



INTEGRATED SCIENCE

ATAR course examination 2016

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

Section Two: Short response

50% (95 Marks)

Question 21

(16 marks)

- (a) Explain why the points on the plotted graph form a straight line. (2 marks)

Description	Marks
For each unit of time the same heat is added	1
so the temperature rises the same amount (directly proportional)	1
Total	2

- (b) Using the equation $E = mc\Delta T$, calculate the specific heat capacity of water from the data provided in this question. (6 marks)

Description	Marks
$E = mc\Delta T \therefore c = E/m \Delta T$ (rearrange equation)	1
Identify ΔT	1
$E = 10 \times 60 \times 1500 = 900\,000$	1
$c = 900\,000 / (3 \times 79)$	1
$= 3797$	1
Correct units $\text{J kg}^{-1} \text{ }^\circ\text{C}^{-1}$ or $\text{J kg}^{-1} \text{ K}^{-1}$	1
Total	6

- (c) The specific heat capacity of water is $4200 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$ but this is **not** the result obtained from the data. One student suggests that the thermometer is inaccurate. If the thermometer was inaccurate, identify the type of error that the student encountered. Would the result be improved by repeating the experiment many times and averaging the results? Provide a reason for your answer. (3 marks)

Description	Marks
This is a systematic error	1
No. It will not be removed by repeating the experiment	1
It will affect all the results in the same way	1
Total	3

- (d) Identify **two** different possible sources of error that would affect the result obtained in part (b). (2 marks)

Description	Marks
One mark for each valid source or error. Maximum two marks. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • mass/volume of water was incorrectly measured • the mass of water was less than 3 kg • as temp increases more heat lost to atmosphere (temp difference increase increases heat transfer) 	1–2
Total	2

Question 21 (continued)

- (e) Compare the unknown liquid graph with the water graph on page 8. Use this information to estimate the specific heat capacity of the unknown liquid. Explain your answer by referring to the difference in the slope of the two graphs. (3 marks)

Description	Marks
Estimated specific heat capacity of unknown liquid = $1900 \text{ J kg}^{-1} \text{ }^{\circ}\text{C}^{-1}$	1
Graph slope approximately twice original	1
Unknown liquid has half the specific heat capacity of water	1
Total	3

Question 22

(14 marks)

- (a) Describe the process of dry land salinity. (3 marks)

Description	Marks
Water-table rises to the surface	1
Dissolving salts on the way	1
Water evaporates leaving salt on the surface	1
Total	3

- (b) Explain how each method below reduces dry land salinity. (4 marks)

Description	Marks
Trees: removes water from soil at depth and releases it by transpiration	1
Lowers water table	1
Gravel trenches: removes water to a greater depth	1
Prevents rise of water table to the surface and rain takes salt down to the water table and the trenches	1
Total	4

- (c) Given that rainfall in Perth is decreasing, state **two** effects this will have on the varying ecosystems of the Perth lakes. (2 marks)

Description	Marks
One mark for each effect. Maximum of two marks. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • some lakes may dry up • some plant or animal species may die out • different plant and animal species may inhabit the areas 	1–2
Total	2

- (d) What is the origin of the groundwater in Perth? (1 mark)

Description	Marks
Rainfall	1
Total	1

- (e) If the decreasing rainfall trend continues and Perth relies more on groundwater for its drinking water, suggest **two** possible negative effects from this increase in groundwater consumption. State how each will affect our lifestyle. (4 marks)

Description	Marks
Two marks for each negative effect, one mark for effect, one mark for affect on lifestyle. Maximum four marks Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • groundwater becomes more brackish • less water for gardens – aesthetics 	1–2
<ul style="list-style-type: none"> • vegetation die out due to lower water table • decreased park areas – decrease in areas for recreation activities 	1–2
<ul style="list-style-type: none"> • increased water restrictions • possible need to purchase bottled drinking water at certain times of the year 	1–2
Total	4

Question 23

(13 marks)

- (a) With your knowledge of heat transfer and using the terms convection, conduction and radiation, describe how the heat energy being released from the burning wood reaches Jack. (4 marks)

Description	Marks
Heat transfers by convection from wood to sides of heater	1
Heat transfers by conduction through heater walls	1
Heat transfers by convection to Jack	1
Heat transfers by radiation to Jack	1
Total	4

- (b) Describe **three** design features that can help to keep a house warmer in winter and cooler in summer. (6 marks)

