

**B O A R D O F S T U D I E S**  
NEW SOUTH WALES

## **2010 HSC Earth and Environmental Science Sample Answers**

This document contains ‘sample answers’, or, in the case of some questions, ‘answers could include’. These are developed by the examination committee for two purposes. The committee does this:

- (a) as part of the development of the examination paper to ensure the questions will effectively assess students’ knowledge and skills, and
- (b) in order to provide some advice to the Supervisor of Marking about the nature and scope of the responses expected of students.

The ‘sample answers’ or similar advice are not intended to be exemplary or even complete answers or responses. As they are part of the examination committee’s ‘working document’, they may contain typographical errors, omissions, or only some of the possible correct answers.

## Section I, Part B

### Question 21 (a)

*Sample answer:*

- Ash clouds are composed of toxic gases and fine particles.
- Lahars are composed of water and ash and quickly move as mud down the volcano enveloping organisms causing them to die.

*Answers could include:*

Volcanic gas emissions

Ash fallout

Debris avalanches

### Question 21 (b)

*Sample answer:*

Volcanoes such as Mount Merapi produce lava, which weathers and breaks down into soil quickly. The soils are very fertile.

These types of volcanoes can attract clouds thus increasing local rainfall. This provides more soil moisture and crops can grow better.

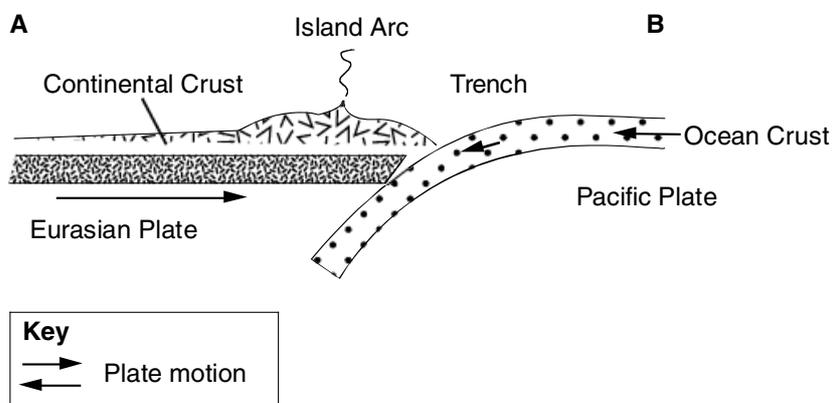
### Question 22 (a)

*Sample answer:*

Conservative boundary or transform fault: the two plates move past each other in opposite directions.

### Question 22 (b)

*Sample answer:*



**Question 22 (c)*****Sample answer/Answers could include:***

Western Pacific is a convergent boundary so a subducting plate partially melts, leading to rising magma and volcanoes on the over-riding plate. There is no subducting plate at Y as the plates are moving horizontally which does not result in melting of either plate and so there are fewer volcanoes.

