ABBOTSLEIGH

2
Centre Number

Student Number

2021 | HIGHER SCHOOL CERTIFICATE **TRIAL EXAMINATION**

# Earth and Environmental Science

**General Instruction**

- Reading time – 5minutes Working time – 3
- hours Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- A geologic timescale is on the back of your multiple choice answer sheet

**Total marks: 100**

**Section I – 20 marks** (pages 2–13)

- Multiple Choice questions
- Attempt Questions 1–20
- Allow about 35 minutes for this part

**Section II – 80 marks** (pages 14-35)

- Longer Response questions
- Attempt Questions 21–34
- Allow about 2 hours and 25 minutes for this part

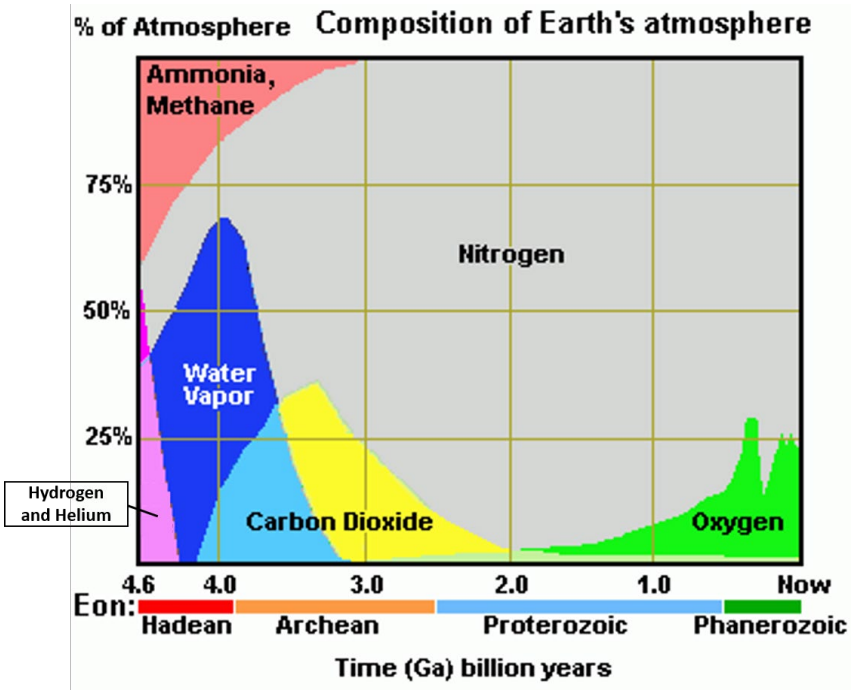
**Section I**
**(20 marks)**

**Attempt Questions 1–20**
**Allow about 35 minutes for this part**

Use the multiple-choice answer sheet for Questions 1–20.

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**1** The following image shows the gas composition of the atmosphere throughout Geologic time.




Identify THREE gases that were present at the formation of the Earth.

A. Oxygen, nitrogen and ammonia.

B. Water vapour, methane and ammonia.

C. Carbon dioxide, hydrogen and methane.

D. Water vapour, carbon dioxide and oxygen.

**2** Which of the following accounts for the addition and increase of oxygen in the atmosphere from 3.0 billion years ago

A. Cyanobacteria.

B. Volcanic outgassing.

C. Respiration of Archaea.

D. The formation of Banded Iron Formations.

**3** Chemoautotrophs are a species of bacteria that live near black smokers. They perform a reaction known as chemosynthesis; a process where they make their own food from reactive chemicals produced by the volcanic vents. The word equation for the reaction is written below:

Carbon dioxide + water + hydrogen sulfide → sugar + sulfur + sulfuric acid

What is the significance of this in developing theories for the origin of life?

