



INTEGRATED SCIENCE

ATAR course examination 2020

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

Section Two: Short response

50% (92 Marks)

Question 21

(20 marks)

- (a) Describe how photovoltaic cells generate electrical current. (4 marks)

Description	Marks
Photons/light hits the solar panel	1
Causes free electrons	1
The electrons flow from the n to the p layer	1
Electrons flow into circuit as electricity	1
Total	4

- (b) Complete the two missing stages involved in producing electrical current from coal. (2 marks)

Description	Marks
Heat water to convert to steam	1
Steam drives the turbine	1
Total	2

- (c) Complete the flow diagram below to show the different energy transformations that occur in a hydro-electric power station. (3 marks)

Description	Marks
Gravitational potential energy	1
Kinetic energy	1
Electrical energy	1
Total	3

- (d) Compare the processes of electrical generation that occur in a coal-fired power station and in a pressurised water reactor nuclear power station. (5 marks)

Description	Marks
Both produce heat	1
Coal-fired uses combustion, while nuclear power station uses nuclear energy/nuclear fission	1
Nuclear uses two stages for heat transfer to steam, while coal-fired uses one stage for heat transfer to steam	1
Both use heat to produce steam and drive a turbine	1
Both use water	1
Total	5

Question 21 (continued)

- (e) Define 'base load supply'. (2 marks)

Description	Marks
Minimum amount of electricity required to be supplied at any time	1
	1
Total	2

- (f) State how coal-fired and nuclear power stations are different in terms of their efficiency and cost, providing reasons. (4 marks)

Description	Marks
Efficiency	
Coal-fired is less efficient due to high heat loss or Nuclear is more efficient as less fuel is required for equal energy	1–2
Cost	
Coal-fired is cheaper to run as coal is cheap or Nuclear is more expensive due to building costs	1–2
Total	4

Question 22

(21 marks)

- (a) Calculate the percentage of light energy stored by the seagrasses annually. Show your workings. (3 marks)

Description	Marks
Converting 1150 MJ in to kJ	1
Working shown $22500/1150000 \times 100$	1
Answer = 1.96%	1
Total	3

- (b) Draw a food chain for the energy pyramid shown in Figure 1. (1 mark)

Description	Marks
seagrasses → shrimp → sea anemone → squid	1
Total	1

- (c) If the energy store of the seagrasses in Figure 1 is 96 000 kJ m⁻² annually, determine the approximate amount of energy transferred annually to the sea anemone. Justify your answer. (2 marks)

Description	Marks
960 kJ m ⁻²	1
Only 10% of energy is transferred from one trophic level to the next trophic level or 90% of energy is lost at each trophic level	1
Total	2

- (d) Outline **four** reasons why the squid would transfer much less energy than the seagrasses in Figure 1. (4 marks)

Description	Marks
Any four reasons:	
<ul style="list-style-type: none"> • all of the organisms that are preyed upon are not consumed • energy is lost during respiration • energy is lost as heat • energy is lost as movement • energy is lost as waste material/faeces. 	1–4
Total	4
Accept other relevant answers.	

- (e) Name the trophic level that is **not** represented in the food web above and outline its role in the ecosystem. (2 marks)

Description	Marks
Decomposers	1
to break down plant and animal remains (to inorganic nutrients)	1
Total	2

Question 22 (continued)

- (f) Describe **two** impacts this would have on the food web in Figure 2, giving reasons for your answers. (4 marks)

Description	Marks
Any two impacts:	
Worm population increases because there are less crabs to prey upon the worm population	1–2
Black bream population decreases because they would have less available food or there are no alternative food sources	1–2
Whitebait population decreases because they are an alternative food source for snapper	1–2
Total	4
Accept other relevant answers.	

- (g) Describe how seagrass beds affect the amount of dissolved oxygen and nutrients in the Shark Bay ecosystem. (4 marks)

Description	Marks
Dissolved oxygen	
Seagrasses produce oxygen through photosynthesis	1
Maintain high levels of dissolved oxygen	1
Nutrients	
Seagrasses use excess nutrients/nitrates to grow	1
Keep nutrient levels low	1
Total	4

- (h) State **one** human activity in the Shark Bay area that could result in increased nutrients in the aquatic ecosystem. (1 mark)

Description	Marks
Any one human activity:	
<ul style="list-style-type: none"> • fertilising land • farming • release of wastewater • destruction of seagrass beds. 	1
Total	1
Accept other relevant answers.	

