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

INTEGRATED SCIENCE

ATAR course examination 2018

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.

2018/61759

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

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

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

Question 21 **(20 marks)**

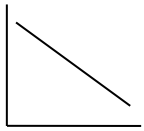
(a) Identify **three** factors that increase how much oxygen is dissolved in water. (3 marks)

Description	Marks
One mark for each way that dissolved oxygen can enter the water.	1–3
Total	**3**
Answers may include, but are not limited to: • photosynthetic activity of aquatic plants • direct diffusion from atmosphere/aeration due to water movement • oxygen rich water flowing in. • if temperature is low	

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

Description	Marks
One mark for each different reasonable way that dissolved oxygen is lost from the water.	1–3
Total	**3**
Answers may include, but are not limited to: • respiration of aquatic plants, animals and bacteria • diffusion to atmosphere • chemical processes/water flowing out of the system. • Eutrphication / Bloom	

(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)

Description	Marks
Correct Labels for the x and y axis	1
Y axis should be dissolved oxygen - X axis should be temperature	1
Sketch is a line graph	1
Correct orientation – no mark it line intersects either axis 	1
Total	**4**

(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)

Description	Marks
Description includes how the dissolved oxygen level changes	1
And the impact of the change	1
Total	**2**
Answers may include, but are not limited to: dissolved oxygen concentration [accept *level*] decreases as temperature increases or dissolved oxygen increases as the temperature decreases.	

Question 21 (continued)

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

Description	Marks
Description includes:	
How the dissolved oxygen level changes	1
Impact on salinity for the dissolved oxygen identified	1
Total	**2**
The dissolved oxygen decreases as salinity increases. The dissolved oxygen increases as salinity decreases.	

(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)

Description	Marks
Description includes:	
How dissolved oxygen levels change	1
Impact of seasons on dissolved oxygen levels	1
Total	**2**
Dissolved oxygen would decrease as the water temperature increases during summer. Flow of water into the estuary during winter would increase the amount of dissolved oxygen.	

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

Description	Marks
Aquatic species need dissolved oxygen /Monitor health of the waterway / preserve economic uses of water way	1
Total	**1**

(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)

Description	Marks
Explanation includes any three of:	
• High levels of dissolved oxygen indicate habitable water for aquatic organisms which supports a good diversity of species • Likely to have large populations of the species which are present • Low levels of dissolved oxygen/indicate unhealthy, uninhabitable water for aquatic species with reduced diversity of species • Low numbers of species/fish kill	1–3
Total	**3**