A. Volcanic gases are toxic to all life.

B. Life must have originated in the oceans.

C. Life can exist without the presence of sunlight.

D. Chemoautotrophs can only exist around black smokers.

**4** A geologist dated rock strata to be 580 million years old. Any fossils found in this rock are most likely to be:

A. Vertebrate teeth

B. Vertebrate bones

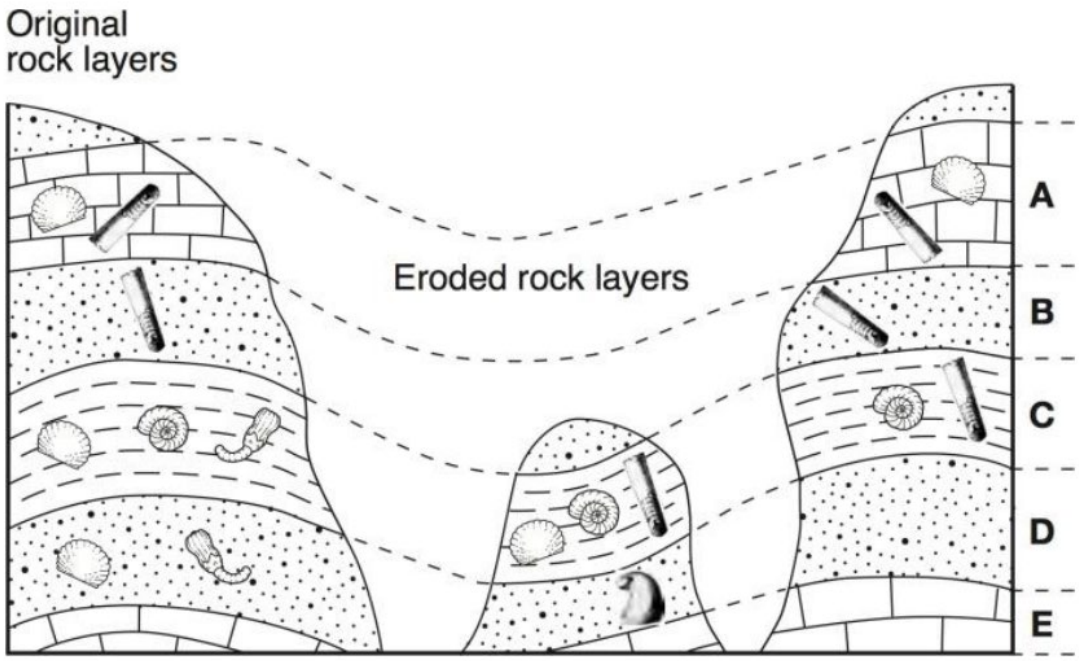
C. Invertebrate shells

D. Soft-bodied metazoans

**5** Which row in the table correctly matches the explosivity of a volcano with its lava chemical composition and boundary type?

| | ***Explosivity*** | ***Chemical composition of lava*** | ***Boundary Type*** |
|---|---|---|---|
| A. | Effusive | Low in silica, high in Fe and Mg | Divergent |
| B. | Explosive | High in silica, low in Fe and Mg | Divergent |
| C. | Effusive | High in silica, low in Fe and Mg | Convergent |
| D. | Explosive | Low in silica, high in Fe and Mg | Convergent |

**6** The diagram below represents three bedrock outcrops. The layers have not been overturned. Letters A through E identify different rock layers and fossils found in the layers.




Which fossils could be classified as an index fossil?

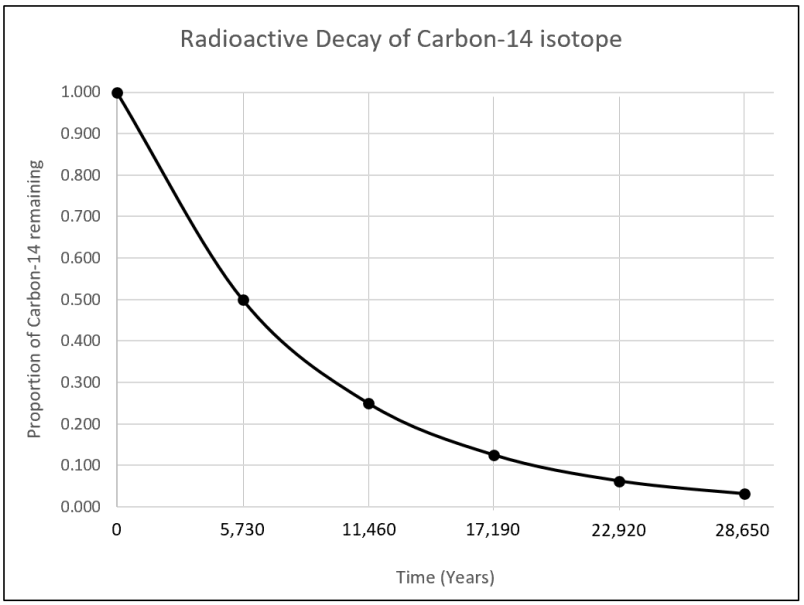
A. 

B. 

C. 

D. 

**7** The '*half-life*' of a substance is the time it takes for half the original radioactive particles to decay to the daughter isotope. The half-life decay of Carbon-14 is 5,730 years and is illustrated in the graph below:




After THREE half lives, what percentage of Carbon-14 remains?

A. 3%

B. 12.5%

C. 25%

D. 50%

**8** When Mount Pinatubo erupted in 1991, global temperatures dropped by 0.5$^{o}$C the following year.

Which of the following gases are most likely to be responsible for this drop in temperature?

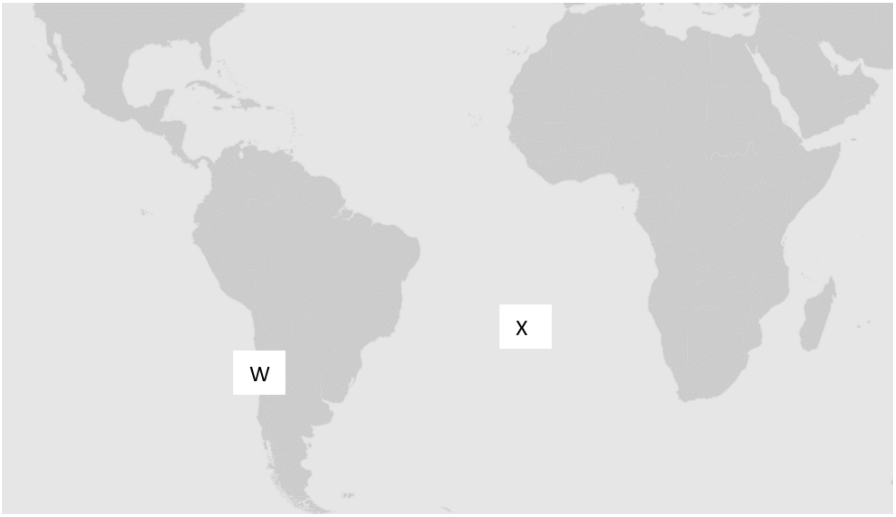
A. Ozone gas

B. Carbon dioxide

C. Sulphur dioxide

D. Chlorofluorocarbons

**9** The following diagram shows the locations of TWO volcanic regions of the Earth.




Which of the following options is correct regarding the chemistry of the magma and volcanic exlosivity associated with each volcanic region

| | **Volcano W** | **Volcano X** |
|---|---|---|
| A. | Mafic and explosive | Felsic and explosive |
| B. | Mafic and effusive | Felsic and explosive |
| C. | Felsic and explosive | Mafic and effusive |
| D. | Felsic and effusive | Mafic and effusive |

