Earth & Environmental Science marking guide and response

External assessment 2024

Combination response (106 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.

Purpose

This document consists of a marking guide and sample responses.

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
- has been annotated using the marking guide.

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.

Where no response to a question has been made, a mark of 'N' will be recorded.

Allowing for FT error — 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 be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

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.

This mark may be implied by subsequent working — the full mathematical reasoning and/or working, as outlined in the sample response and associated mark, is not explicitly stated in the student response, but by virtue of subsequent working there is sufficient evidence to award the mark/s.

Marking guide

Multiple choice

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

Paper 1: Short response

Q	Sample response	The response:
21a)	The earthquake at an active convergent boundary causes the sea floor to move up and down, causing water to move with it. The pressure wave this creates transfers the water upwards, creating a large tsunami wave. The rapid movement of the plates forces water away from the locus of the earthquake. This results in a wave that travels away from the locus until it comes into contact with something to slow it down (e.g. land).	• identifies that earthquakes cause sea floor movement **[1 mark]** • identifies that water is displaced **[1 mark]** • explains that the wave moves away from the locus towards the shore **[1 mark]**
21b)	Early warning systems: deep ocean buoys are monitoring systems, designed to detect and alert regions of an impending tsunami event. Building design: having stilts anchored deep into the surface prevent damage to the foundations enables buildings to withstand the surge of water.	• describes – an early warning system used as part of a tsunami mitigation strategy **[1 mark]** – a building design used as part of a tsunami mitigation strategy **[1 mark]**
21c)	The early warning system works and provides advance notice to authorities. Emergency advice is communicated to the population in sufficient time for the population to seek shelter in safe buildings built to codes.	• identifies – the early warning system creates an alert **[1 mark]** – communication is effective **[1 mark]** – buildings built to code provide safe refuge **[1 mark]**
21d)	The expense of retrofitting the existing building to comply with building codes.	• identifies a limitation **[1 mark]**
22a)	Fractional distillation: separates a mixture of liquids by heating the liquid to form vapours, then condensing the vapours to retrieve a desired liquid fraction. Froth flotation: is a process for selectively separating hydrophobic materials from hydrophilic materials. Gravity separation: is a method of separating a mixture by gravity, based on the components' different densities.	• describes – fractional distillation **[1 mark]** – flotation technique **[1 mark]** – gravity separation **[1 mark]**

Q	Sample response	The response:
22b)	Mineral sands: Gravity separation can be used to separate mineral sand because it has medium density and its reactivity is too low for flotation. Crude oil: Fractional distillation can be used to separate crude oil because it is a liquid.	• identifies a separation technique for – mineral sand **[1 mark]** – crude oil **[1 mark]** • provides an appropriate reason for the technique used to separate – mineral sand **[1 mark]** – crude oil **[1 mark]**
23a)	Magmatic processes: form mineral deposits when magma or molten rock cools and crystallises. Exhalative processes: involve the precipitation of minerals on the seafloor near hydrothermal vents.	• describes – magmatic processes crystallising mineral through cooling **[1 mark]** – exhalative processes precipitating minerals where hydrothermal fluids enter a water reservoir **[1 mark]**
23b)	The gold in rocks being heated is pressurised and migrates out into a solution of hot salty water containing silicon, iron and sulphur. The liquid migrates through fractures in the rock, to cooler regions at lower pressures, where the gold crystallises, often as veins in quartz.	• explains – migration from source rock due to water temp or pressure **[1 mark]** – crystallising in surrounding rock **[1 mark]**
23c)	Gold can be released from its hard rock deposits by weathering and carried by streams. Therefore, placers will be downstream of an ore body. Placers are most likely to be located at points where the stream velocity slows, allowing the gold to settle. Therefore, placers are most likely to be found where a river widens or on the inside of river bends.	• explains that – gold pieces are released by weathering **[1 mark]** – gold placers are located downstream of an ore body **[1 mark]** – slowing of water flow rate/stream velocity allows the gold to settle **[1 mark]** – placers are likely to be located where a river widens or on the inside of river bends **[1 mark]**
24a)	Surface mining exposes soil, causing sediment erosion. Sulphide-rich ores could cause acid mine drainage.	• describes an impact **[1 mark]** • describes a second impact **[1 mark]**

