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2015 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	B
2	C
3	C
4	B
5	C
6	D
7	C
8	B
9	A
10	D
11	C
12	D
13	D
14	A
15	A
16	C
17	A
18	B
19	B
20	A

Section I, Part B

Question 21 (a)

Criteria	Marks
• Sketches in general terms ONE feature of a conservative plate boundary	1

Sample answer:

At a conservative plate boundary the two plates are separated by a transform fault which causes the plates to slide past one another.

Question 21 (b)

Criteria	Marks
• Details TWO features of an oceanic plate	3
• Sketches in general terms TWO features of an oceanic plate OR • Details ONE feature of an oceanic plate	2
• Gives some relevant information	1

Sample answer:

A lithospheric plate under an ocean is a slab of the outer layer of Earth comprising oceanic crust consisting of mostly basalt and the upper-most rigid layer of the mantle which usually consists of olivine-rich or garnet-rich rocks.

Question 22 (a)

Criteria	Marks
• Details ONE advantage and ONE disadvantage	3
• Details ONE advantage or ONE disadvantage OR • Sketches in general terms ONE advantage and ONE disadvantage	2
• Gives some relevant information	1

Sample answer:

This is an explosive volcano that could produce lahars that flow down the mountain destroying buildings, plants and animals.

An advantage of living on or near volcanoes is that the soil is very rich and this promotes plant growth.

Question 22 (b)

Criteria	Marks
• Provides details of the tectonic activity of the Philippine Islands and Australia • Clearly links the cause of tectonic activity to detailed features of the plates on which the Philippine Islands and Australia are located	5
• Provides features of the tectonic activity of the Philippine Islands and Australia • Links the tectonic activity of the Philippine Islands and/or Australia to plate boundaries	3–4
• Gives relevant information about tectonic activity and/or plate boundaries	1–2

Sample answer:

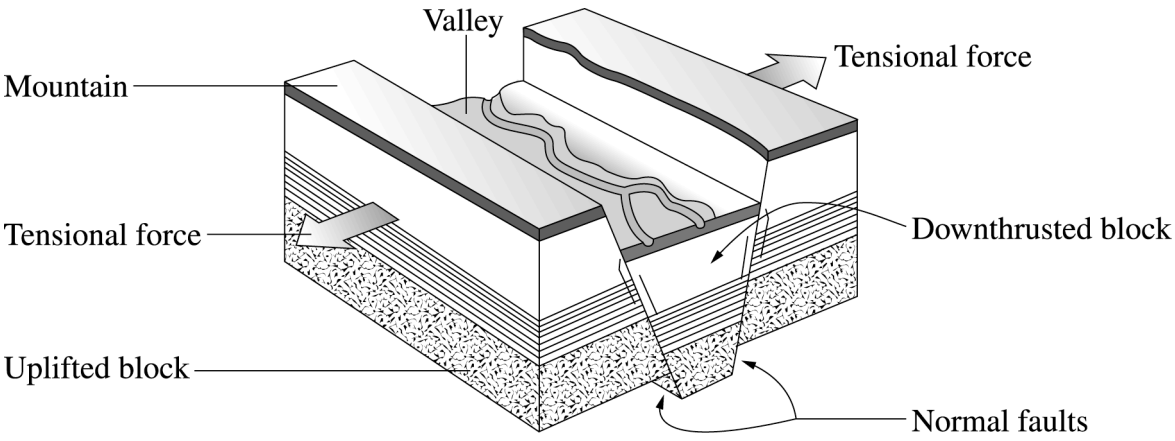
The Philippine Islands are located on a convergent boundary between the Philippine Plate and the Eurasian Plate. There is also a convergent boundary along the eastern edge of the Philippine Plate. Australia is located a long way from the boundaries of the Australian–Indian Plate.

The convergent boundaries of the Philippine Plate have subduction zones that generate earthquakes and volcanoes. The Philippine Islands experience both earthquakes and volcanic activity. Because of its location away from plate boundaries Australia is very stable and only experiences intraplate earthquakes.

Question 23

Criteria	Marks
• Correctly draws a diagram of a rift valley • Labels the features of a rift valley	4
• Correctly draws a diagram of a rift valley • Labels some features of the diagram	3
• Draws a diagram of a rift valley • Gives some details	2
• Gives some relevant information	1

Sample answer:



Question 24 (a)

Criteria	Marks
• Gives at least TWO steps in the formation of ozone	2
• Gives some relevant information	1

Sample answer:

An O_2 molecule is struck by incoming UV ray producing two oxygen atoms.
One free oxygen atom then combines with an O_2 molecule to form O_3 (ozone).

Question 24 (b)

Criteria	Marks
• Gives the role of ozone in blocking UV radiation • Links UV radiation to causing harm to life	2
• Gives some relevant information	1

Sample answer:

The ozone layer absorbs much of the incoming UV radiation energy preventing it from reaching Earth's surface. UV radiation damages living cells so it is important to prevent it reaching Earth's surface.

