2018 HSC Earth and Environmental Science Marking Guidelines

IMPORTANT:
This resource was developed to support a previous version of the syllabus.
It may contain content that differs from the current syllabus.

Section I, Part A

Multiple-choice Answer Key

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

Section I, Part B

Question 21 (a)

Criteria	Marks
• Identifies TWO hazards of these volcanic regions	2
• Identifies ONE hazard of these volcanic regions	1

Sample answer:

Two hazards of these volcanic regions are lahars and poisonous gases.

Question 21 (b)

Criteria	Marks
• Identifies the characteristics of such environments • Links the characteristics and the reason people live there	3
• Identifies at least ONE characteristic of such environments • Links the characteristic and the reason people live there	2
• Provides some relevant information	1

Sample answer:

The fertile soils derived from volcanic rocks lead to highly productive crop land. This means that people are attracted to the highly productive land to grow crops. High rainfall associated with mountainous regions provides a water supply for crops and livestock.

Question 22 (a)

Criteria	Marks
• Identifies the correct answer	1

Sample answer:

Chicxulub

Question 22 (b)

Criteria	Marks
• Demonstrates an understanding of a mass extinction • Describes the impact of a meteor • Provides reasons why a meteor impact results in a mass extinction	4
• Demonstrates an understanding of a mass extinction • Describes the impact of a meteor • Links the meteor impact to a mass extinction	3
• Sketches in general terms the characteristics of a meteor impact and attempts to link it to a mass extinction	2
• Provides some relevant information	1

Sample answer:

The impact of a meteor will cause initial shockwaves at the impact site and can force tonnes of ejecta into the atmosphere. This ejecta can enter the upper atmosphere and circle the globe, affecting global climate by blocking the sunlight thus reducing photosynthesis. This causes ecosystem collapse, resulting in many entire families worldwide dying out.

Question 23 (a)

Criteria	Marks
• Provides a valid strategy for each gas	3
• Provides a valid strategy for TWO gases	2
• Provides a valid strategy for ONE gas	1

Sample answer:

Gas	*Local or global strategy to decrease emissions of gas*
Carbon dioxide	Increased use of renewable energy
Methane	Use anaerobic digesters
Sulfur dioxide	Develop electric vehicles

Question 23 (b)

Criteria	Marks
• Explains how TWO strategies identified in part (a) reduce the emissions of the relevant gases	2
• Explains how ONE strategy identified in part (a) reduces the emissions of the relevant gas	1

Answers could include:

Anaerobic digesters on landfill sites capture methane thus stopping its release into the atmosphere.

Using renewable energy sources such as solar power reduces the amount of carbon dioxide released from the burning of fossil fuels in power stations.

Question 24 (a)

Criteria	Marks
• Identifies a technology that measures the movement of Earth's crust • Gives details of how the technology measures movement	2
• Provides some relevant information	1

Sample answer:

Seismometer – When the Earth's crust moves it emits shockwaves which are detected and recorded by a seismometer.

Question 24 (b)

Criteria	Marks
• Identifies one or more technologies • Describes how technology is used to predict natural disasters • Makes a judgement on the effectiveness of technology in predicting natural disasters • Gives supporting argument/s for the judgement	4
• Identifies one or more technologies • Describes how technology is used to predict natural disasters • Makes a judgement on the effectiveness of technology in predicting natural disasters	3
• Links technology to natural disasters	2
• Provides some relevant information	1

Sample answer:

Modern methods used to assist in the prediction of natural disasters including seismographs, creep meters and satellite GPS are useful, but not fail-safe or perfectly accurate. Seismographs can detect tiny tremors and identify them as foreshocks, but this may or may not lead to a large seismic event. More information would be needed to determine or predict the likelihood of a large seismic event. GPS may be able to provide information on plate speed and direction. Creep meters and laser tracking across fault zones constantly provide data on the strain and movement the region is experiencing. The use of multiple technologies improves the likelihood of predicting a natural disaster.

Question 25 (a)

Criteria	Marks
• Identifies the relevant organism	1

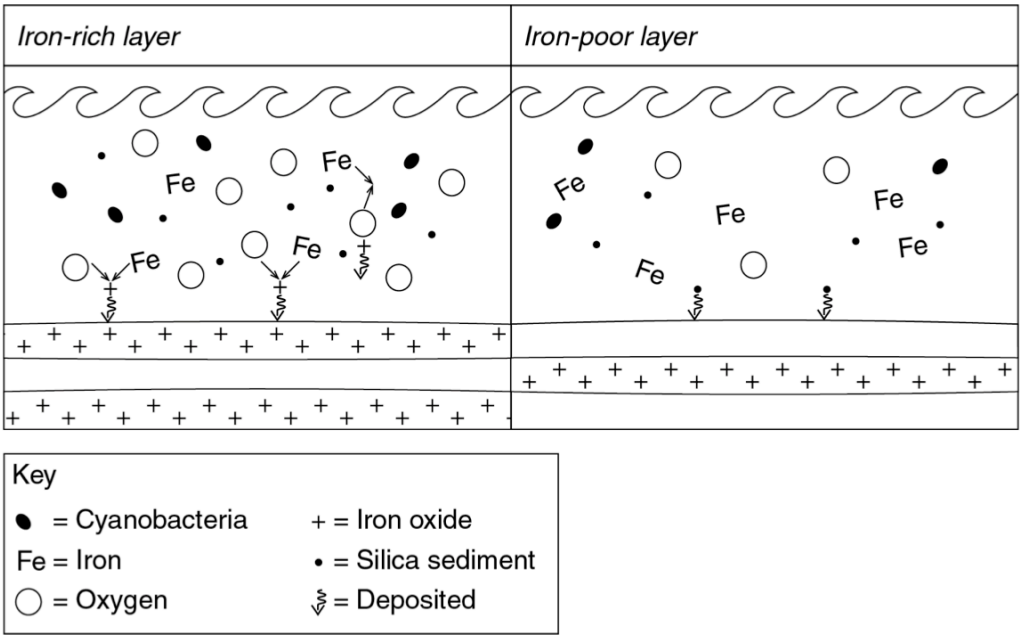
Sample answer:

Cyanobacteria

Question 25 (b)

Criteria	Marks
• Draws fully labelled diagrams that show the environmental conditions for the deposition of both layers	4
• Draws labelled diagrams that show the deposition of both layers	3
• Draws a labelled diagram of the deposition of one layer OR • Draws diagrams to show the deposition of both layers OR • Identifies environmental conditions for the deposition of both layers	2
• Draws a diagram OR • Gives some relevant information	1

Sample answer:



Question 25 (c)

Criteria	Marks
• Gives a reason why BIFs are no longer being formed • Provides a link as to why	2
• Gives one reason why BIFs are no longer being formed	1

Sample answer:

The formation of BIFs removed all of the iron from the ancient oceans and excess oxygen escaped to the atmosphere. In modern environments atmospheric oxygen reacts with iron on the land and thus the formation of iron oxide no longer occurs in the oceans.

Question 26 (a) (i)

Criteria	Marks
• Identifies TWO appropriate species	1

Sample answer:

River red gum and Swamp gum

Question 26 (a) (ii)

Criteria	Marks
• Gives reasons for selecting each plant	2
• Gives one reason for selecting either plant	1

Sample answer:

River red gum – has a high tolerance for salinity and a high tolerance to waterlogging.
Swamp gum – has a moderate to high tolerance for waterlogging and is a local plant.

Question 26 (b)

Criteria	Marks
• Describes a strategy for combating soil erosion • Relates the strategy to the effective rehabilitation of the land	3
• Outlines a strategy for combating soil erosion • Links the strategy to the rehabilitation of the land	2
• Gives some relevant information	1

Sample answer:

The land surface should be reshaped to reduce soil erosion, for example terracing. This involves the construction of banks following the topographic contours of the land. Terracing would decrease the velocity of run-off water which reduces its erosive power.

Question 27

Criteria	Marks
• Identifies the features of shockwaves • Relates the impacts of shockwaves to natural and built environments • Uses data in the table	5
• Identifies most of the features of shockwaves • Relates most of the impacts of shockwaves to natural and built environments • Uses data in the table	4
• Identifies some of the features of shockwaves • Relates some of the impacts of shockwaves to natural and/or built environments	3
• Identifies features of shockwaves and/or identifies the impacts	2
• Gives some relevant information	1

Sample answer:

Surface waves are the most destructive waves on the natural and built environment. Surface waves move at 4 km/h which is slower than P and S waves, therefore have more time to cause damage. Surface waves move in a rolling motion which is more likely to damage rigid structures such as tall buildings and those made of brittle materials such as concrete. Surface waves can also mobilise loose material on a slope causing an avalanche or landslide. These can impact the roots of plants, destabilising them and they die. The higher speed of P and S waves and their location primarily within the earth's surface cause minimal damage on the surface.

Question 28

Criteria	Marks
• Completes all of the table correctly	4
• Completes most of the table correctly	3
• Provides some correct information on the table	2
• Provides some relevant information	1

Sample answer:

Feature	*How the feature gave reptiles an advantage over amphibians in a terrestrial environment*
1. Waterproof skin	The scaly skin of reptiles was an advantage as it reduced water loss.
2. Egg with shell	The leathery shell of a reptilian egg reduced water loss unlike the egg of amphibians which needed to be deposited in water to prevent drying out.
3. Internal fertilisation	Allowed fertilisation to take place in a terrestrial environment without gametes drying out.
4. Larger bones	Larger bones give support in a less supportive environment and provide stronger attachment points for large muscles.

Question 29

Criteria	Marks
• Demonstrates a thorough knowledge and understanding of mine sites and rehabilitation strategies • Makes a judgement supported by arguments regarding the effectiveness of the rehabilitation with clear reference to the goals provided • Provides appropriate examples which link the judgement to the goals provided • Uses specific and appropriate terminology and progression of thought	5
• Demonstrates good knowledge of mine sites and rehabilitation strategies • Makes a judgement supported by arguments regarding the effectiveness of the rehabilitation with reference to the goals provided • Provides appropriate examples which link the judgement to the goals provided • Uses suitable terminology and progression of thought	4
• Demonstrates some knowledge of mine sites and rehabilitation strategies • Makes a judgement regarding the effectiveness of the rehabilitation • Provides a link between the judgement and the goals provided • Uses suitable terminology and progression of thought	3
• Demonstrates some knowledge of mine sites and rehabilitation strategies or makes a judgement regarding the effectiveness of the rehabilitation • Limited use of appropriate terminology	2
• Provides some relevant information	1

Answers could include:

Goal 1 is achieved when the mining company takes on a stage by stage approach to mining and rehabilitation. For example, once mining of a site has finished it should be rehabilitated at the same time as mining takes place in another area; that is, rehabilitation takes place as soon as mining finishes. This means that after a mine has been closed the surface is reshaped with topsoil and planted with endemic vegetation in order to minimise the impact of mining.

Goal 2 is achieved when mining incorporates new technologies or procedures that can reduce the length and area of disturbance. For example, modern drilling and/or blasting methods should specifically target the ore body and not unproductive rock. There should be constant monitoring of all mining activities to ensure best practice is carried out.

