The Challenge of Tectonic Hazards – MARK SCHEME

Question 1a

Using Figure 1, which one of the following statements is true?

One mark for the correct answer:
C. There are many active volcanoes around the edge of the Pacific Ocean
No credit if two or more statements are shaded

Question 1b

Describe the movement of plates along plate margin X.

This question requires application of knowledge to the source.

Plates are coming together/coverging /colliding
One plate is pushed (subducted, sinks) under the other.
The ocean floor is moving under the continental plate
No credit for explanations of plate movement or for stating destructive margin

Question 2

'Long-term responses to a tectonic hazard are more important than immediate responses.'
Do you agree?
Using Figure 5 and one or more examples, explain your answer.

- **Level 3 (detailed)(7-9 Marks)** responses will be developed and include both immediate and long term responses to a tectonic hazard (some may be interlinked). Responses are related to a named example and Figure 5, with some assessment.

Indicative content

- The command is “do you agree” and to “explain your answer”, so the focus of the question is an evaluation of the degree to which long term responses are more or less important than responses in the short term. e.g. Fully agree, disagree, partially agree. Many may feel that short term responses are more significant. Answers should consider their relative importance, supported by evidence.
- Credit only responses (not causes or effects). Answers should refer to a named example, although general answers are creditworthy to the top of Level 2. Examples can include named volcanic events, earthquakes, tsunamis and other hazards. Answers may include just one exemplar but credit can be given for others if relevant. They may make distinctions between responses in HIC and LICs/NEE countries.
- Understanding of immediate responses, i.e. the first/emergency actions taken by people after an event. These include the need to search for and rescue people, getting them to safety or to hospital, possibly moving inland or to higher ground if a tsunami; a need to try to provide medical help, to ensure there is clean water (and food); a need to bury the dead, often in mass graves to stop the spread of disease. All of this may require international aid with teams of sniffer dogs, heavy equipment, medical staff, provisions of water purifying tablets, blankets, setting up shelters, tents etc.
- Long-term responses are responses by people that occur over weeks, months or years. These involve the need to rebuild houses, ideally using different materials and designs, to make them less easy to destroy, and to rebuild public buildings and infrastructure. There may be a requirement to rebuild roads and railways; to ensure jobs are being created; to help people to come to terms with a traumatic event and loss of parents and children; to predict and prepare for future events and introduce measures to reduce the effects of future hazards.
- Evaluation of Figure 5. Allow any reasonable inference from the photographs. Immediate responses include providing water supplies, medicines, first aid and essential supplies for survival. Long term responses involve rebuilding programmes, constructing new houses using strong long-lasting materials, replacing those that were destroyed. This allows people to plan for the future, and may also provide work for local builders, electricians, carpenters etc.

- Knowledge and understanding of specific example(s) of a tectonic event (s). e.g. Haiti 2010
  Many countries responded to appeals for aid, dispatching rescue and medical teams, engineers and support personnel.
  Communication systems, air, land, and sea transport facilities, hospitals, and electrical networks had been damaged by the earthquake, which slowed rescue and aid efforts. As rescues tailed off, supplies, medical care and sanitation became priorities. There were delays in aid distribution. Looting and sporadic violence occurred. Medicines San Frontiers tried to help casualties whilst the USA took charge of trying to coordinate aid distribution.
- Longer term responses. The EU and World Bank provided longer term assistance but response was slow. Huge increase in number of people in relief camps of tents, most with no electricity, running water, or sewage disposal. The Dominican Republic offered support and accepted some refugees. Most debris has now been removed, new building codes have been established, port is being rebuilt, part of the country's debt has been written off and most agencies are resolved to make sure that the recovery is sustainable.
- Evaluation of the relative importance of immediate and long term responses. Both may be considered essential, although longer term responses are sometimes given lower priority after initial publicity ceases. Immediate relief is essential to save lives, provide shelter and food. Short term aid from other countries may be crucial as government is not able to meet the needs of the victims. Long term responses may be considered equally/more important as they ensure the survivors are able to integrate back to their normal life. Length of recovery period may depend on availability of money for longer term reconstruction, available technology, efficiency of distribution systems, communications and infrastructure, level of preparation and planning, and how well emergency services cope.

Question 3a

Using **Figure 4**, which one of the following statements is true?
Shade one circle only.
B. Most earthquakes happened to the east and south east of Japan.
One mark for correct answer:
No credit if two or more answers are circled.

Question 3b

Using Figure 4, name the type of plate margin between the Pacific and Eurasian plates.

Destructive, convergent

No credit for description of movement such as moving towards each other.

Question 3c

Suggest one other tectonic hazard likely to occur near to the plate margins shown in Figure 4.

Volcano/volcanic eruption, tsunami

No credit for non-tectonic hazard

Question 4a

Using Figure 2, which one of the following statements is true?

