Unit 1, Paper 1 - Question 1
The Challenge of Natural Hazards

What are natural hazards?

Natural hazards are **physical** events such as **earthquakes** and **volcanoes** that have the potential to do damage humans and property. Hazards include **tectonic hazards**, **tropical storms** and **forest fires**.

Factors affecting hazard risk

Urbanisation - **Tokyo**, **Istanbul** and **Los Angles**, all are at risk of **severe earthquakes**.
Farming - people choose to live near **floodplains** due to the fertile soils. This puts them at risk of flooding.
Poverty - **LICs** are particularly at risk as they do not have the money to protect themselves.
Climate change - can cause more unpredictable and freakish weather.

The structure of the Earth

The Crust - Varies in thickness (**5-10km**) beneath the ocean. Made up of several large plates.

The Mantle - Widest layer (**2900km thick**). The heat and pressure means the rock is in a liquid state that is in a state of convection.

Inner and Outer Core - Hottest section (**5000 degrees**). Mostly made of **iron** and **nickel** and is **4x denser** than the crust. Inner section is solid whereas outer layer is liquid.

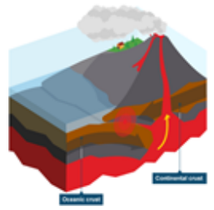
Tectonic plate theory

The **crust** is split into major fragments called **tectonic plates**. There are 2 types: **Oceanic** (**5 - 10km** thick and younger but **dense**) and **Continental** (old and thicker but **less dense**).
These plates move and where they meet (**plate boundaries/margins**) you get **tectonic hazards** (volcanoes and earthquakes).
Plates move due to **convection currents** - this is when heat is generated from **radioactive decay** in the interior of the Earth creates **magma**.

Types of tectonic plate boundaries/margins

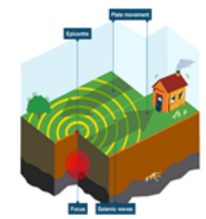
Plates either move against each other (**destructive margin**) away from each other (**constructive**) or next to each other (**conservative**).

Destructive plate margins - When the more dense **oceanic plate subducts** beneath the less dense **continental plate**, **friction** causes it to melt and become **molten magma**. The **magma** forces its ways up to the surface to form a **volcano**. This margin is also responsible for **devastating earthquakes** due to the **friction** caused when the **oceanic plate subducts**. Huge cone shaped volcanoes and mountains form as the **continental plate** is crumpled and forced upwards.



Constructive plate margins - Here two plates are **moving apart** causing new **magma** to reach the surface through the gap. **Volcanoes** formed along this crack cause a submarine mountain range such as those in the **Mid Atlantic Ridge**. This happens as runny **lava** cools and **solidifies** in layers. Minor earthquakes happen here due to friction as plates move.

Conservative plate margins - A conservative plate boundary occurs where plates **slide past each other** in opposite directions, or in the same direction but at different speeds. This is responsible for earthquakes such as the ones happening along the **San Andreas Fault**, USA. As plates are of similar density **intense friction** leads to **devastating earthquakes**.



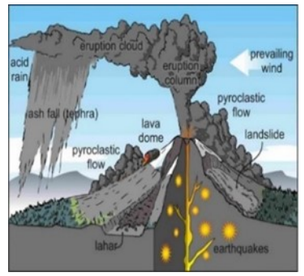
Volcanic Hazards

Ash cloud - Small pieces of pulverised rock and glass which are thrown into the **atmosphere**.

Gas - **Sulphur dioxide**, **water vapour** and **carbon dioxide** come out of the volcano.

Lahar - A **volcanic mudflow** which usually runs down a valley side on the volcano.

Pyroclastic flow - A fast moving current of super-heated gas and ash (**1000°C**). They travel at **450mph**.

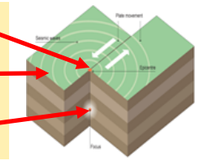


Volcanic bomb - A thick (**viscous**) **lava** fragment that is ejected from the volcano.

Earthquakes

Earthquakes are caused when two **plates** become locked causing friction to build up. From this **stress**, the pressure will eventually be released, triggering the **plates** to move into a new position. This movement causes **energy** in the form of **seismic waves**, to travel from the **focus** towards the **epicentre**. As a result, the **crust vibrates** triggering an earthquake.

