



ATAR course examination, 2019

Question/Answer booklet

INTEGRATED SCIENCE

Please place your student identification label in this box

WA student number: In figures

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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.

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	82	50
Section Three Extended response	2	2	60	55	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 2019*. 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.

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. Which of the following is a form of potential energy?
 - (a) chemical
 - (b) heat
 - (c) sound
 - (d) light

2. One major environmental advantage of using hydrogen gas as an alternative fuel in cars is that it
 - (a) is easier to store in a car than petrol.
 - (b) is easier to transport in bulk than petrol.
 - (c) produces no carbon dioxide when burned.
 - (d) can be readily obtained directly from the atmosphere.

3. Which of the following groups contains only non-fossil energy resources?
 - (a) biomass, coal, solar, tidal
 - (b) oil, solar, biomass, uranium
 - (c) wind, water, natural gas, hydrogen gas
 - (d) geothermal, hydrogen gas, uranium, biomass

4. The diversity and abundance of aquatic life is affected by the physical and chemical conditions of water. Which of the following are chemical conditions?
 - i salt concentration
 - ii nutrients – phosphates and nitrates
 - iii dissolved oxygen
 - iv turbidity
 - v temperature
 - (a) i, ii and v
 - (b) i, iii and iv
 - (c) i, ii and iii
 - (d) i, ii, iii, and iv

See next page

5. A moving petrol-powered car converts
- electrical energy to heat energy.
 - chemical energy to kinetic energy.
 - gravitational potential energy to electrical energy.
 - mechanical energy to gravitational potential energy.
6. One suggested strategy for reducing the risk of dry-land salinity is to plant more trees. Tree planting will help reduce dry-land salinity by
- lowering the groundwater level.
 - reducing bioaccumulation of salt.
 - absorbing carbon dioxide in photosynthesis.
 - reducing pollution in the soil.
7. Electricity generation is achieved in generators through
- electrochemistry.
 - geothermal energy.
 - electromagnetic induction.
 - photovoltaic effect.
8. A Geiger counter is a device that detects radiation. If a Geiger counter was placed in a cardboard box, which forms of radiation could it measure?
- alpha, beta and gamma
 - beta and gamma
 - alpha and beta
 - alpha and gamma
9. Fish have gills that obtain oxygen from water and remove carbon dioxide from their blood. The efficiency of this process depends upon
- the surface area of the gill membrane
 - the volume of water that passes over the gill
 - the concentration of oxygen in the water
 - the size of the fish
- i and ii only
 - i and iii only
 - i, ii and iii only
 - ii, iii and iv only
10. The body temperature of **most** fish is maintained by
- consuming energy in their bodies to create heat when needed.
 - the ability of the surrounding water to keep a relatively constant temperature.
 - their altering the depth at which they swim to seek the correct temperature of water.
 - evaporation from the ocean surface removing heat from the system.

11. A healthy lake has a diversity of life and large numbers of individuals are present. The lake system can be affected by excessive algal growth and, when algae die and decay, the organisms in the lake suffocate. This process is called
- (a) biomagnification.
 - (b) pollution.
 - (c) eutrophication.
 - (d) salination.
12. Our society utilises various energy resources. In which example(s) is solar energy the original source of energy?
- i fossil fuels
 - ii nuclear power
 - iii biofuels
 - iv biomass
 - v wind
- (a) i only
 - (b) iii, iv and v only
 - (c) i, iii, iv and v only
 - (d) i, ii, iv, and v only
13. When you are sleeping in your bed, a blanket **principally** prevents heat loss by
- (a) convection.
 - (b) conduction.
 - (c) radiation.
 - (d) evaporation.
14. Which of the following physical properties can be attributed to the fact that water molecules have an unusual shape?
- i high polarity
 - ii high surface tension
 - iii high conductivity
 - iv high specific heat
- (a) i and ii only
 - (b) iii and iv only
 - (c) i, ii and iii only
 - (d) i, ii, and iv only
15. **Most** of the world's potable water is produced by
- (a) the water cycle.
 - (b) reverse osmosis.
 - (c) thermal solar panels.
 - (d) groundwater reclamation.

16. The solubility of salt in water depends on the water
- (a) pressure.
 - (b) temperature.
 - (c) dissolved gas concentration.
 - (d) depth.
17. In the water cycle, what occurs during the process of condensation? Water
- (a) vapour turns into liquid water droplets.
 - (b) changes state directly from solid water to water vapour.
 - (c) stays in a solid state.
 - (d) changes state directly from solid water to steam.
18. Our water resources face many serious threats, all of which are caused primarily by human activity near rivers. Which of the following activities would **not** adversely affect the quality of water drawn from a river system?
- (a) dairy farming
 - (b) industrialisation
 - (c) the construction of dams
 - (d) the planting of forests
19. One of the reasons migrating fish, such as salmon, are able to move between oceans and rivers is because they
- (a) can adjust their urine concentration from diluted to more concentrated.
 - (b) can adjust their urine concentration from concentrated to more diluted.
 - (c) maintain a concentrated urine for the whole distance.
 - (d) maintain a diluted urine for the whole distance.
20. In an experiment about buoyancy, a group of students placed a block of wood in a dish of warm water and then in a dish of very cold water. Which of the following is the **best** explanation for their results?
- The block floated higher in
- (a) warm water because the water is less dense.
 - (b) cold water because the water is less dense.
 - (c) warm water because the water is more dense.
 - (d) cold water because the water is more dense.

