# Topic 5

## Hazards

### The concept of hazard in a geographical context

Modern ideas see hazards as the outcome of the interaction between human use systems (like land use) and natural event systems (the natural environmental processes which give rise to hazards). This interaction promotes actual hazard events which we perceive and then respond to. The way we react can in turn modify the human use system (for example by changing land use), the natural events system (for example by changing the magnitude/frequency relationship for river flooding), or both.

The Park model of human responses to a hazard sketches the phases following a hazard event.

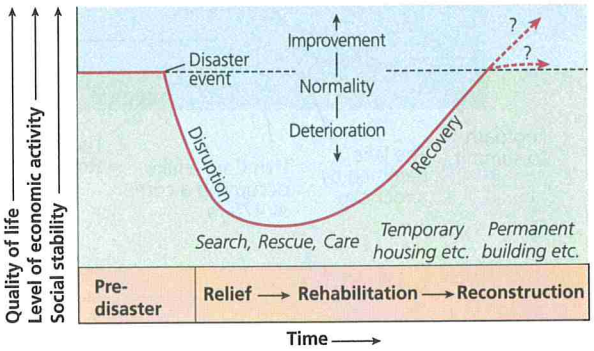


Figure 5.1 The Park model of human responses to a hazard

**1** **Outline the activities that might take place during the relief phase. (AO1, AO2)** 6 marks

**2** **What are the differences between the rehabilitation phase and the reconstruction phase? (AO1, AO2)** 6 marks

**3** **Outline two characteristic human responses to hazards using examples of where these types of responses can be found. (AO1, AO2)** **6 marks**

**4** **Using Figure 5.2 and examples from your studies, explain the extent to which the time interval between disasters impacts on an area's response to those disasters. (AO1, AO2)** **10 marks**

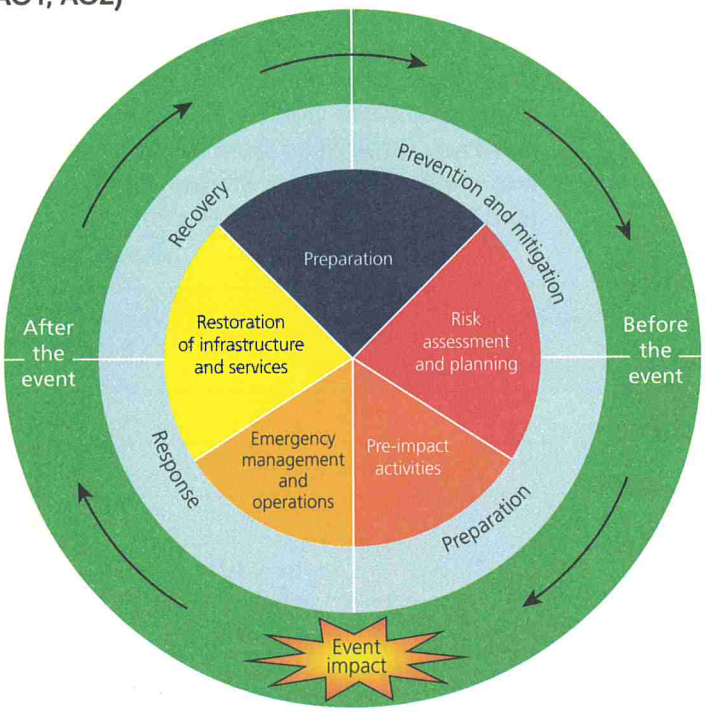


Figure 5.2 The hazard management cycle

# Plate tectonics

Plate tectonics is the theory that the Earth's outer shell (the crust or lithosphere) is divided into several plates that glide over the rocky inner layer (the mantle) above the core. The plates act like a hard and rigid shell compared to the mantle. Developed from the 1950s through to the 1970s, plate tectonics is the modern version of the theory of continental drift, a theory first proposed by Alfred Wegener in 1912.

The crust of the Earth is divided into rigid plates that vary in shape and size and move relative to one another over the globe. There are nine major plates: the Eurasian, African, South American, North American, Nazca, Antarctic, Pacific, Juan De Fuca and Indian–Australian.

