



Western Australian Certificate of Education Examination, 2013

Question/Answer Booklet

INTEGRATED SCIENCE

Stage 3

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

Formulae and Data Sheet

Number of additional answer booklets used (if applicable):

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the WACE examinations

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	30	20	20
Section Two: Short response	5	5	90	85	50
Section Three: Extended response	2	2	60	65	30
Total					100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2013*. Sitting this examination implies that you agree to abide by these rules.

- 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, then shade your new answer. Do not erase or use correction fluid/tape. 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.

- 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.
- 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 that you are continuing to answer at the top of the page.
- The Formulae and Data sheet is **not** handed in with your Question/Answer Booklet.

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, then shade your new answer. Do not erase or use correction fluid/tape. 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: 30 minutes.

1. A mineral resource can become a reserve if
 - (a) world prices fall and more consumption is encouraged.
 - (b) the ore body can be mined economically.
 - (c) new uses can be found for the extracted mineral.
 - (d) it can be mined by new techniques, such as open-cut mining.

2. The mineral sands of Western Australia contain zircon, rutile and some ilmenite, which have a variety of uses. Which of the following statements is **most** correct?
 - (a) Ilmenite and rutile are used to make fine grade sandpapers.
 - (b) Only rutile can be used to make titanium dioxide, a component of paint.
 - (c) Ilmenite and rutile are both used to make titanium dioxide, a component of paint.
 - (d) Rutile is used to make titanium dioxide, a component of paint, and ilmenite is melted to produce fine glass.

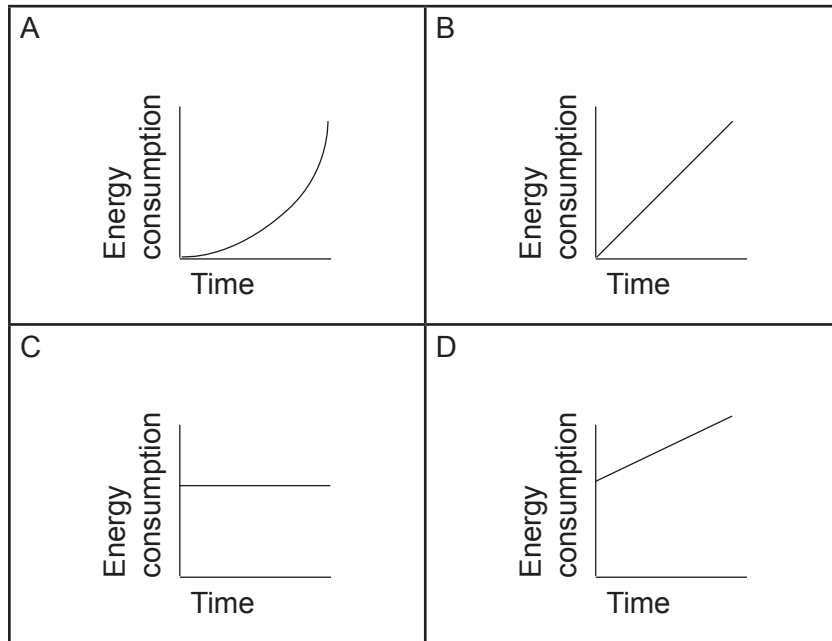
3. In 2012, the United States consumed more energy than ever but lowered its carbon dioxide output. It achieved this change by switching from coal to natural gas (which is mostly methane) for some of its energy requirements. The carbon dioxide output decreased because
 - (a) coal is a fossil fuel but methane is not.
 - (b) methane produces no carbon dioxide when it is burnt.
 - (c) methane produces less carbon dioxide when it is burnt.
 - (d) methane is a gas and coal is a solid.

4. A planet has a high proportion of carbon dioxide in its atmosphere and an average surface temperature of 462° C. Carbon dioxide contributes to the planet's high temperature because it
 - (a) blankets the planet and prevents heat escaping.
 - (b) allows heat onto the surface but does not let any escape.
 - (c) allows visible light to reach the surface but absorbs and re-radiates escaping heat.
 - (d) captures and re-radiates the incoming visible light, keeping the planet warm.

See next page

5. For a chain reaction to continue in a pressurised water nuclear reactor, a minimum of one neutron from each fission reaction must produce another fission reaction. The **best** description of the role of control rods in this process is that they
- (a) absorb neutrons produced by the fission reaction.
 - (b) control the speed of the neutrons so that the reaction can continue.
 - (c) determine the amount of heat that can be absorbed by the coolant.
 - (d) control the depth of the fuel rods, which changes the rate of the chain reaction.
6. Veronica was reviewing some data she collected during an investigation of the population of spotted quolls. She noticed that there was an outlying data point. When calculating the average of the dataset she should
- (a) include the outlier in the calculation because the dataset is large.
 - (b) remove the five largest and five lowest data points.
 - (c) remove the outlier before calculating the average.
 - (d) calculate the average only after she had adjusted the value of the outlier to fit the trend of the data.
7. The rate of flow of charged particles through a conductor is called
- (a) current.
 - (b) voltage.
 - (c) resistance.
 - (d) power.
8. Which one of the following statements regarding the original source of coal and oil is correct?
- (a) Coal and oil are both derived from fossilised plants.
 - (b) Coal comes from plants, oil from algae.
 - (c) Coal comes from animal remains, oil from algae.
 - (d) Coal comes from plants, oil from animal remains.
9. To determine the population of kangaroo mice at a mine site, a system of traps was set up overnight. In total, 80 kangaroo mice were caught. They were tagged by placing small plastic bands on their legs. Exactly seven days later, kangaroo mice were again trapped overnight and 90 were caught, including 46 that had been tagged the previous week. The population of kangaroo mice was approximately
- (a) 121.
 - (b) 41.
 - (c) 52.
 - (d) 157.