Question 25

Criteria	Marks
• Identifies a relationship between body mass and number of living and extinct species • Gives TWO reasons for the relationship • Uses quantitative data from the graph	4
• Identifies a relationship between body mass and number of living and extinct species • Gives ONE reason • Uses quantitative data from the graph	3
• Identifies a relationship between body mass and the number of living or extinct species • Gives ONE reason	2
• Gives some relevant information	1

Sample answer:

Marsupials with a body mass over about 40 kg have died out while those with a lower mass survived. There is a trend of increasing numbers of species up to 40 kg. This could be due to a drying of the climate resulting in food shortages, fire-stick farming by indigenous people resulting in new unsuitable food, or targeting of larger animals for food. Smaller animals are more successful at hiding and surviving on decreasing food supplies.

Question 26 (a)

Criteria	Marks
• Gives well-argued points for and against advantages to prey and predator • Links to increased chances of survival	3
• Gives reasons including advantages to prey and/or predator	2
• Gives some relevant information	1

Sample answer:

Eyes enable hunters to spot prey at a distance. Prey can be easily seen against the background. Prey evolved strategies to avoid being eaten – camouflage (colours), armoured skin (hard exoskeleton), ability to move quickly or hide. Hunters then evolved better eyes. These strategies gave predator and prey better survival chances and so, greater reproductive potential.

Question 26 (b) (i)

Criteria	Marks
• Identifies ONE advantage	1

Sample answer:

Less competition for space.

Question 26 (b) (ii)

Criteria	Marks
• Details environmental difficulties overcome by plants • States how these difficulties were overcome • Gives examples	4
• Identifies difficulties overcome by plants • States how difficulties were overcome • Gives an example	3
• Gives ONE difficulty plants had to overcome • Attempts to show how it was overcome or gives an example	2
• Gives some relevant information	1

Sample answer:

Two difficulties plants had to overcome as they transitioned from water to land were the lack of support from the air around them and dehydration. Plants evolved support tissues that contained lignin. This allowed them to grow taller and obtain more light. To overcome dehydration, plants developed a waterproof cuticle, that stopped evaporation from their cells.

Question 27 (a)

Criteria	Marks
• Names a pest • Sketches in general terms a management practice for the named pest	2
• Provides some relevant information	1

Sample answer:

Pest: Fruit fly
To control fruit flies, males are sterilised rather than using pesticide sprays.

Question 27 (b)

Criteria	Marks
• Gives benefits of the management practice given in (a)	2
• Provides some relevant information	1

Sample answer:

Use of sterilised male fruit flies, instead of pesticides, prevents the death of non-target species such as bees and butterflies. Also biomagnification of toxins is prevented, as poisons are not introduced into the ecosystem.

Question 28

Criteria	Marks
• Logically written method with clear scientifically rigorous instruction • Allows for valid testing of the impact being investigated • Allows for reliable data to be measured and collected	4
• Logically written method with clear instructions • Allows for valid testing or the collection of reliable data	3
• Gives a relevant method	2
• Provides some relevant information	1

Sample answer:

Testing water absorption:

1. Collect 10 soil trays, 10 water collection trays, 20 bricks and 20 kg soil.
2. Place 2 kg of soil in each tray and spread evenly.
3. Label soil trays 1–10.
4. For soil trays 1–5 place 4 bricks on each, spread across the tray to cover the soil area. Leave soil trays 6–10 without bricks.
5. After 24 hrs, remove bricks. Place soil in tray 1 at an angle of 20° with base of tray in a water collection tray.
6. Use a sprinkler system at top of tray, release 300 ml of water onto the soil. Collect and measure water run off after 20 minutes.
7. Repeat steps 5 and 6 for remaining 9 soil trays.
8. Calculate average water runoff for the trays with and without bricks.

Question 29 (a)

Criteria	Marks
• Details geological features for a waste dump	3
• Sketches in general terms geological features for a waste dump OR • Details ONE geological feature for a waste dump	2
• Provides some relevant information	1

Sample answer:

The area should be tectonically stable with no fractures in the rock, to prevent wastes or leachates from moving out of the dump. Ideally there would be a non-porous bedrock that could contain waste and act as a seal.

Question 29 (b)

Criteria	Marks
• Details current landfill management practices • Provides a clear judgement of value/quality of landfill practices in regards to their environmental effectiveness • Answer is logical and well written	5
• Sketches in general terms the main features of current landfill management practices • Provides a judgement of value/quality of landfill practices in regard to their environmental effectiveness • Uses suitable terminology	3–4
• Gives relevant information about current landfill management practices	1–2

Sample answer:

When waste cannot be recycled, disposal of this waste can be achieved using landfill waste dumps. Toxins and other pollutants can be effectively contained on site if the landfill is sealed with no fractures in the lining. Constant monitoring is required to ensure no leaking occurs which protects the surrounding environment from hazardous events.

The breakdown in waste can result in the formation of methane gas. Ideally this gas is collected and used as an energy source to prevent a dangerous build-up in gas as well as preventing its movement into the atmosphere as it is a greenhouse gas.

Current landfill practices are effective in ensuring that the environment is not contaminated by toxic wastes, leachates and gases.