Question 30

Criteria	Marks
• Demonstrates a thorough understanding of the plate tectonic super-cycle • Uses data from the diagram to support analysis • Relates the super-cycle to the extinction and evolution of new species • Uses specific and appropriate terminology and progression of thought	7
• Demonstrates good understanding of the plate tectonic super-cycle • Uses some data from the diagram to support analysis • Relates the super-cycle to the extinction and evolution of new species • Uses suitable terminology and progression of thought	5–6
• Demonstrates some knowledge of the plate tectonic super-cycle • Refers to the diagram • Links plate tectonic super-cycle to extinction and evolution of new species • Uses suitable terminology and progression of thought	3–4
• Provides some information on the plate tectonic super-cycle, and/or extinction of species and/or evolution of species	2
• Provides some relevant information	1

Answers could include:

The plate tectonic super-cycle (PTSC), which is the cyclic rearrangement of Earth's landmass into supercontinent and separate continents, has a very large influence on both the extinction and creation of species. This is because it drives large-scale changes in sea level and climate change, both of which influence evolution and extinction.

The diagram covers the period from the aggregation of landmasses, caused by continental collision, which led to the formation of Pangaea and then the break-up, as a result of rifting, of this supercontinent. The PTSC is repeated every 300 to 600 million years.

The graphs show that as Pangaea was forming, the sea level fell. Thus, near shore communities would become exposed and extinction would result. As new environments are exposed they become available for other organisms to exploit. Over time evolution and speciation can occur.

As Pangaea broke up, the formation of mid ocean ridge systems displaced sea water and sea level rose. As the sea level rose communities near the edge of the landmass would be inundated with salt water, again causing extinction of some species. In turn this also creates new shallow habitats for colonisation, and evolution of new species.

The graphs cover the Permo-Triassic mass extinction, 250 Ma BP, which resulted in 90% of all species becoming extinct. Climate change caused by the PTSC was one of the factors causing the mass extinction.

The data in the graphs support the creation and extinction of organisms during a PTSC. The time at which the biodiversity was smallest, approximately 250 million years ago, corresponds with the mass extinction and also corresponds with the Siberian volcanic event. Volcanism produces carbon dioxide, with massive methane emissions at the same time, which would have resulted in global warming and an acidified and anoxic ocean – both an influences on the extinction of animals.

In summary, the plate tectonic super-cycle affects the distribution of the oceans and landmasses which in turn affect the climate and sea level. These changing conditions result in the extinction and evolution of new species.

Section II

Question 31 (a)

Criteria	Marks
• Identifies a predator • Details the predator–prey strategy for the control of prickly pear • Provides a causal link for successful control	3
• Outlines how an identified predator is used to successfully control prickly pear	2
• Provides some relevant information	1

Sample answer:

The most effective control agent for prickly pear is the larvae of the Cactoblastis moth, which feed on the cactus. The larvae bore into the pads of the prickly pear and eat them from the inside, causing the cactus to collapse and thus preventing the cactus from spreading. Moths lay large numbers of eggs which leads to a rapid decline in prickly pear in a short period of time.

Question 31 (b)

Criteria	Marks
• Constructs an appropriate table to present information • Completes all cells of the table correctly	4
• Constructs an appropriate table to present information • Completes most cells of the table correctly for each method	3
• Constructs a table AND • Completes some cells of both methods OR completes all cells for one method	2
• Provides some correct information	1

Answers could include:

Characteristic	*Bradley method*	*Mechanical removal and replanting*
Level of soil disturbance	Minimal	High
Replanting	Nil	Yes
Timeframe	Long time	Short time

OR

Bradley method	*Mechanical removal*
Minimal soil disturbance	High amount of soil disturbance
No replanting – native regeneration	Replanting
Long timeframe – regeneration dictates clearing rule	Short timeframe – regeneration does not dictate role of clearing

Question 31 (c) (i)

Criteria	Marks
• Sketches in general terms at least ONE feature for at least TWO quarantine procedures	2
• Identifies TWO quarantine procedures OR sketches in general terms ONE feature	1

Sample answer:

X-raying mail that comes into the country can detect prohibited products. Detector dogs sniff luggage at airports to detect biological products like fruit and meat.

Question 31 (c) (ii)

Criteria	Marks
• Demonstrates a thorough knowledge of the quarantine procedures which prevent the spread of new species • Uses examples • Provides points for and/or against the effectiveness of the identified procedures	4
• Demonstrates a sound knowledge of the quarantine procedures which prevent the spread of new species • Uses examples • Includes points for and/or against the effectiveness of the identified procedures	3
• Demonstrates a basic knowledge of quarantine procedures • Gives an example	2
• Provides some relevant information	1

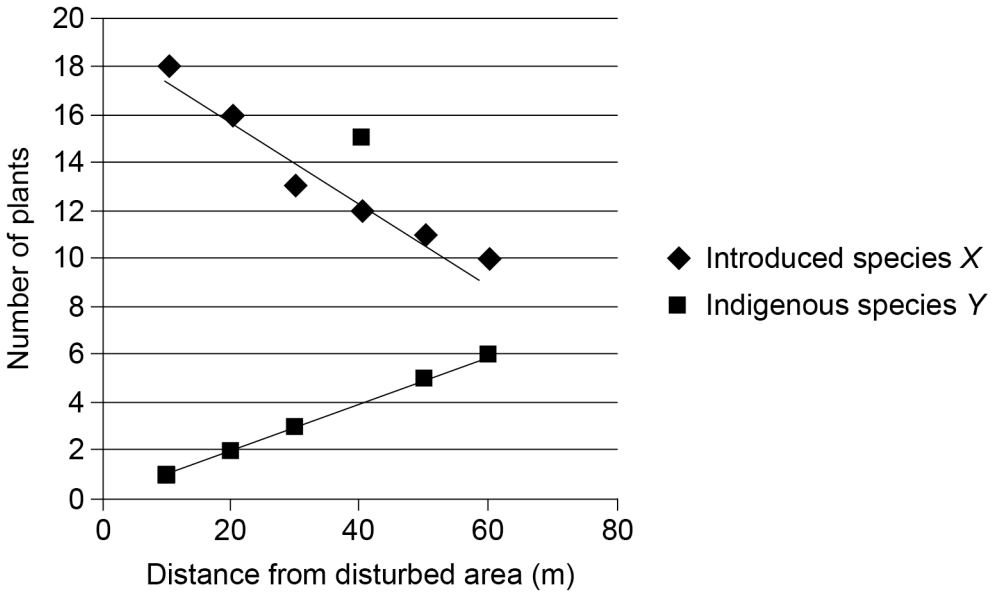
Answers could include:

- Imposing internal restrictions aimed at preventing the spread of pests like fruit flies into other areas and states, for example, binning fruit when crossing borders
- Spraying fruit OR vegetables moving from one area to another
- Preventing dumping of untreated ballast water from contaminated domestic ports eg Pacific Star from Tasmania to mainland.
- No procedure is 100% effective as, for example, people do not bin all fruit OR fruit may be covered by other fruit/leaves when sprayed and thus not get sprayed. Not all members of a species will be eliminated by any treatment.

Question 31 (d) (i)

Criteria	Marks
• Constructs an appropriate graph to present the information • Plots all data points correctly • Draws lines of best fit	4
• Constructs an appropriate graph to present the information • Plots most of the data points correctly • Draws at least ONE line of best fit	3
• Constructs a graph AND • Plots some of the data points correctly OR plots incorrect data points but has lines of best fit	2
• Attempts a graph	1

Sample answer:



Question 31 (d) (ii)

Criteria	Marks
• Describes the data for both species at 40 m • Gives a reason for the outlier	2
• Gives some information about the data for one or both species at 40 m	1

Sample answer:

At 40 m distance from disturbed area there are 12 plants of introduced species *X* and 15 indigenous plants of the species *Y*. The measurement for species *X* fits the trend shown by the line of best fit. The measurement for species *Y* is an outlier and doesn't follow line of best fit. It must be an error in measurement.

Question 31 (e)

Criteria	Marks
• Demonstrates breadth or depth of knowledge and understanding of the development and implementation of control strategies for an introduced animal species, and how science has been utilised • Makes a judgement on the role science plays in control with well-supported arguments • Provides appropriate examples • Demonstrates a coherent and logical progression of thought • Consistently uses appropriate terminology	6
• Demonstrates knowledge and/or understanding of the development and implementation of control strategies for an introduced animal species, and how science has been utilised • Makes a judgement on the role science plays in control with supporting arguments • Uses relevant terminology and/or progression of thought • Gives examples	4–5
• Recalls basic information on the development and implementation of control strategies for an introduced animal species, and/or how science has been utilised • Uses suitable terminology • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Science is pivotal in developing and implementing control strategies for introduced animal species. The variety of introduced organisms necessitates a range of strategies to be developed based on factors such as life cycle, predator/prey relationships, environmental factors of vulnerable habitats and possible impacts on native flora and fauna. Controls should be species specific, and biological controls need to be unlikely to become a pest themselves.

Research by scientists has resulted in the development of biological controls via recombinant viruses or species-specific pathogens, as well as the genetic modification of species to produce 'daughterless' offspring to control introduced species like those used with the European carp and rabbit. The control of the rabbit is one case where the specific method was used to improve the effectiveness of control. Myxamatosis, a species-specific control, was first used on the rabbit after their numbers increased again significantly in the mid 20th century. Rabbits with a natural resistance survived the disease and continued to reproduce and numbers again increased. Scientists collected data to analyse the effectiveness of the control and had to modify their approach. After substantial research, testing and analysis the Callicivirus was released as a biological control specific to rabbits. Scientists assess the effectiveness of the virus, as some regions were shown to have immune populations. Scientists have also experimented with using genetic modification on European carp, that can produce only male offspring which may even be passed on genetically in the future. Scientists at the CSIRO will continue to monitor the success of this strategy for the next 20–30 years, by collecting and analysing data.

Science must continually strive to develop new strategies to improve the effective control of introduced species, especially in regard to use of pathogens to which immunity or resistance can be developed, the success of genetic modification, or the effect on domestic species.

Question 32 (a)

Criteria	Marks
• Names an energy source other than fossil fuels • Describes the use of the energy source in local communities	3
• Names an energy source other than fossil fuels • Outlines the use of the energy source in local communities	2
• Provides some relevant information	1

Sample answer:

Solar energy is an energy source that could be used in local communities. Electricity from solar energy could provide electricity for hot water in individual households or a solar farm could provide electricity for an entire suburb or town.

Question 32 (b)

Criteria	Marks
• Constructs an appropriate table to present information • Completes all cells of the table correctly	4
• Constructs an appropriate table to present information • Completes most cells of the table correctly	3
• Constructs a table AND • Completes some cells for both coal and petroleum OR completes all cells for either coal or petroleum	2
• Provides some correct information	1

Sample answer:

Feature	*Coal*	*Petroleum*
Type of organic matter	Derived from mostly terrestrial plants	Derived from terrestrial plants and/or marine organisms
Type of environment	Freshwater to deltaic	Deltaic to marine
Oxygen levels	Anoxic	Anoxic

Question 32 (c) (i)

Criteria	Marks
• Outlines TWO types of information that drilling provides	2
• Outlines ONE type of information that drilling provides	1

Sample answer:

Drilling allows the rock types of potential traps in the prospect area to be identified and permits stratigraphic relationships between drill holes to be determined.

