SYDNEY GRAMMAR SCHOOL

TRIAL EXAMINATION 2024

EARTH AND ENVIRONMENTAL SCIENCE

Candidate No:

General Instructions

- Working Time: 3 hours
- Reading Time: 5 minutes
- Write using black pen
- Draw tables, graphs and diagrams in pencil

Structure of Paper & Instructions

- Section 1 (20 marks).
  Spend 30 minutes on this section.
- Section 2 (80 marks).
  Spend 2 hours and 30 minutes on this section.

Total marks: 100

Monday 19 August

8:40am

Checklist

Each boy should have the following:

☐ 1 Question paper – Geological timescale may be removed

☐ 1 Multiple choice sheet

FEM Lee



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Section 1: Multiple-Choice

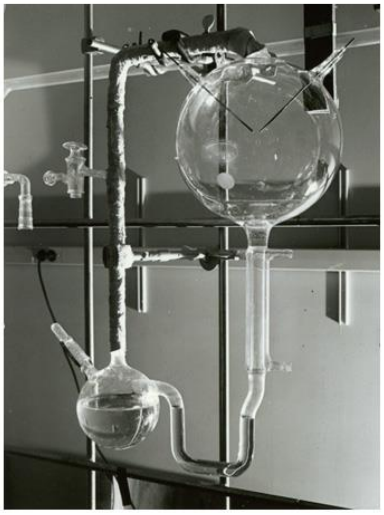
20 marks
Attempt Questions 1–20 using the multiple-choice answer sheet.
Allow about 30 minutes for this section.

1. A rock unit is described as Ordovician in age.

   Which of the following statements can be said with certainty regarding this rock unit?

   (A) The rock unit is 470 million years old.
   (B) The rock unit must be sandstone.
   (C) The rock unit is younger than the Cambrian.
   (D) The rock unit can only be dated using the Law of Superposition.

2. The photograph below shows the Urey-Miller experiment.



   What is the significance of the Urey-Miller experiment in understanding how today's biosphere originated?

   (A) It argued that life originated in space and was brought to Earth by comets and meteorites.
   (B) It proved that the first prokaryotic cells formed directly from inorganic compounds because of early ocean conditions, anoxic atmosphere and presence of lightning.

(C) It simulated prebiotic terrestrial conditions and suggested that amino acids, the building blocks of proteins, can be synthesised using simple inorganic molecules.
(D) The creation of organic molecules occurred by recreating conditions around hydrothermal vents deep in the oceans, where hot gases and elements come from cracks in Earth's crust.

3. Which set of conditions is essential for Banded-Iron Formations to start forming?

(A)	Archaea	Oxygen gas in oceans	Dissolved iron in oceans
(B)	Archaea	Oxygen gas in atmosphere	Dissolved iron in oceans
(C)	Cyanobacteria	Oxygen gas in atmosphere	Undissolved iron in oceans
(D)	Cyanobacteria	Oxygen gas in oceans	Dissolved iron in oceans

4. A fossil is formed when an organism dies and decomposes, leaving an impression of its body shape in the ground. Minerals then fill in the space to form a 3-dimensional copy of the original organism. What type of fossil is this?

(A) Body
(B) Cast
(C) Mould
(D) Trace

5. Which of the following would provide scientists with fossil record evidence of a mass extinction event?

(A) A slow, gradual decrease in diversity of species over millions of years.
(B) A disappearance of a single species is observed but only from one continent.
(C) Fossils that are globally abundant in earlier rock layers are no longer present in later rock layers.
(D) An unusually high concentration of a rare metal like iridium as evidence for an extraterrestrial impact event.

6. The sudden appearance of life on Earth in the Cambrian Event is most likely due to the:

(A) transport of extraterrestrial life forms to Earth by comet or meteorite.
(B) evolution of hard-bodied organisms with greater chances of fossilisation.
(C) the slowing movements of plate tectonics that prevented the destruction of fossils during the Cambrian period.
(D) changing atmospheric conditions from oxygen-poor to oxygen-rich due to the depletion of dissolved iron in oceans.

7. The fossil below shows an early vascular land plant called *Cooksonia*.



Cooksonia is similar to modern flowering plants because it:

(A) has branching roots to absorb water.
(B) produces seeds for sexual fertilisation.
(C) carries out photosynthesis in its leaves.
(D) contains specialised cells to transport water.

8. Krakatoa was a volcanic mountain located in Indonesia that erupted in 1883 killing 36,000 people on a nearby island. The most likely cause of death would have been from:

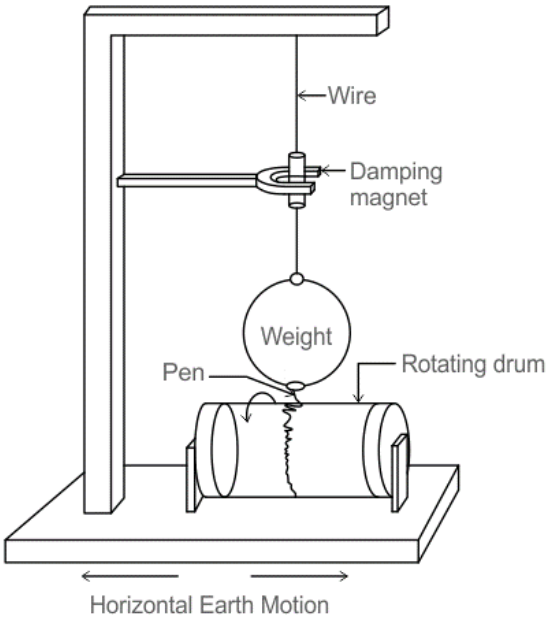
(A) a tsunami.
(B) lava flows from the eruption.
(C) shock waves from the eruption.
(D) asphyxiation from the ash cloud.

9. Many active volcanoes are monitored intensively to assess risk to nearby settlements.

Which of the following could best indicate that a volcano is about to erupt?

(A) Unusually heavy rainfall over the volcano.
(B) A low ratio of oxygen-18 to oxygen-16 isotopes in nearby lakes.
(C) An increased number of shallow earthquakes centred beneath the volcano.
(D) The sudden disappearance of migratory birds from the area around the volcano.

10. The scientific apparatus below is best used to measure which of the following?:



(A) Changes in the Earth's orbit around the Sun.
(B) Concentrations of radon gas beneath the Earth's surface.
(C) The energy of shockwaves produced by movements within the crust.
(D) The distance between two locations before and after a seismic event.

