



Western Australian Certificate of Education Examination, 2010

Question/Answer Booklet

EARTH AND ENVIRONMENTAL SCIENCE

Stage 2

Please place your student identification label in this box

Student Number: In figures

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In words

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Multiple-choice Answer Sheet

To be provided by the candidate

Standard items: pens, pencils, eraser, correction fluid/tape, ruler, highlighters, approved drawing instruments

Special items: non-programmable calculators satisfying the conditions set by the Curriculum Council

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	20	20	20	20	20
Section Two: Short answer	8	8	110	95	60
Section Three: Extended response	3	2	50	30	20
Total					100

Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2010*. Sitting this examination implies that you agree to abide by these rules.
2. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Section One: Multiple-choice

20% (20 Marks)

This section has **20** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 20 minutes.

1. The lustre of a mineral is best described as
 - (a) the way light interacts with the surface of the mineral.
 - (b) the colour of the powder produced when it is dragged across a harder surface.
 - (c) the physical property of allowing light to pass through a material.
 - (d) the general form or mode of growth of a crystal.

2. In stratigraphy, the 'principle of cross-cutting relationships' states that
 - (a) an upright sequence of sediments has the oldest layer on the bottom and the youngest layer on the top.
 - (b) the geologic feature that cuts another is the younger of the two features.
 - (c) the same natural laws and processes that operate today have always operated in the past.
 - (d) layers of sediment initially extend laterally in all directions.

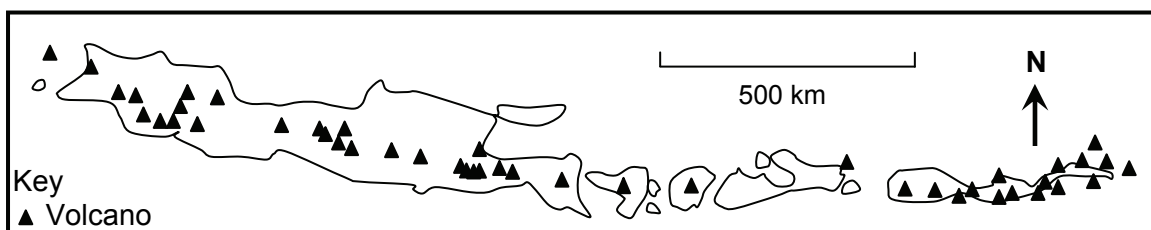
3. Transpiration plays an important role in the cycling of water on Earth. Which one of the following is an example of transpiration?
 - (a) the condensation of water vapour to form clouds
 - (b) the downward movement of water into soil
 - (c) the emission of water vapour from the leaves of plants
 - (d) the loss of sea water to the atmosphere

4. Carbon dioxide is important to the life on our planet because
 - (a) animals need carbon dioxide for the process of respiration.
 - (b) too much carbon dioxide in the atmosphere damages the ozone layer.
 - (c) plants require carbon dioxide for the process of photosynthesis.
 - (d) it helps reduce the harmful effects of burning fossil fuels.

5. Which list below shows the rocks in their correct order of grain size, from largest to smallest?
 - (a) conglomerate, sandstone, siltstone, claystone
 - (b) sandstone, conglomerate, siltstone, claystone
 - (c) siltstone, sandstone, claystone, conglomerate
 - (d) conglomerate, siltstone, sandstone, claystone

See next page

6. Which one of the following textures is most likely to be found in an igneous rock?
- a crystalline texture, showing well-rounded clasts
 - an interlocking crystalline texture, lacking any foliation
 - a uniform crystal size, with well-defined layers
 - a well-sorted texture with a fine-grained matrix
7. According to the Mohs Scale of hardness, which order of minerals is correct, going from hardest to softest?
- talc, calcite, quartz, topaz
 - topaz, calcite, quartz, talc
 - topaz, quartz, calcite, talc
 - quartz, topaz, talc, calcite
8. The epicentre of an earthquake is the
- point within the earth from which the energy originates.
 - place where the maximum intensity is measured on a seismograph.
 - point on the earth's surface from which the activity appears to originate.
 - point on the earth's surface directly above the earthquake's focus.
9. The map shows the distribution of currently active composite/stratovolcanoes in Java and adjacent islands.



