



Climate change

This booklet is designed to help teachers make overall, on-balance judgments by providing examples of student responses. The responses are not an exhaustive set.

E samples

© The State of Queensland (Queensland Studies Authority) 2009

Please read the copyright notice on our website.

Contact information:

Information about QCATs is available on the QSA website <www.qsa.qld.edu.au>.

Direct questions concerning implementation or receipt of materials to:

Project Officer (Operations)

Phone: 07 3864 0299

Email: QCARadmin@qsa.qld.edu.au

Queensland Studies Authority Ground floor, 295 Ann Street Brisbane. PO Box 307 Spring Hill Qld 4004.

Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

E sample: Response 1

Overall grade
As this response demonstrates a very limited level of Knowledge and Understanding, Investigating and Communicating, it is judged to be an overall E.

Guide to making judgments — Year 9 Science

Student

Purpose: To use evidence and scientific argument to draw conclusions and to inform an opinion about climate change and its effects.

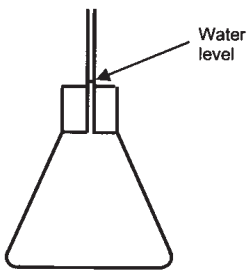
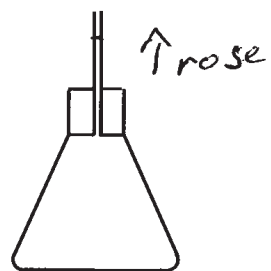
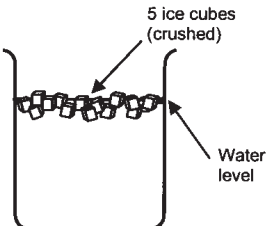
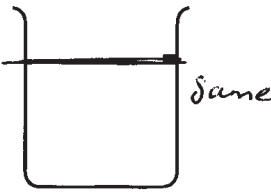
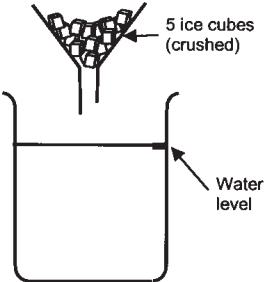
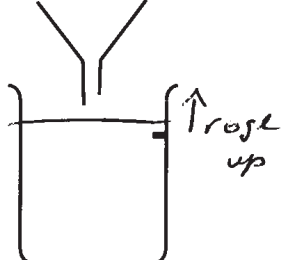
Investigating	Knowledge and understanding	Investigating	Communicating
Draws conclusions and makes predictions consistent with data and evidence. Questions 1, 2, 3, 4, 5, 11, 13	Uses equations and diagrams to describe and explain chemical changes and energy transformations. Questions 8, 9, 10, 12	Uses data, evidence and scientific argument to evaluate and propose hypotheses and to inform an opinion. Questions 6, 7, 14, 15	Uses scientific terminology in conclusions, predictions and arguments. Uses appropriate formats in chemical equations and energy diagrams. Questions 1–15
<p>Investigating Made minimal use of data and evidence to draw conclusions and make predictions. Explanations lacked detail.</p> <p>Consistently and accurately interprets data and evidence.</p>	<p>Knowledge and understanding Attempted equations and diagrams with minimal success.</p> <p>Writes chemical formulas with correct ratios and balances chemical equations. Energy diagrams correctly identify all energy forms and illustrate all transfers and transformations.</p>	<p>Investigating Offered a personal opinion rather than an analysis of the evidence.</p> <p>Provides accurate and insightful scientific arguments, considering all data and evidence.</p>	<p>Communicating Made little use of scientific terminology.</p> <p>Displays fluency in the use of scientific terminology when drawing conclusions, making predictions and constructing arguments.</p>
A	B	C	D
			E

Feedback

E sample: Response 1

Recording sheet

Modelling the effect of global warming on sea levels

		Observations Draw the water level after warming or melting
Experiment 1: Warming of the oceans Modelled by warming water in a flask.	Before warming 	After warming 
Experiment 2: Warming of floating sea ice Modelled by melting ice floating in a beaker of water.	Before warming 	After warming 
Experiment 3: Warming of ice on land Modelled by melting ice above a beaker of water.	Before warming 	After warming 

