



INTEGRATED SCIENCE

ATAR course examination 2022

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

Section Two: Short response

50% (96 Marks)

Question 21

(22 marks)

- (a) Define the terms 'renewable resource' and 'non-renewable resource' and provide **two** examples of each. (6 marks)

| Description | Marks |
|---|----------|
| Renewable resource – derived from a source that is not depleted once it is used/the resource is capable of being replenished. | 1 |
| Any two of: | |
| <ul style="list-style-type: none"> • solar • wind • biofuels • biomass • geothermal • wave/tidal/hydro. | 1–2 |
| Non-renewable resource – derived from a source that is depleted once it is used/the resources is not replenished at a human level time scale. | 1 |
| Any two of: | |
| <ul style="list-style-type: none"> • coal • gas/natural gas • oil/crude oil/petrol/diesel • nuclear | 1–2 |
| Total | 6 |

- (b) The burning of fossil fuels releases greenhouse gases into the atmosphere. Explain how an increase in these greenhouse gases has contributed to the enhanced greenhouse effect. (3 marks)

| Description | Marks |
|--|----------|
| Increasing concentrations of gases create larger layer/ blanket around Earth. | 1 |
| Less radiation passes out of atmosphere into space/ more heat absorbed and re-radiated back. | 1 |
| Increases temperatures on Earth/ leads to global warming. | 1 |
| Total | 3 |
| Accept other relevant answers. | |

- (c) Describe **one** conclusion that can be drawn from the data in the graph. (2 marks)

| Description | Marks |
|---|----------|
| Average CO ₂ concentration is rising at a steady rate. | 1 |
| Some data quoted from graph. | 1 |
| Total | 2 |
| Accept other relevant answers. | |

Question 21 (continued)

- (d) Using the diagram above, complete the table below, to indicate which letter A, B, C, D, E or F, in the diagram corresponds with the location given. (3 marks)

| Description | Marks |
|--------------|----------|
| D | 1 |
| B | 1 |
| F | 1 |
| Total | 3 |

- (e) Explain why water is formed as a waste product. (6 marks)

| Description | Marks |
|---|----------|
| hydrogen enters (anode) | 1 |
| hydrogen ion loses electron/oxidised | 1 |
| positive hydrogen moves into electrolyte/oxygen reduced | 1 |
| oxygen enters at (cathode) | 1 |
| picks up positive hydrogen from electrolyte/reduced | 1 |
| combines to create water | 1 |
| Total | 6 |

- (f) List **two** benefits of using a hydrogen fuel cell. (2 marks)

| Description | Marks |
|---|----------|
| Any two of: | |
| <ul style="list-style-type: none"> • low or zero emissions • secure energy source • quiet operation (limited noise produced) • high energy efficiency • reliable | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

Question 22

(21 marks)

- (a) Define the term 'solubility'. (1 mark)

| Description | Marks |
|---|----------|
| The degree to which a substance/solute dissolves in a liquid/solvent. | 1 |
| Total | 1 |

