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2014 HSC Earth and Environmental Science Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

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

Section I, Part B

Question 21 (a)

Criteria	Marks
• Outlines that Australia and Antarctica were once joined and that a mid-oceanic ridge continues to separate these continents at a divergent boundary	2
• Provides a reason for the separation of Australia and Antarctica	1

Sample answer:

When Australia and Antarctica were joined as part of Gondwana, a rift valley formed to separate them and a divergent boundary formed. Eventually an ocean formed with a mid-ocean ridge that continues to separate the two continents.

Question 21 (b)

Criteria	Marks
• Completes all sections of the table correctly	4
• Completes most sections of the table correctly	3
• Completes all sections of the table correctly for one type of earthquake OR • Completes at least one section for both earthquakes	2
• Provides correct information for one part of table	1

Sample answer:

	South Australian earthquake	*Indonesian earthquake*
Probable cause of the earthquake	A fault occurred due to the build-up of stress over a long time period	A subduction zone between the Indo-Australian Plate and the Eurasian Plate
Probable magnitude	Lower magnitude 3–5	Higher magnitude 6–8
Probable depth of focus	Relatively shallow	Relatively deep (Benioff Zone)

Question 22

Criteria	Marks
• Clearly shows the relationship between the geological formation of Australia and the correct time sequence • Distinguishes between cratons, mountain belts and basins • Makes reference to the map	4
• Identifies cratons, mountain belts and basins • Relates these to the early development of Australia • Makes reference to the map	3
• Mentions at least TWO of cratons, mountain belts or basins • Links these to geological time OR the development of Australia	2
• Gives some relevant information	1

Sample answer:

Before 2500 Ma the Pilbara and Yilgarn cratons had formed the basis of the western part of Australia. Around 1400 Ma the northern Australian craton formed. Cratonisation was followed by a series of orogenies which produced folded rocks around the cratons between 2500 Ma and 545 Ma. The continent had developed substantial areas of land mass which were added as sedimentary basins filled in area between them, including the Adelaide Geosyncline in the mid to late Proterozoic.

Question 23 (a)

Criteria	Marks
• Names any two relevant rocks	1

Sample answer:

Granite, Gneiss

Question 23 (b)

Criteria	Marks
• Provides characteristics and features of two geological structures	2
• Provides some relevant information	1

Sample answer:

- One geological structure is an anticline where compression forces have tightly folded the rock layers
- A second geological structure is a reverse fault where the layers on one side of the fault have been forced above those on the other side

Question 23 (c)

Criteria	Marks
• Clearly shows the relationship between the features of the plate boundary and plates involved • Makes clear links to formation of fold mountain ranges	3
• Gives features of the plate boundary or the tectonic plates involved • Links to mountain formation	2
• Gives some relevant information	1

Sample answer:

A continental/continental convergent boundary is forming between the Indian-Australian Plate and the Eurasian Plate. India is drifting towards Eurasia as the Indian-Australian Plate moves north. As the plates collide, the continental crusts on both plates are pushed together, causing the rocks to buckle and fold. As the land becomes elevated, folded mountain ranges are formed, resulting in parallel ridges of faulted and folded mountains.

Question 24

Criteria	Marks
• Clearly shows the relationship between environmental pressure and changes in organism structure from fish to amphibians to reptiles • Identifies environmental pressures at each stage of development • Consistently uses appropriate terminology and/or progression of thought • Provides examples	6
• Shows links between environmental pressures and changes in organism structure • Identifies environmental pressures at each stage of development • Uses suitable terminology and/or progression of thought • Provides examples	4–5
• Recalls relevant information on the progression from fish to reptile • May use some suitable terminology • Provides examples	2–3
• Provides some relevant information	1

Sample answer:

Two things that needed to change from fish to reptiles were:

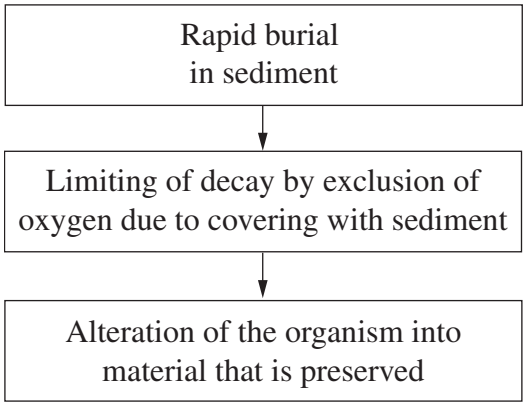
- The need to breathe air
- The need to reproduce out of water.

Fish use gills to absorb oxygen from the water and lay eggs in the water using external fertilisation. Amphibians have gills in their immature forms and lungs as adults. They still reproduce in the water, laying eggs that are externally fertilised. As reptiles evolved, they overcame the reliance on water as they had lungs to breathe oxygen in air, and had internal fertilisation and coated eggs which stopped water loss.