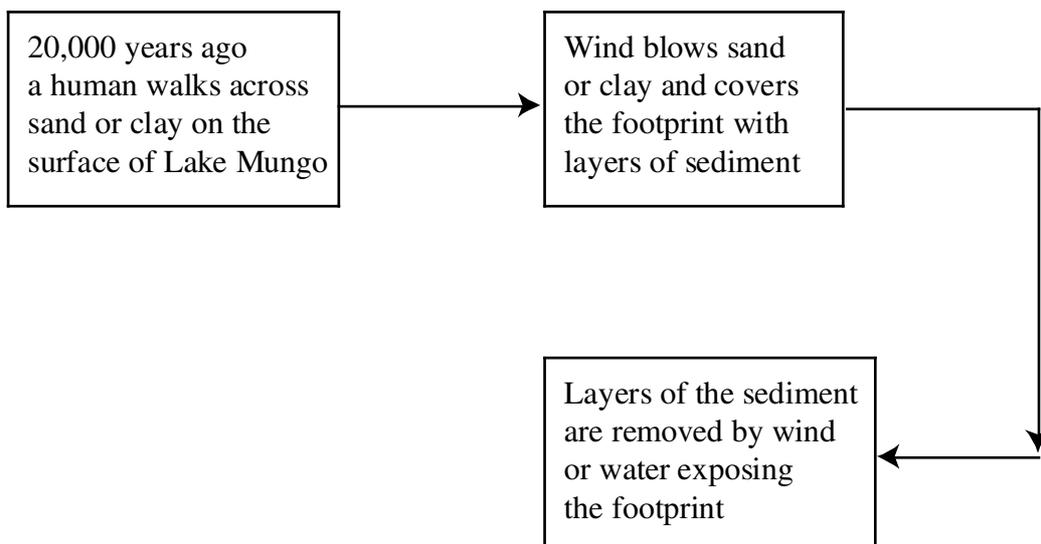
**Question 23 (a)*****Sample answer:***

140 million years +/- 10 million

**Question 23 (b)*****Sample answer/Answers could include:***

Relative dating arranges rocks in chronological order. Absolute dating gives the age of a rock in years. Relative dating would give the first and last appearances of the trilobite.

Absolute dating would give an absolute age of between 490 million years and 350 million years.

**Question 24*****Sample answer:***

**Question 25 (a)*****Sample answer:***

Saline soils can kill native vegetation

**Question 25 (b)(i)*****Sample answer:***

One strategy is to manage water movement through soil by planting more vegetation such as trees and salt tolerant species.

**Question 25 (b)(ii)*****Sample answer:***

Saline soils form when water moves to the surface and evaporates, leaving the salt in the soil. Planting deep-rooted vegetation such as trees and planting more vegetation takes water from the subsoil, thus preventing it from reaching the soil at the surface. Less salt is brought to the surface and a better water balance is maintained.

**Question 26 (a)*****Sample answer:***

	<i>Hypothesis 1</i>	<i>Hypothesis 2</i>
Cretaceous mass extinction	Bolide impact	Climate change
Permian mass extinction	Volcanism	Climate change

**Question 26 (b)*****Sample answer:***

Period: Cretaceous

Hypothesis: Bolide impact

The Chixulub crater below the Yucatan Peninsula has been dated at 65 million years, the exact age of the K/T boundary. A layer of green clay has been found worldwide and occurs at the K/T boundary. The clay contains shattered quartz commonly associated with impacts and contains high concentrations of iridium, which is rare elsewhere. The bolide impact hypothesis is the most likely cause of the mass extinction at the end of the Cretaceous period or K/T event.

**Question 26 (c)*****Sample answer:***

After a mass extinction event environmental conditions are generally different to before. Many organisms have become extinct and there is little competition for resources and some predators are missing. Surviving organisms are able to diversify into new species by natural selection. The new species occupy environmental niches that were empty.

**Question 27*****Sample answer:***

1. Takes trays and add equal amounts of soil to each and level the surface of each, spreading the soil to a uniform thickness.
2. Leave one tray untreated.
3. Place a flat sheet over a second tray and drop a heavy weight on the sheet.
4. Repeat step 3 for the remaining trays, increasing the number of times the weight is dropped.
5. Tilt the trays and allow the same amount of water to run over the surface of each tray.

***Answers could include:***

Field investigation

**Question 28*****Sample answer:***

Australia is an old continent of low relief and has experienced long periods of weathering and erosion. Topsoils have been removed and weathering leaches minerals from the remaining soil, reducing the available nutrients. The continent is also stable with no active volcanoes and no glaciation. This results in no new materials from which soil can form.

**Question 29*****Sample answer:***

Pesticides are absorbed by plants (phytoplankton) and ingested with the food eaten by animals (zoo plankton). This results in higher concentrations of the pesticide in the animals than in the water around them (bio-accumulation). Larger animals higher up in the food chain, such as the shark, need more food and thus take in more pesticide than the organism lower down in the food chain such as fish (bio-magnification).

**Question 30*****Sample answer:***

The movement of plates results in sea floor spreading which alter the distribution of the landmasses and the oceans. This results in either cooler or hotter temperatures and this affects the evaporation of water and rainfall.

Ice ages are thought to be related to the formation of super continents. Subduction can result in carbon dioxide increases and greenhouse warming.

Volcanic activity produces CO<sub>2</sub>, SO<sub>2</sub>, other gases, dust and ash. Locally SO<sub>2</sub> formation can lead to acid rain. Large volcanic eruptions with large emissions of CO<sub>2</sub> can increase global temperatures through greenhouse warming. Dust from volcanic eruptions may form aerosols which result in less solar radiation reaching the Earth's surface and consequently local or global cooling.

