

9

SCIENCE

# STUDENT BOOKLET



## Climate change

Given name: .....

Family name: .....

School: .....



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# Setting the scene: Group discussion

## Background

In November 2007, the Intergovernmental Panel on Climate Change (IPCC) released a report claiming that the Earth's atmosphere and oceans were warming, causing changes in climate patterns. The report also stated that most of this warming was very likely due to human activity.

At the time the IPCC's findings were reported in the media, other articles suggested that human-caused global warming was a hoax by scientists to gain funding.

What should we do when we are presented with conflicting opinions about such an important issue? How do we form our own opinion if we don't know who to believe?

## The problem

In this assessment task you will be required to express your opinion about possible causes and effects of global warming.

To do this you will:

- make predictions based on the results of an experiment
- interpret evidence gathered by climate scientists
- use your scientific understanding to determine how particular human activities can affect carbon dioxide emissions
- consider your predictions, interpretations and conclusions to inform your opinion.

## Using experiments to model real situations

Scientists often use simple models to make predictions about complex systems.

You will carry out three experiments to model the effect of global warming on sea levels. Follow your teacher's directions to complete the experiments below, referring to the diagrams on page 5 as you work.

### Experiment 1: Modelling warming of the oceans

- Accurately mark the water level in the glass tube.
- Stand the flask in a container of warm water.
- Observe any changes in water level in the tube.
- On page 5 record the water level after warming.

### Experiment 2: Modelling melting of floating sea ice

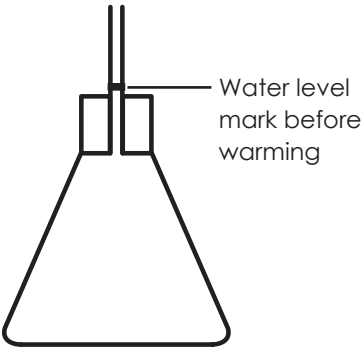
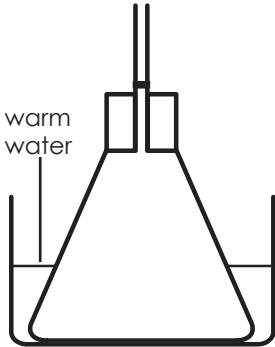
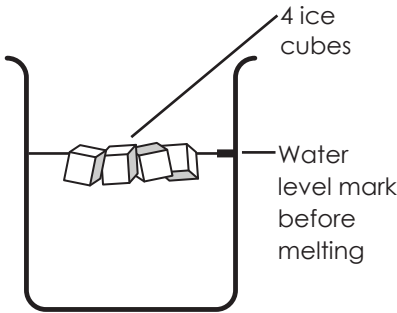
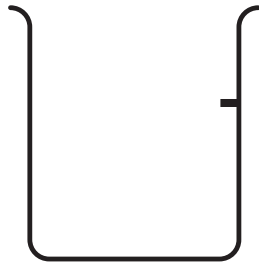
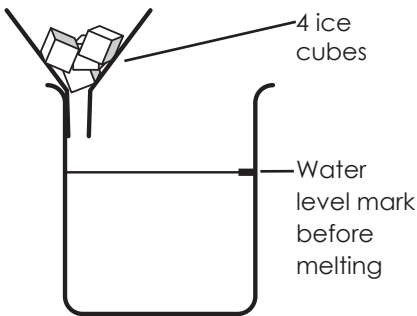
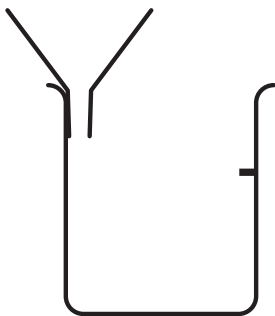
- Place 4 ice cubes into a 250 mL beaker.
- Pour cold tap water into the beaker until it is about  $\frac{2}{3}$  full.
- Accurately mark the water level.
- Observe the water level after the ice has melted.
- On page 5 record the water level after melting.

### Experiment 3: Modelling melting of ice on land

- Use a stand to support a funnel above a 250 mL beaker.
- Pour cold tap water into the beaker until it is about  $\frac{2}{3}$  full.
- Accurately mark the water level.
- Place 4 ice cubes into the funnel.
- Observe the water level after the ice has melted.
- On page 5 record the water level after melting.

## Recording sheet

Modelling the effect of global warming on sea levels.