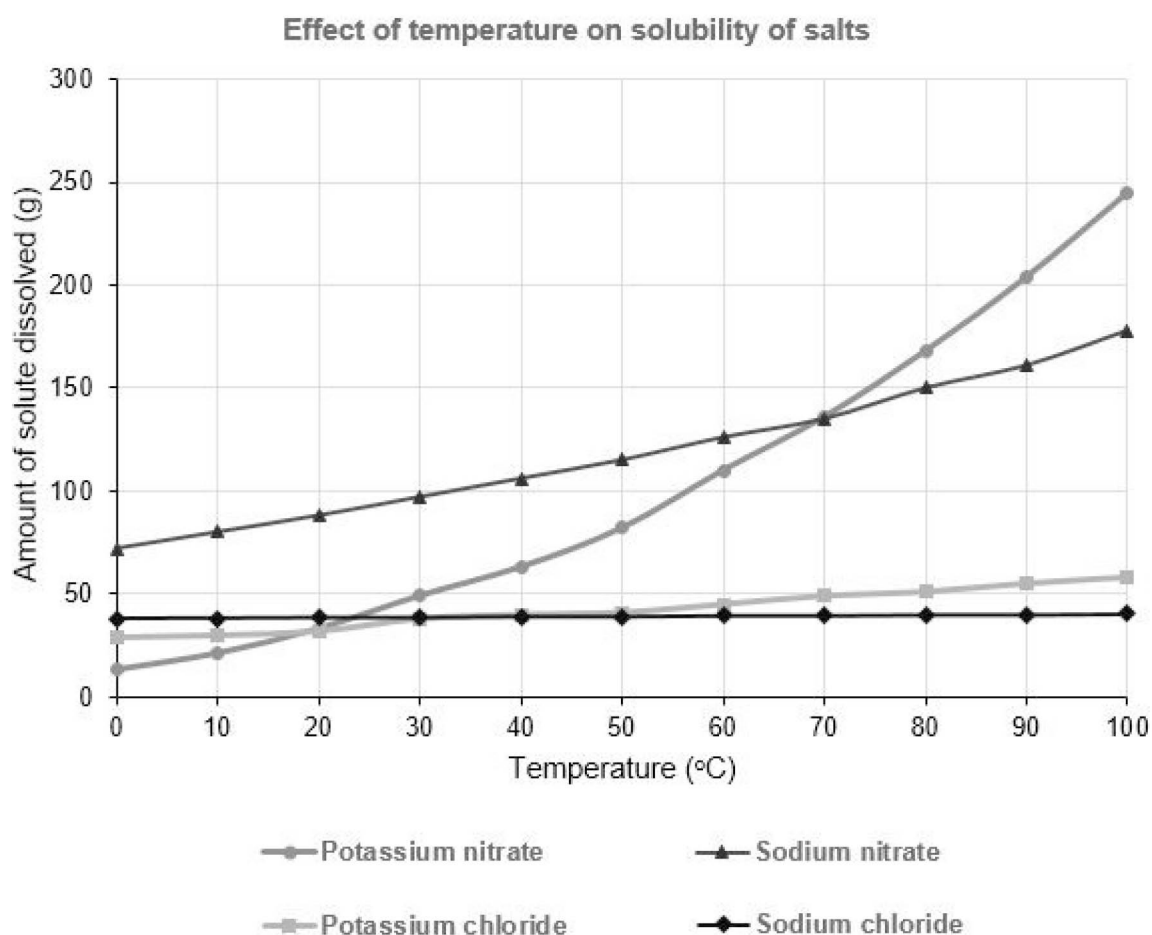
- (b) Identify the following for this investigation: (2 marks)

| Description | Marks |
|---|----------|
| independent variable: temperature/type of solute | 1 |
| dependent variable: solubility/amount of solute dissolved | 1 |
| Total | 2 |

- (c) Write a possible hypothesis for this investigation. (1 mark)

| Description | Marks |
|---|----------|
| Testable statement that includes a relationship between the independent and dependent variables. | 1 |
| Total | 1 |
| Answers could include: <ul style="list-style-type: none"> • increasing water temperature increases solubility of salts • salts have different solubilities at a range of temperatures. Accept other relevant answers. | |

Question 22 (continued)



(d) For the graph above:

(i) add labels to both of the axes (2 marks)

| Description | Marks |
|---|----------|
| X axis: Temperature (°C) | 1 |
| Y axis: Amount of solute/salt dissolved (g) (per 100 mL of water) | 1 |
| Total | 2 |
| Note: units must be included to award marks. | |