Question 30

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of natural and human-induced influences on global temperature and strategies to minimise climate change • Clearly links knowledge and understanding of natural and human-induced influences to global climate • Makes a clear judgement, using supporting arguments, as to society's ability to manage climate change • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Includes data from the graph	7
• Demonstrates relevant knowledge of natural and human-induced influences on global temperature and strategies to minimise climate change • Links the knowledge of these influences to global climate • Makes a judgement using some supporting arguments about the strategies to manage climate change • Uses appropriate terminology, progression of thought and scientific principles • Includes data from the graph	5–6
• Recalls relevant knowledge of influences on global temperature and/or strategies to minimise climate change • Uses suitable terminology • Refers to the graph	3–4
• Provides some relevant information on global temperature and/or strategies to minimise climate change	1–2

Sample answer:

Climate change is driven by both natural and human-induced forces. Natural forces include the movement and changing shape and positions of the continental masses and volcanic activity. Human-induced forces include processes such as burning fossil fuels that increase the level of carbon dioxide in the atmosphere. This results in global warming as a result of the enhanced 'greenhouse' effect.

At present society has done little to change the effect of human-induced global temperature and as a result we see dramatic changes in the global climate. The graph shows that human-induced forces and natural forces driving global temperatures were the same up to about 1955. After 1955 human-induced forces caused larger increases in the temperature than natural forces. However, after 1970 there is a dramatic increase in observed temperatures and modelling shows this increase is due to human-induced forces, not natural forces.

While society cannot mediate the effects of natural forces on climate change, science has given solutions that can mediate the effect of human-induced climate change. For example, changing to a greater use of alternative energy sources, such as solar and wind energy, could reduce society's reliance on fossil fuels. Another strategy that could reduce climate change would be the development of more energy-efficient transport.

In spite of agreeing to international strategies such as The Kyoto Protocol, some countries, such as Australia, are doing little at present to halt global warming and the latest consensus on climate change shows that global warming is accelerating. Society needs a dramatic shift in its priorities if global climate change is to be minimised. Society must implement strategies based on scientific knowledge to reduce human-induced global warming to have any effect on overall climate change.

Section II

Question 31 (a) (i)

Criteria	Marks
• Sketches in general terms a correct reason	1

Sample answer:

The rabbit was introduced to Australia for the purpose of recreational hunting.

Question 31 (a) (ii)

Criteria	Marks
• Puts forward reasons for the rat's success • Links each reason to the rat's success	3
• Puts forward a reason AND links to the rat's success OR • Describes TWO valid characteristics of the rat as a pest	2
• Provides some relevant information	1

Sample answer:

Rats were a successful pest as they had no predators to minimise their population size on Macquarie Island. They also have a high reproductive capacity allowing their population size to grow quickly. Rats are generalists in their diet so their range of food resources is large allowing them to always be able to source food.

Question 31 (b)

Criteria	Marks
• Names a relevant plant and animal • Details how each has altered the abiotic features of the Australian environment	4
• Names a relevant plant and animal • Provides details for either the plant or animal and gives some information for the other as to how they altered the abiotic features of the Australian environment	3
• Names a relevant plant or animal • Gives some information about the effect of ONE on the abiotic features of the Australian environment OR • Gives information for both	2
• Provides some relevant information	1

Sample answer:

Lantana alters the soil of its surrounds as its decaying leaves change the soil chemistry. Its foliage also restricts the light that reaches the ground thereby reducing the light intensity. Water buffalo cause soil compaction due to their hard hooves and large mass as they move through their environment. They can also cause salt water intrusion when salt water mixes into areas of freshwater because of their movement through the wetlands.

Question 31 (c) (i)

Criteria	Marks
• Provides reasons for importance of quarantine procedures in Australia	2
• Provides some relevant information	1

Sample answer:

Quarantine procedures can prevent diseases from entering Australia and causing harm to Australian species. Quarantine procedures can also prevent new species of plants and animals entering which is important as their introduction can result in Australian species being out-competed and ultimately becoming extinct.

Question 31 (c) (ii)

Criteria	Marks
• Details TWO quarantine procedures used at airports • Judges each quarantine procedure in terms of its effectiveness	3
• Details TWO quarantine procedures used at airports OR • Details ONE quarantine procedure used at airports and judges it in terms of its effectiveness OR • Identifies TWO quarantine procedures used at airports and judges ONE in terms of its effectiveness	2
• Provides some relevant information	1

Sample answer:

Use of X-ray machines to scan luggage and cargo can quickly identify potentially harmful objects such as wood with borers, leading to a closer examination and its disposal if needed. Larger volumes of luggage can be assessed this way and this is very effective. Use of sniffer dogs to locate food is somewhat effective as they are well trained but due to the volume of cargo through airports there will still be some instances where potentially harmful food, such as fruit with seeds, enters the country.

Question 31 (d) (i)

Criteria	Marks
• Gives features of the relationship between the numbers of weed and the biological control agent	2
• Provides some relevant information	1

Sample answer:

Initially the population size of the control agent increases until it reaches levels similar to the size of the weed population, then both decrease to be significantly lower with a smaller fluctuation amplitude. With the oscillating nature of the populations, the weed population reaches its maximum first, and then shortly after the control agent reaches its maximum. The maximum and minimum levels of the control agent follow the size of the weed population.

Question 31 (d) (ii)

Criteria	Marks
• Details valid reasons for the success of the biological control • Clearly links each reason to the data provided • Provides an overall judgement on the success of the biological control related to the number of crop organisms	4
• Gives a valid reason for the success of the biological control • States whether the control agent was successful • Refers to the graph	3
• TWO of the above	2
• Provides some relevant information	1

Sample answer:

Over time the crop population increased as the size of the weed population decreased which is an important criterion to measure success.