Human activities since the industrial revolution have resulted in land clearing and deforestation. This influences the absorption of solar radiation which inturn affects evaporation. The increase in the combustion of fossil fuels since the industrial revolution has resulted in large volumes of carbon dioxide entering the atmosphere. Increased carbon dioxide results in greenhouse warming and higher global temperatures, melting of ice caps and higher sea levels. Increased sulfur dioxide leads to increased acid rain fall locally.

## Section II

### Question 31 (a)

*Sample answer:*

Two methods used by Australian quarantine agencies are:

1. The inspection and removal of imported goods at airports that may be harbouring pest species from overseas or interstate, such as fruit and wood products.
2. The emptying of ballast water while still at sea to prevent exotic species being off-loaded in local waters where they could have a detrimental effect on native species.

### Question 31 (b) (i)

*Sample answer:*

The Tasmanian devil population decreases.

### Question 31 (b) (ii)

*Answers could include:*

Introduced pest species do not have natural predators on the island so numbers increase. Pest species also have high reproductive rates, which increase numbers. There is also generally a wide range of food resources suited to the pest.

### Question 31 (c)

*Sample answer:*

The Bradley method involves removing lantana and bitou bush from firstly the least affected areas then progressing to the more affected areas. One other method would be to cut down the introduced plants and replant the native vegetation. The Bradley method minimises soil disturbance and allows native vegetation regrowth to control the rate of lantana and bitou bush removal.

Both methods are labour intensive and both involve removal of the introduced species.

### Question 31 (d) (i)

*Sample answer:*

An increase in soil moisture causes an increase in the number of plants per 100 m<sup>2</sup>.

**Question 31 (d) (ii)****Sample answer:**

1. Plant seeds of the introduced species in several pots and allow several to germinate. After germination remove some seedlings until the same number is in each pot.
2. Divide the pots into several groups of at least two pots; add the same volume of water to each pot in one group and water every week for two months.
3. Repeat step for other groups and pots but vary the amount of water progressively for each group.
4. Count number of live seedlings in each after two months. Record and collate results.

**Question 31 (e)****Sample answer:**

The *Cactoblastis* moth was brought into Australia and released in infected areas. The larva bores into the prickly pear and eats the internal tissue of the plant. The prickly pear collapses, dries out and dies.

**Question 31 (f)****Sample answer:**

Australia is a dry continent with fragile communities adapted to the poor soils and climate conditions. The indigenous plants have adapted to these conditions and can withstand hot dry conditions, for example gum trees and proteas. Most plant communities are in equilibrium with native pests such as insects and a balance is generally maintained.

With the introduction of species such as the rabbit, fox and exotic plants there were no native predators and number of introduced species such as rabbits for example increased rapidly because of low mortality rates. Australian species generally have lower birth rates; for example kangaroos. The increased demand for food by the rabbits meant the slowly growing Australian native vegetables could not reproduce fast enough and woodland environments tended towards desertification.

Introduced species such as lantana change the biotic features of the environment. For example they give a thick ground cover, shading the soil and increasing soil moisture. Australian native plants cannot compete under these conditions. Higher moisture condition can inhibit the spread of fire thus reducing the germination of Australian native plants. Some Australian native plants/seeds need fire to germinate.

**Question 32 (a)*****Sample answer:***

Wind energy is a renewable resource. It is used to generate electricity by turning wind turbines. These spin and convert kinetic energy into electrical energy. Coal is a non-renewable resource. It is used as a fuel source by burning it to boil water and form steam. The steam is then used to turn turbines and change kinetic energy into electric energy.

**Question 32 (b) (i)*****Sample answer:***

As carbon content increases the vitrinite reflectance increases.

**Question 32 (b) (ii)*****Answers could include:***

As coalification increase from brown coal to anthracite:

- the hydrogen content of the coal decreases
- the porosity of the coal decreases
- the volatile content (materials given off when the coal is heated) decreases

**Question 32 (c) (i)*****Sample answer:***

Seismic survey

**Question 32 (c) (ii)*****Sample answer:***

Petroleum forms from organic matter in a source rock. As the depth of cover increases or the temperature increases the petroleum is forced from the source rock through porous strata into nearby porous rocks (primary migration). The petroleum continues to migrate because of its buoyancy or ability to float on water, until it is trapped and accumulates in a porous rock as either a structure or a stratigraphic trap, by an impermeable layer such as claystone.

**Question 32 (d) (i)*****Sample answer:***

As the carbon content of a fuel increases the energy output increases.