One mark for correct answer:

B Earthquakes are found in long narrow zones along plate margins.

No credit if two or more answers are circled.

Question 4b

Using Figure 2, name the type of plate margin at X.

Conservative/passive/transform

Question 4c

Suggest why earthquakes and volcanic eruptions happen close to the plate margin at Y.
Use Figure 2 and your own understanding.

- Level 2 (3-4)(clear) will have linked or elaborated statements and some accurate use of geographical terms. Clear sequence with processes explained.

Indicative content

- The command word is “suggest” so responses should set out the likely causes of both volcanoes and earthquakes from the source, showing an understanding of the processes involved. The map shows a destructive plate margin.
- Accept explanations that refer to slab pull and gravitational movement of plates: the denser plate sinks into the mantle under the influence of gravity, which pulls the rest of the plate along behind it (slab pull).
- Credit also the more conventional theory of the movement of convection currents in the upper mantle as the mechanism for plate movement and subduction.
- Understanding of processes causing volcanic activity at destructive margins. Two plates move towards each other. The denser plate sinks below the lighter, less dense plate and melts in the subduction zone. Hot magma rises up through the overlying mantle and lithosphere, and some can eventually
  erupt out at the surface producing volcanoes.
- Credit the idea that magma becomes increasingly viscous or sticky as it rises to the surface, producing composite volcanoes which are steep sided and have violent eruptions.
- Understanding of earthquakes at destructive margins. As the two plates converge, pressure builds up. The rocks eventually fracture causing an earthquake. Most happen at shallow depths below the surface where the plates collide. They also occur at greater depth, in the lower part of the subduction zone.
- Application of knowledge and understanding to the map. The Nazca Plate is subducted beneath the South American Plate. Expect recognition that this plate boundary is destructive and that the denser ocean crust is subducted.

Question 5

Explain how living in areas that are at risk from tectonic hazard(s) may have both advantages and disadvantages.

- Level 3 (5-6)(detailed) responses will be developed. Some geographical terms will be applied. All aspects of the question are answered, including both advantages and disadvantages, although the two aspects may not be balanced.

Indicative content

The command word is “explain”, so responses should provide a reasoned account of how and why tectonic hazards create advantages and disadvantages for people.
Advantages of living in areas at risk from volcanic hazards.

- In volcanic areas geothermal energy can be harnessed by using steam from underground heated by magma.
- Geothermal power stations produce electricity eg Iceland and New Zealand.
- Volcanoes, including hot springs and geysers, attract tourists. This creates employment and may have a multiplier effect.
- Magma and lava may contain minerals including gold, silver, diamonds, copper and zinc. Basalt can be used in construction and to build roads.
- Weathered lava may form nutrient rich soil which can be cultivated to produce crops and rich harvests.
- New land may be created following a volcanic eruption.
- People believe the chances of the volcano erupting are very slim. Poor people, especially in LICs cannot afford to live away from volcanoes as they provide jobs, and their families and friends live there. Some places are well prepared for volcanic hazards so people feel safe.

Advantages of living in areas at risk from seismic hazards

- Plate margins often coincide with favourable areas for settlement, such as coastal areas where ports are developed. Large settlements in seismic zones offer job opportunities, such as San Francisco and Los Angeles.
- Perception that risk is outweighed by economic or social opportunities.
- Engineering can make people feel safe eg Buildings can constructed to be earthquake proof. Protection, planning and monitoring may be advanced, so potential risks are reduced.
- Fault lines associated with earthquakes can allow water supplies to reach the surface.

Disadvantages of living in areas at risk from volcanic hazards.

- Volcanic eruptions can kill people and damage property. Economic activity can suffer as it is hard for businesses to operate after an eruption.
- Habitats and landscapes are damaged by lava flows.
- Ash disperses in the air, and together with volcanic gases can affect breathing. It may cover the land, including fields, houses, roads, and industrial plants.
- Pyroclastic flows can destroy houses and trees.
- Eruptions may trigger tsunamis, which lead to destructive flooding of the coastline.

Disadvantages of living in areas at risk from seismic hazards.

- In seismic areas ground shaking causes bridges and buildings to collapse, windows to shatter, power lines to collapse, water/gas mains and sewers to fracture.
- Immediate deaths and injuries result from crushing, falling glass, fire and transport accidents.
- People become homeless.
- Slope failures set off avalanches.
- There may be panic, fear and hunger.
- Longer term disadvantages include diseases spread from polluted water, civil disorder, looting, power cuts, reduced emergency services, unemployment, disability, loss of farmland and food production.
- Credit knowledge of specific volcanic areas and earthquake zones, although this is not essential for access to Level 3. Eg Naples area in Italy has olives, vines, nuts and fruit (mainly oranges and lemons) growing on volcanic soils close to Mount Vesuvius. In Iceland, volcanoes provide cheap geothermal power, 28% of all its energy, including heating of pavements in winter in Reykjavik. The Blue Lagoon in Iceland is heated by geothermal heat, with 1.5 million visitors per year

Question 6

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

Prepare emergency aid and distribution (1). Practise earthquake/volcano drills. (1) Plan evacuation routes (1). Stockpile blankets, clean water and food (1). Educate people so they know what to do if an earthquake or volcano happens (1). Prepare hazard maps to show areas most at risk of damage (1).

