



2012 HSC Earth and Environmental Science 'Sample Answers'

When examination committees develop questions for the examination, they may write 'sample answers' or, in the case of some questions, 'answers could include'. The committees do this to ensure that the questions will effectively assess students' knowledge and skills.

This material is also provided to the Supervisor of Marking, to give some guidance about the nature and scope of the responses the committee expected students would produce. How sample answers are used at marking centres varies. Sample answers may be used extensively and even modified at the marking centre OR they may be considered only briefly at the beginning of marking. In a few cases, the sample answers may not be used at all at marking.

The Board publishes this information to assist in understanding how the marking guidelines were implemented.

The 'sample answers' or similar advice contained in this document 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

Sample answer:

	<i>Mountain belt A</i>	<i>Mountain belt B</i>
<i>Type of fault shown</i>	Thrust fault	Normal fault
<i>Type of plate boundary</i>	Converging plate boundary	Diverging plate boundary
<i>Direction of forces</i>	Compressional forces	Tensional forces
<i>One locality where found</i>	Himalayas	East African Rift

Question 22 (a)

Sample answer:

The Burakin area has a high stress regime.

Question 22 (b)

Sample answer:

Earthquakes listed in Table 2 have higher magnitudes and more fatalities occurred. The Australian earthquakes gave out less energy because they are intraplate earthquakes whereas those in Table 2 occur at plate boundaries and produce more energy. The earthquakes with higher fatalities were located in Asia where the population density is much higher than in Australia.

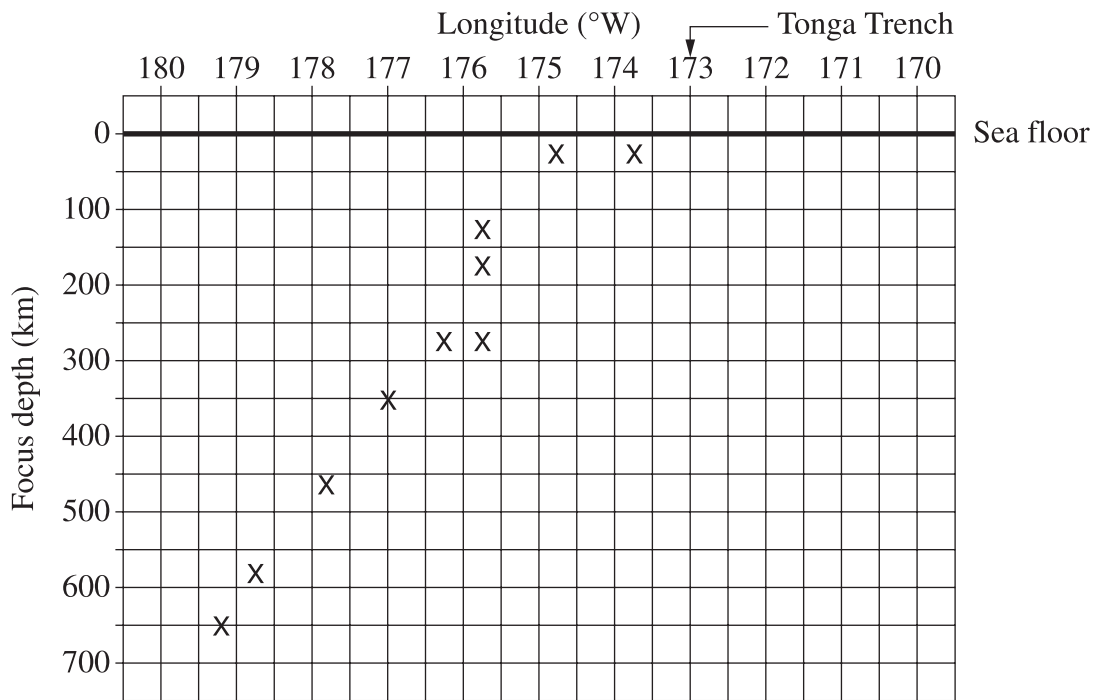
Question 22 (c)

Sample answer/Answers could include:

The study of earthquakes provides data on their origins as well as the impact on the environment and the location. This information is useful in developing prediction methods. Australian scientists can provide data on Australian and other earthquakes, thus increasing the global database and improving our understanding of earthquakes, both of which are needed if we are to reduce the impact of earthquakes.

