BOARD OF STUDIES
NEW SOUTH WALES

2013 HSC Earth and Environmental Science Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

Question	Answer
1	A
2	A
3	D
4	B
5	C
6	A
7	D
8	D
9	D
10	C
11	C
12	B
13	C
14	D
15	A
16	A
17	B
18	B
19	B
20	D

Section I, Part B

Question 21 (a)

Criteria	Marks
• Identifies an appropriate igneous rock • Gives features of the eruption	3
• Identifies an appropriate igneous rock • Gives one feature of the eruption	2
• Gives some relevant information	1

Sample answer:

Basalt. Quiet, non-explosive eruption producing large amounts of low viscosity lava that flows quickly for some distance.

Question 21 (b)

Criteria	Marks
• Clearly shows the relationship between, and correctly identifies the products formed from, the volcanic eruption and the cooling of Western Europe • Recognises the effects of time and distance	4
• Outlines the relationship between the products formed from the volcanic eruption and the cooling effects AND/OR the effects of time and distance	3
• Gives a product AND • Recognises cooling effects AND/OR the time and distance effects	2
• Gives some relevant information	1

Sample answer:

The sulphur dioxide forms droplets (aerosols) of sulphuric acid in the stratosphere. Ash is also trapped in the stratosphere and together, and over time, they are carried to the northern hemisphere where they reflect incoming solar radiation thus cooling the surface beneath.

Question 22

Criteria	Marks
• Gives detailed information about gravity, heat flow and crustal movement • Gives the relationship between the three at plate boundaries	4
• Gives information about gravity, heat flow and crustal movement • Gives relationships between the three	3
• Recalls some information about crustal movement and gravity or heat flow OR • Gives relationships between crustal movement and gravity or heat flow	2
• Gives some relevant information	1

Sample answer:

Heat escaping from the mantle creates convection currents that rise under the crust, creating mid-ocean ridges (MORs). The currents move horizontally from the MORs dragging the crust with them. Gravity helps pull the crust from the more elevated MORs. At the trenches the descending currents pull the crust down. Gravity also drags the crust down aided by the reduced buoyancy of the crust as it cools.

Question 23 (a)

Criteria	Marks
• Names a hazard • Provides information on the origin of the hazard	2
• Gives some relevant information	1

Sample answer:

Magma is created when the Pacific Plate is subducted beneath the Australian Plate. The magma rises to the surface and the lava flows over the surface creating a hazard to living organisms.

Question 23 (b)

Criteria	Marks
• Details a strategy for minimising the effect of the hazard • Shows how the effect of the hazard is minimised	3
• Gives information on a strategy AND/OR • Outlines how the effect of the hazard is minimised	2
• Gives some relevant information	1

Sample answer:

Establish a network of seismometers and tilt meters to monitor magma activity. This would give early warning of a potential eruption that could produce hazardous lava flows. This allows early evacuation of people from high risk areas thus minimising harm to people.

Question 24

Criteria	Marks
• Clearly explains how each model illustrates the process of evolution it represents	4
• Outlines how each model illustrates the process of evolution OR • Clearly explains how one model illustrates the process of evolution	3
• Outlines how one model illustrates the process of evolution OR • Outlines TWO models of evolution OR • Describes both graphs	2
• Gives some relevant information	1

Sample answer:

Graph A – Gradualism
Graph B – Punctuated Equilibrium

Graph A is a straight line which illustrates evolution is a series of small incremental species changes, relatively evenly spaced over a long period of time. Darwin's theory of evolution by natural selection is consistent with this model.

Graph B is a stepped line which illustrates a series of small incremental species changes over time followed by periods of relatively rapid species changes. This model is consistent with Darwin's theory of natural selection interrupted by periods of rapid speciation as occurs after mass extinction events.

Question 25

Criteria	Marks
• Names a mass extinction event and a smaller extinction event • Has an understanding of both the named mass extinction event and the named smaller extinction event • Completes the table with appropriate comparisons	6
• Names a mass extinction event and/or a smaller extinction event • Has a knowledge of both a mass extinction event and a smaller extinction event • Completes most of the table giving most of the comparisons	4–5
• Names a mass extinction event and/or a smaller extinction event • Completes some of the table giving some comparisons	2–3
• Gives some relevant information	1

Sample answer:

	Mass extinction event	*Smaller extinction event*
	Name: Permian mass extinction	Name: Australian megafauna extinction
Comparison 1	More than 95% of all marine species became extinct	Most of the Australian megafauna became extinct
Comparison 2	Was a global event	Occurred in Australia and not elsewhere
Comparison 3	Occurred rapidly (less than 2 million years)	Occurred very rapidly (about 10 000 years)

Question 26 (a) (i)

Criteria	Marks
• Gives two differences	2
• Gives some relevant information	1

Sample answer:

Organisms in *Image A* were sessile bottom dwellers whereas organisms in *Image B* were mobile.

