SL IB Geography

Your notes

7.2 Geophysical Hazard Risks

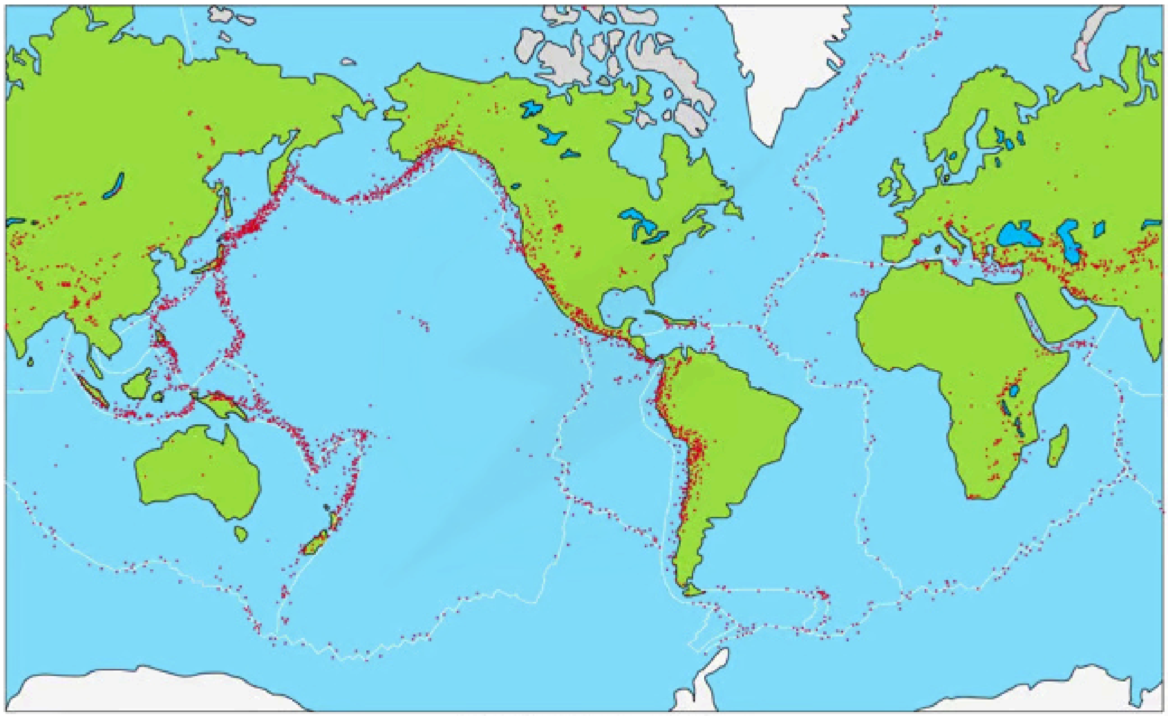
Contents

7.2.1 Distribution of Geophysical Hazards

Your notes

Distribution of Earthquakes

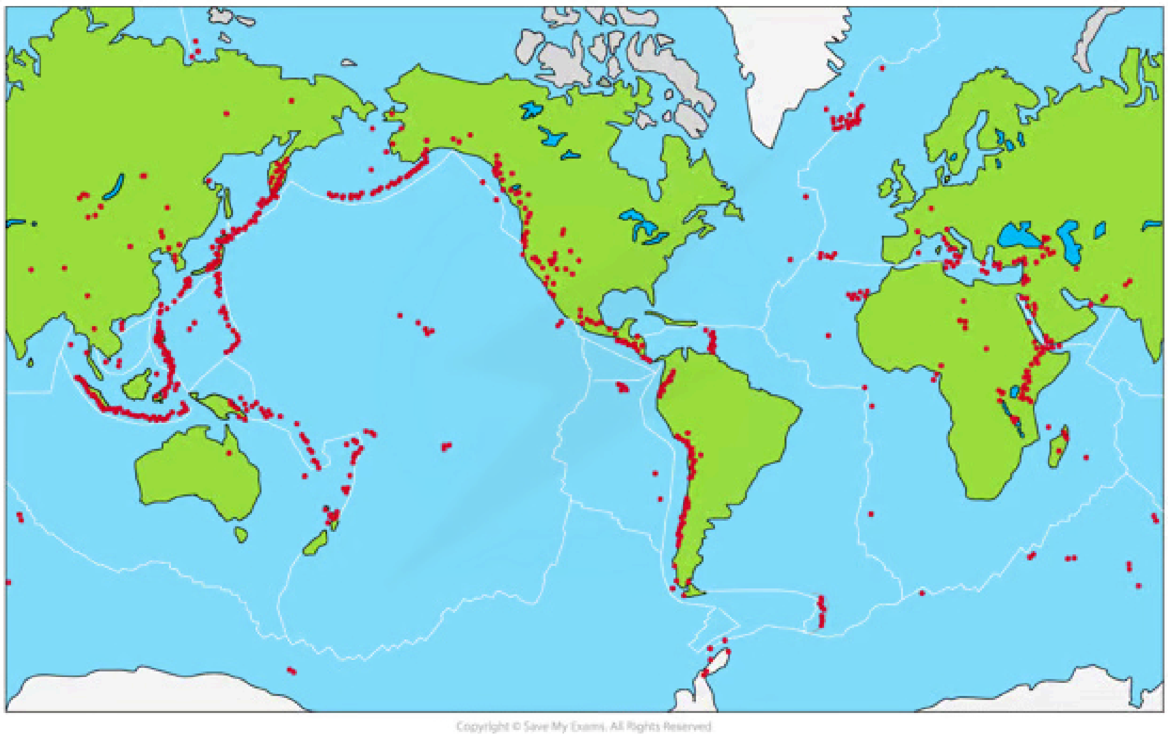
- Earthquakes occur at all types of plate boundaries
  - Most occur along the Pacific "**Ring of Fire**" (approximately 90%)