The point directly above the **focus**, where the **seismic waves** reach first, is called the **epicentre**.
Seismic waves (energy waves) travel out from the **focus**. Their **strength decreases** the further they move from the **focus**.
The point at which pressure is released is called the **focus**.



Causes of Earthquakes in countries of contrasting wealth

Japan (HIC) - March 2011
Magnitude 9 earthquake caused when the **Eurasian plate** was dragged down by the **Pacific plate** until the **pressure** was too great and the plate was thrusted upwards. This caused a **massive displacement** of the water at the **epicentre** sending large amounts of water thrusted towards land - **tsunami**.

Haiti (LIC) - January 2010
The earthquake was caused by the **North American Plate** sliding past the **Caribbean Plate** at a **conservative plate margin**. The pressure that was built up because of the **friction** between the plates was eventually released causing a **magnitude 7** earthquake with an **epicentre 16 miles** West of **Port-au-Prince** and a **shallow focus** of 5 miles.

Primary Impacts of Earthquakes in countries of contrasting wealth

Japan (HIC)
- **15,845 killed** with **3375 missing**
- **78 bridges** damaged
- **128,479 properties** totally destroyed
- **3,918** roads damaged
- **Sendai airport** was totally destroyed
- Communication links, roads, rail lines and electricity destroyed

Haiti (LIC)
- **316,000** killed and **1 million** made homeless.
- **250,000** homes and **30,000** other buildings, were either destroyed or badly damaged
- Transport and communication links were also badly damaged by the earthquake
- Hospitals (**50+**) and schools (**1,300+**) were badly damaged, as was the airport's control tower
- The main prison destroyed - **4,000** inmates escaped

Secondary Impacts of Earthquakes in countries of contrasting wealth

Japan (HIC)
- **39 metre** high **tsunami**
- **Fukushima** power plant destroyed - **200,000** residents **evacuated**
- Agriculture in the **Tohoku** region was devastated. (accounts for **3-4% of Japan's rice production**)
- **209** companies had been forced into bankruptcy

Haiti (LIC)
- **1 in 5** people lost their jobs
- Morgues became full and bodies then had to be piled up on the streets - leading to disease spreading
- Difficult getting **aid** into the area because of issues at the airport

Responses of Earthquakes in countries of contrasting wealth

Japan (HIC)
- **452,000** people placed in evacuation shelters
- **11 military** planes used to assess where aid was needed
- Within **2 seconds** of the initial earthquake happening **27 trains** came to a stop - meaning not a single injury or death reported on trains
- **8 months** after all roads, rail and airports affected were reopen and operational.
- **8 months** after the quake **96%** of the electricity supply had been restored, **98%** of the water supply and **99%** of the landline network..

Haiti (LIC)
- **$100** million in aid given by the **USA** and **$330** million by the **European Union**
- **810,000** people in aid camps
- **115,000** tents and **1,000,000+** tarpaulin shelters provided
- **4.3 million** people provided with food rations
- **1 million** people still without houses after 1 year - aid camps
- **Cash/food-for-work projects** as **70%** of people unemployed
- Temporary schools created and new teachers trainee
- Water and sanitation eventually supplied for **1.7 million people**

Reducing the risks of tectonic hazards

Volcanoes

Monitoring -
- **Seismometers** used to detect earthquakes.
- **Thermal imaging** and **satellite** cameras used to detect heat around a volcano.
- **Gas samples** and chemical sensors used to measure **sulphur levels**.

Prediction -
- Small earthquakes are caused as **magma** rises up.
- Temperatures around the volcano rise as activity increases.
- Release of gas close to eruption

Protection -
- Creating an **exclusion zone** around the volcano.
- Trained emergency services and a good communication system.