Most of the edges of these plates are geologically active.

**5** **Describe the main features (location, temperature, chemistry etc.) of the following: (AO1)**

15 marks

**a** **The oceanic crust**

**b** **The continental crust**

**c** **The asthenosphere**

**d** **The mantle**

**e** **The core**

**6** **To what extent does the mantle convection hypothesis explain plate movements at destructive boundaries and constructive plate margins? (AO1, AO2)**

8 marks

**7** **Describe the differences between the ridge push hypothesis and the slab pull hypothesis. (AO1)**

5 marks

Constructive plate boundaries occur where plates move away from each other and fresh magma wells up to fill the gap. This creates new crust as it cools and solidifies. Figure 5.3 shows how these boundaries evolve from a bulge in the crust underneath upwelling magma to a continental rift valley (e.g. the Great African Rift Valley), to a linear sea (e.g. the Red Sea) and finally to an ocean.

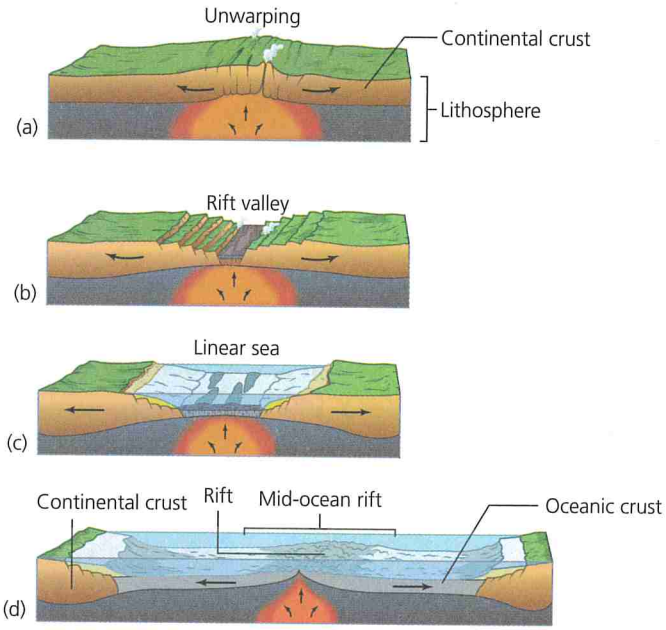


Figure 5.3 The evolution of a constructive plate margin

**8** **Use plate tectonic theory to account for the evolution of oceans as shown in Figure 5.3. (AO1, AO2)**

6 marks

**9** **The magma and lavas produced at constructive plate margins are low in silica content. To what extent does this affect the nature of the volcanic eruptions found at this type of boundary? (AO1, AO2)**

4 marks

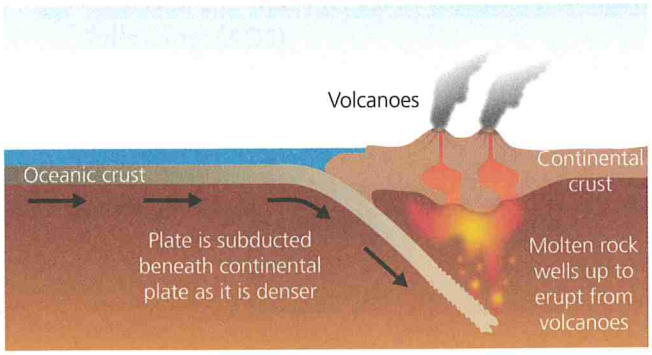


Figure 5.4 An ocean/continent destructive plate boundary

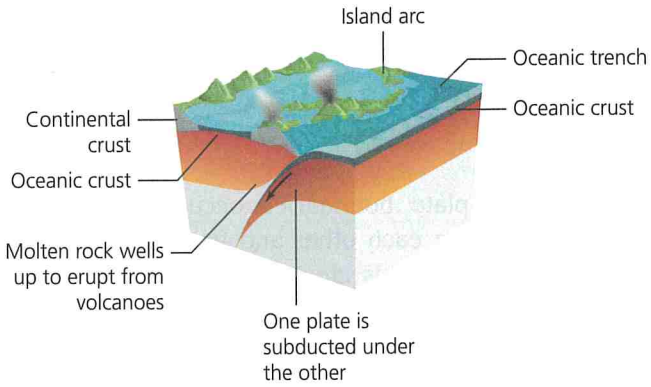


Figure 5.5 An ocean/ocean destructive plate boundary (an island arc)