**Question 32 (d) (ii)*****Sample answer:***

1. Collect at least two samples of each of the several coals of different rank and therefore different carbon contents.
2. Burn each of the coals in a calorimeter and record the rise in temperature of water in each calorimeter.
3. Record and collate the results.

**Question 32 (d) (iii)*****Sample answer:***

Emissions from cars can be reduced by using 'lean-burn' engines, which use an excess of air to better combust the fuel. Less carbon monoxide and unburnt fuel are produced. A secondary way to reduce emissions is to use alternative fuels such as ethanol, which can be mixed with petroleum products. It can improve engine performance when mixed with low octane fuels thus reducing the amount of emissions.

**Question 32 (e)*****Sample answer:***

There are several alternative energy sources for fossil fuels. These include nuclear, solar, wind, wave and tidal and hydro for electricity generation and renewable energy sources such as biofuels, alcohol, batteries and solar for transport. Both coal and petroleum produce large amounts of greenhouse gases, such as carbon dioxide, which cause an increase in global warming. Petroleum is being exploited rapidly and is likely to run out in several decades; Although coal is plentiful resources are also finite. The advantage of using fossil fuels in Australia are they are relatively cheap and we have large coal resources.

The advantages of alternative energy sources are that most of them are cleaner and more environmentally friendly than fossil fuels because they produce far less greenhouse gases. Most alternative energy sources have disadvantages. The major disadvantages of nuclear energy is the long-lived hazardous wastes which are difficult to dispose of and there is also a major problem if there are accidents and radioactive materials escape. The disadvantage of renewable energy sources, such as biofuels, solar energy and wind energy, is they more expensive than fossil fuel energy. There is generally a high cost in setting up the infrastructure to produce them and the per unit cost to produce is also high.

Given the resources of fossil fuels such as petroleum are diminishing rapidly and especially the high cost to the environment of the greenhouse gases produced, society will have to find alternative energy sources for electricity generation and transport in the near future.

**Question 33 (a)*****Sample answer:***

Drilling uses a drilling which uses a motor to turn a drill stem with an attached bit under pressure. The drill bit cuts through rock. Water or air is used as a circulating fluid. Either core or chips are recovered and used to identify rock types and minerals. From this information the size, nature, shape and location of a deposit can be determined.

Magnetic exploration, either aerial or land based, uses a magnetometer which measures the magnetic field intensity of rocks. Rocks with more magnetic minerals give stronger responses. Many ore bodies contain magnetic minerals and the size, shape and depth of one body can be determined from the responses.

**Question 33 (b) (i)*****Sample answer:***

Most iron ore deposits are located on cratons more than 2000 million years old.

**Question 33 (b) (ii)*****Sample answer:***

Iron ore is found in banded iron formations, which form in a sedimentary environment. The BIFs are composed of alternating iron rich layers and chert (iron-poor) layers. Iron is leached from the land mass and transported to a sea or lake where it combines with oxygen to form iron oxides such as hematite. The chert layers represent periods of little or no iron input. After sedimentation, weathering and erosion remove the more soluble non-iron components, thus increasing the iron content. Folding or faulting can help with the removal of non-iron materials.

**Question 33 (c) (i)*****Sample answer:***

An ore is a rock that contains a commodity or useful material (or ore mineral) in such quantities that it can be recovered economically.

A waste rock is the rock that surrounds or is adjacent to the ore and which contains no or uneconomic ore mineral.

**Question 33 (c) (ii)*****Sample answer:***

A gangue mineral is not economically viable because its concentration in the rock is too small.

However:

- if the cost of the commodity increases because it is in short supply, rocks with low grade commodities become viable
- if the costs of mining become less, because of increased production, low grade ore become viable

**Question 33 (d) (i)*****Sample answer:***

An increase in iron content of the ore causes an increase in magnetic intensity.

**Question 33 (d) (ii)*****Sample answer:***

1. Collect up to three samples (of similar size) of ore containing the same known grade of iron.
2. Repeat step 1 selecting samples with different iron grades and non-ore rock.
3. Hold each sample near a magnetometer and record the magnetic intensity.
4. Record and collate results.

**Question 33 (e)*****Sample answer:***

An Environment Impact Statement collates the features and conditions of a mine site prior to mining. Two reasons for an EIS are:

- Government and communities can evaluate and/or monitor the mining proposal and lodge complaints or comments if necessary.
- The impact of mining on the flora can be predicted and changes to mining operations or rehabilitation can be drawn up if necessary.