End of Section One

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Section Two: Short response

50% (82 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

(13 marks)

Some macro-invertebrates are sensitive to the amount of pollution in water. They can be used as indicator species to identify when pollution levels rise.

Due to the influence of industry and human activities, water pollution can sometimes be higher in water that flows through populated areas.

Students investigated the relationship between macro-invertebrate species and distance from a town centre in a river system. They sampled sites at two-kilometre intervals along the river from the town centre. They did this by stirring up the bottom of the river at the edge for two seconds and immediately taking a one litre sample of the disturbed river water. They poured the sample through a fine net to collect any macro-invertebrates present. The macro-invertebrates were observed using a hand lens and identified by comparing them with named images of macro-invertebrates. Then they recorded the names and masses of the macro-invertebrate species present.

At the same time, they recorded the environmental factors to ensure there was no variation at each site. These factors were rate of flow, dissolved gases (oxygen and carbon dioxide), light levels, vegetation adjacent to the river, water depth and width, and nutrient inflow. From these measurements, they determined that each site was ecologically identical apart from the possible pollutants in the water.

Their results for the macro-invertebrate sampling are displayed in the table below.

Mass of macro-invertebrates found in the river system over ten kilometres

		Distance from town centre (km)					
		0	2	4	6	8	10
Macro-invertebrate type	Stonefly larvae	0	0	0	0	65	65
	Dragonfly larvae	0	10	35	45	60	60
	Snails	0	45	50	53	53	55
	Bloodworms	70	70	70	70	70	70

- (a) Suggest **two** improvements to the students' experimental design that would have allowed them to obtain more reliable results. (2 marks)

One: _____

Two: _____

- (b) (i) Which macro-invertebrate was found over the greatest range? (1 mark)

- (ii) Which macro-invertebrate only survived in the least-polluted section of the river? (1 mark)

After looking at the table of results, one student concluded 'You can tell how much pollution there is in the river by the number of snails'.

- (c) Give **two** reasons why this is **not** a valid conclusion. (2 marks)

One: _____

Two: _____

- (d) Which macro-invertebrate would be **most** suitable for assessing pollution? Give **two** reasons to support your answer using the information in the table. (3 marks)

Macro-invertebrate name: _____

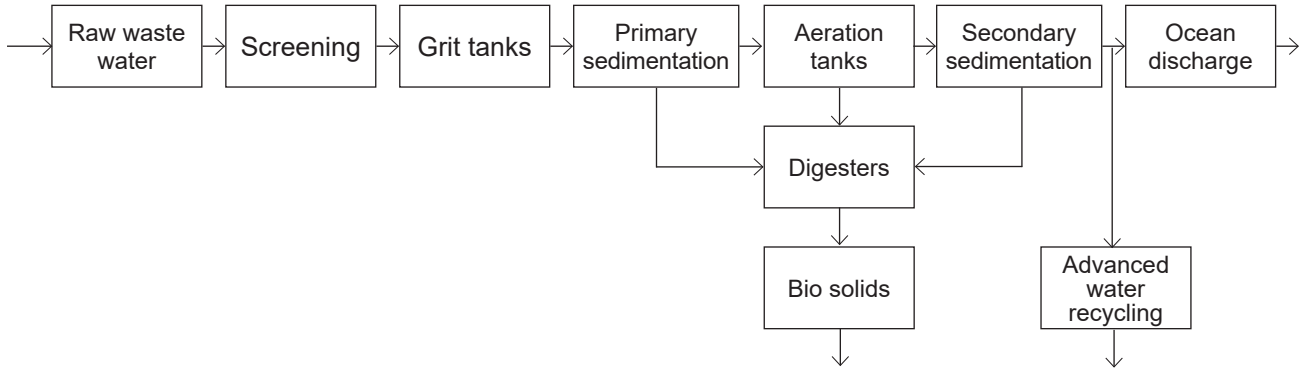
One: _____

Two: _____

Question 21 (continued)

In Western Australia, the Water Corporation wastewater treatment relies on physical, chemical and biological processes.

Wastewater goes through a series of treatment processes to make water safe to return to the environment.



(e) Give **one** reason why each of the four processes listed below is carried out. (4 marks)

Process	Reason
Screening	
Primary sedimentation	
Aeration	
Digestion	

Question 22 (continued)

(d) Explain how reverse osmosis is used to purify saltwater. (4 marks)

(e) There are environmental impacts associated with reverse osmosis. Name and give a reason for **two** such impacts. (4 marks)

One: _____

Two: _____

Question 23**(18 marks)**

The Muja power station near Collie is fired with black coal. It has a maximum energy output of 854 MW or 854 000 kJ of energy each second.

When 1.0 kg of black coal is burnt, 25 000 kJ of energy is released, producing only 6750 kJ of electrical energy.