10. Which one of the following graphs **best** represents growth in energy consumption in Australia over the last 100 years?



- (a) A
- (b) B
- (c) C
- (d) D

11. Most scientists think that climate change is caused by

- (a) increasing sea levels.
- (b) the enhanced greenhouse effect.
- (c) changing weather patterns.
- (d) the hole in the ozone layer.

12. The term 'peak oil' refers to the

- (a) time when oil will be in short supply.
- (b) time when daily oil production is at a maximum.
- (c) way oil production is continuing to increase.
- (d) time when oil will be most expensive.

13. During the process of developing a mine, a number of investigations are undertaken to develop an environmental impact statement (EIS). Which one of the following investigations would **not** form part of the EIS?
- (a) plants and animals located in the area
 - (b) indigenous artefacts located in the area
 - (c) community views about the mine
 - (d) economic viability of the mine

14. An air conditioner carries the following label

240 volt
2880 watt

- If you were to operate this air conditioner for 8 hours, what would be the cost of the electricity if it is purchased at 32 cents per kilowatt-hour?
- (a) \$7372.00
 - (b) 92.18 cents
 - (c) \$14.12
 - (d) \$7.37
15. What current does the air conditioner described in Question 14 draw?
- (a) 3120 A
 - (b) 691 200 A
 - (c) 12 A
 - (d) 0.08 A
16. Peter had a sample of iron ore with a known iron content of 66%. He sent this sample to a laboratory to check the accuracy and precision of their equipment. The laboratory measured the iron ore content of the sample three times and returned results of 69.9%, 70% and 70.2%. The laboratory equipment measured the sample with
- (a) high precision and low accuracy.
 - (b) high precision and high accuracy.
 - (c) low precision and low accuracy.
 - (d) low precision and high accuracy.
17. A sample of iron ore is composed of iron(III) oxide, Fe_2O_3 . What is the approximate percentage of iron in this ore?
- (a) 40%
 - (b) 50%
 - (c) 70%
 - (d) 80%

18. Bauxite is typically strip-mined because
- (a) bauxite deposits are found near the surface.
 - (b) it is mostly found underground in long thin strips.
 - (c) overburden removal in open cut-mines is too expensive when the ore body is at large depths.
 - (d) bauxite mines are often in environmentally sensitive areas.
19. The decay of uranium-235 to lead-207 can be used by geochemists to estimate the age of meteorites. The half-life of uranium-235 is 704 million years. If a meteorite originally contained 150 mg of uranium-235 when it was formed and now contains 37.5 mg of uranium-235, the age of the meteorite is approximately
- (a) 5557 million years.
 - (b) 2100 million years.
 - (c) 2800 million years.
 - (d) 1400 million years.
20. In 2006, Alexander Litvinenko, a former Russian agent, was killed by polonium-210, which emits alpha radiation but not beta or gamma radiation. Which of the following methods could the assassins have used to kill Litvinenko with polonium-210?
- (a) add it to his asthma puffer or place a vial of it underneath his bed
 - (b) place a vial of it underneath his bed or add it to his cup of tea
 - (c) add it to his asthma puffer or wash his clothes in it
 - (d) add it to his asthma puffer or add it to his cup of tea

End of Section One

See next page

Section Two: Short response

50% (85 Marks)

This section has **five (5)** 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 page 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 that you are continuing to answer at the top of the page.

Suggested working time: 90 minutes.

Question 21**(11 marks)**

- (a) List **three** design features that influence the energy efficiency of a building. (3 marks)

One: _____

Two: _____

Three: _____

- (b) Turning off appliances is one way of reducing energy consumption in a home. List **four** other methods of reducing energy consumption. (4 marks)