**10** Which of the following would be **most** likely to present a hazard to people living on a transform boundary?

A. A sinkhole

B. A tsunami

C. An earthquake

D. A volcanic eruption

**11** Consider the volcanic eruption data in the table below.

| VEI | Volume of Eruption Tephra ($km^3$) | Eruption Column Height (km) | Eruption Type |
|---|---|---|---|
| 1 | 0.0001 | <0.1 | Strombolian / Hawaiian |
| 2 | 0.001 | 0.1-1 | |
| 3 | 0.01 | 1-5 | Vulcanian |
| 4 | 0.1 | 3-15 | |
| 5 | 1 | 10-25 | Plinian |
| 6 | 10 | >25 | |
| 7 | 100 | | Ultra- Plinian |
| 8 | 1000 | | |

A volcanic eruption with a volume of eruption tephra of $2km^3$ and an eruption column height of 8 km would be classified as which eruption type?

A. Stombolian

B. Vulcanian

C. Plinian

D. Ultra-Plinian

**12** Geological hazards are caused by which processes?

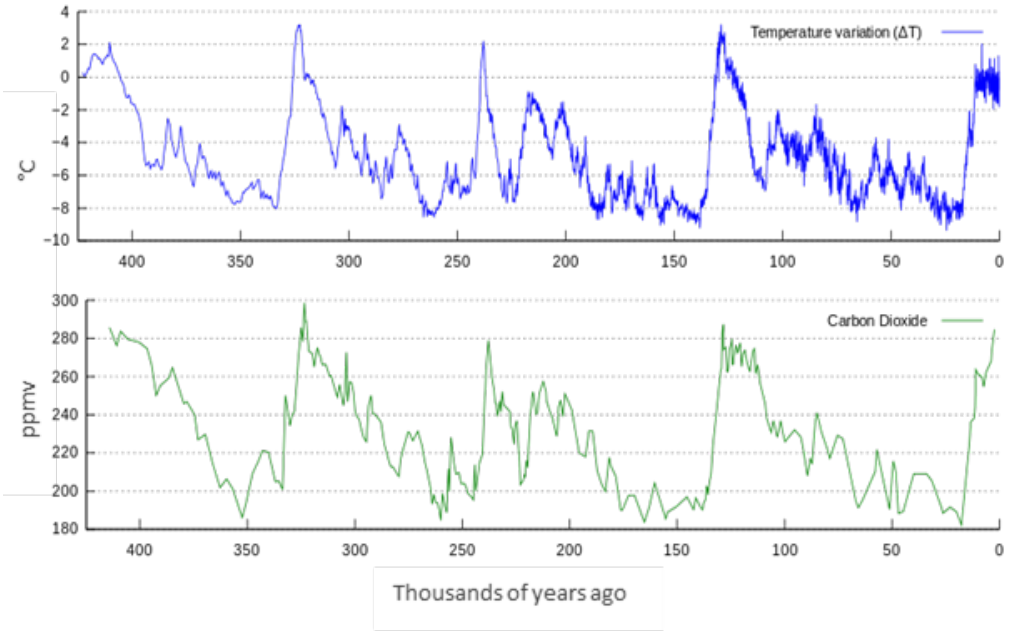
A. Climate processes

B. Coastal processes

C. Atmospheric processes

D. Land and tectonic processes

**13** The graphs show carbon dioxide levels and temperature measured in Antarctic ice cores




Which of the following inferences could be made based on the presented data?

A. Carbon dioxide is the only cause of variations in temperature anomaly.

B. The rapid warming in the past few decades is due to human influences.

C. There is a direct correlation between carbon dioxide levels and temperature variation.

D. There is no obvious relationship between carbon dioxide levels and global temperature.

In 2019 scientists published climate change projections for an Australian city. The table below shows the temperature projections for TWO possible sets of future greenhouse gas emissions into the atmosphere *medium emissions* and *high emissions*. For each of the years 2030, 2050 and 2090, the median temperature rise is given, with the likely temperature rise range in brackets.

| **Average daily maximum temperature, 1986–2005** | **Greenhouse gas emissions scenario** | **Projected changes (°C)** | | |
|---|---|---|---|---|
| | | **2030** | **2050** | **2090** |
| 20.4 °C | medium | 0.9 (0.8–1.3) | 1.6 (1.0–2.0) | 2.2 (1.8–3.4) |
| | high | 1.2 (1.0–1.6) | 1.9 (1.5–2.7) | 4.0 (2.8–5.3) |

Data: JM Clarke, M Grose, M Thatcher, V Round and C Heady, 'Greater Melbourne Climate Projections 2019', CSIRO, Melbourne, Australia, 2019, <https://publications.csiro.au/rpr/pub?pid=csiro:EP195032>

**14** The baseline for temperature projections is the average daily maximum temperature between 1986 and 2005, rather than the previous year's average daily maximum temperature.