- To which geological feature are the volcanoes most likely related?
- continental rift zone
 - convergent margin
 - hot spot
 - mid-ocean ridge
10. Which one of the following is a **disadvantage** of wind power?
- It is renewable.
 - It is non-renewable.
 - It produces no greenhouse gas emissions.
 - It produces varying amounts of electricity.

11. An environmental scientist conducted an experiment in which she sampled water from different locations, and then measured the Total Dissolved Solids (TDS) in each sample.

What would be the **independent** variable?

- (a) amount of water sampled
 - (b) different sources/locations of water
 - (c) the TDS measurement
 - (d) the method by which she conducted her experiment
12. The short-term cycling of organic carbon in a leaf can be broken by
- (a) the living leaf being eaten by an herbivorous animal.
 - (b) the leaf falling from the plant and decomposing on the forest floor.
 - (c) the leaf being transported to the ocean and buried by sediments.
 - (d) the leaf being transported to an equatorial climate.
13. Why is the formation of the ozone layer important to the evolution of life on Earth?
- (a) Ozone filters visible light.
 - (b) Ozone filters ultraviolet radiation.
 - (c) Ozone allows the build-up of ultraviolet radiation.
 - (d) Ozone allows the build-up of long-wave radiation.
14. A major mass extinction event occurred at the end of the Permian period (250 million years ago). This extinction resulted in the loss of 70% of the earth's terrestrial vertebrate species. Researchers have proposed several mechanisms for the extinctions.
- Which one of the following is **not** a suggested cause of this extinction event?
- (a) shifting ocean circulation due to climate change
 - (b) sudden increased volcanism
 - (c) ecosystem disruption by early humans
 - (d) gradual changes in sea levels
15. The flow of energy and nutrients through the organic and inorganic components of the environment is described as a
- (a) stratigraphic cycle.
 - (b) biogeochemical cycle.
 - (c) hydrological cycle.
 - (d) krebs cycle.
16. Which of the following statements best describes the part played by trees and vegetation in the water cycle?
- (a) Plants absorb water from the atmosphere.
 - (b) Water is absorbed into plants and evaporates to form clouds.
 - (c) Plants remove groundwater and trap it in coal and petroleum resources.
 - (d) Plants extract water from the ground and transpire water vapour to the atmosphere.

See next page

17. Which one of the following could be the major contributor to the problem of a stream developing increased growth of green algae?
- (a) pesticides leaching from nearby gardens
 - (b) storm water runoff bringing oils from the roads
 - (c) a lack of native plants along the stream's banks
 - (d) fertilisers washing into the stream from upstream sports fields

18. Which row of the following table gives the correct information about all four layers of the atmosphere?

Layer	Troposphere	Stratosphere	Mesosphere	Ionosphere
(a)	Most weather occurs here	Contains the ozone layer	Outermost layer	Gets colder as you go up
(b)	Gets colder as you go up	Auroras occur in this region and above	Gets hotter as you go up	Contains the ozone layer
(c)	All of the earth's water found here	Most meteors burn up in this layer	Gets hotter as you go up	Electrically charged
(d)	Most weather occurs here	Contains the ozone layer	Auroras occur in this region and above	Gets hotter as you go up

19. Australian megafauna extinctions are thought to have been caused by
- (a) rising sea levels leading to a loss of habitat.
 - (b) increased volcanism lifting global levels of toxic SO₂.
 - (c) a combination of human impact and a natural climate change.
 - (d) a sudden cooling of the environment leading to an ice age.
20. The current 'enhanced greenhouse effect' is **not** caused by
- (a) deforestation.
 - (b) increased volcanic activity.
 - (c) cement manufacture.
 - (d) increased methane and chlorofluorocarbon (CFC) gases.

End of Section One

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Section Two: Short answer

60% (95 Marks)

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- **Planning:** If you use the spare pages for planning, indicate this clearly at the top of the page.
- **Continuing an answer:** If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 110 minutes.

Question 21

(9 marks)

Oxygen is currently the second most abundant gas in the atmosphere. However, the earth's atmosphere did not always have oxygen. The following table shows the oxygen content of the atmosphere through time from 1 000 million years (Ma) ago to today.

Time (Ma)	1 000	900	800	700	600	500	400	300	200	100	0
Atmospheric oxygen (%)	0.8	1.3	2.1	4.6	11.4	19.6	17.3	35.6	18.9	24.5	21.0

(a) Draw a line graph of the data shown in the table on the grid below.

