and their relationship to hazard incidence, intensity, magnitude, distribution and level of development.

AO2

- Plate tectonic theory is that the lithosphere is broken up into tectonic plates that move over the semi-fluid asthenosphere beneath them.
- The relationship between plate tectonic theory and seismic hazards is the recognition that the spatial distribution of earthquakes maps to the margins of most of the tectonic plates.
- Different kinds of plate margins have been observed to produce different kinds of earthquakes.
- As a result of the theory and research to back it up, we can predict where seismic hazards are likely to occur – along plate margins. However, people have long known which areas were prone to earthquakes, so this is not a new influence.
- Plate tectonic theory has meant changes in monitoring and prediction, e.g. measurement of the amount of stress that has built up along a fault/plate margin is valuable in the human responses of preparing for and mitigating against seismic hazards.

- Plate tectonic theory has also influenced the perception of seismic hazards, and therefore human responses to them. For example, in the past more areas may have had a fatalistic perception of earthquakes.
- The confirmation through experimentation of plate tectonics as a scientific explanation for seismic hazards allows for different perceptions that make predictions, management, and mitigation of seismic easier to achieve.
- The evolution of improved monitoring, preparedness, response, recovery and mitigation measures has been a bigger influence. As a result of improvements in these areas, death tolls for major earthquakes are often much smaller than they would have been in past centuries, despite more people living in the affected areas.
- For example, the development of earthquake resistant buildings with seismic isolators that separate the building from the ground with a layer of springs or rubber and automatic window shutters that prevent broken glass from falling into the streets below.
- A likely conclusion therefore is that plate tectonic theory has been more important for understanding seismic hazards than for responding to them.

16 AO1 – Knowledge and understanding of case study of a local scale of a specified place in a hazardous setting.
AO2 – Application of knowledge and understanding to assess the community's responses to the risks in relation to the physical nature of the hazard.
AO1 = 10 AO2 = 10

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

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0	0	• Nothing worthy of credit.

AO1

- Case study at a local scale of a specified place in a hazardous setting to illustrate the physical nature of the hazard and analyse how the economic, social, and political character of its community reflects the presence and impacts of the hazard and the community's response to the risk.

AO2

- Answers should relate to a local-scale case study of a hazardous setting, for example Lahaina, Hawaii. A brief summary of the physical nature of the hazard, e.g. wildfires.
- Consideration of impacts to a hazard event, for example August 2023 wildfires in the case of Lahaina.
- Answers could relate responses to theories about hazard perception and characteristic responses, and the Park model.
- Consideration of responses to the hazard, and evaluation of their effectiveness. In the case of Lahaina, systems and logistics were both seen to be less responsive than they should have been: poor communication, misunderstandings in the community about the severity of the hazard risk (hazard perception), lack of water for firefighting and issues with the emergency management system in general.
- Consideration of community responses after the hazard event: in the case of Lahaina, the process of clearing away toxic debris took several months, and rebuilding has been delayed by slow processes for attaining building permits in Hawaii.