Organisms in *Image A* had soft bodies where organisms in *Image B* had hard external skeletons.

Question 26 (a) (ii)

Criteria	Marks
• Gives the advantage of one feature of an organism in *Image B*	2
• Gives some relevant information	1

Sample answer:

Hard external coverings give the organisms in *Image B* protection from predators and injury, whereas the organisms in *Image A* lack these defence structures.

Question 26 (b)

Criteria	Marks
• Outlines advantages of models and/or simulations	2
• Gives some relevant information	1

Sample answer:

Models are reconstructions such as 3D images based on limited evidence such as a few fossil bones. Features are interpreted thus giving a better understanding of extinct organisms.

Simulations better show the interaction between fossil organisms and their environments based on our understanding of modern environments.

Question 27

Criteria	Marks
• Identifies one management strategy • Describes features of the strategy • Makes a clear judgment on the effectiveness of the strategy with a supporting argument	4
• Identifies one management strategy • Outlines features of the strategy • Makes a judgment on the effectiveness of the strategy	3
• Identifies one management strategy • Gives some information relevant to the strategy	2
• Gives some relevant information	1

Sample answer:

Strategy: Biological controls

Biological controls reduce pest populations by using natural predators such as insects or pathogens, which attack the pest and reduce its numbers. For example, citrus scale is an insect pest that feeds on citrus stems and leaves. Ladybird beetles can be introduced as a natural predator eliminating the citrus scale pest. Biological controls can be expensive and can become pests themselves. However they are highly successful and prevent bioaccumulation/biomagnification of pesticides. Biological controls therefore minimise the effect on non-target species.

Question 28 (a)

Criteria	Marks
• Gives ONE relevant reason why the results may not be valid	1

Sample answer:

Mine waste with seeds and chemical *X* were taken from three sites whilst the control (mine waste with seeds) was taken from one site only.

Question 28 (b)

Criteria	Marks
• Identifies problems of abandoned mine waste • Describes how the problems could be reduced using chemical *X*	4
• Identifies problems of abandoned mine waste • Outlines how the problems might be reduced using chemical *X*	3
• Identifies a problem • Gives some relevant information about the problem	2
• Gives some relevant information	1

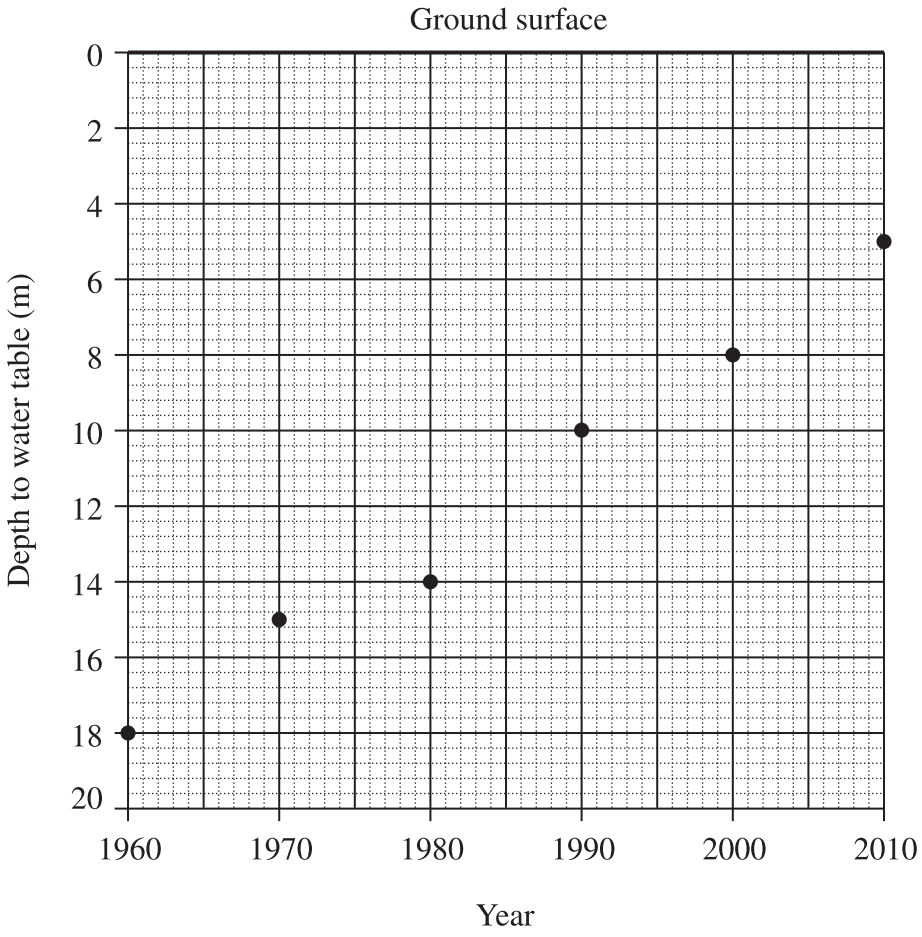
Sample answer:

The regrowth of vegetation and erosion are two problems associated with contaminated, abandoned mine sites. Because chemical *X* binds the toxins to the waste particles, the toxins are less likely to be ingested by plants and animals than they would be in an unbound state. Thus vegetation is less affected by the toxins and will regrow more quicky and help reduce soil erosion as well.

Question 29 (a)

Criteria	Marks
• Correctly plots all points on the graph • Correctly labels X and Y axes	2
• Gives some relevant information	1

Sample answer:



Question 29 (b)

Criteria	Marks
• Identifies changes in depth to water table • States a valid reason for the change in depth to water table	2
• Gives some relevant information	1

Sample answer:

From the graph, the depth to the water table has decreased indicating the water table has risen closer to the surface. Excess water from irrigation could have caused water to seep through the soil to the bore, thus causing the water table to rise.

Question 29 (c)

Criteria	Marks
• Describes a strategy • Shows how the strategy reverses the trend	3
• Outlines a strategy and provides additional information	2
• Gives some relevant information	1

Sample answer:

By planting large deep-rooted plants, such as trees, the roots will penetrate deeper into the soil and absorb more water because they need more water to balance increased transpiration rates. Because the volume of water in the soil is reduced, the water table drops and the trend shown in the data is reversed.

Question 30

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of Australia's resources and environments • Clearly links better management of Australia's resources and environments to concepts of earth and environmental science • Makes a clear judgment using supporting arguments • Demonstrates a coherent and logical progression of thought and indicates a high level use of scientific principles, ideas and terminology • Includes examples	7
• Has a knowledge of Australia's resources and environments • Links the management of resources and environments to concepts of earth and environmental science • Makes a clear judgment using a supporting argument • Uses appropriate terminology, progression of thought and scientific principles • Includes examples	5–6
• Recalls relevant knowledge of Australia's resources and environments and/or concepts of earth and environmental science OR links knowledge of Australia's resources and environments to concepts of earth and environmental science • Uses suitable terminology and/or progression of thought • Includes at least one example	3–4
• Provides some relevant information	1–2

Sample answer:

An understanding of the concepts of earth and environmental science leads to a detailed knowledge of Australia's resources and environments. Australian society has operated at an unsustainable level to such an extent we have overexploited geological resources such as soil and fossil fuels, and harmed many fragile environments. Earth studies provide an understanding of the formation, exploitation and utilisation of Australia's finite resources. Using this knowledge we can find alternatives for those resources being overexploited and monitor those for which there are no alternatives. This will lead to a more sustainable use of our resources.

We have altered the landscape so much that plants and animals cannot cope with the new physical conditions that now exist. If society had a greater understanding of the complexity of the physical and biotic components of the environments the harm to our continent would be reduced. The theories of management strategies and sustainable resource utilisation, which are already understood, would be broadly supported by society and more efficiently implemented. This would reduce human impact on the continent. Problems such as global warming, habitat destruction and water pollution would be better controlled.

Section II

Question 31 (a) (i)

Criteria	Marks
• Correctly defines the term non-indigenous	1

Sample answer:

Non-indigenous – not native to an area

Question 31 (a) (ii)

Criteria	Marks
• Gives reasons why species have been introduced	2
• Gives some relevant information	1

Sample answer:

The European rabbit was introduced for recreation and hunting.
The *Salvinia* Weevil was introduced as a biological control against *Salvinia*.

Question 31 (b)

Criteria	Marks
• Names an ecosystem and details features of an appropriate rehabilitation strategy • Identifies the introduced species and specifies damage caused by the species • Provides a reason for the introduction of the strategy	4
• Names an ecosystem and outlines an appropriate rehabilitation strategy • Identifies the introduced species • Provides a reason for the introduction of the strategy	3
• Recalls some information about introduced species and damage to ecosystems	2
• Gives some relevant information	1

Sample answer:

Ecosytstem: Dry Sclerophyll forest
Species: Lantana

Lantana is a highly competitive plant that reduces light intensity, changes soil pH and increases humidity. It smothers native plants and this impacts on native birds and ground animals that use native vegetation for shelter and food.