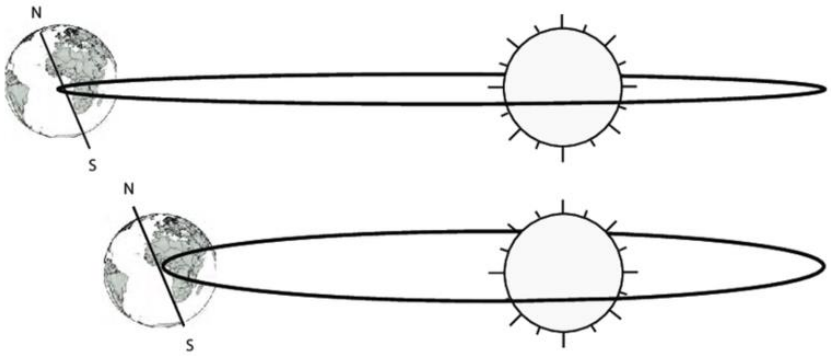
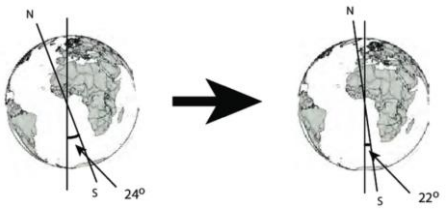
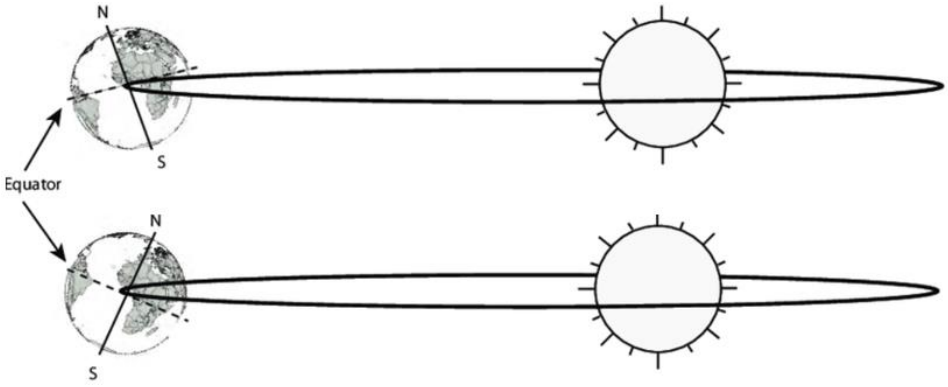
11. Land clearing can reduce the frequency and magnitude of:

(A) floods
(B) droughts
(C) bushfires
(D) landslides

12. Which example provides the most recent evidence of climate variation?

(A) Ocean acidification
(B) Aboriginal rock art
(C) Pollen grains in sedimentary rocks
(D) Isotopes ratios in stalagmites

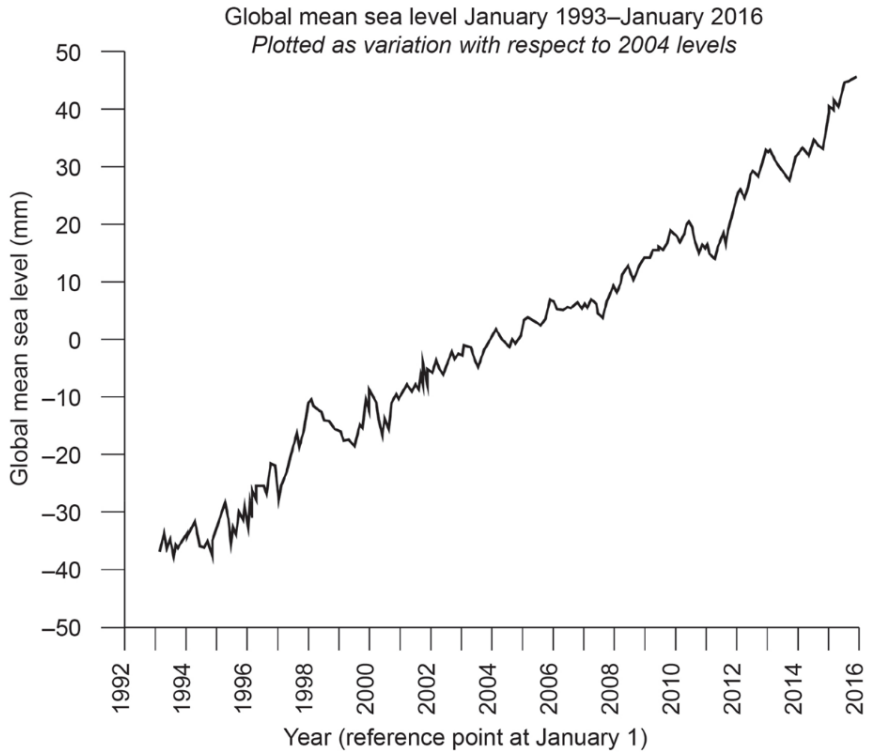
13. Observe the models below representing the Milankovitch cycles.

X	
Y	
Z	

Which row below best identifies the three components of Milankovitch's cycles?

	X	*Y*	*Z*
(A)	Eccentricity	Obliquity/Tilt	Precession
(B)	Eccentricity	Precession	Obliquity/Tilt
(C)	Precession	Eccentricity	Obliquity/Tilt
(D)	Precession	Obliquity/Tilt	Eccentricity

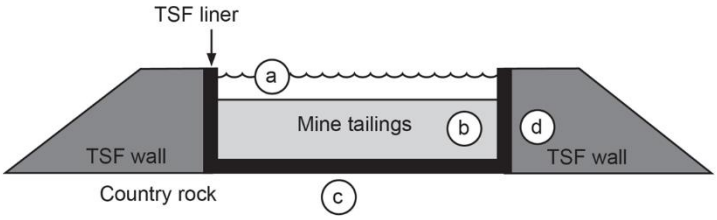
14. The graph below shows global mean sea levels measured by satellite observation between 1993 and 2016.



Which of the following statements is correct, using only the data displayed in this graph?

(A) Sea level has risen every year since 2010.
(B) Sea level in January 1999 was lower than it had been in January 1998.
(C) Global mean sea level is at the highest point it has ever been in Earth's geological history.
(D) Sea level has risen and fallen over the observed period but has remained unchanged overall.

15. The diagram below shows a cross-section through a tailings storage facility (TSF) constructed to contain mine waste and prevent it from contaminating the local water table. The letters a-d show locations around the TSF.



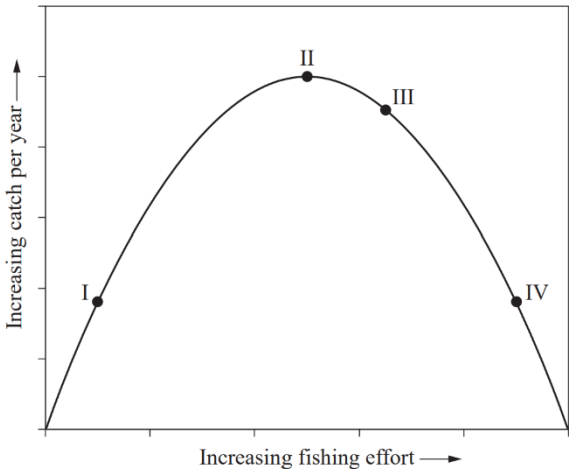
Which would be the best location in the diagram from which to collect a sample to test for leakage of the TSF?

(A) Within the wastewater.
(B) From the mine tailings.
(C) In the rock beneath the TSF.
(D) Within the impervious walls of the TSF.

16. Which of the following definitions best describes overharvesting?

(A) Removing species from the wild at rates that cannot be replaced.
(B) A resource is able to be maintained at the current rate or level.
(C) Meeting the needs of the present without compromising the ability of future generations to meet theirs.
(D) A business or country using resources efficiently and responsibly to produce a financial profit long-term.