This biological control agent was highly successful as it significantly reduced the weed population so that it was well below the damage threshold for crop sustainability. This resulted very quickly (within two fluctuations of population growth).

The biological control agent population size fell as the weed population fell. This ensured that the biological control agent did not become a pest itself as its population was kept in check with the weed population size and stayed this way over time – another reason for it being successful.

Question 31 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of management strategies for introduced species • Clearly understands what a sustainable future for Australian ecosystems is • Makes clear judgement, using supporting arguments, as to whether society has implemented knowledge provided by science to ensure a sustainable future • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Gives examples	6
• Has a knowledge of management strategies for introduced species • Understands what a sustainable future for Australian ecosystems is • Makes a judgement, using a supporting argument, as to whether society has implemented knowledge provided by science to ensure a sustainable future • Uses appropriate terminology, progression of thought and scientific principles • Gives examples	4–5
• Recalls relevant knowledge of management strategies for introduced species • Gives an example and/or refers to sustainability of Australian ecosystems • Uses suitable terminology	2–3
• Provides some relevant information	1

Sample answer:

Australia has unique ecosystems that have evolved to cope with the low fertile soil and dry conditions. The balance of the ecosystems can be disrupted by the introduction of a foreign species. Scientists have researched these species to learn about their impact on the Australian environment and possible ways to manage or eradicate them.

One introduced species is the Prickly Pear. Initial management strategies included poisons which were ineffective. Scientific research identified the biological control agent, the Cactoblastis moth. This was a highly successful strategy that led to a dramatic decline in this pest without harm to other native species. In this instance society effectively used scientific knowledge to best manage Australian ecosystems.

Cane toads are another species that have been introduced. Management strategies have included fencing off water holes and trapping. Some research has been done by scientists but this has not been valued enough by society and both funding and implementation have been limited. As a consequence the impact on Australian ecosystems by this introduced species is significant.

Society has only partially implemented knowledge provided by science. When used for some species eg Prickly Pear it can lead to positive results for the ongoing sustainability of Australia ecosystems. However when not used or valued, damage and reduced sustainability of Australian ecosystems results. More effective research and use of this research is needed to ensure sustainability of Australian ecosystems.

Question 32 (a) (i)

Criteria	Marks
• Carbon content increases with rank	1

Sample answer:

As the rank of coal increases the relative carbon content increases.

Question 32 (a) (ii)

Criteria	Marks
• Comprehensive answer giving a clear explanation as to the different conditions for formation	3
• Some differences of conditions of formation identified	2
• Provides some relevant information	1

Sample answer:

In Bass Strait the organic matter was exposed to lower temperatures and pressures, because the organic matter was not buried as deeply. The lower temperature and pressure converted the organic matter to oil whereas higher temperature and pressure converted the organic matter to gas on the North West Shelf.

Question 32 (b)

Criteria	Marks
• Provides details of more than one similarity and difference	4
• Sketches more than one similarity and difference OR • Provides details of one similarity and difference	3
• Provides details of one similarity or difference	2
• Provides some relevant information	1

Sample answer:

Similarities

- both sedimentary in origin
- both formed by increasing heat and pressure

Differences

- Oil forced out of source rocks as a liquid while coal remains where it was deposited
- Oil requires a geological structure or change in the character of the sedimentary rock to form an economically viable reservoir.

Question 32 (c) (i)

Criteria	Marks
• Technology named and details of its function given	2
• Technology named	1

Sample answer:

Drilling allows a core containing coal to be recovered for testing. Also gives thickness and depth of the coal. Drilling a series of holes gives an idea of the size of deposit.

Question 32 (c) (ii)

Criteria	Marks
• Reasons given to support the use of each process	3
• Reasons given to support the use of two of the processes	2
• Provides some relevant information	1

Sample answer:

Mined coal contains lumps of various sizes and crushing is needed to produce a product of a given maximum size. Screening is used to remove particles that are either too large or too small – again to produce a product of uniform size.

Washing is carried out to remove higher density particles that contain high mineral matter and would adversely affect combustion.

Question 32 (d) (i)

Criteria	Marks
• Gives features of the relationship between the predicted and actual power outputs	2
• Reference to predicted or actual power output	1

Sample answer:

The actual power output exceeds the predicted power output throughout the day apart from the period 0200 and 0600 hours. The fluctuations of the actual power reflect the variable wind speed.

Question 32 (d) (ii)

Criteria	Marks
• Details features of the three curves • Gives reasons for their different shapes related to the air–fuel ratios	4
• Gives some features of the three curves related to air–fuel ratios OR • Details features of two curves with reasons related to the air–fuel ratios	3
• Some comparison of the shapes of the curves OR • Some reasons given to support the difference between the curves	2
• Some relevant information given	1

Sample answer:

The CO and particulates curves fall as the air–fuel ratio increases because they are both the product of incomplete combustion. The more air to fuel there is the more complete the combustion of the fuel will be. The NOx emissions are the result of high temperatures as well as the availability of air (containing N_2). This reaches a maximum at an air–fuel ratio of about 1:1.05.

