



Western Australian Certificate of Education Examination, 2012

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 tape/fluid, 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 total exam
Section One: Multiple-choice	20	20	30	20	20
Section Two: Short response	6	6	90	100	50
Section Three: Extended response	2	2	60	50	30
Total					100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2012*. 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 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. The members of Kym's class conducted an experiment to determine the growth rates of peas that were exposed to varying amounts of sunlight. To save time during the experiment, Kym borrowed four different rulers from her classmates and taped them to the sides of the pots containing the pea seeds. How might using these rulers have influenced the accuracy of her experiment?
 - (a) They introduced an uncontrolled variable.
 - (b) They were source of recording error.
 - (c) They were source of sampling error.
 - (d) They were source of measurement error.

2. Mineral reserves are
 - (a) ore bodies ready for mining.
 - (b) previously mined and stockpiled minerals.
 - (c) quantified and economically viable deposits of minerals.
 - (d) economically viable mineral deposits.

3. Some ores can be identified as 'non-renewable'. What criteria would be considered to determine whether an ore is non-renewable?
 - (i) rate of formation
 - (ii) rate of extraction
 - (iii) rate of consumption
 - (iv) rate of recycling
 - (a) (i) and (ii)
 - (b) (i) and (iii)
 - (c) (ii) and (iii)
 - (d) (ii) and (iv)

4. An archaeologist determined the age of a wooden artefact by using carbon-14 dating. The half life of carbon-14 is 5730 years. If the artefact had one-quarter of the carbon-14 content of new wood from the same area, the age of the artefact was closest to
 - (a) 2865 years.
 - (b) 5730 years.
 - (c) 11 460 years.
 - (d) 17 190 years.

See next page

5. Which one of the following methods is used to separate ilmenite from rutile?
- (a) magnetic separation
 - (b) electrostatic separation
 - (c) gravity separation
 - (d) spiral separation
6. Geraldton is built on a sand plain that is about 70 m deep. Below the sand there is granite rock that contains uranium. This rock has been identified as a possible source of geothermal energy, from which it might be possible to generate electricity. The geothermal energy could be used by
- (a) drilling down to allow hot water to erupt on the surface and drive windmills.
 - (b) drilling two holes into the rock and pumping water down to the rock and then pumping hot water back up to supply to the city.
 - (c) injecting water to produce steam and using the steam to drive a turbine.
 - (d) extracting the uranium in ground water to drive a nuclear reactor.
7. In the production of aluminium, aluminium ions gain or lose which one of the following?
- (a) hydrogen
 - (b) electrons
 - (c) oxygen
 - (d) protons
8. The only large hydroelectric power station in Western Australia is on the Ord River. This form of power generation is
- (a) renewable and produces reduced greenhouse gas emissions.
 - (b) non-renewable and produces reduced greenhouse gas emissions.
 - (c) renewable and produces significant greenhouse gas emissions.
 - (d) non-renewable and produces significant greenhouse gases.

Questions 9 and 10 refer to the following information.

A 600 W microwave oven is operated using a 240 V mains supply.

9. What current does the microwave oven draw?
- (a) 0.0025 A
 - (b) 0.025 A
 - (c) 2.50 A
 - (d) 25 A

10. Given that $1 \text{ W} = 1 \text{ J s}^{-1}$, how much energy will the microwave use in 30 minutes of operation?
- (a) 18 J
 - (b) 1080 J
 - (c) $1.8 \times 10^4 \text{ J}$
 - (d) $1.08 \times 10^6 \text{ J}$
11. The cost of electricity is 21.87 cents per unit (kW h). Which one of the following identifies what the consumer is buying?
- (a) power
 - (b) voltage
 - (c) current
 - (d) energy
12. Which one of the following sentences correctly identifies **both** current and resistance?
- (a) Current is rate of flow of electrons in a conductor, while resistance is opposition to this flow.
 - (b) Current is the flow of electrons in a conductor, while resistance is the speed at which they flow.
 - (c) Current is the continuous movement of free electrons in a conductor, while resistance is opposition to this flow.
 - (d) Current is the movement of delocalised electrons in a metal, while resistance is the speed at which they flow.
13. After electricity is generated at 11 kV in a power station, its voltage is increased to 375 kV before transmission. This is done in order to
- (a) reduce the resistance of the transmission lines.
 - (b) increase the delivery of power to customers.
 - (c) reduce the energy lost during line transmission.
 - (d) increase the rate of energy flow in the transmission lines.
14. What is the name of the device used to increase the voltage of electricity prior to transmission from a power station?
- (a) substation
 - (b) transformer
 - (c) voltage convertor
 - (d) AC adaptor
15. Which one of the following options will increase the electrical resistance of transmission lines?
- (a) increasing the length of the lines
 - (b) increasing the diameter of the lines
 - (c) using a more highly conductive metal
 - (d) using many thin wires twisted together