**10** **Study Figures 5.4 and 5.5. Account for the fact that earthquakes occur at these two types of boundary. (AO1, AO2)**

4 marks

**11** **Describe the nature of the volcanic eruptions at both types of boundaries shown in Figures 5.4 and 5.5. (AO1, AO2)**

6 marks

**12** Explain why collision boundaries such as that between the Indo/Australian plate and the Eurasian plate produce many earthquakes. (AO1, AO2) **4 marks**

**13** Explain why earthquakes at conservative plate boundaries are potentially so destructive. (AO1, AO2) **4 marks**

**14** Using Figure 5.6 explain how the moving Pacific plate and the magma plume work together to form a chain of islands. (AO1, AO2) **6 marks**

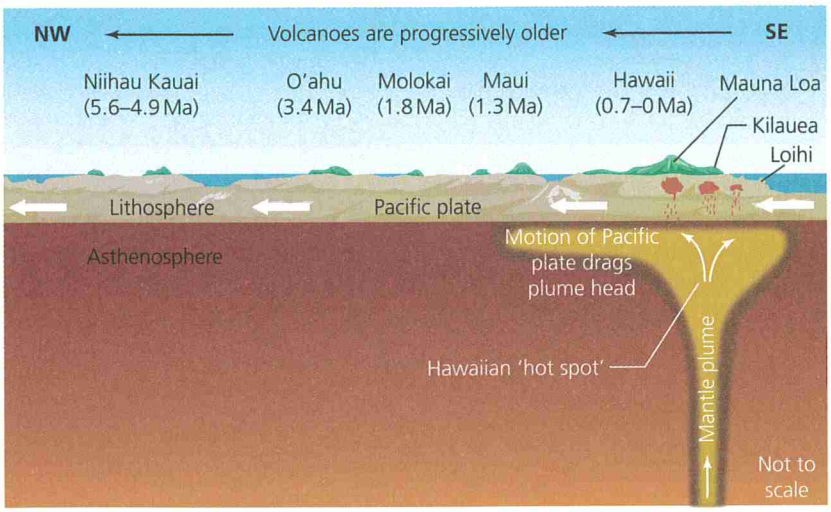


Figure 5.6 A chain of 'hot-spot' volcanoes in the Hawaiian Islands

# Volcanic hazards

A volcanic hazard refers to any potentially dangerous volcanic process (e.g. lava flows, pyroclastic flows, ash). A volcanic risk is any potential loss or damage as a result of the volcanic hazard that might be incurred by persons, property etc. or which negatively impacts the productive capacity/sustainability of a population.

**15** **Describe the distribution of volcanic activity as shown in Figure 5.7 and relate it to the theory of plate tectonics. (AO1, AO2)** **6 marks**

