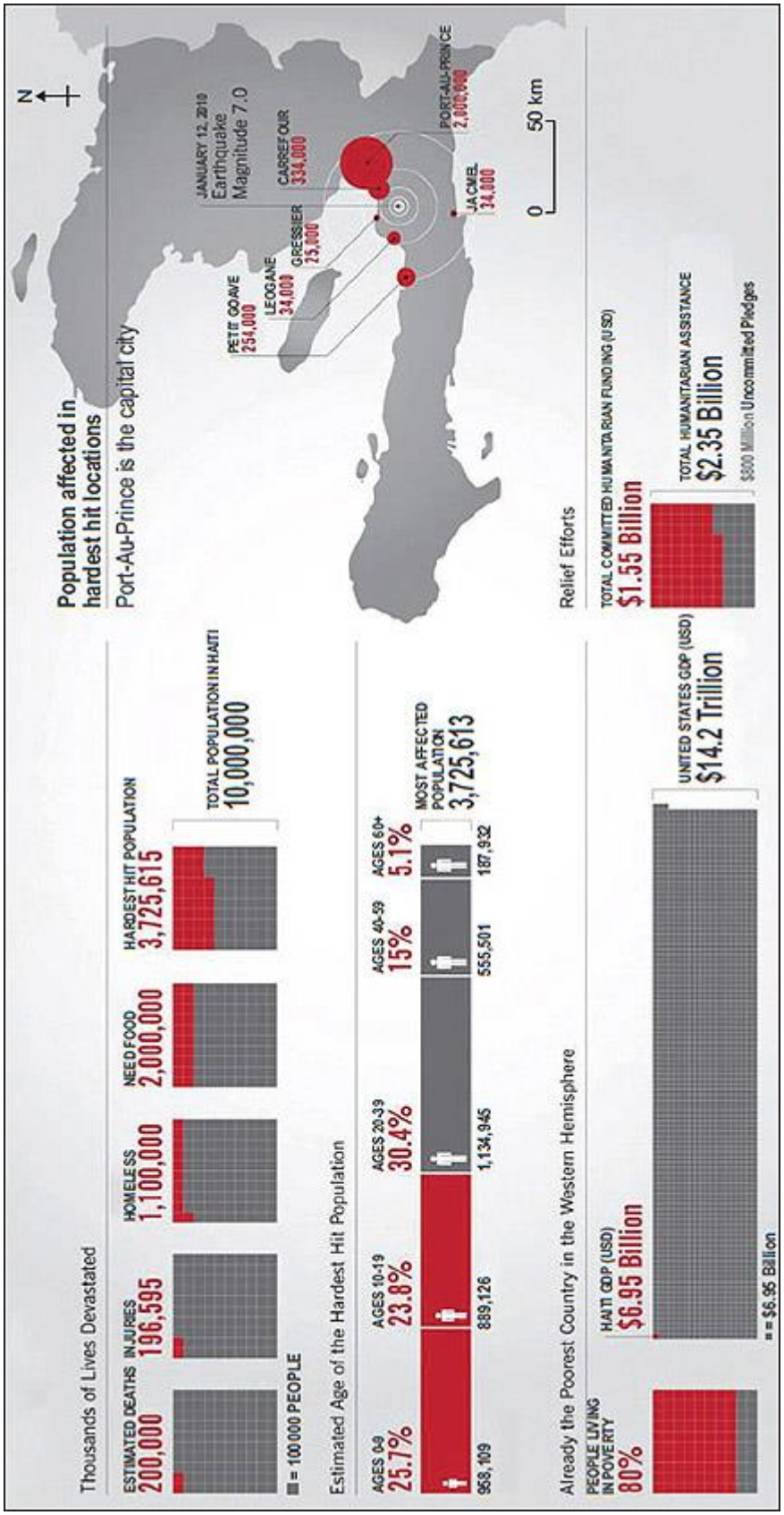
**Q1.**

The diagram below shows information about the 2010 earthquake in Haiti.




Using the diagram above and your own knowledge, assess the challenges in managing

an event such as this.

**[9 marks]**

## Q2.

Which of the following are **all** hazards resulting from seismic events?

**[1 mark]**

**A** Lava flows, nuées ardentes, shockwaves ⬭

**B** Liquefaction, landslides, tsunamis ⬭

**C** Earthquakes, pyroclastic flows, tephra ⬭

**D** Ash flows, liquefaction, mudflows ⬭

## Q3.

Outline the characteristics of liquefaction as a seismic hazard.

**[3 marks]**

## Q4.

'Seismic activity offshore will always present a greater threat to people than seismic activity on land.'

To what extent do you agree with this view?

**[9 marks]**

## Q5.

With reference to a multi-hazardous environment that you have studied, assess the view that the underlying cause(s) leading to the hazards is human activity rather than physical factors.

**[20 marks]**

## Q6.

An investigation is being conducted into the annual number of deaths from seismic activity.

| Year | Death toll ($x$) |
|---|---|
| 2000 | 231 |
| 2001 | 21 357 |
| 2002 | 1 685 |
| 2003 | 33 819 |
| 2004 | 228 802 |
| 2005 | 88 003 |
| 2006 | 6 605 |
| 2007 | 712 |
| 2008 | 8 8011 |
| 2009 | 1 790 |
| 2010 | 320 120 |
| 2011 | 21 953 |

| | |
|---|---|
| 2012 | 629 |

Calculate the mean and interquartile range for the data set in the table above and interpret your findings.

$$\text{Upper quartile} = \frac{n+1}{4}$$

$$\text{Lower quartile} = \frac{n+1}{4} \times 3$$

Interquartile range = upper quartile − lower quartile.

$n$ = number in sample

**[6 marks]**

## Q7.

What is the distinction between primary and secondary impacts arising out of seismic events?

**[1 mark]**

**A** Primary impacts are those which cause the most damage whereas secondary impacts take longer to occur and generally have smaller impacts. ⬭

**B** Primary impacts are those which appear immediately following the event, such as fires. Secondary impacts come about as a result of the aftershocks, such as bridge collapse. ⬭

**C** Primary impacts are immediate and a direct ⬭

result of the tremors. Secondary impacts arise in the aftermath and are a consequence of the primary impacts.

**D** Primary impacts link directly to the P Waves and the type of tremor which they cause. Secondary impacts are directly connected to the type of tremors associated with S Waves. ⬭

## Q8.

Assess the relative usefulness of the Park Model and the Hazard Management Cycle in understanding the impact of seismic events.

**[20 marks]**

## Q9.

Outline the process of liquefaction.

**[4 marks]**

## Q10.

Assess the importance of factors in globalisation in supporting the response to major seismic hazards.