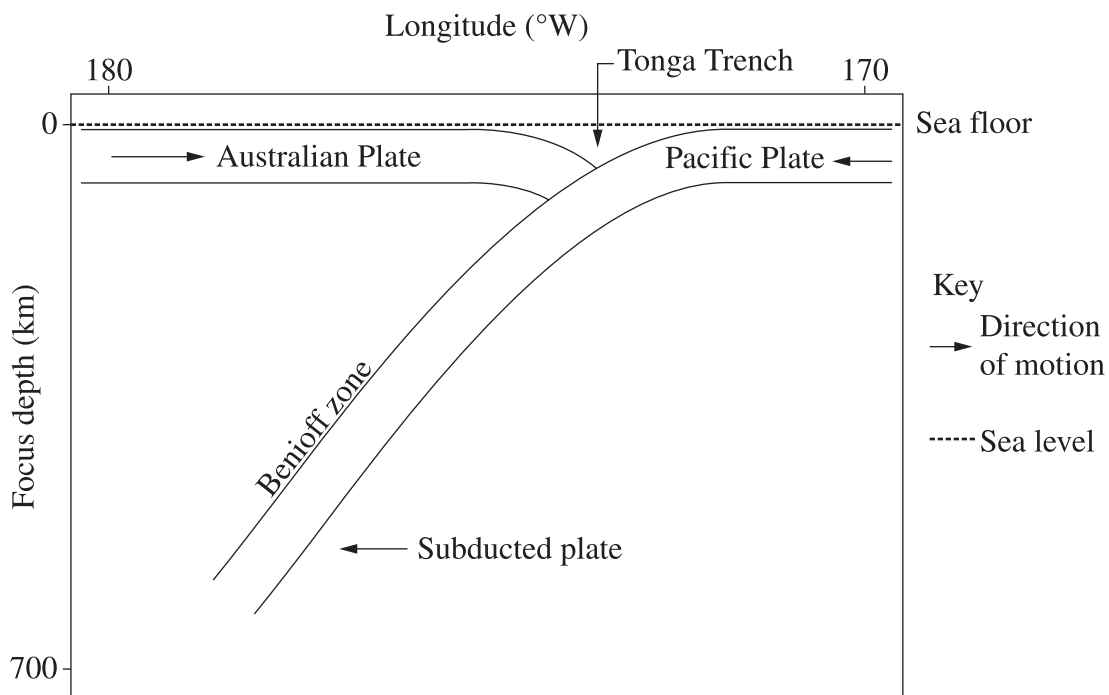
Question 23 (a)

Sample answer:



Question 23 (b)

Sample answer:



Question 24 (a)***Sample answer:***

Mass extinctions

Question 24 (b)***Sample answer:***

Event: Cretaceous extinction

The bolide impact hypothesis states that a large extraterrestrial object, such as a meteor or asteroid, collided with the earth. The major volcanic eruption theory states that extensive volcanism caused the extinction.

The bolide hypothesis suggests a rapid event whereas the volcanic eruption hypothesis would have been slower. Bolide impacts have an intense heat blast causing devastation near the impact. Dust and aerosols would reduce sunlight leading to widespread loss of plants, followed by loss of animals. Volcanism produces carbon dioxide which may have increased global warming to such an extent many species could not survive.

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

Fossil site: Canowindra Fish Bed

Large number of bottom feeding fish of only two species and a smaller number of six different species of larger carnivorous fish.

All occur close together in one sandstone layer.

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

The fish must have lived in a freshwater river or billabong that dried out quickly during a drought killing all the fish. The differences in the number of herbivores and carnivores shows the ecosystem had been in balance.

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

Cyanobacteria

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

Compared to the fossil forms modern stromatolites are rare and live in restricted shallow environments such as at Shark Bay. This is because in modern times there are many grazing invertebrates that feed on the cyanobacteria and larger organisms that can physically disrupt the bacterial mats. In the Archaen and Proterozoic advanced organisms were not present so cyanobacteria could flourish in many different locations.

Question 27***Sample answer:***

The development of vascular tissue by some early plants gave them an advantage in that they could grow taller and thus gain more light to photosynthesise. The vascular tissue enabled water to be absorbed by roots from deeper in the soil and be transported to all parts of the plant. The plants were also able to spread away from permanent water.

Question 28 (a)***Sample answer:***

Tilling, ploughing and harvesting machinery cause soil compaction. The porosity of the soil is thus reduced and this leads to a reduction in water infiltration. Fewer plants are able to grow in compacted soil and this allows wind and/or water erosion of the soil to increase.