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

**STOP HERE: WAIT FOR YOUR TEACHER'S DIRECTIONS**



## Section 1: Interpreting evidence

1. Complete Table 1 using your Recording sheet observations on page 5 and the information given in the table.

Table 1

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

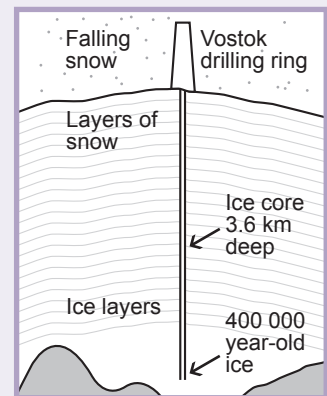
## Use the evidence below to answer Questions 2 to 5.

In 1995, scientists at Vostok Station in Antarctica drilled down 3.6 kilometres through ice formed by the compaction of falling snow. They retrieved ice cores containing air bubbles trapped in snow over the past 400 000 years.

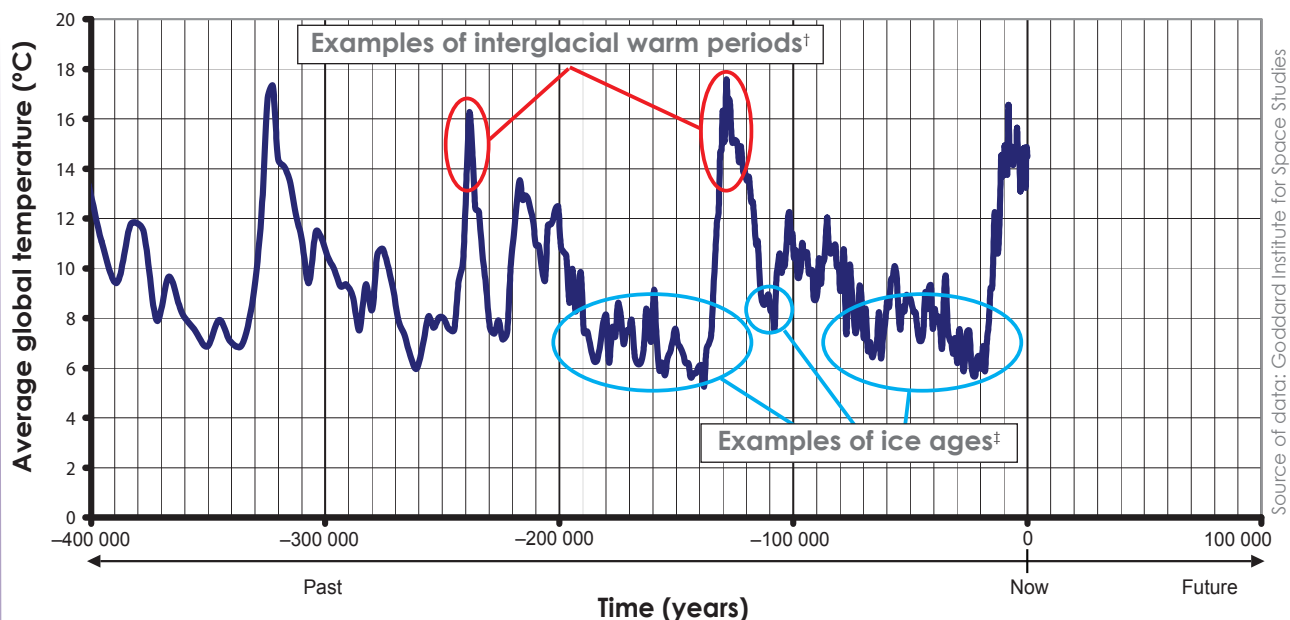
By analysing the air in the bubbles, scientists were able to calculate the **average global temperature\*** for each of the past 400 000 years.

Graph 1 below shows the results of this investigation.

\***average global temperature** is the mean air temperature over the Earth's surface



Graph 1: Average global temperatures over the past 400 000 years



†**interglacial warm periods** are warm times between ice ages

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

2. Describe the variation in the average global temperature over the past 400 000 years. Refer to Graph 1.

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3. Use any patterns in Graph 1 to predict how the temperature might change in the next 20 000 years. Explain.

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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.

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Read the statements below to answer Question 5.

- Archaeological evidence shows that Aboriginal people have lived in Australia for over 50 000 years.
- Aboriginal stories record that the Moreton Bay islands were once part of the mainland, but long ago, water filled the low areas, separating Stradbroke, Moreton and the other islands from the mainland.

5. Do the modelling experiments and the evidence from Graph 1 support the Aboriginal stories about the Moreton Bay islands? Explain.