**[9 marks]**

## Q11.

'Seismic hazards will always be harder to manage than volcanic hazards due to their unpredictability and scale.'

To what extent do you agree with this view?

**[20 marks]**

## Q12.

'The impact of seismic hazards is influenced by the level of development of the place affected.'

To what extent do you agree with this view?

**[20 marks]**

## Q13.

'Earthquakes have a greater impact on the human characteristics of place than the physical characteristics of place.'

With reference to a recent seismic event you have studied, how far do you agree with the statement above?

**[20 marks]**

## Q14.

With reference to **one or more** seismic event(s) that you have studied, assess the importance of past and present processes of development in understanding the impact of the associated hazards.

**[9 marks]**

## Q15.

To what extent do you agree that seismic events will always generate more widespread

and severe impacts than volcanic events?

**[9 marks]**

## Q16.

**Figure 1** shows the number of global reported disasters between 1990 and 2017. It also shows the economic costs associated with the reported disasters.

**Figure 1**

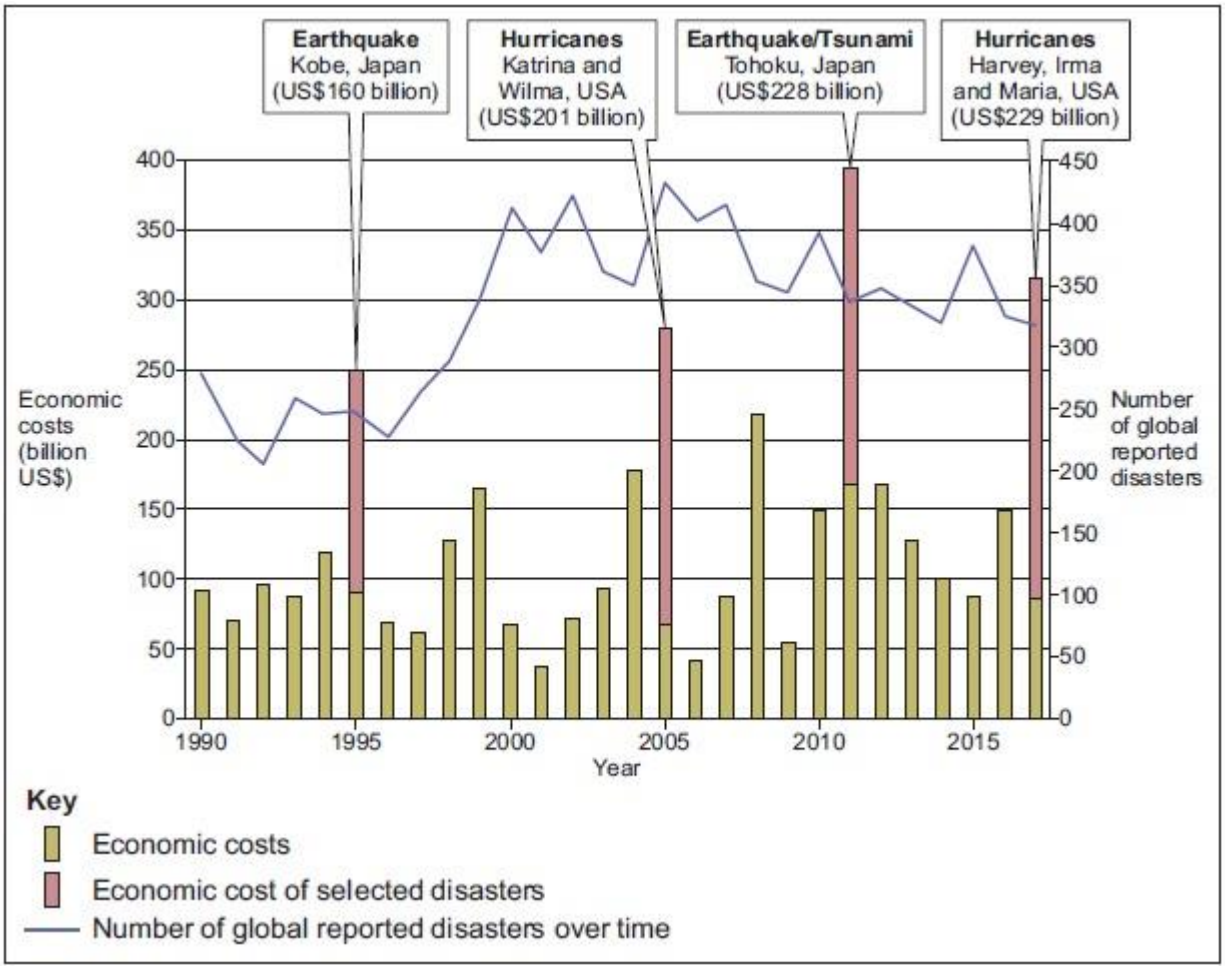
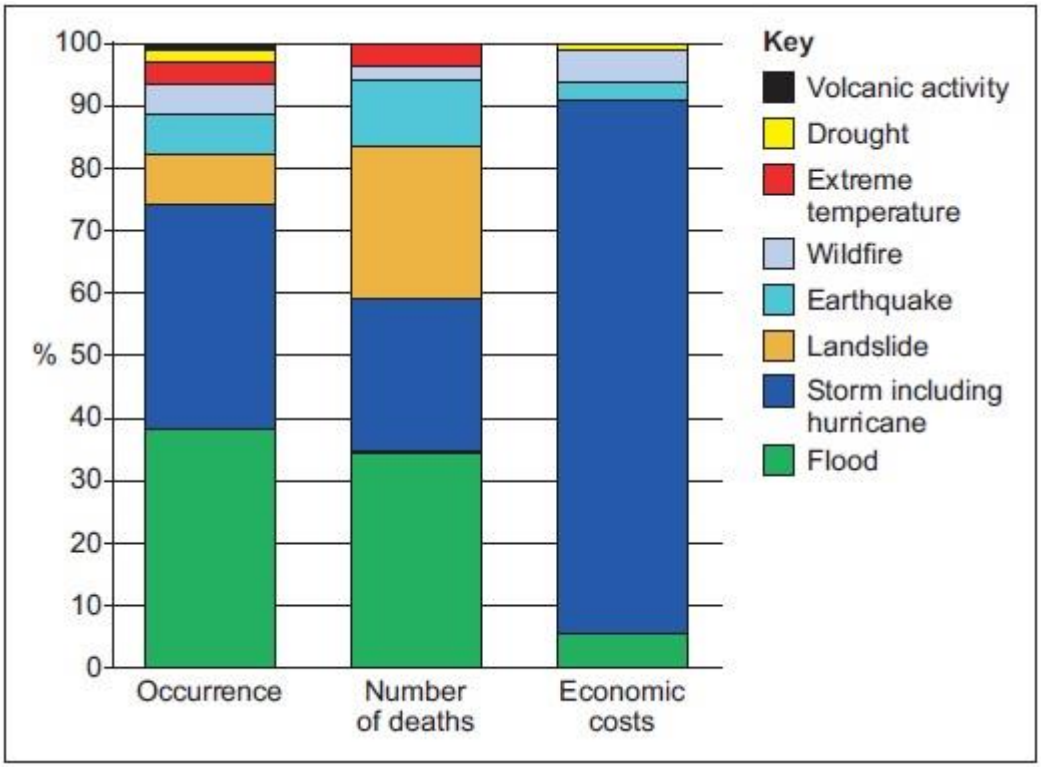



