



2011 Earth and Environmental Science HSC Examination '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 (a)

Sample answer:

A = continental

B = oceanic

Question 21 (b)

Sample answer:

Continental crust is less dense than oceanic crust because it has a higher silica content. Oceanic crust is younger than continental crust because it is formed at mid-ocean ridges, whereas continental crust is formed at subduction zones.

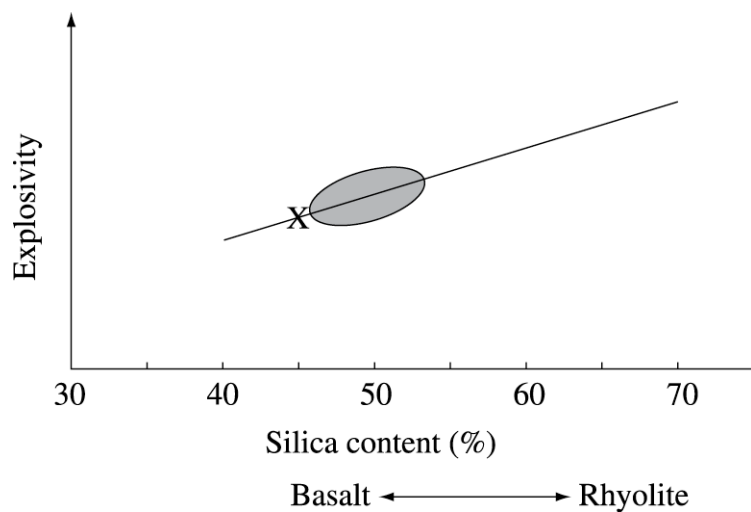
Question 22 (a) (i)

Sample answer:

45%

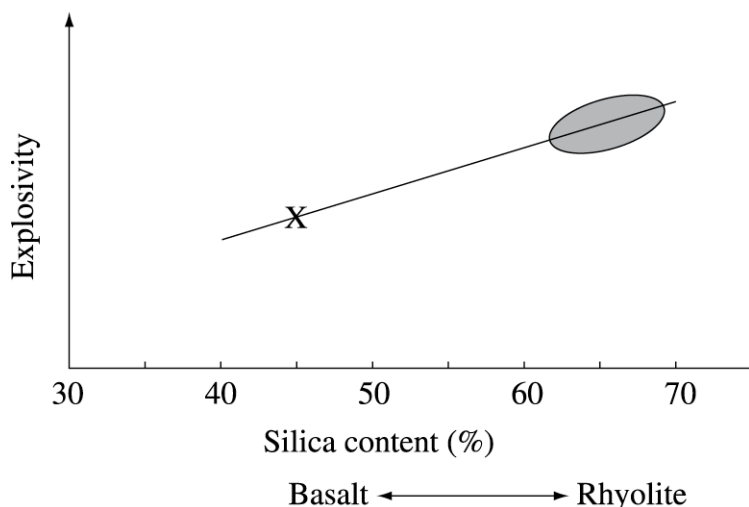
Question 22 (a)(ii)

Sample answer:



Question 22 (a)(iii)

Sample answer:



Question 22 (b)

Sample answer:

Each volcano in the chain shown on the map represents an eruption from a hot spot or area of intraplate volcanic activity. Partial melting of the mantle produces a plume of magma which rises to the surface where a volcano forms. The graph shows the increasing age of the volcanoes the further they are from Kilauea, which is the most recent. The maps show that the hot spot first erupted near the Aleutian Trench, with younger eruptions as the plate moved north then northwest.

Question 23

Sample answer:

Earthquake waves cause violent shaking of the ground surface and buildings, which leads to failure of buildings if they are not well designed and well constructed. Damage can be minimised by using quality construction materials, such as reinforced concrete, and advanced engineering. For example, buildings can be placed on rollers or moveable supports to isolate them from the shaking. The introduction of building codes and planning codes prevents buildings from being poorly built in earthquake-prone areas.