Distribution of earthquakes

Distribution of Volcanoes

- Most volcanoes occur at constructive and destructive plate boundaries
- The majority of **active volcanoes** (approximately 75%) are located around the rim of the Pacific Ocean called the "**Ring of Fire**"
- **Hotspots** occur away from plate boundaries and are plumes/columns of magma that escape through the Earth's crust



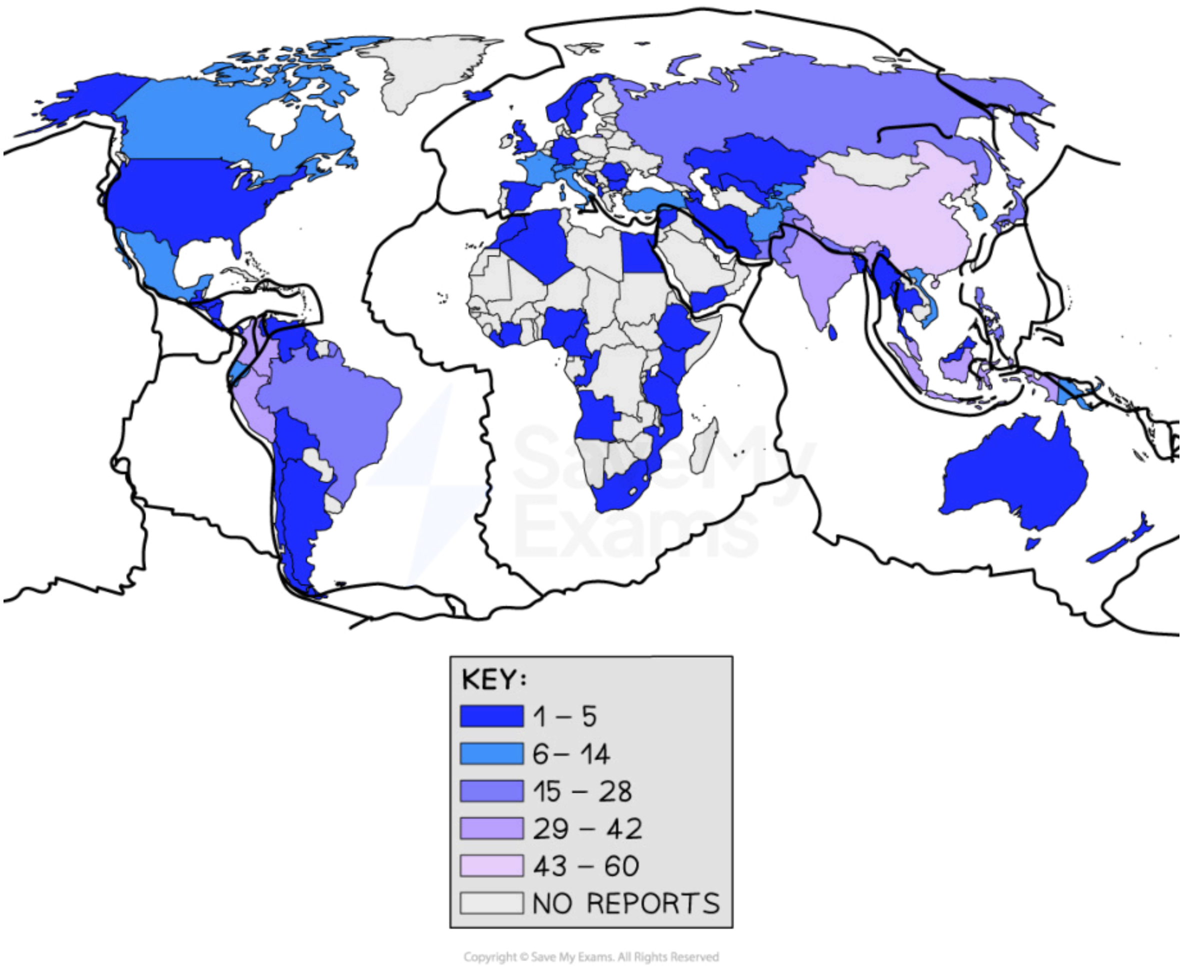
Distribution of volcanic eruptions

Your notes

Distribution of Mass Movement

Your notes

- The majority of mass movements occur in three main areas:
  - Highland areas
  - Along plate boundaries
  - Coastal areas



Distribution of mass movement

Exam Tip

In the exam, you may be asked to outline factors which affect the distribution of geophysical hazards. You must be able to explain why geophysical hazards are often associated with plate boundaries but also identify other factors which may affect distribution. For example, volcanoes can occur at hot spots as a result of magma plumes.