The Bradley Method is a rehabilitation strategy in which exotic plants, such as the lantana, are removed from firstly the least affected areas; then it is removed from the more affected areas. The Bradley Method minimises areas affected. The Bradley Method minimises soil disturbance and allows native vegetation to regrow and this controls the growth of new lantana seedlings. However, the method is slow and labour intensive.

Question 31 (c) (i)

Criteria	Marks
• Gives the distribution of both rabbits and prickly acacia • Refers to the maps	2
• Gives some relevant information	1

Sample answer:

The rabbit occupies most parts of Australia except northern Australia, with denser populations of rabbits in the south. The prickly acacia is most abundant in the north of Australia, with few plants in the south.

Question 31 (c) (ii)

Criteria	Marks
• Details reasons for the distribution of the rabbit and the prickly acacia	4
• Gives reasons for the distributions of the rabbit and prickly acacia	3
• Gives some information on at least one of the distributions	2
• Gives some relevant information	1

Sample answer:

Rabbits are most abundant where temperatures are cooler and rainfall is less. In tropical areas burrowing is restricted because of the high rainfall and clay soils. The rabbit is not suited to these environmental conditions.

Prickly acacia is well suited to hot tropical conditions, high rainfall and high temperatures. These conditions allow for optimum seed dispersal and the clay soils of the tropics enable root systems to develop for optimum intake of nutrients and water.

Question 31 (d)

Criteria	Marks
• Gives a suitable hypothesis • Details a logical method that addresses the hypothesis • Specifies how reliability and validity would be achieved	6
• Gives a suitable hypothesis • Gives a method that addresses the hypothesis • Outlines how reliability and validity would be achieved	4–5
• Gives a hypothesis • Outlines a method that addresses the hypothesis	2–3
• Gives some relevant information	1

Sample answer:

Hypothesis:

As the pH of the soil decreases, the number of lantana plants increases.

Method:

1. Select an area where lantana is abundant and a second area where it is less abundant.
2. Count the number of lantana plants in equal areas in the two locations.
3. Place goggles on before handling chemical equipment.
4. Collect a spoonful of soil from each area and place into separate labelled petri dishes
5. Add four drops of universal indicator to each soil sample and use separate stirring rods to mix the indicator with the soil.
6. Sprinkle barium sulfate powder over each soil sample.
7. Allow two minutes for the universal indicator to soak into the barium sulfate and then observe the colour of the powder.
8. Compare the colour to a pH chart and record your result.
9. Repeat these steps several times, average the results and compare your results with other groups.

Question 31 (e)

Criteria	Marks
• Demonstrates a depth or breadth of knowledge and understanding of introduced species and technologies used to control their introduction and spread • Clearly links control of introduced species to advances in technology • Demonstrates a coherent and logical progression of thought and indicates a high level use of scientific principles, ideas and terminology • Gives examples	6
• Has a knowledge of introduced species and technologies used to control their introduction and spread • Links control of introduced species to advances in technology • Uses appropriate terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant knowledge of introduced species and/or technologies used to control their introduction and spread OR links the control of introduced species to technology • Uses suitable terminology and/or progression of thought • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Species that have been introduced to Australia out-compete native species for food resources and habitats causing or threatening some extinctions, at least at a local level.

Bacterial or viral parasites, genetic manipulation, the release of sterilised males into the population are technologies used to control introduced species.

Myxamatosis and the Calicivirus are biological controls specific to rabbits and only target them, thus reducing the risk of killing native species. Sterilising males involves exposing male pests (blowflies) to a source of nuclear radiation or X-rays, which results in the male population being infertile and hence they cannot fertilise the female eggs.

Quarantine procedures such as the use of X-rays to inspect luggage, shipping containers and incoming mail have significantly reduced the number of introduced species entering Australia.

Advances in technology have been highly successful and effective. New developments and continued research are important to prevent the introduction of new species into Australia. As mutations and genetic resistant strains evolve technology plays an important part in managing and eradicating introduced species from the fragile and vulnerable Australian environment.

Question 32 (a) (i)

Criteria	Marks
• States why oil and natural gas are non-renewable	1

Sample answer:

They cannot be regenerated within a reasonable time.

Question 32 (a) (ii)

Criteria	Marks
• Gives differences in the environments of formation of oil and natural gas	2
• Gives some relevant information	1

Sample answer:

Natural gas is generated at a much higher temperature than oil.

Natural gas is generated from coal by bacterial action whereas oil is not.

Question 32 (b)

Criteria	Marks
• Details the similarities and/or differences between a structural trap and a stratigraphic trap	4
• Gives a similarity or a difference between a structural and a stratigraphic trap	3
• Gives information on traps	2
• Gives some relevant information	1

Sample answer:

Petroleum traps are reservoirs where oil and gas are held in the rocks. There is an impervious barrier such as shale preventing escape of oil or gas from porous reservoir rocks such as sandstone where the oil or gas collects.