2 separate ways are required.

Question 7a

Using Figure 2, how long will it take for the plates to move 100 metres?

One mark for the correct answer:
D 4000 years
No credit if two or more answers are circled

Question 7b

Using Figure 2 and your own understanding, suggest how plate movements cause tectonic hazards in Iceland.
Level 3 (5-6 Marks) (detailed) responses will be developed. Some geographical terms will be applied.

Indicative content

- The command word is “suggest” so responses should set out the likely causes of volcanoes and earthquakes from the source provided, showing an understanding of the processes involved and the hazards.
- Accept explanations that refer to ridge push and slab pull processes.
- The more likely explanation is movement of plates and subduction caused by convection currents
- Understanding of processes causing volcanic activity at margins. Two plates move apart. Magma rises through the crust, and some can erupt producing volcanoes.
- Understanding of earthquakes at margins as plates move apart. Faults are formed at the margin and earthquakes can occur here. They are usually of low magnitude, although some can be high as stated in the source. Some may be linked to volcanic activity. Most happen at shallow depths below the surface where the plates are moving apart.

- Hazards include huge amounts of volcanic ash; glacial floods caused by heat from volcanic activity, lava flows, mudflows (lahars). Earth tremors and quakes can cause sudden movement of the land.
- Credit focus on hazards as events affecting people eg indirect hazards such as famine due to crop damage
- Credit knowledge and understanding of specific events, such as the eruption under Eyjafjallajökull in 2010.
- Application of knowledge and understanding to **Figure 2**. Iceland lies on the plate margin. Molten lava from beneath the Earth´s crust wells up, and is pushed away from the ridge at a rate of 2.5 cm per year. Volcanoes are mostly confined to the ridge in a linear belt where 2 plates are separating.
- Max L1 for explanation of tectonic activity at destructive or conservative margins.
- Top L2 for explanation of one hazard only. Note however that volcanoes (and earthquakes) may be associated with more than one hazard.
- Max 1 mark for description of pattern in isolation.
- There should be some (implied) reference to **Figure 2** to access Level 3.

Question 8

Explain how the risks of a tectonic hazard can be reduced.

- **Level 2 (clear)** responses will be clear explanation(s) or linked statements.
  Some accurate use of geographical terms

Indicative content

- The command word is “explain” which requires an account of how and why one or more strategies are helpful in reducing the risks posed by a tectonic hazard.
- Answers are likely to be specific to earthquakes or volcanoes, but credit more general responses that are appropriate to both. Allow reference to tsunamis as a type of tectonic hazard.
- Strategies to reduce risk are likely to involve one or more of the following, although it is not necessary to use the same terms:

- Monitoring – recording physical changes, such as earthquake tremors around a volcano, to help forecast when and where a natural hazard might strike.
- Prediction – attempts to forecast when and where a hazard will strike. This can be done to some extent for volcanic eruptions, but less reliably for earthquakes.
- Planning – actions taken to enable communities to respond to, and recover from, natural disasters, through emergency evacuation plans and warning systems.
- Protection -actions taken before a hazard strikes to reduce its impact, such as educating people or improving building design.
- For earthquakes, monitoring and prediction may involve using seismometers to monitor earth tremors, but specific times and locations are not possible to predict
- Protection includes constructing buildings so that they are safe to live in and will not collapse. Some examples of building improvements are rubber shock absorbers in the foundations to absorb the Earth tremors, steel frames that can sway during Earth movements, and open areas outside of the buildings where people can assemble during an evacuation.
- Planning. Hospitals, emergency services and residents may practise for an earthquake. They have drills in all public buildings so that people know what to do in the event of an earthquake. This helps to reduce the impact and increases their chance of survival. Planning may also involve emergency evacuation plans.
- For volcanic eruptions, monitoring and prediction may involve measuring gas concentrations, using tiltmeters to monitor changes in the volcano's surface), using seismometers to measure small earthquakes and tremors and thermal heat sensors to detect changes in the temperature of the volcano's surface.
- Protection is difficult but it may be possible to use earth embankments or explosives to divert lava flows away from property. Planning. Hazard maps have been produced for many of the world's most dangerous volcanoes, showing the likely areas to be affected. They can be used in planning to restrict certain land uses or to identify which areas need to be evacuated when an eruption is about to happen.