NESA No.: .....

SCIENCE

2024

Year 12 Assessment Task 4

Trial Examination – Question Booklet

Earth and Environmental Science

General Instructions

- Write using black pen.
- Write your NESA student number at the top of this page.

Section 1 – 20 marks
Attempt questions 1-20
Use the multiple-choice sheet in the Answer Booklet for this section.
Allow 30 minutes for this section.

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1 A road cutting exposes sedimentary rock layers. The top layer contains plastic and metal fragments.
Which principle allows scientists to determine the relative age of this layer?
A. Fossil dating
B. Law of superposition
C. Radiometric dating
D. Law of uniformitarianism

2 Nuclear power is most accurately described as:
A. climate alternative and renewable.
B. climate non-alternative and renewable.
C. climate alternative and non-renewable.
D. climate non-alternative and non-renewable.

3 Which of the following best explains why index fossils are critical for correlating rock layers across different regions?
A. They allow scientists to determine the absolute age of rock layers by measuring radioactive decay.
B. They help identify layers of the same age by appearing in multiple locations within a narrow time range.
C. They provide evidence of evolutionary transitions, showing how species gradually changed over millions of years.
D. They are the only type of fossil that preserves evidence of past climate conditions.

4 What major geological event is associated with the breakup of supercontinents such as Pangaea?
A. Formation of banded iron formations.
B. Increase in global temperatures.
C. Widespread volcanic activity and mass extinctions.
D. Decrease in sea levels.

5 What is the main environmental concern associated with open-pit mining?

A. Increased carbon dioxide emissions.
B. Groundwater contamination and habitat destruction.
C. Depletion of oceanic resources.
D. Increased volcanic activity.

6 Which of the following best explains why earthquakes at subduction zones are more likely to generate tsunamis than those at transform boundaries?

A. Subduction zones involve vertical displacement of the seafloor, while transform faults move laterally.
B. Subduction zone earthquakes are always larger in magnitude than transform fault earthquakes.
C. Transform faults only occur on land, while subduction zones occur underwater.
D. Subduction zones cause stronger ground motion, making tsunamis inevitable.

7 Which factor most directly determines when a geological hazard becomes a disaster?

A. The magnitude of the event (e.g., earthquake strength, eruption size).
B. The level of human exposure and vulnerability to the hazard.
C. The frequency of the geological event occurring in a region.
D. The time of day the hazard occurs.

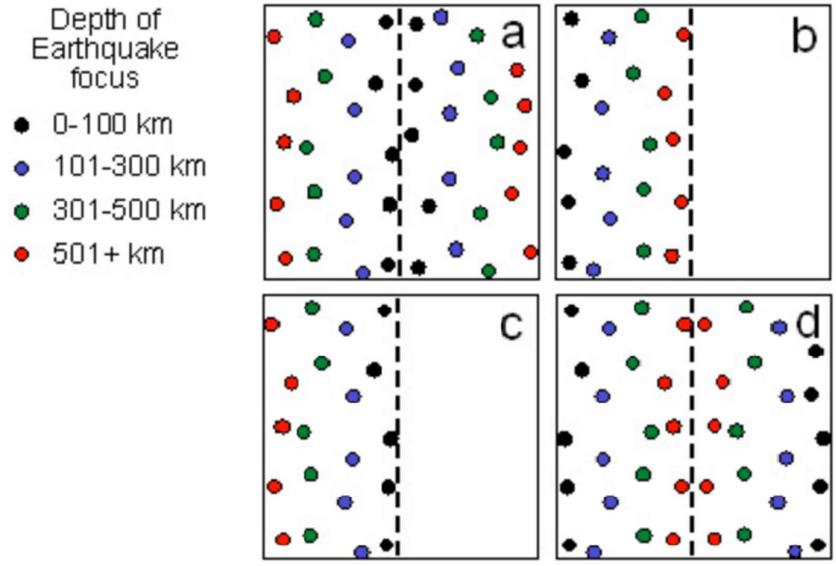
8 Why does ocean acidification occur due to rising CO_2 levels?

A. CO_2 reacts with seawater to form carbonic acid, lowering pH.
B. Increased CO_2 causes ocean temperatures to drop, making water acidic.
C. CO_2 blocks sunlight from reaching the ocean, reducing its alkalinity.
D. The release of CO_2 from marine organisms increases water acidity.

9 Which of the following best explains why rhyolitic eruptions are more explosive than basaltic eruptions?

A. Rhyolitic magma contains more dissolved gas and is more viscous, preventing gas escape.
B. Rhyolitic magma is found at divergent boundaries, where explosive eruptions are common.
C. Basaltic magma forms in subduction zones, where it erupts violently.
D. Rhyolitic magma cools faster than basaltic magma, leading to more pressure build-up.

10 The following image shows the depth of earthquakes at a plate boundary.

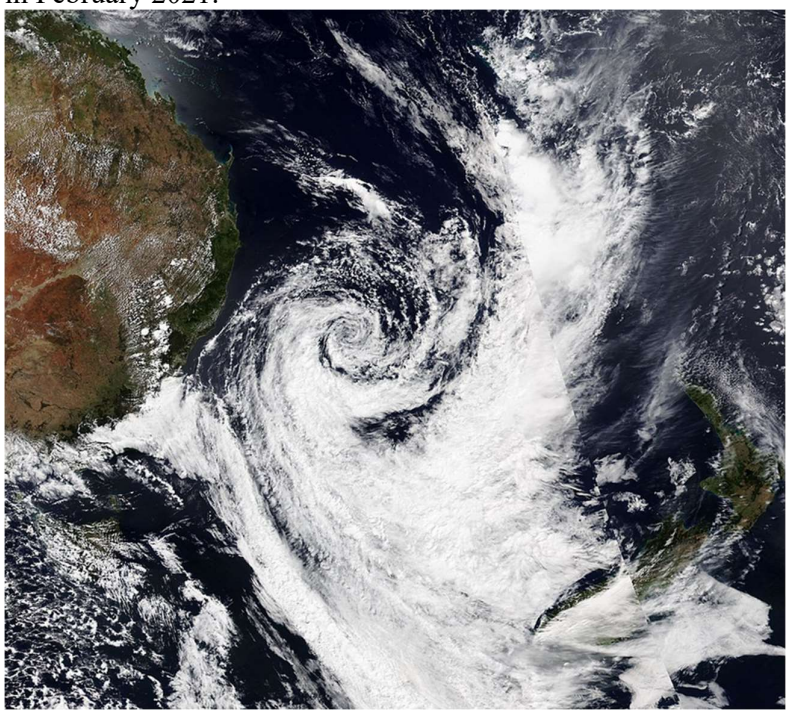


Source: SERC, 2006

Which image correctly shows earthquake depths at a subduction zone?

A. A
B. B
C. C
D. D

11 The image below shows an East Coast Low approaching the New South Wales coast in February 2021.



Source: Wikipedea, 2025

Based on the provided satellite image, which of the following best describes how some east coast lows form?

A. They develop when a tropical cyclone moves south and strengthens over cooler waters.

B. They are formed by interactions between warm, moist air from the Tasman Sea and cold, dry air from the south.

C. They are caused by heatwaves that intensify local thunderstorms, leading to rapid cyclonic development.

D. They form due to sudden drops in ocean temperatures, triggering extreme pressure changes.

12 Which of the following best compares ancient and recent methods of reconstructing climate variation?

A. Ancient evidence, such as isotope ratios in rocks, provides precise annual climate records, while dendrochronology offers only rough estimates of past climate.

B. Both ancient (e.g., fossilized pollen) and recent (e.g., human instrumental records) climate evidence rely on indirect measurements of temperature and CO_2.

