2008 HSC Notes from the Marking Centre Earth and Environmental Science

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Contents

2008 HSC NOTES FROM THE MARKING CENTRE EARTH AND ENVIRONMENTAL SCIENCE

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Earth and Environmental Science. It contains comments on candidate responses to the 2008 Higher School Certificate examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

This document should be read along with the relevant syllabus, the 2008 Higher School Certificate examination, the marking guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Earth and Environmental Science.

General Comments

In 2008, approximately 1250 candidates attempted the Earth and Environmental Science examination. The most popular options were Introduced Species and the Australian Environment (80%) and Oceanography (7%).

Teachers and candidates should be aware that examiners may write questions that address the syllabus outcomes in a manner that requires candidates to respond by integrating their knowledge, understanding and skills developed through studying the course, including the prescribed focus areas. This reflects the fact that the knowledge, understanding and skills developed through the study of discrete sections should accumulate to a more comprehensive understanding than may be described in each section separately. It is important to understand that the preliminary course is assumed knowledge for the HSC course.

Teachers and candidates should also be aware that questions may be asked that focus on the mandatory skills content in Module 9.1.

Overall, the level of understanding of Earth and Environmental Science concepts indicated by the responses was appropriate for most HSC candidates. Candidates need to be reminded that the answer space provided and the marks allocated are guides to the maximum length of response required. Similarly, the key word used in the question gives an indication of the depth of the required response.

Candidates should use examination time to analyse the question and plan responses carefully, working within that framework to produce clear and concise responses. This may include the use of dot points, diagrams and/or tables, and avoids internal contradictions. This is particularly so in holistic questions which need to be logical and well structured. There was evidence that some candidates had a very poor knowledge of the basic terminology associated with the course.

Better responses indicate that candidates are following the instructions provided on the examination paper. In these responses, candidates:

- show all working where required by the question
- do not repeat the question as part of the response

- look at the structure of the whole question and note that in some questions the parts follow from each other, ie responses in part (a) lead to the required response in part (b) etc
- use appropriate equipment, for example, pencils and a ruler to draw diagrams and graphs. (A clear plastic ruler would aid candidates to plot points that are further from the axes and rule straight lines of best fit.)

In Section II, the option question is divided into a number of parts. Candidates should clearly label each part of the question when writing in their answer booklets.

In part (e) of the 2008 option questions, the best responses presented ideas coherently and included the correct use of scientific principles and ideas, and an analysis of the impacts of these.

Candidates are required to attempt one question only in Section II, but some candidates responded to more than one option question. Candidates are strongly advised to answer the option they have studied in class.

Section I – Core

Part A – Multiple-choice

Question	Correct Response
1	C
2	D
3	D
4	A
5	D
6	C
7	A
8	C

Question	Correct Response
9	B
10	B
11	A
12	D
13	D
14	C
15	A

Part B

Question 16

(a) Correct responses identified C as the zone where new crust was being made.

(b) The best responses identified and described two possible mechanisms (hypotheses) to explain the movement of lithospheric plates.

The weaker responses confused mechanisms for plate movement with the type of plate boundary, for example convergence, divergence.

Question 17

Better responses linked proximity to a convergent boundary causing more intense earthquakes and thus an increased risk of tsunamis.
The best responses also recognised that there was a divergent zone further away from the southern margin of Australia. This zone experiences less intense earthquakes, and thus fewer tsunamis.

Question 18

Better responses listed features specific to convergent and divergent zones. For example reverse faults, rather than simply listing faults, mountains or volcanoes.

Question 19

The better responses linked a feature with an effect – for example, SO_2 aerosols are expelled which leads to global cooling because they reflect sunlight away from earth.

Some responses constructed a table to answer the question, clearly showing the long and short-term effects.

Weaker responses listed volcanic effects but failed to link them to a product of volcanic eruptions.

Question 20

Better responses provided a linked sequence of labelled diagrams showing a complete cycle, which included both the mid-ocean rifting and subduction phases of the plate tectonic supercycle. These diagrams were fully labelled and included arrows to show the direction of plate movement.

Weaker responses did not draw a complete cycle.

Question 21

(a) Better responses identified two adaptations.

In the weaker responses, candidates identified general plant features such as photosynthesis, rather than terrestrial adaptations of plants, while others confused environmental change with the adaptations to the environment.

(b) The best responses used an adaptation mentioned in part (a) and clearly demonstrated the link between the adaptation and its function in the terrestrial environment.

Question 22

(a) Better responses identified iron rich and iron poor layers. In weaker responses, candidates exhibited some confusion about the chemical nature of the layers or made no distinction between layers at all.

(b) Better responses identified trends for both atmospheric and hydrospheric oxygen, while weaker responses identified one trend only.

(c) The best responses mentioned cyclic changes in the hydrosphere that led to the alternating layers of sediment being deposited.

Question 23

(b) Many responses identified Carbon-12 or Carbon-13 as a stable isotope.

Better responses expressed the uptake of Carbon-12 as a process indicating life and compared the ratio of Carbon-12 to Carbon-13 in living things with the ratio in the atmosphere, lithosphere or hydrosphere.

Some responses confused radioisotopes with stable isotopes and discussed radioactive decay, whilst others confused the presence of stable isotopes with a dating technique rather than as an indicator of life processes.

Question 24

Better responses drew clear links between each hypothesis, the biotic features of megafauna and their resultant extinction.

Weaker responses did not analyse the hypothesis but rather discussed or assessed it and many confused minor extinctions with mass extinction events.

Question 25

(a) Better responses included a brief description or reason for choosing the strategy named. Weaker responses identified a strategy only.

(b) Better responses linked the method by which their named strategy lowered the water table and how this then mobilized salt away from the surface. Weaker responses did not address the salt moving and only focused on lowering the water table.

Question 26

(a) (i) Correct responses placed an X in the impermeable shale.

(ii) Better responses linked the impermeability of the shale to the containment of waste and leachate on site.

(b) Better responses linked two of the many geological features associated with the mine to the movement of waste and/or leachate off site and to the detriment of the nearby town and/or river. Candidates are reminded to use the data and information given in the stimulus material rather than inferring data or information of their own.

Question 27

Better responses displayed a thorough knowledge of geological and environmental factors as well as linking these features to each other. This was best illustrated in cause and effect relationships. Better responses discussed how these features contributed to the fragility of the continent by

defining the term or using examples that illustrate vulnerability. In some of the better responses, candidates set their ideas out in a clear, logical and sequential manner showing excellent communication skills.
Weaker responses tended to demonstrate limited knowledge and only wrote about one or two features. These responses may have been improved if they had taken an holistic approach to the syllabus rather than concentrating on discrete dot points.

Section II – Options

Question 28

(a) (iii) Weaker responses failed to identify a quarantine practice, naming an agency instead. For example, naming AQIS (an agency or service), rather than identifying a procedure for which they are responsible.

(iv) The best responses named both the organism and its mode of introduction.

(v) The best responses focused on the more common reasons such as food, for sale or as pets.

(b) In the best responses, candidates outlined a feature of the named species of animal, described the Australian environmental conditions that directly suited this animal and then linked this knowledge to an explicit effect on the Australian environment.

Weaker responses failed to link the impact of the organism on the Australian environment with the named species, or used a plant as an example, rather than the animal as requested.

(c) This question required candidates to demonstrate a flow of events through time in a diagrammatic format. Arrows were an effective method of indicating flow.

The best responses used a flow diagram with each significant event as a separate step.