17. The graph below shows a yield curve for fishing.



At which point in the graph, is sustainable harvesting best achieved by Aboriginal and Torres Strait Islander peoples' practices?

(A) I
(B) II
(C) III
(D) IV

Use the following information to complete questions 18 and 19.

A controlled experiment was conducted to compare the energy output of wind turbines using four different blade shapes, measured in kilowatts per hour (kW/h). The results are as follows:

Blade shape	*Trial 1 (kW/h)*	*Trial 2 (kW/h)*	*Trial 3 (kW/h)*	*Average (kW/h)*
L	68	79	131	93
M	298	293	156	249
N	271	204	337	270
O	137	179	155	157

18. Which blade shape produced the most reliable supply of energy?

(A) L
(B) M
(C) N
(D) O

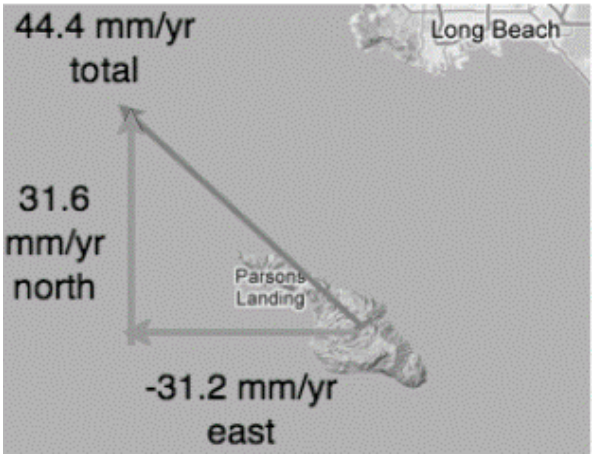
19. Identify the independent variable in this experiment.

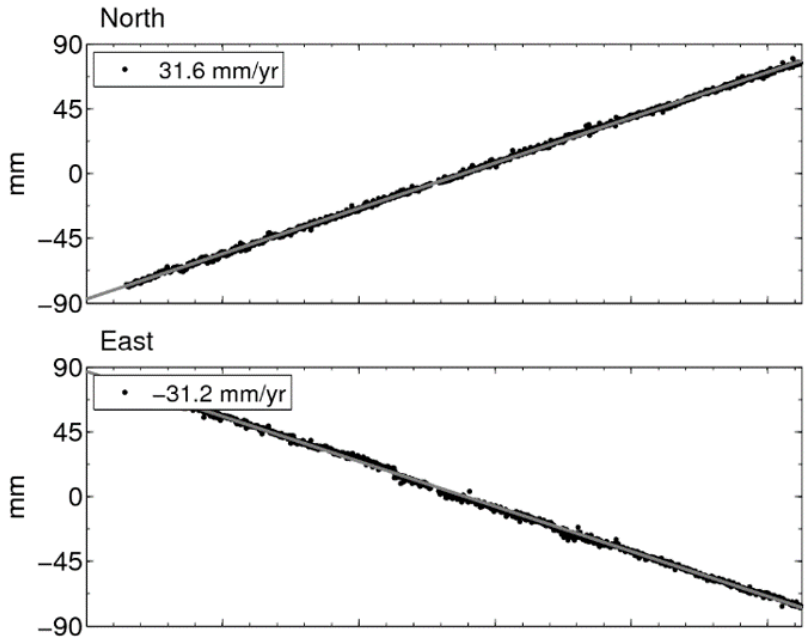
(A) Blade shape
(B) Energy output
(C) Location of wind turbines
(D) Material of wind turbines

20. GPS data can be used to track the movement of a particular location over time. A time-series graph shows this, where a dot represents a dimension: North-South or East-West.

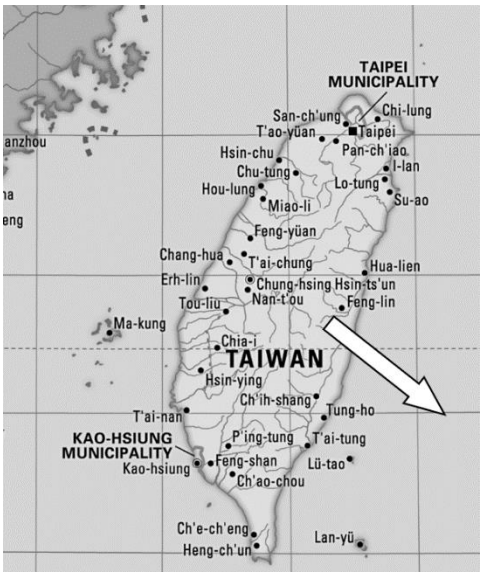
    - If the slope is *positive*, the site is moving northward or eastward.
    - If the slope is *negative*, the site is moving southward or westward, respectively.
    - If the trend line has a gradient slope of *zero*, then the position of the GPS is not moving.

    The graphs below show the movement of GPS station on Catalina Island, California moving in a north-west direction.

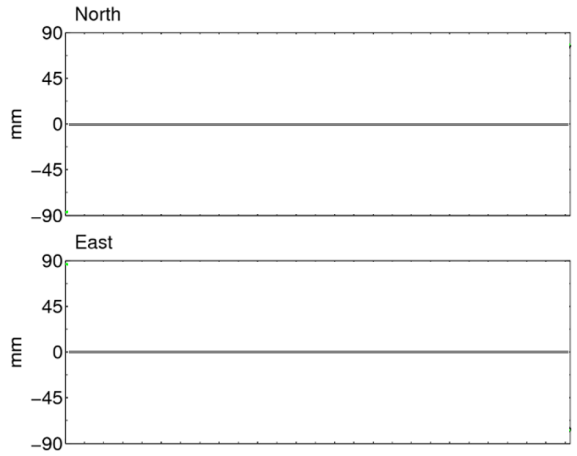




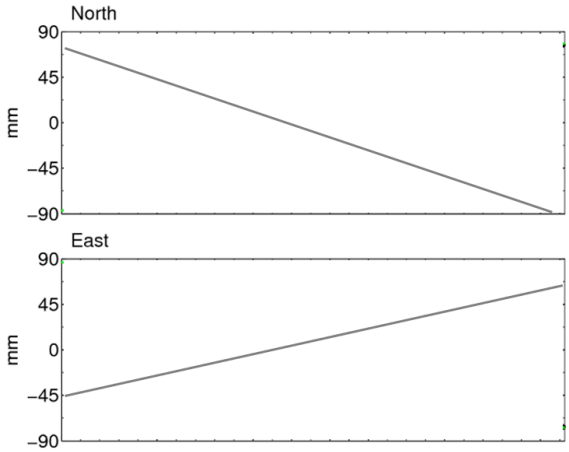
If a GPS station in Taiwan records movement in an east-south direction shown below, which set of graphs would best describe the direction of movement?