This is because…

A. Earth's albedo is rising.

B. Climate varies from year to year.

C. Greenhouse gases are increasing in the atmosphere.

D. The previous year's average daily maximum temperature is likely to be higher than the 1986 to 2005 average.

**15** Increased $CO_2$ levels in the atmosphere has led to ocean acidification.

Why is ocean acidification a problem for marine organisms?

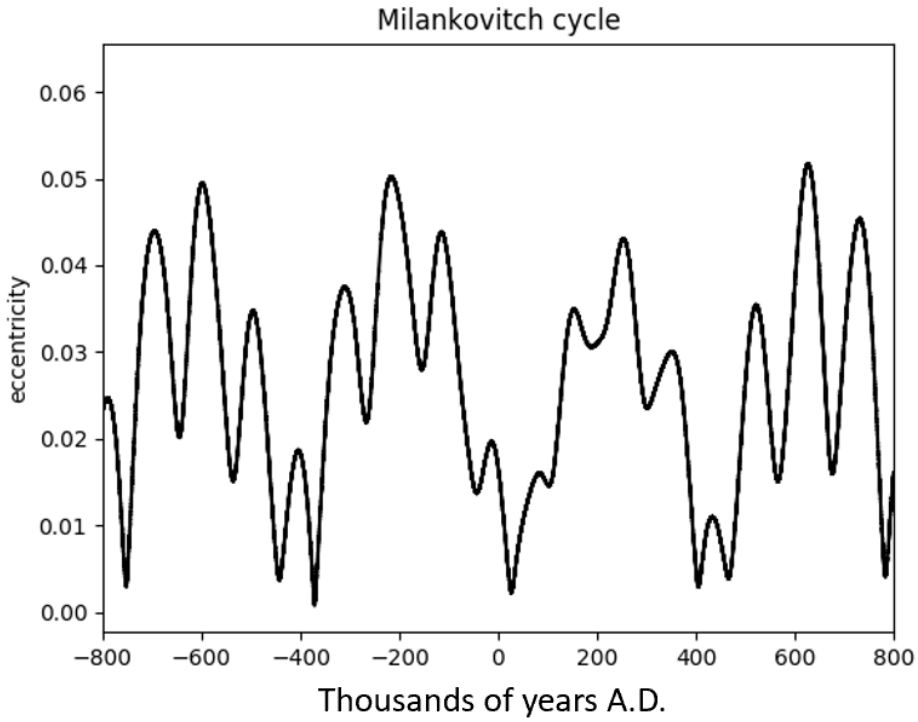
A. Dissolved $CO_2$ is toxic for marine species.

B. Acidic oceans lead to higher predator populations.

C. Coral bleaching is caused by the increased acidity of the water.

D. Carbonic acid reduces the carbonate ions available for shell production.

**16** The Milankovitch Cycles describe the variations in the orbit of the Earth around the Sun. The stages of the cycle can contribute to natural changes to the climate.




According to this data, how long is a single Milankovitch eccentricity cycle?

A. 400 years

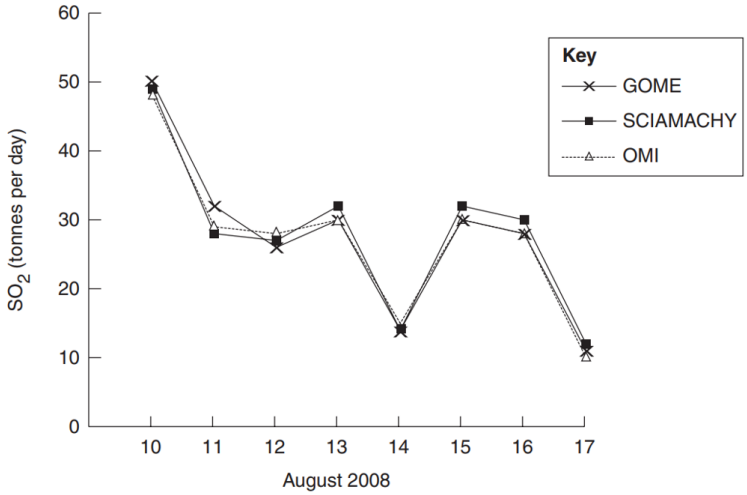
B. 800 years

C. 200, 000 years

D. 400,000 years

The graph below shows the daily emissions of $SO_2$ (Sulphur dioxide) directly above the Kasatochi volcano in the period 10-17 August 2008 as measured by:

- GOME (Global Ozone Experiment – on board the European Remote Sensing Satellite)
- SCIAMACHY (an imaging spectrometer operated by European Space Agency)
- OMI (the Ozone Monitoring Instrument – jointly operated by the UK Meteorological Office and the national Centre for Environmental Prediction)




**17** The readings found here suggest that the results are:

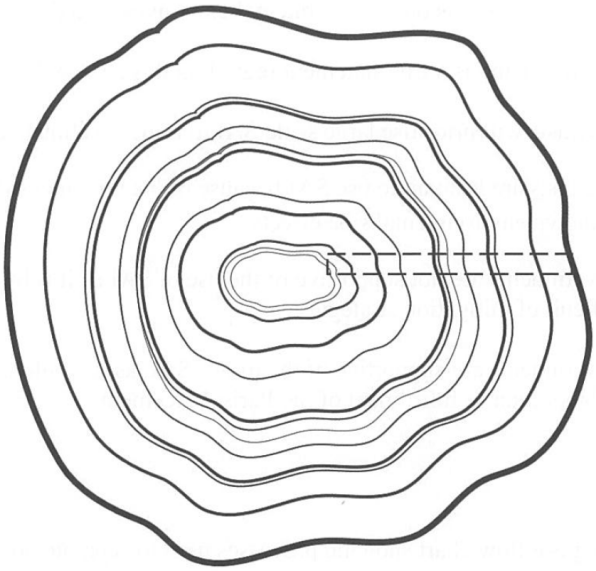
A. Accurate but not reliable.