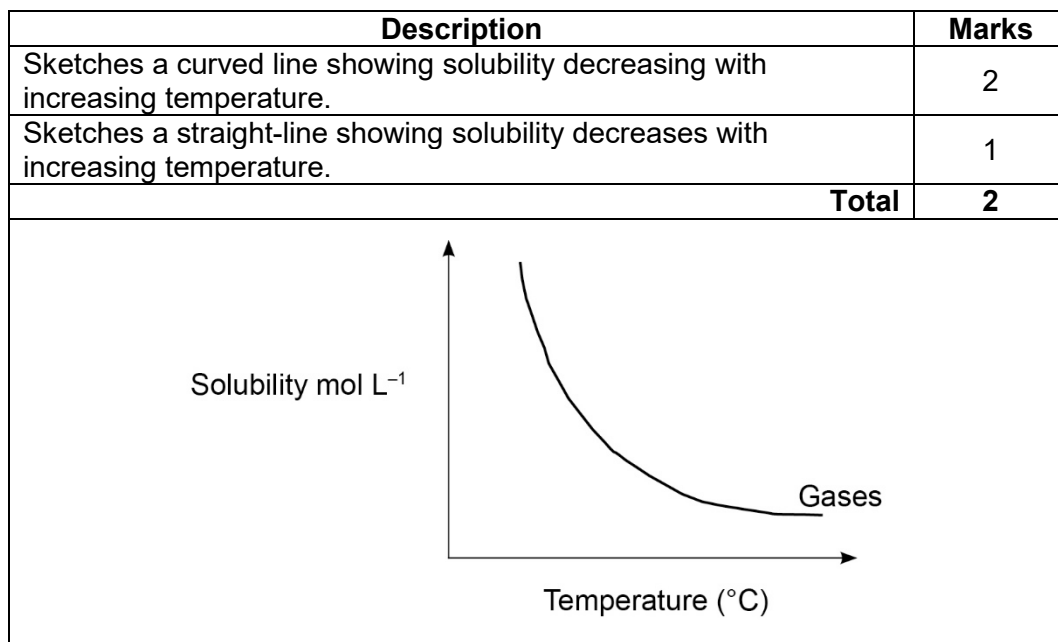
(ii) complete the key to identify which line represents which solute. (2 marks)

| Description | Marks |
|--|----------|
| All four solute/salts identified correctly/correct formulae. | 2 |
| Three identified correctly. | 1 |
| Two or less identified correctly. | 0 |
| Total | 2 |

(e) State a conclusion for the investigation. (1 mark)

| Description | Marks |
|---|----------|
| Any one of: | |
| <ul style="list-style-type: none"> solubility of salt is affected by temperature as temperature of water increases so does the solubility of salts potassium nitrate has the greatest solubility/is the most soluble | 1 |
| Total | 1 |

(f) (i) On the graph below, sketch a line that shows how increasing water temperature affects the solubility of oxygen (2 marks)



(ii) Explain the impact that increasing water temperature has on gas exchange in fish. (3 marks)

| Description | Marks |
|--|----------|
| Fish remove dissolved oxygen from water by absorbing it using gills. | 1 |
| Amount of dissolved O ₂ depends on temperature of water. | 1 |
| As water gets hotter gas solubility decreases so less oxygen is dissolved. | 1 |
| Total | 3 |

(g) Name and describe the process by which fish extract oxygen from water. (3 marks)

| Description | Marks |
|---|----------|
| Diffusion | 1 |
| movement of particles/O ₂ from an area of high concentration | 1 |
| to an area of lower concentration | 1 |
| Total | 3 |

Question 22 (continued)

- (h) (i) Circle the correct direction of blood flow through the lamella. (1 mark)

| Description | Marks |
|--------------|----------|
| from Y to X | 1 |
| Total | 1 |

- (ii) Justify your choice. (3 marks)

| Description | Marks |
|--|----------|
| Oxygen diffuses from high to low concentration/ along a concentration gradient. | 1 |
| Blood flows in opposite direction to water/counter current flow to ensure oxygen concentration in water is higher than in blood. | 1 |
| Allows for continual diffusion of oxygen into blood. | 1 |
| Total | 3 |

Question 23

(23 marks)

- (a) State which
- two**
- fossil fuels are extracted using fracking. (2 marks)

| Description | Marks |
|---------------|----------|
| oil | 1 |
| (natural) gas | 1 |
| Total | 2 |