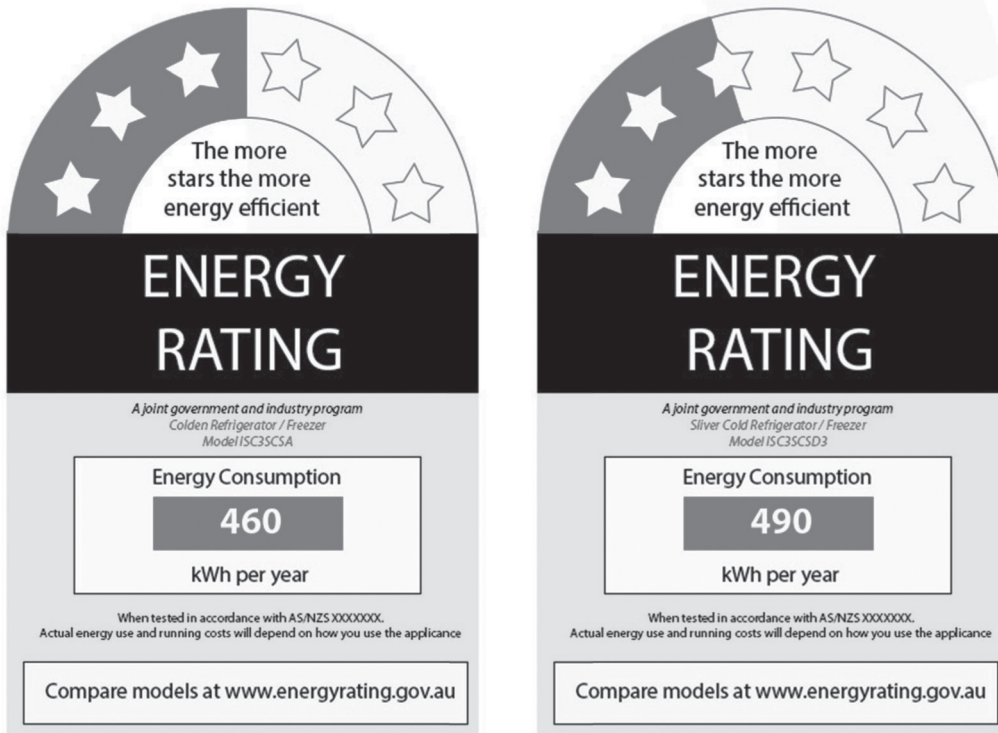
One: _____

Two: _____

Three: _____

Four: _____

- (c) Your household is considering purchasing a new refrigerator, as your current refrigerator needs replacing. Your choice has been narrowed down to two models, whose energy rating labels are shown below. You have been asked your opinion as to which one will cost less to operate.



Model A

Model B

- (i) If both refrigerators cost the same, which refrigerator would you choose to reduce your operating costs? (1 mark)

- (ii) Explain the reason for your decision in (i). (1 mark)

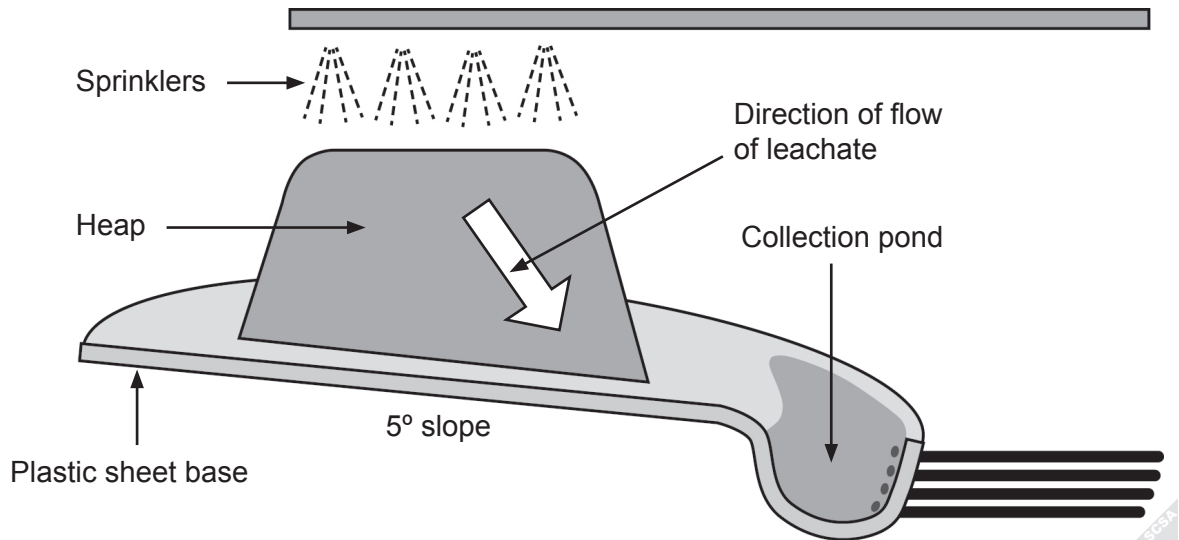
- (iii) If electricity costs 32 cents per kWh and refrigerators use electricity only 10% of the time, calculate the cost of running Model A for 1 year. (2 marks)

Question 22

(23 marks)

Copper mining companies sometimes use bioleaching as a way of exploiting low-grade ores and mineral resources in areas that would otherwise be too expensive to mine.

This diagram represents a typical bioleaching process.



- (a) Name **two** substances that are delivered by the sprinklers. (2 marks)

One: _____

Two: _____

- (b) Explain why the heap has a plastic base with a 5° slope. (2 marks)

- (c) Explain why this process is called 'bioleaching' rather than simply 'leaching'. (1 mark)

- (d) Explain how this process extracts copper as soluble leachate even though the copper ore was insoluble. (3 marks)

- (e) List **three** environmental hazards associated with this type of operation. (3 marks)