Description	Marks
Two marks for each valid feature. Feature one mark, benefit one mark. Maximum six marks. Answers could include, but are not limited to the following:	
• windows facing north – to allow sun in during winter	1–2
• deciduous trees on the north – shading during summer and sun in winter	1–2
• double glazed windows to keep heat in during winter and heat out during summer	1–2
• double brick – insulates heat coming in during summer and going out during winter	1–2
• insulation – reduces heat transfer	1–2
• eaves – stop radiation entering during summer and allows it to enter during winter	1–2
Total	6

- (c) For each of the **three** features you provided in part (b), identify the main method of heat transfer that is limited as a result of that design feature. (3 marks)

Description	Marks
One mark for each method. Maximum three marks. Answers could include, but are not limited to the following:	
• conduction – double brick/double glazing, insulation (winter), windows south facing (winter)	1–3
• radiation – shading/eaves, insulation (summer), windows (summer)	
• convection – closing windows	
Total	3

Question 24

(21 marks)

- (a) Name the test or equipment used for the following water quality tests and explain the importance of the particular test for the monitoring of the health of the aquatic ecosystem.

- (i) pH (3 marks)

Description	Marks
Test equipment: litmus, pH meter	1
Explanation: acidity of the water	1
Can result in death of aquatic life	1
Total	3

- (ii) Turbidity (3 marks)

Description	Marks
Test equipment: Secchi disk	1
Explanation: light cannot reach the plants	1
And they die	1
Total	3

- (iii) Phosphates (3 marks)

Description	Marks
Test equipment: palin test kit	1
Explanation: promotes algal growth	1
Hence decrease in oxygen levels	1
Total	3

- (b) From the table page 16, suggest a likely environmental effect of the recorded changes in (3 marks)

- pH
- temperature
- phosphates and nitrates

Description	Marks
One mark for a valid effect due to a pH change. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • less plants and animals • different plants and animals • more metal ions in the river water 	1
One mark for a valid effect due to a temperature change. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • decrease in oxygen levels • less animals 	1
One mark for a valid effect due to phosphates and nitrates levels changing. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • increase in the amount of algae (eutrophication) • less animals 	1
Total	3

Question 24(b) (continued)

(c) From the table on page 16, suggest a reason why the turbidity value changed. (2 marks)

Description	Marks
Possible eutrophication has taken place	1
No organic material left in water, hence more clear	1
Total	2

(d) Identify **two** human activities that can result in reducing the quality, and hence the availability, of public drinking water supplies. (2 marks)

Description	Marks
One mark for each valid human activity. Maximum two marks. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none"> • pollution by fertilisers (accept any form of contamination) • salination from irrigation • land clearing • mining. 	1-2
Total	2

(e) Explain how reverse osmosis produces fresh water from seawater. A well-labelled diagram should be included as a part of your answer. (5 marks)

Description	Marks
Diagram – correct and clearly labelled	2
Diagram – mostly correct and some labels	1
Uses a semipermeable membrane to remove ions	1
Under high pressure	1
Water moves though membrane leaving saline solution for discharge	1
Total	5

Question 25

(11 Marks)

- (a) Using the graph on page 18, determine the GPE of the toy car 1.5 seconds after launch. (1 mark)

