Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2018

Question/Answer booklet

INTEGRATED SCIENCE

Please place your student identification label in this box

Student number: In figures

In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Multiple-choice answer 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 this examination

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 material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Ref: 18-038

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	20	20	30	20	20
Section Two Short response	5	5	90	88	50
Section Three Extended response	2	2	60	60	30
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2018*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. 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.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

4. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

Section One: Multiple–choice **20% (20 Marks)**

This section has **20** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. 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.

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1. Which of the following statements **best** describes why biomagnification occurs?

   (a) Most organisms within a food web are consumers.
   (b) Producers convert inorganic materials to organic materials.
   (c) Higher trophic levels contain a greater biomass.
   (d) Some substances cannot be broken down by metabolic processes.

2. The high specific heat capacity of water explains why the daytime atmospheric temperature of Rottnest Island, an island off the coast of Western Australia, is

   (a) less changeable than that on the mainland.
   (b) more variable than that on the mainland.
   (c) more extreme than that on the mainland.
   (d) the same as that on the mainland.

3. An experiment is valid if it produces data that

   (a) is accurate and reliable.
   (b) measures what it was supposed to measure.
   (c) is consistent with the results expected for the experiment.
   (d) was collected consistently and reliably.

4. Which of the following properties of water is **not** explained by the polarity of water molecules?

   (a) high surface tension
   (b) high specific heat
   (c) low electrical conductivity
   (d) density

5. International agreements on the need to reduce greenhouse gas emissions have been pursued to

   (a) encourage the development of new technologies.
   (b) identify penalties for countries that don’t reduce greenhouse emissions.
   (c) set greenhouse gas targets for international companies.
   (d) agree on the impacts to the environment associated with not reducing emissions.

See next page

6. Which of the following alternative sources of energy is non-renewable?

   (a) biomass
   (b) nuclear
   (c) hydropower
   (d) solar

7. In order to control their body fluids, marine fish produce

   (a) large volumes of concentrated urine.
   (b) small volumes of concentrated urine.
   (c) large volumes of dilute urine.
   (d) small volumes of dilute urine.

8. The independent variable for an experiment to test whether carbon dioxide concentration in water affects plant growth would be the

   (a) type of plant.
   (b) amount of carbon dioxide in the water.
   (c) growth rate of the plant.
   (d) temperature of the water.

9. Which statement concerning the buoyancy floating ships experience in waters of different temperatures is correct? Cool water is

   (a) less dense than warm water and ships float higher in the water.
   (b) less dense than warm water and ships float lower in the water.
   (c) more dense than warm water and ships float higher in the water.
   (d) more dense than warm water and ships float lower in the water.

10. What do the water properties of polarity and surface tension have in common? They

    (a) increase when temperature decreases.
    (b) increase when temperature increases.
    (c) are properties related to density.
    (d) result from covalent bonds.

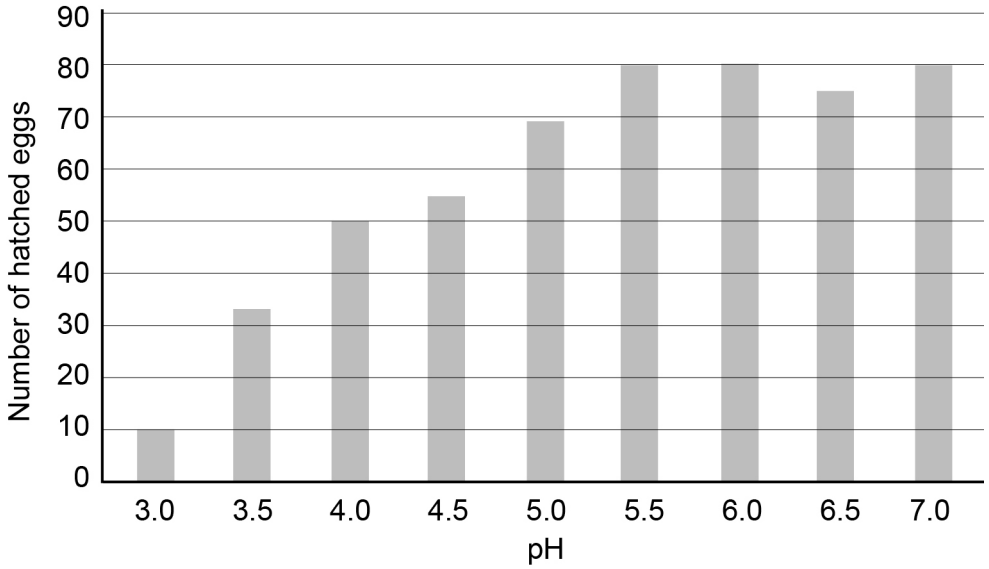
11. The water cycle is made up of different water processes including freezing and condensation. What occurs during the process of condensation?