(d) (i) Better responses identified two abiotic components of an environment that were affected by an introduced species. Weaker responses confused abiotic and biotic factors.

(ii) Better responses described a step by step experimental procedure which included scientific equipment and/or chemicals used as well as safe work practices. Stronger responses emphasised that the procedure was carried out in both an area affected by an introduced species and an area not affected by an introduced species in order to make a comparison.

(iii) Better responses acknowledged that to assess the reliability of data initially obtained, the procedure had to be repeated and that the data collected had to be compared with the original results to see if it was similar.

Weaker responses did not provide a judgment as to the reliability of the two sets of data. Some responses confused reliability with validity.

(e) The best responses identified two impacts that a named introduced animal has had on the Australian environment. They then provided a clear link to a process that caused each

impact and further developed the consequences of each impact, making use of specific examples where applicable. These responses were coherent and included a logical argument with appropriate terminology used. These responses included further information that identified the introduced animal as a pest species.

Weaker responses did not clearly link the impacts and the processes and did not further develop the consequences of each impact. These responses included a limited amount of specific terminology or basic terminology only.

Some weaker responses focused on an introduced plant rather than an animal.

Earth and Environmental Science

2008 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I Part A			
1	1	14.1(a)	H14
2	1	9.4.2.3.1	H9
3	1	9.4.6.3.2	H10
4	1	9.4.4.2.1	H10
5	1	9.4.6.2.3, 9.3.2.2.3	H9
6	1	9.3.1.2.1	H2
7	1	9.3.1.2.4, 14.1(f)	H14, H7
8	1	9.3.3.2.4	H7
9	1	9.3.3.2.1, 14.1(a)	H8, H14
10	1	11.2 (a)	H11
11	1	14.1 (b)	H14
12	1	9.2.1.2.3	H8, H7
13	1	9.2.4.2.5, 9.2.5.2.1, 14.1 (d),	H4, H7, H14
14	1	9.2.2.2.1, 9.2.3.2.1	H7, H8
15	1	9.2.1.2.1, 14.1 (d)	H7, H14
Section I Part B			
16 (a)	1	9.2.1.2.1, 9.2.1.2.3	H8
16 (b)	3	9.2.1.2.4	H8
17	4	9.2.4.2.4, 9.2.4.2.1, 14.1(b)	H4, H8, H14,
18	3	9.2.2.2.1, 13.1 (a)	H7, H13
19	4	9.2.4.2.5	H4, H7
20	6	9.2.3.3.2, 13.1 (c)	H7, H8, H13
21 (a)	2	9.3.4.2.4	H7
21 (b)	2	9.3.4.2.4	H7
22 (a)	1	9.3.1.2.3, 9.3.1.3.2	H7
22 (b)	2	9.3.1.2.2, 9.3.1.2.3, 12.3 (c), 14.1 (a),	H7, H12, H14
22 (c)	3	9.3.1.2.3, 14.1 (g)	H7, H14
23 (a)	1	9.3.1.2.5	H7
23 (b)	3	9.3.1.2.5	H1, H3, H7
24	6	9.3.5.3.3, 14.1 (c)	H1, H2, H7, H14
25 (a)	2	9.4.3.3.1	H1, H6, H9, H10
25(b)	3	9.4.3.3.1, 14.1 (g)	H2, H4, H9, H10, H14
26 (a) (i)	1	9.4.7.2.1	H6, H8, H10
26 (a) (ii)	2	9.4.7.2.1, 13.1(a), 14.1 (b)	H1, H6, H9, H10, H11, H14
26 (b)	4	9.4.7.2.1	H1, H6, H9, H10, H16

Question	Marks	Content	Syllabus outcomes
27	7	9.2.3.2.1, 9.4.1.2.1, 14.1 (e), 14.3 (b)	H1, H4, H6, H7 H8, H9 H10, H14
Section II **Question 28 — Introduced Species and the Australian Environment**			
(a) (i)	1	9.5.1.2.1	H10
(a) (ii)	1	9.5.6.3.1	H10
(a) (iii)	1	9.5.6.2.1	H2
(a) (iv)	1	9.5.1.2.4	H4, H10
(a) (v)	1	9.5.1.2.4	H4, H10
(b)	3	9.5.3.2.1	H4, H13, H14
(c)	4	9.5.5.2.4, 13.1 (b)	H1, H2, H3, H4, H13
(d) (i)	1	9.5.2.2.1	H7
(d) (ii)	3	9.5.2.3.1, 11.2 (c)	H2, H7, H11
(d) (iii)	2	12.4 (c), 12.4 (e)	H12
(e)	7	All 9.5, 14.3 (b)	H4, H6, H9, H10, H14
Section II **Question 29 — Organic Geology – A non-renewable Resource**			
(a) (i)	1	9.6.2.3.1	H6, H13
(a) (ii)	1	9.6.1.2.4	H6
(a) (iii)	1	9.6.1.2.3	H7
(a) (iv)	1	9.6.1.2.1	H6
(a) (v)	1	9.6.2.2.1, 9.6.2.2.3	H7
(b)	3	9.6.3.2.1, 9.6.3.2.2, 13.1 (e)	H3, H13
(c)	4	9.6.2.2.6, 13.1 (e), 14.1 (f)	H8, H13, H14
(d) (i)	1	9.6.5.3.1	H6
(d) (ii)	3	9.6.5.3.1, 11.2 (c), (d)	H6
(d) (iii)	2	12.4 (e)	H12
(e)	7	9.6.1, 9.6.5, 9.6.6, 14.1 (e), 14.3 (b)	H1, H3, H4, H5, H6, H9, H14
Section II **Question 30 — Mining and the Australian Environment**			
(a) (i)	1	9.7.3.2.4	H6
(a) (ii)	1	9.7.1.2.1	H6
(a) (iii)	1	9.7.2.2.1	H4
(a) (iv)	1	9.7.3.2.6	H6
(a) (v)	1	9.7.3.2.1	H6
(b)	3	9.7.3.2.5	H1, H6, H7, H9, H13
(c)	4	9.7.5.2.2, 9.7.4.2.1, 9.7.4.2.3, 9.7.4.3.3, 13.1 (b) (e)	H1, H2, H3, H9, H13
(d) (i)	1	9.7.3.3.3, 11.1 (b)	H7, H11
(d) (ii)	3	9.7.3.3.3, 11.2 (c), (d)	H7, H11, H13
(d) (iii)	2	12.4 (e)	H12
(e)	7	9.7.2, 9.7.3, 9.7.4, 9.7.5, 14.3 (b)	H3, H4, H5, H6, H10, H14

Question	Marks	Content	Syllabus outcomes
Section II **Question 31 — Oceanography**			
(a) (i)	1	9.8.4.2.1	H7
(a) (ii)	1	9.8.1.2.2	H7
(a) (iii)	1	9.8.6.2.3	H7
(a) (iv)	1	9.8.7.2.1, 9.8.5.3.2	H7
(a) (v)	1	9.8.5.2.1	H7
(b)	3	9.8.6.3.3, 9.8.7.2.1	H6, H7
(c)	4	9.8.5.2.3, 9.8.6.3.3, 9.8.6.2.5, 13.1 (b)	H1, H4, H6, H7, H.13
(d) (i)	1	9.8.6.3.1, 11.1 (b)	H7, H11
(d) (ii)	3	9.8.6.3.1, 11.2 (c), (d)	H7, H11,
(d) (iii)	2	12.4 (e)	H12
(e)	7	9.8.2, 9.8.3, 9.8.4, 9.8.5, 9.8.6, 9.8.7, 9.8.8, 14.3 (b)	H1, H3, H4, H5, H7, H10, H14

Section I, Part B

Question 16 (a)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Identifies correct zone	1

Sample answer:

C

Question 16 (b)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Provides features or characteristics of at least TWO mechanisms for plate movements	3
• Sketches in general terms mechanisms of plate movements OR • Provides features or characteristics of ONE mechanism	2
• Identifies mechanisms for plate movement	1

Sample answer:

Two mechanisms for movements of plates are convection currents and slab pull.
Zone A of the diagram demonstrates the slab pull where the oceanic plate is subducting below the continental plate due to the denser plate being driven by gravity.
Zone C, Zone A demonstrates the cycle of material due to the convection currents within the mantle generated by heat from the core.