See next page

16. Methane (natural gas) is considered a clean fuel for buses because when burnt it produces
- (a) no carbon dioxide.
 - (b) only water.
 - (c) less carbon dioxide than using diesel fuel.
 - (d) only carbon dioxide that plants can use in photosynthesis.
17. A scientist wanted to investigate the population of an endangered marsupial as part of an environmental impact study. He trapped 20 of the marsupials, tagged them and released them. The following day he captured 30 of the marsupials, of which 5 were tagged. The estimated population of the marsupials is
- (a) 20.
 - (b) 120.
 - (c) 150.
 - (d) 600.
18. Marie Curie discovered that there were elements, such as polonium and radium, that were far more radioactive than uranium. Radioactivity is
- (a) the emission of electromagnetic waves that can be detected on radios and televisions.
 - (b) the emission of alpha particles, neutrons, electrons or gamma rays.
 - (c) only the formation of alpha particles.
 - (d) only the formation of gamma rays.
19. To protect workers in nuclear power stations who might be exposed to alpha particles, it is necessary to supply them with
- (a) lead aprons.
 - (b) respirators to prevent them from breathing uranium dust.
 - (c) normal clothing as alpha particles cannot penetrate skin.
 - (d) clothing containing concrete to absorb the emissions.
20. In a pressurised water nuclear reactor, the reaction produces neutrons that keep the reaction going. This is called a 'chain reaction'. The neutrons must have exactly the right speed to continue the reaction. The neutron speed is controlled by
- (a) raising and lowering the fuel rods.
 - (b) using moderators.
 - (c) adding more coolant.
 - (d) changing the control rods.

End of Section One

See next page

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Section Two: Short response**50% (100 Marks)**

This section has **six (6)** 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.

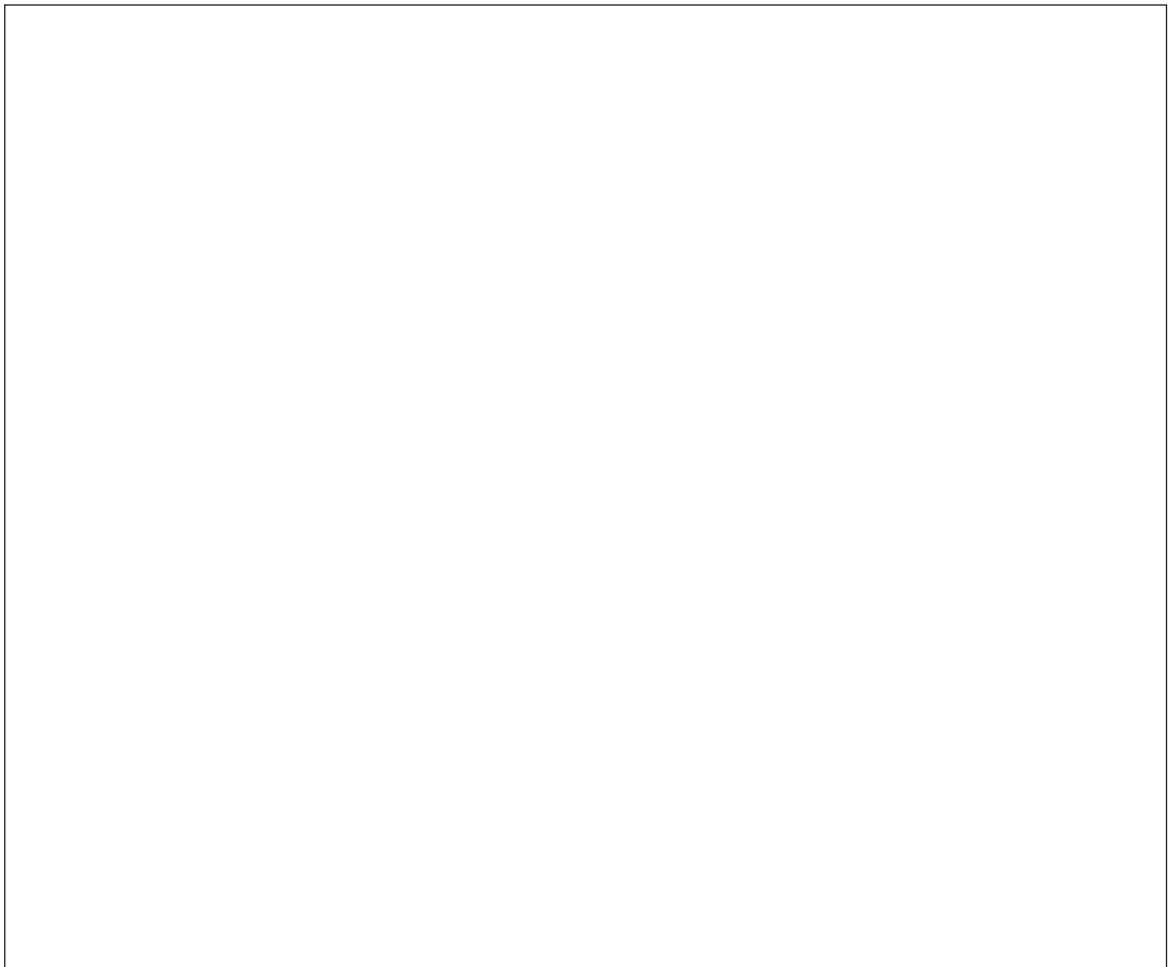
- Planning: If you use the spare page for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question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