Question 24

Sample answer:

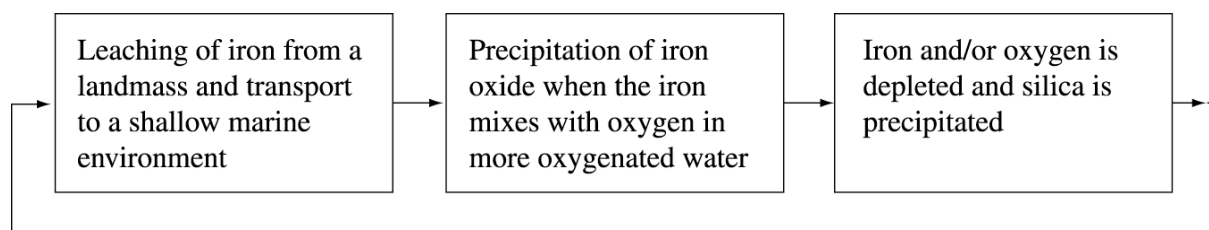
A lahar is a mud flow of wet volcanic debris that can bury vegetation causing it to die.

An ash flow is a body of hot dry pyroclastic debris that can bury organisms causing them to suffocate.

Poisonous gas emitted during an eruption kills organisms because of its toxicity.

Question 25 (a)

Sample answer:



Question 25 (b)

Sample answer:

Banded-iron formations only form when there is oxygen available to combine with the iron. Earths' early atmosphere and oceans did not contain oxygen. The first oxygen had to be produced by oxygen-producing organisms such as cyanobacteria.

Question 26 (a)

Sample answer:

Animal Group	Main environment inhabited	Method for getting oxygen	Age Range		
			Palaeozoic	Mesozoic	Cenozoic
Fish	Aquatic	Gills to absorb oxygen from water			
Amphibians	Terrestrial	Lungs to absorb oxygen from air			
Reptiles	Terrestrial	Lungs to absorb oxygen from air			

Note: The answer could have 'water' and 'gills to absorb oxygen from water' for amphibians.

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

Animals in a terrestrial environment face dehydration because of the atmosphere. Amphibians overcome this by living near water in a humid environment whereas reptiles developed a scaly skin that stops the loss of water through the skin.

A second challenge was the need to support the body. Both amphibians and reptiles have a bony skeleton that supports the muscle tissue and organs.

Question 27***Sample answer:***

Mass extinctions are caused by large-scale catastrophic events, such as the bolide event that was thought to cause the mass extinction at the end of the Cretaceous period, large-scale glaciations or massive volcanic eruptions. Mass extinctions occur on a global scale and affect both terrestrial and marine environments. Large numbers of taxa become extinct.

Smaller extinction events are regional rather than global. Climatic change and human intervention are causes and the effects are the extinction of target groups such as the Australian megafauna and, sometimes, entire ecosystems.

Question 28***Sample answer:***

Problem 1: Toxic elements, such as arsenic, could have leached from the waste rock and entered the dam.

Solution 1: Construct retaining walls and storage dams around the waste dumps so that the leachates are prevented from leaving the site.

Problem 2: Runoff during heavy rain could have caused soil erosion, which would have transported waste into nearby streams.

Solution 2: Rehabilitate the site by adding topsoil and planting native trees and grasses living in the area. This would prevent runoff.

Question 29 (a)***Sample answer:***

Article on a website and an article in a scientific journal.

Question 29 (b) (i)***Sample answer:***

Checked the authors' integrity by seeing if they had published other peer-reviewed articles on pesticides. The sources were checked to see if they were reputable international sources.

Question 29 (b) (ii)***Sample answer:***

The reliability of the journal and website contents was checked for consistency, such as comparing the data in the selected sources with data in as many other sources as possible.

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

Overgrazing could have resulted in a loss of natural vegetation allowing excessive evaporation, which brings salt to the surface.

Clearing of vegetation, such as deep-rooted trees, could have resulted in elevation of the watertable as less water was being removed from the sub-soil. Salt would rise to the surface.

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

Strategy: Undertake surface drainage by constructing deep ditches.

The ditches allow surface runoff and near-surface salty ground water to be removed from the area. This excess water can then be stored in evaporation ponds where the salt can be harvested.

Over time the salt is effectively removed from the ecosystem.

Question 31***Sample answer:***

Australian ecosystems are fragile because of the nature of the Australian continent. Low rainfall and high temperatures have resulted in equilibrium between the biotic and abiotic factors. Small changes in any component can lead to destruction of an ecosystem.

With continued research we have gained a better understanding of Earth's processes such as soil formation, erosion and weathering and salinity. For example, soils in parts of eastern Australia are fertile because they are derived from more recent volcanic activity whereas soils in Western Australia have developed on eroded surfaces and have been leached.

Research has provided us with a better understanding of environmental factors such as water availability in urban and rural areas, deleterious effect of greenhouse gases on climate, methods for agricultural and forestry management, and the impact of pesticides on native flora and fauna.