E sample: Response 1

Section 1: Interpreting evidence

1. Use your recorded observations from *Modelling the effect of global warming on sea levels* to complete Table 1.

Table 1

Global warming event	Effect on sea level (circle your prediction)	Use the observations from the modelling experiments to support your prediction.
<p><u>Warming of water</u> in the oceans</p> <ul style="list-style-type: none"> The oceans cover about two thirds of the Earth's surface. 	<p>rise</p> <p>fall</p> <p>no effect</p>	<p>rise up like the tube</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
<p><u>Warming of ice</u> in the Arctic Ocean</p> <p>The Arctic ocean is</p> <ul style="list-style-type: none"> about twice the size of Australia mostly covered by floating ice about 3 metres thick. 	<p>rise</p> <p>fall</p> <p>no effect</p>	<p>ice melts</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
<p><u>Warming of ice</u> in Antarctica</p> <p>The continent of Antarctica is</p> <ul style="list-style-type: none"> about twice the size of Australia covered with a layer of ice about 2 kilometres thick. 	<p>rise</p> <p>fall</p> <p>no effect</p>	<p>ice melts</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

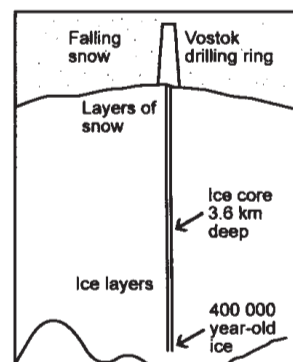
E sample: Response 1

Use the evidence below to answer questions 2 to 5.

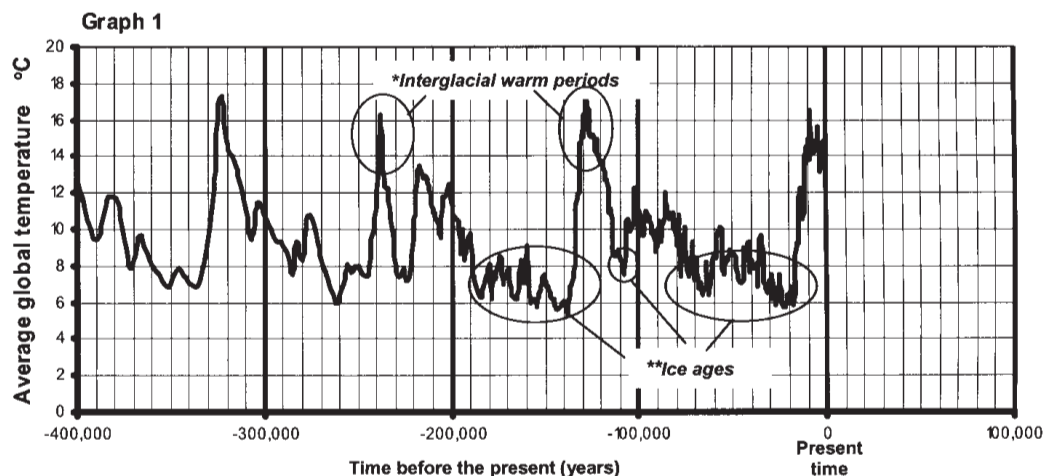
In 1995, scientists at Vostok Station in Antarctica drilled down 3.6 kilometres and retrieved ice cores containing air bubbles which have become trapped in snow over the past 400 000 years.

By analysing the air in the bubbles, scientists were able to calculate the [†]**average global temperature** over the past 400 000 years.

[†]**average global temperature** is the mean temperature of the air at the Earth's surface



Graph 1 shows the results of this investigation.



****Ice ages** refer to times when the polar ice caps expanded and much of the northern hemisphere was covered in ice.

***Interglacial warm periods** are warm times between ice ages

2. Describe how the average global temperature has varied over the past 400 000 years.

every ~~100~~ 100,000 years the temp
 has rises.

.....

.....

.....

.....

E sample: Response 1

3. Use any patterns in the graph to predict how the temperature might change in the next 20 000 years. Explain.

the ice ages are 100,000 years apart.

4. Describe how sea levels may have changed over the past 20 000 years. In your answer, refer to Graph 1 and your answers to question 1.

don't know

Aboriginal stories record that the Moreton Bay islands were once part of the mainland, but long ago, water filled all the low areas, separating Stradbroke, Moreton and the other islands from the mainland.