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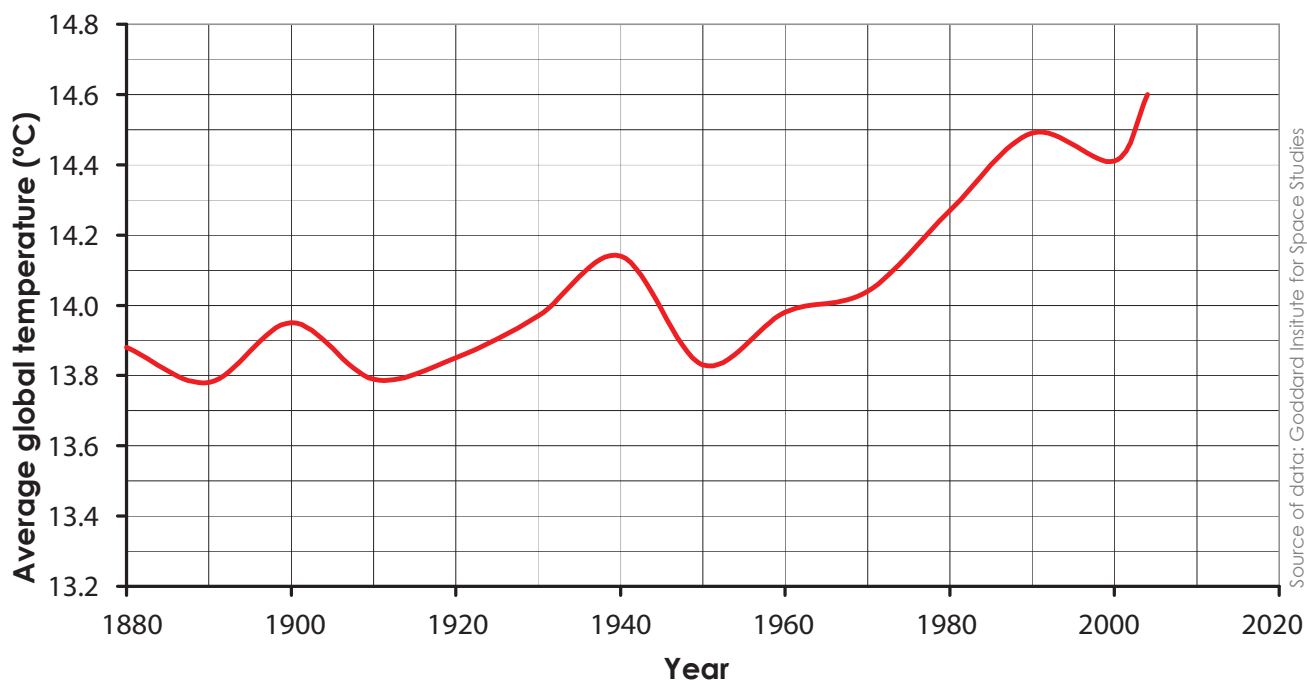
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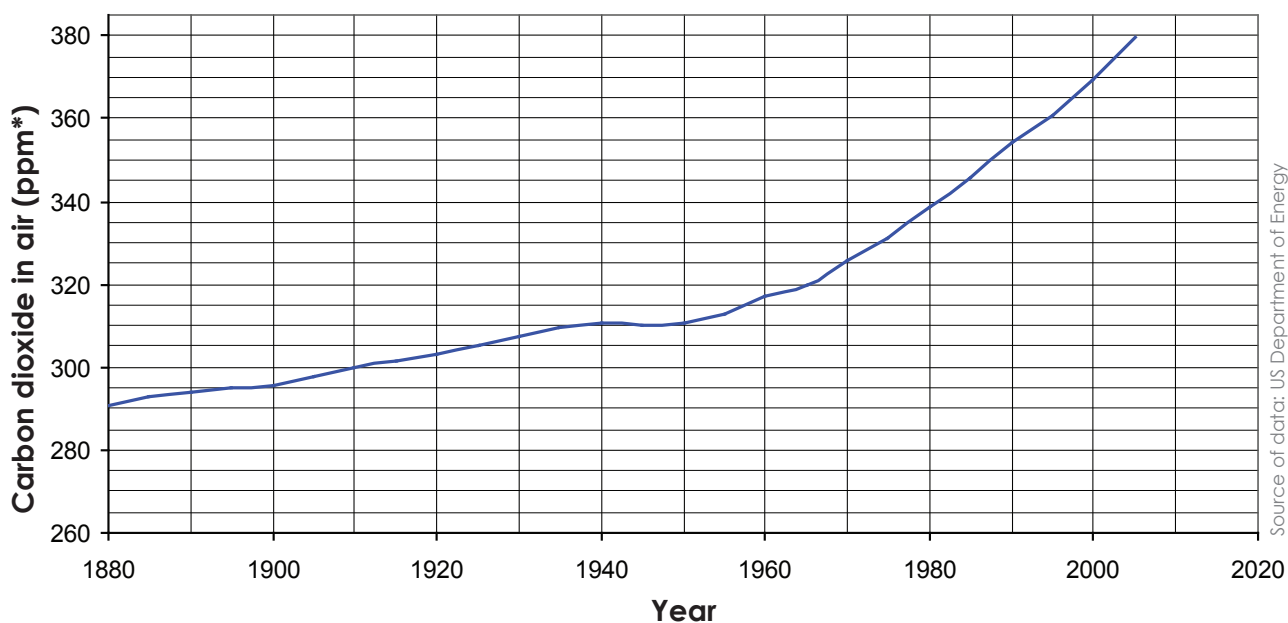
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Use the evidence presented in Graphs 2 and 3 to answer Questions 6 and 7.