Suggested working time: 90 minutes.

Question 21**(13 marks)**

Copper has been mined for approximately 11 000 years. Originally, mines obtained elemental copper, copper carbonate (as the mineral malachite) and copper sulfate (as the mineral azurite) as well as various sulfides of copper. In more recent times, these rich deposits have been exhausted and low percentage composition by mass (low grade) copper ores are now being mined. New technologies, such as bioleaching, have been developed to extract copper from low grade deposits.

- (a) Draw a labelled diagram showing the construction of a 'heap' as used in the copper bioleaching process. Clearly label **five (5)** features of the process. (5 marks)



See next page

- (b) Name **two (2)** major inputs and **two (2)** major outputs in the heap bioleaching process. (4 marks)

Input one: _____

Input two: _____

Output one: _____

Output two: _____

- (c) Describe how metallic copper is obtained from the bioleached product. (4 marks)

Question 22

(21 marks)

The tables and graphs below show development indicators from the World Bank. Use this information to answer the questions that follow.

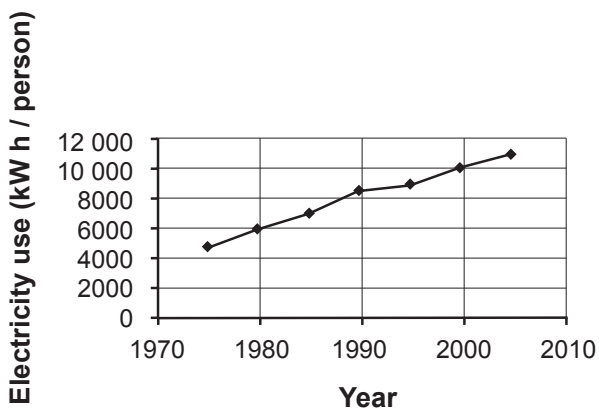
Table 1: Australian development indicators

Year	Energy use (kg of oil equivalent per person)	Electricity consumption (kW h per person)
1975	4345.9	4781.6
1980	4737.5	5915.3
1985	4621.4	7007.6
1990	5052.8	8527.2
1995	5121.5	8994.5
2000	5644.6	10194.2
2005	5863.9	11120.2

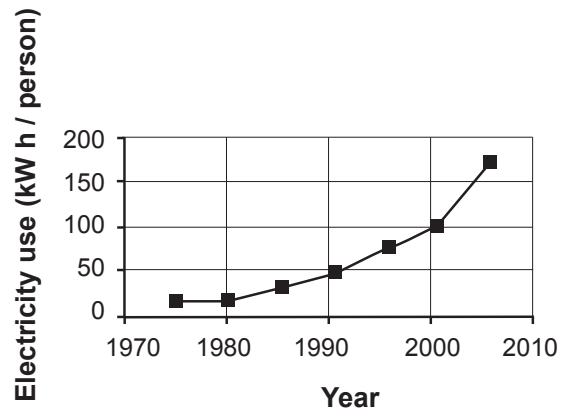
Table 2: Bangladeshi development indicators