Question 32 (c) (ii)

Criteria	Marks
• Demonstrates thorough knowledge of another petroleum exploration method • Gives benefits for using this method in conjunction with drilling	4
• Demonstrates sound knowledge of another petroleum exploration method • Gives benefits for using this method in conjunction with drilling	3
• Demonstrates basic knowledge of another petroleum exploration method • Gives a benefit for using this method	2
• Provides some relevant information	1

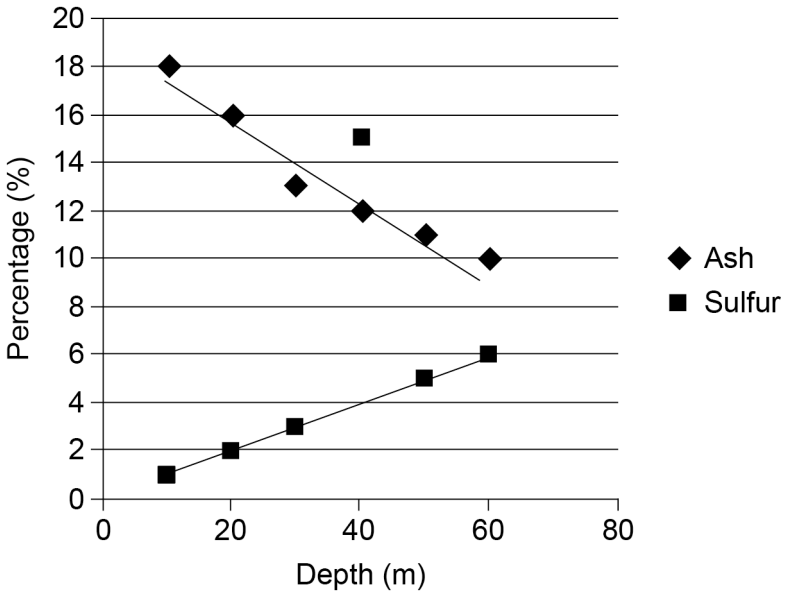
Sample answer:

Another petroleum exploration method is a seismic survey. In a seismic survey an energy source produces waves which pass through the upper crust and are reflected or refracted off rock boundaries. These reflected or refracted waves are detected with geophones. The data are used to interpret the size and stratigraphy of a basin. This information should be used to identify potential traps which should be targeted with drilling. Using both techniques minimises costs and improves chances of finding petroleum.

Question 32 (d) (i)

Criteria	Marks
• Constructs an appropriate graph to present the information • Plots all data points correctly • Draws lines of best fit	4
• Constructs an appropriate graph to present the information • Plots most of the data points correctly • Draws at least ONE line of best fit	3
• Constructs a graph AND • Plots some of the data points correctly OR plots incorrect data points but has lines of best fit	2
• Attempts a graph	1

Sample answer:



Question 32 (d) (ii)

Criteria	Marks
• Describes the data for both ash and sulfur at 40 m • Gives a reason for the outlier	2
• Gives some information about the data for ash and/or sulfur at 40 m	1

Sample answer:

At 40 m depth the 12% ash fits the trend as shown by the line of best fit. However, the 15% sulfur is a outlier and must have been an error of measurement.

Question 32 (e)

Criteria	Marks
• Demonstrates breadth or depth of knowledge and understanding of the role of science in addressing the economic and environmental problems relating to fossil fuels • Provides appropriate examples • Demonstrates a coherent and logical progression of thought • Consistently uses appropriate terminology	6
• Demonstrates knowledge and/or understanding of the role of science in addressing the economic and environmental problems relating to fossil fuels • Uses relevant terminology and/or progression of thought • Gives examples	4–5
• Recalls basic information on the economic and environmental issues relating to fossil fuels and/or how science has been utilised • Uses suitable terminology • Gives one or more example(s)	2–3
• Recalls some relevant information	1

Sample answer:

Traditionally, the combustion of fossil fuels has produced many products that have harmed the environment. Science has allowed a better understanding of the processes and products of combustion. For example, power stations produce large amounts of carbon dioxide. Computer modelling has shown that global warming is increasing rapidly because of carbon dioxide and other greenhouse gases. The models are used to justify the use of alternative energy sources to reduce carbon dioxide levels. Monitoring of power station flue gases has resulted in alteration to the design of chimneys to incorporate technology that removes toxic gases.

The use of petroleum in vehicles results in many harmful emissions. The study of engine design, fuel composition and emissions has resulted in better engine design.

Changing engine design or making modifications to power stations require additional costs and can thus be a deterrent to change. However, not incorporating these changes will result in greater long-term costs. While the short-term economic costs may be great, the long-term consequences of not implementing change may be much greater in both economic and environmental costs.

Science has been instrumental in successfully reducing products harmful to the environment. In many cities the air is cleaner and there should be a reduction in greenhouse gases if more people used the abundant scientific data available. Alternative fuels are being used although these fuels are sometimes more expensive than fossil fuels.

Question 33 (a)

Criteria	Marks
• Identifies a mine site • Describes the rehabilitation methods used • Provides causal links between the methods and the rehabilitation	3
• Identifies a mine site • Outlines one rehabilitation method • Provides a causal link	2
• Provides some relevant information	1

Sample answer:

Mount Lyell in Tasmania is a gold and copper mine. An impervious clay cap was placed over the spoil heaps. This prevents run-off from acidifying waterways. Waste dumps were levelled and planted with native species to stabilise the surface.

