



FIRM FOUNDATION COUNTRY SCHOOL

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NAME:

CLASS:

FORM ONE

GEOGRAPHY 0460

Topic; Tectonic hazards

APRIL 2026 HOLIDAY WORK

INSTRUCTIONS

- You are required to print the whole document.
- You must print in colour.
- Answer all questions.
- Read through the **NOTES** on page 6-29 before answering the questions.
- Write your answer to each question in the space provided.
- Use a black pen or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Do **not** use an erasable pen or correction fluid.

TOTAL [18]

Due date: 12 May 2026

1. (a) Study Fig. 1.1, which shows two different types of volcano.

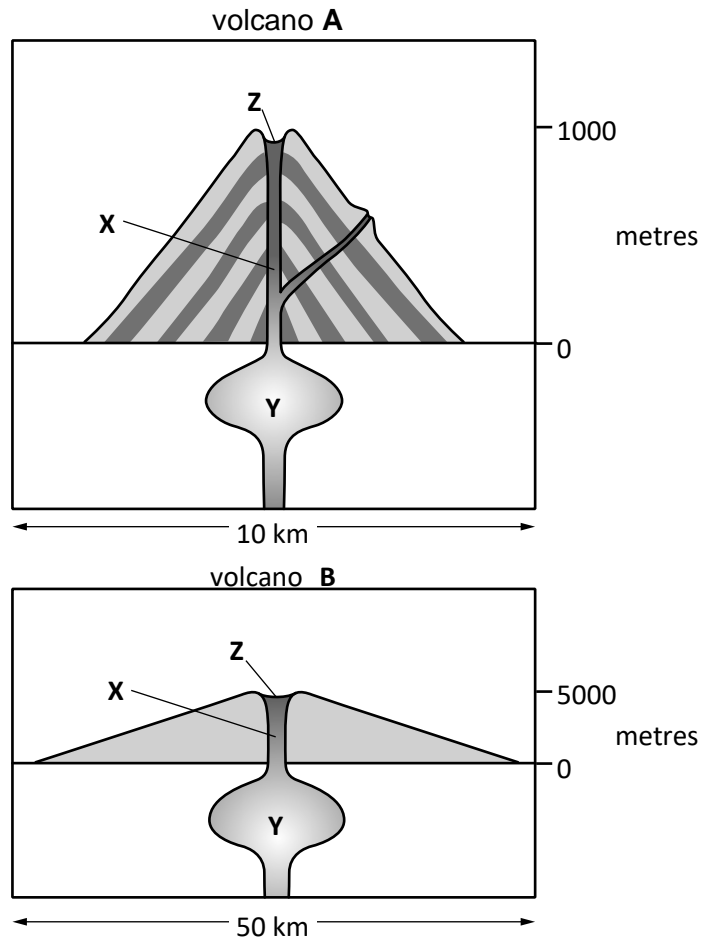


Fig 1.1

(i) Name the two types of volcanoes shown in **Fig. 1.1**. Choose from the following:

- shield volcano
- strato-volcano

A

B.....

[2]

(ii) Describe **three** differences between the types of volcano shown in **Fig. 1.1**

1.....

.....

2.....

.....

3.....

..... [3]

(iii) Using Fig. 1,1 identify the features labelled X, Y and Z in the spaces below.

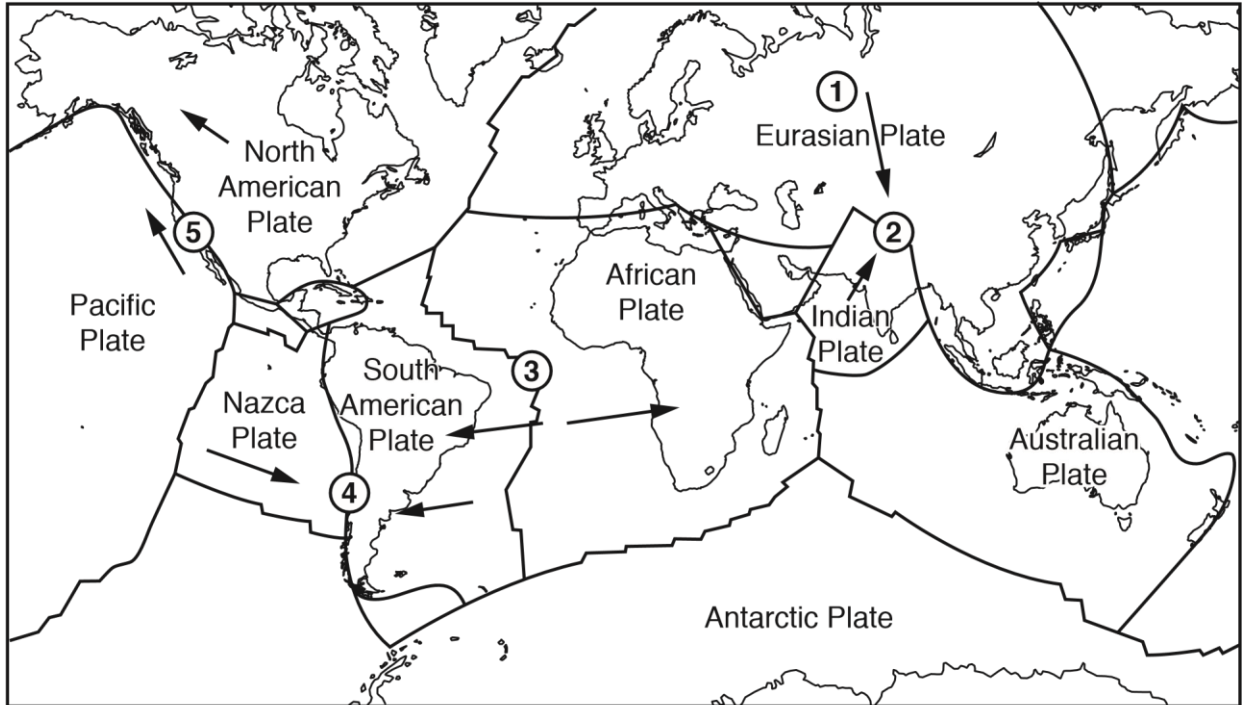
X

Y

Z

[3]

b) Fig. 1.2 is a map showing plates, plate boundaries and the directions of plate movement.



Key ——— plate boundary
 ———> plate movement

Fig. 1.2

Five places, 1–5, are marked in Fig. 1.2. For each question write **one** number in each box below.

Which number on the map shows a:

(i) place where earthquakes are unlikely to occur; [1]

(ii) place where plates are sliding past each other; [1]

(iii) subduction zone; [1]

(iv) place where sea floor spreading is happening? [1]

(c) Study **Fig. 1.3**, which shows an earthquake at a plate boundary.

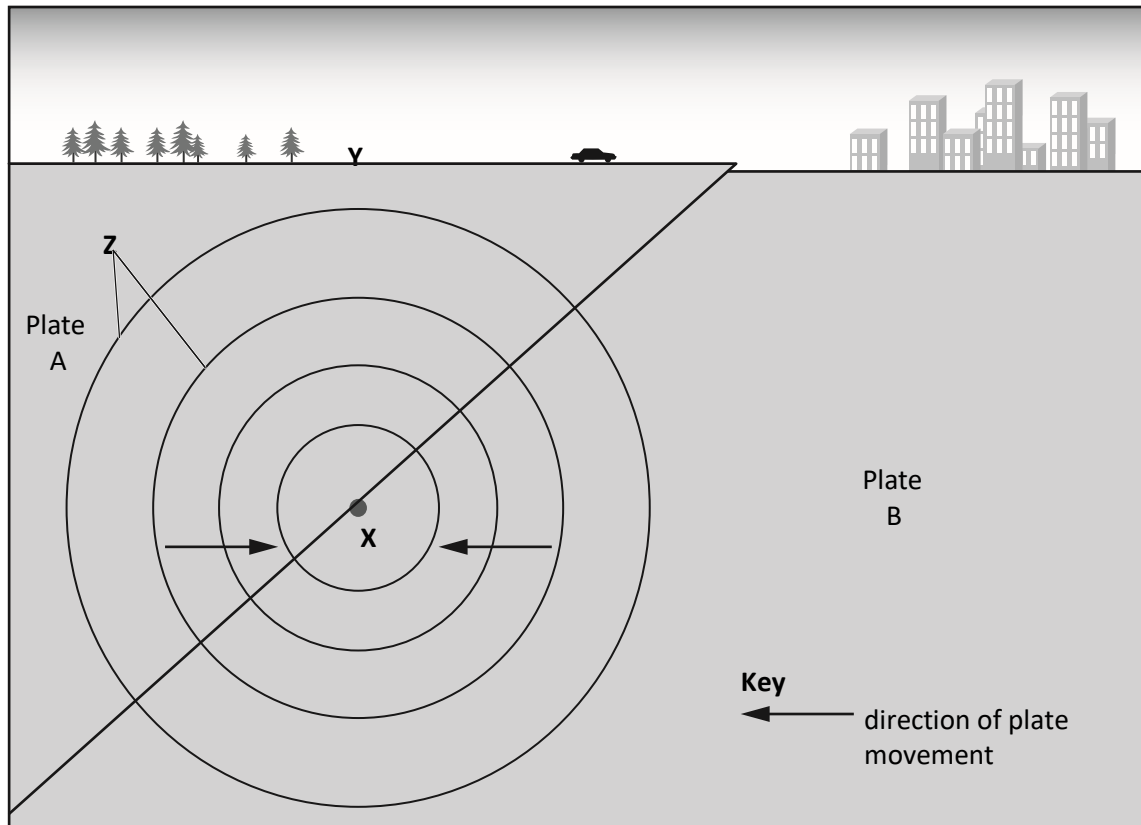


Fig. 1.3

(i) Identify the features labelled **X**, **Y** and **Z** on **Fig. 1.3**.

- X** =
- Y** =
- Z** = [3]

(ii) Study Fig. 1.3, which is a newspaper article describing natural hazards on the island of Hawaii.

Kilauea, one of the world's most active volcanoes, has been constantly erupting for 35 years. Lava flows have covered more than 38 square kilometres. The eruption on the 5 May 2018 caused a series of earthquakes, which reached a magnitude of 6.9. Steam and lava came out of large cracks in the ground. The police force asked hundreds of residents to move to the two evacuation centres. A local resident who has lived there for 35 years said, 'It's just part of life here. I've got lava tunnels on my property which drain lava from the volcano.'

Fig. 1.4

(i) Using Fig. 1.4 **only**, identify **three** reasons why people still live in this area.