**Figure 2** shows information about the global reported disasters for 2017 as shown in **Figure 1**.

**Figure 2**



Analyse the data shown in **Figure 1** and **Figure 2**.

**[6 marks]**

## Q17.

Assess the extent to which the nature of plate margins determines the impacts of earthquake events.

**[20 marks]**

## Q1.

**AO1** – Knowledge and understanding of impact and management issues associated with earthquakes.

**AO2** – Application of knowledge and understanding to the novel situation, to assess the scale of challenge associated with managing the Haiti Earthquake.

Mark scheme

**Level 3 (7–9 marks)**
**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.

**Level 2 (4–6 marks)**
**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.

**Level 1 (1–3 marks)**
**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.

Notes for answers
**AO1**

- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, 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.

**AO2**

- Clearly management in this context is linked to dealing with the aftermath. Responses are likely to consider a range of temporal scales from immediate aftermath to the much longer term.
- The biggest management issue is scale. This event has clearly affected a huge number of people – approximately one third of the population and these are only the hardest hit.
- Another major issue is that the epicentre is the capital city Port Au Prince. As this is also likely to be the administrative centre, being hit so hard will make the

management and deployment of services even harder. Accessing such a densely populated region at the speed required must have proved unmanageable. The 3 million + affected people live in an area with a diameter of only around 50km.

- Trying to access all areas affected in the timescales required must have been impossible. This will almost certainly have exacerbated the loss of life. Younger people up to the age of 40 make up around 80% of the most affected. Some may link this to poverty and residence in sub-standard housing.
- The poverty will also have contributed to the scale of the management challenge. It will no doubt have been the case that people were simply not able to help themselves. The humanitarian funding will have gone some way to plugging the poverty gap but some may note how disappointing it appears that $800 million remains uncommitted. Clearly turning those pledges into real commitments of funding and support has proved yet another challenge.

Credit any other valid assessment.

**AO1 = 4, AO2 = 5**
**[Total 9 marks]**

## Q2.

B

**AO1 = 1**
**[Total 1 mark]**

## Q3.

Point marked
Allow 1 mark for each valid point with additional marks for developed points.

Notes for answers

- Liquefaction is a secondary impact of a seismic event (earthquake) caused by the initial shaking of the ground (1).
- Liquefaction generally occurs in saturated soils (1).
- As the ground shakes soils with a high water content lose their strength and original soil structure (1) and begin to behave like a fluid (1)(d). The hazard is most significant in areas with sandy soils where the water table is close to the surface (1)(d).
- In some cases water / 'mud' rises through the soil surface and can flow down even gentle slopes potentially causing a localised flooding hazard (1).
- Where buildings are built directly on to the soil surface with shallow or no foundations they can lean, topple, sink or even collapse causing an obvious hazard for people living / working in or near them (1).
- If liquefaction occurs suddenly under communications networks, and other infrastructure, there can be sudden disruption / danger to life (1). Allow (1)(d) for elaboration on specific hazards, such as traffic accidents and disruption if roads collapse.

For maximum marks there must be some reference to the potential hazardous nature of liquefaction.

**The Notes for answers are not exhaustive. Credit any valid points.**

**AO1 = 3**
**[Total 3 marks]**

## Q4.

**AO1** – Knowledge and understanding of the impacts of seismic activity.

**AO2** – Application of knowledge and understanding assessing the contrasting impact of tsunamis compared to seismic events on land.

**Level 3 (7–9 marks)**
**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.

**Level 2 (4–6 marks)**
**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.

**Level 1 (1–3 marks)**
**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.

Notes for answers

**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.
- Impacts and human responses as evidenced by a recent seismic event.

**AO2**

- Candidate responses are likely to be heavily influenced by the exemplification and case study material. Clearly the answer to the question depends upon the event. Responses are free to argue either way, but assessment should be based upon evidence presented. Some may take a more theoretical approach without detailed reference to case study for either type of event. This is a legitimate approach.
- Some may refer to events such as the Indian Ocean tsunami (December 26, 2004) or the Japanese tsunami of 2011 (Tohoku).
- For the seismic event, there are many potential case studies which candidates may draw from. Haiti (2010) and Christchurch, New Zealand (2011) may feature as contrasting LIC/HIC events.
- The 2004 Indian Ocean tsunami was thought to result in a final death toll of 283 000, spread across at least eight countries. Around 1.7 million people were displaced. Indonesia was most badly affected. Coastal communities were decimated with many dying in the aftermath due to poor medical care and preventable illness

and disease. It also travelled as far as 3000 miles to Africa and still arrived with enough force to kill people and destroy property.

- The risk of famine and epidemic diseases is extremely high immediately following a tsunami – bodies rotting in the tropical heat, contaminated food and water sources as well as the longer term issues of crop destruction.
- In contrast an event such as Haiti 2010 killed a similar number of people at around 230 000. A number of factors were responsible for such a high death toll. The main issues was the inadequate design of many of the old decaying buildings in Haiti.
- Around 3 million people were directly affected by the earthquake with 1 in 5 people losing their jobs because so many buildings were destroyed. Haiti's largest industry, clothing, was one of the worst affected.
- 250 000 homes and 30 000 other buildings, including the President's Palace and 60% of government buildings, were either destroyed or badly damaged. The large number of deaths meant that hospitals and morgues became full and bodies then had to be piled up on the streets.
- Transport and communication links were also badly damaged by the earthquake. The large number of bodies meant that diseases, especially cholera, became a serious problem.
- Hospitals (50+) and schools (1300+) were badly damaged, as was the airport's control tower. It was difficult getting aid into the area because of issues at the airport and generally poor management of the situation.
- Clearly this event caused widespread, short- and long-term damage. However, it was not just the event, it was also the economic status of the country which exacerbated the impact.
- Some may argue that tsunamis occur less frequently than seismic events on land; also that the areas they can affect are always relatively narrow coastal belts. Others may point to the coastal defences and early warning systems now in place since some of the major events in recent years. Sea walls and public address systems can help to mitigate the worst impacts of tsunamis. Nevertheless in 2018 another tsunami hit Indonesia and the early warning system failed to alert authorities to the tsunami which killed approximately 500 people.