Question 25 (a)

Criteria	Marks
• Correctly draws a flow chart • Gives three major steps	3
• Correctly draws a flow chart • Gives at least two major steps OR • Identifies three major steps correctly	2
• Gives some relevant information	1

Sample answer:



Question 25 (b)

Criteria	Marks
• Names two fossil types • Gives a feature of each fossil type • Relates features to fossil formation	3
• Names one fossil type • Gives a feature of the fossil type • Relates the feature to fossil formation	2
• Gives some relevant information	1

Sample answer:

A fossil such as an Amorite contains a hard shell which is less likely to be dissolved when the animal dies. Thus, there is a greater chance for the shell to become a fossil.

Animals such as a worm or bacteria only have soft bodies and rapidly decay when they are buried so the chance of being fossilised is small.

Question 26

Criteria	Marks
• Provides points for and/or against how knowledge of major changes in life forms has helped develop the Geological Time Scale • Links changes in life forms to time scale intervals • Uses appropriate terminology and/or progression of thought • Gives examples	5
• Has an understanding of the Geological Time Scale • Attempts to link life forms to time scale intervals • Gives examples	3–4
• Provides some relevant information	1–2

Sample answer:

Earth's history has been divided into intervals where the large intervals are called eons, and these are divided into smaller intervals. The boundaries between the intervals are based on such things as significant changes in the structure of life forms and the appearance and disappearance of life forms as shown by the fossil record.

For example the Phanerozoic Eon is distinguished from the Proterozoic Eon by the appearance of animals with hard body parts. Earlier animals did not have hard body parts. A second example is the separation of the Cretaceous and Tertiary Periods, which is marked by the disappearance of the dinosaurs.

Question 27

Criteria	Marks
• Provides detailed features of two named international strategies • Supports arguments with information from the graphs • Gives a clearly stated judgement on the effectiveness of each of the two international strategies	5
• Provides features of two named international strategies • Gives information from the graphs • Attempts to make a judgement on the effectiveness of the two strategies	3–4
• Provides some relevant information AND/OR • Refers to information in the graphs	1–2

Sample answer:

Different atmospheric pollutants have been combated with varying degrees of success. In 1987, the Montreal Protocol was enacted to deal with rising CFCs in the atmosphere. As seen in the graph of atmospheric CFC-11 concentration, the levels of CFCs in the atmosphere have been declining since the early 1990s. However, as seen in the graphs of carbon dioxide and nitrous oxide, greenhouse gas emissions are clearly still on the increase and have shown no signs of slowing, despite a similar agreement dealing with greenhouse gas emissions being enacted in the 1997 Kyoto Protocol. Therefore, the Kyoto Protocol has not been effective in minimising impacts of pollutants on the atmosphere whereas the Montreal Protocol has been successful in reducing CFCs in the atmosphere.

Question 28 (a)

Criteria	Marks
• Provides detailed features of a land management practice • Links the land management practice to the statement given	3
• Outlines a relevant land management practice	2
• Gives some relevant information about land management practices	1

Sample answer:

In the management of salinity the establishment of tree corridors has been effective. The deep roots of the trees absorb water thus keeping the water table well down thus preventing salt from coming to the surface. This is an improvement over past practices where paddocks were clear-felled for crops or pastures which have shallow root systems which allow salinity to increase as the water table rises.

Question 28 (b)

Criteria	Marks
• Provides detailed features of a water management practice • Links the water management practice to the statement given	3
• Outlines a relevant water management practice	2
• Gives some relevant information about water management practices	1

Sample answer:

Drip irrigation is a water management practice that would result in an overall improved land management scenario. Drip irrigation involves supplying water in small volumes directly at the root level of plants, enabling farmers to provide water to their plants where they need it and when they need it. This method reduces the amount of irrigation water lost through evaporation and also mitigates against salinity.

Question 29

Criteria	Marks
• Provides detailed features of soils found in Western Australia and from the east coast of Australia • Clearly links the processes of formation that have led to the differences in the two soils	4
• Provides features of soils found in Western Australia OR along the east coast of Australia • Links a process of formation leading to the features of the soil	3
• Outlines features of soils in Australia • Outlines a process of formation of soils OR • Provides features of soils found in Western Australia AND along the east coast of Australia	2
• Gives some relevant information about soils in Australia	1

Sample answer:

Western Australian soils are typically very low in nutrients. This is due to their great age and the tectonic stability and flatness of the Australian continent. Any available nutrients have been leached out of the system over long periods of time without replenishment by mountain building processes. In contrast, east coast soils are relatively young and in some regions are the product of volcanic activity and/or mountain building and subsequent erosion, providing a higher level of nutrients because of both their young age and their volcanic origin.