Year	Energy use (kg of oil equivalent per person)	Electricity consumption (kW h per person)
1975	95.3	17.2
1980	104.2	18.9
1985	107.8	32.9
1990	121.0	48.8
1995	135.3	76.7
2000	143.6	103.1
2005	169.8	174.6

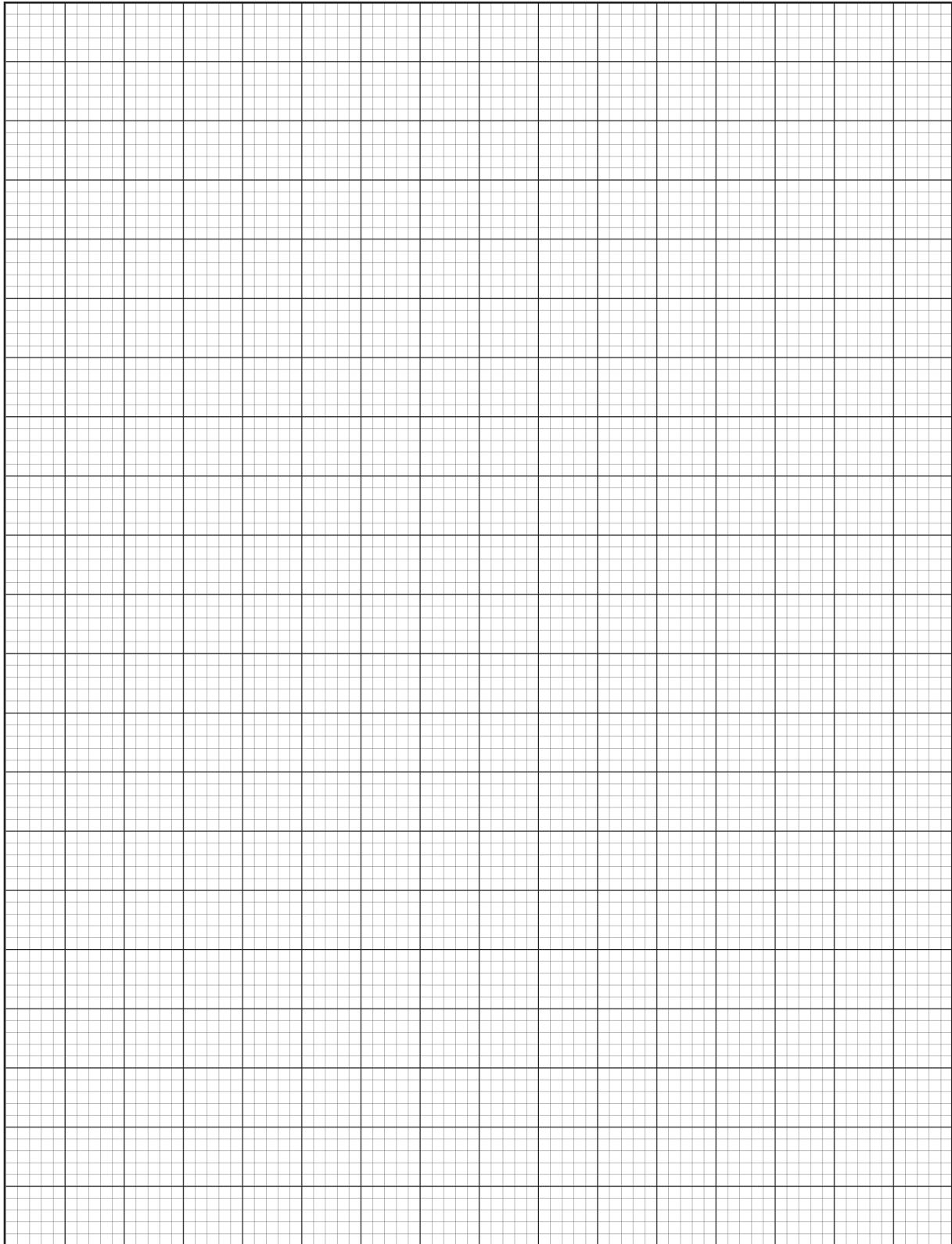
Graph 1: Electricity use in Australia



Graph 2: Electricity use in Bangladesh



- (a) Draw a graph of energy use in Australia from 1975 to 2005 using the data in Table 1.
(5 marks)



A spare grid is provided on **page 35**. If you need to use it, cross out this attempt.