Question 17

Outcomes assessed: H4, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Makes evident the relationship between the low tsunami risk and the southern eastern margin of Australia • Makes evident the relationship between the medium tsunami risk and the northwestern margin of Australia	3–4
• Describes factors related to tsunami risk related to the map	2
• Shows a basic understanding of tsunami risk	1

Sample answer:

The north western coastline of Australia is much closer to potential tsunami-forming events such as earthquakes and volcanic activity along the plate boundary while the coastline of southern Australia is much further away from the active plate boundary.

The plate boundary to the NW of the Australian continent is a convergent margin along which are focused major earthquakes and volcanic activity, whereas the plate boundary to the south of the continent does not have major earthquakes or volcanic activity.

Question 18

Outcomes assessed: H7, H13

MARKING GUIDELINES

Criteria	Marks
• Shows the differences between the plate boundaries by completing the table	3
• Shows the difference between the plate boundaries by completing TWO rows or FOUR cells	2
• Shows a basic understanding of plate boundaries by completing a row or column or TWO cells	1

Sample answer:

	Divergent plate boundary	Convergent boundary
Common rock type	Mafic (basalt)	Felsic/intermediate (andesite)
Typical geological structure	Mountain range with a central rift valley (MOR)	Young fold mountains
Type of volcanic activity	Quiet, effusive	Violent, explosive

Question 19

Outcomes assessed: H4, H7

MARKING GUIDELINES

Criteria	Marks
• Details the differences between TWO short-term effects and long-term effects	4
• Outlines the differences between long-term and/or short-term effects	3
• Describes short-term and/or long-term effects	2
• Recognises short-term and/or long-term effects	1

Sample answer:

A large volcanic eruption may cause local and short-term damage/effects from blast, lahars, pyroclastic flows or tsunami. However, the aerosols and fine ash pushed into the upper atmosphere may cause long term, world wide cooling due to their ability to reflect incoming solar radiation. CO_2 released may cause global warming. The ash that fell locally will eventually weather to form a very rich soil.

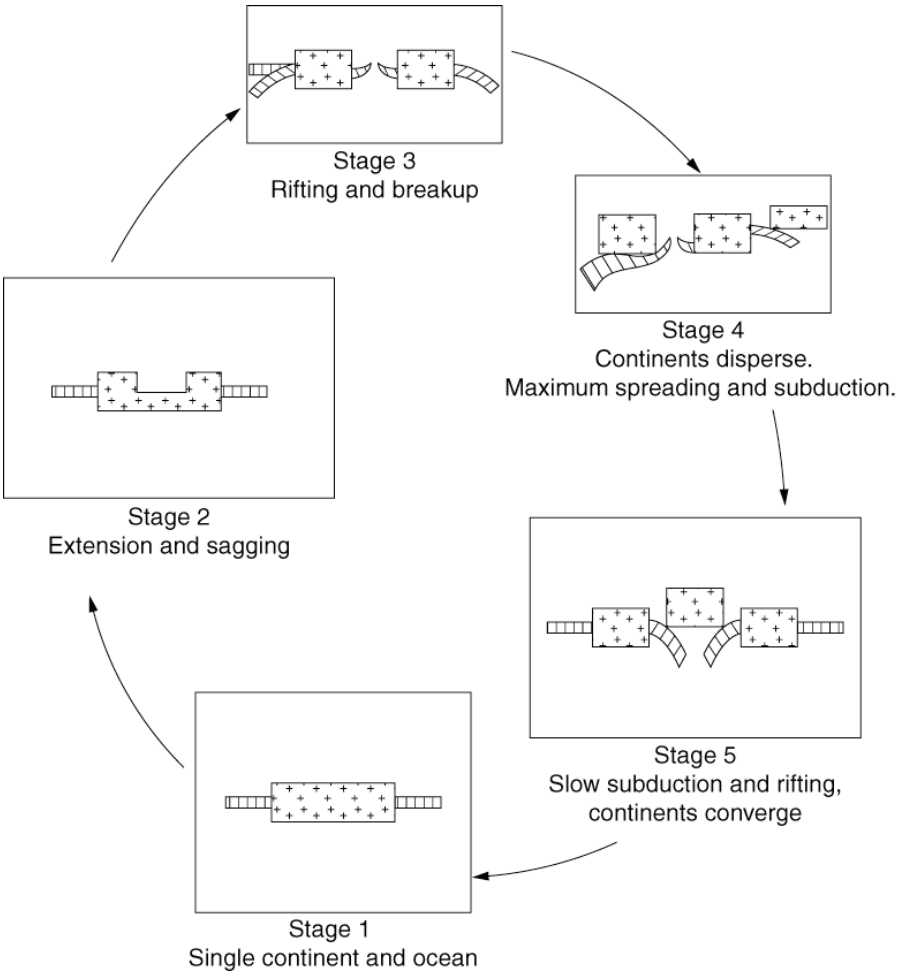
Question 20

Outcomes assessed: H7, H8, H13

MARKING GUIDELINES

Criteria	Marks
• Provides a detailed understanding of the plate tectonic super-cycle, using the appropriate stage descriptions and correctly draws the stages	5–6
• Provides a sound understanding of the plate tectonic super-cycle, using some appropriate stage descriptions and correct diagrams for some of the stages	3–4
• Provides some understanding of the plate tectonic super-cycle using ONE or TWO complete/incomplete descriptions and/or correct diagrams	1–2

Sample answer:



Question 21 (a)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Names TWO adaptations that allowed plants to colonise a terrestrial environment	2
• Names ONE adaptation	1

Sample answer:

- Waxy epidermis
- Protective coating on seeds/spores

Answers could include:

- Vascular tissue/circulatory tissue
- Support tissue

Question 21 (b)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Shows how the adaptation enabled plants to survive in a terrestrial environment	2
• Provides an outline of the appropriate adaptation	1

Sample answer:

The vascular system allowed the circulation of water, minerals and food to all cells in the plant. This contrasts with plants living in water that can access these things directly through their cells from the surrounding water.

Question 22 (a)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• States the meaning of Banded Iron Formation (BIF)	1

Sample answer:

A banded iron formation is a layered sequence of alternating thin iron oxide-rich and iron oxide-poor silicate layers.

Question 22 (b)

Outcomes assessed: H7, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Uses information from the graph to recognise and name the changes in oxygen levels	2
• Provides ONE relevant piece of information from the graph	1

Sample answer:

After 2500 million years atmospheric oxygen increases with a significant/more rapid increase after 1800 million years. After 1800 million years hydrospheric oxygen increases with a significant/more rapid increase after 1500 million years.