Question 30

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of extinctions, including mass extinctions and environmental management practices • Clearly links management practices to the loss of habitats, fauna and flora • Makes a clear judgement using supporting arguments • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Includes data from the table and map	7
• Has a knowledge and understanding of extinctions and environmental management practices • Links management practices to the loss of habitats, fauna and flora • Makes a clear judgement using supporting arguments • Uses appropriate terminology, progression of thought and scientific principles • Includes data from the table and map	5–6
• Recalls relevant knowledge of extinctions and/or environmental management practices • Uses suitable terminology and/or progression of thought AND • Links management practices to the loss of habitats, fauna and flora OR • Uses some information from the map and/or table	3–4
• Recalls some relevant information on mass extinction and/or environmental management practices	1–2

Answer could include:

Since they arrived on the Australian continent, humans have dramatically reduced the number of native plant and animal species through their management practices. For example, Aborigines used fire to promote plant regeneration and to herd animals. European settlers cleared vegetation to implement their farming practices. They also dammed streams and took water from streams for farming and grazing. Also as society needed more commodities, mining operations increased and this altered the landscape.

The use of fire by Aborigines has been associated with the extinction of the megafauna. Fire was used to clear an area of woody shrubs to make way for succulent new growth, attracting wildlife for hunting. As shown in the table, 46 species of large animals from the fossil record were extinct prior to 1750. This implies that the aboriginal land management practices were not conducive to the survival of some animal species.

Subsequent European farming practices have significantly altered the native flora and fauna. For example, 95 species of flora and fauna have become extinct since 1750 and 650 species are endangered. A further 800+ species are vulnerable. The map shows that the greatest change to the native vegetation occurs along the southern and eastern fringes of the continent, where human impact on the environment is greatest. Where intensive farming has not occurred, as in Central and Northern Australia, some areas have more than 70% of native

species remaining. This loss of native vegetation results in loss of habitat for native animal species allowing exotic species to replace them. Most damage has been done in the heavily populated areas.

The data shows that the loss of species has dramatically increased since white settlement. If the rate of species loss continues as rapidly in the future as at present, then Australia is facing a further significant loss of species which could be classified as a regional extinction event. If this rate of species loss is repeated worldwide then it could possibly result in a sixth mass extinction.

To avoid more species loss, current land use practices have to significantly change. For example, farming native species would mean less land degradation through land clearing effects of cattle and sheep.

Section II

Question 31 (a)

Criteria	Marks
• Gives features of two quarantine methods used in Australia	3
• Gives features of one quarantine method used in Australia OR • Outlines features of two quarantine methods used in Australia	2
• Gives some relevant information	1

Sample answer:

A variety of quarantine methods are used in Australia to prevent the entry of introduced species. All cargo, baggage and passengers are screened at arrival ports for possible pests or disease-carrying organic materials through use of physical screening such as searches, sniffer dogs, thermal sensors or by destructive testing and sampling of produce. The restriction of produce such as fruit across state borders prevents transmission of pests such as fruit fly.

Question 31 (b)

Criteria	Marks
• Names a pest and corresponding biological control method • Gives features of the named control method that made it effective • Links control method to success	4
• Names a pest and corresponding biological control method • Links control method to success	3
• Names a pest • Outlines a biological control method	2
• Names a pest OR outlines a biological control method	1

Sample answer:

The use of the South American *Cactoblastis cactorum* moth is an example of a successful herbivore–plant biological control method. The insect was introduced to eradicate the prickly pear cactus that had been introduced into Australia and flourished. The moth's caterpillars exclusively fed on prickly pear. The caterpillars did not find an alternative food source once they had decimated the prickly pear population. This was a good outcome as the insect did not continue to breed and attack any native species and subsequently reduced in population number. As the moth did not completely die out, there are still moths to control excessive increases in the number of prickly pear plants.

Question 31 (c) (i)

Criteria	Marks
• Gives trends in the graph • Relates time to area occupied	2
• Gives some relevant information	1

Sample answer:

From point X there is a slow increase in the area from zero. As time passes the habitat area increases rapidly, and then after a control strategy commences the habitat area only increases slowly. The area of habitat is a function of the number of organisms. The number of organisms plateaus after eradication begins.

Question 31 (c) (ii)

Criteria	Marks
• Names an appropriate introduced species • Addresses two control strategies in the graph after point X • Links each control strategy to a valid reason for changing strategies	4
• Names an introduced species • Addresses a control strategy • Links each to a reason for a change in the control strategy	3
• Names an introduced species • Gives information about the species and/or a control strategy	2
• Gives some relevant information	1

Sample answer:

Fruit fly

Prior to the accidental release of the Mediterranean fruit fly, quarantine was sufficient to prevent the spread of the insect pest. After initial introduction the use of pesticides was required to eradicate this pest. Once resistance developed in the flies and the number of flies increased, containment was required. The use of quarantine at the borders preventing the transfer of the insect between fruit growing areas has become necessary to restrict the spread of further increase in population.

Question 31 (d) (i)

Criteria	Marks
• Provides a relevant conclusion written in scientific format	2
• Provides some relevant information	1

Sample answer:

A species is considered introduced if it occurs in an area that is outside its natural range and was introduced to the area either accidentally or deliberately.