Your notes

7.2.2 Hazard Magnitude & Frequency

Your notes

Risk Management & Hazard Magnitude

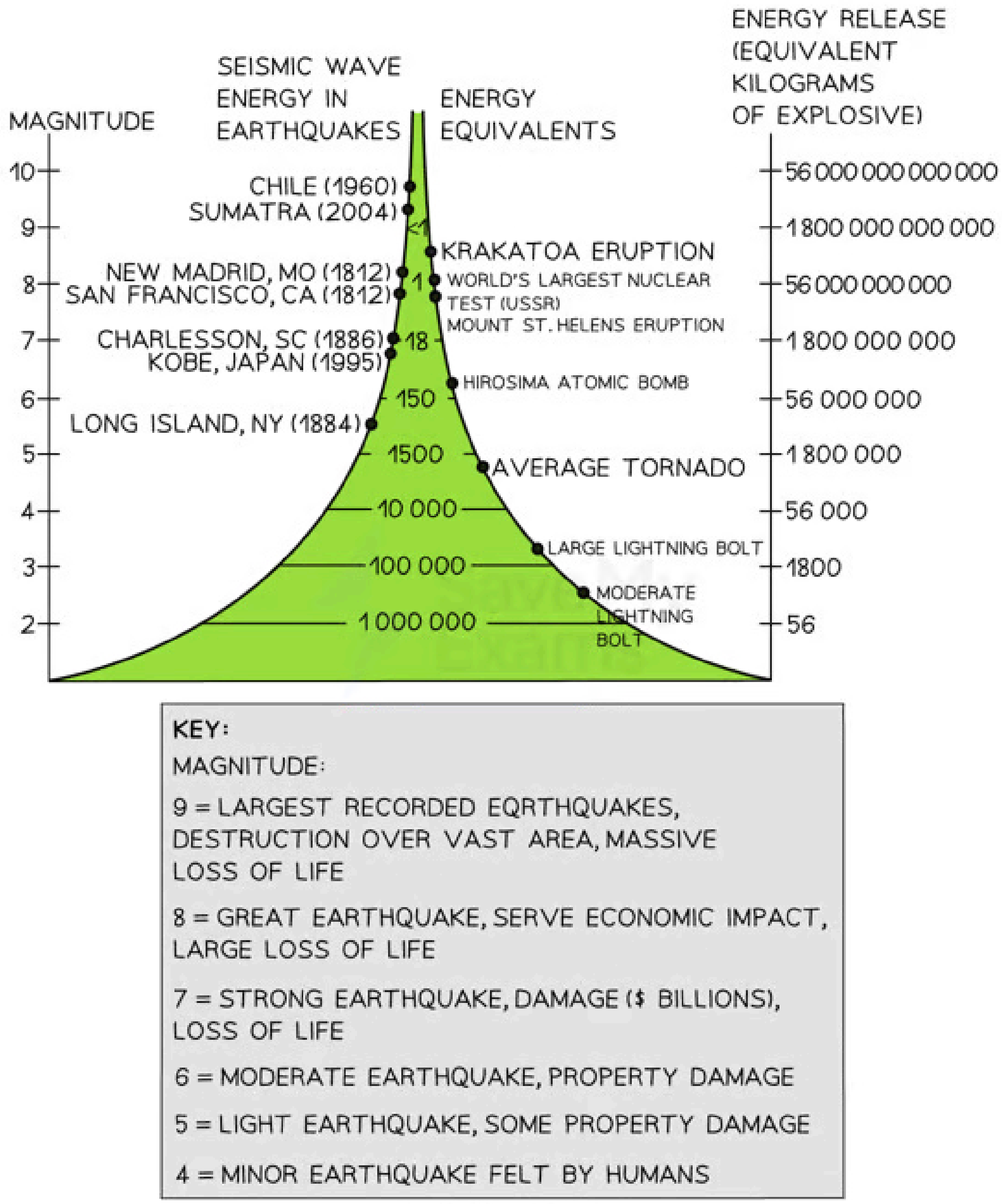
Magnitude and risk management

- The magnitude is the strength of a hazard and often refers to the amount of energy released
- Most hazards are measured using a scale:
  - **Earthquakes** – Moment Magnitude Scale, Mercalli Scale and Richter Scale
  - **Volcanoes** – Volcanic Explosivity Scale
- Higher magnitude events usually result in greater impact