5. Archaeological evidence shows that Aboriginal people have lived in Australia for over 50 000 years. Does the evidence from Graph 1 and the modelling experiments support these Aboriginal stories? Explain.

no ~~at~~ at the beghing of the graph
it is warmer

E sample: Response 1

6. Does the evidence presented in Graphs 2 and 3 support the following hypothesis? Explain.

"The Earth is becoming warmer due to increased amounts of carbon dioxide in the atmosphere"

yes in 1980 the was heavy no
cars and now ther is a huge
amount

7. Offer a different hypothesis to explain the evidence presented in Graph 2 and Graph 3.

ther are to many cars, bus, bikes, etc
that make CO₂

E sample: Response 1

Section 2: Applying knowledge to form an opinion

Since the Industrial Revolution of the 1800s, human activity has been contributing significant amounts of CO₂ into the atmosphere.

For example, heating water for use in homes can produce CO₂.

Most people in Australia choose to use electric, gas or solar hot water systems.

Use the information given below to answer questions 8 to 14.

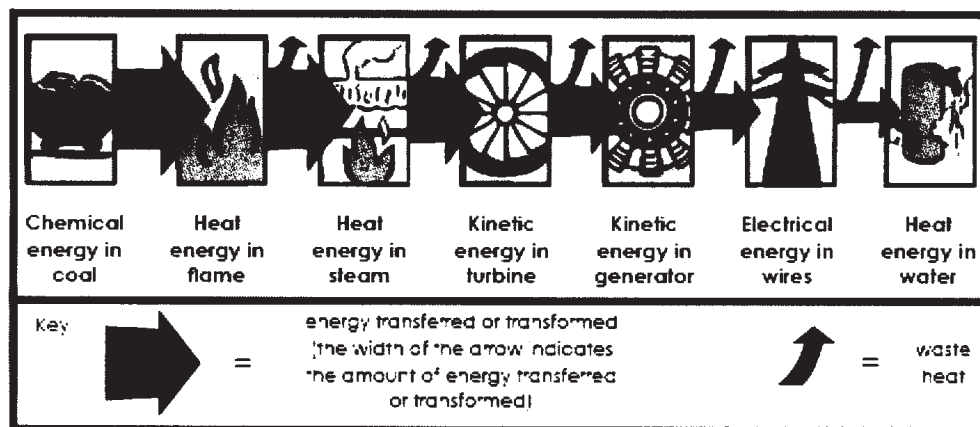
Electric hot water systems

Most of Australia's electricity is generated by burning coal (carbon) which combines with oxygen from the air, producing carbon dioxide.

The heat from burning coal boils water, producing steam to drive turbine-powered generators which produce electricity (electrical energy). Electrical energy is transmitted in wires to the electric hot water system in our homes. The electric element in the hot water system heats the water.

Energy Diagram 1 shows the energy changes that occur when electricity from a coal-fired power station is used to heat water in an electric hot water system at home.

Energy diagram 1: An electric hot-water system



8. Write a word equation for the burning of coal (carbon).

Heat + Coal = Steam with ~~less~~ carbon

Use chemical symbols to write a balanced equation for the burning of coal.

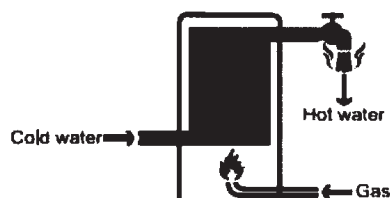
CO₂

E sample: Response 1

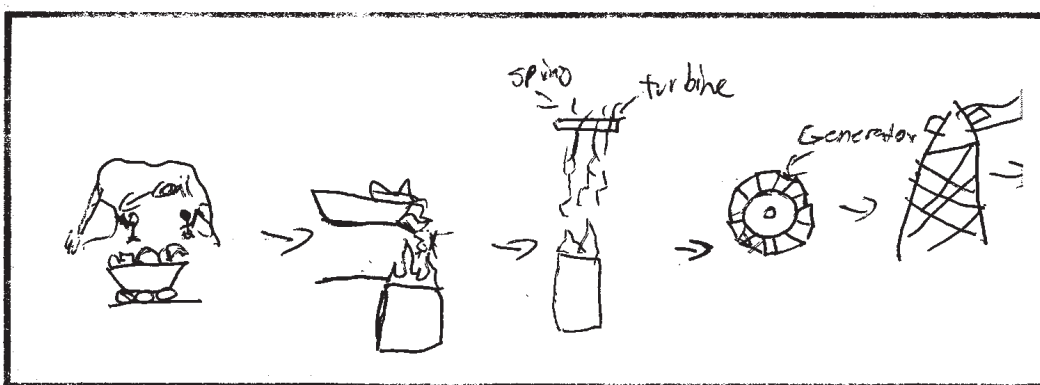
Gas hot water systems

A gas hot water system heats water by burning gas.

