2025/7717
Web version of 2024/81818

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

INTEGRATED SCIENCE

ATAR course examination 2024

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

Section Two: Short response **50% (96 Marks)**

Question 21 **(16 marks)**

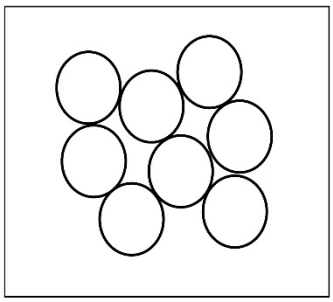
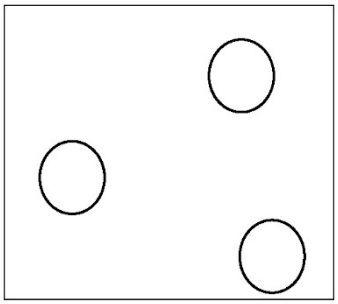
(a) State **three** ways in which surface water can be stored to preserve drinking water supplies for the future. (3 marks)

Description	Marks
Any three of	
• rainwater tanks / water towers • dams • reservoirs • (managed) aquifer recharge	1–3
Total	**3**

(b) Describe the steps involved in the desalination process used to produce potable water. (6 marks)

Description	Marks
pre-treatment/screening	1
filters remove suspended solids and other large particles	1
reverse osmosis	1
removes microscopic particles/ions/salts	1
conditioning/post treatment	1
UV treatment and addition of chlorine/chlorination	1
Total	**6**

(c) Complete the following table by sketching a diagram showing the arrangement of particles in a liquid and a gas. (2 marks)

Description			Marks
diagram shows a clear difference between spacing of particles in a liquid and gas			1–2
	Liquid	**Gas**	
Diagram	 Liquid	 Gas	
		Total	**2**

Question 21 (continued)

(d) Explain the impact of global warming on changing rainfall patterns. (5 marks)

Description	Marks
global warming has resulted in increased (global) average temperatures	1
warmer oceans increase the amount of evaporation	1
warmer air can hold more water vapour than cooler air	1
more water condenses	1
resulting in more precipitation	1
Total	**5**

Question 22 **(21 marks)**

(a) (i) Electromagnetic induction in generators (4 marks)

Description	Marks
processes	
• a coil or magnet rotates within a magnetic field/between two magnets	1
• a changing magnetic flux induces an electromagnetic force (EMF) in the wire	1
• the EMF causes electrons to move, resulting in the generation of an electric current.	1
application	
• used in power stations/industry/electric and hybrid vehicles	1
Total	**4**

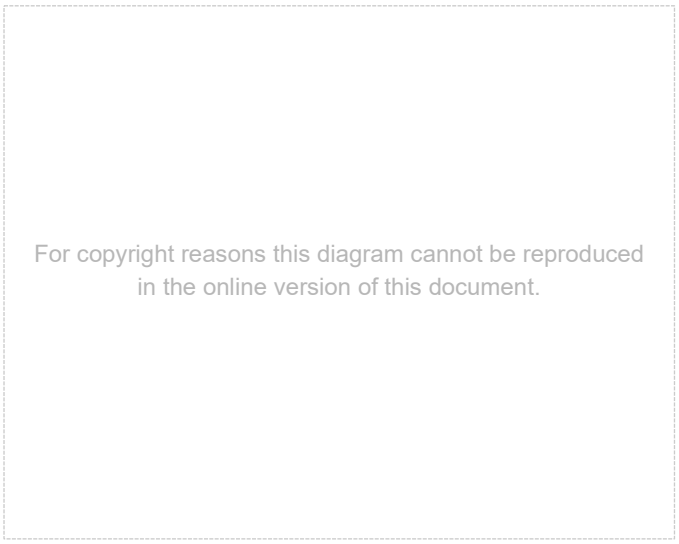
(ii) Photovoltaic effect in solar cells (4 marks)

Description	Marks
processes	
• photons (sunlight) hit the semiconductor material/silicon/glass/ solar cells/ N-type layer	1
• photons energise electrons/electrons become excited	1
• creating a flow current/generating electric current.	1
application	
• solar panels.	1
Total	**4**