**Graph 2: Average global air temperature from 1880 to 2004**



**Graph 3: Amount of carbon dioxide in the atmosphere from 1880 to 2005**



\*1 ppm (part per million) of CO<sub>2</sub> means one particle of CO<sub>2</sub> in one million particles of air

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."

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7. Suggest an alternative hypothesis that is supported by the evidence presented in Graphs 2 and 3.

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## Section 2: Applying knowledge to inform an opinion

Since the Industrial Revolution, human activity has been releasing significant amounts of carbon dioxide ( $\text{CO}_2$ ) into the atmosphere.

Heating water for use in homes is an activity that can produce carbon dioxide. Most people in Australia use electric, gas or solar hot-water systems.

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

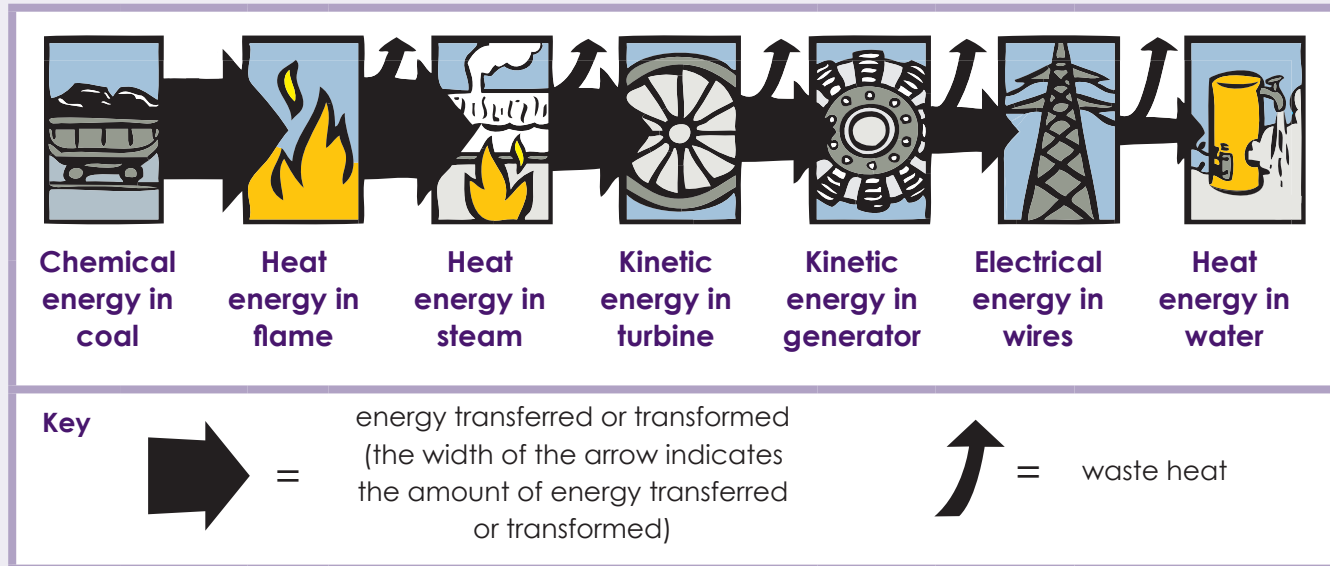
### Electric hot-water systems

Most of Australia's electricity is generated by burning coal to boil water. The steam produced drives turbine-powered generators which generate electricity (electrical energy). Electrical energy is transmitted in wires to the electric hot-water system in the home. An electric element in the hot-water system heats the water.