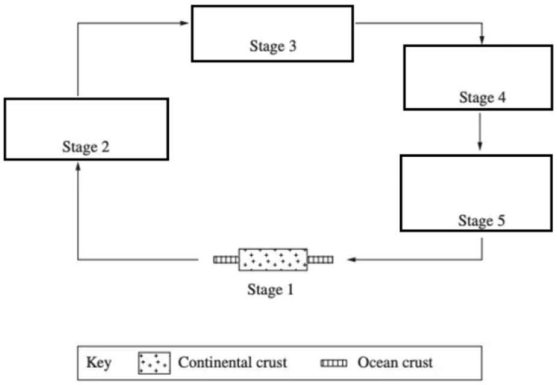
C. Ancient climate evidence, such as microfossils and isotope ratios, allows for long-term climate reconstruction, while recent methods provide higher-resolution short-term data.

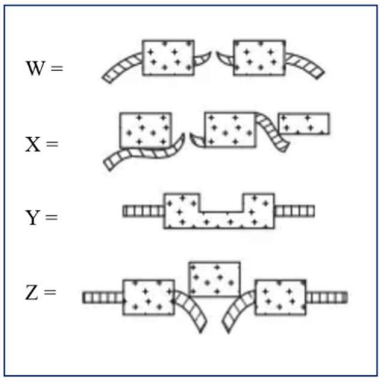
D. Human instrumental records are more accurate than ancient climate evidence because they do not require calibration against other data sources.

13 The Urey-Miller experiment simulated the atmospheric conditions of early Earth to test the abiotic formation of organic molecules. Which of the following factors would most significantly affect the success of their experiment if altered?

A. Increasing the proportion of oxygen in the system.
B. Adding ultraviolet (UV) radiation as an energy source.
C. Decreasing the amount of methane and ammonia.
D. Removing electrical sparks from the system.

14 The following diagram shows a model of the plate tectonic supercycle and the images that should be found in each stage.



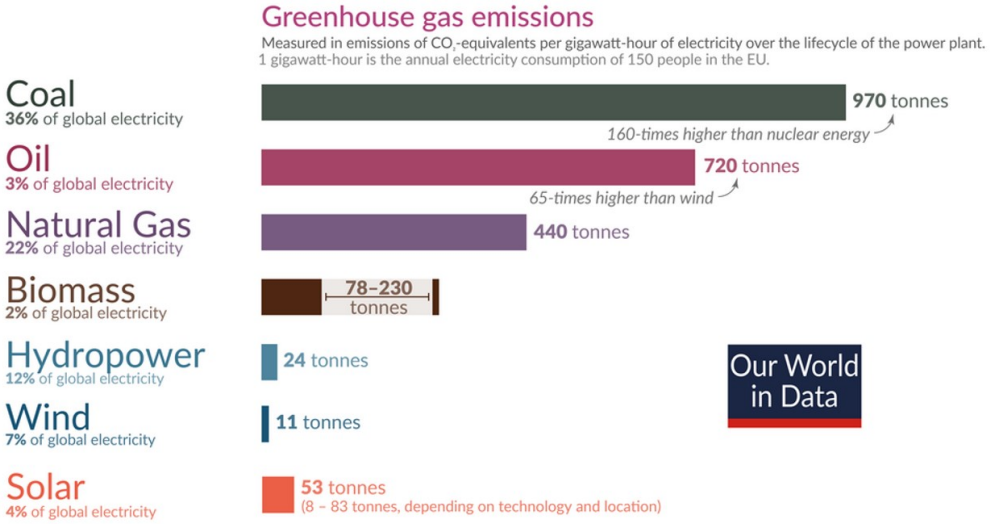


Source: adapted from NESA, 2016

Place the images in order along the flow chart.

A. Y, X, W, Z
B. Y, Z, W, X
C. Y, W, Z, X
D. Y, W, X, Z

15 The following graph compares CO_2 emissions from coal, natural gas, and renewable energy sources



Based on the provided graph, which statement best explains the role of renewable energy in reducing human contributions to the greenhouse effect?

A. Solar and wind energy have reduced CO_2 emissions in some countries, but globally, fossil fuel use remains dominant.

B. CO_2 emissions from fossil fuels have decreased globally as renewable energy has replaced coal and gas.

C. Natural gas contributes no greenhouse gas emissions, making it as sustainable as solar and wind.

D. Coal emits less CO_2 than wind and hydroelectric power when used efficiently.

Use the image to respond to questions 16-17.



Observed atmospheric increase of carbon dioxide (CO_2) since 1750. Bergamaschi, *et. al.*, (2018).

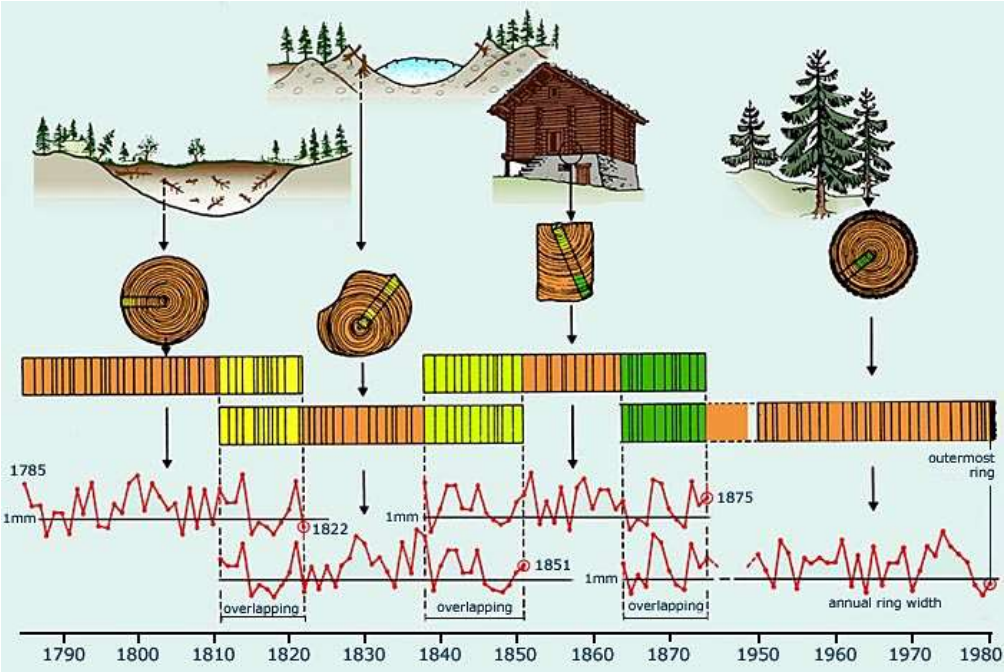
16 The provided graph shows CO_2 levels rising significantly since the Industrial Revolution. What is the primary cause of this increase?

A. Increased solar radiation warming Earth's surface.
B. Higher volcanic activity releasing large amounts of CO_2.
C. Human activities such as fossil fuel combustion and deforestation.
D. More water vapor in the atmosphere trapping additional heat.

17 Which of the following best distinguishes the natural greenhouse effect from the anthropogenic greenhouse effect?

A. The natural greenhouse effect is caused by humans, while the anthropogenic greenhouse effect is a natural process.
B. The natural greenhouse effect maintains Earth's temperature, while the anthropogenic greenhouse effect intensifies warming beyond natural levels.
C. The natural greenhouse effect only occurred in the past, while the anthropogenic greenhouse effect is a new phenomenon.
D. The natural greenhouse effect is beneficial, while the anthropogenic greenhouse effect has no impact on global climate.

18 Dendrochronology, or tree-ring dating, is the scientific method of dating tree rings to the exact year they were formed. The principle of cross-dating allows for the identification of the exact year each ring was formed, even from dead or even fossilised trees.



Source: Unknown

Using the principle of cross-dating, determine when the log cabin this diagram was built.

A. After 1870
B. Between 1840 and 1870
C. Between 1810 and 1840
D. Before 1810

Use the information to respond to questions 19-20.

Juukan Gorge, a 46,000-year-old Aboriginal cultural site in Western Australia, was destroyed by mining company Rio Tinto in 2020 to expand an iron ore mine. The caves contained significant Indigenous artifacts, including tools, sacred objects, and genetic evidence of continuous human occupation. The destruction sparked international outrage and led to:
Government investigations into mining heritage laws.
Increased demand for Traditional Owner consultation in mining projects.
Greater focus on environmental and cultural restoration after mining ceases.
Some mining operations, such as the Ranger Uranium Mine (Northern Territory), have engaged with Indigenous communities in rehabilitation efforts. The Mirarr people played a role in planning and restoring land after the mine closed in 2021, focusing on ecosystem repair and protection of cultural heritage sites.



