# Earth & Environmental Science marking guide and response

External assessment 2025

## Combination response (102 marks)

### Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. describe and explain the use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change
2. apply understanding of use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change
3. analyse evidence about the use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change to identify trends, patterns, relationships, limitations or uncertainty
4. interpret evidence about use of renewable and non-renewable resources and the cause and impact of Earth hazards and global climate change to draw conclusions based on analysis.

**Note:** Objectives 5, 6 and 7 are not assessed in this instrument.

# Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response demonstrates the qualities of a high-level response.

# Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

*Allow FT mark/s* — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

# Marking guide

## Multiple choice

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

## Paper 1: Short response

| Q | Sample response | The response: |
|---|---|---|
| 21a) | 1: Remote sensing techniques are beneficial as access to the land is not required so less permission is required.<br>2: Remote sensing can often also be less expensive as it is less resource intensive. | • explains one benefit **[1 mark]**<br>• explains a second benefit **[1 mark]** |
| 21b) | Site A has low gravity while location B has high gravity. It is more likely that site B will have a metallic resource deposit as metallic resources have higher gravity than the surrounding rock. Site A has low gravity, so it is unlikely that dense minerals are found there. | • predicts site B **[1 mark]**<br>• provides justification **[1 mark]** |
| 21c) | Hyperspectral imagery could be used to identify the dominant mineral in an area by detecting its spectral signature. | • identifies a suitable remote sensing technique **[1 mark]**<br>• provides a valid description **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 22a) | The natural drivers have minimal influence on changes to global temperatures, with a fluctuation between −0.3 and 0.3 °C, whereas human/anthropogenic drivers have influenced a noticeable global temperature change of +1.1°C. | • identifies the influence of natural drivers **[1 mark]**<br>• identifies the influence of human drivers **[1 mark]** |
| 22b) | Land clearing reduces the incidence of photosynthesis as there are less plants undergoing this process. This can lead to an increase in carbon dioxide in the atmosphere, which leads to an increase in absorption of heat radiating from the Earth's surface, which in turn increases global temperatures. | • identifies a direct effect of land clearing **[1 mark]**<br>• explains how the direct effect leads to more heat being absorbed in the atmosphere **[1 mark]**<br>• explains the subsequent increase in global temperature **[1 mark]** |
| 22c) | Natural drivers generally involve cycles that take place over very long timeframes and therefore do not influence short term global temperatures. | • identifies the long timeframe of cycles for natural drivers **[1 mark]** |
| 22d) | A large enough volcanic eruption could reduce global temperatures through the release of ash and sulphur dioxide. Ash and sulphate aerosols reduce the amount of solar radiation reaching the Earth's surface, reducing global temperatures for a few years. Positive feedback mechanisms can extend this cooling effect for hundreds of years. | • identifies a natural driver **[1 mark]**<br>• explains one way the driver could affect global temperature **[1 mark]**<br>• explains a second way the driver could affect global temperature **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 23a) | The run-off coefficient is calculated by measuring the volume of water run-off as a percentage of the rainfall over a given area.<br>Run-off coefficients have a value between 0 and 1 where 0 = 0% run-off and 1 = 100% run-off. | • describes calculation as percentage or proportion of rainfall that is measured as run-off **[1 mark]**<br>• identifies run-off coefficient between 0 and 1 **[1 mark]** |
| 23b) | Remnant bushland (0.12) is less than agricultural land (0.36).<br>This means more water runs off the agricultural land than the remnant bushland. | • identifies a difference between agricultural land run-off coefficient and remnant bushland **[1 mark]**<br>• states more water runs off agricultural land **[1 mark]** |
| 23c) | The difference in run-off coefficient is probably due to the greater amount and variety of vegetation in remnant bushland. As the plants and roots slow down the flow of water, absorption increases. | • identifies a reason for the difference **[1 mark]**<br>• explains the reason for this difference **[1 mark]** |
| 23d) | 0.89<br>Run-off in built-up urban areas is high, due to the large amount of buildings with roofed areas, roads and parking lots, as well as commercial and industrial sites. | • identifies a run-off coefficient between 0.62 and 1.0 **[1 mark]**<br>• provides a valid reason for the high run-off coefficient **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 24a) | Bauxite has a low density (2–2.6 g/cm$^3$) and is found in metamorphic rocks. Gold has a higher density (19.3 g/cm$^3$) and is found in placer deposits. | • contrasts one characteristic of bauxite and gold **[1 mark]**<br>• contrasts a second characteristic of bauxite and gold **[1 mark]** |
| 24b) | Bauxite is milled because it is surrounded by metamorphic rock that is a similar density. The metamorphic rock must be broken up by milling before further processing.<br>Sluicing is used for gold because it has a high density, so can be easily separated from the less dense surrounding rock particles and stays behind in the sluicing machine. | • identifies a reason for milling bauxite **[1 mark]**<br>• justifies the reason **[1 mark]**<br>• identifies a reason for sluicing gold **[1 mark]**<br>• justifies the reason **[1 mark]** |