    (a) Water vapour turns into liquid water droplets and heat is released.
    (b) Water vapour turns into liquid water droplets and heat is absorbed.
    (c) Solid water turns directly into water vapour and heat is released.
    (d) Solid water turns directly into water vapour and heat is absorbed.

See next page

Questions 12 and 13 refer to the information below.
A scientist placed 100 fish eggs into each of nine solutions with different pH. After three days, the numbers of fish from hatched eggs were counted. The results are shown in the graph below.

Effect of pH on fish egg hatching



12. Which of the following statements about pH is correct with regard to its effect on the hatching rate of the eggs?

(a) highest acidity has highest hatching rate
(b) lowest acidity has highest hatching rate
(c) highest acidity has lowest hatching rate
(d) lowest acidity has lowest hatching rate

13. Which **best** describes the aim of the investigation?

(a) to test the hypothesis that the younger the fish, the smaller the pH tolerance range
(b) to observe how many fish would hatch at different pH values
(c) to find out how many fish live in streams with different pH values
(d) to understand how acid conditions affect life in rivers

14. The buoyancy of a floating object is affected by the

(a) density of water.
(b) pH of water.
(c) depth of the water below the object.
(d) volume of the water below the object.

15. Which of the following lists **only** forms of potential energy?

(a) chemical, mechanical, gravitational, electrical
(b) elastic, gravitational, chemical, nuclear
(c) mechanical, sound, heat, electrical
(d) heat, elastic, sound, nuclear

See next page

16. The process used to assist with the production of shale gas is called

    (a) hydraulic fracturing.
    (b) hydraulic extraction.
    (c) hydrodynamic fracturing.
    (d) hydrodynamic extraction.

17. Electrical current from batteries is generated by

    (a) internal combustion.
    (b) electromagnetic induction.
    (c) photovoltaic effect.
    (d) electrochemical reaction.

18. Lead shielding protects workers at nuclear power plants from exposure to which forms of nuclear radiation?

    (i) alpha radiation
    (ii) beta radiation
    (iii) gamma radiation
    (iv) ultra violet radiation

    (a) (i) and (ii)
    (b) (ii) and (iii)
    (c) (i), (ii) and (iii)
    (d) (ii) and (iv)

19. For what time period do radioactive, spent fuel rods produced by nuclear reactors need to be placed in geologic storage?

    (a) a few years
    (b) hundreds of years
    (c) thousands of years
    (d) tens of thousands of years

20. Hydrogen fuel cells in electric cars are alternatives to which of the following devices?

    (a) internal combustion engines
    (b) heat exchangers
    (c) batteries
    (d) electric motors

End of Section One

See next page

Section Two: Short response **50% (88 Marks)**

This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 21 **(20 marks)**

Oxygen is an essential requirement of life. Without it, organisms on the earth, including aquatic life, would not survive.

(a) Identify **three** factors that increase how much oxygen is dissolved in water. (3 marks)

(b) Identify **three** ways in which oxygen is removed from water. (3 marks)

Question 21 (continued)

(c) Using the information in the table below, draw a sketch that represents how dissolved oxygen concentration can vary according to the temperature of fresh water. Label the axes. (4 marks)

Data for Swan River water

Type of water body at sea level	Temperature °C	Salinity parts per million	Dissolved oxygen mg/L
Fresh water	10	0	11.3
Fresh water	25	0	8.4
Sea water	25	35	6.9

(d) On the basis of the data in the table and the sketch you provided in part (c), describe the relationship between temperature and dissolved oxygen in fresh water. (2 marks)

(e) On the basis of the data provided in part (c), describe the relationship between salinity and dissolved oxygen. (2 marks)

(f) Using the information about the Swan River provided on page 8, describe how the amount of dissolved oxygen in the river is expected to change between summer and winter. (2 marks)

(g) State **one** reason why scientists monitor dissolved oxygen levels in aquatic environments. (1 mark)

(h) Considering both high and low levels of dissolved oxygen, explain how the diversity and abundance of aquatic life is affected by the condition of the water. (3 marks)

See next page

Question 22 **(16 marks)**

The table below summarises the sources of energy in a marine ecosystem.

