



INTEGRATED SCIENCE

ATAR course examination 2019

Marking key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

Section One: Multiple-choice

20% (20 Marks)

Question	Answer
1	a
2	c
3	d
4	c
5	b
6	a
7	c
8	b
9	c
10	b
11	c
12	c
13	a
14	d
15	a
16	b
17	a
18	d
19	b
20	d

Section Two: Short response

50% (82 Marks)

Question 21

(13 marks)

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

Description	Marks
At each site repeat the sampling process	1
Repeat the whole investigation	1
Total	2
Accept other relevant answers	

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

Description	Marks
Bloodworms	1
Total	1

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

Description	Marks
Stonefly larvae	1
Total	1

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

Description	Marks
Any two from:	
<ul style="list-style-type: none"> • snails may not extend over whole distance/do not live everywhere/do not live in town centre • snails may grow in a range of pollution concentrations • other factors, e.g. different pollutant might also influence the number of snails 	1-2
Total	2
Accept other relevant answers	

- (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)

Description	Marks
Either snails or dragonfly larvae	1
Snail, any two:	
<ul style="list-style-type: none"> snails are found in both pure and heavily polluted water their numbers increase downstream from the pollution/town centre due to this increase they could be considered as indicators of moderately polluted water 	1–2
Dragonfly larvae, any two:	
<ul style="list-style-type: none"> dragonfly larvae are found in small numbers in heavily polluted water increases in number in the pure water/they increase greatly in numbers further from the pollution/town centre so could be considered as indicators of lightly polluted water 	1–2
Total	3
Accept other relevant answers	

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

Description	Marks
Screening: To remove large objects such as nappies.	1
Primary sedimentation: To remove solids grit, sand, etc.	1
Aeration: To add oxygen/air to allow aerobic bacteria to live.	1
Digestion: To remove nutrients from the waste water using biological processes.	1
Total	4
Accept other relevant answers	

Question 22

(11 marks)

- (a) Identify whether these data are discrete or continuous by circling the correct word below. (1 mark)

Description	Marks
Discrete	1
Total	1

- (b) This graph shows the data presented as a column graph. Name another type of graph that could have been used in this situation. (1 mark)

Description	Marks
Bar graph	1
Total	1

- (c) What is 'potable water'? (1 mark)

Description	Marks
Water that is suitable for drinking.	1
Total	1

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

Description	Marks
Explanation includes:	
<ul style="list-style-type: none"> • identifies need for high pressure • semipermeable membrane used so water can pass through • removes both large and fine particles • salt is larger than water molecules 	1–4
Total	4

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

Description	Marks
Environmental impact – use of electricity to create water pressure	1
Reason – could add to the greenhouse gas burden by burning coal in Western Australia	1
Environmental impact – hypersaline waste water/brine/reject/concentrate	1
Reason – discharged into the ocean increasing local salinity.	1
Total	4
Accept other relevant answers.	

Question 23

(18 marks)

- (a) Calculate the efficiency of electrical energy generation in the Muja power station. (3 marks)

Description	Marks
Efficiency = power out/power in × 100	1
= 6750/25000 × 100	1
= 27%	1
Total	3

- (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)

Description	Marks
Chemical potential (coal) to heat:	1
Any valid example	1
Heat to kinetic (rotation of turbines):	1
Any valid example	1
Kinetic to electrical:	1
Any valid example	1
Total	6

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

Description	Marks
Identifies:	
Strategy: Use non-carbon-based sources of energy (solar, wind, geothermal)/use less fossil fuels.	1
Description includes:	
Source of Energy: Any renewable energy source e.g. solar	1
How reduces CO ₂ : Relevant examples	1
Total	3

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

Description	Marks
Any three of:	
• resource extraction disturbing natural ecosystems	1
- land erosion, etc. land clearing for infrastructure – construction of towns, roads	1
• production of wastes	1
- including fly ash/dust soil, water pollution	1
• consumption and pollution of water	1
- dams, lowering water table, run off of contaminated water	1
• land clearing	1
- for infrastructure	1
Total	6
Accept other relevant answers.	

Question 24

(26 marks)

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

Description	Marks
Conduction - via ceramic material to the outer surface of the cup	1 1
Convection - within the liquid as it cools, hot water rises and in the air above the liquid convection removes heat	1 1
Radiation - heat radiates from the cup outer surface and the surface of the liquid	1 1
Evaporation - absorbs heat as liquid at the surface becomes a gas	1 1
Total	8

- (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)

Description	Marks
Diagram <div style="border: 1px dashed gray; padding: 10px; text-align: center; margin: 10px 0;"> For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at the link listed on the acknowledgements page. </div>	1–2
Any three descriptions:	
High roof – draws hot air away from the inhabitants	1–2
Wide eaves/verandas – provides shading, no solar heat gain	1–2
Solid stone / brick construction – provides insulation	1–2
Double glazed windows – provides insulation	1–2
Curtains – adds to insulation	1–2
Trees – more shade to stop solar heat gain	1–2
Insulation-slows heat transfer	1-2
Aspect – orientation to the sun	1-2
Total	8

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

Description	Marks
Any two :	
<ul style="list-style-type: none"> • more heat lost to the room • longer cooking times • not cooking at the selected temperature 	1–2
Total	2
Accept other relevant answers.	