Q	Sample response	The response:
24b)	Settling ponds are used to manage turbidity within the water discharged from a mine. Settling ponds are designed so that water sits in the pond long enough for suspended solids to settle out. Water can only be discharged from a mine when it has turbidity lower than the levels set by the environmental regulator, and settling ponds allow these levels to be met.	• identifies turbidity as the property being managed **[1 mark]** • describes suspended solids settling **[1 mark]** • describes clear water being released from a mine via settling ponds **[1 mark]**
24c)	$\text{Rate} = 2 \text{ kg h}^{-1} \text{ m}^{-3}$ $24 \text{ hours} \times 7 \text{ days} = 168 \text{ hours}$ $\text{Volume} = 10\ 000 \text{ m}^3$ $\text{Mass of slurry} = 2 \times 168 \times 10\ 000$ $= 3\ 360\ 000 \text{ kg}$	• provides appropriate working **[1 mark]** • calculates the mass of slurry processable in a seven-day period **[1 mark]**

Paper 2: Short response

Q	Sample response	The response:
1a)	Similarity: Both sites have an increase in suspended solids, which resulted in an increase in turbidity. Difference: The increase in suspended solids was much higher for inside the erosion gully compared to downstream of the erosion gully. Significance: Despite inside the erosion gully experiencing a much higher increase in suspended solids, this site does not show a similarly larger increase in turbidity. However, the higher level of suspended solids results in turbidity remaining higher for a much longer time (15 hours compared to four hours).	• identifies – a similarity **[1 mark]** – a difference **[1 mark]** – the significance of the difference or similarity **[1 mark]**
1b)	A solution to the siltation could be a sediment trap. A sediment trap would prevent excess sediment from travelling downstream and thus reduce the impact of sediment build-up.	• identifies a solution to the build-up of sediment **[1 mark]** • explains how the solution would reduce sedimentation **[1 mark]**
2a)	Temperature would increase by 1.4–3.1 °C.	• identifies that temperature would increase by 1.4–3.1 °C **[1 mark]**
2b)	Species B is most at risk of extinction as it has the lowest maximum temperature tolerance.	• identifies species B **[1 mark]** • provides a suitable justification **[1 mark]**
2c)	The distribution of the northern individuals of species D will move south as the temperature increase exceeds the temperature range of these individuals. The southernmost individuals of species D will move further south and expand into new areas as these areas move into their tolerance range.	• makes a prediction **[1 mark]** • justifies the prediction **[1 mark]** • makes a second prediction **[1 mark]** • justifies the second prediction **[1 mark]**
3a)	Rainforest distribution decreased between 1500 and 2020.	• identifies a change in distribution **[1 mark]**
3b)	The Amazon rainforest acts as a carbon sink. Deforestation reduces the capacity for carbon dioxide to be removed from the atmosphere. This contributes to global climate change, as accumulating atmospheric carbon dioxide increases atmospheric temperature and contributes to global warming.	• identifies the rainforest as a carbon sink **[1 mark]** • explains that deforestation increases atmospheric carbon dioxide **[1 mark]** • explains how deforestation contributes to global climate change **[1 mark]**