See next page

Question 22 (continued)

- (b) Use your graph on page 11 to estimate the energy use per person in Australia in 1998. (1 mark)

- (c) From your graph, predict the energy use per person in Australia in 2010. (1 mark)

- (d) Compare the energy use per person in Australia with the energy use per person in Bangladesh in 2005. (2 marks)

- (e) Calculate the percentage increase in energy use in Australia between 1975 and 2005. Show your workings. (2 marks)

- (f) Calculate the percentage increase in energy use in Bangladesh between 1975 and 2005. Show your workings. (2 marks)

- (g) What conclusions can you draw by considering your answers to Parts (d), (e) and (f)? (2 marks)

- (h) Refer to Graphs 1 and 2 on page 10, and describe the difference between the trends in electricity consumption in the two countries. (2 marks)

- (i) What does this difference tell you about the two countries? (4 marks)

Question 23

(23 marks)

The idea that energy cannot be created nor destroyed but can be transformed is one of the fundamental principles of science.

- (a) Define the term ‘energy transformation’ and give an example. (2 marks)

- (b) In the table below, for the three common appliances that use electrical energy, identify the intended form of energy output for the appliance and the forms of energy that are ‘lost’ during the energy transformation. (6 marks)

Energy transformations in household appliances

Appliance	Intended form of energy output	Forms of energy lost
Kettle		
Washing machine		
MP3 player		

- (c) The data in the table show that a certain amount of energy was ‘lost’ during the energy transformation. What is the term used to describe the percentage of successful transformation of electrical energy to its intended form of energy output? (1 mark)

- (d) An old style incandescent light globe uses 60 W of electrical power but 90% of the energy is lost as heat. Calculate the efficiency of the globe. (1 mark)

- (e) (i) If electricity costs 21.87c per unit (kW h), calculate the cost of operating a 40 W incandescent globe from 6.00 pm until 10.30 pm. Show your workings. (4 marks)

- (ii) Calculate the cost of running a 12 W energy saver light globe for the same amount of time. Show your workings. (4 marks)

- (iii) Using your answers to Parts (e)(i) and (e)(ii), calculate the cost savings that can be made by using a 12 W energy saver globe, instead of a 40 W incandescent globe from 6.00 pm to 10.30 pm. Show your workings. (1 mark)

- (f) Calculate the difference in energy use (in joules) between a 40 W incandescent globe and a 12 W energy saver globe being operated from 6.00 pm to 10.30 pm every day for 1 year. Show your workings. (4 marks)

Question 24


(8 marks)

Coal and oil are the main sources of energy in Australia.

- (a) Why are coal and oil referred to as ‘fossil fuels’? In your answer, refer to the Sun as the original source of all energy on Earth. (4 marks)

The major use of coal in industrialised countries is in the generation of electricity in coal-fired power plants.

- (b) Draw an energy flow diagram to identify four energy transformations that occur in the transformation of the energy in coal to electricity in coal-fired power plants. (4 marks)