Question 32 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of Australia's renewable and non-renewable energy resources and their exploitation • Clearly understands what a sustainable future is for Australia's energy needs • Makes clear judgement, using supporting arguments, as to whether society can use knowledge to ensure a sustainable future • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Gives examples	6
• Has a knowledge of Australia's renewable and non-renewable energy resources and their exploitation • Understands what a sustainable future is for Australia's energy needs • Makes clear judgement, using supporting arguments, as to whether society can use knowledge to ensure a sustainable future • Uses appropriate terminology, progression of thought and scientific principles • Gives examples	4–5
• Recalls relevant knowledge of Australia's renewable and non-renewable energy resources and/or their exploitation • Gives examples and/or refers to sustainability • Uses suitable terminology	2–3
• Provides some relevant information about energy resources	1

Sample answer:

Australia has abundant non-renewable (fossil fuels) and renewable (solar, wind, HE) energy resources.

The extraction and use of coal and natural gas (CSG) create serious environmental problems. The risk of damage to farmland and ground water is becoming too high to be maintained. Renewable resources (wind and solar) have minimal environmental impact and their contribution to the total energy generated is increasing. They should soon be able to replace non-renewable energy resources. One problem is the storing of energy generated by these sources. By using heat reservoirs (eg liquid NaCl) and improved batteries, energy should be available whenever it is needed.

Renewable energy sources are essential for a sustainable future. This means that energy sources do not degrade the environment and will continue undiminished into the future. An understanding of the use and extraction of fossil fuels (scientific knowledge) compared to the technology used to harness renewable energy sources will enable society to choose which of the two types of resources will be most sustainable in future.

Question 33 (a) (i)

Criteria	Marks
• Identifies ONE sedimentary ore province	1

Sample answer:

Pilbara iron ore province.

Question 33 (a) (ii)

Criteria	Marks
• Names a landmark decision • Details aspects of the decision • Relates the effects of the decision on mining operations	3
• Names a landmark decision • Outlines aspects of the decision • Links the decision to mining operations	2
• Provides some relevant information	1

Sample answer:

The Wik decision of 1996, affecting pastoral leases, did not extinguish native title rights to the land and decreed that both native title rights and pastoral leases could co-exist. As a consequence mining companies now have to enter into an agreement with Indigenous people when undertaking exploration or mining of a deposit and negotiate such things as rights of access, compensation to be paid and how disputes are to be resolved.

Question 33 (b)

Criteria	Marks
• Provides a detailed understanding of Environmental Impact Statements • Details why mining methods and features of a site have to be included in an EIS	4
• Has an understanding of Environmental Impact Statements • Gives reasons why mining methods OR gives features of a site that have to be included in the EIS	3
• Has some understanding of Environmental Impact Statements • Gives a reason why mining methods OR features of a site have to be included in the EIS	2
• Provides some relevant information	1

Sample answer:

An Environmental Impact Statement requires that mine sites must be rehabilitated to the conditions that existed before exploration and mining commenced. An open pit mine leaves a large hole and spoil and tailings dumps whereas an underground mine leaves spoil and tailings dumps. However, the surface above the mine is liable to collapse. The two methods require different rehabilitation strategies. An EIS also looks at surface features such as sacred sites, flora and fauna. The mine must undertake a habitat management program during mining and give ways these aspects of the environment will be rehabilitated.

Question 33 (c) (i)

Criteria	Marks
• Sketches in general terms how two non-geological factors influence the viability of mining	2
• Provides some relevant information	1

Sample answer:

If transport costs are too high and if interest rates on borrowed capital are excessive, profits will be less. Thus expenditure related to mining may be greater than income, making the mine unviable.

Question 33 (c) (ii)

Criteria	Marks
• Identifies two geological factors that influence the economic value of a deposit • Details how each factor impacts on the economic value of a deposit	3
• Identifies two geological factors that influence the economic value of a deposit • Relates each factor to the economic value of a deposit OR • Identifies one geological factor that influences the economic value of a deposit • Details how the factor impacts on the economic value of a deposit	2
• Provides some relevant information	1

Sample answer:

The economic value of a deposit depends on the income that can be derived from mining. If the ore grade is higher, less ore has to be mined to give the same profits because of decreased mining costs. The deeper the deposit the larger the tonnage of overburden that has to be removed thus decreasing profits due to increased mining costs, making the value of the deposit lower.

Question 33 (d) (i)

Criteria	Marks
• Gives the relationship between total sulfides and both gold and copper grades	2
• Provides some relevant information from the graph	1

Sample answer:

The highest gold and copper grades coincide with the highest total sulphides, between 138 and 142 m depth. A high gold grade also occurs between 133 and 138 m depth. Lowest gold and copper grades occur above 125 m and below 145 m.

Question 33 (d) (ii)

Criteria	Marks
• Details an exploration program that gives the features of drilling and one other exploration method • Gives reasons for this program	4
• Gives an exploration program that gives some features of drilling and gives some features of the other exploration method • Gives reasons for this program	3
• Gives an exploration program that gives some features of drilling and one other exploration program OR • Details either drilling or one other exploration program	2
• Provides some relevant information from the graph or photograph	1

Sample answer:

The surface is relatively flat and without much outcrop, thus a magnetometer survey could locate magnetic anomalies that might be associated with sulfide ores. High magnetic anomalies should be the focus of drilling targets. Magnetic surveys are low-cost surveys that can pinpoint deposits.