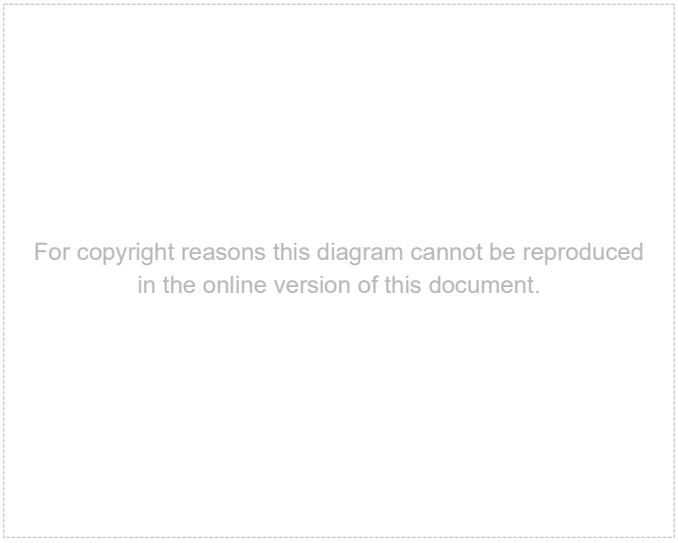
Question 22 (continued)

(b) (i) Label the diagram with the following: (3 marks)

- anode
- cathode
- electrolyte.

Description	Marks
labels identified as per diagram	1–3
	
Total	**3**

(ii) Annotate the diagram using an arrow to show the direction of electron flow. (1 mark)

Description	Marks
flow of electrons shown as per diagram	1
	
Total	**1**

(c) Describe the chemical process that occurs at the anode. (2 marks)

Description	Marks
oxidation/loss of electrons	1
electrons move towards the cathode/positive electrode	1
Total	**2**

(d) State **two** benefits a battery has over each of the other methods of electrical generation stated in part (a) on page 12. (2 marks)

Description	Marks
Any two of	
• rechargeable/reuseable • portable • small/compact • can come in different sizes • can be used for a variety of purposes	1–2
Total	**2**
Accept other relevant answers.	

(e) Describe **two** features that would make a location suitable for a hydroelectric power station. (2 marks)

Description	Marks
high rainfall/large volumes of water	1
high elevation	1
Total	**2**

(f) Identify the type of energy transferred at A and B. (2 marks)

Description	Marks
A: gravitational potential energy	1
B: kinetic energy	1
Total	**2**

(g) Outline **one** economic consideration that could influence the construction of hydroelectric power stations in other Australian states. (1 mark)

Description	Marks
Any one of	
• cost to build infrastructure • cost of producing enough electricity • impact on local businesses • will supply meet demand	1
Total	**1**
Accept other relevant answers.	

Question 23 **(19 marks)**

(a) Identify **two** economic or environmental reasons why passive solar design features are incorporated into homes. (2 marks)

Description	Marks
reduce energy costs	1
reduce greenhouse gas emissions	1
Total	**2**

(b) Describe how the following passive solar design features can be used to keep Perth homes warm during the cooler winter months.

(i) Using materials with a high thermal mass (2 marks)

Description	Marks
increase heat gain during the day/absorb more heat from the sun during the day	1
release heat at night when it's cooler	1
Total	**2**

(ii) Installing roof and ceiling insulation (2 marks)

Description	Marks
traps pockets of air	1
reduces heat loss (by conduction and convection)	1
Total	**2**

(c) An architect considers the orientation of a home on its site.