(5 marks)

(b) Identify **two** trends shown in the data. (2 marks)

One: _____

Two: _____

(c) Describe fully a possible reason for the overall trend displayed in your line graph at (a). (2 marks)

Question 22

(15 marks)

Fossils are the preserved remains or traces of animals, plants and other organisms from the remote past.

- (a) There are many types of fossil preservation. Describe how each of the following is formed. (6 marks)

Trace fossil _____

Petrified remains _____

Mould _____

- (b) Give **two** reasons why organisms that are buried rapidly are more likely to fossilise than those that are buried slowly or not at all. (2 marks)

One: _____

Two: _____

- (c) Give **two** reasons why the fossil record represents only a partial picture of life in the past. (2 marks)

One: _____

Two: _____

- (d) Using an example, explain how fossils can provide information about the environment of deposition. (2 marks)

- (e) Fossils allow correlation of sedimentary rocks. Only certain types of fossils (called 'index fossils') are useful for correlation and not all organisms become index fossils. Identify **three** features of an organism that increase its chances of becoming a good index fossil. (3 marks)

Feature one: _____

Feature two: _____

Feature three: _____

Question 23

(15 marks)

Water is a vital substance for all known forms of life. Water on and under the earth's surface continually moves through a cycle referred to as the water (hydrological) cycle.

- (a) Name the **two** main energy sources that maintain the operation of the water cycle. (2 marks)

One: _____

Two: _____

- (b) Most of the water on our planet is salty, with only 2% of the hydrosphere containing fresh water. Arrange the following freshwater reservoirs in order from the largest volume to the smallest volume.

atmosphere; ground water; glaciers and ice caps; surface water (4 marks)

	Reservoir
Largest by volume	
↓	
Smallest by volume	

- (c) Draw a labelled diagram showing the major processes of the water cycle. (5 marks)

- (d) Name and describe **one** way in which water can cycle between the following reservoirs. (4 marks)

Atmosphere to hydrosphere

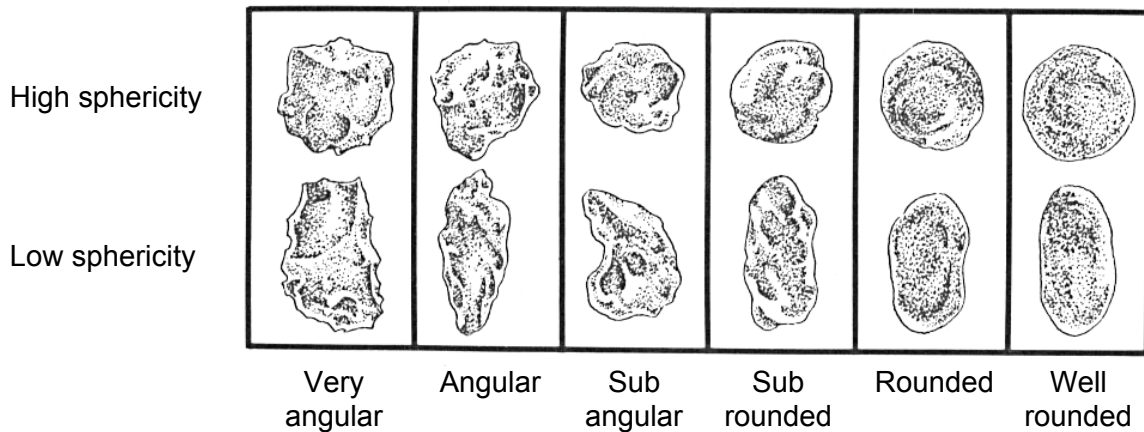
Hydrosphere to biosphere

Question 24

(13 marks)

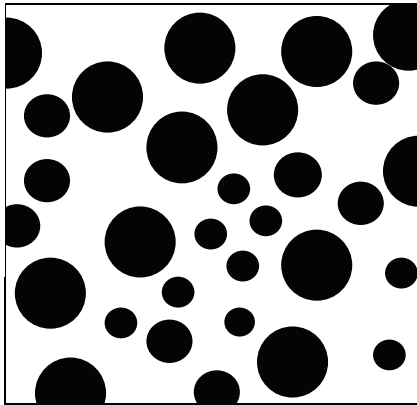
Sediments are formed from naturally-occurring loose material that is broken down by the processes of weathering and erosion. This material is subsequently transported by the action of wind, water or ice and/or by the force of gravity acting on it.