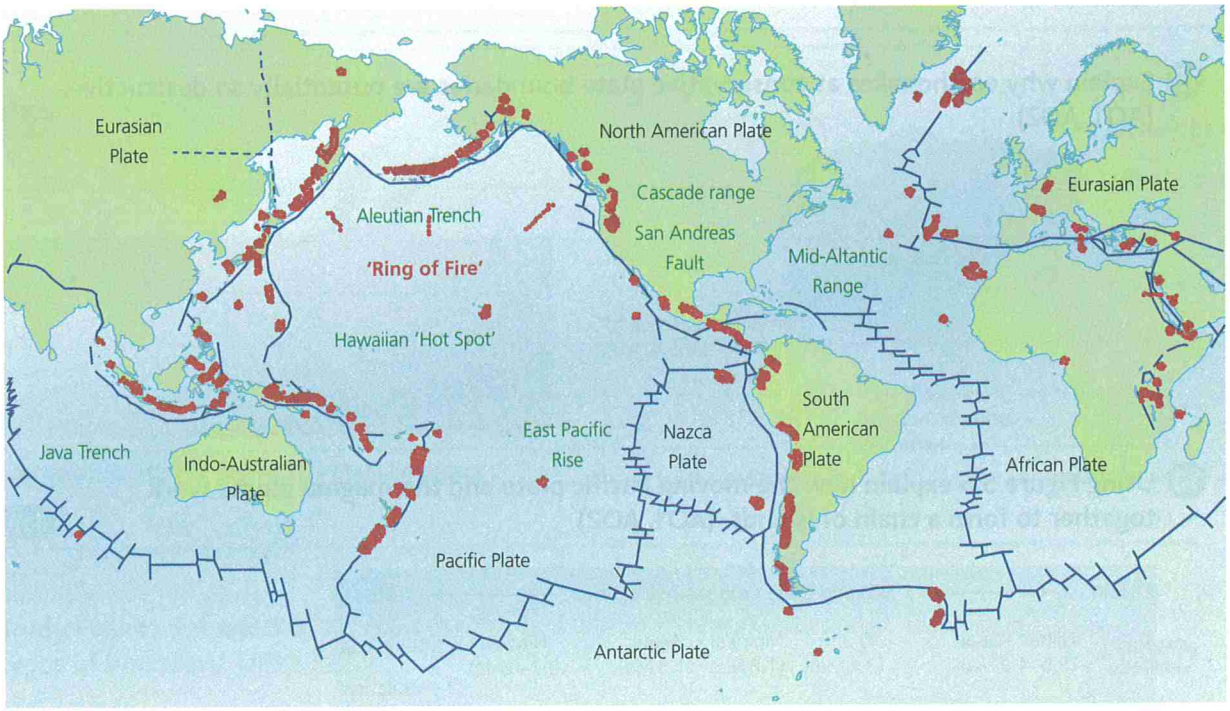


Figure 5.7 Location map of active volcanoes

**16** **Choose two of the volcanic hazards shown in Figure 5.8 and, using examples, explain the cause and describe the effects of the named hazards. (AO1, AO2)** **8 marks**

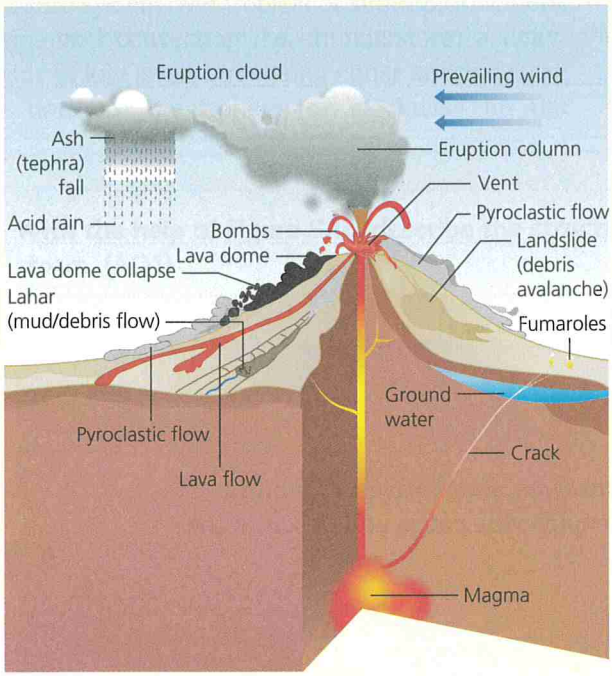


Figure 5.8 A simplified diagram showing some of the most common forms of volcanic hazard

# Seismic hazards

Most of the seismic hazards to people come from human-made structures and the shaking they receive from earthquakes. The real dangers to people are being crushed in a collapsing building, drowning in a flood caused by a broken dam or levee, getting buried under a landslide, or being burned in a fire.