(i) State what is meant by the term 'orientation'. (1 mark)

Description	Marks
the position of a house on its site (in relation to the path of the sun and breezes)	1
Total	**1**

(ii) Explain why the preferred orientation of a home in Australia usually has north-facing living areas. (3 marks)

Description	Marks
the path of the sun is to the north	1
in winter, the sun is lower in the sky so more direct sunlight will enter the home	1
in summer, the sun is higher in the sky so north-facing rooms can be easily shaded by large eaves	1
Total	**3**

(d) (i) Name and describe **three** main methods by which heat can be transferred. (6 marks)

Description	Marks
conduction	1
heat transfer through contact between particles	1
convection	1
hot air rising and being replaced by cooler air	1
radiation	1
energy travels as (electromagnetic) waves in all directions	1
Total	**6**

(ii) Determine the main method by which heat is transferred from each of the following appliances. (3 marks)

- Air-conditioning
- Gas heater
- Woodfire

Description	Marks
air-conditioning: convection	1
gas heater: convection/radiation	1
woodfire: radiation	1
Total	**3**

Question 24 **(12 marks)**

(a) Define the term 'energy efficiency'. (1 mark)

Description	Marks
the amount of input energy that is transferred/converted to useful energy	1
Total	**1**

(b) If electricity costs 28 cents per kWh, calculate the cost of running the **more** efficient model for one year. (1 mark)

Description	Marks
460 x 0.28 = $128.80	1
Total	**1**

(c) State why the amount of energy produced by the appliances is the same as the energy that flows into it. (1 mark)

Description	Marks
energy is neither created or destroyed just transformed	1
Total	**1**

(d) State which appliance is the most efficient, using calculations to justify your answer. Show your workings. (3 marks)

Description	Marks
television 350/500 x 100 = 70%	1
light globe 30/100 x 100 = 30%	1
most efficient is the television	1
Total	**3**

(e) The power consumed by an incandescent light globe is 8 W. If the light was switched on at 6 pm and turned off at 10 pm, calculate the energy used. Show **all** workings. (4 marks)

Description	Marks
express E in terms of $P \times t$	1
converts time to seconds correctly P = 8 W t = 6 pm–10 pm = 4 hours = 14400 seconds	1
substitutes values into formula E = 8 × 14400	1
determines energy needed to run light globe correctly including units E = 115 200 J/115.2 kJ	1
Total	**4**

(f) State **two** ways in which a household could save energy. (2 marks)

Description:	**Marks**
Any two of	
• switch off appliances when not in use • use energy efficient appliances • if you have solar energy run appliances during the day • use LED lights • close curtains/blinds during day to keep heat out/heat in • wash clothes in cold water • draught proof home	1–2
Total	**2**
Accept other relevant answers.	

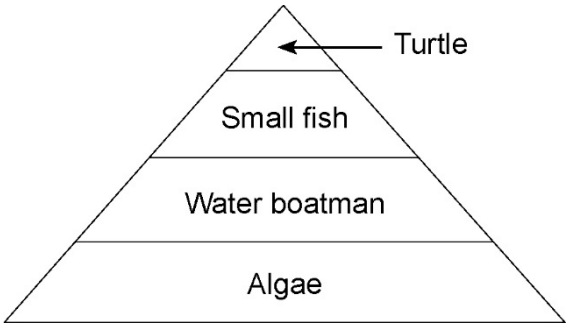
Question 25 **(17 marks)**

(a) Identify the trophic level to which the following organisms belong. (2 marks)

Description	Marks
Algae: producer/first level	1
Subtotal	**1**
Small fish: secondary consumers/third level	1
Subtotal	**1**
Total	**2**

(b) Construct an energy pyramid using the following organisms from the food web shown above. (2 marks)

- algae
- small fish
- water boatman
- turtle

Description	Marks
pyramid correct shape	1
organisms labelled correctly within pyramid	1
	
Total	**2**

(c) Describe **three** reasons why energy transfer between trophic levels of a food web is inefficient. (3 marks)

Description	Marks
Any three of	
• not all of an organism is eaten • heat loss occurs • undigested biomass • energy lost via excretion and defaecation	1–3
Total	**3**

(d) Complete the table below to compare osmoregulation in marine and freshwater fish by indicating which is higher or lower. (6 marks)

Description			Marks
1 mark per box			
	Marine fish (higher/lower)	**Freshwater fish** (higher/lower)	
Relative volume of water consumed	Higher	Lower	1–2
Relative volume of urine produced	Lower	Higher	1–2
Relative concentration of urine produced	Higher	Lower	1–2
		Total	**6**