Producers	**Original source of energy**
Algae (phytoplankton) 7500 kJ per year	Solar energy 902 000 kJ per year
Seagrasses	
Consumers	**Source of energy**
Protozoans	algae
Prawns	algae
Squid	prawns, fish
Fish	prawns, seagrass, algae
Dolphins	fish, prawns, squid
Sharks	fish, dolphins

(a) Calculate the percentage of the solar energy at the water surface that is captured by the algae (phytoplankton). (2 marks)

See next page

(b) Draw a food web showing the energy flow in this ecosystem. (5 marks)

(c) Explain what the arrows in your diagram indicate. (2 marks)

See next page

Question 22 (continued)

(d) Identify **two** ways in which energy is lost as it is transferred between energy levels. (2 marks)

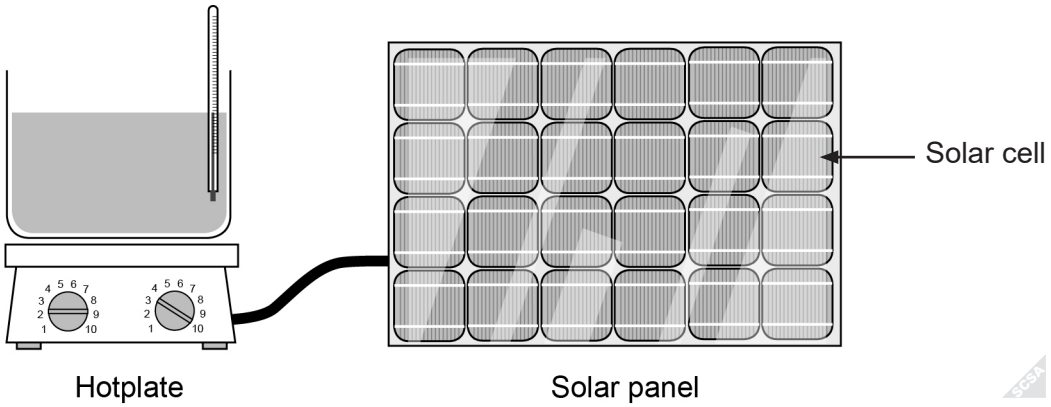
(e) Explain why the second level of a food chain is called 'primary consumers'. (2 marks)

(f) Explain why food chains are rarely longer than four or five energy levels. (3 marks)

See next page

Question 23 **(23 marks)**

Electricity can be produced using solar (photovoltaic) cells in solar panels. In Perth in mid-summer, the sun produces approximately 1050 watts per square metre. To test the efficiency of solar panels, Jai and Sam connected a hotplate to a solar panel and used it to heat 2.00 kg of water. A diagram of the equipment is shown below.



(a) Explain, with the aid of a labelled diagram, how a solar cell produces electricity. (6 marks)

Question 23 (continued)

(b) If a solar panel measured 750 mm x 500 mm, calculate the power it would be expected to produce if it were 100% efficient. (4 marks)

(c) Using the formula below, calculate the energy that a 400 W solar panel produces in 10 minutes.

$$\text{Power (watts)} = \frac{\text{Energy (joules)}}{\text{Time (seconds)}}$$

(3 marks)

See next page

(d) The students found that the temperature of the 2.00 kg of water increased by 5 °C in the 10 minutes that the system operated. Calculate the efficiency of the photovoltaic (PV) panel.

The equation for specific heat is $E=mc\Delta T$ where the specific heat capacity of water is 4.18 Jg^{-1}.

$$\text{Efficiency (\%)} = \frac{\text{Energy out}}{\text{Energy in}} \times 100$$

(5 marks)

(e) Draw a flow chart showing all energy transfers in Jai and Sam's experiment. Use this diagram to show why the experiment complies with the Law of Conservation of Energy.

(5 marks)

See next page

Question 24 **(20 marks)**

The sources and methods used to generate electricity have changed significantly since the first power stations began to provide electricity for homes, street lighting and businesses in the late 1800s.