Structural traps are formed when the reservoir bed is warped or interrupted by a fault preventing the escape of the oil or gas. These are formed after deposition. Stratigraphic traps occur where the nature of the sediment changes, for example, the pores become well cemented thus reducing permeability. These are formed during or shortly after deposition.

Question 32 (c) (i)

Criteria	Marks
• Gives the trends in the graphs • Refers to the graphs	2
• Gives relevant information	1

Sample answer:

The production of coal has increased from 250 mt to 450 mt over 20 years while consumption is falling. The production of oil peaked in 2000 at 800 thousand bbl/d and has since fallen to 400 thousand bbl/d. Consumption has risen from 700 to 900 thousand bbl/d over the same time.

Question 32 (c) (ii)

Criteria	Marks
• Gives reasons for the trends in each of the graphs for both coal and oil	4
• Gives reasons for some of the trends in the graphs	3
• Gives information about the trends in the graphs	2
• Gives some relevant information	1

Sample answer:

Coal production is rising due to export demand while coal used in energy production in Australia is falling as alternative energy sources come on-line and people are more aware of energy savings as price increases. Oil production is falling as known reserves are depleted but the use of oil-based technologies, for example motor vehicles, is increasing.

Question 32 (d)

Criteria	Marks
• Gives a suitable hypothesis • Details a logical method that addresses the hypothesis • Specifies how reliability and validity would be achieved	6
• Gives a suitable hypothesis • Gives a method that addresses the hypothesis • Outlines how reliability and validity would be achieved	4–5
• Gives a hypothesis • Outlines a method that addresses the hypothesis	2–3
• Gives some relevant information	1

Sample answer:

The energy efficiency of a commercially available photovoltaic cell will be less than 20%.

Method:

1. Connect one light globe to a power source. Connect a photovoltaic cell (pv cell) to an ammeter 50 cm away.
2. Turn on the light globe and measure the light output on a light meter. Record the value.
3. Record the current produced by the pv cell.
4. Repeat steps 1 to 3 at least three times using one extra light globe each time.
5. Repeat steps 1 to 4 using a second identical pv cell to check reliability and accuracy of the experiment. Compare results with those from other groups.

Question 32 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of fossil fuel exploration programs and technologies used in these programs • Clearly links advances in exploration programs to advances in technology • Demonstrates a coherent and logical progression of thought and indicates a high level use of scientific principles, ideas and terminology • Gives examples	6
• Has a knowledge of fossil fuel exploration programs and technologies used in these programs • Links advances in exploration programs to advances in technology • Uses appropriate terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant knowledge of fossil fuel exploration programs and/or technologies used OR links exploration programs to technology • Uses suitable terminology and/or progression of thought • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Earliest exploration programs relied on geological surveys to produce geological maps and to interpret cross-sections to identify likely targets. Likely targets were identified from the maps but success rates were poor. With the development of computers new and better technologies were developed.

For example, modern technologies allow vast amounts of data to be collected and processed quickly to produce detailed 3D models of target areas.

- Seismic shot profiling produces 3D/4D underground profiles.
- Smart phones/iPads allow instant GPS locations and photos of outcrops of coal and oil seeps to be recorded.
- Remote sensing satellites use radar surveys to detect potential oil and coal formations in sedimentary basins. Aerial gravity surveys also indicate suitable basins.

As computers developed, the technologies advanced so that more data could be used and more complex models developed. As a result of these improvements in technology, targets can be better identified and the chances of success increased.

Question 33 (a) (i)

Criteria	Marks
• States the meaning of *ore*	1

Sample answer:

An ore is a rock composed of ore minerals and gangue minerals.

Question 33 (a) (ii)

Criteria	Marks
• Sketches in general terms reasons for an environmental impact statement	2
• Gives some relevant information	1

Sample answer:

Mining companies must restore mine sites to reduce environmental damage. The environmental impact statement provides a strategy as to how this has to be done. It gives the condition of the site before mining and outlines how the site is to be rehabilitated. The EIS also addresses any concerns raised by the traditional owners of the site.

Question 33 (b)

Criteria	Marks
• Details features of a metalliferous locality in an island arc terrane	4
• Outlines features of a metalliferous locality in an island arc terrane	3
• Gives some information about a metalliferous island arc terrane	2
• Gives some relevant information	1

Sample answer:

Cadia gold-copper deposit is a porphyry copper deposit located in the Molong Volcanic Belt which is part of the Lachlan Fold Belt.