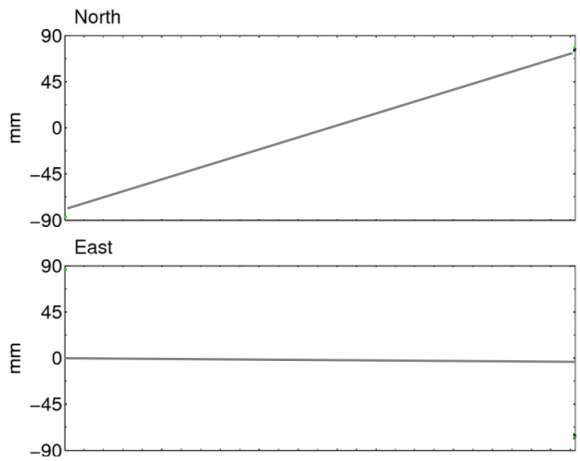
(A)



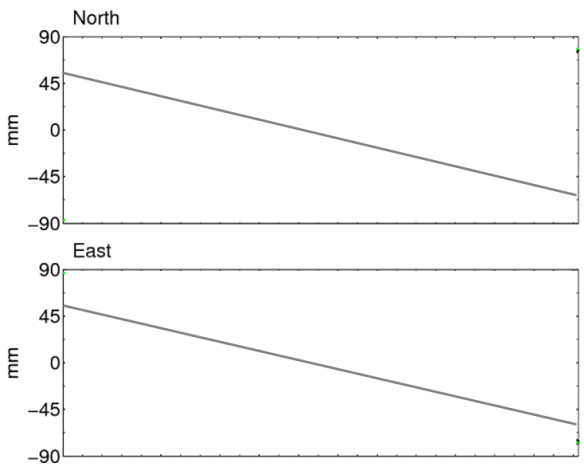
(B)



(C)



(D)



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Candidate No:

Section 2: Short Answer

80 marks
Attempt Questions 21-37.
Allow about 2 hours and 30 minutes for this section.

Question 21 (2 marks)

Use the Geological Time Scale provided to:

(a) Identify the Eon which covers the longest time interval. 1

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(b) Identify the Epoch we currently live in. 1

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Question 22 (3 marks)

Discuss the benefits and limitations of absolute dating over relative dating methods to determine the age of fossils. 3

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Question 23 (4 marks)

The transition of life from the oceans to land was not easy. There were many problems that aquatic organisms needed to overcome before they could fully colonise the terrestrial environment.

List TWO such problems and describe how they were overcome by the first land animals.

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Question 24 (3 marks)

The photograph below is of a sedimentary formation found in shallow reefs from the Proterozoic Eon.



(a) What is the name given to this type of structure? 1

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(b) Explain the significance of this formation as evidence for the development of the biosphere and atmosphere. 2

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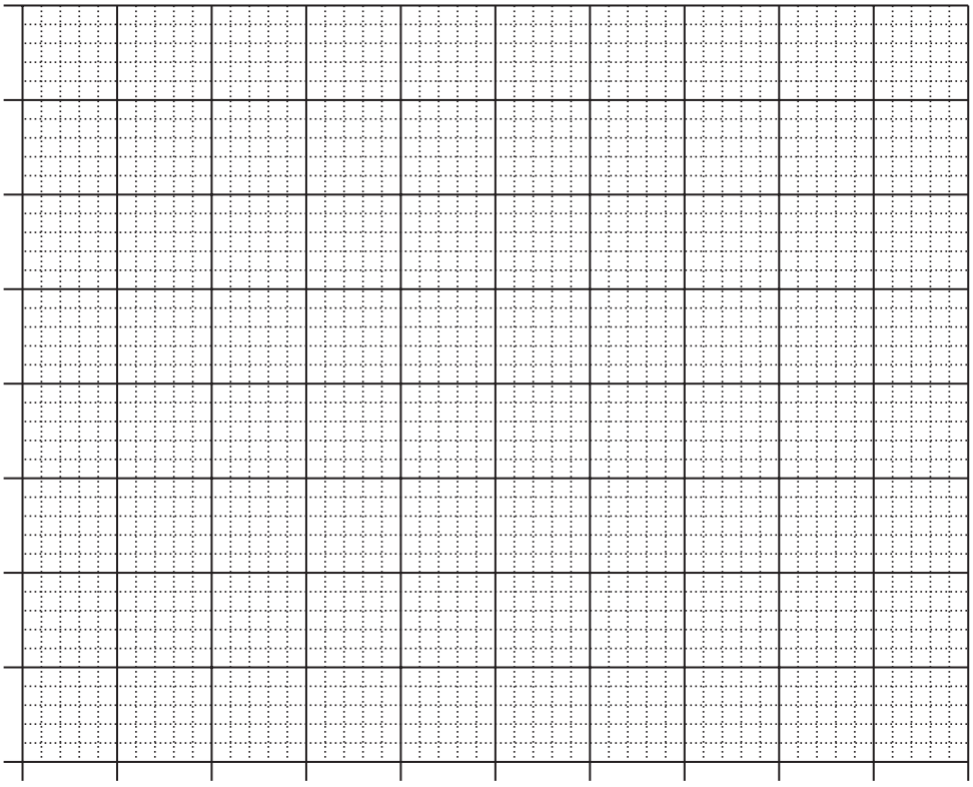
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Question 25 (7 marks)

The table below shows the oxygen content of the atmosphere through geological time.

Time (Ma BP)	1000	800	600	400	200	0
Oxygen content in the atmosphere (%)	0.8	4.1	15.4	31.3	18.9	21.0

(a) Draw a graph of the oxygen content of the atmosphere through geological time using the grid below. 4



(b) Explain the TWO major trends in the data. 3

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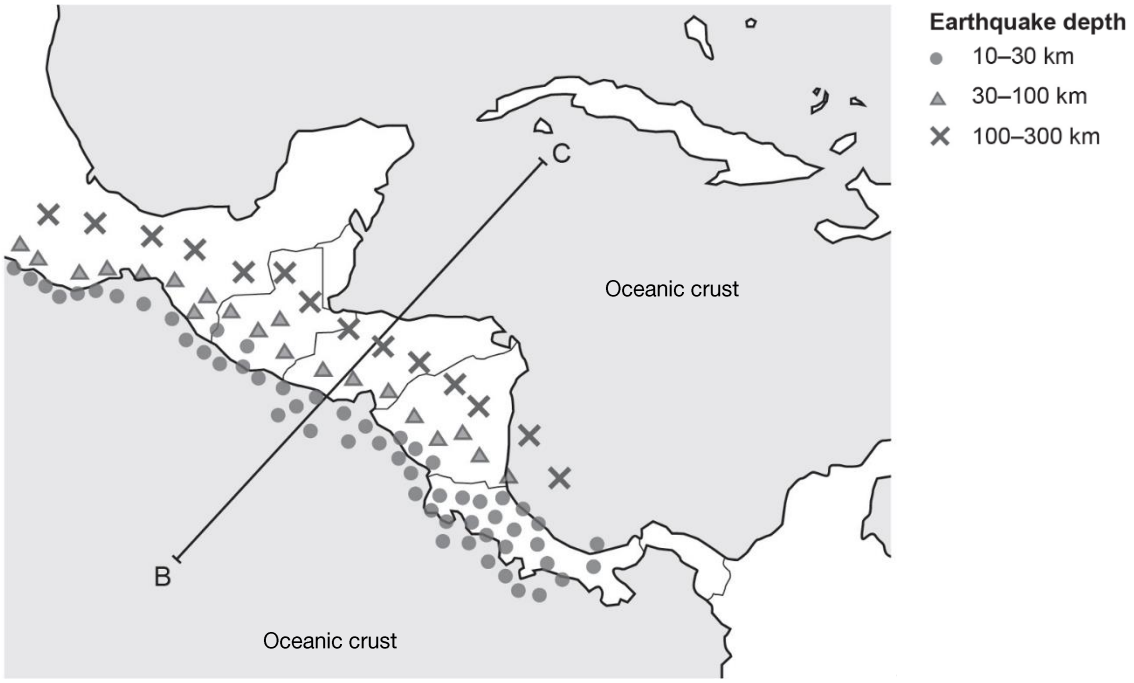
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Question 26 (5 marks)

The map below shows the distribution and variation in depth of earthquakes associated with an active plate boundary.