Question 22 (c)

Outcomes assessed: H7, H14

MARKING GUIDELINES

Criteria	Marks
• Relates in detail information of BIF formation, oxygen production from photosynthesis in stromatolites/simple photosynthetic organisms/cyanobacteria and the availability of iron	3
• Provides some understanding of the relationship between BIF formation and/or oxygen levels and/or iron availability and/or photosynthetic organisms	2
• Gives some knowledge of stromatolites or BIFs or iron availability and/or photosynthetic organisms	1

Sample answer:

Initially, stromatolites released oxygen into the oceans via the process of photosynthesis. The oxygen combined with soluble iron and precipitated as iron oxide minerals on the sea floor. The iron was derived from deep-sea vents or from the land masses. BIF formation decreased when oxygen levels were low (for example when the stromatolites were covered with calcite moulds). At this time quartz-rich layers were deposited.

Question 23 (a)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• States correctly when life first appeared on Earth according to stable isotope evidence	1

Sample answer:

• 3.8×10^9 years
OR
• 3.8 billion years
OR
• 3800 million years

Answers could include:

Anything in the range of 4.1 to 3.5 billion years
(ie 3.5×10^9 years to 4.1×10^9 years
or 3500 million years to 4100 million years)

Question 23 (b)

Outcomes assessed: H1, H3, H7

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough understanding/knowledge of relevant stable isotopes and how they can be used to indicate early life	3
• Identifies relevant stable isotopes and links them to early life	2
• Identifies relevant stable isotope information/fact	1

Sample answer:

Carbon exists in two stable isotopes, Carbon-12 and Carbon-13. Living organisms, including early life forms, concentrate the Carbon-12 isotope resulting in a Carbon-12: Carbon-13 ratio that is different (skewed towards Carbon-12) than that in non-organic materials.

Question 24

Outcomes assessed: H1, H2, H7, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a thorough knowledge of the extinction of Australian megafauna • Identifies TWO different hypotheses • Identifies the components of each hypothesis and draws out the relationship between each hypothesis and the extinction of mega fauna	5–6
• Demonstrates a sound knowledge of the extinction of Australian megafauna • Identifies TWO different hypotheses • Describes each hypothesis	3–4
• Identifies ONE or TWO hypotheses AND/OR • Recalls some simple relevant facts about the extinction of megafauna	1–2

Sample answer:

Climate change from temperate to warm and dry as Australia moved north caused changes in availability of water and gradual reduction in fauna. This put pressure on resources needed by megafauna, for example reduced water supplies in central Australian lakes. Smaller species were better suited to new conditions.

Human intervention – the size and speed of megafauna made them easy prey for early hunters and so the numbers declined while smaller forms survived and reproduced.

However, with smaller scale extinctions such as the megafauna, both events could have coincided or be accompanied by plate movements or extraterrestrial collisions.

Answers could include:

References to Diprotodon, (short-faced) giant kangaroo and giant wombat becoming extinct around 18 million years before present.

Question 25 (a)

Outcomes assessed: H1, H6, H9, H10

MARKING GUIDELINES

Criteria	Marks
• Sketches in general terms a rehabilitation strategy appropriate to a salt-affected area	2
• Identifies a rehabilitation strategy	1

Sample answer:

One strategy is to achieve equilibrium between water supply and demand by balancing water and salt removal. This can be achieved by draining small areas with high water tables or planting deep-rooted native plants.

Answers could include:

- Drip irrigation
- Land care group management
- Reduction of fallow time

Question 25 (b)

Outcomes assessed: H2, H4, H9, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Gives clear description of the scientific principles behind the strategy in 25 (a) AND • Links the principle(s) to the strategy	3
• Outlines how the strategy works OR • Gives sound knowledge of basic principles behind the rehabilitation strategy in 25 (a)	2
• Identifies ONE scientific fact related to the rehabilitation strategy in 25 (a) OR • Recalls basic knowledge about salination	1

Sample answer:

Revegetation of a salt affected area with deep-rooted native plants results in large amounts of water being absorbed. The dissolved mineral salts in the upper layers do not rise up with the water, which would happen if shallow rooted plants were planted. Native plants can survive on low water levels thus reducing the need for irrigation.

Answers could include:

Irrigation causing water table to rise can be substituted by drip irrigation that reduces the amount of water reaching the water table.

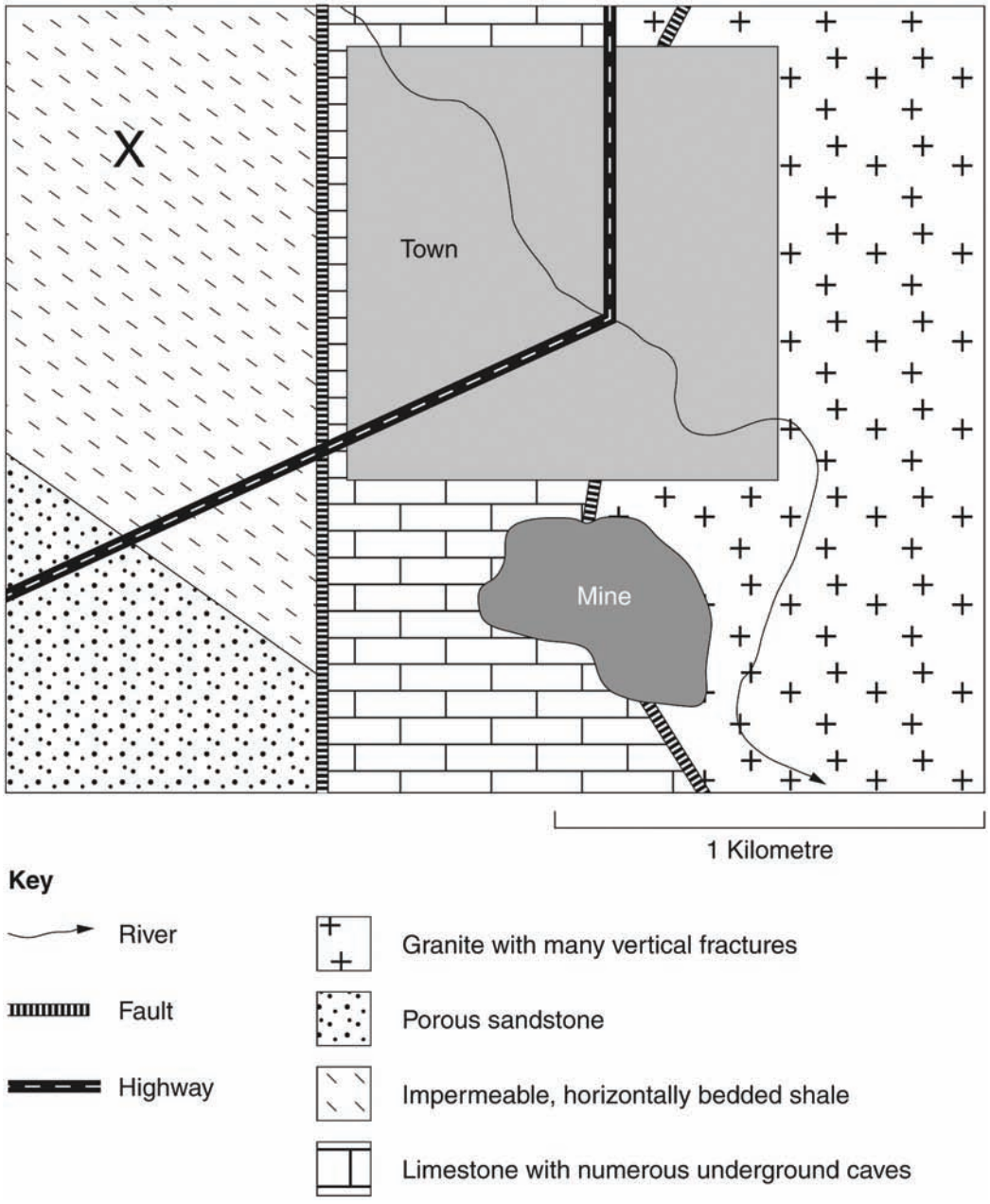
Question 26 (a) (i)