Question 31 (d) (ii)

Criteria	Marks
• Names a local environment that includes an introduced species • Provides a valid logical method to test the aim • Selects a method which demonstrates reliability • Uses appropriate scientific format	4
• Names a local environment • Provides a method to test the aim • Attempts to address reliability • Uses appropriate scientific format	3
• Gives two of the above criteria	2
• Provides some relevant information	1

Sample answer:

Local environment: Ku-ring-gai National Park

Method:

1. A quadrat of 10 m^2 was randomly selected in Ku-ring-gai National Park.
2. The number and type of introduced species in the quadrat were counted and recorded.
3. One or more other features of the environment were measured and recorded.
4. Steps 1–3 were repeated several times.
5. The results were averaged.
6. Results were compared.

Question 31 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of past practices regarding introduced species and the need to change these practices • Clearly links past and present practices to growing scientific knowledge, ensuring sustainability of ecosystems • Consistently uses appropriate terminology and /or progression of thought • Gives examples	6
• Demonstrates a knowledge and understanding of past practices regarding introduced species and the need to change these practices • Links past and present practices with growing scientific knowledge • Uses suitable terminology and /or progression of thought • Gives examples	4–5
• Recalls relevant information on past and/or current practices regarding control of introduced species • Use some suitable terminology • Gives examples	2–3
• Recalls some relevant information	1

Sample answer:

In Australia's past there have been many introduced species both plant and animal now regarded as pests such as donkeys, camels, water buffalo, cats, rabbits, cane toads, lantana, bitou bush, water hyacinth and skeleton weed. It is now understood that such introductions can cause significant change to established and balanced ecosystems as well as degradation of the physical environment. Ineffective attempts at eradication of introduced species in the past have resulted in widespread distribution of organisms that find the new conditions favourable and breed unchecked, such as the introduction of the cane toad to eliminate another pest, the cane beetle. Today biological controls are extensively trialled prior to introduction to avoid such mistakes or alternatives such as the release of sterile males is sought to prevent the introduced species taking over. Quarantine measures are extensive in order to prevent the accidental introduction of new species both internationally as well as between state boundaries, for example restricting the movement of fruit within Australia preventing the spread of fruit fly, thereby protecting the local fruit industries; or preventing the emptying of ballast water in local harbours and examining all cargo and passengers at entry ports using specially trained sniffer dogs, thermal scanners, spectroscopic analysis and microscopic sampling techniques. Such practices are essential if Australia's ecosystems are to be protected from damage by introduced species and remain sustainable in the future.

Question 32 (a)

Criteria	Marks
• Names the type of oil trap • Gives functions X, Y and Z	3
• Names the type of oil trap • Gives function of two of X, Y and Z	2
• Gives some relevant information	1

Sample answer:

This is a structural oil trap.
The functions of the layers are:
X is a cap rock which prevents oil from escaping from the trap.
Y is a reservoir rock in which the oil is trapped.
Z is a source in which the oil is formed.

Question 32 (b)

Criteria	Marks
• Outlines the nature of both coal and petroleum as mixtures • Provides features of the processes used to convert both coal and petroleum into their marketable end products • Links processes to the mixtures	4
• Outlines the nature of both coal and petroleum as mixtures • Outlines features of the processes used to convert both coal and petroleum into marketable end products	3
• Outlines the nature of either coal or petroleum as mixture • Outlines the processes used to convert either coal or petroleum into marketable end products	2
• Gives some relevant information	1

Sample answer:

Petroleum is a mixture of hydrocarbons derived from dead small marine organisms. Petroleum is separated into gas, liquid and solid components by a physical process called fractional distillation using their different boiling points. Hydrocarbons of similar molecular weights can then be separated and collected for marketing.

Coal is a mixture of mineral matter and the products formed by decomposition of dead plants. Coal is crushed and then washed in a washery to remove the excess mineral matter. Where necessary density can be used to produce coal fractions of different densities. Each fraction can be marketed.

Question 32 (c) (i)

Criteria	Marks
• Compares the relationship between energy content and market price	2
• Gives some relevant information	1

Sample answer:

- Gas has a high energy content and has a medium market price, recently becoming cheaper.
- Coal has the lowest energy content but was the cheapest fuel until recently.
- Oil has a medium energy content and is the most expensive fuel.

Question 32 (c) (ii)

Criteria	Marks
• Identifies benefits and limitations of using each fuel into the future • Recommends which fuel would be the best option, giving reasons • Predicts the future use of each fuel • Uses data from the graph and table	4
• Identifies a benefit or limitation of using each fuel • Predicts the future use of each fuel • Uses data from the graph and table	3
• Identifies a benefit or limitation of at least two fuels • Recommends which fuel would be best option OR • Predicts the future use of at least one fuel	2
• Gives some relevant information	1

Sample answer:

The global use for fossil fuels will depend on their reserves, cost and polluting effect. Petroleum will be limited by its availability as it has the lowest known reserves, whereas coal has the highest polluting effect but very large reserves. For the immediate future, it would be the most reasonable use of fossil fuels if natural gas was developed as a replacement for coal and petroleum whenever possible. This would lower the CO_2 output, save money and have the highest energy output. Petroleum has limited reserves and will soon result in unreliable supplies. Coal produces too much carbon dioxide and will not be a suitable fuel if climate change continues to challenge the welfare of the environment.