Either position is acceptable as long as it is coherently argued.

**AO1 = 4, AO2 = 5**

**[Total 9 marks]**

## Q5.

**AO1** − Knowledge and understanding of a named multi hazardous environment. Aware of the factors which have contributed to generate the hazards.

**AO2** − Application of knowledge and understanding to identify and assess the causes of hazards in multi hazardous environments.

Notes for answers

The direction of the response largely depends upon the chosen case study of the multi hazardous environment as well as the hazards contained within that location.

**AO1**

- 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.
- Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological). 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. The Park model of human response to hazards. The Hazard Management Cycle.

**AO2**

- Los Angeles, USA is considered to be a multi hazard environment though other case studies may feature. Expect to reference to places such as Haiti, The Philippines and Japan.
- In Los Angeles, it would be difficult to argue to that all hazards are generated by human activity. As an advanced economy, the city has the economic advantage of being able to manage many of its hazards, though not all are easily manageable or predictable. Lying close to the San Andreas Fault (with a number of other minor faults in the area such as the Northridge / Santa Barbara Fault), the area is prone to significant seismic activity. It is not possible to argue that this root cause is human activity in this regard. However, managing the impact of the hazard is a significant preoccupation and human endeavour in the area. Some may argue that hazard is made more or less dangerous by the extent of management of the hazard. This is a legitimate approach. There are other hazards though, which are certainly the product of human activity.
- Wildfire periodically affects the Los Angeles basin. Whilst the main cause is the flammability of vegetation as a result of drought and the dry vegetation, human factors certainly exacerbate the issue. Human activity is known to start wildfire and building in areas prone to wildfire inevitably adds to the problem. Expect to see reference to recent events in support e.g. June ‘17 four major brush fires struck LA, affecting over 6000 acres of land. It was sparked by a car crash in the San Jacinto mountains. However, it was also fuelled by high temperatures, low humidity and wind gusts of up to 35 mph. This shows that in this case, it was a combination of human and physical factors which created this hazard.

Whatever the approach, there should be more than one hazard considered and a clear overarching response to the question.

**Level 4 (16−20 marks)**

- 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 (AO2).
- 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).

**Level 3 (11−15 marks)**

- 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 (AO2).
- 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).

**Level 2 (6−10 marks)**

- 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 (AO2).
- 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).

**Level 1 (1−5 marks)**

- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretation is basic.
- 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 (AO2).
- 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).

**Level 0 (0 marks)**

- Nothing worthy of credit.

**AO1 = 10, AO2 = 10**

**[Total 20 marks]**

## Q6.

**AO3** − Uses the table to accurately calculate the mean and interquartile. Interpretation shows clear understanding of the data.

Mark scheme

Mean − 813,717 / 13 = 62,593.6 (1 mark)

IQR:

Rank order

| Rank | Fatalities |
|---|---|
| 1 | 320 120 |
| 2 | 228 802 |
| 3 | 88 011 |
| 4 | 88 003 |
| 5 | 33 819 |
| 6 | 21 953 |
| 7 | 21 357 |
| 8 | 6 605 |
| 9 | 1 790 |
| 10 | 1 685 |

| | |
|---|---|
| 11 | 712 |
| 12 | 629 |
| 13 | 231 |

Note: Some may give lowest value as 1. This is acceptable.

UQ 13 + 1 / 4 = 3.5 rounded to the 4th value in the rank order (1 mark)

LQ (13 + 1) / 4 × 3 = 10.5 rounded to 11th value in the rank order (1 mark)

IQR = 88003 (UQ) − 712 = 87291 (1 mark)

Interpretation:

Max 2 marks

1 mark per valid point with additional marks for developed points.

There is an extremely wide variation in the number of annual fatalities (1). Even with the extremes removed from the IQR, there is still a very large range in the number of fatalities (87299) (d)(1). Some may calculate the mean within the IQR range 21990 − much lower with the extremes removed (1). This suggests that there is little reliability in using central tendency as a mechanism for analysing these data (1).

**AO3 = 6**

**[Total 6 marks]**

## Q7.

C

**AO1 = 1**

**[Total 1 mark]**

## Q8.

**AO1** – Knowledge and understanding of models associated with managing natural disasters.

**AO2** – Application of knowledge and understanding to assess the usefulness of the models in understanding the impact of seismic events.

Notes for answers

**AO1**

- Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological).
- 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.
- The Park model of human response to hazards.
- The Hazard Management Cycle.
- 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.

**AO2**
- The Park Model is arguably more useful in that it charts the stages following a natural disaster. The curve charts the changes to a community's quality of life, before during and after a natural disaster.
- Normality is experienced before the event. The downward curve charts the decline (or disruption) which the affected community feels following the event. The steeper the curve and the deeper the drop, the greater the magnitude of the event and the greater the lack of preparedness. The return to normality or recovery to a better quality of life is also charted in Park's Model. This is useful in helping to understand how prepared a community was for the event and how successful it has been in responding to the crisis. The longer it takes to recover normality, the greater the suffering on the people.
- Expect to see exemplification such as the Haiti earthquake of 2010. The country was totally unprepared. It had neither the means nor the communication strategy to manage the event. Poor building design exacerbated the tragedy. Estimates of up to 230 000 deaths may be conservative and fail to identify the secondary impacts.
- The model arguably falls short in helping to understand the situation in Haiti. When Hurricane Matthew struck in 2016, this plunged the community into yet another crisis when it had not yet recovered from the seismic event. It is difficult to see how the model can help with understanding this very complex event.
- The hazard management cycle is more concerned with the management of natural event before and after its inception. Whilst it does help in understanding the impact of the event, this is more implicit. Its primary purpose is to provide a model of action both prior to and after the event. The actions are designed to speed up the recovery process as well as minimise the impact.
- Both models chart the movement of a community through a natural disaster. However, expect most to argue to that the Park Model, despite some limitations, is more useful in helping to understand seismic events compared to the hazard management cycle.

**Credit any other valid assessment.**

**Level 4 (16–20 marks)**
- 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 (AO2).
- 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 (AO1).

**Level 3 (11–15 marks)**
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (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 (AO2).

- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

**Level 2 (6–10 marks)**
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- 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 (AO2).
- 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 (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

**Level 1 (1–5 marks)**
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (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 (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

**Level 0 (0 marks)**
- Nothing worthy of credit.

**AO1 = 10**
**AO2 = 10**
**[Total 20 marks]**

## Q9.

Point marked
Allow 1 mark per valid point with extra mark(s) for developed points (d). For example:

Point marked

**AO1**
- Liquefaction occurs when compacted sediments loses strength and stiffness in response to an applied stress such as shaking during an earthquake (1). Material that is ordinarily a solid behaves like a liquid (1) (d). Liquefaction requires a degree of soil saturation to occur (1) (d).
- The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils (1). This is because a loose sand has a tendency to compress when a load is applied (1) (d). The loss of soil structure causes it to lose its strength (the ability to transfer shear stress), and it may be observed to flow like a

liquid (1) (d).

- Liquefaction can cause buildings and infrastructure to collapse as well as a significant risk to life as it acts like quick sand (1).

The Notes for answers are not exhaustive. Credit any valid points.

**AO1 = 4**

**[Total 4 marks]**

## Q10.

**AO1** − Knowledge and understanding of aspects of globalisation and global interdependence, including factors in globalisation. Knowledge and understanding of the response to seismic events.

**AO2** − Application of knowledge and understanding in analysing and evaluating the benefits of globalisation in supporting the response to hazards.

Mark scheme

**Level 3 (7−9 marks)**
**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. Analysis and evaluation is detailed and well supported with appropriate evidence. A well balanced and coherent argument is presented.

**Level 2 (4−6 marks)**
**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. Analysis and evaluation evident and supported with clear and appropriate evidence. A clear but partial argument is presented.

**Level 1 (1−3 marks)**
**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. Analysis and evaluation basic and supported with limited appropriate evidence. A basic argument is presented

Notes for answers

**AO1**

- Factors in globalisation include the development of technologies, systems and relationships, including financial, transport, security, communications, management and information systems and trade agreements. All of these factors have supported the process of globalisation, but also in times of crisis provide the same vehicles to provide essential support to countries suffering the impacts of natural disasters such as seismic hazards.
- Case studies may include Japan 2011 or the Indian Ocean Tsunami in 2004 as major seismic events needing integrated international effort as part of a global response. Other seismic events such as Haiti in 2010 or Sichuan in 2008 may also feature. The focus must consider responses to the event.

**AO2**

- Analysis − In a crisis following a global seismic event, factors in globalisation invariably support the response to the event.
- Analysis − Technology is used to aid communication and transport bringing immediate relief to affected areas.
- Analysis − Technology allows family members to communicate across great distances, especially important in times of crisis where families are separated.
- Analysis − Countries use their own aid budgets to support seismic events which require the combined efforts of nations to support in response, especially important where countries lack the resource to address the issues independently.
- Evaluation − It really depends upon the supporting material but there must be some assessment of the value / importance of the support facilitated by global action in responding to seismic events.
- Evaluation − More sophisticated responses should show awareness of the lack of consistency around the global response to seismic hazards. There are a number of complicating issues which factors in globalisation cannot alone solve. Political alliances / situations, stages of development, levels of corruptions and internal conflicts are just some of the issues which hinder the response to major seismic events.
- Overall evaluation − There should be some overall assessment of the importance of factors in globalisation in supporting the response to seismic hazards.

**AO1 = 4, AO2 = 5**

**[Total 9 marks]**

## Q11.

**AO1** – Knowledge and understanding of the impact of seismic events and volcanic eruptions.

**AO2** – Application of knowledge and understanding to assess the relative impact of volcanic and seismic events.

Notes for answers

**AO1**

- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases/acid rain, tephra. 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. Impacts and human responses as evidenced by a recent volcanic event.
- 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.

**AO2**

- The direction of the response will largely depend upon the choice of supporting material and case study.
- Evidence suggests that seismic events present a greater threat to life than volcanic events. Recent events such as Haiti (2010), Indian Ocean Tsunami (2004), Tohoku, Japan (2011) and Sichuan, China (2008) all have death tolls in multiple thousands. Whilst this is impact and not management, it does point towards the scale of the management challenge.

- In comparison Mt Merapi Indonesia (2010), Anak Krakatoa, Indonesia (2018) and Nyiragongo, Democratic Republic of Congo (2002) all have death tolls in the hundreds.
- Managing earthquakes is arguably far less predictable than volcanoes as there are less clues to an impending event. It is now clear that events will tend to occur along plate boundaries but not when or at what magnitude. Equally, underwater earthquakes will often trigger tsunamis which can affect huge areas of coastline making then extremely difficult to respond to. Even Japan with its wealth and resources was not adequately prepared for the Tohoku event in 2011. Over 20 000 people died despite a sea wall and a warning system along this area of the coastline.
- Some may argue that it is precisely because of effective management that the number of deaths following volcanic eruptions is so relatively low. Volcanoes produce many early warning signs which are now well known to scientists. This allows for early evacuation and the setting up of exclusion zones.
- Some may consider the Eyjafjallajökull eruption in Iceland as an anomaly in terms of management. Whilst it created no deaths or serious injuries, the ash cloud grounded international air travel for a number of days, causing substantial economic loss. So, whilst the management in this case did not involve dealing with serious casualties, it did prove very difficult to manage and did cause substantial economic losses across Europe in particular.
- Some may consider the concept of the super volcano. The Yellowstone caldera is likely to feature in such responses. Whilst there is no recent evidence of a super eruption, if one did occur, it would be a global event with global consequences. This is likely to counter the idea that seismic hazards are harder to manage.
- Theoretical models are likely to feature in some responses. This is acceptable as long as such material is used to support the argument. The Park Model and the Hazard Management Cycle may feature.

Credit any other valid assessment.

**Level 4 (16–20 marks)**
- 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 (AO2).
- 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 (AO1).

**Level 3 (11–15 marks)**
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).

- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

**Level 2 (6–10 marks)**
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- 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 (AO2).
- 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 (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

**Level 1 (1–5 marks)**
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (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 (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

**Level 0 (0 marks)**
- Nothing worthy of credit.

**AO1 = 10, AO2 = 10**
**[Total 20 marks]**

## Q12.

**AO1** − Knowledge and understanding of a range of seismic hazards. Knowledge of the cause of seismic hazards. Knowledge and understanding of development issues in hazard prone areas.

**AO2** − Application of knowledge and understanding to analyse and evaluate the extent to which level of development is a key determinant in the impact of seismic hazards.