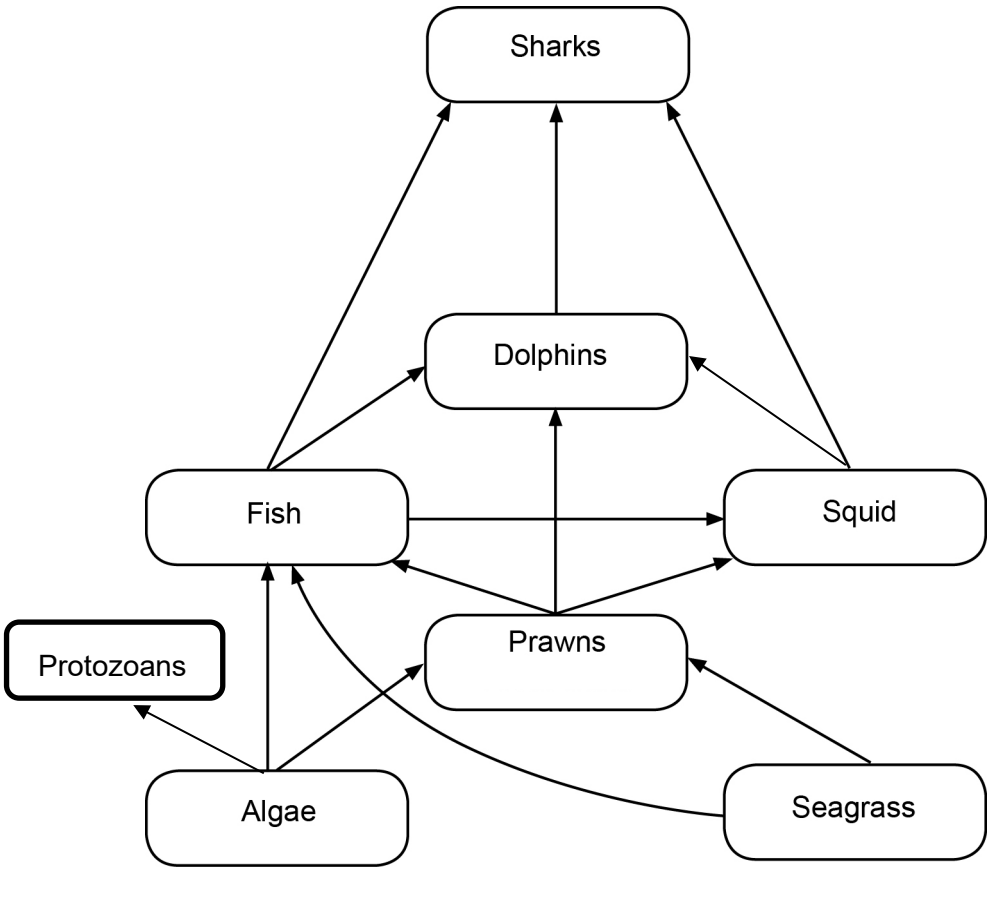
Question 22 **(16 marks)**

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

Description	Marks
7500/902000 x 100	1
= 0.83%	1
Total	**2**

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

Description	Marks
Diagram shows producers at bottom	1
Sharks at top	1
Arrows pointing in correct direction	1
Correct inputs for every organism / all organisms present	1–2
Total	**5**



Question 22 (continued)

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

Description	Marks
Explanation includes:	
The arrow indicates the flow of energy	1
And the direction of flow	1
Total	**2**

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

Description	Marks
Any two of:	
• Respiration • Movement • Metabolism • Heat loss	1–2
Total	**2**

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

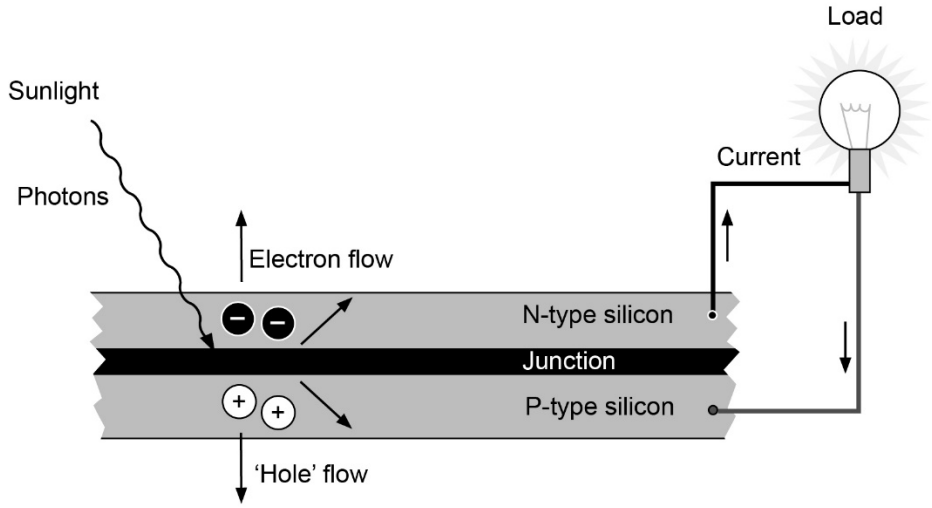
Description	Marks
Explanation includes:	
They are the first organisms to consume producers	2
Total	**2**

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

Description	Marks
Accept any reasonable explanation which includes:	
Energy enters the food chain through the producers	1
Energy transfers from one trophic level to the next and energy is lost at each level (only 10% passed up the food chain).	1
Insufficient energy remains for higher levels	1
Total	**3**

Question 23 **(23 marks)**

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

Description	Marks
	2
Sunlight absorbed	1
Electrons are released	1
From n-type to p-type layers	1
Electrons flow into circuit as electricity	1
Total	**6**

(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)

Description	Marks
Convert measurement in mm to m	1
Find area of the solar panel	1
Panels: area = 0.375 m^2 if correct conversion. Accept area which is correct based on an earlier incorrect answer	1
Power = 0.375 x 1050 = 394 W for correct conversion. Accept power which is correct based on an earlier incorrect answer	1
Total	**4**