Source: SBS, 2020

19 Based on the case study, what is one of the biggest challenges in balancing resource extraction with protecting Aboriginal cultural heritage?

A. Mining companies legally own all land they operate on, so cultural sites cannot be protected.
B. Traditional Owners do not have knowledge of mining, making negotiations difficult.
C. Economic interests in mining often conflict with the need to preserve Indigenous heritage.
D. Destruction of cultural sites is unavoidable, as mining companies cannot adjust their operations.

20 In the rehabilitation of the Ranger Uranium Mine within Kakadu National Park, how did the involvement of the Mirarr Traditional Owners enhance the restoration process?

A. They halted the project and refused access to rehabilitation teams.
B. Their knowledge guided culturally appropriate land restoration practices.
C. They replaced engineering strategies with traditional farming practices.
D. They directed the development of new uranium mines on nearby lands.

NESA No.: .....

Fort Street High School

SCIENCE

2025

Year 12 Assessment Task 4

Trial Examination – Answer Booklet

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 180 minutes
- NESA approved calculators may be used.
- Write using black pen.
- Draw diagrams using pencil.
- Write your NESA student number at the top of this page.
- A Geological Time Scale is provided at the back of this paper

Weighting – 30%

Total marks – 100

Section 1:

- Question 1-20
- Multiple choice (20 marks)

Section 2:

- Questions 21-31
- Extended response (80 marks)

Attempt All Questions (1-31)

Multiple-choice answer sheet

Shade in the circle that corresponds to the most correct answer.

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

Attempt questions 21 - 31

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Allow 150 minutes for this section.

Question 21 (3 marks)

Explain how changes in ocean circulation can lead to natural climate variation. **3**

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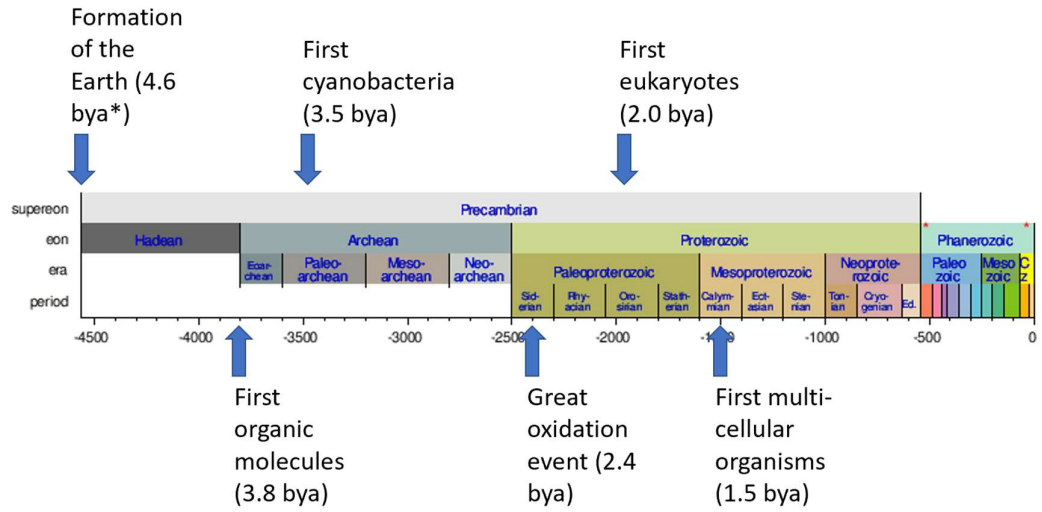
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End of Question 21.
Please turn over.

Question 22 (7 marks)

The following timeline showing major evolutionary and atmospheric events.



*Note: "bya" = billion years ago, x10^9

(a) Describe how cyanobacteria contributed to changes in the Earth's atmosphere. **3**

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(b) Explain how the emergence of cyanobacteria influenced the evolution of the biosphere. Use the information in the timeline and your own knowledge in your response. **4**

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End of Question 22.
Please turn over.

Question 23 (6 marks)

Analyse how different types of geological and meteorological hazards require different strategies for disaster prevention. Support your response with specific examples. **6**

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End of Question 23.
Please turn over.

Question 24 (17 marks)

Mount Pinatubo, located in the Philippines, erupted catastrophically on June 15, 1991. The eruption was one of the largest of the 20th century, producing massive ash clouds, pyroclastic flows, and lahars. However, disaster preparedness and response efforts significantly reduced casualties compared to what could have been expected for such a large eruption.

The following data outlines key preparedness measures and their impacts:

Disaster Preparedness and Response for Mount Pinatubo (1991)

Preparedness Action	**Details**
Seismic Monitoring	Scientists from PHIVOLCS (Philippine Institute of Volcanology and Seismology) and USGS detected increased activity in early April 1991 and closely monitored gas emissions and earthquakes.
Public Warnings Issued	A 5-stage alert system was introduced to warn residents of increasing volcanic activity. By June 5, Alert Level 5 (highest) was issued.
Evacuations	Over 58,000 people were evacuated from high-risk areas in the 10 km danger zone before the main eruption.
Military Base Evacuation	The US Clark Air Base, located 20 km from the volcano, was fully evacuated, preventing a major loss of life.
Fatalities and Injuries	Despite the massive eruption, only ~800 people died, mainly due to roof collapses from ashfall and lahars. Without early warnings, casualties could have been in the tens of thousands.
Impact of Typhoon Yunya	A typhoon hit at the same time, intensifying lahars and ashfall, making evacuations harder but reinforcing the importance of early warnings.
Long-Term Response	Engineering efforts such as dams and river channels were built to manage recurring lahars, which lasted for years.

(a) Outline the sequence of tectonic events leading up to the eruption of Mount Pinatubo in 1991. **2**

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Question 24 continues on page 7.

Question 24 (continued)

(b) Evaluate the effectiveness of the disaster preparedness and response efforts in mitigating the eruption's impacts. **5**

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Question 24 continues on page 8.

Question 24 (continued)

(c) Students in a classroom investigated the concept that the cooling rate of magma affects crystal size and rock strength by comparing how fast different rock types break under force. **4**

The students attempted to break each rock type using gentle taps (showing that fast-cooling rocks like pumice are weaker than slow-cooling granite) to compare to real-world lava solidification at subduction zones vs. mid-ocean ridges.

The students identified the following potential risks:

- Flying rock fragments.
- Hand injury from hammer use.
- Sharp edges on broken pieces.

Compare steps of natural hazard prevention to hazard prevention in laboratory experiments.

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Question 23 continues on page 9.

Question 24 (continued)

(d) Analyse how a volcanic eruption, such as the 1991 Mount Pinatubo eruption, can affect multiple Earth spheres. Use specific examples to support your response. **6**

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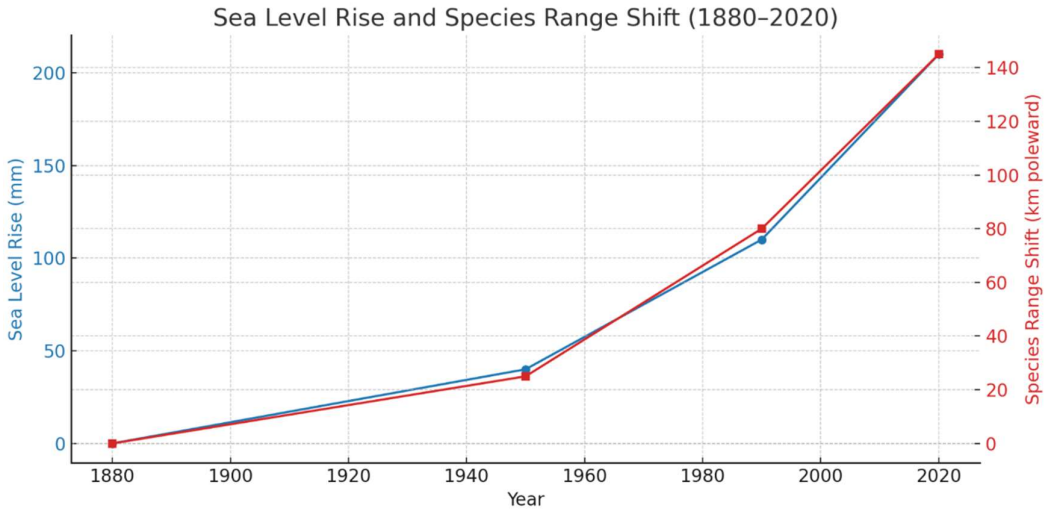
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End of Question 24.
Please turn over.