Question 33 (b)

Criteria	Marks
• Constructs an appropriate table to present information • Completes all cells of the table correctly	4
• Constructs an appropriate table to present information • Completes most cells of the table correctly	3
• Constructs a table AND • Completes some cells for both mineral provinces OR completes all cells for one mineral province	2
• Provides some correct information	1

Sample answer:

Feature	*Volcanics of the Lachlar Fold Belt*	*Hamersley Iron Province in Western Australia*
Age	Ordovician	Proterozoic 2500 Ma
Tectonic setting for formation	Volcanic Island Arc	Sedimentary basin
Major metals mined	Copper, gold	Iron

Question 33 (c) (i)

Criteria	Marks
• Sketches in general terms TWO reasons for carrying out an EIS	2
• Identifies TWO reasons for an EIS OR • Sketches in general terms ONE reason	1

Sample answer:

Two reasons for an Environmental Impact Statement are to identify local flora and fauna and to determine the impact of wastewater produced during mining.

Question 33 (c) (ii)

Criteria	Marks
• Demonstrates a thorough knowledge of the role of government in modern mining operations • Provides examples	4
• Demonstrates a sound knowledge of the role of government in modern mining operations • Provides examples	3
• Demonstrates a basic knowledge of the role of government in modern mining operations • Provides one or more examples	2
• Provides some relevant information	1

Sample answer:

The role of government is to make laws that need to be followed. For example, the NSW Mining Act requires mining companies to advise property owners of their desire to mine and the scope of activities. The companies are also required to pay compensation to the landholder by law.

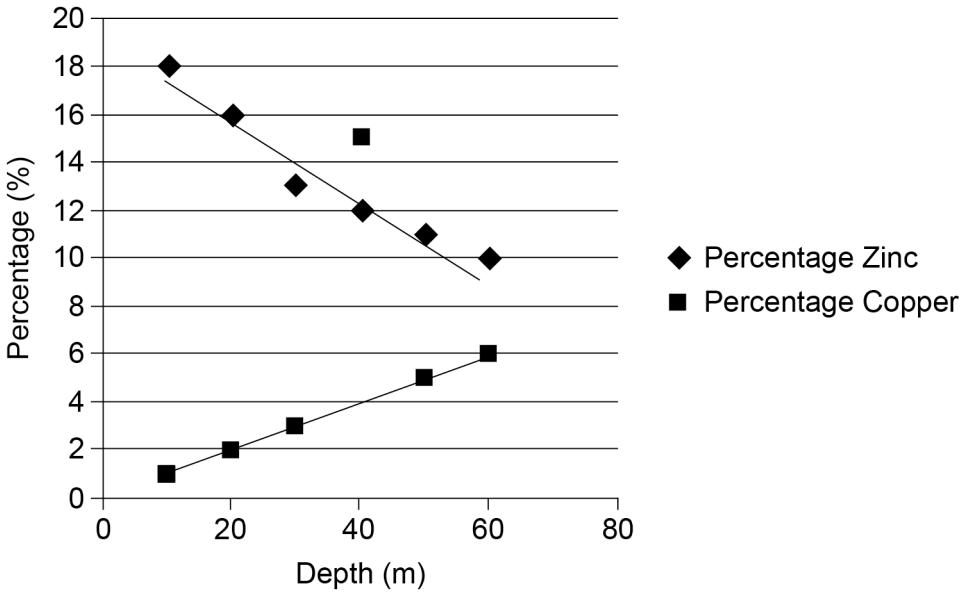
The Native Title Act has allowed traditional landowners to be recognised and have the right to negotiate for the interests of the land and water and make claims of compensation.

These are two laws that governments have introduced that can determine how a mine operates.

Question 33 (d) (i)

Criteria	Marks
• Constructs an appropriate graph to present the information • Plots all data points correctly • Draws lines of best fit	4
• Constructs an appropriate graph to present the information • Plots most of the data points correctly • Draws at least ONE line of best fit	3
• Constructs a graph AND • Plots some of the data points correctly OR plots incorrect data points but has lines of best fit	2
• Attempts a graph	1

Sample answer:



Question 33 (d) (ii)

Criteria	Marks
• Describes the data for both metals at 40 m • Gives a reason for the outlier	2
• Gives some information about the data for one or both metal(s) at 40 m depth	1

Sample answer:

At 40 m depth there is 12% zinc and 15% copper. The zinc value is close to the line of best fit but the copper value is an outlier. The outlier varies so much from the trend that it must have been due to an error in measurement.

Question 33 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of the economic viability of mining ore bodies, and how science has been utilized in its assessment • Makes a judgement on the role science plays in the assessment with well-supported arguments • Provides appropriate examples • Demonstrates a coherent and logical progression of thought • Consistently uses appropriate terminology	6
• Demonstrates a knowledge and/or understanding of the economic viability of mining ore bodies, and how science has been utilized in its assessment • Makes a judgement on the role science plays in the assessment with supporting arguments • Uses relevant terminology and or progression of thought • Gives examples	4–5
• Recalls basic information on the economics of mining ore bodies, and/or how science has been utilised • Uses suitable terminology • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Science plays a vital role in assessing the economic viability of mining ore bodies. This includes using data collected by geophysicists and geochemists. This data is used to determine the grade and quantity of the ore in the ground. However, scientists also need to determine the amount of ore which is extractable at a profit.

Geologists need to determine the nature of the surrounding rock to guide decisions as to how the mine will operate. This also involves the location of the water table and permeability of the surrounding rock which plays a role in drainage. Determining the most cost-effective way to transport the ore is impacted by the local topography and the depth of the deposit. A metallurgical analysis is required to select the most economical method for separating the mineral from the ore.

The affected threatened or endangered species are of particular importance and are usually address in an Environmental Impact Statement (EIS). The methods for rehabilitation need to be described and the costs of this process contribute to the overall economic scalability of the mine. The EIS may also include the impact on the human environment and necessary strategies for minimising any negative effects.