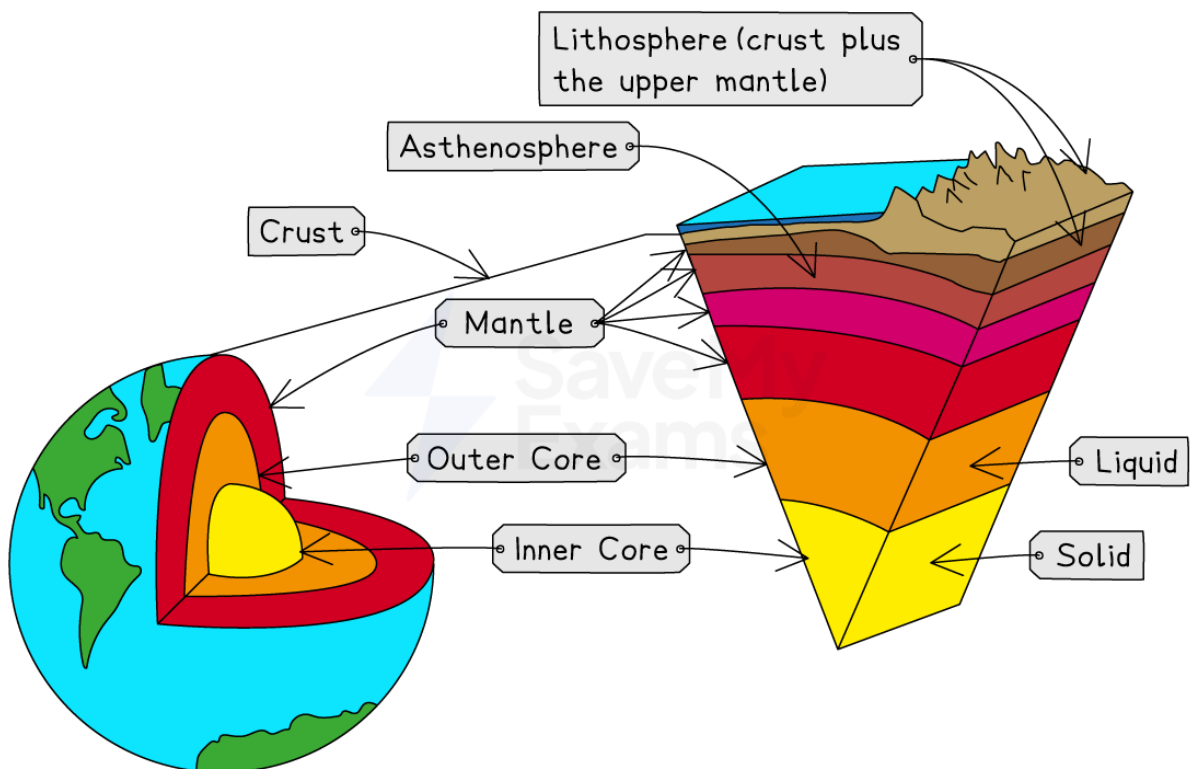
1
.....

2
.....

3
..... [3]

Structure of the Earth

- The Earth is composed of various layers
 - **Inner core:** About 1400km in diameter, a solid and dense layer composed of iron and nickel with temperatures of about 5000 - 6000°C
 - **Outer core:** About 2100km thick, a semi-molten metal layer with temperatures between about 4000 and 6000 °C
 - **Mantle:** About 2900km thick, a semi-molten layer which is less dense than the outer core this is split into two parts
 - **Asthenosphere**
 - **Lower mantle**
- The **lithosphere** is made up of two types of crust together with the rigid upper part of the mantle. The thickness varies.
- The two types of crust are:
 - **Oceanic**
 - **Continental**



Structure of the Earth

Crust

- There are two types of crust and they are part of the lithosphere
 - **The oceanic crust** is thinner (5-10km) but heavier, and denser and is composed mainly of basalt
 - **The Continental crust** is thicker (25-100km) but is older and less dense and is composed mainly of granite

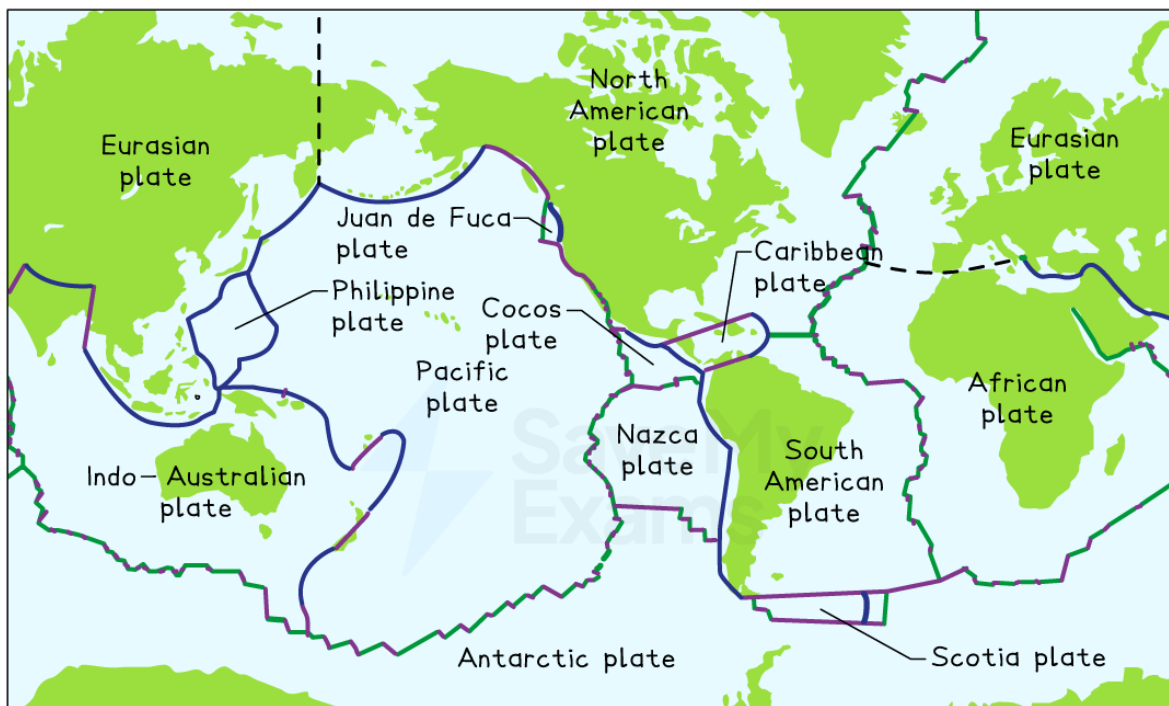
- Oceanic crust is continually being created and destroyed as a result of plate movement where it is denser and so subducts under the continental crust

Mantle

- The mantle is composed of the:
 - The **upper mantle** has two layers
 - The rigid upper layer which is part of the lithosphere
 - The **Asthenosphere** is a partially molten plastic-type layer which moves under high pressure and is between 35 and 250 km
 - The **lower mantle** is solid and the largest of the Earth's layers (2900 km)

Tectonic plates

- The Earth's crust is broken into 15 large **tectonic plates** and several smaller ones
- The places where the plates meet are called plate boundaries



Key:	
—	Divergent/constructive plate boundary
—	Convergent/destructive plate boundary
—	Transform/conservative plate boundary

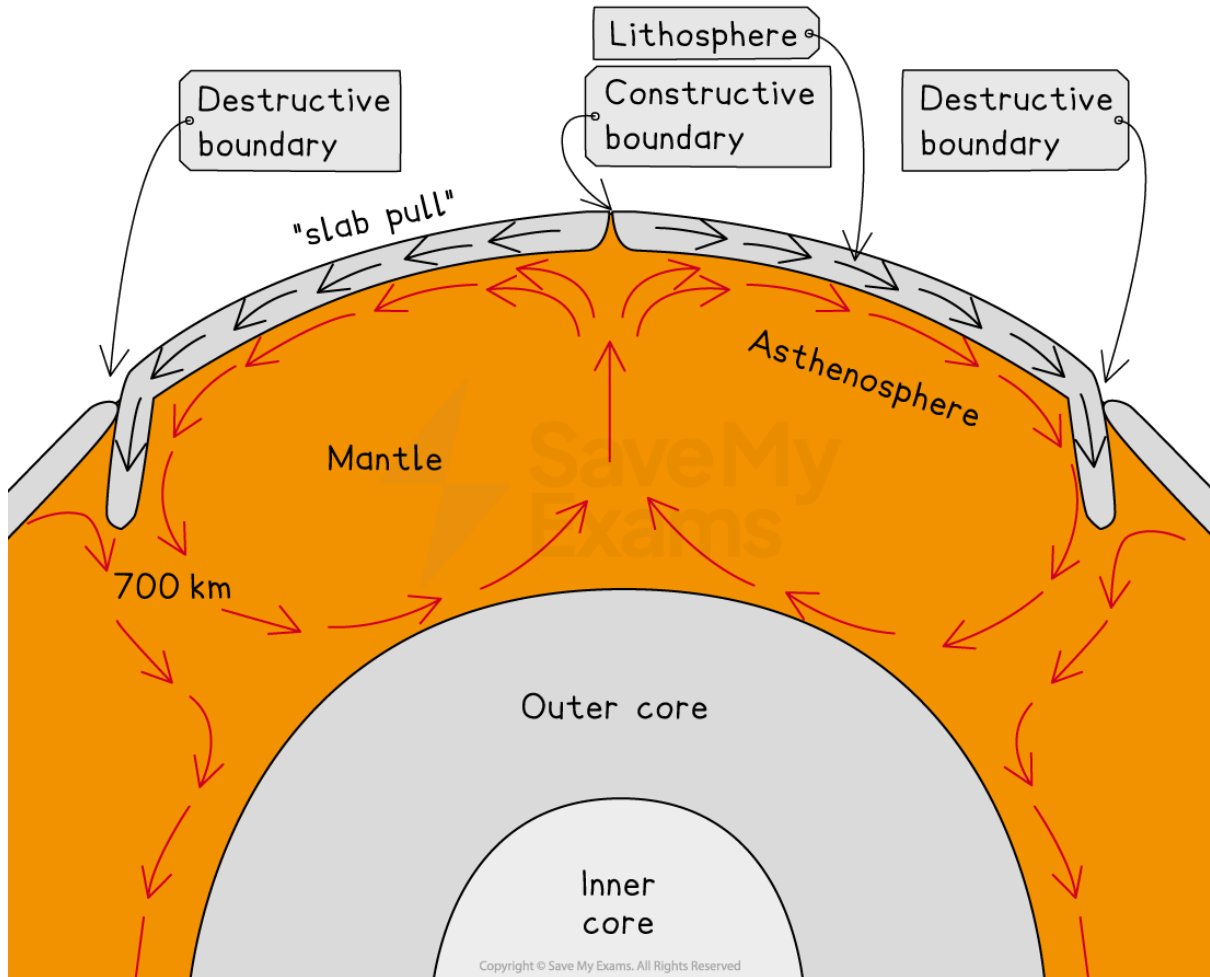
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Map showing the main tectonic plates and boundaries