- (a) Calculate the efficiency of electrical energy generation in the Muja power station.

(3 marks)

- (b) When energy is converted from one form to another, some energy is lost. Identify **three** energy transformations that occur during a power station's electricity generation and identify where the energy is lost. (6 marks)

One: _____

Two: _____

Three: _____

See next page

Question 23 (continued)

Over the past 50 years, there has been an unprecedented increase in the level of greenhouse gases in the atmosphere. One process that has led to this increase is the generation of electricity.

- (c) Identify **one** strategy for the reduction of greenhouse gas emissions in electricity generation. Describe the source of energy used to produce electricity and how it reduces greenhouse gas emission. (3 marks)

Strategy: _____

Description: _____

The generation of electricity can adversely affect the environment in ways other than the production of greenhouse gases.

- (d) Identify **three** other environmental impacts of electricity generation and state how they affect the environment. (6 marks)

One: _____

Two: _____

Three: _____

Question 24**(26 marks)**

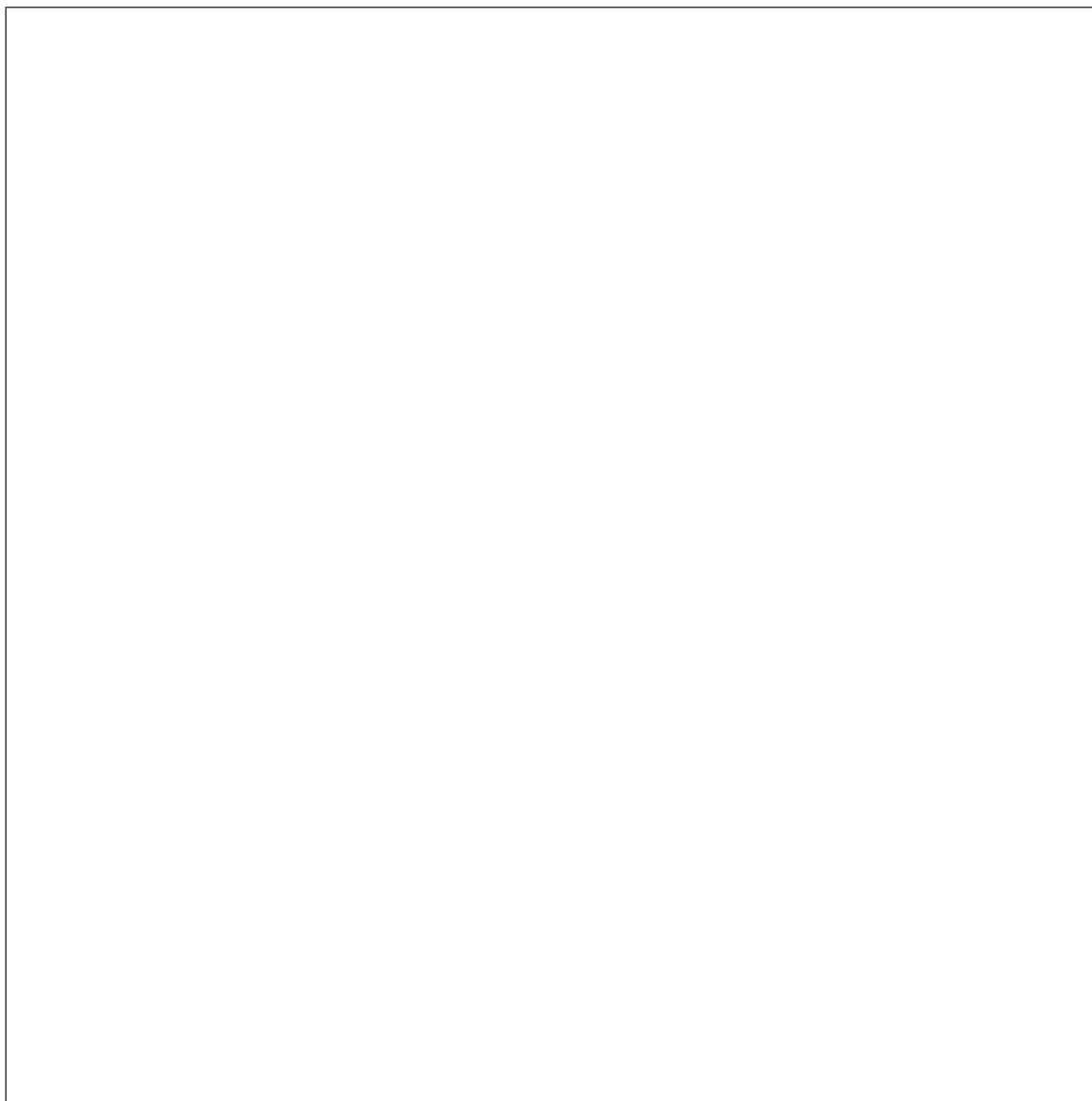
A coffee cup was filled with boiling water and left to cool to room temperature.

- (a) Explain how the water cools by referring to the four mechanisms of heat loss. (8 marks)

Question 24 (continued)

A well-designed home uses passive cooling rather than using air conditioning to keep cool in summer.