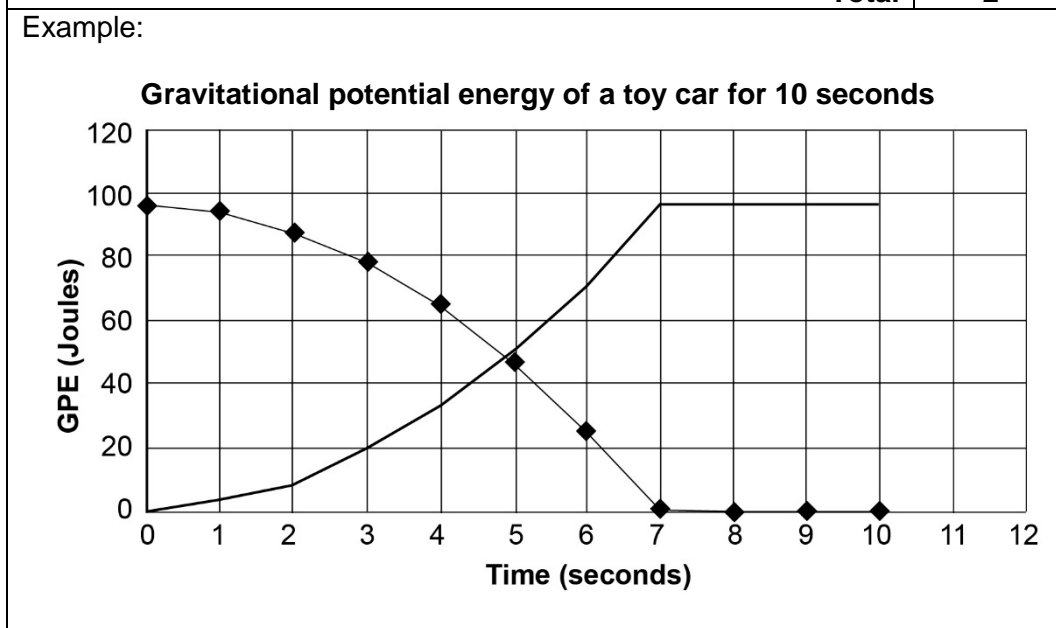
Description	Marks
90 J ± 2	1
Total	1

- (b) Why didn't the GPE of the toy car change between the 7 and 10 second marks? (2 marks)

Description	Marks
It had reached level ground	1
Was no longer converting GPE into KE	1
Total	2

- (c) (i) Add a sketch of the kinetic energy of the toy car over 10 seconds to the graph on page 18. (2 marks)

Description	Marks
Plot shows that KE + GPE is a constant	1
Plot shows a curve of best fit, not a straight line (0 to 7 seconds)	1
Total	2



- (ii) Explain the relationship between the amount of kinetic energy, the amount of potential energy and the total energy of the toy car. (3 marks)

Description	Marks
Rate of loss of GPE equals the rate of gain of KE	1
Law of Conservation of Energy	1
Total energy is constant	1
Total	3

Question 25 (continued)

- (d) The toy car used by Chris and Kerry was a model. Real cars use an internal combustion engine to generate motion. This type of engine is regarded as inefficient as less than 25% of the energy received from the combustion of fuel is used to move the car. List **three** ways in which energy is wasted when using an internal combustion engine.

(3 marks)

Description	Marks
One mark for each valid response. Maximum three marks. Answers could include, but are not limited to the following:	
<ul style="list-style-type: none">• friction• heat• sound	1–3
Total	3

Question 26

(20 marks)

- (a) Define what is meant by the terms renewable and non-renewable resources and give an example of each. (4 marks)

Description		Marks
Renewable resource:	from a source that is not depleted when used, capable of being replenished	1
Renewable example:	any of solar, wind, biomass, biofuel, hydropower	1
Non-renewable resource:	from a source existing in finite quantity; not capable of being replenished	1
Renewable example:	any of oil, coal, fossil fuels	1
Total		4

- (b) Identify and describe **two** ways in which plant materials may be used to produce energy that can be used in vehicles or to produce electricity. Indicate if the energy resource is a renewable or non-renewable resource. (8 marks)

Description	Marks
Four marks for each example. Maximum eight marks.	
One mark for identifying process	1
Good description of process	2
States some information about the process	1
One mark for type of resource	1
Answers could include:	
<ul style="list-style-type: none"> the burning of fossil fuels fossil fuels form from the fossilised remains of dead plants non-renewable resource 	
<ul style="list-style-type: none"> the burning of biomass biomass is matter derived from living, or recently living plants renewable resource 	
<ul style="list-style-type: none"> the burning of biofuel biofuels are biomass (plant material) that is converted into liquid fuels renewable resource 	
Total	8

- (c) Nuclear energy can be used to provide heat or electricity. Draw an energy flow diagram to show how nuclear energy can be used to produce electrical energy. (4 marks)

Description	Marks
Flow diagram to include:	
nuclear energy	1
heat energy	1
kinetic energy	1
electrical energy	1
Total	4

Nuclear energy

→

Heat energy

→

Kinetic energy

→

Electrical energy

Question 26 (continued)

- (d) A large number of Western Australian homes have solar panels that provide electricity to the homeowners. Photovoltaic cells mounted in the solar panels produce electricity. Describe the process that occurs in the cells. (4 marks)

Description	Marks
Sunlight hits the panel electrons absorb energy	1
The electrons become free	1
These highly excited electrons generate an electromotive force	1
Some of the light energy is converted into electric energy	1
Total	4

Section Three: Extended response

30% (58 Marks)

Question 27

(26 marks)

- (a) In lakes and rivers, algal blooms are associated with eutrophication. Describe the process of eutrophication and how this can lead to the death of fish in a river. (9 marks)