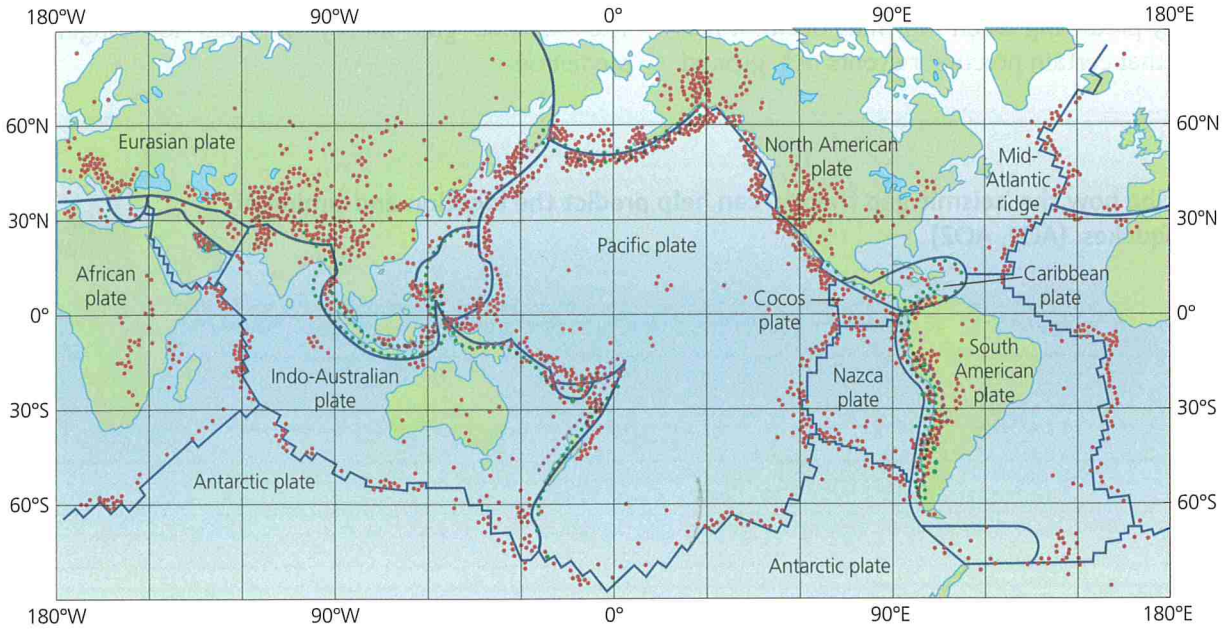


Figure 5.9 Earthquake locations for events between 1965 and 1995. The red dots are shallow earthquakes, the green are intermediate depth, and the purple are deep

**17** To what extent do earthquakes in general, and their depth in particular, conform to what we know about tectonic plate boundaries? (AO1, AO2) 8 marks

**18** Earthquake hazards include earthquakes themselves, shockwaves, tsunamis, liquefaction and landslides. Using examples, explain the cause and describe the effects of two named hazards. (AO1, AO2) 8 marks

Although scientists know most of the global locations where earthquakes are likely to occur, they still have great difficulty predicting when they may occur. It has been noticed that certain precursor events (e.g. ground uplift, emission of radon gas etc.) can be monitored and observed changes can help in short-term prediction. The 'seismic gap theory' is used for longer-term prediction.

**19** Describe how the 'seismic gap theory' can help predict the location and timing of earthquakes. (AO1, AO2) 6 marks

# Storm hazards

A tropical storm (or cyclone) is the generic term for a low-pressure system over tropical or subtropical waters, with organised convection (i.e. thunderstorm activity) and winds at low levels circulating either anticlockwise (in the northern hemisphere) or clockwise (in the southern hemisphere). The whole storm system may be 8,000 m to 9,500 m high and 200 to 700 km wide, although sometimes can be even bigger. It typically moves forward at speeds of 16–20 km/h but can travel as fast as 60 km/h.