Q	Sample response	The response:
3c)	The Amazon Rainforest's ability to act as a carbon sink is decreasing. Approximately 20% of the Amazon Rainforest's total area was deforested between 1500 and 2020 (figure 1). Unprotected areas make up approximately half (51.6%) of the Amazon Rainforest's area (figure 3) and produce the majority (~85%) of its emissions (figure 3). The Amazon Rainforest is currently acting as a carbon sink but produces only −4 billion tonnes of carbon dioxide equivalent gases (figure 2). If deforestation continues in unprotected areas, the entire Amazon Rainforest will act as a carbon source.	• predicts the Amazon Rainforest's ability to act as a carbon sink will decrease if deforestation continues **[1 mark]** • provides a reason using figure 1 **[1 mark]** • provides a reason using figure 2 **[1 mark]** • provides a reason using figure 3 **[1 mark]**
4a)	Hydropower could be used to power City X. This is because City X is adjacent to a water body and river system.	• identifies a suitable renewable energy source **[1 mark]** • provides justification **[1 mark]**
4b)	City X needs to consider the climate and annual rainfall in the area to ensure the longevity of the hydropower station. Low rainfall means the dam will not be replenished, limiting hydropower production. Using hydropower means that water will need to be continually released from the dam. City X also needs to consider the elevation of the river system — if there is no difference in elevation, a hydropower plant will not be able to operate in this area. The dam can only be built in areas where there is a difference in elevation. City X also needs to consider how the energy produced by the hydropower plant will be stored and the efficiency of this storage. Energy storage will entail extra cost and require space to be added to the system. This may limit the viability of hydropower.	• identifies a factor **[1 mark]** • explains the factor **[1 mark]** • describes the impact of the first factor **[1 mark]** • identifies a second factor **[1 mark]** • explains the second factor **[1 mark]** • describes the impact of the second factor **[1 mark]** • identifies a third factor **[1 mark]** • explains the third factor **[1 mark]** • describes the impact of the third factor **[1 mark]**
5a)	The African plate is splitting into two smaller plates (Nubian plate and Somalian plate) that are moving apart, creating a divergent plate boundary.	• identifies divergent plate boundary **[1 mark]** • describes divergent plate boundary **[1 mark]**

5b)	The divergent plate boundary could produce volcanoes as magma is pushed up into the lithosphere.
	Earthquakes may form in this location when the plates move.
		• identifies
		  – volcanoes **[1 mark]**
		  – earthquakes **[1 mark]**
		• provides
		  – a reason for volcanoes **[1 mark]**
		  – a reason for earthquakes **[1 mark]**

Extended response — Question 6

Q	Sample response	The response:
6a)	Location must be within 5 and 30° latitude for the Coriolis force to take effect. Pre-existing weather must be disturbed with sufficient spin and inflow. Wind does not vary greatly with height/ low wind shear. An atmosphere that cools with height, encouraging thunderstorms to form.	• identifies – one condition **[1 mark]** – a second condition **[1 mark]** – a third condition **[1 mark]** – a fourth condition **[1 mark]**
6b)	The factors involved would have included the name of the cyclone before – it would have been a male name starting with the letter 'S'. The name Taylor would also not have been associated with a previous cyclone that resulted in significant damage or the loss of life (unlike Tracy). The country would have had to get the name approved by neighbouring countries to avoid duplication.	• identifies – names are allocated in alphabetical order **[1 mark]** – names are allocated alternating between male and female **[1 mark]** – cyclone names get retired when associated with significant damage or loss of life **[1 mark]** – names are approved by neighbouring countries **[1 mark]**
6c)	Location B would be most affected by a storm surge. A storm surge is an increase in sea level above normal astronomical tide levels, commonly associated with low-pressure weather systems, such as cyclones. Location B has the lowest elevation compared to the other locations and therefore will be most affected by an increase in water level. Although location B is somewhat protected, the bay would be relatively shallow, and therefore more affected by a storm surge than a steep coastline.	• identify location B **[1 mark]** • provides a justification for the location **[1 mark]** • provides a second justification for the location **[1 mark]** • provides a third justification for the location **[1 mark]**
6d)	The cyclone may damage or destroy houses, damage and block roads or other built infrastructure, such as electricity networks, sewage plants and rail lines due to high winds and heavy rainfall. The strong winds of a tropical cyclone would result in the destruction of coastal vegetation in this region. This destruction of coastal vegetation would result in a loss of habitat for flora and fauna. The wind speed, rain and storm surge from the cyclone would move and reshape sand dunes and cause extensive erosion of soil, which would be transported into waterways and the ocean, resulting in sedimentation and increased turbidity.	• predicts an impact on the built environment **[1 mark]** • justifies the prediction **[1 mark]** • predicts an impact on the natural environment **[1 mark]** • justifies the prediction **[1 mark]** • predicts another impact on either the built or natural environment **[1 mark]** • justifies the prediction **[1 mark]**