Tectonic plate movement

- The heat within the Earth (**geothermal**), which is estimated to reach between 5 and 6000 is generated by **radioactive decay**
- Heat rises from the Earth's core and creates **convection currents** in the mantle

- The tectonic plates which make up the crust (**lithosphere**) move on top of the semi-molten mantle below
- The current theory is called **slab pull theory**
 - This suggests that in addition to the convection currents, plate movement is a result of the weight of the denser oceanic plates subducting and dragging the rest of the plate along



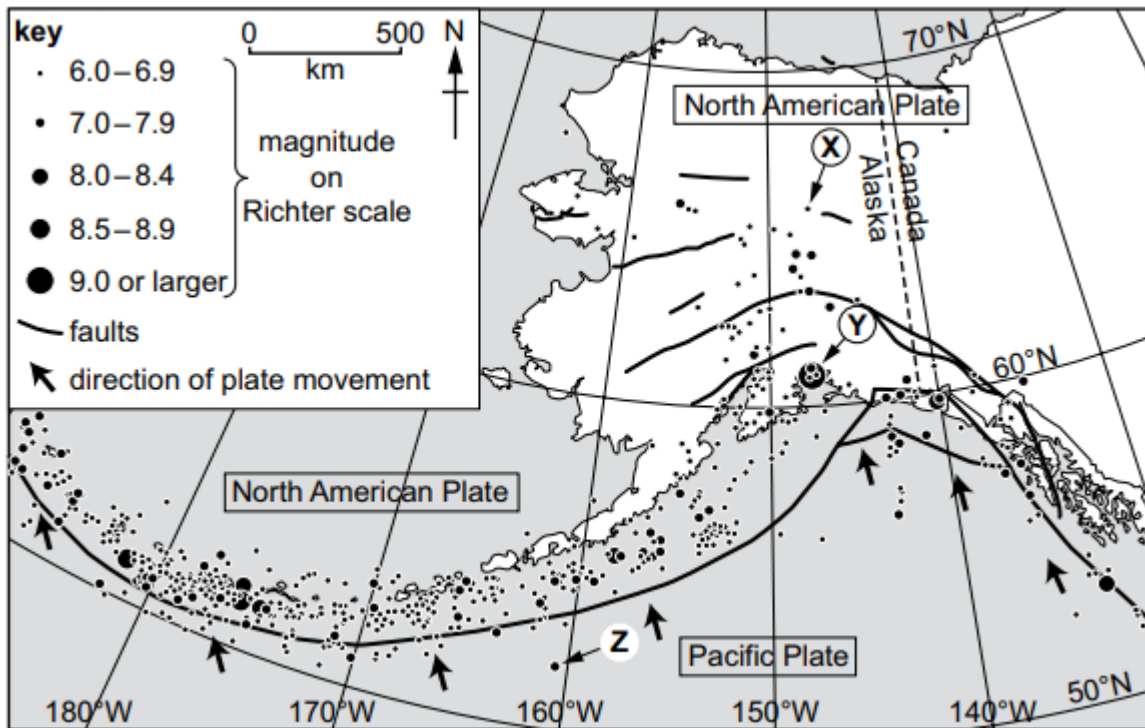
Convection currents and slab pull

Mantle plumes

- Within the mantle, there are also mantle plumes, which are upwellings of superheated rock
- These can lead to either:
 - Divergent plate boundaries
 - Hot spots located at random points on a tectonic plate

Worked Example

Study Figure 1, a map showing the location and magnitude of earthquakes in Alaska, USA.



(i) In which direction is the Pacific plate moving?

	Tick
north (N)	
north-north-west (NNW)	
north-west (NW)	
south-east (SE)	
south-south-east (SSE)	

Answer

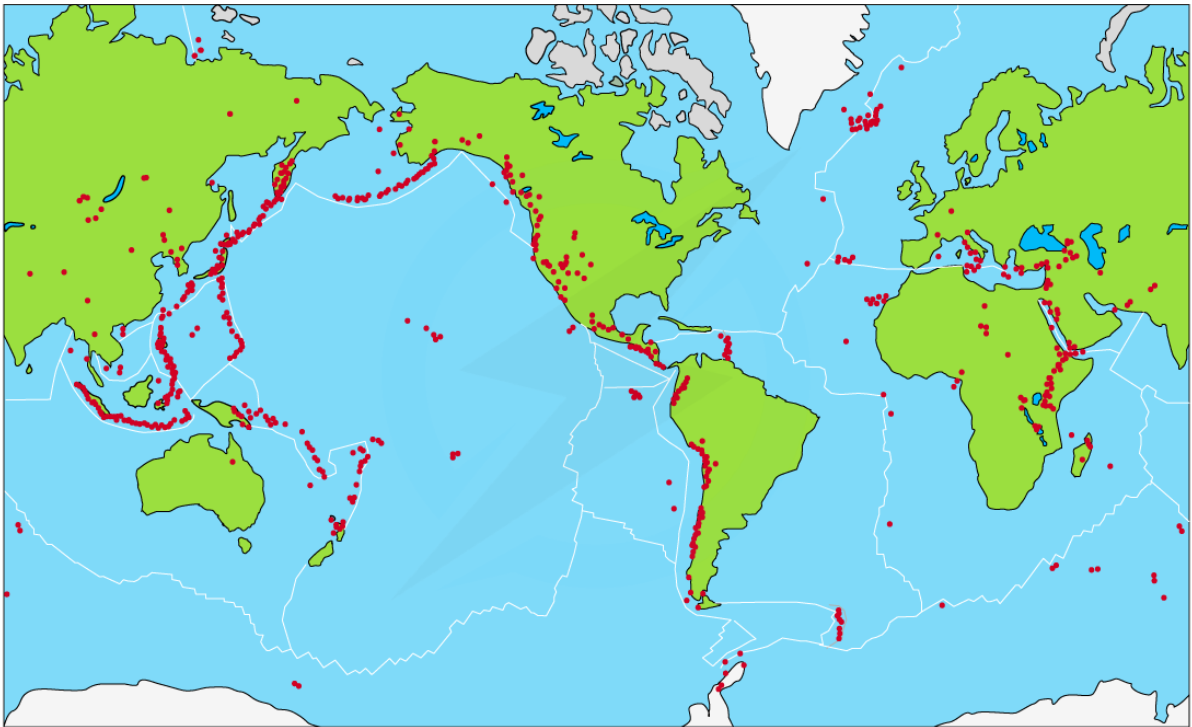
- **north-north-west (NNW)** is the correct answer [1]

Types of plate boundary

- Volcanic eruptions and earthquakes most commonly occur at or near plate boundaries

Earthquake distribution

- Earthquakes occur at all types of **plate boundaries**
 - Most (approximately 90%) occur around the rim of the Pacific Ocean
 - This zone is called the '**Ring of Fire**'

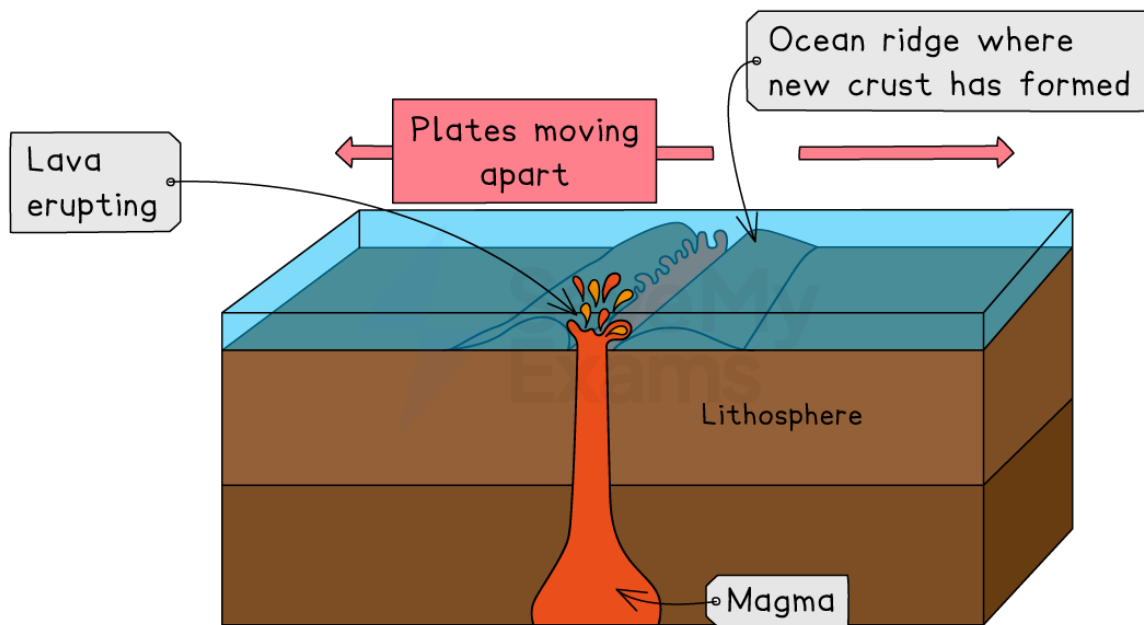


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Map showing global distribution of volcanic eruptions

Volcano distribution

- Most volcanoes occur at **divergent (constructive)** and **convergent (destructive)** plate boundaries
- Like earthquakes, the majority of active volcanoes (approximately 75%) are located around the **Pacific 'Ring of Fire'**
- Volcanoes also occur at **hotspots** away from plate boundaries and are plumes/columns of magma which escape through the Earth's crust

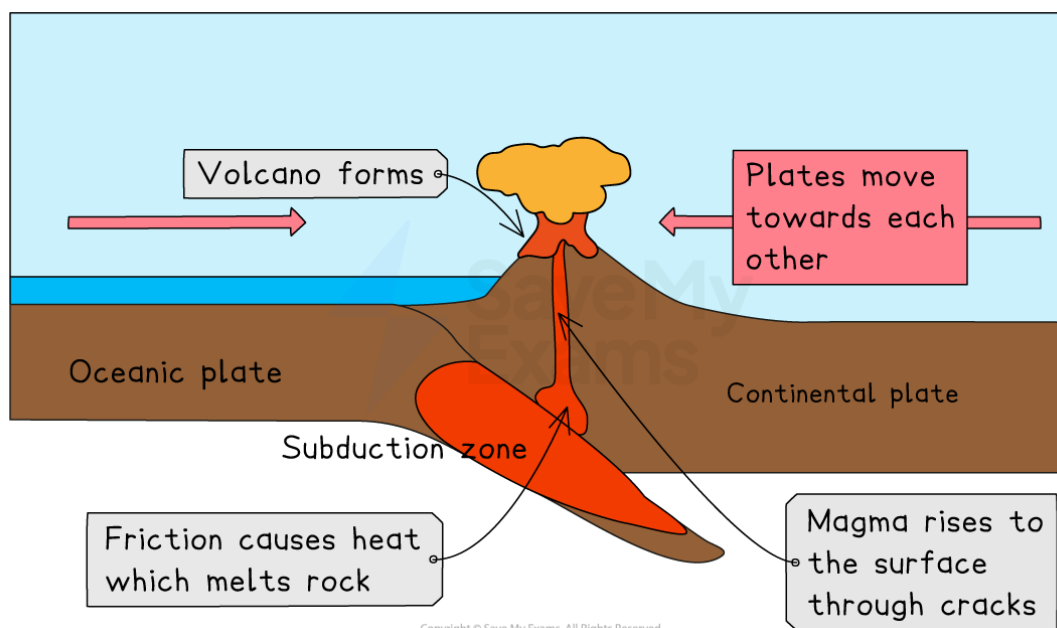


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Constructive (Divergent) plate boundary