- (b) Describe the process of fracking. (2 marks)

| Description | Marks |
|---|----------|
| Pumping a fluid mixture (sand, water, chemicals) deep into the earth. | 1 |
| Fractures/cracks are opened/made wider in (impermeable) rock. | 1 |
| Total | 2 |

- (c) Outline why fracking increases the resource lifetime for the fossil fuels it is designed to extract. (1 mark)

| Description | Marks |
|---|----------|
| Any one of: | |
| <ul style="list-style-type: none"> • it accesses oil/gas that could not previously be extracted • allows oil and gas to be extracted at a reasonable price so makes it cheaper for consumers • allows for crude oil production to be maintained or increased | 1 |
| Total | 1 |
| Accept other relevant answers. | |

- (d) State
- one**
- impact that fracking would have on the Kimberley air
- and**
- land environment. (2 marks)

| Description | Marks |
|--|----------|
| Air – any one of: | |
| <ul style="list-style-type: none"> • release dust/air pollution • releases large amounts of methane | 1 |
| Land – any one of: | |
| <ul style="list-style-type: none"> • destroys local habitats • endanger native species • destroys natural geological formations • increase in seismic activity | 1 |
| Total | 2 |
| Accept other relevant answers. | |

Question 23 (continued)

- (e) Using the information from the table above, draw a food web for this ecosystem. (5 marks)

| Description | Marks |
|--|----------|
| Diagram has algae and seagrass at bottom. | 1 |
| Humans are shown at top along with tiger sharks. | 1 |
| Arrows are pointing in correct direction. | 1 |
| All feeding relationships are in food web. (1 missing = 1 mark, 2 missing = 0 marks) | 1-2 |
| Total | 5 |

- (f) Describe what the arrows within a food web represent. (2 marks)

| Description | Marks |
|--|----------|
| Arrows show feeding relationship/predator – prey | 1 |
| Shows the direction of energy flow | 1 |
| Total | 2 |

- (g) Distinguish between the terms ‘primary consumer’ and ‘secondary consumer’ and give **one** example of each from your food web drawn in part (e). (4 marks)

| Description | Marks |
|--|----------|
| Primary consumer is a herbivore/feeds on plants/producers. | 1 |
| Secondary consumer feeds on primary consumers/are carnivores or feeds on primary consumers and producers/are omnivores. | 1 |
| Primary consumer examples – any one of: <ul style="list-style-type: none"> • prawns • small invertebrates • green turtle • dugong • blue swimmer crab | 1 |
| Secondary consumer example – any one of: <ul style="list-style-type: none"> • small fish • tiger shark • human • blue swimmer crab | 1 |
| Total | 4 |

- (h) Describe what impact a reduction in green turtle numbers would have on the food web drawn in part (e). (3 marks)

| Description | Marks |
|---|----------|
| Any three of: | |
| <ul style="list-style-type: none"> • seagrass levels may increase • algae may increase • tiger shark loses one food source • tiger shark preys on small fish/dugong more • small fish/ dugong numbers may decrease | 1–3 |
| Total | 3 |
| Accept other relevant answers. | |

- (i) State **two** impacts an oil spill might have on ecosystem services used by humans in the Kimberley region. (2 marks)

| Description | Marks |
|--|----------|
| Any two of: | |
| <ul style="list-style-type: none"> • commercial fishing affected • recreational fishing affected • tourism may suffer • diving/snorkelling may be affected • coast lines/shorelines will get oil film on them/unattractive to look at | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

Question 24

(11 marks)

- (a) Using the diagram above, identify the parts of a pressurised reactor in the table below. (2 marks)

| Description | Marks |
|---------------------|----------|
| A – control rods | 1 |
| C – steam generator | 1 |
| Total | 2 |

- (b) (i) State the name of this fuel. (1 mark)

| Description | Marks |
|--------------|----------|
| uranium | 1 |
| Total | 1 |

- (ii) Describe the process of nuclear fission. (3 marks)

| Description | Marks |
|--------------------------------------|----------|
| Uranium atom is hit with a neutron. | 1 |
| Atom splits into two lighter nuclei. | 1 |
| Produces heat energy/extra neutrons. | 1 |
| Total | 3 |