The gas used in a gas hot water system is mostly methane (CH_4). Methane burns by combining with oxygen to produce carbon dioxide and water.



9. Draw a labelled energy diagram below (similar to Energy diagram 1 on page 12) to show the energy changes that occur in a gas hot water system.



10. Write a word equation for the burning of methane.

it ~~is~~ burns by gas and it

Use chemical symbols to write a balanced equation for the burning of methane.

$\text{CH}_4 = \text{CO}_2$

11. Does using a gas hot water system produce more or less CO_2 than using an electric hot water system? Explain by referring to the energy diagrams.

Yes have to burn coal to make steam

.....

.....

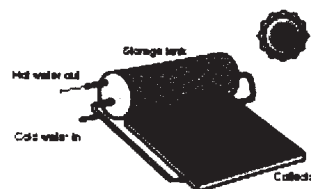
.....

.....

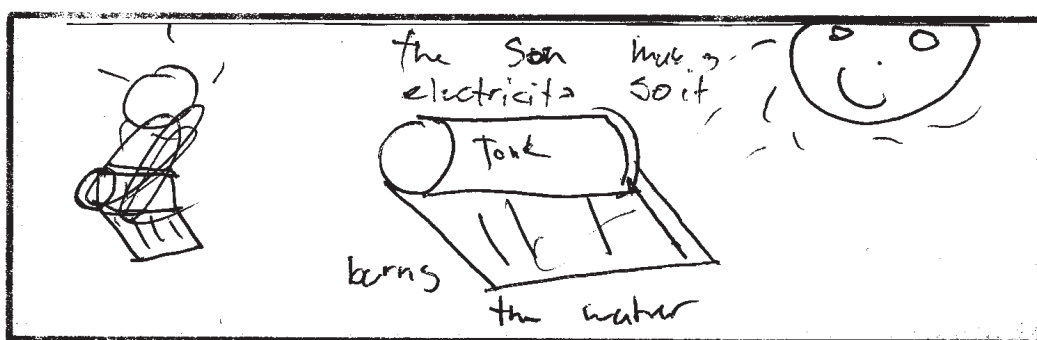
E sample: Response 1

Solar hot water systems

A solar hot water system heats water by absorbing heat from the sun



12. Draw a labelled energy diagram for a solar hot water system.



13. Does using a solar hot water system emit CO_2 ? Explain.

no because there is no coal to burn it
is pure heat

14. Do your answers to questions 8 to 13 support the following hypothesis?
Explain.

"Our energy choices can affect the amount of CO_2 released into the atmosphere."

yes because you can not do
drive a car

E sample: Response 1

"Global temperature changes occur naturally, so there's nothing we can do about it. Anyway, there's no problem being a few degrees warmer."

15. What is your opinion of the statement above?

agree disagree partially agree (circle one)

Justify your opinion by referring to:

- historic and recent temperature and CO₂ data in questions 2 to 8
- information about energy choices in questions 9 to 13
- your predictions from the model in question 1

I think we should all cut
down on using cars extra and by off
Cag.

E sample: Response 2

Overall grade
As this response demonstrates a very limited level of Knowledge and Understanding, and Investigating, and Communicating, on balance it is an overall E.

Guide to making judgments — Year 9 Science

Student

Purpose: To use evidence and scientific argument to draw conclusions and to inform an opinion about climate change and its effects.