We are now better able to manage Australian ecosystems because, if we make changes, we can now monitor and even predict the impact of the biotic and abiotic components on an ecosystem.

During the first two centuries after white settlement of Australia, European-style farming and management practices were used, without regard to the ecosystems. This resulted in degradation of the Australian environment. We are now able to minimise the impact of our actions on the ecosystems and thus better manage the fragile nature of ecosystems.

Section II

Question 32 (a) (i)

Sample answer:

The native species occupies small isolated areas now, whereas it previously occupied a large continuous area across northern Australia. The introduced species occupies a continuous area across northeastern Australia and this is predicted to increase, including a new population in Western Australia.

Question 32 (a) (ii)

Sample answer:

The introduced species will increase its distribution due to its high-dispersal ability, linked to its adaptation to new environments. The current isolated population in northern NSW will spread to the larger northern population for the same reason.

A new isolated population on the southern coast of Western Australia suggests dispersal is facilitated by human activity.

Question 32 (b)

Sample answer:

This treaty will help to prevent the emptying of ballast water near the Australian coastline. In the past species from other waters have travelled in ballast water. Legislation against this practice will ensure that ballast water must be emptied further out to sea. The spread or introduction of new species into Australia in this way will be minimised because the organisms will not readily reach Australian waters.

Question 32 (c)

Sample answer:

Species – rabbit.

One strategy to control rabbits is biological, using myxomatosis: rabbits are infected with a harmful organism that causes death.

A second control method is to use poison baits that are spread in areas known to be infested with rabbits.

Myxomatosis is specific to rabbits and only targets them, thus reducing the risk of killing native species. Other animals can eat baits, causing death to non-target animals. Both methods can control rabbits, but biological control causes less harm to native animals.

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

Table – Numbers of seedlings in three communities

	Number of seedlings		
Community	Eucalypt	Grass	Introduced species
Location 1	4	1	25
Location 2	2	5	35
Location 3	23	19	2

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

For locations 1 and 2 the number of introduced species' seedlings is larger (25 or greater) than the number of grass and eucalypt seedlings (5 or less). For location 3, it is the reverse with more than 19 grass and 23 eucalypt seedlings and only 2 introduced species' seedlings.

Conclusion:

To determine the impact of an introduced species the number of seedlings of eucalypt, grass and introduced species seedlings were counted and it was shown the introduced species was more abundant at two locations but not at the third.

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

Other locations could have been selected and the number of seedlings could have been counted at these locations, so that the results could be compared to see if the same trends were observed.

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

Humans have been regarded as the most harmful of species introduced to Australia. The Australian environment is fragile and comprises plants and animals endemic to and in equilibrium with the abiotic components, such as infertile soils, low rainfall and high temperatures. Aborigines are not endemic and brought animals such as dingoes. European Australians have had a more profound impact, deliberately introducing species such as European and African plants, cane toads, foxes, rabbits and camels. In some cases the animals and plants were brought for food and were distributed over the continent. Some introduced species, such as marine shellfish and insects have been accidentally introduced into Australia.

In many cases the introduced species had a detrimental effect on native species, outcompeting them for food and reproducing faster. Thus native biodiversity has been reduced. Because of human activity a lot more damage has been done to the environment than if humans had not come or had not introduced new species.

Question 33 (a) (i)

Sample answer:

A *non-renewable resource* is a natural resource that is consumed at a rate greater than it can be produced, for example, coal.

Question 33 (a) (ii)

Sample answer:

Catalytic cracking involves using high temperatures and a catalyst, such as zeolite, to break long-chain petroleum molecules into smaller hydrocarbon units, to produce materials that are either not naturally available in that reserve or are not present in required commercial quantities.

Question 33 (b)

Sample answer:

Exploration geologists use seismic surveys to pass waves into the Earth's crust to determine the shape of regional lithological units. The structures, broadly identified through this regional survey, need to be proved, specifically by using an exploration-drilling program to accurately ascertain the location and nature of possible reservoirs. Subsequent drilling after exploration is required to prove the quality, maturity and extent of the reserve located within the identified trap.