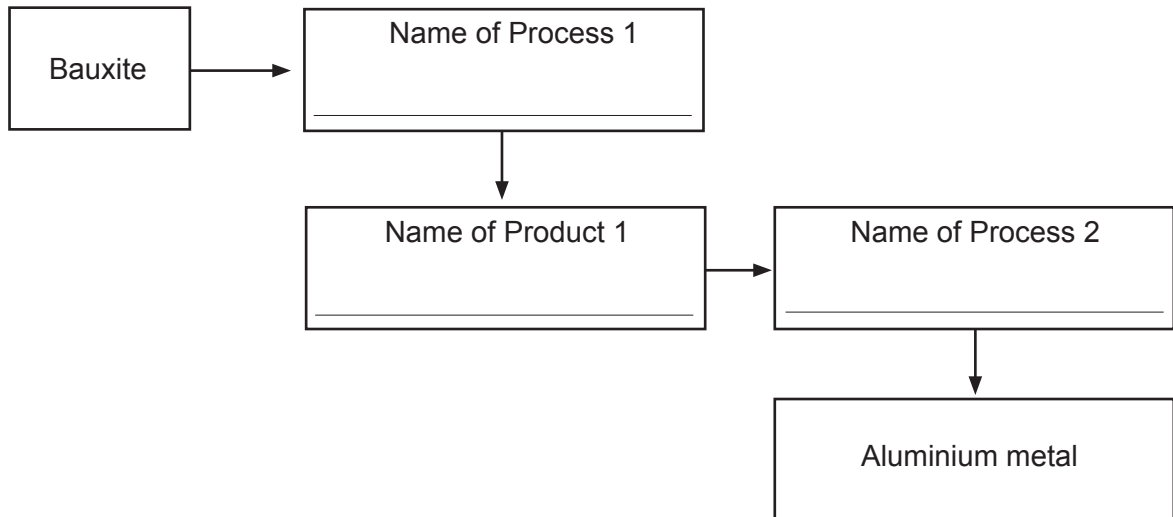


Question 25

(17 marks)

The Darling Range, east of Perth, has vast quantities of bauxite. It has been mined in a number of locations since 1963.

- (a) Complete this flow chart, identifying processes and products by name, to show how bauxite is converted to aluminium metal. (3 marks)



- (b) For Product 1 that you identified in Part (a), list **six (6)** steps in the chemical process used to convert bauxite to Product 1. (6 marks)

One: _____

Two: _____

Three: _____

Four: _____

Five: _____

Six: _____

- (c) Write the names of **two (2)** inputs to Process 2. (2 marks)

Input one: _____

Input two: _____

- (d) Name the main waste product from Process 1. (1 mark)

Mining activities, including those associated with the extraction of bauxite, have a number of different environmental impacts that must be managed as part of mining operations.

- (e) (i) Suggest **two (2)** ways in which mining operations may have contributed to the spread of jarrah dieback. (2 marks)

One: _____

Two: _____

- (ii) If a lake were to be drained to enable mining to be carried out, we could expect a decrease in the local eagle population over the following years, even though eagles rarely visit the lake. Explain how this change might come about. (3 marks)

Question 26

(18 marks)

Most of Australia's energy comes from the burning of fossil fuels, resulting in an enormous amount of carbon dioxide and sulfur dioxide being released into the atmosphere. This can result in a form of pollution known as acid rain, which is caused by these gases dissolving in rain.

You have been contracted to investigate the impact of soil acidification by acid rain on plant diversity 5 km downwind from a coal-fired generator.

- (a) Write an hypothesis for the investigation. (1 mark)

- (b) Identify the independent variable and dependent variable. (2 marks)

Independent variable: _____

Dependent variable: _____

- (c) Identify **four (4)** controlled variables. (4 marks)

One: _____

Two: _____

Three: _____

Four: _____

- (d) Why is it important to collect repeated measurements? (2 marks)

(e) Write a procedure for the investigation.

(5 marks)

(f) Design a table to record the data you will collect.

(4 marks)

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End of Section Two

See next page

Section Three: Extended response

30% (50 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.

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Suggested working time: 60 minutes.

Question 27

(25 marks)

With greater concern being shown about the impact of greenhouse gases, many researchers are attempting to find ways to utilise forms of energy with lower greenhouse gas emissions.

When discussing climate change, the news media often confuse the terms ‘enhanced greenhouse effect’ and ‘greenhouse effect’.

- (a) Using a diagram show how the ‘greenhouse effect’ keeps the Earth warm. (5 marks)

- (b) Distinguish between ‘enhanced greenhouse effect’ and ‘greenhouse effect’. (2 marks)

- (c) Renewable sources of energy will become more important as the government requires more of our electricity to be generated from such sources.