(c) Using the formula, 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)

Description	Marks
10 minutes = 600 s	1
Energy = 400 W x 600 s = 240,000 J	1–2
Total	**3**

Question 23 (continued)

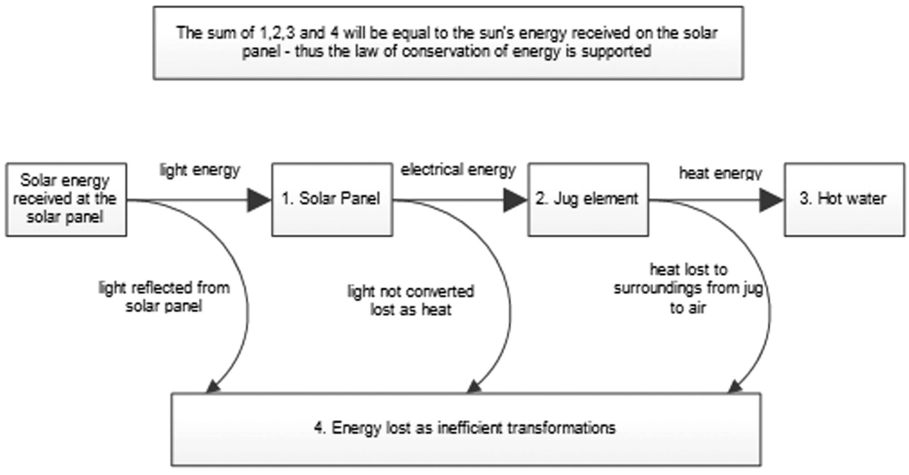
(d) The students found that the temperature of 2.00 kg of water increased temperature by 5 °C in the 10 minutes that the system operated. Calculate the efficiency of the photovoltaic (PV) panel.

The equation for specific heat is $E=mc\Delta T$ where the specific heat capacity of water is 4.18 Jg^{-1}. (5 marks)

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

Description	Marks
Converts the kg to g m = 2000 g	1
Shows working for E (2000 x 4.18 x 5)	1
If correct then E = 41,800 J Accept correct answer which is based on previous mis-calculation	1
Shows workings for calculating percentage using E from this part (d) Power from part (c) Efficiency $\% = \frac{41{,}800}{236{,}250} \times 100$	1
If all contributing calculations are correct then answer is 17% Accept correct answer which is based on incorrect mass	1
Total	**5**

(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)



Description	Marks
Law of conservation of energy mentioned	1
Three elements shown (solar panel, jug element, hot water)	1
Three transformations shown (light → electrical → heat)	1
Energy losses shown at each transformation	1
Flow chart present.	1
Total	**5**

Question 24 **(20 marks)**

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

Description	Marks
diagram should include	
Coal is crushed	1
Then burnt	1
Producing heat for boiler	1
Which is used to produce steam	1
Steam turns turbines	1
Turbine rotate coils in magnet, drives the generator producing electricity	1
Total	**6**

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

Description	Marks
One mark each different type of factors (accept answers which directly demonstrate the factor)	
Increased demand. Accept answers such as increased energy consumption, increased population/number of people wanting to use energy	1
Resources are finite Accept answers such as new ways are needed to get more resource from the ground than previously possible	1
Total	**2**

(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)

Description	Marks
One mark each different reason (accept answers which directly demonstrate the factor):	
• environmental • economic • social/political Only 2 marks are to be awarded for duplication of social/political in environmental or economic. Only 1 mark to be awarded where the same answer is provided for all three headings	1–3
One mark for each example which matches the consideration. Examples may be positive or negative. Students who are awarded less than three marks for duplication across two or more headings is not penalised for example, **if** the example is valid for that heading.	1–3
Total	**6**
For example, responses may include: • environmental –impacts on ecology, water movement, greenhouse gas emissions • economic – cost of the energy produced, impact on local businesses, need for the resource to meet demand • political – Governing party's policy position, ability for the project to influence election campaigns (also accept social licence to operate).	