The following diagram shows different sedimentary clasts of varying sphericity and roundness.

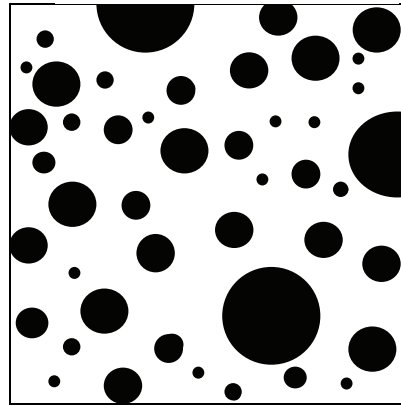


(a) Identify the changes to clast roundness and sphericity as sediment moves down a river. (2 marks)

The following diagrams show two sedimentary rocks that have undergone different degrees of sorting.



Sedimentary Rock A



Sedimentary Rock B

(b) Use the above diagrams to answer the following:

(i) Explain the term 'sorting'. (2 marks)

(ii) Suggest where in a river system these two rocks may have formed. (2 marks)

Rock A _____

Rock B _____

(c) There are a number of stratigraphic principles that control the deposition of sediments. Describe the following two principles.

(i) Principle of original horizontality (2 marks)

(i) Principle of superposition (2 marks)

(d) Lithification is the process of turning loose sediment into sedimentary rock. Describe the changes that occur to a sediment during this process. (3 marks)

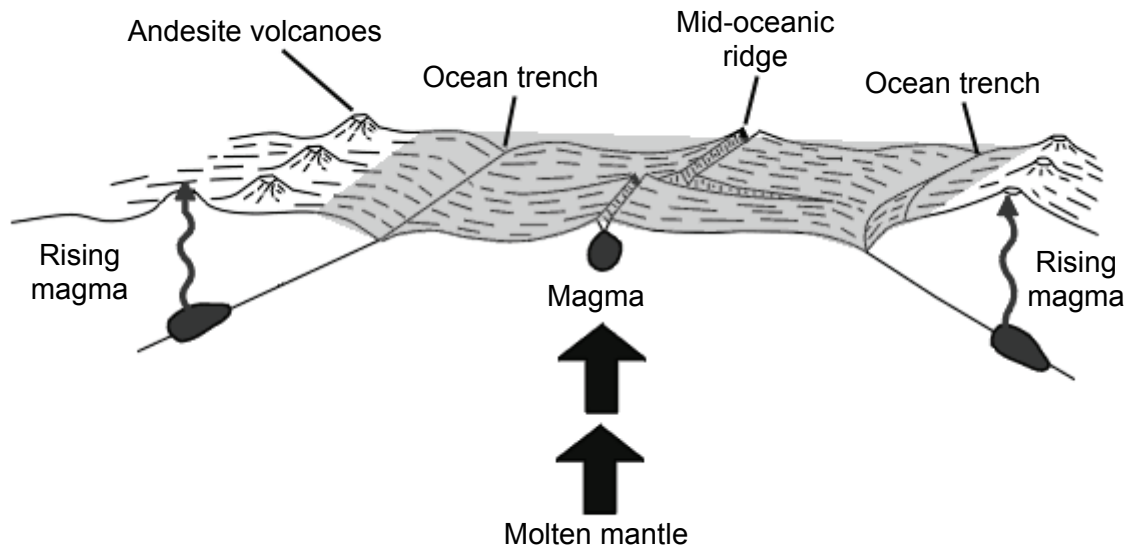
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Question 25

(12 marks)

Seafloor spreading is an important part of the theory of plate tectonics. It is the process (shown below) of new oceanic crust being formed at mid-oceanic ridges.



- (a) Name the outer layer of the earth that is broken into a number of pieces, called 'tectonic plates'. (1 mark)

- (b) Label clearly the direction of oceanic plate movement on the diagram above. (2 marks)
- (c) Faults are common along mid-oceanic ridges. Name the type of fault shown in the diagram above. (1 mark)

- (d) Describe how the age of the oceanic crust changes as the distance from the mid-oceanic ridge increases. Explain why this is the case. (3 marks)

- (e) In the diagram on the previous page, magma is extruded along the mid-oceanic ridge. This magma differs in composition from the magma produced at subduction zones.