Question 25 (6 marks)

The following graph shows sea level rise and species range shift.



(a) Explain one way by which changes in climate can lead to rising sea levels. **3**

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Question 25 continues on page 11.

Question 25 (continued)

(b) Explain how rising sea levels can affect the range of species. **3**

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End of Question 25.
Please turn over.

Question 26 (7 marks)

A school introduced an initiative to improve waste management in the playground. The initiative included:

- Composting bins for food scraps and organic waste.
- Improved recycling stations for paper, plastics, and cans.
- Awareness campaigns encouraging students to reduce waste.

The school conducted a waste audit before and after implementing these changes to measure their effectiveness.

School Playground Waste (kg per week)

Waste Type	Before Initiative (kg)	After Initiative (kg)
Organic Waste	12	6
Recyclables	8	12
Landfill Waste	15	7

(a) Assess the effectiveness of the initiative in reducing waste. **3**

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(b) The school plans to review its waste initiative after one year. Explain how new data can be used to assess long-term effectiveness. **4**

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End of Question 26.
Please turn over.

Question 27 (4 marks)

Complete the flow diagram showing how ice cores are used to reconstruct past climate conditions.

4

Bubbles in ice cores hold air samples from past climates

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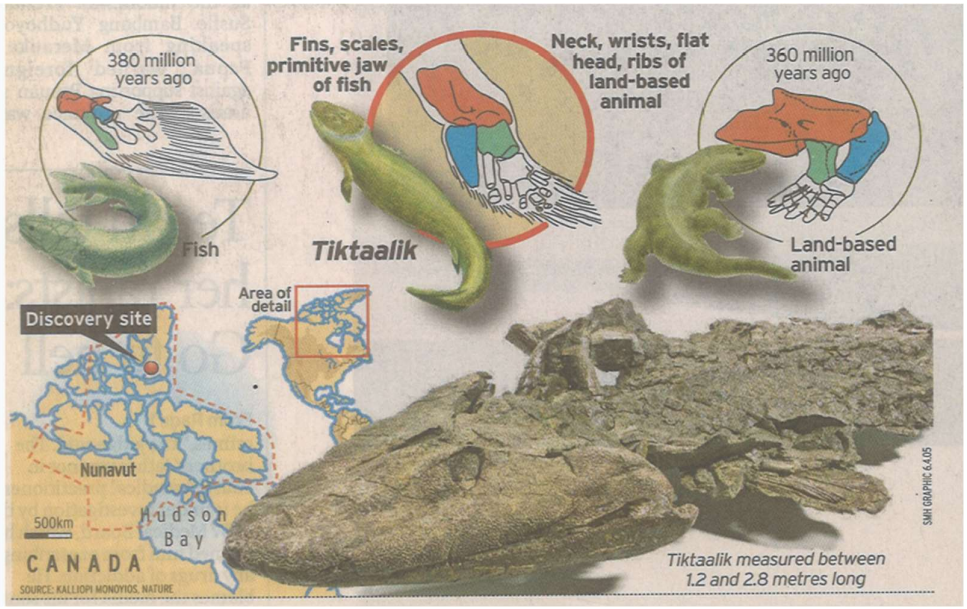
End of Question 27.
Please turn over.

Question 28 (6 marks)

The following table shows key fossil discoveries linked to the conquest of land by plants and animals, along with their significance and where they were found.

Time (MYA)	Fossil Name	Discovery Year	Significance	Location
470	*Cryptospores*	1971	Earliest land plant spores	Argentina, Saudi Arabia
425	*Cooksonia*	1937	First vascular plant	Wales, Ireland
410	*Rhynia*	1917	Early vascular plant	Scotland
375	*Tiktaalik*	2004	Fish-tetrapod transition	Canada (Arctic)
365	*Ichthyostega* & *Acanthostega*	1932	Early amphibians	Greenland
360	*Arthropleura*	1854	Giant land arthropod	Scotland, USA, Germany
340	*Hylonomus*	1859	Oldest known reptile	Canada
315	*Meganeura*	1895	Giant dragonfly-like insect	France, UK
280	*Dimetrodon*	1878	Early synapsid (mammal ancestor)	USA, Germany

The diagram below shows an image from the *Sydney Morning Herald* article (6 April 2006, p. 3) announcing the discovery of *Tiktaalik,* an important fossil in the record of life on Earth. *Tiktaalik* was dated at 375 Ma.



Source: Sydney Morning Herald, 2006

Question 28 continues on page 15.

Question 28 (continued)

Analyse the importance of this fossil for scientific understanding of the development of life on Earth. Refer to the data table and the image as well as your own knowledge in your response. **6**

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End of Question 28.
Please turn over.

Question 29 (10 marks)

Before European colonisation, Aboriginal and Torres Strait Islander Peoples used cultural burning (a form of low-intensity, controlled burning) to manage landscapes, reduce fuel loads, and promote biodiversity. When these practices were disrupted, large, high-intensity bushfires became more frequent.

In 2014, a cultural burning program was reintroduced in a national park in south-eastern Australia. The program involved small, controlled fires during cooler months to prevent dangerous bushfire conditions. The table below shows the number of large bushfires (covering more than 500 hectares) recorded each year from 2000 to 2024 in this national park.

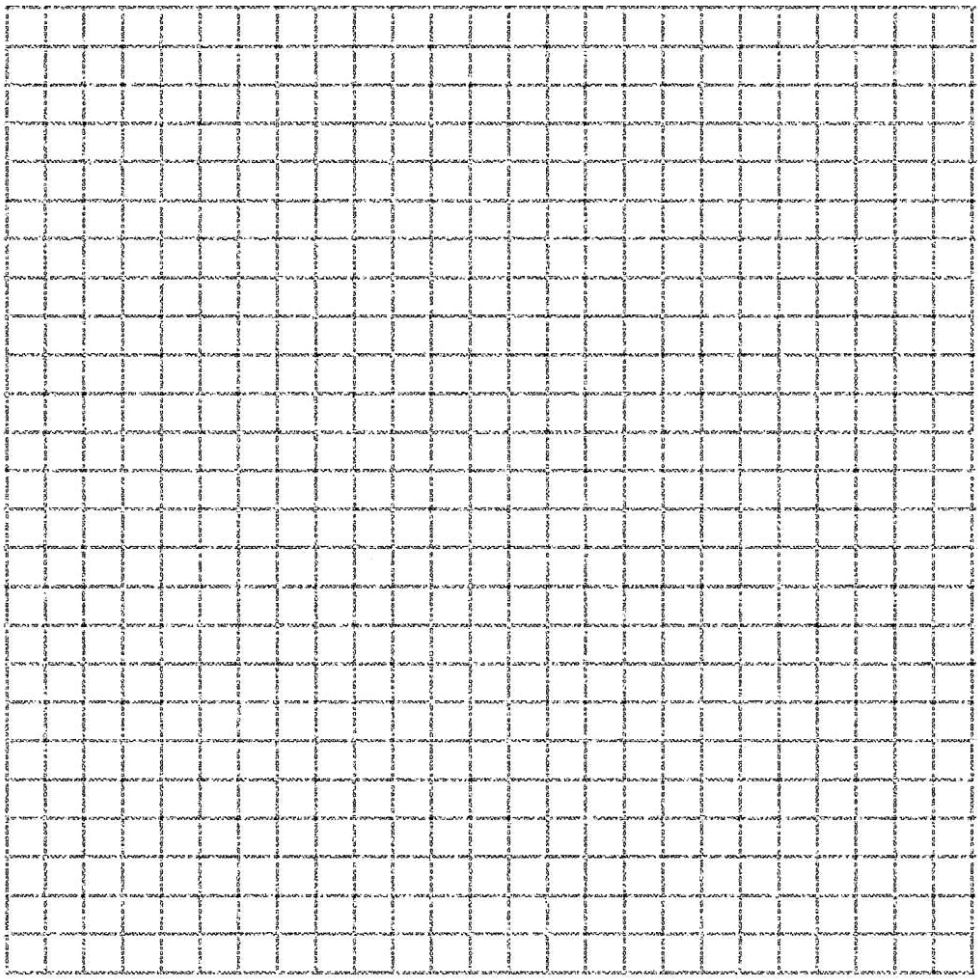
Large Bushfires (500+ hectares) in a National Park (2000–2024)

Year	Number of Large Bushfires
2000	18
2002	20
2004	22
2006	21
2008	19
2010	15
2012	13
2014	9
2016	6
2018	3
2020	2
2022	2
2024	1

Question 29 continues on page 17.