Question 32 (d) (i)

Criteria	Marks
• Provides a relevant conclusion written in scientific format	2
• Gives some relevant information	1

Sample answer:

When coal is completely combusted, carbon combines with oxygen to form carbon dioxide and heat is released. If incomplete combustion occurs, particulates are increased, poisonous gases such as carbon monoxide are produced, and there is less heat.

Question 32 (d) (ii)

Criteria	Marks
• Names a fossil fuel • Provides a valid logical method to test the aim • Selects a method which demonstrates reliability • Uses appropriate scientific format	4
• Names a fossil fuel • Provides a valid logical method to test the aim • Attempts to address reliability • Uses appropriate scientific format	3
• Two of the above criteria	2
• Provides some relevant information	1

Sample answer:

Example: Natural Gas

1 A beaker with 100 ml of water was placed over a Bunsen burner on a blue flame
2 The water was heated for 3 minutes
3 The temperature change was recorded
4 The bottom of the beaker was observed for soot buildup
5 Steps 1–3 were repeated 4 times
6 The amount of air available was reduced by closing the collar on the Bunsen burner
7 Steps 1–4 were repeated
8 The air supply was further reduced 2 more times until there was no extra air supplied
9 The results were recorded, averaged and graphed to compare products formed and the temperature increases for complete and incomplete combustion.

Question 32 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of present and future energy sources • Clearly links present energy resources to qualities needed in future energy sources with growing scientific knowledge • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Consistently uses appropriate terminology • Gives examples	6
• Demonstrates a knowledge and understanding of present and future energy sources • Links problems with present energy resources to qualities needed in future energy sources • Uses relevant terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant information on past and future mining and uses of energy resources • Gives suitable terminology • Gives examples	2–3
• Recalls some relevant information	1

Sample answer:

There is a global dependence on the organic resources – fossil fuels – as our main energy sources and for many products used widely in everyday life.

However, fossil fuels are non-renewable resources. They took millions of years to form and are being used up at a much faster rate then they can be replaced. As human population numbers continue to rise and the developing nations become more industrialised, our dependence on fossil fuels is increasing faster than new deposits can be found and produced and, as there are finite deposits, they will eventually begin to run out. Also, fossil fuels have a polluting effect in the atmosphere by increasing particulate pollutants, especially during incomplete combustion, but also by increasing polluting gases – carbon dioxide which increases the Greenhouse Effect and so has been linked to climate change, and sulphur and nitrogen gases which contribute to photochemical smog.

For these reasons, other energy sources which are renewable and non-polluting are being seen as preferable alternatives for the future. Solar, wind, tidal, hydroelectric, and geothermal energies are all renewable and non-polluting. However, there is a high economic cost in their development and significant research is required to develop them for large-scale production as viable alternatives to fossil fuel.

Although there are no existing large-scale alternatives to fossil fuels at the present, it is clear that scientists should be given the resources by governments to research and develop renewable energy sources. Then, as the problems associated with using fossil fuels compromise the energy needs of countries and the health of the environment, more viable energy sources will be available as cost-effective and efficient resources to all nations to gradually replace organic fuel sources.

Question 33 (a)

Criteria	Marks
• Names a deposit found in this setting • Provides THREE features of the deposit	3
• Names a deposit found in this setting • Gives one feature of the deposit	2
• Gives some relevant information	1

Sample answer:

An example of a deposit found in this geological setting is a hydrothermal gold deposit. Hydrothermal gold deposits are formed near volcanoes and consist of numerous veins containing elemental gold commonly associated with quartz and other minerals precipitated from hot solutions that move through the rocks.

Question 33 (b)

Criteria	Marks
• Clearly shows the relationship between the geological factors and cost factors that affect the value of a deposit • Clearly links the factors to the value of a deposit	4
• Outlines geological factors that affect the value of a deposit • Outlines cost factors that affect the value of a deposit • Links the factors to the value of a deposit	3
• Outlines geological and/or cost factors that impact the value of a deposit	2
• Gives some relevant information	1

Sample answer:

The economic value of a deposit is a measure of the market value of the commodity that can be mined. Thus a large deposit contains more of a commodity than a small deposit, and a deposit with a higher grade, that is more of the commodity per unit of ore, is also worth more. Cost factors include the cost of exploration, cost of mining and cost of processing the ore. A higher grade ore produces more commodity than a lower grade one and thus produces more income although processing costs remain the same. Likewise higher exploration costs resulting from a remote location and higher mining costs such as a deeper mine result in less net income and the value of the deposit is less.

Question 33 (c) (i)

Criteria	Marks
• Gives the trends of both lines	2
• Gives some relevant information	1

Sample answer:

Exploration costs increase in Stages 1 and 2 as the resource is identified and then proven. There is no income during these stages. As mining starts exploration costs generally decrease due to less exploration and income increases. As the resource diminishes income decreases but exploration increases in order to find more resources.