When coal (mostly carbon) burns, it combines with oxygen from the air and produces carbon dioxide.

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.

Diagram 1: Energy changes for an electric hot-water system



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

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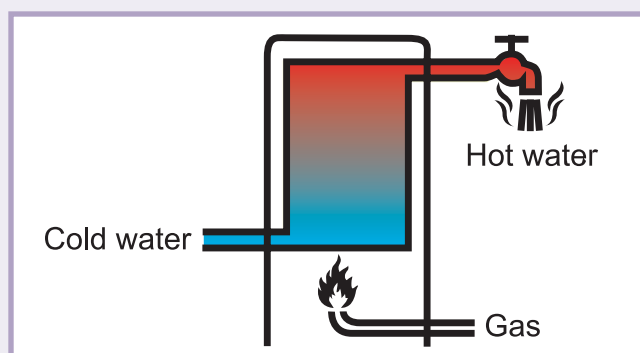
Use chemical symbols to write a balanced equation for the burning of carbon.

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### 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 ( $\text{CH}_4$ ). Methane burns by combining with oxygen to produce carbon dioxide and water.



9. Draw and label a diagram (similar to Diagram 1 on page 12) showing the energy changes that occur for a gas hot-water system.



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

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

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11. Does using a gas hot-water system emit more or less  $\text{CO}_2$  than using an electric hot-water system? Explain by referring to the energy diagrams.

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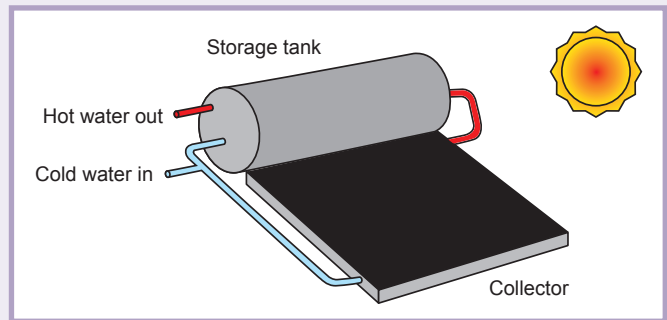
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**Solar hot-water systems**

A solar hot-water system heats water by absorbing solar radiation (sunlight) and transforming it into heat energy.



12. Draw and label a diagram (similar to Diagram 1 on page 12) showing the energy changes that occur for a solar hot-water system.

13. Does using a solar hot-water system emit CO<sub>2</sub>? Explain.

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14. Do your answers to Questions 8 to 13 support the following statement? Explain.

"Our energy choices affect the amount of CO<sub>2</sub> released into the atmosphere."

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**15. Read the comment below.**

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

**Do you agree with the comment? (circle one)**

I agree

I partially agree

I disagree

**Justify your opinion by referring to:**

- historic and recent temperature and CO<sub>2</sub> data in Questions 2 to 7
- information about energy choices in Questions 8 to 14
- your predictions from Question 1.

[illegible]

# 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	
Consistently and accurately interprets data and evidence to justify valid conclusions and predictions.  Uses data and evidence to explain some valid conclusions and plausible predictions.  Draws a valid conclusion or makes a plausible prediction.	Writes chemical formulas with correct ratios and balances chemical equations. Energy diagrams correctly identify all energy forms and illustrate all transfers and transformations, including waste heat.  Correctly identifies reactants and products in word equations. Chooses correct chemical symbols and writes most chemical formulas with correct ratios. Energy diagrams identify and illustrate most energy transfers and transformations.  Partially completes word equations and energy diagrams. Chooses some correct chemical symbols.	Provides accurate and insightful scientific arguments, considering all data and evidence.  Supports the evaluation and proposal of hypotheses with valid interpretations of evidence. Gives a reasoned opinion about climate change and its effects based on a thorough analysis of the evidence.  Offers a valid opinion about climate change and its effects based on an incomplete analysis of the evidence. Uses evidence to evaluate or propose a credible hypothesis.  Offers an opinion based on a minimal consideration of the evidence, with some confusion of concepts or misinterpretation of evidence.  Provides an opinion or hypothesis based on preconceptions.	Displays fluency in the use of scientific terminology when drawing conclusions, making predictions and constructing arguments.  Uses accepted formats when constructing formulas for chemical compounds and when writing and balancing equations. Draws clear, fully labelled energy diagrams.  Correctly uses some scientific terminology when drawing conclusions, making predictions and constructing arguments. Writes formulas and equations with variable use of accepted formats. Draws energy diagrams which adequately convey meaning.  Makes minimal use of scientific terminology and formats.	
A	B	C	D	E

Feedback .....