**20 With the help of Figure 5.10, describe the structure of a typical tropical revolving storm. (AO1)**

6 marks

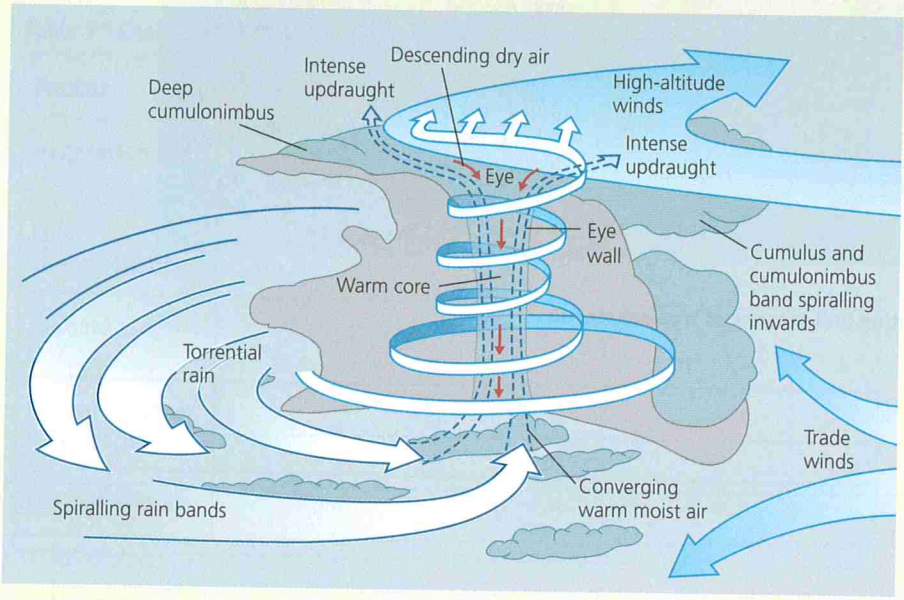


Figure 5.10 The structure of a tropical revolving storm

Tropical storms require a certain set of environmental conditions in order to develop. Once they have been triggered, they move westwards and northwards (southwards in the southern hemisphere) until they come under the influence of westerly winds. They then start to reverse their direction into an easterly path.

**21** **Using Figure 5.11, describe and account for the global distribution of tropical storms and the time of their occurrence. (AO1, AO2, AO3)** **8 marks**

