2024 HSC Earth and Environmental Science Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 21

Criteria	Marks
• Outlines a named strategy for managing solid waste	2
• Provides some relevant information	1

Sample answer:

Strategy: Landfill involves putting household general waste into a red lid bin that is collected by a garbage truck and transported to a tip.

Answers could include:

- Battery collections
- E-waste facilities
- Chemical waste collection
- Incineration
- Traditional recycling
- Compost
- Green waste
- Worm farms
- Fabric recycling facilities

Question 22

Criteria	Marks
• Demonstrates a sound understanding of a named resource and its present and future use • Makes a specific judgement	4
• Demonstrate some understanding of the present and future use of a named resource • Makes an implied judgement	3
• Outlines the present or future use of a resource	2
• Provides some relevant information	1

Sample answer:

Resource: Copper is an essential resource that is presently used worldwide as one of the main metals in electrical wiring and motors. It is likely that there will be an even greater demand for copper in the future for electrical and power resources, especially the transition to renewable energy resources.

Question 23 (a)

Criteria	Marks
• Explains a sequence of tectonic processes related to the formation of Mount Ruapehu, with reference to the diagram	4
• Explains some tectonic processes related to the formation of Mount Ruapehu	3
• Describes a tectonic process related to the formation of Mount Ruapehu	2
• Provides some relevant information	1

Sample answer:

The Pacific plate is subducted under the Australian plate due to the Pacific plate's greater density. As it descended into the mantle, it melted, forming magma. This magma rose through the overriding Australian plate, erupting to form Mount Ruapehu.

Question 23 (b)

Criteria	Marks
• Explains TWO hazards related to Mount Ruapehu	4
• Describes TWO hazards related to Mount Ruapehu	3
• Describes ONE hazard related to volcanic eruptions OR • Outlines TWO hazards related to volcanic eruptions	2
• Provides some relevant information	1

Sample answer:

Lahars occur when ash or rock from the volcano mixes with water from the crater lake. This mixture overflows causing a destructive mud flow that moves down the side of the volcano.

Mount Ruapehu could erupt explosively to produce a pyroclastic flow because the high viscosity magma traps gases under pressure.

Question 23 (c)

Criteria	Marks
• Assesses the extent to which both hazard mapping and public education contributes to the protection of visitors • Provides thorough support with examples from both figures	4
• Explains how both hazard mapping and public education contributes to the protection of visitors • Provides sound support with examples from both figures	3
• Provides some understanding of how both hazard mapping and public education contribute to the protection of visitors	2
• Provides some relevant information	1

Sample answer:

Hazard mapping allows DOC to identify areas that are more dangerous such as near the summit crater lake. They put in place safety restrictions for visitors such as not camping within 1.5 km of the summit, as they may not be able to leave in time if an eruption occurred. This will keep visitors safe only to the extent to which they comply with the advice. DOC can use infographics to clearly communicate simple instructions for visitors. For example, moving out of a valley to the ridge top with a picture of a person walking up the slope. Using pictures increases the chance that visitors will understand the instructions.

Question 24

Criteria	Marks
• Explains an impact of rising sea levels on the distribution of species	3
• Describes an impact of rising sea levels on species	2
• Provides some relevant information	1

Sample answer:

Rising sea levels will cause previously intertidal zones to be permanently covered by sea water. This means species previously living in these zones will need to migrate into zones higher up the shoreline.

Question 25

Criteria	Marks
• Explains how a community initiative could manage a resource sustainably	3
• Describes how a community initiative could manage a resource	2
• Provides some relevant information	1

Sample answer:

My local council has green waste bins to remove biodegradable material such as grass clippings from landfill and turn it into compost. This results in a reduction in the volume of general waste materials that are taken to the local landfill therefore increasing the lifetime of the landfill site for future generations to use whilst meeting current needs.

Question 26

Criteria	Marks
• Demonstrates a thorough knowledge and understanding of environmental concerns and reclamation methods • Justifies both reclamation methods as valid, effective and/or efficient	5
• Demonstrates a sound knowledge and/or understanding of the environmental concern(s) and/or reclamation methods • Justifies a reclamation method	3–4
• Demonstrates some knowledge of environmental concern(s) and/or reclamation method(s)	2
• Provides some relevant information	1

Sample answer:

Environmental concern 1	*Environmental concern 2*
Allowing the above water portion of an offshore oil rig to rust and collapse into the ocean would damage ecosystems that have established on the submerged part of the rig.	Open pits from mines are a serious risk for long term soil erosion which can lead to river sedimentation.
Reclamation method 1	*Reclamation method 2*
Removing the above portion of the offshore rig and returning it to the shore for recycling prevents it from collapsing into the ocean. The submerged section of the rig would be left as an artificial reef to continue to support coral reefs that have established during the life of the rig to prevent damage.	Back filling the open pit with waste rock and other material would reduce exposure for erosion. This in conjunction with planting native vegetation would stabilise the soil, minimise erosion and therefore reduce the risk of soil washing into local water ways.