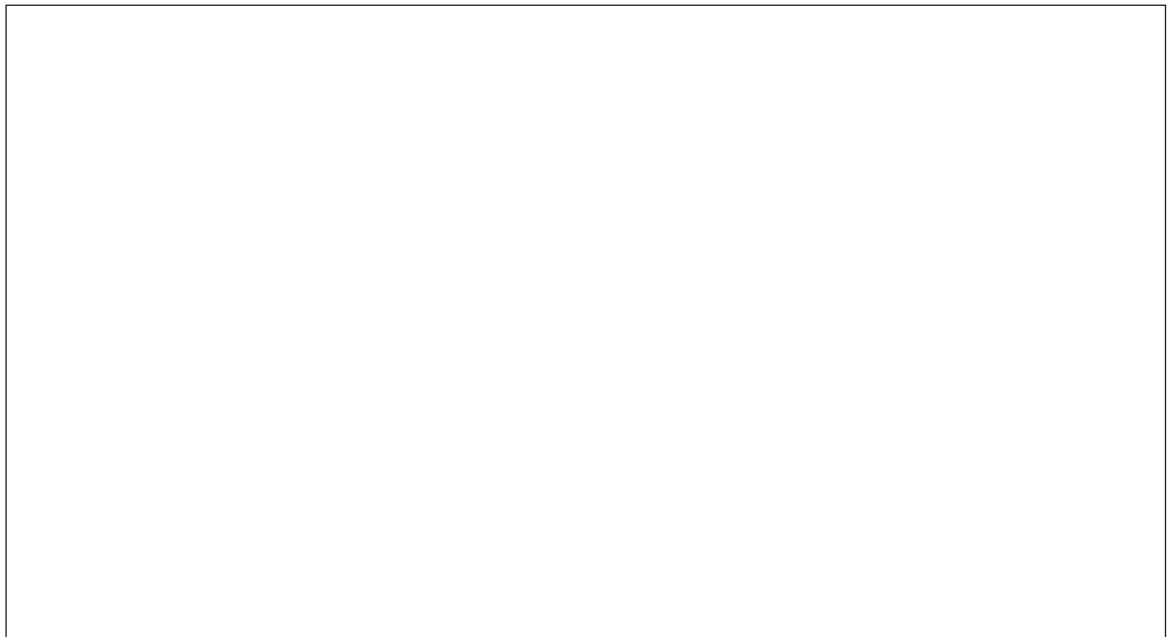
One: _____

Two: _____

Three: _____

- (f) After the copper solution is obtained from the bioleaching process, the copper is extracted from solution using an oxidation-reduction process called electrolysis. Explain what happens when a reactant is reduced. (1 mark)

- (g) Electrolysis is an oxidation-reduction reaction. Draw a diagram of a copper electrolysis cell. Include the anode, cathode, electrolyte and power supply. (6 marks)



- (h) Write the half equation to show the reaction occurring at the cathode in the copper cell. (2 marks)

Cathode: _____

- (i) Aluminium is also produced by electrolysis. Identify **three** ways in which the process of electrolysis of alumina differs from the electrolytic extraction of copper. (3 marks)

One: _____

Two: _____

Three: _____

Question 23

(18 marks)

Fukushima, Japan is the location of a former nuclear power station that was badly damaged by a tsunami in 2011. Fukushima has been contaminated by radioactive materials.

- (a) Explain what is meant by the term 'radioactive'. (4 marks)

- (b) Before the incident at Fukushima, protective equipment and practices were used to reduce workers' exposure to radiation in the plant. List **five** ways in which workers could have reduced their exposure to radiation. (5 marks)