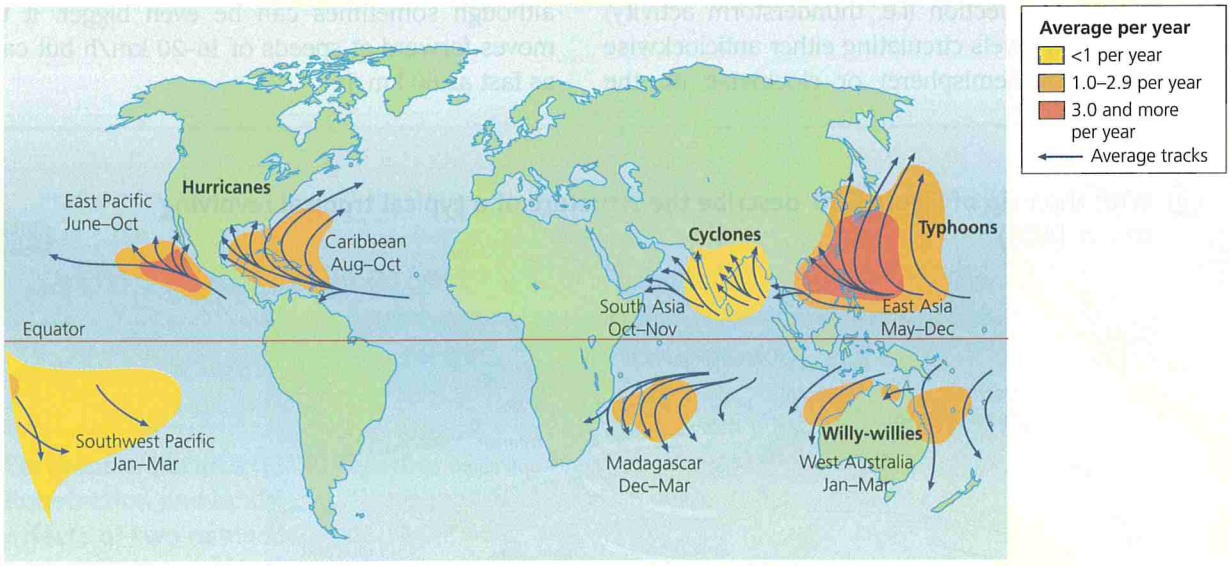


Figure 5.11 Global distribution and seasons of tropical storms

Tropical storms pose threats to coastal communities in the form of high winds, storm surges, coastal flooding and landslides. Their impact is huge. Between 1980 and 2009, 466 million people were affected, including 412,644 deaths and 290,654 injuries. The primary cause of cyclone-related mortality in both developed and less developed countries was storm surge drowning.

**22** **Why might a decreased proportion of deaths and injuries be observed in the aftermath of cyclones as a result of improved early warning systems and evacuation? (AO1)** **4 marks**

**23** To what extent do the impacts of tropical storms and the human responses depend on both the physical nature of the environment as well as the level of economic development? (AO1, AO2)

20 marks

*Write your answer on a separate sheet of paper.*

# Fires in nature

**24** Complete Table 5.1. (AO1, AO2)

8 marks

Table 5.1 Conditions favouring wildfires

| Factor | Impact on wildfire |
|---|---|
| Vegetation type | |
| Fuel characteristics | |
| Climate | |
| Recent weather conditions | |
| Fire behaviour | |

**25** Outline how wildfires can be started. (AO1)

3 marks

**26** For a recent wildfire event you have studied, assess the extent to which the human responses to that event were able to reduce the impact of the fire. (AO1, AO2)

10 marks

## Exam-style questions (AS)

**1** Outline how risk management can reduce the impacts of wildfires. (AO1) 4 3 marks

**2** The United Nations office for Disaster Reduction has produced statistics regarding the number of natural disasters and the total costs of the damage incurred.

Table 5.2 shows the figures for the top ten countries with most disasters between 2005 and 2014.

Table 5.2

| Country | Number of natural disasters | Rank | Total damage ($ billion) | Rank | $d$ | $d^2$ |
|---|---|---|---|---|---|---|
| China | 286 | 1 | 265 | 2 | –1 | 1 |
| USA | 212 | 2 | 443 | 1 | +1 | 1 |
| Philippines | 181 | 3 | 16 | 7 | –4 | 16 |
| India | 167 | 4 | 47 | 4 | 0 | 0 |
| Indonesia | 141 | 5 | 11 | 8 | –3 | 9 |
| Vietnam | 73 | 6 | 7 | 9 | –3 | 9 |
| Afghanistan | 72 | 7 | 0.16 | 10 | ... | ... |
| Mexico | 64 | 8 | 26 | 5 | 3 | 9 |
| Japan | 62 | 9 | 239 | 3 | ... | ... |
| Pakistan | 59 | 10 | 25 | 6 | 4 | 16 |

Calculate the Spearman's rank correlation coefficient for the two sets of data by completing Table 5.2 and using the formula:

$$R_s = 1 - \frac{6 \sum d^2}{n^3 - n}$$

Where:

$R_s$ is the Spearman's rank correlation coefficient

$n$ is the number of pairs of variables

$\sum d^2$ is the sum of the differences in rank squared.

Critical values for Spearman's rank where $n$ = 10:

| $n$ | Significance level | |
|---|---|---|
| | 0.05 | 0.01 |
| 10 | +/– 0.564 | +/– 0.746 |

Complete Table 5.2 and interpret your Spearman's rank result using the critical values above. (AO3) 7 6 marks

**3** **Analyse the extent to which the impacts of volcanic hazards depend on the nature of the vulcanicity. (AO1, AO2)**

10 9 marks

**4** **Assess the extent to which the Park model of human responses applies to TWO or more recent hazard events you have studied. (AO1, AO2)**

22 20 marks

*Make notes below and then write your answer as a separate sheet of paper.*

## Exam-style questions (A-level)

**5** Study Figure 5.12 and analyse the possible climatic variables that have an effect on the occurrence and length of the fire season in the western USA. (AO2, AO3)

