# Answers Plate Tectonics

## Year 9 Science Chapter 7

| | | |
|---|---|---|
| **p167** | **1** | **Plate tectonics** is a scientific theory that is used to explain the movement of the Earth's lithosphere. The lithosphere is the solid outermost shell of Earth. |
| | **2** | Plate tectonics is used to explain **a)** volcanoes, **b)** the movement of continents, **c)** earthquakes, but not the movement of the tides. |
| | **3** | The lithosphere is the rigid layer of rock covering the surface of the Earth. The lithosphere has an average thickness of around 80 km over most of the Earth. |
| | **4** | The Indo-Australian plate is moving north at about 6 cm per year. |
| | **5** | As the Nazca plate pushes against the South American plate, the Andes mountain range will increase in height? |
| **p169** | **1** | Continental drift theory is the theory that the continents had once been joined, and over time had 'drifted' apart. |
| | **2** | Fossil evidence supports the continental drift theory because the same plant and animal fossils can be found on separate continents. |
| | **3** | In support of the continential drift theory, Antarctica would be expected to have similar fossils to that of Australia. |
| | **4** | In support of the continental drift theory, South America would be expected to have similar geological patterns to that of South Africa. |
| | **5** | Wegener theorised that the continents were drifting at about 1 m per century. At this speed, how far did Australia move in the last 1 million years?<br>1 million years of drift = 10 000 centuries at 1 m per century = 10 000 m = 10 km |
| | **6** | The main problem with Wegener's continental drift theory was the lack of a mechanism. Wegener didn't provide an explanation of how the continents drifted apart. |
| **p171** | **1** | The scientific developments that led to the morphing of the continental drift theory into the theory of plate tectonics were: **a)** Mapping of the ocean floor, **b)** Magnetic striping, **d)** Sea-floor spreading, **f)** Plotting of earthquakes and volcanoes. |
| | **2** | Mapping of the seafloor revealed mid-ocean ridges and that they occurred at the edges of tectonic plates. The undersea mountain ridges are formed by erupting magma where the plates move away from each other. |
| | **3** | True - Magnetic striping provided evidence that the sea floor is spreading out from plate boundaries. |

## p173

1 Sea-floor spreading is a process where magma is forced up through mid-ocean ridges and forms new sea-floor. The new sea-floor then gradually moves away from the ridge.

2 The sea-floor spreading explains why the continents are drifting. The theory is that the ocean floors are moving and carrying the continents with them.

3 It is theorised that the continents of Australia, Antarctica, and South America are moving apart due to sea floor spreading. The theory is that the ocean floors are moving and carrying the continents with them.

4 It is believed that sea-floor spreading is a combination of the movement of magma flow and the pulling of the sea-floor as it slips under a continent (similar to the pulling of a table-cloth as it slips off a table).

5 Subduction is the opposite of sea-floor spreading. Subduction happens when a tectonic plate slides under another plate.

6 While new rocks are continuously being formed at the mid-ocean ridges, subduction destroys old rock and explains why the diameter of the Earth remains roughly the same?

7 The relatively young sea-floor rock has been formed, through sea-floor spreading, after the Earth formed.

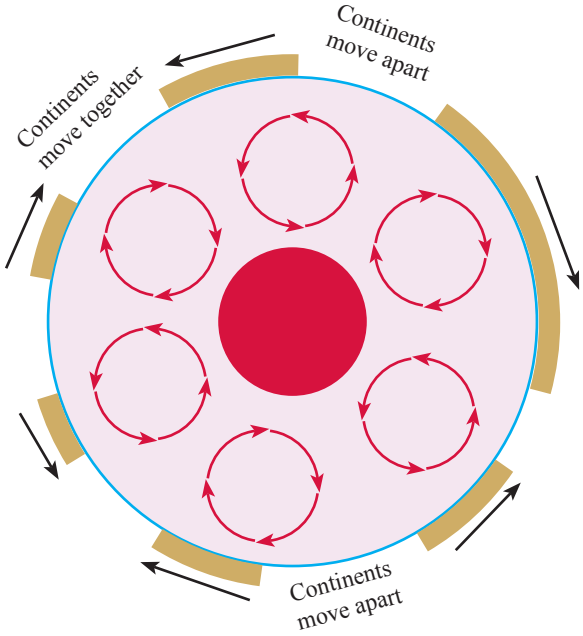
## p175

1 Considerable evidence suggests that all the continents were joined together in a supercontinent called 'Pangaea' around 225 million years ago.

2 **Plate tectonics** is a theory that is used to explain the movement of the Earth's continents. The basis of plate tectonic theory is that the lithosphere, Earth's outer crust, consists of separate and distinct tectonic plates that float on a fluid asthenosphere.