Notes for answers

**AO1**
- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity. This theoretical basis may be used to challenge the theme of the question i.e, that it is tectonic setting which determines scale and impact not economic development.
- Hazard perception and its economic and cultural determinants. These factors also contribute to the impact and can be used to either support the assertion or challenge it. It really depends upon the approach taken and the support chosen.
- Characteristic human responses − fatalism, prediction, adjustment / adaptation, mitigation, management, risk sharing − and their relationship to hazard incidence,

intensity, magnitude, distribution and level of development.

- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Nature, forms and potential impacts of natural hazards. This element may be used to challenge the theme of the question.
- 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. There are clear links to development with this element.
- Impacts and human responses as evidenced by a recent seismic event.

**AO2**

- Evaluation − Responses are expected to show awareness of the impact of level of development upon the hazards associated with a seismic event.
- Analysis − Recent seismic events show that level of development is clearly a factor determining the severity of impact. In Haiti, the 2010 earthquake caused terrible and severe impacts for the people of this poverty stricken island in the Caribbean. 3 500 000 people were affected by the quake; 200,000 people estimated to have died, 300 000+ people were injured. Over 188 383 houses were badly damaged and 105 000 were destroyed by the earthquake (293 383 in total), 1.5m people became homeless. There is no question that level of development was a factor. The poorly constructed building and infrastructure could not cope with the earthquake. People suffered in the immediate earthquake as buildings collapsed. However people also suffered greatly in the aftermath due to the lack of effective management and a lack of resources to cope with the devastation.
- Analysis − Other seismic events, such as that causing the Japanese tsunami in 2011, reveal that level of development is not necessarily significant in understanding the impact of hazards. Japan has a highly developed economy yet the scale of the tsunami overwhelmed the substantial defences of Japan. A tsunami sea wall was already in place along with early warning systems. Despite this, over 20,000 people died.
- Evaluation − More sophisticated responses may suggest that the death toll would probably have been much higher had those management strategies not been in place.
- Analysis − Responses should go further to consider other factors in determining the scale of impact following a seismic event. Expect management strategies to feature and also some awareness of the physical nature of the hazard. Some earthquakes are so powerful that wherever they strike, major impacts will be felt. The Indian Ocean tsunami may be offered as an event which triggered wide ranging and severe impacts across many countries, not least due to the scale of the event at 9.1 on the Richter Scale.
- Analysis − Others may consider local attitudes to hazards such as fatalism, which can have a bearing on the impact of the event. This is a valid approach.
- Overall evaluation may acknowledge that level of development does generally impact on the severity of a seismic event, but this is only part of the issue. The scale and existing management strategies will also play a part.

**Level 4 (16−20 marks)**

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- 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 and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).

**Level 3 (11−15 marks)**
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

**Level 2 (6−10 marks)**
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- 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 (AO2).
- 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 (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

**Level 1 (1−5 marks)**
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (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 (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

**Level 0 (0 marks)**
- Nothing worthy of credit.

**AO1 = 10, AO2 = 10**

**[Total 20 marks]**

## Q13.

**AO1** – Knowledge and understanding of the impacts of a recent seismic event.
Knowledge and understanding of the factors affecting the characteristics of place.

**AO2** – Application of knowledge and understanding to assess the extent to which the recent earthquake affected the place human and physical characteristics of the place.

Notes for answers

**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.
- Impacts and human responses as evidenced by a recent seismic event.
- Factors contributing to the character of places:
  - Endogenous: location, topography, physical geography, land use, built environment and infrastructure, demographic and economic characteristics
  - Exogenous: relationships with other places.

**AO2**

Responses are expected to show an understanding of the impacts of the chosen recent seismic event. There should be clear recognition of the learning from the Changing Places unit in the relative impact of the recent seismic event on both the human and physical characteristics of place. Reciting learned case study material does not constitute AO2. It is the integration of the place study ideas and concepts which allow access to AO2.

- Responses will be influenced by the exemplification and chosen place. The answer depends on the nature of the changes to the human and physical place characteristics that the recent seismic event led to in the chosen place.
- Physical characteristics of place – assessment of the impact of the recent seismic event on:
  - the geomorphology of the land – cracks/fissures appearing in the land surface; elevation/depression of land; landslides and associated impacts; tsunami and associated impacts.
- Human characteristics of place – assessment of the impact of the recent seismic event on:
  - the demographics and population structure of the place due to death, evacuation or displacement of people etc
  - the social characteristics – impacts on physical and mental health, familial and community relationships and structure, disproportionate impacts on specific social groups etc
  - the economic characteristics – extent of economic impacts for individuals, communities and businesses
  - the cultural characteristics – destruction of sites with historical or religious importance
  - the built environment – damage and destruction of infrastructure.
- In order to fully address the AO2 assessment element of the question, the response must come to a view as to which place characteristics the recent seismic event has affected the most.

Any conclusion is acceptable, as long as it is supported by the preceding content.

**Level 4 (16–20 marks)**

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- 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 and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well-integrated where appropriate (AO1).

**Level 3 (11–15 marks)**
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

**Level 2 (6–10 marks)**
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- 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 (AO2).
- 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 (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

**Level 1 (1–5 marks)**
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (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 (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes.
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

**Level 0 (0 marks)**
Nothing worthy of credit.

**AO1 = 10, AO2 = 10**
**[Total 20 marks]**

## Q14.

**AO1** − Knowledge and understanding of the impact of seismic hazards. Knowledge and understanding of the principals associated with understanding people's lived experience

of place.

**AO2** − Application of knowledge of impacts to evaluate the lived experience of the people and the impact upon the character of the place under investigation.

Mark scheme

**Level 3 (7−9 marks)**
**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. Analysis and evaluation is detailed and well supported with appropriate evidence.

**Level 2 (4−6 marks)**
**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. Analysis and evaluation is evident and supported with clear and appropriate evidence.

**Level 1 (1−3 marks)**
**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. Analysis and evaluation is basic and supported with limited appropriate evidence.

Notes for answers

**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.
- Impacts and human responses as evidenced by a recent seismic event.
- How both past and present processes of development can be seen to influence the social and economic characteristics of places and so be implicit in present meanings.
- The socio-economic characteristics of places are shaped by resources, money and investment.
- The characteristics and impacts of external forces operating at different scales from local to global, including either government policies or the decisions of multinational corporations or the impacts of international or global institutions.
- How past and present connections, within and beyond localities, shape places and embed them in the regional, national, international and global scales.

**AO2**
Responses are expected to show an understanding of the impact of a seismic event. There should be clear recognition of the learning from the changing places unit in assessing the impact of the seismic event i.e. how past and present processes of development have a clear bearing upon impact. Reciting learned case study material does not constitute AO2. It is the integration of the place study ideas and concepts which allow access to AO2.
- There is a clear correlation between the impact of a seismic event and levels of

development. Places which have a well- developed infrastructure (and strong investment in developed infrastructure) tend to have reduced impacts arising out the event. Expect to see reference to places such as New Zealand which was struck by a seismic event in 2011 (Christchurch). Others may contrast this with less developed places such as Haiti which was struck by an earthquake in 2010. The impact here was much more severe, not just because of differences in the tectonic event, but also because of past and present processes of development in the area.