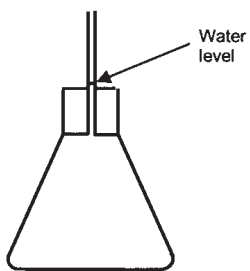
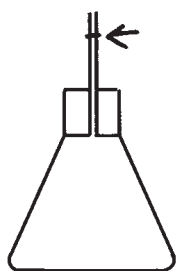
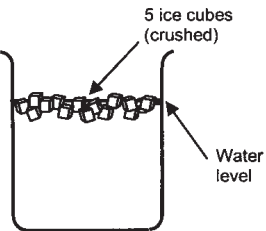
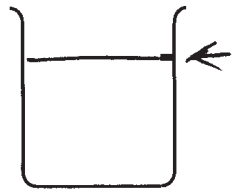
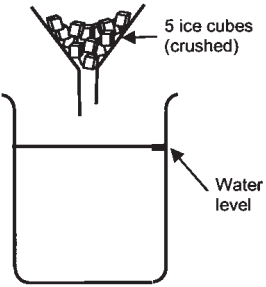
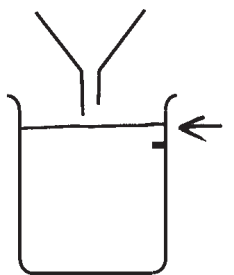
Investigating	Knowledge and understanding	Investigating	Communicating
Draws conclusions and makes predictions consistent with data and evidence. Questions 1, 2, 3, 4, 5, 11, 13	Uses equations and diagrams to describe and explain chemical changes and energy transformations. Questions 8, 9, 10, 12	Uses data, evidence and scientific argument to evaluate and propose hypotheses and to inform an opinion. Questions 6, 7, 14, 15	Uses scientific terminology in conclusions, predictions and arguments. Uses appropriate formats in chemical equations and energy diagrams. Questions 1–15
<p>Investigating Made minimal use of data and evidence to draw conclusions and make predictions. Explanations lacked detail.</p> <p>Consistently and accurately interprets data and evidence.</p>	<p>Knowledge and understanding Correctly wrote a word equation and attempted energy diagrams.</p> <p>Writes chemical formulas with correct ratios and balances chemical equations. Energy diagrams correctly identify all energy forms and illustrate all transfers and transformations.</p>	<p>Investigating Offered a brief opinion with little analysis of the evidence.</p> <p>Provides accurate and insightful scientific arguments, considering all data and evidence.</p>	<p>Communicating Made little use of scientific terminology.</p> <p>Displays fluency in the use of scientific terminology when drawing conclusions, making predictions and constructing arguments.</p>
			A
			B
			C
			D
			E

Feedback

E sample: Response 2

Recording sheet

Modelling the effect of global warming on sea levels

		Observations Draw the water level after warming or melting
Experiment 1: Warming of the oceans Modelled by warming water in a flask.	Before warming 	After warming 
Experiment 2: Warming of floating sea ice Modelled by melting ice floating in a beaker of water.	Before warming 	After warming 
Experiment 3: Warming of ice on land Modelled by melting ice above a beaker of water.	Before warming 	After warming 

E sample: Response 2

Section 1: Interpreting evidence

1. Use your recorded observations from *Modelling the effect of global warming on sea levels* to complete Table 1.

Table 1

Global warming event	Effect on sea level (circle your prediction)	Use the observations from the modelling experiments to support your prediction.
Warming of <u>water</u> in the oceans <ul style="list-style-type: none"> The oceans cover about two thirds of the Earth's surface. 	<div>rise</div> <div>fall</div> <div>no effect</div>	<i>same as experiment</i>
Warming of <u>ice</u> in the Arctic Ocean <i>The Arctic ocean is</i> <ul style="list-style-type: none"> about twice the size of Australia mostly covered by floating ice about 3 metres thick. 	<div>rise</div> <div>fall</div> <div>no effect</div>	<i>"</i>
Warming of <u>ice</u> in Antarctica <i>The continent of Antarctica is</i> <ul style="list-style-type: none"> about twice the size of Australia covered with a layer of ice about 2 kilometres thick. 	<div>rise</div> <div>fall</div> <div>no effect</div>	<i>"</i>

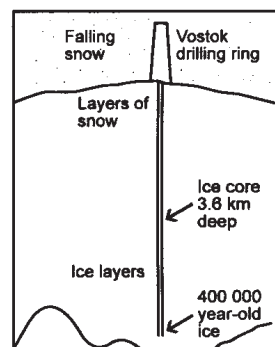
E sample: Response 2

Use the evidence below to answer questions 2 to 5.