Earthquakes

Monitoring -
- **Satellite** surveying (tracks changes in the earth's surface)
- **Laser reflector** (surveys movement across fault lines)
- **Radon gas sensor** (radon gas is released when plates move so this finds that)
- **Seismometer**

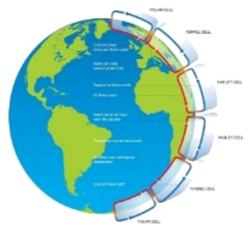
Prediction -
- It is impossible to make an accurate prediction about earthquakes due to the fact there are **no warning signs**

Protection -
- Building earthquake-resistant buildings
- Raising public awareness
- Improving earthquake prediction through research
- Preparing people through evacuation drills

Global atmospheric circulation

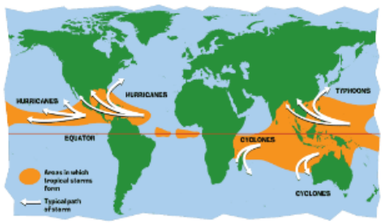
Atmospheric circulation is the large-scale movement of air by which heat is **distributed** on the surface of the **Earth**.

Hadley cells - Largest cell which extends from the **Equator** to between **30° to 40°** north & south. **Low air pressure** causing high levels of **precipitation**.
Ferrel cells - Middle cell where air flows poleward between **60° & 70° latitude**. Responsible for **high air pressure**, causing little to no rainfall.
Polar cells - Smallest & weakness cell that occurs from the **poles** converging with **ferrel cells** - causing air to rise and **precipitation** to occur.



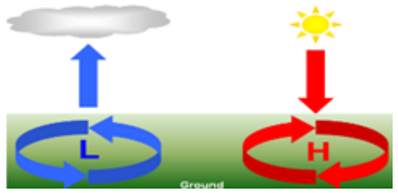
Distribution of tropical storms

Known by different names, including **hurricanes** (North America), **cyclones** (India) and **typhoons** (Japan and East Asia). They all occur in a band that lies roughly **5-15° C** either side of the **Equator**, traveling from east to west.



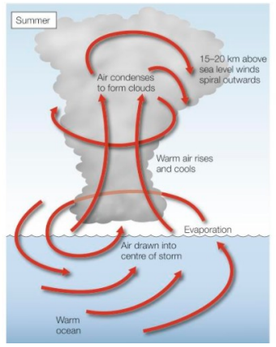
High and low air pressure

Low pressure	High pressure
Caused by hot air rising. Causes stormy, cloudy weather.	Caused by cold air sinking. Causes clear and calm weather.



Formation of tropical storms

1. The sun's rays heats large areas of ocean in the summer and autumn. This causes warm, moist air to rise over the particular spots



2. Once the temperature is 27°, the rising warm moist air leads to a low pressure. This eventually turns into a thunderstorm. This causes air to be sucked in from the trade winds.

3. With trade winds blowing in the opposite direction and the rotation of earth involved (Coriolis effect), the thunderstorm will eventually start to spin.

4. When the storm begins to spin faster than 74mph, a tropical storm (such as a hurricane) is officially born.

5. With the tropical storm growing in power, more cool air sinks in the centre of the storm, creating calm, clear condition called the eye of the storm.

6. When the tropical storm hits land, it loses its energy source (the warm ocean) and it begins to lose strength. Eventually it will 'blow itself out'.

Impacts and responses of Typhoon Haiyan 2013

In **November 2013** 'Super' Typhoon **Haiyan** - a **category 5** storm hit the **Philippines**. Huge areas of coastline and several towns were devastated by winds of up to **275km/h (170mph)** and waves as high as 15m (45ft). It was one of the strongest tropical storms ever recorded.

Impacts of Typhoon Haiyan

Primary Impacts

- **6 300 killed** - most drowned by the storm surge (**5 meter** wave similar to a **tsunami**).
- Over **600 000** people **displaced** and **40 000** homes damaged or flattened - **90%** of **Tacloban** city was destroyed.
- **Tacloban airport** terminal was badly damaged
- **30 000** fishing boats were destroyed.
- Buildings, powerlines and large areas of crops were badly damaged
- Over **400mm** of rain caused widespread flooding.