Destructive (convergent) plate boundary

- At a destructive (convergent) plate boundary, the plates are moving together
 - The denser, heavier **oceanic plate subducts** under the lighter, **less dense continental plate**
 - This leads to friction and heat, which melts the crust and forms magma
 - Magma rises to the surface through cracks in the crust
 - It erupts on the surface as lava and forms a volcano
- The boundary between the **Nazca plate** and the **South American plate** is an example
- Both volcanic eruptions and earthquakes occur at this type of plate boundary

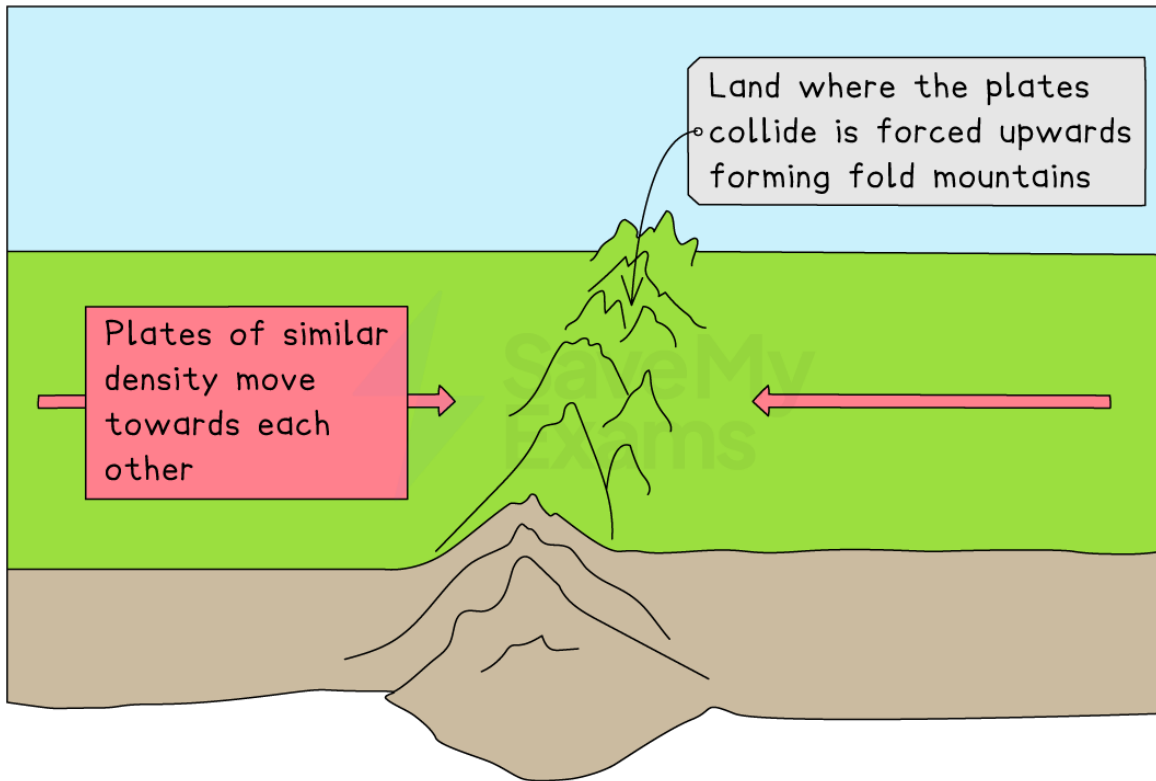


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Destructive (Convergent) Plate Boundary

Collision boundary

- At a collision boundary, two continental plates of **similar density** move towards each other
 - Neither is dense enough to subduct, so the land is pushed upwards
 - This process forms **fold mountains** such as the **Himalayas**
- Earthquakes are the main hazard at this type of plate boundary

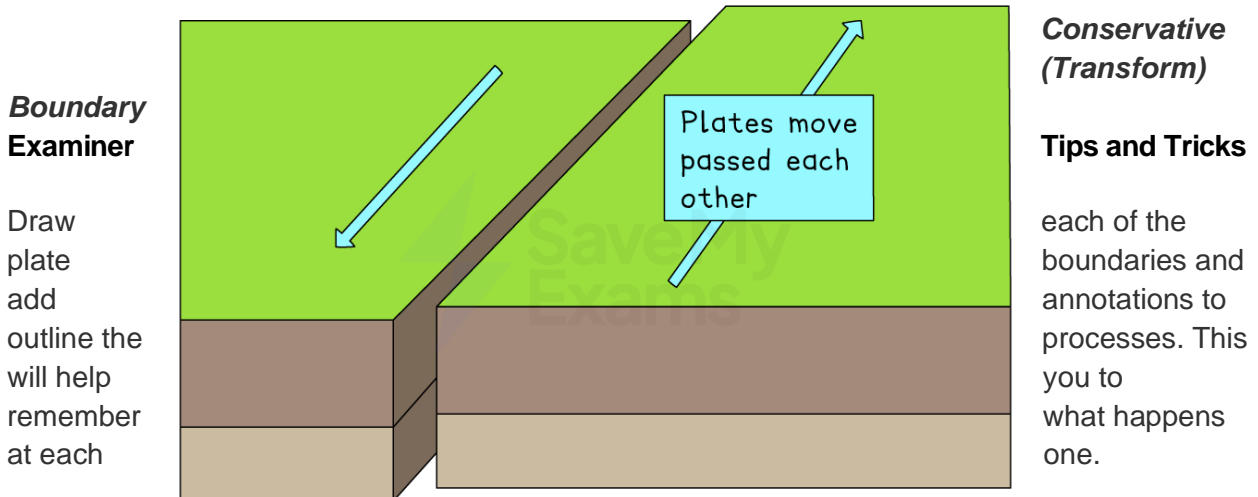


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Collision Boundary

Conservative (transform) boundary

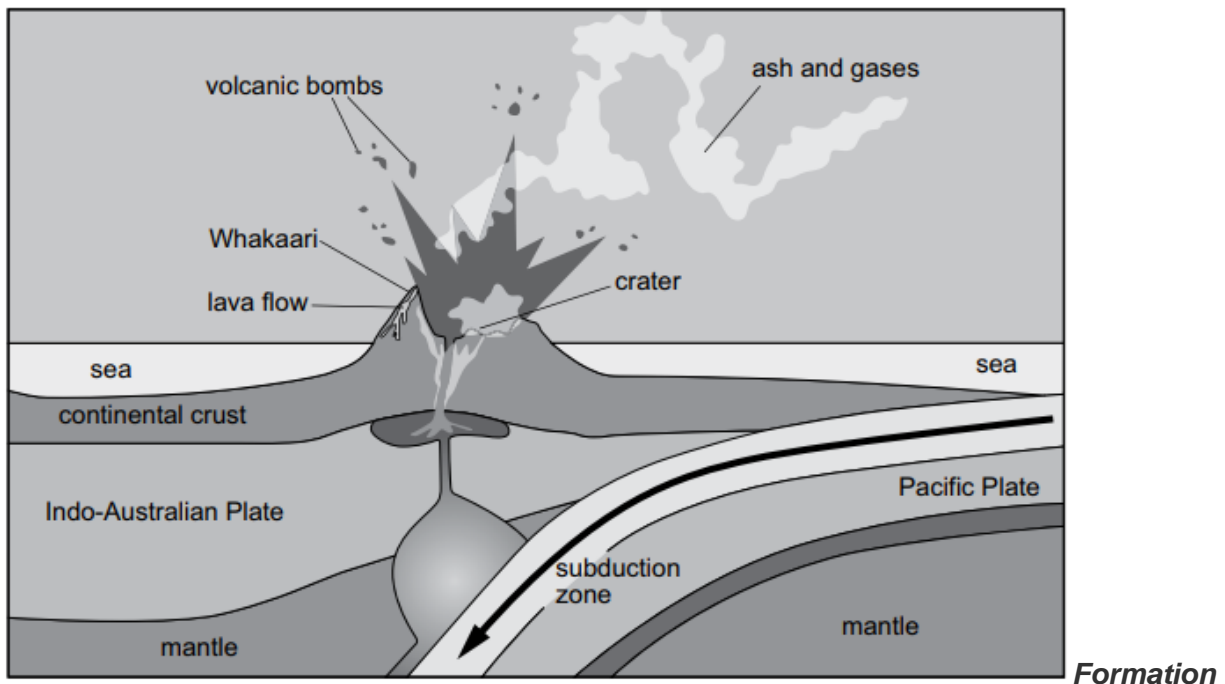
- At a conservative (transform) boundary, the plates move past each other in opposite directions or in the same direction at different speeds
- Earthquakes are the only hazard at this type of boundary



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Worked Example

Figure 1 shows information about a volcanic eruption



of Whakaari volcano

Use Figure 1 to explain why a volcanic eruption occurred on Whakaari.

[5]

To answer this question the process of volcano formation needs to be broken down into steps. Each step should outline a stage in the process. The wording used does not have to be the same as below, but it is essential that the answer covers each stage of the process.