A drilling program should comprise several holes at an angle to the surface thus giving a greater chance of locating possible ore bodies. The existing mine indicates a linear ore body in the old mine and thus the first set of drill holes, if there are no magnetic anomalies, should be parallel to the strike of the mine, and then at right angles to the strike. Angled holes increase the chances of intersecting an ore body.

Question 33 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of Australia's renewable and non-renewable mineral resources • Clearly understands what a sustainable future is in relation to Australia's mineral resources • Makes clear judgement, using supporting arguments, as to whether society has the ability to use current knowledge to ensure a sustainable future • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Gives examples	6
• Has a knowledge of Australia's renewable and non-renewable energy resources • Understands what a sustainable future is in relation to Australia's mineral resources • Makes clear judgement, using supporting arguments, as to whether society can use knowledge to ensure a sustainable future • Uses appropriate terminology, progression of thought and scientific principles • Gives examples	4–5
• Recalls relevant knowledge of Australia's renewable and non-renewable resources • Gives examples and/or refers to sustainability • Uses suitable terminology	2–3
• Provides some relevant information on Australian mineral resources	1

Sample answer:

Exploration methodologies have improved greatly in the last three decades. Thus, using geophysical and geochemical prospecting methods, combined with GIS and computing technologies, Australia is now able to better identify new deposits especially deeper deposits. Thus Australia should have a sustainable mineral future. New exploitation techniques have also improved. For example, robotic miners and larger equipment, such as trucks for transporting ore, mean that lower grades can also now be utilised. Years ago there were only one or two miners of iron ore. Now there are three large miners and several smaller ones and all increase production each year allowing for increasing domestic sales and export.

While our ability to find additional resources should mean a sustainable future, the increasing demand for additional production indicates a non-sustainable future.

To maintain a sustainable mining industry Australia must reduce outputs, recycle metals and increase the success rate for finding new deposits.

Question 34 (a) (i)

Criteria	Marks
• Names two physical features of oceans	1

Sample answer:

Density and temperature

Question 34 (a) (ii)

Criteria	Marks
• Details at least two ways in which light availability varies	3
• Sketches in general terms ways in which light availability varies OR details one way	2
• Gives some relevant information	1

Sample answer:

The intensity of light decreases with depth. At shallow depths red wavelengths are absorbed, while green wavelengths penetrate further.

As latitude increases from the equator the angle of incidence of sunlight at the surface decreases and so less light is available in higher latitude oceans.

Question 34 (b)

Criteria	Marks
• Gives details of at least two abiotic features of hydrothermal vents • Gives details of adaptations, naming at least two organisms • Links adaptations in organisms to the abiotic features	4
• Sketches at least two abiotic features of hydrothermal vents • Identifies the adaptations, naming at least one organism • Links adaptations in one organism to the abiotic features	3
• Identifies the abiotic features of the community OR • Provides some information on how at least one organism is adapted to this environment	2
• Provides some relevant information	1

Sample answer:

Deep ocean hydrothermal vents are formed at active mid-oceanic ridges on the ocean floor or on underwater volcanoes. Cold dense seawater seeps into the cracks formed in the cooling magma in the hot rocks where it becomes superheated, less dense brine. This is ejected as a continuous stream of water that rapidly cools as it leaves the vent, resulting in dissolved sulfides and sulfates precipitating around the vents. These minerals have allowed unique communities of bacteria and invertebrates, including worms, clams, crabs, shrimps and octopuses to develop around the vents, forming complex food chains. The primary producers at the beginning of the food chains are primitive chemosynthetic bacteria called extremophiles, which are able to use hydrogen sulfide to make their own food as there is no light available. Invertebrates including giant clams and tube worms thrive here as they have evolved a symbiotic relationship with microbes that feed on the bacteria.

Question 34 (c) (i)

Criteria	Marks
• Provides features of the formation of oxygen-rich seawater and its sinking to the ocean floor	2
• Provides some relevant information	1

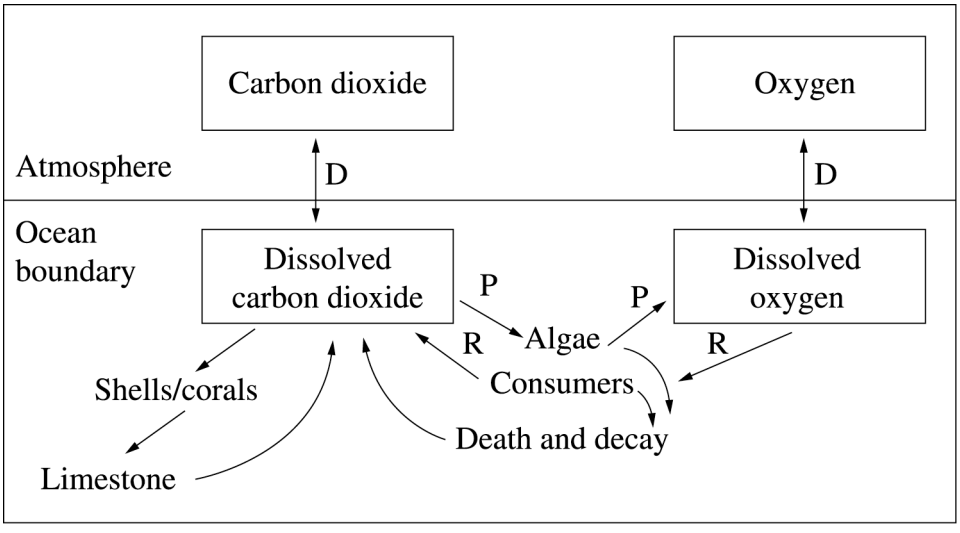
Sample answer:

Oxygen is renewed on the ocean floor when oxygenated, highly saline, dense, cold polar waters sink and join the great conveyor belt that carries oxygen to the sea floor.