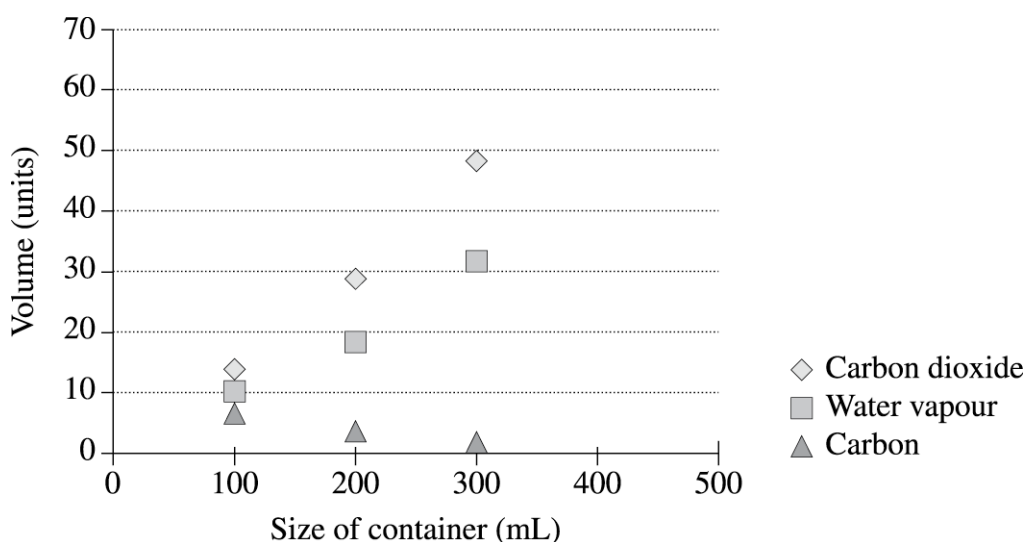
Question 33 (c)

Sample answer:

Coalification and hydrocarbon maturation both refer to the lithification, diagenesis and thermal breakdown of once living organisms to give carbon based products. During coalification, terrestrial plant matter is heated at depth, over time, to produce coal which is a complex organic material. During maturation, terrestrial or marine plant matter is heated over time to produce a mixture of hydrocarbons.

Question 33 (d) (i)

Sample answer:



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

As the container volume increases, the volumes of carbon dioxide and water vapour increase from 15 and 10 units to 48 and 32 units respectively. However, the amount of carbon fell from 5 units to 3 units.

Conclusion:

To compare the products of combustion, coal was burnt in three containers and it was shown that the volumes of carbon dioxide and water vapour increased, but the amount of carbon reduced as the container volume increased.

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

Containers with different volumes to those selected could have been taken, and the same amount of carbon burnt in each of the new containers, so that the results could be compared to see if the same trends were observed.

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

At present, society relies heavily on fossil fuels, especially coal, to produce electricity and petroleum for transport fuels. Alternative sources of energy include nuclear, solar and wind energy for electricity generation and biofuels such as alcohol for transport. Because of the growth in population and the increased standard of living for many developing countries, there will be an increased need for energy in the future.

Petroleum resources are diminishing as demand increases and coal combustion is damaging to the environment, with increasing greenhouse gas levels leading to global warming.

Because of diminishing petroleum resources and the increasing damage to the environment through coal combustion there is a need to find new forms of energy, especially renewable energy sources, such as solar, wind and tidal energy sources. Society must change its reliance on fossil fuels, increase its use of renewable energy forms and develop other alternatives.

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

Lead is found in the Broken Hill metamorphic belt.

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

Broken Hill has silver, lead and zinc in rich lodes in hydrothermal deposits. The metal sulphides were deposited on the ocean floor near a mid-ocean ridge then tilted to almost 90° by a later uplift that also caused regional metamorphism.

Question 34 (b)

Sample answer:

In the first three years, the overburden was removed and infrastructure for the mine was established with little or no income from the sale of the resource. In years 4–9, mining of the mineral produced profits that fluctuated as ore price, grade and tonnages changed from year to year. In year 10, rehabilitation work was done to satisfy the requirements of the environmental impact statement and there was no income.

Question 34 (c)

Sample answer:

The NSW state government requires an EIS for all mining operations. This has affected mining operations, as the environment needs to be considered to get approval for the mine to go ahead. The Native Title or 'Mabo' decision of the High Court of Australia had wide-ranging impacts on the operations of mines. Following this decision mines needed approval from traditional owners before operations could commence. This sometimes caused extra expense for the mining operation because they had to avoid sacred sites.