Outcomes assessed: H6, H8, H10

MARKING GUIDELINES

Criteria	Marks
• Clearly identifies an appropriate site with an X	1

Sample answer:



Question 26 (a) (ii)

Outcomes assessed: H1, H6, H8, H10, H11, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a link between the geology and the site selected	2
• Provides a feature(s) of the site selected	1

Sample answer:

Waste dumps must be sited on stable rocks that do not allow seepage from the site. The shale is a fine-grained rock that is flat (horizontally) bedded and impermeable. Liquid wastes and leachates from the dump would be less likely to seep from the site.

Answers could include:

The site is away from the town and other infrastructure. If the site was located on the porous sandstone, fractured granite or cavernous limestone materials could leach from the waste. The site is also away from the fault.

Question 26 (b)

Outcomes assessed: H1, H3, H7

MARKING GUIDELINES

Criteria	Marks
• Relates coherently the geology of the mine site, and its location, to its unsuitability as a waste disposal site	4
• Makes a weak link between the geology and its use as a waste disposal site	2–3
• Provides a relevant fact about the mine site OR • Provides ONE negative effect	1

Sample answer:

A major fault passes through the mine and liquid wastes might leak along the fault. The granite is very fractured and the limestone has numerous caverns that also may allow leaching of waste material. The mine site is close to the town and may be a health hazard.

Question 27

Outcomes assessed: H1, H4, H6, H7, H8, H9, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a detailed knowledge of relevant geological and environmental processes • Identifies a variety of components that contribute to the fragility of the Australian environment • Links causes to the effects on the environment • Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	6–7
• Demonstrates a thorough knowledge of relevant geological and environmental processes • Identifies some components that contribute to the fragility of the Australian environment • Attempts to link causes and effects • Uses appropriate terminology and logical discussion	4–5
• Demonstrates some knowledge of relevant geological and environmental processes • Describes some causes that relate to the fragile Australian environment • Uses some specific terminology	2–3
• Recalls some basic relevant fact related to geological and/or environmental processes OR • Uses some basic terminology	1

Sample answer:

The Australian continent is very old and has experienced continuous weathering and erosion for a very long time. Thus there has been a high level of leaching from the shallow and poor/infertile soils resulting in many mineral deficiencies. The rocks on which the soils formed are commonly granite and sedimentary rocks, such as sandstone and shale, all of which have low concentrations of elements needed by plants.

Modern agricultural techniques such as ploughing and over-grazing exacerbate the loss of minerals resulting in fragile environments.

Over-use of pesticides and herbicides result in the loss of native vegetation and animals that have adapted to the original conditions. Introduced species may be well adapted to Australian conditions and compete with the native species and cause further deterioration of the environment.

The Australian environment is exposed to extreme temperature ranges/climates.

Poor irrigation techniques can lead to increased salinity further affecting the fragile environment.

Answers could include:

- Land clearing
- Urbanisation
- Pollution
- Damming of streams

Section II

Question 28 (a) (i)

Outcomes assessed: H10

MARKING GUIDELINES

Criteria	Marks
• Correctly states the meaning of the term *introduced species*	1

Sample answer:

Introduced species is a species not indigenous to a particular locality.

Question 28 (a) (ii)

Outcomes assessed: H10

MARKING GUIDELINES

Criteria	Marks
• Identifies ONE role of quarantine organisations	1

Sample answer:

Modern quarantine organisations help prevent the introduction of new species to Australia.

Answers could include:

Protect agricultural industry from risk of pest and disease devastation. Protect the health of Australians from diseases.

Question 28 (a) (iii)

Outcomes assessed: H2

MARKING GUIDELINES

Criteria	Marks
• Identifies ONE quarantine practice used in Australia	1

Sample answer:

Physical inspections

Answers could include:

- Chemical sterilisation treatment
- X-raying unopened containers

Question 28 (a) (iv)

Outcomes assessed: H4, H10

MARKING GUIDELINES

Criteria	Marks
• Sketches in general terms how an organism can be accidentally brought into Australia	1

Sample answer:

Insect larvae inside wooden products such as furniture coming from Asia can escape from that product when it reaches Australia.

Answers could include:

- Organisms in ballast water
- Transport by aircraft of flying insects such as mosquitoes or other parasites inside a human host

Question 28 (a) (v)

Outcomes assessed: H4, H10

MARKING GUIDELINES

Criteria	Marks
• Gives ONE reason for the deliberate introduction of a an organism brought into Australia	1

Sample answer:

Early travellers and settlers brought animals such as pigs and plants as a food source

Answers could include:

- Acclimatisation issues
- Ornamental
- Medicinal
- Animals to act as pollinators
- Biological control

Question 28 (b)

Outcomes assessed: H4, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Relates features of an introduced animal to conditions of the Australian environment	3
• Describes conditions of the Australian environment or feature of an introduced organism that leads to the successful spread of that animal	2
• Identifies ONE condition that leads to introduced organisms success	1

Sample answer:

Feral cats filled a niche as top carnivore in Australian environments. Cats have few native predators, abundant food supply of native marsupials, reptiles and birds and a rapid breeding rate. This has led to an increase in the population size of feral cats who have out-competed native predators resulting in the demise of the latter.

Question 28 (c)

Outcomes assessed: H1, H2, H3, H4, H13

MARKING GUIDELINES

Criteria	Marks
• Constructs a flow diagram that a correctly shows the history of Prickly Pear from its introduction to its successful control • Identifies Cactoblastis as the biological control	4
• Constructs a flow diagram that identifies the significant events that have taken place in the control of Prickly Pear	3
• Provides some knowledge of Prickly Pear as a pest species	2
• Identifies a stage in the control of Prickly Pear OR • Identifies the biological control	1

Sample answer:

1839 – Prickly Pear introduced into New South Wales as a pot plant
1915 – Spread of the plant across Queensland and New South Wales
1920 – Government established a Prickly Pear Board to combat the spread. Investigation of biological control commences
1926 – Release of Cactoblastis moth as a biological control. Larvae bore into the plant eating them from the inside
1928 – 1930 – Widespread release of Cactoblastis
1933 – Last primary stands of Prickly Pear eliminated from Qld
1940 – Prickly Pear numbers controlled and managed

Question 28 (d) (i)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Correctly names TWO components	1

Sample answer:

- Water quality
- Light

Answers could include:

- Soil quality
- Soil compaction

Question 28 (d) (ii)

Outcomes assessed: H2, H7, H11

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of an appropriate procedure • Includes the names of specific equipment/chemicals needed to carry out the investigation	3
• Outlines the steps involved to carry out the investigation	2
• Identifies step(s) involved in carrying out the investigation	1

Sample answer:

1. Select a test area of soil where an introduced plant species is abundant and a second area where the introduced species is absent.
2. Collect a spoonful of soil from each area and place into separate labelled petri dishes.
3. Place goggles on before handling chemical equipment.
4. Add a few drops of universal indicator to each soil sample and use separate stirring rods mix the indicator with the soil.
5. Sprinkle barium sulfate powder over each soil sample.
6. Allow a few minutes for the universal indicator to soak into the barium sulphate and then observe the colour of the powder.
7. Compare this colour to a pH chart and record your result.
8. Repeat this test several times and compare your results with other groups.