(a) Draw a labelled diagram that represents how coal is used to generate electricity in conventional large-scale power stations. (6 marks)

See next page

(b) Identify **two** key reasons why new techniques for extracting traditional energy resources are needed. (2 marks)

(c) Decisions to invest in technologies that harness renewable energy resources are informed by environmental, economic and social or political considerations. Give **one** example of an environmental, economic and social or political consideration and explain how it influences investment. (6 marks)

Environmental

Example:

Explanation:

Economic

Example:

Explanation:

Social or political

Example:

Explanation:

See next page

Question 24 (continued)

(d) Electricity generation affects society and the environment. Provide **one** example of an impact on society and **one** example of an impact on the environment associated with the use of coal to produce electricity. You must consider the extraction of coal, production of electricity and the disposal of waste. The examples used in each of your answers **must** be different. (6 marks)

Extraction

Impact on society: _____

_____

_____

Impact on environment: _____

_____

_____

During electricity production

Impact on society: _____

_____

_____

Impact on environment: _____

_____

_____

Disposal of waste

Impact on society: _____

_____

_____

Impact on environment: _____

_____

_____

See next page

Question 25 **(9 marks)**

The greatest proportion of all energy consumed in Western Australian homes (18 per cent) is used for heating and cooling.

(a) Identify **three** methods by which energy is transferred from a hotter substance to a colder substance. (3 marks)

_____

_____

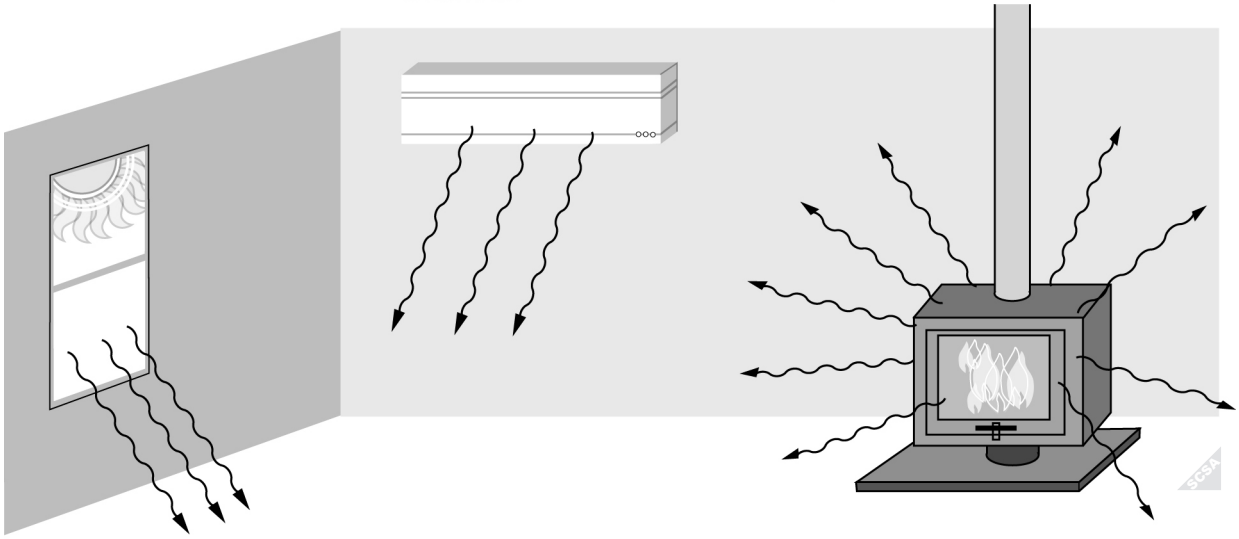
_____

There are a variety of ways in which a home can be heated during winter. In the drawing below, the following common ways of heating a room are shown:

- air conditioning
- sunlight through a window
- wood heater.

Source: _____

Method: _____



Source: _____

Method: _____

Source: _____

Method: _____

(b) On the diagram above, identify the source of the energy and name the matching method of heating. (6 marks)

End of Section Two

See next page

Section Three: Extended response **30% (60 Marks)**

This section contains **two** questions. You must answer **both** questions. Write your answers in the spaces provided.