Question 23

(13 marks)

- (a) Describe kinetic and potential energy and provide a form of energy for each. (4 marks)

Description	Marks
Kinetic energy	
the energy a moving object has	1
Form: Any one – mechanical, heat, electrical or sound	1
Potential energy	
stored energy	1
Form: Any one – chemical, gravitational, elastic or nuclear	1
Total	4
Accept other relevant answers.	

- (b) State the Law of Conservation of Energy. (2 marks)

Description	Marks
Energy can neither be created nor destroyed	1
It can be transferred or transformed	1
Total	2

- (c) Use the Law of Conservation of Energy (assuming no friction) to determine the amount of energy at
- A**
- ,
- B**
- ,
- C**
- and
- D**
- on the diagram above. (4 marks)

Description	Marks
A : 450 J	1
B : 50 J	1
C : 500 J	1
D : 0 J	1
Total	4

- (d) Determine whether each of the situations below demonstrates work being done.
- Circle**
- the correct answer for each situation. (3 marks)

Description	Marks
No	1
Yes	1
Yes	1
Total	3

Question 24

(15 marks)

- (a) Identify the **three** methods of heat transfer from the heater and describe how each method assists in increasing the air temperature in a room. (6 marks)

Description	Marks
Conduction • heat transfers through contact between particles (from metal to air particles)	1 1
Convection • the hot air around the heater heats up and rises/displaced by cooler air, as it cools it falls, creating a convection current	1 1
Radiation • heat is emitted from the burners/heats outer surface and increases temperature of the air surrounding/energy travels as waves in all directions from the source	1 1
Total	6

- (b) Identify passive solar design features that would keep a building warm during winter. Include **two** that would prevent heat loss and **two** that would increase heat gain. (4 marks)

Description	Marks
Features preventing heat loss	
Any two of: • double glazed windows • double brick • insulation in roof/walls.	1–2
Features increasing heat gain	
Any two of: • eaves to allow the lower winter sun to enter the building • windows facing north to allow winter sunlight to enter (orientation) • use building materials with large thermal mass for absorbing and storing energy.	1–2
Total	4
Accept other relevant answers.	

- (c) Explain what is meant by the enhanced greenhouse effect. (3 marks)

Description	Marks
Increased levels of greenhouse gases	1
Causing additional heat being retained in the atmosphere	1
Results in an increase in the average global temperature of the atmosphere	1
Total	3

- (d) Provide **two** advantages of burning wood instead of coal for the generation of electricity. (2 marks)

Description	Marks
Any two advantages:	
<ul style="list-style-type: none">• wood is renewable• burning wood produces less pollutants• wood can be sourced locally.	1–2
Total	2
Accept other relevant answers.	

Question 25

(23 marks)

- (a) Draw a labelled diagram of a water molecule to illustrate its polarity. (3 marks)

Description	Marks
Bent shape	1
Oxygen and hydrogen symbols	1
Partial positive and negative labels	1
<p style="text-align: center;"> δ^- Partial negative charge δ^+ Partial positive charge </p>	
Total	3

- (b) Explain how the specific heat capacity of water provides a desirable environment for aquatic organisms. (2 marks)

Description	Marks
Water has a high specific heat capacity	1
Aquatic environments have a relatively stable temperature/are resistant to temperature change	1
Total	2

- (c) Use your knowledge of water polarity to explain why water striders can walk on water. (3 marks)

Description	Marks
Surface tension	1
There is a strong attraction between water molecules (hydrogen bonding)	1
Water forms polar molecules/regions of positive and negative charges	1
Total	3

- (d) A light piece of wood floats in fresh water at 4 °C. Describe the change in buoyancy of the wood as the temperature of the water increases above 4 °C. (2 marks)

Description	Marks
Buoyancy decreases	1
The light piece of wood will float lower in the water/sink further into water	1
Total	2

- (e) Explain why the density of fresh water decreases as the temperature drops below 4 °C. (3 marks)

Description	Marks
Beginning to change state/forming crystalline lattice (solid structure)	1
Water molecules become spaced further apart	1
Spacing due to repulsion between like charges of water molecules	1
Total	3

- (f) What effect has this change had on dissolved oxygen and carbon dioxide gas levels in aquatic environments? (1 mark)

Description	Marks
Lower dissolved gas levels	1
Total	1

- (g) Describe **three** characteristics of structures that enable efficient gas exchange. (6 marks)

Description	Marks
Large surface area to volume ratio provides a larger area for gas to diffuse across	1–2
Counter current exchange ensures a high concentration gradient is maintained	1–2
Thin membrane allows small gas molecules to diffuse more easily	1–2
Total	6

- (h) State **three** osmoregulation mechanisms these fish utilise to balance internal salt concentration. (3 marks)