Question 33 (c) (ii)

Criteria	Marks
• Describes an exploration method for Stages 1, 2 and 4 • Links the method to the relevant stage or gives a reason for each method	4
• Describes an exploration method for TWO stages • Links each method to the relevant stage or gives a reason for each stage	3
• Describes an exploration method for ONE of the stages • Links the method to the relevant stage or gives a reason for each stage OR • Describes an exploration method for TWO stages	2
• Gives some relevant information	1

Sample answer:

In Stage 1 reconnaissance exploration such as background research or surface mapping is undertaken to identify a prospective locality and to understand the geological setting. In Stage 2 geophysical surveys such as magnetic surveys or resistivity surveys and geochemical surveys are undertaken to identify a likely target. The target is drilled and then an expanded drilling program is undertaken to prove the resource. In Stage 4 exploration is carried out to identify another resource to compensate for the known resource which is being worked out. Exploration techniques include geophysical or geochemical survey of another locality or drilling from the known resource.

Question 33 (d) (i)

Criteria	Marks
• Provides a relevant conclusion written in scientific format	2
• Gives some relevant information	1

Sample answer:

Base metal ores are refined using electrolytic cells which remove the metals from solution.

Question 33 (d) (ii)

Criteria	Marks
• Names an ore • Provides a valid logical method to test the aim • Selects a method which demonstrates reliability • Uses appropriate scientific format	4
• Names an ore • Provides a valid logical method to test the aim • Attempts to address reliability • Uses appropriate scientific format	3
• Two of the above criteria	2
• Provides some relevant information	1

Sample answer:

1. Collect three samples of the same copper ore and three samples of the same waste rock
2. Weigh each of the ore samples using a balance to determine their masses
3. Immerse each sample in water to determine the volume of water displaced for each sample
4. Calculate density of each sample using $D = \frac{M}{V}$
5. Calculate the average density of the ore.
6. Repeat steps 2 to 5 for the waste rock samples
7. Compare the results

Question 33 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of rehabilitation management practices • Clearly links rehabilitation practices at mine sites with growing scientific knowledge • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Gives examples	6
• Demonstrates knowledge and understanding of rehabilitation management practices • Links rehabilitation practices to mines sites • Uses appropriate terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant information about rehabilitation management practices • Uses suitable terminology • Gives examples	2–3
• Recalls some relevant information	1

Sample answer:

Past mining practices have concentrated on taking as much ore as possible for the least cost. As a result environmental considerations have commonly been ignored or at best minimised. Consequently many mine sites have been left in a poor state and rehabilitation is now both difficult and very costly. In addition toxic or harmful metals are being leached from the waste dumps and tailings dams.

Companies now have to produce environmental impact statements and thus give a plan for mine rehabilitation. However, rehabilitation methods are often only poorly tested before being implemented and results are not good. This is where good science is required. In modern mining scenarios rehabilitation methods can be tested and then trialled at actual mine sites. If a methodology is not optimal it can be modified and trialled again.

If Australia's mining industry is to improve rehabilitation methods and thus minimise environmental damage new methods have to be found and introduced. In order to do this there must be a large increase in research funds to allow scientists to develop, test and implement new advanced rehabilitation methods.

Question 34 (a)

Criteria	Marks
• Provides features of two methods used to date ocean floors	3
• Provides features of one method used to date ocean floors OR • Outlines in general terms two methods to date ocean floors	2
• Gives some relevant information	1

Sample answer:

Ocean floors can be dated according to the magnetic banding in the basalt that occurs symmetrically on either side of a mid-ocean ridge. These bands can be cross-checked with known banding on continental rocks to align dates with the bands on the sea floor. Another method involves analysing the sediment layers on the bottom of the ocean. Depending on the composition and origin of these sediments, the micro-fossils that make up the layers within these sediments can be correlated and relative ages allocated to the basal sediments.

Question 34 (b)

Criteria	Marks
• Provides features of differences in food chains in both surface waters and in deep water • Clearly links these differences to physical properties at each location	4
• Provides features of differences in food chains in both surface waters and in deep water • Attempts to link these differences to physical properties	3
• Sketches in general terms features of food chains in surface waters AND in deep water OR • Sketches in general terms the physical properties of each location	2
• Gives some relevant information	1

Sample answer:

Surface water food chains are dependent on the presence of sunlight to provide the energy input for the food chains. Photosynthetic phytoplankton are the key producers and exploit the abundance of sunlight to form the basis of the food chain. Generally, the surface water is the warmest part of the ocean, and this provides an environment in which fish and other organisms can swim quickly to either chase prey or to evade predation, resulting in highly mobile organisms in predator–prey relationships. In contrast, the lack of light in deep water regions of the ocean means that the input of energy to the food chain must come from chemosynthetic bacteria which consume sulphur compounds escaping from hydrothermal vents. Therefore, there are no photosynthetic producers in these food chains. The cold temperatures of deep water regions also limit the amount of activity organisms can exhibit, resulting in a predominance of more sessile and/or opportunistic forms of life in these food chains.