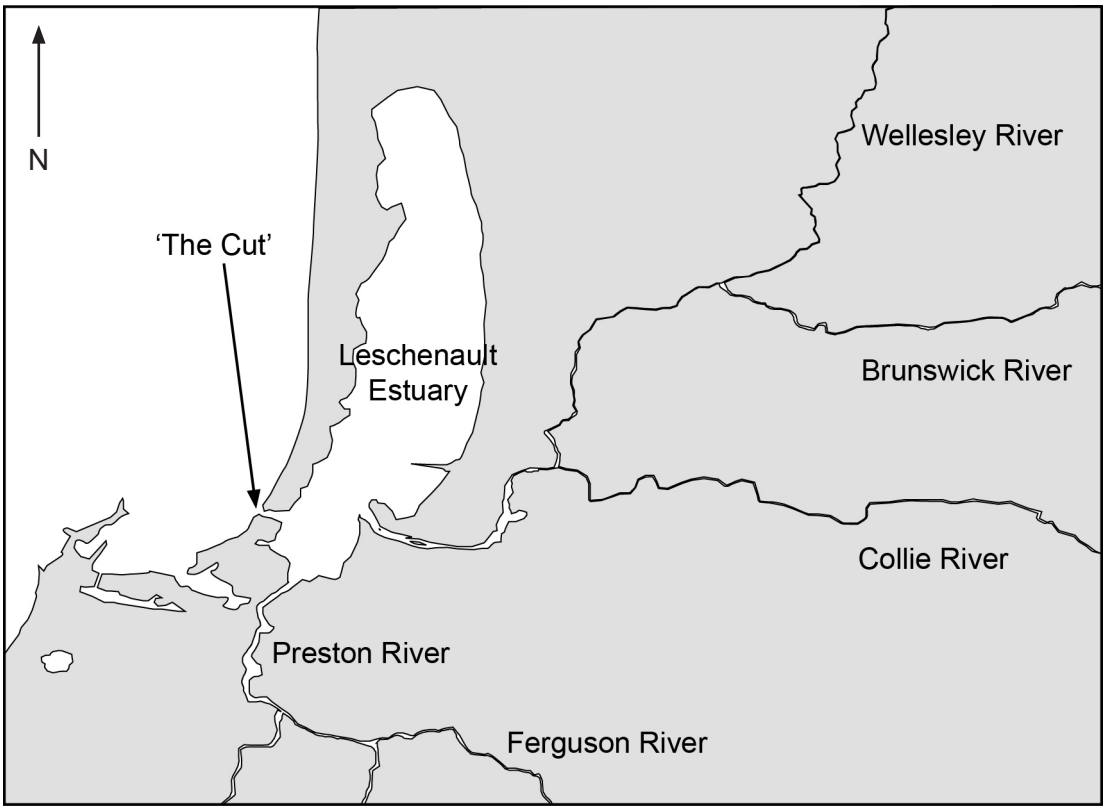
Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 60 minutes.

Question 26 **(30 marks)**

The Leschenault Estuary is a shallow water body approximately 13.5 km long and 2.5 km wide at its widest point. An opening to the Indian Ocean was constructed by cutting through the sand dunes and is known as 'The Cut', as shown in the figure below.

Waterways of the Leschenault Catchment



A number of rivers feed into the Estuary. Each passes through agricultural lands where catchment run-off transports nutrients and rainfall from inland regions to the Estuary. This has resulted in an increased frequency of eutrophication events in the Estuary. Decreasing rainfall levels have also been recorded in the region. As the Estuary is connected to the ocean, salt water flows into the Estuary, with tidal movement increasing the salinity concentration over time.

In 2007, the Western Australian Department of Water produced a report which made recommendations for the management of the Leschenault estuarine system, including the Estuary and the rivers that feed into it. The report identified management strategies and actions to improve the water quality of the Estuary.

See next page

(a) Since the construction of 'The Cut', the distribution of white mangroves, native bushes that grow in saline mud in tidal estuaries, have increased their distribution to the north of the Estuary. Describe **one** factor that has resulted in this change in distribution. (2 marks)

Nitrogen and phosphorus levels have been routinely monitored in the Estuary system since 1998. Increased levels of nutrients have been identified over this time.

(b) (i) Describe how the nutrients may have entered the Estuary and its feeder rivers. (2 marks)

(ii) Explain the effect of increased nutrient levels in the estuarine system. (4 marks)

Question 26 (continued)

(c) Identify **four** indicators, other than nutrient levels, that may have been used by the Department of Water to assess the quality of the water. (4 marks)

(d) Describe how a macro-invertebrate sample could be collected and explain how data is obtained from the sample to analyse the water quality. (6 marks)

See next page

To the east of the Leschenault Estuary, the Wellington Dam has reduced the flow of water from the Collie River downstream into the Estuary. A desalination plant is planned for the Dam to provide less salty water for agriculture and, potentially, to supply potable water.