Question 29 (continued)

(a) Construct a suitable graph to show the number of large bushfires over time. **3**



Question 29 continues on page 18.

Question 29 (continued)

(b) Describe the trend in large bushfire frequency before and after the cultural burning program was introduced. **2**

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(c) Explain how Aboriginal and Torres Strait Islander fire management practices contribute to bushfire hazard reduction. **5**
Support your response using data from the graph and your understanding of natural hazard prevention.

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End of Question 29.
Please turn over.

Question 30 (6 marks)

Evaluate one mitigation strategy and one adaptation strategy used to reduce the effects of climate change. Support your answer with scientific evidence. **6**

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End of Question 30.
Please turn over.

Question 31 (8 marks)

Human activity has significant impacts on Earth's systems, and our ability to manage these impacts relies on scientific understanding.

Use specific examples from at least two of the following modules to support your response:

- Module 5 – Earth's Processes
- Module 6 – Hazards
- Module 7 – Climate Science
- Module 8 – Resource Management

Evaluate the extent to which human understanding and application of Earth and Environmental Science influences the long-term functioning of Earth's systems. **8**

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Question 31 continues on page 21.

Question 31 (continued)

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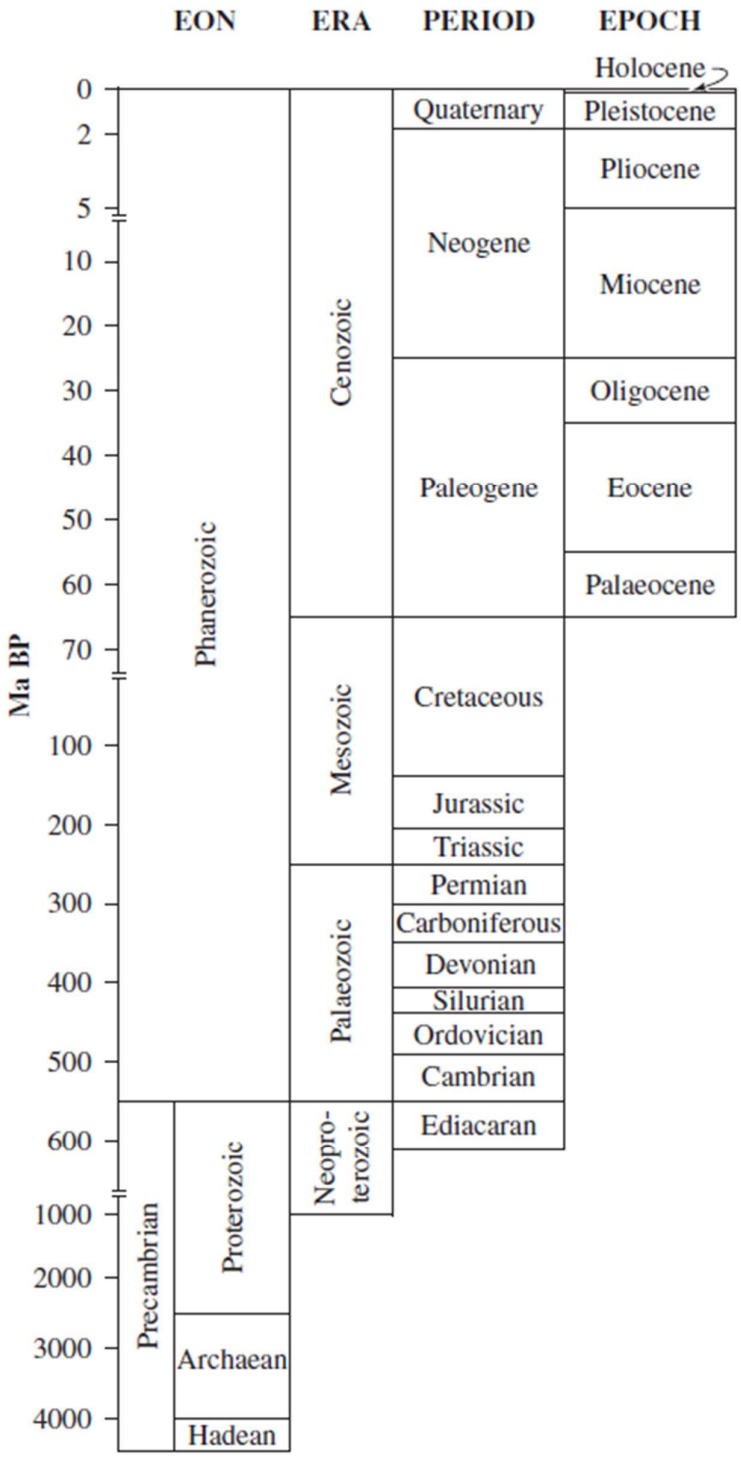
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End of test

Earth and Environmental Science

Geological Time Scale



Section II extra writing space
If you use this space, clearly indicate which question you are answering.

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Section II extra writing space
If you use this space, clearly indicate which question you are answering.

12EES Trial 2025 Marking Criteria

KU = MC, Q23, 24d), 25, 28, 30

SECTION I

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

Question 1

Answer: B
Outcomes: EES11/12-5, EES12-12
Explanation:
B is correct: the Principle of Superposition states that in undisturbed sedimentary sequences, the youngest layers are on top.

- **A** (Fossil dating) refers to index or absolute fossil correlation, not this context.
- **C** (Radiometric dating) provides absolute, not relative, ages.
- **D** (Uniformitarianism) explains that current processes explain the past, but doesn't determine layer order.

Question 2
Answer: C
Outcomes: EES11/12-5, EES12-15
Explanation:
C is correct: nuclear power is a *climate alternative* (low carbon emissions compared to fossil fuels) but *non-renewable* because it relies on finite uranium resources.
• A is incorrect—nuclear is not renewable.
• B misrepresents both its climate role and energy source.
• D is incorrect—nuclear is low-emission and *is* a climate alternative.

Question 3

Answer: B
Outcomes: EES11/12-5, EES12-12
Explanation:
B is correct: index fossils are widespread and short-lived, useful for correlating rock layers of similar age.

- **A** refers to absolute dating, not correlation.
- **C** is about evolution, not stratigraphic matching.
- **D** confuses index fossils with climate proxies.

Question 4

Answer: C
Outcomes: EES11/12-5, EES12-12
Explanation:
C is correct: supercontinent breakup causes widespread volcanism and has been linked to mass extinction events.

- **A** refers to older geological processes.
- **B** may be a consequence but is not diagnostic.
- **D** may occur but not as a primary global trend.

Question 5

Answer: B
Outcomes: EES11/12-5, EES12-15
Explanation:
B is correct: open-pit mining disturbs surface ecosystems and may contaminate groundwater.

- **A** (CO_2 emissions) is more related to fossil fuel use.
- **C** is unrelated.
- **D** has no scientific basis.