- (c) State **three** effects exposure to high levels of radiation can have on the human body. (3 marks)

| Description | Marks |
|---|----------|
| Any three of: | |
| <ul style="list-style-type: none"> • lowered bone marrow activity • anaemia • nausea • vomiting • diarrhoea • loss of vision • seizures • coma • severe weakness and tiredness • fever • shock • changes to DNA structure • cancer • skin burns | 1–3 |
| Total | 3 |
| Accept other relevant answers. | |

- (d) Identify **two** advantages that nuclear power stations have over coal-fired power stations. (2 marks)

| Description | Marks |
|---|----------|
| Any two of: | |
| <ul style="list-style-type: none"> minimal/little/no release of greenhouse gases into the atmosphere smaller storage areas required for fuel sources at the power station maintenance possible whilst station is still capable of operating more efficient/creates more energy/reliable cheaper to run once established. | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

Question 25**(19 marks)**

- (a) State how we know that work is being done in the process of the ball being thrown. (1 mark)

| Description | Marks |
|--|----------|
| Energy has been transformed from kinetic to potential/energy transferred from hand to ball/ball is moving. | 1 |
| Total | 1 |

- (b) Outline the difference between these forms of energy. (2 marks)

| Description | Marks |
|---------------------------------------|----------|
| Kinetic energy is energy of movement. | 1 |
| Potential energy is stored energy. | 1 |
| Total | 2 |

- (c) On the diagram above label where the ball has (2 marks)

- maximum potential energy, and
- maximum kinetic energy.

| Description | Marks |
|--|----------|
| Correct label for potential energy. | 1 |
| Correct label for kinetic energy. | 1 |
| Total | 2 |
| <p>For copyright reasons this diagram cannot be reproduced in the online version of this document, but may be viewed at the following link https://energytalk.weebly.com/kinetic-and-potential-energy.html</p> | |

Question 25 (continued)

- (d) Draw a flow chart to show all the energy transformations that occur in the process of generating electrical energy from coal. (4 marks)

| Description | Marks |
|---|----------|
| four labels in correct order | 4 |
| three labels in correct order | 3 |
| two labels in correct order | 2 |
| one label in correct order | 1 |
| Total | 4 |
| chemical/chemical potential → heat → kinetic → electrical | |

- (e) Define the term 'efficiency'. Support your answer with an appropriate mathematical formula. (2 marks)

| Description | Marks |
|---|----------|
| The amount of useful energy that is transferred/converted to useful energy. | 1 |
| energy efficiency = energy out/energy in × 100% | 1 |
| Total | 2 |

- (f) (i) How efficient is this transformer? Show your working. (3 marks)

| Description | Marks |
|--------------------------------|----------|
| $120\,000/220\,000 \times 100$ | 1 |
| = 54.5% | 1 |
| percentage/unit included | 1 |
| Total | 3 |

- (ii) How much more efficient is this transformer than the coal-fired power station transformer mentioned in part (e) above? (1 mark)

| Description | Marks |
|--------------------------|----------|
| $54.5\% - 30\% = 24.5\%$ | 1 |
| Total | 1 |

- (iii) Why is it not possible to have an efficiency greater than 100%? Justify your answer by referring to the law of conservation of energy. (2 marks)

| Description | Marks |
|--|----------|
| This would mean that more energy is being produced than is being supplied. | 1 |
| Law of conservation of energy states that energy cannot be created or destroyed. | 1 |
| Total | 2 |

(g) State **one** positive and **one** negative economic **or** social impact from the closure of a coal fired power station (2 marks)

| Description | | Marks |
|--------------------------------|---|---|
| States a positive impact. | | 1 |
| States a negative impact. | | 1 |
| Total | | 2 |
| Answers could include: | | |
| | Positive | Negative |
| Economic impact | <ul style="list-style-type: none"> using renewable energy instead of non-renewable energy saves money create new jobs for manufacture of renewable energy creating structures/processes | <ul style="list-style-type: none"> development of renewable resources is costly loss of jobs from power plant for local community/loss of income |
| Social impact | <ul style="list-style-type: none"> popular with public opinion people feel they are doing the right thing to help minimise impact on environment | <ul style="list-style-type: none"> unemployment cost of setting up renewable energy impacts on low-income earners increase in taxes to offset start-up costs |
| Accept other relevant answers. | | |