3 A theory for the movement of continents is that they float on convection currents. The proposal is that the very hot molten rocks near the core of the Earth are less dense than the cooler rocks in the upper mantle. Because these rocks near the core are less dense they rise up, while the denser rocks in the upper mantle sink thus causing a circular convection current.

4




5

6 As the continents float on a liquid asthenosphere, it is very likely that sometime in the future, the continents would collect together and form another supercontinent sometime in the future.
Assuming continental movement of about 1 m per century, and that the furtherest continents are 12 000 m apart, the continents would have to move a distance of at least 6 000 m.
It would take 6 000 centuries, or 6 billion years, to form a supercontinent.

Given that the age of the earth is almost 5 billion years and that supercontinents have formed a number of times already, it might be expected that continental movement is most likely faster that 1 m per century.

**p177**

**1** The greater majority of the earthquakes are located at tectonic plate boundaries.

**2** The meaning of each of the following earthquake zone terms:

**a)** Divergent zones happen where plates are pulled apart (eg., at mid-ocean ridges).

**b)** Convergent zones happen at the boundaries of tectonic plates where oceanic plates and continental plates collide and one plate is subducted.

**c)** Transform zones happen where plates scrape against each other.

**3** The Pacific Ring of Fire is a 40,000 km horse-shoe shaped area around the Pacific Ocean where a large number of earthquakes and volcanic eruptions occur.

**4** Convergent zones would be expected to produce the most severe earthquakes. The built up forces of plates pushing against each other, suddenly giving way, would produce severe earthquakes.

**p179**

**1** Convergent, divergent, and transform tectonic plate boundaries that produce earthquakes.

**2** Converging plates at subduction zones tend to move past each other at about three to ten centimetres per year. The descending plate pushes against and causes the continental plate to fracture and produce earthquakes.

**3** Divergent boundaries are found where two tectonic plates are moving apart. The majority of divergent boundaries are found at mid-ocean ridges. Because the sea-floor spreading isn't uniform along the mid-ocean ridge, massive stresses build throughout the ridge. These massive stresses cause rocks to fracture and produce earthquakes.

**4** Transform boundaries are found where two tectonic plates slide past each other. Earthquakes are produced along the boundary as each plate scrapes and grinds past the other plate.

**5** A subduction zone belongs to convergent zones.

**6** A seismograph is used to measure the strength of earthquakes.

**p181**

**1** Most of the world's active **volcanoes** are found on or near tectonic plate boundaries and are called 'plate boundary' volcanoes.

**2** Some volcanoes are found away from plate boundaries and are called 'intra-plate' volcanoes.

**3** Mt Vesuvius sits on a tectonic plate boundary where the African Plate is being subducted under the Eurasian Plate. The melting of the subducted African Plate as it slips into the asthenosphere is building up pressure under Mt Vesuvius and periodically causes violent and explosive eruptions.

**4** What is a volcanologist?

**5** Mt Vesuvius is considered to be extremely dangerous to human life because a very large number of people live close to the volcano. Given that the last massive eruption was in AD 78, and that there has been a massive eruption roughly every 2000 year, a massive eruption could be expected (The eruption in 1944 was relatively minor).

**6** Yellowstone Caldera, in the USA, is a massive supervolcano. It is capable of extremely severe hydrothermal explosions.

Karkatoa, in Indonesia, is extremely violent and has destroyed islands and produced tsunamis that have killed more than 40 000 people.

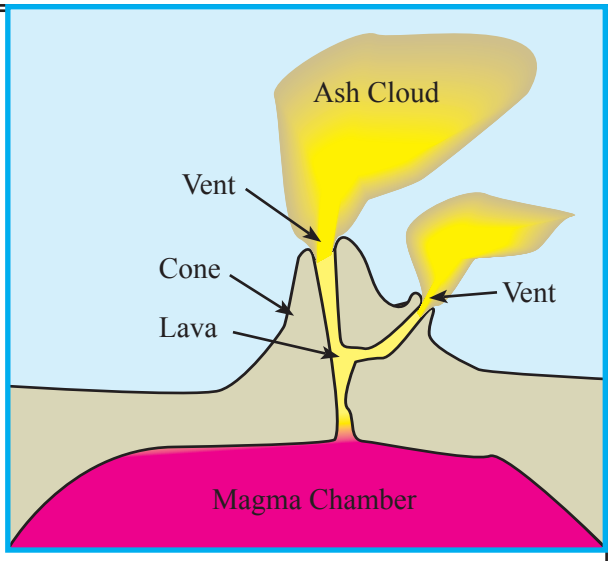
Popocatepeti, in Mexico, is expected to produce a massive explosion at any time and threatens the highly populated Mexico City.

Mt Vesuvius, in Italy, is due for a massive explosion, and threatens the three million people that live nearby. The city of Naples is situated beside Mt Vesuvius.

Nyiragongo, in DR Congo, is an extremely violent and large stratovolcano.