Question 6

Answer: A
Outcomes: EES11/12-5, EES12-13
Explanation:
A is correct: vertical displacement of the seafloor at subduction zones can displace large volumes of water, generating tsunamis.

- **B** is incorrect—magnitude alone doesn't determine tsunami generation.
- **C** is false—transform faults can occur under the ocean.
- **D** overstates inevitability; not all subduction events cause tsunamis.

Question 7

Answer: B
Outcomes: EES11/12-6, EES12-13
Explanation:
B is correct: a hazard becomes a disaster when it significantly affects vulnerable populations.

- **A** refers to magnitude, but impact depends on exposure.
- **C** (frequency) affects risk, not disaster status.
- **D** (time of day) may influence outcomes, but isn't the defining factor.

Question 8

Answer: A
Outcomes: EES11/12-5, EES12-14
Explanation:
A is correct: CO_2 dissolves in seawater to form carbonic acid, which lowers pH.

- **B** is incorrect—CO_2 warms oceans, not cools them.
- **C** misunderstands the greenhouse mechanism.
- **D** confuses CO_2 sources.

Question 9

Answer: A
Outcomes: EES11/12-5, EES12-13
Explanation:
A is correct: rhyolitic magma is high in silica, more viscous, and traps gas, building pressure.

- **B** is incorrect—rhyolitic magma is uncommon at divergent boundaries.
- **C** reverses plate settings.
- **D** cooling rate isn't the main factor in explosivity.

Question 10

Answer: C
Outcomes: EES11/12-5, EES12-13
Explanation:
C is correct: subduction zones show a pattern of increasing earthquake depth inland along the descending slab.

- **A**, **B**, and **D** incorrectly represent the geometry or depth pattern of subduction-related seismicity.

Question 11

Answer: B
Outcomes: EES11/12-5, EES12-13
Explanation:
B is correct: East Coast Lows form when warm, moist air from the Tasman Sea interacts with cold, dry air from the south, creating instability and intense low-pressure systems.

- **A** refers to tropical cyclones, not ECLs.
- **C** incorrectly attributes formation to heatwaves.
- **D** misrepresents the cause of pressure changes.

Question 12

Answer: C
Outcomes: EES11/12-5, EES12-14
Explanation:
C is correct: ancient proxies like isotope ratios provide long-term records, while recent evidence (e.g. dendrochronology, instrumental data) offers high-resolution, short-term information.

- **A** reverses the resolution of data types.
- **B** is incorrect—instrumental records are direct, not proxy.
- **D** overstates accuracy without context.

Question 13

Answer: A
Outcomes: EES11/12-5, EES12-14
Explanation:
A is correct: adding oxygen would disrupt the reducing atmosphere required for the abiotic synthesis of organic molecules in the Urey-Miller experiment.

- **B** would provide energy, not inhibit synthesis.
- **C** removes key gases required for reactions.
- **D** removes the energy source entirely, halting the experiment.

Question 14

Answer: D
Outcomes: EES11/12-5, EES12-12
Explanation:
D is correct: the images show the tectonic supercycle stages in order—assembly, stability, breakup, and dispersion.

- **A–C** show incorrect sequencing of stages or misplacement of images.

Question 15

Answer: A
Outcomes: EES11/12-5, EES12-14
Explanation:
A is correct: solar and wind energy have reduced CO_2 in some regions, but global fossil fuel use remains dominant.

- **B** is incorrect—fossil fuel use continues to grow globally.
- **C** falsely claims natural gas has no emissions.
- **D** is factually wrong—coal emits far more CO_2 than renewables.

Question 16

Answer: C
Outcomes: EES11/12-5, EES12-14
Explanation:
C is correct: the graph shows a sharp rise in CO_2 since the Industrial Revolution due to human activities such as burning fossil fuels and deforestation.

- **A**, **B**, and **D** are incorrect or minor contributors compared to human influence.

Question 17

Answer: B
Outcomes: EES11/12-5, EES12-14
Explanation:
B is correct: the natural greenhouse effect regulates Earth's temperature, while the anthropogenic greenhouse effect intensifies warming.

- **A**, **C**, and **D** contain factual inaccuracies or oversimplifications.

Question 18
Answer: A
Outcomes: EES11/12-5, EES12-12
Explanation:
A is correct: the outermost rings on the timber used in the cabin match tree-ring sequences extending into the 1870s, indicating the tree was cut after 1870.
• B is incorrect—the matched rings from the cabin post-date 1870.
• C and D refer to earlier sequences matched through cross-dating but do not include the final growth rings from the cabin timber.
• The principle of cross-dating allows overlapping ring patterns from living and dead trees to establish a continuous and exact timeline.

Question 19

Answer: C
Outcomes: EES11/12-5, EES12-15
Explanation:
C is correct: the case study shows how economic priorities often override cultural heritage protection, as seen in Juukan Gorge.

- **A** is legally and factually incorrect.
- **B** underestimates Indigenous expertise.
- **D** is false—mining operations can be modified.

Question 20

Answer: B
Outcomes: EES11/12-5, EES12-15
Explanation:
B is correct: the Mirarr people contributed cultural knowledge to guide restoration and reintroduce native species at the Ranger Uranium Mine.

- **A** is false—they supported rehabilitation.
- **C** incorrectly implies Indigenous methods replaced all others.
- **D** is untrue—there was no push for more uranium mines.

Section II

Question 21 (3 marks)

Outcome(s): EES11/12-5, EES12-14

Criteria	Marks
• Uses cause-and-effect to clearly link changes in ocean circulation to natural climate variation.	3
• Describes relevant features of changes in ocean circulation.	2
• Provides some relevant information.	1

Suggested Response:

Changes in ocean circulation, such as the slowing of the thermohaline circulation, can affect the transfer of heat between the equator and poles. For example, if warm ocean currents weaken, less heat is transported to higher latitudes, which can lead to cooler temperatures in those regions. These shifts alter atmospheric patterns and can contribute to natural climate variation over decades or centuries.

Question 22 (a) (3 marks)

Outcome(s): EES11/12-5, EES12-12

Criteria	Marks
• Describes how cyanobacteria contributed to changes in the Earth's atmosphere.	3
• Describes relevant features of cyanobacteria.	2
• Provides some relevant information.	1

Suggested Response:

Cyanobacteria were among the first organisms to perform oxygenic photosynthesis, using sunlight to convert carbon dioxide and water into glucose and oxygen. As they released oxygen into the atmosphere, the concentration of atmospheric oxygen gradually increased. This led to the Great Oxidation Event around 2.4 billion years ago, which significantly changed Earth's atmosphere and enabled the evolution of aerobic life.

Question 22 (b) (4 marks)

Outcome(s): EES11/12-5, EES12-12

Criteria	Marks
• Uses cause-and-effect to clearly link the emergence of cyanobacteria to its influence on the evolution of the biosphere. • Refers directly to source.	4
• Describes relevant features of cyanobacteria and the evolution of the biosphere. • Refers to source in indirect/general terms.	3
• Outlines a feature of the biosphere.	2
• Provides some relevant information.	1

Suggested Response:

The emergence of cyanobacteria around 3.5 billion years ago introduced oxygen into the atmosphere through photosynthesis, as shown on the timeline. This oxygen gradually accumulated and led to the Great Oxidation Event at 2.4 bya. The increase in atmospheric oxygen allowed aerobic respiration to evolve, which is more energy-efficient than anaerobic processes. This supported the development of more complex organisms and eventually enabled the evolution of eukaryotes and multicellular life, as shown on the timeline at 2.0 and 1.5 bya. Thus, cyanobacteria played a crucial role in shaping the biosphere by enabling the evolution of oxygen-dependent life.