Answers could include:

- Measuring light, wind speed
- Soil moisture

Question 28 (d) (iii)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Provides a judgement of the reliability of the data	2
• Identifies a method of improving the reliability of data	1

Sample answer:

By repeating the investigation under similar conditions you should hopefully obtain similar sets of data. This similar data improves the reliability of the results gained from the investigation. The more repetition the greater the reliability if the data collected is of a similar nature.

Question 28 (e)

Outcomes assessed: H4, H6, H9, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive and detailed knowledge of the impact of a named introduced animal on the Australian environment • Identifies a number of effects that contribute to this impact • Links the causes to the effects on the environment • Uses appropriate terminology in a coherent and logical argument	6–7
• Demonstrates a sound knowledge of relevant details of a named introduced animal and its impact on the environment • Identifies some effects that contribute to the environmental impact of the introduced animal • Attempts to link cause and effect of the animal on the environment • Uses appropriate terminology and logical discussion	4–5
• Demonstrates some knowledge of some environmental implications of an introduced organism AND • Describes some causes that relate to environmental issues AND/OR • Uses some specific terminology	2–3
• Recalls some basic relevant facts related to the Australian environment OR • Names an introduced organism OR • Uses some basic terminology	1

Sample answer:

Cane Toad

In 1935, 101 cane toads were brought into Australia from South America to control two types of sugar cane beetle pests. The toads were bred in captivity and 60,000 toads were released into 11 cane growing areas in Queensland.

The cane toad was well adapted to Australian conditions. It had no native predators and reproduced rapidly because it laid many eggs, up to 30,000 per month. The toads spread rapidly throughout coastal Queensland and by the 1980s had spread into the Northern Territory and recently to Western Australia.

The toad eats many native species including insects, lizards, snakes and mice. The toads are tolerant of many physical conditions, including water salinity and exert great pressure on the environment.

The rapid and extreme spread of the toad has resulted in the loss of many native species from the areas it has invaded because the large numbers require a huge food resource. It also produces poisons that kill many native species that try to eat it.

Question 29 (a) (i)

Outcomes assessed: H6, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly names an area	1

Answers could include:

Australia: Bass Strait, Cooper Basin, North-west Shelf, Surat Basin
Overseas: Persian Gulf, North Sea

Question 29 (a) (ii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies ONE component	1

Sample answer:

Carbon

Question 29 (a) (iii)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• States the meaning of the term *fossil fuel*	1

Sample answer:

A fuel derived from altered/preserved plant and/or animal remains.

Question 29 (a) (iv)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• States the meaning of the term *non-renewable*	1

Sample answer:

Non-renewable means a resource or substance that cannot be replaced within a reasonable time ie a human lifetime.

Question 29 (a) (v)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Provides ONE common condition	1

Sample answer:

Coal and oil both form under anaerobic conditions

Answers could include:

Form under water

Question 29 (b)

Outcomes assessed: H3, H13

MARKING GUIDELINES

Criteria	Marks
• Describes and shows how TWO methods are similar or different	3
• Identifies TWO methods OR • Describes ONE method	2
• Identifies ONE method	1

Sample answer:

Seismic exploration

Seismic profiles are produced from recordings of the time it takes compression waves to be reflected from various layers within the Earth's crust. Waves are reflected from the boundaries between rock layers. Coal seams are good reflectors and can be identified on seismic profiles. Oil trap can be identified by the geometry of the rock layers.

Drilling

Drill holes intersect rock layers and the properties of the rocks can be determined. Both coal and oil reservoir rocks can be identified from core or geophysical logging.

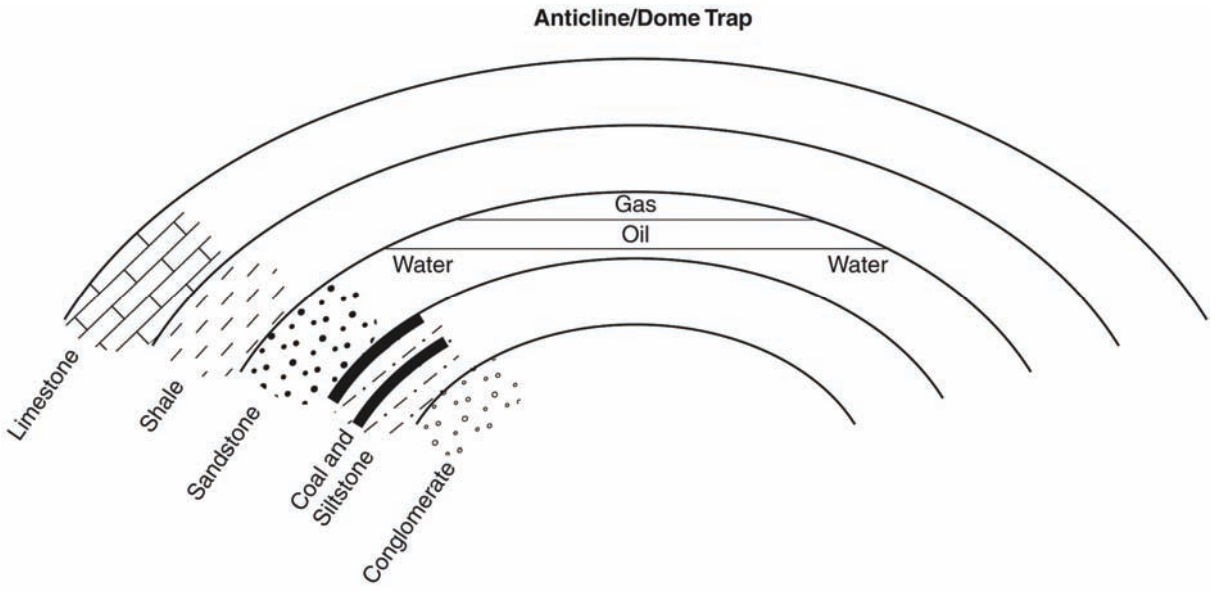
Question 29 (c)

Outcomes assessed: H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Draws a trap with correct labels and uses rocks from the column	4
• Draws a correct trap with correct labels or uses rocks in column correctly	2–3
• Identifies any oil trap	1

Sample answer:



Answers could include:

Fault, salt dome, pinch-out, tight sands.

Question 29 (d) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Names TWO products	1

Sample answer:

Carbon dioxide and water

Question 29 (d) (ii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of an appropriate procedure • Includes the names of specific equipment/chemicals needed to carry out the investigation • Safe work practices included where appropriate	3
• Outlines the steps involved to carry out the investigation	2
• Identifies step(s) involved in carrying out the investigation	1

Sample answer:

Combustion of Methane

1. Light a bunsen burner and allow it to burn with the air hole open on a heat-proof mat.
2. Collect the gases using a gas hood (complete combustion)
3. Close the air hole on the bunsen burner and allow it to burn
4. Collect the gases using a gas hood (incomplete combustion)
5. Test the gases produced with lime water to test for carbon dioxide and cobalt chloride paper to test for water vapour.
6. Check the gas hood for soot (unburnt carbon)

Goggles and aprons should be worn and the procedure carried out in a fume cupboard.