Question 34 (c) (i)

Criteria	Marks
• Provides two reasons for changes in the ocean current	2
• Provides some relevant information	1

Sample answer:

At X on the map, the ocean current is forced southward by the geography of the ocean basin, being forced to bend away from the Indian subcontinent. It also rises to the surface and warms as the water nears the equator, as it is being warmed by the sun.

Question 34 (c) (ii)

Criteria	Marks
• Provides detailed features of the circulation of global ocean currents • Provides reasons for the features given • Clearly links the features given to information in the diagram	4
• Provides features of the circulation of global ocean currents • Provides reasons for the features given • Links to information in the diagram	3
• Outlines in general terms a feature of global ocean currents AND/OR • Outlines a reason related to information in the diagram	2
• Provides relevant information about global ocean currents	1

Sample answer:

The global circulation is related to both the temperature and the salinity of the ocean waters. Nearer the polar regions, the ocean currents cool, resulting in an increase in density, so that the surface currents sink to become deep water currents. Further, nearer to the equator, the ocean currents become warmer with the input of energy from the sun, resulting in a decrease of density keeping the surface currents separate from the deeper water currents. The salinity of ocean currents also plays a role in their global circulation, most clearly seen near the North Atlantic Ocean on the diagram. In this region, the higher salinity, higher density surface waters encounter lower salinity, lower density continental runoff waters. The higher salinity current then sinks because it encounters the lower density continental runoff. These processes together contribute to the global conveyor belt of ocean currents.

Question 34 (d) (i)

Criteria	Marks
• Provides a relevant conclusion written in scientific format	2
• Gives some relevant information	1

Sample answer:

In general, higher temperature waters will have higher salt concentrations due to higher rates of evaporation while lower temperature of waters will have lower salt concentrations due to lower rates of evaporation.

Question 34 (d) (ii)

Criteria	Marks
• Names a salt • Provides a valid logical method to test the aim • Selects a method which demonstrates reliability • Uses appropriate scientific format	4
• Names a salt • Provides a method to test the aim • Attempts to address reliability • Uses appropriate scientific format	3
• Two of the above criteria	2
• Gives some relevant information	1

Sample answer:

Name of salt: Sodium Chloride

- Three test tubes were placed in a test tube rack and labelled Test 1, Test 2 and Test 3
- Equal volumes of water were added to each test tube:
  - Test 1 – ice water
  - Test 2 – room temperature water
  - Test 3 – near boiling water
- Exact temperatures were recorded with a thermometer
- Salt was added to each with stirring, half a teaspoon at a time until no more salt dissolved
- The number of teaspoons of salt that dissolved in each test tube was recorded
- Process was repeated two more times and average values were calculated.

Question 34 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of past management of ocean resources and sustainable management of ocean resources • Clearly links sustainable management practices and natural balances in the ocean with growing scientific knowledge • Demonstrates a coherent and logical progressions of thought and includes correct use of scientific principles and ideas • Consistently uses appropriate terminology • Gives examples	6
• Demonstrates a knowledge and understanding of past management of ocean resources and sustainable management of ocean resources • Links sustainable management practices and natural balances in the ocean • Uses relevant terminology and/or progression of thought • Gives examples	4–5
• Recalls relevant information on the past management of ocean resources and/or sustainable management of ocean resources • Uses suitable terminology • Gives examples	2–3
• Recalls some relevant information	1

Sample answer:

In the past, our knowledge of the balances and tipping points within ocean resources has either been unknown or thought not to be affected by our activities. However, the increase in technological advances of the 20th century matched with unbridled global growth patterns have resulted in many instances where the ocean's resources have been unwisely used.

Fisheries such as the Grand Banks cod fishery in Canada and the orange roughy fishery off the southeast coast of Australia have been overexploited to the point of collapse using technologies such as sonar to locate, track, and remove virtually all fish within populations.

Pollution resulting in fouling of waterways in the form of heavy metals released by industry (as first documented in Minamata, Japan) resulting in toxic levels of chemicals in aquatic organisms and fertiliser run-off from agricultural lands resulting in algal blooms, choking of corals, toxins from algae, and oxygen deprivation are evidence that we have been using the oceans as an open sewer for our wastes.

The instances described above make it clear that we need to change to a more sustainable management of our resources, not only for the benefit of ourselves in the preservation of these resources for our own use going into the future, but also for the need to preserve unique environments around Australia and the world, from estuaries and coral reefs to pelagic communities and deep ocean ecosystems.

This is being achieved through the limitation of fishing licences, curtailing technologies that result in overharvesting and increasing research and development into the sustainability of commercial fisheries.

Modern environmental legislation is attempting to curb the influx of wastes into the ocean. Educational programs have also been effective in increasing awareness of the fragility of ocean environments.