- (b) In the space below, draw a diagram of a house that has incorporated **three** passive solar design techniques to keep it cool in summer. Identify each technique by labelling the diagram and describe briefly how each will keep the house cool. (8 marks)



One: _____

Two: _____

Three: _____

When shopping for a new oven, a customer found two similar ovens for sale. The cheaper oven had a 2-star efficiency rating and the more expensive oven a 5-star rating.

- (c) (i) If the customer purchased the cheaper oven, identify **two** ways in which it might be less efficient. (2 marks)

One: _____

Two: _____

- (ii) If the customer intends to use the oven for twenty years, explain why the more expensive oven might be better value. (2 marks)

In January 2019, South Australia recorded some of the State's highest temperatures for 80 years.

- (d) With reference to base-load supplies, explain why an unexpectedly hot day can cause problems for an electricity supplier. (3 marks)

- (e) If demand exceeds the base-load supply, what **three** actions can an electricity supplier take to maintain supply? (3 marks)

One: _____

Two: _____

Three: _____

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See next page

Question 25

(14 marks)

An extract from a report in a national newspaper stated the following:

'... there are fears thousands of yellowtail kingfish that escaped from a state government jointly-run fish farm off Port Stephens will devastate the wild fish population after their sea cages were damaged during a recent storm.'
The Newcastle Herald, February 1, 2018.

Yellowtail kingfish can grow to 1 m long, weigh 10 to 15 kg and are highly aggressive predators.

- (a) How would an increase in the population of yellowtail kingfish affect pink snapper, which are tertiary consumers, in the wild fish population? Give reasons for your answer. (3 marks)

Conservation groups and local tourism operators described the multimillion-dollar fish farm as a 'disaster', threatening the pristine Port Stephens marine park's delicate ecosystem. However, other members of the community are in favour of retaining the fish farm.

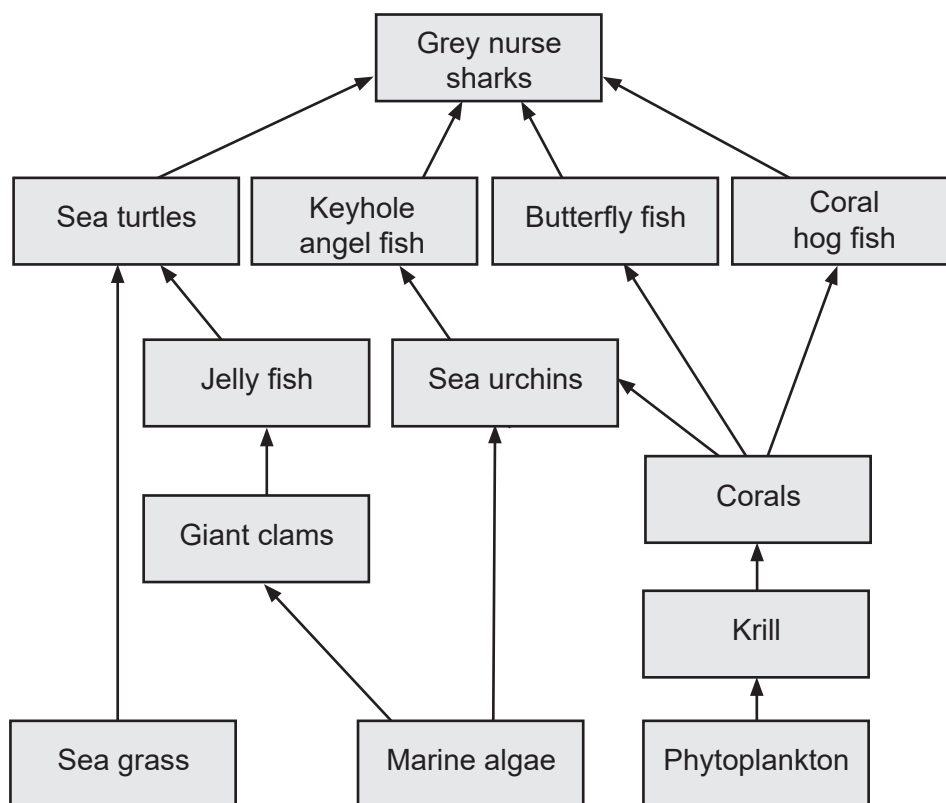
- (b) State **one** advantage and **one** disadvantage to the communities in the area if the fish farm continues to operate. (2 marks)

Advantage: _____

Disadvantage: _____

Question 25 (continued)

The food web below shows some of the feeding relationships at Nelson Bay which is part of the Great Lakes Marine Park at Port Stephens.



- (c) Name **two** producers in the food web. (2 marks)

One: _____

Two: _____

- (d) With reference to the food web, explain how grey nurse sharks can be identified as tertiary consumers. (3 marks)

- (e) The number of grey nurse sharks in the Port Stephens Great Lakes Marine Park is much less than the number of coral hog fish. State **two** reasons why. (2 marks)

One: _____

Two: _____

- (f) There has been an increase in the crown-of-thorns starfish population in the marine park. It is a predator of coral and is preyed upon by sea snails. Add this information to the food web on page 20. (2 marks)

Section Three: Extended answer**30% (55 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**(22 marks)**

The Sandfire copper mine, 900 km north of Perth in Western Australia, is the first mine in Australia to rely on renewable energy. The mine site is not connected to the electricity grid.