Earthquake magnitude

- **Magnitude** is the most common way to measure an earthquake
- This is a measure of the energy released at the source **(focus)**:
  - The magnitude can be measured on different scales
  - The most well-known scale is the **Richter Scale**
  - The one that is increasingly used now and is reported on the news when an earthquake occurs is the **Moment Magnitude Scale (MMS)**
- The MMS goes from 1, which is not felt by humans, to 10
- The MMS is a logarithmic scale, which means that a 6 on the scale is a ten-times increase in amplitude from a 5:
  - The energy release is 32 times greater

Diagram to show the magnitude of earthquakes



Magnitude of earthquakes

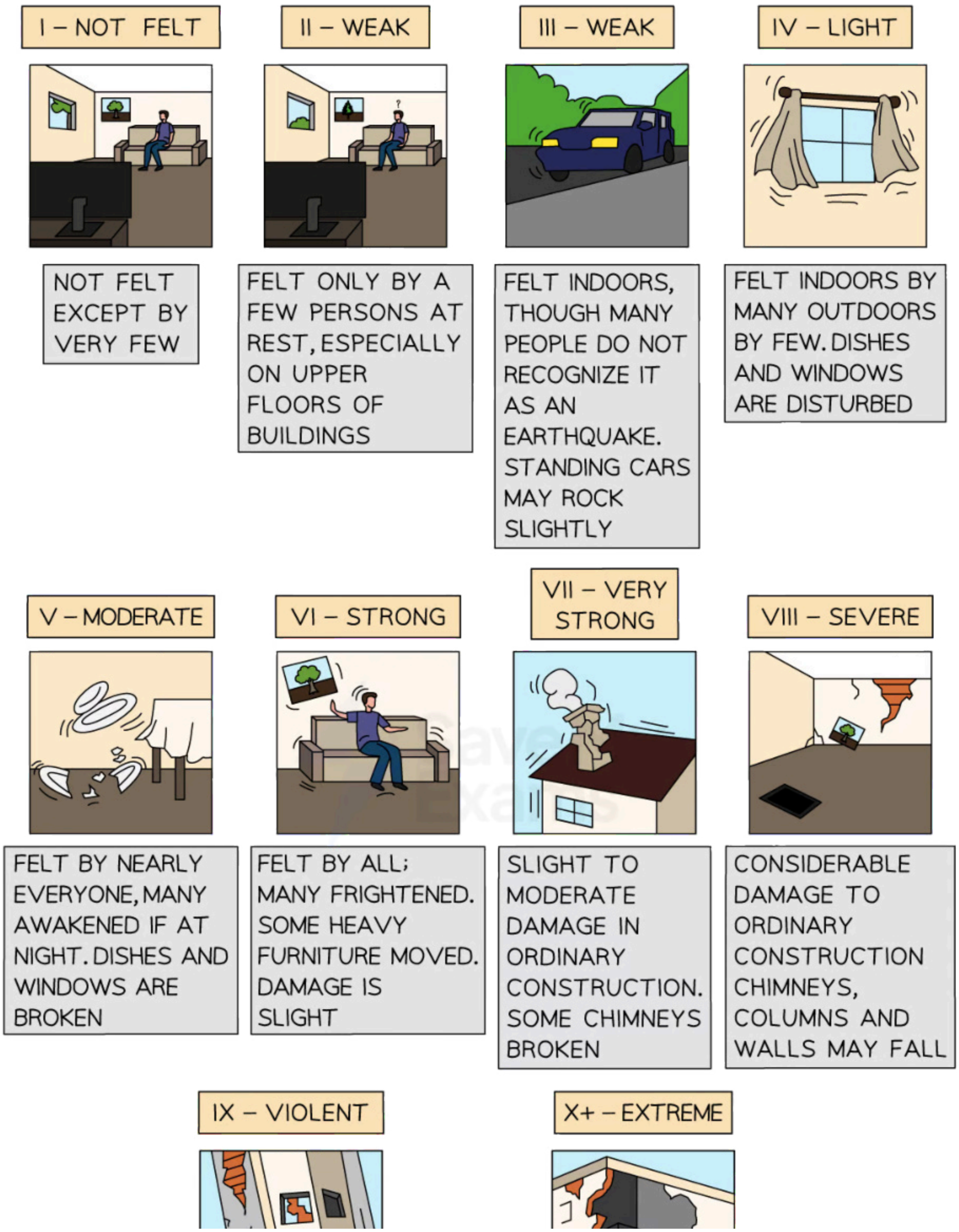
Earthquake intensity

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

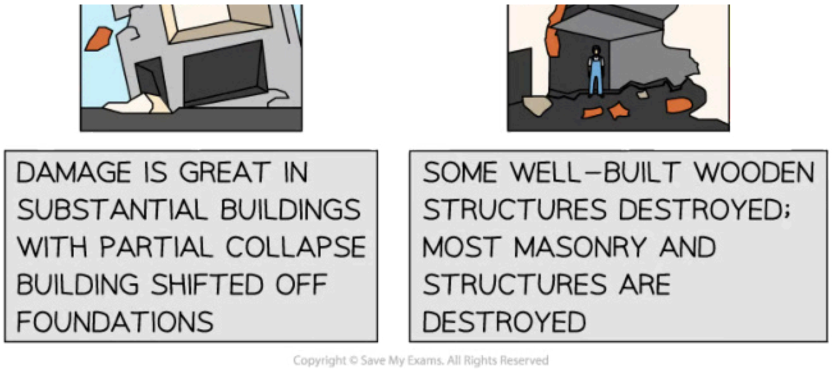
The Modified Mercalli Intensity Scale

Your notes

Your notes


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
X+ – EXTREME

Your notes



Modified Mercalli Intensity Scale

Exam Tip

Remember not to confuse magnitude and intensity.

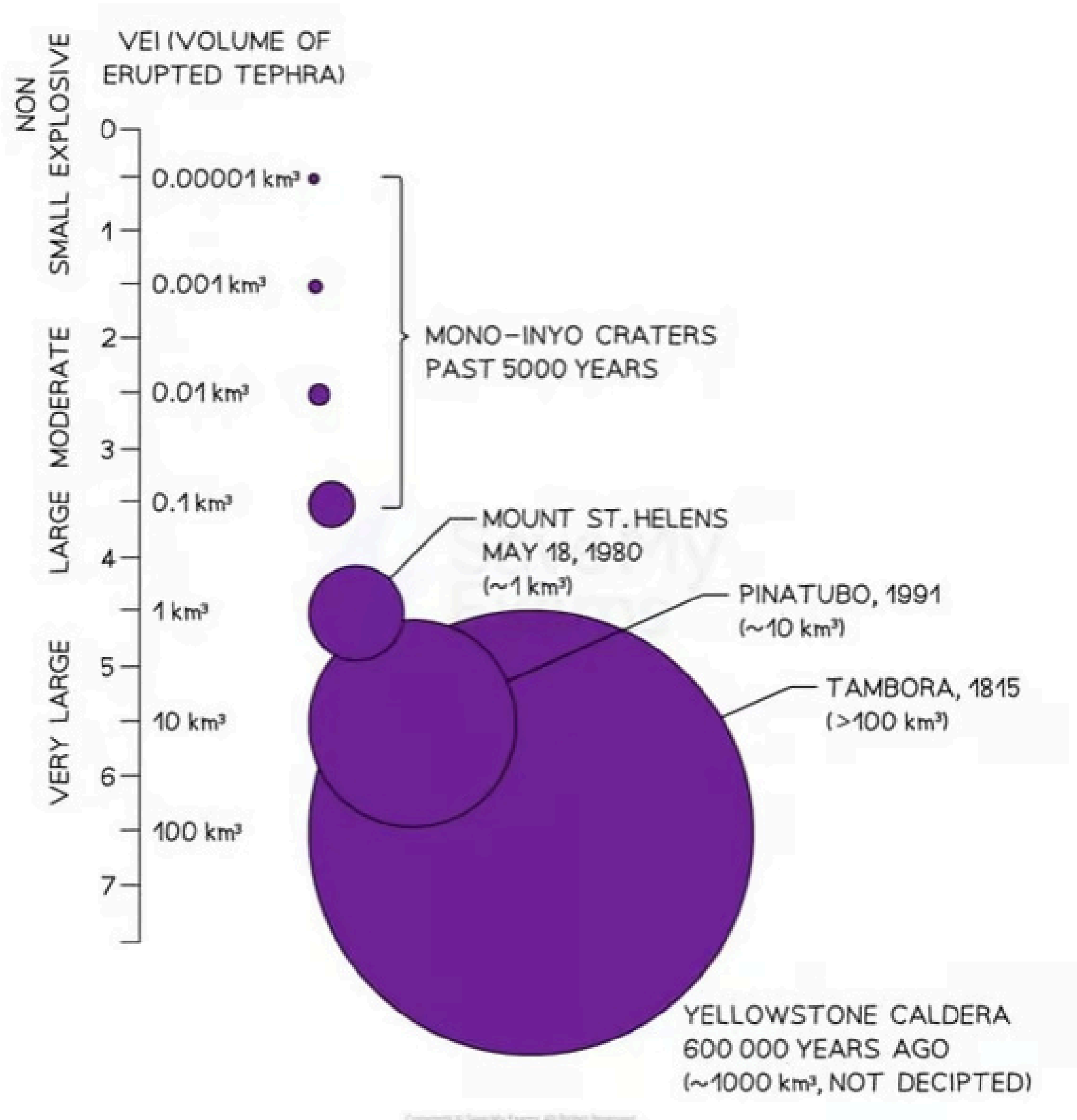
Magnitude is the amount of energy released, whereas intensity is the severity of ground shaking at a particular place based on the effects on humans, buildings and the environment.