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)

Description	Marks
Extraction	
Impact on society: One mark for a valid negative or positive impact. Examples could include: • noise and dust from the mine site • local job creation from mining	1
Impact on environment: One mark for a valid negative or positive impact. Examples could include: • land clearing for mine (also accept infrastructure) • disturbance to natural ecosystems	1
During electricity production	
Impact on society: One mark for a valid negative or positive impact. Examples could include: • health impacts from dust (or noise) from the power station (if these are not used as an example in the extraction) • emits airborne pollutants (if not also used for environment) • provides electricity to community	1
Impact on environment: One mark for a valid negative or positive impact. Examples could include: • consumes and/or pollutes water • emits greenhouse gases • emits airborne pollutants	1
Disposal of waste	
Impact on society: One mark for a valid negative or positive impact. Examples could include: • waste materials contaminate ground and surface water resources meaning they are unable to be used for drinking or recreation • intergenerational equity issues due to the loss of resource	1
Impact on environment: One mark for a valid negative or positive impact. Examples could include: • produces fly ash (waste materials) which can be reused (i.e. replacement for Portland cement) • produces waste materials which need to be disposed of (or can result in contamination of water) • production of CO_2	1
Total	**6**

Question 25 **(9 marks)**

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

Description	Marks
Conduction	1
Convection	1
Radiation	1
Total	**3**

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

Description	Marks
Window	
Source – sun	1
Method – radiation	1
Air conditioner	
Source – electricity	1
Method – convection	1
Fire	
Source – burning wood (chemical energy)	1
Method – radiation	1
Total	**6**

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

Question 26 **(30 marks)**

(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)

Description	Marks
Description includes:	
• Less flow of salty water to the south • The location of the Cut means that tidal water is coming in further north	1–2
Total	**2**

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

(2 marks)

Description	Marks
Agricultural activities/fertiliser/animal wastes	1
Washed / runs into waterways	1
Total	**2**

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

Description	Marks
Explanation includes:	
Eutrophication	1
Increased algae → algal blooms	1
Depletion of oxygen/released toxins	1
Death of organisms	1
Total	**4**

(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)

Description	Marks
One mark for each of four reasonable change/reason:	
Answers may include, but are not limited to: • temperature • pH • dissolved oxygen • turbidity • salt concentration (accept salinity levels) • presence of algae	1–4
Total	**4**

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

Description	Marks
Description includes:	
Method: A set net or a scoop net may be used (other techniques acceptable)	1
Description of method :The captured animals are transferred to individual labelled jars or containers containing water from which they animals were taken	2
Data : Individual species present are recorded / Numbers of each species are counted and recorded	1
Interpretation: The species present indicate the salinity, oxygen content, maturity of the ecosystem	1-2
Total	**6**
Note: Other sampling methods equally viable, for example, random sampling at different depths/sites/flow locations or capture, mark, recapture method.	

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

Description	Marks
Water suitable for drinking	1
Total	**1**

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

Description	Marks
Surface water or rainwater	1
Groundwater	1
Total	**2**

(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 utilised to prevent it. (5 marks)

Description	Marks
Description includes:	
Dryland Salinity is an increase in soil salt concentration	1
on land (as opposed to in water bodies)	1
Identification of a strategy. Could include, but not limited to: • increased vegetation • reduced clearing • deep drainage • changing water surface flows to increase flushing	1
Discussion of how the management strategy can manage Dryland Salinity - could include a solution and the ensuing costs/benefits. • lowers water table (may be used to discuss outcomes from a number of strategies) • increases water surface flows to increase flushing	1–2
Total	**5**

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)

Description	Marks
One mark for each part of the process.	
Either of two responses: septic tank **or** primary, secondary and tertiary processing are acceptable. Screening, sedimentation, bio-digestion, chlorination. **or** Two compartment tank, sedimentation, bacterial activity, gravel soak pit **or** Screening, sedimentation, aeration, sterilization.	1–4
Total	**4**

Question 27 **(30 marks)**

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

Description	Marks
A valid hypothesis which is experimentally verifiable. Student's answer needs not to be 'correct', but needs to be possible, to be awarded the mark. For example: The LED light will use the least power for the same brightness as the other globes tested	1
The hypothesis includes dependent and independent variables	1
It describes the relationship between them	1
Total	**3**