## p183

**1**




**2** Magma is a paste of molten rock, minerals and gases

**3** A volcano is active if lava or gas is being released from the volcano. A volcano is dormant if the vent has been blocked by cooled lava to form a plug, and hasn't erupted for 20 years. A volcano is considered extinct if it hasn't erupted for 10,000 years

**4** Magma is composed of molten rock and is stored in the Earth's crust. Lava is magma that reaches the surface of our planet through a volcano vent.

**5** As the edge of a subduction plate melts into the asthenosphere, some of the newly formed magma rises and erupts as volcanoes along the subduction zone.

**6** All volcanoes are constructive as they build up landmass, and provide rich soils for agriculture.

## p185

**1** The Australian Plate is a major tectonic plate that includes the Australian continent and large amounts of the surrounding ocean.

**2** GPS measurements suggest that the Australian land mass is moving north at a speed of around 6 cm per year.

**3** The Australian landmass is not near tectonic plate boundaries and is relatively stable compared to the major volcano activity at the plate boundaries. A major volcanic eruption is not expected in the near future.

**4** Australia experiences earthquakes that are generally attributed to the stresses caused by collision with adjoining plates.

**5** The Indo-Australian Plate was a major tectonic plate that included the continent of Australia and surrounding ocean, and extended northwest to include the Indian subcontinent and adjacent waters.

## p186

**1** Scientists can predict where earthquakes are likely to occur. The greater majority of earthquakes occur at tectonic plate boundaries and at fault zones.

**2** Scientists have extreme difficulty in predicting when earthquakes will occur. It is even more difficult to predict a major earthquake in time for affected communities to prepare and/or evacuate.

**3** Radon gas, toads, unsettled birds.

**4** The use of satellites to detect **electromagnetic** disturbances provide some promise, but requires significant technological development.

**5** Earthquakes can displace large volumes of water resulting in tsunamis.

## p187

**1** Three clues that may suggest that the magma chamber under a volcano is increasing in size:

- Small earthquakes and vibrations caused by the moving magma.
- Increase and change in the gases emitted by the volcano - especially sulphur dioxide.
- Slight swelling of the slopes of the volcano as the increasing magma chamber builds up pressure under the volcano.

**2** Matching the instrument with the eruption warning sign.

| *Instrument* | *Warning sign* |
|---|---|
| Seismograph | earthquakes |
| Spectrometer | sulphur dioxide |
| Tiltmeter | volcano swelling |

**p190**

**1** **Plate tectonics** is a scientific theory that is used to explain the movement of the Earth's lithosphere. The lithosphere is the solid outermost shell of Earth.

**2** Plate tectonics is used to explain **a)** volcanoes, **b)** the movement of continents, **c)** earthquakes, but not the movement of the tides.

**3** The lithosphere is the rigid layer of rock covering the surface of the Earth. The lithosphere has an average thickness of around 80 km over most of the Earth.

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**6** Continental drift theory is the theory that the continents had once been joined, and over time had 'drifted' apart.

**7** Fossil evidence supports the continental drift theory because the same plant and animal fossils can be found on separate continents.

**8** In support of the continential drift theory, Antarctica would be expected to have similar fossils to that of Australia.

**9** Wegener theorised that the continents were drifting at about 1 m per century. At this speed, how far did Australia move in the last 1 million years?
1 million years of drift = 10 000 centuries at 1 m per century = 10 000 m = 10 km

**10** The main problem with Wegener's continental drift theory was the lack of a mechanism. Wegener didn't provide an explanation of how the continents drifted apart.

**11** The scientific developments that led to the morphing of the continental drift theory into the theory of plate tectonics were: Mapping of the ocean floor, Magnetic striping, Sea-floor spreading, Plotting of earthquakes and volcanoes.

**12** Mapping of the seafloor revealed mid-ocean ridges and that they occurred at the edges of tectonic plates. The undersea mountain ridges are formed by erupting magma where the plates move away from each other.

**12** The rocks at the mid-ocean ridges are younger than the rocks further from the ridges?

**14** True - Magnetic striping provided evidence that the sea floor is spreading out from plate boundaries.

**p191**

**1** Sea-floor spreading is a process where magma is forced up through mid-ocean ridges and forms new sea-floor. The new sea-floor then gradually moves away from the ridge.

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**6** While new rocks are continuously being formed at the mid-ocean ridges, subduction destroys old rock and explains why the diameter of the Earth remains roughly the same?