Its 34 080 solar photo-voltaic (PV) cells cover a total area of over 0.2 km². It is the largest integrated off-grid solar and battery storage facility in Australia.

- (a) Describe how PV panels generate electricity in a solar power station. (4 marks)

On the mine site there is also a 19 MW diesel generator. It is integrated with the solar and battery storage facility to provide a continuous baseload supply to the mine site.

- (b) Identify **two** advantages and **two** disadvantages of using diesel fuel to produce electricity. (4 marks)

Advantage one: _____

Advantage two: _____

Disadvantage one: _____

Disadvantage two: _____

The solar power station can store a maximum of 3 200 000 kWh of energy in its battery bank. The mine consumes a maximum of 150 000 kW of electrical power.

- (c) Calculate how many hours of stored energy can be supplied to the mine site as electrical power. Show your workings. (3 marks)

Time = _____ hours

- (d) This solar power station does **not** operate at the highest potential output every day of the year. Give **two** reasons why this is the case. (2 marks)

One: _____

Two: _____

Question 26 (continued)

The table below shows the efficiency for different methods of generating electricity.

Type of energy source	Renewable	Efficiency (%)
Coal	No	41
Natural gas	No	48
Solar	Yes	33
Tidal	Yes	26
Wind turbine	Yes	30

- (e) Describe why there is a difference in the efficiency between the renewable and non-renewable energy sources. (2 marks)

- (f) The efficiency of solar electricity generation is higher than for all other renewable sources. Suggest **one** reason why. (1 mark)

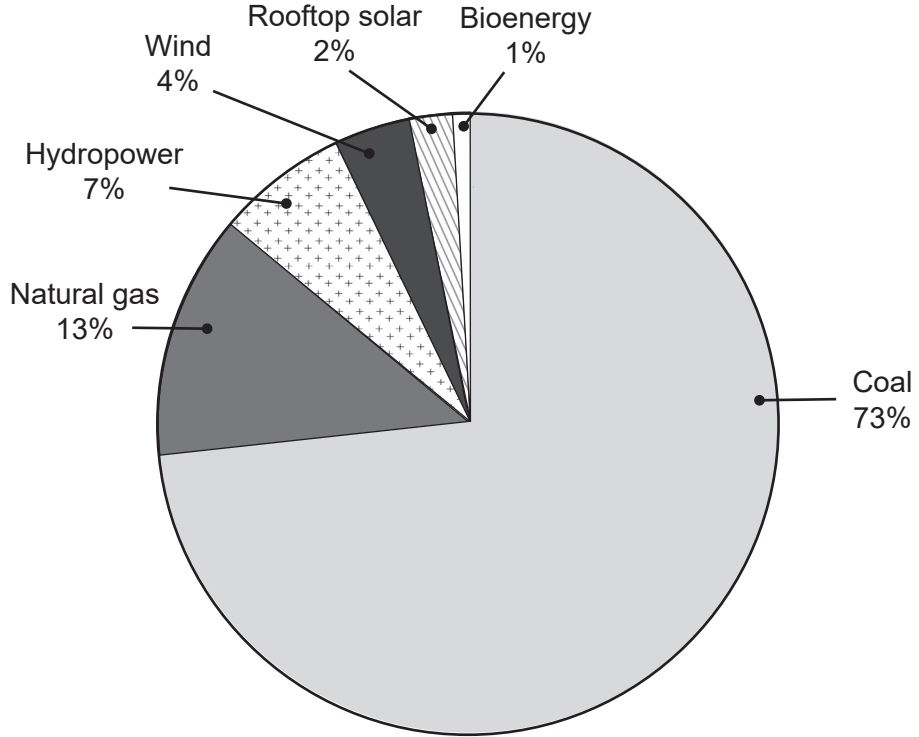
Australia has one-third of the world’s uranium deposits but has never built a nuclear power station.

- (g) Identify **two** environmental issues associated with the use of nuclear power stations and the impact each might have. (4 marks)

One: _____

Two: _____

The most recent data describing the resources used to generate electricity in Australia is presented below.



Australia's energy mix 2016

Household solar power generation has been increasing rapidly in Australia in recent years. Some estimates suggest that one in five homes has solar panels.

(h) If this is the case, why is more coal being burned each year to make electricity? (2 marks)

Question 27

(33 marks)

The student members of a science club read about salinity problems in waterways. They discovered that salinity is measured by analysing the total dissolved salts (TDS) in water. This information is usually presented as milligrams per litre (mg/L) of TDS.

The impact of rising salinity depends on the purpose for which water is used.

Various members of the club offered suggestions as to how they could learn more about a nearby lake.

One student suggested they collect and test water samples from the lake. The first thing he did was write down an hypothesis. His hypothesis was: 'Our lake is salty'.