Earth and Environmental Science

2014 HSC Examination Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.2.1.2.1	H7
2	1	9.2.1.2.3	H7, H8
3	1	9.2.4.2.6	H7, H14.1f
4	1	9.2.5.2.1	H7
5	1	9.2.5.2.1, 9.2.4.2.3, 9.2.4.2.5	H7
6	1	9.2.1.3.1	H7
7	1	9.2.1.2.3	H7
8	1	9.3.1.2.5	H7
9	1	9.3.2.2.1	H7, H9
10	1	9.3.5.2.2, 9.3.5.3.1	H7
11	1	9.3.4.2.1, 9.3.4.2.2	H7
12	1	9.3.3.2.2	H8, H12.4a, H14.1a
13	1	9.3.1.2.3	H7, H8
14	1	9.3.3.2.1	H7
15	1	9.4.2.2.1, 9.4.2.3.2	H9, H10
16	1	9.4.2.3.1	H10, H11.2c
17	1	9.4.5.3.1, 9.4.7.3.1	H10, H14.1a
18	1	9.4.3.3.1	H9, H10
19	1	9.4.6.2.1	H10
20	1	9.4.4.2.1, 9.4.4.3.1	H10

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	2	9.2.1.2.3	H7, H8
21 (b)	4	9.2.4.2.8	H7, H8
22	4	9.2.3.3.1	H7, H14.1f, H14.1g
23 (a)	1	9.2.2.2.1	H7, H8
23 (b)	2	9.2.2.2.1	H7, H8
23 (c)	3	9.2.2.2.1	H7, H8
24	6	9.3.4.2.4	H2, H7
25 (a)	3	9.3.1.2.4	H7, H13.1e
25 (b)	3	9.3.1.2.4	H2, H7
26	5	9.3.1.2.1, 9.3.3.2.1	H2, H7, H8
27	5	9.4.6.3.2, 9.4.6.3.3	H4, H9, H10
28 (a)	3	9.4.2.2.1	H7, H8
28 (b)	3	9.4.3.2.2, 9.4.5.2.1	H7, H8
29	4	9.4.5.2.1, 9.4.3.2.2	H4, H9, H10, H14.1b
30	7	9.3.5, 9.4.2, 9.4.3, 9.4.5, 9.4.6	H6, H9, H10

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		**Introduced Species and the Australian Environment**	
31 (a)	3	9.5.6.2.1	H7, H10
31 (b)	4	9.5.5.2.3, 9.5.5.2.4	H10
31 (c) (i)	2	9.5.4.2.2, 9.5.5.2.7, 9.5.6.2.1	H10, H14.1a
31 (c) (ii)	4	9.5.4.2.2, 9.5.5.2.7, 9.5.6.2.1	H10
31 (d) (i)	2	9.5.1.3.1	H12.3a–d, H12.4.4a–f
31 (d) (ii)	4	9.5.1.3.2	H12.1a–d, H12.2a–b
31 (e)	6	9.5.4.2.2, 9.5.4.3.1, 9.5.5.2.6, 9.5.5.2.7, 9.5.5.3.4	H5, H6, H13
Question 32		**Organic Geology – A non-renewable Resource**	
32 (a)	3	9.6.2.2.6, 9.6.2.2.7	H6
32 (b)	4	9.6.4.2.1, 9.6.4.2.2	H6
32 (c) (i)	2	9.6.1.2.4, 9.6.1.2.5, 9.6.1.2.6	H6, H14.1a
32 (c) (ii)	4	9.6.5.2.2, 9.6.5.2.3	H6
32 (d) (i)	2	9.6.5.3.2	H2.3a–d, H12.4a–f
32 (d) (ii)	4	9.6.5.3.1	H12.1a–d, H12.2 a–b
32 (e)	6	9.6.1.2.2, 9.6.4.2.3, 9.6.5.2.2, 9.6.6.2.2	H5, H6, H13
Question 33		**Mining and the Australian Environment**	
33 (a)	3	9.7.1.2.2	H6
33 (b)	4	9.7.3.2.6	H6, H7
33 (c) (i)	2	9.7.4.2.3	H6, H14.1a
33 (c) (ii)	4	9.7.4.2.1, 9.7.4.2.2, 9.7.4.2.3	H6
33 (d) (i)	2	9.7.4.3.4	H12.3a–d, H12.4a–f
33 (d) (ii)	4	9.7.3.3.3	H12.1a–d, H12.2a–b
33 (e)	6	9.7.2.2.2, 9.7.2.3.1, 9.7.5.2.1, 9.7.5.2.2, 9.7.5.3.1	H5, H6, H13

Question	Marks	Content	Syllabus outcomes
Question 34		**Oceanography**	
34 (a)	3	9.8.2.3.1, 9.8.8.2.1	H7
34 (b)	4	9.8.5.2.3	H7
34 (c) (i)	2	9.8.4.2.1	H7, H14.1a
34 (c) (ii)	4	9.8.4.2.1	H7
34 (d) (i)	2	9.8.3.3.4	H12.3 a–d, H12.4a–f
34 (d) (ii)	4	9.8.3.3.3	H12.1a–d, H12.2a–f
34 (e)	6	9.8.4.2.4, 9.8.4.3.2, 9.8.5.2.5, 9.8.5.3.2, 9.8.8.3.1	H5, H6, H13