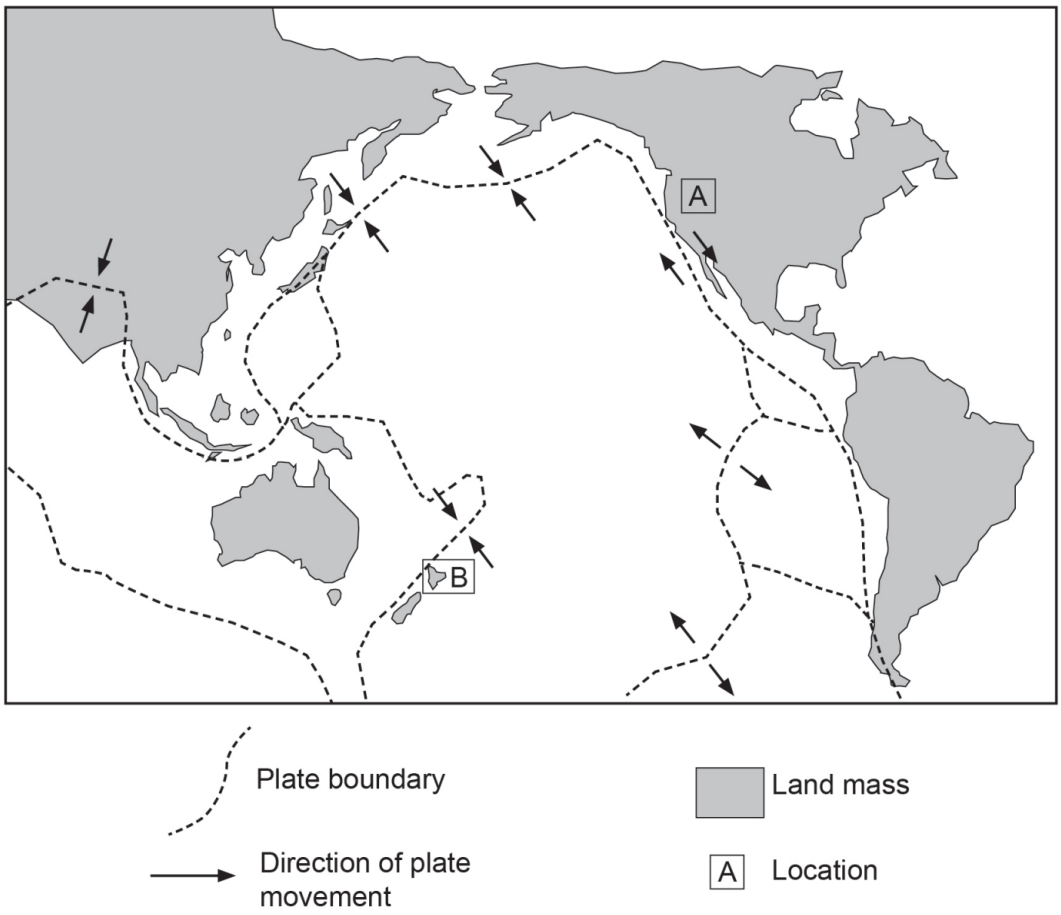
(a) Using the information provided, draw a line marking the boundary between two plates on the map above. 1

(b) In the box below, draw a cross-section of the boundary along the line B-C. B and C have been marked on the box for you. 4

B C

Question 27 (6 marks)

Observe the map of plate tectonic interactions below. 6



Complete the table below, comparing the tectonic settings and geological hazards at locations A and B.

	Location A	*Location B*
Identify the type of plate boundary		
Describe ONE geological hazard that is likely to occur		
Describe ONE way in which deaths can be minimised because of the hazard identified above		

Question 28 (5 marks)

Construct a series of labelled diagrams that model the effects that a series of massive, explosive volcanic eruptions can have on global climate. 5

GLOBAL WARMING EFFECT

GLOBAL COOLING EFFECT

Question 29 (4 marks)

On Friday 5 April 2024, a landslide closed the only road in and out of Megalong Valley. Hundreds of visitors had to be evacuated and food and emergency supplies needed to be airlifted into the Blue Mountains community. The landslide follows significant flooding in the areas. 4



Explain how TWO human activities could increase or reduce the frequency of landslides occurring in the future.

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Question 30 (4 marks)

Global warning potential describes the amount of heat absorbed by a greenhouse gas, taking into account how long it stays in the atmosphere.

Gas	Chemical formula	Lifetime (years)	Global warming potential (time period)		
			20 years	100 years	500 years
carbon dioxide	CO_2	variable	1	1	1
methane	CH_4	12 ± 3	56	21	6.5
nitrous oxide	N_2O	120	280	310	170

(a) Identify one natural source of carbon dioxide. 1

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(b) Account for the difference between global warming potentials for carbon dioxide and methane. 3

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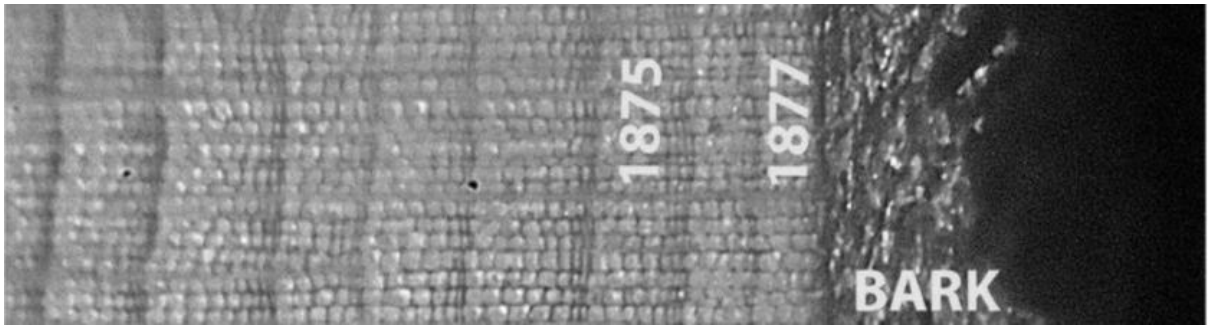
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Question 31 (4 marks)

Observe the photograph below of tree growth rings from a tree that was felled in 1878.