- (a) State **two** reasons why this is **not** a suitable hypothesis. (2 marks)

One: _____

Two: _____

Another student suggested as an alternative hypothesis: 'The presence of frogs indicates that the lake water is healthy'. The students decided to set traps to see how many frogs were living in the lake.

- (b) Identify **three** factors they would need to consider to ensure their investigation was valid and give a reason for each. (6 marks)

One: _____

Two: _____

Three: _____

Another student suggested that trapping might contravene animal ethics principles and it would be better to photograph frogs that were seen rather than trapping.

- (c) List **three** fundamental principles of 'animal ethics'. (3 marks)

One: _____

Two: _____

Three: _____

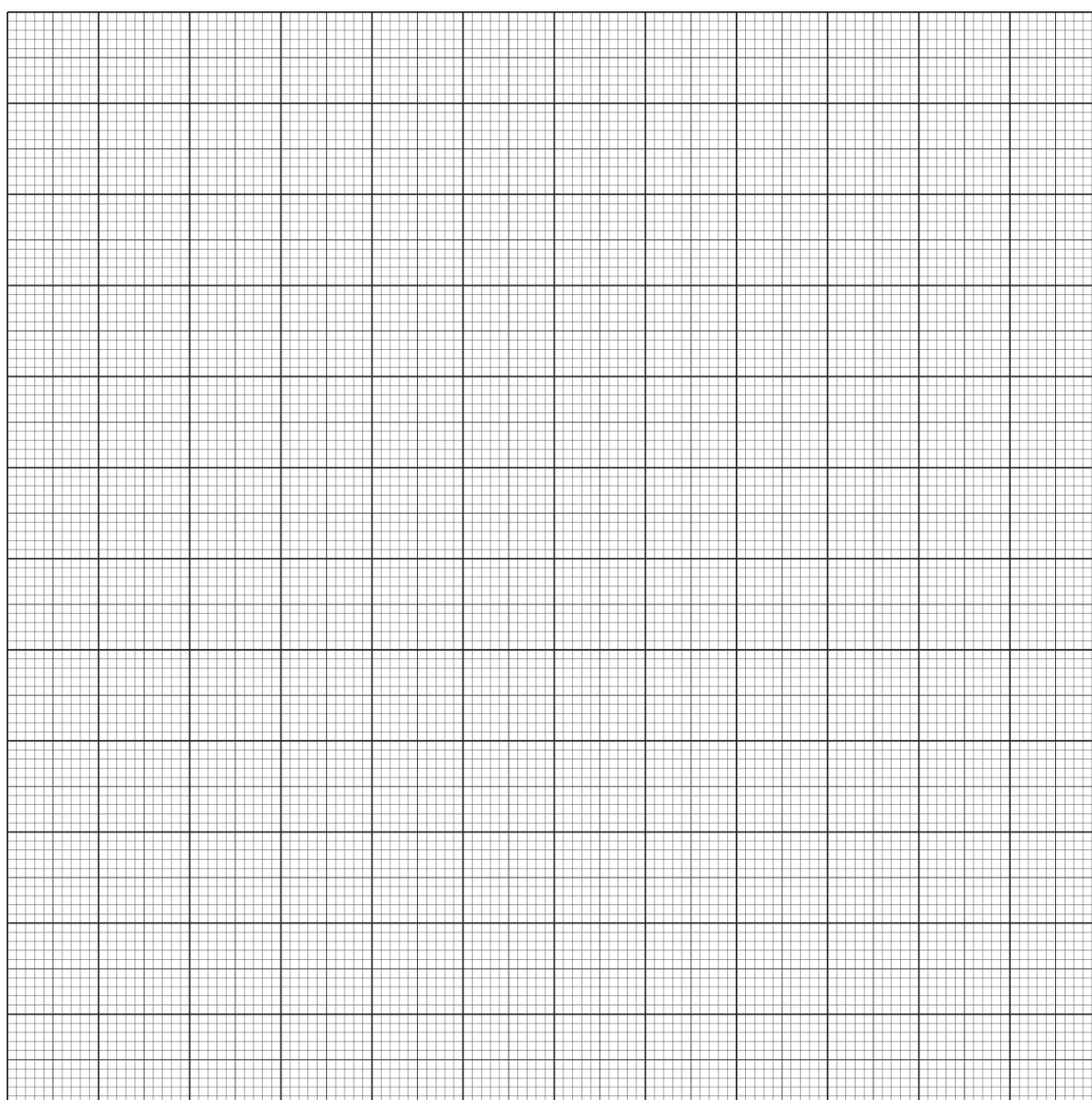
Question 27 (continued)

The students decided to use a data logger (salinity meter) to measure salinity in the lake during the year. Each day they would measure the salinity of the lake.

Salinity levels of the lake during 2017

Month	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Mean TDS (mg/L)	485	515	530	525	330	320	310	295	330	395	425	460

(d) On the grid below, create a suitable graph to represent these data. (5 marks)



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

- (e) Describe the trends shown in the graph and state why these have occurred. (4 marks)

For copyright reasons this table cannot be reproduced in the online version of this document, but may be viewed at the link listed on the acknowledgements page.