Name the type of magma that erupts at mid-oceanic ridges and the rock produced from the solidification of this magma. (2 marks)

Magma type _____

Igneous rock produced _____

- (f) Identify **three** other differences between the magma produced at a mid-oceanic ridge and that produced at a subduction zone. (3 marks)

One: _____

Two: _____

Three: _____

Question 26

(11 marks)

Igneous rocks are formed from the cooling of magma. Common examples include; basalt, dolerite, gabbro, granite, obsidian, pegmatite, pumice, rhyolite and andesite. These rocks show a large range of textures and compositions.

(a) Explain the following igneous textural terms:

Phenocryst

(2 marks)

Glassy

(1 mark)

(b) Select **five** rocks from those listed above to complete the table below by identifying the igneous rocks based on their description. (5 marks)

Description	Igneous rock
An igneous rock dominated by light coloured minerals approximately 3 mm in size	
A fine-grained igneous rock with approximately equal proportions of light and dark minerals	
An igneous rock consisting completely of volcanic glass	
A light coloured igneous rock that contains a large proportion of air bubbles	
An igneous rock dominated by dark minerals that that are too small to see without the aid of a hand lens	

(c) Select an igneous rock that you have studied and explain how it was formed.

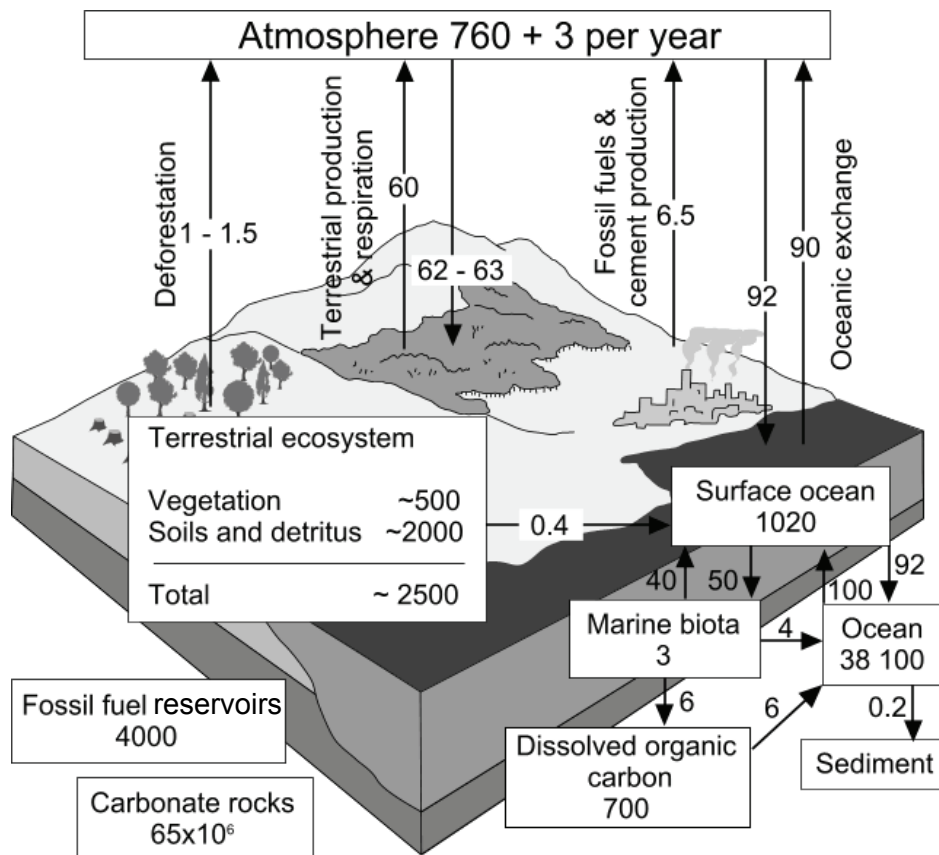
(3 marks)

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Question 27

(9 marks)

Carbon is present in all known life forms and is one of the most important elements for study in order to understand how our planet works. The following diagram shows the amount of carbon in each reservoir and the yearly cycling of carbon between the reservoirs. The numbers represent gigatonnes (Gt) of carbon. Note: A Gt is a gigatonne of carbon or 10^9 (billion) tonnes of carbon.