The volcanic rocks are intermediate to mafic volcanoclastics with co-magmatic intrusions (monzonite/granite) and limestones. The ore is in sheeted quartz veins, stockwork quartz veins and also disseminations in skarn. The copper is mostly chalcopyrite and the gold mineral is elemental gold.

Question 33 (c) (i)

Criteria	Marks
• Gives the trends in the graphs • Refers to the graphs	2
• Gives some relevant information	1

Sample answer:

With Chemical 1 up to 90% of the galena is recovered as grain size decreases to 0.001 mm. Only 40% of sphalerite is recovered.

With Chemical 2 up to 70% of the sphalerite is recovered as the grain size decreases to 0.001 mm. At this grain size 20% galena is recovered and recovery rapidly decreases as grain size increases.

Question 33 (c) (ii)

Criteria	Marks
• Details a method to concentrate gold • Details a method to concentrate sphalerite • Details a method to concentrate galena • Gives the correct order	4
• Outlines a method to concentrate gold • Outlines a method to concentrate sphalerite • Outlines a method to concentrate galena	3
• Gives information about flotation and/or the separation of ore minerals	2
• Gives some relevant information	1

Sample answer:

Crush the ore to a grain size of at least 0.01mm. Pass the ore through a density separation unit to remove the free gold. Now add the ore to a froth flotation cell and add Chemical 2. Aerate the cell and remove the froth which will contain mostly sphalerite and a very small amount of galena.

Next place the ore in a froth flotation cell with Chemical 1 and aerate. Collect the froth which will contain mostly galena.

Question 33 (d)

Criteria	Marks
• Gives a suitable hypothesis • Details a logical method that addresses the hypothesis • Specifies how reliability and validity would be achieved	6
• Gives a suitable hypothesis • Gives a method that addresses the hypothesis • Outlines how reliability and validity would be achieved	4–5
• Gives a hypothesis • Outlines a method that addresses the hypothesis	2–3
• Gives some relevant information	1

Sample answer:

Hypothesis:
The ore mineral, magnetite (iron oxide) is attracted to a magnet.

Method:
1. Take several different ore samples.
2. Crush one ore sample and move a magnet through the crushed ore.
3. Identify if magnetite is present on the magnet.
4. Repeat steps 2–4 several times using different ores containing magnetite and some ores without magnetite. Record the results.
5. Compare the results with those from other groups.

Question 33 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of mineral exploration programs and technologies used in these programs • Clearly links advantages in exploration programs to advances in technology • Demonstrates a coherent and logical progression of thought and indicates a high level of scientific principles, ideas and terminology • Gives examples	6
• Has a knowledge of mineral exploration programs and technologies used in programs • Links advantages in exploration programs to advances in technology • Uses appropriate terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant knowledge of mineral exploration programs and/or technologies used in these programs OR links exploration programs to technology • Uses suitable terminology and/or progression of thought • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Earliest exploration methods used prospecting to find outcrops of ores. Later geological surveys were used to produce maps. Subsurface features could be interpreted from geological maps. Nowadays new and better technologies such as computers have been developed. More data can be collected and processed. For example, satellite imagery combined with remote sensing, allows detailed maps of elements such as uranium, thorium and potassium to be produced. More sensitive magnetometers and resistivity meters mean more detailed aerial and ground surveys can be undertaken. More sensitive spectroscopes give improved detection limits, are more accurate and more reliable. Detailed 3D models can be prepared to identify target areas. The new technologies and techniques permit larger areas to be surveyed more quickly and more cheaply with better definition of drilling targets. Success rates are improved greatly.

Question 34 (a) (i)

Criteria	Marks
• Gives a correct definition of ocean salinity	1

Sample answer:

Salinity is the term used to describe the salty nature of the water in the oceans.

Question 34 (a) (ii)

Criteria	Marks
• Correctly gives the reasons for salinity	2
• Gives some relevant information	1

Sample answer:

Most of the salt in the oceans comes from elements leached by rain from newly-formed volcanic rocks and during the early outgassing of chemicals such as hydrogen chloride released during volcanic activity. The elements are carried to the oceans by rivers.

Question 34 (b)

Criteria	Marks
• Details evidence that shows the ocean floor area has changed over time • Details evidence that shows ocean basins are younger than the continents • Clearly relates the evidence to the changes	4
• Gives evidence that shows the ocean floor area has changed over time • Gives evidence that shows ocean basins are younger than continents	3
• Gives information relating to ocean floors	2
• Gives some relevant information	1

Sample answer:

Basaltic rocks are formed at mid-ocean ridges. The youngest rocks are at the ridge and older rocks further from the ridge, with the oldest being 350 million years old. This compares with the oldest continental rocks which are more than 3.8 billion years old. Sediment thickness, which is greatest furthest from the ridge, and the age of the sediment above the basalt (based on microfossil ages) and the magnetic reversals in the basalts are dating techniques used to give the ages.