Question 34 (c) (ii)

Criteria	Marks
• Draws a suitable labelled flow chart or diagram • Shows major reservoirs of carbon and oxygen in the atmosphere and ocean • Shows interconnectivity between reservoirs	3
• Draws a flow chart or diagram • Shows most of the major reservoirs of carbon and oxygen in the atmosphere and oceans with some connectivity	2
• Shows some relevant information	1

Sample answer:



D – Diffusion P – Photosynthesis R – Respiration

Question 34 (d) (i)

Criteria	Marks
• Identifies a correct sediment type at each of X and Y	2
• Identifies a correct sediment type at either X or Y	1

Sample answer:

At X: Silt and other terrestrial sediments
At Y: Fine-grained sediments such as clays

Question 34 (d) (ii)

Criteria	Marks
• Gives details of the sedimentation processes producing the main sediment types • Links to sediment thickness in at least two locations in the Pacific Ocean • Refers to map, including quantitative data	4
• Outlines some sedimentation processes and the sediment types they produce • Links to sediment thickness in at least two locations in the Pacific Ocean • Refers to map	3
• Gives outline of at least one sedimentation process and sediment type • Links to the sediment thickness OR relates the sediment type to the map	2
• Provides some relevant information	1

Sample answer:

The nature and depth of deep sea sediments is related to the sea floor proximity to continents, the influence of plate tectonics causing subduction zones and MORs and so, the age of the ocean floor. Ocean temperature and nutrient availability for life also influence sediment type and thickness.

Sediments near continents originate mainly from the erosion of the land by rivers and coastal wave action. They are usually thickest at the bottom of the continental slope, up to 5000 m thick due to the accumulation of sliding sediments, as seen on the map, off the NE coast of Australia.

Sediments in the open ocean form from the settling of dust and ash from the atmosphere, or from the remains of dead organisms from the water column above. These form either thin deep sea clays (from dust and ash), less than 50 m thick, or thicker pelagic oozes from the remains of dead organisms in more nutrient-rich waters. These can vary in thickness and location due to the circulation of warm and cold ocean currents and nutrient availability for life.

Question 34 (e)

Criteria	Marks
• Demonstrates a breadth or depth of knowledge and understanding of the oceans and their resources • Clearly understands what a sustainable future is in relation to the oceans • Makes clear judgement, using supporting arguments, as to whether society has the ability to use current knowledge to ensure a sustainable future • Demonstrates a coherent and logical progression of thought and includes correct use of scientific principles and ideas • Gives examples	6
• Has a knowledge of Australia's oceans and their resources • Understands what a sustainable future is in relation to the oceans • Makes clear judgement, using supporting arguments, as to whether society can use knowledge to ensure a sustainable future • Uses appropriate terminology, progression of thought and scientific principles • Gives examples	4–5
• Recalls relevant knowledge of the oceans and their resources • Gives examples and/or refers to sustainability • Uses suitable terminology	2–3
• Provides some relevant information on the oceans or their resources	1

Sample answer:

Oceans have been exploited as a resource by humans since our beginnings. Humans used the oceans for travel and transport, as a source of food and more recently for aquaculture, communication cables, mining and energy generation. By using a variety of new technologies, science has increased our understanding of the oceans, for example, ocean current movements and sea floor topography. As a result, science has increased our ability to access these resources. For example, marine life is being increasingly exploited as larger vessels are used to track and harvest species for consumption. Using radar and satellite humans have improved their ability to find diminishing harvest species.

Humans have historically exploited the ocean as a waste destination. The pollution of the ocean from human wastes and oil spillages from exploration, mining and transport of oil by ship has a serious and on-going impact on the quality of ocean water for sea life.

Science is providing on-going information needed for the sustainability of our oceans. Marine parks have been successfully established and laws have been legislated to limit harvest sizes, and to prevent further pollution by toxic waste and oil spillage. Ecological studies of marine populations are helping people to understand how they must change their ways in which they have used the oceans' resources in the past if they are to remain a sustainable resource for an increasing human population. Society has the knowledge needed to care for the oceans and, at the same time, to continue to use them to provide food through aquaculture and as a resource for clean waste.