(e) Explain why freshwater fish cannot survive in saltwater. (4 marks)

Description	Marks
saltwater is more concentrated than the blood of freshwater fish	1
water would move out of the blood into the water	1
by osmosis	1
fish would become dehydrated	1
Total	**4**

Question 26 **(11 marks)**

(a) State the **three** main potable water resources in Western Australia. (3 marks)

Description	Marks
groundwater	1
surface water	1
desalinated water	1
Total	**3**

(b) With reference to the data provided in the table on page 24, describe the trends seen for:

(i) annual rainfall between 2000 and 2004. (2 marks)

Description	Marks
irregular wet–dry years/wet year followed by a dry year then a wet year then a dry year	1
states some data, for example 2000, was wet 307.7 mm while the following year 2001 was dry 143.7 mm	1
Total	**2**

(ii) annual rainfall between 2005 and 2010. (2 marks)

Description	Marks
declining trend/steadily decreasing	1
states some data, for example rainfall, fell from 315 mm in 2005 to 106.2 mm in 2010	1
Total	**2**

(c) Complete the following table by describing a management strategy that helps to prevent the issue and the impact the strategy has on the water catchment area. (4 marks)

Description			**Marks**
	Dryland salinity	**Erosion**	
Management strategy	• prevent over irrigation • plant deep rooted trees • do not clear land of deep-rooted trees	• plant fringing vegetation/hedges • maintain good soil structure by improving soil organic matter content • restrict livestock around susceptible area	1–2
Impact on water catchment area	• prevents water table rising • prevents water table rising • keeps water table supressed/lowered	• stabilises soil/prevents turbidity of water • stabilises soil so it is not moved into waterways • reduces loss of vegetation due to grazing so soil is not loosened.	1–2
		Total	**4**
Accept other relevant answers.			

Section Three: Extended response **30% (65 Marks)**

Question 27 **(29 marks)**

(a) State whether nuclear power is renewable or non-renewable. (1 mark)

Description	Marks
non-renewable	1
Total	**1**

(b) Name the specific type of primary fuel used in nuclear fission. (1 mark)

Description	Marks
Uranium-235 or Plutonium-239 (include isotope)	1
Total	**1**

(c) State **one** potential environmental concern related to the primary fuel source named in part (b). (1 mark)

Description	Marks
Any one of	
• disposal of radioactive water/waste • risk of accidents/radiation leak • land degradation	1
Total	**1**

(d) The flow chart below shows a simplified layout of a nuclear power plant. Under each heading, outline what is occurring at each stage. (4 marks)

Description	Marks
nuclear reactor: atoms split apart/fission occurs/heat produced	1
boiler: (heat energy) converts water into steam	1
turbine: steam spins/moves turbines	1
generator: mechanical/kinetic energy transformed into electrical energy	1
Total	**4**

(e) Distinguish between ionising radiation and non-ionising radiation, providing an example of each. (4 marks)

Description	Marks
ionising radiation has more energy than non-ionising	1
ionising radiation can remove electrons from an atom while non-ionising cannot	1
ionising radiation example: nuclear radiation X-rays gamma rays	1
non-ionising radiation example: UV radiation visible light microwaves radar	1
Total	**4**

(f) Describe why lead shielding is fitted around a nuclear reactor. (2 marks)

Description	Marks
lead is very dense	1
absorbs radiation/prevents radiation penetrating through the reactor	1
Total	**2**

(g) (i) Outline why it is important for workers at a nuclear power plant to wear a radiation dosimeter. (1 mark)

Description	Marks
measures the amount of radiation a worker has been exposed to	1
Total	**1**

(ii) Suggest why a radiation dosimeter is usually worn on the chest or torso. (1 mark)

Description	Marks
closest to vital organs/most representative of exposure of whole body	1
Total	**1**

(h) State **three** symptoms of acute radiation sickness. (3 marks)

Description	Marks
Any three of	
• nausea • vomiting • irritated skin • reddened skin • diarrhoea • loss of appetite • headache • weakness/fatigue • hair loss • low blood pressure	1–3
Total	**3**
Accept other relevant answers.	