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

Description	Marks
Less electricity would be used each day	1
Over 20-years will cost less to run	1
Total	2

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

Description	Marks
The supplier provides for a base-load of electricity using its power stations,	1
A hot day will cause demand for air-conditioning	1
When the demand exceeds the base-load, the supplier may not meet this demand	1
Total	3

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

Description	Marks
Use alternate generators	1
Import from another nearby source in a different time zone and different demand time.	1
Turn off supply to some customers	1
Total	3

Question 25

(14 marks)

- (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)

Description	Marks
One mark for each change in the populations.	
How: Population of pink snapper will decrease	1
Reason 1: As yellowtail kingfish eat wild fish food source or competes for the wild fish food source	1
Reason 2: Therefore less food source for pink snapper	1
Total	3

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

Description	Marks
Advantage	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • more employment for local • financial benefits to the community due increase in population 	1
Disadvantage	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • disruption to local way of life • pressure on community services 	1
Total	2
Accept other relevant answers.	

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

Description	Marks
Any two from:	
<ul style="list-style-type: none"> • sea grass • marine algae • phytoplankton 	1–2
Total	2

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

Description	Marks
At the top of the food web	1
Refers to primary consumers and secondary consumers	1
They do not have predators	1
Total	3

- (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)

Description	Marks
Either	
Coral hog fish use 90% of the energy they gain from food for movement	1
Metabolism only passing on 10% to grey nurse sharks	1
Or	
The energy available from one coral hog fish does not supply all of the grey nurse shark's needs	1
One grey nurse shark needs to consume many coral hog fish to gain its energy needs	1
Total	2

- (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)

Description	Marks
Full name added.	1
Two arrows in correct direction linking corals to crown-of-thorns starfish to sea snails	1
Total	2

Section Three: Extended answer

30% (55 marks)

Question 26

(22 marks)

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

Description	Marks
Description includes: <ul style="list-style-type: none"> • absorb sunlight • electrons released • from n to p • electrons flow 	1–4
Total	4
Accept other relevant answers.	

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

Description	Marks
Advantages	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • availability at all times • common fuel • generators inexpensive 	1–2
Disadvantages	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • non-renewable so will run out • security of supply • produces gases which contribute to global warming • pollution / noise • other suitable answers 	1–2
Total	4

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

Description	Marks
Equation $P = \frac{E}{t}, \therefore t = \frac{E}{P}$	1
Correct substitution $t = \frac{320\ 0000}{150\ 000}$	1
≈ 21 hours	1
Total	3

- (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)

Description	Marks
Any two of:	
<ul style="list-style-type: none"> • the number of daylight hours varies • angle of sun depending on seasons • weather – clouds • a maximum possible electrical output only possible during summer 	1–2
Total	2

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

Description	Marks
Description includes:	
<ul style="list-style-type: none"> • non-renewable are high energy input – heating with gas and coal • renewable are low energy input 	1–2
Total	2
Accept other relevant answers.	

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

Description	Marks
Less wasted energy – friction, sound	1
Total	1

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

Description	Marks
Name two environmental problems:	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • release of radiation into the environment • storage/disposal • mining for nuclear materials 	1–2
Name two impacts:	
Answers may include, but are not limited to: <ul style="list-style-type: none"> • radiation on the human body can include nausea and vomiting and mutations which can lead to cancers, and/or death • the long time-frame needed for nuclear materials to be non- radioactive, means suitable sites are difficult to find/need for long-term disposal sites • loss/destruction of habitats means for loss species/biodiversity 	1–2
Total	4
Accept other relevant answers.	