2015 HSC Earth and Environmental Science Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.2.1.2.1, 9.2.2.2.1	H7, H12, H14
2	1	9.3.1.2.1, 9.3.1.3.1, 12.3 (c)	H12
3	1	9.3.4.2.2	H7
4	1	9.4.1.2.1	H7
5	1	9.2.4.2.1	H7
6	1	9.2.4.2.4	H7
7	1	9.4.6.2.1, 9.4.6.3.2	H9, H10
8	1	9.4.3.2.2	H9
9	1	9.3.1.2.4, 14.1 (d)	H14
10	1	9.4.6.2.3, 9.4.6.3.4	H9
11	1	9.3.5.2.4, 9.3.5.3.2	H7
12	1	9.3.3.2.1, 14.1 (a), (d)	H14
13	1	9.2.5.2.1, 9.2.5.3.1	H7
14	1	9.4.3.2.2, 14.3 (c)	H9, H14
15	1	9.2.3.3.1	H7
16	1	9.4.6.3.2, 12.3 (c)	H9, H12
17	1	9.4.4.2.1, 9.4.4.3.1	H1, H3
18	1	9.2.1.2.1, 9.2.1.3.1	H7, H14
19	1	9.3.1.2.2, 9.3.1.3.2	H8
20	1	9.2.4.2.2, 14.1 (c)	H7, H14

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	1	9.2.1.2.3	H7
21 (b)	3	9.2.1.2.1	H7
22 (a)	3	9.2.4.2.3, 9.2.4.2.5	H7
22 (b)	5	9.2.4.2.1, 14.1 (g)	H7, H14.1.g
23	4	9.2.2.2.1, 9.2.2.3.1, 13.1 (e)	H7, H13
24 (a)	2	9.3.2.2.2	H7
24 (b)	2	9.3.2.2.3	H7
25	4	9.3.5.2.3, 9.3.5.3.3, 14.1 (a), 14.1 (d)	H7, H14
26 (a)	3	9.3.3.2.5, 9.3.3.3.2	H7
26 (b) (i)	1	9.3.4.2.5	H7
26 (b) (ii)	4	9.3.4.2.3, 9.3.4.2.4	H8
27 (a)	2	9.4.4.2.2, 9.4.4.3.2	H10

Question	Marks	Content	Syllabus outcomes
27 (b)	2	9.4.4.2.2	H10
28	4	9.4.2.3.1, 11.2 (b), 11.2 (c), 11.2 (d)	H9, H11
29 (a)	3	9.4.7.2.1	H10
29 (b)	5	9.4.7.2.2, 9.4.7.3.2	H10
30	7	9.2.5.2.1, 9.2.5.2.2, 9.4.6.2.1, 9.4.6.2.2, 9.4.6.3.1, 9.4.6.3.2, 14.1 (a), (c)	H1, H5, H14

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		**Introduced Species and the Australian Environment**	
(a) (i)	1	9.5.1.2.4	H10
(a) (ii)	3	9.5.3, 9.5.4	H10
(b)	4	9.5.2.2.2	H10
(c) (i)	2	9.5.6.3.1	H10
(c) (ii)	3	9.5.6.2.1, 9.5.6.2.3, 9.5.6.3.1	H10
(d) (i)	2	14.1 (a)	H14
(d) (ii)	4	9.5.5.2.1, 9.5.5.2.3, 9.5.5.3.1, 14.1 (d) (g)	H10, H14
(e)	6	9.5.4, 9.5.5, 9.5.6	H1, H4, H10, H16
Question 32		**Organic Geology – A non–renewable Resource**	
(a) (i)	1	9.6.1.2.4	H7
(a) (ii)	3	9.6.2.2.3, 9.6.2.2.4	H7, H8
(b)	4	9.6.2.2.1, 9.6.2.2.3, 9.6.2.3.2	H7
(c) (i)	2	9.6.3.2.1	H7
(c) (ii)	3	9.6.4.2.1, 9.6.4.3.1	H9
(d) (i)	2	14.1 (a)	H14
(d) (ii)	4	9.6.5.2.1, 14.1 (a) (b) (g)	H7, H14
(e)	6	9.6.1, 9.6.5.2.2, 9.6.6	H1, H4, H6, H9, H16
Question 33		**Mining and the Australian Environment**	
(a) (i)	1	9.7.1.2.1	H7
(a) (ii)	3	9.7.2.2.1	H4, H7
(b)	4	9.7.5.2.2, 9.7.5.2.4, 9.7.5.3.2	H4, H7
(c) (i)	2	9.7.3.2.6, 9.7.3.3.2	H7
(c) (ii)	3	9.7.3.2.6, 9.7.3.3.2	H7
(d) (i)	2	14.1 (a)	H14
(d) (ii)	4	9.7.4.2.1, 9.7.4.2.2, 9.7.4.3.2, 9.7.4.3.3, 14.1 (a), 14.2 (b)	H7, H14
(e)	6	9.7.3, 9.7.5	H1, H4, H6, H9, H16
Question 34		**Oceanography**	
(a) (i)	1	9.8.1.2.1	H7

Question	Marks	Content	Syllabus outcomes
(a) (ii)	3	9.8.3.2.4	H7
(b)	4	9.8.6.2.4, 9.8.6.2.5, 9.8.6.3.3	H7
(c) (i)	2	9.8.4.2.2	H7
(c) (ii)	3	9.8.1.3.1, 13.1 (e)	H7, H13
(d) (i)	2	9.8.7.3.1, 13.1 (e)	H7, H13
(d) (ii)	4	9.8.4.2.4, 9.8.7, 9.8.7.2.1, 9.8.7.2.2	H7
(e)	6	9.8.3, 9.8.4.2.4, 9.8.4.3.2, 9.8.5, 9.8.8	H1, H4, H6, H9, H16