One: _____

Two: _____

Three: _____

Four: _____

Five: _____

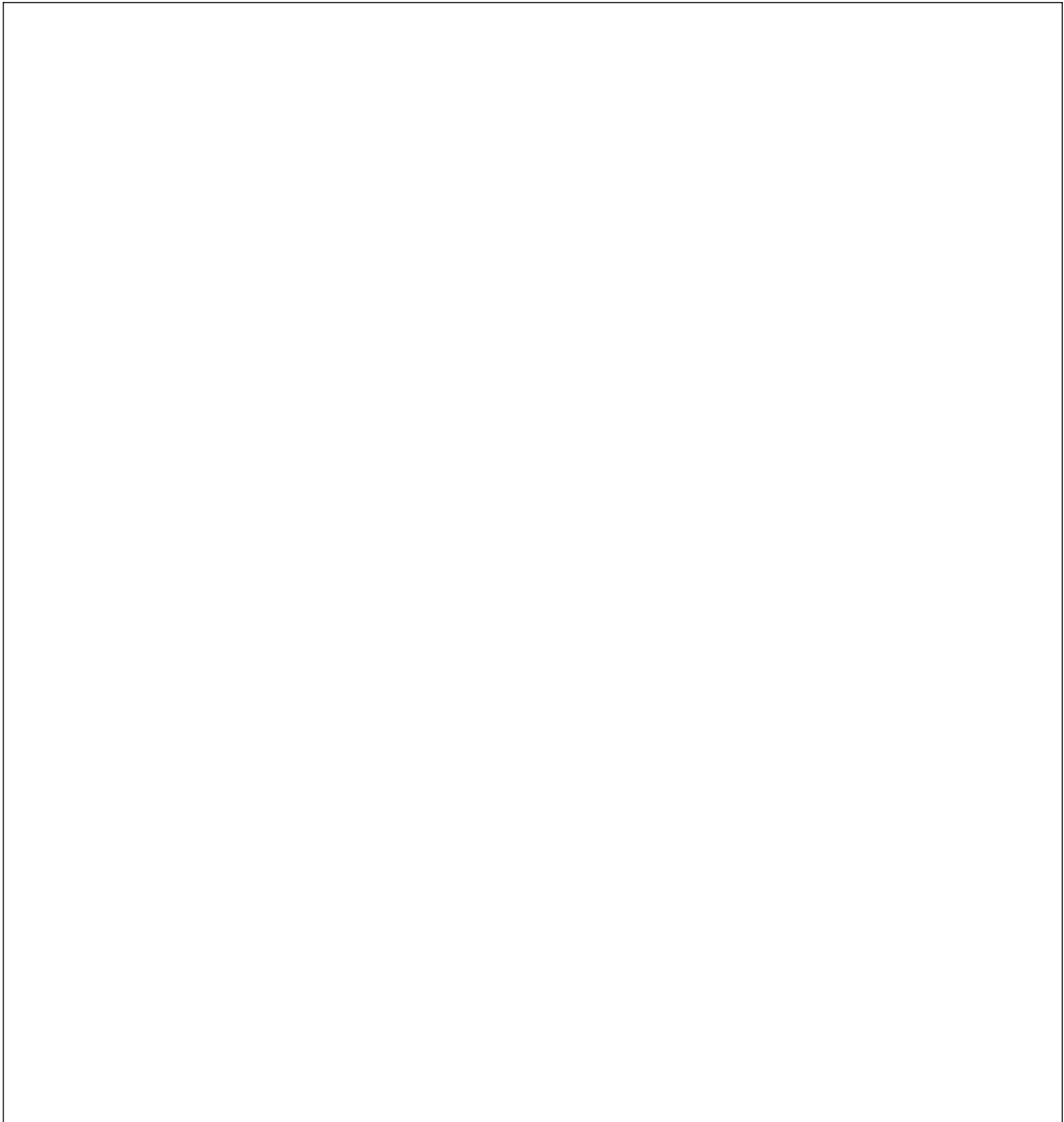
Most nuclear power stations use pressurised water reactors.

- (c) Name and describe the type of nuclear reaction used by pressurised water reactors. (2 marks)

Name: _____

Description: _____

- (d) Draw a labelled diagram of a pressurised water reactor showing **five** major components.
(7 marks)

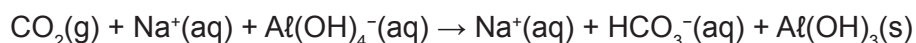


Question 24

(14 marks)

Transforming bauxite red mud into soil

1. At three of the four alumina refineries in Western Australia (Kwinana, Pinjarra and Wagerup), vegetation is established directly on treated bauxite residue (red mud). The Darling Range bauxite produces red mud that is too alkaline to support vegetation. The bauxite contains a high proportion of sand which, once washed, is kept for making embankments.
2. Rehabilitation work concentrates on treating the red mud with gypsum and fertilisers covered by a woody mulch, followed by establishment of vegetation. The mulch serves to prevent wind erosion, aids seed germination and provides an environment for biological activity.
3. Several methods have been used to improve red mud as a soil. These include thickening, drying and a variety of chemical treatments.
4. Healthy plant growth requires soil with an adequate supply of air, water and nutrients. It should not contain harmful toxins or be compacted. To achieve all these improvements for red mud is chemically, physically, biologically and economically challenging.
5. The concentration of sodium aluminate and sodium hydroxide in red mud gradually diminishes through contact with atmospheric carbon dioxide, which converts the alkaline substances into sodium hydrogen carbonate and insoluble aluminium hydroxide.



6. At the Kwinana refinery, the red mud is mixed with waste carbon dioxide from an ammonia plant nearby.
7. Carbon dioxide from living organisms is the main mechanism by which alkalinity is neutralised when organic materials, such as compost and sewage sludge, are mixed with red mud. Plant roots will contribute microorganisms once vegetation is established. This remediation occurs slowly and is not effective deep in the soil unless there are large inputs of neutralising agents, plus some physical mixing by ploughing.
8. Rehabilitation of bauxite residue requires plant nutrient deficiencies to be corrected. When rehabilitation aims at restoring a cover of natural vegetation, the provision of plant nutrients is even more challenging, because there is not the same opportunity for later adjustment as there is on agricultural land.

- (a) What is the name of the industrial process that takes bauxite as an input, removes alumina and produces the red mud discussed in Paragraph 1? (1 mark)

- (b) List **two** inputs to the process discussed in (a), other than bauxite. (2 marks)

One: _____

Two: _____

- (c) Explain why the red mud is alkaline, when bauxite is neither acidic nor basic. (2 marks)