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

Description	Marks
Any two of:	
<ul style="list-style-type: none"> • demand is increasing rapidly • solar use is increasing slowly • the difference is being taken up by coal 	1–2
Total	2

Question 27

(33 marks)

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

Description	Marks
Any two of:	
<ul style="list-style-type: none"> • It does not relate to an independent variable • It does not relate to a dependant variable • Shows a relationship between dependent and independent variables • Is testable 	1–2
Total	2

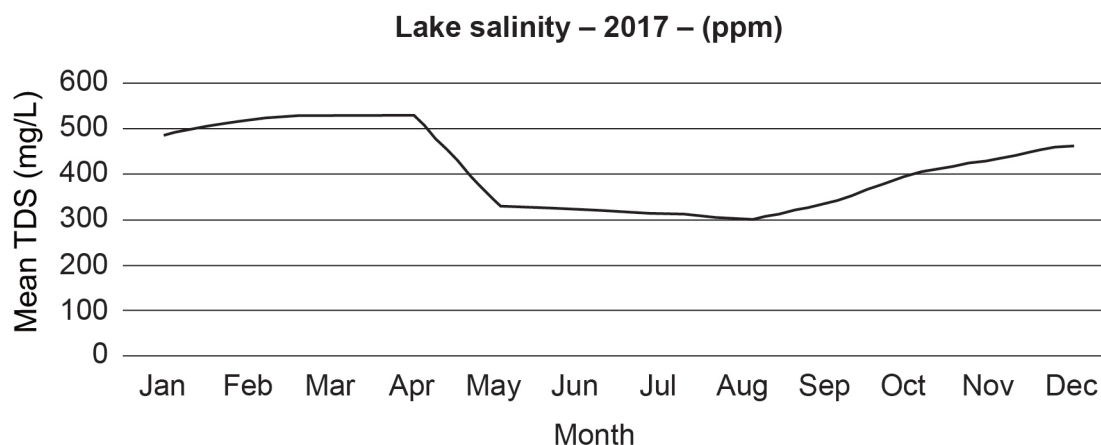
- (b) Identify **three** factors they would need to consider to ensure their investigation was valid and give a reason for each. (6 marks)

Description	Marks
Answers may include but are not restricted to the following:	
Factor: The traps would need to be set evenly around the lake	1
Reason: Uneven spacing may allow more frogs to be captured in some areas than others	1
Factor: The traps would need to be set at the same time of day, not at different times	1
Reason: Frogs may be more active at night and quiet during the day	1
Factor: The traps would all need to be identical in size shape and operation	1
Reason: Different sized traps or traps with different operations will render the results invalid as they may catch more or less frogs	1
Total	6
Accept other relevant answers.	

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

Description	Marks
Humane care for animals – minimises pain and distress	1
Accountability for responsibility for the animals	1
Use of animals for scientific purposes must have scientific or educational merit	1
Total	3

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



Description	Marks
Line graph or bar/column graph	1
Title	1
Suitable scales	1
x-axis labelled	1
y-axis labelled	1
Total	5

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

Description	Marks
Low salinity June–August	1
Increasing salinity August to April	1
Salinity rises as summer progresses due to evaporation	1
Salinity falls with winter rain – May–August	1
Total	4

(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)

Description	Marks
Yes	1
0–500 TDS is suitable for humans and for two months the water is only just above 500 and is still suitable	1
Total	2

Question 27 (continued)

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

Description	Marks
Have multiple trials and use the average	1
Remove outliers	1
Calibrate equipment	1
Duplicate equipment	1
Total	4

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

Description	Marks
Mining that would contaminate the runoff.	1
Agriculture, animal husbandry / spraying of crops that might cause contamination	1
Total	2
Accept other relevant answers.	

- (i) Draw a labelled diagram of the water cycle, illustrating four stages in the process. (5 marks)

Description	Marks
<p>The diagram illustrates the water cycle with the following stages and processes:</p> <ul style="list-style-type: none"> Evaporation/Transpiration: Shown as wavy arrows rising from a body of water and trees. Condensation: Shown as a cloud with an arrow pointing to it from the evaporation/transpiration stage. Precipitation: Shown as rain falling from a cloud onto a mountain range. Collection/Runoff: Shown as dashed arrows indicating water flowing down the slopes of the mountains and into a stream. 	1
Evaporation/transpiration	1
Condensation	1
Precipitation	1
Collection/runoff	1
Total	5

ACKNOWLEDGEMENTS

- Question 24(b)** House illustration provided by courtesy of a member of the examining panel
B & W tree icon. Retrieved October, 2019, from https://www.clipartmax.com/middle/m2H7i8m2H7G6H7A0_this-free-icons-png-design-of-tree3-b-w-b-and-w/
- Question 26(d)** Extract adapted from: Assessment and Qualifications Alliance (AQA). (2013). Science A/Physics [Mark scheme]. Retrieved October, 2019, from <https://pastpapers.co/aqa/GCSE/Physics-4403/AQA-PH1HP-W-MS-JAN13.PDF>
- Question 27(d)** Lake salinity–2017–(ppm) graph provided by courtesy of a member of the examining panel
- Question 27(i)** Diagram of the water cycle adapted from: National Aeronautics and Space Administration (NASA). *Water cycle diagram*. Retrieved November, 2019, from <https://pmm.nasa.gov/education/water-cycle>

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303 Sevenoaks Street
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