## Paper 2: Short response

| Q | Sample response | The response: |
|---|---|---|
| 1a) | Carbon dioxide concentrations fluctuated in a cyclical pattern prior to the Industrial Revolution and have consistently increased since the Industrial Revolution. | • identifies a feature of carbon dioxide concentrations<br>– before the Industrial Revolution **[1 mark]**<br>– after the Industrial Revolution **[1 mark]** |
| 1b) | Fossil fuels are consumed through the process of combustion, which increases the concentration of carbon dioxide to the atmosphere.<br>Carbon dioxide is a greenhouse gas that traps heat energy in the atmosphere, causing Earth to heat up. | • infers a human activity that affects global climate **[1 mark]**<br>• explains the activity's contribution to<br>– atmospheric carbon dioxide concentration **[1 mark]**<br>– global climate **[1 mark]** |
| 1c) | Prehistoric ice core data provides scientifically supported data of historical climate change beyond recorded history, but this data is less reliable (e.g. timescale uncertainty) than directly measured data. | • identifies a strength **[1 mark]**<br>• identifies a limitation **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 2a) | A potential cause of increased chlorophyll-a is fertiliser run-off. Fertiliser run-off adds additional nutrients to the water, causing algae to grow and increasing the amount of chlorophyll. | • identifies a potential cause **[1 mark]**<br>• explains the cause **[1 mark]** |
| 2b) | $2003 = 4\ \mu g/L$<br>$2010 = 14\ \mu g/L$<br>$\%\ \text{increase} = \frac{14-4}{4} \times 100$<br>$= \frac{10}{4} \times 100$<br>$= 250\%$ | • provides appropriate working **[1 mark]**<br>• calculates percentage change **[1 mark]** |
| 2c) | Chlorophyll-a concentration rises and peaks at 14 μg/L in 2010, before dropping below 6μg/L until 2024. Dissolved oxygen increased, but dropped after a peak of 85% in 2009, and quickly returned to typical levels, around 75%.<br>Oxygen % changes lag behind chlorophyll-a by approximately one year, indicating that chlorophyll-a concentration affects oxygen saturation. | • identifies a trend in chlorophyll-a concentration **[1 mark]**<br>• identifies a trend in dissolved oxygen saturation **[1 mark]**<br>• determines the relationship **[1 mark]** |
| 2d) | Chlorophyll-a increasing in 2025 will result in a decrease in dissolved oxygen to 65 %.<br>If this continues it may result in fish dying, as there is not enough oxygen to sustain life. | • predicts a decrease of dissolved oxygen **[1 mark]**<br>• predicts a potential impact on the waterway **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 3a) | Region A experienced the smallest earthquake and had the lowest mortality rate. Region B had the second smallest and second lowest mortality. Region D experienced the greatest magnitude earthquake of 7.8, which also had the highest mortality.<br>But region C does not support the claim. The magnitude of earthquake would be expected to have a mortality rate between 0.004 and 0.03 but was much lower at 0.00005. | • identifies data that supports the trend **[1 mark]**<br>• identifies data that does not support the trend **[1 mark]**<br>• determines whether the claim is valid with reference to data **[1 mark]** |
| 3b) | Region C appears to have implemented effective earthquake strategies because, although it has the highest population density, it has the lowest mortality rate. | • identifies region C **[1 mark]**<br>• provides a justification **[1 mark]** |
| 3c) | 1: Buildings, such as homes, offices and schools, being built to withstand earthquakes.<br>2: Emergency alerts issued promptly.<br>3: Public education on what to do in the event of an earthquake. | • identifies one mitigation strategy **[1 mark]**<br>• identifies a second mitigation strategy **[1 mark]**<br>• identifies a third mitigation strategy **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 4a) | Hydroelectricity: depends on water availability<br>Solar energy: needs lots of sun<br>Wind energy: requires good average wind speed | • identifies a constraint on hydroelectricity **[1 mark]**<br>• identifies a constraint on solar energy **[1 mark]**<br>• identifies a constraint on wind energy **[1 mark]** |
| 4b) | Qld 1868 + 2142 = 4010 MW<br>4010/10063 x 100 = 39.85%<br>NSW 292 + 826 = 1118 MW<br>1118/10963 x 100 = 10.20%<br><br>Solar energy generates approximately 40% of energy in Qld, which is possible because Qld receives a large amount of sunshine, whereas only solar only generates 10% in NSW due to more variable weather. | • calculates % solar for Qld **[1 mark]**<br>• calculates % solar for NSW **[1 mark]**<br>• identifies a reason for the difference **[1 mark]** |
| 4c) | Although solar energy has the lowest efficiency (at 20%), it is still able to produce a large output of energy (e.g. small solar produces 2142 MW in Qld). There is a lot of sun in Australia, and rooftop deployment produces a lot of energy. Southern states will have less efficiency due to climate variability. | • determines an effective renewable energy source **[1 mark]**<br>• provides a justification **[1 mark]**<br>• identifies a constraint **[1 mark]** |