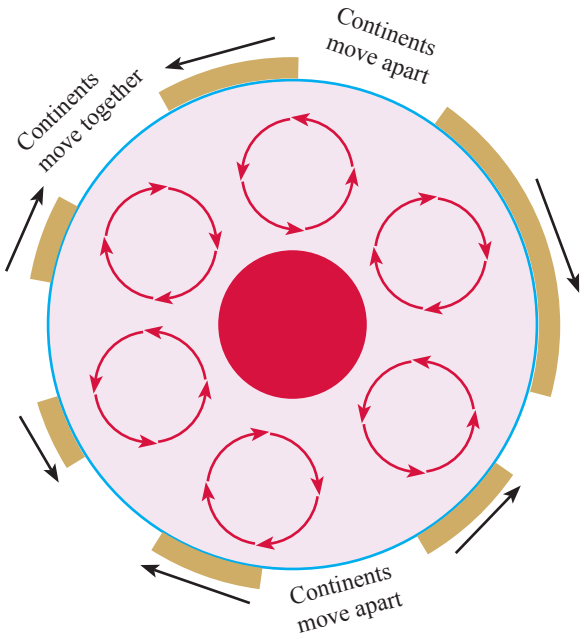
**7** The relatively young sea-floor rock has been formed, through sea-floor spreading, after the Earth formed.

**8** A theory for the movement of continents is that they float on convection currents. The proposal is that the very hot molten rocks near the core of the Earth are less dense than the cooler rocks in the upper mantle. Because these rocks near the core are less dense they rise up, while the denser rocks in the upper mantle sink thus causing a circular convection current

## p191

**9**

**10**




**11** As the continents float on a liquid asthenosphere, it is very likely that sometime in the future, the continents would collect together and form another supercontinent sometime in the future.
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**12** **a)** Subduction destroys old crust.
**b)** Sea-floor spreading creates new crust.

## p192

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**2** The meaning of each of the following earthquake zone terms:

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**7** Transform boundaries are found where two tectonic plates slide past each other. Earthquakes are produced along the boundary as each plate scrapes and grinds past the other plate.

**8** A subduction zone belongs to convergent zones.

**9** The most severe earthquakes would be expected to be found in convergent zones.

**10** A seismograph is used to measure the strength of earthquakes.

## p193

**1** The completed grid is: 3,4,1,2,5
2,5,3,1,4
5,1,4,3,2
1,2,5,4,3

**2** The odd one out is e)
c) is the mirror image of a)
d) is the mirror image of b)

**3** The frog gets out on the 10th jump.

## p194

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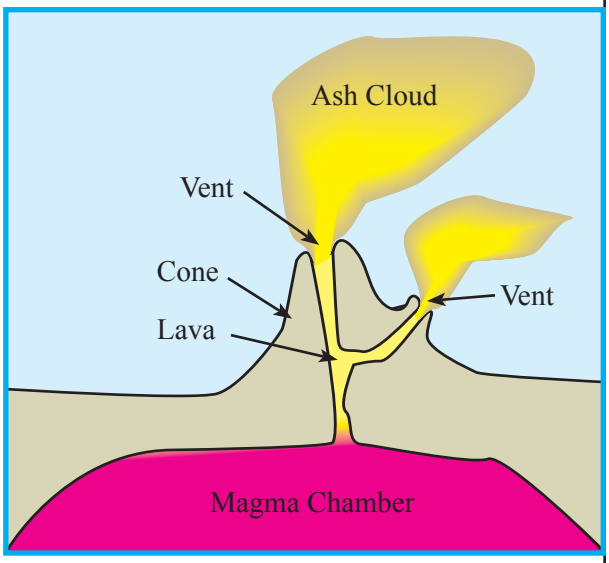


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**12** Matching the instrument with the eruption warning sign.

| *Instrument* | *Warning sign* |
|---|---|
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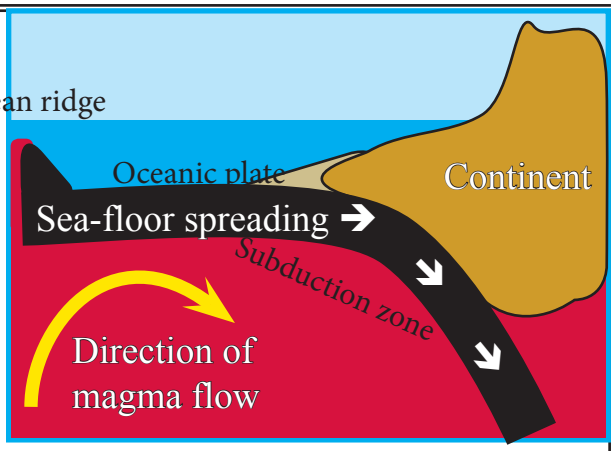
| Spectrometer | sulphur dioxide |
| Tiltmeter | volcano swelling |

## p195

**1** c) **2** c) **3** c) **4** b)

**p196**

**1**
Mid-ocean ridge




**2** c) $V_{core} = 4\pi r^3/3 = 44\ 000\ km^3$

**3** c)

**4** a) Converging plates have raised the Andes mountain range.

**5** c)

**6** c)