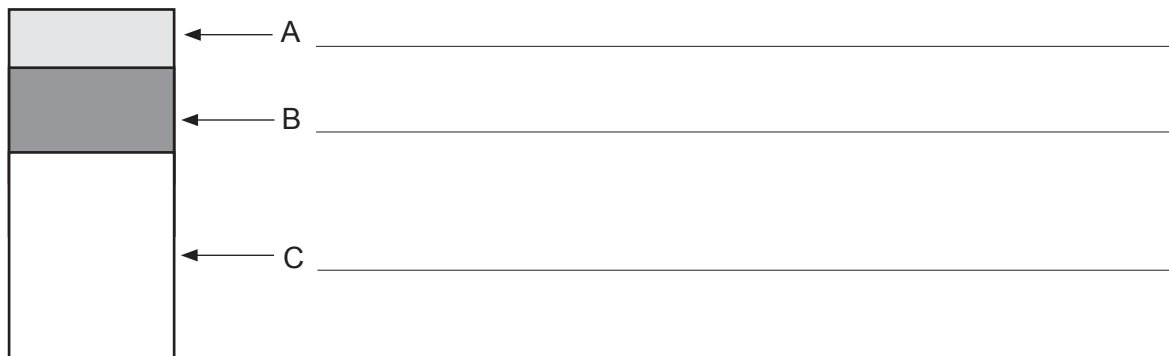
- (d) Describe **three** ways in which the environment benefits from the Kwinana process that mixes red mud with waste product from the ammonia plant. (3 marks)

One: _____

Two: _____

Three: _____

- (e) Label the diagram below showing the soil profile described in the article. (4 marks)



Question 24 (continued)

- (f) The alkaline red mud is stored in large, shallow ponds to decrease its alkalinity. This is a slow process but the size and shallowness of the ponds speeds it up. Explain why this is so. (2 marks)

Question 25

(19 marks)

The first claim of an iron ore deposit in Western Australia was granted in the 1950s. Iron ore has grown to be one of Western Australia’s major exports.

- (a) Name a geophysical exploration technique for iron ore and list the **three** key steps used in the exploration for iron ore using this method. (4 marks)

Technique: _____

One: _____

Two: _____

Three: _____

- (b) With reference to an iron ore mine you have studied, describe how the ore is extracted from the ground. (5 marks)

- (c) Identify an impact on the ecosystem of mining iron ore in this way. Explain **two** possible effects that might be observed. (3 marks)

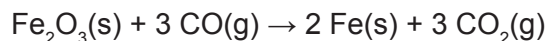
Impact: _____

One: _____

Two: _____

- (d) Iron ore is processed into iron and steel in a blast furnace. Draw a labelled diagram of a blast furnace, showing where the reactants are added, the iron is tapped off and the waste products are formed. (5 marks)

- (e) In the process of converting the iron ore into iron, one of the common ores of iron, hematite (Fe_2O_3), is reacted with carbon monoxide (CO) according to the following equation:



In the above reaction, which reactant has been oxidised and which has been reduced? (2 marks)

Oxidised: _____

Reduced: _____

End of Section Two

See next page

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See next page

Section Three: Extended response**30% (65 Marks)**

This section contains **two (2)** questions. You must answer **both** 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 that you are continuing to answer at the top of the page.

Suggested working time: 60 minutes.

Question 26**(34 marks)**

David was asked to record his electricity consumption at home to find out whether he could achieve a 5% energy saving. For his project, David collected the following data when he read the electricity meter at home. After four weeks of collecting data, his family stopped using the air conditioner to cool the house to see if this could achieve the 5% saving.

Dates	Meter Reading
Thursday 17 March	5865
Thursday 24 March	5991
Thursday 31 March	6121
Thursday 7 April	6246
Thursday 14 April	6379
Thursday 21 April	6533
Thursday 28 April	6605
Thursday 5 May	6717
Thursday 12 May	6829

- (a) Write an aim for this experiment. (1 mark)

- (b) Write a hypothesis for this experiment. (2 marks)

Question 26 (continued)

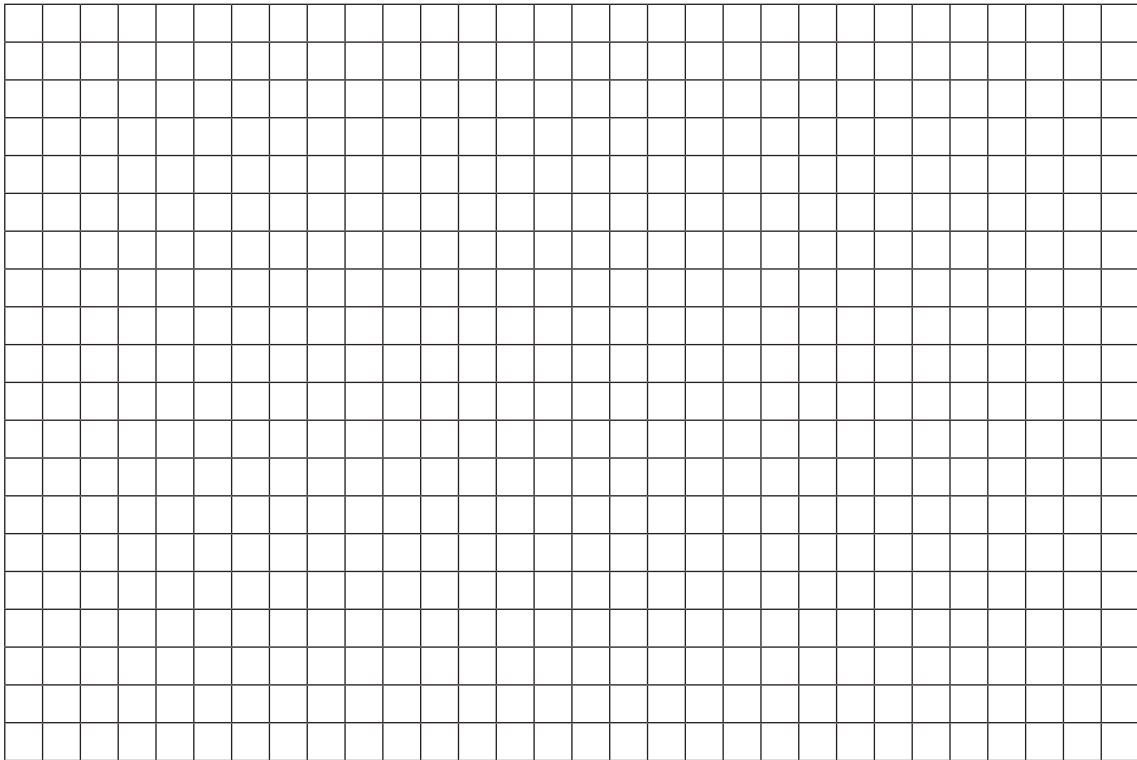
- (c) Write a procedure for this experiment. (5 marks)