As more basalt forms at the mid-ocean ridges the oceans expand. However if there is no mid-ocean ridge there is no expansion with possible contraction in area because of formation of trenches.

Question 34 (c) (i)

Criteria	Marks
• Gives the trends in the graphs • Refers to the graphs	2
• Gives some relevant information	1

Sample answer:

As the depth increases the light intensity rapidly decreases.

Salinity increases from 33 to >34 ppt, down to 10 000 m.

As depth increases, temperature decreases from 25°C at the surface to 4°C at 2000 m, with little change after that.

Oxygen concentration decreases from 3000 units at the surface to 400 units at approximately 800 m and then decreases only slowly after that.

Question 34 (c) (ii)

Criteria	Marks
• Names two zones • Details features of organisms in both zones • Relates the features to changes in depth • Gives examples	4
• Names two zones • Gives features of organisms in both zones • Relates the features to changes in depth • Gives examples	3
• Names two zones • Gives some information about organisms and depth	2
• Gives some relevant information	1

Sample answer:

Zones: Epipelagic Zone, Hadalpelagic Zone

Free-floating algae are found in the epipelagic zone where ample light is available for photosynthesis. They often carry air-filled structures to help them float and stay at the surface. Some surface fish have fins to help them move quickly and avoid predation such as by flying through the air. In the Hadalpelagic zone, animals are able to withstand high pressures and have bioluminescent structures to attract mates or prey to compensate for the lack of light. Chemosynthetic bacteria, such as methogens, use gases from black smokers for respiration in the absence of light for photosynthesis.

Question 34 (d)

Criteria	Marks
• Gives a suitable hypothesis • Details a logical method that addresses the hypothesis • Specifies how reliability and validity would be achieved	6
• Gives a suitable hypothesis • Gives a method that addresses the hypothesis • Outlines how reliability and validity would be achieved	4–5
• Gives a hypothesis • Outlines a method that addresses the hypothesis	2–3
• Gives some relevant information	1

Sample answer:

Hypothesis:
As the surface area to volume ratios of solids increase, the cooling rates in water increase.

Method:

- Take three small copper solids with the same volume but different surface areas and place these on a wire gauze over a bunsen flame. Heat evenly for five minutes.
- Take three 50 ml beakers and fill each with 40 ml of water using a measuring cylinder. Measure the temperature of the water in each beaker.
- Place each solid in a different beaker.
- Record the temperature of the water in each beaker after one minute.
- Record the rise in temperature.
- Repeat the experiment several times and average the results.
- Compare the results with those of other groups.

Question 34 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of the ocean and technologies used to study the ocean • Clearly links a better understanding of the ocean to advances in technology • Demonstrates a coherent and logical progression of thought and indicates a high level use of scientific principles, ideas and terminology • Gives examples	6
• Has a knowledge of the ocean and technologies used to study the ocean • Links a better understanding of the ocean to advances in technology • Uses appropriate terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant knowledge of the ocean and/or technologies OR links an understanding of the ocean to technology • Uses suitable terminology and/or progression of thought • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

The topography and depth of the ocean floor has previously been mapped using echo sounders. This allows depth and irregularities to be mapped, providing an understanding of the sea floor topography. More advanced technologies such as multibeam echo sounders can be used to produce maps of the sea floor directly underneath the ship while it is moving. This map gives better definition of features.

Our knowledge of ocean biota grows each year as new vessels and improved sampling techniques are developed. Trawling, using nets of varying sizes, allows samples to be collected ranging from microscopic plankton to large fish. Remote controlled submarines view, photograph and gather samples from the deepest parts of the ocean.

Bathythermographs allow temperature and depth measurements to be taken from moving ships. Sophisticated technologies used in satellites, such as infrared imaging devices, measure sea surface temperatures. The data is collated using computers which model daily and annual sea surface temperature changes and produce detailed maps.

Advances in technology allow us to gather data more quickly and more accurately. These data can be modelled to give 3D images with better resolution and with more detail than previously possible.