7 6 marks

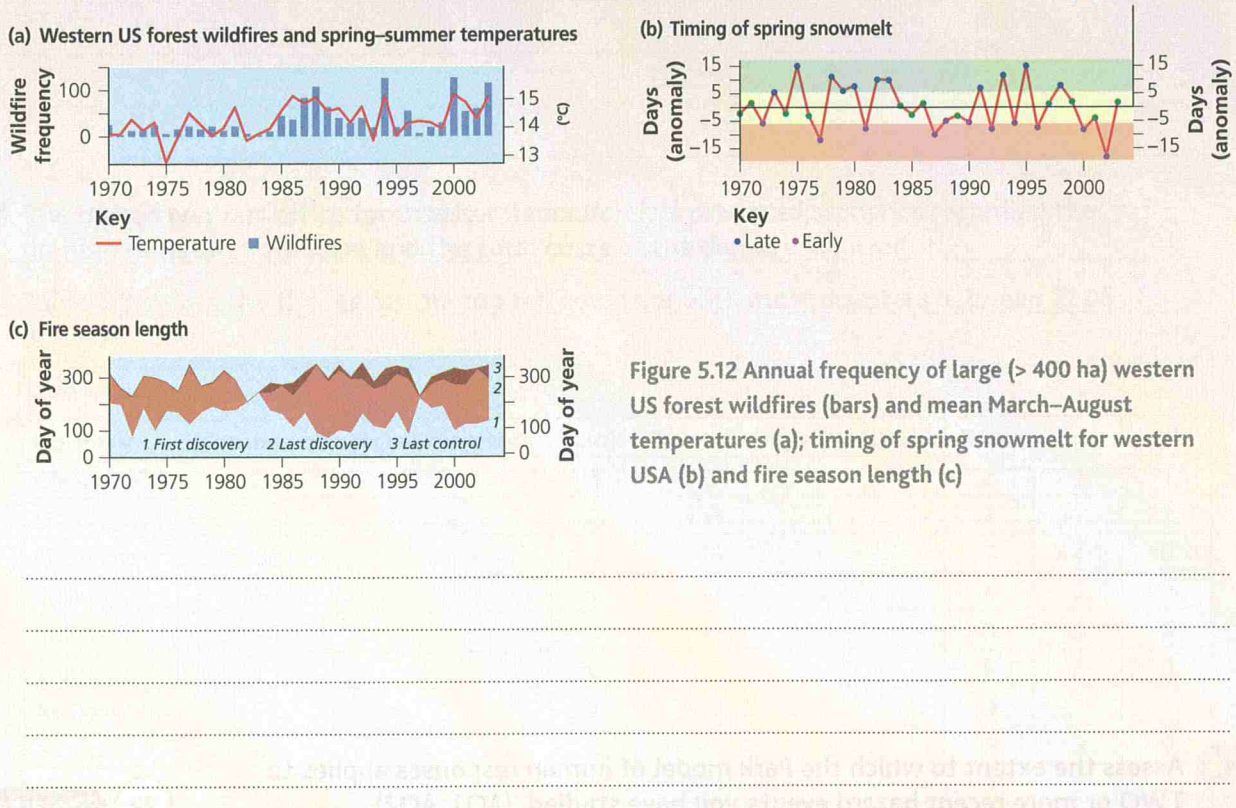


Figure 5.12 Annual frequency of large (> 400 ha) western US forest wildfires (bars) and mean March–August temperatures (a); timing of spring snowmelt for western USA (b) and fire season length (c)

**6** To what extent do you agree that risk management has had an effect on the impacts of a recent volcanic event you have studied? (AO1, AO2)

11 9 marks

**7** Outline the theory of plate tectonics and assess the extent to which the position of young fold mountains, rift valleys, ocean ridges, volcanoes, deep sea trenches and island arcs support that theory. (AO1, AO2)

11 9 marks

**8** Using an example of a multi-hazardous environment beyond the UK, illustrate and analyse the nature of the hazards of that environment and the social, economic and environmental risks presented. To what extent do human qualities and responses contribute to its continuing human occupation? (AO1, AO2)

25 20 marks

*Make notes below and then write your answer on a separate sheet of paper.*