| Q | Sample response | The response: |
|---|---|---|
| 5a) | Similarity: Both population 1 and 2 increased from 2010 to 2022.<br>Difference: Population 2 only had a total increase of 2 over this time, whereas population 1 increased by 31 individuals.<br>Significance: Population 1's increase is much greater than population 2's increase, suggesting that the fenced protected area was successful in rehabilitating the population. | • identifies a similarity **[1 mark]**<br>• identifies a difference **[1 mark]**<br>• explains the significance **[1 mark]** |
| 5b) | Population 3 is closest to the edge of the national park and the nearby development. The housing development may have caused habitat destruction as a large amount of land would have needed to be cleared to develop the area. Although this land was not national park, it may still have been habitat for the wallaby. | • infers the housing development is the reason for decline **[1 mark]**<br>• provides a valid justification **[1 mark]** |
| 5c) | Some species, such as the cane toad, outcompete native species, having a negative impact on the environment. Removing this species reduces the competition for native species and therefore has a positive impact on the viability of native species and the ecosystem as a whole. | • identifies a species whose removal has a positive influence **[1 mark]**<br>• describes the positive influence **[1 mark]** |

## Paper 2: Extended response

| Q | Sample response | The response: |
|---|---|---|
| 6a) | Particle size<br>$\text{Mean} = \frac{\text{sum of all values}}{\text{number}}$<br>$\text{Mean} = \frac{178+181+172+175}{4}$<br>$\text{Mean} = 179\ \mu\text{m}$<br><br>The sediment would be classified as fine sand, because it is between 0.125 and 0.250 mm. | • calculates mean particle size of 179 **[1 mark]**<br><br>• determines sediment classification **[1 mark]** |
| 6b) | Very fine sand quickly accumulates a thickness of 10 cm in 400 seconds, but then slows down, accumulating only an additional 2 cm over the next 400 seconds. | • describes the trend in very fine sand sediment thickness **[1 mark]**<br>• provides data to support the trend **[1 mark]** |
| 6c) | If the mine were to decrease the milling size to 50 µm the average settling time will increase, e.g. settling time for a thickness of 10 cm would increase from 200 seconds to approximately 1000 seconds. | • predicts the effect on average settling time **[1 mark]**<br>• provides data to support the effect **[1 mark]** |
| 6d) | Both baffles and flocculation would improve the settling out of sediment. Baffles would act to slow the rate of flow in the settling pond, allowing more time for sediment to settle out, thereby allowing more sediment to settle out. Flocculation would act to increase particle size, thereby allowing the sediment to settle out more quickly. So the flocculation process would be more appropriate to increase the speed of sediment processing in processed water. | • identifies a similarity **[1 mark]**<br>• identifies a difference **[1 mark]**<br>• explains the significance **[1 mark]** |
| 6e) | If the sediment has insufficient time to settle it could affect the hydrosphere by increasing turbidity. To monitor the hydrosphere, water samples could be taken ensuring the turbidity does not change.<br>Sediment could affect the biosphere by causing animals to change their distribution if the sediment is too thick. Animal frequencies could be monitored in transect surveys to ensure they are not leaving the area. | • predicts an impact on the hydrosphere **[1 mark]**<br>• identifies a valid monitoring strategy **[1 mark]**<br>• predicts an impact on the biosphere **[1 mark]**<br>• identifies a valid monitoring strategy **[1 mark]** |