(i) Explain how exposure to radiation can produce genetic mutations. (3 marks)

Description	Marks
radiation alters DNA in cells	1
if mutation occurs in germline cells, it is heritable	1
mutation appears in offspring and is passed onto future generations	1
Total	**3**

Question 27 (continued)

(j) There are no nuclear power plants in Australia. Apart from health risks, state **two** community concerns about nuclear power. (2 marks)

Description	Marks
Any two of	
• cost to build power stations • damage to environment/environmental impact • noise pollution • viewed as a dangerous process • high operation cost • storage of nuclear waste	1–2
Total	**2**

(k) Explain how the process of fracking can be used to extract gas for use in power stations. (4 marks)

Description	Marks
well bore drilled into ground/pipe inserted into ground	1
fluid pumped into earth	1
fluid fractures impermeable rock/breaks apart rocks	1
gas is released and can be captured by wellbore/pipe/pumped out of ground	1
Total	**4**
Accept other relevant answers.	

(l) State how the efficiency and cost of conventional electricity generation by coal-fired power stations is different from those of nuclear power stations. (2 marks)

Description	Marks
Any one of the following efficiencies	
• coal-fired less efficient due to heat loss • nuclear is more efficient as less fuel is needed to create same amount of energy.	1
Any one of the following costs	
• coal-fired is more expensive to run and maintain • nuclear is more expensive as cost of infra structure is higher.	1
Total	**2**
Accept other relevant answers.	

Question 28 **(36 marks)**

(a) Identify **two** physical properties tested. (2 marks)

Description:	Marks
Any two of	
• colour • temperature • turbidity	1–2
Total	**2**

(b) (i) Name this piece of equipment. (1 mark)

Description	Marks
Secchi disk	1
Total	**1**

(ii) State which water property the equipment shown is used to measure. (1 mark)

Description	Marks
turbidity	1
Total	**1**

(iii) Describe how the equipment is used to measure the water property for which it is designed. (3 marks)

Description	Marks
Any three of	
• insert/lower disk into water • lower disk until it disappears • raise disk up until you can see it again • measure difference in distance on string between when you see it and when you cannot with either a measuring tape or use markings on string	1–3
Total	**3**
Accept other relevant answers.	

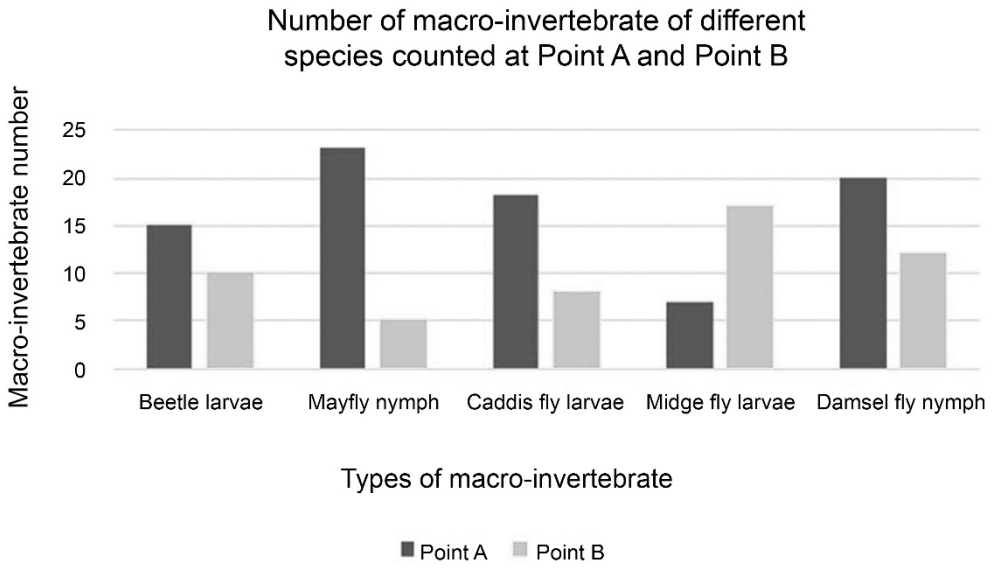
Question 28 (continued)