B. Reliable but not accurate.

C. Both accurate and reliable.

D. Neither accurate nor reliable.

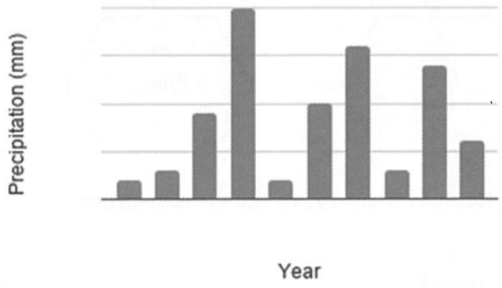
**18** The diagram below shows the internal rings of a tree.



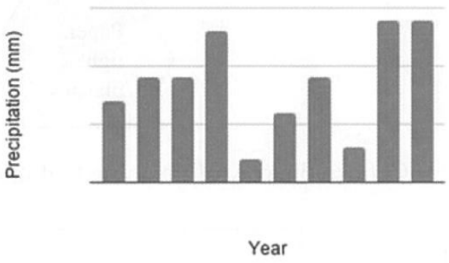
A core, shown by a dotted line, was extracted to analyse the rainfall levels over several years.

Which graph below best represents the rainfall levels in the time represented by the tree core.

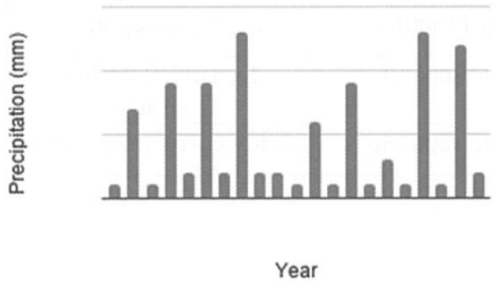
(A)



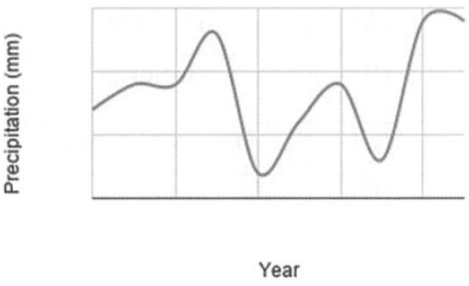

(B)




(C)




(D)



**Use the table below to answer questions 19 and 20.**

The table shows the trends in household waste between 2016 – 2019.

Household waste by waste material

| | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|
| Masonry materials | 0.3 | 0.3 | 0.3 |
| Metals | 1.1 | 1.2 | 1.1 |
| Organics | 6.2 | 6.5 | 6.4 |
| Paper & Cardboard | 2.0 | 2.2 | 2.2 |
| Plastics | 1.2 | 1.1 | 1.2 |
| Glass | 0.8 | 0.9 | 0.8 |
| Textiles, leather & rubber (a) | 0.2 | 0.3 | 0.3 |

a. Textiles, leather and rubber excludes tyres.

**19** Identify the waste type that contributes most to household waste.

A. Organics

B. Masonry materials

C. Paper and cardboard

D. Textiles, leather and rubber

**20** Which household waste type has seen an increase over the whole time period?

A. Glass

B. Metals

C. Masonry

D. Paper and cardboard

**End of Section I**

**2**

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|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

Student Number

# Earth and Environmental Science

## Section II Answer Booklet

**80 marks**
**Attempt Questions 21–34**
**Allow about 2 hour and 25 minutes for this part**

**Instruction**

- Write your Student Number at the top of this page.
- Answer the questions in the spaces provided on your answer booklet. These spaces provide guidance for the expected length of response.
- Show all relevant working in questions involving calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are

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**Question 21** (6 marks)

The plate Tectonic Supercycle describes the breakup and reformation of supercontinents throughout Earth's history.

The following diagram represents the break-up of Gondwana over the past 200 million years.




(a) Draw a typical type of plate boundary that would have caused the separation of Australia and Antarctica **3**

(b) Identify the source of the heat that drives the convection currents in the plate tectonic model **1**

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**Question 21 continues on the next page**



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(c) Outline the effect that the plate tectonic supercycle has on the evolution of life. **2**

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**Question 22** (3 marks)