Answer

Step 1 - The Indo-Australian plate and Pacific plate are moving towards each other. [1]

Step 2 - The Pacific plate is denser and so subducts under the Indo-Australian plate. [1]

Step 3 - This leads to the Pacific plate melting due to the friction and heat. [1]

Step 4 - The molten crust is magma which builds up causing an increase in pressure. [1]

Step 5 - The magma rises and erupts at the surface forming the volcano. [1]

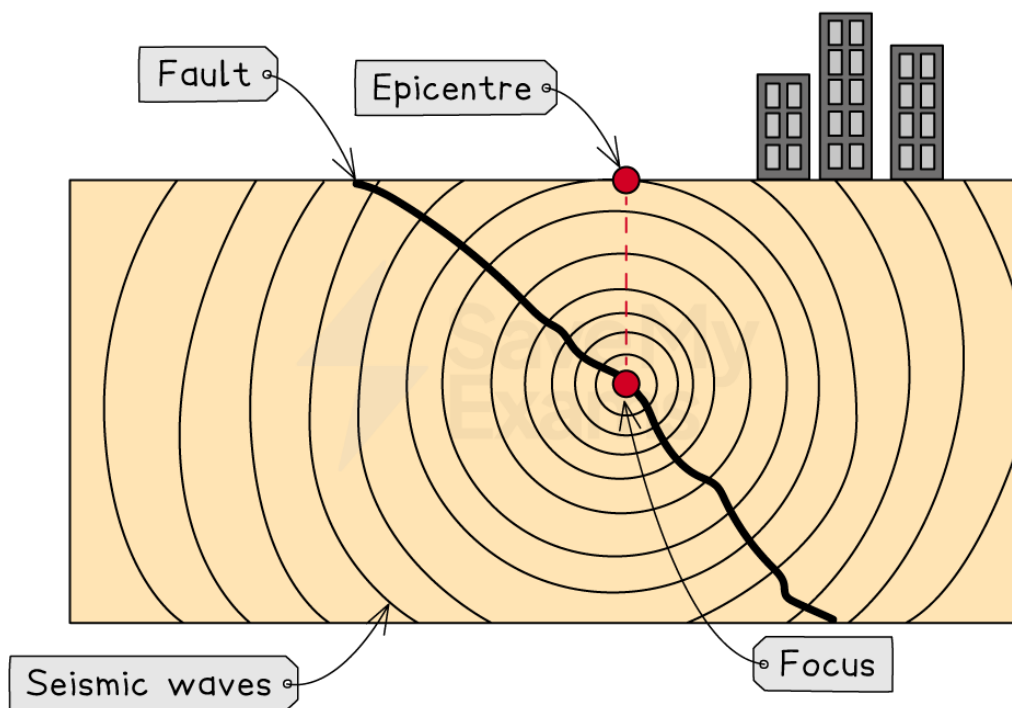
Earthquake characteristics

- An earthquake is the **sudden, violent shaking** of the ground
- Earthquakes are the result of pressure building when **tectonic plates** move
- The **epicentre** is the point on the Earth's surface directly above the focus
- The **focus** is the point at which the earthquake starts below the Earth's surface
- The **magnitude** (amount of energy released) by earthquakes is measured on the **Moment Magnitude Scale**, which replaced the **Richter scale**

- The damage caused by earthquakes is measured on the **Mercalli Scale**

Earthquake sequence

- The sequence of an earthquake is the same regardless of the boundary at which it happens:
 - As the tectonic plates move, they can get stuck
 - Pressure builds as the plates continue to try to move
 - Eventually, the plates jolt free and the pressure is released as energy
 - The point at which the earthquake starts is the **focus**
 - The **epicentre** is the point directly above the focus on the earth's surface
 - The energy passes through the Earth's crust as waves, which is the earthquake



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Features of an earthquake

- Earthquakes can also happen as a result of human activity, such as drilling into the crust or mining
- At a **divergent (constructive)** plate boundary, earthquakes tend to be **weaker** as the plates are moving apart
- Earthquakes tend to be **stronger** at **convergent (destructive), collision** and **conservative (transform)** plate boundaries

Types and classification of volcano

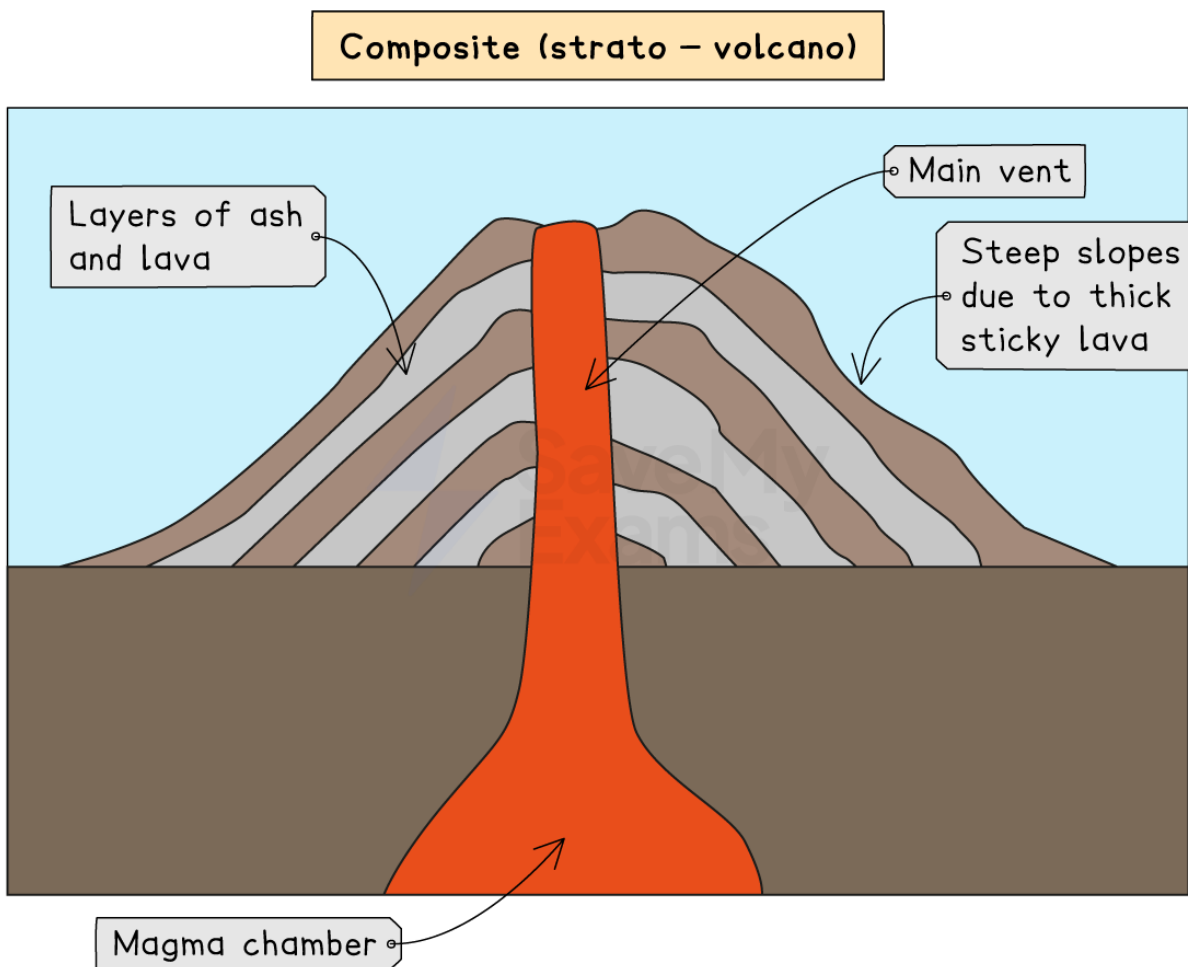
Types of volcano

- There are three main types of volcanoes:
 - **Composite (strato-volcano)**
 - **Shield volcano**
 - **Cinder volcano**

- The type of volcano which forms depends on the type of lava which erupts

Composite (strato-volcano)

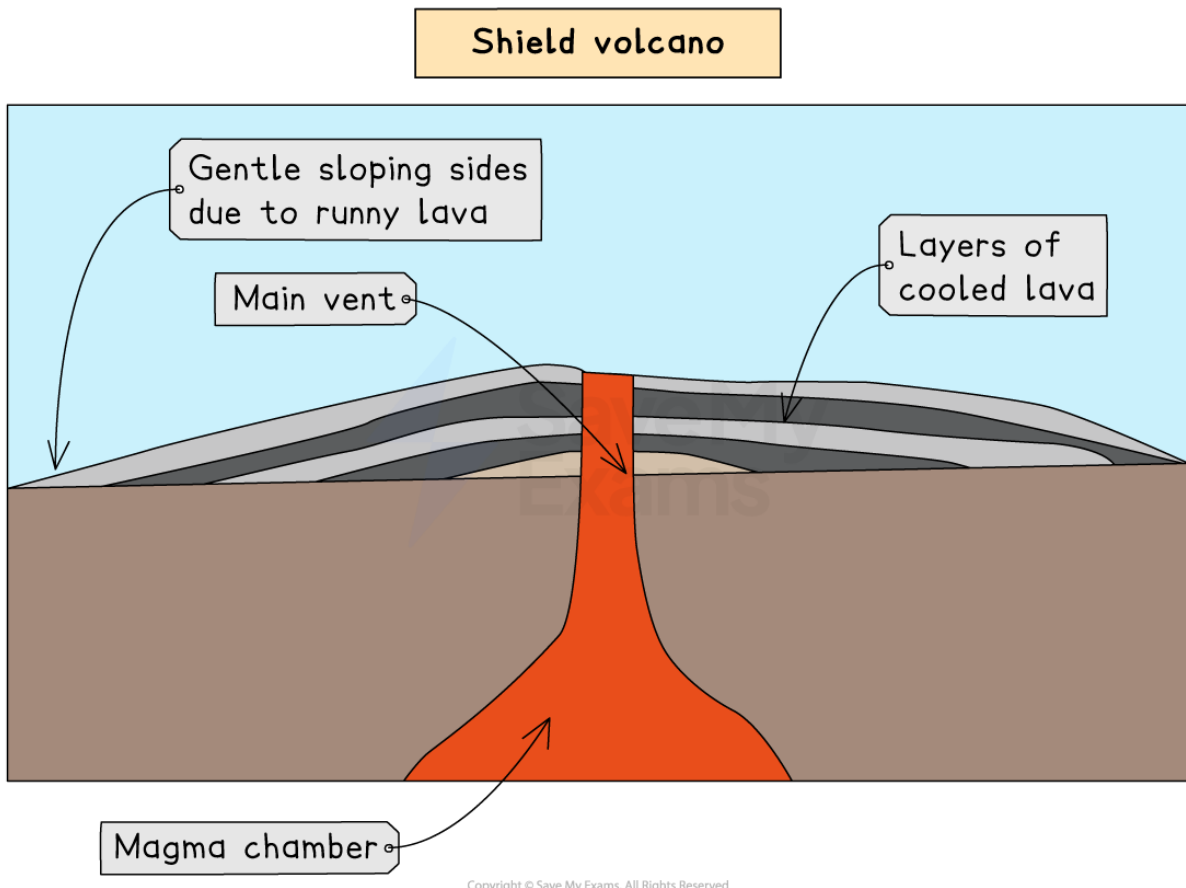
- Composite volcanoes, also known as strato-volcano, have:
 - steep-sides
 - sticky (**viscous**) lava
 - more explosive eruptions
 - alternating layers of ash and lava
- They tend to form on **convergent (destructive)** plate boundaries