Question 27

Criteria	Marks
• Explains the importance of cultural burning linking these to aspects of sustainability with reference to the diagrams	4
• Describes the importance of cultural burning with reference to the diagrams	3
• Outlines the importance of cultural burning	2
• Provides some relevant information	1

Sample answer:

Cultural burning is often low intensity and is beneficial to the environment as it may reduce the frequency and intensity of bushfires over time. High-intensity fires damage soil structure by removing nutrient rich materials and making soil water resistant, whereas low-intensity cultural burning increases the nutrient composition of the soil and encourages new plant growth. Soils take hundreds of years to recover from high-intensity fires and thus cultural burning is beneficial as it maintains the soil in a healthy state for current and future generations, thus supporting sustainability.

Question 28 (a)

Criteria	Marks
• Justifies the need for different building codes linked to different levels of earthquake risk • Links the tectonic settings to both high and low earthquake risk	3
• Justifies the need for a building code linked to the level of earthquake risk in one tectonic setting OR • Links the tectonic setting of areas to both high and low earthquake risk	2
• Provides some relevant information	1

Sample answer:

Areas that are located near plate boundaries are at higher risk of earthquakes occurring. In order to protect buildings from damage, strict building codes are needed in these areas. For example, building houses is now banned in the rezoned suburbs as they could be damaged in future earthquakes. In areas that are away from plate boundaries that have lower risk of earthquakes, lower standards of buildings are acceptable making construction cheaper.

Question 28 (b)

Criteria	Marks
• Explains how a building technology reduces damage to people or property	3
• Describes a building technology OR • Outlines an outcome of a building technology	2
• Provides some relevant information	1

Sample answer:

In earthquake prone areas, buildings could have base isolators like large rubber disks in their foundations that would absorb the shaking during an earthquake. This would mean the building is protected and doesn't collapse and kill people.

Answers could include:

In flood prone areas, houses could be built on stilts to keep the living areas above the expected water levels so that people's belongings are not damaged, and they could continue to live there after the water went down.

Question 29 (a)

Criteria	Marks
• Provides a reason for the inclusion of the coin	1

Sample answer:

For scale

Question 29 (b)

Criteria	Marks
• Outlines relevant steps in the process of trace fossil formation	2
• Provides some relevant information	1

Sample answer:

The empty worm burrow fills with mud, which hardens to rock over time and forms a cast of the burrow.

Question 29 (c)

Criteria	Marks
• Explains the suitability of relative dating and absolute dating with a sound understanding of both techniques	3
• Explains the suitability of relative dating or absolute dating OR • Outlines both techniques	2
• Provides some relevant information	1

Sample answer:

Fossils occur in sedimentary rocks and the photo shows sedimentary grains, so relative dating is suitable for these fossils if we know the age of lower, older strata, or higher, younger strata.

Absolute dating relies on measuring the decay of radioisotopes in igneous rocks. This could also be suitable if there is volcanic ash below or above the trace fossils to assist in narrowing the age range.

Question 30 (a)

Criteria	Marks
• Identifies ONE disturbance	1

Sample answer:

Cyclone

Answers could include:

Pollution, rising sea levels, ocean acidification, increasing ocean temperatures

Question 30 (b)

Criteria	Marks
• Outlines the relationship linking reef health to resilience	2
• Provides some relevant information	1

Sample answer:

As reef health decreases the resilience of the reef also decreases.

Question 30 (c)

Criteria	Marks
• Provides a reason for the change in reef health supported with interpretation of the graph	2
• Provides some relevant information	1

Sample answer:

Any single disturbance will reduce the reef's ability to perform its function and so reduce its peak health. As the frequency of disturbances increases, it becomes more difficult for the reef to carry out its functions and this further reduces its health.

Question 31

Criteria	Marks
• Demonstrates a thorough understanding of index fossils and applies this to cyanobacteria/stromatolites • Makes judgement based on criteria regarding the use of stromatolites as index fossils	4
• Demonstrates a sound understanding of index fossils and applies this to cyanobacteria/stromatolites • Makes a judgement with a criterion regarding the use of stromatolites as index fossils	3
• Provides a characteristic of index fossils and/or a characteristic of cyanobacteria/stromatolites	2
• Provides some relevant information	1

Sample answer:

Index fossils are distinctly identifiable species, widespread globally, and confined to a brief interval of geological time. They can therefore be used to precisely identify geological times. Stromatolites are sedimentary structures built by photosynthetic cyanobacteria but the organisms themselves are small and soft bodied, so they don't form distinct fossils. Stromatolites are only found in a few locations. Stromatolites are unsuitable as index fossils because the species are not distinctly identifiable or widespread.