Question 23 (6 marks)

Outcome(s): EES11/12-5, EES12-13

Criteria	Marks
• Demonstrates an extensive understanding of how different types of geological and meteorological hazards require different strategies for disaster prevention. • Integrates relevant examples.	6
• Demonstrates a thorough understanding of how different types of geological and meteorological hazards require different strategies for disaster prevention. • Integrates a relevant example	5
• Demonstrates a sound understanding of strategies for natural disaster prevention. • Uses a relevant example(s)	4
• Demonstrates some understanding of natural disaster prevention.	2-3
• Provides some relevant information	1

Suggested Response:

Geological and meteorological hazards differ in how they form and how much warning time is available, so different strategies are needed for disaster prevention. Earthquakes, a geological hazard, cannot be reliably predicted, so prevention focuses on preparation strategies like enforcing building codes in earthquake-prone areas (e.g. Japan) and public education. In contrast, meteorological hazards like cyclones can be forecast days in advance, allowing early warning systems and evacuations to reduce harm. For example, cyclone tracking in northern Australia enables communities to prepare and relocate. These differences in predictability and hazard type require distinct approaches to minimise risk and protect lives.

Question 24 (a) (2 marks)

Outcome(s): EES11/12-5, EES12-13

Criteria	Marks
• Outlines the sequence of tectonic events	2
• Provides some relevant information.	1

Suggested Response:

Oceanic crust subducted beneath the Philippine plate, causing gas to rise through fractures in the crust. Pressure built up until it was released in an explosive volcanic eruption.

Question 24 (b) (4 marks)

Outcome(s): EES11/12-5, EES11/12-6, EES11/12-7, EES12-13

Criteria	Marks
• Demonstrates a thorough understanding of the effectiveness of the disaster preparedness and response efforts in mitigating the eruption's impacts. • Makes a judgement statement based on criteria regarding effectiveness of the disaster preparedness and response efforts.	5
• Demonstrates a sound understanding of the effectiveness of the disaster preparedness and response efforts in mitigating the eruption's impacts. • Makes a statement with criterion based on the effectiveness of the disaster preparedness and response efforts.	3-4
• Demonstrates some understanding of effectiveness of the disaster preparedness and response efforts.	2
• Provides some relevant information.	1

Suggested Response:

The disaster preparedness and response efforts for the Mount Pinatubo eruption were highly effective in reducing loss of life and managing impacts. Seismic monitoring and gas emission data allowed PHIVOLCS and USGS to detect early warning signs, and the staged alert system gave residents time to evacuate. Over 58,000 people were safely moved from high-risk zones, and the evacuation of Clark Air Base also prevented major casualties.

Although around 800 people died, this number was significantly lower than expected for an eruption of this magnitude. Long-term engineering controls to manage lahars showed continued response. However, the event highlighted a need for stronger infrastructure, as many fatalities were caused by roof collapses under ash weight — an area where future disaster planning could be improved.

Question 24 (c) (4 marks)

Outcome(s): EES11/12-2, EES11/12-3, EES11/12-6, EES12-13

Criteria	Marks
• Demonstrates a sound understanding of the similarities and/or differences of natural hazard prevention to hazard prevention in laboratory experiments.	4
• Demonstrates some understanding of the similarities and/or differences of natural hazard prevention to hazard prevention in laboratory experiments.	2-3
• Provides some relevant information.	1

Suggested Response:

Both natural hazard prevention and laboratory safety aim to reduce harm by identifying risks and applying controls. In volcano monitoring, equipment like seismometers and gas sensors are used, similar to how thermometers or fume hoods are used in labs. However, natural hazard events are unpredictable and large-scale, while lab hazards are controlled and occur in closed environments.

Question 24 (d) (6 marks)

Outcome(s): EES11/12-5, EES11/12-6, EES11/12-7, EES12-13

Criteria	Marks
• Demonstrates an extensive understanding of how a volcanic eruption can affect multiple Earth systems. • Integrates relevant examples.	6
• Demonstrates a thorough understanding of how volcanic eruptions can affect multiple Earth systems. • Uses relevant examples	4-5
• Demonstrates a sound understanding of how volcanic eruptions can affect Earth systems. • Uses a relevant example	3
• Demonstrates some understanding of the effect of volcanic eruptions.	2
• Provides some relevant information	1

Suggested Response:

The 1991 eruption of Mount Pinatubo had major effects on both the biosphere and the atmosphere. In the **biosphere**, ashfall and pyroclastic flows destroyed vegetation and animal habitats near the volcano. Lahars, intensified by Typhoon Yunya, buried agricultural land, displacing communities and damaging crops. These impacts disrupted local ecosystems and food sources.

In the **atmosphere**, the eruption injected large quantities of ash and sulphur dioxide into the stratosphere, forming an aerosol layer that reflected sunlight. This caused a global temperature drop of around 0.5 °C over the following year. The ash also led to short-term respiratory health issues in affected populations. These examples show how volcanic eruptions impact multiple interconnected Earth systems.

Question 25 (a) (3 marks)

Outcome(s): EES11/12-5, EES12-14

Criteria	Marks
• Uses cause-and-effect to clearly link one way by which changes in climate can lead to rising sea levels.	3
• Describes relevant features of changes in climate and/or rising sea levels.	2
• Provides some relevant information.	1

Suggested Response:

Rising global temperatures due to climate change cause glaciers and polar ice sheets to melt, adding more water to the oceans. This contributes to sea level rise. In addition, thermal expansion occurs as ocean water warms and expands. Both melting ice and thermal expansion are direct results of climate change and lead to a measurable increase in sea levels, as shown in the graph from 1880 to 2020.

Question 25 (b) (3 marks)

Outcome(s): EES11/12-5, EES12-14

Criteria	Marks
• Uses cause-and-effect to clearly link rising sea levels to the range of species.	3
• Describes relevant features of rising sea levels and/or the range of species.	2
• Provides some relevant information.	1

Suggested Response:

Rising sea levels can inundate coastal habitats, reducing the available habitat for species that rely on shorelines, wetlands, or estuaries. As a result, these species may be forced to migrate inland or toward cooler, higher latitudes to find suitable environments. This leads to a shift in their geographical range, as shown in the graph where species have moved poleward as sea levels and temperatures have risen.

Question 26 (a) (3 marks)

Outcome(s): EES11/12-5, EES11/12-6, EES12-15

Criteria	Marks
• Demonstrates a sound understanding of waste reduction initiatives. • Makes a specific judgement statement.	3
• Demonstrates some understanding of waste reduction initiatives. • Makes an implied judgement statement.	2
• Provides some relevant information	1

Suggested Response:

The data shows that the school's initiative significantly reduced landfill waste from 15 kg to 7 kg per week and cut organic waste in half, while increasing recyclables. This suggests the initiative successfully diverted waste from landfill and promoted more sustainable sorting practices. It can be judged as an effective strategy for reducing the school's environmental impact.

Question 26 (b) (4 marks)

Outcome(s): EES11/12-5, EES12-15

Criteria	Marks
• Uses cause-and-effect to clearly link how new data can be used to assess long-term effectiveness.	4
• Describes relevant features of new data and its use in assessing long-term effectiveness.	2-3
• Provides some relevant information.	1

Suggested Response:

New data from future waste audits can be compared with previous results to identify long-term trends in waste reduction. If landfill waste continues to decrease and composting and recycling levels remain high or improve, this indicates that the initiative is having a lasting impact. Consistent or improved results over time show sustained behavioural change and successful implementation, while any decline can highlight areas needing further intervention or education.