Description	Marks
Drinking large amounts of sea water	1
Excreting small amounts of concentrated urine	1
Active transport of salt from gills	1
Total	3

Section Three: Extended response

30% (63 marks)

Question 26

(34 marks)

- (a) Identify **two** main ways in which surface water is stored for drinking. (2 marks)

Description	Marks
Any two of:	
<ul style="list-style-type: none"> • rainwater tanks • dams • reservoirs. 	1–2
Total	2

- (b) Explain how water is collected in catchment areas. (3 marks)

Description	Marks
It flows over land as surface run-off	1
Soaks into ground/infiltrates/percolates	1
Collects in valleys/dams	1
Total	3

- (c) Describe a management strategy that could be used to prevent the likelihood of water being affected by dry land salinity, turbidity and eutrophication. (6 marks)

Description	Marks
Dry land salinity	
Ensure catchment area has sufficient long rooted trees to keep water table low or Prevent over-irrigation to keep water table low/prevent water table rising	1–2
Turbidity	
Ensure recreational activities in dams/water sources/rivers/lakes/streams do not cause disturbance to sediment or Ensure enough vegetation to stop soil being washed into dams/water sources/rivers/lakes/streams	1–2
Eutrophication	
Ensure enough vegetation to stop excess nutrients being washed into dams/water sources/rivers/lakes/streams or Ensure no agricultural activities will wash organic matter containing nutrients into dams/water sources/rivers/lakes/streams	1–2
Total	6
Note: Answers must include a strategy and impact.	

- (d) Explain **two** negative effects the increased use of groundwater would have on lakes and their ecosystems. (6 marks)

Description	Marks
Any two negative effects:	
Water table drops Causing lakes to dry out aquatic organisms die	1–3
Water table drops Vegetation around area dies out increasing erosion	1–3
Less available water around wetlands Decrease in diversity in ecosystem change in ecosystem	1–3
Total	6
Accept other relevant answers.	

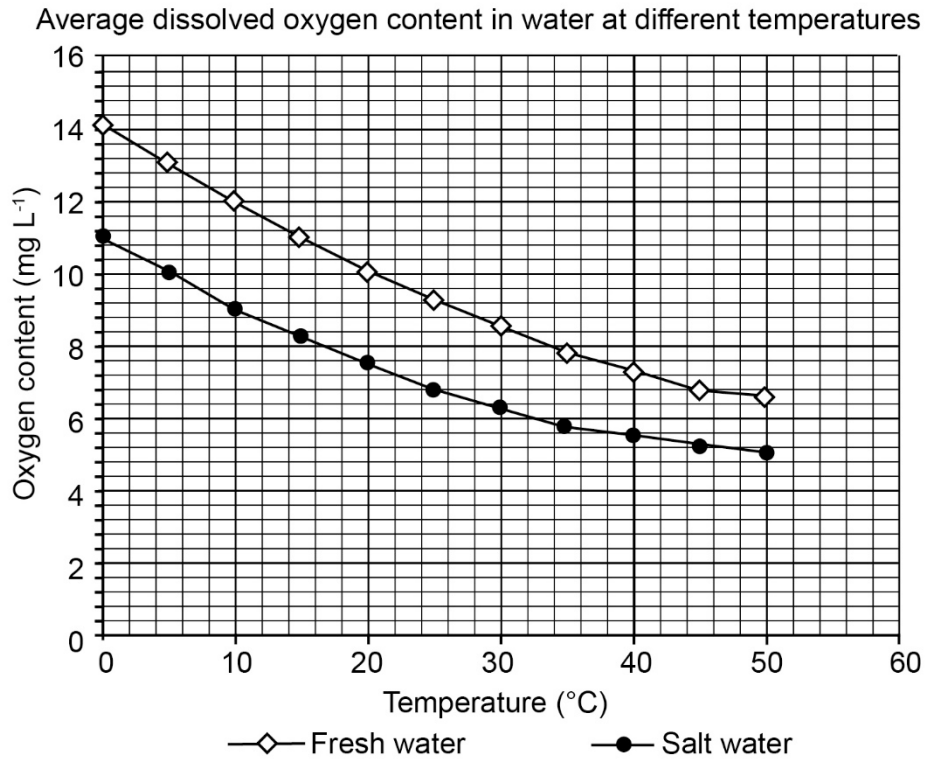
- (e) On the basis of the results in Table 1, describe the trend in salinity levels over the three years and propose a reason for this trend. (3 marks)

Description	Marks
Salinity levels have increased over time	1
Any one reason described:	
Greater evaporation due to higher water temperatures results in higher salt concentration or Increased water temperature increases solubility resulting in more dissolved salt	1–2
Total	3

Question 26 (continued)

(f) Graph the data from Table 2 on the following grid.