Question 28 (b)***Sample answer:***

A management plan would be to reduce or eliminate tillage farming, and thus minimise the use of heavy machinery. This would reduce the amount of soil subjected to compaction thus allowing more soil to retain good water infiltration. Secondly, the use of minimum tillage farming would leave crop stubble in the ground which would act as a mulch, covering the soil thus reducing soil exposure to wind and running water. This would then reduce erosion in the areas at risk.

Question 29***Sample answer:***

An effective strategy would be to use pesticide 1 and also remove weaker plants. This would be effective because it would reduce the total amount of pesticides used, as pesticides 2 and 3 would be unnecessary. It would still give good control of all pests except fungus B, but no method seems to give effective control of that pest. The reduction in pesticide use would lessen the effect of pesticide residues on the environment.

On the other hand, pesticides would still have to be used because overall they give better control of a wider range of pests than the other methods. The use of pesticides is less labour-intensive, and therefore less costly.

Question 30 (a)***Sample answer:***

Energy use

Question 30 (b)***Sample answer:***

CO₂ emissions from energy production have continued to increase because people are using more electrical and electronic appliances in their homes therefore more fossil fuels are being burnt to produce the CO₂. On the other hand CO₂ emissions from forestry have decreased because of a decrease in demand for wood products. More trees are left to absorb CO₂ from the air.

Question 31***Sample answer:***

Recent advances in earth science, such as the theory of plate tectonics, have given us an understanding that the Australian continent has evolved over billions of years through the interaction of lithospheric plates. This has resulted in many different regions, each with unique climates, landforms and biodiversities, ranging from hot deserts to warm humid rainforests. Each region has vast natural resources including the biota, soil, underground and surface water, and commodities.

Early agricultural practices were based on European methods that were incompatible with Australian conditions. For example, forests were cut down and too many animals were allowed to graze on drier areas. Practices such as these led to degradation of the fragile communities. Earth and environmental science gives us a better understanding of the landmass and its resources. Geological studies teach us that richer soils are associated with basalts. Salinity studies show us that deep-rooted trees lower the water table and reduce salinity. Climate studies help with rainfall predictions and therefore we can better manage surface and underground water resources, reduce stocking rates in drier areas and therefore reduce soil erosion.

Without Earth and Environmental Science we would not have the depth of knowledge we now have of the dynamics of Australian ecosystems. We can now implement better management practices to minimise degradation and therefore use our diverse resources more sustainably than we have in the past.

Section II

Question 32 (a) (i)

Sample answer:

An introduced species is one that is not indigenous to a particular locality.

Question 32 (a) (ii)

Sample answer:

The dingo is an introduced species in Australia as it did not evolve in Australia. It can be classified as a native because it has been here long enough to be a part of a specific balanced ecosystem.

Question 32 (b)

Sample answer/Answers could include:

The graph shows that the use of mechanical devices was not effective. Despite an increase in devices to 9000 in 1928, the area covered by prickly pear continued to expand from about 21 million km² to almost 25 million km². Similarly the use of poison was ineffective. The area covered by prickly pear continued to expand even after 300 tonnes of poison was used in 1927 and again in 1928.

However, moths proved to be highly effective. Within 4 years of the release of the first moths, the area covered by prickly pear decreased dramatically from 25 million km² to only about 6 million km².

Question 32 (c) (i)

Sample answer:

Animal: Rabbit

Rabbits breed rapidly, allowing large populations to build up quickly. Rabbits can survive by eating many different types of vegetation, once again leading to an increase in population size to pest proportions.

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

Two strategies that have been used are:

1. Mechanical destruction of burrows
2. Biological control using rabbit calici virus

Mechanical destruction of burrows requires explosives or machinery to destroy the burrows. It is labour intensive and destroys the soil profile. It is relatively unsuccessful because rabbits dig other burrows.

Biological control is very effective because there is a high mortality rate. It does not damage the soil profile and does not affect other animal species. A negative is some rabbits develop some immunity to calici virus.

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

The elevated area at B was probably too dry to allow the introduced species to spread there.

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

The students would need to collect data from an area within the reserve where there were few introduced plants. Collection of additional data on light intensity, soil moisture, abundance and distribution mapping would allow comparisons to be made about the impact of the introduced species on natives.

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

With the Bradley method, introduced species are removed from areas where they are least numerous so their impact on that part of the community is minimised as much as possible. In the reserve, introduced species are most numerous along the creek and least numerous on the elevated areas. Introduced species could be removed from areas near B then from A moving eastwards, allowing the native species to regenerate faster than the introduced species. The rate of regeneration would dictate the rate of weeding.