(a) Contrast the growth of the tree during the years 1874 and 1876. 1

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(b) Account for this difference in growth and explain how tree rings can be used as evidence of climate variation. 3

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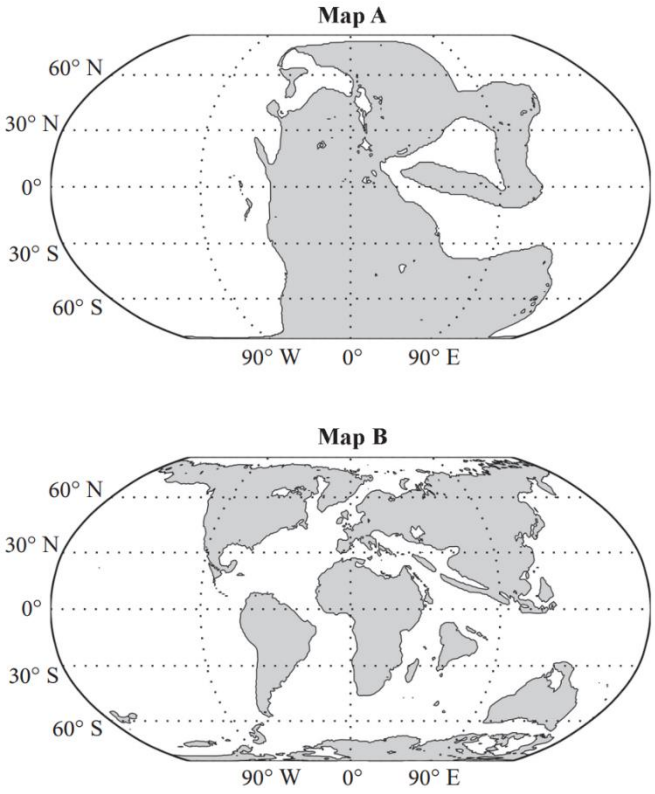
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Question 32 (6 marks)

The maps below show two continental configurations from Earth's geological history. 6



Analyse the roles of the plate tectonic supercycle and changes in ocean currents and ocean circulation as causes of climate variation.

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Question 32 continues on following page

Question 32 continued

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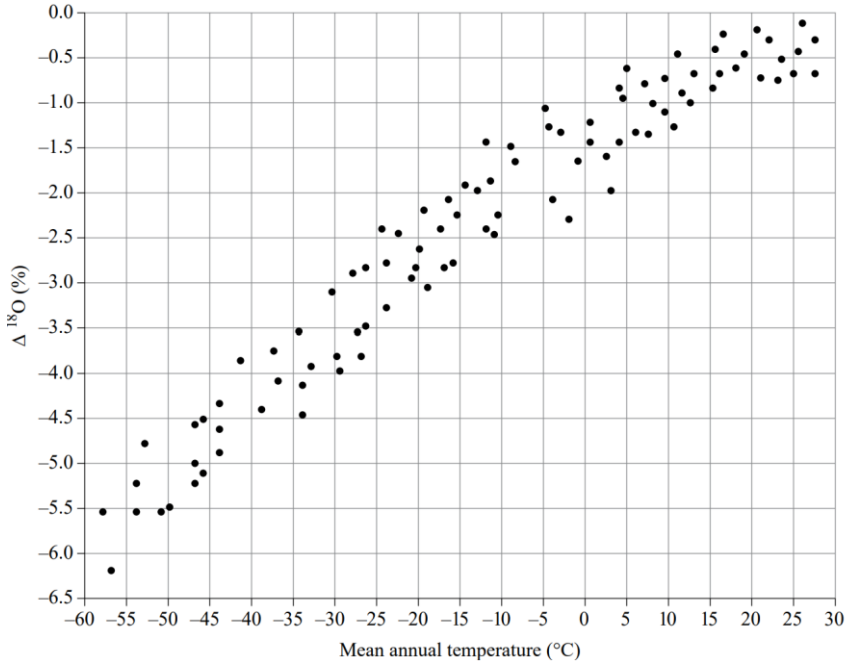
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Question 33 (5 marks)

The graph below compares the different levels of isotope oxygen-18 found in annual precipitation at different air temperatures. The difference in concentration is measured as $\Delta^{18}O(\%)$.



(a) Describe the trend shown in the graph. 1

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(b) How can studying high levels of oxygen-18 found in fossils of marine shells provide conclusions about climate at the time when fossilisation occurred? 4

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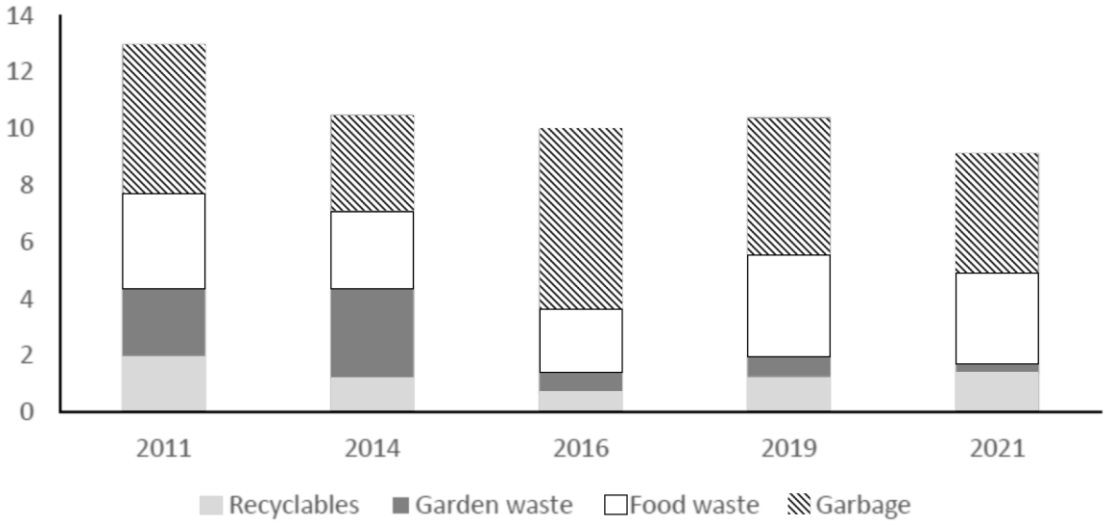
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Question 34 (4 marks)

The Blue Mountains City Council conducted a city-wide household garbage, recycling and green waste bin audit from 2011-2021. Below are the results showing the waste produced by the average household per week.



(a) Identify the largest component of waste that makes up household waste each year. 1

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(b) Justify a waste management option that could be implemented to reduce the waste type you have identified in part (a) in the average household. 2

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(c) Identify one improvement that could be made to the graph above to better our understanding of the data provided. 1

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Question 35 (4 marks)

In your study of *Earth and Environmental Science*, you researched a sustainability initiative in your community.

Describe the initiative and assess its impact on economic and environmental sustainability.