(6 marks)



Description	Marks
Correct title – includes relationship of independent and dependent variable	1
Accurate plotting	1
Appropriate graph drawn – two lines	1
Correct labels on axes including units	1
Even scales on axes	1
Key to lines	1
Total	6

(g) Identify **one** trend shown in the graph.

(1 mark)

Description	Marks
As temperature increases oxygen content decreases or As temperature decreases oxygen content increases	1
Total	1

- (h) Use your graph to predict the missing 2019 dissolved oxygen content for the freshwater lake in Table 1 on page 23. (1 mark)

Description	Marks
28 °C = 8.6–9.0 mg L ⁻¹	1
Total	1

- (i) Describe the stages in the process of eutrophication that lead to decreased dissolved oxygen levels. (6 marks)

Description	Marks
Increased nutrient levels	1
Causes an algal bloom	1
Algae use up nutrients and die	1
Decomposer activity increases	1
Photosynthesis reduced due to turbidity	1
Decomposer respiration increases/consume more oxygen	1
Total	6

Question 27

(29 marks)

- (a) Referring to the diagram and Table 3, write a possible procedure for this experiment. (6 marks)

Description	Marks
Change fuel type	1
Measure and record starting temperature of water	1
Measure and record final temperature of water	1
Measure mass of water (20 g)	1
Burn 2 g of fuel	1
Other controlled variables – distance between wick/flame and test tube or any other relevant controlled variable	1
Total	6

- (b) Using the data from Table 3, calculate the heat energy in joules, absorbed by the water from the bioethanol. Show your working. (3 marks)

Use the formula $Q = mc\Delta T$, where the specific heat capacity of water is 4.180 J g^{-1} .

Description	Marks
Temperature change = $38.6 - 20.2 = 18.4$	1
$Q = 20 \times 18.4 \times 4.180$	1
$= 1538.24 \text{ J}$	1
Total	3

- (c) (i) Provide **one** reason why the experimental results are lower than the theoretical values. (1 mark)

Description	Marks
Heat loss	1
Total	1

- (ii) Referring to the data in Table 4, state whether the differences between values could be a result of random or systematic errors. (1 mark)

Description	Marks
Systematic errors	1
Total	1

- (iii) Why is bioethanol considered to be a biofuel? (1 mark)

Description	Marks
Produced from organic matter/ <u>biomass</u> /plant materials/animal waste	1
Total	1

- (d) State **two** disadvantages of using biofuels. (2 marks)

Description	Marks
Any two disadvantages:	
<ul style="list-style-type: none"> • high cost of production • use of fertilisers/other resources • shortage of food • use of water • industrial pollution. 	1–2
Total	2

- (e) State what is occurring during each of the four strokes of the engine cycle. (4 marks)

Description	Marks
Intake: Air and fuel enter the cylinder/the piston moves down and intake valve opens	1
Compression: Piston moves up reducing the cylinder volume/pushes fuel and air close together	1
Combustion: Fuel and air is ignited (spark plug)/the explosion pushes piston down	1
Exhaust: Waste products (and extra reactants) are expelled as the piston moves up and exhaust valve opens	1
Total	4

- (f) Describe the differences between an electric vehicle motor and an internal combustion engine, referring to:
- efficiency
 - environmental impact
 - impact on resources.
- (6 marks)

Description	Marks
Efficiency	
Electric vehicle (EV) is more efficient/less heat loss or Internal combustion engine (ICE) is less efficient/more heat loss	1–2
Environmental impact	
EV is more environmentally friendly/no exhaust waste or ICE is less environmentally friendly, high CO ₂ /there are pollutants produced in exhaust gases	1–2
Impact on resources	
EV can be run renewably/can use solar to charge/requires batteries that use minerals such as mining (lithium) or ICE is non-renewably run/less fossil fuel available over lifetime	1–2
Total	6

Question 27 (continued)

- (g) Explain how a hydrogen fuel cell functions to produce electricity. In your answer, provide a general description of the processes that occur, referring to the diagram above.
(5 marks)

Description	Marks
Hydrogen reacts and produces electrons or Oxidation occurs at the anode producing electrons	1
Electrons flow from the anode to the cathode	1
Produces an electrical current	1
Oxygen reacts at the cathode/reduced with hydrogen ions or Reduction occurs at the cathode using electrons	1
Forms water	1
Total	5

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