Question 34 (a)

Criteria	Marks
• Details the relationships between temperature, salinity and circulation • Provides causal links	3
• Outlines the general relationship between temperature, salinity and circulation OR • Details the relationship between salinity and circulation, providing a causal link OR • Details the relationship between temperature and circulation, providing a causal link	2
• Provides some relevant information	1

Sample answer:

When water temperature decreases, the water becomes more dense. When water becomes more saline, it also becomes more dense. As water becomes more dense, it sinks, and as such, temperature and salinity both influence vertical circulation within the oceans.

Question 34 (b)

Criteria	Marks
• Constructs an appropriate table to present information • Completes all cells of the table correctly	4
• Constructs an appropriate table to present information • Completes most cells of the table correctly	3
• Constructs a table AND • Completes some cells for both deep ocean organisms and top 30 m organisms OR completes all cells for either deep ocean organisms or top 30 m organisms	2
• Provides some correct information	1

Sample answer:

Feature	*Deep ocean organism*	*Top 30 m organism*
Eyes	Very large OR absent	Normal size
Mouth	Very large with inward pointing teeth	Small mouth mostly with teeth
Bioluminescence	Present	Not present

Question 34 (c) (i)

Criteria	Marks
• Sketches in general terms TWO characteristics of oozes	2
• Sketches in general terms ONE characteristic of oozes OR • Identifies TWO characteristics	1

Sample answer:

Oozes are fine grained in texture, biogenous in composition.

Question 34 (c) (ii)

Criteria	Marks
• Describes an identified sediment other than oozes • Describes the origin of the sediment including depth of sediment • Describes the environment of deposition • Links the origin and environment of deposition to where it is found	4
• Describes an identified sediment other than oozes • Outlines the origin including depth of sediment • Outlines the environment of deposition • Links the origin and environment of deposition to where it is found	3
• Gives some features of a sediment other than oozes • Gives information about the origin and/or location and/or environment of deposition	2
• Provides some relevant information	1

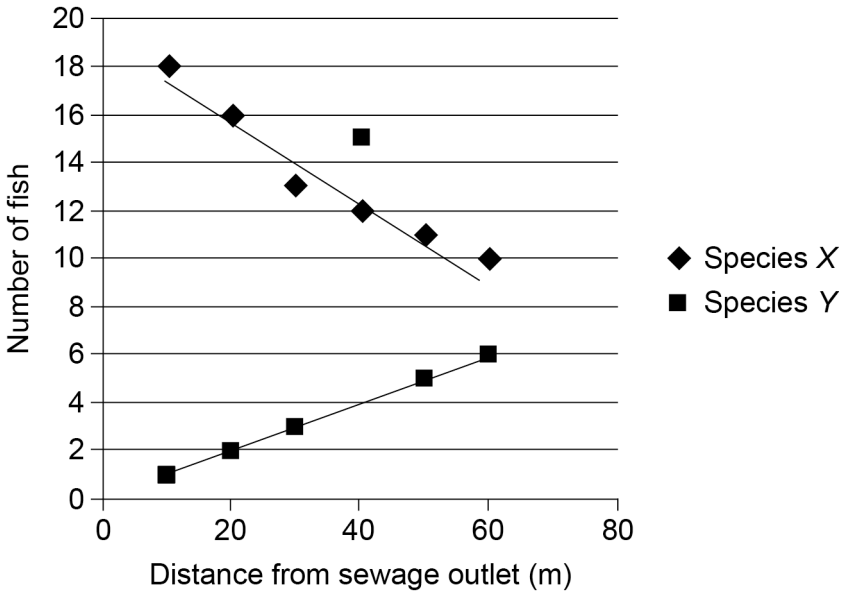
Sample answer:

Manganese nodules are associated with hydrothermal fluids and originate via chemical precipitation around a ‘seed’ particle. They are only found in deep, quiet waters where the water is rich in manganese (hydrothermal fluids) and the current and rate of other sedimentation are very low. This allows for the process of precipitation to occur, if a ‘seed’ particle is present, in concentric layers. If current or sedimentation rates are too high this process will be inhibited or stopped, which accounts for their distribution only in the deep oceans.

Question 34 (d) (i)

Criteria	Marks
• Constructs an appropriate graph to present information • Plots all data points correctly • Draws lines of best fit	4
• Constructs an appropriate graph to present information • Plots most of the data points correctly • Draws at least ONE line of best fit	3
• Constructs a graph AND • Plots some of the data points correctly OR plots incorrect data points but has lines of best fit	2
• Attempts a graph	1

Sample answer:



Question 34 (d) (ii)

Criteria	Marks
• Describes the data for both species at 40 m • Gives a reason for the outlier	2
• Gives some information about the data for one or both species at 40 m	1

Sample answer:

At 40 m from the sewage outlet there are 12 of species *X* and 15 of species *Y*. The species *X* value is close to the line of best fit, but the species *Y* value is an outlier. The outlier varies so much from the trend that it must have been due to an error.

Question 34 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of oceanic resources, and how science has been utilised in their location and management • Makes a judgement on the role science plays with well-supported arguments • Provides appropriate examples • Demonstrates a coherent and logical progression of thought • Consistently uses appropriate terminology	6
• Demonstrates a knowledge and/or understanding of oceanic resources, and how science has been utilised in their location and management • Makes a judgement on the role science plays with supporting arguments • Uses relevant terminology and or progression of thought • Gives examples	4–5
• Recalls basic information on the location and management of oceanic resources how science has been utilised • Uses suitable terminology • Gives examples	2–3
• Provides some relevant information	1

Sample answer:

Science is essential when locating and managing the world's oceanic resources. Ocean resources include food (fish, shellfish), minerals and power. These resources are essential to our growing population and being able to use them in a sustainable fashion requires a scientific approach.