Description	Marks
Excess nitrates and phosphates are washed into water way from surrounding area	1
Nutrients build up in waterway	1
Ideal conditions for algae growth	1
Algae begin to increase to large amounts	1
When nutrients depleted algae begin to die	1
Dead algae settle to bottom of waterway providing large food source for decomposers	1
Decomposer activity increases	1
Decomposers use more dissolved oxygen	1
Decrease in oxygen cause fish to suffocate and die	1
Algae also release toxins into the water that will affect the fish	1
Total	9

- (b) Algal blooms produce a small quantity of poisonous substances in the river water. Explain how these poisons can kill cormorants (birds) through the consumption of fish (unaffected by the poisons) from the river. (4 marks)

Description	Marks
Smaller organisms absorb/consume small non-lethal amounts of toxins	1
Larger organisms consume large amounts of small organisms	1
Toxins levels build up through the food chain	1
Toxin concentration increase within larger organism	1
Total	4

- (c) Name **two** substances that have the potential to biomagnify. Explain why these substances biomagnify and sodium chloride does not. (5 marks)

Description	Marks
One mark for each substance. Maximum two marks.	
Examples of substances included: <ul style="list-style-type: none"> metals – particularly heavy metals novel organic substances (DDT, PCBs, tetra ethyl lead) pharmaceuticals (accept drugs) persistent organic pollutants 	1–2
Explains that these substances are lipophilic (accept answers which describe lipophilic substances; oil loving, etc.) and accumulate in the fatty tissue of an animal, hence stay in the animal's body	2
States that substance stays in the animal's body	1
Sodium chloride is removed from the animal' s body in the form of ions	1
Total	5

Question 27 (continued)

- (d) Explain why the system is represented as a pyramid rather than a square. (4 marks)

Description	Marks
The diagram represents available energy at each level	1
Energy transformations are not efficient	1
At each trophic level 90% of the energy is lost	1
So each subsequent level has less energy and a smaller width	1
Total	4

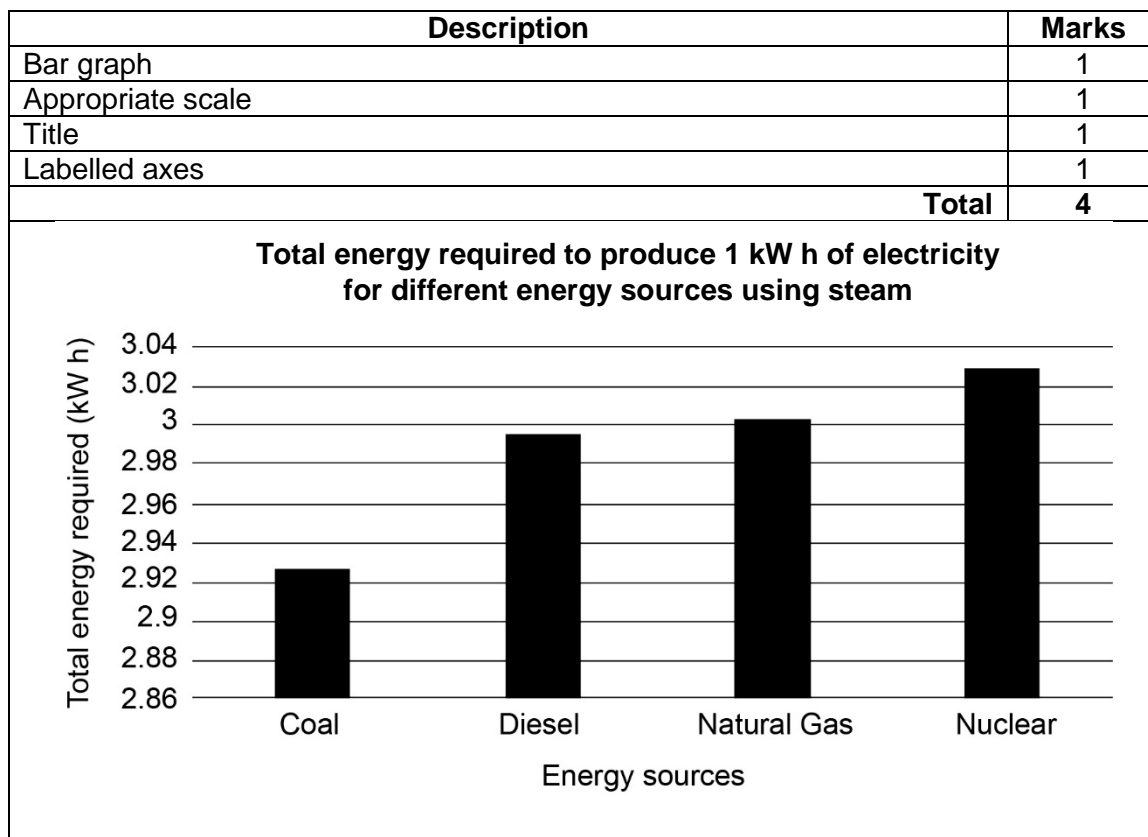
- (e) Explain how the cycling of matter occurs in an aquatic ecosystem. Use an example to describe what would happen if matter is **not** recycled. (4 marks)