Draw a flow diagram to illustrate the formation of a mould fossil. **3**

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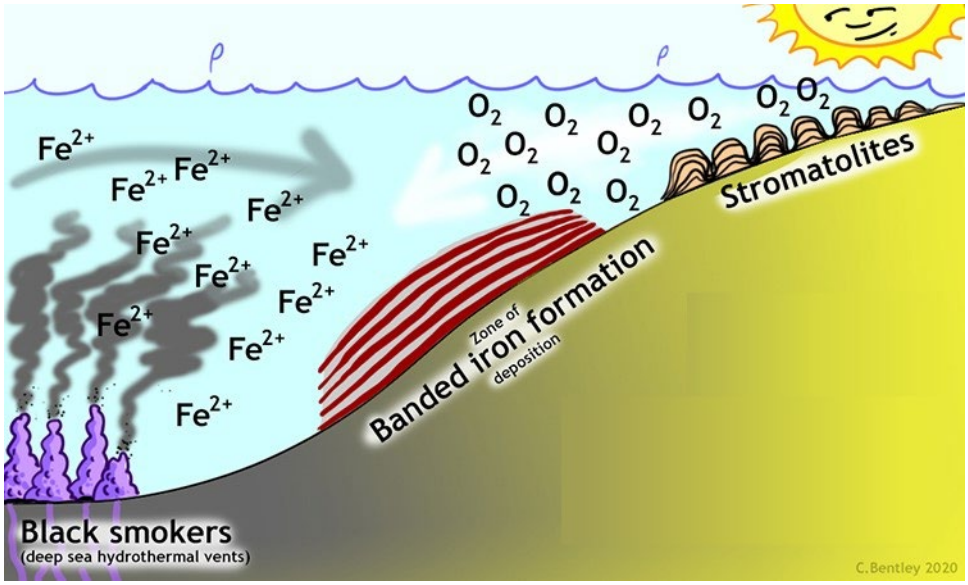
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**Question 23** (3 marks)

Oxygen has played an important part in the formation of Earth as we know it.




With reference to the diagram outline the processes involved in the formation of Banded Iron Formations. **3**

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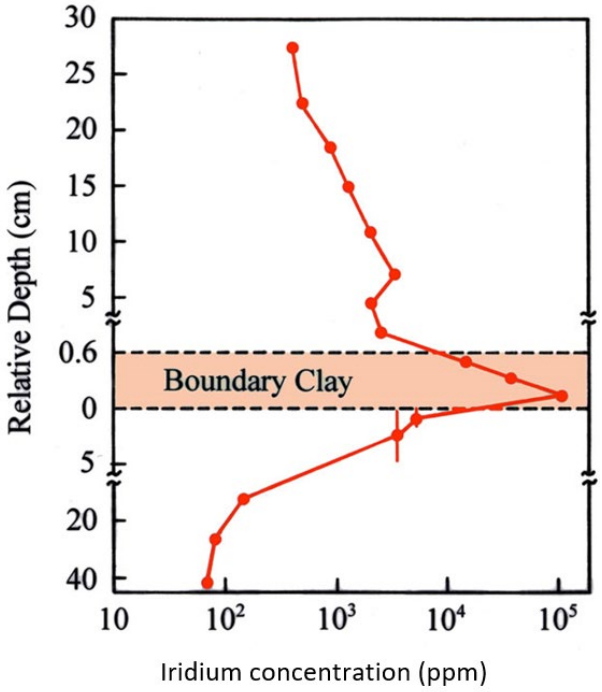


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**Question 24** (4 marks)

Below is a graph which represents the changing concentration of *iridium* in a section of rock strata. Iridium is rare in Earth's surface materials, but abundant in comets. The material above the *Boundary Clay* belongs to the Tertiary Period whilst material below corresponds to the Cretaceous Period.




**4**

Using the data above and one other piece of evidence, discuss a hypothesis for the End Cretaceous extinction event.

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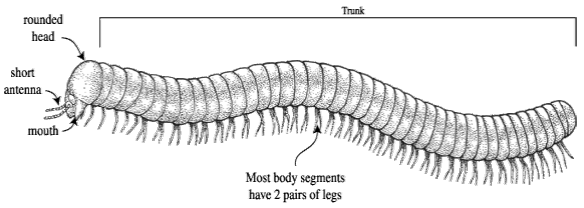
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**Question 25** (5 marks)

Many consider invertebrates to be the first animal species to have conquered terrestrial environments. Pictured below is an image of a fossil of the millipede *Zanclodesmus willetti (Z. willetti)* believed to be from the Silurian Period alongside a generalised diagram of a millipede.



Fossilised *Z. willetti*




Generalised diagram of millipede

Discuss in detail, the adaptations *Z. willetti* must have had to successfully colonise terrestrial environments. **5**

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**Question 26** (5 marks)

*"There are reports that wild animals leave their sleeping and nesting places immediately before strong (earth)quakes and that pets become restless"*
– (Max Planck Institute of Animal Behaviour, www.mpg.de)

Evaluate the effectiveness of anomalous animal behaviour and ONE other named technology in predicting earthquakes **5**

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**Question 27** (8 marks)

Evaluate the physical impact of bushfires on Australian ecosystems AND outline how human activities may contribute to the frequency and magnitude of bushfires. **8**

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**Question 28** (6 marks)

Volcanic eruptions produce different hazards, depending on the tectonic setting and nature of the eruption. People living near volcanic regions can be at high risk during volcanic eruptions.