Earth and Environmental Science

2013 HSC Examination Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.2.3.2.1	H7, H14.1a
2	1	9.2.3.2.2	H7, H8
3	1	9.2.4.2.1, 9.2.4.2.8	H7, H14.1a
4	1	9.2.1.2.2	H7, H14.1a
5	1	9.2.2.2.1, 9.2.2.3.1	H7
6	1	9.2.2.2.1	H7
7	1	9.3.4.2.2	H7, H14
8	1	9.3.4.2.2, 9.3.4.2.3	H7
9	1	9.3.1.2.1, 9.3.4.3.1	H7
10	1	9.3.1.2.1, 9.3.2.3.1	H7
11	1	9.3.1.2.2, 9.3.1.2.3, 9.3.2.2.2	H7
12	1	9.3.3.2.1, 9.3.3.3.1	H7, H14.1e
13	1	9.3.1.2.2, 9.3.1.2.5, 9.3.3.2.5	H7
14	1	9.4.2.2.1	H7, H14.1e
15	1	H14.1 a, d, f	H14.1a, d, f
16	1	9.4.6.2.1	H7
17	1	9.4.6.2.3	H7, H9
18	1	9.4.6.3.1, 14.1 a, f	H7, H10
19	1	9.4.6.2.2, 12.3 c, 14.1 f	H7, H12, H14
20	1	H14.1 a, c, g	H14

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	3	9.2.1.2.2, 9.2.4.2.5	H7
21 (b)	4	9.2.1.2.1, 9.2.4.2.1	H7
22	4	9.2.1.2.3, 9.2.1.2.4	H8
23 (a)	2	9.2.4.2.1, 9.2.4.2.4, 9.2.4.2.5	H7
23 (b)	3	9.2.4.2.3, 9.2.4.3.3	H5, H7
24	4	9.3.5.2.1	H8, H14.1f
25	6	9.3.5.2.2-5, 9.3.5.3.1-3	H7, H8
26 (a) (i)	2	9.3.3.3.2	H2
26 (a) (ii)	2	9.3.3.2.4, 9.3.3.2.5	H7
26 (b)	2	9.3.3.3.2	H8, H14.1a
27	4	9.4.4.2.2, 9.4.4.3.2	H4

Question	Marks	Content	Syllabus outcomes
28 (a)	1	H12.4 d	H12
28 (b)	4	9.4.7.2.3	H3, H4, H9
29 (a)	2	H13.1 f	H13
29 (b)	2	9.4.3.2.2, 9.4.3.3.1	H9, H10
29 (c)	3	9.4.3.2.1	H9, H10
30	7	9.2, 9.3, 9.4	H1, H2, H3, H4, H5, H6, H7, H8, H9, H10

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		**Introduced Species and the Australian Environment**	
(a) (i)	1	9.5.1.2.1	H10
(a) (ii)	2	9.5.1.2.4	H10
(b)	4	9.5.5.2.5, 9.5.5.2.6, 9.5.5.3.3	H10
(c) (i)	2	H14.1a	H14
(c) (ii)	4	9.5.4.2.1	H10
(d)	6	9.5.2.3.1, H13.1 a, H11.2, c, d, e H14.1d	H10, H11, H12, H13, H14
(e)	6	9.5.5.2.2, 9.5.6.2.3, 9.5.6.3.1	H1, H3, H4, H7
Question 32		**Organic Geology – A non-renewable Resource**	
(a) (i)	1	9.6.1.2.1	H8
(a) (ii)	2	9.6.2.2.1, 3	H8
(b)	4	9.6.2.2.6, 9.6.2.2.7	H7
(c) (i)	2	H14.1 a	H14
(c) (ii)	4	9.6.4.2.3, 9.6.5.2.2	H6, H9
(d)	6	H13.1 a, 9.6.6.3.2, H11.2 b, c, d, e H14.1d	H9, H11, H12, H13, H14
(e)	6	9.6.3	H1, H3, H4, H10
Question 33		**Mining and the Australian Environment**	
(a) (i)	1	9.7.3.2.2	H7
(a) (ii)	2	9.7.5.2.2	H4
(b)	4	9.7.1.2.1, 9.7.1.3.1	H7
(c) (i)	2	H14.1 a	H14
(c) (ii)	4	9.7.4.2.6, 9.7.4.3.4	H6
(d)	6	H13.1a, 9.7.4.3.2, H11.2c, d, e, H14.1d	H11, H12, H13, H14
(e)	6	9.7.4.2.1, 9.7.4.3.1	H1, H3, H4, H10

Question 34		Oceanography	
(a) (i)	1	9.8.1.2.1	H7
(a) (ii)	2	9.8.3.2.1	H7
(b)	4	9.8.2.2.1-7	H2, H7
(c) (i)	2	H14.1a	H14
(c) (ii)	4	9.8.3.2.3, 5, 9.8.4.3.1, 9.8.5.2.1, 2, 4, 9.8.6.2.5	H7, H8
(d)	6	H13.1a, 9.8.6.3.1, H11.2 b, c, d, e, H14.d	H8, H13, H12, H13, H14
(e)	6	9.8.2.3.1, 9.8.4.3.1, 9.8.8.2.1, 9.8.8.3.1	H1, H3, H4