Question 27 (4 marks)

Outcome(s): EES11/12-5, EES12-14

Criteria	Marks
• Uses cause-and-effect to clearly link how ice cores are used to reconstruct past climate conditions. • Completes a clearly-sequenced flow chart	4
• Describes relevant features of ice cores and past climate conditions. • Adds to given flow chart	2-3
• Provides some relevant information.	1

Suggested Response:

Bubbles in ice cores hold air samples from past climates

↓

Gases such as CO_2 and CH_4 are measured from the trapped air

↓

Concentrations of greenhouse gases are compared over time

↓

Links are made between gas levels and temperature, revealing past climate changes

Question 28 (6 marks)

Outcome(s): EES11/12-5, EES12-12

Criteria	Marks
• Provides an extensive knowledge and understanding of importance of this fossil for scientific understanding of the development of life on Earth. • Uses explicit data from the table and the image to support argument.	6
• Provides a thorough understanding of importance of this fossil for scientific understanding of the development of life on Earth. • Refers directly to both sources.	4-5
• Provides some understanding of the use of fossils for developments in scientific knowledge. • Refers to source(s) in indirect/general terms.	2-3
• Provides some relevant information	1

Suggested Response:

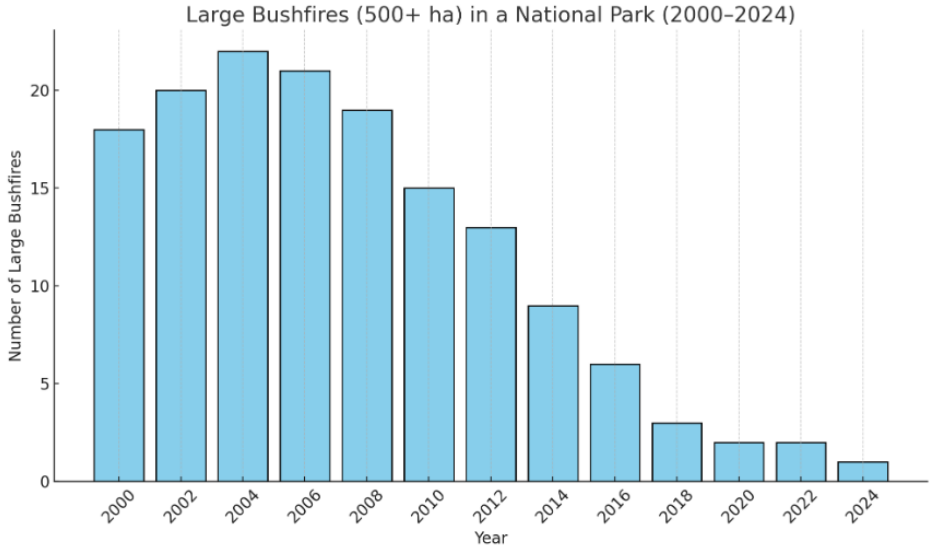
Tiktaalik is significant because it provides evidence of the evolutionary transition from aquatic to land-dwelling animals. According to the table, it was discovered in 2004 and dated to 375 million years ago, placing it between earlier fish and later amphibians like Ichthyostega and Acanthostega. The image highlights that Tiktaalik had features of both fish (fins, scales, jaw) and land vertebrates (flat head, neck, wrists), which helps scientists understand how vertebrates adapted to life on land. Its discovery in the Canadian Arctic fills a key gap in the fossil record and supports models of gradual anatomical change leading to the development of tetrapods. This contributes to the broader understanding of evolutionary processes and the development of life on Earth.

Question 29 (a) (3 marks)

Outcome(s): EES11/12-4, EES11/12-5, EES12-15

Criteria	Marks
• Labels axis. • Scales correctly. • Plots correctly into a column graph.	3
• Provides any TWO of the above. OR • Plots a line (or other style) graph correctly.	2
• Provides at least ONE correct component of the graph.	1

Suggested Response:



Question 29 (b) (2 marks)

Outcome(s): EES11/12-4, EES11/12-5, EES12-15

Criteria	Marks
• Describes the trend in large bushfire frequency before and after the cultural burning program was introduced.	2
• Provides some relevant information.	1

Suggested Response:

Before the cultural burning program began, the number of large bushfires was high but gradually decreasing. After its introduction in 2014, the frequency dropped more rapidly, from 9 in 2014 to 1 by 2024.

Question 29 (c) (5 marks)

Outcome(s): EES11/12-5, EES12-13

Criteria	Marks
• Uses cause-and-effect to clearly link Aboriginal and Torres Strait Islander fire management practices to bushfire hazard reduction. • Uses explicit data from source to support argument.	5
• Links Aboriginal and Torres Strait Islander fire management practices to bushfire hazard reduction. • Refers directly to source.	4
• Describes relevant features of Aboriginal and Torres Strait Islander fire management practices. • Refers to source in indirect/general terms.	2-3
• Provides some relevant information.	1

Suggested Response:

Aboriginal and Torres Strait Islander fire management practices, such as cultural burning, use low-intensity fires during cooler months to reduce fuel loads like dry grass and leaf litter. This reduces the risk of large, high-intensity bushfires. The data shows that before cultural burning was reintroduced in 2014, there were consistently high numbers of large bushfires—between 13 and 22 every two years. After 2014, the number of large bushfires steadily declined, reaching only 1 by 2024. This shows that cultural burning is an effective hazard reduction method, helping to manage the landscape and lower the likelihood and severity of destructive bushfires.

Question 30 (6 marks)

Outcome(s): EES11/12-5, EES12-14

Criteria	Marks
• Demonstrates an extensive knowledge and understanding of one mitigation strategy and one adaptation strategy. • Makes a judgement statement based on criteria regarding reducing the effects of climate change.	6
• Demonstrates a thorough understanding of mitigation strategies and/or adaptation strategies. • Makes a statement with relevant criterion.	4-5
• Demonstrates some understanding of climate mitigation and/or adaptation strategies. • Attempts a basic judgement statement.	2-3
• Provides some relevant information.	1

Suggested Response:

One mitigation strategy is transitioning from coal-fired power to renewable energy sources like solar and wind. This reduces greenhouse gas emissions, which are the primary driver of climate change. Scientific studies, such as those by the IPCC, show that reducing CO_2 emissions slows the rate of climate change and sea level rise. One adaptation strategy is building sea walls to protect coastal areas from rising sea levels and storm surges. For example, the Netherlands has implemented extensive flood defences to protect against climate impacts. While mitigation addresses the cause and reduces long-term impacts, adaptation reduces the damage from existing and future changes. Together, these strategies are most effective when used in combination.

Question 31 (8 marks)

Outcome(s): EES11/12-5, EES12-12, EES12-13, EES12-14, EES12-15

Criteria	Marks
• Demonstrates an extensive knowledge and understanding of the impacts of human understanding and application of Earth and Environmental Science influences the long-term functioning of Earth's systems • Makes an informed judgement statement. • Integrates relevant examples from at least TWO modules.	8
• Demonstrates a thorough understanding of the impacts of human understanding and/or application of Earth and Environmental Science influences the functioning of Earth's systems. • Makes an informed judgement statement. • Integrates relevant examples from the modules.	6-7
• Demonstrates a sound understanding of an impact of human understanding and application of Earth and Environmental Science on Earth's systems. • Makes a statement with appropriate criterion. • Identifies relevant examples.	4-5
• Demonstrates some understanding of Earth's systems.	2-3
• Provides some relevant information.	1

Suggested Response:

Human understanding and application of Earth and Environmental Science has a significant influence on the long-term functioning of Earth's systems.

In **Module 6 – Hazards**, improved scientific understanding of plate tectonics and subduction zones has enabled the development of early warning systems for tsunamis in countries like Japan, reducing the loss of life and enabling more resilient infrastructure planning.

In **Module 8 – Resource Management**, knowledge of non-renewable resource impacts has led to practices such as environmental impact assessments and mine site rehabilitation to reduce land degradation and ecosystem disruption. These examples show that while human activity can negatively impact Earth's systems, scientific understanding allows us to monitor, mitigate, and manage these impacts.

Therefore, the long-term functioning of Earth's systems depends heavily on how effectively this understanding is applied.

Responses could also include:

Module 5 – Earth's Processes • Understanding of plate tectonics enables hazard zoning and land use planning. • Knowledge of rock and mineral formation informs sustainable mining practices. • Monitoring volcanic gases and ground deformation helps predict eruptions. Module 6 – Hazards • Seismic hazard mapping and building codes reduce earthquake impacts. • Remote sensing and satellite data improve bushfire and cyclone response. • Knowledge of hazard frequency and magnitude supports disaster planning.	Module 7 – Climate Science • Ice core and palaeoclimate data help identify past climate variation. • Climate modelling informs international mitigation policies (e.g. Paris Agreement). • Understanding of carbon sinks (e.g. forests, oceans) supports conservation efforts. Module 8 – Resource Management • Scientific methods guide water recycling and salinity control. • Cultural burning and traditional knowledge reduce bushfire risk. • Lifecycle analysis supports the shift from non-renewable to renewable resources.