Measuring volcanic eruptions

- Every eruption is unique; some are gentle, others are hugely explosive
- The **Volcanic Explosivity Index (VEI)** is used to measure the size of an eruption
- This can not be measured on a scientific instrument so is calculated based on a series of measurements and observations:
  - These include:
    - Height of material ejected into the atmosphere
    - Volume of material
    - Duration of the eruption
- This is a logarithmic scale from 0–8

Diagram to illustrate the Volcanic Explosivity Index (VEI)

Your notes



Volcanic Explosivity Index

Risk Management & Hazard Frequency/Recurrence

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- The **recurrence interval** of a hazard event is measured in years
- It is the expected occurrence of an event of a particular size
- Large magnitude events have a longer recurrence interval than smaller magnitude events
- This means there are many small-scale earthquakes, eruptions and landslides and few large-scale ones

Recurrence of Earthquakes of Different Magnitudes

Magnitude	Average number annually
8+	1
7 – 7.9	15
6 – 6.9	134
5 – 5.9	1319
4 – 4.9	13,000
3 – 3.9	130,000
2 – 2.9	1,300,000

Based on data from USGS

Recurrence of Volcanic Eruptions of Different Magnitudes

Magnitude	Occurrences In last 10,000 years
8	0
7	7
6	51
5	166
4	421
3	868
2	3,477
1	Many
0	Many

7.2.3 Geophysical Hazard Risk

Your notes

Factors Affecting Hazard Risk

Vulnerability

- **Vulnerability** is how **susceptible** an area or population is to damage from a particular hazard event
- This can be affected by a number of factors, including:
  - **Economic factors** – level of development and technology
  - **Social factors** – education and gender
  - **Demographic factors** – population density and structure
  - **Political factors** – governance

Hazard risk equation

- The greater the vulnerability and the lower the capacity to cope, the greater the risk to the population, environment and economy
- The greater the hazard magnitude and the lower the capacity to cope, the greater the risk of disaster

$$\text{Risk} = \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity to cope}}$$

- The hazard risk equation allows a judgement to be made regarding an area's resilience
- The equation can help explain why hazards such as the Nepal (2015) earthquake and the New Zealand (2016) earthquake can be similar in magnitude but have such different impacts
  - Almost 9,000 people died in Nepal whereas only two people died in New Zealand

Economic factors affecting vulnerability

- Levels of development and wealth impact upon:
  - **Building quality and design** – in Nepal, 2015, many buildings collapsed due to poor construction, materials and design
  - **Access to technology** – lack of access to TVs, radios, phones and computers means that people can't keep up-to-date with warnings and information about actions to take, such as evacuation
  - **Insurance** – people in poorer countries are less likely to have insurance to cover the costs of rebuilding

Social factors affecting vulnerability

- **Education**
  - Level of education often affects people's income levels and their ability to afford good-quality housing

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    - Public education regarding the hazard risks and actions to take reduces the vulnerability of the population
- **Gender** – women are among the most vulnerable groups in hazard events
    - Gender inequalities in society affect the way in which women are impacted by and recover from hazard events
    - Women are often caregivers and have responsibilities for children and the elderly; this impacts their ability to react to the hazard. During the 2004 Indian Ocean tsunami women were more likely to suffer injuries or be killed than men

Demographic factors affecting vulnerability

- **Population density** – areas with high population density are more vulnerable to hazard events because:
    - It makes it harder to evacuate
    - Buildings are more tightly packed, which increases the impact if some collapse
- **Age** – the elderly and the young are more vulnerable. In the case of the elderly this may be due to lack of mobility:
    - In the 1995 Kobe earthquake, the death rate in the over 75s was significantly higher than any other age group
- **Disabilities** – people with disabilities are up to four times more likely to die as a result of a hazard event

Political factors affecting vulnerability

- **Governance** – the way in which a country or region is run is known as **governance**; this also impacts vulnerability and resilience:
    - **National governance** refers to how the whole country is run
    - **Local governance** is how local areas are run
- If a place has **good governance**, that means it is well run and the local or national government is effective:
    - These areas are more able to cope with hazard events and will have a faster recovery
- Alternatively, **weak or poor governance** leads to increased vulnerability and impacts on the area's ability to cope with a hazard event
- Poor governance impacts on the ability of governments to:
    - **Plan** for hazard events using techniques such as hazard mapping and land-use zoning
    - **Educate** the population about the risk and how best to protect themselves
    - **Predict** events as they do not have the technology and equipment available
    - **Prepare** by ensuring that stocks of water, food, medical equipment and shelter are available
- Poor governance may also be linked to:
    - A lack of openness, which means that governments are not held to account
    - **Corruption** can have a number of impacts:
        - Money is not spent on preparation
        - Construction companies can get around building regulations or land-use zoning by bribing officials
        - In Turkey, corruption related to construction led to increased deaths in the Izmit earthquake (1999) and the more recent Kahramanmaras (2023) earthquake