Question 29 (d) (iii)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Provides a judgement of the reliability of the data	2
• Identifies a method of improving the reliability of data	1

Sample answer:

By repeating the investigation under similar conditions you should hopefully obtain similar sets of data. This similar data improves the reliability of the results gained from the investigation. The more repetition the greater the reliability if the data collected is of a similar nature.

Question 29 (e)

Outcomes assessed: H1, H3, H4, H5, H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive and detailed knowledge of fossil fuels, alternative energy sources and electricity generation • Identifies a number of effects that would occur if electricity from fossil fuels is replaced by alternative sources of energy • Links the causes to the effects if the replacement takes place • Uses appropriate terminology in a coherent and logical argument	6–7
• Demonstrates a sound knowledge of relevant details about the generation of electricity • Identifies some effects that would occur if electricity from fossil fuels is replaced with electricity from another source • Uses appropriate terminology and logical discussion	4–5
• Demonstrates some knowledge of some aspects of electricity generation AND • Describes some causes that relate to the replacements of fossil fuel with alternative source generation AND/OR • Uses some specific terminology	2–3
• Recalls some basic relevant facts related to the generation of electricity OR • Names an alternative source for generation of electricity OR • Uses some basic terminology	1

Answers could include:

- Describe emissions produced when electricity is generated from fossil fuels such as coal – CO_2, SO_2 and NO_2 gases, particularly materials from chimneys, unburnt residues or ash.

- Describe the effects these have on the local or global environment; for example CO_2 leads to global warming, chimney particulates contain toxic elements such as mercury.

- Describe the emissions, if any, from alternative sources of energy.

- Evaluate the impact of changing to alternative sources of energy; for example cost of setting up infrastructure, impact on the environment, running costs, reduced pollution, advantages/disadvantages of alternative sources of energy.

Question 30 (a) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Defines an *ore*	1

Sample answer:

A rock containing an economically viable mineral or element

Question 30 (a) (ii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies a locality	1

Sample answer:

Cadia

Answers could include:

Brown's Creek, Copper Hill

Question 30 (a) (iii)

Outcomes assessed: H4

MARKING GUIDELINES

Criteria	Marks
• Correctly names ONE decision	1

Sample answer:

Mabo decision

Question 30 (a) (iv)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correctly defines *grade of ore*	1

Sample answer:

The proportion of ore minerals to gangue minerals in a rock/ore

Question 30 (a) (v)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• States the meaning of the term *renewable resource*	1

Sample answer:

A renewable resource is one that can be replaced within a reasonable time for example, one human lifetime.

Question 30 (b)

Outcomes assessed: H1, H6, H7, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Gives the difference between an ore mineral and a gangue mineral • Describes how a gangue mineral can become an ore mineral	3
• Gives the difference between gangue and ore minerals	2
• Identifies a gangue mineral and/or an ore mineral	1

Sample answer:

An ore contains at least one mineral that can be processed into a commodity and other minerals (gangue) that have no economic value at the present time although they may contain the same elements but in a lower proportion.

Gangue minerals can become ore minerals if:

i. An existing ore mineral is exhausted

ii. The price of a commodity increases making a gangue mineral now economic

iii. A new commodity is used and can be processed from a previous gangue mineral

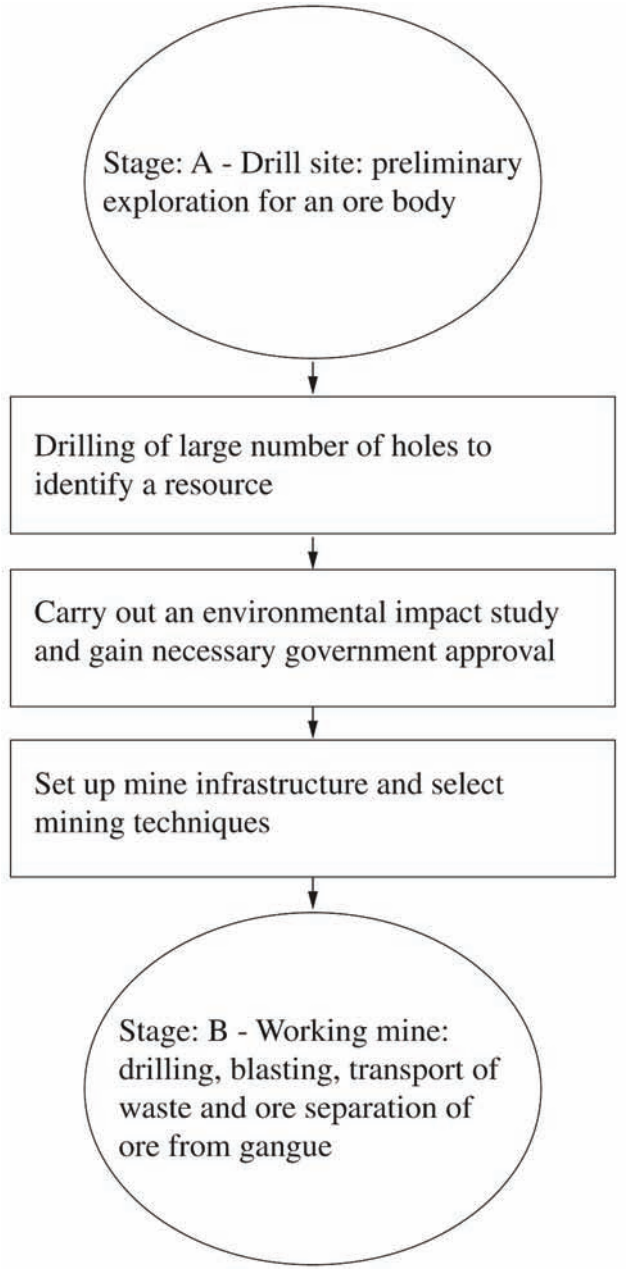
Question 30 (c)

Outcomes assessed: H1, H2, H3, H4, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Constructs a flow diagram that correctly identifies the stages in the photographs • Shows other stages in developing a mine from exploration to exploitation the ore	4
• Constructs a flow diagram that identifies the stages shown in A and B, with at least one intermediate stage	3
• Provides some knowledge of drilling programs and/or mining	1–2

Sample answer:



Question 30 (d) (i)

Outcomes assessed: H7, H11

MARKING GUIDELINES

Criteria	Marks
• Names TWO techniques	1

Sample answer

- Density (SG) determination
- Physical properties (such as magnetic properties)

Question 30 (d) (ii)

Outcomes assessed: H7, H11, H13

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of an appropriate procedure • Includes the names of specific equipment/chemicals needed to carry out the investigation • Safe work practices included where appropriate	3
• Outlines the steps involved to carry out the investigation	2
• Identifies step(s) involved in carrying out the investigation	1

Sample answer:

Copper Ore

1. Take a piece of rock that contains a copper mineral such as malachite
2. Crush the rock to separate the various component minerals and place in a beaker
3. Carefully add dilute sulfuric acid to the beaker
4. Separate and filter the solid residue from the solution
5. Place some iron in the solution and identify copper as a pink covering on the iron
6. Use safety goggles and take care when handling the acid

Question 30 (d) (iii)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Provides a judgement of the reliability of the data	2
• Identifies a method of improving the reliability of data	1

Sample answer:

By repeating the investigation under similar conditions you should hopefully obtain similar sets of data. This similar data improves the reliability of the results gained form the investigation. The more repetition the greater the reliability if the data collected is of a similar nature.