Composite (strato) volcano

Shield volcanoes

- **Shield** volcanoes have:
 - gently sloping sides
 - runny/thin lava
 - less explosive—gentle eruptions
 - frequent eruptions
- They tend to form on **divergent (constructive)** plate boundaries or **hot spots**



Shield volcano

Cinder volcano

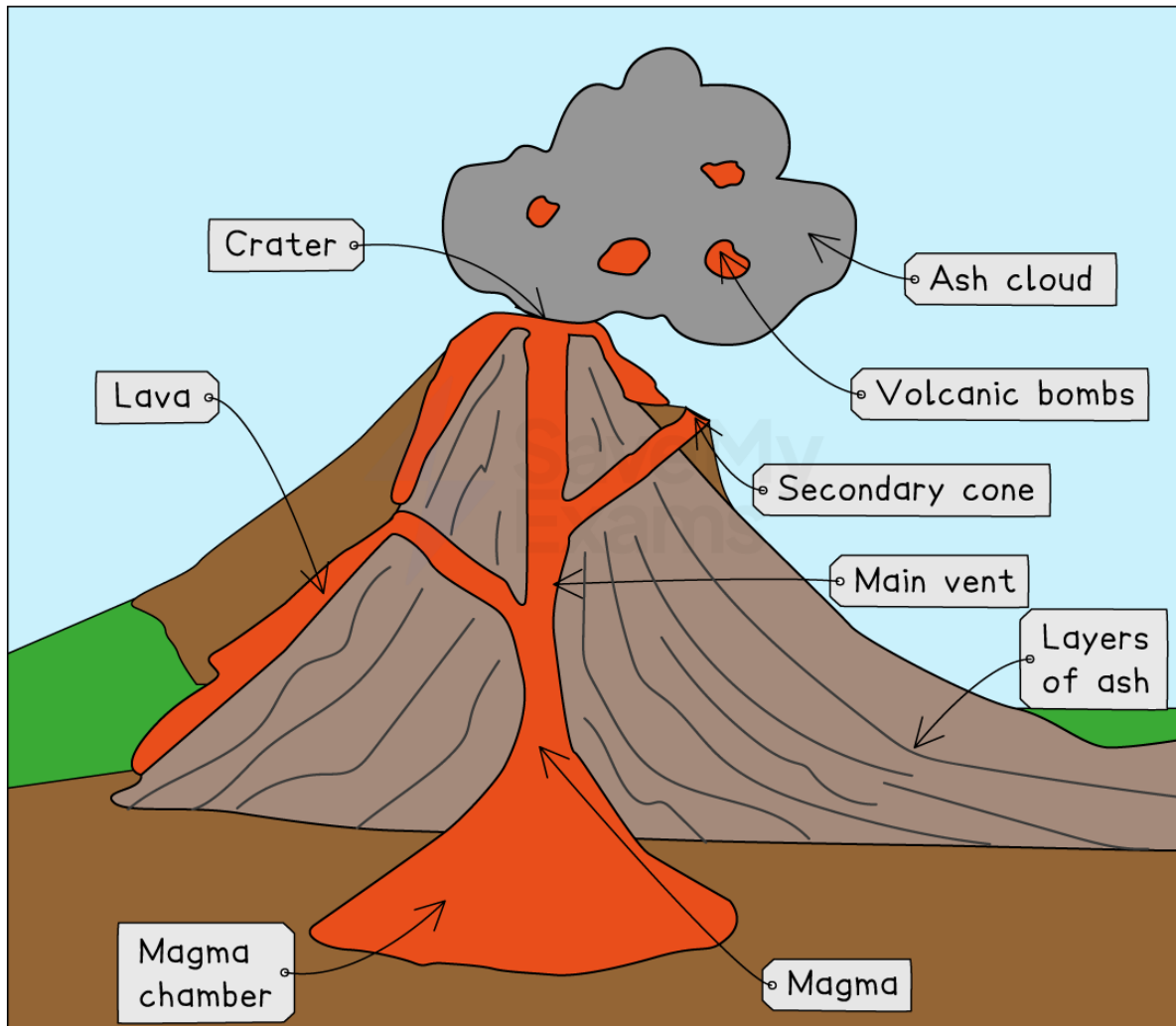
Classification of volcanoes

- Volcanoes may be active, dormant or extinct
 - **Active**
 - The volcano has recently erupted and is likely to erupt again
 - **Dormant**
 - Has not erupted for many years but there is evidence of a magma reservoir
 - **Extinct**
 - Shows no evidence of eruption in historic times and there is no evidence of a magma reservoir

Main features of volcanoes

- A volcano forms when **magma** erupts onto the Earth's surface as **lava** through a vent in the Earth's crust
 - When magma erupts onto the surface, it is called lava
- The magnitude of a volcanic eruption is measured on the **Volcanic Explosivity Index (VEI)**
 - The scale is open-ended but the highest in recorded human history was an 7 (**Tambora 1815**)

Features of a volcano



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Main features of a volcano

Volcanic hazards

- Volcanic eruptions may include a range of features
- Some of these hazards are localised or can have a global impact

Tephra

- Tephra refers to all the material that is ejected during an eruption, including ash and volcanic rocks
- **Ash** is **pulverised** solid lava which measures less than 2 mm in diameter
 - Ash is ejected into the atmosphere and can travel thousands of kilometres

- The ash fall can cover large areas, disrupting transportation, damaging infrastructure and affecting animal/human health
- **Volcanic rocks** are fragments of molten rock which are ejected from the volcano
 - These are between 60 mm and 5 m in diameter

Pyroclastic flow

- Pyroclastic flow is fast-moving, very hot clouds of poisonous gases mixed with ash
 - Average speeds of about 100 km/h but can move at up to 700 km/h
 - Can cover large areas and lead to total destruction

Lahars

- Lahars occur when volcanoes erupt and snow and ice on the peak melt
 - The meltwater combines with the ash
 - This creates fast-moving mudflows or lahars
 - The lahars can cover large areas, destroying infrastructure, buildings and crops

Lava flows

- When magma erupts to the surface, it is known as lava
 - The lava can be thin and runny or thick and slow-moving
 - This depends on the composition of the magma
 - Lava can cover extensive areas leading to the destruction of buildings and infrastructure

Earthquakes

- These are caused by magma rising to the surface through the vents in the volcano
 - This increases pressure on the Earth's crust, leading to earth tremors

Toxic gases

- Gases released during an eruption include carbon dioxide, sulphur dioxide and hydrogen sulphide
- The gases can travel long distances depending on the wind patterns
- They pose a health hazard to humans and animals

Why do people live in tectonic hazard areas?

- Billions of people live in areas which are vulnerable to tectonic hazards
- It is the interaction between the natural event, humans and the human environment that makes the event a hazard
- There are several reasons why people continue to live in these areas:
 - A lack of education and information means that people are not aware of the risks
 - People believe that the advantages of living in the area outweigh the disadvantages
 - Advantages include:
 - **fertile soil in volcanic areas**
 - **geothermal energy**

- **access to water**
- **trade**
- **jobs**
- **tourism**
- People are too poor to move away; they have little choice about where they live
- People were born in an area and have friends/family there so do not want to move
- If disasters do not happen frequently, people may believe that they are unlikely to be affected
- Historically settlements have developed in areas on the coast and near rivers which are vulnerable to hazards

Impacts of earthquakes and volcanic eruptions

- The impacts of earthquakes and volcanic eruptions can be categorised into:
 - **Primary hazards:** these are a direct result of the earthquake or eruption
 - **Secondary hazards:** these occur as a result of the primary effects
- Although the characteristics of earthquakes and volcanic eruptions are very different, many of the impacts are similar

Earthquakes and volcanic eruption impacts

Loss of life and injury

- This may be immediate through falling buildings in the case of earthquakes or **pyroclastic flow** or **ashfall** during a volcanic eruption
- Alternatively, it may be in the days and weeks after the event due to unclean water or disease
 - After the 2010 Haiti earthquake over 10,000 people died due to **cholera** which spread through contaminated water

Transport network

- Roads, bridges and railways may be damaged or destroyed
- This can impact the speed at which aid can get to affected areas

Loss of jobs and businesses

- This impacts the economy when factories and offices are destroyed or damaged

Power and water supply damaged

- This affects the supply of clean water, which can lead to disease
- Energy supplies can also be affected with gas pipes and electricity cables being damaged

Damage to the environment

- Loss of vegetation and habitats
- The effects on the climate of ash in the atmosphere
 - The ash reduces the amount of solar radiation

- This can reduce overall global average temperatures

Earthquake impacts

Collapse or destruction of buildings

- This leads to people being homeless for months and even years after the event
- The more buildings that are destroyed or damaged, the higher the costs of rebuilding

Volcanic eruption impacts

Closure of airports

- It is dangerous for jet planes to fly through ash clouds due to possible engine failure, so flights are cancelled

Loss of crops

- Ashfall from the eruption causes the death of crops
- This leads to food shortages and affects farmers' income

Examiner Tips and Tricks

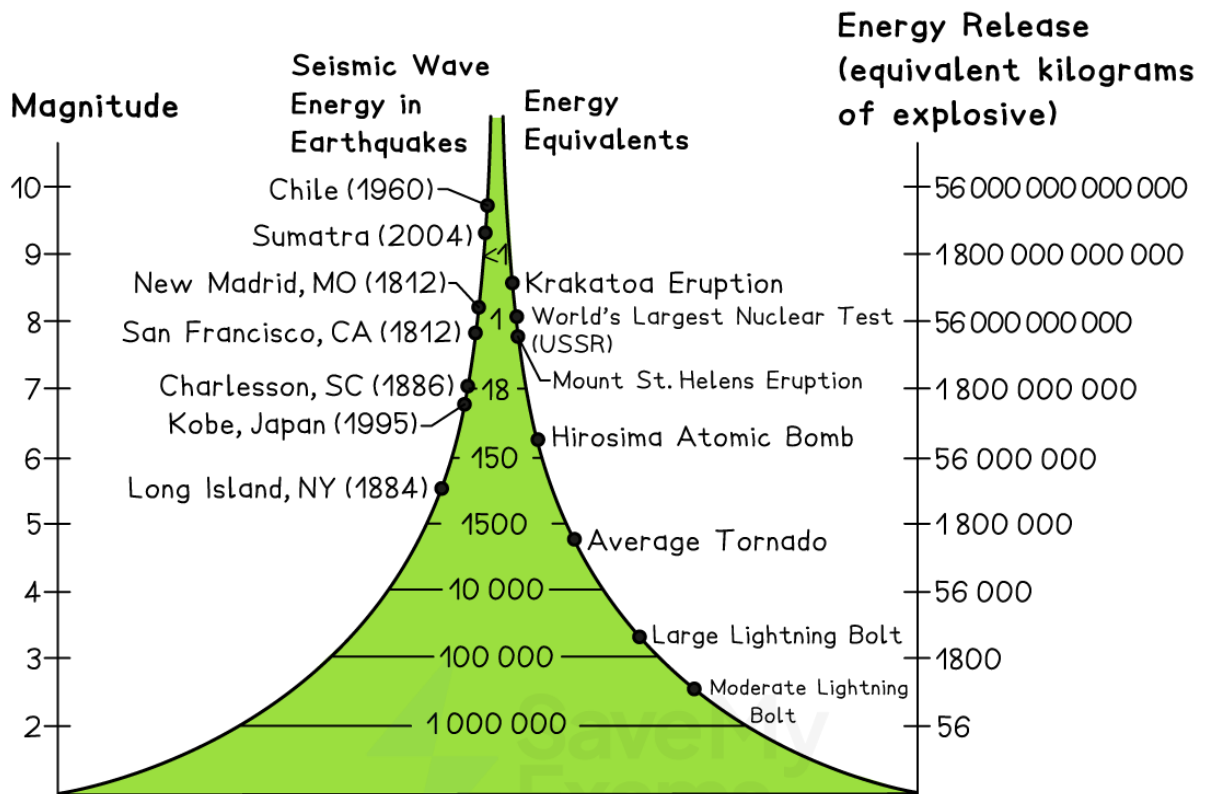
It is easy to confuse the primary and secondary effects/impacts of earthquakes and volcanic eruptions. Remember:

- **Primary effects** are those that occur directly from an earthquake or volcanic eruption. For example, buildings collapsing is a direct result of the earthquake ground shaking.
- **Secondary effects** are those things that result from the primary hazards. For example, fires caused by gas mains that have fractured.

Measuring earthquake and eruption magnitude

Richter scale and moment magnitude scale (MMS)

- **Magnitude** measures the energy released at the source (**focus**)
 - The magnitude can be measured on different scales, including the **Richter Scale** but the one which is reported on the news when an earthquake occurs is the **Moment Magnitude Scale (MMS)**
 - It is measured using **seismographs**
- The Richter scale and the MMS go from 1, which is not felt by humans to over 10
- Both are **logarithmic scales**, which means that a 6 on the scale is ten times an increase in amplitude from a 5
 - The energy release is 32 times greater

**Key:**

Magnitude:

9 = Largest recorded earthquakes, destruction over vast area, massive loss of life

8 = Great earthquake, severe economic impact, large loss of life

7 = Strong earthquake, damage (\$ billions), loss of life

6 = Moderate earthquake, property damage

5 = Light earthquake, some property damage

4 = Minor earthquake felt by humans

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Magnitude of earthquakes**Mercalli scale**

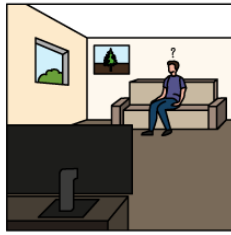
- The intensity of an earthquake is its impact on people, as well as on the built and natural environments
- The **Modified Mercalli Intensity Scale** is used to measure the intensity
- The scale goes from I to XII

I – Not felt



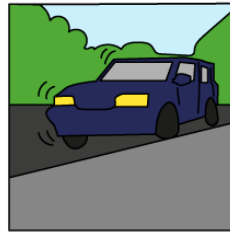
Not felt except by very few

II – Weak



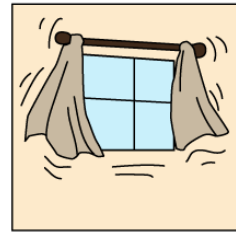
Felt only by a few persons at rest, especially on upper floors of buildings

III – Weak



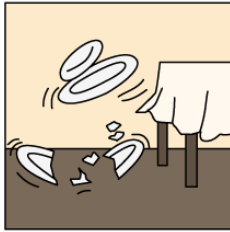
Felt indoors, though many people do not recognize it as an earthquake. Standing cars may rock slightly

IV – Light



Felt indoors by many outdoors by few. Dishes and windows are disturbed

V – Moderate



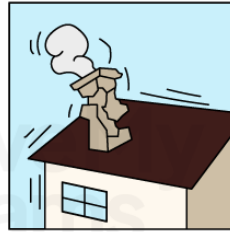
Felt by nearly everyone, many awakened if at night. Dishes and windows are broken

VI – Strong



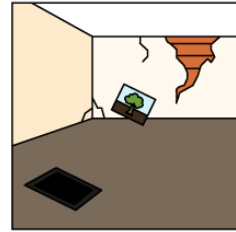
Felt by all; Many frightened. Some heavy furniture moved. Damage is slight

VII – Very strong



Slight to moderate damage in ordinary construction. Some chimneys broken

VIII – Severe



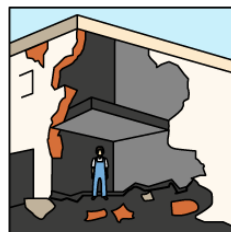
Considerable damage to ordinary construction chimneys, columns and walls may fall

IX – Violent



Damage is great in substantial buildings with partial collapse building shifted off foundations

X+ – Extreme

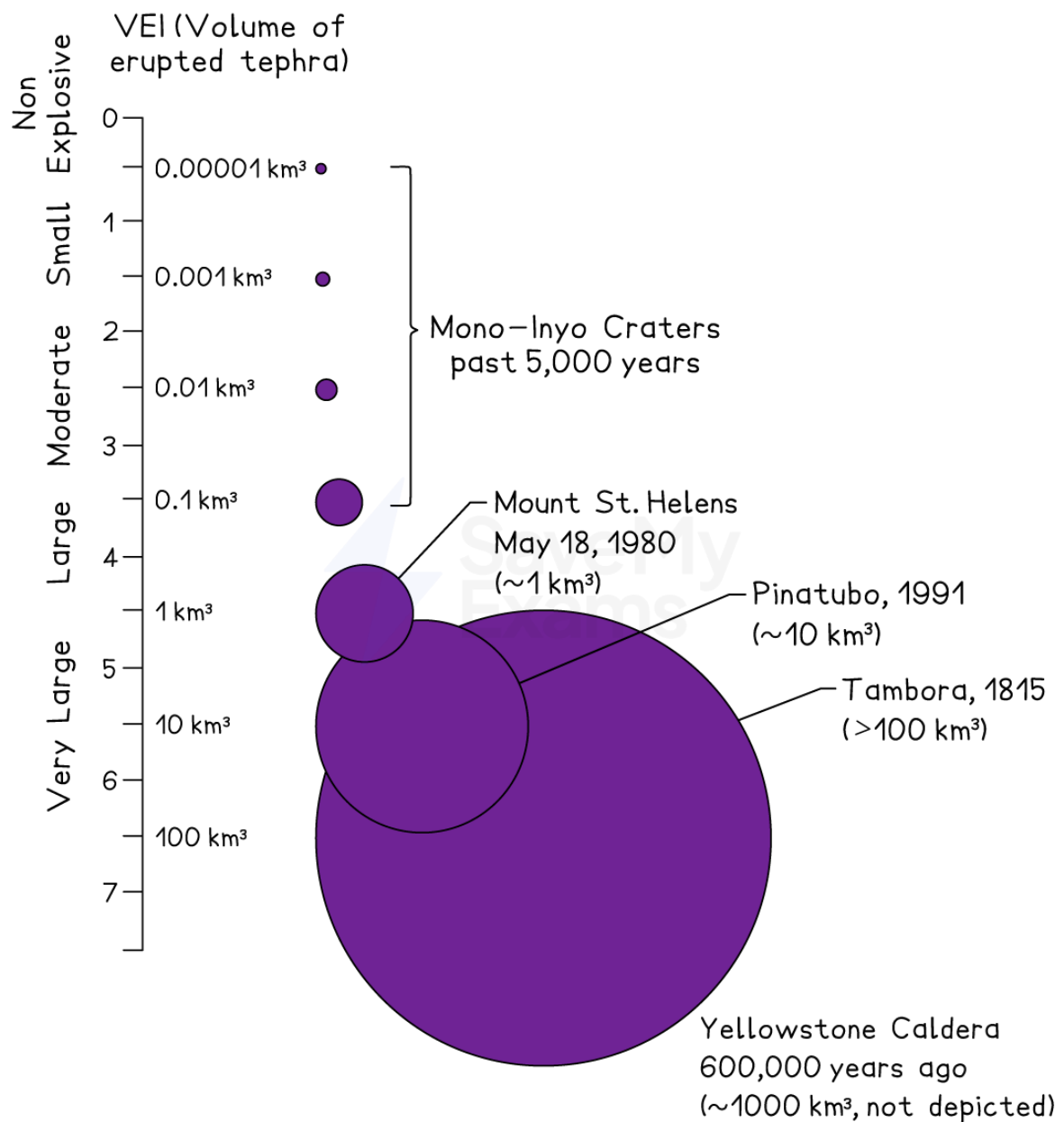


Some well-built wooden structures destroyed; Most masonry and structures are destroyed

Modified Mercalli Intensity Scale

Volcanic Explosivity Index (VEI)

- Some volcanic eruptions are gentle and **effusive**, while others are hugely explosive
 - This is dependent on the magma composition
- The **Volcanic Explosivity Index (VEI)** is used to measure the magnitude of an eruption
- This is a **logarithmic scale** from 0 to 8
- It cannot be measured on a scientific instrument so is calculated based on a series of measurements and observations
 - These include the:
 - height of material ejected into the atmosphere
 - volume of material
 - duration of the eruption



Volcanic Explosivity Index Worked Example

Name **two** scales which can be used to measure earthquakes.