Question 32 (a)

Criteria	Marks
• Compares frequency and intensity of El Niño and La Niña events before and after 1960 • Supports comparison with specific numerical references to the graph	3
• Compares frequency and/or intensity of El Niño and La Niña events before and after 1960	2
• Provides some relevant information	1

Sample answer:

The frequency of El Niño and La Niña events has remained fairly constant before and after 1960, however, the events have become more extreme in intensity since 1960. Three of the El Niño temperatures after 1960 have been higher in difference from average temperature >2°C than any of the events before 1960.

Question 32 (b)

Criteria	Marks
• Demonstrates an extensive knowledge and understanding of the effects of rainfall and temperature variance • Justifies ONE adaptation strategy for each of El Niño and La Niña	7
• Demonstrates a thorough knowledge and understanding of the effects of rainfall and temperature variance • Justifies ONE adaptation strategy for each of El Niño and La Niña	6
• Demonstrates a sound knowledge and/or understanding of the effects of rainfall and temperature variance • Justifies ONE adaptation strategy	4–5
• Demonstrates some knowledge of rainfall and temperature variance and adaptation strategy(ies)	2–3
• Provides some relevant information	1

Sample answer:

Drought and lack of rain associated with El Niño leads to shortfall in water supplies causing lack of drinking water, destabilisation of soil through loss of ground cover leading to soil erosion and increased dust storms. Loss of livestock and crop failure can occur due to lack of water.

Changes to agricultural practices such as replacing water intensive crops like cotton and rice with crops with low water demand and replacing flood irrigation with drip irrigation, will help to conserve water during dry El Niño events.

La Niña can cause flooding, soil and river erosion, leading to infrastructure damage, loss of livestock and crop failure. Health issues due to contaminated water supplies and stress related mental health problems can occur. More intense rainfall increases the risk of flooding in previously low-risk areas.

Strategies to reduce flood damage during La Niña events include flood rezoning to include areas not previously at high risk of flooding and changing building codes restricting construction of buildings in areas of increased risk of flooding.

Answers could include:

Effects

- Increased risk of bushfires
- Reduction in wetland/riverine habitats
- Injury or death from floodwaters
- Interruption to food supply
- Disrupted/closed transport networks.

Strategies

- Desalination plants to increase drinking water supply
- Use of recycled water for irrigation or industrial processes
- Reducing impervious surfaces and improving drainage networks
- Replanting trees on hillside in the catchment
- Relocating infrastructure to higher areas safe from flooding.

Question 33

Criteria	Marks
• Demonstrates extensive knowledge and understanding of relationships between Earth's interacting spheres and humans • Integrates relevant examples	8
• Demonstrates a thorough knowledge and understanding of relationships between Earth's interacting spheres and humans • Uses relevant example(s)	6–7
• Demonstrates a sound knowledge and understanding of relationships between Earth's interacting spheres and humans • Uses relevant example(s)	4–5
• Demonstrates some understanding of Earth's interacting spheres	2–3
• Provides some relevant information	1

Note to markers: not all spheres need to be addressed.

Sample answer:

Photosynthetic cyanobacteria evolved during the Archean Period, using solar energy to draw carbon dioxide from the atmosphere into the biosphere, and returning oxygen to the hydrosphere and atmosphere. Oxygen converts to ozone in the upper atmosphere absorbing dangerous UV light, protecting humans from sunburn and skin cancer.

During the Carboniferous and Permian periods, much organic matter from the biosphere was buried, modified and incorporated into the geosphere as coal. Human use of coal enabled the Industrial Revolution, vastly improving the standard of living for many people over centuries. Coal is mined and burned to generate electricity, providing employment and abundant, cheap energy which improves standards of living.

Answers could include:

- Plate tectonic supercycle and earthquakes or volcanoes changing climate or causing natural disasters.
- Photosynthesis extracting CO_2 from the atmosphere, affecting global warming and producing timber as a resource.
- Burning coal increasing greenhouse gases causing climate change.