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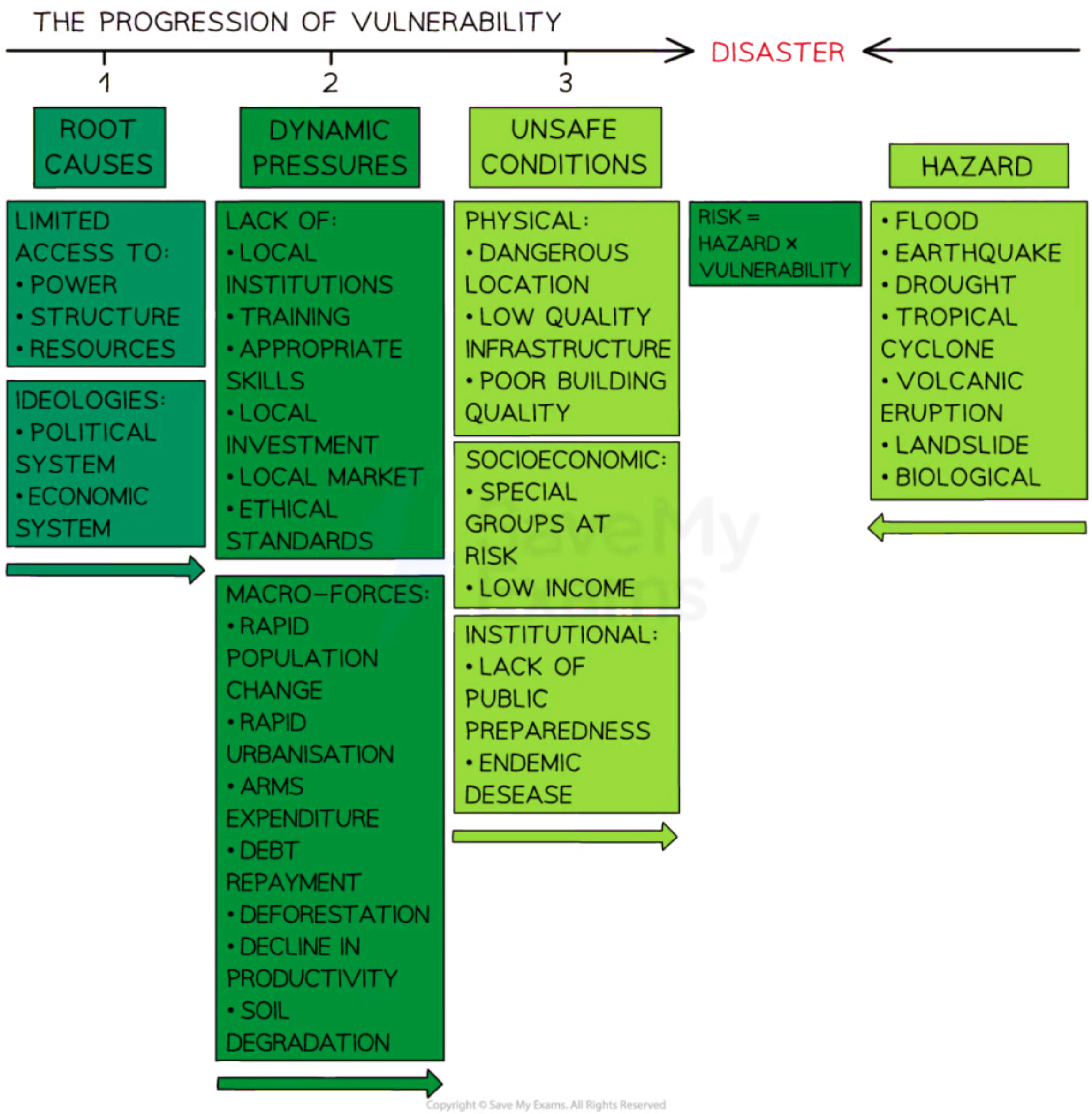
Progression of vulnerability

- The pressure and release model takes into account the socio-economic context of a hazard

Pressure model

- The pressure model demonstrates how there are a range of factors that increase vulnerability and why some areas lack resilience
- Within the pressure mode there are:
  - **Root causes** – related to resources, decision making and governance, these lead to dynamic pressures
  - **Dynamic pressures –** relate to education, urbanisation and population change, which create unsafe conditions
  - **Unsafe conditions** – poor-quality housing and infrastructure, poverty
- These are then combined with the hazard itself to increase risk

The pressure model



The pressure model

Release model

- The release model demonstrates that vulnerability can be reduced and resilience increased by addressing:
  - Safety
  - Reducing the pressures

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- Addressing the root causes
- Hazard mitigation

The release model

Your notes

Your notes

The release model

Exam Tip

It is essential for the exam that you are able to outline the factors which affect a population/areas vulnerability to a hazard event. These may be two mark questions which ask you to briefly describe how a particular factor impacts vulnerability. Alternatively, it may be a 10 mark question which asks you to examine the relative importance of different factors.