- (d) Complete his results table. (4 marks)

Dates	Meter reading (kWh)	Total weekly electricity consumption (in kWh)	Daily average kWh use for the week
17 March 2013	5865	–	–
24 March 2013	5991	126	18
31 March 2013	6121	130	19
7 April 2013	6246	125	18
14 April 2013	6379	133	19
21 April 2013	6533	154	22
28 April 2013	6603		
5 May 2013	6715		
12 May 2013	6827	112	16

- (e) Calculate the total amount spent on electricity from the 24 March to 12 May, based on an electricity cost of 32 cents per kWh. (4 marks)

- (f) Construct a graph showing the daily average electricity consumption from 31 March to 12 May. (5 marks)



If you wish to make a second attempt at this item, the graph is repeated at the end of this Question/Answer Booklet. Indicate clearly on this page if you have used the second graph and cancel the working on the graph on this page.

Question 26 (continued)

- (g) (i) Is there any trend in the daily average before and after the air conditioner stopped being used? Discuss. (3 marks)

- (ii) Identify an unusual data point (an outlier) and suggest a reason why it occurred. (2 marks)

- (iii) If David recorded data at different times each day, how would this affect the daily average and total consumption? (2 marks)

- (h) David calculated that the overall average daily use was 18.5 kWh for the first 4 weeks. Determine the overall average daily use for the second 4 weeks. Show **all** workings (2 marks)

- (i) Write a general conclusion appropriate to this experiment. (3 marks)

- (j) Refer to the table on page 20. Explain why there are no data in the 'Total weekly electricity consumption' and 'Daily average kWh use for the week' columns for 17 March 2013. (1 mark)

Question 27

(31 marks)

A significant gold deposit has been discovered in Western Australia. Due to its size it is predicted to be a major contributor to both the local and national economies and a large employer of the local Aboriginal population.

The deposit is on the edge of a national park that contains flora and fauna unique to the area. Although the mine is in a high rainfall area and a creek flows through the mine site, the project plans to draw 50 million litres of water each day from an underground water supply, known as an aquifer, to supply the mineral processing plant.

The main deposit is located beneath a hill that overlooks the surrounding area. It is planned to exploit the deposit using open-cut mining techniques and that a tailings dam, used to store liquid waste, and a leach heap will be required. An accommodation village, airport and roads will also have to be built.

- (a) (i) Name a geochemical exploration technique that may have been used to discover the deposit. (1 mark)

Name: _____

- (ii) List a sequence of **five** steps involved in identifying the size and location of the deposit using your chosen geochemical technique. (5 marks)

One: _____

Two: _____

Three: _____

Four: _____

Five: _____

- (b) The environmental impact statement requires that the company consider the impact of the mine on the local flora. Name **one** sampling technique and list **three** steps involved in determining the density and distribution of the flora population on the mine's 100 km² site. (4 marks)