- In Christchurch, 185 people died as a result of an earthquake which registered 6.3 on the Richter Scale. Over half of these deaths were due to one building collapsing, Canterbury Television Building. Some may point to the fact that an earthquake measuring 7.1 on the Richter Scale, struck the year before. This is a significant factor in the second earthquake as many buildings were already weakened by this earthquake. Older buildings, from an earlier period of development of Christchurch suffered greater damage as they did not contain reinforced concrete. Some may refer to the relatively well developed economy of Christchurch which has helped it prepare for earthquakes as well as respond i.e. minimising impacts. The area has extensive trade in agricultural produce, manufacturing and, more recently, high technology industries.
- In Haiti, over 220,000 people died in an earthquake measuring 7.0 on the Richter Scale. It is a much less well developed country and has a dense population many of whom live in poverty. It has been heavily influenced by Spanish and French colonialists and more recently, the USA has been heavily involved in the country. Haiti is one of the world's poorest countries. Poverty, corruption, poor infrastructure, lack of health care and lack of education are the main issues. This lack of development without doubt contributed to the impact of the earthquake. It is estimated that 250,000 homes and 30,000 official buildings were damaged or destroyed by the earthquake. In terms of past and present development, the infrastructure could not cope with the disaster, many old buildings, roads and bridges simply collapsed. Equally, due to a lack of development in the emergency response, many died in the aftermath.
- Other may contrast tsunamis such as the Indian Ocean (2004) and Japanese Tsunami (2011). Whatever the approach there must some consideration of past and present processes of development.

**AO1 = 4, AO2 = 5**

**[Total 9 marks]**

## Q15.

**AO1** − Knowledge and understanding of a range of impacts of volcanic and seismic hazards.

**AO2** − Application of knowledge and understanding to bring specification areas together and to analyse and evaluate, based upon evidence about which types of hazard are more severe and / or widespread. There should be some explicit assessment regarding the extent.

Mark scheme

**Level 3 (7−9 marks)**
**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. Analysis and evaluation is detailed and well supported with appropriate evidence. A well balanced and coherent argument is presented.

**Level 2 (4−6 marks)**

**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. Analysis and evaluation evident and supported with clear and appropriate evidence. A clear but partial argument is presented.

**Level 1 (1−3 marks)**
**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. Analysis and evaluation basic and supported with limited appropriate evidence. A basic argument is presented.

Notes for answers

The direction of the response largely depends upon the argument that the student wishes to put forward.

**AO1**

- When considering volcanic hazards expect to see reference to pyroclastic flows, lava flows, volcanic bombs, ash clouds and seismic activity (at the volcano). Some may bring case study material to the response and consider the impacts of these events and particularly violent events.
- Some may go further and contrast impacts in different places around the world such as Chaiten in Chile (2008) with Mt Etna in Italy (ongoing eruptions).
- For seismic events − hazards will mainly relate to the violent shaking and the associated damage to the built environments, to include wider infrastructural damage.
- Some may consider tsunamis as a hazard created by seismic events.
- Case studies are likely to include Japan 2011 or the Indian Ocean Tsunami in 2004. These may be contrasted with major events such as Haiti in 2010 or Sichuan in 2008.

**AO2**

- Evaluation − Overall it is extremely difficult to generalise as each is event is unique. However seismic events on land tend to generate extremely severe impacts particularly where the earthquake epicentre strikes a large urban area. Seismic events are also generally associated with more deaths than volcanic events. Management is also a factor in the sense that many countries have mechanisms in place to mitigate against the impact of such hazards, thus reducing the impact and severity. The ash cloud associated with volcanic eruptions can cause very widespread impacts, more widespread than seismic events which tend to cause more localised and severe damage.
- Evaluation − An exception to this is a supervolcano eruption. Whilst there are no recorded incidents of such eruptions, the geological record and structure of places such as Yellowstone, USA tells us that a caldera exists and a supervolcanic eruption could occur. Modelling of a potential eruption suggests the potential for enormous devastation with average global temperature reduction of up 20 °C, due to the generation of a vast ash cloud. More locally, millions of Americans would be killed and up to two thirds of the USA would become uninhabitable.
- Analysis and evaluation − For the ‘widespread’ element of the question, it is reasonable to consider events such as the Icelandic volcano (2010) and suggest that the potential impact upon aviation and therefore the regional economy is much more severe than any seismic event. Specific case study knowledge may be applied

to support this position.

- Analysis and evaluation − Others may contrast based upon income levels of countries, asserting that impacts tend to be managed more effectively in higher income countries, i.e. it is not seismic or volcanic nature which determines the scale of impact, but it is the location.

**AO1 = 4, AO2 = 5**

**[Total 9 marks]**

## Q16.

**AO3** – There are two resources to use in conjunction with each other. The skills relate to graph interpretation.

**Level 2 (4–6 marks)**
**AO3** – Clear analysis of a geographical issue or question. Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.

**Level 1 (1–3 marks)**
**AO3** – Basic analysis of a geographical issue or question. Basic analysis of the quantitative and qualitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.

Notes for answers

**AO3**

- In terms of the number of reported disasters, there is no overall pattern or trend. The lowest number recorded is around 210 in 1992 with a peak of 430 in 2005. Whilst the range is large, it is not possible to suggest a trend of increasing numbers of natural disasters. Some may suggest that the 2000s and 2010s saw an increase compared to the 1990s. A longer time period would really be needed to test the idea of increasing hazards over time.
- Typically, economic losses appear to be around $40 – $200bn, with the exception of 4 years where losses were much higher. These same four years appear to be dominated by a small number of extreme events. In all four events damage was in excess of $250bn.
- In the breakdown for 2017, floods dominated by occurrence (38%), loss of life (35%) and number of people affected (59%). However, it was storms which generated the huge proportion of the economic losses (85%). These storms costs appear to be dominated by Harvey, Irma and Maria, using the data in the graph above.

Credit any other valid analysis.

**AO3 = 6**

**[Total 6 marks]**

## Q17.

**AO1** – Knowledge and understanding of the nature of plate margins. Knowledge and understanding of the factors affecting the impact of earthquake events.

**AO2** – Application of knowledge and understanding to assess the extent to which the nature of plate margins determines the impacts of earthquake events.