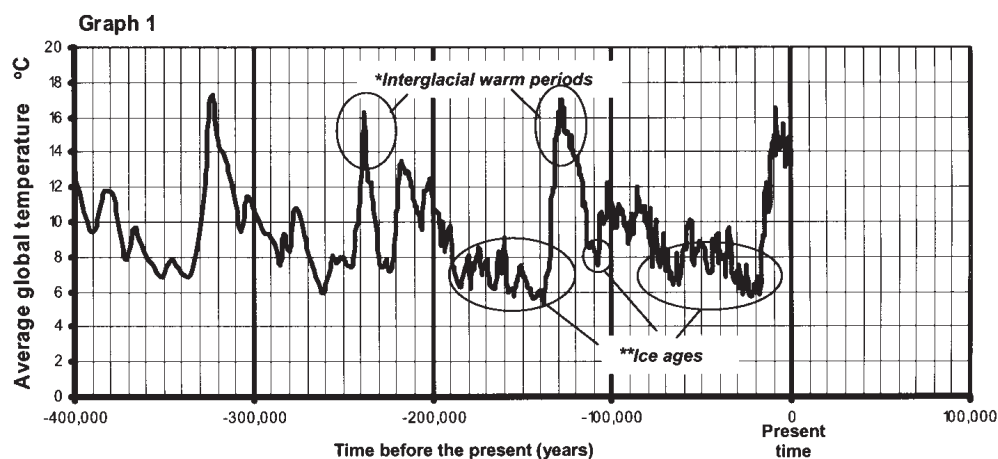
In 1995, scientists at Vostok Station in Antarctica drilled down 3.6 kilometres and retrieved ice cores containing air bubbles which have become trapped in snow over the past 400 000 years.

By analysing the air in the bubbles, scientists were able to calculate the [†]**average global temperature** over the past 400 000 years.

[†]**average global temperature** is the mean temperature of the air at the Earth's surface



Graph 1 shows the results of this investigation.



****Ice ages** refer to times when the polar ice caps expanded and much of the northern hemisphere was covered in ice.
***Interglacial warm periods** are warm times between ice ages

2. Describe how the average global temperature has varied over the past 400 000 years.

It has been raising and getting lower.....

E sample: Response 2

3. Use any patterns in the graph to predict how the temperature might change in the next 20 000 years. Explain.

don't know!!

4. Describe how sea levels may have changed over the past 20 000 years. In your answer, refer to Graph 1 and your answers to question 1.

Aboriginal stories record that the Moreton Bay islands were once part of the mainland, but long ago, water filled all the low areas, separating Stradbroke, Moreton and the other islands from the mainland.

5. Archaeological evidence shows that Aboriginal people have lived in Australia for over 50 000 years. Does the evidence from Graph 1 and the modelling experiments support these Aboriginal stories? Explain.

No... because they would probably not of stayed
alive in the cold

E sample: Response 2

6. Does the evidence presented in Graphs 2 and 3 support the following hypothesis? Explain.

"The Earth is becoming warmer due to increased amounts of carbon dioxide in the atmosphere"

Yes because carbon dioxide is being used every day and is making it warmer

7. Offer a different hypothesis to explain the evidence presented in Graph 2 and Graph 3.

E sample: Response 2

Section 2: Applying knowledge to form an opinion

Since the Industrial Revolution of the 1800s, human activity has been contributing significant amounts of CO₂ into the atmosphere.

For example, heating water for use in homes can produce CO₂.

Most people in Australia choose to use electric, gas or solar hot water systems.

Use the information given below to answer questions 8 to 14.

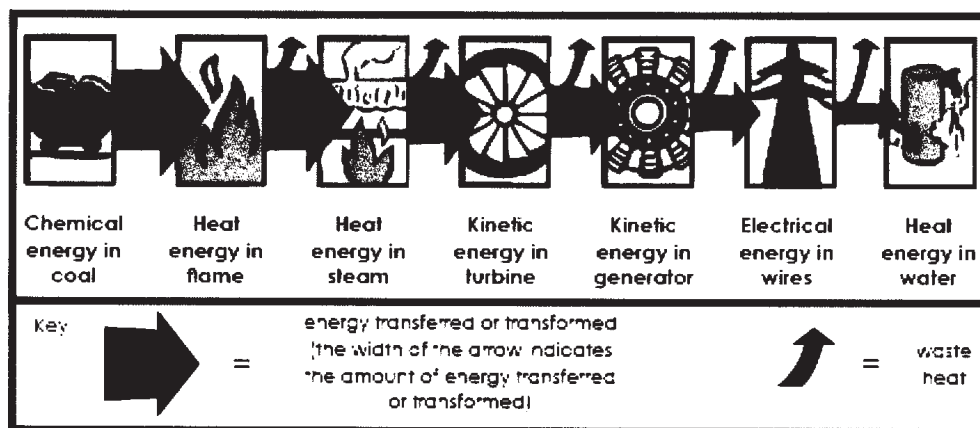
Electric hot water systems

Most of Australia's electricity is generated by burning coal (carbon) which combines with oxygen from the air, producing carbon dioxide.