Section Three: Extended response

30% (60 Marks)

Question 26

(26 marks)

- (a) State the equipment/test that would be required to test for each of the following: (3 marks)

| Description | Marks |
|--|----------|
| turbidity – turbidity tube/secchi disk | 1 |
| dissolved nitrate concentration – nitrate/Palin test kit/colorimetric/photometric test | 1 |
| dissolved oxygen level – oxygen meter | 1 |
| Total | 3 |

- (b) Comment on each reading taken by the farmer and propose a cause for the decline in river water quality on the farm. (4 marks)

| Description | Marks |
|--|----------|
| turbidity above normal levels | 1 |
| nitrates are low | 1 |
| dissolved oxygen at(lower range) of normal | 1 |
| provides one cause for the decline in river quality on the farm | 1 |
| Total | 4 |
| Sample answer for cause of decline in river quality on the farm: | |
| Land clearing has caused increase erosion/turbidity. | |
| Accept other relevant answers. | |

- (c) Describe **two** ways increased turbidity can affect aquatic organisms. (4 marks)

| Description | Marks |
|---|----------|
| Any two of: (2 x 2 marks) | |
| <ul style="list-style-type: none"> • water temperature is higher than optimum range resulting in death • clog gills causing suffocation • block sunlight to plants preventing photosynthesis • decreased oxygen levels in the water due to higher temperature causing suffocation | 1–2 |
| Total | 4 |
| Accept other relevant answers. | |

- (d) (i) Using the data from the table, predict the rainfall total for 2022. (1 mark)

| Description | Marks |
|-------------------------------------|----------|
| 445–450 mL (units must be included) | 1 |
| Total | 1 |

- (ii) State **one** impact this reduced rainfall may have on the farmer's ability to produce crops. (1 mark)

| Description | Marks |
|--|----------|
| Any one of: | |
| <ul style="list-style-type: none"> • less natural water for farmer to access/less water falling into river • farmer needs to find alternative water sources • may have to irrigate crops more | 1 |
| Total | 1 |
| Accept other relevant answers. | |

- (iii) List **two** possible alternative sources of water available to the farmer, excluding accessing the town's water supply or the river system. (2 marks)

| Description | Marks |
|--|----------|
| Any two of (2x1 mark) | |
| <ul style="list-style-type: none"> • damming of local creeks • surface water catchments (building dams) • (abstraction) bores/ground water • water tanks | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

- (e) Explain how the clearing of land by the farmer to plant crops may have contributed to an increase in dry land salinity. (4 marks)

| Description | Marks |
|--|----------|
| land clearing of deep-rooted trees/ planting of shallow rooted crops | 1 |
| water table rises | 1 |
| dissolving salts on the way | 1 |
| water evaporates leaving salt on the surface | 1 |
| Total | 4 |
| Accept other relevant answers. | |

Question 26 (continued)

- (f) (i) Propose **two** management strategies the farmer could implement to prevent dry land salinity, eutrophication, or erosion on his land. (2 marks)

| Description | Marks |
|---|----------|
| Any two of: | |
| <ul style="list-style-type: none"> plant diverse plant species of differing root depths maintain ecosystem prevent runoff regularly monitoring the water quality do not over irrigate/or fertilise rotate crops to prevent over fertilisation | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

- (ii) Outline **two** strategies that government authorities could implement to manage the water resources sustainably. (2 marks)

| Description | Marks |
|---|----------|
| Any two of: | |
| <ul style="list-style-type: none"> suitable surface water drainage maintenance of river water quality and aquatic life within the river maintenance of the river flow (water source allocation enough for downstream users/sufficient quality and quantity) maintenance of the ground water quality and volume maintain use of ground water (particularly if used as a fresh water resource) | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