- (f) Using the information in the table above, would you suggest the water in the lake is suitable for human consumption? Give a reason for your answer. (2 marks)

Question 27 (continued)

In 2018 the students continued their research, this time measuring salinity three times each morning. They used the average value of the measurements and compared it with published data. They inspected their data to determine whether they had random or systematic errors.

- (g) Describe how they could reduce the incidence of random and systematic errors in future studies. (4 marks)

The data produced by the students from the monitoring of water resources and analysis of water quality could be used in deciding what land use was permissible in the catchment area.

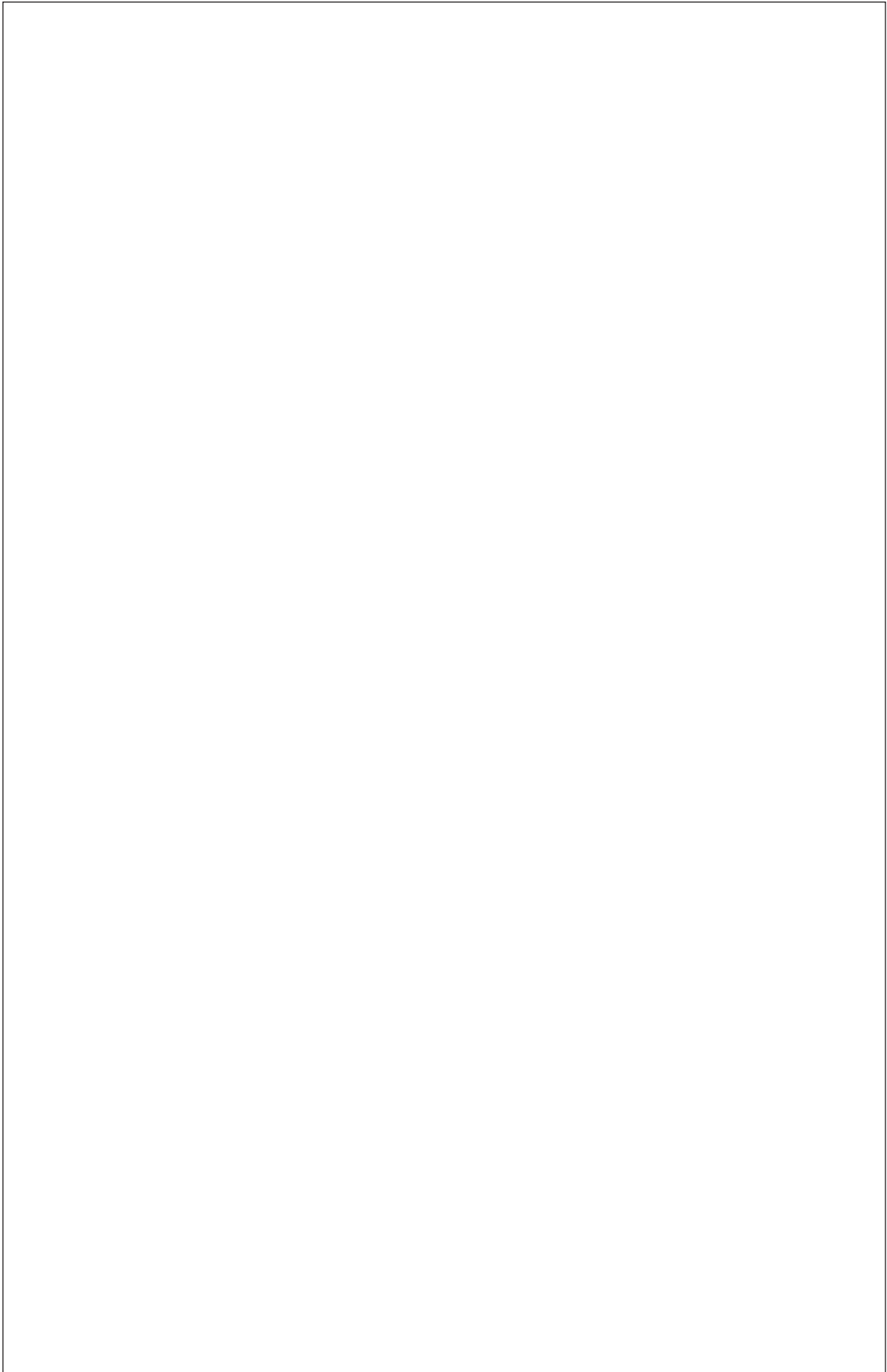
- (h) Suggest **two** land use activities that would be acceptable in Australia but would **not** be permitted in a catchment area. (2 marks)