Question 34

Criteria	Marks
• Provides a thorough explanation of change to both climate and evolution with integrated examples	4
• Provides a sound explanation of change to both climate and evolution with examples	3
• Describes changes to climate and/or evolution	2
• Provides some relevant information	1

Sample answer:

Sunlight is more intense near the equator. Australia's northward drift towards the equator has consequently caused a warmer and drier climate, resulting in an increase in arid areas, such as deserts.

Australia's northward drift has forced fauna evolution. Megafauna were adapted to cold climates. As Australia has warmed, the megafauna became extinct. Smaller mammals are better adapted to a warmer climate and they have flourished.

Question 35

Criteria	Marks
• Provides a thorough analysis of the existing and potential new evidence with implications for the panspermia hypothesis	4
• Provides a sound analysis of the existing and potential new evidence and an implication for the panspermia hypothesis	3
• Provides some understanding of the panspermia hypothesis • Identifies existing or potential new evidence	2
• Provides some relevant information	1

Sample answer:

The Panspermia hypothesis suggests life originated elsewhere in the solar system and came to Earth on a meteorite. Meteorites containing organic molecules and possible degraded fossils have been found. If Perseverance finds similar molecules or fossils on Mars, the hypothesis is supported as organic molecules could have arrived on both planets on meteorites from the same source.

2024 HSC Earth and Environmental Science Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	Mod 5 Development of the biosphere	12-12
2	1	Mod 6 Impact of natural disasters on the biosphere	12-13
3	1	Mod 5 Development of the biosphere	12-12
4	1	Mod 6 Impact of natural disasters on the biosphere	12-13
5	1	Mod 7 Fossil formation and stratigraphy	12-14
6	1	Mod 5 Development of the biosphere	12-5, 12-12
7	1	Mod 6 Prediction and prevention of natural disasters	12-13
8	1	Mod 7 Mitigation and adaptation strategies	12-14
9	1	Mod 5 Plate tectonic supercycle	12-5, 12-12
10	1	Mod 7 Influence of human activities on changes to climate	12-14
11	1	Mod 7 Influence of human activities on changes to climate	12-5, 12-14
12	1	Mod 7 Natural processes of variations in climate	12-5, 12-13
13	1	Mod 6 Geological natural disasters	12-2, 12-13
14	1	Mod 8 Waste management	12-5, 12-15
15	1	Mod 8 Waste management	12-2, 12-15
16	1	Mod 8 Waste management	12-5, 12-15
17	1	Mod 7 Natural processes of variations in climate	12-14
18	1	Mod 5 Plate tectonic supercycle	12-4, 12-12
19	1	Mod 8 Sustainability	12-4, 12-15
20	1	Mod 8 Sustainability	12-4, 12-15

Section II

Question	Marks	Content	Syllabus outcomes
21	2	Mod 8 Waste management	12-15
22	4	Mod 8 Using Australia's natural resources	12-15
23 (a)	4	Mod 6 Geological natural disasters	12-13
23 (b)	4	Mod 6 Geological natural disasters	12-6, 12-13
23 (c)	4	Mod 6 Prediction and prevention of natural disasters	12-7, 12-13
24	3	Mod 7 Influence of human activities on changes to climate	12-14
25	3	Mod 8 Sustainability	12-15
26	5	Mod 8 Using Australia's natural resources	12-7, 12-15
27	4	Mod 8 Sustainability	12-5, 12-15
28 (a)	3	Mod 6 Prediction and prevention of natural disasters	12-5, 12-13
28 (b)	3	Mod 6 Prediction and prevention of natural disasters	12-13
29 (a)	1	Mod 5 Fossil formation and stratigraphy	12-7, 12-12

Question	Marks	Content	Syllabus outcomes
29 (b)	2	Mod 5 Fossil formation and stratigraphy	12-12
29 (c)	3	Mod 5 Fossil formation and stratigraphy	12-12
30 (a)	1	Mod 7 Influence of human activities on changes to climate	12-14
30 (b)	2	Mod 7 Influence of human activities on changes to climate	12-5, 12-14
30 (c)	2	Mod 7 Influence of human activities on changes to climate	12-14
31	4	Mod 5 Fossil formation and stratigraphy	12-12
32 (a)	3	Mod 7 Natural processes of variations in climate	12-5, 12-14
32 (b)	7	Mod 7 Mitigation and adaptation strategies	12-6, 12-14
33	8	Mod 5 Changes in the geosphere, atmosphere and hydrosphere Mod 6 Impact of natural disasters on the biosphere Mod 7 Influence of human activities on changes to climate Mod 8 Using Australia's natural resources	12-6, 12-7, 12-12, 12-13, 12-14, 12-15
34	4	Mod 5 Plate tectonic supercycle	12-12
35	4	Mod 5 Development of the biosphere	12-12