The heat from burning coal boils water, producing steam to drive turbine-powered generators which produce electricity (electrical energy). Electrical energy is transmitted in wires to the electric hot water system in our homes. The electric element in the hot water system heats the water.

Energy Diagram 1 shows the energy changes that occur when electricity from a coal-fired power station is used to heat water in an electric hot water system at home.

Energy diagram 1: An electric hot-water system



8. Write a word equation for the burning of coal (carbon).

carbon + oxygen = carbon dioxide

Use chemical symbols to write a balanced equation for the burning of coal.

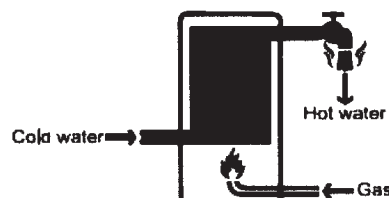
I don't know!

E sample: Response 2

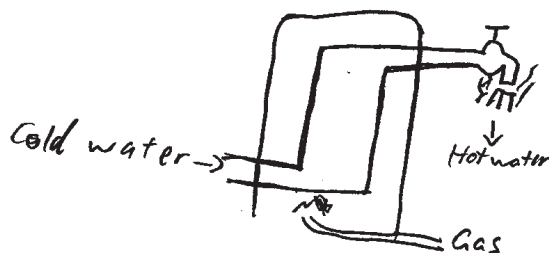
Gas hot water systems

A gas hot water system heats water by burning gas.

The gas used in a gas hot water system is mostly methane (CH_4). Methane burns by combining with oxygen to produce carbon dioxide and water.



9. Draw a labelled energy diagram below (similar to Energy diagram 1 on page 12) to show the energy changes that occur in a gas hot water system.



10. Write a word equation for the burning of methane.

...combining.....

Use chemical symbols to write a balanced equation for the burning of methane.

.....

11. Does using a gas hot water system produce more or less CO_2 than using an electric hot water system? Explain by referring to the energy diagrams.

Yes because gas can take a while and electric hot-water system is faster.

.....

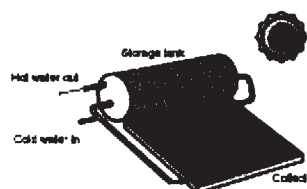
.....

.....

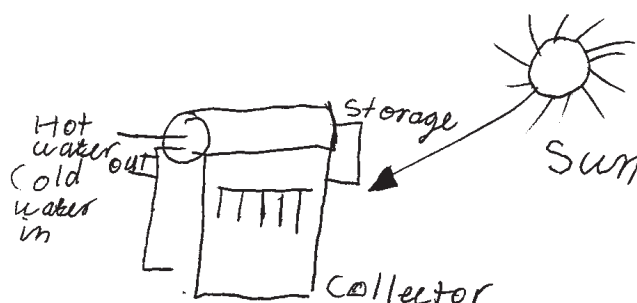
E sample: Response 2

Solar hot water systems

A solar hot water system heats water by absorbing heat from the sun



12. Draw a labelled energy diagram for a solar hot water system.



13. Does using a solar hot water system emit CO₂? Explain.

No

14. Do your answers to questions 8 to 13 support the following hypothesis? Explain.

"Our energy choices can affect the amount of CO₂ released into the atmosphere."

Yes in some ways it can.

E sample: Response 2

"Global temperature changes occur naturally, so there's nothing we can do about it. Anyway, there's no problem being a few degrees warmer."

15. What is your opinion of the statement above?

agree disagree partially agree (circle one)

Justify your opinion by referring to:

- historic and recent temperature and CO₂ data in questions 2 to 8
- information about energy choices in questions 9 to 13
- your predictions from the model in question 1

I agree cause over millions of years things have changed like solar power, carbon dioxide