Question 30 (e)

Outcomes assessed: H3, H4, H5, H6, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive and detailed knowledge of Government policies on mining in Australia • Identifies a number of policies that effect mining operations in Australia • Links the causes to the effects of these policies • Uses appropriate terminology in a coherent and logical argument	6–7
• Demonstrates a sound knowledge of Government policies on mining in Australia • Identifies some policies that effect mining operations in Australia • Attempts to link cause and effect of these policies • Uses appropriate terminology in a logical discussion	4–5
• Demonstrates some knowledge of Government policies on mining AND operations in Australia • Describes some policies that relate to mining operations in Australia AND/OR • Uses some specific terminology	2–3
• Recalls some basic relevant facts related to Government policies OR mining operations in Australia OR • Uses some basic terminology	1

Answers could include:

- Identification of specific local, state and federal policies relating to mining
- These could include laws regarding infrastructure, environmental protection, royalties, access to land, Native Title, environmental impact studies
- Each of these need to be discussed in light of the effect of each ONE on the mining company's application to mine, cost of mining, size of mine, mining methods
- Government policies need to be separated into areas they are most concerned with

ie Local ➔ access
State ➔ environmental
Federal ➔ Native Title

Question 31 (a) (i)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Identifies ONE type of mass motion of water in the oceans	1

Sample answer:

Surface currents

Answers could include:

- Deep circulation
- Tides
- Tsunamis

Question 31 (a) (ii)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• States the proportion of the Earth covered by oceans	1

Sample answer:

Approximately 71%

Answers could include:

7/10, 70%

Question 31 (a) (iii)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Identifies ONE substance that scavenges elements from the ocean rocks	1

Sample answer:

Brine

Answers could include:

- Hydrothermal water
- Hydrothermal fluids
- Water

Question 31 (a) (iv)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• Identifies ONE potential mineral resource formed on the ocean floor	1

Sample answer:

Manganese nodules

Answers could include:

- Sulfides
- Gold

Question 31 (a) (v)

Outcomes assessed: H7

MARKING GUIDELINES

Criteria	Marks
• States the meaning of the term *community of organisms*	1

Sample answer:

A community of organisms is the interrelationship between different species (or organisms).

Question 31 (b)

Outcomes assessed: H6, H7

MARKING GUIDELINES

Criteria	Marks
• Demonstrates a sound understanding of both calcareous and siliceous oozes in the oceans • Relates each ooze to its distribution	3
• Provides a basic understanding of both calcareous and siliceous oozes OR • Gives a sound understanding of ONE ooze OR • Relates at least ONE ooze to its distribution	2
• Gives a basic understanding of ONE type of ooze OR • Relates ONE type of ooze to its distribution	1

Sample answer:

Calcareous ooze occupies 35% of the ocean floor and is composed of precipitated calcium carbonate (calcite) and/or shell material. It is formed in shallow warm water. Siliceous ooze occupies 15% of the ocean floor and is composed of precipitated quartz or shells. It is formed in deeper and colder water than calcareous ooze.

Question 31 (c)

Outcomes assessed: H1, H4, H6, H17, H13

MARKING GUIDELINES

Criteria	Marks
• Constructs an appropriate table providing a thorough understanding of a food chain in the top layers of the ocean AND a food chain near a hydrothermal vent • Provides the similarities AND/OR differences of both	4
• Constructs a table providing a basic understanding of a food chain in the top layers of the ocean AND a food chain near a hydrothermal vent	3
• Describes a food chain in the top layers of the oceans AND/OR • Describes a food chain near a hydrothermal vent AND/OR • Provides ONE similarity or difference between the TWO food chains	1–2

Sample answer:

Order	Top Ocean Layer	Hydrothermal Vent
Second Order Consumer	Small predator (fish)	Small predators (fish/crab/starfish)
First Order Consumer	Herbivore/Browser/Plant eating animal (fish)	Bottom dwellers/sediment feeders (worm)
Producer	Photosynthetic Plants (algae)	Chemosynthetic organisms (bacteria)

Question 31 (d) (i)

Outcomes assessed: H7, H11

MARKING GUIDELINES

Criteria	Marks
• Correctly names TWO factors	1

Sample answer:

- Temperature difference
- Mass of solid

Answers could include:

- Volume of water
- Volume of solid
- Surface area of solid

Question 31 (d) (ii)

Outcomes assessed: H7, H11

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of an appropriate procedure • Includes the names of specific equipment/chemicals needed to carry out the investigation • Safe work practices included where appropriate	3
• Outlines the steps involved to carry out the investigation	2
• Identifies step(s) involved in carrying out the investigation	1

Sample answer:

1. Obtain different sized cubes made from the same type of metal. Determine the surface area and volume of each cube.
2. Put on safety goggles.
3. Place the cubes into beaker of continually boiling water ensuring they are completely submerged.
4. Transfer ONE cube into a beaker of cool tap water of known temperature and volume. Use metal tongs for the transfer to avoid burns to skin.
5. Monitor the temperature change of the water in the beaker using a data logger and temperature probe or a hand held thermometer until the temperature ceases to rise.
6. Repeat using the other cubes and similar volume and temperature of cool water.
7. Compare the results gained with other student groups in the class.
8. Record the trend in data.

Question 31 (d) (iii)

Outcomes assessed: H12

MARKING GUIDELINES

Criteria	Marks
• Provides a judgement of the reliability of the data	2
• Identifies a method of improving the reliability of data	1

Sample answer:

By repeating the investigation under similar conditions you should hopefully obtain similar sets of data. This similar data improves the reliability of the results gained from the investigation. The more repetition the greater the reliability if the data collected is of a similar nature.

Question 31 (e)

Outcomes assessed: H1, H3, H4, H5, H6, H7, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Demonstrates an extensive and detailed knowledge of relevant new technologies and ocean environments • Identifies a number of technologies that contribute to our understanding of ocean environments • Links the impacts of new technologies to the information gained • Uses appropriate terminology in a coherent and logical argument	6–7
• Demonstrates a sound knowledge of relevant new technologies and ocean environments • Identifies some technologies that contribute to our understanding of ocean environments • Attempts to link impacts of new technologies to the information gained • Uses appropriate terminology and logical discussion	4–5
• Demonstrates some knowledge of technologies and ocean environments • Describes some technologies that increase our understanding of ocean environments • Uses some specific terminology	2–3
• Recalls ONE or more basic relevant fact related to new technologies ocean environments OR • Uses some specific terminology	1

Sample answer:

New technologies provide greater detail or better and newer information about the ocean floor, the ocean water and its physical properties. This permits us to better understand the oceans and this will result in better use of resources, less degradation of the various ocean environments and increased understanding of ocean communities. Examples such as:

- Echo sounding/PDR sonar. This technology allows us to determine the topography of the ocean floor, structures and features
- Sampling (core samples, grab samples, dredging). New sampling techniques allow us to get samples from greater depths and samples that are less contaminated. This allows us to determine more accurately the physical properties of ocean sediments and rocks, the composition and identify potential resources
- Satellite imagery and remote sensing. These techniques provide data that can provide better interpretations of weather, ocean, currents, wind patterns and temperature

Answers could include:

- Niskin Bottle
- Research vessels and submarines
- Geophysical techniques such as magnetometer, seismic surveys