Considering the following renewable sources of energy

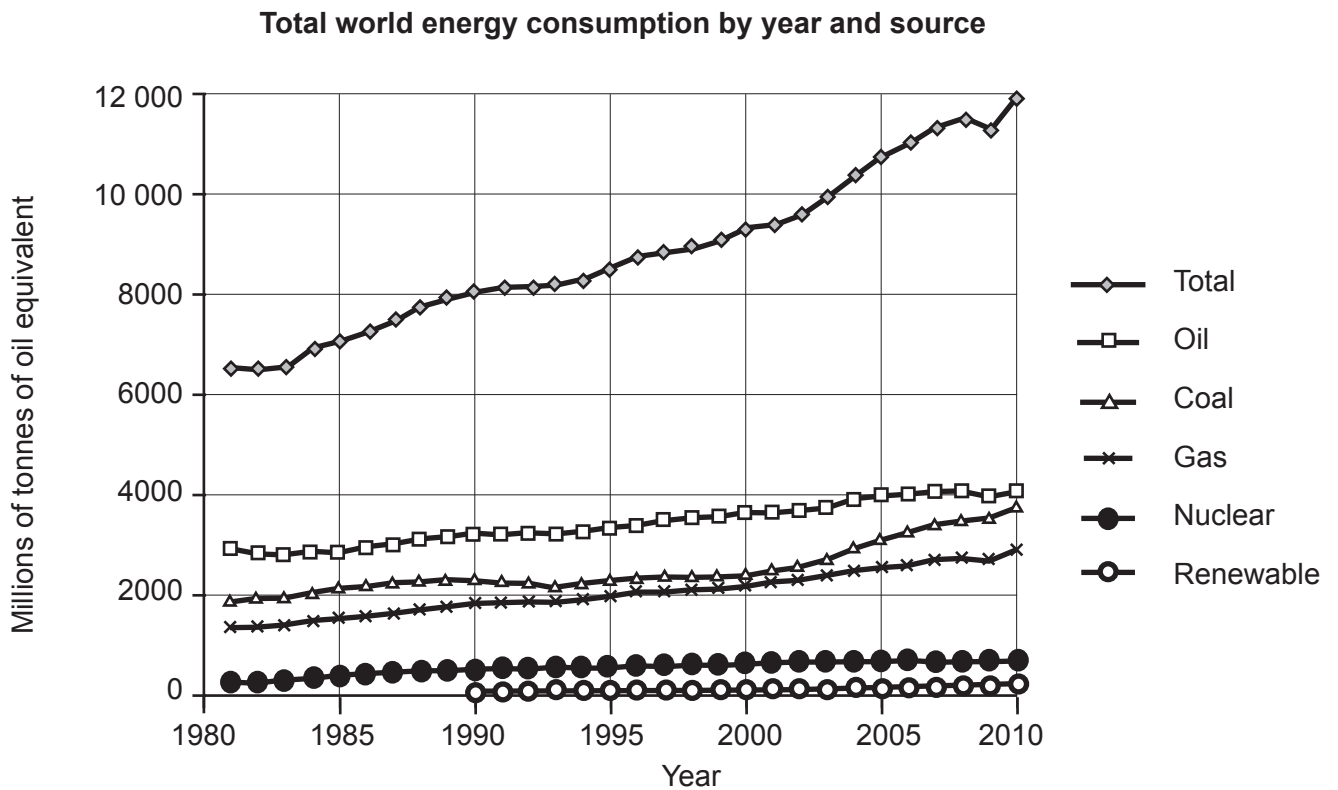
- biomass
- waves
- wind

list **two (2)** advantages and **two (2)** disadvantages of each renewable energy source compared with coal. (12 marks)

Source	Advantage	Disadvantage
Biomass	One	One
	Two	Two
Waves	One	One
	Two	Two
Wind	One	One
	Two	Two

Question 27 (continued)

Study the graph below which provides information about the total consumption of energy in the world and the sources of that energy for the years shown.



(d) Give **two (2)** possible reasons for the overall trend of the 'total' energy consumption line. (2 marks)

One: _____

Two: _____

(e) If global carbon dioxide emissions were lowered as a result of international agreements, how would the production of electricity from each of the following be affected? (4 marks)

Oil-burning power stations: _____

Gas-fired power stations: _____

Wind turbines: _____

Nuclear power stations: _____

Question 28

(25 marks)

Gold was one of the first minerals mined in Western Australia and today is worth over \$8 billion per year to the Australian economy. The life of a mine site starts long before the first ore is removed.