(e) Define the term 'potable water'. (1 mark)

(f) Identify the **two** types of water resources that can be used to provide potable water. (2 marks)

(g) In many parts of Western Australia, dryland salinity can affect the productivity of agricultural land. Describe what 'dryland salinity' is and discuss **one** potential management strategy that could be used to prevent it. (5 marks)

See next page

Question 26 (continued)

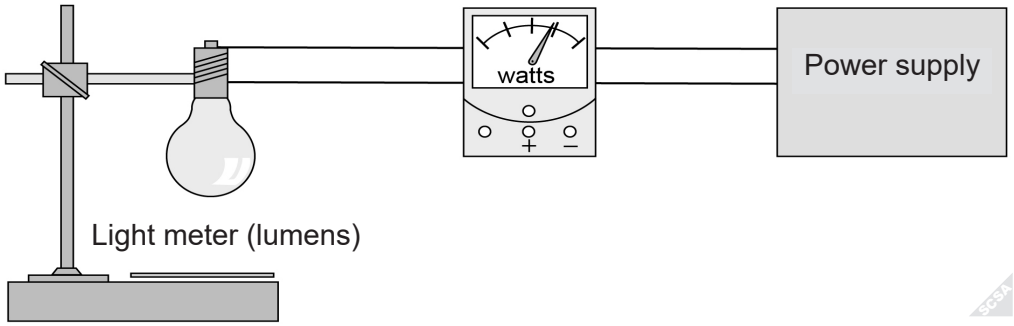
(h) An alternative to desalination is the treatment of domestic wastewater, which is currently discharged into the ocean and the ground. Describe how domestic wastewater is treated before it is recycled for use in irrigation, agriculture or industry. (4 marks)

See next page

Question 27 **(30 marks)**

Two students, Chris and Sato, conducted an investigation on the energy efficiency of light bulbs. To do this, they measured the power input to the light bulbs (in watts (W)) required to produce different levels of brightness. The brightness was measured in lumens (lm), which indicated the visible light energy given out by the bulbs.

A diagram of the apparatus set up by Chris and Sato is shown below.



(a) Write a hypothesis for this experiment. (3 marks)

(b) Identify the independent and dependent variables. (2 marks)

(c) Identify **two** safety precautions that need to be considered when conducting this experiment. (2 marks)