One: _____

Two: _____

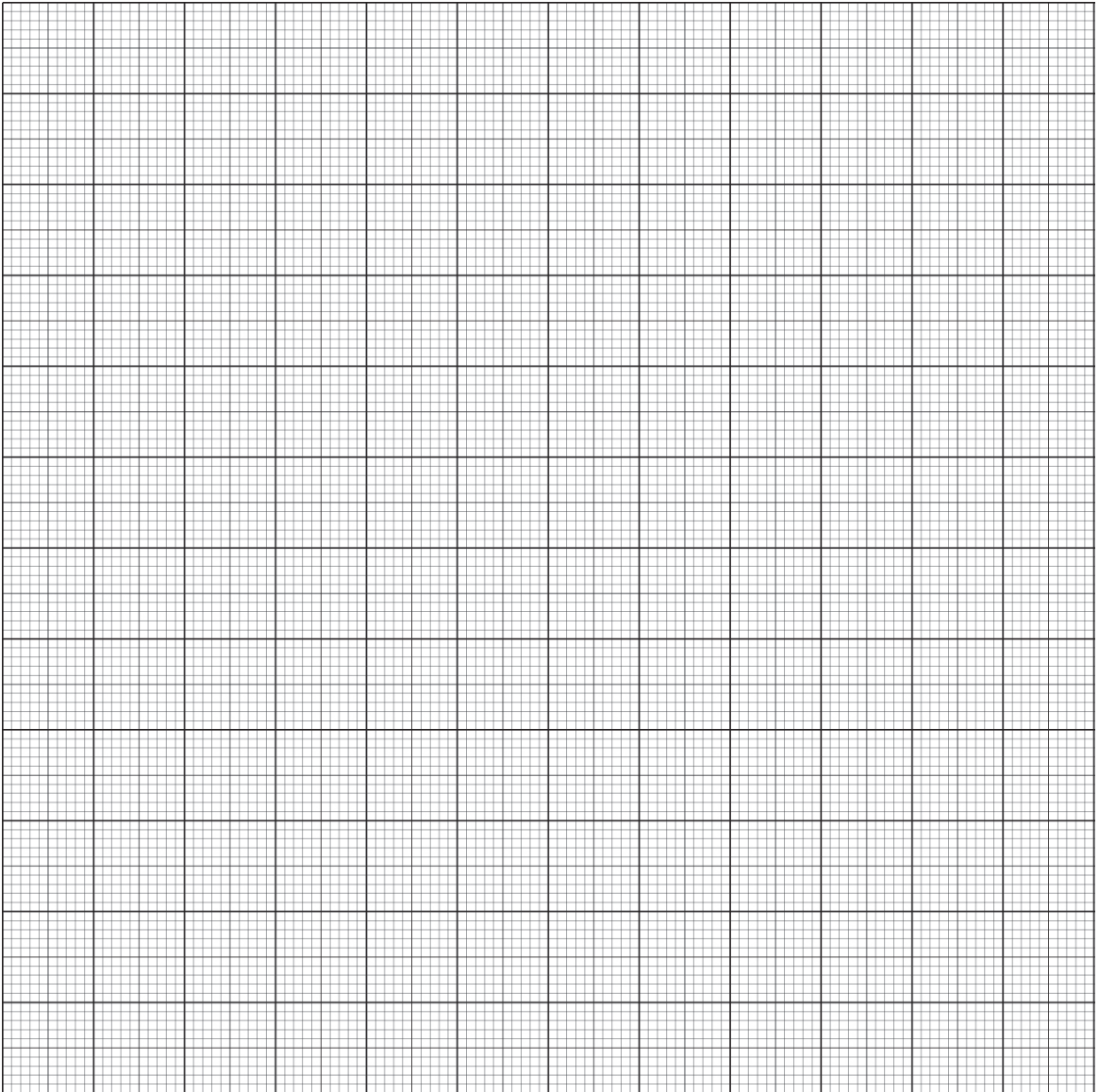
- (i) Draw a labelled diagram of the water cycle, illustrating four stages in the process.

(5 marks)



End of questions

Spare grid



ACKNOWLEDGEMENTS

- Question 22(a)** Graph adapted from: Bureau of Meteorology. (2019). *Annual rainfall Southwestern Australia (1900 to 2017)*. Retrieved December, 2018, from http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=timeseries&tQ=graph%3Drain%26area%3Dswaus%26season%3D0112%26ave_yr%3D0
Used under a Creative Commons Attribution 3.0 licence
- Question 25** Extract adapted from: Page, D. (2018, February 1). Depths of despair as 20,000 'ravenous' kingfish hit Port Stephens marine park. *Sydney Morning Herald*. Retrieved May, 2019, from <https://www.smh.com.au/environment/conservation/depths-of-despair-as-20000-ravenous-kingfish-hit-port-stephens-marine-park-20180201-h0rpqi.html>
- Question 26(h)** Introductory sentence adapted from: Nuclear power in Australia. (2019, May). In *Wikipedia*. Retrieved May, 2019, from https://en.wikipedia.org/wiki/Nuclear_power_in_Australia
Used under a Creative Commons Attribution-ShareAlike 3.0 Unported licence
Data source: Department of the Environment and Energy. (2018). *Australian Energy Update 2018*. Retrieved May, 2019, from https://www.energy.gov.au/sites/default/files/australian_energy_update_2018.pdf
Used under a Creative Commons Attribution 4.0 International licence
- Question 27** Table adapted from: Mary River Catchment Coordinating Committee. (n.d.). *Fact sheet: Water quality salinity standards*. Retrieved May, 2019, from <http://mrccc.org.au/wp-content/uploads/2013/10/Water-Quality-Salinity-Standards.pdf>

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