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

Australia has a unique flora and fauna that has evolved over time and are in equilibrium with arid and/or fragile environments. Plants such as blackberry and many ornamental trees were deliberately brought into Australia by early white settlers. Because they did not have native predators, many escaped and spread rapidly.

Some plant products brought into Australia have allowed entry of pests. The European wasp which has the potential to destroy the timber industry came with imported timber.

Exotic plants may not have native predators and therefore reproduce more rapidly than native plants. An example is prickly pear. Exotic plants can change aspects of the Australian environment.

Consequently many introduced plants can become a pest if allowed into Australia. These plants can reduce farming productivity and out-compete native species thus changing the equilibrium of fragile environments. Australia must maintain strict quarantine regulations.

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

It is fossil because it is formed from organisms that lived long ago, and it is a fuel because it can be burned to give energy.

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

As the rank of coal increases the energy yield increases. Also, fixed carbon increases but volatile matter and water decrease as rank increases.

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

The supply of energy from coal increases moderately from 1980 to 2020 whereas energy from wind and solar is negligible until the 1990s with both increasing after that. Wind supply only begins to increase in the late 1990s and then increases most rapidly of all.

In 2020, total wind and solar energy supply is 50 petajoules compared to more than 2000 petajoules from coal. Governments have subsidised renewable energy sources making them cheaper. Therefore there have been increases in wind and solar and less reliance on fossil fuel sources.

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

Each fossil fuel is formed in a unique environment which has specific features, for example some coals are formed in delta environments. Locations with the same geological features indicate similar environments of formation. Because each fossil fuel is formed in an environment with unique features we should look for new localities which have the same geological features as those for known fossil fuel deposits.

Question 33 (c) (ii)***Sample answer/Answers could include:***

After literature reviews for both, coal exploration uses geological mapping whereas oil exploration uses geophysical methods such as seismic surveys.

Both methods use an exploration drilling program to intersect likely targets. Oil exploration holes are generally deeper than coal exploration holes. Both exploration methods geophysically log the holes. If oil is intersected, directional drilling is used to define the size of the reservoir. If coal is intersected, many closely-spaced holes are drilled.

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

More energy is produced during complete combustion than during incomplete combustion.

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

Experiment 2 represents incomplete combustion. To bring about complete combustion, a greater supply of oxygen is required.

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

Carbon is a particulate that causes visible pollution and respiratory illnesses if inhaled. Carbon monoxide is a poisonous gas causing death if inhaled. Water is a greenhouse gas.

Overall the products of incomplete combustion are all detrimental to the environment and/or to human health.

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

Australia relies on fossil fuels, such as coal and petroleum, for electricity generation and transport. Reserves of these are decreasing and we are using more each year. Coal is a 'dirty' energy and its emissions contribute to global warming.

Australia has a low base level use of alternative renewable energy sources such as hydroelectricity, tidal and wave generators, biofuels, and no nuclear energy. Synthetic oil can be produced from biomass and ethanol, produced from sugar cane or grain, can be added to petrol. Both products would reduce the consumption of petroleum products.

Alternative energy sources are initially costly because of the set up and infrastructure costs. However, once in place they will be less costly than petroleum products which will become more expensive as reserves dwindle. Alternative energy sources are less damaging to the environment than coal combustion.

There is an urgent need to set up alternative energy projects in addition to wind and solar projects to offset our reliance on petroleum and coal. This will reduce our carbon footprint thus contributing less to global warming.

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

Timber (renewable) and copper (non-renewable)

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

Computers process large amounts of data very rapidly which allows accurate maps to be produced and new models of ore-forming processes to be developed. These can be used to better target exploration programs.

Question 34 (b)***Sample answer/Answers could include:***

A fall in the price of nickel below \$20 per kilogram would halve the mine income and reduce the viability of the mine.

The value of each tonne of ore mined could be doubled if only the ore with twice the grade (previously mined) was taken. Income would be doubled and the mine would remain viable.

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

The size of the ore deposit at Cadia Hill was determined by drilling a large number of holes in a grid pattern until no mineralisation was encountered. The grade was determined by analysing the copper and gold content of drill cores and using statistical methods to calculate an average grade.

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

At Cadia Hill, the deposit is very large but of a very low grade. Therefore a very large volume of ore needs to be mined and processed. In this case open pit mining is most suitable. To process this large volume of ore a large SAG mill and ball mills are used to crush and grind the ore. A high volume flotation circuit is the most efficient way to separate the low ore mineral contents from the gangue.