- (g) Outline how each of the following processes enables potable water to be produced in a desalination plant. (3 marks)

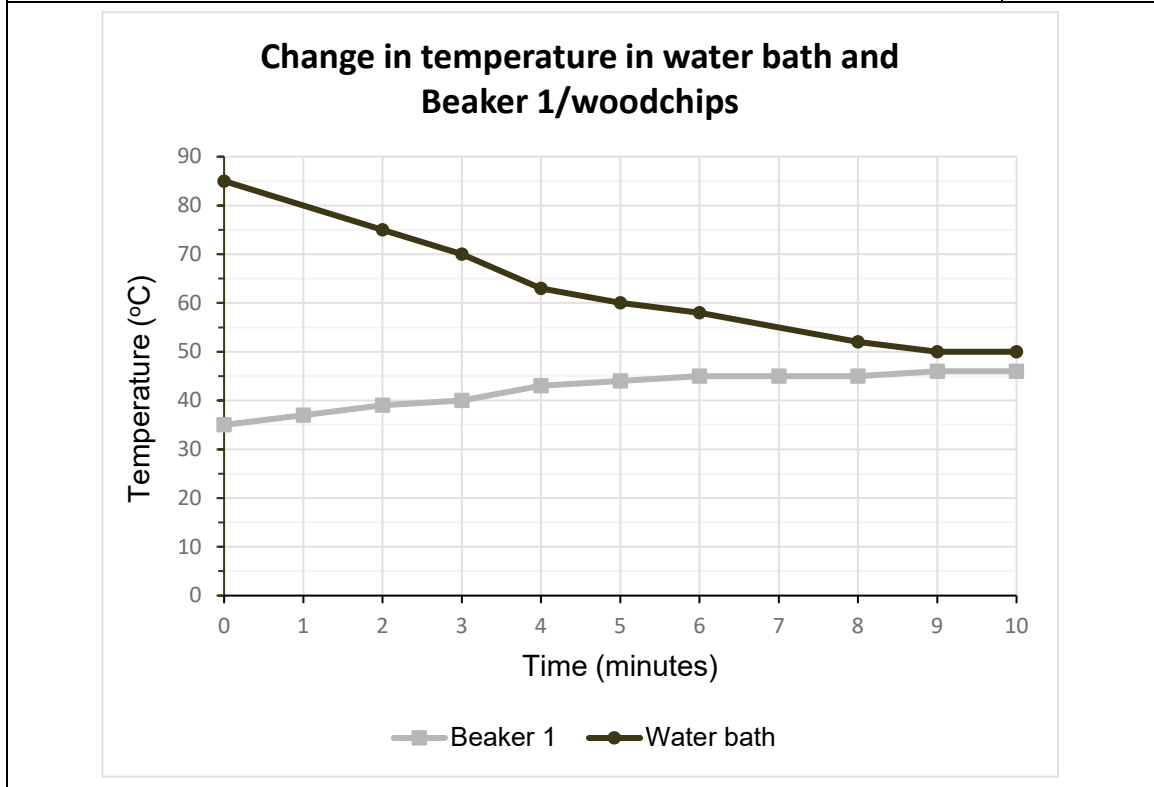
| Description | Marks |
|---|----------|
| Screening – any one of: | |
| <ul style="list-style-type: none"> remove solid matter/particles from the sea water add chemicals/coagulants to bind particles | 1 |
| Reverse osmosis – any one of: | |
| <ul style="list-style-type: none"> remove dissolved salts remove impurities (bacteria/viruses/biological material) | 1 |
| Post treatment procedures – any one of: | |
| <ul style="list-style-type: none"> (UV) disinfection/sterilise treat to meet drinking water standards/add chlorine and other minerals | 1 |
| Total | 3 |
| Accept other relevant answers. | |

Question 27

(34 marks)

- (a) Graph the data for Beaker 1 **and** the water bath in the table on page 30 on the grid below. (6 marks)

| Description | Marks |
|--------------------------------|----------|
| line graphs | 1 |
| appropriate title | 1 |
| axes labelled, including units | 1 |
| data plotted accurately | 1 |
| appropriate scale on axes | 1 |
| key to lines | 1 |
| Total | 6 |