(a) Name the largest reservoir of carbon shown in the diagram above. (1 mark)

(b) Describe how living plants remove carbon from the atmosphere. (2 marks)

(c) Describe **one** way in which living things can add carbon to the geosphere. (2 marks)

(d) Describe how carbon can move from the atmosphere to the hydrosphere. (2 marks)

(e) According to the data shown on the diagram, we are currently adding three gigatonnes more carbon to the atmosphere than is being removed each year. Explain **one** consequence for our planet if this is allowed to continue. (2 marks)

Question 28

(11 marks)

Choose **one** renewable energy resource that you have studied (for example, geothermal hot-rock technology, wave, biogas/alcohol, solar, wind) and use it to answer the following questions.

Renewable energy resource: _____

- (a) Describe how usable energy is produced from this resource. (3 marks)

- (b) Outline **two** site requirements for the resource you have chosen. (2 marks)

One: _____

Two: _____

- (c) Suggest **one** location in Australia that could provide a suitable site for developing the resource. Explain why you have selected this location. (2 marks)

- (d) Identify **two** advantages and **two** disadvantages of the use of this energy resource. (4 marks)

Advantages

One: _____

Two: _____

Disadvantages

One: _____

Two: _____

End of Section Two

See next page

Section Three: Extended response

20% (30 Marks)

This section contains **three (3)** questions. You must answer **two (2)** questions: the compulsory question (Question 29) and **one (1)** of the other questions (Question 30 or Question 31). Write your answers in the space provided following Question 31.

If you use a page for planning, indicate this clearly at the top of the page.

Suggested working time: 50 minutes.

Question 29

(15 marks)

The rock cycle is an essential concept in the study of the earth. It can be used to explain how the three basic rock types; igneous, metamorphic and sedimentary are related to each other, and how natural processes change a rock from one type to another through geological time.

Illustrate and explain the rock cycle. Your answer should include:

- (a) a labelled diagram of the rock cycle; and (6 marks)
- (b) a description of the processes that produce all three rock types (igneous, sedimentary and metamorphic). Include an example of each rock type. (9 marks)

Answer Question 30 or Question 31.

Question 30

(15 marks)

Water is essential to human and other life on our planet. However, current water usage practice is not sustainable and Australia is facing unprecedented water management challenges.

Assess the environmental consequences that follow from the unsustainable use of water. In your answer you should:

- (a) identify **three** different sources of fresh water available for human use. (3 marks)
- (b) explain **two** different ways in which human activity can pollute sources of fresh water. (4 marks)
- (c) describe **one** major impact that a severe water shortage would have on our society. (2 marks)
- (d) explain **three** ways to improve the sustainability of Western Australia's sources of fresh water. (6 marks)

or

Question 31

(15 marks)

The greenhouse effect is an essential natural process, as it helps make this planet suitable for life as we know it.

Discuss the importance of greenhouse gases in the earth's atmosphere. In your answer you should:

- (a) identify **two** different gases in the atmosphere that are generally described as greenhouse gases (2 marks)
- (b) explain why greenhouse gases are an important part of the atmosphere. (2 marks)
- (c) explain, with the aid of a diagram, how the greenhouse effect works. (4 marks)
- (d) describe **two** ways in which human activity has increased the natural levels of greenhouse gases. (4 marks)
- (e) describe how computer models can be used to predict the effects of further increasing greenhouse gas levels on climate. (3 marks)

End of questions

ACKNOWLEDGEMENTS

Section Two

- Question 21 Data from: Board of Studies, New South Wales. (2002). Earth and Environmental Science: Higher School Certificate Examination (Question 19). Retrieved May, 2010 from www.boardofstudies.nsw.edu.au/hsc_exams/hsc2002exams/pdf_doc/earth_env_science_02.pdf
- Question 24 Diagram from: Stimac, J.P. (1999). *Sedimentary rocks*. Retrieved May, 2010, from www.ux1.eiu.edu/~cfjps/1300/sed_rxs.html
- Question 25 Diagram adapted from: Jessey, D. (2009). *Plate Tectonics*. Retrieved May, 2010, from <http://geology.csupomona.edu/drjessey/class/Gsc101/Plate.html>
- Question 27 Diagram from: Boston University, Department of geography. (2002). *Radiative Forcing of Climate Change–Carbon budget*. Retrieved May, 2010, from <http://cybele.bu.edu/courses/gg312fall02/chap02/figures/fig2.2.gif>

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