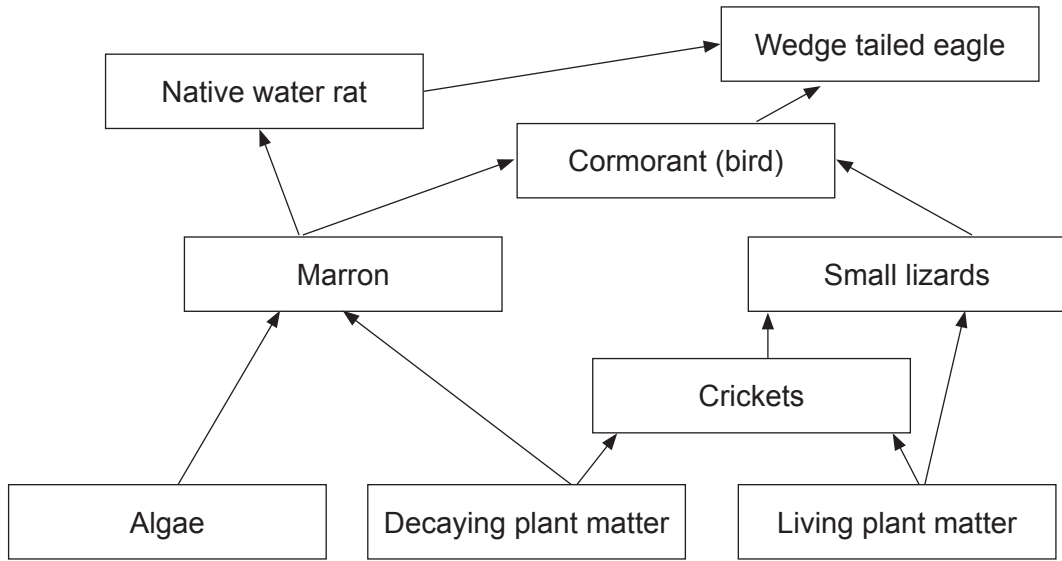
Sampling Technique: _____

One: _____

Two: _____

Three: _____

- (c) The food web below applies to the area of the planned mine site. Identify the top order consumer, a first order consumer and a producer. (3 marks)



Top order consumer: _____

First order consumer: _____

Producer: _____

- (d) When an environmental officer researched this habitat, she noticed that the number of marron had decreased significantly. Identify **four** components of the food web that would be **most** affected by this change and state how their population numbers would change. (8 marks)

	Species	Change in population numbers
One	_____	_____ _____
Two	_____	_____ _____
Three	_____	_____ _____
Four	_____	_____ _____

Question 27 (continued)

- (e) List and explain **three** potential impacts of the mine on the surface water, ground water and environment. (6 marks)

Surface water: _____

Ground water: _____

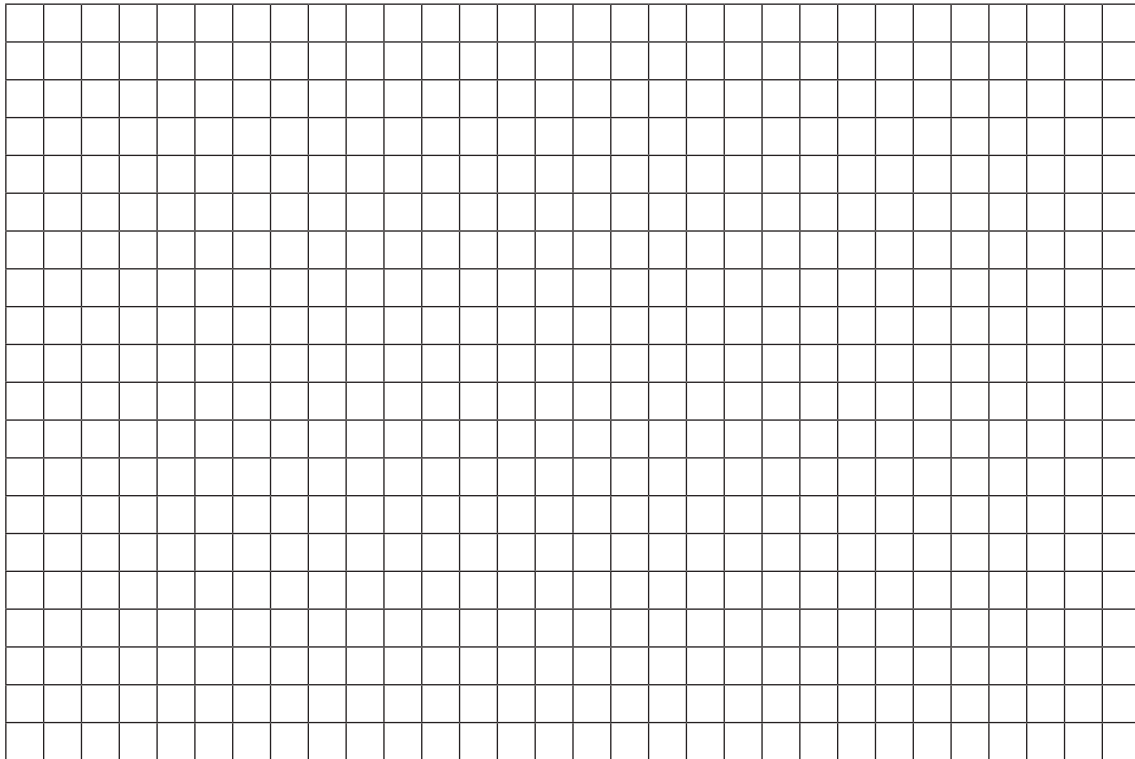
The rest of the environment: _____

- (f) Identify **two** waste products formed when gold is obtained from the ore. List their effects on human health. (4 marks)

	Waste products	Effect on human health
One	_____	_____ _____ _____
Two	_____	_____ _____ _____

End of questions

Spare grid.



ACKNOWLEDGEMENTS

Section Two

Question 21(c) Adapted from: Department of Resources, Energy and Tourism. (n.d.). *Sample energy rating label* [Image]. © Commonwealth of Australia. Retrieved April, 2013, from www.energyrating.gov.au/ Licensed under the Creative Commons Attribution 3.0 Australia Licence.

Question 24 Adapted from: Fey, M.V., & Dobrowolski, M.P. (n.d.). *Transforming bauxite residue mud into soil for rehabilitation* [Unpublished paper].

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