7.2.4 Factors Affecting the Impacts of Geophysical Hazard Events

Your notes

Factors Affecting the Impacts of Geophysical Hazard Events

- There are many factors that affect the impact of geophysical hazards, including:
  - **Magnitude and frequency**
  - **Location** – rural or urban
  - **Population density**
  - **Building quality**
  - **Time of day**
  - **Distance** from the hazard event
  - **Geology** – rocks and sediment
  - **Level of development**

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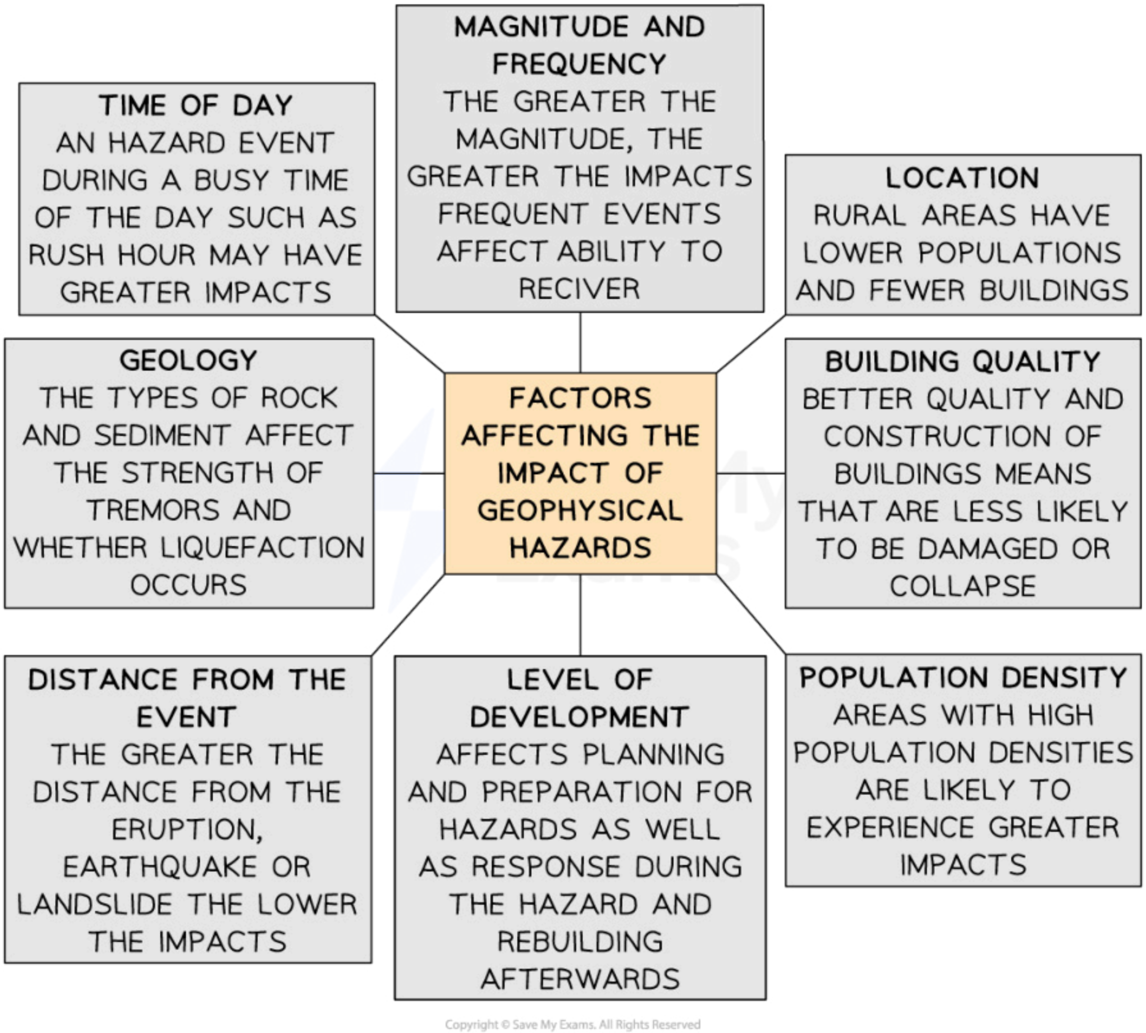

Factors affecting the impacts of geophysical hazards

Exam Tip

It is important to recognise that all of these factors are interlinked and may affect one another. For example, level of development affects building quality, and can also affect population density. It is important in the exam that you acknowledge that these factors do not affect the impacts of a hazard event in isolation; it is the combination of all of them that determines the impact that a hazard event has.