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

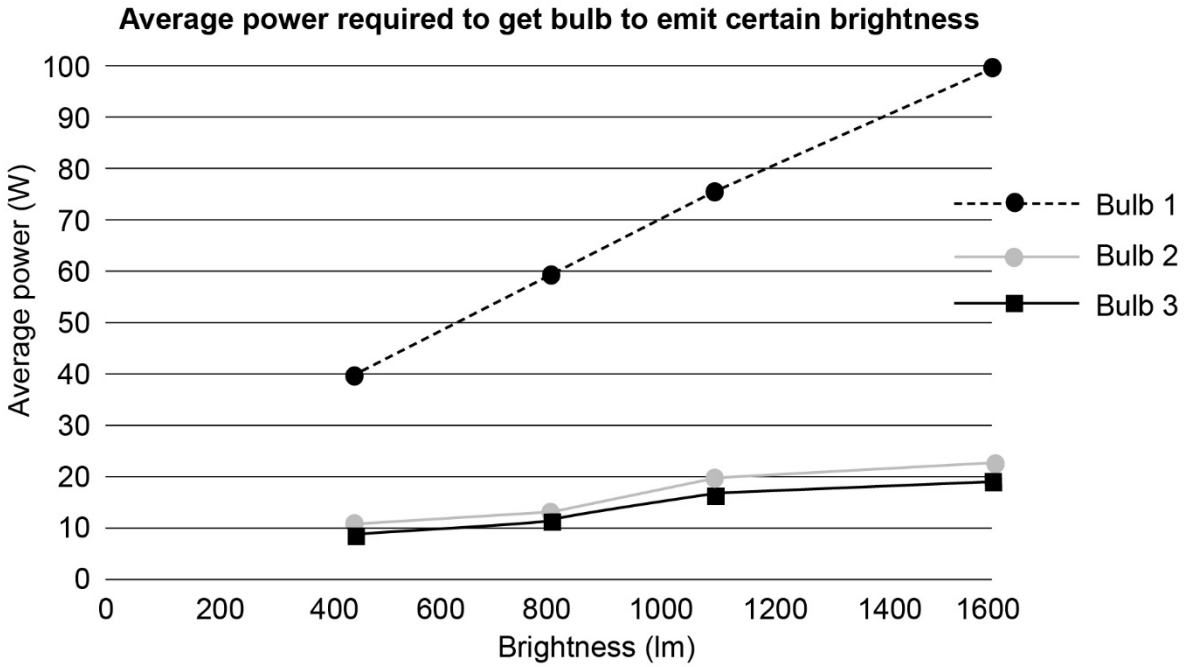
Description	Marks
Independent variable – power input	1
Dependent variable – brightness	1
Total	**2**

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

Description	Marks
One mark for each safety precaution specific to this experiment.	
Possible responses could include: • use of RCD switch • not removing the globe whilst it is still hot • use of oven mitts when handling hot things • wearing of covered shoes in case glass bulb is dropped	1–2
Total	**2**
Note: generic safety precautions such as lab coat, safety glasses are not specific.	

Question 27 (continued)

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



Description	Marks
Key for each bulb	1
Line graph is presented	1
Labels for the x and y axis	1
Units for the x and y axis	1
Appropriate scales for the x and y axis	1
Appropriate title for the graph	1
Total	**6**

(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)

Description	Marks
Shows working using the efficiency equation they identified for each globe Bulb 1 $\text{efficiency} = \frac{1100}{75}$	1
Bulb 2 $\text{efficiency} = \frac{1100}{20}$	1
Bulb 3 $\text{efficiency} = \frac{1100}{17}$	1
Bulb 1 is 14.7 lumens per watt	1
Bulb 2 is 55.0 lumens per watt	1
Bulb 3 is 64.7 lumens per watt	1
Total	**6**

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

Description	Marks
Certainty level is low (not confident)	1
Answer identifies reliability of the data provided (Trial 1) (accept 6) is not representative **or** Answer includes how reliability is affected (or not) by including Trial one (and/or Trial 6) **or** The results are not reliable because the measurements are not similar in value for each trial.	1
Total	**2**

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

Description	Marks
Remove outlier(s) - 3.5 is an outlier (accept 3.5 and 14.5 are outliers if shown in average calculations)	1
Calculate average using correct count of data points = 12.1 W (accept between 12.05 and 12.48 W)	1-2
Total	**3**

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

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

Description	Marks
Shows working converting 1 hour to 3600 s	1
Uses $E = Pt$	1
E = 100 x 3600 = 360,000 J	1
E = 23 x 3600 = 82,800 J	1
Difference = Saving = 360,000 – 82,800	1
277,200 J = 277,000 J	1
Total	**6**

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