[2]

Answer

- Any two of the three below would be awarded marks
 - Richter scale [1]
 - Moment magnitude scale [1]
 - Mercalli scale [1]

Managing the Impacts of Tectonic Hazards

Primary and secondary responses

- Types of response to tectonic hazard
 - The responses to any tectonic hazard can be divided into two groups
 - **Immediate** or **emergency**
 - **Long term**

Immediate or emergency responses

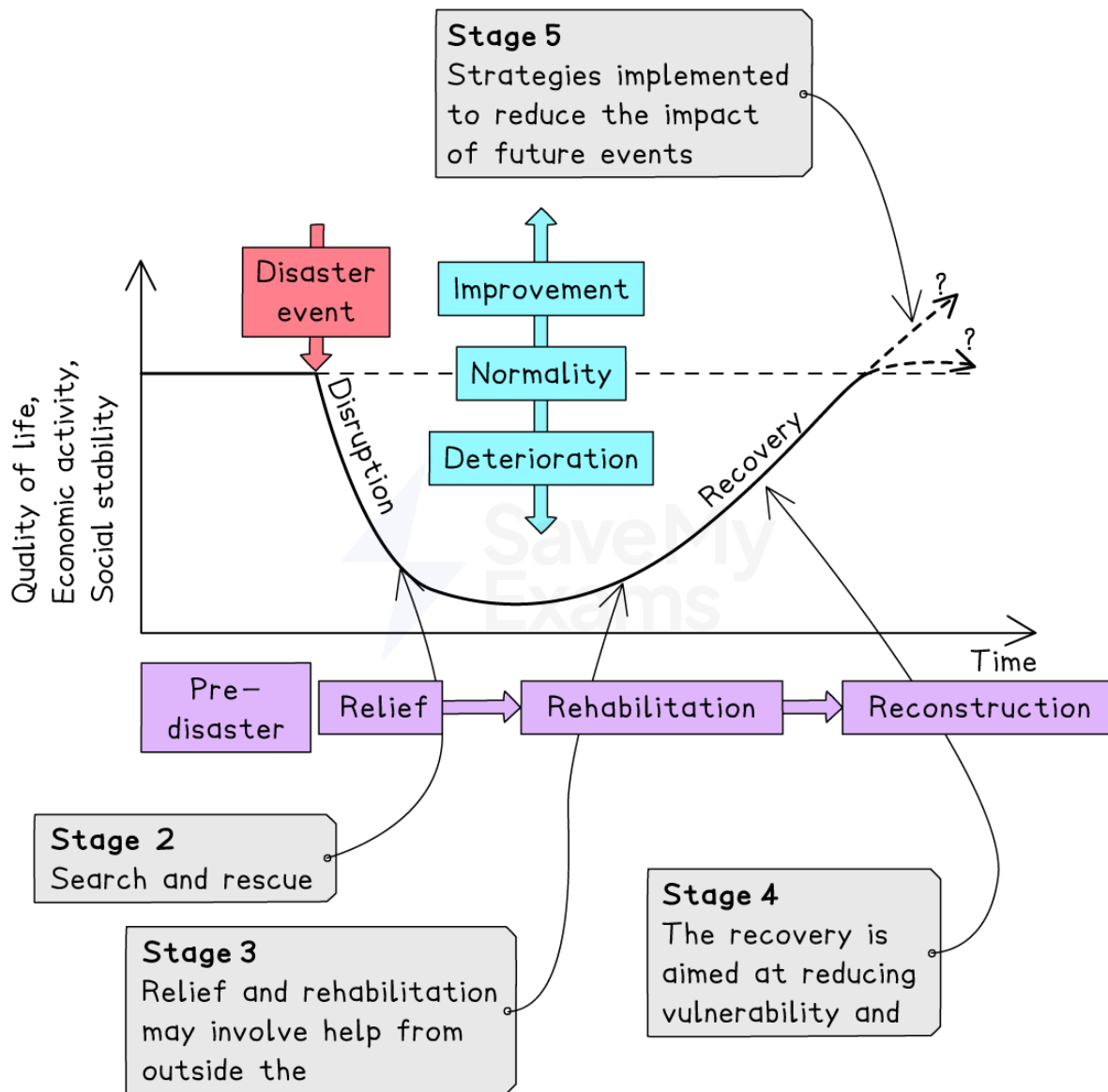
- The immediate or emergency response is the action taken immediately after a hazard event, such as an earthquake
 - Rescue teams search for survivors
 - Medical assistance for injured people
 - Shelter provided for those people made homeless
 - Food and water provided
 - Recovery and burial of bodies
 - Evacuation if needed
 - Clearing ash and debris
 - Reconnect gas, water and electricity supplies
- This response has to be coordinated, as many **NGOs** and government organisations, including the armed forces, may be involved

Long term responses

- The long-term responses happen over the months and years after the hazard
 - Rebuilding homes and other buildings
 - Improve building regulations
 - Improve drills, evacuation plans and warning systems
 - Money given to farmers for seed and new livestock
 - Data used to inform future hazard planning
 - Government planning improved
 - Transport routes rebuilt

Park's hazard response curve

- The stages of hazard response can be seen in **Park's hazard response curve**



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Park's hazard response curve **Examiner Tips and Tricks**

Remember that although there is an immediate or emergency response in all countries where there is a natural hazard event, the response will be slower and often less well-organised in low-income countries (LICs). This delay often increases deaths and recovery time.

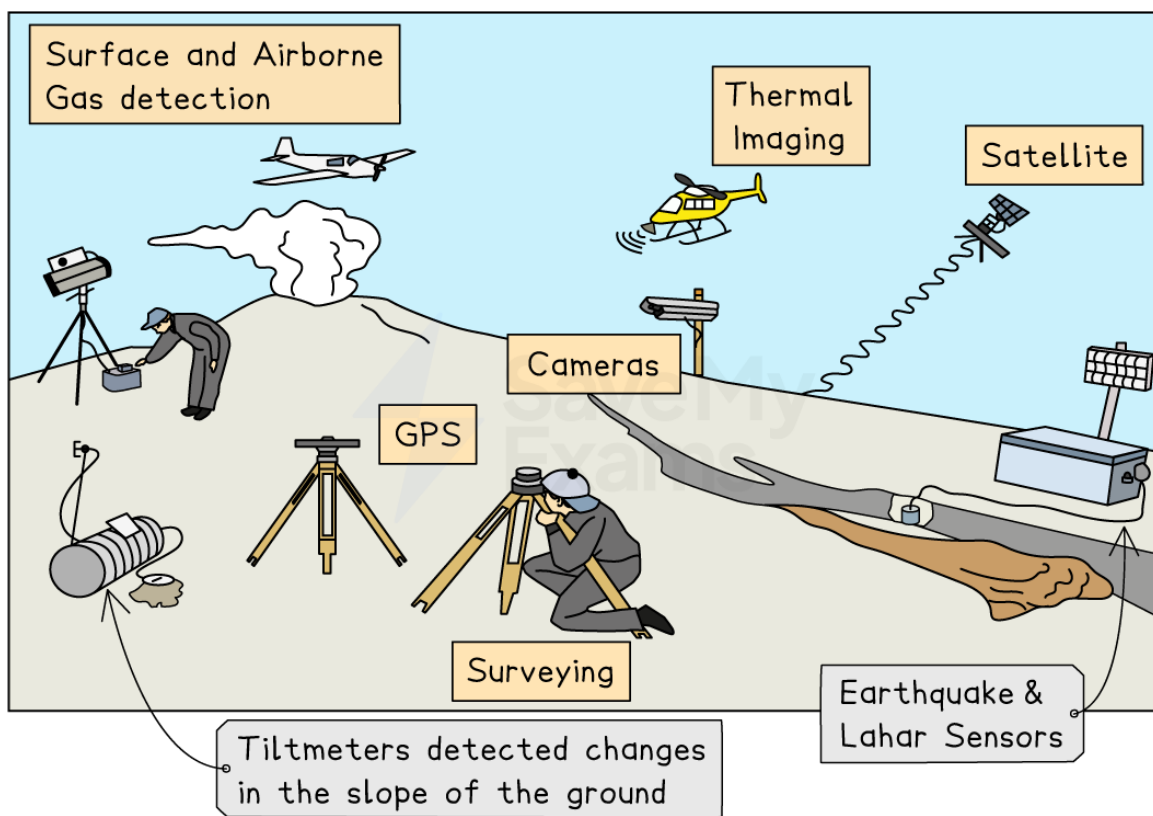
Strategies to manage the impacts of tectonic hazards

- To reduce the risks from tectonic hazards, the five key management strategies and techniques are:
 - o monitoring
 - o prediction
 - o protection

- planning
- technology

Monitoring

- Active **volcanoes** are monitored using a range of equipment
 - **Seismometers** record earth movements and can detect the slightest tremor
 - **Lasers** and **tiltmeters** are used to detect ground deformation; changes in land shape can be a sign of rising magma
 - **Remote sensing** is where satellites are used to detect heat increases within the volcano, another sign of rising magma
 - **Gas sensors** detect increases in gases such as sulphur and radon which increase before an eruption



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Monitoring volcanic activity

- **Earthquakes**
 - **Seismometers** record earth movements and can be used to detect foreshocks
 - **Gas sensors** detect increases in radon gas, which some scientists believe is released before an earthquake
 - **Groundwater level** changes have been recorded before earthquakes

Prediction

- **Volcanoes:**
 - Monitoring of volcanoes now allows more accurate predictions to be made of when eruptions will happen
 - This allows for **evacuation** and **exclusion areas** to be put in place

- Accurate timings for eruptions are not possible
- **Earthquakes:**
 - **Impossible** to predict the date, time or location because it is a very sudden release of stress that has built up over long periods

Protection

- **Volcanoes:**
 - Evacuation and exclusion zones move people out of areas at risk
 - Buildings cannot be protected against lava or pyroclastic flow
 - Strengthening of roofs to support the weight of falling ash
 - Airports can be closed to ensure that planes are not flying through ash clouds
 - In June 2025, Bali's international airport was closed due to the eruption of Mount Lewotobi Laki-Laki
- **Earthquakes:**
 - **Building regulations** and codes require new buildings to include earthquake-resistant features, including:
 - shutters on windows prevent falling glass
 - **cross-bracing** or diagonal bracing of steel frames
 - flexible building materials
 - foundations sank deep into the bedrock
 - frames which sway with the earthquake tremors
 - rubber **shock absorbers** to reduce tremors moving through the building
 - reinforce walls/pillars with concrete
 - shatterproof/reinforced glass
 - fire-resistant materials
 - automatic cut-off for gas/electricity
 - In many countries, earthquake drills are regularly carried out
 - The drills help people prepare for what to do in an earthquake to protect themselves
 - **Educating** people about how to prepare homes means they are less likely to be injured by falling objects and furniture
 - Sea walls to protect against tsunami

Planning

- **Volcanoes and earthquakes:**
 - **Hazard mapping** and **risk assessment** are used to identify areas which are at greater risk – this means people can be moved or buildings restricted in those areas, particularly essential buildings (hospitals) and transport
 - Evacuation plans
 - Education about what actions to take, including drills
 - Stockpile of emergency supplies
 - Training of emergency services

Examiner Tips and Tricks

High-income countries (HICs) often have less to change in their long-term planning because their preparation for the hazard is better. However, the costs of any disaster are often greater than in a developing country. This is due to the higher cost of the damaged buildings, roads, and infrastructure.

Technology

- **Hazard mapping** and **geographical information systems (GIS)** can be used to:
 - Map the areas where earthquakes are most likely to occur
 - Enable planning of where important services and infrastructure should be located
 - **land use zoning**
 - Identify the **correlation** between risk and vulnerability
- **Remote sensing** of the Earth's surface by satellites such as Sentinel 1 provides data about changes in ground movement