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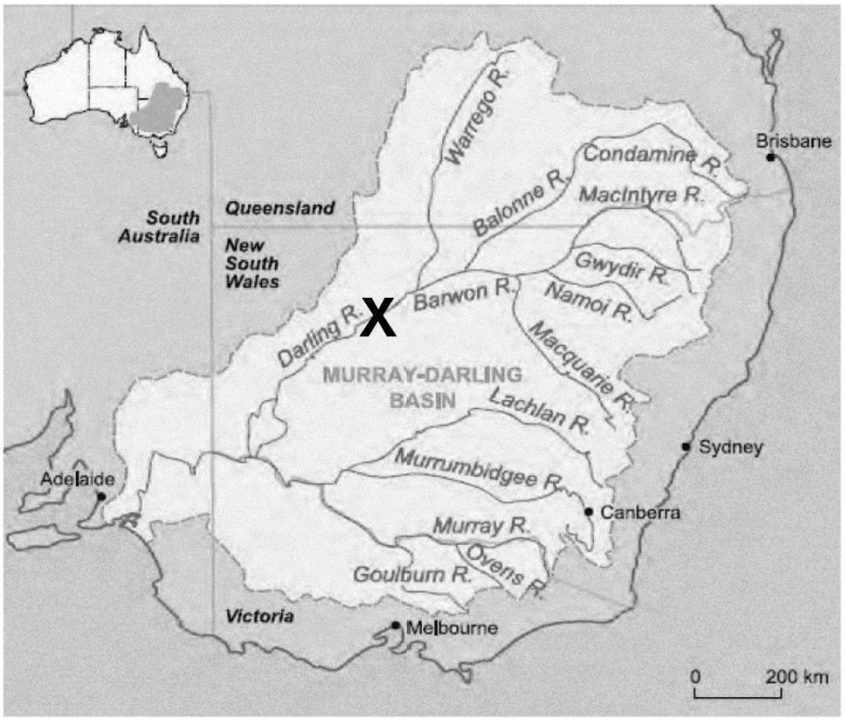
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Question 36 (8 marks)

> "The mining industry's approach to mined land rehabilitation has improved significantly over past decades driven by sustained company investment in research to strengthen the science underpinning rehabilitation methods, evolving corporate values, community expectations and government regulation."

You are the senior executive with an open-cut mining company. You are to address the local council regarding a proposed copper mine in the Murray River Basin of NSW.

The proposed mine location is marked 'X' on the map below.



(a) Describe TWO matters of environmental concern that you may need to address regarding this mine type. 2

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(b) Considering the statement above from the Minerals Council of Australia, design a plan to minimise the impact of mining on the environment of a mine. Consider what must occur before, during and after mining. 4

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(c) In your study of *Earth and Environmental Science*, you prepared a case study investigating the involvement of traditional owners in the planning and closing of mines. Propose ONE way traditional owners can be involved in the plan you designed above. 2

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Question 37 (7 marks)

Figures 1-3 below summarises the reproductive and commercial fishing statistics of blue swimmer crabs and spanner crabs across New South Wales and Queensland.

Figure 1 is a graph showing the commercial catch of blue swimmer crabs and spanner crabs from 2008-2017.

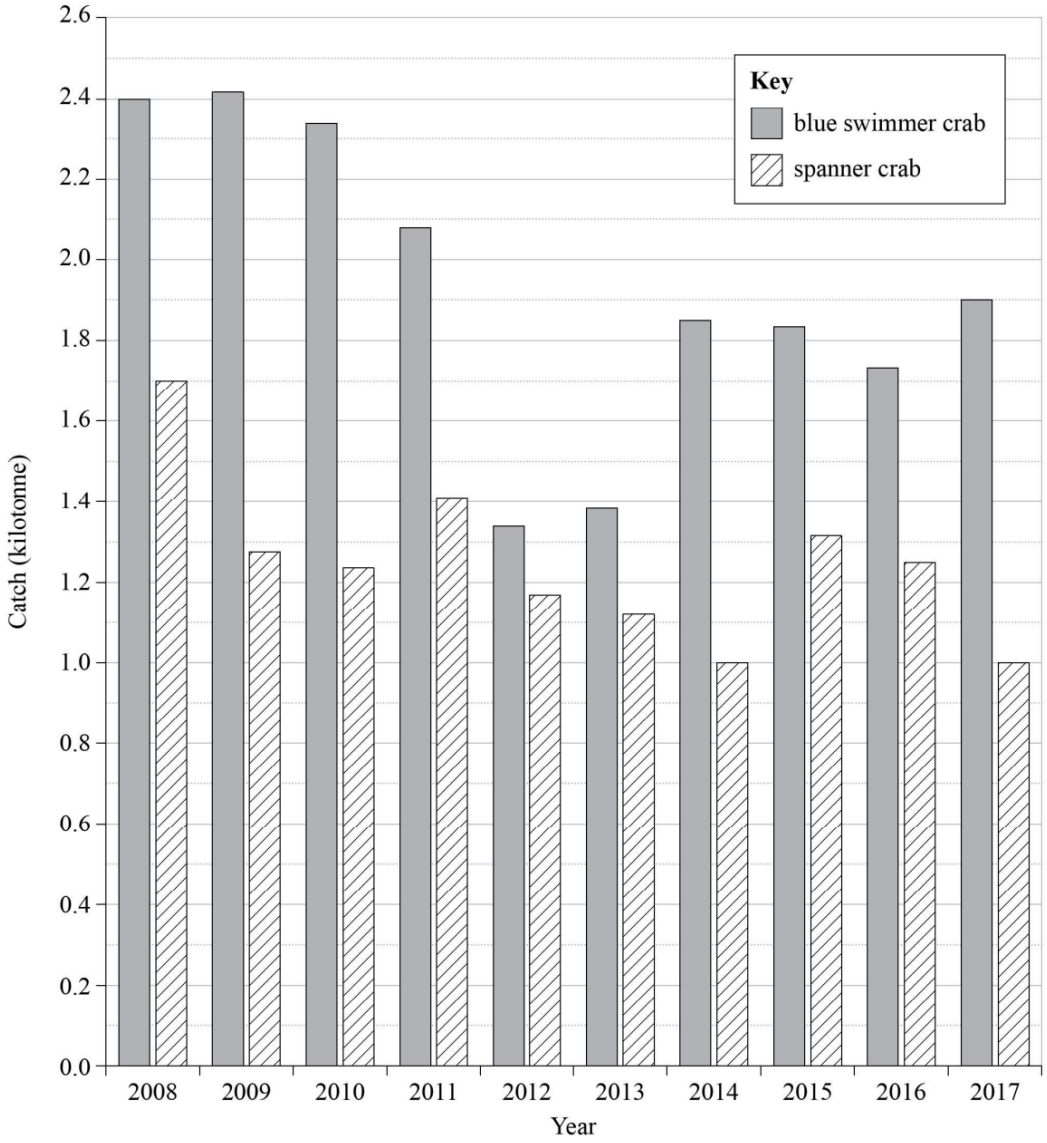


Figure 2 summarises the reproductive information of blue swimmer crabs and spanner crabs.

Species	*Female egg production (per season)*	*Time to reach sexual maturity (years)*
Blue swimmer crab	2,000,000	0.5 – 1
Spanner crab	240,000	2 – 3

Figure 3 compares the commercial fishing management methods for blue swimmer crabs and spanner crabs.