See next page

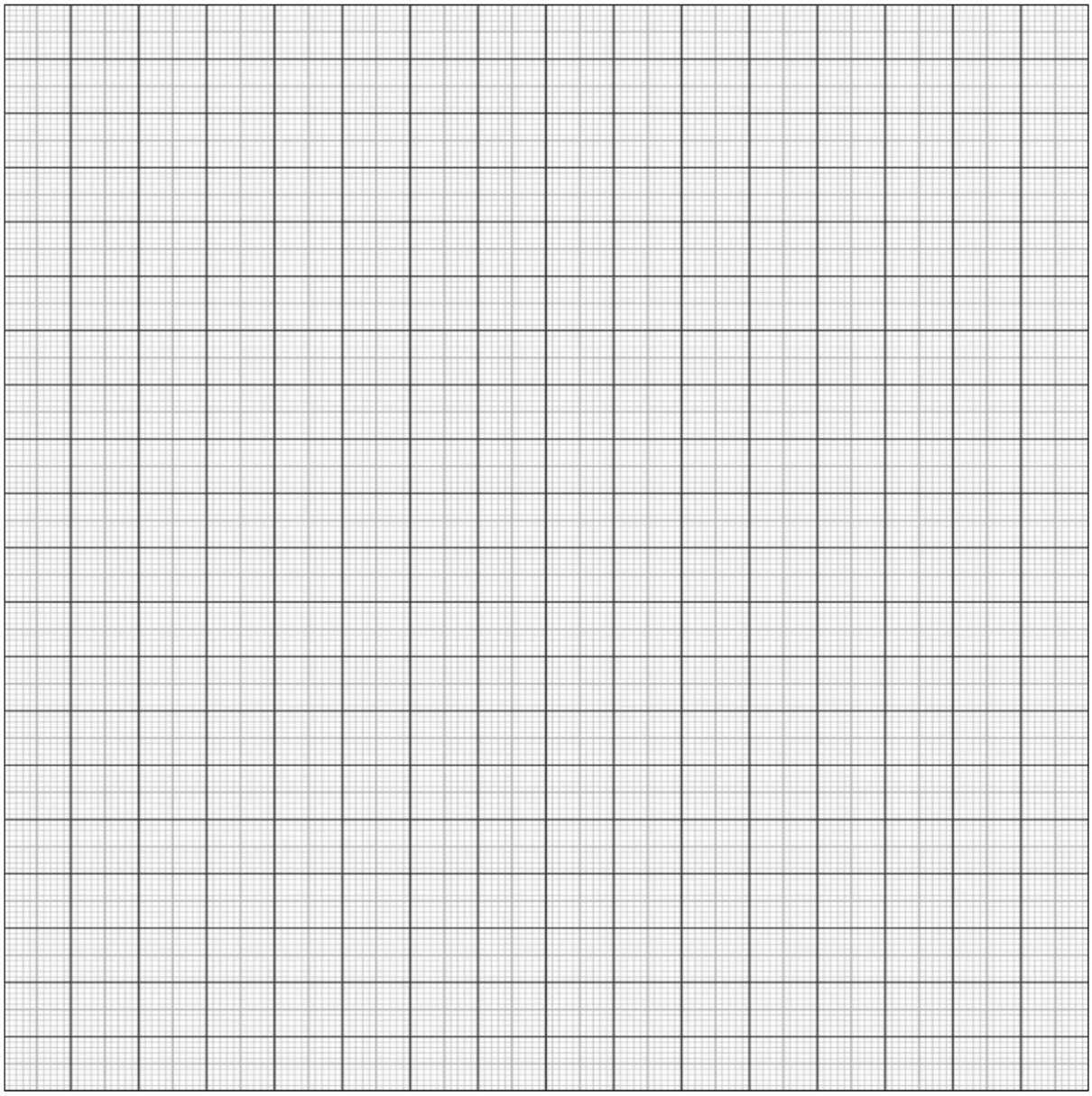
Question 27 (continued)

Chris and Sato conducted six trials for each bulb and calculated the average power input, as shown below.

Average power input required to produce different levels of brightness

Brightness (lm)	Average power input (W)		
	Bulb type 1	Bulb type 2	Bulb type 3
450	40	11	9
800	60	13	12
1100	75	20	17
1600	100	23	20

(d) Graph the results of Chris and Sato's investigation. (6 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate clearly that you have redrawn it on the spare page.

See next page

(e) The energy efficiency of light bulbs is usually described as the amount of lumens per watt.

Calculate the energy efficiency (in terms of lumens per watt) of the three types of light bulb used in Chris and Sato's experiment, using the results of their 1100 lumens test.

$$\text{efficiency} = \frac{\text{brightness}}{\text{power}}$$

Show **all** workings. (6 marks)

Question 27 (continued)

To determine the average amount of power needed at the different levels of brightness, Chris and Sato recorded the power supplied six times and then calculated the average. For Bulb type 2, they determined the average power required to produce 450 lumen of light to be 11 watts. The data they recorded for each of the trials is shown in the table below.

Power required to produce 450 lumens of light for Bulb type 2

Trial	Power (W)
1	3.5
2	11.9
3	11.6
4	12.8
5	11.9
6	14.2
Average	11.0

(f) How certain are you that using the average they determined (11.0 W) was correct? Identify the reasons for your answer. (2 marks)

(g) If this was your experiment, how would you calculate the average? Justify your answer and show **all** workings. (3 marks)

Average:

Justification:

See next page

(h) Calculate the energy saved each hour by using Bulb type 2 rather than Bulb type 1 to produce 1600 lm of light. Show **all** workings. (6 marks)