Secondary Impacts

- **14 million** people affected, many left homeless and **6 million** people lost their source of income.
- Flooding caused **landslides** and blocked roads,
- **Power supplies** in some areas were cut off for months.
- Ferry services and planes were disrupted for weeks,
- Shortage of water, food and shelter caused disease
- **Looting** and violence broke out in the city of **Tacloban**.
- Destruction of **hospitals**, **schools** and other important **infrastructure**

Responses to Typhoon Haiyan

Immediate Responses

- International government and **aid agencies** responded with food, water and temporary shelters.
- **US aircraft carrier George Washington** and helicopters assisted with search and rescue and delivery of aid.
- Over **1200 evacuation centres** were set up to help the homeless.
- UK government sent **shelter kits** each one able to provide emergency shelter for a family.

Long term Responses

- The **UN** and countries including the **UK**, **Japan** and **USA** donated **financial aid**, supplies and medical support.
- '**Cash for work**' programmes - people paid to help clear debris and rebuild the city.
- **Rice farming** and fishing quickly re-established.
- Aid agencies like **Oxfam** supported the replacement of fishing boats - a vital source of income.

Reducing the impacts of tropical storms

Protection

- Using **reinforced concrete** for buildings. Build on stilts so they're safe from floodwaters.
- **Flood defences** can be built along rivers (levees) and coasts (sea wall) to reduce flooding.
- **Storm drains** can be built in urban areas to take away excessive water

Planning

- New houses, can be planned to avoid the **areas most at risk**.
- Emergency services can train and prepare for disasters e.g., by **practising** rescuing people from flooded areas with helicopters.
- Governments can plan **evacuation routes**

Monitoring

Technology has made it possible to predict and **monitor** tropical storms, more accurately. In the N Atlantic, there are two levels of **warning** issued by the National Hurricane Centre in Miami:

- **Hurricane watch** - advises that hurricane conditions are possible.
- **Hurricane warning** - advises that hurricane conditions are expected and that people should take **immediate action** e.g., **evacuate**

UK Weather

Caused by **steep sided valleys**, surround **impermeable rock**, uncharacteristically high levels of **precipitation** and built up **urban areas** close to rivers.

Impacts

- **600 homes** where flooded
- **£10 million** in damage
- **1000 livestock** had to be evacuated
- **140,000 m²** farmland under water for 4 weeks
- Bristol to Taunton railway line had to be closed
- Water **contaminated** and undrinkable

Responses

- **Evacuations**, using sandbags and moving vulnerable family members to safety
- Temporary accommodation
- **8km** of the **Rivers Tone** and **Parratt** were **dredged**
- **Roads elevated**
- Flood defences like **flood walls**, **pumping stations** and a planned **tidal barrage**

What is climate change?

Climate change is a large-scale, long-term shift in the planet's weather patterns or average temperatures. Evidence of changing climate includes global temperatures, rising sea levels, melting ice sheets and seasonal changes.

Causes of climate change

Natural causes

Earth's orbit - **Elliptical** orbit causes global temperatures to increase. **Circular** orbit causes temperatures to decrease
Volcanic activity - Volcanoes release large amounts of dust containing gases. These can block sunlight and results in cooler temperatures.
Sunspot activity - Dark spots on the Sun are called **Sun spots**. They increase the amount of energy Earth receives from the Sun.

Human causes

Recently there has been an increase in humans burning **fossil fuels** for energy. These fuels (**gas, coal and oil**) emit greenhouse gases. This is making the Earth's atmosphere thicker, therefore trapping more solar radiation and causing less to be reflected. As a result, the Earth is becoming warmer.

Impacts and managing climate change

Impacts

- Sea levels rise as **glaciers melt**
- Loss of **polar habitats**
- Increased **erosion** in places like **Maldives**
- Death of **coral reefs** and loss of **marine wildlife**
- More unpredictable weather
- **Tropical storms** becoming more **intense** and distribution to move **north** and **south** of the tropics
- Increase in deaths caused by **heatwaves** and **dehydration**
- Coastal flooding
- Spread of **tropical diseases**
- **Food shortage** due to arid land and poor farming

Management - mitigation

Carbon capture - This involves new technology to **capture** and **store carbon**.

Afforestation - Planting trees **absorbs carbon** from **the atmosphere**

International agreements - Countries aim to cut emissions by signing **international deals** and by setting targets.

Renewable energy - Replacing fossil fuel energy with clean/natural sources of energy e.g., solar, wind

Adapting - this is when you put in measure to cope with the risk e.g., build **sea defences**, change **farming techniques** and **manage water** more effectively