- (b) Use your graph to complete the missing data for the water bath in the table on page 30. (2 marks)

| Description | Marks |
|---------------------|----------|
| 1 minute: 78–80 °C | 1 |
| 7 minutes: 54–56 °C | 1 |
| Total | 2 |

- (c) Using your knowledge of heat transfer, explain why the material in Beaker 1 gained heat while the water bath lost heat. (4 marks)

| Description | Marks |
|--|----------|
| heat moves from warmer materials to cooler ones | 1 |
| via conduction | 1 |
| heat moves from/ transferred from water bath to material in beaker | 1 |
| water bath loses heat via radiation/convection to surroundings | 1 |
| Total | 4 |

Question 27 (continued)

- (d) State which of the three materials tested would be the best to use in the walls of a passive solar house. Use the available data explain your choice. (4 marks)

| Description | Marks |
|---|----------|
| bricks | 1 |
| loses/gains the least amount of heat/retains starting temperature for longest time | 1 |
| Any two pieces of data stated from graph/table – for example | |
| <ul style="list-style-type: none"> brick took 5 minutes to increase in temperature/only gained 2 °C concrete took 2 minutes to increase in temperature wood chips gained heat the fastest/11 degrees over 10 minutes | 1–2 |
| Total | 4 |

- (e) Using the diagram above, identify which arrow A, B or C, shows the summer and winter sun rays. (2 marks)

| Description | Marks |
|--------------|----------|
| Summer – B | 1 |
| Winter – A | 1 |
| Total | 2 |

- (f) Outline how each of the following components of a house can be utilised to conserve heat during the winter months.

- (i) Insulation (1 mark)

| Description | Marks |
|---|----------|
| Prevents heat transfer to exterior of house through walls/roof. | 1 |
| Total | 1 |
| Accept other relevant answers. | |

- (ii) Windows (1 mark)

| Description | Marks |
|---|----------|
| Any one of: | |
| <ul style="list-style-type: none"> double glazed to keep heat inside house north facing windows to capture sunlight | 1 |
| Total | 1 |
| Accept other relevant answers. | |

- (g) (i) Label A to D on the diagram below showing how a photovoltaic solar cell produces electricity. (4 marks)

| Description | Marks |
|------------------------------------|----------|
| A: electron flow/negative ion | 1 |
| B: 'hole' flow/positive ion/proton | 1 |
| C: N-type silicon | 1 |
| D: P-type silicon | 1 |
| Total | 4 |

- (ii) Explain how photons produce electric current in a solar cell. (6 marks)

| Description | Marks |
|---|----------|
| photons hit solar cell | 1 |
| material found in cell absorbs photons | 1 |
| electrons are removed/dislodged from atoms/become excited | 1 |
| electrons move/migrate to front region of cell | 1 |
| a charge difference is created | 1 |
| current produced | 1 |
| Total | 6 |

- (h) State **two** reasons why the installation of rooftop solar cells has increased over the last few years. (2 marks)

| Description | Marks |
|---|----------|
| Any two of: | |
| <ul style="list-style-type: none"> • government incentives with money rebates • social impact of reducing environmental impact/carbon footprint • cost saving after initial installation • increase property value • low maintenance cost • make money by selling unused energy | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

- (i) Outline **two** reasons why fossil fuels are still used as the primary fuel source in power stations. (2 marks)

| Description | Marks |
|--|----------|
| Any two of: | |
| <ul style="list-style-type: none"> • need for base load supply during unsuitable times for solar/wind • not every household can afford to install solar panels • no electricity produced at night | 1–2 |
| Total | 2 |
| Accept other relevant answers. | |

ACKNOWLEDGEMENTS

Question 25(a) Adapted from: [Diagram of baseball throwing arc]. (n.d.). Retrieved April, 2022, from <https://energytalk.weebly.com/kinetic-and-potential-energy.html>

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