$$P = \frac{E}{t}$$

End of questions

Question number: _____

Question number: _____

Supplementary page

Question number: _____

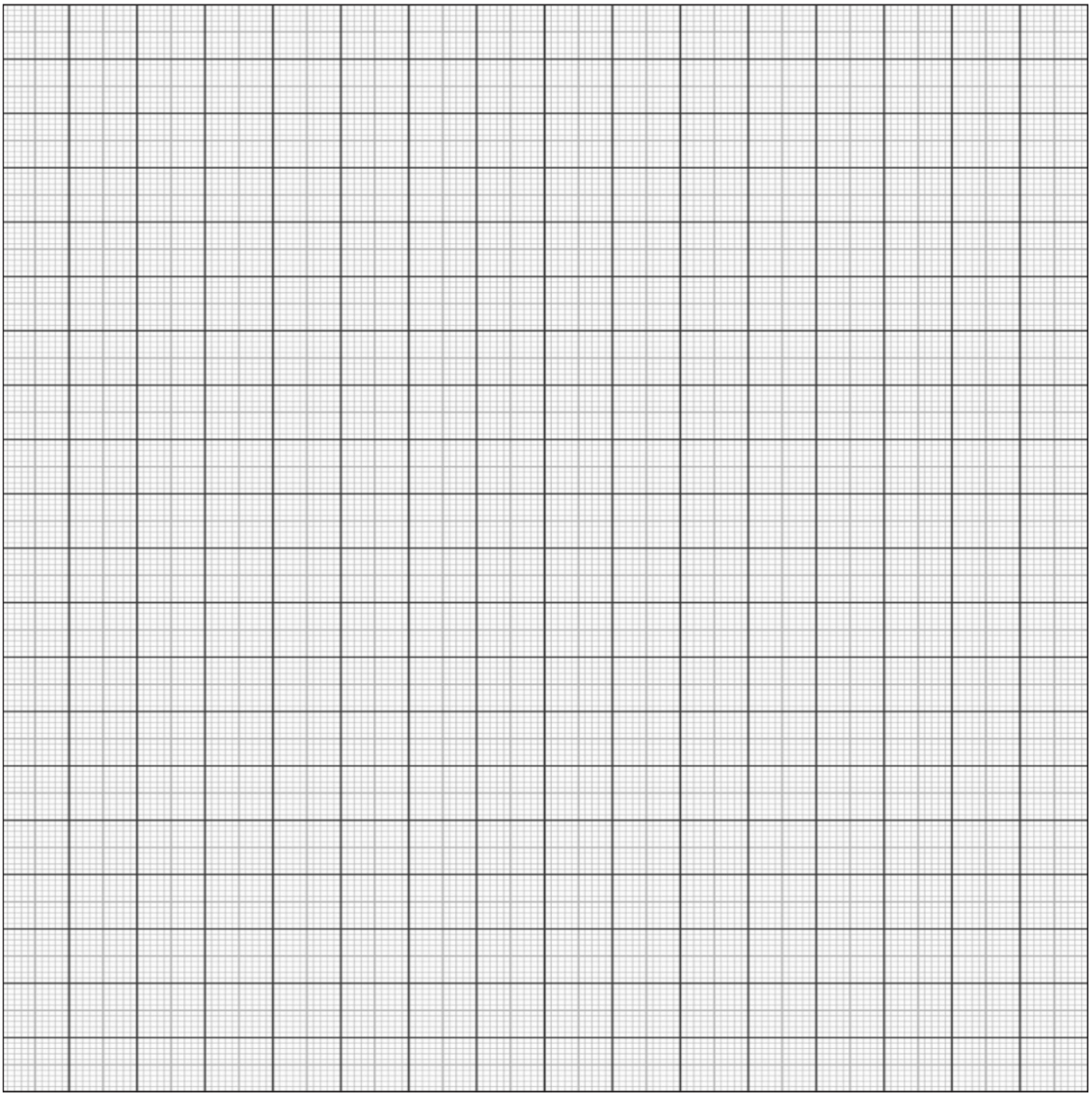
Supplementary page

Question number: _____

Supplementary page

Question number: _____

Spare grid:



ACKNOWLEDGEMENTS

Question 26

Information from: McKenna, M. (2007). *The Leschenault estuarine system, South–Western Australia: Condition statement and recommendations for management.* Retrieved May, 2018, from https://rei.dwer.wa.gov.au/wp-content/uploads/2016/10/Leschenault-condition-statement-2007.pdf
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Figure adapted from: McKenna, M. (2007). *The Leschenault estuarine system, South–Western Australia: Condition statement and recommendations for management* (p. 9, fig. 3). Retrieved May, 2018, from https://rei.dwer.wa.gov.au/wp-content/uploads/2016/10/Leschenault-condition-statement-2007.pdf
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Question 27(c)

Table adapted from: Batteries Plus Bulbs. (n.d.). [Light bulb efficiency guide]. Retrieved May, 2018, from http://blog.batteriesplus.com/2012/energy-efficient-light-bulbs

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