(a) Complete the following table outlining the hazards associated with volcanoes **4**

| Hazard | Description of hazard | Impact on the Biosphere and/or atmosphere |
|---|---|---|
| **Ash eruptions** | | |
| **Lava flows** | | |

(b) Discuss the point at which a geological hazard becomes a disaster **2**

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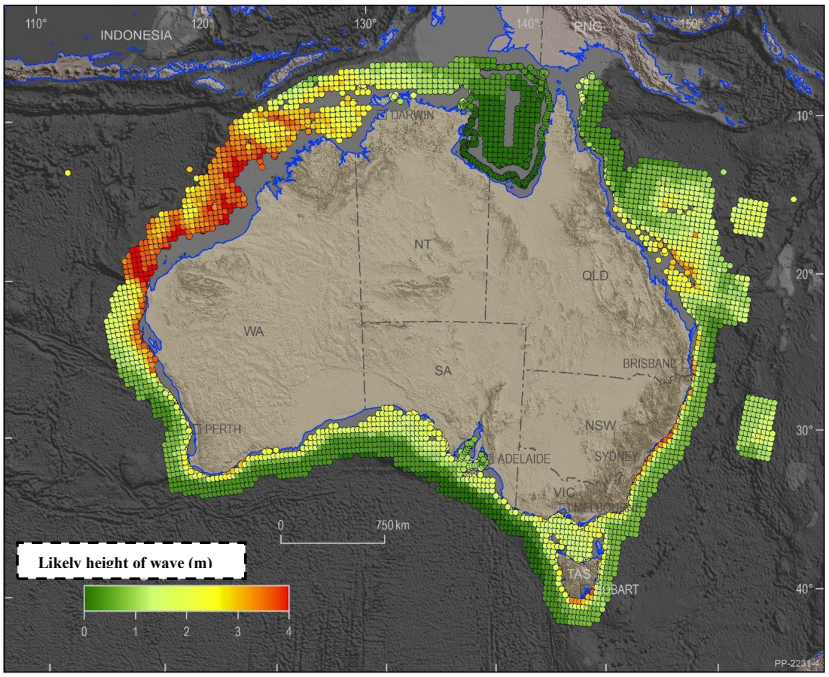
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**Question 29** (6 marks)

The diagram shows tsunami risk for the Australian coastline. The map indicates the likely height of a one-in-1000-year wave.




With reference to the above tsunami model, assess the role of modelling as a tool to help society understand natural and human-induced scientific processes.

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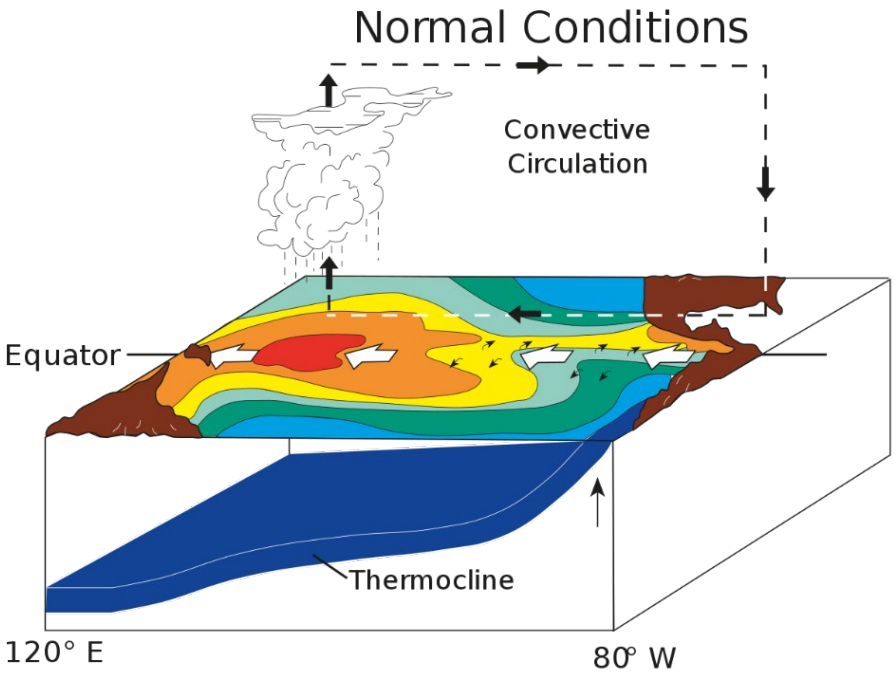


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**Question 30** (3 marks)

The diagram is a cross-section of the El Nino Southern Oscillation (ENSO)




**3**

In reference to ENSO, explain the cause of flood events in Australia.