(c) Name a piece of equipment and describe a sampling technique that could be used to obtain a macro-invertebrate sample from a stream. (3 marks)

Description	Marks
Equipment: any one of	
• net/scoop/traps • containers/jars.	1
Subtotal	**1**
Technique: any two of	
• catch organisms, mark them, release, and then resample • use calculation to calculate population size • random sampling at different depths/locations • catch macro-invertebrates at various depths/record numbers of species captured • place quadrats in location determined randomly • count numbers of macro-invertebrates of a particular species found in quadrat	1–2
Subtotal	**2**
Total	**3**

(d) Draw a graph of the sampling data on page 32 using the grid provided below. (5 marks)

Description	Marks
title	1
axes labelled correctly including units	1
scales correct	1
column graph drawn correctly/columns spaced evenly	1
data plotted accurately	1



Total	**5**

(e) Using the results from the macro-invertebrate sampling data on page 32, determine which location (Point A or Point B) appears to be the more polluted. Justify your choice. (3 marks)

Description	Marks
Point B	1
Any two of	
• more Midge fly larvae at Point B that are pollution tolerant • less Caddisfly larvae at Point B because they are pollution intolerant • less Mayfly nymph at Point B because they are pollution intolerant	1–2
Total	**3**
Accept other relevant answers.	

(f) (i) Describe **two** possible causes for this increase in nitrates at Point B. (2 marks)

Description	Marks
Any two of	
• waste from industrial site • excess fertiliser from agriculture has run off into stream • animal waste from agriculture has run off into stream	1–2
Total	**2**
Accept other relevant answers.	

(ii) Outline how an increase in nitrates in water can lead to a decrease in dissolved oxygen levels. (4 marks)

Description	Marks
increased nitrates lead to eutrophication	1
this increases growth of aquatic plants/algae	1
as plants/algae decompose/get decomposed by bacteria	1
bacteria consume oxygen	1
Total	**4**

(g) (i) Describe **two** features of lamellae that increase the rate of gas exchange. (2 marks)

Description	Marks
Any two of	
• highly branched/large surface area • thin membrane/wall of lamellae • large capillary network	1–2
Total	**2**

Question 28 (continued)

(ii) Explain how the mechanism of counter-current exchange works to maintain the concentration of oxygen in the blood of fish. (3 marks)

Description	Marks
blood flows in the opposite direction to the water flowing over the gills	1
oxygen diffuses from higher concentration in water to lower concentration in blood	1
thus, as water flows through gills, it always has a higher concentration of oxygen in the blood	1
Total	**3**
Accept other relevant answers.	

(h) State a hypothesis for this investigation. (2 marks)

Description	Marks
written as a testable statement	1
describes a relationship between independent and dependent variable	1
Total	**2**
Answers could include: pH level above or below neutral decreases macro-invertebrate activity levels	

(i) Outline the dependent variable for this investigation. Justify your answer. (2 marks)

Description	Marks
macro-invertebrate activity/survival	1
variable that is being measured/responds to change in independent variable	1
Total	**2**

(j) State **one** way in which you could increase the reliability of this investigation. (1 mark)

Description	Marks
Any one of	
• repeat/replicate experiment • increase sample size • reducing random errors	1
Total	**1**

(k) Construct a conclusion for this investigation that could be supported by the data shown in the table on page 36. (2 marks)

Description	Marks
states a conclusion	1
uses data from table	1
Total	**2**
Answers could include: very acidic and very alkaline water affects activity of macro-invertebrates the most for example at pH of 1 there was very low activity with some macro-invertebrates dying.	
Accept other relevant answers.	

ACKNOWLEDGEMENTS

Question 22(b) Adapted from: Farag, M. (2013, June). *Lithium-Ion Batteries: Modelling and State of Charge Estimation* (Fig. 2.6) [Diagram]. Retrieved May, 2024, from https://www.researchgate.net/publication/306240899_Lithium-Ion_Batteries_Modelling_and_State_of_Charge_Estimation

Published by the School Curriculum and Standards Authority of Western Australia
303 Sevenoaks Street
CANNINGTON WA 6107