	Blue swimmer crab	*Spanner crab*
Protection of female crabs	✓	✓
Minimum size limit for fishing	✓	✗
Daily catch limit	✓	✗

Using the information provided, evaluate the long-term sustainability of fishing both crab species over the next thirty years. 7

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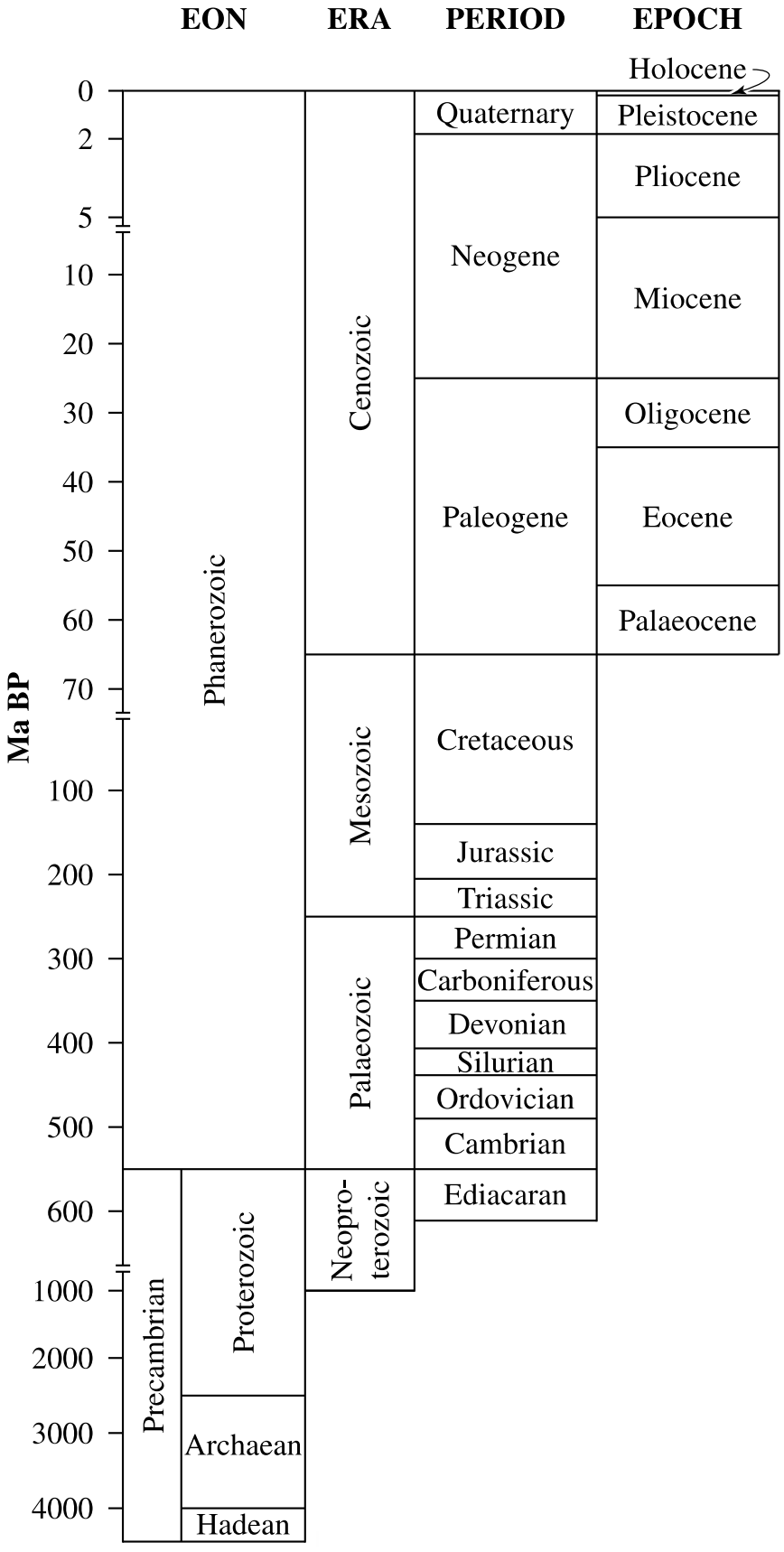
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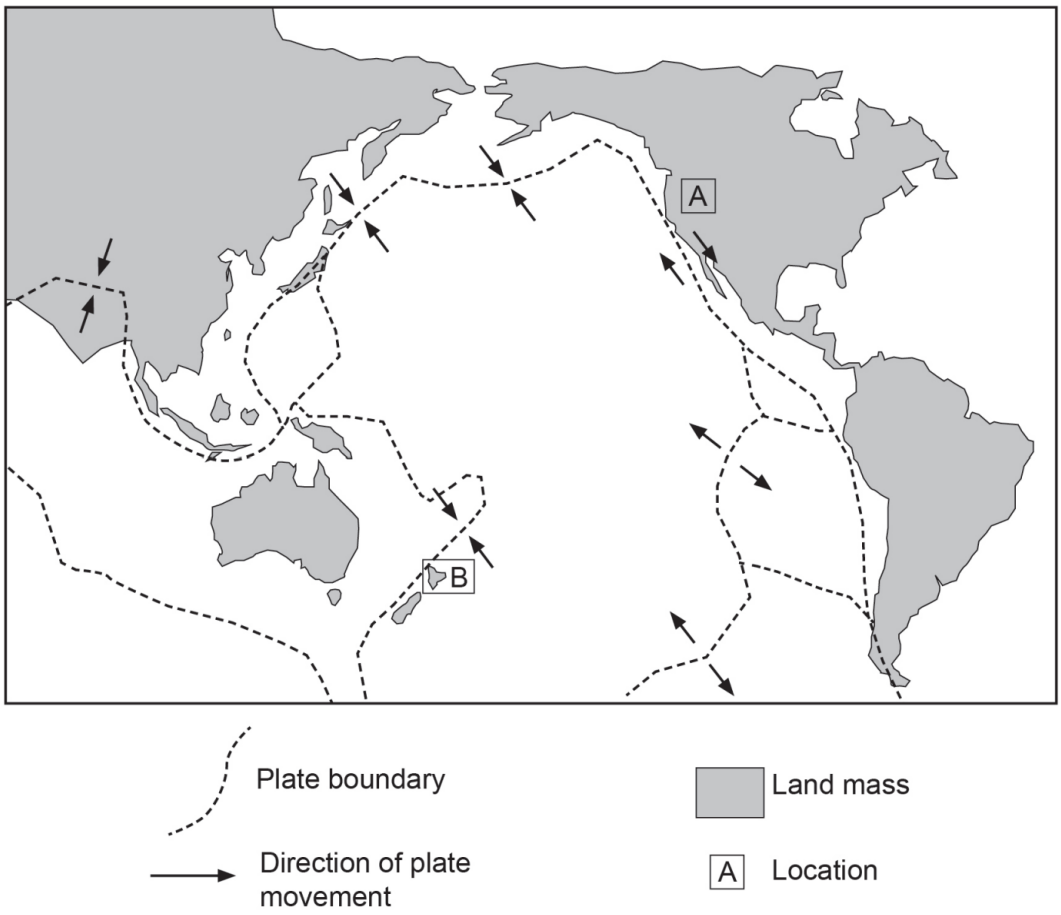
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Geological Time Scale



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Observe the map of plate tectonic interactions below. 6



Complete the table below, comparing the tectonic settings and geological hazards at locations A and B.

	Location A	*Location B*
Identify the type of plate boundary		
Describe ONE geological hazard that is likely to occur		
Describe ONE way in which deaths can be minimised because of the hazard identified above		