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

Qualitative – streak
Quantitative – density

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

Density could be worked out by first measuring the mass of the mineral sample. The volume could then be worked out by measuring the amount of water displaced using a measuring cylinder. The density could then be calculated by dividing mass by volume.

Question 34 (d) (iii)***Sample answer/Answers could include:***

The ore minerals are A, D and F. The gangue minerals are B, C and E. The ore minerals generally have a metallic lustre, higher density and are strongly coloured or have darker streaks, compared to gangue minerals which have a lower density and white or pale streaks.

Question 34 (e)***Sample answer/Answers could include:***

At Cadia Hill mine, environmental regulations have affected the operation of the mine from the beginning. In order to reduce air pollution the day-to-day operations include watering roadways to reduce dust emission. Run-off water from roads, dumps and ore stock piles is stored in containment ponds. The water is re-used in ore processing, thus reducing demand on local water supplies, and at the same time preventing any contaminants leaving the mine site. This is in accordance with the regulations imposed on the mine.

In the long-term, government regulations require the mine site to be rehabilitated after mining is finished. Rehabilitation procedures are carried out in parallel with the mining. This reduces the need for a larger amount of rehabilitation to be done after mining is completed and helps to keep the surrounding land in a sustainably useful state for farming, forestry or nature reserves. These environmental regulations may add to the day-to-day costs of mining, but reduce the long-term cost to both the mining company and the taxpayer.

Question 35 (a) (i)***Sample answer/Answers could include:***

Echo sounder and dredges

Question 35 (a) (ii)***Sample answer/Answers could include:***

One deep sea sediment is siliceous ooze. Its origin is from the silica discs and plates secreted by diatoms and radiolarians.

Its distribution is mainly in cold ocean water basins since these organisms are found there. They cover 15% of the deep sea floor.

Question 35 (b)***Sample answer:***

Highest salinities (greater than 36 g/l) are in the warm tropical regions of the north and south Pacific Ocean. Lowest salinities (<32g/l) are around the margins of the continents and across the central part of the ocean (32 to 34g/l).

The high salinities in the tropical region show where evaporation is greatest. The low salinities around the margin show where freshwater runoff is highest whereas the low salinities in the central part show where precipitation is highest.

Question 35 (c) (i)***Sample answer:***

We now know that the undersea mountains that form a ridge under the Atlantic and Antarctic oceans have been formed at divergent plate boundaries as they rift apart. Hydrothermal vents formed at these active ridges result in the deposition of metals and sulphide minerals on the ocean floor causing a chemical environment surrounded by hot brine solutions. The rifting also explains the high incidence of earthquakes along mid-oceanic ridges.

Question 35 (c) (ii)***Sample answer:***

The biotic communities around deep ocean vents are highly specialised life forms that can withstand high pressures, high temperatures, high salinities and sulphurous chemical environments. The food chains begin with chemosynthetic bacteria which are able to use the hydrogen, sulphur and methane given off from the hydrothermal vents to produce food. Invertebrates have evolved to survive the harsh environments around the vents. They include giant tube worms, clams, shrimps and octopus that feed on the bacteria.

Question 35 (d) (i)***Sample answer:***

Short breeding cycle and easy to feed.

Question 35 (d) (ii)***Sample answer:***

All variables other than the salinity and temperature must be kept the same. In the first experiment the temperature should be varied and in the second experiment the salinity should be varied.

Question 35 (d) (iii)***Sample answer:***

The tolerance of brine shrimp to temperature change is limited, with an optimal temperature of 25°C and less tolerance for temperatures between 20°C and 30°C. The tolerance to salinity is much greater since more than 40% of the shrimp hatch in salinities between 20 and 90 g/L.

Question 35 (e)***Sample answer:***

Global circulation patterns influence temperature, salinity, weather patterns and the distribution of substances in the water.

Humans use the oceans for the disposal of sewage and stormwater. Both carry heavy metals, fertilisers and other toxic materials into the oceans. These materials are spread along coastlines by coastal currents and into the deep ocean by the major global ocean currents. Because we know harmful materials will be distributed throughout the oceans we should find alternative ways of disposing of them.

Humans farm fish and other marine organisms. Some live in deep cold water and others live in shallow warm water. A knowledge of ocean currents allows us to predict where the temperature zones occur. A rich nutrient supply is brought to the surface in zones of up-welling water and this is where large populations of fish are found. Because of a knowledge of ocean currents, the fishing industry knows where marine organisms are to be found and they can be harvested in a more sustainable way.