Question 34 (d) (i)

Sample answer:

Ore	Hardness		
	<i>Ore mineral</i>	<i>Gangue mineral A</i>	<i>Gangue mineral B</i>
Lead ore	2.5	7	6
Copper ore	3.5	7	6.5
Zinc ore	4	6	6

Question 34 (d) (ii)

Sample answer:

Trends:

For the lead, copper and zinc ores, the ore mineral had hardness ranging from 2.5 to 4, whereas the gangue minerals have a hardness ranging from 6 to 7.

Conclusion:

To distinguish between ore minerals and gangue minerals, the hardness of the minerals was tested and it was found that ore minerals are softer than gangue minerals.

Question 34 (d) (iii)

Sample answer:

The hardness of ore minerals and gangue minerals in other ores could have been tested, and the results compared with the initial results, to see if the same trends occurred.

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

Exploration of a mineral deposit generally results in disturbance of the surface and vegetation. For example, drilling results in contaminated water being released and the vegetation and soil is generally disturbed.

Exploitation of a mineral deposit generally causes much more damage to the land surface. For example, an open-cut mine may cover hectares, leave a large hole and large mounds of waste rock and tailings from the processing plants. An underground mine can cause subsidence, which results in disturbance of the surface and disruption of the water table.

Modern laws require mines to disturb the area as little as possible and to rehabilitate areas where damage occurs. Examining the environmental issues such as distribution of flora and fauna, native culture and soil qualities before exploration provides a database for minimising disturbance and helping rehabilitation.

Environmental issues should be considered in both exploration and exploitation of mines.

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

As light intensity decreases with depth, there are fewer phytoplankton.

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

Hydrothermal vents are holes in the sea floor at active mid-ocean ridges that emit heated water. The water passes through the underlying rock, dissolving elements. When the hot fluid or brine mixes with the colder seawater, metals can be precipitated.

Biotic communities evolve around vents and contain species that are different to those living in the photic zone. Organisms such as bacteria and archaea use sulphur, hydrogen and methane to synthesis food. Other animals live on these primary producers, leading to a greater diversity of marine organisms.

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

Modern studies of oceans use many technologies, such as echo sounders, submersibles, sediment sampling, geophysics and remote sensing. Each technology provides unique data. For example, remote sensing using satellites can gain data on ocean currents, surface temperatures, ice cover and salinity. Sediment collection provides samples that can determine the compositions of each. Composition can then be related to sediment source. Because of the different data provided by the different technologies, it is possible to undertake a more comprehensive study of ocean. It is important to develop new technologies to better improve our understanding of oceans.

Question 35 (c)

Sample answer:

Sediment at X comprises terrigenous sand, clay and organic debris, such as shells transported from the coastal zone. The sand and clay is derived from the landmass as a result of weathering and erosion.

At Y the sediment comprises siliceous ooze, calcareous ooze, deep sea clay and some terrigenous sediments. The calcareous and siliceous oozes are composed of tiny skeletons of coccoliths, or foraminifera and radiolaria respectively.

Question 35 (d) (i)

Sample answer:

Salt	Temperature (°C)		
	0	20	100
Sodium chloride	35	36	39
Potassium chloride	28	34	58
Magnesium chloride	53	55	73

Question 35 (d) (ii)

Sample answer:

Trends:

The mass of sodium chloride, potassium chloride and magnesium chloride dissolved in water increased as the temperature increased. More magnesium chloride dissolved at each temperature than sodium chloride and potassium chloride.

Conclusion:

To study the influence of water temperature on solubility, three salts were dissolved in water at different temperatures. More salt dissolved at higher temperatures in each case.

Question 35 (d) (iii)

Sample answer:

Other salts could be dissolved in water at some temperatures and the results compared to see if the same trends could be observed.

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

Many communities discharge sewage into the oceans without significant treatment. This reduces visibility. Society also dumps waste materials, including toxic wastes, metals and organic chemicals into the oceans, which can kill marine organisms, thus disrupting the food chain and reducing the diversity of flora and fauna. Human activity on the land results in increased erosion, which leads to higher sediment input into the oceans. The sediments, as well as the human wastes, are spread around the oceans by the currents.

The sediments can produce turbid water, which allows less light penetration, resulting in less biodiversity.

Humans harvest the biological resources, such as fish, sharks, crustaceans and shellfish. Overfishing results in diminished stocks and even extinction of some species. This is illustrated by the much poorer catches of fish in the North Sea. Some sharks are on the verge of extinction.

Humans have had a very harmful affect on both the nature of the oceans and the biological resources. Humans must change their habits or much more damage will be done.