Notes for answers
**AO1**

- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity and vulcanicity. Associated landforms: young fold mountains, rift valleys, ocean ridges, deep sea trenches and island arcs, volcanoes.
- 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.

**AO2**

- A number of plate margins (destructive, constructive, conservative) could be the focus of the response and this may affect the direction in which the candidates argue.
- Some responses may assess the extent to which the nature of the different kinds of plate margins affects the impacts, this is a valid approach. This may suggest that the nature of the plate boundaries affects the magnitude, frequency and depth of focus of the earthquakes, which may be very significant in determining the impacts of earthquakes. Expect such responses to be supported with illustrative examples to provide evidence of the primary/secondary, environmental, social, economic and political impacts, with assessment of the extent to which the nature of the plate boundary where the earthquake happened determined these impacts.
- Some responses may seek to assess the extent to which the nature of plate boundaries determines the impacts of earthquakes compared to other factors. These responses may seek to compare the nature of plate boundaries to factors such as the perception of the hazard posed by the earthquake and the level of development of the location. Others may assess the role of the nature of the plate margin in comparison to the nature of the human response to it, which may include: fatalism, prediction, adjustment/adaptation, mitigation, management and risk sharing, and the extent to which these are determinants of the impacts of earthquakes. Equally some may seek to compare the nature of the plate boundaries to factors such as other environmental or physical geographical features, such as location, relief or climate of the area affected.
- In relation to the chosen illustrative examples assessment may come to the view that the nature of the plate boundaries is the most significant factor in determining the impacts of earthquakes, whilst others may conclude that it is other factors that are more important in determining the impacts of earthquakes, whilst others will conclude that it is a combination of factors that determines the impacts of earthquakes.
- Assessment must focus on, and come to a view on, the extent to which the nature of plate boundaries determines the impacts of earthquakes.
- Any view is acceptable, as long as it is supported with reasoned argument and illustrative examples and evidence.

Credit any other valid approach.

**Level 4 (16–20 marks)**

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (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 (AO2).

- 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 and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well-integrated where appropriate (AO1).

**Level 3 (11–15 marks)**
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (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 (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

**Level 2 (6–10 marks)**
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- 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 (AO2).
- 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 (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

**Level 1 (1–5 marks)**
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (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 (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes.
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

**Level 0 (0 marks)**
Nothing worthy of credit.

**AO1 = 10, AO2 = 10**
**[Total 20 marks]**

**Q2.**

83% of students scored this mark by shading lozenge B.

**Q3.**

The most effective responses gave succinct definitions and highlighted how liquefaction posed a hazard. Some defined liquefaction but did not suggest how it presented a hazard, whilst others clearly had little or no understanding of the process.

**Q4.**

In this question most understood that this was about comparing earthquakes and tsunamis. Those who offered detailed support to substantiate their position generally scored well. For the extended response most understood the implicit link between climate change and increased impact of tropical storms and wildfire. Most agreed with the direction of the question, but not all responses were well supported.

**Q5.**

Some students self-penalised here by referring to more than one multi hazard environment. This did not allow such responses to get to the required depth in such a relatively short amount of writing time. In considering the question, the best responses understood that human activity is always the underlying the cause. The fact is that an event only becomes a hazard when it affects people in places. It is the human occupation of the place which creates the hazard. However equally others argued that the underlying cause is often physical, for example referencing tectonic processes in the development of seismic hazards. Either approach was credited. Some students ran out of time and lost marks simply through poor time management.

**Q8.**

Knowledge and understanding of the models was inconsistent. Those that understand the premise of both models generally did well. Those that failed to clearly distinguish between the Park Model and the Hazard Management Cycle failed in turn to engage with the theme and demands of the question. Models have appeared on previous papers and so there is clear precedent for assessing this type of theory in relation to real world events. Those that did understand the models generally applied them to recent seismic events with success. Students were free to argue in favour of either model, though the majority favoured the Park Model through its assessment of impact upon quality of life. After all, quality of life variation is a clear indicator of impact in a seismic event. Others took a more critical view of the limitations of both models and this was a reasonable and therefore creditworthy approach, given the question.

**Q9.**

It was surprising to see so many students confuse liquefaction with processes taking place in the mantle, as opposed to a hazard arising out of seismic activity. Those that understood the hazard were able to outline the process with relative ease.

**Q11.**

This was another highly accessible question which allowed students full access of the

mark range depending on their preparation. The main differentiators related to the depth of support and the quality of the argument. Most agreed with the statement, though some considered the super volcano concept or Pinatubo eruption as evidence of global impact, thus challenging the statement. In this sense, they split predictability and scale and produced quite sophisticated responses.

## Q13.

This question required students to make a link across the specification units. Such a question will always feature in each examination series. It is clear that many students were well prepared for this with over 60% of students achieving Level 3 or better. In this case, the link was from Hazards to Changing Places. The concept of human and physical characteristics of place, was integrated into this hazards question. Examiners encountered a range and variety of case studies. However, some centres clearly still interpreted the requirement to study a 'recent' event very broadly. Students were not penalised for this. The best answers had clear specific details from their case study, and carefully differentiated between the impacts on the human characteristics of place, and the impacts on the physical characteristics of place. At the highest levels there was an expectation that students would identify physical characteristics of place as referring to the natural environment/physical geography, not the human built environment.

One issue that was encountered by all examiners was the unexpectedly high number of students that did not see, or ignored, the requirement to make "reference to **a** seismic event", singular. The specification only directs students to study one recent seismic event, so the exam questions cannot ask for reference to more than one. This was problematic, but examiners awarded credit for the best AO1 knowledge and understanding for one case study and then tried to take a more holistic view of the quality of the AO2 assessment across the response as a whole.

## Q14.

The requirements of this question crossed specification units. It is important that centres note that every series there will be one question which crosses specification units at both AS and A Level. In this case, the link was to Changing Places. The concept (from that unit) of past and present processes of development, was integrated into this hazards question. It is an Ofqual requirement that such questions are set every series so that students can demonstrate understanding and learning from across the breadth of study. Most considered levels of development and compared relatively recent earthquakes in Haiti and New Zealand. This was a legitimate approach provided there was clear consideration of impact of seismic events. Others considered developments in technology and how these have been developed over time to minimise impacts. This was also creditworthy. The mean mark of 4.6 showed students were able to 'think on their feet' and apply their knowledge in this more sophisticated way. However, there was also room for improvement with only 16.5% accessing Level 3.

## Q16.

For this skills question, a lot of data was provided. The quality of analysis seemed to suffer when students tried to engage with too many aspects of the data. For these question types, students are advised to ascertain overall trends, offer some calculations, consider links between data sets and pick out anomalies. These are the main routes to credit.