(a) Identify a gold mine you have studied this year. (1 mark)

(i) Mine site: _____

(ii) Describe the method used to mine gold at this site. (5 marks)

Method: _____

Question 28 (continued)

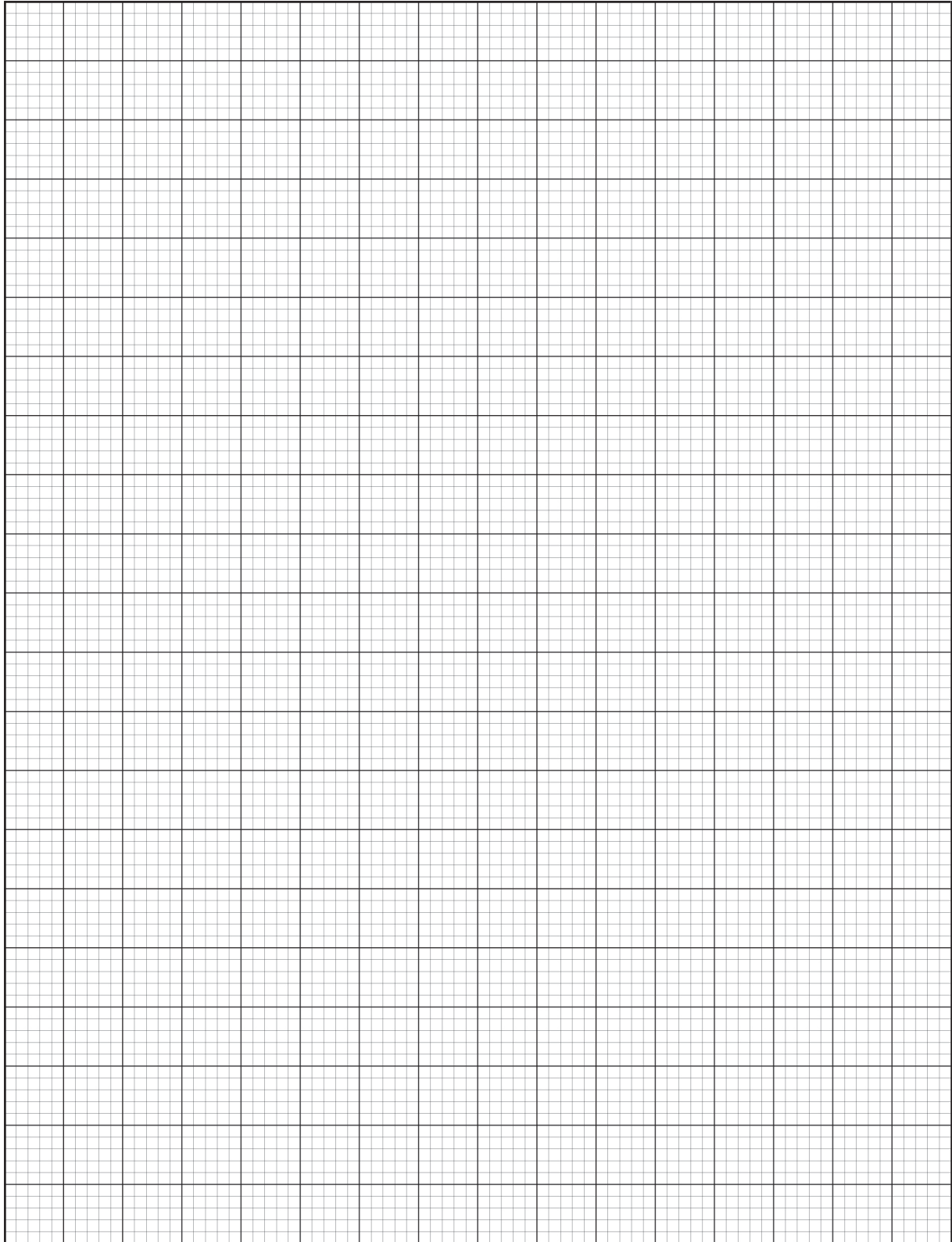
- (b) Identify the sequence of steps that a geologist would take in carrying out geochemical exploration for gold. (6 marks)

Before the government grants approval for a mining operation, the company that wishes to mine must submit an environmental impact statement.

- (c) One requirement of an environmental impact statement is an investigation of the local habitat to determine the presence of endangered species. Describe a process used to identify endangered plant species found near the site of a proposed mine. (5 marks)

- (d) After a mine has become uneconomical, it is closed. List the steps involved in the rehabilitation of a mine site after the permanent closure of the mine. (8 marks)

Additional working space



ACKNOWLEDGEMENTS

Section Two

Question 22 Data source: World Development Indicators. (2012). *The World Bank*. Retrieved January, 2012, from http://data.worldbank.org/data-catalog/world-development-indicators?cid=GPD_.

Section Three

Question 27 Adapted from: BP. (2009). *BP statistical review of world energy June 2010*. Retrieved January, 2012, from www.bp.com.

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