Locating resources such as fish can be done using echo sounding. Sound waves are emitted from a device, bounce off dense objects and back to the device which converts the travel time into a distance and then an image on a screen. This allows commercial fishers to see in real time what is below their boat allowing them to obtain maximum yields. The management of fish resources has also been aided by science as we have been able to measure population abundance and distribution using research vessels, catch and tag and computer modelling, which allows us to set catch limits on certain species in order to keep their populations healthy.

Mineral resources can also be located using scientific methods such as SONAR and also using geophysical methods. One such method is the use of a magnetometer to locate iron-bearing rocks which may be of future interest as a source of metal. The magnetometer is towed behind a boat and detects and measures magnetic fields/strength of the rocks on the sea floor.

2018 HSC Earth and Environmental Science Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.3.1.3.1	H8, H12
2	1	9.2.1.2.2	H7
3	1	9.2.1.2.1	H7
4	1	9.4.7.2.2	H1, H10
5	1	9.3.5.2.2	H8
6	1	9.4.6.3.1	H6
7	1	9.4.6.3.3	H1
8	1	9.4.6.2.1	H6
9	1	9.2.4.2.1	H7
10	1	9.3.3.2.1	H7, H14
11	1	9.3.1.2.3	H7
12	1	9.4.4.2.2	H4, H14
13	1	9.3.2.2.1	H7
14	1	9.3.1.1.4	H4, H12
15	1	9.4.7.3.2	H4, H9
16	1	9.2.2.2.1	H7
17	1	9.2.4.2.1, 9.2.4.2.8	H7
18	1	9.2.5.3.1, 9.3.5.2.5, 9.3.5.3.3	H7, H14
19	1	9.4.7.2.2	H4, H7, H14
20	1	9.2.1.2.4, 9.2.1.3.1	H8, H14

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	2	9.2.4.2.5	H4
21 (b)	3	9.2.4.2.3	H4
22 (a)	1	9.3.5.2.2, 9.3.5.2.3, 9.3.5.3.1	H14
22 (b)	4	9.3.5.2.2, 9.3.5.2.3, 9.3.5.3.1, 9.3.5.2.4	H4, H7
23 (a)	3	9.4.6.2.1	H6, H9
23 (b)	2	9.4.6.3.1, 9.4.6.3.2	H6, H9
24 (a)	2	9.2.4.3.2	H3
24 (b)	4	9.2.4.2.2, 9.2.4.3.3	H3
25 (a)	1	9.3.1.2.2	H7
25 (b)	4	9.3.1.2.3	H8, H13
25 (c)	2	9.3.1.2.3	H7
26 (a) (i)	1	9.4.3.3.1	H6, H14
26 (a) (ii)	2	9.4.3.3.1	H10, H14

Question	Marks	Content	Syllabus outcomes
26 (b)	3	9.4.2.3.2, 9.4.3.3.1	H6
27	5	9.2.4.2.7	H4, H14
28	4	9.3.4.2.2, 9.3.4.2.3, 9.3.4.2.4	H1, H2, H7, H14
29	5	9.4.7.2.3	H4, H6, H9
30	7	9.3.4, 9.3.5, 9.2.3	H4, H7, H8, h13, H14

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		**Introduced Species and the Australian Environment**	
(a)	3	9.5.5.2.2	H3, H10
(b)	4	9.5.5.3.2	H10, H13
(c) (i)	2	9.5.6.2.1	H4
(c) (ii)	4	9.5.6.2.3	H4, H7
(d) (i)	4	H13.1 (f), (g)	H13
(d) (ii)	2	H14.1 (a), (c)	H14
(e)	6	9.5.5, 9.5.4, 9.5.6	H1, H2, H3, H4, H5, H7, H10
Question 32		**Organic Geology – A non-renewable Resource**	
(a)	3	9.6.6.2.1	H6
(b)	4	9.6.2.2.3, 9.6.2.2.1, 9.6.2.3.2	H7
(c) (i)	2	9.6.3.2.2, 9.6.3.3.1	H6
(c) (ii)	4	9.6.3.2.2, 9.6.3.3, 9.6.3.2.3	H6, H12
(d) (i)	4	H13.1 (f), (g)	H13
(d) (ii)	2	H14.1 (a), (c)	H14
(e)	6	9.6.5, 9.6.6, 9.6.4, 9.6.1	H1–H6, H9, H14
Question 33		**Mining and the Australian Environment**	
(a)	3	9.7.5.2.3, 9.7.5.3.2	H9
(b)	4	9.7.1.2.1, 9.7.1.3.1	H7
(c) (i)	2	9.7.5.2.1, 9.7.5.2.2, 9.7.5.3.1	H1, H6
(c) (ii)	4	9.7.2.3.1, 9.7.2.2.2, 9.7.2.3.1, 9.7.4.2.4	H3, H6
(d) (i)	4	H13.1 (f), (g)	H13
(d) (ii)	2	H14.1 (a), (c)	H14
(e)	6	9.7.3, 9.7.4, 9.7.5	H1–H6, H9, H14
Question 34		**Oceanography**	
(a)	3	9.8.4.2.1	H7
(b)	4	9.8.5.2.4, 9.8.5.3.1	H7
(c) (i)	2	9.8.7.2.1, 9.8.7.3.1	H7
(c) (ii)	4	9.8.7.2.1, 9.8.7.3.1, 9.8.7.2.1	H7
(d) (i)	4	H13.1 (f), (g)	H13
(d) (ii)	2	H14.1 (a), (c)	H14
(e)	6	9.8.6, 9.8.7, 9.8.8	H1–H6, H9, H14