Description	Marks
Explains clearly that decomposers breakdown matter which allows nutrients to be recycled	2
States that decomposers breakdown matter	1
Describes clearly, with example, that all food chains would cease	2
States that all food chains would cease	1
Answers could include, but are not limited to the following: <ul style="list-style-type: none"> • matter (nutrients) would be locked up in waste generated by a dolphin and in the organic residue of dead animals. This means that organisms lower in the food chain would not get any nutrients and die. All food chain would cease. • without bacteria and fungi, processing the organic matter, nutrients would not be available to plants, fish or dolphins and they would die out. 	
Total	4

Question 28

(32 Marks)

- (a) Construct an appropriate graph showing the energy consumed by steam generators to produce 1.00 kW h of electricity using coal, diesel, natural gas and nuclear power. (4 marks)



- (b) With reference to your graph showing the energy consumed by steam generators and considering each method's environmental, economic and social impact, outline which method you would recommend for power generation. (4 marks)

Description	Marks
Makes reference to the graph stating very little difference in the energy required	1
For the method chosen:	
Outlines in detail – gives multiple reasons for using the method	3
Outlines briefly – gives a reason for using the method	2
States a valid fact for using the method	1
Total	4
Answers could include, but are not limited to the following: Coal – plentiful, cheap, good infrastructure, good employment Diesel – plentiful, cheap, good infrastructure, good employment Natural gas – plentiful, less pollution, good employment Nuclear – cheap, no pollution if wastes are contained.	

Question 28 (continued)

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

Using the information from page 25 and the above formula, calculate the efficiency of the following power stations. (4 marks)

Description	Marks
coal – 34.13%	1
nuclear – 33%	1
diesel – 34.72%	1
natural gas – 45.05%	1
Total	4

- (d) On the basis of your answers to part (c), which type of power station is the most efficient? Provide **one** reason why you made this selection. (3 marks)

Description	Marks
Most efficient power station – Natural gas	1
Outlines that less energy is wasted due to less energy transformations	2
States less energy is used	1
Total	3
Note: If answers to part (c) are incorrect, award marks based on answers given in part (c)	

- (e) Emissions from power stations contribute to the enhanced greenhouse effect. Explain what we mean by the 'enhanced greenhouse effect'. (4 marks)

Description	Marks
Increase in the amount of greenhouse gases (eg. CO ₂ , CH ₄) in the atmosphere	1
Enhances the greenhouse effect	1
Leads to more heat being trapped on the planet	1
Extra heat is causing global warming and/or affecting Earth's weather patterns	1
Total	4

- (f) Explain why power stations that provide a base-load supply of electricity typically use non-renewable energy sources. (3 marks)

Description	Marks
Explains clearly with multiple valid reasons	3
Outlines two valid reasons	2
States a valid fact about the use of renewable energy sources	1
Reasons could include, but are not limited to the following:	
<ul style="list-style-type: none"> • plentiful supply • cheap to build and operate • can produce large quantities of electricity • not weather dependant. 	
Total	3

- (g) Energy efficiency is also important in the home. Light bulbs range in energy efficiency. Outline the design of an investigation that you would use to determine the efficiency of the following light bulbs.

Type of light bulb	Incandescent bulb	LED bulb
Power rating (Watts)	15 W	15 W

In your design make sure you include:

- number of bulbs used of each type
- variables you would measure
- variables you would control
- a safety precaution
- expected results.

(10 marks)

Description	Marks
Outlines clearly a suitable investigation design	2
States some information about a valid design	1
Investigation uses replication trials of each globe type	2
Investigation uses only one of each globe type	1
Names a suitable variable to be measured (i.e. temperature or brightness)	1
Names two suitable control variables (i.e. exposure time and temperature/ brightness measurement distance)	2
Names one suitable control variable	1
States a reasonable safety precaution (i.e. something related to the heat of the globe or electrical safety)	1
Outlines clearly the expected results which seem reasonable	2
States the expected results which seem reasonable	1
Total	10

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