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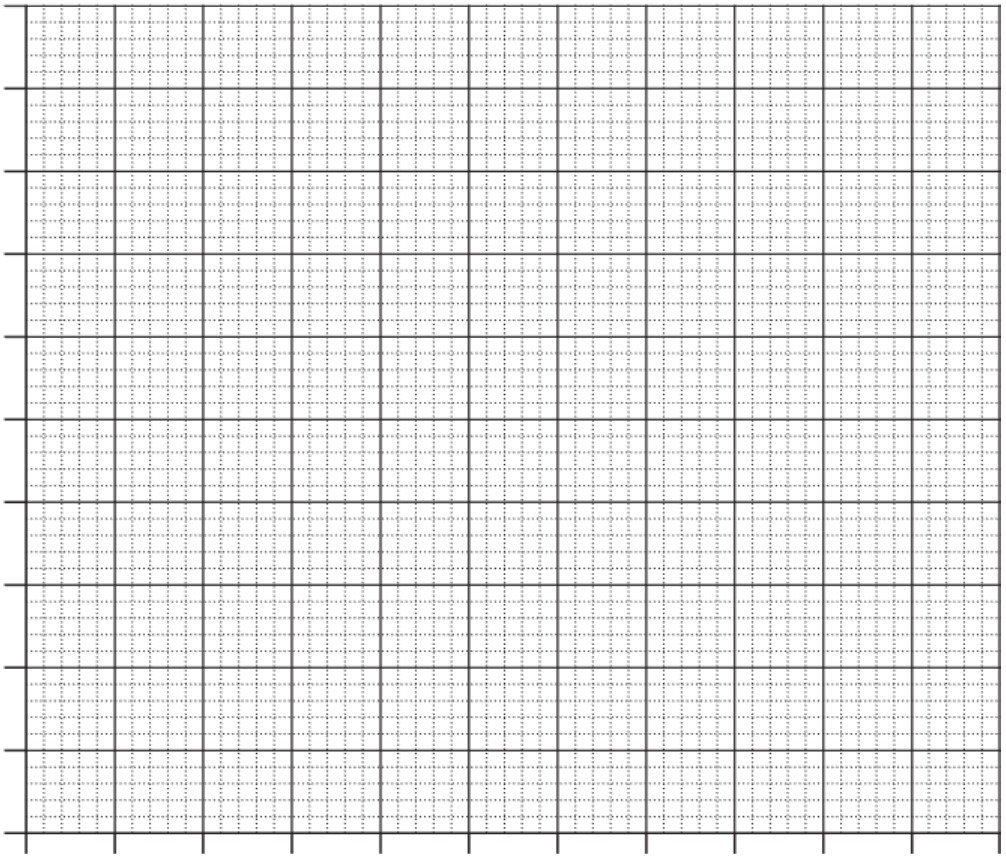
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**Question 31** (7 marks)

The following data shows the changes in the Antarctic ice shelf cover in millions of kilometres.

| Year | Millions of $km^2$ |
|---|---|
| 1996 | 6.9 |
| 1998 | 6.5 |
| 2000 | 7.4 |
| 2002 | 6.0 |
| 2004 | 5.8 |
| 2006 | 5.7 |
| 2008 | 4.6 |
| 2010 | 5.0 |
| 2012 | 4.2 |
| 2014 | 4.8 |
| 2016 | 4.5 |
| 2018 | 3.0 |

(a) Graph the data below and include a line of best fit. **4**



**Question 31 continues on the next page**



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(b) Explain the effects that changes in the cryosphere, such as the decrease in the Antarctic Ice shelf, have on climate change. **3**

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**Question 32** (10 marks)

A student wanted to perform an investigation with the aim to determine the mass composition of general waste at her school over the course of a year. Her school had no recycling or food scrap bins and all rubbish produced is categorised as "general waste".

(a) Complete a risk assessment for this investigation. **2**

| **Hazard** | **Precaution** |
|---|---|
| | |
| | |
| | |

(b) Write a valid method for this investigation. **4**

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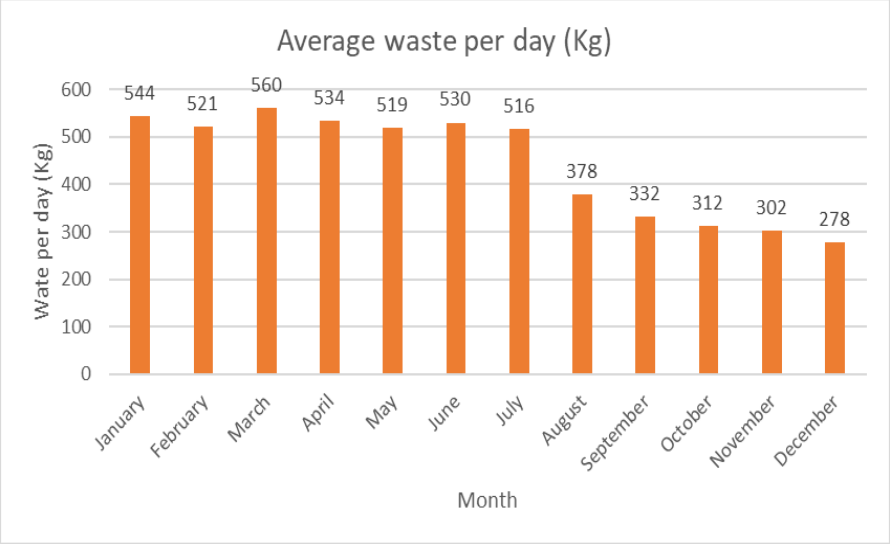
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(c) The following graph shows the average general waste produced per day in the school.




during the students investigation they discussed sustainable waste management strategies with the school principal. After these strategies were put in place, the student noticed a change in the mass of general waste produced.

i) Identify when the strategies are likely to have been put in place. **1**

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ii) Identify a possible waste management strategy that might have been made by the student AND explain how this would have led to the observed results. **3**

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**Question 33** (4 marks)

Compare ONE example of ancient climate evidence and ONE example of more recent climate evidence.

| **Ancient Climate evidence** | **Recent Climate evidence** |
|---|---|
| | |

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**Question 34** (10 marks)

The ocean and aquatic environments have been significantly impacted by anthropogenic climate change.

(a) Distinguish between the natural greenhouse effect and the anthropogenic greenhouse effect. Include a diagram of the greenhouse effect in your answer. **4**

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**Question 34 continues on the next page**



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(b) Explain how human activities have caused ocean acidification. **3**

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(c) Describe the current and future impact of ocean acidification on a particular ocean ecosystem. **3**

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