**Question 33 (f)*****Sample answer:***

Mining in Australia is influenced by factors such as government policy and decisions, mining costs, infrastructure costs and technologies associated with processing and environmental issues.

Australia has many mineral deposits that could be mined in the future but whether these will be mined depends on many factors. For example there are several uranium deposits that could be developed. However opposition to nuclear power is likely to restrict the development of the deposits.

Some gold and other metalliferous deposits are uneconomic at present. However, if the cost of the commodities increases because of supply shortage or an increase in demand marginal deposits could be mined and Australian mining will be expanded.

Environmental issues such as endangered species and rehabilitation costs influence mining. There is a growing concern for the Australian environment and this is likely to limit expansion of mining some deposits. The recognition of indigenous culture means some deposits are unlikely to be mined because of the need to preserve sacred sites.

On the other hand a shortage of many commodities such as copper and gold adds pressure to mine new deposits and expand known sites such as Cadia gold. These factors encourage expansion of the Australian mining industry.

**Question 34(a)*****Sample answer:***

Deep-sea sediments come from the water columns above the sea floor and consist mainly of fine-grained clays from volcanic and continental dusts, siliceous and calcareous oozes from the remains of diatoms and small calcareous organisms, respectively that live in the water above.

Continental margin sediments consist mainly of sediments, which have been eroded from continents and washed into the ocean. These consist mainly of gravel, sand and silt.

**Question 34 (b) (i)*****Sample answer:***

A deep current moves north in the western Pacific Ocean and rises as a shallow current, which moves south in the eastern Pacific Ocean.

**Question 34 (b) (ii)*****Sample answer:***

Surface water are supplied with oxygen from the photosynthesis carried out by phytoplankton and the absorption of atmospheric oxygen. In the Polar Regions the oxygenated surface waters sink and are carried by deep-water currents, which mix with bottom water. The currents move the oxygenated waters at depth around the oceans.

**Question 34 (c) (i)*****Sample answer:***

Mid-ocean divergent boundaries are found near the centres of oceans. At these boundaries magma is brought to the surface and solidifies forming young rocks. Because of sea floor spreading the old rocks are pushed away from the ocean centres and thus the oldest rocks are found near the ocean margins.

**Question 34 (c) (ii)*****Sample answer:***

A magnetometer measures the magnetic intensity of rocks. As it is towed behind a boat away from a mid-oceanic ridge the magnetic characteristics of the rocks are measured. The characteristics of the ocean rocks can be compared to those of rocks on land for which the ages have been determined.

**Question 34 (d) (i)*****Sample answer:***

An increase in water temperature causes more potassium chloride to be dissolved.

**Question 34 (d) (ii)*****Sample answer:***

1. Add equal volumes of water to several containers and divide the containers into groups.
2. Leave one group of at least two pots at room temperature and heat/or cool other groups to different temperatures.
3. To the first group of containers, add known weights of potassium chloride, whilst stirring, until no more potassium chloride dissolves. Repeat step 3 with the other groups of containers.
4. Record and collate results.

**Question 34 (d) (iii)*****Sample answer:***

Sea floor volcanic activity produces saline solutions, which dissolve in the seawater, increasing salinity. Increased evaporation of surface water increases salinity.

**Question 34 (e)*****Sample answer:***

The oceans contain vast resources such as fish, sharks, petroleum and salt and ores such as manganese nodules. In addition society contaminates the oceans with sewage, solid waste such as old ships and accidental spills such as oil and fuel. Society is looking increasingly to the ocean to exploit the resources and use it for waste disposal such as sewage.

Society's wastes and sewage contain materials harmful to organisms such as toxic metals (eg mercury and ore) and pathogens. In addition, sewage depletes oxygen levels.

Circulation of ocean currents carries pollutants in both surface waters and deep-sea currents, thus spreading the thousands of kilometres from the source.

Many fish populations are being over fished and stocks are depleting and many commercial species are no longer sustainable.

Marine laws are needed to ensure that wastes and sewage are properly treated and disposed of. Laws are needed to restrict the number of licences for fishing and the size of catches. Off shore drilling especially in sensitive areas such as the Barrier Reef need to be regulated. Laws will ensure exploitation and use of the oceans are sustainable.